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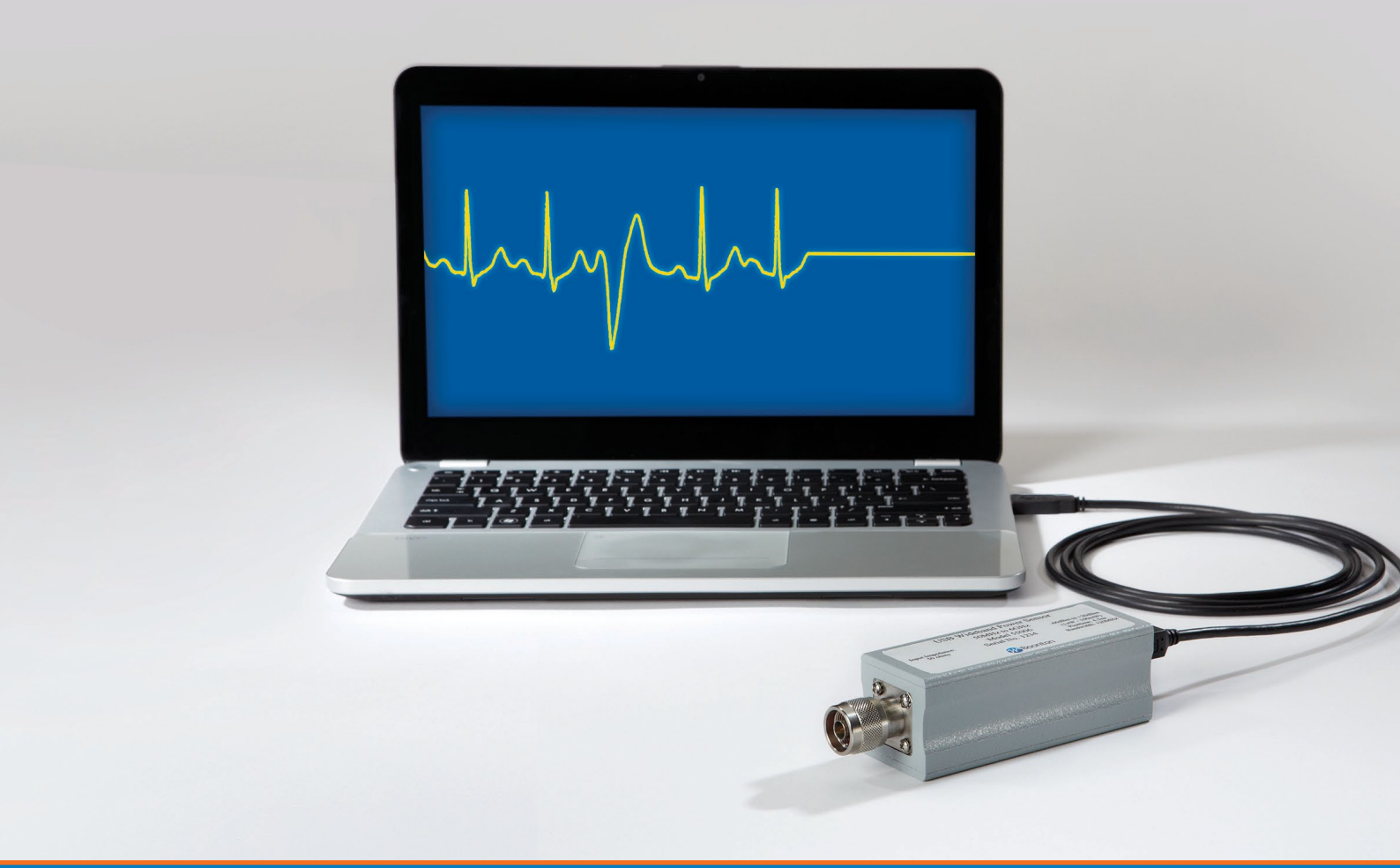

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If a car is really 'autonomous,' why V2X?

For most consumers, self-driving cars are still stuff of the future, despite Google's popular driverless car demo and its breathless coverage in some of the media's more gullible precincts. Many of us may not live long enough to be driven in one of those.

In contrast, for the automotive industry, the future of autonomous cars is real, urgent, and significant. For this technology, the industry's undivided attention, engineering efforts, and smart decisions are needed today, not 10 years from now.

The question splitting the automotive industry now is what level of V2X services — including both communication between vehicles, V2V (vehicle to vehicle) services, and V2I (vehicle to infrastructure) services — are necessary before the future of fully autonomous cars becomes reality.

In other words, as the Advanced Driver Assistance System (ADAS) used in smart cars further improves, and cellular services such as LTE proliferate, do autonomous cars even need to wait for the elusive V2X future?

Speaking of the lengthy regulatory process necessary to get the mandate done ("a minimum of eight years") and the time it takes ("15 to 20 years") to actually put a sufficient proportion of cars on the road to realize the V2X dream, Roger Lanctot, associate director of Strategy Analytics, bluntly told me, "Bottom line, this is really not going to happen."

What changed?

Several forces, currently at work, might dramatically change the original V2X concept from the blueprint initially drawn up by the automotive industry and government bureaucrats years ago.

First, the biggest force sweeping the automotive industry today is the smartphone. "Back in 2007, when Japan originally mapped out the V2I plan, we've never imagined the proliferation of smartphones in this magnitude," observed a spokesman of ITS Japan in a recent interview with EE Times in Tokyo.

There's also the Google factor. Google currently runs its semi-autonomous vehicles with no V2X support. "On-board LIDAR/RADAR/ camera technology is not V2X," stressed Ian Riches, Strategy Analytics' director responsible for global automotive practice. "The vehicle is not communicating with anything, but rather directly sensing its environment independently of every other vehicle and the infrastructure."

A third factor is the cost to deploy V2X. Juniper Research's Anthony Cox, in his blog posted earlier this year, wrote: For V2X to really work it needs to be wide-scale and it is only truly effective if the take-up level is high (some suggest over 97%). To date there is little indication of how quickly this will happen but, for sure, it must be a long way off. Getting V2X technology into vehicles will be the biggest challenge. While it is possible that it could be mandated that new vehicles should be furnished with V2X technology, the challenge on how V2X should be installed in existing vehicles will remain for many years to come.

Fourth, there are too many other technologies available now, beyond Dedicated Short Range Communication (DSRC) tech operating at the 5.9 GHz frequency based on 802.11p, whose mandate in a future car for V2V communication is being considered in the United States.

Strategy Analytics' Lanctot noted, there are "too many alternative paths to delivering comparable performance [to V2X] from sensor-based, telecom-based or WiFi-based technologies."

Lanctot added, "Most important likely and emerging alternatives are LTE Advanced — which includes proximity communication between modules not requiring tower-only communication — WiFi Direct, and both embedded modems and smartphone-based technologies." Further, "executives at both GM and Qualcomm have proposed handset deployment of DSRC technology, which may even enable pedestrian detection, though DSRC purists scoff at this."

The very notion of integrating DSRC into smartphones is interesting. It could even bypass the quandary of how to retrofit cars without DSRC.

Strategy Analytics' Riches told EE Times, "The smartphone is becoming ubiquitous amongst vehicle owners. When is the last time you took a drive without one?" He contends that leveraging the LTE platform could lead to a much more rapid rollout of V2X capabilities across the fleet.

Of course, there are critics who are worried about LTE's latency issues. Riches, while conceding the point, noted, "They may have a point for some

highly time-critical situations — but these are the ones that are often better served with on-board sensors."

Big mistake

Perhaps, one of the biggest mistakes the United States is making in its vision for the future of V2X is the conspicuous absence of US mobile operators in the debate, according to Egil Juliussen, HIS Automotive's principal analyst responsible for infotainment and ADAS. He pointed out that cellular operators are natural partners for V2X, because their cell towers can integrate V2I. Without leveraging the cellular infrastructure to integrate V2I, V2X will be a much more expensive proposition. In contrast, he told us, in Europe, the mobile industry has been actively participating in V2X trials.

Riches, pointing out that most government and big-industry developments are avoiding LTE, said, "That could be a big mistake."

He elaborated: "If certain vehicle functions are only available when the car is connected via some form of V2X, then those functions can only take off when there is a significant proportion of the road network and/or fleet that supports those technologies. It's building a new network from scratch."

How the industry will deal with V2X's lack of scalability remains unknown. "It's a bit crazy," Riches added, "and no one has really explained to me who is going to pay for it all."

Meanwhile, Japan, which has gone ahead with building ITS (Intelligent Transportation System) spot services infrastructure, appears to be going through a major rethinking of its strategy.

By Junko Yoshida
EE Times

UltraCMOS® antenna switch in Samsung Galaxy S4 smartphone

Peregrine Semiconductor Corporation has announced that it supplies the main antenna switch driving RF performance in the Samsung Galaxy S4 LTE-Advanced (LTE-A) smartphone.

The PE421280 MultiSwitch was selected for its ability to support simultaneous multi-band operation of up to 14 frequency bands while delivering exceptional linearity, insertion loss performance and small size.

The Samsung Galaxy S4 is touted as the first-ever implementation on the 4G LTE-A network. The LTE-A protocol uses carrier aggregation — or the simultaneous reception of multiple frequency bands – to improve data throughput. According to Samsung, a three-minute download over 4G LTE would only take about one minute on 4G LTE-A.

Peregrine's PE421280 antenna switch features an innovative combination of two SP7T switches in a single IC to support 14 different frequency bands including simultaneous multi-band operation. With HaRP™ technology enhancements, the PE421280 delivers high linearity with an IIP3 of +75 dBm, as well as extremely low insertion loss (0.35 dB at 900 MHz; and 0.45 at 1900 MHz) and high isolation (38 dB at 698-2170 MHz; and 33 dB at 2500-2690 MHz). The switch also features industry-leading 2fo and 3fo for LTE of less than -80 dBm at 700 MHz. High linearity and isolation performance are critical to ensure that radio signals don't spill into other bands during multi-band operation.

www.psemi.com

Skyworks targets GPS/GNSS LNA FEMs in emerging markets

Skyworks Solutions has announced that its highly integrated, low noise amplifier (LNA) front-end modules (FEMs) are being leveraged by various OEMs to enable global positioning systems (GPS) and global navigation satellite systems (GNSS) in smartphones, tablets and other mobile devices in emerging markets.

The modules offer high linearity, excellent gain and an integrated filter. These devices are also the first semiconductors to support China's BeiDou navigation satellite system (BDS), China's second-generation system that is enabling GPS in consumer platforms in addition to other public safety applications such as transportation systems, water conservancy, forest-fire prevention and disaster relief.

According to Frost & Sullivan, there will be an increasing prominence of Position, Navigation and Timing (PNT) data derived from GNSS and associated Value Added Services (VAS) in the next 10 to 20 years. In their Market Insight report entitled "Global Navigation Satellite System Market Assessment – In Pursuit of New Business Opportunities," they predict that Asia Pacific will continue to represent the fastest growing region through 2021, with the market more than doubling in 10 years from $29 billion to over $74 billion by 2021.

The SKY65709-81 is a front-end module (FEM) with an integrated low noise amplifier and pre-filter designed for the BDS, GPS, GNSS and Galileo receiver applications. Fabricated using advanced silicon technology, the device features high linearity, excellent 14.5 dB gain, a high 1 dB input compression point and a superior 2 dB noise figure. With minimal external components, the embedded pre-filter provides low in-band insertion loss and excellent rejection of the cellular, personal communication system and wireless local area network frequency bands. It also uses surface mount technology in the form of a small form factor, 6-pin, 1.7 x 2.3 millimeter multi-chip module package, allowing for a highly manufacturable and low-cost solution.

www.skyworksinc.com

AT&T to maintain lead in cellular M2M in the US

New analysis of the United States M2M market by ABI Research finds AT&T is expected to maintain its leadership position in total cellular M2M connections over the next 5 years even though it plans to shut down its 2G network by 2017.

Practice director Dan Shey comments, "Several factors contribute to AT&T's current and expected leadership position in M2M connections. First, it has a dominant position in certain verticals that are expected to grow, several which prefer GSM because of its worldwide presence. Second, it has built competencies in M2M services further up the stack which expand its appeal to a broader set of customers. Finally, as demonstrated by its recent win of the GM OnStar contract, it's doing a better job selling a vision for key market segments which is exciting OEMs and businesses."

www.abiresearch.com

Alcatel-Lucent to supply ultra-broadband 4G LTE to Telefonica in Spain

Alcatel-Lucent has reached an agreement with Telefónica, to become a reference supplier for its 4G LTE network in Spain, in a 4G LTE project that is among the largest in Western Europe.

Telefónica Spain selected Alcatel-Lucent to deliver a 4G LTE network overlay, deploying some 8,000 4G LTE base stations and the 5620 Service Aware Manager (5620 SAM). Alcatel-Lucent will also deliver installation and turnkey project management services in the initial phase of the project, as well as systems integration, maintenance and configuration optimization.

The agreement follows two successful pre-commercial 4G LTE pilot networks in Madrid and Barcelona and the demonstration of Alcatel-Lucent's 4G LTE capabilities over a live network- consisting of small 'metro cells' and macro base stations — with Telefónica in Barcelona at Mobile World Congress 2012. The deployment complements Telefónica Spain's existing ultra-broadband fiber network with the capacity to meet customers' data needs today and into the future.

www.alcatel-lucent.com

Nujira selects ASE for packaging and test of handset ET chip

Nujira Ltd has selected ASE as the company's production packaging and test partner for its Coolteq.L family of High Accuracy Tracking ET ICs.

With ET technology set to be adopted across the LTE smartphone industry in 2013, Nujira is ramping its Coolteq.L family to volume production. Nujira is addressing the demanding supply chain requirements of its customers, which include several household names in the handset industry, by partnering with industry leading manufacturing services companies such as ASE. Providing flexibility and superior customer support, ASE enables Nujira to achieve its packaging and test objectives to high standards quickly and effectively.

Nujira selected ASE's flip-chip Wafer-Level Chip Scale Packaging (WL-CSP) to meet the stringent performance requirements for its Coolteq.L ET chips, which deliver the highest bandwidth, fastest slew rates, and lowest output impedance available in the market.

Patrick McNamee, VP of Silicon Operations, Nujira commented: "Moving into volume production is a huge step for the company, so it is absolutely critical that we select world-class supply chain partners to ensure every step of the process runs smoothly, and support the rapid volume ramps expected by our customers."

www.nujira.com

Next generation hotspot Wi-Fi to raech $150 billion by 2018

The Wireless Broadband Alliance (WBA) has announced the findings of its Next Generation Hotspot (NGH) business model report conducted with research firm Senza Fili.

Interest in this technology has been fueled by the world's largest operators and vendors recently completing a number of advanced trials of NGH which led to the introduction of critical features such as seamless authentication; automatic network detection selection, adoption and secure access. This will ultimately give users easier access to a far greater number of public Wi-Fi access points around the world, without the need for usernames and passwords.

