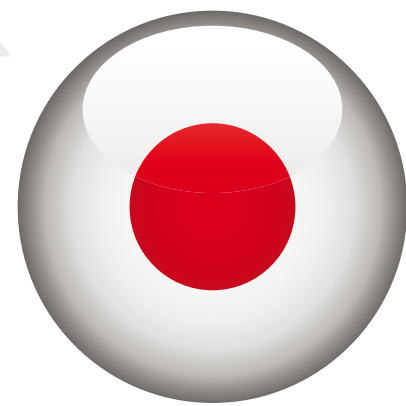
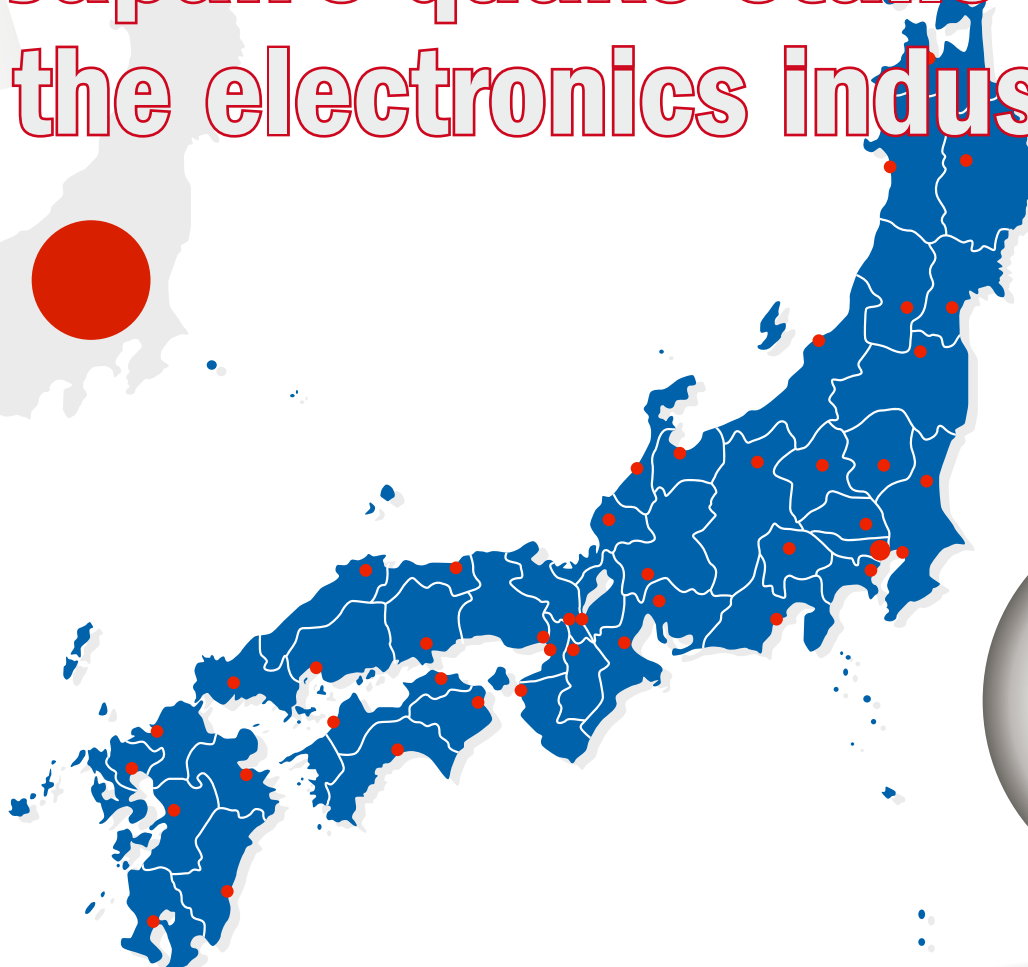


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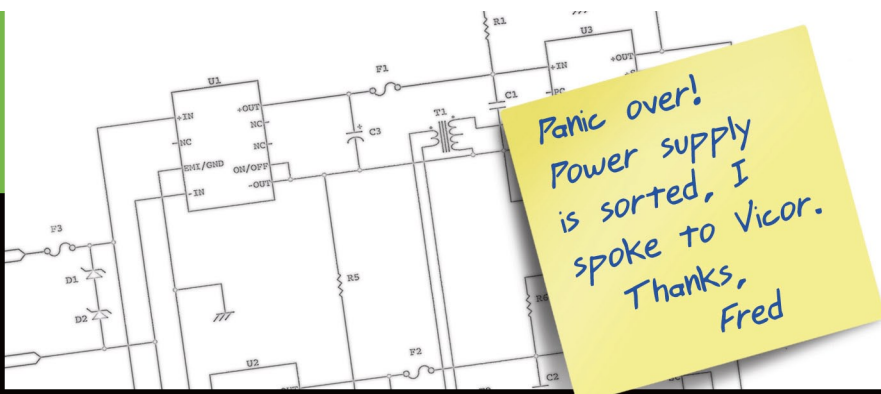
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Supply chain: too lean, too mean, too late now

By Peter Clarke

Analysts are trying to think through the implications for global manufacturing of the lost and damaged production of materials, equipment and ICs in Japan as a result of the devastating earthquake three weeks ago.

Despite some differences of opinion it is becoming increasingly clear that the world will now be asked to pay a price for the past globalization of the electronics industry.

Of course, people will not be paying so high a price as the thousands of people who lost their lives one week ago or the ongoing and mounting price that hundreds of thousands of displaced people are paying in Japan right now. Our thoughts are with them.

But the issues identified around the supply of raw silicon wafers, of chemically engineered resin for packaging, of microcontroller ICs and other issues, highlight that the pursuit of the leanest and meanest just-in-time supply chain over the last decade has now put the global economy at some risk.

It is still not possible to know how this will exactly play out. Some have said that the loss of Japanese production in 2011 will be made up for by the additional stimulus to the economy of rebuilding efforts after the quake. Market research firm IHS iSuppli had warned about an inventory build-up in the supply chain that was happening prior to the earthquake. They now state that the inventory buffer could mitigate the worst effects of lost Japanese production. But it is still likely that on one account or another, a lack of adequate second sourcing and disposable manufacturing capacity is going to affect global GDP in 2011.

Peter Clarke is European News Director at EETimes - he can be reached at peter.clarke@ubm.com

There was a time when electronics was seen as strategic in a military sense and domestic suppliers and second sources were seen as mandatory. That has now been largely forgotten. The pursuit of the highest possible volume at the lowest price created vertical disintegration, caused companies to leave markets unless they could be a market leader, and to drop activities where they did

“Global chip manufacturing has been running at greater than 90 percent capacity utilization throughout 2010 and into 2011, which effectively means sold out”

not have economies of scale.

The result is that the semiconductor industry has become a constellation of specialists that are all highly dependent upon each other. But when one is stricken there is no-one able to take the strain.

The adage “for want of a nail” is called to mind and we must consider that some automobile may not be made in Germany, for lack of a chemical or a gas or a film or an IC that was in the process of being made in the north of Japan last Friday.

The result, on just one count, is now likely to be that automobile companies, white goods manufacturers, consumer electronics companies will see loss production due to a lack of microcontroller ICs. At the same time, notwithstanding IHS iSuppli's comments, such chips as they can source are

likely to be much more expensive.

It must be born in mind that global chip manufacturing has been running at greater than 90 percent capacity utilization throughout 2010 and into 2011, which effectively means sold out. With wafer fabs likely to be out for up to six months as surrounding infrastructure is rebuilt it seems unlikely that building from inventory will suffice. No other manufacturers can take up the slack and if the provision of raw wafers becomes an issue than manufacturing capacity will be further hobbled.

This is likely to manifest itself in the second and third quarters of 2011 while any shortages of chip making equipment could affect the chip industry's ability to increase manufacturing capacity in 2012.

Malcolm Penn, founder and principal analyst with consultancy Future Horizons Ltd., has long spoken out against the fablite chip company business model and the attenuated supply chain.

He has long said that average selling prices for ICs cannot go on falling forever.

He also, like a prophet without honour in his own country, repeatedly said that losing control of strategic capabilities such as chip production and manufacturing more generally, are expediencies that in the long-term would prove detrimental to companies, nations and regions.

It now looks like the Japan earthquake and tsunami could make Penn's points for him although I am sure he would wish that his analysis had not been underlined in this way. The move from state-supported national and regional champion chip companies to a globalized electronics industry has provided us with a decade of cheap electronics. Globalization is now going to ask for the rest of the bill to be paid. ■

Computing has hit 'power wall'

By George Leopold

AS MOORE'S LAW RUNS OUT of steam and computing goes mobile, technologists are searching for ways to make the leap to new parallel programming frameworks that can leverage low-power multicore architectures.

The move has been spurred by growing industry concern that today's microprocessor computing engines have hit a "power wall". That in turn has prompted a re-evaluation of the roadmap for high-performance computing, a reassessment that yielded a new study published by the National Research Council on the future of computing performance. The report's bottom line is summed up in its subtitle: "Game Over or Next Level?"

"The era of sequential computing must give way to a new era in which parallelism is at the forefront," the report asserts. "The next generation of discoveries is likely to require advances at both the hardware and software levels..."

The challenge, added the report's editor, Samuel Fuller, chief technology officer at Analog Devices, is whether "we can develop software environments to develop new applications for multicore architectures." What is needed are new parallel programming

environments, Fuller said. "The breakthrough needs to be in the software environment."

As single processors and CMOS technology approach the end of the technology line, the computing report concludes that chip designers and software developers alike must shift their focus to parallelism. To that end, the report specifically recommends that research funded by industry, government and universities along with partnerships among them should focus on:

New algorithms that can exploit parallel processing; Developing new programming methods with an eye toward broader industry use;

Overhauling the traditional computing "stack" to account for parallelism and resource-management challenges;

Investing in new parallel architectures that are driven by emerging applications like mobile computing;

Investing in R&D that focuses on power efficiency at all system levels.

Further, the report recommends that R&D should directly address the looming "power wall" issue by "making logic gates more power

efficient" and by looking beyond CMOS to lower-power device technologies.

As for software, some experts argue that the Open Source movement could help lead the charge in developing new programming methods for leveraging parallel processors.

Open Source projects tend to operate like successful electronics industry consortia, according to David Liddle, a computer industry veteran who now serves as a general partner with U.S. Venture Partners. The Open Source movement has had a "huge impact" on computing, Liddle said, and a new effort is needed "to create the momentum necessary to attack the software" problem.

Others insist that performance improvements in devices like mobile phone SoCs have been hampered by power limits. "We're in this box," said Mark Horowitz, chairman of the electrical engineering department at Stanford University and chief scientist at Rambus Inc. "Performance now comes with a power penalty." The consensus is that chip designers and software developers are now bound more tightly together as they seek a new paradigm for high-performance computing. ■

MIPS plans 64-bit multithreaded cores

By Rick Merritt

HOPING TO GET A JUMP on archrival ARM Ltd, MIPS Technologies aims to launch this fall at least two 64-bit synthesizable cores. Unlike its now-discontinued offerings from several years ago, the Prodigy family will include members that support multithreading and issue multiple instructions per clock cycle.

MIPS will not provide product details on the cores until the launch this fall. But they are expected to act as upgrades for the company's 34K midrange 32-bit cores. Prodigy will include at least two members, a single core executing a single instruction per clock and a multiprocessor executing at least two instructions per clock. The multicore version

will support at least four threads per core, two virtual processors and nine thread contexts.

The existing MIPS 74K processor is expected to continue to command the company's high-end given its focus on fast single-thread performance with an out-of-order pipeline. MIPS has not implemented test versions of the Prodigy designs yet, and is not expected to have production quality RTL shipping until early 2012.

MIPS is aiming Prodigy at the ARM Cortex A15 core announced last fall, a 32-bit chip with extended memory addressing. ARM has not yet announced a 64-bit architecture or support for multithreading, but the Denver project,

a family of ARM processors in the works at Nvidia, is rumored to include support for both technologies.

Some ARM chip makers including Marvell are driving their chips into server and high-end networking apps. They are putting pressure on ARM to roll out a 64-bit core with multithreading.

An analyst briefed on Prodigy was undecided on whether the cores will help MIPS expand its share of the processor core market, currently stable at about 13 percent by revenue. ARM commands two-thirds of the market with the rest going to a handful of smaller players including Tensilica, IBM and others. ■

Japan's fabs assess the damage in quake's aftermath

By the EE Times staff



Aerial image of refinery plant fire at Cosmo Oil Co. Ltd. in Ichihara, Chiba prefecture, after a 9.0 magnitude earthquake struck off the coast of northeastern Japan on March 11.

(GETTY IMAGES PHOTO/THE ASAHI SHIMBUN)

THE MASSIVE EARTHQUAKE and tsunami that rocked Japan on March 11 halted semiconductor production in many locations, damaging fabs and production equipment. At least a dozen fabs in northern Japan remained offline a week later, and some companies reported employees had sustained injuries. Japan continues to grapple with quake damage and possible meltdowns at nuclear reactors. And even those facilities that did not incur damage must work around rolling blackouts expected to be in effect in Tokyo and surrounding prefectures until the end of April.

Renesas Electronics Corp. appeared hardest hit, with five wafer fabs and two back-end production facilities rendered idle, and with structural damage confirmed at five of the seven facilities. On March 15, Texas Instruments said its fab in Miho had suffered substantial damage and would not be returned to full production until mid-July at the earliest.

The sudden reduction in capacity is likely to exact a toll on the industry and its customers. The disruption of the supply chain might also make many of the materials used

in chip making harder to come by.

Japanese suppliers accounted for more than a fifth of global semiconductor production in 2010, when companies headquartered in Japan generated \$63.3 billion in chip revenues, according to market research firm IHS iSuppli. The firm warned that while there had been few reports of actual damage at electronics production facilities, the impact of the quake on Japan's transportation and power infrastructure would likely lead to rising prices and shortages for NAND flash; DRAM; microcontrollers; standard logic products; and LCD panels, parts and materials.

IHS also noted that Japan is the world's largest supplier of silicon used to make semiconductors, accounting for about 60 percent of the global total.

Here, we detail the status of fabs and other facilities affected by the earthquake. The companies provided most of the information.

Elpida Memory Inc.

Japan's sole DRAM maker said its 300mm fab in Hiroshima "suffered little impact because

it is located in southwest Japan, far from the regions struck by the earthquake." As of March 12, the plant was operating normally.

Elpida's Akita Elpida Memory unit, based in Akita-shi, Akita, wasn't so lucky. That facility is responsible for chips requiring advanced packages and is Elpida's principal mass-production facility. "The Akita Elpida plant is not in operation as of the time of this announcement due to a power shutdown caused by the earthquake," the company stated. On March 16, Elpida announced that Akita Elpida, a packaging and testing subsidiary, had resumed operation "as the electrical power supply has been recovering gradually." With more than 90 percent of the company's packaging and testing operation outsourced over seas, the DRAM maker said, "the impact on Elpida's earnings due to the shutdown of the operation at Akita Elpida is expected to be minimal."

Freescale Semiconductor Inc.

Freescale reported that its 150-mm wafer fab in Sendai survived the quake with no equipment damage, but it did not provide a timetable for when the facility might reopen. The fab, formally known as Tohoku Semiconductor Corp., is located in Izumi-ku, Sendai, about 8 miles from the coast that was devastated by the post-quake tsunami.

A spokesperson for Freescale said the company had been in the process of transferring production from Sendai to other sites as part of a previously announced plan to close and possibly sell the fab, where it builds flash memory embedded microcontrollers, analog/digital embedded microcontrollers, pressure sensors and acceleration sensors. Freescale was working around the clock to assess the impact of the situation, the spokesperson said.

Fujitsu Ltd.

A number of Fujitsu facilities sustained damage from the earthquake, including the Fujitsu Semiconductor Ltd. fab in Iwate prefecture and the Fujitsu Integrated Microtechnology Ltd. Miyagi plant in Miyagi prefecture, as well as four facilities in Fukushima

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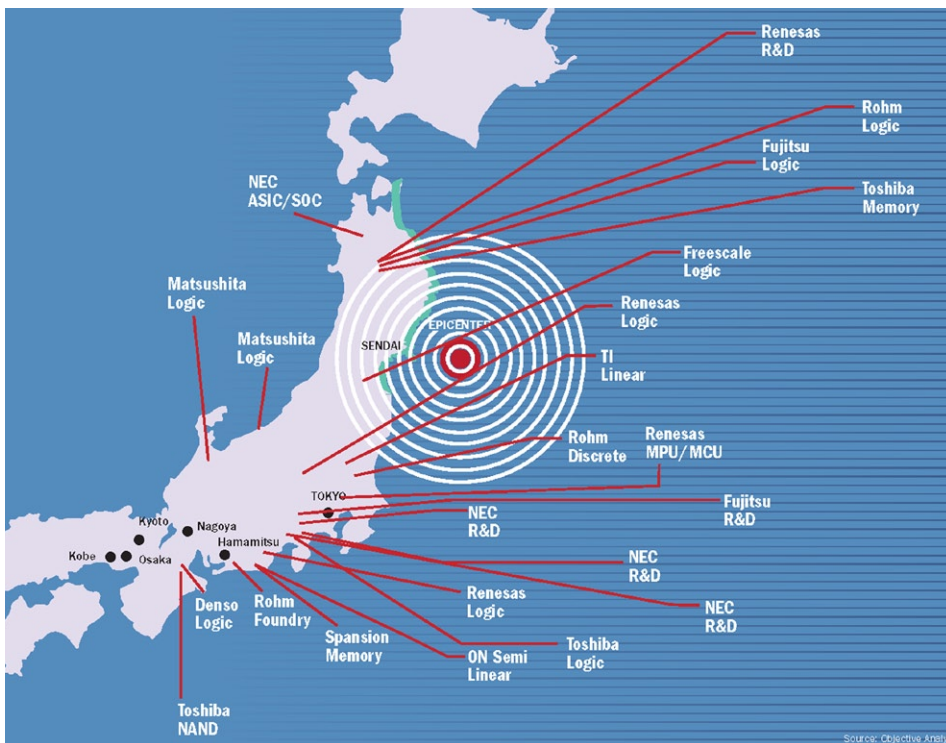
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prefecture. The company said the extent of the loss and the effects on profit as a result of the quake were still unknown.

Hitachi Group

On March 17, Hitachi confirmed that its main production facilities in Ibaraki prefecture suffered damage including cracks in walls; broken glass; and fallen ceilings, roofs and walls. Damaged facilities include Hitachi Displays Ltd., in Chiba prefecture, as well as two auto-motive systems plants, an appliance factory and an information and control systems production facility, Hitachi said. Power to the facilities was gradually being restored last week.

Hitachi had no timetable for the recovery of utilities such as water and gas, but the company said it would work toward resuming operations as quickly as possible, with safety the priority.

Hitachi said production had resumed at Hitachi Appliances Inc.'s plant in Tochigi-shi, Tochigi prefecture, which produces air conditioners and refrigerators, though the company expects interruptions due to rolling blackouts.

Regular operations also resumed late last week at Hitachi's main production sites in Kanagawa prefecture, where IT and telecommunications equipment is produced. Dry-cell battery production has also resumed at Hitachi Maxell Ltd.'s plant in Ibaraki-shi, Osaka, the company said.

According to a report by Taiwan-based

news outlet WantChinaTimes.com, the disaster may have a tangential impact on Hitachi's chemical production. Taiwan's vice economics minister, Huang Chung-qi, said March 13 that production of two vital raw materials— anisotropic conductive film (ACF) adhesives, used in panel module driver ICs, and silicon wafers—had been affected. Huang said Hitachi Chemical accounts for more than 50 percent of total global ACF production.

Maxim Integrated Products Inc.

On March 17, Maxim reported that its partner facility, Seiko Epson, had incurred no structural damage from the quake but that regional power outages had affected production. The Seiko Epson site in Sakata provided about 15 percent of Maxim's wafer starts last quarter.

Maxim said all the products that Seiko Epson manufactures for it could be made elsewhere, provided there was sufficient capacity available. The company said it had begun shifting production to internal fabs and other foundries.

MEMC Electronic Materials Inc.

On March 15, silicon wafer maker

MEMC Electronic Materials said employees at its facility in Utsunomiya, approximately 130 miles from Sendai, were safely evacuated following the earthquake. But operations at the facility remained suspended as of Tuesday.

MEMC has a network of 12 silicon wafer manufacturing facilities around the world. The Utsunomiya facility is one of eight that manufacture semiconductor wafers and one of three that engage in the slicing and polishing of 300-mm wafers. The facility also handles a small volume of 200-mm wafers.

Molex Inc.

The U.S.-based passives giant said its employees in Japan were safe and that none of its three facilities had been damaged. Molex has major operations in Shizouka, Kagoshima and Yamato City, none of which are in the part of the country that was hardest hit by the earthquake and tsunami.

ON Semiconductor Corp.

On March 16, ON Semi updated the status of its production facilities in northeastern Japan, saying its fabs in Aizu and Gunma would remain shut down until infrastructure services were restored. ON Semi had originally reported power loss and limited physical damage to its 6-inch wafer fab in Aizu, but because of infrastructure disruption the Aizu fab remained temporarily shut down, the company said last week.

ON Semi said its Niigata fab, recently acquired along with Sanyo Semiconductor, had also reported limited physical damage but no power loss, and had resumed production on March 12. Another former Sanyo fab, in Gifu, sustained limited damage and was taken off line temporarily, but on March 16 the company reported the Gifu fab's production up and running.

ON Semi's Gunma fab, leased from Sanyo Electric, reported power loss, but limited power and communications had been restored as of last Wednesday. The company said it was still assessing the impact of the earthquake on production at the fab.

Two of ON Semi's back-end packaging facilities were also damaged but resumed production March 13, according to the company.

Panasonic Corp.

The electronics giant maintains a number of production facilities in Japan, including two centrally located logic fabs, according to Objective Analysis. Panasonic reported some minor injuries among its employees. But its list of affected facilities did not include the wafer fabs in the central cities of Arai and Uozu.

Panasonic suspended production at two factories that produce audio products and



```
{  
printf  
("Hello World!\n");  
}
```

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digital cameras in Fukushima, and at one in Sendai that makes camera lenses. Because of aftershocks, people had not been able to enter those plants.

The company said it had received a few reports of injuries and had yet to confirm the safety of all its employees.

Renesas Electronics Corp.

Five wafer fabs and two back-end packaging facilities owned by Renesas remained closed as of March 15. As mentioned earlier, Renesas confirmed that the earthquake had caused structural damage to five of the seven facilities. It also confirmed partial damage at its Tsugaru fab in Aomori prefecture, Takasaki fab in Gunma prefecture, Kofu fab in Yamanashi prefecture and Yonezawa back-end test and assembly facility in Yamagata prefecture.

A “defect” was identified at Renesas’ Naka fab in Ibaraki prefecture, and the company was in the process of assessing the extent of the damage. No structural or equipment damage had been confirmed at the Renesas Tsuruoka fab in Yamagata prefecture or at the Renesas High Components Inc. back-end test and assembly facility in Tsuruta-cho, Aomori prefecture. Renesas was busy assessing the status of the production equipment at the Tsugaru and Naka fabs, though both remained without power at the time of the company’s last update.

It also confirmed partial damage to equipment at the Kofu fab and the Yonezawa back-end line.

At press time, Renesas was preparing to restart production at five facilities as rolling blackouts subside.

On March 16, Renesas confirmed the quake had not damaged the structure or equipment at its Renesas Eastern Japan Semiconductor back-end line in Tokyo. It said it had restarted production at that facility, but only for products in progress at the time of the earthquake.

Rohm Co. Ltd.

According to the analog specialist, “Operations at the Oki Semiconductor Miyagi facilities and Rohm Tsukuba facilities have been stopped as of 11:00 a.m., March 13, because of infrastructure supply problems. The details are under investigation.”

Water and electric power had yet to be restored at Oki Semiconductor Miyagi Co. as of March 16, but a “substitute production system” was being formulated at the Rohm Kyoto main factory and Rohm Hamamatsu

Co. Ltd. Efforts were being made to maintain supply so that chip orders could be filled.

