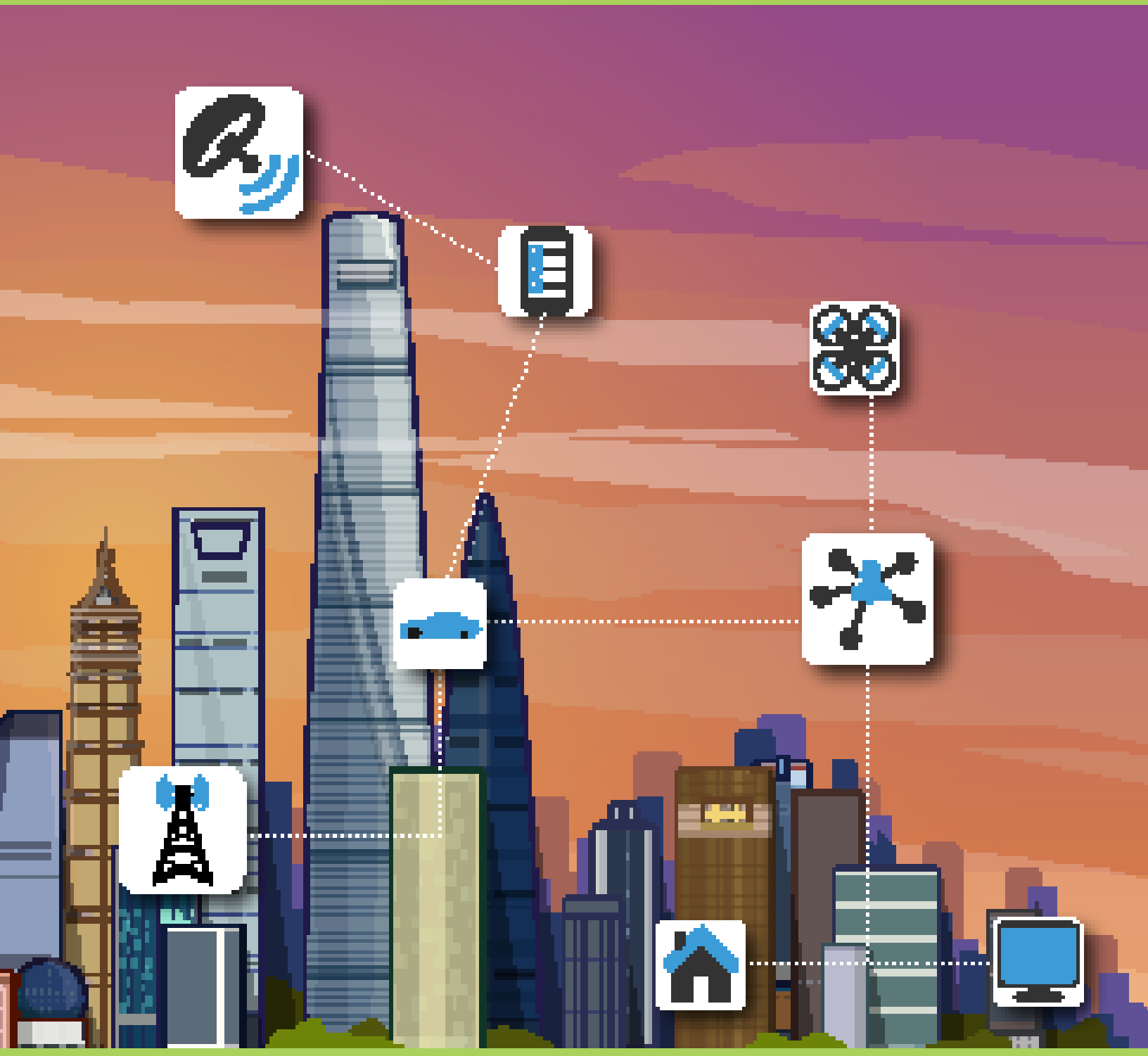
EDI CON CHINA 2017 Electronic Design Innovation Conference 电子设计创新大会

Shanghai Convention & Exhibition Center of International Sourcing

April 25-27, 2017

Shanghai, China



CONFERENCE GUIDE

EDI CON CHINA 2017 Electronic Design Innovation Conference 电子设计创新大会

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EET电子工程专辑

Official Publications

Microwave Journal

Microwave Journal China 微波杂志

Signal Integrity Journal

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Wednesday April 26: 9:00-17:00
Thursday April 27: 9:00-13:00

Conference Schedule

Tuesday:

920-1000: ..... Workshops
10:00-10:20: ..... Tea Break (exhibition floor)
10:30-12:00: ..... Plenary Session
12:00-13:00: ..... Lunch Break
13:00-15:00: ..... Technical Sessions
15:00-15:20: ..... Tea Break
15:20-17:30: ..... Workshops & Panels
18:00-19:30: ..... Welcome Reception

Wednesday:

9:00-9:45: ..... Technical Sessions
9:45-10:05: ..... Tea Break (exhibition floor)
10:10-12:00: ..... Technical Sessions
13:00-14:25: ..... Workshops
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14:50-17:00: ..... Workshops

Thursday:

9:00-9:40 ..... Workshops
9:45-10:30: ..... Technical Sessions
10:30-10:50: ..... Tea Break (exhibition floor)
10:50-12:25: ..... Technical Sessions

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EDI CON China Technical Advisory

The EDI CON China 2017 Technical Advisory Committee is made up of leading experts in RF/microwave and high-speed digital design who are committed to the educational mission of EDI CON. They review and evaluate submitted abstracts to determine their quality and impact, and these committee members are essential to helping EDI CON reach the highest levels of quality and relevance.

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Janine Love,
Technical Program Director, EDI CON China
jlove@horizonhouse.com

▼ Tuesday, April 25, 2017 ▪ 9:20 - 10:00 ▼

Workshops

Workshop
Room: 305A
GaAs and GaN Manufacturing Technology at SAIC
John Wang, Xiamen San'an Integrated Circuit Co

Workshop
Room: 305B
Multilayer PTFE PCBs in 5G Technology
Oliver Zhu, Taconic

As 5G technology R&D evolves, more designers have resorted to PTFE laminate materials to achieve low loss and better thermal dissipation. However the challenge for RF designers is how to select a suitable PTFE material from the standpoint of electrical properties and manufacturability. PCB fabricators will have to embrace PTFE multilayer's but they will also expect laminate materials to be dimensionally stable and easy to drill and plate.

5G Advanced Communications Workshop
Room: 307A
Pave Your Way for the 5G Era
Fangze Tu, National Instruments

5G technology will encompass an evolution of today's LTE technology and the addition of new radio access technologies such as massive MIMO, new waveforms, network improvement strategies, and the use of broad bandwidths available in mm-wave spectrum. This workshop is intended as an industry view to cover practical and industrial implementations of the 5G technology and 5G wireless test technology.

Workshop
Room: 307B
Advanced III/V MMIC Process Roadmaps for Terahertz Applications
Marc Rocchi, OMMIC/Sichuan YiFeng Electronic Science & Technology Co. Ltd.

In the near future, defence, space, instrumentation, security, automotive and telecommunication systems are planning to use higher frequencies up to 300GHz. OMMIC can provide the Advanced III/V MMIC processes remaining an indispensable complementary solution to Si(Ge) solutions for all RF applications.

▼ Tuesday, April 25, 2017 ▪ 10:30 - 12:00 ▼

Plenary Keynote Talks

Technologies for the Next Wave of Mobile Data
Peter Rabbeni, GLOBALFOUNDRIES

Abstract

The continued increase in the demand for data has driven system performance requirements and complexity to levels not experienced before. Gigabit-per-second wireless data is now a reality, but as more users adopt newer standards, the demands on both mobile devices and the networks that serve them must scale to meet these higher performance and complexity needs. If the constraints of power, size and cost are lifted, the solution is academic. However, the expectation by the consumer is that the new solution provides better performance at the same or lower cost without violating the established mechanical ID or physical envelope. Ah, the life of an engineer!

We have consistently relied on Moore's Law to help predict the evolution of semiconductor technologies, and each time we thought the end of Moore's Law was near an innovation in materials or processing saved us from the precipice. RF and high-speed digital applications have benefited from these advances, and innovations in tomorrow's networks will likely rely

on a broader adoption of these technologies. This presentation reviews market dynamics and trends that lead us to our current state and explores which technologies will play a transformational role in enabling the next wave of mobile data.

Biography

Peter Rabbeni joined GLOBALFOUNDRIES in October 2012 and brings over 30 years of design/development, field applications engineering, technical sales, business development and marketing experience in the area of RF systems, circuits and technologies. Mr. Rabbeni is responsible for all business development and product marketing related activity for GLOBALFOUNDRIES RF Business Unit which specializes in differentiated technology solutions such as RFSOI and SiGe. Prior to joining GLOBALFOUNDRIES, Peter served as WW Business Development Program Director for IBM Microelectronics Division Specialty Foundry business from 2010 to 2012 where he helped focus the division's 200mm foundry offerings in capturing silicon content in front end modules and created one of the most successful and profitable design-win periods in the divisions history resulting in more than $3B in long-term revenue. He joined IBM in 2001 and held various leadership roles in foundry sales and marketing before heading up the business development and strategy responsibility for the microelectronics foundry business unit. Prior to IBM, Peter held various RF systems and circuit design engineering positions at Ericsson, Raytheon and the U.S. Army Millimeter Wave Lab. Peter received his BSEE degree from the Stevens Institute of Technology and MSEE from the University of Massachusetts in 1986 and 1991, respectively. Peter has co-authored several papers and published a number of trade journal articles and blogs and speaks regularly on the trends and developments in the RF space. Mr. Rabbeni is a member of the IEEE.

The Impact of New Spectrum on Design and Test
Satish Dhanasekaran, Keysight

Abstract

Since the dawn of the cellular age, spectrum policy has driven significant engineering discipline and investment to enable our connected mobility. Providing a fundamental underlying constraint on diplexer and multiple-access topologies in 1G, spectrum issues are driving new increasing complexity in 4G and 4.5G including now 50 LTE bands, large-scale carrier aggregation, and unlicensed access. Each new generation of mobile communications has either been driven by, or enabled by spectrum policy updates. Combined with the technology, these provide both increased opportunity for the industry to change the way people use their mobile systems and new challenges for designers and operators. It can be argued that the most significant updates in spectrum policy, those related to licensing spectrum above 6GHz for mobile communications and those associated with shared access spectrum, are now upon us. The opportunities are already manifest with investment in mmWave technology across multiple disciplines. But this is new territory for the majority of cellular radio designers, most of whom have little experience with electromagnetic wavelengths shorter than 5cm. Not only do we in the technical community have to address the opportunities and challenges with the physics associated with mmWave, we also have the additional constraints that will be associated with specific policy (bands, bandwidths, power requirements, SAR, etc.). In addition, new techniques related to traditional radio and microwave frequencies will be required with emerging requirements associated with shared licensed spectrum. The impact on the design and test industry as we move these technologies from the niches to mainstream radio include the use of unprecedented semiconductor technology, new and smart antenna schemes, much wider bandwidths, new interconnect technologies, active spectrum management, and cognitive radio. This talk will explore the impact on design and technology and some of the emerging challenges to commercializing a mobile multiple-access network in the context of the new frontier of spectrum.

Biography

Satish Dhanasekaran is Vice President and General Manager of Wireless Test at Keysight Technologies. Satish started in Agilent Technologies in 2006 as a Wireless Applications Engineer. Since then he has held several leadership roles as Technical Architect, Wireless Business Development Manager. In his current role Satish manages technology development, strategy and marketing of test products to the wireless industry. Before joining Agilent in 2006 as a Wireless Applications Engineer, he worked at Motorola designing and leading development of RF sections for first-generation smart phone devices. Satish received his MS EE from Florida State University.

5G OTA: Cutting the Cables
Corbett Rowell, Rohde & Schwarz

Abstract

One of the central tenets of 5G is the use of massive MIMO to increase both spectral and energy efficiency by integrating

the radio transceiver with the antenna, creating an active antenna array that combines multi-use MIMO with beam forming. The consequent loss of dedicated external RF test ports in these systems is leading to a new measurement paradigm where most measurements of the radio and antenna will be performed only via an over-the-air (OTA) interface. In this talk, the challenges facing massive MIMO deployment and measurement will be briefly addressed with a focus on the required over-the-air (OTA) measurements for both R&D and production in the sub 6GHz and mmWave frequency bands.

Biography

Corbett Rowell is a 5G technology manager at Rohde & Schwarz and an honorary adjunct professor on the electronic and computer engineering faculty at Hong Kong University of Science and Technology. Prior to joining Rohde & Schwarz, Corbett was an electrical engineering professor in Kazakhstan for two years; an R&D director at China Mobile Beijing, responsible for development of massive MIMO systems for 4.5G and 5G; an R&D director at the Hong Kong Applied Science and Technology Research Institute for almost a decade, where he focused on advanced RF systems; and an entrepreneur who founded two successful startups. He has over 50 patents granted/pending and has had over 40 papers published in international journals and at conferences with an h-index of 16. He has also served as the technical program co-chair for the IEEE International Wireless Symposium. His research interests include massive MIMO, OTA, mmWave, and antenna measurement systems.

Transitioning from AC to AX and 4.5 to 5G: Hopes, Technologies, and Challenges
Jason White, National Instruments

Abstract

2017 will be the year of active rollouts of new wireless technologies ranging from 802.11ax to LTE-Advanced Pro. As we look forward to future 5G technologies like enhanced mobile broadband (eMBB) and narrowband IoT (NB-IoT), new wireless technologies create significant challenges for today's design and test engineers. In this presentation, attendees will learn about key physical layer changes associated with LTE-A Pro, 802.11ax, and 5G – and the strategies they will need to evolve their development processes.