With an increasing number of sophisticated and data hungry mobile devices now available on the market, operators have been forced to address the capacity conundrum and Wi-Fi has proven to be the silver bullet. However, there is a need to move beyond legacy hotspot Wi-Fi and upgrade to NGH that today boasts secure authentication and automatic service discovery and selection, and will soon include online signup and policy support. However, what are the ROI benefits that operators can expect when they take the plunge and deploy this type of network?

Key findings include:

- A higher proportion of data traffic carried by NGH Wi-Fi leads to lower per-bit costs. Mobile operators can reduce their per-bit RAN costs by 18% when they carry 20% of their traffic through NGH Wi-Fi.
- The combination of Wi-Fi and cellular small cells brings additional cost savings and higher profitability. The per-bit cost in a network with NGH Wi-Fi and 4G small cells may be 38% of those of a 3G macro network.
- The ability of NGH Wi-Fi to drive more traffic than legacy Wi-Fi from the same infrastructure results in lower per-bit costs for NGH Wi-Fi over legacy Wi-Fi. If the traffic in a legacy network is 25% of that in an NGH Wi-Fi network, the overall per-bit costs will grow by 18%.
- Based on the potential cost savings and operator commitments, it is forecasted that NGH Wi-Fi to account for 9% of global mobile traffic and reach $150 billion USD in operator revenue by 2018.

www.wifiglobalcongress.com

LTE software developer mimoOn closes series B investment round

A leading developer of LTE software for small cells and terminals, mimoOn GmbH, has closed a Series B investment round.

Participants are the existing investors, the management team and a new tranche of investors including the German Start-Up Group as well as private investors. The funds will be used to expand sales and support activities and accelerate product development for next the next generation of LTE technology.

"mimoOn's LTE product portfolio is unparalleled. No other developer has the breadth and depth of products for both terminal and small cell product developers," says Dr. Claas Heise, responsible for Technology and Innovations Investments at NRW.BANK in Düsseldorf, Germany.

www.mimoon.de

Micrel acquires Discera to expands clock, timing and MEMs products

Micrel, Inc., has signed a definitive agreement to acquire the business of Discera Inc., a leading provider of silicon timing solutions.

The acquisition is intended to complement Micrel's high performance clock and timing products, as well as expand its MEMS (micro-electrical mechanical systems) capabilities. The transaction is expected to close in September of 2013..

Discera has been on the forefront of MEMS resonator development, creating a disruptive technology in the timing space. Discera's PureSilicon™ oscillators and Crystal-less™ clock generators provide a variety of significant benefits to timing customers, including system-wide cost effective solutions, enhanced ruggedness, space savings, and excellent stability over a wide temperature range.

With this addition, along with our PhaseLink acquisition and our recently released ClockWorks™ Flex and Fusion products, Micrel plans to be a one-stop shop for our customers' high-performance clock and timing needs," noted Ray Zinn, Chairman and CEO, Micrel.

www.micrel.com

Largest open source RF network deployed for million-person event

Lime Microsystems has announced the largest open source RF base station technology has been successfully deployed by Event Connection and Fairwaves to ramp up the communication networks during one of the world's largest annual music festivals.

This citywide network covered almost 60 square kilometres and is the world's largest deployment of an open source GSM network and highlights the reliability and potential of open source RF technology.

The four-day Walk of the World festival sees over 1-million people descend each July on the ancient Dutch city of Nijmegen. The influx of people regularly overloads the city's commercial networks.

By using an open source network based on field programmable RF technology, the event support firm Event Connection were able to deploy a citywide network using unlicensed GSM spectra. This ensured emergency services, security staff and event teams had access to GSM networks even when commercial networks overstretched to cope with the traffic.

To add the capacity, Event Connection and Fairwaves deployed a small scale GSM network that connected with traditional phone networks via VoIP. The network was based on Fairwaves' UmSITE base station, which runs Osmocom open-source software and UmTRX open-source hardware.

To supply the frequency band flexibility required for such a deployment, the network also uses field programmable RF transceivers from Lime Microsystems as part of the UmTRX hardware.

www.limemicro.com

4G envelope tracking PA claims record with 40 MHz bandwidth

Nujira Ltd has successfully demonstrated in its latest lab tests that it is able to support 40 MHz channel bandwidths for 4G LTE-Advanced signals, using its NCT-L1300 ET modulator IC and a commercially available handset RF power amplifier.

Enabled by Nujira's leading ET technology, it is the first time that an ET system has delivered 40 MHz bandwidth, while meeting stringent regulatory compliance standards.

The results used the Carrier Aggregation feature of the LTE-Advanced specification to transmit a 200 Resource Block LTE waveform — the highest bandwidth currently specified (CA Class C), corresponding to an instantaneous data rate of approximately 150 Mbps.

Performance was measured at 27 dBm at the PA output, corresponding to 23 dBm at the antenna, the maximum power permitted for LTE terminals. Error Vector Magnitude (EVM) of 3% and Adjacent Channel Leakage Ratio of -35 dBc were achieved using Nujira's patented ISOGAIN® ET Linearization technique, giving comfortable margin over regulatory requirements without relying on Digital PreDistortion or other modem assistance techniques.

Achieving the full bandwidth is important, as it is always preferable for the handset to transmit data at the highest data rate for as short a time as possible, to maximize network capacity and to save energy. Transmitting the same amount of data over a 20 MHz channel, rather than 40 MHz, would take twice as long and use almost twice as much power.

Field trial data from LTE networks has shown that high bandwidth transmissions from the handset can represent more than 50% of the energy consumed by the RF front end.

www.nujira.com

ANT+ integrated in Samsung GALAXY Note 3

ANT Wireless has confirmed that native ANT+ has been included in Samsung's latest flagship product, Samsung GALAXY Note 3.

This integration brings the proven and reliable ANT+ functionality to the Samsung product and their dedicated applications, allowing consumers to experience the practical creativity and breadth of ANT+.

The Samsung GALAXY Note 3 is the first to deploy the ANT concurrency feature – uniquely available to ANT in Android - which makes it possible for consumers to utilize a variety of third party ANT apps all at the same time. Additionally, the ANT protocol (the basis of the ANT+ interoperability standard), features extensive and flexible network topologies also suited for home and process automation such as lighting control.

www.thisisant.com/directory

Microwave transmission revenue grew 13 percent in Q2 2013

According to the latest report by Dell'Oro Group the point-to-point Microwave Transmission equipment market grew 13 percent in the second quarter 2013.

"The microwave market turned in its highest growth rate since the second quarter 2012 but nevertheless fell short of historical revenue levels as use of microwave systems for mobile backhaul remained low," said Jimmy Yu, Vice President of Microwave Transmission research at Dell'Oro Group. "We do, however, anticipate that this sub-billion dollar market trend will reverse during the remainder of the year as mobile operators drive their LTE network expansion into additional geographic regions where using microwave systems will be preferred over laying additional fiber," Yu added.

In the second quarter 2013, four vendors comprised more than two thirds of the microwave equipment market at nearly 70 percent. Huawei managed to capture the most market share in the second quarter by growing its revenue 41 percent sequentially; the highest growth rate among the top four vendors.

www.DellOro.com

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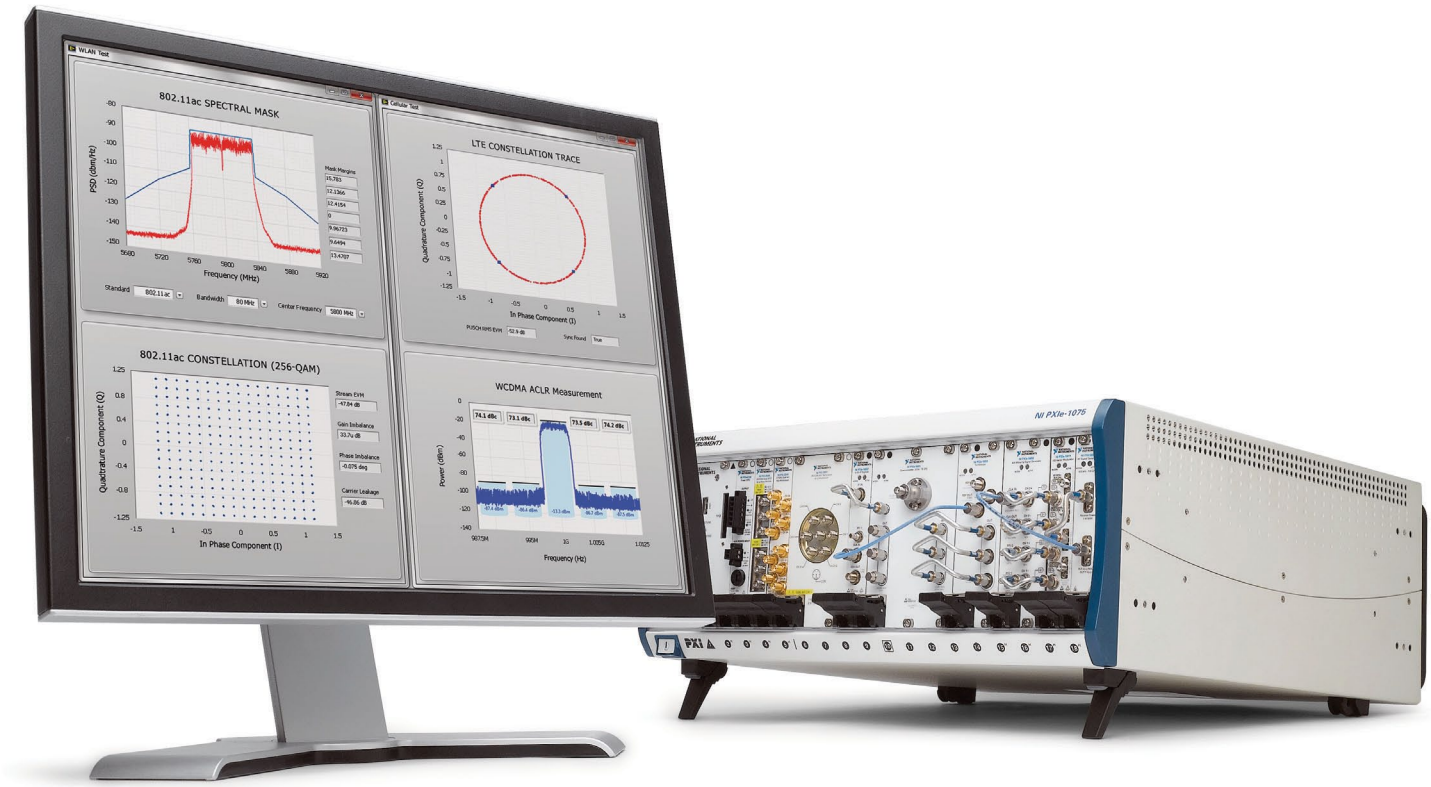

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High-integration silicon-on-sapphire MMICs optimise active antennas

By Peter Bacon and Duncan Pilgrim, Peregrine Semiconductor Corporation

Silicon devices fabricated in standard CMOS processes deliver performance at RF and microwave frequencies far beyond what was thought possible only a few years ago. In every sector of electronic technology where CMOS is applied, perhaps the most significant contribution the technology has to offer is high level of integration; active antenna arrays, the subject of this article, are no exception.

Active antenna arrays are an increasingly common feature of many high-RF and microwave-frequency systems, including satellite communications, radar and point-to-point high-capacity links. The fundamentals of their operation are simple to grasp; rather than setting the characteristics of an antenna by its physical shape (e.g. a parabolic dish) the array antenna achieves beam-forming (for example) by combining the signals radiated (or received, the usual reciprocal relationship applies) by an array of antenna elements, usually mounted side-by-side in a single plane. Progressively adjusting the phase and amplitude of the signal across such an array enhances the response in wanted directions, and nulls it off-axis.

A long-established way of achieving this is the passive beam-forming array, wherein a single signal source and power amplifier feeds some form of splitter with phase-shifting facility in each antenna element path. With complex waveguide and YIG-based components, not the least drawback of those systems is that the end-to-end path is far from lossless. The active array also uses a single signal source, but transmit PA stages and receiver front-ends are replicated at each element – together with the key phase-shift/delay functions and others such as calibration and both analogue and digital control. High levels of integration, such as are enabled by Peregrine Semiconductor's UltraCMOS® technology lead to this approach showing benefits in accuracy, efficiency, thermal parameters, reliability and ruggedness, and maintainability. RF power is distributed over the array rather than being generated in a single PA, bringing it within the capabilities of a MMIC. Having the PA physically immediately adjacent to the antenna virtually eliminates the path that accounts for greatest losses in a passive system. Per-element power level is often less than 5 W depending upon the specific array requirements and the total number of elements. Additionally, the ability to run at a higher duty cycle due to the distributed thermal load and higher reliability of a solid state solution enables an even greater peak power reduction for an active array while not compromising total system performance compared to an equivalent passive approach.

Once again, in the receive path the lower loss per element and the non-correlated noise contribution of each element improve total noise performance of the active array. The reduced loss of the interconnect from the antenna to the LNA translates directly into a 1-2 dB SNR improvement for the array. Processing of coherent signals received is enhanced because of the non-coherent noise contribution coming from each individual element. For radar applications in particular, coherent integration across multiple radar pulses, such as with synthetic aperture radar (SAR), can also be used to further reduce external noise interference and clutter effects.

With an active array having a distributed, semiconductor-based transmitter within a Tx/Rx module, minimal set up time is required for the individual, lower power transmit amplifiers. Warm-up time is eliminated and the transmit function of the array can be activated and ready for operation within a few micro-seconds. The total average system power of the distributed approach is reduced, typically by half compared to a passive array implementation, as a result of the power savings achieved due to the lower insertion loss between the antenna and transmitter.

Underlying technology

The high transmit power and low receive levels characteristic of active antenna systems have traditionally required the use of exotic compound semiconductor process technologies for the active devices within the transmitter and receiver. In most cases some type of III-V semiconductor device, or even tube-based devices such as a high-power Klystron amplifier have been used. These processes and devices are limited in the amount of integration and control that can be implemented, and they often lack the manufacturing robustness and cost structure that mainstream silicon CMOS technologies can achieve.

Substrate	tan δ @ 10 GHz	ε_r
GaAs	0.0016	13.1
Si	0.015	11.9
Alumina 99.5%	0.0003	9.6
Sapphire	0.0001	9.4

Table 1: Loss tangents and relative dielectric constants for common semiconductor and microwave substrates.

UltraCMOS technology is fabricated by a completely standard CMOS process, in a silicon layer grown on a nearly-perfectly insulating sapphire (Al_2O_3) substrate (SoS, silicon-on-sapphire). This makes the process ideal for developing high-performance integrated RF solutions as it combines the integration, reliability and consistency of a high-volume CMOS process with the high-performance RF capabilities a highly insulating substrate enables. Table 1 lists key substrate parameters for common semiconductor substrates used today.

