January/February 2014

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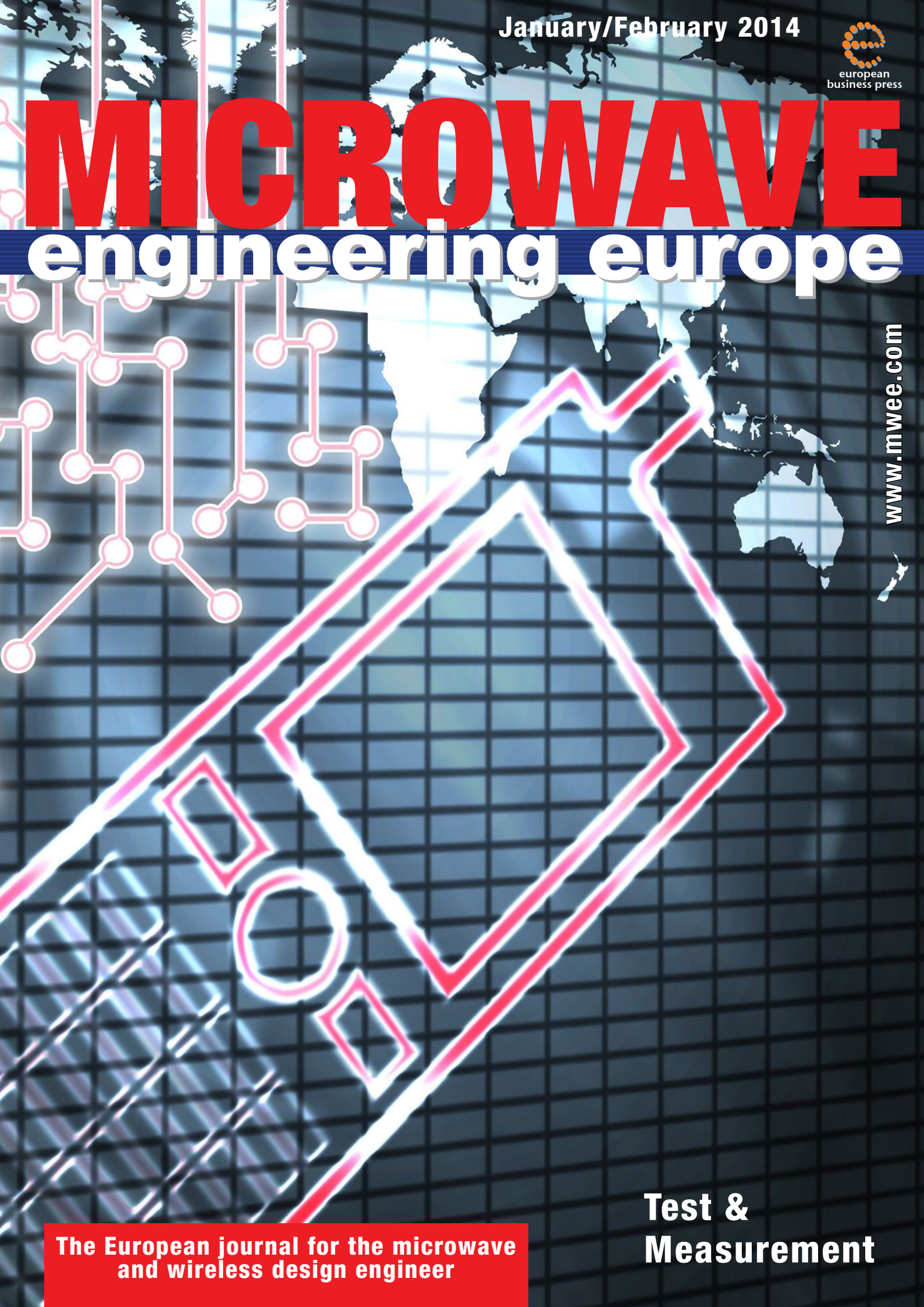

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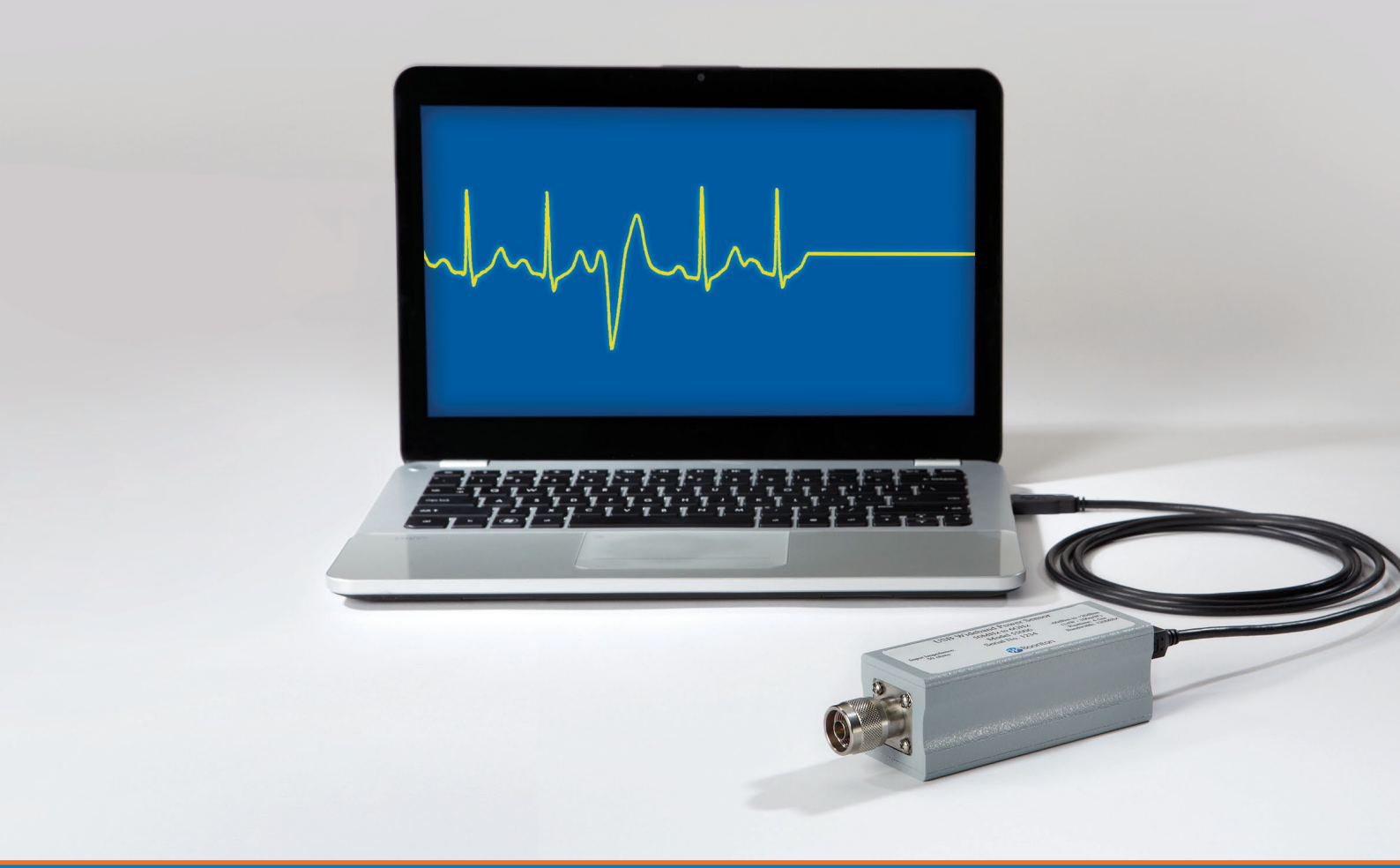

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Lime drives their field programmable RF concept with next generation CMOS MIMO transceiver IC

With a continuous operation spectrum of 0.05 to 3.8 GHz and software configured to operate up to 50 MHz IF bandwidth, the second generation LMS7002M multi-standard / frequency single chip MIMO transceiver provides the majority of RF applications today with a cost-optimised, power-optimised platform to build highly agile SFDR systems.

The LMS7002M supports all cellular standards and frequencies, including 2G, 3G and 4G / LTE and their TDD / FDD variants amongst numerous other standards such as WiFi.

The latest device, which has already been taped out and will be demonstrated at Mobile World Congress, uses 65nm CMOS technology to significantly reduce the cost of FPRF transceiver technology as well as significantly reduce the power consumptio. The chip also integrates 2x2 MIMO functionality and significantly extends the spectrum coverage. This makes LMS7002M ideal for both consumer and professional applications.

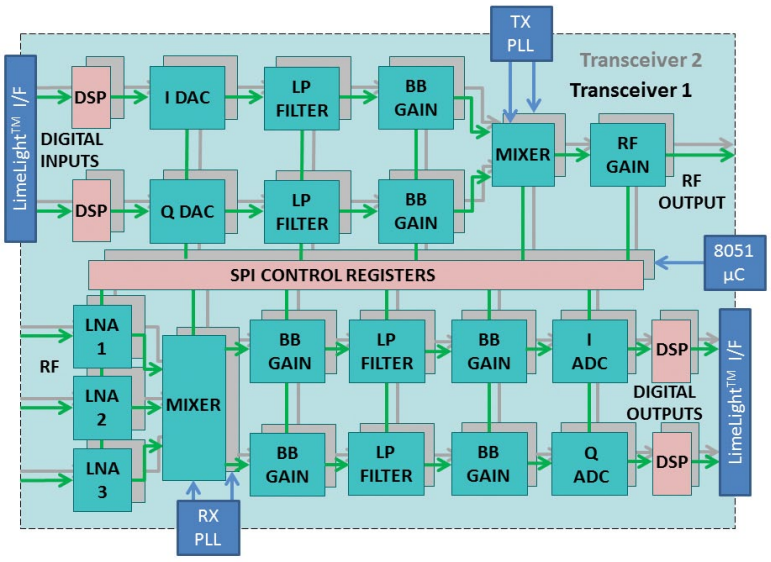
This second generation chip builds on the earlier LMS6002D, which is the first field programmable RF (FP-RF) transceiver IC and remains popular in many applications. Lime built the second generation trasceiver based on a lot of customer feedback. As the majority of applications are up to 3.8 GHz, the need for much higher frequencies did not yield an advantage as power consumption would rise at a higher frequencies — and the need for lower power consumption was considered a key requirement. However, designers can still use up- or down-conversion to achieve any frequencies they might need, and still have a lower power footprint than is possible using other approaches.

Lots of integrated funtionality

Leveraging a key feature of CMOS, the company has also added a significant amount of functionality, especially DSP functions and digital side I/Q correction.

Lime CEO, Ebrahim Bushehri commented: “The flexibility, low power consumption, functionality and price of the LMS7002M FPRF, makes it an exceptionally disruptive entry to the transceiver chipset market. Our new architecture delivers an industry leading transceiver function for a fraction of the cost of existing solutions. And it can be configured to perform many of the functions used within the chip as standalone parts too.”

The transceiver’s extensive on-chip DSP, provides superior functionality and greatly improves the overall system performance. The DSP enhances the analog gain and filtering with digital control and is an important factor in reducing the overall power consumption.



Other features, such as the on-chip microcontroller, simplify the calibration and installation. The chip is programmed by a serial bit stream, and designed using a free open source configuration tool suite.

With a programmable modulation bandwidth of 1.5, 1.75, 2.5, 2.75, 3, 3.84, 5, 5.5, 6, 7, 8.75, 10, 12, 14, 20 and 28 MHz, the device supports both FDD and TDD full duplex. It also integrates a high performance 12-bit ADC and DAC, rducing component count further for applications that require up to 12-bit resolution.

The LMS7002M can operate from a single supply rail of 1.8 V with individual blocks capable of being powered down when not required for further power savings. This makes it suitable for a wide range of battery and mains powered mobile communications devices – from professional devices, such as small cells and software-defined radios, to consumer, machine to machine (M2M) and military radio applications.

The chip will also be offered at an aggressive price point that will also make it cost-effective when used for standalone functions such as ADC, DAC, DDS, AGC, PLL or RF VGA.

Covering all base

The transceiver IC can run on any standard and on any commonly used mobile communications frequency – both licensed and unlicensed - making it ideal for any wireless communications and broadband project.

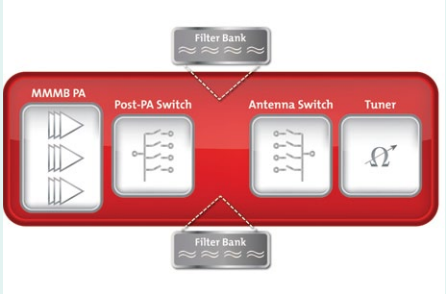
Since the LMS6002D requires few external components, designers can build simpler systems quicker that are in effect programmable (SFDRs) — thereby future proofing products against ever changing standards. In the future, this SFDR trend would make the hardware agnostic to the application, so in-effect one could have a generic radio for small cells or basestations. Such generic hardware platforms based on FPGAs and Lime Microsystem’s field programmable RF concept would allow potentially huge cost savings in inventory and enable products to be in service much longer, as they would just need to be programmed to adhere to new standards or new configurations or use cases.