The quake severed the water main for factory operations at Rohm Tsukuba, but the facility was planning a partial restart at press time. Rohm said it had devised a “substitute production system” at Rohm Wako Devices Co. Ltd. and Rohm Apollo Devices Co. Ltd.

SanDisk Corp.

The flash memory vendor said in a statement on March 11 that the epicenter of the quake was approximately 500 miles from Yokkaichi, the location of two fab joint ventures between SanDisk and Toshiba. Both fabs were down for a short period but were back up that same morning, local time. There were no injuries to employees in Japan.

Sony Corp.

Operations at several Sony facilities were affected by the quake, tsunami and widespread power outages. None of the sites reported significant injuries to employees. As of the March 14, operations remained suspended at Sony’s Shiroishi Semiconductor Inc. fab in Miyagi prefecture, two Sony Energy Devices Corp. lithium ion battery production facilities in Fukushima prefecture, and a surface mounting equipment production facility in Saitama prefecture.

Spansion Inc.

The NOR flash company’s final manufacturing sites are outside Japan, so the impact to near-term product supply “is expected to be minimal,” the company said. But one of Spansion’s foundry fabs is TI’s Aizu-wakamatsu plant, which was damaged by the quake. TI recently acquired that fab from Spansion; the latter also has its own 200-mm fab in Austin, Texas, and has a foundry deal with China’s Semiconductor Manufacturing International Corp.

Sumco Corp.

Silicon wafer maker Sumco said on March 14 that activity at its plant in Yonezawa, Yamagata prefecture, had been suspended so that the company could inspect the facility “in preparation for restarting the operation.” The company stated that it “operates several plants in the Kyushu region that manufacture the same products as the Yonezawa plant” and that “a system of backup supply” was being considered.

Texas Instruments

TI initially reported that the earthquake had

affected its Miho and Aizu sites and Tokyo offices, and that employees at the sites had been safely evacuated. On March 14, it said the Miho fab had suffered substantial damage and would not return to full production until mid-July at the earliest.

TI plans to restart production in stages, starting with several lines in May. The schedule could be delayed if the region’s power grid remains unstable. The infrastructure systems at the Miho fab that deliver chemicals, gases, water and air were damaged, TI said, and repairs should be complete in about three weeks. The building itself suffered little damage and remains structurally sound, the company said.

The Miho fab produced about 10 percent of TI’s output as measured by revenue in 2010. DLP products accounted for about a third of the total; analog products accounted for the remainder.

TI said the fab in Aizu-wakamatsu was also damaged though equipment there was already being restarted, with full production estimated for mid-April, assuming a stable power supply. A fab in Hiji, about 500 miles south of Tokyo, is running at normal capacity, TI said.

Toshiba Corp.

Toshiba said it had complied with a request by Tokyo Electric Power to conserve power by suspending activity at facilities not providing essential services. As of March 15, production remained halted at its Iwate wafer fab in Kitakami City, in the Tohoku region strongly hit by the earthquake.

Toshiba said there appeared to be no significant damage to the building and that the company was evaluating the status of the production equipment. It was uncertain when production at the facility, which produces logic ICs for consumer and industrial applications, would restart.

Also on March 15, Toshiba said its two 300-mm NAND flash memory fabs in Yokkaichi, Mie prefecture, were operating normally. The fabs had briefly halted production when the earthquake hit but soon restarted. The company was still examining the fabs’ production equipment for possible damage but said that so far the effect on its Yokkaichi operations appeared to be minimal.

Toshiba added that its Ome factory in Tokyo, where the company makes laptop PCs, was closed because of a planned power outage on March 15. A Toshiba spokesperson emphasized that Toshiba builds most of its laptops outside of Japan. ■

Worldwide manufacture braces itself for semiconductor shortage

By Iain Bowles

TECHNOLOGY PRICES are set to rise after a chemical plant damaged by the Tsunami has been highlighted as a core producer of a unique resin used by nearly half of the World's semiconductor manufacturers

Semiconductors are used to manufacture a broad variety of complex technology based components used in everything from cars to LCDs. And the resulting global shortage of this unique resin will drive semi-conductor manufacturing delays and costs up, which will be passed through the supply chain to end user prices.

Car plants in the USA and Germany have already confirmed they are looking closely at their supply chain to define future product levels; many are heavily reliant on electronic

Iain Bowles is market analyst at Probrand
www.probrand.co.uk

component manufacture in Japan.

The Sendai located plant also produced Copper based products and solvents for cleaning Printed Circuit Boards (PCBs). Both are further critical materials used in the production of key technology components.

And whilst many large manufacturers have already invoked Business Continuity plans to overcome short-term supply issues, concern is rising over medium to long term plans to overcome a global shortage.

Probrand's Iain Bowles, said: "IT materials are at the start of the supply chain – an issue at this birthing stage of products has a knock-on effect further down the chain globally. "South Korean and Taiwanese semi-conductor manufacturers have confirmed they are unsure how long existing inventories of materials will last or how logistics, power or staffing disruptions will

impact supplies. Fuel shortages in Japan are significantly disrupting logistics, which is hampering alternative supply routes.

"Changing to an alternative resin source is a major issue as its characteristics influence overall design and performance of a semi-conductor and therefore the end-user product. This is the cleft stick in the middle of the IT supply chain. Redesign is both time and money sensitive.

"The full impact of this disaster is still not clear but we can see a pattern of short-term power and fuel shortage limiting production in Japan that will influence delivery of products well into the future and some brands are already defining product shortages April onwards. Additional nuances like unique chemical supply are adding to the complexity of Japan's supply chain challenges." ■

Missing sensor hits global automakers

By Peter Clarke

JAPANESE AND GLOBAL automotive production is being hit by the lack of an airflow sensor, according market research firm IHS Automotive. Global automobile production is likely to see a further marked drop in vehicle production – beyond that due to missing Japanese production – within a matter of weeks, the analyst said.

One estimate puts global vehicle output slumping 30 per cent within six weeks. And this is just one example of the difficulties being faced by automakers as a result of the earthquake and tsunami that hit Japan on March 11.

The supply of airflow sensors has come under pressure after a Hitachi Automotive plant in Sawa, Ibaraki prefecture, was damaged by the earthquake and subsequent tsunami. IHS Automotive estimates that Hitachi makes about 60 percent of the airflow sensors used by all leading car makers including Ford, General Motors, Renault-Nissan, Toyota and Volkswagen.

Meanwhile automakers in Japan are finding it difficult to restart vehicle production due to the lack of resumption of more general component supplies, and rolling electricity black outs affecting their plants. Some auto plants that restarted quickly after the earthquake hit have now started to scale back production, the market research firm said. All the major Japanese makers, including Suzuki, Mitsubishi, Toyota and Isuzu, are affected.

IHS Automotive said the supply shortage, already affecting global automakers, would begin to be felt even more intensely by the middle of April. Many automakers have already started adjusting production because of delays in supplies of components manufactured in Japan.

Supplies of plastics, rubber, and electronics components are reported to be falling short and General Motors (GM) and PSA Peugeot-Citroën have either announced

production cuts or are in the process of reducing production in the US and Europe, IHS Automotive said.

GM has already halted production of small pick-up trucks at a plant in Shreveport, Louisiana (US) as a result of the lack of airflow sensors, according to IHS. In addition, GM has stopped some production at its facilities in Eisenach (Germany) and Zaragoza (Spain), IHS added. PSA Group is also considering reducing production at most of its European facilities owing to the shortage of sensors, which is expected to affect production of the Peugeot 207, Citroën C3, and other models.

PSA is considering cutting production at its plants in Madrid and Vigo (Spain), Poissy and Aulnay (France), and Trnava (Slovakia) by between 40 and 50 percent, while production at plants in Sochaux, Sevelnord, and Mulhouse is being cut by up to 75 percent, according to IHS Automotive. ■

Rudi De Winter wants limping X-Fab to get up to speed

By Christoph Hammerschmidt

PAST FEBRUARY, Rudi De Winter has been appointed co-CEO for semiconductor foundry X-Fab. Since his appointment took place shortly after X-Fab had released nine-month figures in red ink, speculations circulated that the move was aiming at a major course correction or a generational handover in the company. De Winter knows X-Fab very well: during the past 14 years he was CEO of fabless automotive chipmaker Melexis SA, a major customer for the foundry.



Fresh power at the X-Fab bridge: Rudi De Winter oversees strategic segments R&D and sales.

EE Times Europe: Mr. De Winter, X-Fab now has a dual leadership, with you being responsible for R&D, marketing and sales, and long-standing CEO Hans Juergen Straub for finance, HR and operations. This looks like in the long term you are intended to replace Mr. Straub. Does the move initiate a generational succession?

Rudi De Winter: No. Perhaps not many companies have two CEOs, but I've worked before at Melexis which was also running with two CEOs, and that worked very well. Actually, X-Fab has great plans to further grow the company.

For a pure-play foundry, economies of scale are very important and those must be realized across several fields. On one

hand, we will grow through acquisitions and strategic plans and on the other hand we have to make sure that our ongoing customer-owned tooling (COT) business grows accordingly. Economies of scale demand that wafer fabs get bigger and bigger, that's why it makes a lot of sense to work in team and to split responsibilities.

EE Times Europe: With you being responsible now for R&D and sales, what will change at X-Fab?

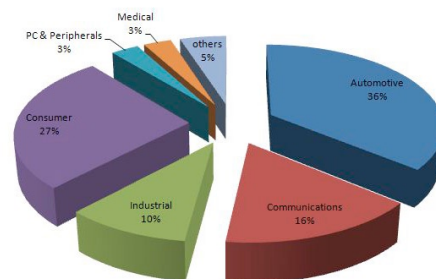
De Winter: The strategy at X-Fab will not change. An important focus will remain on COT business, so we invest in innovative technologies to remain on the leading edge with respect to SoCs, integration with high voltage, sensors, embedded Flash etc in monolithic solutions. On the other hand we also offer proprietary processes, we prefer to say customer processes, for the high volume consumer customers who wish to really optimize their processes for specific products.

EE Times Europe: In recent foundry rankings, X-Fab made a big jump ahead, ranking number twelve globally now, up from rank 15. Among pure-play foundries, X-Fab even ranks number nine now. Is this solely a result of the acquisition of ZMDs manufacturing activities in 2007?

De Winter: The semiconductor market is quite dynamic, so the additional business gained through this acquisition helped us to move forward. Another reason was our capacity expansion through the formal acquisition of 1st silicon in Malaysia. At this large facility, we are converting the product portfolio from "More Moore" to "More than Moore" where functional diversification within a package adds more than just shrinking the devices.

This process will take a couple of years. The technologies are there, but growing the business with our customers takes some time. "More than Moore" is a market with some inertia; the designs take some time to mature, to get into volume production. But once in volume production they have a

Strong exposure to automotive industry



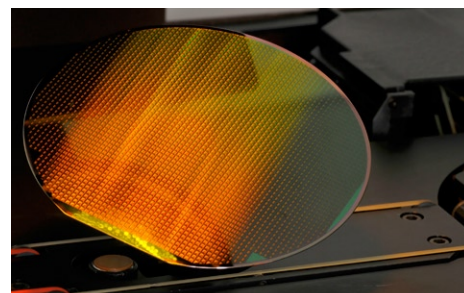
X-Fab's sales by industry segment for 2010 show that the company depends heavily on the automotive industry.

much longer product lifetime. Thus, it is a significant step for us to switch from pure digital-based products to the More than Moore technologies.

EE Times Europe: Until recently, utilization in the semiconductor industry went through the roof, customers complained about lead times. Has the situation improved now?

De Winter: After the downturn there has been a strong raise because people started buying products again. Stocks were empty across the entire supply chain; it was like rebooting the industry. This situation caused some hiccups in the supply chain. Since end of Q3 2010, this has stabilized in my view. There are enough products in the market; maybe there is a small undershoot now. We are going now into more stabilization for the rest of 2011. In comparison to 2010 we expect a somewhat softer market.

EE Times Europe: X-Fab is selling to a large extent to the automotive and medical electronics industry where high quality requirements and the need for certification of the products have a retarding effect to



Slow go: the modernization of X-Fab's Malaysian fab did not proceed as fast as expected.

technology changes. At the same time, consumer devices are entering automotive environments and call for quicker movements in the automotive industry supply chain. To which extent does this situation affect X-Fab?

De Winter: Yes, at X-Fab about 40 percent of our products go into cars; among the pure-play foundries we are probably the one with the most pronounced focus on this market. Serving the automotive industry requires a certain organization to meet the quality requirements and the reliability in the field. Certainly, there is an additional market opening up for infotainment in the car. But while it is nice to have all these gadgets in the car, the end user expects a different level of reliability as soon as this functionality is integrated into the car as opposed to when these devices are used stand alone. A phone is typically thrown away after a year or two, but a car is used for 15 or even 20 years.

EE Times Europe: In the semiconductor industry, the mainstream moves quickly towards smaller geometries. To which extent a specialty fab like X-Fab has to follow this trend?

De Winter: We do follow this trend with a time lag of several technology generations. Also the analog and More than Moore technologies have evolved from one micron 15 years ago to 0.18 micron today. The roadmap will go further to 90 nanometers in the next five years. We also invest a lot in our design kits by permanently improving the accuracy of the models and creating a richer portfolio of IP blocks to increase the productivity of our customers.

EE Times Europe: Industry watchers say that X-Fab runs the risk of losing its focus. Recently X-Fab has opened up another technology front by acquiring a stake in MEMS fab MFI. How does this move fit into your focus?

De Winter: It fits perfectly into our More than Moore strategy, because sensors and micro-actuators are part of the analog world. They will be further integrated and combined with CMOS intelligence to make micro-actuators intelligent. For this reason, our engagement with MFI is a natural move and a logical step for an analog foundry. Technology-wise it is of course a challenge because these technologies are not the same as CMOS. That's why through the cooperation with MFI and the proximity to Fraunhofer Institute we can leverage to develop those technologies.

EE Times Europe: Despite high demand, X-Fab lost money in the first nine months of 2010. How can one lose money in a landscape that was the best of all possible worlds for the semiconductor industry?

De Winter: One important and quite large activity is our wafer fab in Malaysia where we are about to convert the technology mix from the digital and memory market into More than Moore products. This process is still ongoing. The crisis caused some delay there, some companies stopped or lowered their innovation pace and new product designs in 2009. But now everything is moving forward well and we are confident that this is becoming a very modern and productive site.

EE Times Europe: When will X-Fab return to profitability?

De Winter: X-Fab is in fact quite healthy financially. For the full year 2010, X-Fab records a positive net profit despite a negative operational result. We expect to become operational profitable by 4Q2011. ■



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Researchers integrate silicon, III-V

By R. Colin Johnson

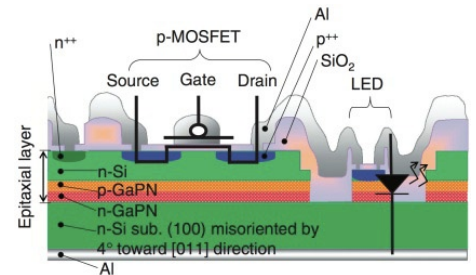
INTEGRATING GALLIUM NITRIDE emitters and other optical materials onto silicon substrates was recently demonstrated at the Toyohashi University of Technology.

Researchers there claim to have solved the lattice mismatch problem between silicon and III-V materials, thereby enabling future integration of optics onto silicon chips.

Silicon photonics has been demonstrated for most optical functions, including waveguides, resonators and switches, but optical emitters has remained a task for III-V materials using gallium, arsenide, indium and their various nitrides.

Now, Akihiro Wakahara, the project team leader at Toyohashi Tech (Aichi, Japan) and colleagues claim to have invented a method of mitigating the lattice mismatch between silicon and III-V materials, thereby enabling optical emitters, including lasers, to be fabricated on silicon chips.

As a demonstration, Wakahara's team constructed a one-bit opto-electronic counter circuit that combines silicon field effect transistors (FETs) alongside gallium phosphide nitride (GaPN) LEDs on a single chip. The key to solving the lattice mismatch between silicon and III-V was accomplished



by growing a thin gallium phosphide (GaP) layer using migration-enhanced epitaxy with III-V-N alloys. The resulting lattice matched Si/GaPN/Si hetero-structures were grown on silicon substrates using dual-chamber molecular beam epitaxy (MBE) ■

Eurotech opens European hub in Paris

By Julien Happich

WITH 250 SQUARE METERS of office space, dedicated rooms for technology demonstrations, product trainings or video conferencing, embedded computers specialist Eurotech has inaugurated brand new offices on the outskirts of Paris. The company chose Paris as a central location where European customers and engineers can easily meet and discuss new technology, and also with plans to boost its presence on the French market.

Arlen Nipper, President and CTO of Eurotech's US branch presented the company's Everyware vision of the embedded computing market, providing the technology and the infrastructure necessary to distribute process knowledge and associated parameters within the enterprise and beyond.

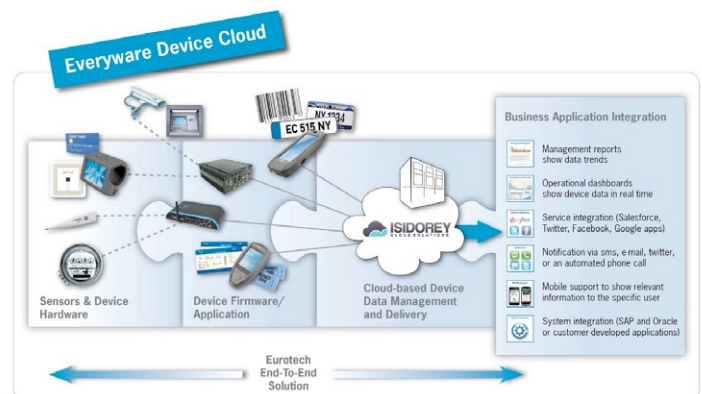
Eurotech's Everyware Device Cloud (EDC) solution (also presented at Embedded World) enables engineers to design and deploy device-to-cloud solutions that exchange valuable data between distributed devices and business applications. With EDC, M2M (machine-to-machine) solutions that connect embedded devices to a network and capture valuable data can be deployed in minimal time.

The Everyware Device Cloud solution

consists of easy-to-use building blocks, the Isidorey Device Cloud for instant accessibility to device data and management, the Everyware Software Framework (ESF) based on Eclipse IDE for immediate productivity, the Wind River Linux operating system with a complete and robust development tool chain and Eurotech's industrial-grade and rugged Intel Atom-based family of hardware platforms.

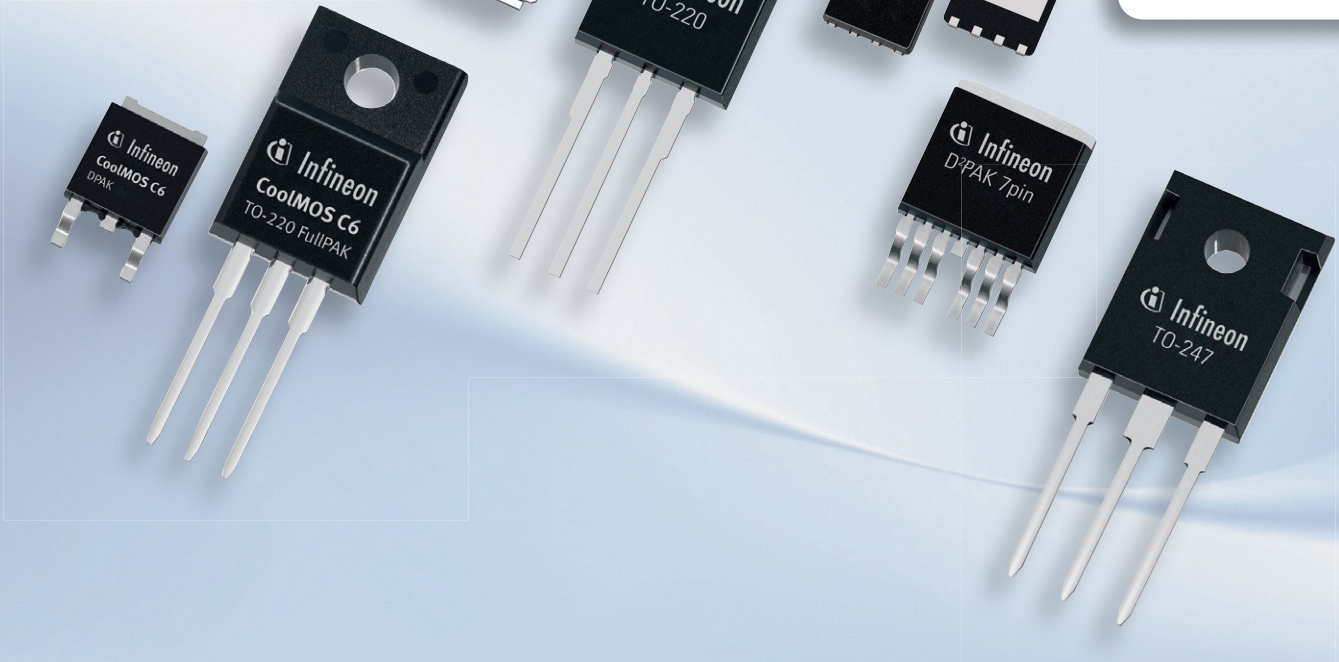
The EDC provides protection against hardware obsolescence through an advanced, feature-rich middleware framework that natively connects to the Isidorey Device Cloud where data is collected, safely stored and delivered to common business applications.

The company demonstrated control applications running sensor devices of which data was processed through the cloud and sent back to a monitor. Compared to most



closed-loop systems that only communicate locally, using a secure connection to the cloud means the data of any processing plant or any transport system can be communicated across different branches and operations to interconnect or synchronise operations, with no special protocols to write.

Once in the cloud, the process data can be stored for later analysis or is available for real-time analysis. It could even be opened to third party developers or to end-users. For example, it is conceivable that train or bus passengers could access transport data to run their own iPhone applications when on-board. ■



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Bluetooth in 467M health devices by 2016

By Rick Merritt

AS MANY AS many as 467 million health care and personal fitness devices will ship in 2016 using Bluetooth Low Energy, according to a new report by ABI Research. But a delay releasing the spec has given competing technologies a leg up in the new markets, it said.

The Bluetooth Core Specification Version 4.0 was released in July 2010, more than six months later than anticipated, said Jonathan Collins, principal analyst at ABI Research and author of the report.

"The wait for adoption by the Bluetooth

SIG has put a brake on many wireless health and sports devices' market launches," said Collins in a press release. "Where [the delay] hasn't halted product development it has fostered adoption of rival traditional Bluetooth and proprietary offerings in the market," he said.

The alternative approaches include "a host of rival protocols from 802.15.4-based offerings to low-power Wi-Fi to proprietary wireless protocols," said Sam Lucero, another ABI analyst.

Chips supporting the Bluetooth 4.0 spec are now sampling and systems using them should be available in 12 months, the report said. The chips also will be used in some smartphones, it said.

About half of the wireless health and fitness systems sales by 2016 will be for medical systems in hospitals and clinics, ABI estimates. Another third will be for fitness devices. The smallest percentage will go to home-based health care devices, ABI said. ■

Tabula secures US\$108 Millions in series D funding

By Julien Happich

FABLESS SEMICONDUCTOR company Tabula announced it has secured USD 108 million in series D funding. The company will use the new capital to accelerate production of its 3PLD ABAX product family, expand customer and partner support infrastructures, and further next-generation product development to extend its market leadership in the rapidly growing programmable logic sector.

The financing was led by Crosslink Capital and DAG Ventures. Existing investors, Balderton Capital, Benchmark Capital, Greyllock Partners, Integral Capital, and NEA also participated in this round.

"Our chips and software are in customers' hands, and our Spacetime technology is delivering on its promise in the marketplace.

This enormous infusion of capital provides the remaining ingredient for us to transform the electronics industry," notes Steve Teig, Founder and CTO of Tabula

Committed to bringing business and technology innovation to the semiconductor industry, Tabula recently completed the roll-out of its 40nm ABAX family of 3PLDs supported by the Stylus development software. The company also announced Cisco Systems as being one of several Tier 1 OEM customers planning to use the chip in communications infrastructures.

"Tabula is well positioned to capitalize on the growing migration of ASIC and ASSP towards programmable logic devices," said Dave Strohm, Partner of Greyllock Partners.

