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www.microwave-eetimes.com

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BPA WORLDWIDE BUSINESS

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IN BRIEF

Khronos releases APIs for mobile TV, audio

The Khronos Group has released three new application programming interfaces that aim to speed development of mobile software, especially in audio and digital TV.

The latest efforts are a sign mobile developers believe mobile digital TV will make a comeback. They also show Google, which contributed to the effort, continues to drive Android as the leading open alternative to closed mobile platforms from Apple, Microsoft and Research in Motion which did not participate in forging the APIs.

Khronos released OpenMax AL 1.1, a broad C language API for mobile systems, as well as an extension to that API targeted at digital TV. In addition, it released OpenSL ES 1.1, an audio API enabling a broad range of features including 3-D sound.

www.khronos.org

Cambridge Pixel wins Radar Scan Conversion contract with BAE Systems

The contract is to supply Cambridge Pixel's SPx radar scan conversion solutions to BAE Systems Mission Systems, for deployment on the British Royal Navy's Type 45 destroyers and the Queen Elizabeth Class aircraft carriers. The contract is valued at around £600,000.

BAE Systems Mission Systems in New Malden and Portsmouth, England has integrated Cambridge Pixel's software-based SPx radar scan converter into its command and control client software. This enables radar video to be received from multiple radars on-board the ships into a server application and then distributed over Ethernet networks to command and control displays across the ship. The server application is built from Cambridge Pixel's HPx-100 radar acquisition cards and SPx software modules for compression and network interfacing.

www.cambridgepixel.com

Imec launches research program on high-bandwidth optical I/O

Imec has launched an industrial affiliation program on high-bandwidth optical input/output (I/O). The primary objective of the program, which is part of imec's research platform on deep-submicron CMOS scaling, is to explore the use of optical solutions for realizing high-bandwidth I/O between CMOS chips.

According to the ITRS roadmap, the aggregate data rate for off-chip communication is expected to exceed 100Tb/s by 2020. However, no known manufacturable solution for achieving such bandwidth density is currently available. Silicon photonics has been identified as a prime candidate to deliver a technology solution for enabling cost-effective short-range optical links.

The main benefits of silicon-based optical interconnects are their high speed, compact footprint, low power consumption and low cost, which enable the realization of a scalable interconnect solution. Moreover, the compatibility with existing CMOS processing infrastructure as well as the possibility of co-integration with CMOS circuits are additional important assets of the silicon photonics technology.

During the past ten years, imec and its associated lab INTEC at Ghent University have proven a track record in demonstrating the outstanding performance of silicon-based optical devices for high-speed data transmission, using silicon-on-insulator (SOI) substrates. Imec's latest optical I/O

program builds on this extensive expertise and aims at further developing a silicon-photonics solution for addressing the upcoming scaling challenges in interconnecting CMOS chips, in close collaboration with imec's industrial partners.

The program includes a two-fold path-finding effort. First, the complete electrical-to-optical-to-electrical (E-O-E) transmission path will be modeled for various technological implementations and benchmarked against the requirements for various applications, as well as against existing solutions. This benchmarking effort will focus on optimizing bandwidth density, power consumption, thermal robustness and cost at the system level. Second, demonstrators of the full optical link will be realized in silicon, including all required components such as optical modulators, germanium-based photodetectors, and thermally robust optical multiplexers, as well as their CMOS-based driving and receiving circuits.

www.imec.be

Femtozone applications hold the keys to Femtocell success

The initial use-case of Femtocells has been to enhance indoor cellular coverage, but it is now clear that their potential utility is much wider. It is based on "femtozone services" that use key attributes such as location and presence to trigger innovative applications residing on the mobile device, or in the access point, the core gateway, or the cloud.

A simple example: a family alert system. A young person arrives at the family home, and the femtocell there registers the presence of his or her mobile phone and sends out an SMS notification to the parents. Such systems are already in use in Japan. Other kinds of femtozone applications can turn on lights or activate security systems, while still others can be used to sync content between mobile phones and other devices in the home such as TVs, laptops and media players. Via the mobile network, they can even allow remote access to digital content stored at home.

ABI Research forecasts about 2.3 million femtozone subscribers in 2012, providing revenue of more than $100 million. These numbers rise sharply to 2015, when 45 percent of femtocell users will subscribe to femtozone services. Femtozone services will see initial adoption in the Asia-Pacific region, but ultimately the North American market will be by far the largest.

www.abiresearch.com

This month's cover represents the feature on wireless infrastructure with 2011 being the year for many carriers to roll out LTE services. However, many challenges still remain, such as indoor coverage, and costs versus cheaper, higher performance 3G networks.

EDITOR IN CHIEF
JEAN-PIERRE JOOSTING
Tel. +32 2 7400056
email: jean-pierre.joosting@eetimes.be

EDITORIAL ADVISORY BOARD
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ADVERTISING PRODUCTION
LYDIA GIJSEGOM
Tel +32 (0) 2 740 00 50
email: lydia.gijsegom@eetimes.be

CIRCULATION & FINANCE
LUC DESIMPEL
Tel +32 (0) 2 740 0055
email: luc.desimpel@eetimes.be

ART MANAGER
JEAN-PAUL SPELIERS
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email: jean-paul.speliers@eetimes.be

ACCOUNTING
RICARDO PINTO FERREIRA
Tel +32 (0)2 740 0051
email: financial@eetimes.be

PUBLISHER
ANDRE ROUSSELOT
Tel +32 (0)2 740 0053
email: andre.rousselot@eetimes.be

EUROPEAN BUSINESS PRESS SA
144 Avenue Eugène Plasky
1030 Brussels - Belgium
Tel: +32 (0)2 740 00 50
Fax: +32 (0)2 740 00 59
www.microwave-eetimes.com
VAT Registration: BE 461.357.437
RPM: Brussels
Company Number: 0461357437

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IN BRIEF

Hittite buys analog firm

Hittite Microwave has acquired Arctic Silicon Devices, a developer of advanced mixed-signal integrated circuit (IC) technology, located in Trondheim, Norway. The acquisition price was approximately $12.0 million in cash and equity.

The acquisition provides Hittite with a line of analog-to-digital converters (ADCs). The employees of Arctic Silicon Devices will continue to work at their existing facility.

www.hittite.com

Qualcomm and Duracell to explore wireless power

Qualcomm Incorporated and Duracell have announced the signing of a non-binding Letter of Intent (LOI) to explore the possibility of working together to develop an industry alliance that supports and promotes flexible coupling-based wireless power solutions to the consumer electronics industry.

Qualcomm's WiPower wireless power technology uses RF to transfer energy wirelessly over short distances between a transmitter-equipped charging pad and devices containing built-in receivers. Dependent upon the combination of devices, multiple devices can be charged concurrently, typically at rates equal to wired solutions.

www.qualcomm.com

DARPA seeks lighter energy source for radios

The military needs lighter, more efficient energy storage devices for its personnel. The Defense Advanced Research Projects Agency has awarded a $1.7 million contract to Maxwell Technologies for developing an advanced energy storage device for portable radios.

The initial one-year phase of an eventual $8 million program is targeting lighter, longer-lasting energy supply for field radios and other portable electronic equipment carried by military personnel.

www.maxwell.com

MEMS market enters new growth cycle as iPhone 4 spurs demand

With the iPhone 4 paving the way, global demand for MEMS devices in cell phones will rise robustly during the coming years, helping the total MEMS market to expand in healthy measure at least through 2014, according to IHS iSuppli.

Following two years of decline, the MEMS market enjoyed a strong 2010, with revenue rising by 18.3 percent compared to 2009. While growth will decelerate in 2011 after the boom of 2010, revenue still will increase at nearly a double-digit rate, climbing 9.5 percent. This growth will vastly exceed the 5.1 percent expansion of the overall semiconductor industry. And with the MEMS market set to enjoy double-digit growth from 2012 through 2014, market revenue will rise to $10.81 billion in 2014, up from $5.97 billion in 2009.

Cell phones will generate the strongest demand growth during the coming years, with MEMS revenue to the segment rising to $3.73 billion in 2014, nearly triple from $1.30 billion in 2009.

"The Apple iPhone 4 was a key milestone for the MEMS market, marking the first cell phone to use a MEMS gyroscope, and one of the first mobile handsets to use two MEMS microphones for noise suppression," said Jérémie Bouchaud, director and principal analyst for MEMS and sensors at IHS. "This has had an enormous 'me-too' impact on the rest of the cell phone industry, with a flood of companies offering MEMS-equipped handsets."

www.isuppli.com

Personal femtocell for the iPhone, claims to world's first attocell

Ubiquisys claims to offer the world's first attocell — a personal femtocell. Designed primarily for people travelling abroad, it enables mobile calls to be made and received as though in their home country. Although developed specifically for the iPhone, the attocell works out of the box with any 3G phone, and has also been tested with Blackberry, Nokia and Android smartphones.

The attocell connects to a user's laptop via USB, which provides power and an internet connection. It then analyses the IP address and radio environment to determine which country it is in, and sets its 3G radio power accordingly to below the licenced level. In some countries its range will be just 5-mm, in other countries, it could cover a whole room.

Like Ubiquisys femtocells, the attocell continuously monitors its radio environment to ensure that there is zero impact on existing mobile networks.

www.ubiquisys.com

Targeting microwave backhaul with multipoint platform

Cambridge Broadband Networks Limited has launched VectaStar Gigabit, what it claims is the world's first microwave backhaul product to enable network designers to create point-to-multipoint (PMP) networks and individual links using a single platform. It provides 150Mb/s Ethernet link capacity and is described as a 'zero-footprint' design; eliminating the need for external cabinets or indoor units.

The company claims that VectaStar Gigabit gives network designers an unrivalled level of flexibility in the design and build of microwave backhaul networks. The elimination of the requirement for any indoor equipment to support the multipoint functionality means that it can be deployed for individual links, stand-alone sectors or as a PMP hub. Designers can select VectaStar when they first start planning their network, laying down individual links and then expanding them to multipoint sectors or hubs as their network grows.

www.cbnl.com

MICROWAVE engineering europe

SALES OFFICES

EUROPE

Austria
Victoria & Norbert Hufmann
Tel +49 911 93 97 64 42 - sales@hufmann.info

Belgium
Nadia Liefsoens
Tel: +32-11-224 397 - nadia@fivemedia.be

France, Spain & Portugal
André Rousselot
Tel:+32 2 740 0053 - sales@eetimes.be

Germany PLZ 0-3, 60-65, 8-9
Victoria & Norbert Hufmann
Tel: +49 911 93 97 64 42 - sales@hufmann.info

Germany PLZ 4-5
Armin Wezel
Tel: +49 9568 897 097 - armin@eurokom-media.de

Germany PLZ 66-69, 7
Ralf Stegmann
Tel: +49 7131 9234-0 - r.stegmann@x-media.net

Israel
Amir Ben-Artzi
Tel: +972 73 7367966 - amir@amircm.com

Italy
Ferruccio Silvera
Tel: +39-02-284 6716 - info@silvera.it

Scandinavia
Jeff Draycott
Mobile: +46-(0)702 067636 - jeff.draycott@comhem.se

Switzerland
Monika Ailinger
Tel: +41-41-850 4424 - m.ailinger@marcomedia.ch

UK & Ireland & **The Netherlands**
Tim Anstee
Tel: +44-1732-366555 - sales@starmediaservices.co.uk

USA

US East Coast
Karen Smith-Kernc
Tel: +1 717 397 7100 - KarenKCS@aol.con

US Central & West Coast
Alan Kernc
Tel: +1 717 397 7100 - AlanKCS@aol.com

ASIA

Japan
Masaya Ishida
Tel: +81-3-6824-9386 - MIshida@mx.itmedia.co.jp

Hong Kong
Asian Sources Publications Ltd.
Tel: +852 2831 2775 - bennie@globalsources.com

South Korea
J. W. Suh
Tel: +82-2-7200-121 - hauintl@chol.co

Taiwan
Lotus Business
Tel: +886-4-23235023 - medianet@ms13.hinet.net

EUROPEAN BUSINESS PRESS SA

André Rousselot
Sales director
Tel +32 (0)2 740 0053
email: andre.rousselot@eetimes.be

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Will femtocells change the way we work and play?