Disaster relief is a typical application where getting up a network quickly would be hugely beneficial. Programmable radios would allow just that, and enable an operator, for example, to restore service in hours.

Needless to say, this device will be part of a trend to making RF programmable with its functionality defined in software, rather than hardware — similar to the reprogrammable nature of the digital world.

By Jean-Pierre Joosting
Editor: Microwave Engineering Europe

First reconfigurable RF front-end system enables single-SKU design globally



Peregrine Semiconductor has announced UltraCMOS Global 1, which, for the first time, enables 4G LTE platform providers and OEMs to be able to save time and money by creating a single-SKU design for global markets — an industry-first reconfigurable RF front end (RFFE).

To support over 40 frequency bands and a more than 5,000-fold increase in the number of possible operating states, a truly reconfigurable RFFE is now a requirement. This level of reconfigurability is only feasible with a CMOS process.

Global 1's entire system — multimode, multiband (MMMB) power amplifier (PA); post-PA switch; antenna switch; and antenna tuner — is based on the company's UltraCMOS 10 technology platform. This platform leverages 25 years of RF expertise with proven performance demonstrated by more than 2 billion RF SOI units shipped. In addition, Global 1 features the first LTE CMOS PA with the same raw performance as the leading gallium arsenide (GaAs) PAs and has a 33-percent efficiency increase over other CMOS PAs.

"For years RF engineers have been looking for an integrated, CMOS RF front-end offering that performs as well as GaAs for mobile devices," says Joe Madden, founder and principal analyst at Mobile Experts. "Peregrine's UltraCMOS technology has demonstrated GaAs-level efficiency performance at high power, which could be a game-changer."

On a single chip, the Global 1 RFFE system delivers the scalability to easily support higher band counts through low-loss switching and tunability; high isolation to solve interoperability issues; simple, digitally-controlled adaptation across modes and bands; and, most importantly, PA performance equivalent to GaAs.

Global 1 includes a multimode, multiband power amplifier, post-PA switch, antenna switch and antenna tuner on a single chip.

Global 1 system's reconfigurable RFFE delivers: a 3-path MMMB PA, post-PA switching, antenna switch and antenna tuner; support for envelope tracking, and a common RFFE MIPI interface.

"Creating a global, single-SKU design for LTE devices is currently the toughest, unmet challenge in RF," says Jim Cable, CEO at Peregrine Semiconductor.

Before now, no vendor has been able to deliver GaAs-level PA performance in a CMOS PA, which prevented CMOS PAs from competing in the performance-driven LTE handset market. The Global 1 system integrates the company's established, best-in-class RF switches and tuners seamlessly with the first CMOS PA to match the performance of GaAs PAs. This level of performance is reached without enhancements from envelope tracking or digital predistortion, which is often used when benchmarking CMOS PAs with GaAs PAs.

The UltraCMOS Global 1 PA will be demonstrated by appointment at Mobile World Congress in Barcelona. It will complete platform integration in 2014 and will be in volume production in late 2015.

www.psemi.com

Swiss breakthrough in polymers could lead to bendable tablets, smartphones

Swiss-based multinational Lonza is introducing ultra-low loss and high temperature thermoset materials developed by 'system solution' polymer material company Novoset, LLC, which look like paving the way to the advent of bendable tablets and smartphones.

The thermoset resins, based on Cyanate ester (CE) chemistry, are ideal materials for the telecommunication and advanced semiconductor packaging industries.

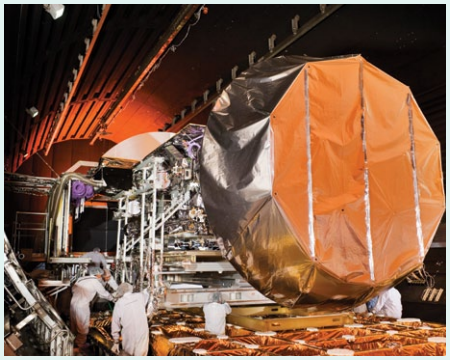
Primaset ULL-950 is suitable for high-performance applications such as power amplifiers for 4G LTE and 4G LTE advanced base stations for smartphones, internet infrastructure and high-layer count servers for cloud computing. Low dielectric properties coupled with high a Glass transition temperature (Tg) makes the Primaset HTL-300 thermoset resin an ideal candidate for advanced IC substrates for semiconductor packaging materials and next generation application processors for mobile chips.

"We can design and fabricate high-layer count ultra-low dielectric boards without using Teflon. Primaset ULL-950's electrical performance is similar to Polytetrafluoroethylene, it can be processed as easy as FR-4 technology and reaches Tg of Cyanate esters or Polyimides," explained Dr. Sajal Das, President & CEO of Novoset. "We are getting close to fabricating bendable tablets, smartphones and other devices from high temperature thermosets such as derivatives of Primaset ULL-950 and Primaset HTL-300 in the foreseeable future."

Depending on the backbone structure Primaset ULL-950 has a dissipation factor (Df) ranging from 0.0009 to 0.003 and dielectric constant (Dk) between 2.3 - 2.6 up to 40 GHz. The Tg can vary between 175 - 320°C. High temperature bendable devices can be fabricated utilizing its flexibility. The products also exhibit low moisture uptake and short lamination cycles. The high temperature capabilities and toughness are critical for lead-free assemblies in PCB and build-up films.

www.novoset.com
www.lonza.comi

MUOS satellite could solve comms challenges in the Arctic



In the arctic people are spread thinly over thousands of square miles and access to secure, reliable communications is problematic. Further, satellite signals tend not to reach far North reliably.

Lockheed Martin has demonstrated that the U.S. Navy's Mobile User Objective System (MUOS) satellites could help solve communication challenges in the arctic. During company-funded tests, MUOS voice and data signals reached much farther north than previously thought, just 30 miles and 0.5 degrees of latitude shy of the North Pole.

Wideband Code Division Multiple Access (WCDMA) capability was demonstrated using three different radios as far north as 89.5 degrees, under peak orbit conditions. This inherent voice and data access is well beyond the 65-degree system requirement.

The additional coverage comes at a time when demand is surging for dependable polar communications.

"As the arctic becomes more accessible, the U.S. and its allies need reliable communications to maintain a safe and secure presence," said Paul Scearce, director of Military Space Advanced Programs at Lockheed Martin. "Demand for consistent voice and data services will only increase. The area is experiencing more shipping, tourism and natural resource exploration, which will also likely increase demands for search and rescue."

The demonstrations show MUOS has an advantage over legacy satellite communications.

www.lockheedmartin.com

Motorola goes to Lenovo for $2.9B but patents stay with Google

Google will sell Motorola Mobility to Lenovo for $2.9 billion less than two-and-a-half years after it bought the smartphone and tablet maker for $12.5 billion.

The Motorola/Lenovo combination becomes the world's third largest smartphone maker with a 6% market share behind Samsung (32%) and Apple (15%), according to Strategy Analytics. The deal comes just six days after Lenovo agreed to buy the x86 server business from IBM for $2.3 billion.

The deal is a win for all three companies, said one market watcher. Google "divests a loss-making hardware division…Motorola gains an ambitious sugar daddy with a strong presence in China" and Lenovo gets Motorola's smartphone sales which are strongest in the U.S. and Latin America, said a blog post from Strategy Analytics.

Google retains all but about 2,000 of Motorola's patents " to defend the entire Android ecosystem," said Google chief executive Larry Page in a blog post announcing the deal.

Software-only face and eye tracking for smartphones

Face and eye-tracking has existed for decades, however, Israeli company Umoove brings a new software-only approach that provides precise face and eye-tracking on any smartphone or tablet with a front facing camera. This technology is now available to mass audiences through mobile apps, business partnerships, and an analytics platform, according to Umoove.

The company has also made available 3D face and eye tracking flying game, Umoove Experience, on the iTunes store to demonstrate the potential that this software can offer developers. Developers can add face and eye interaction to new or already existing apps.

The Umoove software is designed to address shakiness, lighting and limited hardware resources typical of mobile devices. Further, it requires as low as 5% CPU capacity in real-time and the raw frames of the front-facing camera for input.

The software is built on unique algorithms with over fifteen patent files pending. It comprises a core and an interpretation layer. The interpretation layer converts the face and eye movements into a language that describes interaction and valuable data.

Umoove's technology is available as a FaceSDK and EyeSDK, both of which are available on iOS and are coming soon to Android. Developers can use FaceSDK to integrate face-tracking into new or existing software via a plug and play process. In beta stage, EyeSDK is available to select strategic partners.

www.umoove.me

Next-generation encrypted smartphone receives EU approval

A smartphone app for secure voice communication and text messaging, Sectra Panthon 3, has been granted EU approval for the protection of EU classified information at the EU RESTRICTED level.

This enables EU authorities and officials to securely communicate sensitive information over ordinary mobile networks without fear of interception. Sectra Panthon is also available as a service, not requiring any infrastructure investments nor managing of encryption keys.

With Sectra Panthon, users can safely share sensitive information through encrypted voice- and text conversations. Hardware-based key protection ensures the very high level of security.

The Sectra Panthon app is designed to support the SCIP-protocol,

www.sectra.com

MediaTek looks to under-$50 wearable devices

MediaTek is quietly going after the emerging market of under-$50 wearable devices. The company's new "all-in-one" SoC, called Aster, is sampling now only to a select group of customers.

The chip is not officially announced yet, with no datasheets or block diagrams publicly available.

Aster integrates ARM7 ESJ, Bluetooth 4.0/Bluetooth Low Energy, power management IC, and memory (4 Mbytes of flash and 4 Mbytes of SRAM). Housed in a 5.4 x 6 mm package, MediaTek describes Aster as the "smallest SoC" with "highest integration" for wearable devices.

Aster also comes with a comprehensive Application Framework. Its Run-Time Environment will make it easy for users to install and upgrade apps and run them on wearable devices, according to MediaTek.

With an ear close to the ground in China, Taiwan's consumer chip behemoth MediaTek appears to know about something not readily evident to most system vendors and chip companies in the West: a surge in Chinese consumer demand for new gizmos designed to leverage the power of smartphones.

"Innovation can come up very quickly in China compared to Western society," according to Cliff Lin, senior director of MediaTek's US corporate marketing.

MediaTek's Aster, together with the company's wearable "turnkey solutions," is designed to let a thousand flowers bloom in a number of new consumer devices, ranging from a Bluetooth dialer to a smartwatch. These devices are meant to be wirelessly connected to a smartphone, a device already ubiquitous.

It's important to note that these wearable devices MediaTek has in mind are not positioned to replace smartphones - an idea sharply divergent from the hopeful thinking, more popular in the West, that wearable devices will supplant phones.

www.mediatek.com

Alcatel-Lucent and BT achieve real-world fiber speeds of 1.4Tb/s

Alcatel-Lucent and BT have announced trial speeds of up to 1.4Tb/s with a record spectral efficiency of 5.7 bits per second per Hertz (b/s/Hz) on an existing core fiber connection. This is believed to be the fastest speed ever achieved in commercial grade hardware in a real-world environment and is equivalent to transmitting 44 uncompressed HD films in a second.

The field trial, conducted over an existing fiber link between the BT Tower in London and BT's Adastral Park research campus in Suffolk, used a new 'flexible grid' infrastructure (Flexgrid) to vary the gaps between transmission channels, usually set at 50 GHz. By increasing the density of channels on the fiber, this approach achieved up to 42.5 percent greater data transmission efficiency compared to today's standard networks.The trial demonstrated that use of the Flexgrid approach can increase core network capacity using existing optical fibers,

www.alcatel-lucent.com

3D graphene structures for use in super-capacitors inspired by sugar bubbles

Xuebin Wang and Yoshio Bando at Japan's World Premier International Center for Materials Nanoarchitectonics (WPI-MANA), together with co-workers across Japan and China, have created a new way of making 3D graphene using bubbles blown in a polymeric glucose solution. The resulting 3D graphene is robust and maintains excellent conductivity.

Graphene sheets are immensely strong, lightweight and good at conducting electricity. Theoretically, macroscopical 3D graphene assemblies should retain the properties of nanoscale graphene flakes. However, recent attempts to make 3D graphene have resulted in weak conductivity due to poor contact between graphene sheets. Loss of strength is also a problem, and self-supporting 3D graphene has not yet been produced.

Inspired by the ancient food art of 'blown sugar', Bando and his team reasoned that the strutted, coherent nature of conjoined bubbles would lend itself to strength and conductivity if graphene could be structured in the same way. The researchers created a syrup of ordinary sugar and ammonium chloride. They heated the syrup, generating a glucose-based polymer called melanoidin, which was then blown into bubbles using gases released by the ammonium. The team found the best quality end-product resulted from a balance of equal ammonium decomposition and glucose polymerization during this stage.