"With a proven world class management team, products that are leading in a high-growth PLD market and shipping to a growing list of Tier 1 customers, this round of funding will help drive their customer expansion and increase their technological lead. We look forward to their continued success." ■

Highest density mobile DRAM uses 30nm process

By Philip Ling

EARLIER THIS MONTH, Samsung Electronics started production of four gigabit (Gb), low power double-data-rate 2 (LPDDR2) DRAM using 30 nanometer (nm) class technology. The mobile DRAM chip targets thinner, lighter smartphones, tablets and other mobile devices, with longer battery life, at a level unachievable until now. The 30nm-class 4Gb LPDDR2 DRAM increases productivity by 60 percent.

Samsung developed the 4Gb LPDDR2 DRAM in December of last year and began mass producing it earlier this month.

The new chip also combines high performance and energy efficiency. It delivers a data transmission speed of 1,066Mbps, which is more than double that of today's MDDR, which operates between 333 to 400Mbps.

In addition, the chip enables a thinner, memory solution. When creating a 1GB (8Gb) LPDDR2 package with the previously highest density chips of 2Gb, four chips had to be stacked together. With the new 4Gb LPDDR2, stacking only two chips will achieve the same density, while providing a 20 percent package height reduction from 1.0mm to 0.8mm. It also consumes 25 percent less power.

Samsung plans to produce the 4Gb LPDDR2 chip based 1GB (8Gb) packages beginning this month, and plans to produce 2GB (16Gb) packages consisting of four 4Gb devices next month to accommodate a growing need for high-density mobile DRAM solutions.

Samsung expects that the new 4Gb LPDDR2 based solutions will benefit mobile device makers greatly as they launch competitive products using dual-core processors, which require mobile memory with higher performance and density.

According to iSuppli, shipments of mid to high-end smartphones will increase at about an 18 percent annual rate, from 2009 to 2014. This is expected to lead to dramatic expansion in the use of mobile DRAM, which could grow at an annual rate of 64 percent. ■

New: TI's Analog Signal Chain Guide

TI's new Analog Signal Chain Guide features product overviews for the industry's broadest portfolio of signal chain devices, which target a wide variety of applications from industrial, medical, communications, audio, consumer and computing.

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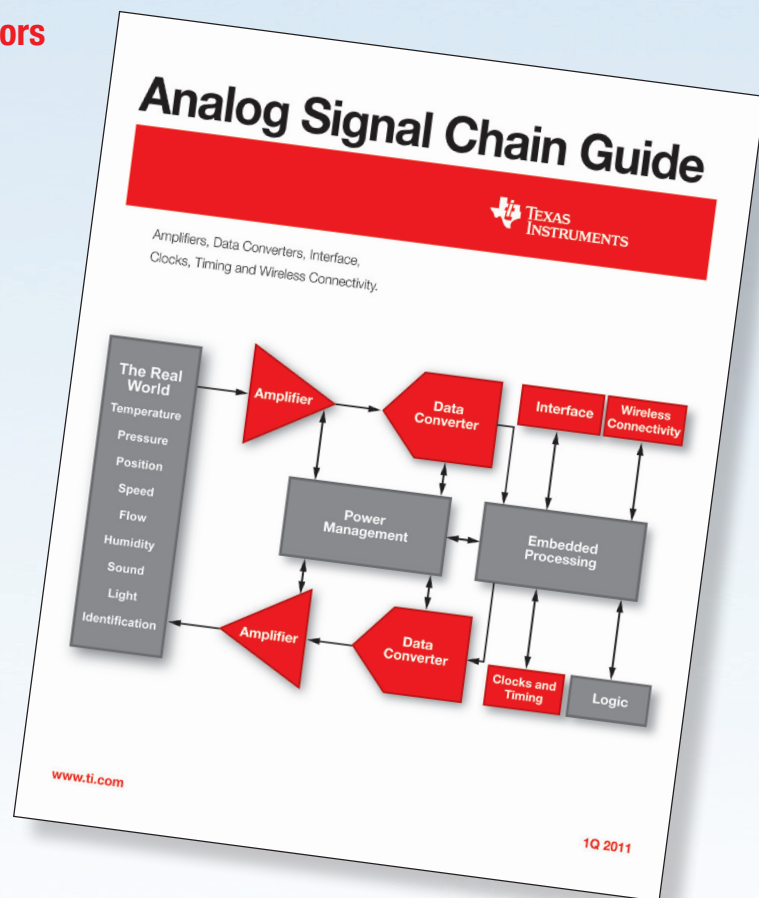
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Omnidirectional 3D antenna printing yields higher performance

By Julien Happich

RESEARCHERS AT THE University of Illinois have experimented with omnidirectional printing techniques using metallic nanoparticle inks and a 3D controlled dispensing nozzle to manufacture very compact and high performance antennas.

So far, antennas produced by screen-printing, inkjet printing, and liquid metal-filled microfluidics were designed in simple motifs, such as dipoles and loops, but with limited spatial resolution and dimensionality. This yielded planar antennas that occupy a large area relative to the achieved performance.

“Omnidirectional printing of metallic nanoparticle inks offers an attractive alternative for meeting the demanding form factors of 3D electrically small antennas (ESAs),” stated Jennifer A. Lewis, the Hans Thurnauer Professor of Materials Science and Engineering and director of the Frederick Seitz Materials Research Laboratory at Illinois.

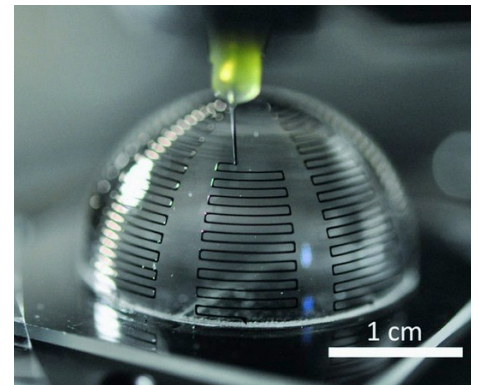
These antennas are electrically small relative to a wavelength (typically a twelfth of a wavelength or less) and exhibit performance metrics that are an order of magnitude better

than those realized by monopole antenna designs, claim the researchers.

“There has been a long-standing problem of minimizing the ratio of energy stored to energy radiated, the Q of an ESA,” ECE Professor Jennifer Truman Bernhard explained. “By printing directly on the hemispherical substrate, we have a highly versatile single-mode antenna with a Q that very closely approaches the fundamental limit dictated by physics (known as the Chu limit).

Conformal printing allows the antenna’s meander lines to be printed on the outside or inside of hemispherical substrates, adding to its flexibility. “Unlike planar substrates, the surface normal is constantly changing on curvilinear surfaces, which presents added fabrication challenges,” Lewis noted. To conformally print features on hemispherical substrates, the silver ink must strongly wet the surface to facilitate patterning even when the deposition nozzle (100 μ m diameter) is perpendicular to the printing surface.

To fabricate an antenna that can withstand mechanical handling, for example, the silver nanoparticle ink is printed on the interior surface of glass hemispheres.



A 3D antenna during the printing process on a dome-shaped structure.

Other non-spherical ESAs can be designed and printed using a similar approach to enable integration of low Q antennas on, for example, the inside of a cell phone case or the wing of an unmanned aerial vehicle. The antenna’s operating frequency is determined primarily by the printed conductor cross-section and the spacing (or pitch) between meander lines within each arm.

According to the researchers, their design can be rapidly adapted to new specifications, including other operating frequencies, device sizes, or encapsulated designs that offer enhanced mechanical robustness. ■

U.K. prepares auction for 4G spectrum

By Peter Clarke

OFCOM, THE UK government’s regulatory body for telecommunications, has announced plans for an auction of radio spectrum for 4G mobile services in the U.K. It has announced a consultation procedure as it decides the detailed rules for the auction which is expected to take place in the first quarter of 2012.

Ofcom defines 4G to include Long-Term Evolution (LTE) and WiMax communications and the U.K. needs the technology and spectrum to provide high bandwidth, such as streaming video, for mobile users. 4G will allow mobile bandwidth to approach that of current ADSL wired connections.

The auction is due 1Q12 with a view to

deployment of services in 2013. This puts the U.K. some way behind such territories as the United States and Japan, which already have some 4G networks. Ofcom is also building conditions into the auction procedure to ensure coverage of 95 percent of the population and competition in the form of ensuring there are at least four national wholesale 4G service providers.

The auction will be for two spectrum bands – 800 MHz and 2.6 GHz. The lower frequency 800 MHz band is part of the digital dividend, which is being freed-up as the UK switches from analog to digital TV. This spectrum is ideal for widespread mobile coverage. The 2.6 GHz band is at a

higher frequency, and is ideal for delivering the capacity needed to deliver higher speeds. These two bands add up to 250 MHz of additional mobile spectrum. The auction is also likely to be boon for the government. The last auction of spectrum, for 3G spectrum which took place in 2000, raised £22.5 billion (about \$36.7 billion).

The increased mobile penetration and significance of mobile to people’s lives and businesses is thought to make the next auction even more valuable. However, there it is also thought that the service providers who did gain 3G spectrum paid too much and that this slowed deployment down for many a number of years. ■

Malcolm's semiconductor update

THE YEARLY GROWTH in 2010 versus 2009 weighed in at 31.8 percent, hitting US\$298.3 billion, just shy of the elusive US\$300 billion threshold and until a few weeks ago, the market was right where we said it would be at our recent 2011 Forecast seminar.

It is not just semiconductors that were off to a good start ... the connector and foundry industries were already reaching tight capacity... yet until Japan's disastrous earth quake and ensuing nuclear accident stalled the country's chip manufacturers, few people believed there was a supply problem in

Malcolm Penn is Chairman & CEO of Future Horizons – www.futurehorizons.com
He can be reached at mpenn@futurehorizons.com

prospect. Industry denial was rampant, way beyond reasonable caution and ignoring the underlying trends of too many fab-lite business models to cater for occasional surges in demand.

We had already been running at a very lean capacity for the two or three previous years, which means there is no slack in the supply chain to absorb such a disruption of capacity. And even without these dramatic events, there was probably not enough chip capacity to meet seasonal demand anyway.

The events in Japan will have a far-reaching impact on the whole electronics industry.



It is not just the chip production that is being affected, but also the poly-silicon wafer production and their raw silicon suppliers too. In the short term, because of its very low inventory level, memory pricing could double. But the real problem will come in three months' time, when what's not being made today

which takes three months to work its way through the production cycle, will impact the second or third quarters of this year. Once the first few months of inventory will be gone, there will be more shortages just when seasonal demand becomes higher. ■

Groups merge smart grid interface efforts

By Rick Merritt

THE USNAP ALLIANCE and the Electric Power Research Institute (EPRI) will merge separate efforts to develop a modular interface specification for linking consumer gear to a smart grid. The collaboration is one step toward a broader convergence still in the works.

The groups are responding to a request from the National Institute of Standards and Technology to merge efforts and deliver them to a formal standards group. NIST is leading efforts to drive standards for smart grids.

Several protocols and network types are vying to carry smart grid data to consumer devices. They include the EPRI and USNAP protocols, the Smart Energy Profile, OpenADR and a handful of vendor-specific protocols. They may ride over a variety of powerline, Wi-Fi, Zigbee or vendor specific nets such as Z-Wave.

In October, the Association of Home Appliance Manufacturers picked Smart Energy 2.0 and OpenADR as their two most favored application-layer protocols. The group blessed HomePlug GreenPHY powerline and Wi-Fi and Zigbee wireless for the network

and media layers.

Whirlpool Corp. made a public commitment to ship in 2011 a million dryers ready to plug into a smart electric grid if there was a suitable networking standard the company could use. Proponents hope the merged efforts of USNAP and EPRI help pave the road for such efforts.

EPRI, a research arm supported by major utilities, finished in January a draft of its Demand Response Socket Interface Specification, working with a variety of appliance, consumer and communications companies. It defines a Direct Current power link, a simple command set geared for low-end appliances such as water heaters and a pass through mechanism for multiple protocols.

In December, USNAP published the 2.0 version of a spec defining a 1.5 square inch module for a wired or wireless chip with a DC link and a ten-pin connector that sends data to a system using the Serial Peripheral Interface. Half a dozen small companies started shipping products this year using USNAP 1.0.

The two groups aim to finish in about six months a spec that merges the best of both

efforts. It will include the EPRI command set and support both the separate Smart Energy 2.0 and OpenADR protocols.

"The two specifications are similar in technical approach and are nearly identical in their basic purpose," said Brian Seal, senior project manager for EPRI, in a press release. "We are making great progress in merging the specifications, retaining the best attributes from each and coordinating with related standards organizations," he said.

Many smart meters have already adopted Zigbee and the Smart Energy Profile. Barry Haaser, executive director of the USNAP Alliance, believes many broadband devices and nets will adopt OpenADR due to its use of XML schemas. That may force a requirement for Smart Energy/OpenADR gateways, he said.

The merged EPRI/USNAP spec could be useful for devices from either side of the home-network. Vendors will still have to decide which wired or wireless networks to support, but they will be able to do it with a single module, he said. ■

The biggest challenge now facing the M2M sector could be complexity

By Philip Ling

THE CONCEPT OF Machine-to-Machine communications, or M2M, spans an almost limitless number of vertical applications and markets, and arguably that is because fundamentally M2M remains a concept; any communication between two devices could be classed as M2M. However, the commercial conditions that stimulate growth in particular sectors using M2M technologies have conspired to shine a spotlight on this nebulous concept and draw attention to specific, enabling features.

For example, Macario Namie, senior director of product marketing at Jasper Wireless, said: "The term makes it easy for the telecommunications industry to describe a common set of technologies across disparate vertical industries. But outside of this ecosystem, there is no company that classifies itself as an M2M company; a car manufacturer is just that, a car manufacturer; an energy company is an energy company, and so on." There are, of course, some requirements that are common across many of the emerging and existing M2M application areas. For the emerging markets, these include: reliability, to support a long time-in-service; low power, for the same reason, and; security. For Inside Secure, a company that provides turnkey IP protection, data confidentiality, authentication and end-to-end communication, M2M is a strategic sector. Unlike many other companies in this area, its focus isn't on wireless communications, but wireline. Laurent Sustek, smart metering marketing manager for Inside Secure, said: "Low power is a selection criteria in applications we are serving with our products, wireless is not. For smart grid, IMS Research estimates dominance or wireless for recent years, but dominance of wired by 2014."

Toby Colquhoun, market research analyst for the Industrial Automation Group of IMS Research, added: "In most applications, the main barrier is getting power to a device. Having run a power cable to a device really

diminishes the benefits of using wireless technology as most of the associated infrastructure like wire racks and junction boxes are already there. There is certainly a lot of interest in energy harvesting technologies; there are some solutions out there for solar and there's one solution from ABB that uses an alternating magnetic field, but I don't know of any breakthroughs on the horizon." Having said that, Colquhoun believes the biggest change in the M2M market over recent years has been the emergence of industrial automation specific wireless protocols, such as WirelessHART, ISA 100.11a and WIA-PA: "In future, we'll see something similar for the discrete automation market; ISA 100.16 and PI Wireless," he added. He sees the biggest driver at the moment being mobility: "The largest area is operator mobility; extending the office network to your field workers. Having service history/production information/diagnostic information to hand can enhance the productivity of technicians or plant workers."

There are still challenges ahead, of course. Olivier Beaujard, group VP of market development for Sierra Wireless, believes complexity is one of them: "There really are a lot of complexities across the value chain, ranging from segment-specific technology requirements to service pricing. Reducing complexity will benefit everyone in the value chain and is key to unlocking growth." Inside Secure's Sustek feels the main issue is privacy: "Not because of the confidentiality of the information, but because of the nature of the interconnected systems; aggregation of differently originated information could generate a side effect threat." According to Jasper Wireless' Macario Namie, the single biggest technological challenge the M2M sector faces today is the creation of the wireless component: "The next generation of connected devices is not being built by traditional handset manufacturers of the world; among others, the automotive, construction,



Olivier Beaujard, Group VP Market Development, Sierra Wireless: "Cellular industry has become increasingly focused on M2M."

machinery, consumer electronics and energy industries are now building wireless devices, but they are doing so without the mobile expertise of established handset companies. As such, many times these companies struggle to get wireless right the first time, both the device design and resulting service processes."

The solution to these challenges is increasingly falling on the operators, Namie added: "Operators must have the platform and systems in place to eliminate the complexity of embedded mobile connectivity. This starts in the development phase by providing device manufacturers with the design tools to build a high-quality product. It continues by enabling companies to eliminate dead-on-arrival devices through network testing capabilities for use at the time of manufacture. Once at its final location, whether in the hands of an installer or a consumer, the wireless device should automatically function on first power-up, effectively enabling the device to simply work out of the box." While ISM band wireless technologies may offer short-range solutions, moving data over longer distances requires a larger infra-

structure, which is why cellular operators have been monitoring M2M for some time. Beaujard noted: "In the last few years, the 'mainstream' cellular industry has become increasingly focussed on M2M. As mobile network operators face progressively more saturated core markets, they are searching for new growth opportunities, and M2M provides a great opportunity for this."

Unlike the consumer-led mobile phone business model, M2M comes with a different set of priorities: "M2M applications allow carriers to charge based on the type of data, rather than the amount of data," explained Beaujard. "With an alarm application, for example, the customer will place a higher value on the immediate transmission of an alarm, while the monitoring of log file information can be sent overnight. Carriers are starting to recognise this trend as offering a profitable alternative to 'all you can eat' plans that characterise the handset market." While cellular wireless connectivity is undoubtedly critical for some applications, there are still places where cell coverage is limited or unreliable, particularly in an M2M application. Here, companies such as Inmarsat, through a partnership with SkyWave, are offering satellite services for M2M communications for assets located in regions where cellular service is either unavailable or unreliable. For SkyWave, this is its entire business focus, while for Inmarsat it is an opportunity, as Joel Schroeder, Inmarsat's business development manager for Land Mobile Services explained: "We see lots of untapped opportunity in the M2M market for a reliable global service than can offer more data, more flexibility and a more reliable network."



The Inmarsat/SkyWave partnership is just one of many being forged between M2M providers.

SkyWave's marketing manager, Anu Snood, reiterated that the M2M market has 'exploded' over the past five years, with many market studies now putting its value in the billions of dollars. During this growth it has changed: "One area that was an early adopter of M2M technology was fleet management. However, while this sector hasn't disappeared it has evolved; now customers don't

simply want to know the location of their vehicles but also what is happening in and around the vehicles. They want to send work forms and receive delivery signatures in order to optimise their drivers' time and quickly bill customers once the products have been delivered."

Legislation often plays a key role in developing new markets and the same is true for M2M applications, the most obvious being metering: "One of the most recent trends is for energy regulators to mandate the deployment of smart meters to 100% of an energy utility's customer base," said Schroeder.

"This requirement creates an immediate demand for M2M services to connect metering infrastructure, generally by connecting meter aggregation points - where multiple meters are connected to a central point via a local radio network. Satellite solutions are frequently selected to connect the 2 to 5% of those customers located outside the reach of terrestrial networks, as satellite is ubiquitous it offers immediate coverage at a lower cost than building additional network infrastructure across a utility's service area."

"One of the most important areas for development in 2011 will be end-to-end energy management," said Beaujard. "The western world has been consuming energy without any control for the last 50 years and the brutal reality is that more than two billion people want to join the party. Countries won't solve a problem of this magnitude by building more power plants, or simply monitoring energy usage; the solution is controlling business and consumer energy demand. Sierra Wireless is ahead of the curve in this market, providing the M2M building blocks that make it easy to develop and deploy an end-to-end wireless energy management solution for industrial and residential consumers, substations and power generation applications - and automotive charging stations in the future."

Electric vehicles may not be an obvious M2M application area, but it seems clear it will enable it, as Beaujard observed: "There is a lot of focus on electric cars but I think the broader vision will be new sales and ownership models based on electric cars. In the future consumers may buy the car and rent the battery; the companies that rent the batteries will develop applications for monitoring them remotely to optimise performance and reliability, and also help their customers find and book charging stations. This is a long term vision, but we'll see the infrastructure actually starting to emerge in 2011."



Laurent Sustek, Smart Metering Marketing Manager, Inmarsat: "The main issue is to solve user privacy."

Beaujard added: "The automotive industry will be another growth area for M2M, with a wide variety of applications including emergency calling and diagnostics, navigation and infotainment, and stolen vehicle tracking and recovery."

"Another example is Long Range Identification and Tracking," added SkyWave's Snood. "Established by the International Maritime Organisation's Maritime Safety Committee, LRIT requirements came in to effect on January 1st 2009. Vessels affected include passenger ships, cargo ships and mobile offshore drilling units. Compliance requires that vessels automatically transmit their identity and date and time-stamped position at regular intervals."

Both cooperation and competition are expected to increase in the near future, as Namie stated: "M2M deployment has turned in to an arms race, with global operators eager to form strategic partnerships and prove that they are active in this space."

Inmarsat's Schroeder added: "Many partnerships are being forged between hardware manufacturers, service providers and application providers in order to provide a complete solution for the end user."

Sierra Wireless' Olivier Beaujard concluded: "Today the momentum is very clear; strategic investments are happening everywhere, especially on the network operator side. In five years, observers from the outside will have the impression that 'wireless everywhere' was an overnight success, but those of us who have been involved in the industry for a long time will know that it really took a couple of decades of hard work, innovation and a great execution." ■

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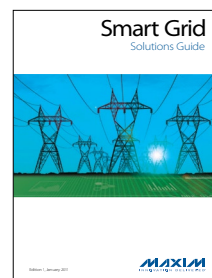


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Connected cars fill frequency bands and swamp address schemes

By Christoph Hammerschmidt

CARS ARE BECOMING TALKATIVE and communicative. One could expect that future vehicles will automatically transmit data to the outside world, with other vehicles, roadside units and even the cloud as their communication partners.

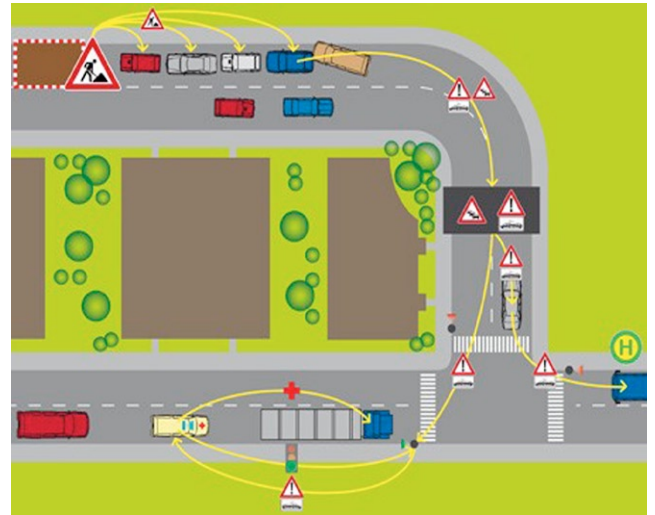
The car of the future will be like the smartphone of its user: always on. An increasing number of applications require a continuous flow of data to and from cars: navigation systems download maps and traffic information, fleet management systems transmit current position data to their home base, car-to-x systems exchange the latest information on traffic flow and road condition with roadside units and oncoming vehicles. And on top of these data streams, bored rear-seat passengers can surf on the internet, prompting the infotainment system to download bandwidth-intensive video streams.

The radio technology for all of these processes is mainly based on 2G and 3G mobile radio technology. If one thinks three to five years ahead, LTE appears on the horizon for a handful of vendors. IEEE 802.11p, a member of the 802.11 protocol family optimized for communications with fast-moving stations, is used for specific applications such as cars. At the recent CeBIT and Embedded World industry meetings, research institutes as well as commercial companies showcased their visions of "smart" traffic scenarios with

telematics, car2x and infotainment content generated in the cloud being the major building blocks.