While all eyes will be on LTE and the expected roll out of 4G networks this year at the Mobile World Congress in Barcelona, February 14th to 17th February 2011, there will be undercurrents of a strong 3G market, especially with HSPA+, and femtocells, which appear to be coming of age. Along with the questions of LTE versus HSPA+ with respect to costs and the timing of an upgrade to LTE, the femtocell market will be looking not only at the network infrastructure side where femtocells could provide the much needed army of small, cheap basestations required for LTE, but also at the personal level, as a hub in the home or even a personal mobile hub.

To this end, Ubiquisys is offering the first attocell - a personal femtocell designed primarily for people travelling abroad to enable mobile calls to be made and received as though in their home country. The attocell connects to a user's laptop via USB, which provides power and an internet connection. It then analyses the IP address and radio environment to determine which country it is in, and sets its 3G radio power accordingly to below the licenced level. In some countries its range will be just 5-mm, in other countries, it could cover a whole room.

Going back to the case where Femtocells are primarily used to enhance indoor cellular coverage, it is becoming clear that their potential utility is much wider based on "femtozone services" that use attributes such as location and presence to deliver applications residing on the mobile device, in the access point, the core gateway, or the cloud. According to ABI Research, the femtozone services market is expected to reach almost $2 billion in revenue by 2015, but operators need to act fast, as the popularity of Wi-Fi/GPS-based over the top applications could pose a hindrance.

It is apparent from these trends that femtocells, especially if they become portable (pocket-sized) could provide a means to deliver and run mobile applications to the end user, directly from the mobile network. Besides applications such as those from Google, Apple, Nokia and so on, other applications, for example, could be written to turn on lights or activate security systems at home or even allow remote access to digital content stored at home, or even enable health monitoring to elderly and disabled people.

The femtocell paradigm has huge potential and could change the way people and organisations work once again.

Jean-Pierre Joosting
Editor
joosting@mac.com
Mobile:- +32-473-606005

IN BRIEF

Anritsu meets protocol certification targets for LTE devices

Anritsu's ME7873L LTE RF Conformance Test (RFCT) and ME7832L LTE Protocol Conformance Test (PCT) systems have achieved the Global Certification Forum's (GCF) 80 percent test case validation threshold for multiple bands, supporting the recent start of certification for LTE devices.

The company says the ME7873L has becomes the first test system in the world to reach the 80 eorcent threshold for bands 1, 7, 13, and 20. Additionally, the ME7832L has reached the same threshold for band 13.

The ME7873L LTE RFCT system offers TX, RX, Performance, RRM, and operator acceptance test capability in a single scalable platform, allowing users to verify conformance of a UE's RF layer to 3GPP and operator-specific LTE standards. Pre-written, validated test cases that conform to GCF Work Items and PTCRB Request for Test are available.

www.anritsu.com

Aeroflex to acquire LIG Nex1 analyzers

Aeroflex Limited has signed an asset purchase agreement to acquire the spectrum analyzer assets from LIG Nex1 Co, Ltd. The primary assets to be acquired under the transaction include bench-top spectrum analyzer product lines that Aeroflex has offered under its own brand.

These products include the 2399C, 2394A, 2395A spectrum analyzers as well as the newer 3250 Series spectrum analyzers, along with all the respective intellectual property. The closing is subject to certain delivery requirements by LIG Nex1, as well as certain customary closing conditions.

"The long relationship with Aeroflex and LIG Nex1 will allow a smooth transition of this product line without any loss of customer support" said Robert Vogel, President of Aeroflex Test Solutions.

www.aeroflex.com

RFMD achieves 4G performance milestone related to PowerSmart power platforms

RF Micro Devices has achieved a major performance milestone related to its PowerSmart™ power platforms — a new product category reshaping the future of multimode, multi-band cellular RF architectures.

During independent product testing, PowerSmart achieved HSPA+ 4G data upload speeds while drawing approximately 15 percent less current than competitive solutions. Product qualification tests, which are routinely performed to evaluate each new cellular product's front end, transceiver and baseband, are currently being conducted in support of a highly anticipated product family spanning multiple form factors, to be launched by a leading cellular device manufacturer beginning in the March, 2011, quarter.

PowerSmart power platforms feature an RF Configurable Power Core™ that delivers multi-band, multi-mode coverage of all cellular communications modulation schemes, including GSM/GPRS, EDGE, EDGE Evolution, CDMA, 3G (TD-SCDMA or WCDMA) and 4G (HSPA+, LTE or WiMAX).

HSPA+ 4G devices are capable of maximum data upload speeds of 22 Mbps. Because the RF Configurable Power Core is compliant with all current and known future 4G data standards, the company anticipates subsequent smartphones featuring PowerSmart will support upload speeds significantly greater than 22 Mbps.

www.rfmd.com

NXP converters achieve interoperability with Nujira OpenET envelope tracking solutions

The CGV series of JESD204A-compliant data converters from NXP Semiconductors are now interoperable with Nujira's OpenET envelope tracking (ET) and digital pre-distortion (DPD) solutions.

The CGV analog-to-digital converters (ADCs) and digital-to-analog converters (DACs) claim to be the first in the industry to implement the JEDEC JESD204A serial interface, which reduces the number of interconnect signals between data converters and VLSI logic devices, and enables synchronous bonding of multiple data converter channels or lanes. Nujira's next-generation Coolteq-h envelope tracking modulators now also support JESD204A as an interface option.

Assured interoperability and interworking between programmable logic devices and high-speed converters is a critical acceptance criterion for equipment designers, because it reduces risk and cost associated with project schedules.

www.nujira.com, www.nxp.com

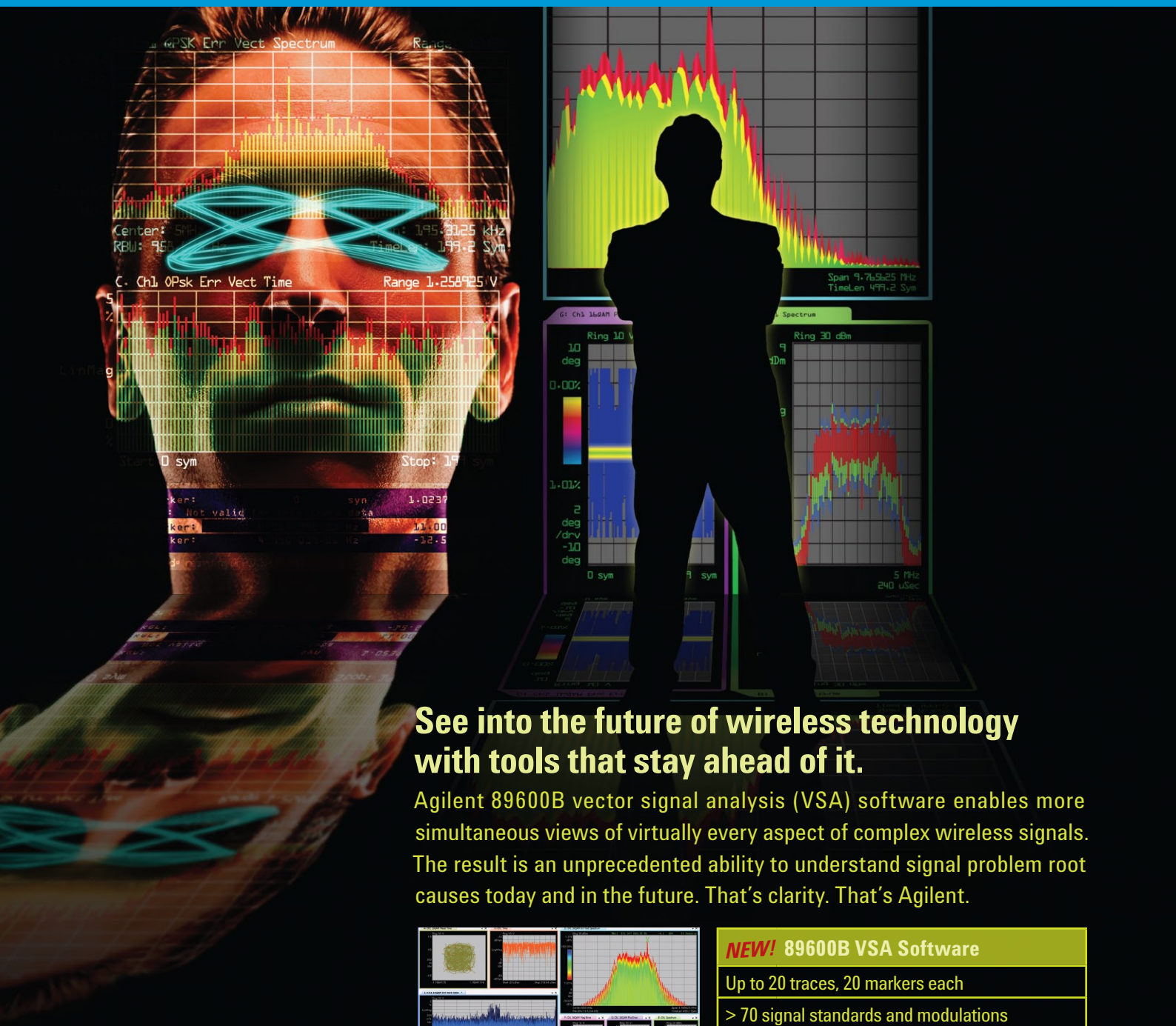
ZigBee remote controls now covered by TRaC's ZigBee test service

Test, certification and compliance specialist, TRaC, has further expanded its capabilities in ZigBee Testing to include testing for ZigBee Remote Control (ZRC) devices. The service covers both the remote control devices and their target counterparts, with ZRC increasingly being employed in cutting edge equipment such as HD TV, Blu-ray, Set Top Boxes and other products using similar advanced technology.

The ZigBee Remote Control standard has been developed by the ZigBee Alliance, and defines an advanced RF remote control system which is built on an RF4CE platform.

TRaC already offers a complete Platform Test Service to RF4CE, however, the test specification for ZigBee Remote Controls has recently been published allowing manufacturers of ZRC devices to seek profile certification and apply the ZigBee and ZRC logos. TRaC are also preparing for further RF4CE profiles.

www.tracglobal.com



See into the future of wireless technology with tools that stay ahead of it.

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LTE indoors – the impact of Software Defined Radio on in-building coverage

By Håkan Samuelsson, CTO, Axell Wireless, www.axellwireless.com

LTE, the technology that promises to deliver true broadband data to the mobile platform is becoming a reality all over the world. In the European market Telia Sonera has rolled out LTE networks in metropolitan areas in Norway and Sweden, while T-Mobile Austria has deployed LTE in Innsbruck. Meanwhile, German mobile operators are having discussions about the possibility of rolling out of a joint LTE network in the country.

LTE in the radio access network (RAN) has the theoretical capability to deliver a 100+ Mbit/s uplink and 50+ Mbit/s downlink. In reality it's unlikely any user, unless they are the only person accessing a particular cell tower and they are standing next to it, will actually achieve the theoretical rates but it will still offer a vast improvement on what we are currently experiencing. Of course, it isn't simply the number of users on the network, or their proximity to a cell tower that impacts on the connection rates available on a mobile device. The same old problems impact on LTE in the same way they do on 2G and 3G networks, most notably the signal degradation and deflection caused by solid objects.

If you're standing outside and you have 'line of sight' to the cell tower that isn't going to be a concern but unfortunately you'll be in a minority. Mobile handsets and devices may originally have been conceived as outdoor devices, but the fact is that most mobile use takes place within buildings. Research conducted by Analysys Mason estimates that by 2016 over 80% of global wireless data traffic will be generated indoors. The demand for high speed mobile broadband and data services will be concentrated to public spaces, such as coffee shops, shopping malls or offices, where people have the opportunity to stop and browse the internet, check emails and stream video.

For operators this trend means that LTE services are going to have to find a way through brick, concrete, steel and glass if the promise of universal, multi-megabit, services is to be realised for the vast majority of mobile users. The challenge for RF and microwave engineers is how to deploy robust systems that are capable of dealing reliably with multiple users, within walls and under roofs, all wanting to access and transmit large amounts of data – photos, audio and video.