Using sapphire as the substrate material also precludes the generation of secondary non-linear effects commonly associated with bulk and high-resistivity silicon substrates. As the modulation complexity for communication active arrays continues to increase, so does the need for an ever-more linear RF channel. Eliminating unnecessary, secondary sources of non-linearity helps assure the most efficient and linear channel is provided.

In UltraCMOS, active device F_T and F_{max} metrics exceeding 40 GHz and 96 GHz, respectively, permit integra-

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tion of efficient driver amplifiers, general purpose gain blocks, and IF strips. Combined with a high-performance RF switch R_{on}*C_{off} metric of less than 200 fsec, and the ability to scale voltage handling to address up to 50 W power handling, UltraCMOS provides a robust technology platform for implementing the majority of high-performance RF and microwave circuitry needed for active array transmit/receive elements.

Maximum operating frequencies continue to increase, and as UltraCMOS technology follows the established CMOS scaling curve, peak performance and frequency of operation both increase. Existing 250 nm process nodes are supporting high power and extremely linear performance well into the 20-30 GHz frequency range. Table 2 shows the insertion loss and isolation levels across this range for two different SPDT switches developed on UltraCMOS.

Integration of multiple RF functions into fully integrated transmit and receive chains is one benefit supported by UltraCMOS technology. Further integration is possible and is beneficial to more complex arrays that use dual polarized elements or that perform some form of simultaneous transmit/simultaneous receive (STSR). These more complex arrangements often need multiple transmit and receive paths per antenna element. Therefore, integration of multiple RF paths within a single die is often required to simply meet the space requirements dictated by the element spacing. In addition, further RF integration will leverage the digital and analog overhead support functions, such as a serial interface or band gap voltage generator, that are commonly required for any discrete die to function and communicate.

Beamforming

Flexibility in beamforming is at the heart of an active array antenna architecture. Whether it is analog or digital beamforming, both applications leverage the spatial agility of the active antenna array compared to fixed or rotating antennas. Digital beamforming adds even more flexibility and signal complexity as multiple beams can be addressed, each having potentially unique waveforms for radar applications or complex modulation schemes for communications platforms.

The accuracy of the beamforming is critical to maintaining antenna gain and side lobe suppression, and overall beam efficiency. To support the ever increasing data rate demands of communication markets, active antenna arrays need RMS phase and amplitude accuracies less than 3° and 0.5 dB respectively. Without this level of accuracy, side lobe suppression degrades causing more power to be lost in the side lobes while also, for cellular applications, increasing the potential for site-to-site co-interference.

To support accuracy requirements, UltraCMOS technology can be used to produce integrated solutions offering repeatability and greater levels of resolution than have been thus far achievable. For example, phase shifters are in development that exhibit less than 1.0° RMS phase error while also achieving better than 0.2 dB RMS amplitude error. These results are due to a combination of design accuracy, having a stable and manufacturable semiconductor process, and increased levels of integration. The combination of 8-bit resolution and a spare optimization bit support very fine phase resolution while permitting further optimization over sub-bands. Figure 1 depicts the performance of an S-band phase shifter over its entire, primary band of interest along with the improved performance over sub-bands. Improvement in amplitude error is also achieved when performance is optimized over a smaller sub-band.

Similarly, broadband digital step attenuators having up to 7-bits of resolution with the LSB (least significant bit) equating to 0.25 dB have been provided

	>2W SPDT		>0.5W SPDT	
	IL (dB)	Isol (dB)	IL (dB)	Isol (dB)
20 GHz	1.5	25	1.6	20
30 GHz	-	-	2.3	15

Table 2: Basic SPDT measured insertion loss and isolation performance.

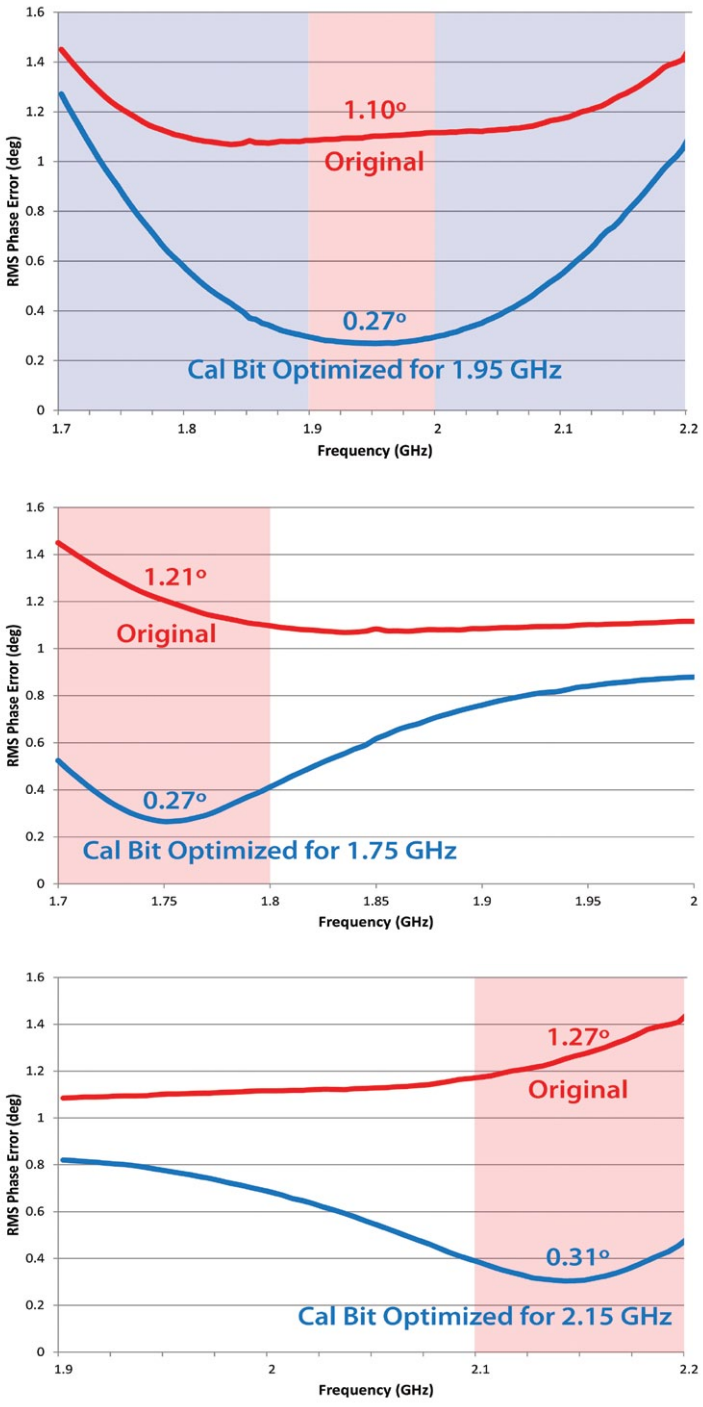

Figure 1a (top): Full bandwidth, 8-bit performance and sub-band optimized performance for (b)(middle) 1.75 GHz and (c)(bottom) 2.15 GHz

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by Peregrine Semiconductor to multiple markets. Coupled with the phase and amplitude accuracy, both phase shifters and attenuators exhibit high linearity as measured by second and third-order intermodulation products. Figure 2 shows the typical IP3 linearity performance for L & S band phase shifters and a 7-bit attenuator.

Reliability

The reliability of the active antenna is also significantly improved as it has no single point of failure in the RF channel and a graceful degradation in performance occurs if one of the elements fails. Should one element fail in an active antenna array, the expected impact is minimal and can be largely compensated for by modifying the array programming, such as element amplitude tapering across the array.

As noted, the MMIC at each individual element is generating a much lower RF power level, and for that reason alone the overall reliability of these elements is improved. The total thermal power to be dissipated is spread over a larger area – the breadth of the array – largely eliminating localised areas of large temperature rise. Overall, power management is generally less of an issue and thermal management can be achieved with a reduced overall size and weight compared to passive architectures. These factors have greater importance for airborne and space-deployed systems where both reliability and overall weight and size become more dominant factors in the overall mission and system life cycle.

A fully integrated core chip solution made possible by the high-linearity performance of UltraCMOS technology eliminates the numerous interconnects common to traditional implementations further enhancing system reliability. Assembly costs and yields are also improved, and increased complexity is made possible by not having to go on/off chip to access segregated RF, digital, and analog functionality.

The manufacturing volume and demonstrated repeatability of the UltraCMOS technology also helps to improve reliability by minimizing the required manufacturing tolerances. A silicon-fabrication process with tightly-controlled production spread – which is a characteristic of UltraCMOS – leads directly to lower manufacturing cost and complexity. The reduced manufacturing guard band results in more margin remaining with the RF performance budget.

Array calibration and maintenance

A significant challenge facing array-based antennas is calibration and maintenance. The manufacturing variation accumulated within each Tx/Rx element, particularly those based upon III-V compound semiconductors, requires that the array be calibrated to address the resulting element phase and amplitude variation. This calibration effort is a very test-intensive activity that can readily escalate to requiring millions of unique element level test states in an array having a thousand elements.

When a high level of integration can be deployed, and with Peregrine's UltraCMOS technology in particular, additional functions can be "wrapped around" the signal chain: for example, high-performance RF circuitry, such as phase and power detectors, along with logic for control and EEPROM to store element specific information. Self-calibration then becomes possible and phase and amplitude offsets can be stored in non-volatile memory for both transmit and receive paths.

Array maintenance is also a challenge as elements do, periodically, fail. Although the active antenna array is more robust and degrades gracefully as individual elements fail, at some point the array needs to be repopulated. Replacement Tx/Rx modules already calibrated against a common reference, and preprogrammed to address their individual variability, can be held in readiness. As such a unit is nearly identical to the original element being replaced, the array can be back in operation much faster than if than if a full element-by-element calibration needs to be done.

Figure 3 depicts a system architecture supporting self-calibration at the element level. Either in an autonomous, closed loop fashion, or in conjunction with an automated test system, phase and amplitude information is gathered, processed, and stored to provide information at the element level about its phase and magnitude offsets with respect to a standardized value. System

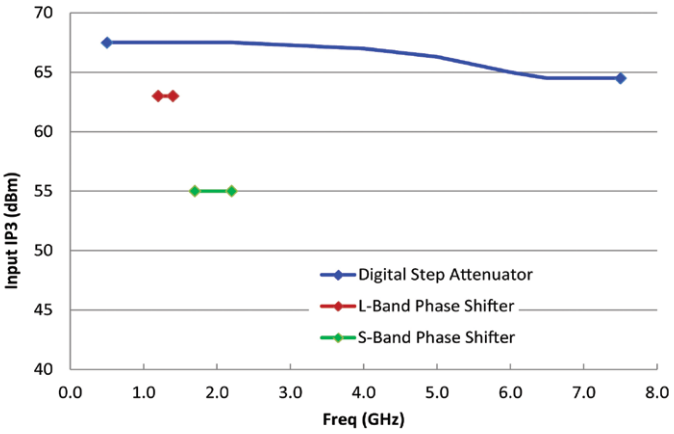


Figure 2: 8-bit Phase Shifter and 7-bit Attenuator 3rd order intermodulation intercept point (IIP3).

Phase # of Bits	Phase States (P)	Amplitude # of Bits	Amplitude States (A)	Temperature Points (T)	Array # of Elements (N)	Total Test States (P*A*T*N*)
5	32	5	32	3	1000	3,072,000

Table 3: Total array test states is dependent upon array size, phase and amplitude resolution.

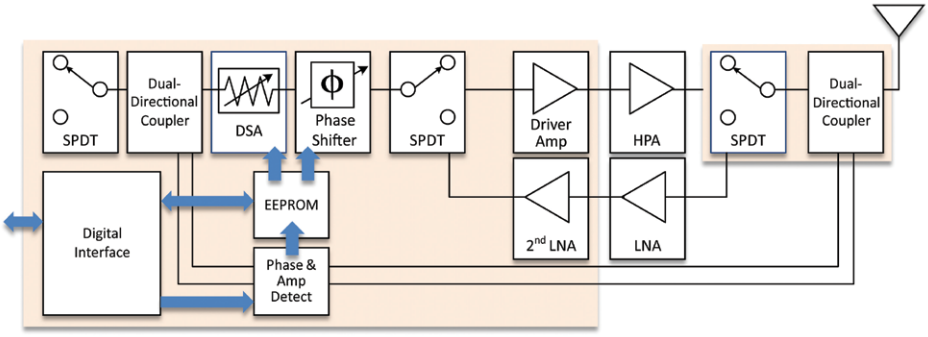


Figure 3: Functional diagram depicting integrated self-calibration

programming can either read-back this information, or simply let the element compensate the programmed phase and amplitude internally.

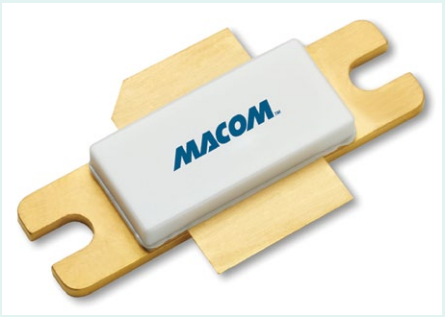
Conclusion

Active array antennas continue to gain acceptance in both radar and communications applications. Advantages leveraged include graceful degradation, significantly reduced and distributed transmit power levels at each element, and improved size, weight, and power efficiencies compared to passive array architectures.

Element and array level performance can be enhanced by employing mainstream CMOS technologies targeted for high frequency and high performance requirements. Peregrine's UltraCMOS technology, a patented Silicon-on-Sapphire technology, has demonstrated this level of RF performance coupled with integration levels common to CMOS-based technologies.

Peter Bacon is the Director of Systems Engineering, and Duncan Pilgrim is the Director of Strategic Marketing at Peregrine Semiconductor Corporation —www.psemi.com.

600-W GaN on SiC pulsed power transistor



M/A-COM Technology Solutions have announced a ceramic GaN on SiC HEMT power transistor for avionics applications.

The MAGX-001090-600L00 is a gold-metalized, matched GaN on Silicon Carbide, RF power transistor optimized for pulsed avionics applications, such as secondary surveillance radar in air traffic control systems. It provides 600 W of output power with a typical 21.4 dB of gain and 63% efficiency. The device has very low thermal resistance of 0.05 °C/W and best-in-class load mismatch tolerance of 5:1. In addition, the device has the lowest pulse droop of 0.2 dB and also can be used effectively under more demanding Mode-S ELM operating conditions.

The company's GaN transistor technology has been fully qualified with accelerated, high-temperature lifetime tests and this device has a predicted MTTF of over 600 years at a maximum junction temperature of 200 °C. The device also boasts very high breakdown voltages, which provides customers with reliable and stable operation even in extreme load mismatch conditions.