Car2x communications

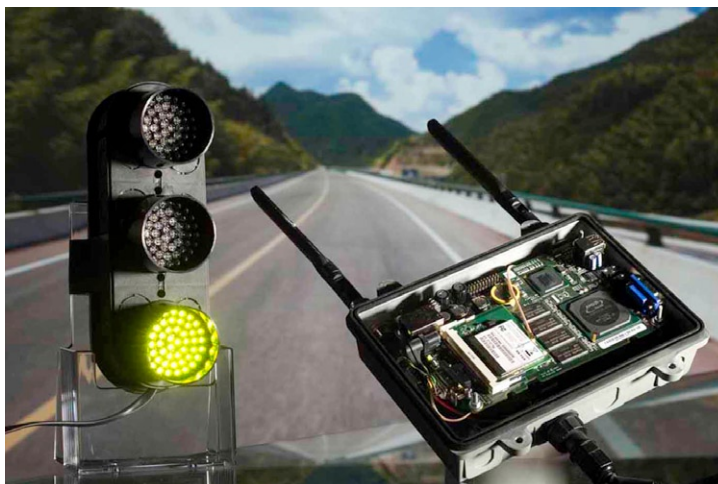
Car2x communications is one group of communications applications. Initially, the concept only included car-to-car communications (c2c) processes. The idea was that an on-board computer in the vehicles would detect critical road conditions, traffic stalls and other situations relevant to oncoming drivers but beyond their field of view, and automatically exchanges such data with other vehicles. At an early stage of development, the communication architects figured out that it would make a lot of sense to include so called roadside units (RSUs) which could also participate in the radio talk between the vehicles. RSUs can transmit speed limits, traffic light information or traffic congestion data to the vehicles and relay car-generated messages along the roads, increasing the range of their original transmitter. Communications between cars and RSUs is defined as car-to-infrastructure (c2i) communication.



Communication among cars can improve traffic safety.

Source: Fraunhofer ESK

tion processes. At Embedded World, German research institute Fraunhofer ESK showed a prototype car-to-x communication platform which can be used for vehicle-based systems as well as for RSUs. While the standardization for is not yet concluded, the researchers have defined three groups of datagrams: The first group includes periodic standard datagrams that are transmitted up to ten times per second to other vehicles as well as to RSUs. These datagrams include information with regard to position, speed and driving direction. These messages help recipients to generate an overview over the general road situation and potential hazards. The second group embraces event-based messages such as accidents along the road. If many cars within the range of an RSU suddenly and simultaneously slow down, the system can interpret this as an accident disturbing the car flow. By the same token, the RSU can identify traffic stalls and spread this information among drivers. Similarly, if in many cars the electronic stability control (ESC) is activated, the system could send an alert to car drivers warning that the road is slippery. The third category includes so called application messages - for instance messages related to traffic lights ahead, or traffic-related messages. RSUs can feed data from external sources such as broadcast stations or traffic



Fraunhofer Institute has developed a versatile car-to-x communications platform that can be used for development purposes. Source: Fraunhofer ESK

In the car2x context, the radio connections are established by means of the IEEE 802.11p standard, a member of the 802.11 protocol family optimized for communications with fast-moving stations. Recent research results hint that car-to-infrastructure communications will significantly outweigh purely car-to-car communica-

control centers into the system. A common ontology enables services to describe themselves along with their requirements. Drivers as well as RSUs can request and offer specific services. The Fraunhofer project also looks into ways to balance the workload across groups of RSUs. Despite the fairly detailed description of most message and service types, the system still is subject to standardization.

Telematics and internet connectivity

Car2x however is only one channel that connects the vehicles to the outside world. Developers focus even more on mobile radio data exchange. Many applications such as technical status reports for the garage, the European emergency call system eCall or fleet management systems do not require high data rates. For this reason, they can rely on simple, cost-effective GSM communication modules. However, innovative applications are emerging, calling for connections with more bandwidth. "For the time being, GSM prevails for cost reasons. When it comes to pricing, standard GSM modules are simply unbeatable", said Hendrik Nieweg, project coordinator for M2M solution provider Device Insight. "UMTS and LTE are future platforms for M2M communications. However, this will take a while to materialize". Perhaps this future will come faster than Nieweg believes. Increasingly, infotainment applications are calling for broadband access. Navigation systems could download their maps from a remote server or rear-seat infotainment systems could access internet-based video streams, to mention just a few examples.



Future vehicles will run apps, much like today's smart phones.

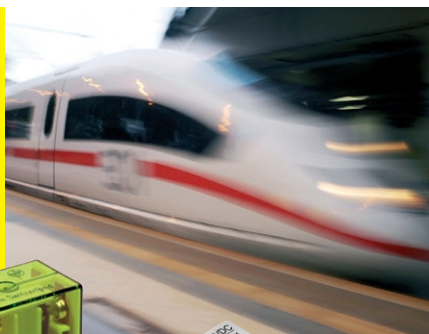
Internet connectivity is a precondition for this scenario.

In this context, there are various options to establish a broadband wireless connection. For instance, some smart phones can be used as broadband modem to the outside world; inside the car, they communicate with the head unit or the infotainment system via Bluetooth. In some cases, automotive OEMs such as Audi even offer in-car WiFi nodes for the connection between the smart phone, operating as UMTS modem, and other data sources and sinks within the vehicle. An alternative to smart phone modems are automotive-based communication platforms such as Continental's AutoLinq which bring the modem functionality into the car itself. Already, some applications take shape that make use of cloud computing. "Since processing resources inside the vehicles will remain scarce, many applications could be outsourced to the cloud", explained Thilo Koslowski, automotive expert at IT market researcher

Gartner. An example would be the voice control component in automotive human-machine interfaces. Other examples of cloud-based automotive applications that require a wireless broadband connection include real-time navigation data processing where the navigation system does not need a map anymore. Instead it constantly downloads the map images from a cloud-based server.

Against this background, telecommunication experts already raise their eyebrows. "The challenge will be the scalability of the telecommunication networks", explained Josef Lorenz, Head of Technology / West South Europe at Nokia Siemens Networks. It is not so much the amount of data that concerns the expert but the number of participants. "We are running out of IP addresses," he said. "The growing number of networked cars clearly contributes to the rising pressure to roll out IPv6." ■

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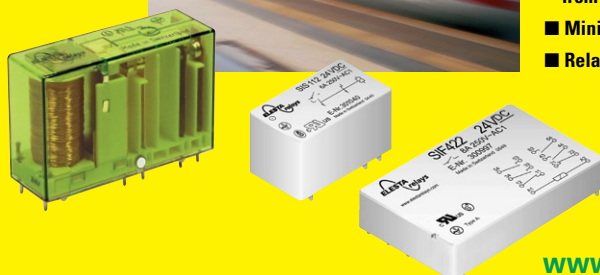
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Ultra wideband geolocation soon a commodity among machines

By Julien Happich

AEROSCOOUT is in the business of assets tracking. It provides its customers with battery-powered wireless tags that use triangulation techniques in standard Wi-Fi networks.

The company claims a geolocation to within 3 to 5 meters indoor. Some of its most sophisticated tags feature bi-directional communication or even integrate a GPS unit capable of tracking the tag's physical location to within 5 to 10 meters in remote outdoor locations that would not be reached by Wi-Fi. Applications are plentiful, ranging from ID badges for patient or staff monitoring in large hospitals, to car tracking on parking lots, or logistics in shipping yards and manufacturing facilities.

This unique form of Wi-Fi RFID and geolocation has also entered consumer electronics in the form of Skyhook's Core Engine, a software-only location system based on Wi-Fi positioning, GPS and cell tower triangulation, leveraging the position databases of millions of Wi-Fi access points throughout populated areas (claimed accuracy range from 10 to 20 meters). After a mobile device has collected raw data from nearby emitters, the Skyhook client sends this data to a location server and a single location estimate is returned.

In emergency situations or in law enforcement, a few meters of accuracy indoors can only be interpreted as any adjacent room or corridor, unless you are standing in the middle of a large warehouse. Now what if you could narrow down this geolocation to a few centimeters instead of a few meters? You could pinpoint hundreds of tag within the most complex industrial maze. And what if all these tags could communicate with each other and mesh into a network of their own, in the pure ZigBee fashion?

Dublin-based DecaWave has been brewing such a solution for real time location since its foundation in 2004. In the process, Decawave's President and CTO Michael McLaughlin largely contributed to the ZigBee's 802.15.4a amendment (ratified in 2007), which added two additional physical

interface (PHY) standards to the original 802.15.4 standard, one of them based on Ultra Wideband.

The standard supports four different data rates 110kbps, 850kbps, 6.8Mbps and 27Mbps, over 15 different frequency bands, and it includes specific support for ranging.

The Irish company has just received sample silicon for a chip it has dubbed "ScenSor1" designed on a 90nm CMOS process from TSMC, and AeroScout is developing its first ultra-precision asset-tracking prototypes based on the Ultra Wideband device.

The ScenSor single chip wireless transceiver which will be commercialized as part number DW1000 is named after its main functions, Seek, Control, Execute, Network / Sense, Obey, Respond. Thanks to its use of Ultra Wideband radio technology, the chip communicates much more reliably in highly reflective RF environments such as manufacturing plants where multipath fading is usually an issue for competing narrowband devices. Geolocation accuracy is down to $\pm 10\text{cm}$, nearly two orders of magnitude compared to competing solutions, and according to DecaWave's CEO Ciaran Connell, the transceiver also cuts down the power budget by enabling sensors to use about 50 times less power in transmit-mode and 10 times less power in receive-mode than the best 2.4GHz narrowband devices. Yet, they support data rates of 110kbit/s, 850kbit/s or even 6.8Mbit/s. The chip can be used as either a Scen or Sor device.

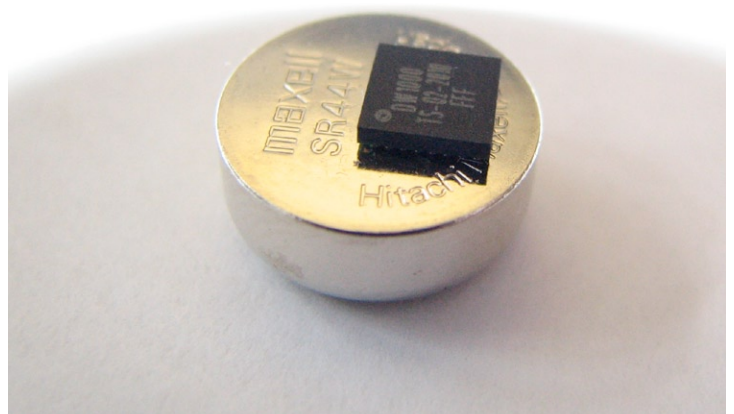
Microstrain is another early adopter of DecaWave's ScenSor technology and is currently prototyping a new breed of stress-monitoring sensors that would take advantage of

DecaWave's low power Ultra Wideband solution. "Just looking at power consumption which is often a limiting factor for battery-based sensor networks, our next-generation of devices based on the ScenSor radio could operate for ten times longer than with the current ZigBee solutions we use at the moment" said Chris Townsend

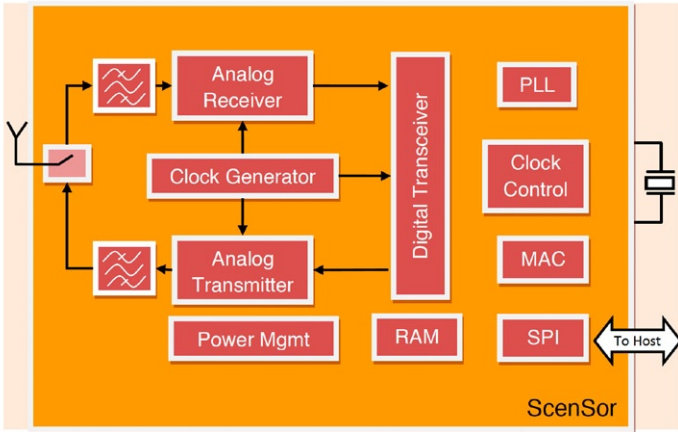
vice president of MicroStrain. "That's partly because their data rate is three times faster than ZigBee, hence we cut both transmission times and power consumption drastically", he added. Alternatively, Microstrain could perform measurements more frequently to gather more data on the structures it monitors.

DecaWave has made a number of key innovations in the implementation of the 802.15.4a standard. The first is in using a coherent receiver that allows more energy to be extracted from the received signal than would be the case in a non-coherent implementation. This increases the operating range in non-line-of-sight conditions up to 40m (and about 400m in line-of-sight). The DW1000 supports two-way ranging as well as one-way ranging, using time-of-flight and time-difference-of-arrival methods.

The second innovation is proprietary to DecaWave and is the subject of patent ap-



DecaWave's ScenSor chip (the DW1000) enables geolocation with a $\pm 10\text{cm}$ accuracy. It comes in a 4.5x4.5mm 64-pin BGA package.



The ScenSor's functional block diagram.

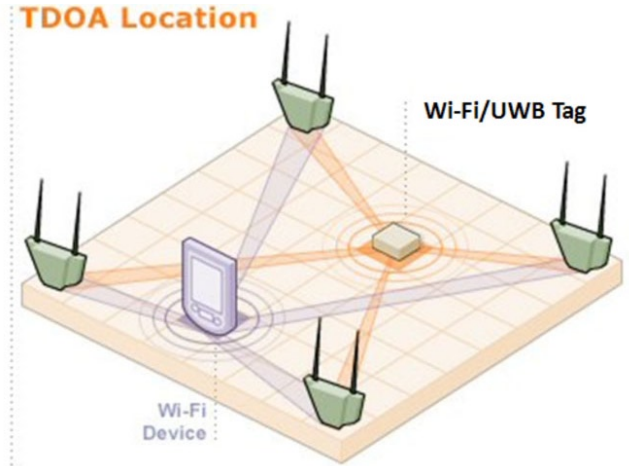
applications on the modulation and encoding schemes. "Our strong IP portfolio enabled us to design a new architecture and a new set of algorithms, it made it possible to pack all the geolocation and communication functionalities into a 7mm² die whereas competing solutions would be prohibitively expensive at around 20x this size" commented Connell. "With this sort of die area and at a \$1 price point in high volume, we could target mass markets including mobile phones, tablet PCs and WLAN access points. You could locate any one carrying a mobile with a ±10cm accuracy in buildings equipped with ScenSor-enabled Wi-Fi" he added.

The location accuracy is maintained even for tagged objects moving at up to 5m/s. Theoretically, more than 11,000 tags could be located in a 20m radius non-line-of-sight. Other specifications of the DW1000 which operates from a single 2.5 to 3.6V supply voltage include a transmit power of -14dBm

or -10dBm with a current consumption as low as 16mA, a transmit power density less than -41.3dBm / MHz and a receive mode consumption as low as 33mA.

The ScenSor11 will be in full volume production in Q3 2012 but the company has already positioned two variants on its roadmap. A Scen-specific part (Seek, Control, Execute, Network) could be designed in WLAN access points, bearing most of the geolocation routines for accuracy, while a Sor part (Sense, Obey, Respond) would be optimised for low power consumption and easy integration into sensor units.

In the future, DecaWave's goal would be to ship as many Scen chips as possible to run alongside Wi-Fi chips in public installations, or the company could license the Scen as embedded IP to Wi-Fi chip manufacturers in order to enable the geolocation of all mobile devices bearing a Sor chip. "Splitting the



The concept of geolocation based on the tag signal's time difference of arrival (TDOA) as it is received by ScenSor-enabled Wi-Fi antennas at well known positions in the network infrastructure.

ScenSor would make two very cost-competitive chips, something in the range of \$50 cents in high volume", estimates Connell.

Currently the company is engaging with Wi-Fi access point vendors to have its ScenSor technology included as standard. Depending on its success, any building equipped with a WiFi network would also automatically be enabled for high-precision real time location systems.

"All our IP is in the digital domain", concluded Connell, "and as we speak, we already have the algorithmic solution for a chip that could offer a ±1cm accuracy, relying on a periodic autocorrelation function for each message sent out". No doubt that the internet of things is evolving towards geolocation, soon machines and objects could not only have an IP address, but also their real time location tagging along. ■

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NFC-tag writing app

for Android smartphones and tablets

NXP Semiconductors has launched an application which allows Android smartphone users to use their NFC-enabled handset to create their own NFC tags. These tags can then be used in multiple environments to share details and launch applications with other NFC handset users. The app also includes a tag reader for reading NFC tags. The NXP TagWriter app is available for download at the Android Market. The new app supports the NFC Forum's NFC Data Exchange Format, offering tag writing support to any NFC-enabled device. It integrates seamlessly like a plug-in into Android and provides an extended feature set compared

to the built-in Tag application. It also stores the history of data read from tags and data written to tags, enabling it to be re-used at a later time.



Users can launch applications on a tap to initiate calls, open websites, send SMS messages and more. One possible application may be incorporating NFC tags into business cards will enable contact details to be shared and stored onto the

handset immediately. The retail market may also be a target; taking NFC into the retail space offers new ways for retailers to interact with their customers.

NXP Semiconductors

www.nxp.com

Wireless bar code scanner

targets healthcare facilities

IDC has launched its ZB111 wireless-based, bar code scanner, to provide low cost inventory management systems (IMS) in healthcare facilities. Designed to avoid the expense of Windows CE handheld terminals, the ZB111 takes the complexity and cost out of the handheld unit and transfers it to a central server, making the system simple to support and upgrade.

The ZB111 targets healthcare facilities that need to track the booking in and issuing of stock across many stores locations. The simple wireless mesh networking of the ZB111 enables separate stores locations to be linked via IDC's ZB104 Ethernet gateway to existing estate

PCs, that can provides wireless management, web-based access, and management of communications from the scanners to a hosted server - a system configuration that keeps system costs to a minimum.



Designed for wireless mesh operation with licence-free IEEE 802.15.4/ZigBee wireless sensor networks, the ZB111 reads all commonly used barcodes and can be used for a variety of logistics applications. The unit has low power requirements and is rechargeable from a standard 5VDC/ mains charger. The ZB111 is provided with a keypad featuring ten keys which can be individually customised.

Intelligent Distributed Controls

www.idcsimplicon.com

Wireless MCUs

powers sub-GHz mesh network modules

Silicon Laboratories is providing the wireless microcontroller technology for a new line of sub-GHz wireless mesh networking modules from California Eastern Laboratories (CEL). Powered by the Si10xx, the MeshConnect Sub-G modules are CEL's first series in the sub-GHz ISM band targeting smart meters, home automation, security systems, remote keyless entry, irrigation control and weather stations. The 868 MHz and 902-928 MHz frequency ranges suit non-line-of-sight applications; the modules can achieve a link budget up to 140 dB with a sensitivity of up to -121 dBm. The modules support multiple software platforms, providing compliance with US and European operating

standards, using Synapse SNAP embedded firmware, wireless M-Bus, Silicon Labs' EZMac software and CEL's proprietary application programming interface (API).



The modules also provide a 1 MB flash memory option to support over the air (OTA) programming, giving system manufacturers and users the flexibility to perform software updates and system optimizations quickly and easily. CEL's wireless modules provide pre-certified hardware/software solutions, helping to reduce development time by months and eliminate the costly certification process.

Silicon Laboratories

www.silabs.com

5 GHz WiFi front end modules

for handsets, smartphones and tablets

RF Micro Devices has announced the expansion of its industry-leading 5 GHz WiFi product portfolio to include two 5 GHz high-band WiFi front end modules (FEMs) with integrated power amplifiers (PAs). The two latest 5 GHz FEMs — the RF5506, and the RF5516 — deliver high power and linearity and are optimized for the rapidly growing smartphone and tablet markets. The global WiFi market is growing rapidly and is forecast to represent a greater than \$1 billion total addressable market (TAM) by 2014. Adoption of dual-band WiFi (2.4-GHz/5-GHz) in handsets is estimated to increase from approximately 25 percent of all handsets in 2011 to approximately 50 percent of all handsets in 2012, with increasing emphasis on the 5 GHz band for use in 3G/4G smartphones. The anticipated growth in tablet

devices is also forecast to support 5 GHz FEM adoption, as mobile WiFi chipsets for tablets increasingly adopt dual-band functionality.

To satisfy the growing market demand, the company has developed FEMs with high levels of integration, small package sizes, and best-in-class linearity performance. RFMD offers a broad portfolio of highly integrated FEMs that include the PA, the switch, filtering, baluns and an optional low noise amplifier (LNA) for both single-band (2.4 GHz or 5 GHz) and dual-band (2.4-GHz/5-GHz) operation. The company's WiFi product portfolio also includes discrete PAs, switches and switch/LNA products that support integrated chipset solutions.

RF Micro Devices

www.rfmd.com

Cloud-based collaboration

for M2M applications over wireless networks

Verizon Wireless and Sierra Wireless have announced a new collaboration to co-market the Sierra Wireless' AirVantage; a cloud-based platform for developing, deploying and operating the next generation of connected devices and M2M applications. The solution combines AirVantage with Verizon Wireless' wireless network and Machine to Machine Management Center to provide a complete platform for M2M solution development. Customers will be able to use the platform to monitor, control and manage wireless subscription services and mobile communication devices through a single, easy-to-use interface. As a result, they can simplify the management of their connected devices,

software and services and accelerate the development and deployment of M2M applications, as well as lower ongoing operating costs.

M2M services represent a rapidly growing market for both network operators and customers building connected vertical applications. AirVantage Subscription Management will connect to Verizon Wireless' unified Web services interface, enabling direct activation and deactivation, suspend, resume, and the tracking of data usage, while monitoring the connection status of devices operating on the Verizon Wireless network.

Verizon Wireless

www.verizonwireless.com

Multi-protocol wireless router

connects ZigBee sensor networks to the Internet

The Meshlium Xtreme multi-protocol router from Libelium supports five wireless standards, WiFi, ZigBee, GPRS, Bluetooth and GPS, as well as wireline

Ethernet. It also supports the storage of the sensor data in its internal database system as well as with external Internet servers. The WiFi

Mesh radio and antennas can work at both 2.4GHz (802.11b/g) and 5GHz (802.11a), so it is possible to change the WiFi radio frequency dynamically without any physical changes to the router itself. Meshlium clients can use the WiFi AP radio both to access internally-stored sensor

data and as an access point for the Internet.

The Bluetooth module includes a "discover and store" application, which allows Meshlium to

scan and store the MAC addresses of users in a database in order to track their routes. For mobile applications, a GPS module enables

real time location by providing parameters such as latitude, longitude and speed in real time. The product is supplied with an aluminium IP67 waterproof enclosure.

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Filter DC voltages outside your supply rails

By Kendall Castor-Perry

YOU WANT TO FILTER a bias, a reference or even a power supply voltage effectively, but only using circuitry that runs off a much lower supply rail? Although this might sound impossible, it is not. Active low-pass filters can have a wide range of AC response characteristics but they all have one thing in common, and that's that they pass DC. Like other analog processing blocks, they can therefore introduce errors in both the DC offset and the gain or span.

Most filter configurations introduce DC offset error due to the offset voltages of the amplifiers used. We saw, in "Low-pass filters that don't", an approach that can mitigate this to some extent. In the final circuit presented there – see Figure 1 – the heavy lifting of frequency response management is done by an active "side-chain", and the main signal just passes along a resistor network from input to output. The only contribution to offset error comes from amplifier input leakage currents dropping voltage across this resistor network. In modern MOS amplifiers these leakage currents are tiny (at least at room temperature).

There are some use cases that this configuration still doesn't support, though. One is where you can't rely on the amplifier input currents being low enough to neglect. This might be the case, even with MOS amplifiers, if the filter is inside a seismic sensor sitting at the bottom of a very deep hole in the ground. The other case might not seem like a legitimate case at all at first glance. That's where the voltage you want to filter is outside the supply voltages that you have available to run your active circuitry. For instance, say you've got a high-value bias voltage of tens or hundreds of volts, and you're trying to low-pass-filter it to remove some ripple, but you only have a 5 volt power supply on your circuit board. Attenuating the voltage to 'fit' is out of the question, since

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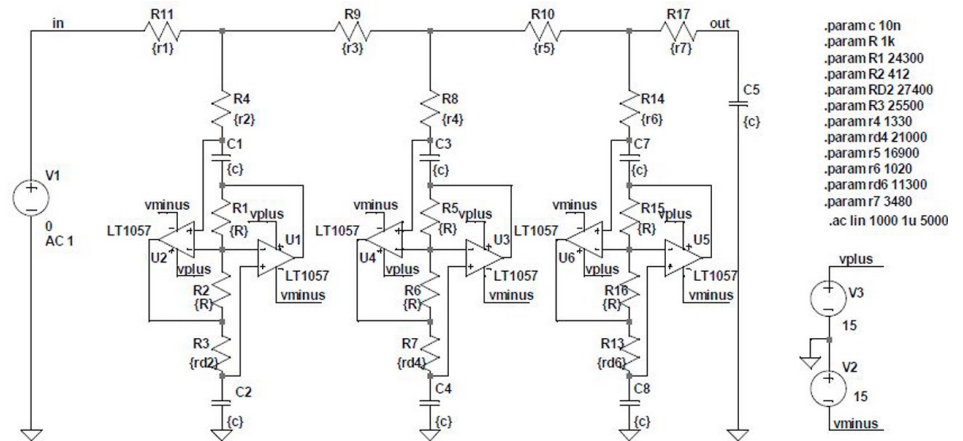


Figure 1: A DC-coupled lowpass D-element filter with low offset voltage.

you want the filtered voltage to be the same value as the input, just cleaner.