Axell Wireless' D-MBR repeater is powerful enough to drive a passive Distributed Antenna System (DAS) for coverage areas over 100,000 ft^2 (10,000m^2) in buildings, parking lots, malls, warehouses and offices.

So what are the options? The answers for residential application seem to be reasonably well established. WIFI and femtocell offload are working effectively already even if it does mean the mobile operator relies on a fixed line network out of their direct control. Unfortunately those solutions don't scale for major in-building implementations, either in terms of the number of concurrent users that can be supported or in the desired quality of service parameters. Picocells might be OK for hotspot provision but they are also capacity limited and prone to overload if too many users want access at the same time. Dedicated LTE base stations deployed indoors are possible but it is a costly and time consuming process.

It is for those reasons that operators are turning to sophisticated digital repeaters connected to a Distributed Antenna System (DAS) that propagates signal throughout the building. A single repeater linked to a roof mounted donor antenna, or to a dedicated base station, can 'drive' a DAS providing coverage for 100,000 ft^2. The result is a cost effective solution that provides universal coverage for mobile equipment users and data transfer capabilities that are the equal of uninterrupted outdoor connections. Users remain 'on-network' with no requirement to configure a connection for data offload onto a fixed line network and, if properly configured, there is no danger of network overload.

That leads us on to the specific requirements for repeaters and it's at this point that we have to consider how mobile networks evolve. We won't suddenly all be turning on to LTE overnight and so the repeater needs to be multiband, able to simultaneously handle 2G and 3G network connections and potentially, those frequencies set aside for dedicated emergency services use. Remote monitoring and configuration is also important and it's important that the unit can take account of standards variations, spectrum availability and the individual requirements of operators. In that potentially complex mix of requirements software-defined-radio (SDR) is making its presence felt.

In the simplest of installations, in which the repeater is serving the subscribers of a single carrier, the system needs to ensure that the repeater only amplifies signals from that

operator's base stations and rejects those from other networks. Traditionally that was achieved through the use of surface acoustic wave (SAW) filters but SAW filters have temperature dependent filter characteristics. The pass band drifts in frequency with temperature which becomes a problem in repeater applications where the filter skirts should be able to reject frequencies very close to the pass band.

The ideal filter for repeater applications should have a flat, low loss pass, band over all frequencies belonging to the operator, but should reject all other frequencies. At the same time, the propagation delay through the filter should be minimal with very low ripple within the pass band. If more than one pass band needs to be amplified (several operators share one repeater or one operator has more than one allocation of spectrum), the repeater must be equipped with several SAW filters working in parallel which amplifies the potential issues. SDR technology meets all the requirements to make it possible to design frequency-stable filters with performance far exceeding analog SAW filters and which are also programmable in center frequency and bandwidth.

SDR also makes it is possible to download new field-programmable gate array (FPGA) code to the repeater if a new set of filters are to be implemented. In fact, if the repeater is equipped with an FPGA with sufficient capacity, several sets of filter parameters can be stored and called up at will. This makes the repeater very flexible, as new requirements (more bandwidth, support of a new radio technology etc.) can be immediately implemented to upgrade repeater functionality.

Digital multi-band repeaters, employing SDR, are changing the way operators address in-door coverage for commercial environments. The multi-megabit connection requirements for LTE are demanding, but they can be effectively and efficiently addressed by an established mobile network technology that has now been significantly enhanced. Individual operators can deploy the equipment for their own dedicated use but equally, it opens the door to innovative micro-network sharing arrangements, in which operators make use of the same in-building infrastructure but retain direct access to their consumers and control over the network.

By sharing a single network operators are able to compete on price, services and mobile content, rather than geographic coverage. For in-building purposes mobile operators are now in a position to consolidate their networks by deploying multi-band repeaters that can be configured remotely to support a wide range of frequency bands. Sharing infrastructure also reduces installation costs and the disruption to commercial buildings or public spaces caused by engineers, and maintenance teams.

The deployment of repeaters has always been perceived as a temporary solution. The shortfalls commonly associated with repeater technology such as interference, noise and sensitivity reduction have been addressed and developments in digital signal processing have solved performance related issues. SDR adds an entirely new dimension that makes repeaters a long-term solution – not just a temporary fix. So much so that for the next release of the LTE standard the industry is considering the integration of repeaters, relay nodes, as a standard network element.

SON solution addresses the integration of legacy 2G and 3G networks into LTE self-organising networks

Celcite Management Solutions has launched its Multi-Technology Self-Organising Networks (SON) solution. As networks are becoming more complex, integrating multi-band (700/900/1800/2100/2 600 MHz), multi-carrier systems and combining GSM, UMTS, HSPA and LTE technologies, inter-technology interaction now has a three-dimensional impact on network performance. The company's Multi–SON solution has been specifically developed to measure and manage the interaction between the different technologies and layers, and provides a technology- and vendor-agnostic platform that enables operators to manage complex networks efficiently.

Presently, LTE SON standards (Rel9) include several use cases such as plug & play installation, Automatic Neighbour Relation (ANR) or HandOver (HO) optimisation, although these are only valid for single-vendor networks. In reality the mobile operators will continue to employ underlying multi-vendor GSM / UMTS / HSPA networks that carry substantial traffic/ARPU, and these will need to be maintained and optimised alongside LTE deployment.

With multiple UMTS carriers being launched to meet increasing data traffic demands, the use of LTE SON alone will not help operators reduce their OPEX spend in managing the existing technology layers that continue to provide the majority of their revenues. To increase network efficiency and improve service quality to end users, operators need to deploy a multi-technology SON solution such as Celcite's, which works across 2G, 3G and 4G technologies, allowing them to incrementally reduce OPEX spend.

Operators who are managing the legacy 2G/3G technologies will wish to run their LTE operations and maintenance using existing workflows and resources. By using the Multi-Technology SON solution, they can achieve substantial savings that are generated through:

- centralised, multi-technology, multi-vendor intelligent Operating Support System (OSS);
- automation of tasks with more than 70% operation efficiency;
- flexible engineering rules and algorithms that work across technologies;
- Root Cause Analysis using Automatic Intelligent Correlation of performance, configuration, alarms and planning data;
- substantial reduction of drive testing by correlating OSS mobile recordings/traces and geo-location data.

The company is already helping wireless operators manage over 250,000 multi-vendor, multi-technology sectors with substantial improvements in efficiency (more than 70%) resulting in reduced OPEX, as well as achieving better KPIs and establishing consistency between different engineers and markets.

With its centralised platform, Multi-Technology SON processes terabytes of network information – KPIs / KQIs along with configuration / alarms data – across all vendors and technologies, and provides root cause analysis and optimisation recommendations to improve network KPIs, based on the automatic intelligent algorithms. The engineer is given the option to either accept, reject or implement the changes that have been recommended.

www.celcite.com

Designing for today's wireless infrastructure base stations using VGAs

By Randy Cochran, HPRF Infrastructure Manager, NXP Semiconductors, www.nxp.com

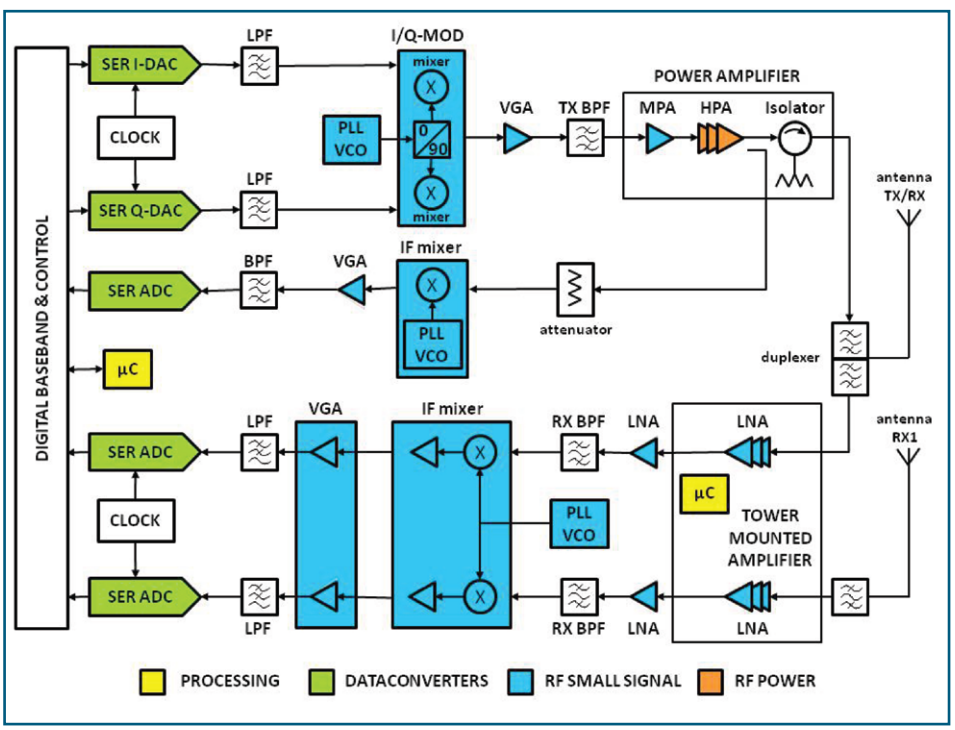
When designing for applications such as wireless infrastructure base stations, engineers not only have to consider the frequency band of operation but also the air interface standard (e.g. GSM, 3G, 4G, LTE, to name a few.) Thus, in initially selecting products for these systems, parts that can be used for multiple bands or technologies typically provide a greater benefit. And beyond that, higher performance products make the final cut.

With a wide variety of variable gain amplifiers available on the market today, which ones offer the greatest benefits and highest performance? The key to answering this question requires a closer look at a base station transceiver block diagram, taking into consideration the entire receive system to select the best VGA product.

Over the past years, open-collector VGA devices have been readily available on the market, but these devices require impedance transformation, where external matching is required to obtain the optimal power performance. This impedance transformation often resulted in decreased performance at the higher IF VGA output powers. Today, however, VGAs that are matched directly to 150 to 200 Ohms provide a significant advantage for engineers, as they allow for a simplified system design where the VGA product can directly drive the filter into the ADC.

NXP has recently introduced several new products, which incorporate this integrated matching functionality and offer the enhanced performance required by today's RF engineers. The BGA7350 and BGA7351 provide two good examples that support these system design techniques. These VGAs parts are dual independently digitally controlled IF VGAs operating from 50 MHz to 250 MHz, and have a gain range of 24 dB and 28 dB respectively. At their maximum gain setting, these VGAs deliver 17 dBm output power at 1 dB gain compression and offer superior linearity performance. The 5 V operational VGAs are also optimized for a differential gain error of less than ±0.1 dB for accurate gain control and have a total integrated gain error of less than ±0.4 dB, meeting the demanding phase error requirements for GSM.

Figure 1: Base station transceiver block diagram.



These unconditionally stable devices offer ESD protection at all pins and meet moisture sensitivity level 1. The RoHS compatible devices are housed in 5x5 mm^2 leadless HVQFN packages, and are well suited for GSM, W-CDMA, WiMAX, LTE base-station infrastructure, and multi-carrier systems.

What enables these VGAs' high performance is NXP's innovative SiGe: C QUBiC4 process, which allows more functionality on-chip with less space. Smaller devices also mean more competitive costs, and added functionality on a single chip improves reliability and gives significant manufacturing advantages.

NXP's state-of-the-art QUBiC4 technology speeds the migration from GaAs to silicon by offering best in class linearity, power consumption, immunity to out-of-band signals, spurious performance and output power. Available since 2002, this process continues to upgrade to meet today's system performance requirements. This extensively tested process and widely deployed in the field offers consistent parameter performance.

Beyond these VGAs, NXP is one of the very few companies that can actually supply products for the complete signal chain (i.e. analog mixed signal components such as ADC/DAC + RF Small-Signal + High Power RF), allowing engineers to purchase products that work well together as part of the overall system design. This systems approach is certainly one that gives design engineers an edge when purchasing RFICs and MMICs from a supplier such as NXP. Clearly, it is an important strategy for semiconductor companies to take when designing and developing ICs for today's high performance wireless infrastructure.