Biography

As Director of Product Marketing for RF and Wireless Test, Jason White leads the global team responsible for product management, product marketing, and application segments of NI's RF and wireless test business. Since joining NI in 1995, White has held various engineering leadership roles in software and hardware for Data Acquisition, Test and RF, and Embedded product lines as well as some less traditional engineering roles. He is recognized for his versatility across multiple engineering and business disciplines. White is the inventor or co-inventor on 6 patents. White holds a bachelor's degree in physics from Hendrix College and completed master's studies ABT in electrical engineering at Texas A&M University.

▼ Tuesday, April 25, 2017 ▪ 13:00 - 13:20 ▼

Technical Sessions

Amplifiers Track
Room: 307B
High Linear CMOS Power Amplifier and Tracker for LTE Advanced Applications
Florinel Balteanu, Skyworks Solutions

RF power amplifiers are typically the most power hungry and take up much of the area in a wireless transmitter. With expanding band proliferation as well the use of carrier aggregation and multiple input multiple output techniques, the research area of improving the cost, performance, and the size of the RF transmit solution is very active with many recent developments. The proliferation of smart phones worldwide has been in part possible due to increased computational power of CMOS technology in lower feature nodes as 14nm/28nm. This has made it possible to enhance RF CMOS through DSP and digital calibration. Despite this progress, there is a shift in terms of what parts of the RF system are portioned in advanced CMOS nodes and what blocks are left and integrated together with other analog and RF blocks in a front-end module. This paper proposes a solution for this partitioning for lower cost and size and with high linearity performance which is mandatory for new multimode multiband front-end modules.

Measurement & Modeling Track
Room: 305B
Advanced Materials Measurement Techniques for Permittivity and Permeability
Ryoji Takizawa, Keysight

Accurate measurements of material permittivity and permeability can provide valuable information to properly incorporate the material into its intended application, such as electronic, aerospace defense, medical and automotive. There are various methods to measure permittivity and permeability, because the best method depends on a variety of test conditions such as frequency of interest, expected result values, and the form of material. This technical session introduces advanced measurement techniques for measuring industry materials permittivity and permeability with measurement data and accuracy analysis. Millimeter-wave measurement methods and fixtures will be mainly discussed because high-frequency test needs have been increased in recent years. A latest free-space test system provides easy-to-operate banded frequency solution up to 1.1 THz. Another resonant cavity test system provides around 10 multiple frequency points test using single fixture that is suitable for low-loss materials. Measuring techniques for liquid materials are also discussed in this session.

5G Advanced Communications Track
Room: 305A
Polar Code for 5G Mobile Communication
Xiaofeng Shi, Rohde & Schwarz

Polar code is the first constructive technique to provably achieve channel capacity with rich algebraic structure and excellent analysis properties. Starting from channel polarization and polar coding, this paper summarizes popular polar decoding algorithms with performance comparisons. Hardware architecture complexity and decoding latency are also investigated for practical 5G implementations.

Radar/Communications Track
Room: 307A
900W GaN-HEMT transistor for L-band Radar applications
Weishu Zhou, Microsemi

In current L band radar applications, there are two demanding R&D development focus areas. The first one would be a single –end very high output power transistor for short and medium pulse width with medium duty cycle. The output power requirement for single transistor would be around 1kW (medium pulse width and around 10% duty cycle application) or 2KW (short pulse and low duty cycle application). This high power transistor will significantly reduce power combiner circuit complexity and loss for a few of thousand watts amplifier design. The second one would be a single-end broad band high power transistor with long pulse and high duty cycle application. It usually required small transistor package size with total circuit size limitation. The challenges of these transistors development are high power density cell design, multiple die thermal arrangement under small package size, and stability of multiple-die configuration. The traditional silicon base transistor cannot meet these requirements due to low power density, thermal handling capability and low breakdown voltage. GaN on SIC HEMT technology has strong advantages to meet these kind of challenges with high power density, around 250V breakdown voltage, and SIC substrate's excellent thermal performance.

▼ Tuesday, April 25, 2017 · 13:25 - 13:45 ▼

RF & Microwave Design Track
Room: 302A
Embedded Thin Film Planar Resistors in 5G Power Dividers for Improved High Speed Signal Integrity
Helena Li, Shanghai Gentronics Electronics. Ltd.

With 5G designs advancing quickly, PCB designers are facing the growing challenge of increased board complexity including higher layer counts, space restrictions and accurate impedance matching, while facing the dilemma of reducing EMI for improved electrical performance. This paper describes a thin-film NiP (Nickel Phosphorous) resistive material that is electrodeposited onto copper foil, laminated to a dielectric material and then processed using conventional PCB print/etch techniques to create discrete resistive elements that can be used on a PCB surface or embedded within a multilayer PCB inner layer.

5G Advanced Communications Track
Room: 305A
Ultra-Wideband Signal Phase and Amplitude Calibration Method for High Performance 5G mmWave Device Testing
Li Feng, Keysight Technologies

Along with sub-6GHz RF band technologies becoming mature, 5G high-band prototype and commercial product development is the next hotspot in wireless industry. Many aggressive trials have been conducted on 15GHz/28GHz/39GHz/60-90GHz with 500M+ ultra-wideband and massive MIMO technology to achieve ultra-high data throughput, so ultra-wideband modulation on mmWave band is recognized as a 5G key technology. Currently, the biggest challenge in this area is how to perform high quality testing on 5G mmWave components and equipment, such as EVM and other power/spectrum measurements. Traditional signal generation and analysis will face issues such as phase and amplitude distortion, IQ imbalance, and DC leakage. These problems exist widely not only in the instrument, but also in external fixtures, connecting parts and test accessories. Traditional calibration methods embedded in the source and analyzer cannot solve the problems in the latter case. This paper introduces a new calibration method for calibrating the entire test system, including the instrument and external connections.

Radar/Communications Track
Room: 307A
EM/Circuit Co-simulation of T/R Front-end Module and Actively Scanned Antenna Array
Milton Lien, AWR Corporation

The impedance at the input of a phased-array antenna will vary as the antenna beam is steered in various directions. This presents different load impedances for the RF front-end circuitry controlling the phase and amplitude of the signals driving each element in the array, thereby impacting the signal delivered to the antenna, which, in turn, affects the antenna pattern. Recent advances in circuit/EM co-simulation captures the coupling between the antenna and the circuit directly. The designer identifies the antenna data source, the circuit schematic driving the antenna, and the measurement under consideration, for example the power radiated over scan angle. This presentation illustrates this concept with a number of interesting examples in phased arrays, where the antennas can be represented by measured data or simulated S-parameter/radiation field patterns using any commercial planar MoM or 3D finite-element electromagnetic simulators. Corrective matching networks between individual T/R modules and radiating elements can then be implemented by the designer.

Measurement & Modeling Track
Room: 305B
De-skew, Gating, Fixture Removal, and Correlation Analysis
David Feng, Molex

In high-speed data transmission channels, signal integrity is the important issue that should be investigated. In most cases, the testing for the signal channels cannot avoid the test fixtures, so it is challenging to measure the performance of the signal channels accurately with the effects of the fixtures. Currently, the industry provides several fixture removal tools, and they can remove the effects of fixtures and achieve accuracy close to that of TRL calibration. However in reality, the features of fixtures are not ideal that meet all the requirements for the fixture removal methodology. We look at the different features of the fixtures and how accurate the measurements can be achieved by using the fixture removal method, as compared to traditional post data processing methods such as de-skew and gating. This will be helpful for test engineers to select the correct fixture and data processing methods to meet the desired test accuracy.

Amplifiers Track
Room: 307B
Novel Impedance Flattening Network for Wideband Doherty Power Amplifier at 3.4-3.8GHz
Rui Ma, Mitsubishi Electric Research Labs

Demand of high bandwidth (BW) and applications of high PAPR modulated signals in cellular communication have generated immense interest towards wideband Doherty power amplifiers (DPAs). The benefit of high back-off (average) efficiency from DPA makes them a prime candidate for next generation high-efficiency PAs used in cellular base-stations. However, the load-modulation network (LMN) in a conventional DPA is only suitable for narrowband operation. Hence, there is a significant need for DPAs that can simultaneously support wide-BW and high-efficiency. In this work, an impedance flattening

network (IFN) is proposed to overcome the efficiency degradation at back-off while maintaining wide-BW.

▼ Tuesday, April 25, 2017 · 13:50 - 14:10 ▼

Measurement & Modeling Track
Room: 305B
New method for Debugging Crosstalk Issues in your Design
Min Jie Chong, Keysight Technologies

Have you ever found it a challenge to identify which aggressor sources are causing crosstalk to your signal? Have you ever wondered what your signal would look like if the effects of crosstalk could be removed? Crosstalk is a big challenge in today's high-speed serial design because it can corrupt the data transmission and close the eye opening, adding jitter into your design. Crosstalk can come from various aggressor sources such as an adjacent high-speed bus, power supply, and phase lock loop or reference clock. Debugging crosstalk issues can be really challenging, especially identifying the aggressors and quantifying how much crosstalk each aggressor is contributing to your signal. In this paper, you will learn a new method that can help you identify, quantify and remove the effect of crosstalk from your signal using a real-time oscilloscope. This can help you decide if the improvements from removing crosstalk are worth implementing in your real design.

5G Advanced Communications Track
Room: 305A
MIMO OTA Certification Testing: Multi-Probe Method
Andy Wang, Hwa-tech Information System Company

This paper explains why we need MIMO over the air test, MIMO OTA technology directions, existing problems and solutions, how to achieve effective performance of MIMO OTA testing, and the significance of MIMO OTA testing in 5G marketing. MIMO extends one-dimensional smart antenna technology with a high spectrum utilization, and it can improve the capacity of the communication system without increasing bandwidth. Through the continuous development in recent years, MIMO technology will be applied to a variety of wireless communication systems. International organizations including 3GPP, CTIA, IC1004 are working to formulate MIMO test.

Radar/Communications Track
Room: 307A
RF Environment Generation for Radar and Receiver Tests
Steffen Heuel, Rohde & Schwarz

Radar systems require enormous amount of test and certification before they are allowed market access and customer handover. Current test procedures are extremely costly and are required to be conducted over many days of measurement campaigns for radar performance verification against various conditions. In order to reduce the required time and to enable convenient and reproducible test scenarios of newly developed radar hardware and software, a method for environment RF signal generation is presented. This approach allows engineers to generate the environment consisting of arbitrary radar echo signals, correlated sea clutter data and even interference signals that may be present from other RF sources to stimulate a radar system under test. The generated signals support test and verification of radars in a laboratory environment and reduce field tests to a minimum.

Amplifiers Track
Room: 307B
Design of a High Efficiency GaN-on-Si 3-Way Doherty Amplifier for Base Station Applications
Xin Liu, MACOM

Today, in this era of 'big data', social media, cloud computing and other multimedia services, there is an urgent requirement of high speed and low energy consuming data transfers. Base stations, the crucial part of a communication network, must be evolved to be friendlier to the environment, easier to install and maintain. This gives the base station manufacturers very high motivation to continuously improve the performance of the RF power amplifier, which is one the of largest power consuming parts in the whole base station system. This paper shows the combination of the latest GaN on silicon technology and advanced Doherty power amplifier topologies in a major communication operation frequency band. Firstly,

the unique advantages of GaN on silicon HEMTs compared to other power transistor technologies are summarized. Then the paper presents the performance of the GaN on silicon transistors by using MACOM's Gen 4 GaN on silicon technology. At last, a design of GaN on silicon 3 way Doherty power amplifier is described. The Doherty amplifier shows state-of-the-art back off efficiency as well as linearity, which can be adopted in the commercial base station.

▼ Tuesday, April 25, 2017 ▪ 13:50 - 15:00 ▼

Panel

RF & Microwave Design
Room: 302A
Solid-State RF Energy in 2017: The Volume Breakthrough is Finally There, is it not?
Klaus Werner, RF Energy Alliance

Solid-state RF energy based on semiconductor devices is clearly a dynamic and exciting technology which holds great potential for new and existing applications. Highly complex system integration, high costs, and a lack of knowledge in the markets have delayed mass market adoption. The RF Energy Alliance formed three years ago to tackle these three "inhibitors" and pave the way for technology success. Recent developments, however, show a clear uptake of the technology in various segments and may indicate a breakthrough in adoption.This panel will assess the current status quo and will debate whether the "tipping point" for this breakthrough in 2017 is finally there, and signaling the end of the magnetron has begun. Additionally, the panelists will offer different perspectives from the value/supply chain: including semiconductor suppliers, PCB materials, connectors, and distributors.

Invited panelists include: Ampleon, Pinglu Chen, Head of Sales Asia and Country Manager Greater China; Macom, Mark Murphy, Senior Director of Marketing; NXP Semiconductors, Mr. Dong Wu, Senior Director of BU RF Power, AP Region; Rogers Corporation, Art Aguayo, Senior Business Development Manager; and Innogration Technologies, Yinghao Zhuo (non-member), Product Marketing Director.

▼ Tuesday, April 25, 2017 ▪ 14:15 - 14:35 ▼

Technical Sessions

Measurement & Modeling Track
Room: 305B
The Latest Trend for Mobile FEM and Noise Figure Measurements
Hong-Liang Gu, Keysight

Mobile data traffic continues to grow significantly and higher downlink (DL) and uplink(UL) data speeds are required. To achieve higher DL data speeds, higher order modulation, MIMO and carrier aggregation are key technologies and new user equipment (UE) designs are required to support multiple band combinations. As new UE architecture also includes a low-noise amplifier (LNA) front end module (FEM) to support multiple component carriers in the DL, fast and accurate noise figure measurement is becoming more important. This paper focus on the challenges of LNA integration and noise figure measurement in design verification/production test as well as basic comparison of two types of noise figure measurement techniques. In addition, this paper shows how to select the right solution from a wide variety of solutions for design verification test (DVT)/production.