In these circumstances, don't we usually just use a series resistor (of suitably low value) and a shunt decoupling capacitor? For sure, no matter what the ripple level is, we can suppress it to negligible levels by sufficiently increasing the time constant of the resulting single-pole passive low-pass filter. But – and you may have already encountered this in your own designs – you can suffer the undesirable double whammy of capacitor-size-too-big and step-settling-too-slow, if you just rely on this simple method.

It seems obvious to consider using a higher order filter to solve this problem. If the ripple frequency is quite low, a passive filter may require inconveniently large inductors. There's more about passive approaches, and picking an actual filter response, in the next article. Right now let's concentrate on inductorless solutions such as active filters.

Can we use the D-element ladder filter technique shown in figure 1 to create a suitable high order filter? Well, not as it stands. You can see

from the schematic that the amplifiers are connected to the input voltage through a resistive path, and this sets the static voltage at each of the op-amp terminals. There's no practical way round that. What we need is a D-element topology that doesn't actually 'see' the DC voltage that it is attached to. And, while we're at it, wouldn't it be a good idea if it used fewer amplifiers? (Op-amp manufacturers need not answer that question). To get us started, let me reintroduce you to a filter configuration with which you may well be quite familiar:

This is probably most popular second order band-pass filter circuit around, and the web is awash with information on it. Now as it stands this doesn't look like it is much use here, because it is a band-pass filter, and

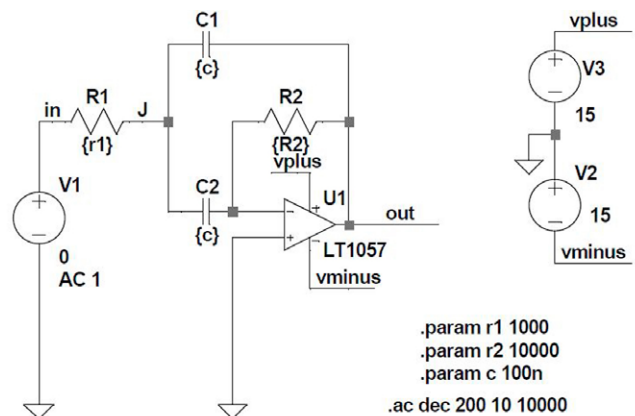


Figure 2: The ever-popular multiple feedback bandpass filter.

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the filtered signal appears at the amplifier output. That's a bit, well, conventional, and we need to take another look.

Think about what's happening at the point labeled J in Figure 2. Can you see by inspection what the frequency response at that point will look like, referred to the input? Well, we know that the voltage at the amplifier output has a band-pass characteristic. And we can also see that the block formed by C₂, R₂ and amplifier is just a differentiator, with a +6 dB per octave rising slope. So, the voltage at J, when multiplied by this +6 dB/octave slope, looks like a band-pass. For that to happen, J's voltage must actually have a second order low-pass response with respect to the input, as shown in Figure 3:

Why is that useful? Well, it shows that we can make a circuit that we can tack onto a resistor to give us more stop-band rejection than just using a shunt capacitor alone. You might think of this as a 'super capacitor'. But hang-on, isn't that another of the nicknames for the D-element introduced in "Bruton Charisma" and "Gee, I See!?" You bet! It turns out (and you can show this easily with a bit of hand analysis) that at the junction of C₁ and C₂ our circuit 'looks like' the parallel combination of a capacitor of value C₁+C₂ and a D-element of value C₁C₂R₂. It's a bit easier to see if you look at the circuit sideways, as in figure 4:

What's more, both the output and the inverting input of the amplifier are connected to resistor R₁ through capacitors. There's no galvanic connection between the input voltage and the active part of the filter electronics. And that means we can put whatever voltage we want on that resistor (subject to capacitor breakdown ratings, naturally), independent of the amplifier supply voltage.

We can chain a bunch of these together to get an RDC ladder filter, as shown in figure 5:

Now, we've not made a pure D-element, but one with a capacitor in parallel. When we use these in our ladder filter circuits instead of pure D-elements, we get a filter circuit that's not covered by the standard design methods. The equivalent LCR passive filter (before we apply the Bruton transform) contains capacitors that each have a resistor in parallel. How do we take this into account? Well, you'll remember my attachment to the Million Monkeys Method, using a spreadsheet solver to manhandle a filter circuit to have the right response. We'll see again next time how those monkeys can indeed do a good job, and create useful filter designs.

What's more, you can see that we've only had to use one amplifier for each branch in the filter. Figure 5 is a seventh order filter

and it uses only three amplifiers instead of the six required by the regular singly-terminated D-element design in Figure 1. ■

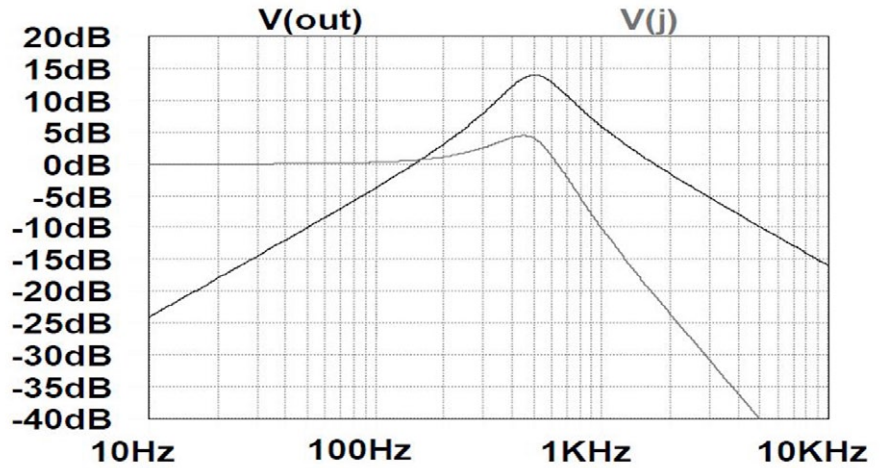


Figure 3: Voltages at nodes out and J in Figure 2. V(j) is a lowpass response.

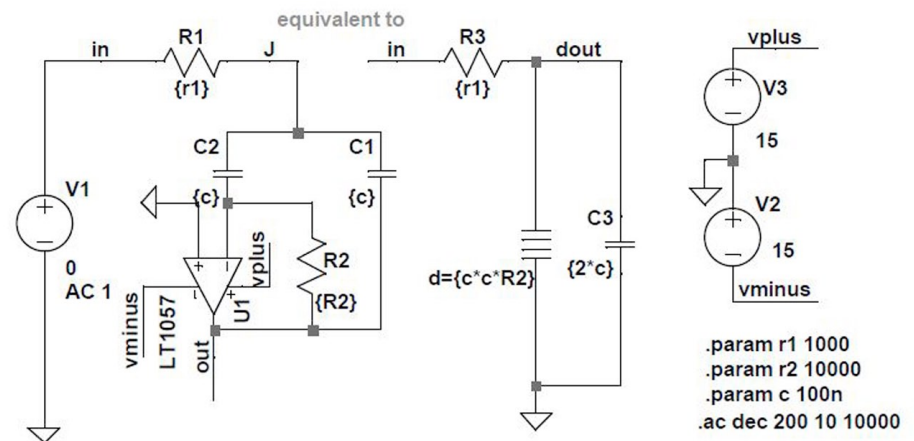


Figure 4: A sideways look at figure 2, showing the 'hidden' D-element.

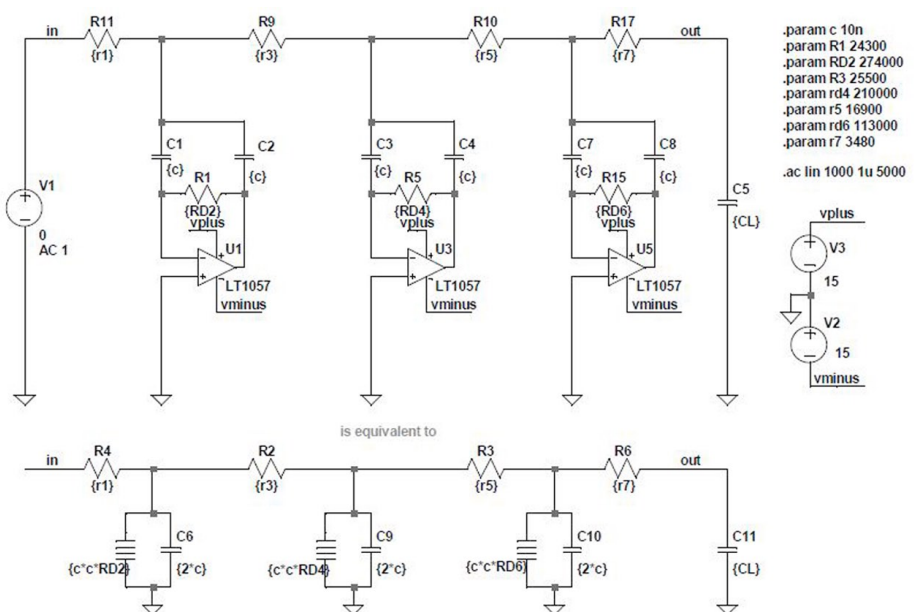


Figure 5: Stringing our new circuits together to make a higher order filter.

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Design with the best

Beware of circulating currents in a SEPIC coupled-inductor

By Robert Kollman, Texas Instruments

IN THIS ARTICLE, we establish the leakage inductance requirements for the coupled-inductor in a single-ended primary-inductor converter (SEPIC) topology.

The SEPIC is a useful topology when electrical isolation between the primary and secondary circuit is not required and when the input voltage is higher or lower than the output voltage. It can also be used in place of a boost converter when short circuit protection is required.

A SEPIC converter features single-switch operation and continuous input current, resulting in low electromagnetic interference (EMI). The topology – see figure 1 – can use two separate inductors or, since the voltage waveforms across inductors are similar, can use a coupled-inductor, as shown.

The coupled-inductor is attractive because its volume and cost are less than two individual inductors. The downside is standard inductors are not always optimized for the entire range of possible applications. The current and voltage waveforms in this circuit are similar to a continuous current mode (CCM) flyback design. When Q1 is turned on, it applies the input voltage across the primary of the coupled inductor to build energy in the circuit. When Q1 is turned off, the voltage on the inductor reverses and is clamped to the output voltage.

Capacitor C_{AC} is what differentiates the SEPIC from the flyback; when Q1 is on, the secondary inductor current flows through it to ground. When Q1 is off, primary inductor current flows through C_{AC}, adding to the output current that is flowing through D1. The big advantage to this topology over a flyback is that both the FET and diode voltages are clamped by C_{AC}, and there is little to no ringing in the circuit. This results in the ability to select lower-voltage, and hence more-efficient, power devices.

Since this topology is similar to a flyback, many people think that a tightly coupled set

of windings is required. However, this is not the case. Figure 2 shows the two states of operation for the continuous SEPIC where the transformer has been modelled with leakage inductance (LL), magnetizing inductance (LM), and an ideal transformer (T).

2a) MOSFET ON:
 $V_{LL} = V_{C_AC} - V_{IN}$
 $= \Delta V_{C_AC}$ (DC component cancels)

2b) MOSFET OFF:
 $V_{LL} = V_{IN} + V_{OUT} - V_{C_AC} - V_{OUT}$
 $= \Delta V_{C_AC}$ (DC component cancels)

Upon inspection, the voltage across the leakage inductance is equal to the voltage across C_{AC}. So a large AC voltage from a small value of C_{AC}, or a small leakage inductance, creates a large circulating current. A large circulating current will degrade the efficiency and EMI performance of a converter, which is undesirable.

One method of reducing this large circulating current is to increase the coupling capacitance (C_{AC}). However, this carries a cost, size, and reliability penalty. A more prudent approach is to increase the leakage inductance, which is easily done when specifying a custom magnetic component.

Interestingly, few vendors have recognized this fact and many have produced inductors with low-leakage inductance for SEPIC applications. On the other hand, Coilcraft has a 47 µH MSD1260 with a leakage inductance of approximately 0.5 µH, and has recently developed alternate versions of this design with leakage inductances over 10 µH, which we will characterize in March's Power Tip. Please rejoin us then.

The circuit of Figure 3 was built and characterized. This circuit might find application in the automotive

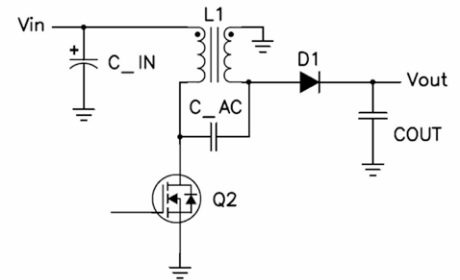


Figure 1: A SEPIC converter uses a single switch to step-up or -down the output voltage.

market. Here, there is a wide-ranging input of eight to 36 volts, which can be above or below the regulated 12-V output. The automotive market prefers ceramic capacitors due to their wide temperature range, long life, high-ripple current rating and high reliability. Consequently, the coupling capacitor (C6) is ceramic. This means that it will have a high AC voltage across it compared to an electrolytic capacitor, and the circuit will be more sensitive to a low value of leakage inductance.

Two 47 µH Coilcraft inductors are characterized in this circuit: a MSD1260 with very low leakage inductance (0.5 µH); and a MSC1278 with a high leakage inductance (14 µH). Figure 4a and Figure 4b show the primary current waveforms for the two inductors.

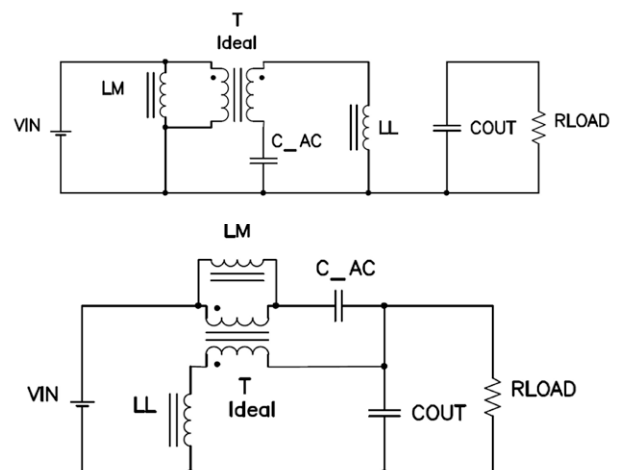


Figure 2a and 2b: Both states of operation of the SEPIC converter. The AC voltage on the leakage inductance equals the coupling capacitor voltage.

Robert Kollman is a senior applications manager and distinguished member of technical staff at Texas Instruments - www.ti.com

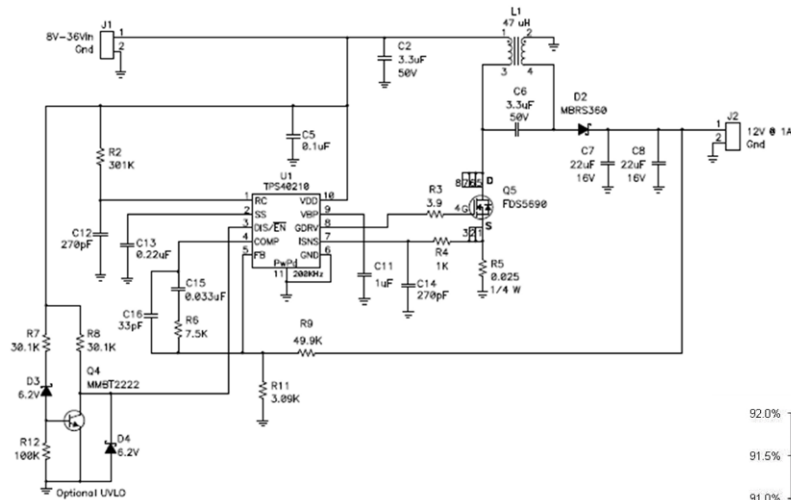


Figure 3: SEPIC converter can buck or boost with a single switch.

Looking at the waveform of Figure 4a, we see the input current (flowing into pin 1 of L_1) with the MSC_{1278} inductor, and on the right is the MSD_{1260} input current waveform. The current in the upper figure is what is typically expected. The current is mostly DC with a triangular AC component to it. The waveform of Figure 4b is what you get with high AC voltage on the coupling capacitor and a low value of leakage inductance. The peak current is almost twice the DC input current and the RMS current is 50 percent more than that for the case of the high-leakage inductor.

Obviously, electromagnetic interference (EMI) filtering of this power supply with the tightly coupled inductor is going to be more problematic. The ratio of AC input currents between the two designs is almost five-to-one, meaning another 14 dB of attenuation will be needed.

The second impact of this high circulating current is on the efficiency of the converter. With 50 percent more RMS current in the power supply, conduction losses will more than double. Figure 5 compares the efficiency for the two different inductors with nothing

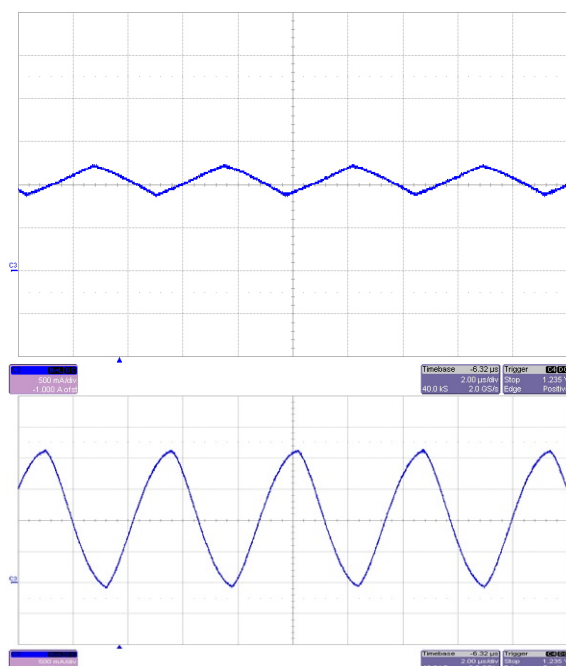


Figure 4: (a upper) Loosely coupled; (b lower) tightly coupled. Low leakage (a) causes severe circulating currents with a coupled inductor.

else changed in the circuit. Both results are respectable at around 90 percent for 12 V-to-12 V conversion. However, the loosely coupled inductor yields 1-to-2 percent better efficiency over the load range, even though it has the same DC resistance as the tightly coupled inductor. To

summarize, a coupled inductor in a SEPIC converter can reduce the size and cost of the power supply. The inductor does not need to be tightly coupled. In fact, tight coupling will increase currents within the supply, complicating input filtering and degrading efficiency.

The simplest way to pick an acceptable amount of leakage is through simulation. However, you can also estimate the voltage on the coupling capacitor, set an allowable ripple current, and then calculate a minimum leakage inductance. ■

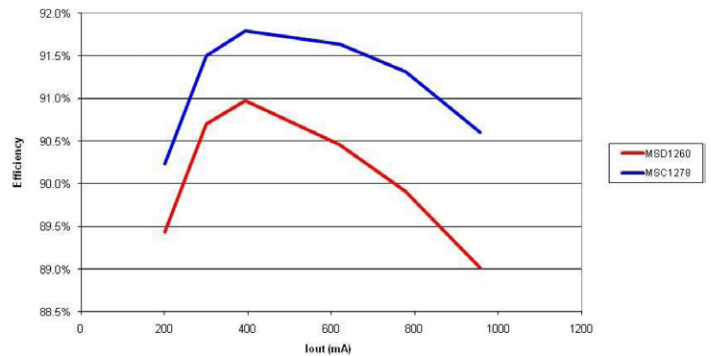


Figure 5: High leakage (MSC1278) yields better efficiency due to reduced currents.

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Conflicting design goals in 3G terminals power control systems

By Jim Nohrden

WE HAVE MOVED into the “Fourth Wave of Computing”. One where computation is less about raw horsepower and more about connectivity and power efficiency. In other words, we are moving from the era of PCs and into the era of smartphones and tablets.

This transition will take us to an ever more intuitive and interactive experience with our electronic devices. From mobile apps to augmented reality, the next generation of computation devices are wirelessly-connected and always on.

Our everyday lives are becoming more dependent on these next generation devices and we expect them to be reliable and connected at all times. Advanced wireless standards such as WCDMA, WiFi, and LTE ensure that our products are interoperable with each other and around the world. We rely on these standards to ensure the robust operation of the mobile products we own.

In order to provide products that are reliable, fun to use and safe, mobile device designers strive to create products that first can achieve high total radiated power (TRP). Consumers want devices with elegant industrial design and hidden antennas, all while simultaneously not violating radiated safety limits, measured as SAR (specific absorption rate). Balancing these three conflicting goals is no simple task for mobile device designers.

Wireless operators would prefer to see mobile devices with the highest TRP, ensuring the highest data rates and fewest dropped calls. Consumers make the buying decision based on other factors such as software interface and great industrial design. At the same time, government safety regulators must ensure that wireless devices in the market err on the side of safety, limiting wireless SAR emissions that are considered harmful, but possibly also limiting TRP.

A factor affecting these three design goals is the power control system of a mobile de-

vice. In 3G WCDMA and CDMA communications systems, very tight control of mobile device power is also required in order to ensure that received power level at the base station is the same for all devices in the cell. To ensure this

tight control, the base station is constantly (at a rate of about every 500 us) sending commands to the mobile device to either increase or decrease output power. Of course, as the mobile device moves close to the edge of the cell, the base station will continuously demand increased output power. At some point the mobile device itself must disregard the base station's request for higher power. Output power must be limited by the mobile device itself in order to ensure SAR safety.

Mobile devices today use three methods to limit power to safe levels. The first method is “open-loop” power control. In this case, the mobile device is set to maximum power during production, and the internal transceiver power level (point A in Figure 1) is recorded. Once deployed in the field, the mobile device software ensures that the transceiver power (P_{XCVR}) never exceeds the calibrated level. This approach gives a good first-order approximation to the TRP of the device. However, the antenna faces a variety of loads in the real world not seen on the production line and some of the power can be reflected at the antenna, but not accounted for by the transceiver. Because the power is being measured at point A and not point G, open-loop power measurement is only a first-order approximation to the power that is actually delivered to the load (the air via the antenna). The second method is “closed-loop” power control using a directional coupler. In this case, the power is measured at the output of the PA (point F in Figure 1). A directional coupler is conceptually a parallel wire that couples some of the RF energy from the output of the

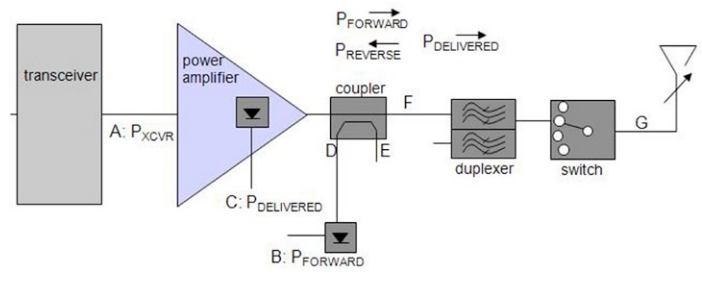


Figure 1: Mobile phone transceiver front end.

PA. Further, by using a quarter-wave length of wire, the two endpoints (or ports) of the coupler measure forward and reverse (or reflected) power. By tapping both the forward (“coupled”) and reverse (“isolated”) ports of the coupler (points D and E in Figure 1), the mobile device can determine exactly how much power is delivered to the load ($P_{\text{DELIVERED}} = P_{\text{FORWARD}} - P_{\text{REVERSE}}$). However, for reasons of both cost and practicality of implementation in high volume, just a single power detector is connected to the coupled port and only P_{FORWARD} is measured in mobile devices that use closed-loop power control today.