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CHANGING THE STANDARDS

Half-inch UMTS base station receiver

By Douglas Stuetzle, Senior Module Design Engineer and Todd Nelson, Module Development Manager, Linear Technology Corporation

How much integration is possible while still meeting macrocell base station performance requirements? Process technology still dictates that certain key functions are made in specific processes: GaAs and SiGe in the RF realm, fine-line CMOS for high-speed ADCs, and high-Q filters cannot be implemented well in semiconductor materials. Yet the market demands more density.

With that in mind we elected to use system-in-package (SiP) technology to build a receiver occupying about one-half square inch (just over 3cm^2). The boundaries of the receiver are the 50-ohm RF input, the 50-ohm LO input, the ADC clock input and the digital ADC output. This leaves the LNA and RF filtering to be added for the input, LO and clock generation, and digital processing of the digital output. Within the 15-mm x 22-mm package is a signal chain utilizing SiGe high frequency components, discrete passive filtering and fine-line CMOS ADCs.

The following is the design analysis for two µModule® products: the LTM9004 implementing a direct conversion receiver, and the LTM9005 implementing an IF-sampling receiver.

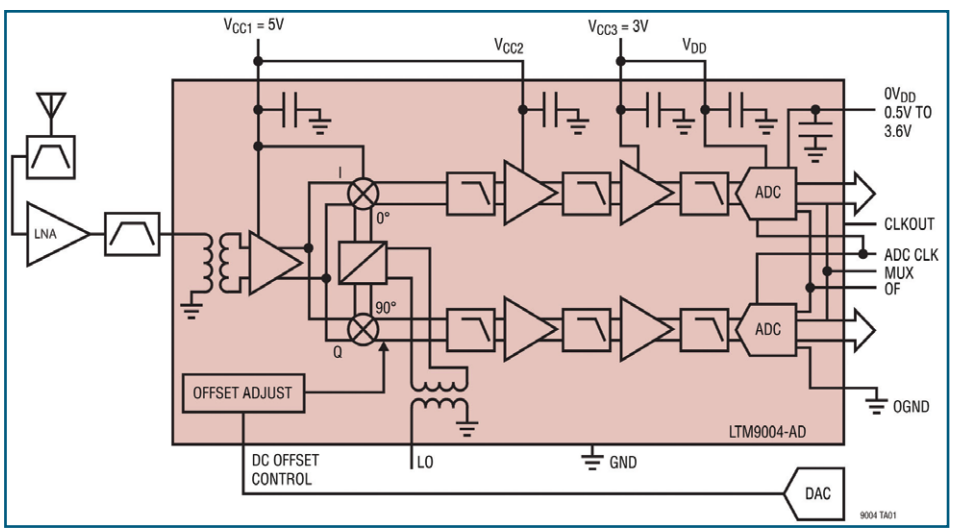
Design targets

The design target is a UMTS uplink FDD system, specifically the Medium Area Base station in Operating Band I as detailed in the 3GPP TS25.104 V7.4.0 specification. Sensitivity is a primary consideration for the receiver; the requirement is ≤ -111 dBm, for an input SNR of -19.8 dB/5 MHz. That means the effective noise floor at the receiver input must be ≤ -158.2 dBm/Hz.

Design analysis – zero-IF or direct conversion receiver

The LTM9004 is a direct conversion receiver utilizing an I/Q demodulator, baseband amplifiers and a dual 14-bit, 125 Msps ADC as shown in Figure 1. The LTM9004-AC lowpass filter has a 0.2 dB corner at 9.42 MHz, allowing four WCDMA carriers. The LTM9004 can be used with an RF front end to build a complete UMTS band uplink receiver. An RF front end consists of a diplexer, along with one or more low noise amplifiers (LNAs) and ceramic

Figure 1: Direct conversion architecture implemented in the LTM9004 µModule receiver.



bandpass filters. To minimize gain and phase imbalance, the baseband chain implements a fixed gain topology; therefore, an RF VGA is required preceding the LTM9004. Here is an example of typical performance for such a frontend:

- Rx frequency range: 920 to 1980 MHz
- RF gain: 15 dB maximum
- AGC range: 20 dB
- Noise figure: 1.6 dB
- IIP2: +50 dBm
- IIP3: 0 dBm
- P1dB: -9.5 dBm
- Rejection @ 20 MHz: 2 dB
- Rejection @ Tx band: 96 dB

Given the effective noise contribution of the RF front end, the maximum allowable noise due to the LTM9004 receiver must then be -142.2 dBm/Hz. Typical input noise for the LTM9004 is -148.3 dBm/Hz, which translates to a calculated system sensitivity of -116.7 dBm.

Typically such a receiver enjoys the benefits of some DSP filtering of the digitized signal after the ADC. In this case assume the DSP filter is a 64 tap RRC lowpass with alpha equal to 0.22. To operate in the presence of co-channel interfering signals, the receiver must have sufficient dynamic range at maximum sensitivity. The UMTS specification calls for a maximum co-channel interferer of -73 dBm. Note the input level for -1 dBFS within the IF passband of the LTM9004 is -15.1 dBm for a modulated signal with a 10 dB crest factor. At the LTM9004 input this amounts to -53 dBm, or a digitized signal level of -42.6 dBFS.

With the RF automatic gain control (AGC) set for minimum gain, the receiver must be able to demodulate the largest anticipated desired signal from the handset. This requirement ultimately sets the maximum signal the LTM9004 must accommodate at or below -1 dBFS. The minimum path loss called out in the specification is 53 dB, and assumes a handset average power of +28 dBm. The maximum signal level is then -25 dBm at the receiver input. This is equivalent to -14.6 dBFS peak.

There are several blocker signals detailed in the UMTS system specification. Only a specified amount of desensitization is allowed in the presence of these signals; the sensitivity specification is -115 dBm. The first of these is an adjacent channel 5 MHz away, at a level of -42 dBm. The level of the digitized signal is -11.6 dBFS peak. The DSP post-processing adds 51 dB rejection, so this signal is equivalent to an interferer at -93 dBm at the input of the receiver. The resulting sensitivity is -112.8 dBm.

The receiver must also contend with a -35 dBm interfering channel ≥10 MHz away. The IF rejection of the µModule receiver will attenuate it to an equivalent digitized signal level of -6.6 dBFS peak. With the DSP post-processing it amounts to -89.5 dBm at the receiver input and the resulting sensitivity is -109.2 dBm.

Out of band blockers must also be accommodated, but these are at the same level as the in-band blockers which have already been addressed.

In all of these cases, the typical input level for -1 dBFS of the LTM9004 is well above the maximum anticipated signal levels. Note that the crest factor for the modulated channels will be on the order of 10 to 12 dB, so the largest of these will reach a peak power of approximately -6.5 dBFS at the LTM9004 output.

The largest blocking signal is the -15 dBm CW tone ≥ 20 MHz beyond the receive band edges. The RF front end will offer 37 dB rejection of this tone, so it will appear at the input of the LTM9004 at -32 dBm. Here again, a signal at this level must not desensitize the baseband µModule receiver. The equivalent digitized level is only -41.6 dBFS peak, so there is no effect on sensitivity.

Another source of undesired signal power is leakage from the transmitter. Since this is an FDD application, the receiver described here will be coupled with a transmitter operating simultaneously. The transmitter output level is assumed to be ≤ +38 dBm, with a transmit to receive isolation of 95 dB. Leakage appearing at the LTM9004 input is then -31.5 dBm, offset from the receive signal by at least 130 MHz. The equivalent digitized level is only -76.6 dBFS peak, so there is no desensitization.

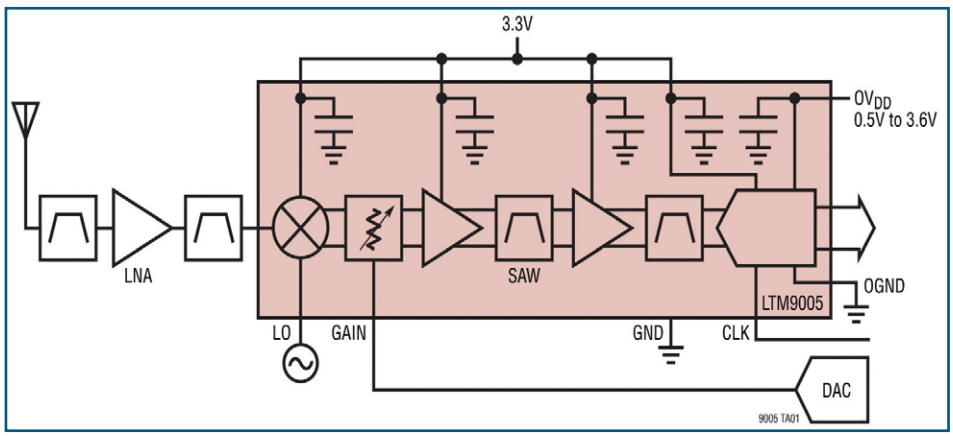
One challenge of direct conversion architectures is 2nd order linearity. Insufficient 2nd order linearity will allow any signal, wanted or unwanted, to create DC offset or pseudo-random noise at baseband. The blocking signals detailed above will then degrade sensitivity if this pseudo-random noise approaches the noise level of the receiver. The system specification allows for sensitivity degradation in the presence of these blockers in each case. Per the system specification, the -35 dBm blocking channel may degrade sensitivity to -105 dBm. As we have seen above, this blocker constitutes an interferer at -15 dBm at the receiver input. The 2nd order distortion produced by the LTM9004 input is about 16 dB below the thermal noise, and the resulting predicted sensitivity is -116.6 dBm.

The -15 dBm CW blocker will also give rise to a 2nd order product; in this case the product is a DC offset. DC offset is undesirable, as it reduces the maximum signal the A/D converter can process. The one sure way to alleviate the effects of DC offset is to ensure the 2nd order linearity of the baseband µModule receiver is high enough. The predicted DC offset due to this signal is < 1 mV at the input of the ADC.

Note that the transmitter leakage is not included in the system specification, so the sensitivity degradation due to this signal must be held to a minimum. The transmitter output level is assumed to be ≤ +38 dBm, with a transmit to receive isolation of 95 dB. The 2nd order distortion generated in the LTM9004 is such that the loss of sensitivity will be < 0.1 dB.

There is only one requirement for 3rd order linearity in the specification. In the presence of two interferers, the sensitivity must not degrade below -115 dBm. The interferers are a CW tone and a WCDMA channel at -48 dBm each. These will appear at the LTM9004 input at -28 dBm each. Their frequencies are such that they are 10 MHz and 20 MHz away from the desired channel, so the 3rd order intermodulation product falls at baseband. Here again, this product appears as pseudo-random noise and thus will reduce the signal to noise ratio. The 3rd order distortion produced in the LTM9004 is about 20 dB below the thermal noise floor, and the predicted sensitivity degradation is < 0.1 dB.

Figure 2: IF-sampling architecture implemented in the LTM9005 µModule receiver.



Design analysis – 140 MHz IF-sampling receiver

The LTM9005 is an IF-sampling receiver utilizing a downconverting mixer, IF amplifiers with a variable attenuator, a surface acoustic wave (SAW) filter and a 14-bit, 125 Msps ADC, as shown in Figure 2. The LTM9005-AB SAW filter has a center frequency at 140 MHz and a bandwidth of 20 MHz, allowing four WCDMA carriers. The LTM9005-AB can be used with a similar RF front end, as described above, to build a complete UMTS band uplink receiver. In this case, an appropriate front end should have a maximum RF gain of 14.5 dB.

Here are the typical key specifications for the LTM9005-AB:

- Signal input for -1 dBFS: -17.8 dBm
- Input noise level: -158 dBm/Hz
- IIP3
  - 2 tones inside IF: +17.7 dBm
  - 2 tones outside IF: +19 dBm
- P1dB, outside IF passband: +8.8 dBm
- Rejection outside IF passband: 40 dB

Typical input noise for the LTM9005-AB is -158 dBm/Hz. Given the noise of the RF front end, the predicted system sensitivity is -122.2 dBm at maximum RF gain.