As the bubbles grew, the remaining syrup drained out of the bubble walls, leaving within intersections of three bubbles. Under further heating, deoxidization and dehydrogenation, the melanoidin gradually graphitized to form 'strutted graphene: a coherent 3D structure made up of graphene membranes linked by graphene strut frameworks, which resulted from original bubble walls and intersectional skeletons respectively.

The bubble structure allows free movement of electrons throughout the network, meaning that the graphene retains full conductivity. Not only this, but the mechanical strength and elasticity of the 3D graphene is extraordinary robust — the team were able to compress it down to 80% of its original size with little loss of conductive properties or stability.

Following their discovery, Bando and his team reliably produced gram-level strutted 3D graphene with a cost $0.5 per gram in their lab. The low-cost, high scalability of this new method could have many applications in engineering and electronics. Selectively the abundant product was applied as a highly effective super-capacitor; its maximum-power-density is highest among 3D graphene-based aqueous super-capacitors.

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Implementing 802.11ac – revolution or evolution?

By Stephane Persyn, Fluke Networks

The 802.11ac standard is due to be ratified in early 2014. This article explains what it offers and provides tips on planning implementation.

Growing demands on the wireless LAN (WLAN) are creating increased pressure to provide more bandwidth at higher rates. To address congestion and the need for higher throughout speeds, the IEEE is developing the new 802.11ac standard, which is expected to be ratified by February 2014 and will be backwards compatible with 802.11n.

802.11ac moves wireless traffic to the 5 GHz band, instead of 2.4 GHz, and claims to provide 'faster throughput at greater distance' through:

- wider channels
- higher modulation and coding
- beamforming
- multi-user MIMO
- more spatial streams.

Wider channels

One of the key ways 802.11ac gains speed is by using 80 MHz wide channels. In a second phase this will increase to 160 MHz channels (although these will be optional). However, this means fewer available channels in the 5 GHz band. In Europe, 802.11ac has four available 80 MHz channels, and will have two available 160 MHz channels. In comparison, there are 19 non-overlapping 20 MHz channels available.

Note that without using DFS, in Europe the available 80 MHz channels drops to 1 so DFS support in APs and clients is going to be a necessity to deploy 802.11ac effectively.

Higher modulation and coding schema

802.11ac introduces higher order modulation using 256QAM. This increases the number of bits that can be encoded in a single symbol and can provide up to a 33 per cent improvement in bit rates. However, it requires a change in transmitter and receiver design, making RF system design more challenging.

Beamforming

Beamforming allows 802.11ac routers to deliver a wireless signal straight to a device. Although supported in 802.11n, the new standard is more efficient — in part because it only includes one method of beamforming.

Multi-user MIMO – more spatial streams via more antennae

802.11ac will use multi-user MIMO (Multiple Input Multiple Output) to support simultaneous transmissions to multiple clients, provided they are spatially separated. In theory 802.11ac can handle up to four spatial streams per client, and each device continuously receives the full bandwidth on offer (Figure 1).

GCMP security protocol

The security protocols used with 802.11ac will in most respects be the same as those used with 802.11n, so devices will largely use AES-CCMP. However, 802.11ac also permits use of GCMP – the Galois/Counter Mode Protocol - which reduces latency and is also computationally faster.

Phased introduction

The first wave of 802.11ac will include 80MHz channels and 3x3 APs. The next wave will bring 160 MHz channels, MIMO configurations greater than 3x3 and multi-user MIMO. Physical layer connection rates will eventually reach 6.9 GHz.

In theory, most initial implementations should enable speeds of up to 1.3 Gbps as well as better coverage than 802.11n. In practice, 802.11ac can only reach Gigabit-per-second speeds in laboratory conditions. Its range is also likely to be more limited than 2.4 GHz 802.11n and 802.11g, and it can only deliver as much broadband as the slowest link in the network. However, user throughput (in bits per second) will increase, increasing AP capacity. Table 2 shows a comparison between 802.11n and 802.11ac protocols.

Planning 802.11ac introduction

We believe most people will have a hybrid network for some time. This will require design and planning capability to cover 802.11ac and 802.11n to ensure users obtain the best performance with both.

Network engineers should also consider upgrading the capacity of their

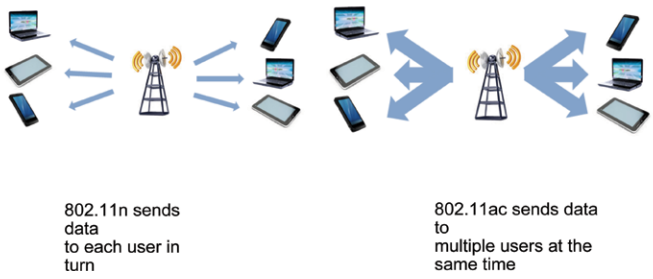


Figure 1 — Multi-user MIMO.

	Including DFS*		Excluding DFS	
Channel size	US	EUROPE	US	EUROPE
40 MHz	6	9	4	2
80 MHz	3	4	2	1
160 MHz	1	2	--	---

Table 1 — Available 802.11ac channels. *DFS = Dynamic Frequency Selection — for avoiding interference with weather radar.

	802.11n	802.11ac
Frequency band	2.4GHz and 5GHz	5GHz
Channel width	20 and 40MHz	20, 40, 60, 80MHz (option 160MHz)
Spatial streams	1 to 4	1 to 8 (up to 4 per client)
Multiple user MIMO	No	Yes
Single stream max. client data rate	150Mb/s	433MB/s (if 80MHz channel)

Table 2 — Comparison of 802.11n and 802.11ac protocols.

Ethernet access and uplink networks. For example, if the AP links are currently 100MB, they will need to be upgraded to 1GB; if 1GB, consider upgrading them to 2GB. Aggregation links need to be sized to allow for all the 802.11ac APs they will have to accommodate.

There are five key factors to consider when planning implementation.

1) **Throughput** - 802.11ac should give better performance and require fewer APs, but technologies such as beamforming mean signal strength is not a true indicator of WLAN performance. Engineers will need to measure throughput, carrying out active site surveys as well as Iperf surveys so they can measure and map actual end-user performance using an 802.11ac adapter.
2) **Capacity** – to find out if there is sufficient WLAN capacity in a hybrid network requires a network performance planning tool that supports both existing and new protocols. Measuring channel width, channel overlap and MCS coverage will help assess where high throughput can be obtained to support high client density
3) **Channel allocation** – the wider channels introduced with 802.11ac make co-channel interference more likely, so it is important to develop a channel application plan. 802.11ac designates one sub-channel in a bonded channel as 'primary'; this is used for transmission at a specific bandwidth. The planning tool needs to show where primary and secondary channels interfere with each other to enable adjustment of channel allocations and AP locations to maximise performance.
4) **Impact of using DFS channels** – to avoid using the same frequency range as radar, the 5 GHz band contains channels with Dynamic Frequency Selection (DFS) capabilities, and the AP has to vacate its channel if it detects radar. A planning tool incorporating a spectrum analyser will identify if DFS channels are available or occupied and show any non-WiFi interference.
5) **Impact of older standards** – in a hybrid network it is vital to ensure that the slower transmission rates of older standards do not reduce 802.11ac performance. A coverage map enables visualisation of the areas where legacy clients can be supported, and a throughput survey using an 802.11ac client validates whether the WLAN can provide the required user performance.

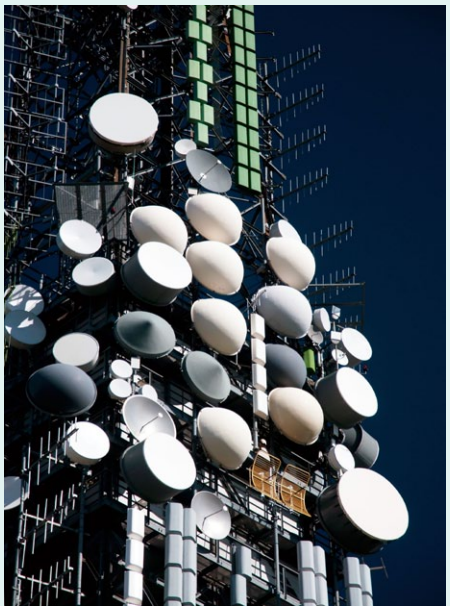
So while 802.11ac offers significant advantages, there are a lot of factors to consider when adding it to a network. Fluke Networks offers the ability to detect, analyse and troubleshoot 802.11ac APs using currently supported 802.11n adapters. These solutions provide key metrics such as the number of 802.11n and 802.11a clients present in the network, the APs these clients are connected to and network channel utilisation by 802.11n and 802.11a clients.

The AirMagnet Planner, for example, has multi floor planning capability, enabling users to visualize coverage and performance heat maps in 2D and 3D across floors providing powerful insight into bleed over to adjacent floors.

By decoding 802.11ac management frames in real time, engineers can detect VHT capabilities of the AP and thus troubleshoot performance issues in 802.11ac networks resulting from the presence of legacy clients.

The author, Stephane Persyn is the Field Marketing Manager for wireless and network performance solutions at Fluke Networks — www.FlukeNetworks.com.

Multi-Band and MIMO requirements of LTE put pressure on antenna vendors



ABI Research estimates US$ 1.4 billion worth of LTE-capable antennas were shipped in 2013. This is equivalent to 1.89 million antennas with expected growth to 3.14 million in 2018.
A large part of this growth in sales is being primed by the need for Multiple In, Multiple Out (MIMO) antennas which is a key ingredient to make LTE, and LTE-Advanced in particular, ultra-fast. Furthermore, the clamor for additional LTE spectrum bands is encouraging operators to invest for the long-term by selecting multi-band and ultrawide-band antennas. From 2014, the proportion of LTE-antennas shipped that will be multi-band will grow markedly, from 30% to 68% in 2018.

The mobile cellular network antenna has been the unsung hero of the mobile cellular revolution. "The spotlight is often cast onto the latest and greatest smartphones and LTE download speeds, which underpin the end-user's mobile video streaming, Facebook account browsing, and/or WhatsApp instant messaging habits. And yet the mobile operator's antenna is the lynchpin in the whole experience," comments Jake Saunders, VP and mobile carrier strategy practice director.

Competition in the antenna segment has been heating up recently. Historically the sector has been dominated by Kathrein and CommScope (Andrew); however, Huawei has been methodically able to build up base station relationships with operators in Europe, Asia, and the Middle East and Africa which include utilizing its own antennas.

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Radar cross-section: a guide to field measurements using the latest portable VNAs

By Ferdinand Gerhardes, Anritsu (Germany), www.anritsu.com

Radar cross section (RCS) is the measure of a target's ability to reflect radar signals in the direction of a radar receiver. A number of different factors determine how much scattered electromagnetic energy returns to the source, and so different objects of similar size and shape can have a dramatically different RCS.

Of course, RCS is a crucial parameter to manufacturers and users of, for instance, aeroplanes and ships. In general, designers are tasked with maximising the RCS of civil aircraft and vessels, and minimising that of their military counterparts. This means that any technique offering faster or more accurate RCS measurements can offer great value.

This article describes how accurate RCS measurements can be made with an instrument not normally used for the task: a portable VNA. Complex RCS measurements are normally thought to require the use of bench-top instruments. But this article provides a brief guide to the way S-parameter measurements, taken by a portable VNA in the field or when the target is in flight, can be used as the basis for an RCS calculation.

The fundamentals of RCS measurement

The measurement of the RCS of targets, both simple and complex, is a difficult and challenging electromagnetic problem that has existed since radar was invented. Although the principles of electromagnetic theory are well developed, the application of those principles for estimating RCS often results in complex and extensive computations. Thus there is always the need to test or validate theory or to verify predictions; such actions are best accomplished by test range measurements.

In mathematical terms, the RCS of a target is the projected area of an electrically large and perfectly conducting metal sphere that would scatter the same power to the receiver as the target does (see Figure 1). It is usually represented by the Greek letter σ and has the unit of area (m^2). This quantity depends on three factors:

- Geometric cross-section;
- Reflectivity;
- Directivity.

These three factors help explain the distinctive design of the 'Stealth' bomber aircraft used by US military forces to evade detection by enemy radar: a low profile (to present a small geometric cross-section), coated with radar absorbent materials (to reflect less of the incident energy) and with a structure consisting of many small flat panels at various angles (to reflect most incident energy away from the receiver).

A spherical shape is useful in field and laboratory measurements, since the orientation or positioning of the sphere does not affect the measurement of radar reflections. Such measurements can therefore be used as a reference for calibration. But targets such as ships and aircraft are very complex and have a great variety of reflecting elements and shapes. The RCS of these objects therefore cannot easily be calculated, and must be measured.

Performing RCS measurements in the field

The challenge for the engineer, then, is to take effective and accurate RCS measurements of actual objects such as aircraft (see Figure 2). This article now describes a technique for calculating RCS on the basis of S-parameter measurements. The advantage of using S-parameter measurements is that they may be made with a Vector Network Analyser (VNA), a proven and highly accurate type of measuring instrument.