Amplifiers Track
Room: 307B
The New Frontier in Solid State Power Amplifiers: The Spatial Power Amplifier
Maurizio D'Antoni, Mitec

Communication systems employed in airborne and space applications are subjected to strict requirements in terms of reliability, size, and efficiency. Particular attention must be given to the weight of the power amplifier (PA), which assumes a very important role in the selection of material and technologies to be employed in the whole PA. High RF power levels are traditionally demanded of vacuum tubes amplifiers like TWTA and Klystron. However vacuum electron devices present well known disadvantages. In airborne communication systems, vacuum devices should be replaced by a combined solid-state PA (SSPA) if they can reach the same RF power requirements while offering the great advantage of solid state technology.

The spatial power combining (SPC) technique is an alternative technique to combine many SSPAs addressed to reduce combining losses while dramatically increasing amplifier power density, and giving a highly desirable graceful degradation.

5G Advanced Communications Track
Room: 305A
RF SOI Technology for Reliable 5G Beam Forming
Charles Gui, Peregrine Semiconductor

Picture a large stadium packed full of tens of thousands of enthusiastic fans. With smart phones in hand, these fans demand high-speed, reliable data and a low latency network to share pictures on Facebook and WeChat, or for FHD live streaming. To support the promise of 5G, high-frequency RF signals must be able to keep reliable and high-speed internet connection for thousands of smart phones almost simultaneously. Which technologies and products will enable 5G to live up to the hype and deliver reliable communications? One proposed solution is to flexibly steer these 5G signals through beam forming arrays. The benefits to this approach include reduced interference, reduced power consumption, increased data rates and increased bandwidth per user. Using a sports stadium as an example, this technical session will explore the use of RF silicon-on-insulator (SOI) technology to develop a highly integrated 5G beam forming solution. This highly integrated beam former must support fast scanning, fine phase resolution, accurate amplitude control and pre-stored algorithms, and it must combine multiple beams to improve link margin. Further, this presentation will explain how SOI technology can address system, performance and integration challenges in the form of single-die solutions.

Radar/Communications Track
Room: 307A
Automotive Radar Interference Test
Steffen Heuel, Rohde & Schwarz

Fully automated vehicles are currently under research and development and will become reality in the near future. Key enabling sensors in this area are automotive radars, which currently support driving comfort and crash prevention. These radars operate in the 24 GHz and 76-81 GHz bands as of today and occupy the spectrum heavily. Hence automotive radar sensors require immunity to the interference of other automotive radar sensors. This paper presents methods to verify interference mitigation techniques using very wide band arbitrary RF signals in high frequency mmWave domain. It shows measurements that the noise floor increases in between 10 dB to 25 dB depending on the interference signal level and waveform. Without interference cancellation objects with low radar cross sections, like pedestrians, would most likely go undetected.

▼ Tuesday, April 25, 2017 ▪ 14:40 - 15:00 ▼

5G Advanced Communications Track
Room: 305A
5G Device Design Verification and Test Challenges
Li Xin, Keysight

This paper discusses the new verification and test challenges faced by 5G device makers.5G has different stages, organizations and technology candidates, besides Verizon 5G 28G/39G fixed wireless access trial, most industry players believe 5G NR will likely to be deployed in sub 6G first, then go to mmW solutions. Before Sep 2018 when the 5G NR is going to be released, this paper discusses how 5G device makers can prepare for future 5G device design verification and test and measurement, face the verification and test challenge in new technologies, and especially the implementation of mmW and wideband related technologies.

Measurement & Modeling Track
Room: 305B
New Approach of Building RF PA/FEM Test Systems
Jianhui Wang, Keysight

As the development cycle of RF PA/FEMs is getting shorter, one of critical challenges for PA/FEM vendors is to reduce the burden of developing and maintaining in-house test programs. An ideal solution for this is to have an “off-the-shelf” test software which supports both ready-to-use measurements requiring no programming effort, as well as customizability to adopt to the user’s unique test environments. But what are the critical selection criteria for selecting a test software

product? In this paper, we review the main considerations in selecting test software and provide a detailed design and test example of how an automated test for PA/FEMs can reduce measurement time, showing real test data. We review the main considerations in setting up test configurations, and what mistakes to avoid optimizing test time.

Radar/Communications Track
Room: 307A
Modeling Large Phased-Array Antenna Systems with an Advanced Behavioral Model and Simulated/ Measured Radiating Elements
Gent Paparisto, AWR Group/National Instruments

Phased-array antennas are gaining considerable interest for radar and communication systems that use electronic beam steering to improve performance over previous generations. The performance of a phased array assembly is influenced by array geometry, antenna characteristics, RF link characteristics, assignment of antenna and RF link characteristics to individual elements, power splitter characteristics and mutual coupling characteristics. System-level simulation of phased-array antennas allow the designer to determine the individual component requirements that will lead to the desired array performance metrics such as gain, directivity and side-lobe suppression as a function of signal conditioning into each radiating element.

Amplifiers Track
Room: 307B
Design of MMIC class- E Adaptive Bias Power Amplifier with Built-In Linearizer using 0.5µm GaAs E-pHEMT Technology
Shanthi P, R.V.COLLEGE OF ENGINEERING

This paper presents a topology of a power amplifier that was designed and developed in 0.5µm GaAs pHEMT technology from WIN semiconductors. The design adapts a built-in linearizer and adaptive bias control circuit which resulted in better linearity and efficiency. Power added efficiency, output power and power consumption in design are discussed. Adaptive bias two stage classE amplifier achieves an maximum PAE of 72.9% at OP1dB of 13dBm and IMD3 suppression of -29dBc at 1dB of 11 dBm.The proposed cold- pHEMT built in linearizer achieves better linearity performance with IMD3 of -45.7dBc at 17dBm (OP1dB) with appreciable PAE of 23.5% .The proposed topology is a novel technique to enhance the output power as well linearity with the WIN 0.5µm GaAs pHEMT technology.

▼ Tuesday, April 25, 2017 ▪ 15:20 - 16:00 ▼

Workshops

Measurement & Modeling Workshop
Room: 305A
From Wave-based Load-Pull to Behavioral Nonlinear Models
Xianfu Sun, Focus Microwaves

Recent trends in load-pull data acquisition technology include the use of a VNA for capturing complex traveling waves to and from the device under test (DUT). When compared to a scalar load-pull bench, such a system has a very high throughput and a very good dynamic range. Focus Microwaves and Mesuro have developed a technique to transform data from swept load-pull measurements into a behavioral model (“Cardiff Model+” and “Load-dependent X-parameters”). This upgrade adds great value to users of existing and future “wave-based” load-pull, because the models can be directly used within the CAD environment for amplifier design.

High-Speed Digital Design Workshop
Room: 307A
Via Structure Optimization for Pre-layout PCIE Channel Design
Kezhou Li, ANSYS

As data rates increase on high-speed differential buses, efforts must be made to guarantee that crosstalk and impedance discontinuities are minimized to keep channels from being dominated by undesirable SI effects. One source of impedance mismatch on a high-speed channel is the PCB via which allows traces to transverse from one layer to the next. Generally, via poses a serious impedance discontinuity. This workshop explains two important via features: “thru part” and “stub

part." To minimize intersymbol interference (ISI) due to reflections in the channel, the stubs should be mitigated. Stubs will continue to be of serious concern as data rates increase. This effect can be considered in a channel and tuned for best performance to achieve a desired channel solution space. Topics covered include via stub, transition effect, and via optimization.

5G Advanced Communications Workshop
Room: 305B
Verizon 5G and 3GPP New Radio(NR) Generation and Analysis
Jian Wang, Rohde & Schwarz

In July 2016, Verizon Wireless, the largest network operator in the USA, published technical specifications that describe the physical layer characteristics of a 5G signal. The specified signal is derived from LTE and adapted to be used at cm frequencies, initially 28 GHz but also 39 GHz. The signal is a multicarrier OFDM signal with a subcarrier spacing of 75 kHz. It is aiming for a bandwidth of 100 MHz per component carrier. Up to eight carriers can be aggregated. Meanwhile, 3GPP organization has started standardization work on 5G New Radio (NR), supporting flexible subcarrier spacing from 3.75 kHz to 480 kHz. High bandwidth and high frequency required by 5G pose a challenge for transceiver components such as amplifiers, filters, and mixers. To design these components and later integrate them into an mm-wave transceiver, adequate test and measurement solutions are essential. 5G power amplifier characterization based on Verizon 5G waveform is taken as an example to be addressed.

Workshop
Room: 307B
E-Foundry Model Provides New Opportunity
Fan Chanling, Chengdu Hiwafer

With the gradual application of new applications such as Internet of things and 5G communications, RF and microwave devices are becoming more compact and chip-based, so more customers are considering entering into MMIC chip design field. However, due to the high cost of MMIC chip industry, high technical threshold, many customers are challenged. As one of the earliest foundry semiconductor foundry companies, HAIWEIHua core to launch a new E-Foundry business model, hoping to help customers more quickly and economically engage in chip design and achieve a wider range of value.

Measurement & Modeling Workshop
Room: 302A
New High Performance Test Cable Assemblies, Millimeter Wave Integrated Multi-Pin Connector Harness Assemblies & Aerospace High Speed Data Master Cable Assemblies
Wei Liu, Mitron

This workshop introduces MIcable latest products – new high performance test cable assemblies, millimeter wave integrated multi-pin connector harness assemblies, and aerospace high-speed data master cable assemblies. Specifically, it will cover a microwave/millimeter wave test cable assembly, 40GHz integrated multi-pin connector harness assemblies, and super-light aerospace data master cable assemblies.

▼ Tuesday, April 25, 2017 ▪ 16:05 - 16:45 ▼

Measurement & Modeling Workshop
Room: 305A
Load Pull: A Critical Tool for Model Extraction, Validation and Design
David Li, Maury Microwave

While load pull has been discussed for over 30 years, it has never been more important than today with direct implications in compact model validation, behavioral model extraction, and amplifier design. This presentation covers the theory and modern methodologies of load pull including passive and active, scalar, active, hybrid-active and mixed-signal techniques. An emphasis will be put on using these various techniques directly with compact model validation, behavioral model extraction and amplifier design.

High-Speed Digital Design Workshop

Room: 307A
Interfacing FPGA with High-Speed Data Converter Using Parallel and Serial Interface
Marc Stackler, e2v

The current trend for many applications requiring data converters is to get closer and closer to a full SDR (software defined radio) system. While SDR architecture brings many benefits in terms of flexibility and SWAP (size, weight, and power) it often translates into higher bandwidth capability and is directly linked to the data converter sampling speed with the Shannon-Nyquist theorem. And this complicates the interface between the FPGA (field programmable gate array) and data converter. Indeed the speed at which the FPGA processes information is very limited compared to the amount of data generated by the high-speed data converter. Of course, this is dealt with through massive parallel processing. However, transmitting and receiving this huge amount of data has become the system bottleneck as data needs to be transmitted in larger and larger quantities, faster and faster. This workshop covers and compares the two means of interfacing at high-speed between the FPGA and data converter currently used today: high-speed LVDS parallel interface and high-speed serial interface. It starts by introducing these 2 types of interfaces, comparing them and identifying their benefits and drawbacks at multiple levels. Then it discusses the FPGA design of a high-speed parallel interface at 1.5Gbps. It focuses on a transmission from an FPGA to a DAC (digital to analog converter) using the example of an Arria V FPGA from Altera interfacing with an EV12DS460A from e2v. Before concluding, it covers a high-speed serial interface FPGA design at 6Gbps using the ESIstream (efficient serial interface) protocol. It focuses on a transmission from an ADC (analog to digital converter) to an FPGA using the example of an EV12AD500A from e2v interfacing with a Virtex 7 from Xilinx.

5G Advanced Communications Workshop
Room: 305B
Portable MIMO Testing Platform Based on the Technology of Software Defined Radio
Hanchao Liu, Sample Technology Shanghai R&D Center

Learn about the SDR1000 series: a software defined radio (SDR) testing platform that is based on the RF chip and SOC system owned by Sample Technology. It provides a 2x2 or 4x4 MIMO SDR. Engineers can learn how to use the FPGA space and dual-core to rapidly enable different modulation and demodulation for TD-LTE, IEEE802.11, WiMAX, TD-SCDMA and TDD, FDD system. The SDR1000 also provides a compatible reference architecture and open-source project for rapid testing. It is well suited as part of a portable system with strict requirements on weight, power, and size such as an LNA, power amplifier, or radio frequency switch. From 2400-2500MHz, it can achieve -90dBm as receiver sensitivity, 60dB dynamic range, 20MHz as analog bandwidth, and -40dBm~+30dBm transmission power.

5G Advanced Communications Workshop
Room: 302A
Massive MIMO Prototype and MIMO OTA Test
Zhu Wen, Keysight

Massive MIMO and MIMO OTA test are very hot topics in wireless communication, especially in 5G. There are many technical challenges in massive MIMO and MIMO OTA test, such as system design and implementation with large number of channels, efficiency and cost, test and calibration methodologies, etc. In this workshop section, we will provide some updates on the research of massive MIMO and MIMO OTA test, including: massive MIMO real-time beam forming prototype systems, fast and cost effective RF performance test and calibration system for digital massive MIMO, and UE MIMO OTA test system and methodologies.