The UMTS specification calls for a maximum co-channel interferer of -73 dBm. With the receiver set for maximum gain, the level reaching the µModule receiver input is then -58.5 dBm. Note that the crest factor for a modulated channel will be on the order of 10 to 12 dB, so this signal will reach a peak power of approximately -48.5 dBm at the µModule receiver input. This amounts to -31.7 dBFS at the ADC input.

With the RF AGC set for minimum gain and a handset average power of +28 dBm, the minimum path loss called out in the specification is 53 dB. The maximum signal level is then -25 dBm at the receiver input. This condition sets the maximum RF gain that can be placed before the µModule receiver. Assuming an RF AGC range of 20 dB, the signal level at the LTM9005-AB input is -30.5 dBm. Accounting for crest factor, this signal will reach a peak power of approximately -20.5 dBm at the µModule receiver input. This amounts to -3.7 dBFS at the ADC.

Consider the receiver set for maximum RF gain in the presence of blocker signals. Again, the sensitivity specification is -115 dBm. Note that once the received signal is digitized, additional bandpass filtering will be done using DSP. Assume a rejection factor of 20 dB for this operation.

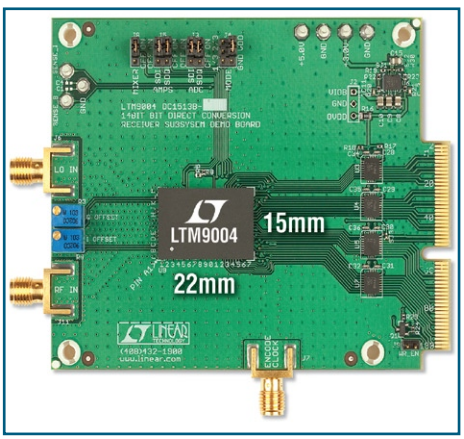
The first of these blockers is an adjacent channel at a level of -52 dBm. The IF rejection of the µModule receiver is 40 dB, and the DSP post-processing adds another 20 dB. This signal is thus equivalent to an interferer at -114.5 dBm at the input of the receiver; the level of the digitized signal is -50.7 dBFS. The resulting sensitivity is -122.2 dBm.

The receiver must also contend with a -40 dBm interfering channel ≥ 10 MHz away. Here again, the RF front end will offer no rejection of this channel, but the IF and DSP rejection of the µModule receiver will attenuate it to an equivalent level of -102.5 dBm at the receiver input. This amounts to a digitized signal level of -38.7 dBFS, and the resulting sensitivity is -119.8 dBm.

In all of these cases, the typical input level for -1 dBFS of the LTM9005-AB is well above the maximum anticipated blocker levels. Note that the resulting sensitivities are all within the -115 dBm specification.

Out-of-band blockers must also be accommodated, the largest of which is the -15 dBm CW tone ≥ 20 MHz beyond the receive band edges. The RF front end will offer about 37 dB rejection of this tone, and the IF filter will afford another 40 dB of attenuation. Accounting for the DSP rejection, this tone is then equivalent to -114.5 dBm. The resulting sensitivity is then -122.2 dBm, and the digitized signal level is -60.7 dBFS.

Figure 3: Actual demo board photo showing minimal external required circuitry.



The transmitter output level is assumed to be ≤ +38 dBm, with a transmit to receive isolation of 95 dB. The equivalent level at the receiver input, accounting for IF and DSP rejection, is then -119.5 dBm, or -55.7 dBFS. The resulting sensitivity is -122.2 dBm, which is also within the -115 dBm specification.

For 3rd order linearity, in the presence of two interferers, the sensitivity must not degrade below -115 dBm. The interferers are a CW tone and a WCDMA channel at -48 dBm each. These will appear at the LTM9005-AB input at -33.5 dBm each. Their frequencies are such that they are 10 MHz and 20 MHz away from the desired channel, so the 3rd order intermodulation product falls within the IF passband. Here again, this product appears as pseudo-random noise. Using the IIP3 appropriate for tones outside the passband, the predicted 3rd order product appears at -131.1 dBm. This is about 30 dB below the noise level and has no effect on sensitivity.

Conclusion

The LTM9004 and LTM9005 exhibit the high performance necessary for UMTS base station applications, yet offer the small size and integration necessary for very compact designs (see Figure 3). By utilizing SiP technology, the µModule receivers utilize components made on optimum processes (SiGe, CMOS) and passive filter elements.

Smartphones raise profile, prospects for analog/ mixed-signal ICs

By Tunç Doluca, Maxim Integrated Products, www.maxim.com

There has been a major shift in the cell phone market, with smartphones gaining prominence over feature phones in the past few years. The paradigm shift in phones has created market opportunities for other consumer products, such as e-readers and tablet computers.

E-commerce is driving additional market changes, as smartphones and other portable devices continue to evolve and as entire ecosystems grow up around them. In tandem with that evolution, power management ICs will progress and integrate more functions, yielding devices such as an audio codec with noise-canceling digital-signal processing, a microcontroller, more memory and system clocks.

Ultimately, the complete mixed-signal system-on-chip will mark the beginning of a new category of product—a Power SoC, perhaps. Such a chip, with an integrated microcontroller, will offer the flexibility (via firmware updates) to work across multiple platforms and device generations.

The smartphone paradigm shift has elevated the importance of high-performance analog and mixed-signal ICs while creating opportunities for suppliers of mixed-signal application solutions.

Even though smartphones are typically bigger than feature phones to accommodate the larger screens, they are often much thinner. In fact, the board size of today's smartphones is only 40 percent that of older feature phones. To produce slimmer-profile phones, pc boards can no longer be stacked on top of the battery pack.

Smartphones' multiple power-consuming functions—such as entertainment (gaming, videos and pictures), navigation and Web browsing—exacerbate the problem of constrained board space. That's because such functions require an even bigger battery pack, further reducing available room.

Furthermore, today's smartphones typically pack two major logic chips—the baseband controller and an applications processor for graphics, multimedia and other compute-intensive functions—plus several megabytes of memory and firmware. The rest of the phone often contains discrete components to handle all of the audio, battery and power management functions.

Smartphone makers must therefore find ways to meet the challenge of fitting more functions into smaller spaces.

The third socket

The only way to achieve this goal is to develop higher-integration devices. By integrating the required functions into a single chip that sits on the board (the "third socket"), developers can reduce parts count, save power and lower total system cost.

The industry is addressing the challenge through the development of high-integration power management chips that integrate all power, charging, interface and analog functions. Such chips require 40 percent less board area than the previous solutions.

These chips are more than just power management ICs. They are perhaps the beginning of a new category of device, one that fills the third socket in a cell phone or other portable platform. Indeed, the chips have to be flexible so that they can be used across multiple types of products (phones, e-readers, tablets and the like) for generations.

Looking forward, system designers should expect to encounter stricter power requirements as application processors move to faster clock speeds and as multicore processors require more power to satisfy consumers' application and content cravings.

That means battery capacity will continue to increase, creating more headaches. Currently, that capacity is up to 1,500 milliampere-hours, but I would not be surprised to see it rise to 2,000 mAh. (Tablets, in fact, are now at 4,000 mAh and beyond.) Charging higher-capacity batteries could take twice as long. And with a bigger battery, board constraints in smartphones will become a major dilemma.

Companies such as Maxim Integrated Products are addressing these problems by delivering high levels of integration to minimize board space, lower the total bill of materials and improve performance.

The author, Tunç Doluca is president and chief executive officer of Maxim Integrated Products (Sunnyvale, CA).

Measuring satellite end-to-end group delay using a microwave system analyzer

By Graham Stevens, Aeroflex Test Solutions, www. aeroflex.com

There is increasing demand for bandwidth on satellite systems, as with almost all telecoms systems, due to growing levels of Internet traffic, digital TV and other digital services being carried on these links. Consequently satellite operators are being forced to use all of the available bandwidth right up to the band edges, where signal quality can be degraded by components such as filters within the satellite transponder and the ground systems within the transmission path (Figure 1). Established satellite transponders are typically configured with channel bandwidths in the range 36 MHz to 72 MHz – depending on the particular satellite system – although it is not unusual for newer systems to be configured with bandwidths of several hundreds of megahertz.

The relative group delay measurement across the bandwidth of these transponder channels is important, in order to determine the amount of distortion or signal degradation that could take place due to increased delay changes at the band edges of these channels. The delay must be measured in order to apply accurate compensation and thus avoid possible data corruption.

To convey information without the risk of corruption requires a flat amplitude response and a linear phase response over the bandwidth of interest. Group delay flatness is a measure of the phase linearity and there are several techniques for measuring this. The two most common are direct phase and envelope delay (modulation delay). Most vector network analyzers traditionally use the direct phase method, and while these instruments offer high accuracy there are complications when characterizing frequency converting devices. A sophisticated microwave system analyzer overcomes these problems by using the receiver in the spectrum analyzer as a tuned scalar input and employing the envelope delay measurement technique.

The microwave system analyser (MSA)

A microwave system analyzer (MSA) is typically an instrument that combines a

Figure 1: To get the best performance out of a satellite link it is necessary to measure and accurately compensate for distortion caused by group delay at the band edges.

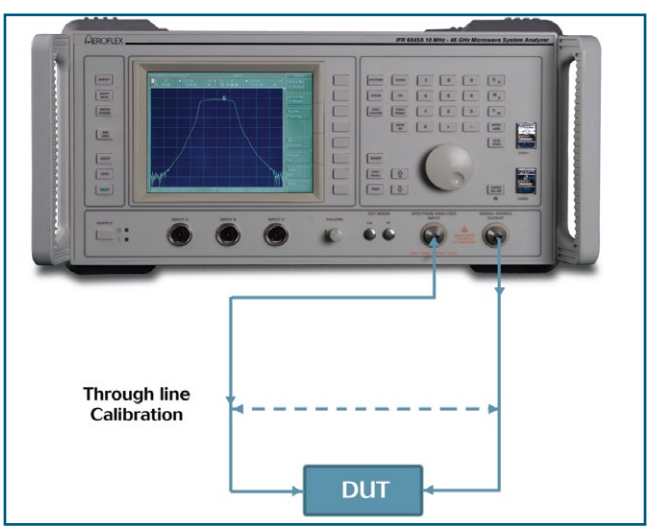


Figure 2: Through-line calibration of microwave system analyzer.

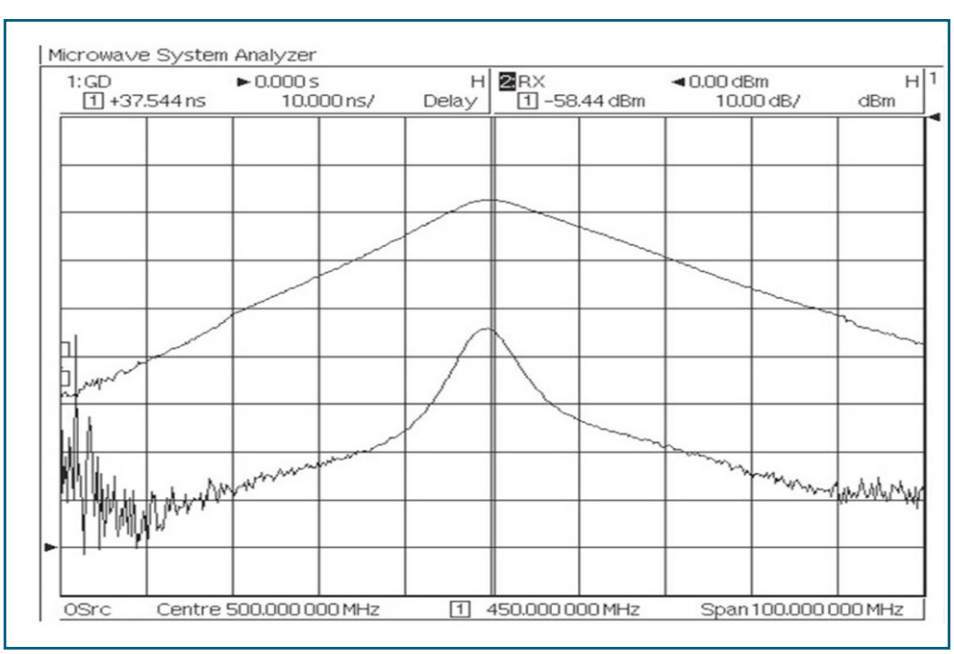


Figure 3: Amplitude and delay response of a downconverter.

spectrum analyzer with a synthesized source and scalar analyzer, with the addition of frequency modulation and envelope group delay options. This provides the capability to measure frequency converting devices and networks, and to perform group delay measurements on components and subsystems.