RCS measurements are, of course, crucial to manufacturers and users of aircraft and ships. For them, a portable

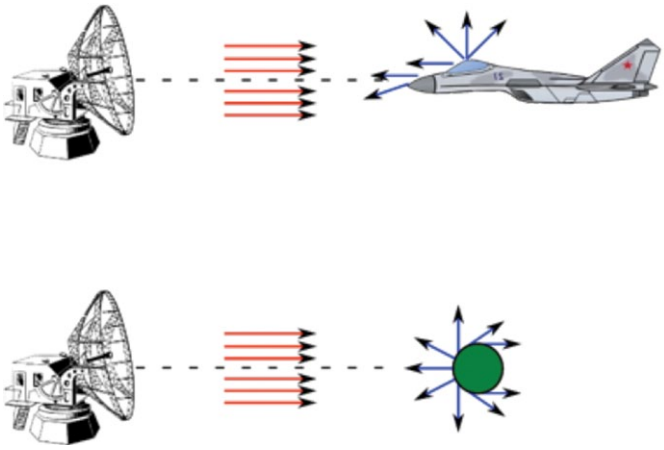

Figure 1: the RCS is expressed as the projected area of a metal sphere that would scatter the same power to the receiver as the target does.

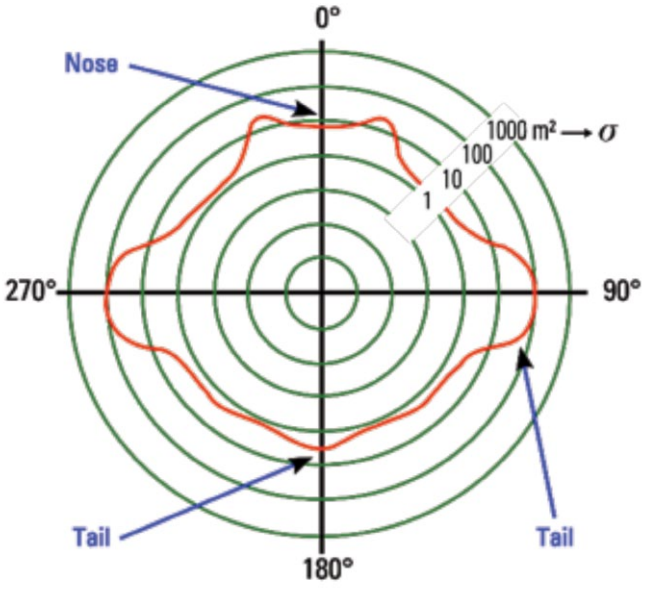

Figure 2: RCS of a typical bomber. The plot is an azimuth cut made at zero degrees elevation (on the aircraft's horizon).

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NATIONAL INSTRUMENTS

VNA such as the MS202xC/MS203xC VNA Master™ series of handheld VNAs from Anritsu may replace a bulky, AC-powered and expensive bench-top VNA. With a broad frequency range of 5kHz to 20 GHz, fast sweep times, waveguide support, and advanced time-domain capabilities, the MS202xC/MS203xC series offers comparable features and performance to many bench-top instruments, and is ideal for taking mobile RCS measurements.

The role of the VNA Master is to measure S-parameters in the frequency domain. The frequency range for the measurements is chosen to correspond to the radar frequency band (8.2-12.4 GHz for a WR-90 X-band waveguide). The time-domain function of the VNA will transform the S-parameter frequency-domain measurement (Γ versus frequency) to the time domain (Γ versus time or distance).

For the purpose of illustration, the measurement target may be taken to consist of an aircraft either mounted on a low-reflection pedestal, or stand-alone on a flight path. But before measuring a real aircraft a calibration, or reference, is required. For a typical measurement configuration, the Transmit antenna is connected to port 1 of the instrument, and the Receive antenna is connected to port 2. The E field of both antennas is pointed vertically. The following arrangement delivers successful results:

- The antennas are located as close as possible to each other, in either the vertical or horizontal plane.
- To develop a polarisation matrix, both the Transmit and Receive antennas should be capable of 90 degree rotation.
- The target should be located at a distance D > AFR/2 > 20λ, and so that the entire target is within the beam of the antennas.
- The target dimensions should be within -1 dB of the azimuth and elevation angles of the antenna beam.

Antenna system calibration

A full 12-term calibration is performed at the output of the coaxial cables to establish the reference plane for the RCS measurements. An $S_{21}(f)$ frequency-domain measurement is performed on the target area. The S-parameter data $S_{21}(f)$ are transformed to the distance-domain mode $S_{21}(D)$ using band-pass mode processing. Reflections from the target area or support structure are shown in Figure 3. It is important to take care that reflections from extraneous objects, including target support structures, are at least 20 dB below those of the estimated target.

In order to do an RCS measurement, it is necessary to calibrate the system by measuring a target of known RCS and referencing all other targets to the known target.

For our example we will use a 6" sphere as the reference object. Assuming that the radius r of the sphere meets the requirement of $(2\pi r / \lambda) > 10$, RCS is calculated with the equation $\sigma = \pi \cdot r^2$. Thus the RCS of an ideal 6" sphere is 0.018 m². Other potential calibration objects are shown in Figure 4.

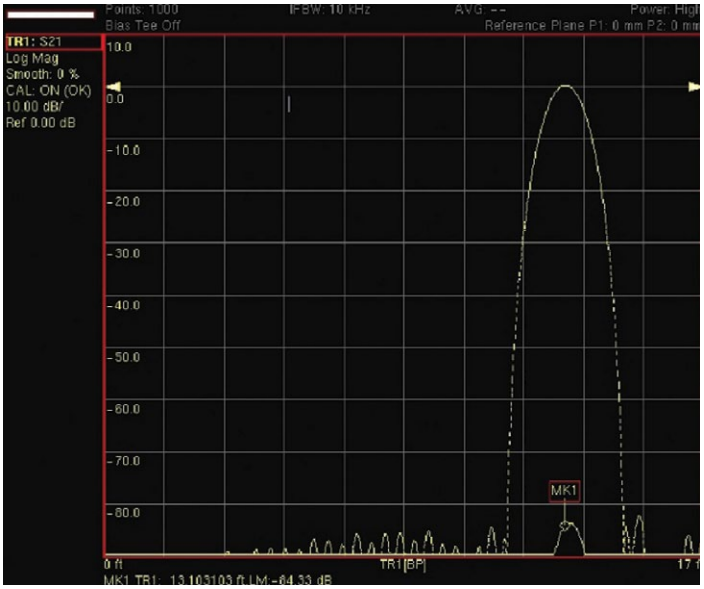


Figure 3: START GATE set to 3.5 m, STOP GATE set to 4.5 m; GATE FUNCTION ON; some multi-path background reflections are visible.

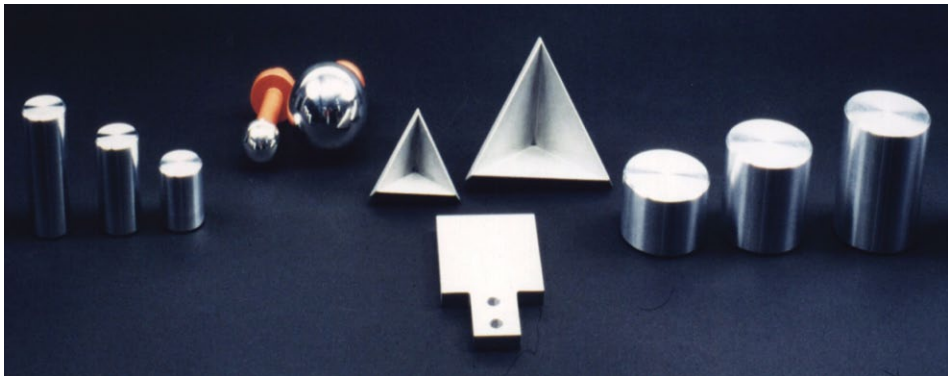


Figure 4: standard objects valid for use in RCS calibration.

Now an $S_{21}(f)_{Std}$ frequency-domain measurement is performed on this 6" sphere, and the data transformed to the time-domain mode. An appropriate time gate is centred at the distance (D) to the target with a gate width greater than the observed size of the target. Setting a gate has the effect of eliminating all other, unwanted, reflections. The magnitude of the S_{21Std} parameter of the standard reflection is measured and provides the reference for the subsequent RCS target measurement.

If the standard were a sphere with an RCS of 1 m², then the RCS of the target is given by equation E2:

E2: $RCS_{Tgt}[dBsm] = RCS_{Std}[dB] - RCS_{Tgt}[dB]$

E3: $dBsm = 10 \bullet \log_{10}(RCSm^2)$ [dB]

The data are expressed in dBsm (decibels referenced to one square metre). RCS in square metres can be converted to dBsm using the equation E3.

In Figure 5 the level S_{21Std} of the calibration object's standard reflection is measured with the equation:

$$S_{21Std} = 10 \cdot \log\left(\frac{P_{Std}}{P_T}\right) \qquad \text{E4}$$

= -62,54 dB, and corresponds to the known RCS (in m²).

Target measurement

In the next step, the calibration standard is replaced by a 12" sphere acting as the target under Test (TUT) and the backscattered level S_{21Tgt} is measured again. The target is repeatedly rotated in order to gain the azimuth dependency of the RCS. Finally the difference is calculated by using the trace math (memory – data = S_{21Std} - S_{21Tgt}) feature of the VNA Master.

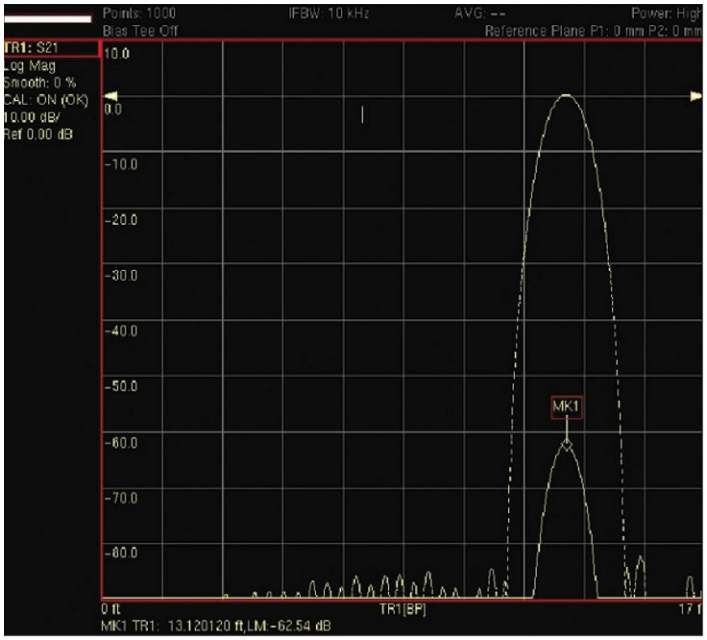


Figure 5: target reflection with a level of -62,54 dB from a 6" diameter calibration sphere (σ = 0,018 m²).

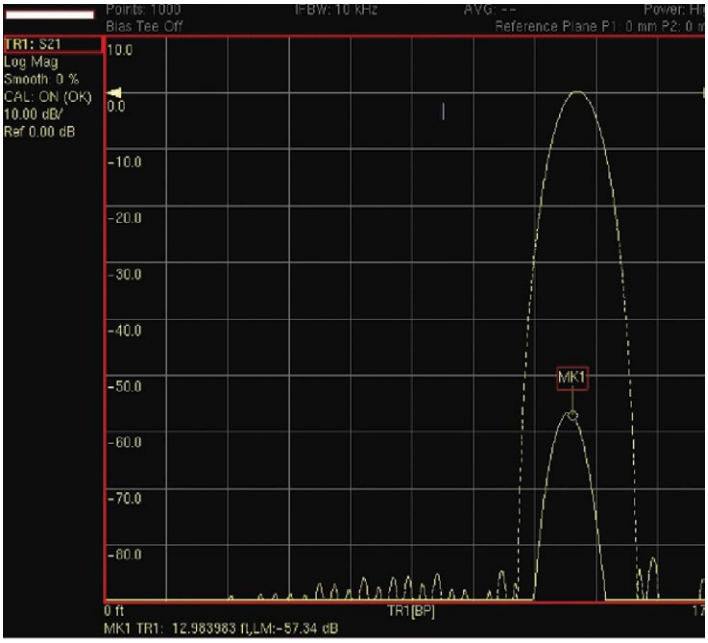


Figure 6: RCS measurement for a target of a 12" diameter sphere.