Typical performance parameters include 1030-1090 MHz frequency, Pout of 600-W, Vd of 50 V, power gain of 21.4 dB, drain efficiency of 63 %, pulse/duty of 32/2 µs/%, pulse droop of 0.2 dB, VSWR of 5:1, Rth of 0.05 °C/W, and MTTF of 5.2 x 10E6.

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Tackling EMC noise challenges for LTE applications

By Masaki Nakas, Application Engineer, Murata Manufacturing Company

As the adoption of smartphones and tablets grows, so does the need for higher speed wireless communications. Leading the need for data speed are online games and the ability to stream media across the wireless communications networks to our phones. As consumers, we all have experienced poor network speeds and long latency periods. Phone network providers view this lucrative service provision as a priority and are continuing to invest heavily in the necessary infrastructure. In turn, increasing the data rates requires a far more efficient approach to managing the available spectrum in order to maximize both the speed and numbers of users simultaneously downloading data. Equally, the need to decrease latency is as important as increasing the transfer speed. Many operators already view the current 2G and 3G networks as approaching their transfer speed limits and are looking to future technologies to maintain the necessary and continued growth in data rates.

Initially introduced in 2010, Long Term Evolution or LTE, promises to deliver higher transfer speeds and much lower latency than 3G today. LTE is in the process of being of rolled-out across cellular networks around the world. With speeds at least 4x faster than the fastest HSPA+ 3G networks today, and a fifth of the latency rate, LTE looks set for a promising future.

However, as the data rates increase, so does the potential for EMC noise radiated from the cellular phone to impact overall performance. For an LTE-based cellular phone to achieve its desired performance criteria it is necessary to carefully understand the sources of EMC and reduce them. This article will examine the causes of EMC noise within a phone, and the steps engineers need to take to reduce them.

Let us look at some of the factors that create noise within a LTE phone compared to a conventional 3G phone in use today. One of the first points to consider is that it is necessary to be able to deal with noise over a wide band of frequencies. Cellular handset manufacturers are keen to develop a single design that can be satisfy the telecommunication regulations of individual country and regional requirements. LTE will be deployed across many bands from 700 MHz to up to 2.6 GHz. It is also highly likely it will be use across other frequency bands, particularly as available spectrum continues to be at a premium. Any EMC noise reduction techniques will need to be effective across a wide bandwidth of frequencies so that an LTE device can be used worldwide.

In order to maximize available signal strengths, and accommodating multiple signal paths, the use of a multiple-input, multiple-output (MIMO) antenna is likely to be used in a LTE-based handset. This approach, using multiple antennas differs from a conventional wireless communication approach where a single antenna is used to receive signals. Care needs to be taken that in implementing noise reduction technologies that each antenna needs to be catered for.

To illustrate this article let us take investigate a test case. Figure 2 shows a test set up for a phone to measure the coupling noise from the antennas. A LTE smartphone using Band 13 (700MHz band) was used for testing purposes. An investigation was carried out as shown in Figure 2 with the line to the antennas cut off and a coaxial cable connected to the antenna side instead. Also, the coaxial cable was connected to the spectrum analyzer via the signal amplifier to look into noise coupling to the antennas.

The results of measurement showed the wideband noise coupled to both the main and sub antennas, as shown in Figure 3. It seems that this noise impairs the signal-to-noise (S/N) ratio of received signals, affecting the integrity of communication. Next, an examination of the noise source mentioned above showed high-level noise on the data lines of the flexible cable that connects between the LCD screen and the main substrate. Also, in order to

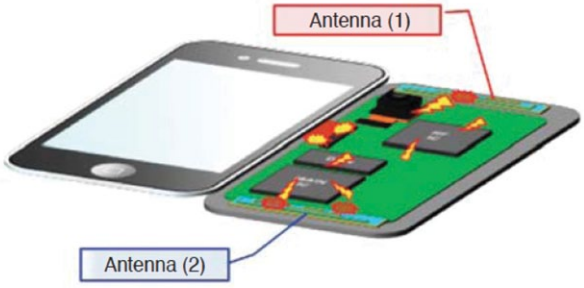

Figure 1: Phone using MIMO antennas.

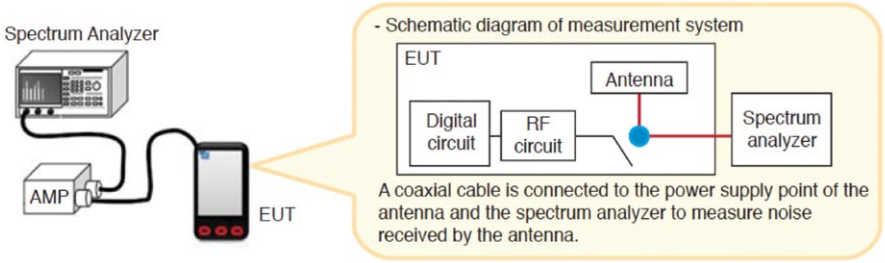

Figure 2: Overview of the system for measuring coupling noise for the antennas.

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determine whether this conducted noise is the same as the coupling noise for the antennas, the time variation of the noises was examined.

As a result, it was found that the noises had the same period, as shown in Figure 4. These results led to the conclusion that the data lines of the LCD are the noise source that affects the integrity of communication.

Having identified the source of the noise, a solution was then investigated to achieve suppression of noise on the data lines. A Murata combined LC noise suppression filter, part number NFA18SL227V1A45, was inserted into the data lines from the host to the LCD. This part has a nominal cut-off frequency of 220 MHz with a rated current of 25 mA and voltage of 10 VDC. The reason for selecting this filter is that they can significantly reduce noise while minimizing the effects on signal waveforms. If another frequency band is taken into consideration, other parts that are effective in eliminating noise over a wide bandwidth need to be selected.

Following the insertion of the noise suppression filter, the antenna coupling noise was re-examining. Tests revealed that in both the main and sub antennas, the use of noise suppression filters reduced the noise close to the noise floor. It was also found that the local magnetic field strength was also reduced considerably by the noise suppression filters. Moreover, it was determined that there are no problems in the integrity of waveforms. Finally, data before and after the implementation of the noise solution are compared to see how the integrity of communication in LTE was improved.

Figure 5 shows the results of over-the-air (OTA) measurement of the throughput and the minimum receiver sensitivity. The measurement system used a reverberation chamber in order to examine the integrity of communication using MIMO. The results of the measurement show that both the minimum receiver sensitivity and the throughput were improved significantly.

Using this approach, the integrity of communication can be improved by inserting an appropriate number of EMC solution components in the right locations to reduce noise.

This example solution demonstrates that a solution to noise is essential in order to improve the communication integrity, and the important point of the solution is to use an EMC solution component in an appropriate location. It can be considered that also in other bands, noise can be reduced by selecting a filter that is effective in eliminating noise over a wide bandwidth, like the EMC solution component used in this example, enabling the integrity of communication to be improved.

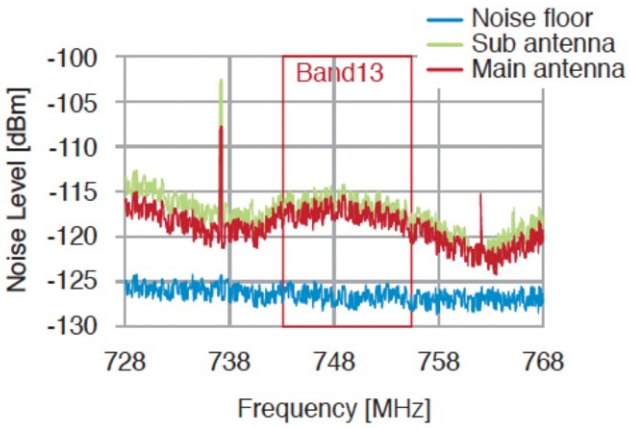

Figure 3: Measurement of coupling noise for the antenna.

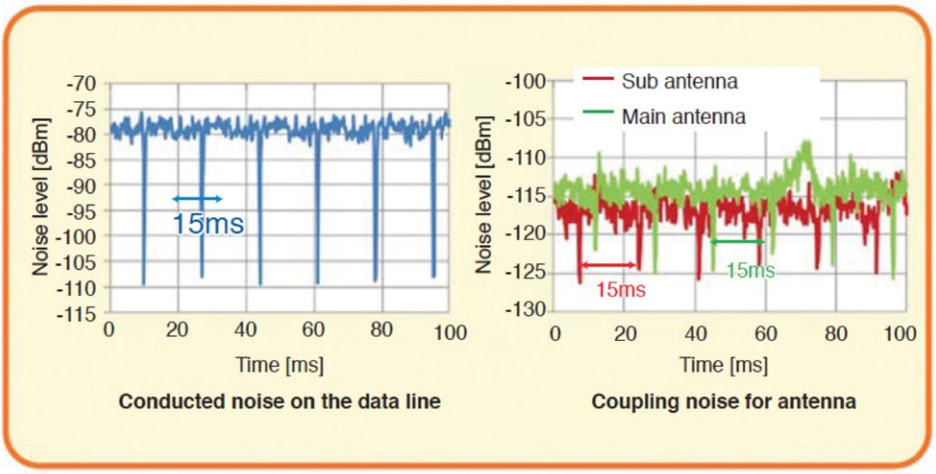

Figure 4: Results of investigation into time variation of noise.

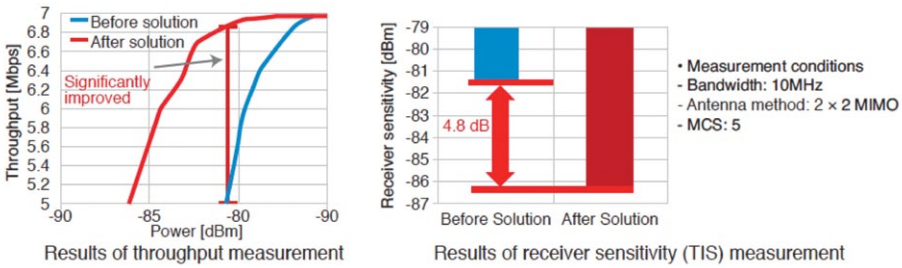

Figure 5: Improvement in communication integrity though noise reduction.

Accelerate verification of algorithm IP in wireless and video processing systems

By Ken Karnofsky, Senior Strategist for Signal Processing Applications, MathWorks

Verification of algorithm-intensive systems is a long, costly process. Studies show that the majority of flaws in embedded systems are introduced at the specification stage, but are not detected until late in the development process. These flaws are the dominant cause of project delays and a major contributor to engineering costs.

It doesn't have to be this way. Many designers of algorithm-intensive systems already have the tools they need to get verification under control. Engineers can use these same tools to build system models that help them find and correct problems earlier in the development process. This can not only reduce verification time, but also improves the performance of their designs. In this article, we'll explain three practical approaches to early verification that make this possible.

First, let's examine why the current algorithm IP verification process is inefficient and error-prone. Algorithm IP can differentiate systems with communications, audio, video, imaging, and navigation functions. Unlike off-the-shelf IP components, algorithm IP is a company's "secret sauce", is inherently application-specific, and requires a different approach to verification.

In a typical workflow, designs start with algorithm developers, who pass the design to hardware and software teams using specification documents. (Figure 1)

Each team typically crafts its own test procedures to determine that the implementation is functionally correct. These test procedures are often constructed in an ad-hoc fashion, and they rely on the engineer's interpretation of the specifications. This is a problem because hardware and software engineers often lack the application domain knowledge or tools to correctly interpret and implement the specifications. Conversely, algorithm developers may lack the tools and expertise to ensure that they have identified all of the "real-world" requirements. They often discover late in the development process that algorithms don't work as intended in the target environment.

Compounding this inefficiency is the use of separate tools and workflows for software, digital, and RF/analog hardware components, which inhibits cross-domain verification of system behavior. This can lead to unexpected hardware and software interactions. As a result, system verification does not occur until the end of the workflow, at the system integration phase, when design changes are most difficult and expensive to make.

Because most errors are introduced at the specification stage, conventional hardware, software, and ESL tools cannot solve these problems; conventional tools assume that the requirements have been adequately and accurately captured in the specification. The verification problem must be tackled at the beginning of the process and by connecting algorithm and behavioral modeling with the downstream workflows.

Early verification with model-based design

Model-Based Design offers a better approach. It provides a set of tools for algorithm design, system simulation and prototyping, and rigorous analysis. Using these tools, the algorithms and tests are designed as part of a behavioral system model. This system model serves as the basis of an executable specification that all design teams can use as a design reference and test bench. This approach gives all the design teams—including the algorithm, system architecture, and various component development teams—a shared, unambiguous understanding of the design requirements. (Figure 2)

Using Model-Based Design to verify system and component behavior has several advantages:

- Design and integration problems can be found early through simulation, when they are still easy to correct.

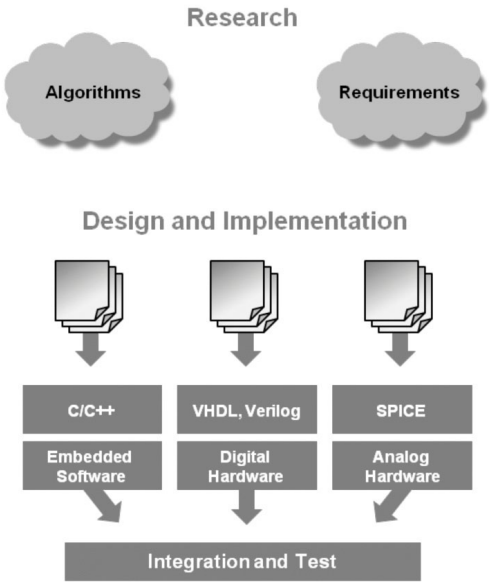

Figure 1: In a typical flow, designs start with algorithm developers, who pass the design to implementation teams using static specification documents.

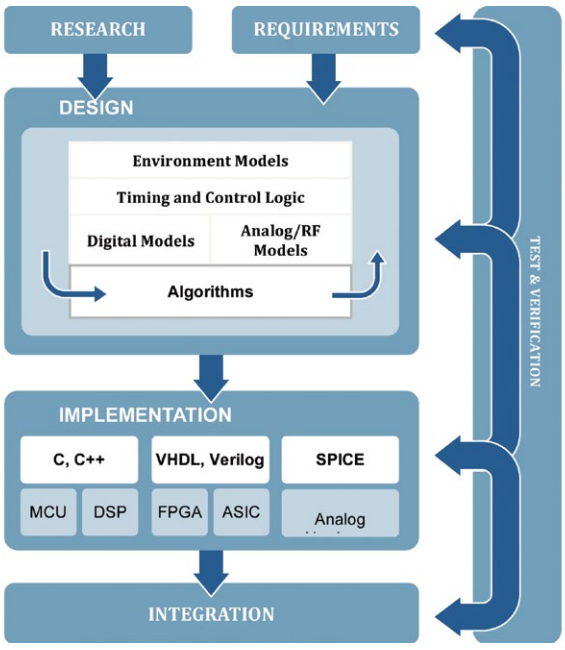

Figure 2. The Model-Based Design workflow enables early verification.