In the MSA the source and receiver can be made independent of each other, so that the stimulus can be set to operate at one frequency while the receiver receives at a different frequency. Because the group delay measurement is derived from the modulation envelope and the modulation is preserved through a frequency translation, direct characterization is possible without the need for access to local oscillators and the use of extra mixers and oscillators in the test set up.

Group delay measurement and calibration using an MSA

To measure group delay, the source is frequency modulated with a known low frequency and applied to the device under test (DUT). After passing through the DUT, the signal is demodulated and the phase of the recovered low frequency is compared with that of the original modulating signal to measure the group delay. The envelope delay is the average value of group delay over the modulated signal bandwidth. The bandwidth of the modulated signal is known as the measurement aperture and needs to be small in comparison with the group delay variations for accurate measurements. The upper limit of the absolute group delay measurement is plus or minus half the period of the modulation frequency then it 'wraps around' and repeats.

Calibrating out the delays inherent in the MSA can be performed very quickly using a simple through connection, as shown in Figure 2. This will present some compromise in accuracy when testing frequency translation devices but in most instances this compromise will not be an issue. If greater accuracy is required then this can be achieved by using a 'golden standard' technique, as described in the next section, where a well-characterized component is measured first and compared with the DUT.

Figure 3 shows a screen shot of the amplitude and delay response of a 2.2 GHz to 500 MHz down converter, on a MSA that had been calibrated by the through connection method.

Golden Standard calibration

In some cases, the through connection calibration described above may not give sufficient accuracy. The alternative is to use a 'golden standard' device with known or assumed delay performance to calibrate the instrument. A suitable golden standard device could be a well-matched broadband mixer with external LO. Another option is to use a modified DUT in which the group delay critical components (usually the filters) have been bypassed.

Converter LO accuracy and drift

The FM envelope delay method used by the Aeroflex 6840 MSA has the advantage that, unlike some VNA methods, it does not require access to the frequency converter LO. However, there are some requirements on LO accuracy.

The maximum resolution (aperture) bandwidth of the 6840 spectrum analyzer is fixed to 3 MHz for group delay measurements. When this resolution bandwidth and FM demodulator considerations are taken into account, this means that the MSA frequency offset must be set within ±500 kHz of the actual frequency offset for the measurement to be valid.

Frequency error causes the group delay response of the spectrum analyzer filters to be offset on the trace, which does not present a problem if only the flatness is of interest. However if the frequency stability of the converter LO is poor then this offset will drift up and down, which causes more difficulty. Although auto scaling may help in this case, the only real solution is to stabilize the converter LO. The magnitude of this effect has been measured as typically 0.1 ns change in group delay per 1 kHz frequency error.

Satellite in-orbit group delay

Testing group delay flatness on a test bench is fine for components that are relatively portable, but there are many instances where the device under test does not lend itself to this approach. A particular example is when the DUT is a complete satellite link, which clearly cannot be measured by a single instrument in a test lab. There are many reasons why satellite in-orbit testing needs to be carried out. It is generally performed following launch and prior to the release of the satellite to the customer, to verify the integrity of the communications payload and the antenna platform. Regular checks may also be carried out in service for the purpose of verifying performance or resolving anomalies.

Group delay over frequency, especially through frequency conversion, has proved a particularly difficult parameter to measure for satellite links. Figure 4 shows linear and parabolic group delays, which are typical of the types of delay experienced in satellite networks. Parabolic delay is usually associated with bandpass filters found in satellite transponders and communication equipment. The sinusoidal delays are often caused by impedance mismatches in the system. Ideally, the group delay should be flat – a straight line with no slope – so that all frequencies across the carrier bandwidth experience the same time lag through the link. If this is not achieved then there will be interference between the recovered digits, making them difficult to discriminate between and thus causing errors.

Measurement system

The Aeroflex satellite group delay test system uses two microwave system analyzers fitted with the Group Delay Option 22, coupled with a control PC and serial modems running dedicated software to obtain a relative group delay measurement across the entire link. The test system is configured to generate the test signal to be applied to the uplink, and to analyze the transponded signal received at the downlink to obtain the group delay variation and to perform in-band gain flatness measurements. The two systems are synchronized together across the frequency sweep.

The system can be used for the measurement of group delay and other transfer characteristics of satellite links from ground stations, either co-located or remote, through the in-orbit transponder. A set-up screen enables the selection of the input, output and/or conversion frequencies and levels.

Transit time

The transit time to and from a satellite can be considerable, even for one that is in low earth orbit. For a geostationary satellite it is typically around 250 ms. Because the source and receiver frequencies are synchronized, this can mean in practice that the receiver, which will have an aperture of around 1 MHz, will have moved beyond the received signal, making it necessary to further offset the source and receiver frequencies to compensate for the transit time.

This offset should be calculated as:

Foffset (MHz) =
Sweep (MHz/ms) * Transit time (ms)

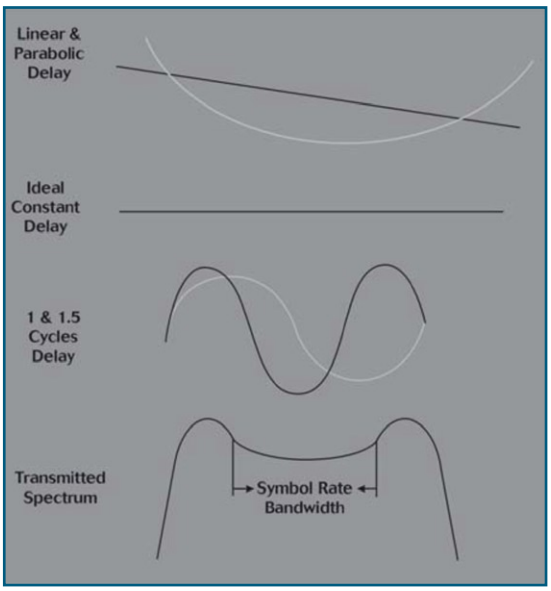
As an example, if the uplink (source) frequencies are 14 – 14.5 GHz and the downlink (receive) frequencies are 11.2 – 11.7 GHz, and the satellite is in a geostationary orbit, the MSA is set to a sweep time of 10 seconds and an aperture (resolution bandwidth) of 1 or 3 MHz.

Then if the transit time is 285 ms and the sweep rate is 0.05 MHz/ms,

Foffset = 14.25 MHz

To avoid generating a transmitter alarm, it is preferable for the source frequencies to remain unchanged (i.e. 14 - 14.5 GHz). The receiver should therefore be set to sweep between 11.18575 GHz and 11.68575 GHz. The instrument will display the receive frequency range, and the received frequency itself will be well within the resolution bandwidth. The predicted offset alone may not be sufficient, as geostationary satellites are not in fact stationary and will also have a Doppler component that needs to be taken into account. The Doppler shift varies throughout the day, on a cycle that repeats daily and reaches zero twice a day. The Doppler frequency is easily measured and the additional offset must then be applied. Failing to take Doppler shift into account may produce a slope on the group delay characteristic.

Figure 4: Group delay and the transmitted spectrum.



In-orbit measurement

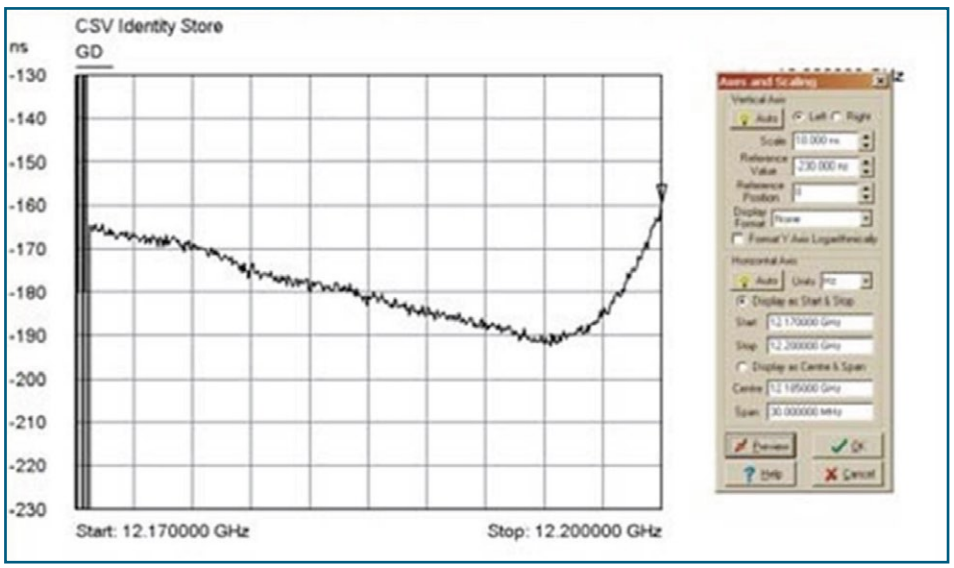
Figure 5 shows the measured group delay characteristic of a satellite in geostationary orbit measured through a single ground station. Input (uplink) frequencies are 14.47 - 14.5 GHz and the output (downlink) frequencies are 12.17 - 12.2 GHz. Calibration was carried out at the input frequencies – it is normal to calibrate at the source frequency rather than the receiver frequency to remove the delay changes inside the instrument through band switching and the frequency modulation hardware. The instrument calibration and performance of group delay measurements are the same as for the standalone measurement described earlier. In this case the sweep time was 10 s and the sweep rate was therefore 3 kHz/ms. The transit time offset is less than 1 MHz, so with an aperture of 3 MHz it can be ignored.

Remote ground stations

This group delay test can also be carried out across links where the ground stations are not co-located. The MSA acting as the source is co-located with the control PC running dedicated software at the main station of the link provider. The second MSA that acts as the receiver is installed at the receiving end, and this may be located anywhere in the world where the satellite has a transmission footprint. Using a control interface to the local MSA

and a serial connection via modems to the remote MSA, the instruments are configured to obtain a relative group delay measurement across the section of the link to be analyzed. The two instruments are synchronized across the frequency sweep using a local high stability frequency reference (typically rubidium) at either end of the system for accurate synchronization, and measurement data are returned from the remote MSA to the local PC for review and storage of the results. Either MSA can be configured as the source or the receiver so the transmission path can be tested in both directions without the need to move the equipment. If there are several receiving stations, it is possible to install a remote MSA at each station allowing measurements from all remote stations from one location.

Figure 5: Measured group delay characteristic of a satellite in geostationary orbit.



Conclusion

A test system for end-to-end measurement of a satellite communications system has been described, based on two microwave system analyzers fitted with dedicated group delay measurement capability and specialist software. The Aeroflex 6840 Series MSA covers all current and future satellite frequency band allocations up to 46 GHz.

The same system is also applicable for ground system evaluation and installation. The measurement of group delay allows distortion across the band to be compensated for, and thus ensures the integrity of the data that is transmitted across the link.

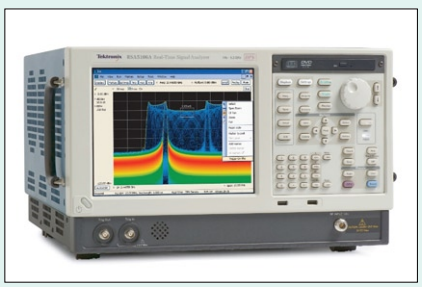
Mid-range signal analyser uncovers secrets of ISM band

Tektronix has expanded its spectrum and vector signal analysis offerings with the introduction of the RSA5000 series signal analyzer. Offering more than double the currently available acquisition bandwidth and real time capabilities, they target applications including spectrum management, radar, electronic warfare, radio communications and EMI/EMC.