With the help of the Radar Equation it is possible to derive the target's RCS in an analytical way. This is done using the equation:

$$P_{RX} = P_{TX} \cdot G_{TX} \cdot G_{RX} \left(\frac{\lambda}{4\pi R}\right)^2 \cdot 4\pi \frac{\sigma_{tgt}}{\lambda^2} \cdot \left(\frac{\lambda}{4\pi R}\right)^2 \quad \text{E5}$$

where P_{RX} is the backscattered received power at the receive antenna. Representing the two comparative measurements with a calibration object in the form of a 6" sphere and a target object, the above equation can be transformed as follows:

$$P_{Std} = \sigma_{Std} \cdot P_{TX} \cdot G_{TX} \cdot G_{RX} \cdot \frac{\lambda^2}{(4\pi)^3 R^4} \quad \text{and}$$

$$P_{Tgt} = \sigma_{Tgt} \cdot P_{TX} \cdot G_{TX} \cdot G_{RX} \cdot \frac{\lambda^2}{(4\pi)^3 R^4} \quad \text{E6}$$

where the index Std refers to the RCS of the calibration standard (in our case a 6" sphere) and Tgt refers to the target.

Therefore the two VNA measurements can be written as:

$$S_{21Std} = 10 \cdot \log\left(\frac{P_{Std}}{P_T}\right) \quad \text{and} \quad S_{21Tgt} = 10 \cdot \log\left(\frac{P_{Tgt}}{P_T}\right) \quad \text{E7}$$

$$\frac{P_{Std}}{P_T} = 10^{\frac{S21Std}{10}} \quad \text{and} \quad \frac{P_{Tgt}}{P_T} = 10^{\frac{S21Tgt}{10}} \quad \text{E8}$$

To calculate the RCS of the target the following relation can be applied:

$$\frac{P_{Tgt}}{P_{Std}} = \frac{\sigma_{Tgt}}{\sigma_{Std}} = 10^{\frac{S21Tgt - S21Std}{10}} \quad \text{and} \quad \sigma_{Tgt} = \sigma_{Std} \cdot 10^{\frac{S21Tgt - S21Std}{10}} \quad \text{E9}$$

Figure 6 shows the RCS measurement at a level of -57.34dB for the target, a 12" diameter sphere, and Figure 8 shows the RCS for the calibration standard (a 6" diameter sphere) at -62.54dB. The difference of 5.2 dB is equal to:

$$dB = 10 \cdot \log_{10}\left(\frac{\sigma_{Tgt}}{\sigma_{Std}}\right) \Rightarrow \sigma_{Tgt} = 0{,}06 \ \text{m}^2 \quad \text{E10}$$

Dissolving the above equation to σ_{Tgt} results in the same value as that derived from a theoretical radar equation: the theoretical value for a 12" sphere is 0.073 m² or 0.77dB in dBsm. Most of the error can be attributed to small movements in the VNA's support mechanism during measurement.

Proven implementation of RCS measurement in the field

The close match between the measured and the expected results shows that the use of a high-performance portable VNA can provide reliable and accurate measurements of RCS in the field. The straightforward measurement set-up described above can realistically be implemented in any required environment, since a portable, battery-powered VNA can be located in the optimal location for the measurement of large targets such as aircraft and ships. Functions and settings built in to a portable VNA facilitate the configuration of RCS measurements and the calculation of the results, helping the engineer to perform measurements quickly while using a familiar and well-understood instrument.

The author, Ferdinand Gerhardes is the Program Manager (education and research markets) at Anritsu (Germany) — www.anritsu.com.

Performing component verification in the field using a rugged vector network analyzer

By Rolland Zhang, Agilent Technologies, www.agilent.com

The installation and maintenance of specialized systems—radio networks, satellite ground stations, radars—often requires in-field verification and adjustment of filters, diplexers, duplexers and antennas. Although the preferred tool is a vector network analyzer (VNA), typical benchtop units are neither portable nor rugged enough for field use. To address this need, Agilent's FieldFox family of RF and microwave analyzers makes it possible to make precise measurements under non-ideal conditions: in a hangar during a snowstorm, aboard a ship sailing rough seas, or at a satellite trailer in a sandstorm (Figure 1).

When working in the field, reality often dictates the need for a balance between precision and practicality. In the case of vector network analysis, the key tradeoffs are between speed, accuracy and the complexity of the calibration process. This article will focus on analyzer configurations and calibration methods that support high quality vector network measurements in a short amount of time.

Accounting for the range of potential problems

Any scenario that involves accurate device characterization usually conjures up images of a network analyzer and one or more calibration kits on a lab bench. Today, more and more engineers and technicians need to make accurate measurements in remote locations and harsh environments—and they want to do so with less equipment and in less time.

Extreme conditions make it difficult to perform essential measurements and get accurate results. Indoor tests may be in limited space, perhaps near other operating equipment. Examples include vehicles, aircraft, ships and submarines. Hazards to the equipment-under-test include heat, stress, vibration and mishandling. Also, oils and other contaminants may leak into the components. Outdoor measurements may be performed in extreme temperatures, heavy precipitation and strong winds, and perhaps with hostile combatants nearby. These conditions have the potential to damage cables, antennas, filters and other system elements.

Severe conditions make it difficult to produce accurate, repeatable measurements of characteristics such as voltage standing wave ratio (VSWR), return loss, insertion loss, isolation, distance-to-fault (DTF), S-parameters and cable loss. What's more, the possible physical configurations and distances will dictate the practicalities of making one- or two-port measurements.

The need to carry a minimum amount of equipment into the field has implications for calibration. More external accessories mean more a larger, heavier field kit. Complex calibration setups mean spending more time in nasty conditions, and can lead to user errors in the cal process.

Figure 1. The handheld FieldFox microwave vector network analyzer enables favorable tradeoffs between speed, accuracy and calibration in the field.

Getting accurate, repeatable results in the field

A FieldFox analyzer can be configured for cable-and-antenna test (CAT), vector network analysis and spectrum analysis—individually or in combination—with maximum frequency coverage that ranges from 4 GHz to 26.5 GHz. To survive field use, the analyzers are durable enough to comply with MIL-PRF-28800F, which includes water resistance and a dust-free design, and type tested under IP53 (dust and rain). FieldFox has also been type-tested for operation in explosive environments according to MIL-STD-810G, Method 511.5 Procedure 1. As an added element of user safety and convenience, the analyzers can be controlled and monitored remotely through an iOS app.

Configuring for the required results

The minimalist configuration for field use is the CAT analyzer. With these capabilities, the instrument measures magnitude-only S-parameters and reports values such as return loss, VSWR and insertion loss. These are useful when characterizing antenna components and transmission line systems including cables and waveguides.

As a VNA, FieldFox can be configured for either transmission-and-reflection measurements (forward only) or full two-port measurements (forward and reverse). In either case, the analyzer can measure the full set of complex-valued (magnitude and phase) S-parameters.

In a transmission/reflection (T/R) configuration, the DUT must be disconnected and reconnected to make measurements in the reverse direction. Because the full two-port configuration includes an internal switch matrix, the device-under-test (DUT) need be connected only once. A full two-port unit provides the highest level of measurement accuracy because it allows the characterization and removal of all systematic measurement errors.

Utilizing built-in calibration capabilities

FieldFox offers several types of calibration, ranging from simple to advanced. The simplest types are CalReady and QuickCal. Neither requires an external cal kit, and this reduces the amount of equipment to be carried into the field. It also means fewer steps and therefore shorter total measurement times.

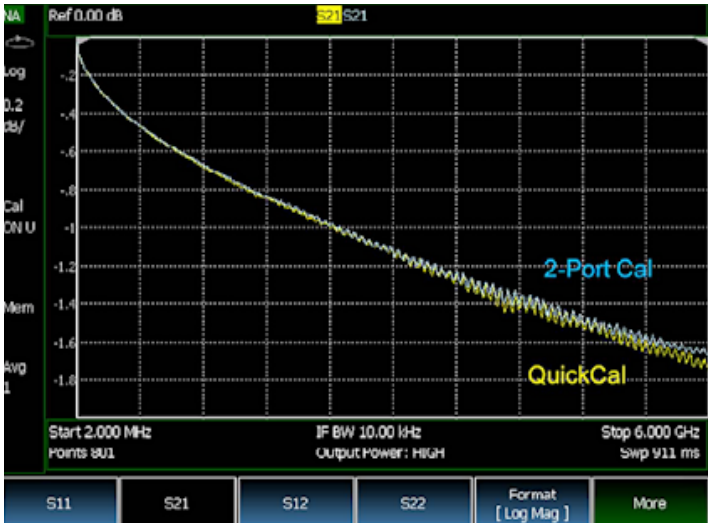


Figure 2: By extending the measurement plane to the DUT, QuickCal can produce results that are comparable to those from a full two-port calibration.

With CalReady, the instrument is already calibrated at power-on (or after a preset) and is ready to go without any additional steps. It applies full two-port error correction at the test ports.

QuickCal enables the user to perform calibration without additional accessories. Because the cal plane is extended out to the actual connection to the DUT, this method can compensate for test cables and adapters placed between the instrument and the DUT.

In field applications, QuickCal coupled with a full two-port configuration provides the best balance between precision and practically. It also offers the optimum blend of speed, accuracy and cal simplicity.

Figure 2 compares two measurements of forward transmission, S21, made on a short coaxial cable using QuickCal and a traditional full two-port mechanical calibration. As shown, there is very little difference between the two traces, and this suggests the value of QuickCal as an alternative to mechanical calibration when making measurements in the field.

If even greater precision is needed, FieldFox also supports advanced calibration methods: one-port open-short-load (OSL), full two-port short-open-load-through (SOLT), quick SOLT (QSOLT) and enhanced response. Although these offer the highest level of accuracy, they do require the user to carry high-quality cal kits into the field. In terms of tradeoffs, greater accuracy comes at the expense of cal complexity and set-up time. Also, the cal kits include coaxial and waveguide standards that must be kept clean and protected from damage.

Carrying precision into the field

With the configurations and capabilities outlined above, it is possible to carry precision into the field and perform accurate, repeatable vector network analysis. Making this a reality requires a handheld instrument that is on the leading edge of today's technologies—electrical and mechanical.

Making it economical comes from configurability: the ability to carry multiple instruments in a compact, durable package provides a meaningful cost advantage. For example, the initial purchase can be for a unit that provides many useful capabilities while fitting into existing budget constraints. Additional capabilities can be added later as budgets allow.

Update on the Draft R&TTE Directive

By Jean-Louis Evans, Managing Director, TÜV SÜD Product Service

Since its introduction in April 2000, the Radio and Telecommunications Terminal Equipment Directive (R&TTE) has been the required method for manufacturers to test and show compliance of any radio and telecoms equipment that is sold across Europe.

The Directive encompasses all products that use the radio frequency spectrum, such as car door openers, mobile devices and radio transmitters, as well as all devices connected to public telecommunications networks, including ADSL modems, phones and telephone systems.

The R&TTE replaced the Telecommunications Terminal Directive and national standards that may have previously existed within each individual EU country. It was introduced to reduce trading barriers in Europe, while continuing to ensure that products met minimum requirements related to health and safety, EMC and the protection of the radio spectrum.

As a result of the R&TTE, it now takes less time and money to gain approval than with the previous legislation. As manufacturers are no longer encumbered by any national differences between individual country safety requirements, the time to market for new goods has also been significantly reduced.

A new draft is introduced

Following several market surveillance campaigns, the European Commission is concerned about the low level of compliance with the current requirements of the R&TTE for some categories of radio equipment. This, coupled with the huge increase in the number of mobile devices and wireless applications, has led the European Commission to publish a new draft of the R&TTE. The core goals of the draft are to strengthen the level of compliance with the Directive, so that EU citizens have compliant radio equipment, as well as clarifying and simplifying the Directive.

The new requirements were intended to clearly spell out the responsibilities and obligations for every market player, be they a manufacturer or importer. It was hoped that simplification would come in the form of reduced administrative overheads, such as the suppression of notification requirements of certain products.

A press release issued by the European Commission at the same time as the proposed new draft said: "The proposal aims to make sure all market players comply with the rules regarding the avoidance of interference, so that consumers do not have problems when opening car doors, monitoring their babies or listening to radio. The Commission also proposes to clarify and simplify the Directive, to facilitate its application and to eliminate unnecessary burden ultimately increasing all stakeholders' confidence in the regulatory framework."

The European Commission subsequently sought input from Member States. The concerns that they have raised range from dissatisfaction with the transparency of the negotiations leading to the drafting of the proposed Directive, through to fears about the anticipated consequences of the Directive if it was enacted in its current proposed form.

Draft highlights

The suggested changes to the R&TTE Directive in some instances are wide ranging, with Annexes being renumbered and updated. However, many suggestions within the draft have already been rejected and this article provides a few key highlights.

Telecommunications Terminal Equipment has been excluded from the scope of the draft Directive; however, it is not yet clear whether radio receivers, e.g. TV and radio broadcast receivers, are excluded.

Article 5 (Registration of radio equipment within some categories) of the R&TTE draft introduces the possibility to require the registration of products, that fall within categories showing low levels of compliance, in a central database. It was intended that this would enhance the efficiency and effectiveness of market surveillance and therefore contribute to ensure a higher level of compliance with the Directive.