- Tests can be developed concurrently with design to ensure that the executable specification satisfies requirements.
- Reusing models as test benches for component implementation eliminates manual test creation and reduces interpretation errors.
- Designers can quickly evaluate tradeoffs, component interactions, and system-level metrics.

These early verification capabilities address the largest source of product delays by enabling engineers to find and correct flaws at the specification stage. Independent research has shown that this can cut product development time and costs in half, and can lead to superior product designs.

Automated verification and test bench reuse

Getting started with Model-Based Design is surprisingly straightforward. As a first step, the algorithm designers and implementation teams can work together to automate existing test procedures with the tools they already use. From the perspective of the algorithm designers, this automation amounts to a change in thinking more than a change in workload because algorithm designers already develop test benches in order to check their own work. In the traditional design flow, these test benches remain within the algorithm design group. With Model-Based Design, this work can be reused rather than being lost in the handoff to the implementation team.

The reuse is achieved by automation interfaces in the algorithm and system modeling tools that enable cosimulation with widely used hardware simulators and development boards. This cosimulation replaces manual and script-based comparison techniques that would otherwise be needed to verify that C code, HDL, and analog circuit implementations meet system-level metrics. Test bench reuse significantly reduces verification effort and allows each team to more efficiently use existing tools and workflows.

Multidomain modeling

Another problem with the traditional design process is that the software, digital, and analog hardware teams use disparate tools and workflows. These disparate tools inhibit cross-domain design and verification, leaving errors undiscovered until the system integration phase. This problem can be addressed by pushing verification up to a higher level in the design flow. Model-Based Design supports this aspect of early verification through "virtual integration," simulating algorithms, software, digital hardware, and analog together in one environment. This multidomain modeling approach allows designers to evaluate design tradeoffs, component interactions, and system-level metrics early in the design process.

Average Spec. to RTL Cost: *Before*	Average Spec. to RTL Cost: *After*	Net Direct Savings	Percent Savings
$3.1M	$1.3M	**$1.8M**	**56%**

Figure 3. Design costs before and after using Model-Based Design.
Source: Return on Investment in Simulink for Electronic System Design, © 2005 International Business Strategies.

Multidomain modeling and simulation brings together discrete-time modeling for digital components and continuous-time modeling for analog components. It can also incorporate timing and control logic, finite state machines, event-driven simulation, and fixed-point simulation. Designers can start with an abstract algorithmic model to capture behavior and validate requirements. As work progresses, they elaborate the model until they achieve timing- and bit-true accuracy.

By using these models for virtual integration, engineers can see how component design decisions affect overall system behavior without becoming experts in different domains or tools. As a result, they can more quickly find solutions that satisfy or exceed requirements, and can address problems that typically aren't found until late in the process, at the system integration stage.

This approach offers immediate benefits in fast-moving markets like wireless communications. A wireless system designer is concerned not just with the baseband algorithms but also the RF chain, receiver synchronization, integration with higher layers in the stack, network latency and throughput, and so on.

For example, a common challenge is the use of lower-performance power amplifiers to reduce base station cost and power consumption. These amplifiers require the use of digital predistortion (DPD), a Digital Signal Processing (DSP) technique that compensates for device nonlinearities. Multidomain models enable the DSP engineers to verify that these algorithms work properly by using a model of the relevant RF impairments.

Rapid Prototyping

A third verification challenge occurs when algorithms don't work as intended in the target environment. In the traditional workflow, algorithm problems may not be discovered until the end of the design process. This can force extensive re-working of the entire design—a situation that is obviously undesirable.

With Model-Based Design, the same tools used for algorithm development and system simulation can be used to prototype designs on processors and FPGAs, without low-level programming. This early verification technique allows designers to quickly prove the viability of new ideas and analyze performance under real-world conditions.

With rapid prototyping, design-test cycles that took weeks can be completed in less than a day. This capability is particularly valuable for engineers who have new, untested design ideas that they need to verify quickly and thoroughly.

Quantifying the results

Leading communications, electronics, and semiconductor companies have used early verification with Model-Based Design to gain competitive advantage by cutting development costs. As illustrated in Figure 3, independent studies have shown that companies who adopt this approach can cut development costs in half. These results were measured prior to the existence of interfaces to HDL simulators. Since those products were introduced, customers are achieving even greater results. For example, an international communications and information technology company reports an 85% reduction in functional verification time.

Perhaps even more important is the ability to create better product designs and evolve existing ones as robust system models makes is easier to develop derivative designs, or to adapt to new requirements quickly.

The companies who adopt early verification techniques find that they improve communication and collaboration among distributed, multidiscipline teams. Smaller teams also report significant time and cost savings, even if they adopt only one aspect.

Leading communications, electronics, and semiconductor companies have used all of these early verification techniques to gain competitive advantages by simultaneously reducing their test and verification costs while strengthening their ability to develop and ship innovative new products faster.

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Bringing the real world into the lab

By Jeff Atkins, Spirent

Jeff Atkins, wireless infrastructure director at Spirent, explains how new approaches to end-to-end testing for wireless communications can save time and money by modeling realistic test conditions even in the development stages

Wireless technology is, by default, complicated and every several years, a surge of new technologies presents a dramatic increase in complexity. Today, major innovations in the mobile device, Radio Access Network (RAN), core network and services are all hitting at once, driving wireless technology to unprecedented levels of complexity and presenting significant challenges in delivering the expected Quality of Service (QoS) to every mobile subscriber.

Wireless communication has never been a simple matter, but every few years a number of technical innovations come together and the level of complexity takes a quantum leap. This is happening right now. Mobile devices come in an awesome range of variations based on a range of chipsets, radios, displays, batteries and operating systems. As well as these innovations in the device, new developments in the Radio Access Network (RAN), core network and service layer all impact wireless technology and raise it to unprecedented levels of complexity – see Figure 1.

With increased complexity comes the risk that the test procedures of the past no longer identify issues between today's more complex interactions and new technology deployments. This means that testing and quality validation efforts need to be more flexible and faster to ensure the issues are identified before services and equipment go live. Without faster and more precise testing, it is impossible to be sure that new technology, devices and infrastructure will deliver services that meet end-user expectations in the live network.

This pressure to improve testing and validation has driven leading industry players to rethink the whole process of bringing new services, devices and infrastructure to market. One key priority is to isolate problems as early as possible. As we proceed further down the development path, more work is entailed in correcting design errors, and as the process moves from a controlled lab environment to a dynamic live network, even more time and resources are needed to isolate and correct problems. When testing and validation move from the lab to the live network, cost and delays caused by emerging problems rise dramatically (see Figure 2). Identifying problems earlier will save much time and money.

Figure 1: A wave of innovations in wireless technology is leading to unprecedented complexity.

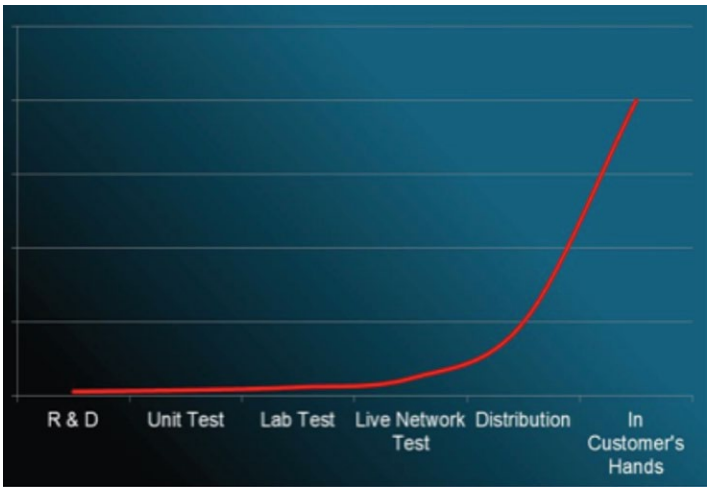


Figure 2: Costs and time delays rise significantly the later in the test cycle problems are detected.

Achieving new levels of testing realism

The latest test solutions, designed specifically to address these new demands, enable the live network to be modeled with unprecedented realism and accuracy in a controlled lab environment. By accurately and realistically emulating real-world conditions in the lab, many problems that only appear in live network testing can be successfully identified and resolved during lab tests – slashing the resources and time needed to get new devices, services and infrastructure launched.

These solutions increasingly use live network measurements – of various sources from protocol captures to RF signal data – to drive sophisticated emulation engines. The current generation solutions use actual live network drive tests to enable their channel emulation engines to accurately model the dynamic RF conditions of multi-cell live networks.

In a live network, RF transmissions are incredibly dynamic, consisting of fast and slow fading signals from hundreds of cells (see Figure 3). In addition to all those RF signals, there is noise and extra-system interference. Furthermore, both HSPA and LTE rely on multiple-input multiple-output (MIMO) antenna transmission to improve system performance.

Modeling live wireless environments like these in the lab raises several key challenges. First, the cost and complexity of base stations limits the number of

cells which can be used for lab tests – typically from 1-4 cells will be available for lab tests compared with 10-100 cells along a test route in the live network. So the signal variations measured across a large number of cells in the live network need to be mapped onto a much smaller number of lab-based cells, while still capturing the essential variability of the desired and interfering signals.

A second key challenge is to accurately model MIMO configurations in the lab, which may not yet exist in the live-network. For example, a LTE live network may only have 2x2 MIMO deployed, whereas lab tests may require testing for 4x4 or other future MIMO configurations. Furthermore, drive test measurement equipment may not capture all aspects of the wireless channel with sufficient resolution to enable an accurate channel model to be developed. To solve these challenges, lab-based channel models must begin with as much data as possible from live network drive tests and then model the additional channel aspects that aren't available in the drive test.

Thirdly, the channel models developed from the drive test data must be converted into an import format that a channel emulator can use to create a real-time wireless channel that mimics live network conditions. This import format must take into account the specifics of the experimental configuration, including the number of RF antennas used by the base station and mobile device, the bi-directional or unidirectional nature of the test and other factors.

A radical approach is needed to address all of these challenges. Spirent's solution is based on a "Virtual Drive Test Conversion Tool" (VDT-CT) that converts live network drive test data from multiple commercial field capture tools into channel models which may be imported into our channel emulators. Let us see how this works in practice.

The VDT-CT solution

VDT-CT addresses the challenge of modeling live wireless environments in the lab in three main stages:

- Filtering live network drive tests;
- Mapping live network data to lab-based cells;
- Generating a channel emulator configuration file.

Each of these is based on algorithms that are technology independent – applying equally to CDMA, UMTS & LTE technology families.

The main purpose of the filtering algorithm is to remove fast-fading effects from the live network drive test data. This leaves a processed set of signals from each base station which includes only slow fading effects – i.e. signal variations due to shadowing of buildings or other obstructions between the base station and the mobile device.

Using only these slow fading effects from the drive test allows the channel emulator to apply any supported MIMO configuration on top of the data. The channel emulator uses the slow-fading signal as a baseline for all MIMO transmission paths, then adds fast-fading and Doppler effects with a user-defined level of signal correlation on top of the slow-fading signal.

Fast-fading effects are filtered using the well-known and widely used wavelength-based averaging approach. Signals are averaged over a 40λ distance (at 2 GHz, 40λ=6m). Figure 4 and Figure 5 give an example of the algorithm's impact.

Figure 4 shows a typical drive test from a UMTS network. The WCDMA RCSP signals in this figure include both slow and fast-fading effects. Figure 5 shows a set of WCDMA RCSP signals from the same drive test after VDT-CT has removed the fast-fading effects.

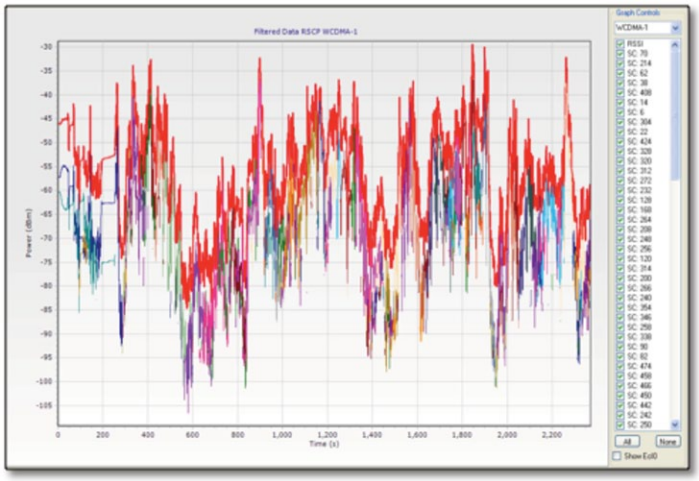


Figure 3: An example of the dynamic, complex nature of the wireless channel: more than 76 base stations were observed during a 35 minute drive test of a live UMTS network.

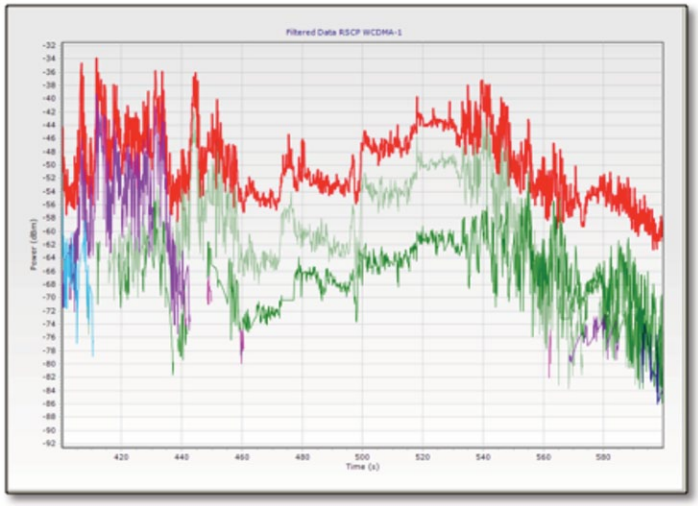


Figure 4: WCDMA RSCP signals with fast-fading effects included.

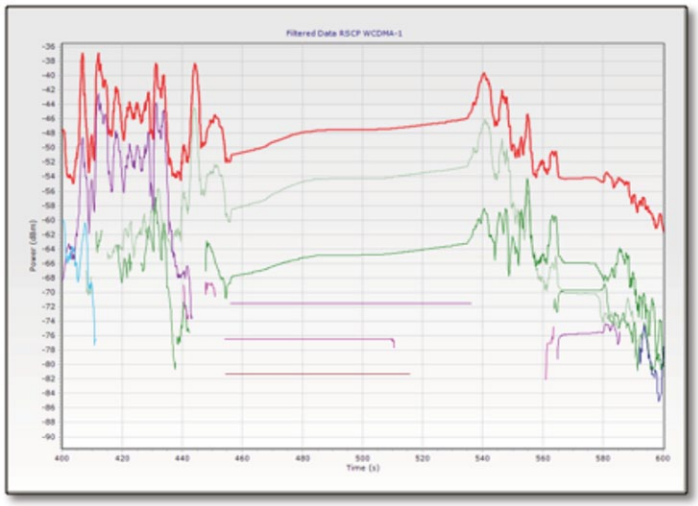


Figure 5: WCDMA RSCP signals with fast-fading effects removed. Signal variations are due to slow-fading only.