As RF signals become increasingly complex and the use of ISM band technologies more ubiquitous, designers, engineers and operators must be able to reliably and efficiently discover transient spectral phenomena created by digital RF circuitry over increasingly wider operational bandwidths.

According to Tektronix, traditional signal analyzers are unable to trigger on transient problems and the maximum available acquisition bandwidth in the mid-range is just 40 MHz. Using time, amplitude, and DPX (Digital Phosphor Technology) trigger functions combined with swept DPX, the RSA5000 delivers discovery and capture of these intermittent and rapidly changing signals and up to 85 MHz bandwidth, covering the entire ISM band where common technologies are used, such as, Bluetooth, Zigbee, RFID, and Wireless LAN.

The DPX Live RF spectrum display of the RSA5000 series signal analyzer allows quick detection of previously unseen signal behaviour, and improves test confidence by catching very short duration transients missed by conventional spectrum analyzers. The Swept DPX engine can collect up to 292,000 spectrum updates per second over its full bandwidth, up to 85 MHz, and can sweep the DPX across the full input range of the RSA5000 Series, up to 6.2 GHz. DPX is capable of measuring spectral transients as brief as 5.8 µs.



To capture transients for analysis, the RSA5000 offers frequency mask, frequency-edge, density, time-qualified and runt triggers. It can also be used to isolate hard to find hardware and software anomalies with cross domain triggering between multiple instruments. It can capture a seamless time record of RF frequencies into deep memory for up to 7 seconds at 85 MHz bandwidth.

For faster troubleshooting, the RSA5000 series provides the ability to analyze captured data in any domain at any time with correlated markers. Automatic pulse measurement and detection helps to simplify and save test time by supporting multiple measurements on the same set of captured data.

This reduces the cost of test by providing a single versatile instrument that replaces multiple test sets. Along with wide bandwidth and DPX display, the RSA5000 series offers leading spectrum and vector signal analysis with +17 dBm TOI and -154 dBm/Hz DANL at 1 GHz along with superior low frequency performance with phase noise of -131 dBc/Hz at 10 kHz offset, -150 dBm DANL at 10 MHz carrier frequency.

www.tektronix.com

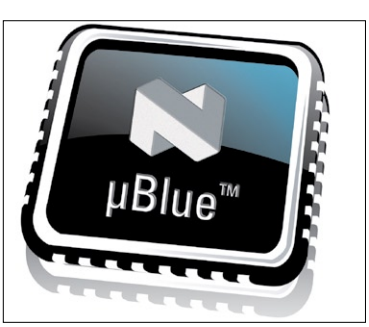
Low power chip fully qualified to Bluetooth Version 4.0

By delivering sub 12.5 mA peak currents and connected mode average currents as low as sub 12 µA (for 1 s connection intervals), the µBlue nRF8001 from Nordic Semiconductor ASA claims to be the industry's lowest power Bluetooth low energy solution. The device is the company's first chip in its latest µBlue Bluetooth low energy product line.

Complementing Nordic's existing ULP nRF24Lxx and ANT™ 2.4 GHz RF product lines with a complete and fully qualified Bluetooth Version 4.0 ("Bluetooth v4.0") low energy solution, the nRF8001 is a highly integrated wireless connectivity solution supplied in a compact 5- x 5-mm, 32-pin QFN package that when combined with its best-in-class low power consumption makes the device ideally suited to the typically space-constrained coin cell battery operated applications.

In addition, the nRF8001 integrates a DC/DC regulator that, if enabled, can further cut peak currents and average currents by up to 20 percent when running from a coin cell battery source. The nRF8001 is also the first fully qualified Bluetooth v4.0 low energy design to combine the Radio, Link Layer, and Host into one End Product Listing (EPL), enabling designers to easily create new Bluetooth end products without any additional listing fees.

The nRF8001 chip makes it as straightforward as possible for designers to add Bluetooth low energy wireless connectivity to existing applications by integrating a complete Bluetooth v4.0 low energy Radio, Link Layer, and Host stack supporting Peripheral ("slave") role operation, and featuring a simple serial interface supporting external microcontrollers of a designer's own choosing given the individual requirements of their application. The chip also integrates a unique low tolerance 32 kHz RC oscillator that eliminates the need for external 32 kHz crystals, a 16 MHz crystal oscillator



supporting low cost 16 MHz crystals, plus an on-chip linear voltage regulator that provides a supply range of 1.9 to 3.6 V as an alternative to its integrated DC/DC regulator.

The ULP consumption of µBlue does not come with a compromise on radio performance

www.nordicsemi.com

3G CMOS power amplifiers

improve reliability, data rate and cost

Black Sand Technologies has launched two 3G CMOS RF power amplifier (PA) product lines that significantly improve the reliability and data throughput of mobile phones, tablets and datacards. The product lines consist of six power amplifiers across multiple frequency bands.

The BST34 series of power amplifiers has been designed as a drop-in replacement for existing 3G GaAs RF PAs and, as such, are fully function and pin-compatible. Switching from GaAs to CMOS enables mobile device manufacturers to benefit from an improved supply chain, higher reliability, and lower cost.

The BST35 series, with its TrueDelivered™ high-performance power detector, improves total radiated power (TRP) performance by up to 2 dB, reducing the incidence of dropped calls and increasing the data rates in real-world operating environments. The BST3501 claims to be the industry's first chip to bring this functionality to the RF front end. The device's performance figures match or exceed those of GaAs power amplifier ICs for output power, linearity, efficiency and noise.

The BST34 and BST35 series are packaged in a 3- x 3-mm 10-pin form factor. The BST34 series products include an integrated directional coupler with daisy-chain support, integrated overvoltage and over-temperature protection circuitry. The BST35 products include Black Sand's TrueDelivered power detection technology and are robust to 100:1 VSWR, 10 times that of GaAs power amplifiers.

www.blacksand.com

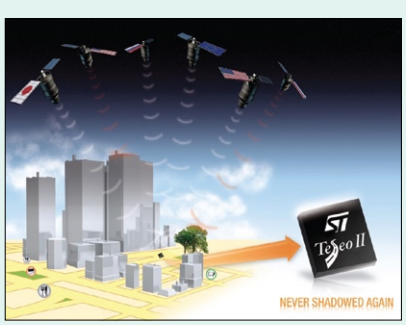
Single-chip positioning device for multiple global navigation systems including GPS, GALILEO, GLONASS and QZSS

STMicroelectronics has introduced Teseo II, a new generation of single-chip stand-alone positioning receivers for portable navigation devices, in-car navigation and telematics applications. These SoCs claim to be the industry's first monolithic devices capable of receiving signals from multiple satellite navigation systems, including GPS, GALILEO, GLONASS and QZSS.

The Teseo II family combines high positioning accuracy and indoor sensitivity performance with powerful processing capabilities and superior design flexibility. The ability of these positioning devices to acquire the position, velocity and time data from all major global navigation systems greatly improves the user position accuracy and navigation in poor satellite visibility conditions, such as in urban canyons.

Teseo II chips also offer exceptionally short signal-acquisition times (Time To First Fix), leveraging ST's own Self-Trained Assisted GPS™ technology, which improves the startup performance of a positioning device in difficult signal conditions.

In addition, the Teseo II family comprises automotive-grade product versions, designed to meet the specific and rigorous demands of the automotive market. These are qualified to AEC-Q100, a critical stress-test qualification for automotive integrated circuits, and manufactured using ST's rigorous automotive production flow methodology aimed at zero parts-per-million failure rate.



A stand-alone solution, the Teseo II positioning receiver integrates a powerful ARM9 core for on-chip data processing. Further increasing cost-effectiveness, the unique open-platform approach provides the ARM9 processing capability and a rich set of peripherals for flexible customer application designs. The peripherals include USB 2.0, CAN (Controller Area Network), A/D converter, I2C, MSP (Multi-channel Serial Port), UART (Universal Asynchronous Receiver-Transmitter) and general-purpose I/Os.

www.st.com

Patch antennas

meet Iridium compliance and testing requirements

Spectrum Advanced Specialty Products has announced that its patch antenna elements have successfully fulfilled Iridium Satellite Communications' "Iridium Compatible Equipment (ICE) Certification" requirements. This certification eliminates the need for re-certifying equipment when using the patch antennas according to Iridium's guidelines.

Currently, the PA25-1621-025SA and PA45-1621-1575SA patch antennas have achieved ICE Certification, however several of the company's antennas and assemblies are in the approval process and certification is expected in 2011. The company produces a range of antenna types, including aperture, slot, loops, spiral, planar, switched arrays, EBAs, beam-forming static, cavity backed and custom network/baluns for applications in the 400 MHz to 8 GHz range as well as high efficiency, high gain applications.

www.specemc.com

Cavity bandpass filter

handles outdoor 2.4 GHz WiFi installations

Anatech Electronics has introduced the Model Wifi2437-6A, a ruggedized, weatherproof cavity bandpass filter for outdoor WiFi installations that has excellent rejection, handles up to 40 W of RF input power, and is extremely selective.

The filter has a center frequency of 2437 MHz and a bandwidth of more than 30 MHz (2427 to 2447 MHz), along with maximum insertion loss of less than 2 dB and passband ripple of less than 0.2 dB. It has rejection of at least 60 dB at 2412 MHz and 2462 MHz and return loss of more than 18 dB.

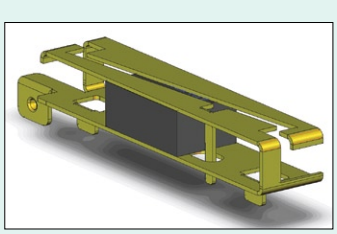
www.anatechelectronics.com

Ceramic patch antenna replacement

enables thinner GPS devices

Antenova has released the Acuta A10415 GPS antenna, a standard GPS antenna intended to replace the ceramic patch antenna in embedded GPS applications. Further, the antenna enables substantially thinner devices, without sacrificing performance, than the industry standard 12- x 12 mm ceramic patch antenna.

Acuta A10415 is a high performance standard GPS antenna which operates at 1575 MHz and is suitable for L1-band GPS and A-GPS systems. This slim 25.0- x 5.0- x 4.0-mm size standard GPS



antenna is intended for edge mounting by soldering directly onto the host PCB. Acuta is intended to be mounted on the edge of the host device PCB, facing the sky, which provides an optimal upward hemispherical right hand circular polarization (RHCP) radiation pattern.

Precision 7-16 DIN adapters

hold up to frequent torquing

Precision 7-16 DIN adapters from RF Precision Products hold up to frequent torquing. These low loss, low VSWR "rugged" adapters are highly desired in test applications such as base station passive intermodulation (PIM) testing and are designed to be used with portable antenna and cable analyzers.

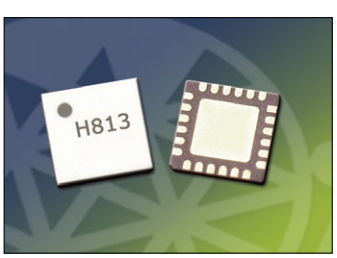
Anritsu's Site Master™, Summitek's SI™ series and Boonton's PIM testers are examples where high grade DIN adapters are used. Some features include stainless steel coupling nuts, white bronze plated bodies for tarnish free service, superior electrical performance and low PIM.

White bronze plating offers a non-magnetic solution while retaining high conductivity in the conductor paths. Engineered for long life in field applications, they are also suitable for lab environments. All 7-16 DIN adapters are machined to exacting specifications and stand up to the competition, surpassing expectation when compared to typical silver plated products.

www.rfp2.com

Wideband limited RF output SDLVAs

available in in chip and SMT formats



Hittite Microwave has launched two successive detection log video amplifiers (SDLVAs) with a limited RF output feature that operates over the 1 to 26 GHz and 1 to 20 GHz frequency ranges respectively. The HMC813 and the HMC813LC4B are ideal for designers with space and power-constrained applications including EW and ELINT receivers, DF radar, ECM, IFM systems, and missile guidance.