Panel
Room: 307B
The Future Outlook of RF GaN: Applications and Performance
Gary Lerude, Microwave Journal
Richardson RFPD

The proliferation of GaN in commercial RF applications is reaching a critical mass which creates a virtuous cycle as the price/performance tradeoffs open up even more opportunities to use GaN. The participants in the panel represent several companies invested in RF GaN, and multiple points of view will be discussed. Moderator: Gary LeRude, Technical Editor, Microwave Journal. Panelists: Dong Wu, NXP; Mark Murphy, MACOM.

▼ Tuesday, April 25, 2017 ▪ 16:50 - 17:30 ▼

Measurement & Modeling Workshop
Room: 305A
Accelerating Design Cycle Time of key RF FEM Circuit Blocks Through Innovative Modeling Methods
Haiying Deng, GLOBALFOUNDRIES

Growing use of mobile communication devices continues driving the growth of the RF front end module (FEM) market. New standards and increasing system complexity lead to tougher RF performance specs and module level integration trend. Market players must choose the best advanced foundry technologies and design enablement platforms to release competitive products in short design cycle time in order to stay competitive in this dynamic market environment. With increasing focus on better accuracy in prediction of figures-of-merit for linear high-power PA, LNA and RF switches, we push the envelope on RF enablement by developing a set of modeling unique features. In this presentation, we introduce our advanced time-dependent physics-based thermal model, Dynamic Depletion SOI FET model, and how GLOBALFOUNDRIES rigorous modeling methodology can maximize customer design productivity and minimize design-to-sample cycle time.

5G Advanced Communications Panel
Room: 305B
Which Technology is better for the First 5G Systems: Massive MIMO sub-6 GHz or mmWaves?
Patrick Hindle, Microwave Journal

This panel will debate whether the first 5G systems should be implemented with mmWave networks where bandwidth is plentiful or are there enough challenges that sub-6 GHz massive MIMO systems should be used. Sub-6 GHz networks are well understood, work with fast moving objects, propagate farther than mmWaves, are not blocked by objects and are lower in cost but capacity is constrained, spectrum crowded and power consumption is high for massive MIMO. MmWave networks have much greater capacity with plenty of spectrum available, are directional so energy can be more efficiently aimed, can reflect off of objects for multiple paths and are very compact but suffer from propagation loss, are blocked by objects, have challenges communicating with fast moving objects and do not penetrate.

Panelists: Dr. Chih-Lin I, Chief Scientist, Wireless Technologies, China Mobile; Dr. Thomas Cameron, CTO Communications Business Unit, Analog Devices; Peter Rabbeni, Sr. Director of RF BU Bus. Dev. & Product Mkt., GLOBALFOUNDRIES; Randy Becker, Application Engineer, Keysight; Ribo Tang, Business Development Manager, Rohde & Schwarz (China); Jason White, Director of Product Marketing for RF and Wireless Test, National Instruments

Measurement & Modeling Workshop
Room: 307A
High Speed Simulation and Measurement
Chun Tong Chiang, CST

Simulation can dramatically reduce the design cycles for high-speed digital engineers as it can serve as a virtual lab where verification can be done without waiting for an expensive and time consuming prototype cycle. Of course, this advantage can only be leveraged if a high confidence in the simulation and measurement results has been established. As both simulation and measurement can have their pitfalls, in this seminar we will give a practical guide on how set up this kind of simulation correctly and how to produce high-quality VNA measurements. Among other topics we will cover aspects of meshing, material characterization, and launch design.

Workshop
Room: 302A
Multiport Automatic Testing System Based on Switch Matrix with High Reliability
Zhang Hong, Mini Circuits/Mitron

The network analyzer is one of the most popular pieces of wireless testing equipment; however, customers have to pay too much money to purchase and maintain it. So how to save cost of equipment on production line, improve the testing efficiency and realize automatic testing? Every wireless product manufacturer is working with perseverance to achieve these goals. Just for this reason, Mitron developed a multiport automatic testing system based on a switch matrix with high reliability. In the current market, automatic test systems are usually constructed on switch matrixes. Most of switch matrixes are realized by mechanical, not solid-state switches. The reason is solid-state switches have higher insertion loss and lower isolation, which will causes low VSWR measurement accuracy and smaller dynamic range.As the actual example, this workshop introduces the features and advantages of Mitron's 2X12, 2X9 multiport antenna automatic testing system.

Workshop
Room: 307B
GaN RF Power Devices
Tom Gao, Dynax Semiconductor

The presentation will focus on DYNAX quality and reliability management on GaN RF power devices, and the product road map and applications. Attendees will learn about a local GaN fab that provides IDM service of material growth, device design and manufacturing. Also, how GaN devices provide best RF performance, and how to control and manage reliability and consistency in GaN RF power devices.

▼ Wednesday, April 26, 2017 ▪ 9:00 - 9:20 ▼

Technical Sessions

RF & Microwave Design Track
Room: 302A
Advanced Techniques for Spurious Search in RF and Microwave Devices
Martin Schmaehling, Rohde & Schwarz

Spurious emission search is an essential measurement in the design, verification and production of RF and microwave devices. RF designers, especially in the aerospace and defense industry need to measure very low-level spurs. Thus, very narrow resolution bandwidths are required to make the measurements with low noise floor and high sensitivity. Moreover, the location of the spurs in spectrum is often unknown, i.e. a wide frequency range has to be measured with resolution bandwidths of only a few Hz, which increases the measurement time. Even with fast FFT spectrum analyzers, a spur search may take several hours or even days. In this paper, we review the basics of spurious measurements with spectrum analyzers and how the parameters used can affect the system performance in common applications. It will then describe traditional measurement methods and introduce a new technique that provides a better usability and speed, especially when searching low-level spurs.

Systems Engineering Track
Room: 305B
Addressing Multi-Channel, Wide-Band Test and Data Management in 5G
Sheri DeTomasi, Keysight

As wireless technologies evolve, new standards are being investigated to support use cases like streaming of HD video, virtual reality gaming, remote surgery, or connection of billions of devices for IoT. The test requirements are becoming more complex and demanding, requiring test solutions to go to higher frequencies, wider bandwidths, greater measurement resolutions, and multiple channels. Traditional test methods used in 4G will not be sufficient for 5G. This paper compares competing test methods that can be used in 5G. It describes how wideband AWGs and digitizers are being used today to address these new demands. It describes the challenges of an accurate multi-channel, wideband measurement solution and compares the differences between using multi-channel digitizers verses oscilloscope solutions. With multi-channel wideband measurements, calibration and data management are very complex.

5G Advanced Communications Track
Room: 307B
New Wireless Technologies for Tomorrow's Connected Devices
David Hall, National Instruments

Wireless technologies are constantly changing, and it's hard to keep up. By 2020, connected devices will have standardized on a set of wireless technologies that we only dream of today. In this paper, we provides a detailed explanation into the market requirements of next generation wireless communications systems and explain how enhancements to the physical layer specifically address new and emerging requirements. In addition, we also investigate the design and test implications of the hottest wireless technologies for the IoT and mobile, including NB-IoT, LTE-M, LTE-Advanced Pro, Qi, 802.11ax, 802.11ad/ay, 5G and more. In this session, engineers will not only become more aware of what's new in wireless; but will be better equipped to evolve their organization for the future of wireless design and test.

Measurement & Modeling Track
Room: 305A
Techniques for Extending Microwave Frequency Instruments for mmWave Measurements
Wei Lin, National Instruments

The need for millimeter wave (mmWave) measurements is rapidly evolving in application spaces such as 5G, 802.11ad, automotive radar, and material characterization. This paper discusses how traditional microwave frequency instruments (in the K- or Ka-band) can be extended to perform measurements in the mmWave frequency band. These techniques include concepts such as a complete down conversion, external harmonic waveguide mixing, and block down conversion. Each technique has its pros and cons, ranging from dynamic range, noise floor specifications and frequency range. In this paper we will discuss these pros and cons and present experimental results using the block down conversion and waveguide mixing techniques.

IoT Design Track
Room: 307A
Electromagnetic and Structural Co-Design of A Smart Watch
Cier Siang Chua, CST

Wearable wireless devices are increasingly moving into the mainstream of our society led by the rapidly expanding health and fitness markets. Recent advances in smaller, lower-powered processors have enabled the development of smart and connected products that incorporate more and more electronics into less and less space. Engineering teams are asked to meet ever increasing and interdependent product requirements while reducing time to market. In order to push the design envelope while mitigating risk, engineers need to develop a deeper understanding of the product behavior under realistic operating conditions and quickly evaluate design trade-offs based on overall system behavior in order to minimize the risk of early product failures or malfunctions. Increasing product complexity and interdependency of various requirements necessitates a co-design methodology involving 3D structural, thermal and electromagnetic domains. This requires synchronizing design changes across different teams, enabling multi-disciplinary optimization and providing tighter integration between different physics and scales during simulation. In this paper, we demonstrate how structural and electromagnetic simulation tools can be used to co-design many functional aspects of a smart watch.

▼ Wednesday, April 26, 2017 ▪ 9:25 - 9:45 ▼

5G Advanced Communications Track
Room: 307B
Compact Phased Array with Beam Forming Network for 5G MIMO System at 60-GHz on Liquid Crystal Polymer Substrate
Wu Jiarui, Keysight Technologies

This paper presents the design of a 60-GHz beam-steerable phased-array antenna based on the Butler matrix beam forming technique for 5G wireless applications. Eight beam states are produced by 8-way Butler matrices, which control the horizontal angle. The array is designed using a liquid crystal polymer (LCP) substrate material of 4 mil thickness and dielectric constant of 3.2. The designed antenna has eight linear array elements and is fed to 8x8 Butler matrix to obtain the beam scanning ranging from -30 to +30 degrees. Maximum gain of 22 dBi and a wideband that covers 59.5 GHz to 60.5 GHz was obtained. Both the antenna and beam forming network are designed in a single 35x35 mm chip suitable for 5G devices.

RF & Microwave Design Track
Room: 302A
A Multi-offset PLL Synthesizer with Phase Detector Noise Floor Degeneration
Alexander Chenakin, Micro Lambda Wireless, Inc.

A multi-offset PLL frequency synthesizer architecture and test results are presented. The proposed architecture offers improved phase noise characteristics by removing frequency division from the PLL feedback path. This minimizes the impact of the phase detector residual noise floor. Moreover, phase noise is further improved by inserting a frequency multiplier into the feedback path. Phase noise at a 10 GHz output and 10 kHz offset is measured at –127 dBc/Hz that is close (within measurement accuracy limits) to phase noise of the utilized reference recalculated to the same output. The phase detector comparison frequency spurs are better than –80 dBc. This presentation starts with a brief overview of traditional PLL synthesizer techniques. Various design limitations and trade-offs are discussed. A new method of PLL phase noise reduction

is proposed. The method is implemented by inserting a frequency multiplier instead of the frequency divider within PLL loop that drastically improves phase detector phase noise.

IoT Design
Room: 305A
Challenges and Test Solution of Low Power Wide Area Network
Jian Li, Keysight Technologies

Low power WAN (LPWAN) is wireless wide area network technology for devices interconnecting. LPWAN technologies including are designed for IoT and machine-to-machine applications, with longer range, higher power efficiency and lower cost than traditional cellular mobile technologies. There are two major groups of LPWAN technologies, cellular network based NB-IoT and LTE CAT-M using licensed spectrum band, and LoRaWAN, Sigfox and other emerging technologies using unlicensed band. This paper introduces the key performance challenges of LPWAN including broad coverage, large scale devices capacity, extremely long battery operation life and how to characterize and overcome the potential issues with proposer test and measurement methods. Simulation and characterization of multi formats LPWAN transceivers will be discussed in practical terms. Battery drain test correlated to different transceiver working mode can give you the true insight of overall power consumption. Electromagnetic conformance (EMC) evaluation is also essential step of LPWAN device design.

Systems Engineering Track
Room: 305B
Building a Multi-GHz Real-Time RF Streaming System
Shivansh Chaudhary, National Instruments

Advanced cellular and wireless standards are rapidly expanding their instantaneous RF bandwidth requirements, and with operating frequencies moving into mmWave spectrum, channels of 1 GHz and wider become increasingly likely. Furthermore, carrier aggregation and MIMO systems require multiple wideband channels, placing even higher demands on the system. No longer satisfied with short bursts of captured data or generation of repetitive waveforms, researchers and design engineers need products and systems that can continuously process data at these wider bandwidths. This presentation addresses the various ways in which data can be continuously transferred and processed in real-time, or stored to disk for extended periods and post-processed. Also, multiple system configurations are provided to stream multi-GHz of RF data, in real-time, with flexible bits of resolution and data rates.

IoT Design
Room: 307A
Channel Emulation for RFID Baseline Test
Hui Shao, JX Instrumentation Co Ltd

RFID is one of the most important information technologies in IoT. In real-world applications, RFID communication is seriously influenced by the environment. In order to evaluate the performance of an RFID system in real applications, we need some method to simulate the application scenario of tags and readers. These RFID performance tests under standardized simulated application circumstances are named “baseline test.” In baseline test, we need to simulate complicated RF channels including fast moving, interferences, pile of goods, etc. Instead of establishing the test environment with real-world materials, we developed a channel emulator to enable the test under controlled lab environment with high repeatability. This paper introduces the RFID baseline test for complicated scenarios, channel emulation methods, channel modeling, and how we developed this test system which reduced the cost, increased the repeatability and enabled much more difficult tests. Test results are given with the design.

▼ Wednesday, April 26, 2017 ▪ 10:10 - 10:30 ▼

High-Speed Digital Design Track
Room: 305A
Timing Mistakes in High-speed PCB design
Wu Jun, Edadoc

Length matching is very important during high-speed digital design. In addition, how to think about timing issues is a key problem for many engineers. This paper discusses the details of timing design and helps the engineer understand how to do a better job with timing. Topics include: common clock bus, the source synchronous clock bus and high-speed serial bus

timing principle, timing calculation formula, as well as the basic principles of time-length design.