Secondly, VDT-CT incorporates several algorithms for mapping signals from live network cells to lab-based cells. Each algorithm has unique characteristics suited to specific testing needs. The following list provides an overview of each algorithm:

- Preservation (Normal) – This option is most appropriate when a large number of cells are measured in the live network drive test. The algorithm determines the nth best serving cell at each point along the drive test, based on the received power. All power measurements associated with the nth best serving cell are then mapped to the nth lab-based cell – until all lab-based cells are assigned.
- Preservation (Harsh) – This option is most appropriate when the lab testing scenario requires significant signal level changes across lab-based cells (ie a "harsh" environment). The top n serving cells at the start of the live network drive test are identified and ordered from best to worst (based on power levels at the beginning of the drive test only). The power measurements associated with each cell in the ordered list are mapped to the nth lab-based cell, until all lab-based cells are assigned. If a live network cell observed at the start of the drive test is not measured later in the drive test, it will be replaced by a new serving cell not already in the ordered list.
- Maximum Power – This algorithm is most appropriate when the live network drive test includes fast-rising cell signals which appear briefly and then subside. The algorithm is similar to the Preservation (Normal) algorithm; however, at any point along the drive test, the nth best serving cell can only change if the power of a lower-ranked serving cell exceeds that of the current serving cell by a user-defined threshold.
- One-to-One (Longest) – This option is most appropriate when a small number of cells are measured in the live network drive test. The algorithm sorts the live network cells based on the total amount of time that the cells were observed during the drive test. For each live network cell in decreasing order, all the power measurements associated with the live network cell are mapped to one lab-based cell, until all lab-based cells are mapped.
- One-to-One (Strongest) – As above, but the peak power observed during the drive test is used for sorting instead of observed time.

More information on the specifics of each algorithm can be obtained from the Spirent VDT-CT user manual. Figure 6 and Figure 7 provide a sample of the Preservation (Normal) algorithm in action. Figure 6 shows a typical UMTS live network drive test, during which more than 76 cells were observed. Figure 7 shows how this live network environment would be mapped onto 2 lab-based cells using the Preservation (Normal) algorithm. The 2 lab-based cells are represented by the blue and green lines in Fig 7.

In addition to the cell mapping algorithms above, VDT-CT has the capability to add Adaptive White Gaussian Noise (AWGN) to model the power contributions of any cells not mapped to a lab-based cell. Furthermore, additional AWGN may be added to ensure the total power of all modeled signals in the lab matches the live network. In Figure 7, the red line represents the sum of the power from the 2 lab-based cells plus AWGN. Notice that the fundamental variability and overall power levels in Figure 6 and Figure 7 remain consistent.

The last step in the live network modeling process is to take the processed drive test data and convert it into a form that the channel emulator can use. In order to do this, VDT-CT needs to know key aspects of the lab-based test configuration such as:

- Technology (e.g. LTE FDD, LTE TDD);
- Band;
- Fader connection type: Uplink and downlink; RF channel mapping; MIMO channel mapping and order (e.g. 2x2); Bi-directional or unidirectional.

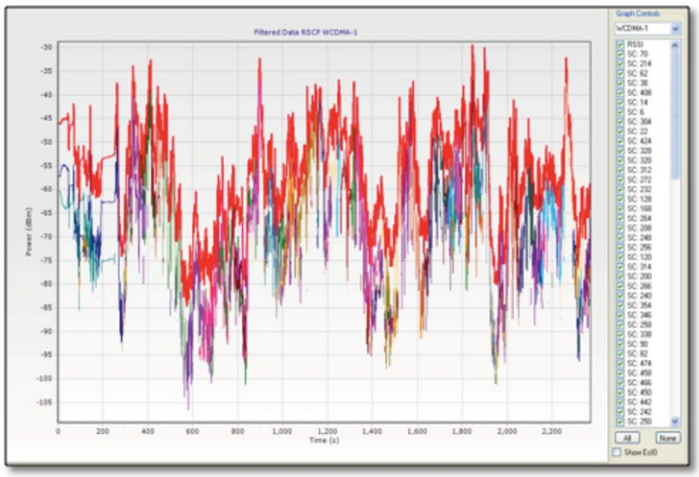


Figure 6: RSCP data from a drive test of a live UMTS network. 76 cells were observed during the test.

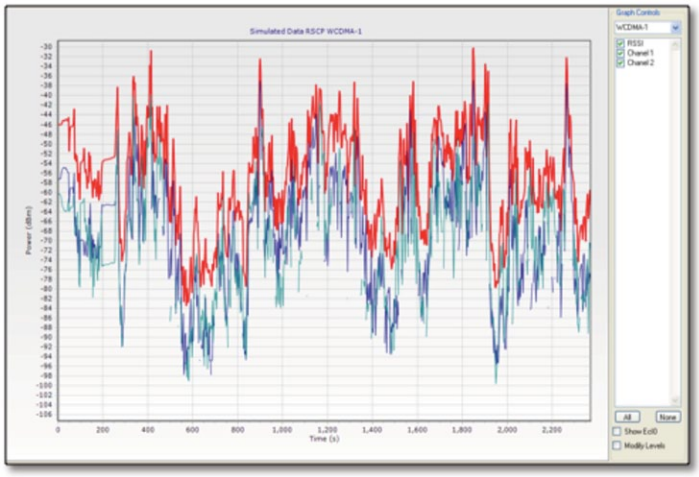


Figure 7: RSCP data after filtering. Source data from 76 cells has been mapped onto 2 cells.

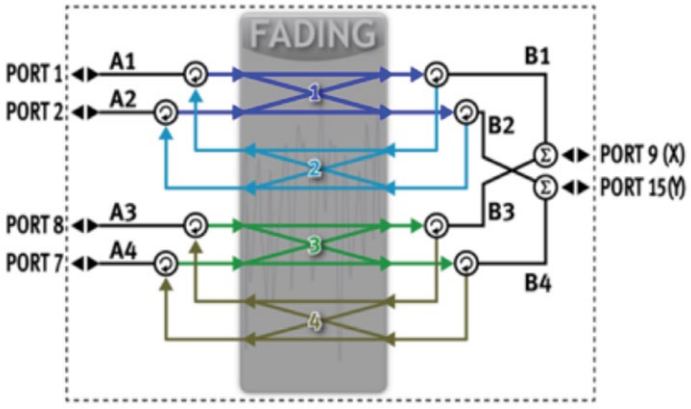


Figure 8: Fader connection diagram for creating a live network channel model import file for a 2 cell, 2x2 bi-directional MIMO fader connection type.

Using this information, VDT-CT creates a live network channel model file that can be imported into the channel emulator and used to emulate the live network environment in the lab.

Building realism into practical, easy to use test solutions

It is a clear advantage to be able to emulate real world test conditions in the laboratory throughout the design process, and it is equally important to deliver these tests in a simple, repeatable and easy-to-use manner.

Spirent does this by providing automation solutions for end-to-end QoE measurements using a mix of real off-the-shelf devices and, optionally, real base station or core network infrastructure if needed. This automated virtual drive test can cover device testing, RAN validation and pre-launch testing of new services. We also offer a specific mobile device test solution for automating carrier acceptance tests for mobile devices.

The ultimate test of any wireless network must lie in the hands of the user, but we are faced with such a range of devices and performance across use cases and applications that the challenge of ensuring an all-around enjoyable mobile experience is growing. Launching wireless services that delight users demands the development and execution of comprehensive and robust test scenarios well in advance of their launch. By the time they launch, the cost of correcting mistakes may be prohibitive both in terms of fault rectification and damage to reputation.

The solution is to emulate as much of that final test as simply and realistically as possible early in the development process. The latest generation of test solutions not only achieve this in the laboratory with new levels of precision, they also deliver these highly sophisticated tests in a format that is easy to use, automated and highly flexible to allow nimble test adaptation to fast-moving changes in technology and network deployment.

Anite leads LTE-A test case validations at PTCRB

Anite has announced that it has achieved validation for the most number of LTE-Advanced (LTE-A) Carrier Aggregation (CA) protocol test cases by the PTCRB (a wireless device certification forum led by North American mobile operators).

Anite used its market-leading Conformance Toolset for protocol conformance testing to validate the greatest number of distinct LTE-A CA test cases, more than any other testing equipment vendor and in more inter-band combinations.

Anite worked closely with leading chipset and device manufacturers from the U.S., Korea and China to develop and validate these test cases which will now become part of the PTCRB device certification requirements mandated by North American mobile operators. Anite submitted these test cases to RAN5 for verification in June this year. As a result of the company's expertise in driving the development of LTE-A CA testing capability, device and chipset manufacturers are able to accelerate the development of LTE-A products. LTE-A CA enables mobile operators to achieve superior data rates through combining spectrum resources.

www.anite.com

USB brings portability and flexibility to the microwave test bench – wherever it may be

By Vaunix Technology Corporation — www.vaunix.com

Measurement technology is constantly evolving, in part because of its close ties with software and computer control. One of the more significant enhancements to RF/microwave test equipment in recent years has been the growing availability of key measurement functions in the form of easy-to-use Universal Serial Bus (USB) modules. With each new USB test module, RF/microwave engineers receive another option on assembling an automated measurement system that can be fully controlled under USB. In addition, when needed, these modules, which each weigh only a few pounds, and a laptop computer can be assembled into a backpack to form an easy-to-carry and truly portable RF/microwave measurement system for on-site testing.

The USB control interface has been built into a growing number of test-and-measurement modules, some from firms long associated with much larger, rack-mount and benchtop RF/microwave instruments. Most, if not all, of the instrument suppliers offering USB test instruments include operating software for the personal computer with their instruments, typically usable on Windows operating systems. The different control programs are compatible with each other, as well as with leading commercial test programs, for ease of creating an automatic-test-equipment (ATE) system of USB measurement devices. Of course, the small size of a USB test instrument will translate into some sacrifice of functionality compared to a rack-mount or benchtop version of the same instrument. An obvious difference is the display screen on the larger instrument, compared to the USB instrument, which uses the display screen on the USB-connected computer. For many applications, however, the ease of setup and portability of a USB-based system may override the additional functionality of a benchtop- or rack-mount-based test system.

A variety of different measurement functions can be found in the portable USB format, including signal generation, signal attenuation, power detection and measurement, phase control. Vaunix Technology offers many of the functions on the signal-generation side of an ATE system, including signal generators, switches, attenuators, and phase shifters. For example, the company's Lab Brick® families of test products connect to computers by means of USB 2.0 interface and all employ straightforward graphical user interfaces (GUIs) for command and control.

Many different measurement functions can be found in the portable USB format.

The Lab Brick signal generators include the cost-effective LSG series and the full-featured, high-performance LMS series instruments. In a non-USB application, both LSG and LMS series signal generators can operate from a battery or remote power supply. Both series of signal generators are also programmable by means of LabVIEW software drivers from National Instruments (www.ni.com). The Lab Brick signal generators are RoHS compliant and comply with international requirements for electromagnetic-compatibility (EMC) emissions and immunity for Class A Industrial-Scientific-Medical (ISM) band devices.

The LSG signal generators currently cover a total frequency range of 20 MHz to 6 GHz. They can be powered totally by the USB port without additional DC supply voltage or battery power. These versatile little signal sources provide a number of different operating modes, including continuous wave (CW) and swept-frequency modes, and they are designed with adequate internal memory to store different instrument states, so that a user can power up an LSG signal source in a specific instrument state. Each LSG signal generator ships with a USB flash drive with GUI software and a copy of the programming guide; the GUI software can control multiple signal generators and other USB instruments for ease of setting up an ATE system. The LSG signal generators measure just 4.90 x 3.14 x 1.59 in. (124 x 80 x 40 mm) and weigh less than 1 lb. (0.45 kg).

Examples of LSG series USB signal generators are model LSG-222, with frequency range of 500 to 2200 MHz, and model LSG-602, with span of 1500 to 6000 MHz. Both provide output power levels from -45 to +10 dBm with 0.5-dB resolution. They tune frequency with 100-kHz resolution and ±2 ppm frequency accuracy. The lower-frequency unit exhibits phase noise of -90 dBc/Hz offset 10 kHz from any carrier frequency in its range and -110 dBc/Hz offset 100 kHz from any carrier in its range. The model LSG-602 exhibits phase noise of -75 dBc/Hz offset 10 kHz from any carrier frequency in its range and -95 dBc/Hz offset 100 kHz from any carrier in its range. These two signal generators and the other members of the LSG series are available with several options, including an external reference option (Option 001) and an option for +13-dBm output power (Option 002).

The Vaunix LMS Series Lab Brick USB signal generators are currently available across a total frequency range of 0.5 MHz to 20 GHz, such as model LMS-203, with a tuning range of 10 to 20 GHz. All LMS series signal generators tune frequency with 100-Hz

resolution and ±2 ppm accuracy with 100-µs switching speed. The LMS signal generators provide output levels from -40 to +10 dBm, adjustable with 0.5 dB resolution. They exhibit typical harmonic levels of -40 dBc and spurious levels of -80 dBc. The model LMS-203 exhibits phase noise of -75 dBc/Hz offset 10 kHz from any carrier frequency in its range and -83 dBc/Hz offset 100 kHz from any carrier in its range.

All of the LMS series Lab Brick USB signal generators are available with several options, including an option for high output power (to +13 dBm), an option for high-speed pulse modulation (Option 003), and an option for performing phase-continuous linear frequency sweeps (Option 004). The pulse modulation option features 30-ns rise/fall times with typical pulse depths of -70 dBc through 12 GHz and -45 dBc through 20 GHz. The phase-continuous linear frequency sweep can be used across the full bandwidth of the selected signal generator, with sweeps performed up, down, or bidirectionally in frequency and with sweep times ranging from 1 ms to 1000 s.

In a test system, the Vaunix Lab Brick signal generators might be coupled with a switch, an attenuator, or even a phase shifter, and the firm offers all three of these functions in USB form. For example, the LDA series of Lab Brick digital attenuators includes models for use through 6 GHz. Like the signal generators, they are RoHS compliant and can be fully USB powered. As with the signal generators, their GUI software supports multiple units at once and is compatible with Microsoft Windows™ standard OS software for PCs, including Windows 2000, Windows XP, Windows Vista, and Windows 7. The Lab Brick attenuators measure just 3.86 x 2.52 x 1.35 in. (98 x 54 x 34 mm) and weigh 0.5 lb. (0.23 kg).