The third method is closed-loop power control using a power detector integrated into the PA that directly measures $P_{\text{DELIVERED}}$ without requiring a directional coupler and pair of power detectors to measure and subtract (in dB) P_{FORWARD} and P_{REVERSE} . An example is Black Sand Technologies' BST35 series of power amplifiers. Using TrueDelivered power detect technology, the BST35 series accurately measures $P_{\text{DELIVERED}}$ without a coupler via a patented on-chip power detector implemented in CMOS technology.

3G mobile device output power (point G on Figure 1) is typically calibrated to 24 dBm on the production line. Assuming 2.5 dB of insertion loss for the duplexer and antenna switch, this is equivalent to 26.5 dBm of output power from the PA (point F on Figure 1) and, assuming 26.5 dB of PA gain, this is equivalent to 0 dBm of output power from the transceiver (point A on Figure 1).

Walking through the calibration procedure (done at 50 ohms) for the three

Jim Nohrden is a co-founder and serves as VP of marketing at Black Sand Technologies - www.blacksand.com - responsible for business development and product definition

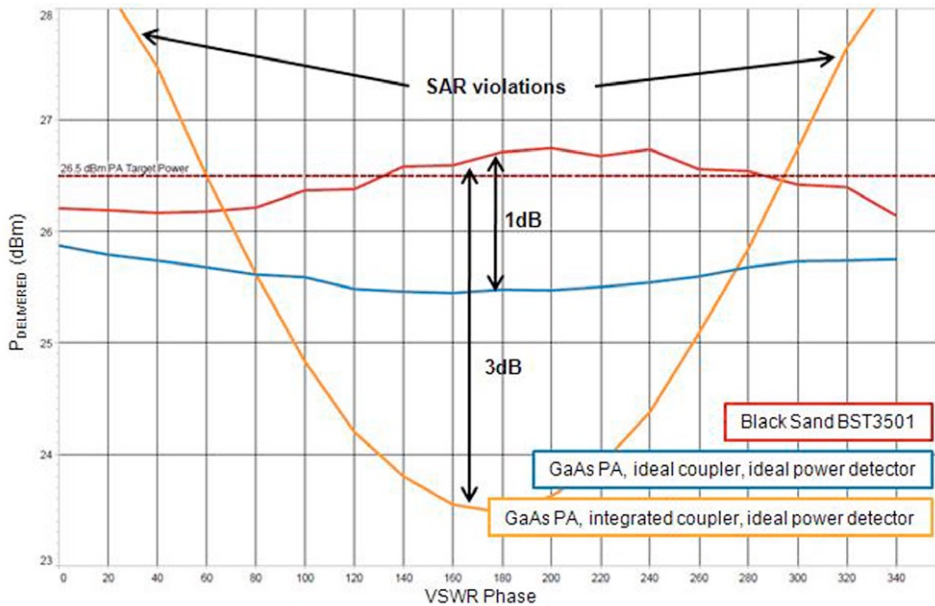


Figure 2: The benefit of measuring $P_{\text{DELIVERED}}$ rather than P_{FORWARD} or PXCVR. Measurement results using a PA in open loop (green), a PA with a high quality coupler (directivity = 20 dB) in closed loop, a PA with a low-quality coupler (directivity = 5 dB) in closed loop, and Black Sand's BST3501 TrueDelivered detector in closed loop.

approaches in this example we see:

1) Open-loop: The calibration would detect and record 0 dBm transceiver power as the power limit. (Point A in Figure 1)

2) Closed-loop with coupler: The calibration would detect the voltage from the power detector (point B in Figure 1) associated with 23.5 dBm output power (let's arbitrarily assume that ends up at 1.0 V). The power detector is connected to the coupled port of the coupler therefore measures forward power. At 50 ohms, forward power and delivered power are the same.

3) Closed-loop with integrated detection of delivered power: The calibration would detect the voltage from the integrated power detector (TrueDelivered power detector in the case of the BST35 series – point C in Figure 1) (let's also arbitrarily assume that ends up at 1.0 V).

Figure 2 compares the performance of the three approaches with mismatch of 17:1 VSWR at the antenna. With 2.5 dB of insertion loss, this produces a mismatch of 3:1 VSWR at the PA output, not uncommon in the real world. In each case, the power control system maintains the mobile device at the calibrated maximum output power.

This means that for the open-loop case (1), transceiver power is maintained at 0 dBm. For the closed-loop with coupler case (2), the forward power detected is maintained at 1 V,

and in the third case (closed-loop with integrated delivered power detection), the delivered power detected is maintained at 1 V.

Figure 2 shows the benefit of measuring $P_{\text{DELIVERED}}$ rather than P_{FORWARD} or PXCVR. Measurement results using a PA in open loop (green), a PA with a high quality coupler (directivity = 20 dB) in closed loop, a PA with a low-quality coupler (directivity = 5 dB) in closed loop, and Black Sand's BST3501 True-Delivered detector in closed loop.

It can quickly be concluded that for closed loop to have a benefit over open-loop a certain level of coupler directivity performance is required and that both TRP and SAR performance are significantly degraded. Also, the mismatch error caused by using a coupler in closed-loop but only measuring P_{FORWARD} clearly results in lower TRP even with a high quality coupler. The best way to maintain high TRP while still ensuring SAR safety is to implement a closed-loop power control that measures $P_{\text{DELIVERED}}$.

As 3G mobile devices continue to become more essential to our daily lives, it is ever more important that they operate to the highest level of performance possible. By implementing closed-loop power control that relies on actual $P_{\text{DELIVERED}}$, mobile device designers will be able to better balance TRP, ID, and SAR in the future. ■



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Digital or analogue POL?

Key points to consider

By Patrick Le Fèvre

Given the widespread availability of tried-and-tested analogue POLs, why specify a digital POL rather than an analogue one? The short answer is that following many years of continual improvement, analogue dc-dc converters have reached a development plateau that requires a fundamental re-appraisal in order to optimise conversion efficiency, power density, and application flexibility. Mixed-signal silicon processes now allow chip designers to economically combine a digitally-controlled core that generates the PWM stream alongside a supervisory measurement and control subsystem together with the industry-standard communications interface, PMBus.

By dynamically adapting its inner-loop's responses to line-and-load conditions, the digital core flattens and extends the optimal operating efficiency area, especially towards the light load levels that today's power-sensitive applications increasingly demand. The measurement and control subsystem allows system architects to implement strategies

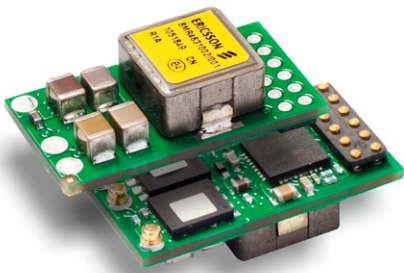


Figure 1: Ericsson's BMR46x is an example of a second-generation POL converter that eliminates external components for current-sharing.

that range from acquiring key parametric data in real-time to actively managing power demand. The PMBus interface hugely simplifies connectivity, yet any properly-designed digital POL will also run in a standalone mode that delivers conversion efficiency

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benefits in analogue-POL replacement applications. That sounds great, but are there any features that digital POLs uniquely deliver?

The features that have just been described are typical of first-generation digital POLs, where arguably the single greatest advantage over their analogue counterparts is the massive improvement

in application flexibility that the on-board measurement and control subsystem enables. Excluding the considerable footprint that any external control system would add around a typical analogue POL, a representative digital POL can also deliver power density improvements of approximately three times with no detriment to its electrical or thermal performance.

Second-generation digital POLs are now available that embody the most user-requested features, namely, the ability to operate autonomously in a parallel current-sharing mode that requires no external OR-ing components while dynamically managing phase-spreading duties between varying numbers of parallel-connected converters. These facilities make it possible to disable POLs during light load conditions to save static conversion energy, and switch them back in when the current demand increases. Other applications that are now straightforward to implement include fault-spreading and redundancy schemes.

Autonomous current sharing without external OR-ing components: how does this work?

Implementing a current-sharing scheme requires to accurately balance the power delivery between paralleled converters. In a conventional topology, external droop re-

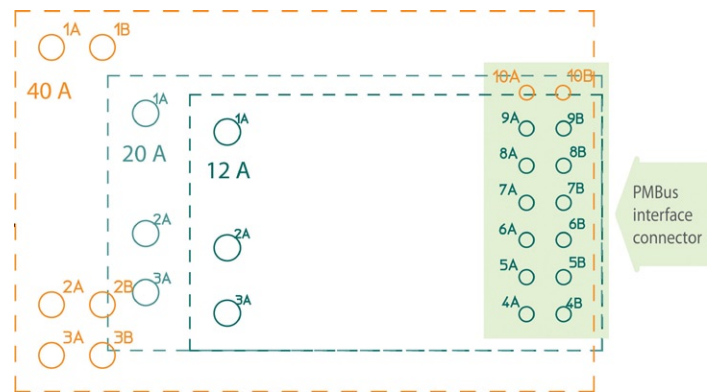


Figure 2: In second-generation POL converters a single footprint accommodates all members of a product family whilst supporting greater functionality.

stance forces each converter to deliver approximately equal amounts of current, and reverse-blocking diodes prevent any converter from sinking current. The implementation that Ericsson Power Modules adopted for its second-generation BMR46x family dispenses with these external components by using a dedicated converter-to-converter bus to exchange real-time data between appropriately-configured devices.

In this scheme, a form of digitally-controlled artificial droop resistance enables each device to accurately assess its inductor current. One device acts as a master that broadcasts its inductor current via the single-wire Group Communications Bus to as many as seven slave devices that then adjust their output voltages to balance their power delivery to within a few percent. The process runs continuously until a phase is dropped or a fault occurs, when suitably configured devices will automatically recover the situation. Because each converter withstands external bias voltages, it is now possible to connect up to eight converters in parallel using no external components, and to configure them to manage their behaviour to suit a variety of applications.

Impact on physical layout

The additional connectivity that digital POLs can deliver requires extra connec-

tions beyond the typical set of power in/out, voltage trim, remote sense, and on/off pins that analogue POLs possess. Conceptually, the minimum number of additional pins would be the four lines that PMBus demands, but a practical design also includes a PMBus addressing arrangement together with any dedicated functions that the specific digital POL offers. The connections that appear on a representative family of first-generation digital POLs comprise 10 pins on a 2-mm dual-row communications header that includes the legacy analogue functions alongside the PMBus lines (six with addressing support) and a clock synchronization input. A second-generation digital POL family that supports autonomous current-sharing and a voltage-tracking feature that greatly simplifies complex sequencing applications requires 12-14 pins.

Importantly, a single footprint can accommodate all of the members of a digital POL family. This makes it easy to substitute higher-current devices when upgrading a system with no changes to the PCB layout.

Key points to consider when selecting digital POLs

One aspect of application flexibility that complements the ability to precisely tune a properly-designed digital POL to its environment, dynamically in a running system, if the system architect wishes to optimise energy conversion efficiency, is the general programmability of the device. A digital POL may be programmed once by its maker or at any later time to set parameters such as output voltage, turn-on/off delay times and slew rates, and warning and fault thresholds. In many instances, a single device can replace multiple similar variants, easing inventory holdings. Designers who are new to digital power converters can take advantage of development environments together with the application support that enables them to explore and implement sophisticated power management schemes with unprecedented ease. To this end, Ericsson offers the 3E evaluation kit that includes a USB-to-PMBus adapter and a software environment that suits prototyping through to generating production-ready device set-up files. ■

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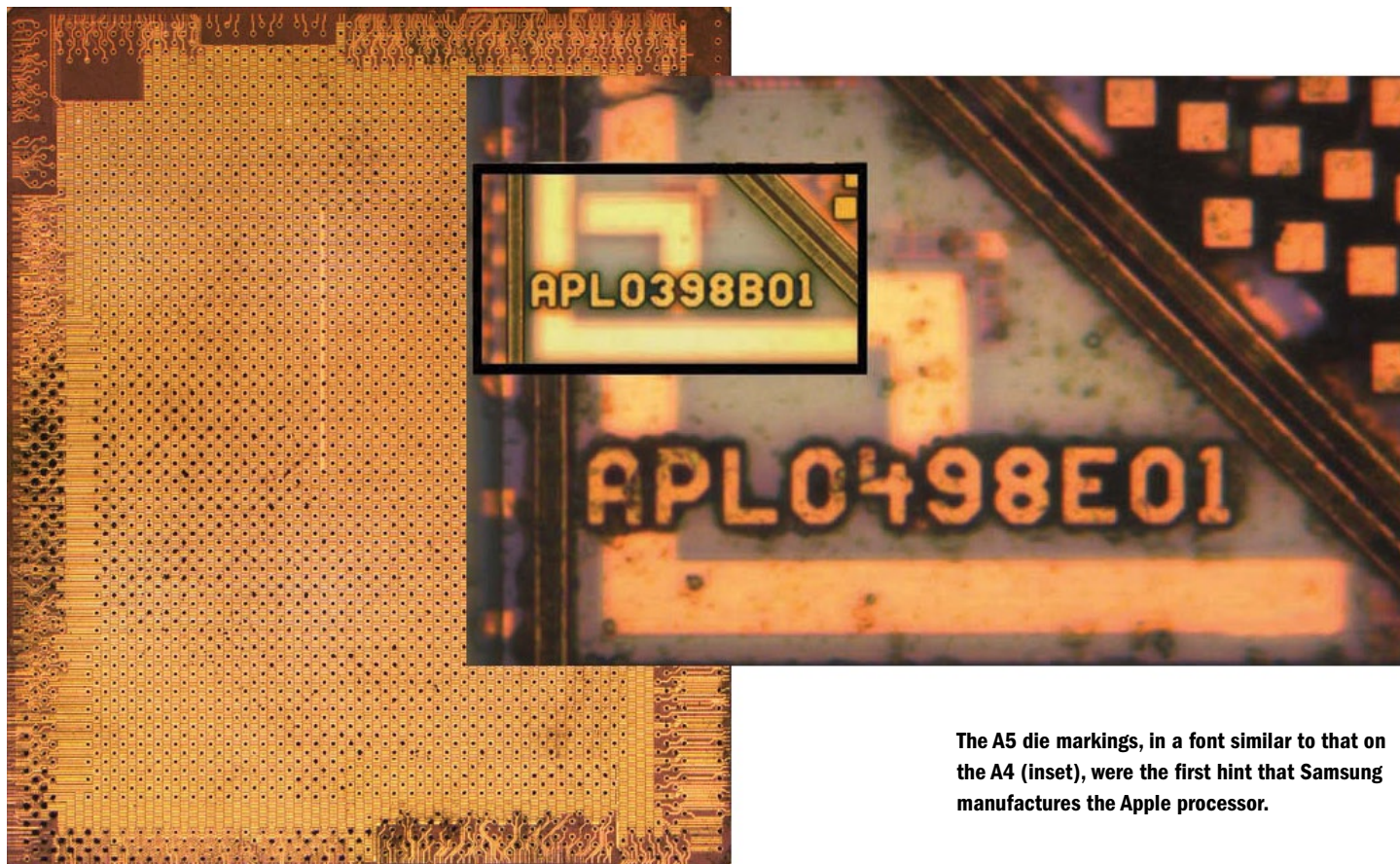
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Teardowns shed light on iPad2, A5

By Rick Merritt



The A5 die markings, in a font similar to that on the A4 (inset), were the first hint that Samsung manufactures the Apple processor.

Die photo of the A5.

THE TEARDOWN EXPERTS TechInsights have been burrowing into the secrets of the iPad2, including Apple's new A5 microprocessor. In the process, they've identified Samsung as the foundry provider for the A5, verified design wins for Qualcomm at Infineon's expense and observed extensive design reuse on the tablet's boards.

Qualcomm again scored major design slots, notably for the MDM6600 multimode baseband. Essentially, Qualcomm has pushed Infineon—whose wireless properties now belong to Intel—out of Apple's flagship products.

"It makes you wonder if Intel might have buyer's remorse, considering they purchased [the Infineon group] while it had the iPhone and iPad design wins," said Allan Yogasingam, technical marketing manager with UBM TechInsights, a sister division of EE Times publisher UBM Electronics.

The iPad2 teardown also revealed significant reuse from past products. "The wireless data card, for example, shows virtually 100 percent of the same components we found in the corresponding sockets of the Verizon iPhone 4," said Yogasingam.

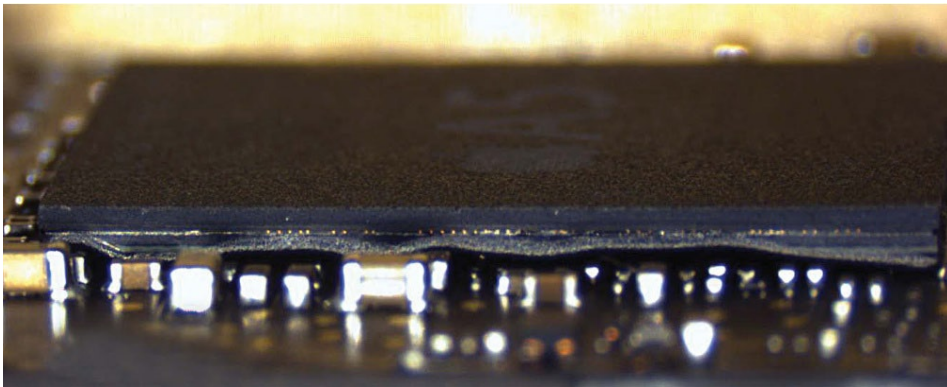
David Carey, vice president of technical intelligence at UBM TechInsights, noted that before the iPad 2's release, "we'd speculated that Apple's design patterns would suggest the iPad 2 would borrow heavily from the Verizon iPhone 4—and Motorola Xoom—by selecting a Qualcomm multimode-ready radio. It turned out to be the exact same radio as found in the iPhone 4 and Motorola Xoom available from Verizon."

In terms of the processor, "the A5's general specifications match the Nvidia Tegra 2 dual-core processor studied in the Motorola Xoom, so for CPU costs we assume a comparable price of about \$15 to \$20," he said.

"We can use past history to speculate and estimate component costs [to conclude] that the iPad 2 has an approximately \$270 bill-of-materials cost," Carey said. "Apple's volumes and [design reuse] will certainly factor into keeping their BOM costs competitive to their tablet competition."

The components on the main logic board include the Apple A5 dual-core processor; a Samsung K9PFG08U5A multilevel-cell (2-bit/cell) NAND flash chip; a Broadcom BCM5973 I/O controller; a Texas Instruments CD3240B touchscreen line driver; a Broadcom BCM5974 touchscreen controller; an Apple-branded (3430542) Dialog Semiconductor DI946A power management IC; and an Apple-branded (338SC940) Cirrus Logic CLIR546A0 audio codec.

The iPad2 communications board includes a Qualcomm PM8028 power management IC; a Skyworks SKY77711-4



Side view of the A5 shows stacked dice.

power amplifier module for CDMA/PCS; a Skyworks SKY77710-4 power amp module for dual-mode CDMA/AMPS; an Avago AF105Z front-end module; a Toshiba Y9A0A111308LA memory package; and the Qualcomm MDM6600 multimode baseband, supporting GSM/GPRS/E, CDMA, HSDPA and HSPA+, as well as EV-DO.

Inside the A5

Much of Apple's secret sauce for the iPad2 is either in its software or in its system-on-chip processor, the A5. We can't do a teardown exposing the code, but we can explore the processor.

"The primary observation is that the A5 is huge, with a processor die size of 12.1 x 10.1 mm," said Robert Widenhofer, a senior technical analyst at UBM TechInsights.

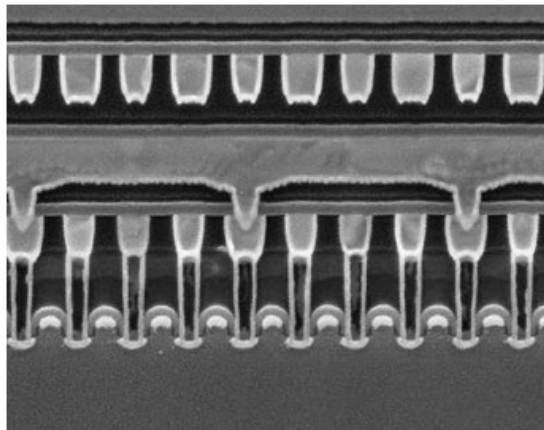
The team conducted a cross-section analysis of the chip that revealed details indicating Samsung made the chip in its 45-nm process—the same process and fab Apple used for its A4 SoC.

Previously, several sources had speculated Apple might take its internally designed A5 SoC to Taiwan Semiconductor Manufacturing Co. But "we can say with 100 percent certainty that this is a Samsung-made chip," said Yogasingam.

The A5 die markings were the first indication the chip could be a Samsung manufactured device. The A5 markings use a font similar to the one used on the Apple A4.

TechInsights used optical die and SEM cross-section images to analyze important features, such as die edge seal, metal-1 pitch, logic and SRAM transistor gate measurements. Those features were then compared with other manufacturers' specs in the company's database, including those for other Samsung 45-nm parts. The Samsung process uses nine metal layers and one poly

layer. Said Widenhofer: "You'll recall that the A4 was a package-on-package, with the processor and its supporting memory stacked one capsule atop another, and it had a processor die size of 7.3x7.3 mm. For the A5, we see a single package containing the processor die and a pair of 256-Mbyte low-power DDR2 SDRAM dice—512 Mbytes of total memory—likely configured to support a 64-bit bus."



SEM cross-section shows SRAM transistors.

In separate teardowns in Austin, Texas and in Ottawa, TechInsights' teardown experts found two different LP-DDR2 DRAMs from two manufacturers: Samsung and Elpida.

The Samsung K4P2G324EC LPDDR2 die marks the first time analysts have seen Samsung's new 45-nm LPDDR2 memory. A separate analysis conducted by IO Snoops found that while the Apple A4 clock speed was steady at 1 GHz, the A5 clock speed varied depending on the application being run. TechInsights said the finding indicates advanced power management circuitry for controlling the clock speeds of the cores.

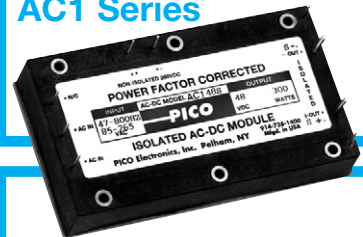
That feature, new with the A5, may explain the use of a power management IC from Dialog Semiconductor on the iPad 2 that differs from the chip on previous Apple products. ■

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Selecting capacitors to optimise the performance of battery-operated equipment

By Martin Barta, Radovan Faltus and Bharat Rawal

AN ENORMOUS RANGE of handheld, portable, battery-operated wireless devices are now available serving a wide variety of markets. Just a few examples include medical handheld analysis equipment, industrial and process control systems, and flow monitors for leak detection. Such devices share two common factors, small size and low power consumption in order to extend operating time. The careful selection of passive components, such as capacitors, can help optimise their overall performance.

Capacitors support the battery by acting as a reservoir, capable of short term, high power delivery on demand for peak load requirements. As the battery is being discharged, the initial voltage declines to a point referred to as the cut-off voltage, this is the lowest voltage required for the application to operate. Discharge curves

vary depending on the battery specifications, typical characteristics can be seen in figure 1. The main specifications of the battery are its dimensions, nominal voltage and capacity. For some applications it is also important to consider the internal resistance (or impedance) which is defined as the opposition to the flow of current within the battery. Using Ohm's Law, internal resistance can be

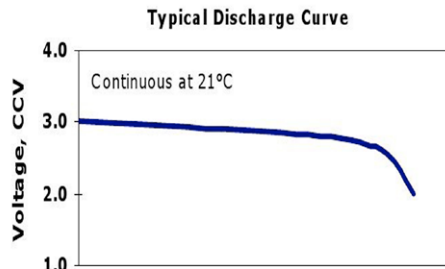


Fig. 1: Characteristic of a battery being discharged

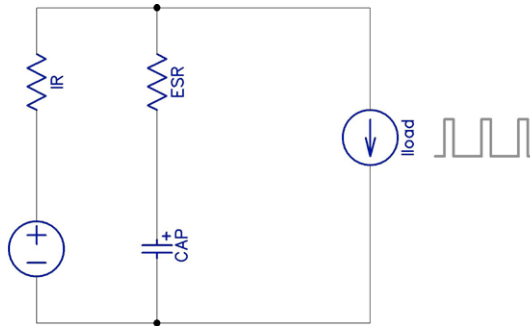


Fig. 2: Capacitor in parallel with the battery, circuit under current load

calculated based on the voltage drop across the battery under a known load.