EMC/EMI Track
Room: 307A
Real-Time Measuring Equipment Optimized for Faster Detection of Critical EMI Signals
Volker Janssen, Rohde & Schwarz

The development of military and commercial products and the growing complexity of electronic devices has led to a significant increase of EMC conformance testing. Due to market pressures, product design cycle times continue to decrease. Companies are spending more money on multiple iterations of product EMI compliance testing at EMC test laboratories. Many companies pay for a product to be repeatedly tested at an EMC test laboratory, but it often makes more financial sense for companies to invest in their own test solutions. Such equipment could, for example be high-end signal and spectrum analyzers being upgraded to real-time analyzers that provide the functionality of a traditional signal and spectrum analyzer as well as real-time functionality. All available real-time display modes run in parallel on the real-time analyzer. This means that all available real-time results can be displayed in multiple diagrams at a time and a frequency mask trigger can be used in addition to capture rare events. This flexibility results in a time saving, reliable, accurate testing method to reduce device design cycles without compromises to oversee sporadic or non-stable signals in gapless recording by real-time analyzers. The paper describes the implementation of real-time function used today with modern spectrum analyzers and test receivers supported by example screen shots of critical signal detection.

Measurement & Modeling Track
Room: 305B
Novel Modeling Method Based on Field Measurement Data in OTA Chamber for UE Performance Test
Huaizhi Yang, Keysight

This paper introduces one novel in-lab test method to reproduce field radio channel data in lab, and it uses recorded field data as an example to evaluate TDD-LTE UE performance. First, we present the field measurement method based on the scanner, and then introduce an accurate modeling method as conversion to generate in-lab playbacking file and also mapping to support CE based MPAC test solutions. Finally, we show in-lab throughput results as KPI to fulfill end-user experience oriented 4G UE performance test.

5G Advanced Communications Track
Room: 307B
Introduction to 802.11ax: High Efficiency Wi-Fi
Alejandro Buritica, National Instrument

Although the creation of new wireless standards promises many benefits to us as consumers, they introduce new design and test challenges. One exciting new technology is 802.11ax, also known as High-Efficiency Wi-Fi (HEW). HEW is an evolution to 802.11ac, and is expected to become a mainstream Wi-Fi technology by 2017. Designed to deliver better Wi-Fi performance in outdoor environments, HEW uses several technologies that are new to Wi-Fi including narrower sub-carriers, higher-order modulation schemes (1024-QAM), and orthogonal frequency division multiple access (OFDMA). In this presentation/article, we will provide a basic overview of the new features of 802.11ax, compare and contrast it to 802.11ac, and explain several practical considerations that it introduces for RF design and test.

RF & Microwave Design Track
Room: 302A
High Performance Material Considerations for Use in Wireless Communications Infrastructure
Art Aguayo, Rogers Corporation

Today's wireless communication networks are evolving to allow users to transfer as much data as possible, as fast as possible in all places, indoors to outdoors as well as while moving at high speeds. We have seen this transition from 2G to 3G and then on to 4G and now we are preparing for the promises of 5G. To do so, the radio access portion of the networks has expanded to higher frequencies, higher power levels and increased functionality of the components in the system. In the past, a few PCB materials choices were needed for the high power amplifiers, antennas and microwave radio links; however, now we see a need for a much broader selection of options to accommodate the new frequencies, circuit configurations, and component functions. In addition, new material choices have been introduced in the last couple of years that are designed to address more specific designer needs than in the past. This paper will focus on high-performance PCB ma-

terials, their electrical and thermo-mechanical properties and other key parameters that designers need to consider when selecting the right PCB material for their application.

▼ Wednesday, April 26, 2017 ▪ 10:35 - 10:55 ▼

RF & Microwave Design Track
Room: 302A
CMOS and SOI for RF Modules
Malcolm Smith, AnalogSmith Design Solutions LLC

For many devices, the RF front-end is not easy to design. For devices with similar requirements, such as mobile devices, one approach to easing the design problems is to use standard or semi-standard RF modules. The first of these modules were the power amplifier (PA) modules (PAMs) and antenna switch modules (ASMs) but these rapidly developed into Tx modules (TxMs) and even full radio front-end modules. The critical components in these modules are switches, filters, and PAs. All three of these components were originally made in non-standard, specialized technologies, and while filters have remained an area where specialized technologies are required, switches have moved into standard CMOS based SOI technologies and PAs are also slowly moving into standard bulk or SOI CMOS technologies as well. In this talk I will cover the design of CMOS PA components, SOI switches, and their use in RF modules. I will emphasize modules for low end mobile phones where cost is important but also cover other applications. The talk will cover considerations ranging from circuit through system design with some coverage of manufacturing and cost trade-offs on design choices.

High-Speed Digital Design Track
Room: 305A
Fast and Accurate Measurement of PCB Quality Parameters
Yang Hongwen, Rohde & Schwarz

With continuously increasing data rates, signal integrity aspects of high-speed PCBs become more challenging. Particularly at higher data rates, vector network analyzers (VNA) are replacing traditional time domain reflectometry (TDR) setups for PCB testing. Users hereby benefit from the higher accuracy, speed and ESD robustness of the VNA, making the VNA the instrument of choice in this field. In this article, we will discuss the latest PCB test solutions based on VNAs and deem bedding tools (such as Delta-L+, SFD) to help to evaluate and optimize your PCB and the circuit.

5G Advanced Communications Track
Room: 307B
Software Defined Radio Techniques Applied to 5G Emulation
Thomas Higgins, Keysight Technologies

The 5G new radio interface brings forward many technical challenges. To achieve the high data rates needed for the 5G enhanced mobile broadband (eMBB) usage scenario, many system design challenges must be addressed in the baseband signal and protocol processing, RF front end design, antenna design and system integration. Effective 5G emulation solutions, which can emulate the functionality of the base station or user equipment, can aid in the testing and validation of 5G implementations. In this paper, several software defined radio (SDR) technologies are used to address the challenges; namely, a well-defined architecture which can enable the add-in of custom MAC layer and above protocols, and a hardware transparent physical layer implementation architecture which can migrate among different baseband processing hardware platforms. The prototype emulation system and corresponding experimental results are provided to show the effectiveness of the SDR technologies.

Measurement & Modeling
Room: 305B
Advanced PA Test Techniques: Advanced Technologies for DPD, ET, and Measurement Acceleration
Alejandro Buritica, National Instruments

With the increasing peak to average power ratio (PAPR) characteristics of modern communications signals like 802.11ac and LTE advanced, engineers face an increasing need to linearize handset power amplifiers (PAs). Some of the most common models for PA linearization include the memory less lookup table (LUT), memory polynomial model (MPM) and generalized memory polynomial model (GPM). When applying each of these models, engineers must make careful tradeoffs

between the computational complexity of the model and the resulting RF performance of the PA. In this paper, we will compare and contrast each implementation, and present results regarding the relative performance of each model. As a result, attendees will gain a better understanding of the relative performance differences between each model for various signal types.

EMC/EMI Track
Room: 307A
Protecting the Next Generation Technologies-5G, IoT and Automotive Through EMC Solutions
Sangam Baligar, AR RF/Microwave Instrumentation

Mobile Internet, Internet of things (IoT) and automotive (electric and self-driving) are widely recognized as major driving forces of next-generation technologies. These amazing technologies are built with today's faster and smarter electronics. The more electronic devices that these technologies (5G & IoT) interact with, the greater the potential for disturbance (RF interference) among them. The largest challenge for these emerging applications will be RF compliance not only with regard to regulatory requirements but also a greater awareness of the intended operational environment of these products to ensure proper performance, and safety. These emerging trends are also driving changes in EMI/EMC standards, and innovation in test & measurement equipment. This presentation will discuss product features requiring greater awareness of the EMC environment in which they operate, and new test approaches.

▼ Wednesday, April 26, 2017 ▪ 11:00 - 11:20 ▼

High-Speed Digital Design Track
Room: 305A
Signal Integrity Measurement Using a Vector Network Analyzer
Fei Yu, Rohde & Schwarz (China) Technology Co., Ltd

This paper describes a method of eye diagram measurement with a vector network analyzer (VNA) that is based on the frequency domain analyze theory of signal transmission system. In modern digital systems, high data rates require better performance of the transmission lines. To measure such performance, traditional methods use a rapid rising step signal as stimulus, measure the time domain response, and display as an eye diagram. In our approach, the VNA uses a frequency sweeping continuous wave (CW) signal as stimulus, and measures S-parameters as the system transmission model. Then, we generate a digital signal waveform as input, convert to the frequency domain (using FFT) and multiply with a transmission parameter. Then, we revert the response signal to time domain (IFFT). The result is also displayed as eye diagram for measurement. Further, once the measurement is done, the transmission model has been established. A VNA can do more software simulation with the model: change into other digital data signals, encoder, emphasis, equalizer, fixtures and match network embedding. This can fulfill the tuning requirement at the R&D stage.

EMC/EMI Track
Room: 307A
Smart Tone Proposal of EMC
Andy Zhang, Hwa-tech Information System Company

Public mobile communication, broadcasting, railroads and other industries dependent on radio are growing, and 3G, LTE, Internet and other wireless technologies are flourishing. More devices with electromagnetic radiation are becoming part of people's lives, and it can be said that anywhere in our environment there is artificial electromagnetic radiation. In a traditional RS immunity test system, according to ISO16000-4-3, in the test frequency range, people-by-frequency control signal source based on 1% logarithm step test takes several hours or even days for immunity testing.Improving efficiency is at present the main problem of radiated immunity test. This paper describes a test program that has been applied at the Shanghai Institute of Measurement and Testing Technology.

RF & Microwave Design Track
Room: 302A
Very High Efficiency High-Power Schottky Diode Frequency Doubler Operating at 180-190 GHz
Michael Crowley, Farran Technology

This paper explains Schottky doubler efficiency principles and a design methodology. It demonstrates an efficient use of software simulators for a fast and successful component design. We present simulation and test data for a fixed-tuned ultra-high efficiency high power Schottky diode 180-190 GHz frequency doubler. The device is based on a circuit topology presented originally by Erickson and further modified by Porterfield.

Measurement & Modeling Track
Room: 305B
Millimeter Wave OTA Test Challenges
Prasadh Ramachandran, Keysight Technologies

Industry is intensifying the activities towards 5G which has a goal of achieving > 100 billion connections, < 1ms latency, and > 10Gbps data throughput. The high-speed connectivity requires culmination of several technologies like MU-MIMO, massive MIMO along with efficient use of spectrum. Spectrum is scarce in the sub-6GHz frequency bands, so in order to meet the requirements of wide bandwidth, the focus is towards millimeter wave (mmWave) frequencies. These frequencies offer wide bandwidths; however, they have a high path loss which reduces the coverage area during cell deployment. This mandates the use of sophisticated beam forming methodologies to achieve reasonable coverage area. Closed loop beam forming enables efficient spectrum utilization and reduced inter cell interference compared to the sub-6GHz bands, currently used for LTE. This paper focuses on the aspects of mmWave based product design and the unique test challenges which require to be addressed in a cost effective way.

5G Advanced Communications Track
Room: 307B
5G Antenna for Mobile Terminal Device Application
Bin Yu, Speed Wireless Technology Co., Ltd

The 5G wireless access is the next step in the evolution of mobile communications, projected to be in place by 2020. 5G systems will shift the frequency to mm-wave band to obtain wider bandwidths. The use of this higher frequency will call for a change in the way mobile terminal device antenna front ends are designed. Our study focuses on 5G antenna solutions for mobile device application, especially for the mm-wave beam steering array antenna (up 20GHz) and antenna in package (up 60GHz). For 60GHz, AiP (antenna in package) is a possible solution. We focus on different AiP antenna types and package solutions. We study the patch, grid and yagi antenna for different package solutions, such as LTCC, eWLB and HDI. More over,at mm-wave frequencies the manufacturing tolerances will become critical, so that the assembly methods for the different components (flip chip, bonding, packaging) have to be carefully considered.

▼ Wednesday, April 26, 2017 • 11:25 - 11:45 ▼

High-Speed Digital Design Track
Room: 305A
PAM-4 Challenges and Testing in 400G Ethernet
Li Kai, Keysight

PAM-4 is the key physical layer technology of next generation 200G and 400G Ethernet. The signal generation method has experienced the transition from combination of NRZ signals to direct DAC technologies. At the same time, the lower noise margin, higher linearity requirements, more complex switching jitter, forward error correction (FEC) and other characteristics also put forward higher challenges for signal testing methods. This paper introduces the PAM-4 signal challenges, test method of key parameters like test pattern, rise time, jitter, eye diagram, linearity, extinction ratio, TDECQ, and bit error ratio etc.

RF & Microwave Design Track
Room: 302A
Broadband Microwave Frequency Doublers with Improved Harmonic Suppression Based on Quasi-Vertical GaAs Shottky Diodes
Nikolay Drobotun, TUSUR

The problem of a wideband RF or microwave signal forming is most momentous in system design, such as point-to-point radios, test and measurement equipment and systems, and remote sensing. There are two main techniques to form wideband RF signals. The first one is oscillating at the fundamental harmonic. The second one is general low-frequency range forming using phase lock loops and secondary frequency division and/or multiplication (scaling). Since each frequency doubling causes 6 dB phase noise addition, passive frequency multipliers are preferred in applications where the output signal should be formed with minimal phase noise. Typical passive multipliers are based on Shottky diodes, due to their high switching speed which is suitable for high frequency ranges. This paper presents a versatile design method of broadband microwave frequency doublers based on quasi-vertical GaAs Shottky diodes, and a diode's simplified SPICE model development which is applicable for design process up to millimeter wave range. As an example of successful EM design

and physical implementation, two broadband GaAs MMIC frequency doublers with a 10-26 GHz and a 20-60 GHz output frequency ranges are shown.