After feedback from Member States it has been proposed that this idea should be withdrawn, mainly because such a requirement would entail an additional burden to 'economic operators' and would raise confidentiality issues. Also, categories of radio equipment where a high level of compliance was not attained tend to be low value goods, such a remote control toys, and additional costs would no longer make

compliant manufacture worthwhile and possibly do the reverse of the draft's intention to increase compliance.

Article 10 (Obligations of manufacturers) refers to changes to the system for the declaration of Conformity. It suggests that manufacturers will now have two options within the new Directive. One is to include a copy of the full EU declaration of conformity covering all applicable Directives with each piece of radio equipment.

The simplified EU declaration of conformity, previously introduced following a TCAM interpretation, is now an explicit option. This must include the internet or e-mail address where the full EU declaration of conformity can be obtained. It must also be available in a language or languages required by the Member State in which the radio equipment is placed.

The draft Directive also introduces new responsibilities for importers with regards to sample testing of products. It is not entirely clear at what point this becomes a mandatory requirement as the draft uses the words "when deemed appropriate with regard to the risks presented by radio equipment", so this is currently quite subjective. However, to protect the health and safety of consumers, importers will be required to carry out sample testing of radio equipment made available on the market. They must also investigate and keep a register of complaints of non-conforming radio equipment and of product recalls, and keep distributors informed of such monitoring.

Specific responsibilities for market surveillance authorities are defined in the draft Directive for the evaluation of compliance of radio equipment to ensure that, if considered justified, non-compliant radio equipment is withdrawn or recalled from the market.

Recent proposals have included the mandating of universal battery chargers, particularly for mobile phones, and the introduction of CE marking on integral screens.

While the new R&TTE Directive is still in draft form, following feedback from Member States, it is hoped that the first reading of the new Directive will be put before the Commission in early 2014. While there are no defined deadlines, it is important that manufacturers, importers and wholesalers of radio equipment become familiar with the new format and requirements, especially as Annexes in the old Directive have been renumbered quite extensively. However, this has been probably the slowest review of a directive in the history of the EU and with an expected transition period of 18 months to two years, it is unlikely that the new Directive will come into force until 2016 at the earliest.

Jean-Louis Evans is the Managing Director at TÜV SÜD Product Service, a global product testing and certification organisation, and at its sister company, TÜV SÜD BABT, the world's leading radio and telecommunications certification body — www.tuv-sud.com.

Coaxial connector to microstrip transition optimization

By Dr. Jaakko Juntunen, AWR Europe, www.awrcorp.com

This example briefly discusses how a coaxial connector to microstrip transition can be optimized using AWR's Analyst™ 3D finite element method (FEM) EM simulator.

Overview

When comparing measurement results to simulated ones, the transition (Figure 1) from the measurement hardware's coaxial cable to the signal trace of the DUT is commonly assumed to be ideal. But in reality, this "ideal" condition results in data mismatch (simulation data =/ measurements) at higher frequencies.

This ideal assumption is implicitly made as soon as the simulation input/output ports are on the trace, e.g., on the microstrip or coplanar waveguide (Figure 2). While there are multiple methods that can be used for ensuring the transition has as little reflection as possible, this specific example highlights the approach of using a full 3D FEM EM model for the connector. Doing so enables the treatment of the transition's parasitics in an analytic fashion and moves us away from the "ideal" and toward reality.

The design

In the schematic (parent document), we have drawn a printed circuit board (PCB) with the signal trace. The 3D connector that is designed for 20mil substrates is, technically speaking, a sub model (or child) of the parent document, i.e., the design is hierarchical. The connector model allows for the placement of a port on the coaxial cable end of the connector (input port), and for the other port to be defined as a regular wave port at the end of the microstrip (output port). The reference plane of the output port is moved just after the connector.

Transition quality without optimization

Looking at S11 (Figure 3) of the transition reveals that the inherent matching is good only up to about 2 GHz. At the target design frequency of 10 GHz, the reflection is as high as -10 dB. Clearly the design would now benefit from an optimized transition - not only because of lost energy, but also because the mismatch is a considerable source of error for the measurement versus simulation.

Optimization strategy

The transition model can be optimized in a schematic using the EM document as a regular sub model. It is easy to determine that a series-L parallel-C matching circuit would do the optimization job at 10 GHz. In microstrip, a series-L can be realized by a narrow segment of strip, while a parallel-C can be realized by a wide strip segment. It is straightforward to optimize the required strip dimensions, as shown in Figure 4.

The final step is to put the matching circuit dimensions in the 3D model and run a verification simulation, as shown in Figure 6.

It can be seen that the first matching attempt is excellent.

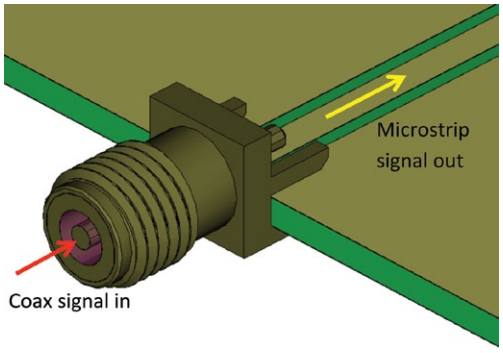


Figure 1: SMA connector is used to connect measurement hardware coaxial cable to the PCB, and converting the coaxial mode signal into microstrip mode propagating towards the device under test.

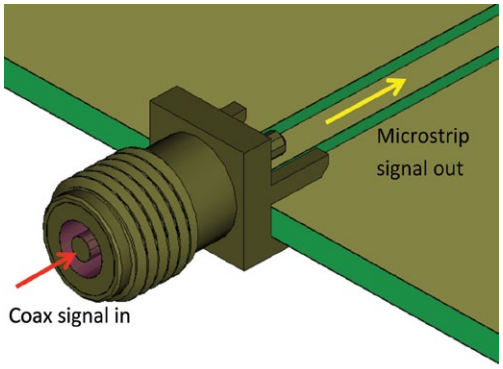


Figure 2: Typically the simulation port is directly on the microstrip, neglecting the discontinuity represented by the connector in Figure 1, and thus systematically distorting the simulated versus measured results.

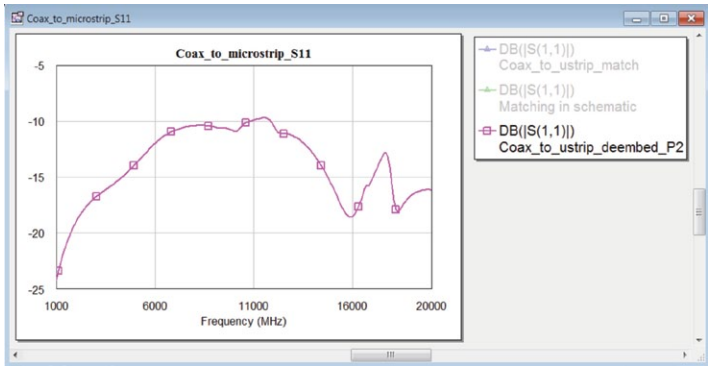


Figure 3: Reflection coefficient of the transition at coax port before optimization.

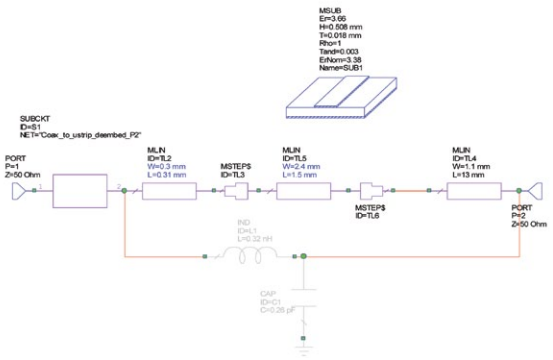


Figure 4: Matching circuit candidate to optimize transition from coax to microstrip.

It is also instructive to view and animate the surface currents at 10 GHz, as shown in Figure 7.

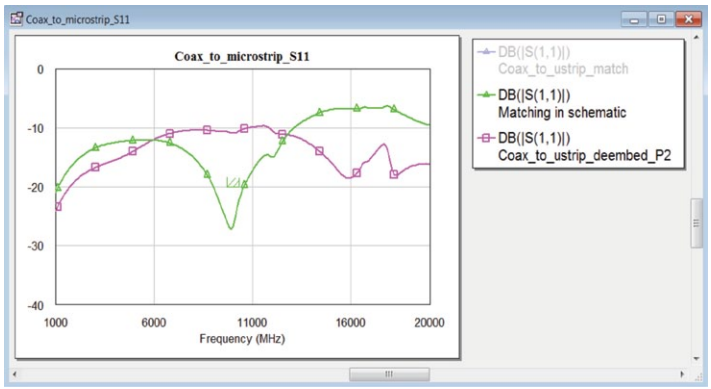


Figure 5: Reflection coefficient of the transition at coax port using the closed-form models of the matching circuit (green curve).

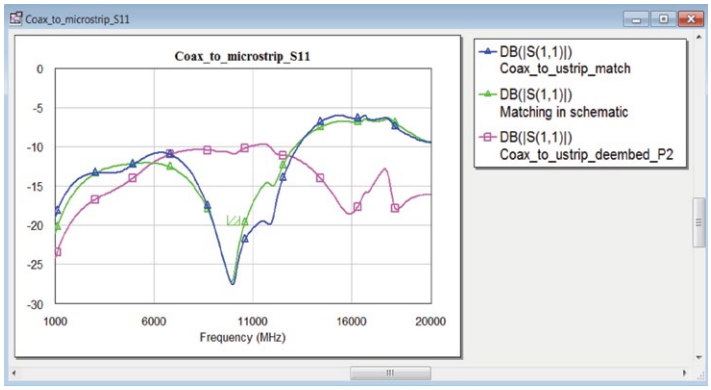


Figure 6: Reflection coefficient of the transition at coax port including a full 3D model of the matching circuit geometry (blue curve).

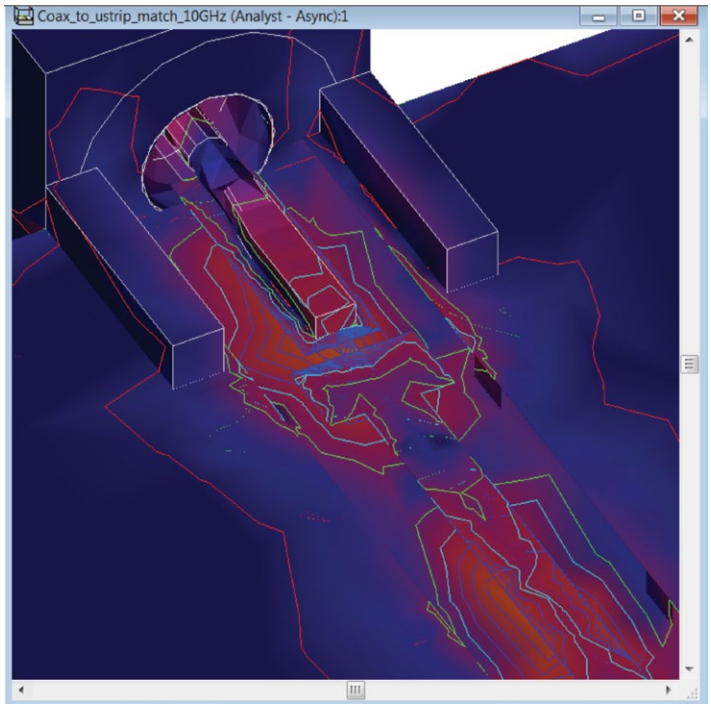


Figure 7: Surface current annotation of the optimized transition at 10 GHz.

To summarize, such a simple matching circuit provides signal transmission from coax cable into microstrip with less than -20 dB reflection at 10 GHz target design frequency. The matching bandwidth is about 2 GHz, and it is easily and reliably optimized using conventional circuit models with the connector EM model. A full 3D EM verified solution is readily available with the optimized geometry.

Various transition models from different connectors to different board substrates can be stored as a library, and conveniently used in any subsequent circuit design. Integrated 3D EM tool enables keeping all design data within one AWR Design Environment™ (AWRDE) project file, including connectors, bonded packages, housing or any other arbitrary 3-dimensional objects. This eliminates the risk of model misuse e.g. in case where a horizontal connector is changed to a vertical; the graphical view of the design layout immediately reveals which 3D model is used, unlike in the case where the S-parameters of the connector are evaluated elsewhere and imported as a blind file into AWRDE. Single project file also means easier documentation, design transfer, storage and reuse.

Mobile apps being used for DDoS attacks to increase

Prolexic Technologies, a leader in Distributed Denial of Service (DDoS) protection services, has reported that mobile applications are being used in DDoS attacks against enterprise customers. This is one of many key findings found in the company's Q4 2013 Global DDoS Attack Report.

"The prevalence of mobile devices and the widespread availability of downloadable apps that can be used for DDoS is a game changer," said Stuart Scholly, president of Prolexic. "Malicious actors now carry a powerful attack tool in the palm of their hands, which requires minimal skill to use. Because it is so easy for mobile device users to opt-in to DDoS attack campaigns, we expect to see a considerable increase in the use of these attack tools in 2014."