To select an optimal capacitor we must examine the application of the capacitor in parallel with the battery with the circuit under pulse current load – see figure 2. To simplify the calculation, we will consider the worst possible option, when the battery's initial voltage drops to the cut-off voltage.

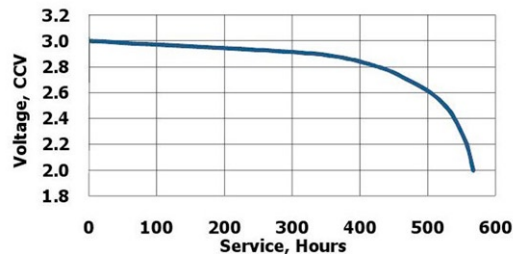
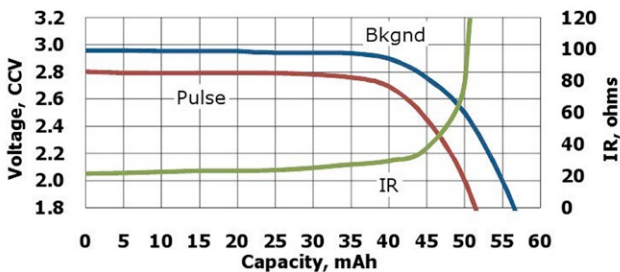


Fig. 4: a) Lithium coin battery characteristics - b) load conditions

Radovan faltus and Martin Barta are field application engineers and can be reached at radovan.faltus@eur.avx.com and martin.barta@eur.avx.com respectively. Bharat Rawal is product manager and can be contacted at brawal@avxus.com - All work at AVX

The value of the impedance of the battery is significantly higher than the ESR (equivalent series resistance) of the capacitor. Therefore we can assume that all the current is coming from the capacitor.

The electric current from the capacitor is given by:
So the capacitance

$$i = C \frac{dv}{dt}$$

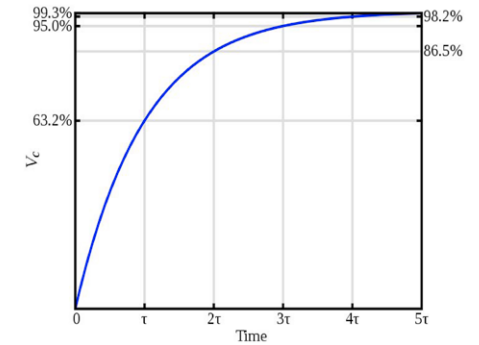


Fig. 3: Charging characteristic of capacitor

needed to provide enough energy for the pulse is:

$$C = i \frac{dt}{dv}$$

After the pulse, enough time must be allowed for the capacitor to become charged. The time it takes for the capacitor voltage to rise to its final value depends on its time constant, defined as τ :

$$\tau = RC$$

Therefore, the greater the value of the time constant, the longer it takes to charge the capacitor. The value of τ depends on the value of the capacitor (C) and the resistance in the circuit (R). In this case the total

resistance is a combination of IR and ESR. In practical applications 5τ represents the time required for the capacitor to be fully charged - see figure 3.

Case study

Given the battery specification and pulse load condition in the application we can



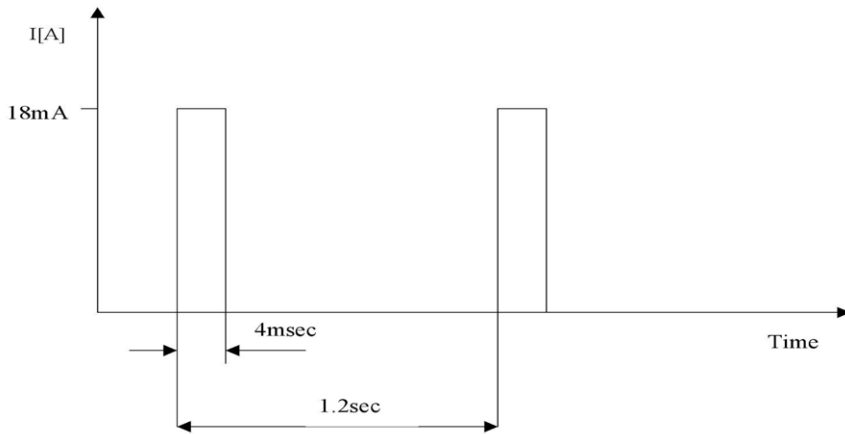


Fig. 5: Pulse current load value

calculate the value of the capacitor required for connection in parallel with the battery.

For this example, we'll choose a Lithium coin battery with a nominal voltage of 3V and a typical capacity of 620mAh. The battery characteristics and its load condition are described in figures 4b and 4c respectively.

The load of our application is described in figure 5, with a pulse current value of 18mA for a width of 4ms and a cycle time of 1.2 seconds. On top of these requirements, there is a voltage drop limitation, where 2V is the minimum voltage required for the application to function.

The capacitor voltage is the initial voltage minus the voltage drop of ESR. As the ESR value is low enough to be considered insignificant, we can reasonably use an approximate value of 0.5Ω. Therefore, the ESR voltage can be calculated as $0.5 \times 0.018 = 0.009V$. ($RI = V$). This gives a capacitor voltage of: $2 - 0.009 = 1.991V$ which gives a capacitance (C) of: $0.018 \times 0.004 / 1.991 = 36\mu F$.

Hence for our application, the optimal capacitor would be 36μF or higher. The nearest manufactured capacitor value is 47μF. Given the cycle time of 1.2s, the time allowed for the capacitor to become charged is: $(1.2 - 0.004) = 1.196s$

Thus the capacitor will be fully charged unless the value of 5τ exceeds 1.196s, which yields a suitable time constant that must be lower than 0.2392s. The maximum possible value of resistance in the circuit, R_{max} , is given by:

$$R = \frac{\tau}{C}$$

Therefore $R_{max} = 0.2392 / 0.00047 = 5089\Omega$

So, there will be enough time for the capacitor to be fully charged, unless the series connection of IR and ESR exceeds R_{max} . Both solid tantalum and niobium oxide capacitors are suitable choices for this example. TAJ

and NOJ series devices from AVX meet the calculated circuit requirements, or if the current load is higher, low ESR devices can be selected, such as TPS or NOS series products.

In our application example a TPS series capacitor with a 6.3V rated voltage, an ESR of 0.250Ω, a B size case and a failure rate of 1% per 1000 hours (at 85°C, VR with 0.1Ω/V series impedance) would work fine. ■

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Sensible Solutions... Fast!

Evolution in quartz crystal production

By Nick Amey and Paul Smith

THE USE OF QUARTZ as a frequency controlling device has developed continuously over the last 50 years. The improved processing of the quartz together with techniques to shrink the quartz blank size has resulted in smaller and technically better crystal based devices.

However, the basic method of using the inherent piezo-electric effect of quartz and combining it with an amplifier & feedback-loop to provide a quartz controlled oscillator has remained relatively unchanged. The raw quartz used for crystal production must be of very good quality and high purity. Many

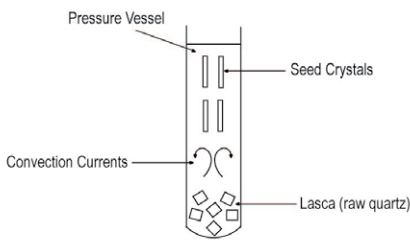


Fig.1: An autoclave for growing quartz blanks.

years ago, the quartz used was mined and small amounts were of good enough quality to be used in the crystal industry. However, the need for high volumes, high quality and low cost drove the development of artificial quartz production.

Modern synthetic quartz is now grown artificially in an autoclave. This is a high pressure, high temperature vessel that holds “seed” quartz onto which the quartz grows. This method controls the purity of the quartz produced making it suitable for modern day applications.

Having produced the synthetic quartz bar or stone, it is then cut into wafers. As the ‘angle’ at which the cuts are made affects the stability over temperature, it is critical to cut the quartz precisely. This is achieved using an X-ray machine to ensure the cuts

are correct according to the crystallographic axes. As 90% of quartz crystals are based on what is termed the ‘AT-cut’, the quartz is cut at an angle of $35^{\circ} 15'$ from the Z axis of the original bar.

Specialist multi-blade saws are used to cut the raw quartz bars and can include laser refraction measurement equipment within the cutting saw, combined with a mounting and gluing system. This enables stones to be bonded together with the crystallographic angles aligned. The saw can then cut through the bars and give finished products with deviations of around 10 arch secs (a 360th of a degree!).

AT cut crystals have a temperature curve which is similar to $y = x^3$ and deviations in the angle of cut used will affect the shape of the curve and frequency stability of the finished product.

Modern electronic applications demand high stability crystals that operate over wide temperature ranges. As can be seen from the graphs of AT cut quartz angles, there is a basic physical law that can't be overcome and so the use of electronic temperature compensation circuitry can be used as in a TCXO device to compensate for frequency movement over temperature.

As with any production process, the yield of the quartz produced must be controlled. To manufacture crystals that meet tight angle requirements requires a larger quantity of crystals to be produced which can then be separated into groups. The rest are used to meet other wider specification applications, hence crystal factories often have a library of crystal blanks at hand.

After producing the crystal blank, the frequency at which the crystal will resonate needs to be set. This frequency is inversely proportional to the mass of the quartz crystal. For AT-cut blanks the resonant

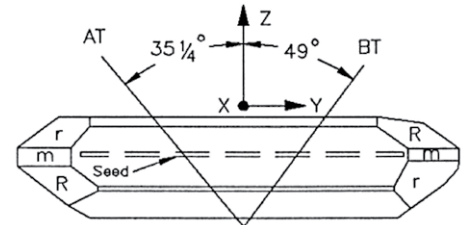


Fig. 2: The meaning of different crystal cuts

frequency of the parts will be approximately 1680 divided by the thickness in meter. For example a 10MHz product will need to be ground, lapped, etched and polished until the thickness is around 0.168mm. At each process stage there is a risk of chipping, cracking, scratching or loss of parallelism. Any of the problems can cause the final product to function incorrectly, give spurious operation or perhaps sudden changes in frequency under particular circumstances.

With the demand for higher and higher frequencies, a point is reached whereby it is impractical to process the blank as it has become too thin. For older HC49 style blanks, the highest fundamental frequency that can be practically produced is around 40MHz. However, to achieve higher frequencies there are a number of techniques that can be used.

Firstly, the crystal can be operated at an ‘overtone’ of its fundamental frequency. As with all resonating systems there are harmonic resonances at odd multiples of the fundamental mode. By adding an appropriate filter to the oscillator circuit that can suppress the fundamental oscillation, a higher frequency mode of operation can be produced. Each successive mode means the gain is less, making the circuit design more

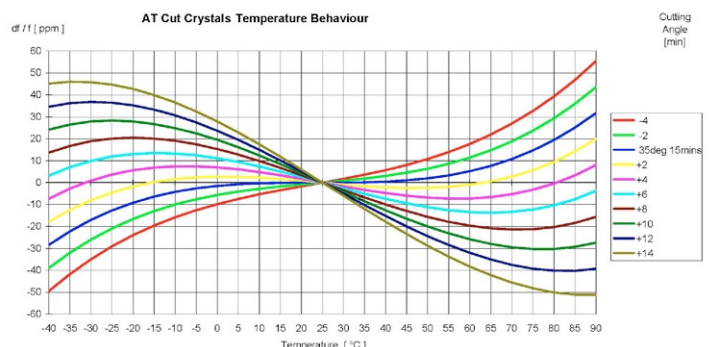


Fig. 3: Frequency variations across temperature of various AT cut crystals with different cut angle tolerances.

Paul Smith is application support engineer at IQD Frequency Products and Nick Amey is engineering manager at the same company – They can be reached at info@iqdfrequencyproducts.com www.iqdfrequencyproducts.com

sensitive and combined with the complexity of the filter this adds cost to both the design and component count. IQD's HC49s are available up to 9th overtone and frequencies up to 270MHz.

A 'multiplier' circuit can also be used to create a high frequency circuit from a low frequency crystal. The problem is they can require more power, produce longer start-up times and are likely to have detrimental effects on the circuit noise. Most standard crystal oscillator products employ optimized circuits using both the above techniques to achieve outputs of up to 800MHz. However, for high frequencies where noise is critical, we can use a quartz blank designated an inverted MESA. This design is also sometimes called a High Frequency Fundamental blank (HFF). This technique uses a quartz blank that has its centre portion etched away to give the thinness needed for high frequency oscillation, while the outer ring is left thicker as a support for the crystal.

Although the MESA crystal requires only a small area of the surface to be etched,

this is a complex process and can only be done one at a time. The inverted MESA is an excellent solution to the problem of high frequency quality crystals as long as cost is not a critical factor. For example, IQD's IQXO-660 series uses a HFF crystal to generate the high frequencies required.

As the electronics industry constantly demands smaller and smaller components, production process have been automated. Since the crystal blanks are now smaller, they also have to be thinner to maintain the appropriate dimensional proportions. This allows higher frequency fundamental modes to be achieved. For instance IQD's IQXC-26, housed in 1.6x1.2mm package, is available up to 80MHz in fundamental mode.

Having produced a crystal blank the next stage is to plate both sides of the crystal to create the electrodes that provide the external electrical connections and then mount the crystal inside an appropriate package. Plating is done by mounting the crystal behind a mask, placing it in a vacuum chamber and vaporising either silver or gold

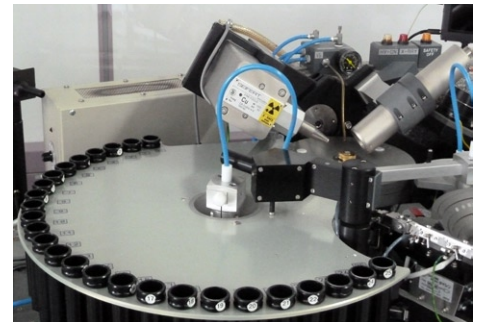


Fig. 4: An angle sorter used to bin the crystals according to their cut.

to coat the exposed surface. The choice of metal is determined by the cost and ageing requirements. This can be illustrated by IQD's CFPX-181 which uses gold plating to achieve guaranteed ageing within +/-1ppm in the first year compared with the CFPX-218 which offers guaranteed ageing within +/-3ppm in the first year.

The plated crystal then needs to be mounted and bonded inside a holder. This process traditionally used a silver epoxy which provides mechanical anchorage and electrical conductivity. However with the introduction of ceramic SMD packages, this process has become automated and the ep-

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<p>knitter-switch Neue Poststrasse 17, Postfach 10 02 33, 85598 Baldham, Germany Tel: +49 (0)8106-36 21 0 Fax: +49 (0)8106-36 21 40 E-mail: info@knitter-switch.com www.knitter-switch.com</p>		

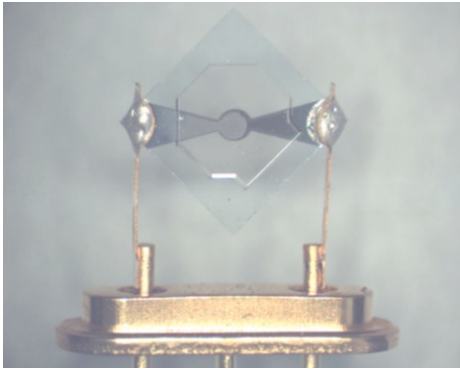


Fig. 5: An inverted MESA crystal before encapsulation.

oxy changed to a silicon-based adhesive. The bonding is slightly less rigid which increases the ability to withstand shock and vibration too. It also reduces mounting stress within the blank which could cause unwanted frequency changes and increased ageing.

Having mounted the crystal in the holder it can be fine-tuned to its final frequency. Until recently this was done by measuring the resonant frequency while depositing a spot of metal on the crystal electrode. The process was similar to the plating process using a vacuum and mask. The mask size has become so small nowadays that for package sizes below 5x3.2mm the deposition can't be controlled to a high enough standard. Modern processes make use of an ion beam which is fired through a mask and used to

deplete the metal surface, reducing the mass and raising the crystal's frequency. This is the method used by IQD for the manufacture of its IQXO-26 measuring only 1.6x1.2mm.

With the crystal complete the unit needs to be sealed. For ceramic SMD packages there are two main technologies, seam and glass sealing. Both types give a hermetic seal which is necessary to create an inert internal atmosphere and avoid excessive ageing. Glass sealing is cheaper but it involves passing the component through a reflow process with a temperature above 350°C which can affect the internal structure of the device. Seam sealing is a more controlled process as it can be performed in a sealed chamber within a pure nitrogen atmosphere or for the new smaller components this equipment has been



Fig. 6: Surface mount packaging.

modified to leave the finished part containing a vacuum. In the drive for smaller components, many obstacles have been overcome such as the use of ceramic for the base of the device. These base units are constructed from ceramic layers which are bonded together, the walls of the box being the most delicate part. In a 7x5mm package the wall thickness is 1.4mm but this method is not sufficient for use on a 2.5x2.0mm device.

To overcome this issue, manufacturers of the base units have had to develop new ceramic compounds which can be manufactured and handled at even thinner dimensions without breaking. The new components have flexural strengths 1.5 times more than earlier components (620MPa as compared to 400MPa) to allow the next generation of small size crystals and oscillators to be manufactured at 2x1.5mm and below. This same advanced method is used to achieve thinner packages suitable for use in for example PCMCIA cards.

We have come a long way in the 50 years that quartz crystal timing products have been in large scale production and at IQD we are constantly looking forward to the next innovation that will best meet the demands of modern electronic designs. ■

Power factor correction capacitors

rated up to 1000V

TDK-EPC has extended its range of power factor correction (PFC) capacitors: the Epcos PhaseCap Compact series, to also include types with voltages of 690, 800, 900 and 1000V. The capacitors of the B25673A*A* series offer PFC values of between 5 kvar (50 Hz) and 33 kvar (60 Hz) at capacitance values of between 3 x 11 and 3 x 55 µF. Thanks to their compact design with diameters of only 116 and 136 mm at insertion heights of 164 and 200 mm, these capacitors are particularly useful for designing space-saving PFC



systems for industrial networks.

Based on the proven MKK technology these capacitors can withstand inrush currents of up to 400 times their rated current. The components are PCB-free and self-healing. An integrated over-pressure disconnecter ensures additional safety.

The capacitors are designed for a case temperature of 65 °C (hot spot temperature up to 85 °C) and a service life of up to 200,000 hours.

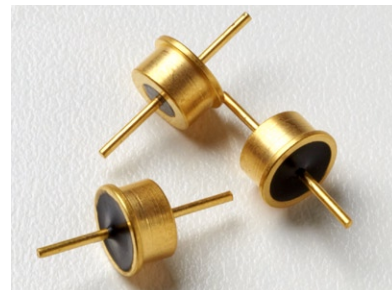
TDK-EPC

www.epcos.com/pfc

Large diameter solder-in EMI filter

comes in 10.16mm diameter, withstands 300 °C

Spectrum Advanced Specialty Products added a high temperature version to its solder-in filter product line of 10.16mm (0.400") diameter mounting EMI filters, with a construction able to withstand 300°C. This new solder-in filter



offers increased capacitance compared to the company's miniature solder-in series, with capacitance values up to 1.2µF. The higher cap values make this filter well suited for low to medium impedance circuits where large amounts of capacitance-to-ground can be tolerated. The large diameter EMI filter provides excellent filtering in

applications with voltage ratings of up to 400 VDC and 125 VAC/400Hz. The filter meets or exceeds applicable portions of MIL-PRF-28861/13, and is suitable for the military/aerospace, microwave, industrial and communications markets. These filters

are a lower cost alternative to competitive models and are a direct drop-in replacement. Customized versions of the solder-in filter are available with a variety of terminations, sizes and circuit configurations.

Spectrum Advanced Specialty Products

www.SpecEMC.com

SPECIAL FOCUS: PASSIVE COMPONENTS

Mini lug NTC thermistors

only require 65mm² of mounting space

The series of Mini Lug negative temperature coefficient (NTC) thermistors from Vishay Intertechnology offer the industry's smallest mounting

space at 65mm² of footprint and a short response time of less than 4 seconds to provide fast and

accurate measurements over a wide temperature range from -40 to +125°C. In addition to their small diameter, the NTCALUG03 thermistors feature a tiny 5.5 mm ring tongue that can be mounted with M2 screws or American studs #1 to 2. These small dimensions, when combined with the devices' silver-plated nickel conductor, result



in a low thermal gradient of less than 5% for accurate surface-temperature measurement in space-limited applications. The thermistors offer designers a

choice of electrical resistance values at +25°C (R₂₅) to meet the self-heating, voltage output, or noise suppression needs of their applications. The NTCALUG03 devices feature R₂₅ of 10, 12 or 47kΩ, with tolerances of ±2% and ±3%. The thermistors are available with an optional 1.5 mm pitch ZHR-2 connector, and they offer customizable lead lengths and screw sizes.

Vishay Intertechnology

www.vishay.com

MLCCs designed for LED lighting

reduce flicker and acoustic noise

The GR3 and RDE series of multi-layer ceramic capacitors (MLCC) have been designed by Murata to be incorporated in LED lighting circuits, immediately following

the bridge rectification stage, to provide DC supply smoothing and EMI filtering. The GR3 family is for re-flow soldering

and the RDE family provides radial leaded insertion production. Compared to standard ceramic capacitors, tests by Murata showed a 10dB reduction in acoustic noise by using the new GR3 MLCC capacitors. Further noise reductions are possible with the RDE leaded parts. Both families provide better DC bias

and acoustic noise reduction performance than X7R series. The GR3 is available in 250, 450 or 630 VDC rating and popular capacitances starting from 10nF

and up to 1,000nF for the 250 VDC range, to 560nF for 450 VDC and 270nF for the 630 VDC. Package sizes for the GR3 series include 0805, 1206, 1210, 1812 and 2220. The RDE leaded series has the same voltage rating as the GR3 series with capacitances of 10nF to a maximum of 2.2µF for the 250 VDC part, 1.2µF for the 450 VDC, and 560nF for the 630 VDC component.

Murata

www.murata.eu



Oxide capacitors guide

virtual library guide available on CD

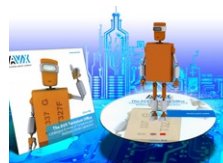
AVX Corporation has created a new CD detailing its tantalum and niobium oxide capacitors which will help designers access information more easily and select the correct capacitor for their applications. Featuring a 3D animated character called Mr OxiCap, users can quickly and easily find what they are searching for and have fun at the same time. The interactive and user friendly CD, called The AVX Tantalum Office, contains product offerings, technical papers and market specifications

or requirements, as well as presentations, teardown reports and information on the latest software tools.

Designed as a walkthrough guide, Mr. OxiCap welcomes users in a reception area and takes them through to a virtual conference room, where there's an explanation about what a tantalum capacitor is and information about its structure and how it is manufactured.

AVX Corporation

www.avx.com



High sensitivity coils

for use in hearing aid applications

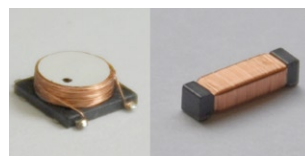
Premo announced two high sensitivity coils for use in hearing aid applications. The TP0602-TC is wound with thin copper wires less than 25 micron (up to 0.012mm diameter) and inductance values range from 40 to 170mH. This telecoil achieves a high sensitivity to magnetic fields in the 1kHz operating frequency range of most hearing aids. The ferrite core material provides a stable performance in the -10 to +40°C temperature range. The ZTC0602 (Tx-coil) is specially Z-axis designed for mobile phones to transmit an audio signal to a hearing aid device. Typical inductance range from 90 to 180µH and the Rdc value for the Z-TC0602

coil ranges from 4 to 32 ohms. The devices are delivered in SMD configuration for automatic

PCB assembly processes. The Telecoils enable users to control the volume of their hearing aid and reduce background noise when using cell phones in noisy places. Users can switch the phone coil between manual and automatic modes to create the required magnetic field that induces the signal into the hearing aid's coil. These series are available with "custom" electrical specifications.