Model LDA-102, the lowest-frequency model in the LDA series of Lab Brick digital attenuators, operates from 0.1 to 1000 MHz with a total attenuation range of 63 dB, adjustable in 0.5-dB steps. It boasts switching speed of 70 ns and insertion loss of 7 dB. The maximum input/output VSWR is 2.0:1, a parameter that is more typically 1.30:1. The digital attenuator handles input levels to +22 dBm and has an input third-order intercept (IP3) of +32 dBm. It draws 65 mA from a +5-VDC supply and is equipped with SMA female connectors. At higher frequencies, the LDA-602 Lab Brick attenuator also provides a total attenuation range of 63 dB with 0.5-dB steps, for a frequency range of 6 to 6000 MHz. It has higher insertion loss than the LDA-102, reaching 10 dB at the highest frequencies. Both attenuators feature attenuation accuracy of ±0.3 dB ±5% of attenuation setting.

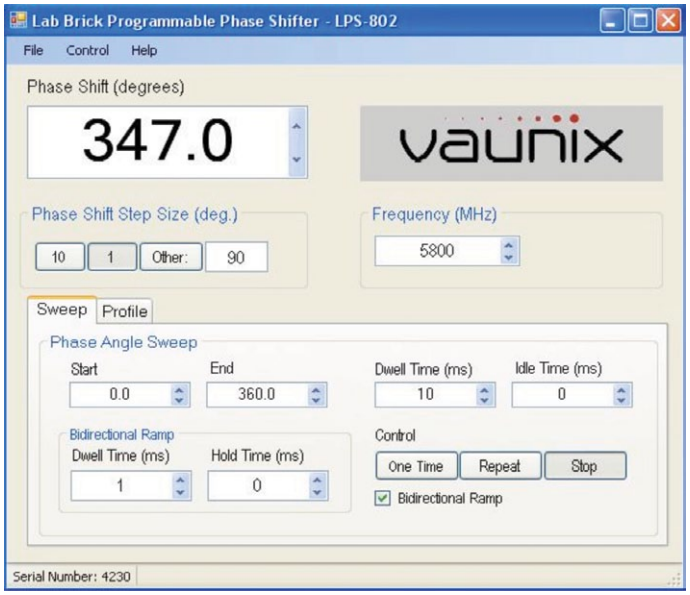
USB-based instruments are available from a growing number of suppliers, and include such products as ultra low phase noise frequency synthesizers from Holzworth Instrumentation, Inc., (www.holzworth.com) , including the firm's model HSM6001A with output levels of -100 to +10 dBm operating from 100 kHz to 6.7 GHz. With low -40 dBc harmonics and -70 dBc spurious content, this 6-GHz frequency synthesizer has phase noise of -118 dBc/Hz at 10 kHz offset from a 6-GHz carrier. The firm also offers their model HSM18001A RF Synthesizer Module with a frequency range of 10 MHz to 20 GHz.

Quonset Microwave (www.quonset-microwave.com) offers a USB frequency synthesizer in a stick, its model QM2010-10-20-H USB Stick Synthesizer Module with frequency range of 10 to 20 GHz. It also supplies its model QM2010-4400 USB Stick Synthesizer Module with lower-frequency range of 138 MHz to 4.4 GHz.

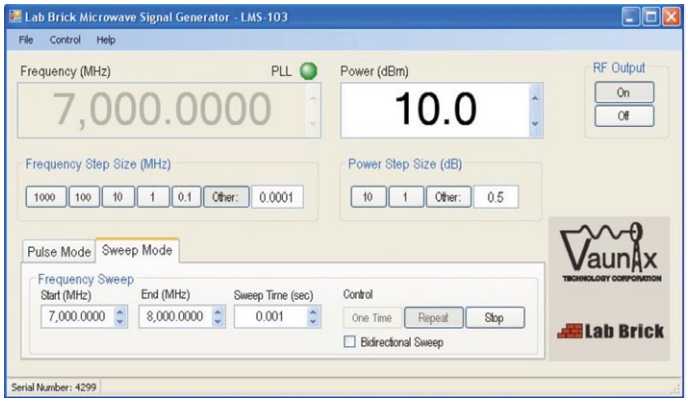
Some USB test signal sources are large enough to include their own displays, such as the model PHS4000 handheld frequency synthesizer from Pronghorn Solutions (www.pronghorn-solutions.com). It uses a front-panel liquid-crystal-display (LCD) for updates and covers 150 MHz to 9 GHz, with more than +10-dBm output power to 6 GHz. It measures 3.6 x 5.8 x 1.25 in. The compact USB synthesizer includes a voltage-controlled-oscillator (VCO) and its own 10-MHz oven-controlled crystal oscillator (OCXO) frequency reference. The phase noise is typically -105 dBc/Hz offset 10 kHz from a 500-MHz carrier and -80 dBc/Hz offset 10 kHz from an 8-GHz carrier. Harmonics are -30 dBc or better and spurious content is -50 dBc or better.

Any complete measurement system requires analysis as well as signal-generation equipment, and numerous test-equipment suppliers offer USB-based power measurement and spectrum analysis equipment. One of the newer names, Signal Hound (www.signalhound.com), has developed a number of cost-effective spectrum analyzers, including their recently introduced model BB60A spectrum analyzer and RF recorder. It spans 9 kHz to 6 GHz with resolution bandwidths of 10 Hz to 10 MHz. It has a dynamic range of -151 to +10 dBm. It can stream a digitized 20-MHz swath of bandwidth to a PC at a rate of 140 Mb/s. However, for some owners of older computers, it is geared for use with USB 3.0 interfaces (for the fast data rates), although it is shipped with open-source GUI software for ease of use. For USB signal analysis equipment, additional suppliers include Boonton (www.boonton.com) with USB power sensors, Copper Mountain Technologies (www.coppermountaintech.com) with a USB network analyzer, Giga-tronics (www.gigatronics.com) with USB power sensors, LadyBug Technologies LLC (www.ladybug-tech.com) with USB power sensors, and TTi-Satori (www.satori-technology.com) with USB power sensors.

Although some of the names for suppliers of USB test instruments may not be long-time RF/microwave manufacturers, that does not mean that some of the more established firms are not interested in this instrument configuration. Anritsu Co., (www.anritsu.com), for example, has developed its model MA24118A power sensor with USB port. It features a 60-dB dynamic measurement range from 10 MHz to 18 GHz with true root-mean-square (RMS) power measurements. It can take average power readings on CW as well as digitally modulated signals to 18 GHz, including on burst waveforms. It is supplied with the free PowerXpert™ software for measurements on a PC, and the USB sensor is compatible with the firm's other in-field portable instruments, including its Spectrum Master™ portable spectrum analyzers.



Lab Brick programmable phase shifter — LPS 802.



Lab Brick microwave signal generator — LMS 103.

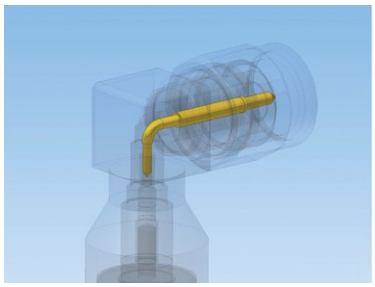
A company name synonymous with benchtop instrumentation, Agilent Technologies (www.agilent.com), has shown its flexibility in developing a diversity of USB test instruments, including a function generator, oscilloscopes, a switch matrix, and a source measure unit. The firm's U2700A series USB modular instruments have won numerous industry awards for originality and performance. Using the connected computer's screen as a display, the model U2702A oscilloscope operates over a standard USB 2.0 interface. It is a two-channel, 8-b, 200-MHz oscilloscope that works with the bundled Agilent Measurement Manager (AMM) software to provide a familiar front-panel interface on the computer.

While such small modules can provide tremendous flexibility, availability of some form of port or docking station can be just as valuable as the instruments. The use of a hub or docking station can provide secure connections for USB instruments, since the USB interface was not initially designed to be as robust as connections in a local-area-network (LAN) configuration. Vaunix, for example, offers its model LPH-204B USB hub. The four-port station provides as much as 1 A current at +5 VDC to each of its four USB ports simultaneously. The ROHS compliant USB hub, which supports cable lengths to 15 ft., is built in a cast-aluminum enclosure measuring 3.86 x 2.52 x 1.35 in. (98 x 64 x 34 mm) and weighing just 0.5 lb. (0.23 kg).

The model HSM6001A 20 GHz RF frequency synthesizer from Holzworth with output levels of -100 to +10 dBm operating from 100 kHz to 6.7 GHz.

Microwave right-angle connector

targets spaceflight applications



The low-profile right-angle connector (ZQA) features a non-bifurcated swept contact design for use with low-loss microwave coaxial cable qualified for 32 GHz spaceflight applications.

Traditional box right-angle connectors are often associated with poor VSWR performance, particularly at frequencies approaching 18 GHz, Gore asserts. This is because many box right-angle designs employ a bifurcated (two-part) internal contact. While the bifurcated configuration allows for easy assembly and low cost, its shape does not lend itself to good internal impedance control or to a robust solder connection.

The ZQA connector incorporates the physical advantages of the box right-angle designs – i.e., low profile and compact size – while maintaining electrical performance comparable with conventional straight connectors. Gore replaced the two-piece bifurcated concept with an internal swept right-angle configuration. The ZQA provides a more robust design with improved impedance control, maintaining a low reflection path as the signal transitions from cable through connector.

As a 2.92 mm instrument grade connector, the ZQA adheres to IEEE 287 standards for precision coaxial connectors with respect to inner conductor, outer conductor, and contact height dimensions.

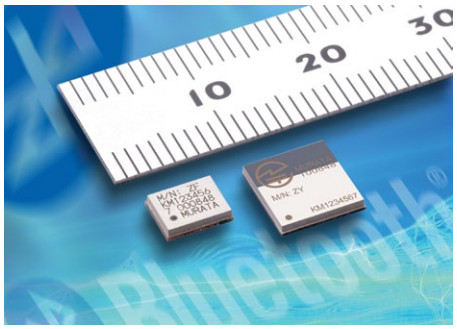
www.gore.com/zqaconnector

Tiny Bluetooth smart wireless module

compact, features ultra-low power consumption

Murata has announced the LBCA series of ultra compact and ultra low power consumption Bluetooth Smart modules.

Measuring only 5.4 x 4.4 mm (LBCA2BZZFZ without antenna), these surface mount devices are a quarter of the size of previous models and are aimed at the increasingly wide range of wearable devices, especially wrist-band-type applications, such as fitness monitoring, smart watches and remote controllers. Conforming to the Bluetooth 4.0 low energy protocol, the modules are available both with (LBCA2HN-ZYZ) or without a built-in antenna (LBCA2BZZFZ)).



With a 0 dBm output power, the modules typically have a range of 30 metres. Interfaces include UART, SPI, I2C and GPIO. Peak current consumption is up to 4.5 mA, dropping down to a deep sleep current of 0.6 µA or less. Average current consumption during communications is 6 µA when 20 bytes of data are transmitted once per second. It is anticipated that with this use case up to 4 years operation is possible when using CR2032-type coin cells.

The modules come certified to FCC/IC, CE and TELEC regulations, significantly helping to reduce the development costs and time-to-market for new designs.

www.murata.eu

Hermetic hybrid housings

with over 30 GHz bandwidth for RF applications

SCHOTT offers high-performance, miniaturized, hermetic hybrid housings with a bandwidth greater than 30 GHz. By using multilayer ceramic feedthroughs, they bridge the height difference between the RF signal inside a surface-mount device and the host board. The company uses virtual prototyping to achieve the optimal design quickly and efficiently.

Used as hermetic feedthroughs, multilayer ceramics are ideal to bridge the height difference of the planar waveguide for the signal path inside the housing and the host board, while keeping the RF path reflection at a minimal level. They also allow for complex structures of electrical, optical, and thermal interfaces to be integrated into the housing. Common butterfly packages, on the contrary, require cutouts in the host board or bent leads—options that, for technical, design, and assembly reasons, were not ideal.

To realize this unit, metallic lines and vias are applied to thin sheets of ceramic with the help of punching processes and silk screen printing. Several layers are then stacked, laminated, and co-fired at high temperatures. A device is formed that can be mounted on the surface of a printed circuit board (PCB).

Recently, SCHOTT developed a space-saving, standard-looking surface-mount device with a bandwidth greater than 30 GHz that allows for a highly customizable design of the package interior. Using finite element simulation tools to analyze the electromagnetic field, SCHOTT is able to model the most suitable packaging. The signal path quality can thus be improved before a prototype is actually created; shortening the time to market and enabling enhanced designs of hermetic hybrid packages..

www.us.schott.com/epackaging

Digi-Key adds low-power Wi-Fi SoC Modules

Distributor Digi-Key has announced the addition of GainSpan, a leading supplier in the low-power 802.11 Wi-Fi market, to its product lines. GainSpan is a semiconductor solutions company in low-power Wi-Fi and Wi-Fi connectivity for the Internet of Things. Their system-on-chip (SoC) modules and software allow you to use the large installed base of Wi-Fi access points and smartphones to create connected products for healthcare, smart energy, and control/monitoring in industrial, commercial, and residential markets. The modules feature an ultra-low-power SoC that consumes a few µA of standby current and goes from standby to active mode in a few msec.

GainSpan is a spinoff of Intel Corporation with a broad portfolio of low-power Wi-Fi and ZigBee/Wi-Fi chips, modules and software; GainSpan is a member of the Wi-Fi Alliance and the ZigBee Alliance.

www.gainspan.com
www.digikey.com

Optenni Lab and ANSYS HFSS workflow

for designing matching circuits for antennas and RF components

Optenni Ltd has announced a new link between ANSYS® HFSS™ and Optenni Lab™ for designing matching circuits for antennas and other RF components based on 3D models simulated using the HFSS electromagnetic field simulation software. An important challenge in the daily work of antenna design engineers is to ensure that technical specifications are met for antenna impedance bandwidth and efficiency. These characteristics can be enhanced significantly faster and easier using matching circuits than by modifying the antenna's geometry. Traditionally, designing matching circuits has required special expertise in the areas of impedance matching and circuit simulation tools.

Using a single macro command, impedance results from ANSYS HFSS simulations can be transferred to Optenni Lab for matching circuit generation and other analyses of the simulated impedances. Optenni Lab provides fully automatic matching circuit generation and optimization routines. The user needs to specify only the desired frequency ranges and number of components in the matching circuit after which Optenni Lab provides a choice of optimized matching circuit topologies. Optenni Lab features an intuitive component library, fast tolerance analysis and simultaneous multiport matching.

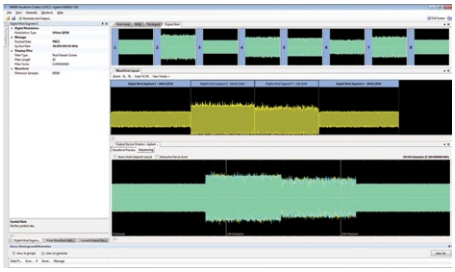
In addition to matching circuit design, Optenni Lab can be used to predict the obtainable antenna bandwidth from simulated impedance data, using the concept of bandwidth potential, which helps the antenna designer to understand how the antenna is working and how the design should be modified for optimal bandwidth.