EMC/EMI Track
Room: 307A
Discussion of EMC Test Technology for Automotive Electronics
Cinya Tu, Institute of EMC & Electronic Measurement, EVERFINE Instrument Co., Ltd.

With the rapid development of automotive electronics technology, also the increasing improvement of automobile automation and intelligence, the kinds of electronic equipment widely used in power control systems, security control systems, automobile body electronic systems, as well as entertainment and communication systems of automobiles will play an important role in the safety, reliability, comfort, energy conservation, and emission reduction of automobile driving. Due to the increasing quantity and type of electronic equipment for automobiles, and the continuous improvement of the working frequency, the electromagnetic environment inside automobiles is becoming increasingly complicated, so it also brings new problems of electromagnetic compatibility (EMC). Based on the latest developing trend of automotive electronics EMC test and relevant international standards, this paper introduces the EMC test standards and test items of automotive electronics, and mainly expounds on the conducted emission, radiation emission, BCI and transient immunity test techniques.

5G Advanced Communications Track
Room: 307B
Verification of Beam Forming Devices with Over-the-Air Power Sensors
Fabricio Dourado, Rohde & Schwarz

Antenna arrays of 5G devices in mmWave frequency range provide no access to connectors due to physical size limitations. Therefore conducted measurements will be mainly replaced by OTA measurements which can be challenging due to high signal attenuation and sensitivity of the mechanical arrangement. Functional tests are necessary to verify the beam output power and beam peak direction. These measurements can be performed by using antenna modules with integrated diode detectors in bench top chambers. In this session you will learn the principles of over-the-air (OTA) power sensor architecture. The theoretical background on OTA power and pattern measurements is described and the recommended setup of the test solution is explained. Real measurement results are shown and discussed.

Measurement & Modeling Track
Room: 305B
Distortion Measurements on Radio Front-End (RFFE) Components and Chains
Gareth Lloyd, Rohde & Schwarz

Between modems in a communications link, lie the RFFE and the channel. The RFFE comprises a cascade of components including mixers, filters and amplifiers; each type generating its own signature distortion. Types of distortion include linear and non-linear, but their effects can change over time and frequency (memory effects). Using representative conditions, especially modulated signals, is critical for optimum test, measurement and development of RFFE components and chains. This paper demonstrates a method to do the requisite analysis and insight, rapidly and simply.

▼ Wednesday, April 26, 2017 ▪ 13:00 - 13:40 ▼

Workshops

RF & Microwave Design Workshop
Room: 305A
Design Flow and Simulation Technologies Supporting Multi-technology RF Modules for Wireless Applications
Milton Lien, National Instruments, AWR Group

The design of multi-technology-based modules and advanced packaged power amplifiers (PAs) both incorporate different IC and PCB process technologies, often leveraging different design tools. To develop smaller wireless devices with optimum performance, it is common for front-end module manufacturers to integrate GaAs, SiGe, or RF CMOS PAs, CMOS or silicon-on-insulator (SOI) switches, and acoustic filters—all mounted on a single laminate package. Today's wireless integrated devices require concurrent chip/package co-design for successful implementation. This workshop introduces a unified

design flow for full module simulation, inclusive of all process technologies, enabling designers to leverage the strengths of specialized EM modeling and circuit analysis tools to address various functional block technologies maintained through a single-user interface. An RF module design flow will be presented using NI AWR software to address multiple technologies based on a dual band, 1.9 GHz (cellular)/ 2.5 GHz WLAN front-end that includes two PAs (GaAs and SiGe), surface-mount bulk acoustic wave (BAW) filters, and a single laminate substrate.

5G Advanced Communications Workshop
Room: 305B
60GHz Wireless Systems with Circuit/EM Co-Simulation
Yunhui Xiao, ANSYS

The collaborative method of EM/circuit simulation by using HFSS can help to consider the parasitic effect and circuit system collaborative design, and to perform accurate simulations of the antennas, the feed networks, and other passive components in a wireless system, and finalize an optimal solution in the design stage. This workshop aims at the design of antenna array, beam forming, the collaborative design of array and the feed system, the array and carrier platform integration and other core issues in 5G systems. It launches a simulation case presentation and discussion, providing a reference for the similar simulation scheme of wireless system development and engineering design.

IoT Design Workshop
Room: 307A
Narrowband IoT: Operation Modes and Their Use-Cases
Muthu Kumaran, Keysight Technologies

Attendees to this workshop will gain an understanding of the narrowband IoT (NB-IoT) design targets and technical characteristics with specific focus on the different operation modes of NB-IoT. The use-cases, economic drivers and continuous evolution of the NB-IoT standards beyond 3gpp will be presented. Other discussion topics include the latest progress of LPWAN and applications, challenges of LPWAN for IoT applications, and how to address potential issues of LPWAN with simulation and measurement approaches.

Workshop
Room: 307B
High Performance Material Considerations for Use in Wireless Communications Infrastructure
Art Aguayo, Rogers Corporation

Today's wireless communication networks are evolving to allow users to transfer maximum data at lightning speeds with total coverage indoors and outdoors while the user is moving at higher and higher speeds. We have seen this transition from 2G to 3G and then on to 4G and now we are preparing for the promises of 5G. To do so, the radio access portions of the networks have expanded to higher frequencies, higher power levels and increased functionality of the components in the system. In the past, a few PCB materials choices were needed for the high power amplifiers, antennas and microwave radio links; however, now we see a need for a much broader selection of options to accommodate the new frequencies, circuit configurations and component functions. In this presentation, we will cover the strengths and weaknesses of current and new material choices up to millimeter wave frequencies, and key considerations regarding environmental effects on circuit reliability. We will also discuss PCB fabrication techniques and their impact on overall circuit performance.

Workshop
Room: 302A
Key Design Solutions for High-Reliability Semiconductors with e2v
Marc Stackler, e2v

This workshop is dedicated to help engineers, project managers and purchasing officers understand the capabilities offered by e2v's semiconductors product and identify and understand the scope of high- performance semiconductors suitable for their application and needs. e2v has been a leading company, through evolution and acquisitions, in high-reliability semiconductors targeting aerospace, defense, industrial, telecommunication, medical and life science applications. Its extensive portfolio comprises microprocessors, high-speed data-converters, memories, PLL, DC-DC converter, digitizers and more. High-reliability solutions are supported through certification up to QML-V, extended temperature range screening and long term support. This presentation shows how these products and capabilities can be designed into these applications. After introducing e2v's portfolio and capabilities, we will look at the different application segments through system design example considering the key parameters and benefits to look for to achieve the required performance and reliability.

▼ Wednesday, April 26, 2017 ▪ 13:45 - 14:25 ▼

RF & Microwave Design Workshop
Room: 305A
Simulation of a Large Cassegrain Antenna with an FSS Subreflector
Yong Yuan, ANSYS

A FSS (frequency selective surface) sub reflector can be utilized in a Cassegrain system in order to apply two or more feeds that operate on different frequencies, thereby a single antenna system can meet the requirements of different frequency band communications. Because of its flexibility and low cost, a multi-feed Cassegrain reflector antenna is widely used in microwave communication. This workshop shows how to use the hybrid FEM-IE-PO algorithm in HFSS for FSS Cassegrain antenna applications.

Radar/Communications Workshop
Room: 307B
New Challenges for Next-Generation Vehicles
Lisi Ma, National Instruments

With the increasing number of new technologies in the automotive industry, vehicles cannot be only considered as a mechanical product. In the future, we will witness many different wireless technologies integrated into next-generation vehicles. For example, radar based advanced driver assistance systems (ADAS), which integrate RADAR into a self-contained unit, will lead the path to full autonomous driving. Connected cars, with different wireless technologies including 802.11p, will ultimately enable the vehicle as a new access point for the next-generation network. However, to achieve all these innovations, engineers are facing more severe challenges in both design and test than ever before. In this workshop, we will discuss these two most representative wireless communication technology topics in the automotive industry. We will share information on the new design architecture and new test measurement approaches in these areas.

Systems Engineering Panel
Room: 307A
Trends in Mobile Infrastructure
Gary Lerude, Microwave Journal

Mobile networks are rapidly evolving to LTE-Advanced, LTE-Advanced Pro and 5G. In this discussion panel, we'll explore the impact of these changes on the base station transmitter, including inroads by GaN vs. LDMOS, which flavor of GaN is winning (silicon or SiC), and the requirements imposed by network densification, massive MIMO, and the new radio (NR).

5G Advanced Communications Workshop
Room: 305B
20W Fully Integrated 3.5 GHz GaN Doherty MMICs for 5G Applications
Francis Auvray, Ampleon

To satisfy all the requirements of the new massive MIMO systems, we have chosen to follow the approach of an ultra-compact fully-integrated MMIC PA. The power amplifier, able to cover the 3.4-3.6 GHz band, is integrated in a QFN plastic package of 7x7 mm2 and is based on the Doherty architecture to boost the efficiency at high output power back-off (OBO). During this workshop, we will introduce different PA solutions we designed to achieve the specifications of 5G and compare the PA performance in order to determine the best MMIC solution.

Workshop
Room: 302A
Advanced PCB Rule Checking for Signal Integrity and EMC
Chun Tong Chiang, CST

The performance of a printed circuit board (PCB) for signal integrity (SI) and electromagnetic compatibility (EMC) is mostly based on the placement of components and the routing of signal nets and their power/ground planes. Manual checking of all the various layers of today's high speed circuit boards is too time-consuming and prone to human error. Rule checking software has proven to be a valuable aid for engineers in today's fast paced design process. It relieves the tedium and

removes the human error by rigorously analyzing the geometry of the PCB against a set of rules. All detected rule violations can typically be visually highlighted within such a tool. In this workshop, we will explore the usage of CST BOARDCHECK on a realistic PCB.

▼ Wednesday, April 26, 2017 ▪ 14:50 - 15:30 ▼

Measurement & Modeling Workshop
Room: 305B
VNA based Measurements and Nonlinear Modeling for Efficient RF PA Circuit Design
Tony Gasseling, Maury Microwave

All the players in the RF industry are looking to develop high efficiency circuits and are willing to invest heavily to achieve this target. Increasing power efficiency enables decreasing power consumption, thus reducing the use of the resources provided from the battery, to reduce the size of cooling systems, improve reliability, and ultimately reduce the electricity bill. For advanced design of RF power amplifier circuits, this requires a detailed knowledge of the optimal matching conditions that can leverage the best performances offered by the transistor. If the RF designer can use an accurate transistor model for the simulation with a proper design method, then the design target will be hit. If there is no model available, alternative methods must be found in order to retain the best RF design. In the latter case, for die or packaged transistor, two approaches are proposed in this workshop. Both tend to secure the design flow of a high efficiency amplifier when a complete compact transistor nonlinear model is not available.

RF & Microwave Design Workshop
Room: 305A
Designs of GaN on Silicon Doherty PAs for Commercial Base Station Application
Xin Liu, MACOM

This paper shows the combination of the latest GaN on silicon technology and Doherty power amplifier topologies at different power levels in major communication operation frequency bands. Firstly, the unique advantages of GaN on Silicon HEMTs compared to other power transistor technologies are summarized. Then the workshop shows the performance of GaN on silicon transistors by using MACOM's Gen 4 GaN on silicon technology. At last, several designs of GaN on Silicon Doherty power amplifiers, including symmetrical Doherty, asymmetrical Doherty and N way Doherty topologies are described. Each Doherty amplifier shows state-of-the-art back-off efficiency as well as linearity, which can be adopted in the commercial base station immediately.

5G Advanced Communications Workshop
Room: 307A
Wideband Amplitude & Phase Control Matrix for 5G MIMO Channel Simulation
Wei Liu, Mitron

Amplitude and phase control matrix is the key of 5G MIMO channel simulation, it can help realize the simulation of the 5G application environment for developing, evaluating and testing 5G systems and antenna. However, because of the limit of attenuator and phase shifter accuracy and bandwidth in the market, the availability of high accuracy wideband MIMO channel simulation system is a difficulty. This paper introduces a high accuracy amplitude and phase control matrix that covers 1.7-6GHz and 25-40GHz. The product is composed of high resolution amplitude/phase control module, calibration module/software, and controlling circuit and software. The matrixes have wide frequency coverage. The phase and amplitude of every channel can be controlled independently and synchronously with the very fine step and accuracy: amplitude dynamic 30 dB (60 dB available), step 1 dB, accuracy 0.2 dB, phase control 360 degree, step 1 degree, accuracy 2 degree. As the actual example, 1X32 matrixes respectively covering 1.7 to 6GHz, and 25 to 40 GHz are developed, they are all put in a 7 U 19" box. The GUI software allows the customer to setup the required amplitude and phase value, and test data and curves are given.