Premo

www.grupopremo.com



Precision & Reliable Ultimate Thin Film Chip Resistors



Susumu established in Kyoto, Japan in 1964 has been the industrial leader in thin film resistors for over 45 years, enjoying the largest share of the thin film resistor market in the world.

Products

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www.susumu.de

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SSM SUSUMU
Thin Film Specialist and Innovator

U-shaped coaxial interconnect

eliminates costly cable assemblies

Bomar Interconnect Products added the coaxial "F" U connector to its proprietary Eliminator Series. The new parts are provided with two "F" push-on male connectors in a U-shaped configuration, and are engineered to eliminate costly cable assemblies in board-to-board applications, or to eliminate panel jumpers to the same panel. The connector/adaptor is a true 75-ohm device designed for video applications where equally spaced rows of female "F" connectors need be jumpered horizontally or vertically. They boast excellent return loss and insertion/withdrawal charac-



teristics along with superior RF performance. The devices are most commonly employed by

integrators and OEMs requiring a fast and reliable means to jumper multiple "F" panel females in video applications. Offered with Teflon insulators, the coaxial adapter is manufactured of precision-machined brass, and features gold-plated contacts to ensure continuous reliability with low VSWR. Part's operating temperature range is -40 to +65°C.

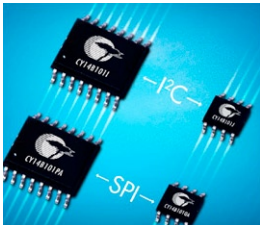
Bomar Interconnect Products

www.bomarinterconnect.com

Serial nvSRAMs for industrial use

with I²C and SPI interfaces up to 104MHz

Cypress Semiconductor has introduced new serial non-volatile static random access memory (nvSRAM) chips. With their I²C and SPI interfaces they aim at applications in metering, industrial and automotive markets. The new Cypress memory devices deliver operating frequencies up to 104 MHz for the SPI devices (3.4 MHz for the I²C products) and are also offered with an optional integrated real-time clock that enables



time-stamping of critical data to be backed-up. The nvSRAMs are manufactured on its S8 0.13-micron SONOS (Silicon Oxide Nitride Oxide Silicon) embedded non-volatile memory technology, enabling high reliability and improved performance. nvSRAMs the technology of choice solutions for applications requiring absolute non-volatile data security such as electronic smart meters, PLCs,

motor drives, electronic data recorders in automobiles, RAID systems as well as medical and data communication systems, Cypress said. The serial nvSRAM family includes 1-Mbit, 512-Kbit, 256-Kbit and 64-Kbit devices in multiple configurations. These devices feature an industry-

first SPI operating frequency of up to 104 MHz, SPI Modes 0 and 3, infinite read/write and recall cycles with 20 years of data retention. These devices

are available in industry-standard small footprint 8-SOIC and 16-SOIC packages. Cypress's serial nvSRAMs are available in I²C (1-Mbit: CY14B101J) and SPI (1-Mbit: CY14B101QA) interfaces in small footprint 8-SOIC and 16-SOIC packages. The devices are also available in 512-Kbit, 256-Kbit and 64-Kbit densities.

Cypress Semiconductor

www.cypress.com

Kinetis MCU tool kits

10 development boards to win choose from the K40 and the K60



This month, Freescale is giving away ten development kits worth \$139 each for EETimes Europe's readers to win. You can choose from either the TWR-K40X256-kit, a development tool for the K40 and K30 families of Kinetis microcon-



trollers or the TWR-K60N512-kit aimed at the K60 and K10/20 families of Kinetis MCUs. Both kits are part of the Freescale Tower System, a modular, reusable development platform. The K40 and K60 MCU modules can operate as a standalone debug tool and can be purchased separately from the kits and feature a K40X256 MCU or a K60N512 MCU respectively.

Both kits come with capacitive touch pads, an integrated, open-source JTAG, an SD card slot, a MMA7660 3-axis accelerometer, a Tower Plug-In (TWRPI) Socket for expansion (sensors, etc.) A Touch TWRPI Socket adds support for various capaci-

tive touch boards such as keypads, rotary dials, sliders and the like. The platforms feature Tower connectivity for access to USB, Ethernet, RS232/RS485, CAN, SPI, I2C, Flexbus, and other interfaces. The kits also feature a potentiometer, four LEDs, two pushbuttons and an infrared port. The TWR-K40X256-KIT is supplemented with a 28-segment LCD.

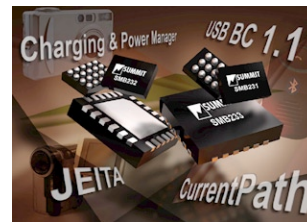
Freescale

Check the reader offer online at www.electronics-eetimes.com
www.freescale.com

USB charger ICs

combine programmability and safety features

Summit Microelectronics has introduced its fourth-generation programmable battery charger IC family for single-cell Li-Ion, Li-Polymer, and Li-FePO4 battery packs. The SMB231, SMB232 and SMB233 claim to integrate the largest feature



set in the industry, including compatibility with all relevant industry standards: USB Battery Charging Revision 1.1, USB 2.0/USB3.0, JEITA Safety, IEEE1725, Chinese USB Charging, and others.

All three products incorporate innovative functionality that allows automatic matching between the AC/DC adaptor's current capability and the portable device's charging requirements. The SMB231/2/3 products incor-

porate Summit's CurrentPath functionality to allow independent output current paths for the system and the battery, al-

lowing the system to turn on with a missing or deeply-discharged battery. This charging configuration reduces the charge and discharge

cycles on the battery, thereby extending its operating life. The devices also include input current limit which allows USB500/100, USB900/150 or AC/DC operation (300 mA – 1500 mA).

The SMB231, SMB232 and SMB233 operate with an input range from +3.7 V to +6.2 V input and safely withstand continuous input over-voltage up to +20V.

Summit Microelectronics

www.summitmicro.com

ChipESD protection devices

now available from global distributor TTI

Global distributor TTI now makes available new ChipESD packages developed by TE Connectivity. These bi-directional silicon-based ESD protection devices help reduce assembly challenges because they offer the advantages of an active silicon device combined with a traditional SMT passive body package.

Available in 0201 and 0402 sizes, Chip ESDs are easier to install and re-work than traditional semiconductor-packaged ESD devices, as they operate bi-direc-

tionally and can be placed onto a PCB with no orientation constraints, eliminating any need for polarity inspection. Electrical specifications include a surge rating of 2A under 8x20µs surge and an ESD rating of 10kV contact discharge. The devices' low-leakage current (1.0µA max) reduces power consumption and a fast response time (<1ns) helps equipment to pass IEC61000-4-2, level 4 testing.

TTI Europe

www.ttiEurope.com

RFMW to distribute Microwave Technology's lines across EMEA

RFMW Ltd and Microwave Technology (MwT) announced a distribution agreement for Europe, the Middle East, Africa and Israel (EMEA) effective immediately. Specialist distributor RFWM will distribute MwT's broad portfolio of RF and Microwave products including discrete semiconductors, GaAs and GaN RF power amplifiers, low noise pHEMT devices, MMICs, wireless amplifiers, hybrid modules, Gunn diodes (packaged and chip) and microwave amplifiers. According to Joel Levine, president of

RFMW, teaming with MwT in Europe, the Middle East, Africa and Israel allows the distributor to offer customers more of the world's best RF/microwave semiconductors. MwT has a long history of developing high performance GaAs semiconductors. With MwT's recent advances in GaN based products, customer interest has been piqued and RFWM stands ready to promote these products.

Microwave Technology

www.rfmw.com

TT electronics' resistor portfolio

now extended with Welwyn Components

Mouser Electronics expanded its distribution agreement with TT electronics by including the product range from Welwyn Components.

Building upon record sales and a continuous commitment to global expansion, the extended agreement further strengthens Mouser's global reach, specifically into Europe, by providing customers with the complete TT electronics resistor portfolio. Mouser anticipates that

Welwyn's application engineering focus will complement their strategy of supplying innovative solutions to design engineers. When asked about the importance of this agreement to Mouser, Andy Kerr, Mouser Vice President of Passives, added, "It definitely gives us a stronger foothold into the European marketplace."

Mouser Electronics

www.mouser.com

Digi-Key first to stock NXP LPC11C2x

integrated CAN microcontroller and transceiver

Electronic components distributor Digi-Key Corporation is the first to stock NXP's LPC11C2x series; industry's first integrated CAN microcontroller and transceiver solution; it is now available for purchase on Digi-Key's global websites. The device removes the need for separate, often expensive, CAN transceiver. CAN is recognized as a robust and reliable communication channel for rugged environments. The LPC11C22 and LPC11C24 with integrated high speed CAN physical layer transceiver and easy to use on-chip CANopen drivers offers complete CAN functionality in a low-cost LQFP48 package.

Typically, CAN transceivers can cost as much as or even more than the microcontroller itself.

Integrating the CAN transceiver on board increases system reliability and quality, reduces electrical interconnect and compatibility issues, and reduces board space by over 50 percent while adding less than 20 percent to the MCU cost. CANopen drivers are provided in on-chip ROM with easy-to-use APIs enabling users to rapidly adopt the LPC11C22/C24 into embedded networking applications based on the CANopen standard. This standardized layer (EN 50325) is well suited for embedded networks in all kinds of control, such as machines and elevators, making proprietary or application-specific application layers obsolete.

Digi-Key Corporation

www.digikey.com

Pan-European distribution contract

between Quectel Wireless Solutions and MSC

Germany-based distributor MSC Vertriebs has signed a Pan-European distribution contract with Shanghai-based manufacturer of 2G/3.5G and GPS communication modules, Quectel Wireless Solutions. Quectel Wireless Solutions' modules are aimed at smart metering, automotive infotainment, POS terminals, security, tracking, tracing as well as remote maintenance and monitoring applications. "The

Furthermore, the existing pin and functionality compatibility to modules produced by other leading manufacturers enables



technical data, quality, reliability and the price of Quectel products have convinced us right away" said Walter Puhl, head of the RF-department within MSC. Due to their outstanding technical features and the excellent technical support offered by the manufacturer, Quectel's wireless-modules are highly suitable for the use within a wide variety of cost-sensitive and at the same time highly-demanding industry and automotive applications.

a fast and therefore cost-saving redesign. In the future, Doron Zhang, Vice President R&D of Quectel Wireless Solutions Ltd. and Walter Puhl, Head of RF-department within MSC Vertriebs GmbH, intend to commonly supply the M2M- and automotive market with high-quality GPRS/UMTS- and GPS-modules at attractive prices.

MSC Vertriebs

www.msc-ge.com

3D motion-sensing chipset

advanced filtering and predictive software engine

STMicroelectronics' latest iNEMO chipset features a new advanced filtering and predictive software engine that integrates the outputs from a 3-axis accelerometer, 3-axis gyroscope and 3-axis magnetometer. Fusing the sensors' data through sophisticated algorithms, the dual chip solution delivers



dramatically more accurate and reliable sensor performance for next-generation smart consumer devices running new motion-based applications.

For many current applications, such as free-fall detection, screen rotation or pedometers, a single MEMS accelerometer meets the system requirements. However, a new class of advanced applications is emerging, for example: location-based services, enhanced motion-based gaming, pedestrian dead-reckoning for indoor and multi-floor naviga-

tion, robotics or human-body tracking. These applications require multiple MEMS sensors, together with advanced software, to achieve better

overall system performance in terms of accuracy, resolution, stability and response time. The software can correct for magnetic distortions

registered on the magnetometer, dynamic distortion measured by the accelerometer, and inherent drift over time of the gyroscope. This protects the accuracy of heading information, removes pointing inaccuracies and drift problems, and virtually eliminates timeouts for calibration. The iNEMO engine is a two-chip sensor solution (LSM303DLHx e-compass and the L3G4200D gyroscope)

STMicroelectronics

www.st.com

Self-retaining T-1 LED mounting spacers

ensures uniform and perpendicular LED positioning

Keystone Electronics unveiled a new series of self-retaining, T-1 LED mounting spacers designed to assure uniform and perpendicular LED



positioning while reducing assembly costs. These latest additions to the company's expanding group of universal, self-aligning LED spacers feature internal retention "teeth" which secure spacers onto LED leads, prior to assembly on PCB's. The unique design also eliminates the possibility of LED lead shorting by separating and retaining component leads while inserting into a PCB. In addition, no

special tools are required to preassemble LED's to spacers. The new spacers feature 0.5mm legs incorporated into the

moulded Nylon 6/6 structure to serve the dual purpose of heat dissipation and easy post-solder cleaning. Overall height of the spacers range from 3.0 to 23.5mm. Keystone also offers a selection of "Universal" and "Self-aligning" LED spacer mounts which accommodate both Tri-lead and Bi-lead T-1 and T-1 3/4 LED's.

Keystone Electronics

www.keyelco.com

Fanless multi-purpose box PCs

target industrial applications

Kontron has announced the fanless and ultra-compact Embedded Box PC CB 511 and Embedded Box PC CB 753, featuring a range of industrial interfaces.

The Kontron Embedded Box PC CB511 has been developed



to operate in especially tough environmental conditions. It is equipped with an Intel Atom N270 and designed for the extended temperature range of -15°C to +60°C. The Kontron Embedded Box PC CB 753 with Intel Core 2 Duo processor offers a compact construction with a high level of performance. It features two PCI slots and a PCI Express Mini Card slot for flexible configuration, making it ideal for a wide range of OEM applications which could previously only be addressed by 2U servers. With an extensive range of industrial interfaces they can be integrated seamlessly into a broad range of OEM applica-

tions in the fields of automation, digital signage, gaming and entertainment. Due to the energy-efficient characteristics of both Box PCs passive cooling in the closed

aluminium chassis suffices and makes them more robust than previous designs. Additionally, if

rotation-free, flash-based storage media are used, the operating noise is 0db, which makes the Box PCs ideal for noise-sensitive applications in medical technology where equipment is close to patients. Different mounting options are available for vertical and horizontal mounting or for rack-mount. The MTBF (Mean Time Between Failures) has been specified at approximately 50,000 hours (Kontron CB 753: 40,000 hours). Kontron's Embedded Box PCs CB 511 and CB 753 are CE certified and designed to meet UL.

Kontron

www.kontron.com

Public key hardware accelerator IP

less than 30k ASIC gates, over 5000 operations/s

Barco Silex unveiled the BA414E, an enhanced version of the company's public key hardware accelerator designed to be power efficient and easier to integrate into embedded systems. The universal, fast and small footprint solution is flexible and scalable. It is based on a highly pipelined and optimized arithmetic unit and exploits efficiently the high potential of parallelism offered by hardware implementations. With the use of re-configurable elementary DSP blocks, the BA414E can be easily mapped to any existing FPGA technology as well as all ASIC processes. The IP can be implemented in less than 30k

ASIC gates, but the hardware can also be stretched to execute more than 5000 operations per second for 1024-bit CRT sign or decrypt. Barco Silex describes the BA414E as a "Smart Engine", this means that it does not require any assistance from the main CPU to handle the complete public key processing. Based on a cost-effective μ -coded sequencer (coupled to a μ -DMA), the core is able to support a lot of complex operations and algorithms like RSA, CRT, DSA & ECDSA, including Pre- & post-processing.

Barco Silex

www.barco.com

Thermal chassis simulator

for the evaluation of CPU passive cooling

Advanced Digital Logic (ADL) released the CS-100 thermal chassis simulator, a 100-in.-sq. collapsed chassis that is used to provide a thermal mass and radiative cooling surface for passive cooling of ADL CPUs. Drilled with ADL's universal mounting pattern, the CS-100 is compatible with all ADL PC/104 heat spreaders and pipes, regardless of the CPU upon which they are mounted. The unit contains both M3 and 4-40 hardware, as well as precision standoffs to support 0.600" or 1.000" clearance spreader solutions. Constructed from Blanchard-ground powder-cast plate aluminium, the surface flatness is better than 0.001" across the entire face. The



anodizing gives the unit a basic emissivity of 0.75 or better, and represents the radiative area of an aluminium enclosure with 200sq.in. of surface area. The

CS-100 is also deployed as a development platform for proof of concept passive cooling systems. The extra hole-pairs around the perimeter are linked by a recessed groove on the back of the CS-100. These hole-pairs make convenient strain-relief attachment points for the interface cables from the mounted PC/104 CPU, keeping cables neat and preventing undue harm to the connectors on the PC/104 motherboard.

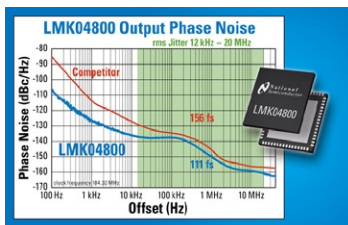
Advanced Digital Logic

www.adl-europe.com

Clock jitter cleaner ICs

claim industry's lowest phase noise

National Semiconductor has introduced a new family of clock jitter cleaners it claims features the industry's lowest phase noise and rms jitter performance: 111 fs from 12 kHz to 20 MHz, and a wideband noise floor of -162 dBc/Hz at 184 MHz output frequency.



The LMK04800 family comprises of four ICs including the LMK04808, LMK04806, LMK04805 and LMK04803, and is optimized for generating different frequencies up to 1.5 GHz for clocking ADCs, DACs, SerDes and FPGAs. With integrated features such as holdover, switchover, multiple inputs, digital delay, analogue delay, odd/even dividers and 12 programmable output format

drivers, the LMK04800 ICs are highly flexible and configurable to support a variety of different architectures. The combination of performance and functional

integration reduces clock architecture complexity and provides design engineers with multiple options to trade-off system performance, component count and cost. The LMK04800 clock jitter cleaners combine with National's high-speed op amps and ADCs (LMH6554, LMH6517, ADC12D1600, ADC12D1000, and ADC16DV160) to provide a complete signal-path system solution.

National Semiconductor

www.national.com

3D-measurement vision camera

has laser line extraction for 3D scanning

Matrox Imaging's GatorEye GigE Vision industrial camera now offers 3D capabilities. For triangulation-based 3D digitizing applications, the unit extracts the laser line in an image to sub-pixel accuracy and produces the corresponding positional depth/height array. Only the resulting array is transmitted, which lightens the load on the Gigabit Ethernet link and PC. The PC can then focus on other tasks, including 3D measurement and analysis. Designed for the harshest and most demanding manufacturing environments, the Matrox GatorEye industrial camera has an IP67 rating and offers a sturdy, dust-proof, and washable casing. The camera is



available in six sensor configurations including 640x480 at 110fps 1/3-inch in monochrome or colour CCD; 1280x960 at 22.5fps 1/3-inch monochrome or colour CCD; and 1600 x 1200 at 15fps 1/1.8-inch monochrome or colour CCD. For connectivity to external devices, the Matrox GatorEye includes an opto-coupled trigger input, strobe output, eight GPIOs, and a controlled current source for driving LED illuminators directly. The camera can be powered either by 12-24 Volts DC, which is common in industrial environments, or by Power-over-Ethernet (PoE).

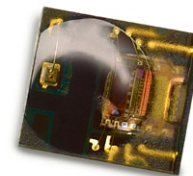
Matrox

www.matrox.com

Three-channel reflective encoders

measure 3.95x3.40mm, 304 lines per inch

At 3.95x3.40x0.95mm, the AEDR-850x series is the market's smallest three-channel reflective encoder, claims manufacturer Avago Technologies. The encoders feature built-in interpolation for high-resolution measurement well suited for a wide range of control applications.



A standard reflective encoder module contains two digital output channels for direction sensing, with another module required for indexing purposes. For motion feedback applications requiring high-resolution measurement, an external interpolation device had previously been necessary. The Avago AEDR-850x reflective encoders integrate an LED light source, photodetecting and interpolator circuitry, and the three channels in a single package with a

3.95x3.40mm footprint. With high resolution encoding of 304 lines per inch (12 lines per mm), the compact, highly-integrated modules enable a new level of miniaturization for applications where size and space are primary concerns. The AEDR-850x encoders offer interpolation of up to 4X and enable various resolution designs by changing the codewheel size. The optical-based modules are significantly less susceptible to EMI compared with Hall Effect devices. With an absolute operating temperature range of -20 to 85° C, the rugged encoders are suitable for commercial and industrial operation environments.

Avago Technologies

www.avagotech.com

What will it take to survive the mobile platform wars?

By David Wood

OPPORTUNITIES FOR MOBILE application (“app”) developers have never been brighter. Users of mobile phones, of all ages and all walks of life, have become increasingly comfortable with the notion that “there’s an app for that.”

More and more people have visited application stores or received information about applications from trusted friends or colleagues. Apps are available for fields as diverse as entertainment, insurance, health care and well-being, navigation, education, social networking, business automation, and much more. New payment models also mean that for developers who get things right, significant profits can be earned. And that’s just the start.

Mobile technologies (both hardware and software) are nowadays being recombined in new ways, inside different product categories and form factors. This new wave of embedded software incorporates smartphone technology inside a wide variety of devices that do not look like typical smartphones, ranging from wearable computers to consumer electronics to smart, connected cars. Each of these product categories supports wireless communications, local and remote data storage, mobile internet access, and this is the really interesting point for developers, adding the potential for installing new apps that enhance the original functionality.

New mobile devices are appearing all the time, based on a competing variety of underlying operating platforms. These platforms are backed by some of the largest players in technology – such as Apple (iOS) – used in the iPhone and iPad; Google (Android); Microsoft (Windows Phone); Intel (MeeGo); HP (WebOS); RIM (BlackBerry); and Samsung (Bada). Given that the stakes for the winning mobile platforms are so high, it’s no surprise that a ferocious battle is underway. App developers can easily become bruised in this battle.

It’s a battle of words as well as a battle of technology. One claim that has recently circu-



“A third-party application factory, cloud-based, can centralize resources and flexibly develop app for your product”.

lated worldwide is that there will only be three mobile platforms worth supporting. If true, that would appear to simplify the task facing mobile developers. But I’m skeptical. Although I’d like to see consolidation in the platform space, I expect that platform fragmentation is here to stay. The number of live platforms in today’s mobile space, in fact, is much closer to 10 than to three. The powerful backers of platforms are unlikely to back down. What’s more, history suggests that existing platforms will fragment internally and produce multiple, splinter platforms.

This leaves development companies with four options: select a small number of mobile operating systems and focus on those as the key targets while disregarding the rest of the market; build teams to support platforms with significant share and accept the resulting inefficiencies of effort while seeking some commonalities between the teams; use one or more intermediate platforms, such as Java, Flash, Qt, web applications and cross platform development tools, which do a lot to hide the differences in the underlying operating systems; and use an “application factory,” where mobile

software development occurs in the cloud.

The final option, working with a third-party application factory, has considerable merit. While the company concentrates on its domain of experience (whether that be health-care, entertainment, education, or whatever), the application factory can make decisions about when to implement an application at the “native” level of one or more operating systems, and when to use intermediate platforms. It can grow and shrink teams focused on whichever intermediate platforms deliver the best performance and quality at any time and can spread resources efficiently across multiple development teams.

Choosing good development partners, therefore, is a key step towards surviving the mobile platform wars. Selecting strong users is just as important. Focusing on the passionate aspirations of real users is a useful antidote to the tendency of developers to focus on technology for technology’s sake. Development teams need people with a profound interest in user experiences and a relentless bias towards simplicity.

Rather than responding to every issue by adding new feature or configuration options, skilled app designers will keep hunting for simplifying principles and avoid their apps becoming bogged down in needless complexities. In a recent survey conducted by Accenture, more than half of U.S. and U.K. consumers interviewed said they are frustrated with frequently used electronic devices that freeze or crash, and they want better performing devices with just the right number of useful functionalities. Keeping close tabs on mobile consumer trends pays big dividends. Developers should examine what users are trying to do, quickly deliver a prototype solution, and then observe how they use it. Learn, modify, iterate again and again. But this won’t work unless the development team has two core skills: tools that can swiftly translate user interface ideas into working prototypes; and agile development practices that support rapid iteration and incorporation of customer feedback. These are skills an application factory should be able to provide, making it a viable option that developers ought to consider. ■

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