The link between ANSYS HFSS and Optenni Lab is available as of now. The HFSS macro for implementing the link can be downloaded from the Optenni web site.

www.optenni.com

Waveform Creator

for easy development of baseband and vector signals



Agilent Technologies has introduced the M9099 Waveform Creator, a modular software application that supports analog and digital modulation formats, for the Agilent M9381A PXIe vector signal generator. The software provides a simple, open and expandable environment that increases productivity and speeds time to deployment through superior connectivity with design and modelling software.

M9099 Waveform Creator is the latest addition to Agilent's growing lineup of modular PXI and AXIe products. It was specifically designed to support custom-

ers who need to create and manage the assembly of custom waveforms for developing and testing defense electronics, military radios, and next-generation wireless communication devices.

The company's SystemVue software (a focused design automation environment for electronic system-level design) and its 89600 VSA software (a comprehensive set of tools for signal demodulation and vector signal analysis) work together in the M9099 Waveform Creator environment.

Waveform Creator can create individual segments using available waveform plug-ins or user-created plug-ins. Assembling a signal is a matter of dragging and dropping waveform segments into tracks and modifying the segment attributes with user-definable parameters. Noise, IQ impairments and pre-corrections can be customized for the aggregated waveform as needed. Finally the signal is downloaded to the M9381A PXI VSG or a waveform file. During each step Waveform Creator automatically recalculates the final waveform and displays the result prior to download.

www.agilent.com/find/M9099

500 W high power amplifier in a 3U chassis

Empower RF Systems continues to leverage next generation hardware and software architecture with the next series of the ''size matters" portfolio, a 500 W amplifier family in a 3U chassis.

This PA family operates in the frequency ranges of 20 - 500 MHz (Model 2173), 500 - 1000 MHz (Model 2174) and 20 - 1000 MHz (Model 2175) with the output power guaranteed over full bandwidth and temperature.

With respect to size, weight and power delivery, the 500-W CW amplifier in a 3U chassis in this frequency range is unprecedented. Pulse applications in narrower bandwidths can also be addressed – pulse power up to 2 kW.

Remote access user experience is provided by the latest generation software, which has a feature rich menu that includes not only the software update process, but also real time monitoring, protection and control, sensor driven dynamic adjustments to the amplifier while in operation, remote user access, and a selection of communications protocols that can be enabled by the end user during system set up. The software update capability can also be exercised via a "direct connect" link, if permitted by the customer, from Empower to the fielded amplifier via the amplifier's embedded web server.

The amplifiers use high power LDMOS devices that provide wide frequency response, high gain, high peak power capability and low intermodulation distortion.

A configurable, universal power supply [single phase, two phase, three phase provides status and operating conditions for the modular power sup-

plies that are integral to the HPA. The amplifiers deliver 500-W P3dB, minimum – full bandwidth under all specified temperatures and environmental conditions from -10 to +50 C ambient temperature.

The product line platform is configurable without being custom, while a minimal touch design eliminates a number of manual manufacturing process steps – DME analysis and a full set of factory acceptance tests.

www.EmpowerRF.com

Mini-benchtop, programmable attenuators

JFW Industries has added two products to their series of mini-benchtop, programmable attenuator assemblies.

The 50BA-011-95 offers 0-95 dB of attenuation in 1 dB steps from 200-6000 MHz, while the 50BA-010-127 gives 0-127 dB and operates 700-3000 MHz. Other configurations are also available.

www.jfwindustries.com

0.8 W power amplifier

offers wide frequency band operation

Richardson RFPD has announced immediate availability and full design support capabilities for a 0.8 W power amplifier (PA) from Wavelex.

The WPA0214N offers wide frequency band operation, from 175 to 1400 MHz, 50 ohm impedance, and 29 dBm P1dB. It is versatile for a range of applications, including VHF, UHF, avionics, GPS, PA driver amplifiers, RF bench tests, and fixed wireless communication.

The PA is packaged with precision machine housings in Wavelex's IP-2 package. All products are 100% production-tested on all minimum and maximum electrical specifications. Other features include a gain of 13.5 dB, a gain flatness of ±0.5 dB, typical VSWR of 1.8:1 and 43 dB IP3.

www.richardsonrfpd.com

Qualified M3933/30 DC-32 GHz attenuators

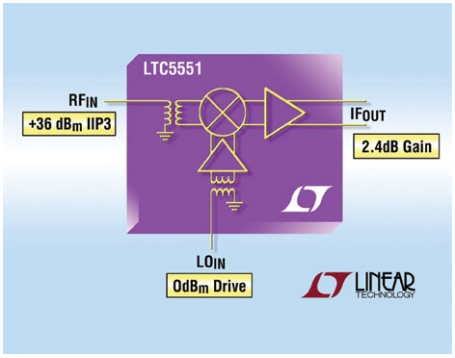
SV Microwave has officially been approved by DLA as the ONLY QPL source for M3933/30 DC-32 GHz attenuators. The company's line has the precision, quality and performance using 2.92 mm connectors for the frequency range DC through 32 GHz.

SV Microwave's dB values range from 0.5 to 30 dB with low VSWR and flat attenuation. Screened and non-screened versions are also available.

www.svmicro.com

Downconverting mixer

delivers 2.4 dB conversion gain and +36 dBm IIP3



LTC5551 is a what Linear Technology terms an ultra-high dynamic range RF down-converting mixer for demanding applications. It offers very high linearity of +36 dBm IIP3, (input third-order intercept), and low 9.7 dB noise figure – comparable to the highest IIP3 passive mixers available.

Unlike passive mixers which typically have 7 dB to 9 dB of conversion loss, the LTC5551 boasts 2.4 dB of conversion gain, substantially improving receiver dynamic range. The device also has broad RF frequency range capability, operating from 300 MHz to 3.5 GHz.

Passive mixers require high LO (local oscillator) drive to reach their headline IIP3. The LTC5551 has an integrated LO buffer requiring only 0 dBm drive level, hence external circuitry and costs are minimised. With the elimination of a high power LO signal in the users' receiver, it substantially reduces a potential source of undesirable radiation, thus simplifying filtering and RF shielding requirements.

LTC5551 ensures robust radio performance with its high 1-dB compression point of +18 dBm. Both the RF and LO inputs have integrated balun transformers, further reducing cost and external components while simplifying the design task. The mixer is powered from a single 3.3V supply with current consumption of 204 mA. If needed, the mixer also has a low power mode controlled via the ISEL pin. In this mode, current consumption drops by 30% to 142 mA, trading off the IIP3 slightly to +29.3 dBm.

The performance of this mixer suits it, Linear says, for a wide range of mission-critical, high performance applications that are exposed to strong interference sources such as multi-carrier GSM, 4G LTE and LTE-Advanced multimode basestations, point-to-point backhauls, military communications, wireless repeaters, public safety radios, VHF/UHF/white-space broadcast receivers, radar and avionics.

www.linear.com/product/LTC5551

Hand-held RF field strength meter

offers spectrum analyser capability

Now available from Link Microtek is a hand-held RF field strength meter that incorporates spectrum analyser functionality, providing engineers and technicians with a cost-effective yet versatile tool for RF signal analysis.

AWT Global's UBA 9290 covers the frequency range 100 kHz to 2.9 GHz and has a sensitivity of -117 dBm, which means it is capable of detecting and analysing even weak RF signals.

Equally at home in the field and in the laboratory, the new instrument is suitable for the installation, maintenance and testing of a wide variety of RF systems,

including mobile phone infrastructure, TV and radio broadcast equipment, RFID systems, private mobile radio (PMR) transmitters and telemetry systems.

Waveforms are shown on the 320 x 240 pixel TFT colour display, while dual markers allow the user to read out absolute amplitude and frequency as well as delta values. Up to 100 waveforms or settings can be stored in the unit's memory.

As the UBA 9290 supports high-speed USB, measurement data can be transferred to a PC for further analysis, and the instrument can also be controlled from the computer using the software supplied.

www.linkmicrotek.com

Base station tester

provides all-in-one tool for field measurements

Anritsu Company introduces the MT8220T BTS Master, a multi-function handheld durable tester with all the capabilities network operators, sub-contractors, installers, and regulatory authorities need when measuring base stations.

The third generation of Anritsu's field-proven BTS Master family, the MT8220T has improved performance, including a standard GPS receiver, enhanced two-port dynamic range, faster LTE scanner, and expanded spectrum analysis capability, in a design that is thinner and lighter than previous models.

Combining a cable and antenna analyzer, spectrum analyzer, and internal power meter, the MT8220T BTS Master offers line sweeping, comprehensive wireless measurements, ultra-sensitive spectrum analysis and sophisticated interference tracking in a compact handheld solution. It also features a standard GPS receiver with antenna. By providing multiple testing capabilities, including comprehensive Over-the-Air (OTA) measurements to support Remote Radio Heads (RRH) and MIMO, the MT8220T is well suited for co-siting of new systems, such as LTE, with existing networks.

Improving the cable and antenna analyzer two-port dynamic range to >100 dB (typical 110 dB) over the key cellular fre-

quency range of 400 MHz to 2800 MHz allows users to conduct cellular repeater testing where isolation measurements up to 100 dB are required. Dynamic range is also enhanced to >90 dB between 2800 MHz and 4000 MHz, and >85 dB up to 6000 MHz.

www.anritsu.com

Programmable attenuator

for cellular fading simulation

Renaissance has developed a new solid state programmable attenuator that can be used to perform fading simulations. The device operates from DC – 3 GHz with 5.5 dB insertion loss and can attenuate 90 dB in 0.5 dB steps. The attenuator can handle 20 dBm over -40 to +85 C.

The attenuator featues TTL control, 16 dB return loss and 100 ns switching time. It is easily integrated into existing systems, has an industry standard footprint and offers an operating life of 10E9 cycles.

www.rec-usa.com

Vector signal analyzer

boosts test speed for power amplifier front-end modules

Agilent Technologies has introduced the M9391A, a 1-MHz to 3- or 6-GHz PXIe vector signal analyzer (VSA), with up to 160-MHz bandwidth designed to test the latest wireless standards.

Used in combination with the company's modular X-series applications, the M9391A delivers a consistent user interface, common measurement consistency, and backward-compatible APIs to accelerate test development and throughput.

The M9391A is a complementary product to the M9381A PXIe VSG for testing and design validation of wireless power amplifiers, transceivers and cellular base stations, primarily picocell and femtocell. The latest analyzer performs more tests in less time, significantly reducing costs. It features innovative Fastune technology that enables unprecedented servo-loop test times through rapid frequency and amplitude adjustments. Plus, its hardware-accelerated power measurements maximize throughput while retaining measurement integrity.

Engineers can use the M9391A PXIe VSA with the M9381A and modular X-Apps to test wideband power amplifiers, front-end modules, transceivers and more.

www.agilent.com/find/M9391A

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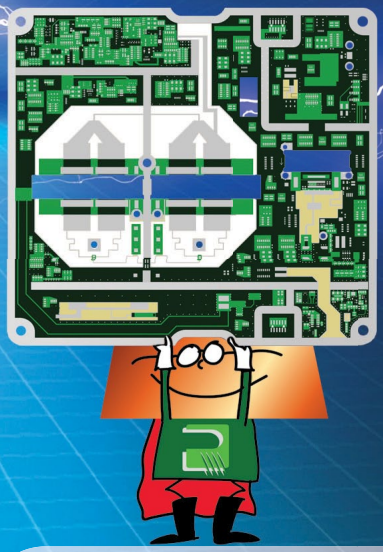
Give your next amp a boost with

RO4360G2™

6.15 Dk High Frequency Laminates



When amplifier designers asked, Rogers listened and developed RO4360G2™ high-frequency laminates. These thermoset materials feature a powerful balance of high performance, low cost and ease of processing in a laminate with a dielectric constant of 6.15.

RO4360G2 laminates deliver the low loss and high thermal conductivity sought by amplifier designers. Suitable for a variety of commercial and industrial applications, RO4360G2 laminates can be processed similar to FR-4 & support lead-free, RoHS-compliant manufacturing practices.

Features

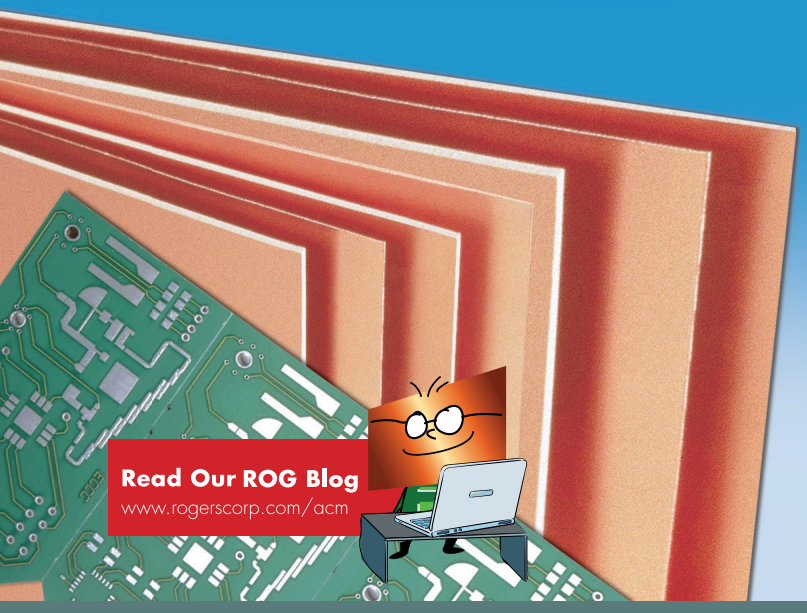
- High dielectric constant
- Low loss
- High thermal conductivity
- Low Z-axis CTE (30 PPM/°C) for reliable PTHs

Total Cost Solution

- Priced better than alternatives
- Low fabrication cost

Ease of Fabrication

- Ideal for multilayer circuits
- Suitable for automated assembly lines
- Processes similar to FR-4
- Lead free, RoHS compliant



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ADF2013

AWR DESIGN FORUM EUROPE

29 OCTOBER TO 28 NOVEMBER

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The AWR Design Forum (ADF) is an open event at which designers of microwave and RF circuits and systems such as monolithic microwave integrated circuits (MMICs), RF printed circuit boards (RF PCBs) and LTE communication systems can network, share useful information and resources pertinent to high-frequency design, and collaborate on industry issues and trends. These events are **FREE** to attend. For agendas and registration, visit: www.awrcorp.com/ADF2013

Location	Date
Brussel	29 October
Woerden	31 October
Helsinki	5 November
Rome	5 November
Gdansk	5 November
Stockholm	6 November
Warsaw	7 November
Milan	7 November
Prague	12 November
Istanbul	26 November
Ankara	28 November

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