Measurement & Modeling Workshop
Room: 307B
Cardiff Model+ Investigating Bias and Frequency Interpolation Using RAPID Behavioral Model Extraction
Xianfu Sun, Focus Microwaves

With increased popularity of behavioral models, questions arise about the model's ability to accurately interpolate over bias and frequency space. This is seen as vital in moving these models from a convenient way to move measured data into the simulator to a more complete model of the device. Real time measurement solutions such as Focus Microwaves RAPID solution allows much denser model data collection to allow a more complete, systematic investigation into model interpolation. An investigation into how dense or sparse the data collection can be to allow for accuracy of the model is conducted. Different devices are analyzed to show any differences with technology. Finally model extrapolation in frequency and bias is investigated, how graceful is the degradation of the Cardiff model+

Workshop
Room: 302A
Sanan III-V Semiconductor Foundry Service
Jasson Chen, Xiamen San'an Integrated Circuit Co

▼ Wednesday, April 26, 2017 ▪ 15:35 - 16:15 ▼

Measurement & Modeling Workshop
Room: 305B
The Next Generation WLAN Standard and Overcoming the Test Challenges
Xiang Feng, Keysight

This paper gives an overview of the next generation WLAN technologies of 802.11ax and 802.11ad, and describes key test requirements and challenges for each technology respectively. Measurement results will be provided. Wi-Fi technology, governed by the IEEE 802.11 standards body, has been providing users with pervasive, low-cost access to high-data-rate wireless connectivity. With the demand for new usage models and more applications, the new 802.11 standards, 802.11ax and 802.11ad have been proposed for different use scenarios. 802.11ax is the enhancement for 802.11 PHY and MAC in 2.4 and 5GHz by utilizing OFDM, up to 1024 QAM, and multi-user MIMO, mainly for dense Wi-Fi deployments and more outdoor and public access. While 802.11ad is a directional, line-of-sight technology at 60GHz that provides multi-gigabit connectivity with low latency for a variety of data intensive applications, such as wireless docking, AR/VR, media entertainment.

RF & Microwave Design Workshop
Room: 305A
Monolithic Alternatives to PIN Diodes – RF SOI Power Limiters & Switches
Eric Song, Peregrine Semiconductor

This workshop will discuss monolithic, silicon-on-insulator (SOI) alternatives to discrete, PIN-diode RF solutions for two use cases—power limiting and 4.5G/Pre-5G TD-LTE switching. For power limiting, monolithic alternatives eliminate thermal hysteresis issues and are 8 times smaller than the board space required by PIN-diode solutions. In addition, these alternatives provide a 10–100x improvement in response-and-recovery time, deliver 10–40 dB linearity (IIP3) improvement and offer a 20x improvement in ESD protection. The other use case will explore the industry rollout of 4.5G/Pre-5G TD-LTE and what is needed to support the latest RF switching requirements. This session will compare using PIN diodes versus monolithic RF SOI switches or limiters in these two use cases, and assess how each stack up on key features such as power handling, DC power consumption, insertion loss, reliability, linearity, ESD performance and integration.

Workshop
Room: 307A
5G Over-the-Air Measurements
Jian Luo, Rohde & Schwarz

Massive MIMO replaces existing separate radio units and passive antennas with an integrated transceiver plus antenna arrays to create an active antenna system with the coexistence of beam forming and MU-MIMO architectures. The active antenna system requires over-the-air measurements in order to measure both traditional radiated parameters such as EiRP, EiS, and gain as well as transceiver performance such as EVM. mmWave presents another challenge where due to the small size of the antenna, a conventional conductive antenna measurement will result in error due to the influence of the cable. This workshop addresses the challenges of over-the-air (OTA) measurements for 5G massive MIMO and mmWave equipment.

RF & Microwave Design Workshop

Room: 307B
RF& Microwave Coaxial Switches: How to Reach 10 Million Cycles with an Electromechanical Device
Vonie SUN, Radiall

Considering the increased complexity of RF and microwave systems, this presentation is intended to show a specific design used inside electromechanical switches in order to improve RF performances and increase life span. A technology called RAMSES (RAdiall Modular System for Electromechanical Switches) was developed and patented which enables RF and microwave coaxial switches to be manufactured with a typical operating life of 10 million cycles without a decrease in contact resistance reliability over time. Based on a no-friction concept, this technology has been deployed to high-frequency coaxial switches (up to 50GHz) with high repeatability improvement. In addition, a unique internal construction approach based on modularity allows to apply the technology on more than 20,000 different coaxial switching devices, made for various applications on different markets such as Instrumentation, defense, telecom & industrial.

▼ Wednesday, April 26, 2017 ▪ 16:20 - 17:00 ▼

Measurement & Modeling Workshop
Room: 305B
Challenges of Evaluating RF Performance of High Frequency Wide Bandwidth Devices
Randy Becker, Keysight Technologies

Proposed 5G communications systems are targeting a range of new capabilities including higher bandwidth, more connected devices, low latency, and better coverage. To address the higher bandwidth requirements, researchers are exploring higher frequencies in the microwave and millimeter-wave bands where more spectrums is readily available. Compared to the traditional bandwidths used at sub 6-GHz for cellular communications, the use of hundreds of MHz or several GHz of bandwidth require components with much tighter physical tolerances to achieve the desired performance. This workshop will explore key concepts in optimizing a flexible 5G test bed for evaluating the RF performance of a wide bandwidth high frequency device. Additionally, a new approach will be shown for calibrating the test bed to exclude the effects of associated test fixtures from the test equipment to the device under test to enable the true device characteristics to be evaluated.

RF & Microwave Design Workshop
Room: 305A
Wide Bandwidth, Low-Current Consumption Amplifier for 5G Massive MIMO Applications
Angela Wang, IDT

The high-gain broadband F0424 RF amplifier from IDT provides high linearity, low power consumption along with wide bandwidth and low noise figure. Utilizing the IDT proprietary Zero_Distortion Technology, the F0424 delivers +39dBm of output IP3 with 60mA of current consumption. In addition, the 1.5dB noise figure at 2GHz is the lowest among RF amplifiers with 39dBm IP3 in Si technologies. The broadband F0424 covers applications from 600MHz to 4200MHz (Another variant covers 4000 ~ 6000MHz). The IDT F0424 also offers the flexibility to further reduce power consumption with reduced OIP3. The versatile F0424 could be crucial for various 5G wireless systems and also small cell wireless systems.

Workshop
Room: 307A
Addressing the Test Challenges of 4.5G PA and Device Measurements
Jason White, National Instruments

3GPP release 13 defines and evolutionary step between 4G and 5G with introduction of LTE-Advanced Pro. With higher-order modulation schemes, carrier aggregation, and MIMO technologies, LTE-A Pro introduces significant test complexity and test challenges. This session will provide a basic overview of key physical layer characteristics of LTE-A pro. In addition, we will explain common test practices to address multi-carrier and high-order MIMO test configurations. Finally, the session will also provide a status update on 3GPP's development of a "new radio" physical layer to support future enhanced mobile broadband (eMBB) applications.

Workshop
Room: 307B
New Radiated Immunity System
Jiankun Xu, Beijing Xutec

You can use the smallest field probe (the size of a corn kernel), and you can use fiber to replace the RF cable to connect with a PC directly. These innovations lead to a perfect and precise E-field measurement. They also make it possible to test in narrow spaces such as in strip line cases. Fiber optic technology can also be used on power meters. You can connect those power meters directly in front of antenna in the chamber, to get real forward and reflected power monitoring. This workshop explains this new radiated immunity system.

▼ Thursday, April 27, 2017 ▪ 9:00 - 9:40 ▼

Workshops

Workshop
Room: 305B
Revolutionary Filter/IPD Technology for 5G Applications
Ming Hao Yan, Mini-Circuits

This session introduces a new class of reflection less filters that absorb and internally terminate stopband signals rather than reflecting them back to the source. Filter derivation and design methodology is reviewed and performance characteristics are examined. An improved design topology is presented to compare the rejection performance with 1st generation filters and current LTCC filters in the market. Advantages in various practical applications will be discussed and available high frequency (up to 40GHz) filter models for 5G market are announced. Reflection less filters overcome a number of systemic problems typical of conventional filter designs and are especially useful for pairing with sensitive devices such as mixers, multipliers, and high-gain amplifiers. The absence of stop band reflections unique to these filters results in the elimination of in-band intermodulation and spurious signals, significantly improving linearity and dynamic range in a wide variety of microwave systems.

Workshop
Room: 305A
Innovative Solutions of Radio Signal Chain in Wireless Transmission
Zhang Yong, ADI

There are more and more wireless communication systems, not only in traditional cell communication, but also in many industrial, commercial and military applications, such as HD video in UAV. All these application scenarios ask for new mixed-signal processing parts that can have high integration, low power and easy-to-use features. ADI's Radio Verse wideband RF transceivers are a good product to meet these needs. This workshop introduces the basic theory of AD9371 and explains why AD9371 is lowest power, and smallest PCB size and minimum filtering system, compared with other radio architectures. ADI's other innovative products in converter will also be introduced, which could enable higher dynamic range Rx, max bandwidth. Together with ADI's microwave products, it could enable an mmwave antenna-to-bits signal chain.

Workshop
Room: 307A
A Multipurpose Millimeter Wave High Power and Low Noise GaN/Si Process for High Frequency Transmit-Receive MMICs
Marc Rocchi, OMMIC/Sichuan YiFeng Electronic Science & Technology Co. Ltd.

OMMIC has developed a GaN/Si process dedicated to microwave applications. This process has the same noise figure, gain and frequency cut-off than a 130nm PHEMT process, but with a much higher output power. It makes use of an in-situ passivation to keep lag effects not higher than P-HEMT counterparts, re-grown Ohmic contacts to reduce source resistance, and a 100 nm mushroom gate. Several MMICs have already been produced with this process, including a 10W 30GHz power amplifier and a 1.2dB NF X band robust LNA. This workshop explains how this multipurpose process is suitable for high performance complete TR-Chips, including PA, LNA and switch on the same MMIC for military, space or 5G high frequency applications.

▼ Thursday, April 27, 2017 ▪ 9:45 - 10:05 ▼

Technical Sessions

Systems Engineering Track
Room: 305A
WiGig: 802.11ad Is Coming, Test Equipment Closes Behind and What Does It Mean to us?
Wei Lin, National Instruments

This presentation introduces and explains some of the measurement challenges of 802.11ad. In particular, it will focus on how to extend the use of WiGig test solutions to ensure positive quality of service (QoS) and quality of experience for customers, and prevent customer churn. 802.11ad is the new WLAN standard with much higher instantaneous bandwidth and very high throughput (VHT) PHY layers in the 60 GHz range. This presentation will provide a brief examination of key 802.11ad parameters, describe the required measurements and test setups, and provide several important recommendations for over-the-air (OTA) measurements. In addition, it will cover methods for optimizating linear signal chains in hardware and software in order to maximize EVM and SFDR.

RF & Microwave Design Track
Room: 307B
Design & Build Intelligent Switching Management System for Large-Scale RF Switching
Wang Qi, Pickering Interfaces

New RF/microwave communication techniques have been deployed in consumer electronics, automotive, aerospace, aviation and military applications. Most of these new products integrate multiple RF bands, multiple standards, and multiple channels that require more features for both functional test and performance test. In new types of ATE systems, the test efficiency and instrument occupying efficiency is more important for RF testing, so the larger scale and better performance switching systems are more important. For a switching system with large scale, complicated interconnection, and signal routings, there is requested an intelligent management software to manage multiple switching hardware, in order to automatically setup to route, reduce coding, optimize after service. This paper introduces a method that meets the above requirements.

Measurement & Modeling Track
Room: 307A
Measurements of Phase Noise at Frequencies above 50 GHz
Wolfgang Wendler, Rohde & Schwarz

With recent enhancements in semiconductor technology, the microwave frequency range beyond 50 GHz becomes more attractive, especially for wideband communication applications like 802.11ad, microwave links, or automotive RADAR. Low phase noise is essential for these applications to work properly, and accurate measurements of phase noise are needed to improve the performance. However, phase noise test is a difficult task at these frequencies, because normally there is a huge frequency drift of the sources and phase deviations are quite high. Setups for accurate tests become difficult, especially when cross correlation is needed to get rid of additional phase noise added by the local oscillators or mixer stages. In this session, a setup will be presented, where two external harmonic mixers are used for phase noise analysis in combination with a commercially available phase noise tester. Cross correlation of the two receive paths helps to improve sensitivity. Signal sources with frequencies up to 500 GHz can theoretically be measured with these frequency extenders. Beside a detailed description of the setup, measurement results for phase noise of high end sources above 50 GHz will be presented.

High-Speed Digital Design
Room: 305B
Modeling and Calibration of High-Speed Passive Channels
Bruce Wu, Edadoc

The efficiency and accuracy of modeling high-speed passive channels is very often the focus of simulation. 3D-EM simulation achieves a nice combination of efficiency and accuracy. In this paper, we use TRL calibration to measure an accurate result, and then calibrate our simulation result. We also use the 3DEM/Hybrid mixed method, trying to keep the accuracy and improve the efficiency.

▼ Thursday, April 27, 2017 ▪ 10:10 - 10:30 ▼

High-Speed Digital Design Track

Room: 305B
Power and Signal Integrity Insight for DDR4/LPDDR4 Systems
Jennie Grosslight, Keysight Technologies

Signal integrity and power integrity issues are often the root cause when systems don't behave as expected. Learn new techniques to gain rapid insight into power integrity and signal integrity in systems with high speed DDR4/LPDDR4 memory. Observe how to easily acquire cross-correlated measurements of traffic on DDR/LPDDR buses and the power integrity of systems. Innovative new probing of power usage and supply voltage fluctuations are used to correlate power usage and power integrity to specific areas of memory activity.

Systems Engineering Track
Room: 305A
Minimizing Uncertainty in Noise Figure Measurements
Wei Lin, National Instruments

Like most RF measurements, the mechanics of making a noise figure measurement is the easy part. However, determining the measurement uncertainty can be challenging. Whether you are using either the popular Y-factor or cold-source technique, not understanding measurement uncertainty can result in inaccurate measurements. This paper reviews the more important contributors to measurement uncertainty when measuring noise figure. In addition to explaining the sources of uncertainty and their relative importance, we then share common mistakes in the noise figure measurement process that can potentially lead to accuracy issues.