Data gathered in Q4 from attacks against Prolexic's global client base shows that mobile devices participated in a DDoS attack campaign against a global financial services firm. Digital forensics and attack signature analysis conducted by the Prolexic Security Engineering and Response Team (PLXsert) detected the use of AnDOSid, an Android operating system tool that performs an HTTP POST flood attack.

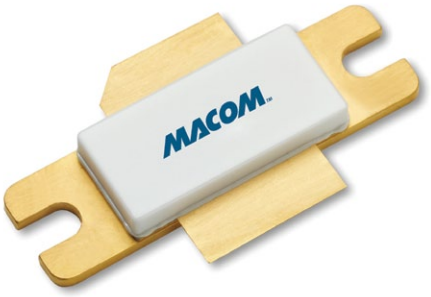
"Mobile devices add another layer of complexity," explained Scholly. "Because mobile networks use super proxies, you cannot simply use a hardware appliance to block source IP addresses as it will also block legitimate traffic. Effective DDoS mitigation requires an additional level of fingerprinting and human expertise so specific blocking signatures can be developed on-the-fly and applied in real-time."

Prolexic's latest DDoS attack report shows the total number of attacks against its clients in Q4 2013 once again set a new record for one quarter, illustrating the heightened level of DDoS activity throughout 2013. Compared to the same quarter one year ago, total attack volume increased 26 percent.

www.prolexic.com/attackreports

GaN on SiC HEMT power transistor

pulsed radar applications



A GaN on SiC HEMT power transistor for L-Band pulsed radar applications, from M/A-COM Technology Solutions, operates between the 960 MHz to 1215 MHz range.

The MAGX-000912-500L00 is a gold-metalized matched GaN on SiC RF power transistor optimized for pulsed avionics and radar applications. It provides 500 W of output power with 19.8 dB of gain and 60% efficiency. The device also boasts very high breakdown voltages, which allows for reliable and stable operation at more extreme load mismatch conditions.

The transistor is ideally suited for broadband avionics applications in the 960 to 1215 MHz range such as Traffic Collision Avoidance Systems (TCAS), Distance Measuring Equipment (DME) and Datalinks. It is assembled using state of the art design and packaging assembly, and is offered in both flange and flangeless ceramic packages.

Highly robust, the transistor boasts a mean time to failure (MTTF) of 600 years.

www.macomtech.com

Modular software defined radio platforms

cover DC to 6 GHz

USRP X300 and USRP X310 are high-performance, modular software defined radio (SDR) platforms from Ettus Research, a National Instruments company.

Both platforms combine two RF transceivers covering DC through to 6 GHz with up to 120 MHz baseband bandwidth and a large user-programmable Kintex-7 FPGA. The USRP X300 and USRP X310 both feature multiple high-speed interface options, including PCI Express, dual 10 Gigabit Ethernet and dual 1 Gigabit Ethernet and is available in in a convenient desktop or rack-mountable half-wide 1U form factor.

The USRP Hardware Driver™ (UHD) architecture, common to all USRP™ (Universal Software Radio Peripheral) devices, provides a comprehensive, easy-to-use interface. Developers can programmatically control the USRP with the UHD C++ API, or choose from a wide selection of third-party tools and software such as GNU Radio. The USRP X300 and USRP X310 use a flexible software ecosystem to deliver cost-effective, high-performance SDR solutions that help wireless system designers quickly create simple prototypes, develop complex systems and accelerate their wireless research.

Both the USRP X300 and USRP X310 leverage the Kintex-7 family of FPGAs from Xilinx. The USRP X300 uses the XC7K325T, and the USRP X310 is based on the larger XC7K410T. Kintex-7 FPGAs integrate up to 1,540 DSP48 slices operating in parallel so USRP users can deploy custom or third-party signal processing algorithms onto each device. Users can process data in real time using their own DSP algorithms such as filters, modulators/demodulators and coders/decoders. They can also access and control the wide range of peripherals available on each USRP, including the RF front ends.

www.ettus.com
www.ni.com

Software for single- and multi-satellite simulation

Enhancements to the N7609B Signal Studio for Global Navigation Satellite Systems (GNSS) software from Agilent Technologies now includes real-time simulation of SBAS (Satellite-Based Augmentation Systems), such as WAAS, EGNOS, MSAS, GAGAN and QZSS (Quasi-Zenith Satellite System for Japan).

The software also has the ability to add up to four CW interference signals inside the GPS, GLONASS or BeiDou bands for jamming tests.

With the enhanced N7609B software basic option, users can now create either single- or multi-satellite waveform files. Waveform-file simulation, a cost-effective solution for manufacturing, can be performed using the Agilent M9381A, PXIe VSG, E6607 EXT, X-Series vector signal generators, or the E6630 or E6640A EXM wireless test sets.

Several new intuitive information displays let users know the current scenario-playing status from a receiver's point of view. Scenario information displays include satellite sky view, which shows the location of all visible satellites in the sky; power view, which displays the instant power of all visible satellites in a bar chart; and trajectory view, which displays the trajectory of the moving receiver in a scenario.

The N7609B software helps users create validated real-time GNSS signals that can simulate satellites for U.S. GPS, Russian GLONASS, European Galileo, China BeiDou, SBAS and Japan QZSS. It can create either static scenarios for stationary receivers or dynamic scenarios for moving receivers. The simulation can be for an ideal environment or for one with impairments.

www.agilent.com

Single-box LTE-A base station tester

An extended version of the Aeroflex TM500 industry-standard base station tester is now available. It is capable of emulating several thousand LTE user equipments (UE), fading channel models, and LTE-A carrier aggregation functionality in a one-box benchtop unit.

"Carrier aggregation allows operators to achieve the wider channel bandwidths and higher data rates needed to offer true 4G services," said Ngwa Shusina, product manager at Aeroflex. "The LTE-A features provided by the compact one-box TM500 allow cellular infrastructure vendors to develop carrier aggregation capability and to emulate real network traffic across thousands of terminals, ahead of the widespread availability of real LTE-A handsets."

LTE-A carrier aggregation was first supported on the TM500 in early 2012, and has since been used by operators worldwide to demonstrate the real-world performance of carrier aggregation technology in field environments.

www.aeroflex.com

Complete line of PIM rated jumperss

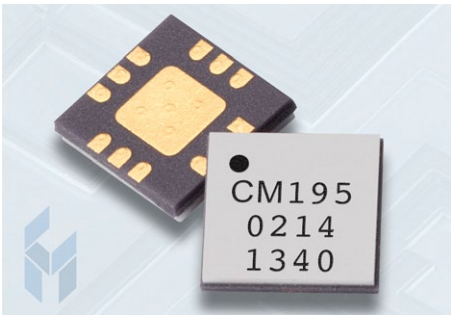
Times Microwave Systems has anounced a full line of PIM rated jumper cables, including PIM rated jumpers for plenum applications.

PIM testing includes the important dynamic testing in order for cables for provide good PIM performance after installation. All these PIM assemblies are 100% tested for static and dynamic PIM and verified to provide stable PIM performance prior to shipment.

In addition, plenum rated cables need to be UL listed and printed with the UL file number, otherwise a building inspector may not allow them to be installed or may require them to be removed after they are installed. All the company's plenum cables are UL listed and printed with the UL file number.

www.timesmicrowave.com

DC to 18 GHz non-reflective SPDT switches



Two DC-18 GHz SPDT non-reflective switches, the CMD195C3 and the CMD196C3 have been introduced by Custom MMIC. Although both switches cover the same bandwidth and are housed in the same 3 x 3 mm RoHS-compliant SMT package, they differ in their insertion loss.

The CMD195C3 has an insertion loss of 2.25 dB at the low end of its bandwidth, which then reduces monotonically to 1.5 dB at the higher frequencies. The positive slope in insertion loss versus frequency allows for several of the CMD195C3s to be cascaded together without the need for additional gain equalization circuitry. By contrast, the CMD196C3 is a general purpose SPDT design with a low insertion loss of 1.5 dB that increases slightly as the frequency approaches the upper end of the operating bandwidth.

Both switches electronically terminate the isolated port, have an isolation of 40 dB or greater, and a fast switching speed time of 1.8 ns. Switching is controlled by complementary negative logic levels of 0/-5 V.

www.CustomMMIC.com

Software defined radio platforms

modular, ideal for small cells

Highly scalable, the X-1200 adaptive dual-band NLOS (Non-Line-of-Sight) system from BLiNQ Networks allows mobile operators to rapidly deploy small cells to deliver coverage and capacity and is capable of simultaneously supporting licensed and unlicensed sub-6 GHz bands.

The X-1200 uses advanced antenna technology to enable high levels of NLOS coverage and simple installation, reducing OPEX and CAPEX associated with backhaul deployments. Operators can quickly deploy networks of small cells to provide both coverage and capacity where they are most needed.

This claims to be the first backhaul system able to effectively and seamlessly adapt to changes in the network. It is available today and the first operator deployments are expected in mid-2014.

According to the company, a system based on the X-1200 can be configured and installed using integrated software functions, in 20 minutes or less. The X-1200 has continuous real-time closed-loop RF environment characterization and can deliver capacity when and where needed by matching traffic type with optimal radio resources. The system supports link rehoming, which minimizes the need for 'truck rolls' as the network scales or changes.

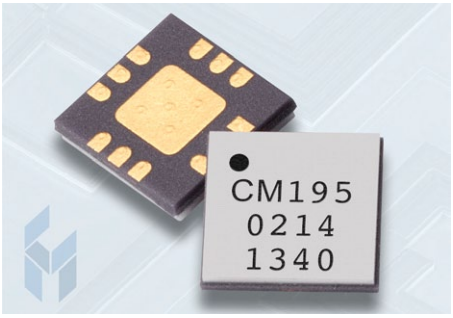
www.BLiNQnetworks.com

Active downconverting mixer

covers all cellular bands from 450 MHz to 3.6 GHz

LTC5577 is a 300 MHz to 6 GHz active downconverting mixer with +30 dBm IIP3 (Input Third Order Intercept) and 0 dB

conversion gain. It has wide operating frequency capability, covering all cellular bands from 450 MHz to 3.6 GHz with a single part.



The device's IF output port, usable from 1 MHz to 1.5 GHz, delivers flat conversion gain performance to over 600 MHz bandwidth, for LTE and LTE-Advanced base stations, as well as other wideband receiver applications. Its exceptionally low M•RF x N•LO mixing spur products are suitable for low distortion receivers and improve the distortion correction performance of digital predistortion (DPD) receivers. Its very low LO to RF leakage enable receivers to satisfy spurious emissions requirements with little or no RF input filtering. The IC's RF input is designed to withstand strong in-band blocking signals while delivering the lowest noise figure, ensuring receiver sensitivity in the presence of interference.

The LTC5577 has integrated wideband RF and LO input transformers, enabling the mixer to operate 50 Ohm single-ended from 700 MHz to 4.3 GHz continuously with the same external matching. As a result, minimum external components are needed. The LO input remains 50 Ohm terminated regardless of whether the device is powered on or off, and hence can be TDD (Time Division Duplex) enabled and disabled rapidly without causing disturbance that can unlock a PLL (phase-locked loop). The LO input is buffered, requiring only 0 dBm drive level and thus can be driven directly from a VCO circuit with minimum or no frequency pulling. All these features combine to yield a cost-effective solution that is space efficient and easy to design.

Aside from cellular base station applications, the LTC5577 is also suited for a range of radios requiring robust performance, such as cable TV transceivers, wideband military radios, broadband VHF/UHF white space broadcast radios, software-defined radios, RF test instrumentation, wireless repeaters and satellite communications.

www.linear.com

Variable attenuators 'hot switch' up to 6 GHz

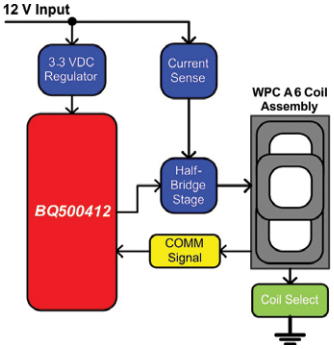
Fairview Microwave's compact hot-switchable variable RF attenuators can be used to reduce the amplitude of an electronic signature in many common electronic scenarios including lab testing equipment, distributed antenna and power and signal monitoring systems.

The devices come in 3 and 6 GHz frequency models and several different connector configurations including SMA and N type connectors with side or rear mount positions. Several of these attenuators are hot-switchable, meaning attenuation can be changed on the fly without powering down the system, allowing test data to be read continuously. Several models with varying attenuation adjustments are available including 0 to 12 dB attenuation in 1 dB steps and 0 to 40 dB attenuation in 10 dB steps, with other options available upon request.

www.fairviewmicrowave.com

Qi wireless power transmitter circuit

with foreign object detection



For Qi wireless charging stations, Texas Instruments has added an integrated WPC 1.1-compliant controller that reduces component count, and that gives smartphone users greater flexibility to charge from 5-V or 12-V charging stations

The next-generation wireless power transfer circuit with foreign object detection will be the basis of 3-coil, 5-V and 12-V A6 charging stations compliant with the Wireless Power Consortium (WPC) 1.1 specification. The bq500412 controller requires half the components compared to other solutions.