Available in die and ceramic 4- x 4-mm SMT formats, the SDLVAs feature power limiter circuitry at their RF outputs and carry a class 1 A ESD rating (250 V HBM). Also ideal for high speed channelized systems that require improved ESD performance, these SDLVAs employ a successive compression topology, which delivers a logging range of 55 dB and provides a nominal log video output slope of 15 mV/dB.

The HMC813 and the HMC813LC4B are capable of processing RF pulses with amplitudes from -53 dBm to +7 dBm with less than 10 ns rise/fall times, and with recovery times of less than 20 ns. These SDLVAs exhibit frequency flatness of better than ±1.5 dB at -25 dBm input power, while logarithmic linearity is better than ±0.5 dB over the full -55 °C to +85 °C operating temperature range. The devices consume less than 153 mA from a single +3.3 V supply.

www.hittite.com

Ultra stable TCXO

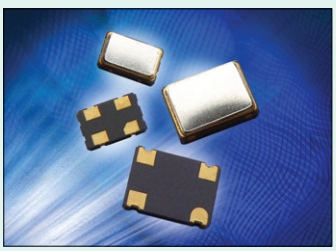
targets femtocells and base stations

Precision Devices has announced the TS05, an ultra stable temperature compensated crystal oscillator (TCXO) in a 5-mm by 3.2-mm by 1.5-mm package.

The TS05 provides stability of only ±0.2 ppm over an operating temperature range of -40 °C to +85 °C. When operating over a restricted temperature range of -10 °C to 70 °C, stability is even lower at ±0.1 ppm.

Stability is ±0.05 ppm for supply voltage variations up to 5 percent, and for load variations up to 10 percent. With aging, the maximum change is only ±0.5 ppm per year, to ensure reliable long-term performance.

The oscillator has excellent phase noise characteristics. At a frequency of 26 MHz,



typical phase noise figures are -117 dBc/Hz at an offset of 100 Hz, -138 dBc/Hz at an offset of 1 kHz and -152 dBc/Hz at an offset of 10 kHz.

Targeted at femtocell and base station applications, the TS05 covers the frequency range from 10 MHz to 52 MHz.

The oscillator operates from a 3 V supply voltage, and draws 2 mA current when generating a clipped sinewave output, and 4 mA when generating a CMOS squarewave output.

www.pdixtal.com

Compact 2-way power divider

offers high performance over 3.0 GHz to 45.0 GHz

Krytar has announced a 2-way power divider offering high performance over the broadband frequency range of 3.0 to 45.0 GHz in a single compact package.

Targeting broadband electronic warfare (EW) systems and complex switch-matrix applications, for example, the company used its proprietary design to produce a matched-line directional divider (MLDD) with ultra-high performance over the broadband frequency range of 3.0 to 45.0 GHz. Designated Model 6030450, it offers high-pass frequency response to attain low insertion loss and high isolation.

The company's technological advances has extended the frequency range of this 2-way

unit from 3.0 to 45.0 GHz with greater than 14 dB Isolation and ±0.50 dB amplitude tracking. The two-way divider exhibits insertion loss of less than 1.9 dB across the frequency range. Maximum Input VSWR is 1.9 and output is 1.99. Phase tracking is ±7 degrees. Model 6030450 is a compact package measuring 3.30- x 2.54 x 1.05-cm, weighs only 31.2 grams, and comes with 2.4-mm coaxial female connectors.

www.krytar.com

Postage stamp size radio module family

with ETSI-compliant units for European applications

Anaren has added two new members to its fast-growing line of Anaren Integrated Radio (AIR) modules. In order to meet operating demands and compliance requirements specific to the European market, the AIR line now includes ETSI-compliant models A1101R08A (embedded antenna) and A1101R08C (connectorized).

Like all AIR modules, these ETSI modules offer the simplicity, cost-savings, and fast time-to-market advantages of an all-in-one, plug and play radio — with no extensive RF experience required.

If used as specified, engineers can deploy these modules on board European-targeted end products without any additional EN 300 328, EN 300 440, or EN 300 489 testing required. AIR modules arrive ETSI compliant right on the reel.

These 'plug and play' RF modules – each with a footprint being smaller than a postage stamp – find applications in industrial control, building automation, and low-power sensor networks, through to lighting and equipment and appliances intended for inclusion in smart-grid scenarios (such as automated meter reading).

www.anaren.com

Low poser GPS chip

enables standalone GPS unit with 7- x 8-mm footprint

Designed for small, low-power, low cost applications, u-blox' latest GPS single-chip UBX-G6010-NT delivers the industry-leading positioning performance of u-blox 6 technology in a micro-miniature package measuring only 5- x 6- x 1.1-mm. Its high-level of integration means a complete, stand-alone GPS system design can now fit on a PCB area smaller than the size of a thumbtack. The chip requires no external host.

The UBX-G6010-NT provides high sensitivity, down to -162 dBm or -148 dBm during coldstart, and fast acquisition times. Sophisticated RF-architecture and interference suppression ensures maximum performance even in GPS-hostile environments.

The chip minimizes PCB area to less than 7- x 8-mm for a complete standalone GPS

receiver. With most passive components integrated, the total system BOM requires as few as 5 external components including SAW filter and TCXO. An LDO and LNA are integrated and costly external memory is not needed. Lower price GPS crystals as well as TCXOs are supported.

A 2-layer PCB integration capability and small footprint ensures further cost savings.

Designed for low power consumption, the chip includes breakthrough intelligent power management to support low-power applications. The chip operates from -40° C to 85° C.

www.u-blox.com

CALENDAR

2011 Mobile World Congress
14th - 17th February 2011
Fira de Barcelona
Barcelona, Spain
www.mobileworldcongress.com

Embedded World 2011
1st - 3rd March 2011
Nuremberg, Germany
www.embedded-world.de

IWCE 2011
7th - 11th March 2011
Las Vegas Convention Center
Las Vegas, Nevada
USA
www.iwceexpo.com

Satellite 2011
14th - 17th March 2011
Walter E. Washington Convention Center
Washington DC
USA
www.satellitetoday.com/satellite2011

DATE 2011
14h - 18th March 2011
Alpexpo Espace Alpes Congres
Grenoble, France
www.date-conference.com

EMV 2011
15th - 17th March 2011
International Congress Center
Stuttgart, Germany
www.mesago.de/en/EMV/home.htm

International CTIA Wireless
21st - 24th March 2011
Orange County Convention Center
Orlando, Florida, USA
www.ctiawireless.com/events/future.cfm

Smart Systems Integration 2011
22nd - 23rd March 2011
Hilton-Dresden, Germany
www.mesago.de/en/SSI/home.htm

ARMMS RF & Microwave Society Conference
4th - 5th April 2011
Milton Hill House
Oxfordshire, UK
www.armms.org

WAMICON 2011 — IEEE Wireless and Microwave Technology (WAMI) Conference
18th - 19th April 2011
Hilton Clearwater Beach Resort
Clearwater, Florida, USA
www.wamicon.org

European Wireless 2011
27th - 29th April 2011
Vienna University of Technology
Austria
www.ew2011.org

LTE World Summit 2011
17th - 19th May 2011
Amsterdam RAI
The Netherlands
http://ws.lteconference.com

LIDAR & RADAR 2011
26th - 29th May 2011
Hohai University
Nanjing, China
www.lidar2011.org

International Microwave Symposium 2011 (IMS 2011)
5th - 10th June 2011
Baltimore Convention Center
Baltimore, Maryland
USA
www.ims2011.org

Wireless Technologies 2011
27th - 28th September 2011
Schwabenlandhalle
Stuttgart-Fellbach
Germany
www.mesago.de/en/wireless/0

European Microwave Week 2011
9th - 14th October 2011
Manchester Central
Manchester, UK
www.eumweek.com

Productronica 2011
15th - 18th November 2011
New Munich Trade Fair, Munich
Germany
http://productronica.com

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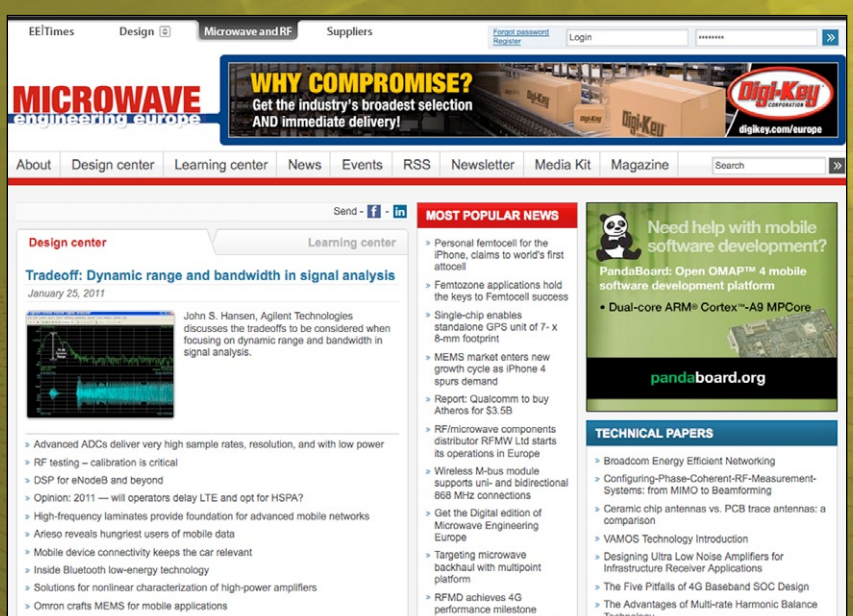

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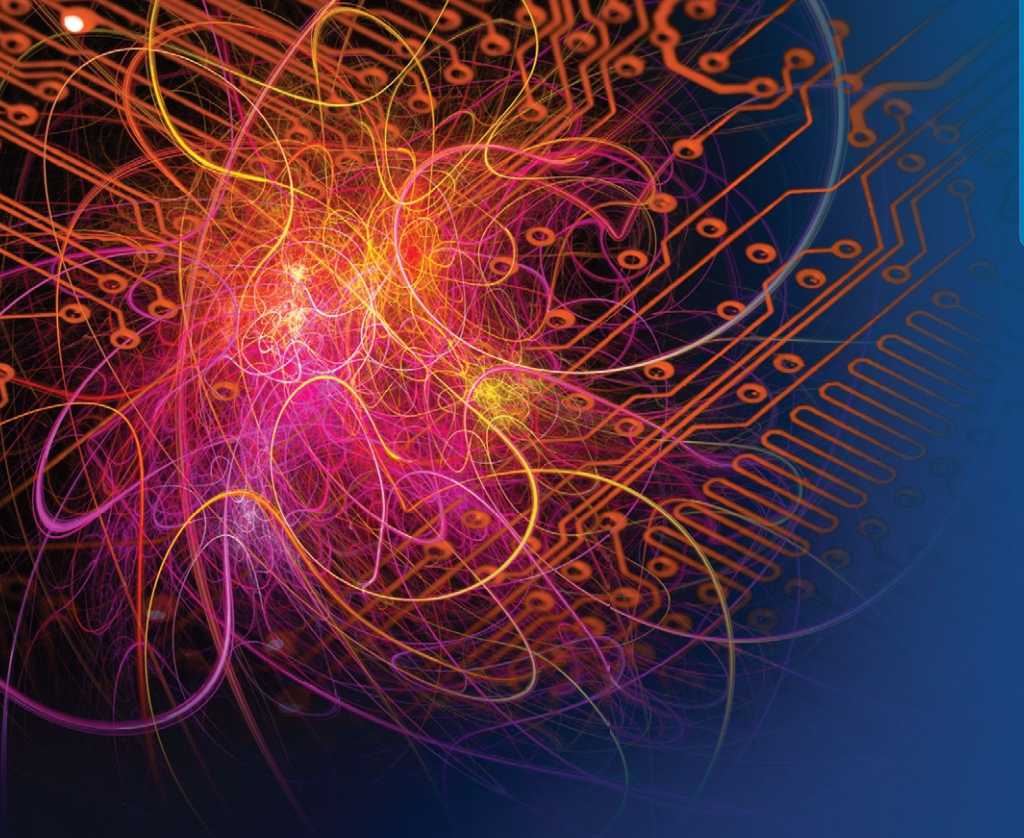

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