Giving users improved charging, the bq500412 integrates all functions required to control wireless power delivery from the charging station to a receiver circuit used in a Qi-enabled smartphone or other device. In addition to 12-V charging pads, the circuit can be combined with a boost converter to create a 3-coil, 5-V USB charging pad, while taking advantage of a Dynamic Power Limit feature to ensure quality operation independent of the power capability of the port.

The bq500412 also supports an enhanced foreign object detection scheme, which makes it easier for designers to implement the requirements of the WPC 1.1 specification.

www.ti.com

Highly integrated smartphone platform

targets entry level market

Well suited for handset makers building devices for the entry level smartphone market, Spreadtrum Communications' latest single-core smartphone platform integrates WiFi, Bluetooth, GPS and FM connectivity features. Further, it is faster with an upgrade to a Cortex™-A7 core processor (up to 1.2 GHz) from the company's previous generation.

Spreadtrum is introducing three chipsets with the launch of its next generation single-core smartphone platform. The SC7715, which is sampling now, is a single-core WCDMA smartphone chipset with integrated connectivity, supporting WCDMA/HSPA+ and EDGE/GPRS/GSM standards. It integrates a single-core Cortex™-A7 CPU running at speeds up to 1.2 GHz, a Mali 400 GPU for high performance graphics, as well as GPS, WiFi, Bluetooth® and FM functions. The chip also supports up to a 5 megapixel camera, 720p video and display resolution up to WVGA.

Spreadtrum is also sampling its next generation single-core EDGE smartphone chipset (SC6815) and will release a similar platform for TD-SCDMA (SC8815) in the second quarter.

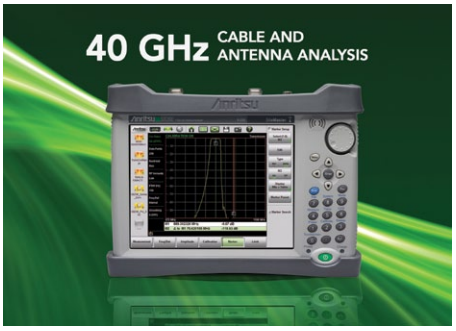
www.spreadtrum.com

Handheld cable and antenna analyzer

claims world first with 1 MHz to 40 GHz coverage

Microwave Site Master S820E from Anritsu Company claims to be the first handheld cable and antenna analyzer with frequency coverage of 1 MHz to

40 GHz. Site Master S820E offers field technicians, engineers and wireless network installers industry-leading dynamic range, directivity, and durability so they can conduct highly accurate measurements during the installation, maintenance, and troubleshooting of microwave communications systems. Additionally, the instrument will feature vector network analyzer (VNA) measurement functionality.



With dynamic range of 110 dB up to 40 GHz, the Site Master S820E brings performance typically only achieved with a benchtop instrument into the field to address the measurement challenges of today's wireless networks. Best-in-class frequency resolution of 1 Hz provides maximum frequency flexibility for users. The wide frequency coverage provides high-resolution distance resolution, so the handheld analyzer can conduct more accurate Distance-To-Fault (DTF) measurements.

A powerful processor has been designed into the Site Master S820E, allowing the analyzer to have a sweep speed of 650 µs/data points, improving field productivity. The instrument delivers the high directivity in a handheld analyzer for maximum field accuracy. It also features RF immunity of +17 dBm so users can acquire stable, accurate measurements in the harshest RF environments.

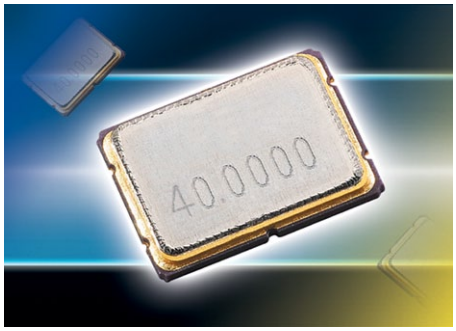
Designed for measuring coaxial and waveguide systems, Site Master S820E conducts all key one-port measurements, such as return loss, VSWR, cable loss, DTF, phase, and Smith Chart. Users can also conduct two-port transmission measurements and two-port cable loss tests with the Site Master S820E.

www.anritsu.com

2.5 x 2.0 mm SMD crystal

features a fundamental of up to 125 MHz

The SMD02502/4 MINI-SMD crystal from PETERMANN-TECHNIK comes in



a ceramic casing of 2.5 x 2.0 mm (4pad) and offers a massive fundamental frequency spectrum of 12.0 to 125.0 MHz. This MINI-SMD crystal offers a frequency tolerance of ±10 ppm and a temperature stability from ±8 ppm. The user can choose from aging rates of ±1 ppm to ±3 ppm/year, which means that the frequency tolerances, as well as narrowband and broadband wireless applications, can be realised.

The crystals, which can be easily configured with a Pierce oscillator (with two external capacities to GND), can also replace high-frequency third overtone crystals and high-frequency crystal oscillators (as long as this is possible with the IC being used).

www.petermann-technik.com

Low power 2G M2M module

ideally suited to cost-sensitive applications

Wireless modules vendor u-blox addresses cost-sensitive M2M applications with the SARA-G340, a dual-band (900/1800 MHz) GSM/GPRS module in a compact LGA module form factor. The device addresses automotive applications such as fleet management and eCall but also industrial M2M applications like metering, security and payment terminals for deployement in Europe and Asia.

The SARA-G340 voice/data module is the ninth variant of the company's SARA modem series consisting of the SARA-G3 GSM/GPRS and SARA-U2 UMTS/HSPA/GSM/GPRS/EDGE module families. The SARA series includes full-featured and cost-optimized versions to cover a wide range of application requirements. Very low power consumption is a primary feature of the SARA-G3 module series, with a standby current of less than 0.9 mA.

In Europe and Asia, GSM/GPRS is a key and popular technology for connected M2M devices. u-blox has optimized the SARA-G340 for these applications, enabling customers to integrate 'smart' M2M connectivity into their products. At the same time, the company's module compatibility philosophy gives customers a path to the creation of an HSPA version of their products via the SARA-U2 series, the industry's smallest 3G module.

SARA-G340 provides mobile connectivity in an ultra-small 16 x 26 mm LGA form factor. All 9 SARA cellular GSM and UMTS modules provide seamless pin compatibility with each other. They also provide migration to TOBY LTE modules to support future-proof 4G designs.

www.u-blox.com

Software defined radio demonstrator

for FDMA digital/analogue PMR

CML Microcircuits has released a software defined radio demonstrator for FDMA digital/analogue PMR (Professional Mobile Radio), aimed at companies that want a fast route to digital radios.

The DE9944 system can be used to demonstrate a complete RF transceiver and baseband function incorporating a direct conversion receiver and VCO 2-point modulation transmitter. It features a built in keyboard, display, microphone and speaker and so can be used to demonstrate peer-to-peer operation in a stand-alone configuration.

The DE9944 features both-embedded digital PMR and analogue PMR operation. In digital mode the board is ETSI dPMR TS 102 658 compliant and in analogue mode legacy TIA-603-D/EN 300 086 standards are supported.

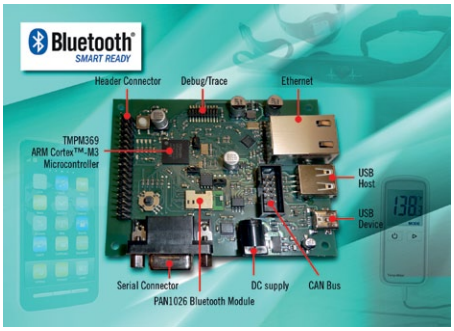
The board is based on the CMX7141 FDMA PMR processor and incorporates the CMX618 RALCWI vocoder, the CMX7262 TWELP professional radio vocoder and the CMX994 direct conversion receiver.

www.cmlmicro.com

Bluetooth starter kit and software

speeds up dual mode development

Toshiba has a starter kit for users of its TC35661SBG-501 ("Chiron-501") Dual Mode Bluetooth IC (BT 4.0). The starter kit (BMSKTOPASM369BT) is based around a Panasonic PAN1026 module featuring an embedded "Chiron-501" IC with a dual mode Bluetooth protocol stack and profiles and includes a Toshiba TMPM369 ARM Cortex-M3 based MCU with 512 kB flash memory.



The embedded dual mode software has a high level Serial Port Profile (SPP) and Bluetooth Low Energy (LE) GATT API for device set up, connection and data transfer. A high level driver layer allows access to the function set of the Bluetooth IC. Application examples are provided on the internet that can be compiled to run on the TMPM369 MCU with FreeRTOS integration (OS itself is available from Real Time Engineers Ltd). The application software includes a set of BLE standard reference profiles and a design guide on how to develop a proprietary BLE profiles.

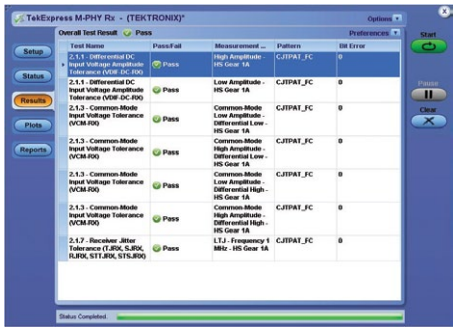
A J-Link JTAG debugger interface incorporated in the starter kit board is compatible with commonly available third party toolchains such as those from Atollic, IAR and Keil. The embedded MCU also supports standard interfaces on the board for Ethernet, CAN, USB (host and device), serial and UART connection.

www.toshiba-components.com

MIPI M-PHY receiver test solution

offers extensive capabilities

Tektronix has announced expanded capabilities for its industry leading M-PHY receiver test solution.
The additional capabilities include physical layer receiver testing for High Speed Gear2 and Gear3, support for PWM Mode (G0-G7), auto-calibration and margin testing.



Engineers developing next generation mobile devices based on the M-PHY physical layer can now use this test system to resolve design challenges and overcome signal integrity issues by performing automated conformance, product validation and margin tests with ease.

Support for HS Gear2 and Gear3 and PWM Mode (G0-G7) gives designers the flexibility to perform tests at the full range of data rates for comprehensive insights into their designs. The auto calibration support for high speed gears reduces the complexity of setup, saves time, and enables users to test devices faster. Margin testing for high speed gears allows designers to validate and stress their devices to maximum potential resulting in competitive technical specifications for their products.

www.tektronix.com

Wireless test set

enables new insights into LTE-Advanced Category 6 chipsets

Agilent Technologies has introduced the E7515A UXM wireless test set, which claims to be the most highly integrated signaling test set created for functional and RF design validation in the 4G era and beyond.

The UXM provides a broad range of capabilities that enable testing of the newest wireless device designs, delivering LTE-Advanced category 6 now and handling increasingly complex test cases in the future.

In design validation of LTE and LTE-A chipsets and user equipment, the UXM enables realistic verification of bidirectional category-6 performance with stable throughput at 300-Mbps downlink. Engineers can further wring out new designs with flexible receiver testing and trusted transmitter measurements. They can go deeper in functional testing with the UXM's wide range of network emulator capabilities, including complex handover scenarios and VoLTE support. The UXM also ensures greater confidence in RF performance with flexible automated testing and industry-proven Agilent X-Series measurement science.

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LTE protocol stack targets M2M

for FDMA digital/analogue PMR

NextG-Com has launched an LTE protocol stack designed to meet the needs of target niche and special markets such as machine-to-machine (M2M) devices, LTE backhaul, relay nodes, routers and gateways.

ALPS 520 is the first Release 11 compliant LTE protocol stack product designed with modular architecture and well-defined interfaces targeted for these diverse markets and applications, which range from low memory and low cost M2M applications to high performance special applications, with or without mobility.

ALPS 520 has been tested against 3GPP standard conformance test cases and includes a host of tools — Trace, ASN.1, SE-RTOS™ — that help to accelerate product development and reduce third party licensing costs.

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KEYNOTE

How Data, Devices and Personalization are Fueling Demand for Innovation

Vida Ilderem - *Vice President, Intel Labs; Director, Integrated Computing Research, INTEL CORPORATION*

Vida Ilderem is Vice President of Intel Labs and Director of the Integrated Computing Research [ICR] for Intel Corporation. ICR explores the next revolution in computing with focus on new emerging platforms. The research vectors include breakthrough technology innovations for seamless connection, highly integrated small form factors, and enablement of Internet of Things. Prior to joining Intel in 2009, Vida served as vice president of Systems and Technology Research at Motorola's Applied Research and Technology Center. Vida holds a PhD in Electrical Engineering from Massachusetts Institute of Technology, and has 27 issued patents.

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