Measurement & Modeling Track
Room: 307A
An Innovative Methodology for Probe Pin Characterization with Vector Network Analyzer
Andrew Ko, Keysight Technologies

For test system engineering, probe pins are a key component used in electrical test fixtures to contact the test point, component lead, and other conductive features of the device under test (DUT). The probe pins are usually press-fit into probe sockets to allow their easy replacement on test fixtures which may remain in service for long hours, testing many thousands of DUTs in automatic test systems. The probe pin plays an important part for making physical contact to the DUT, its characteristics will affect the measurement signal integrity. The simple probe model consists of a series inductor, resistor and capacitor. Its inductive impedance will increase with respect to the frequency. An impedance analyzer with a side-contact fixture is an accurate and acceptable platform to characterize the probe pin with an equivalent circuit. Many engineers may only have access to a vector network analyzer. The key challenge of VNA reflection measurements for impedance is that it can provide accurate measurements only around 50 Ohms. This paper provides an innovative methodology to apply the VNA transmission measurements to determine the trans-impedance for the probe pin inductance estimation. Applying the concept of the micro-strip line structure, a simple but effective fixture has been designed to make good contacts with probe pins of various sizes, short as well as long (>10cm).

RF & Microwave Design Track
Room: 307B
An RF Solution With Design Flexibility for Mid-Tier Smart Phones
Locker Jiang, Qorvo

We describe an approach to RF front end integration that provides the design flexibility required to rapidly produce different regional variants of mid-tier and entry-level smart phones. Mid-tier and entry-level handsets, which are particularly important in China, are typically designed for regional use with some roaming capabilities. Fast changing customer requirements lead to very short development timelines and the need for great design flexibility; manufacturers need to rapidly adapt mid-tier handset designs for different regions and customers, yet they seek to minimize handset cost by including only the RF components needed for the target region. Typically, the goal is to use a single PCB layout that can be used to produce multiple SKUs by adding different RF components. We describe architecture, exemplified by Qorvo's RF Flex™, which integrates core RF components, such as PAs and switches, that are common to multiple regional variants of a handset. Manufacturers can then quickly produce regional handset variants by adding the filters and duplexers required for specific operator networks and regions. The architecture is also scalable; manufacturers can design a model for China domestic use and quickly add more filters to support the bands used in Europe, for example.

▼ Thursday, April 27, 2017 ▪ 10:50 - 11:10 ▼

Measurement & Modeling Track
Room: 305A
Understand Smearing-Effect of Time-Domain Pulse-Waves Radiated from a Wire Antenna
Shi Pu, Wuhan University of Technology

Some scholars have performed detailed analyses for the physical process of pulse signal waves radiated from dipole antennas, according to the view of moving charges. Also the time-domain method and its procedure of finding solutions of the equivalent circuits have been shown. Based on these explanations, with wire antennas as the basic radiating element, different time-domain pulse signals as the excitation, and antenna phase center as the reference point, the output waveforms of different far-field points in different directional angles will be observed. Furthermore, our research is focused on the effect or the influence of the wire antenna structure itself on transmission of various kinds of time-domain pulse signals. Thus it aims to help understand more clearly the radiation mechanism of pulse antennas in the physical point of view. Preliminary results show that the wire antenna structure really has some differential effect on the Gaussian pulses, and the more or less smearing effects are found from the output waveforms of the observation points. In the future, the method of loading resistors along the wire rods is in the plan to suppress or the control the signal smearing effect.

RF & Microwave Design Track
Room: 307A
System Accuracy Verification for Real-Time Hybrid Load Pull System under Large Mismatch Condition
Xianfu Sun, Focus Microwaves

Hybrid real-time load traction measurement system has been widely used in power die and power amplifier design because of its larger load distribution range. In this paper, a set of 8mm real-time system is established and its working principle is analyzed briefly. Then, the verification method of the measurement system under the large load reflection coefficient is studied, and the sum of the working gain of different ideal reflection coefficients is put forward as the verification index. Finally, two calibration schemes are used to calibrate the system, and a better calibration scheme is given by comparison.

Radar/Communications Track
Room: 305B
Automotive Radar Target Simulator
Hieng Ling Tie, Keysight

The automotive industry is using radar increasingly in advanced driver assistance system (ADAS) to quickly and precisely measure the speed, size and distance of objects, regardless of weather conditions. The millimeter wave radars are commonly used for adaptive cruise control, stop-n-go, blind spot monitoring and collision avoidance systems. Thus, it is important that every single part of the radar system goes through performance verification testing to ensure quality before being shipped. This presentation provides an overview of automotive radar technologies, with 4 major frequency bands explained and then followed by in-depth discussion on the radar target simulator. The fundamental theory of frequency-modulated continuous wave (FMCW) radar and how the RTS applies frequency shift, signal delay and amplitude to simulate radar target speed, size and distance will be discussed in the presentation.

5G Advanced Communications
Room: 307B
5G Simulation using Phased Array
Shuai Zhang, Keysight

Massive MIMO is one of the hottest topics of 5G research. The main challenge of massive MIMO is how to get the performance of numerous antennas and RF chains in a wide communication band with high speed. In this paper, we present a phased array simulation that starts by running a compression sweep on the phased array design (single chain topology) at the frequency specified at the receiver or transmitter. The data collected characterizes the system's non-linear behavior at each of its nodes. Noise analysis is also performed during this quick sweep to characterize the system's noise performance. Then the phased array engine analyzes the simplified single chain topology of the system and expands it to its full representation with the appropriate number of paths before the RF chains to decrease the simulation time. The simulation results show that phased array models can perfectly model various types of scenarios and impairments in 5G wide band communication system researches and get the performance in a short simulation time.

▼ Thursday, April 27, 2017 • 11:15 - 11:35 ▼

Measurement & Modeling Track
Room: 305A
On-Wafer Measurement and Analysis of Flicker Noise and Random Telegraph Noise
Gu Feng, Keysight Technologies

Electrical noise is inherent in every circuit, ranging from current flowing through a resistor or transistor, to leakage current through a tantalum capacitor. To minimize its effects, it becomes necessary to measure and quantify the noise of the constituent parts, and then connect the constituent noise contributions to overall circuit performance. In this paper, we discuss the basics of noise spectral density, noise measurement applications, practical considerations in noise measurements, and how the Advanced Low-Frequency Noise Analyzer (A-LFNA) in combination with WaferPro Express (WPE) measurement software addresses these challenges. We will also review best practices that may help to reduce the typical problems encountered when doing wafer-level measurements of low frequency noise, such as minimizing the likelihood or effects of device oscillation, power line spurs and excessive environmental noise.

RF & Microwave Design
Room: 307A
Applying Crest Factor Reduction (CFR) for the Partial Band of DOCSIS 3.1 System
Maxwell Huang, Cisco Systems

Orthogonal frequency division multiplexing (OFDM) has been adopted by the DOCSIS 3.1 standard. However, OFDM has a very big peak-to-average-power ratio (PAPR), so it may degrade BER performance if a large back-off is not applied to the power amplifier. However, the more back-off it applies, the lower the power efficiency of the amplifier. This leads to concern about the reliability of the hybrid fiber coaxial (HFC) node, which already has a huge increase in the power dissipation due to supporting remote PHY module and enabling super high RF power output capability. Crest factor reduction (CFR) is the technique for reducing the PAPR to require the less back-off for the mixed SC-QAM/OFDM application or the pure OFDM application. Hereby the product DC/AC power can be reduced as a result of the improved power efficiency of the power amplifiers. But CFR would cause performance degradation and/or increase computational complexity. HFC node output has a unique character of having a tilted cable spectrum. As a result, the peak power envelopes from highest frequency channels are much greater than that of lower frequency channel. In the paper the partial band CFR will be introduced, including how to reduce PAPR for a broadband system while minimizing the negative impacts.

Measurement & Modeling
Room: 307B
One Novel In-Lab Performance Test Technique for 3D MIMO Base Stations
Huaizhi Yang, Keysight

This paper introduces an in-lab test technique based on a geometric channel modeling method, which could create accurate and reciprocal channel models for downlink and uplink with importing the geometric location information and mobility information of multi-users, so that beam forming benefit could be measured with this geometric models. Meanwhile, the geometric topology of a BTS antenna array with more than 64 elements will be analyzed to see the final performance test result, which needs to be considered in this advanced modeling method as well as other important geometric information. Then, this paper will introduce a multi-channel-emulator sync-up test platform considering the requirement of hundreds of logical channels in 3D MIMO performance test, which is used to validate the geometric models for the 3D MIMO BTS performance test. Compared with lab set-up, accurate phase calibration within +/-5 degree between hundreds of logical channels was requested and performed with some special sync-up method so that to keep the accuracy of beam forming gain of 3D MIMO BTS. Finally, this presentation shows some practical measurement results to prove the validity of this modeling method and test technique. Also, from throughput side, the practical in-lab measurement results with pure-LoS models could match field result very well for peak throughput result, and in case of 3GPP defined 3D models of 36.873, the throughput result was downgraded with reasonable 20% lower than the peak due to multi-path effect. In one word, one novel test technique with geometric modeling method, which is globally 1st in-lab test solution, and the only one for 3D MIMO BTS performance verification, also practical test platform with multi-channel-emulator sync-up system with good measurement result validate it. Now, it is the only test technique adopted by pioneer operators and BTS vendors in the world, which could bring bigger progress in 3D MIMO BTS performance test domain.

Radar/Communications Track
Room: 305B

Sophisticated Pulse Scenarios: How to Achieve Long Signal Play Time with High Sample Rate When ARB Size is Limited?
Frank-Werner Thuemmler, Rohde & Schwarz

Sophisticated pulse scenarios often requires a very high number of pulses, chirped pulses, frequency hopping and variable PRIs (pulse repetition intervals). These signal properties have a direct impact on the waveform size. In addition for testing e.g. RWRs (radar warning receiver) long signal durations of seconds or even minutes are needed. So, unlimited waveform signal play time is not feasible, since the ARB memory size is limited. How to achieve a very long signal play time? In this paper we present a way how to overcome this issue by using PDWs (pulse descriptor words). There are two different alternatives how to realize it. Replaying customer specific PDW lists is one way to enable customers to re-use legacy simulation scenarios that have been created. Another possibility is real time streaming of pulse descriptor words (PDWs) into the VSG (vector signal generator). Its real time control interface provides agile control of the baseband signal via a continuous stream of control information (PDWs) from an external connected simulator source.

▼ Thursday, April 27, 2017 ▪ 11:40 - 12:00 ▼

Measurement & Modeling Track
Room: 305A
The New Method of Nonlinear Parameter of Measurements
Zong Huiqing, Rohde & Schwarz (China) Technology Co.Ltd

This paper describes a new method of nonlinear parameter measurements with a vector network analyzer. In modern communication and radar, high power components have been widely used in order to improve system ability, such as farther transmission distance and faster data rates. A traditional method based on polyharmonic distortion modeling (PHD) can measure nonlinear parameters of the DUT, but the system is too complex to realize. Engineers are burdened with huge nonlinear parameter test data. This paper will introduce a new method based Cardiff Model (CM) Plus that takes more terms into account in the model. In addition, the nonlinear parameter can be easily performed on a vector network analyzer with less test data and higher accuracy.

Radar/Communications Track
Room: 305B
Tackling the Test Challenges of Next Generation ADAS Vehicle Architectures
Alejandro Buritica, National Instruments

Advanced Driver Assistance Systems (ADAS) are driving a major surge in innovation in automobiles, ultimately on a path to full autonomous driving. Today, these systems are largely implemented as self-contained units, with a sensor such as radar, camera, ultrasonic or LIDAR, combined in the same package as a processor that analyzes the sensor data and communicates to one or more electronic control modules (ECMs). This approach has allowed ADAS functionality to be added incrementally to existing vehicles. However, to achieve full autonomy, the need to combine data inputs from many different sources is driving the development of ADAS platforms in which data processing is done in a more centralized architecture. This paper talks about the evolution of ADAS technologies from current approaches to future centralized platforms, and the new test challenges that arise from this technology evolution, as well as some near-term solutions for these challenges.

RF & Microwave Design Track
Room: 307A
Circularly-Polarized Antipodal Fermi Tapered Slot Antenna for Millimeter-Wave Applications
Abdel Sebak, Concordia University

Due to their diverse polarity, micro strip antennas are widely in demand in radar, satellite, navigation, imaging and wireless communications applications. Circular-polarization (CP) antenna types are able to achieve better weather penetration and no orientations are required between communication terminals unlike linearly polarized antennas. Importantly, in satellite and point-to-point communications, CP antennas are preferred, since they reduce loss caused by polarity misalignment between the transmitting and receiving antennas. Furthermore, CP probes in millimeter-wave (mmw) imaging and detection systems provide additional information about the object's shape, orientation and surface material. Polarization diversity increases the intensity of pixel resolution in target's images generated by imaging and detection systems. Majority of mmw systems require a low-cost, lightweight, and low-profile directive CP antenna with high gain to compensate for the propagation loss at mmw frequencies. This paper describes a proposed single-fed CP antipodal Fermi tapered slot antennas

(AFTSA) that shows significant performance as a low cost, high gain CP and a highly efficient antenna for potential future research work in millimeter-wave imaging detection system applications.

Systems Engineering Track
Room: 307B
Using Software-Centric Solution to Build Cloud-Based Test
Shanshan Cong, Keysight

Traditional test is using one or several instruments together with embedded and/or PC-based software to implement test. The test software is usually bundled with the test set and assigned to a specific DUT in a test plan. Highly integrated software is a method to improve test speed in traditional instrument test. Today, evaluating a test system's performance is not just from a single test time, but also the capability to maximize test capacity of the whole network. To adapt abstraction, virtualization, and containerization characteristics of cloud-based internet infrastructure requirements, the test system is required to be more flexible, which is built on software-centric architecture. This paper introduces a cloud-based test method.

▼ Thursday, April 27, 2017 ▪ 12:05 - 12:25 ▼

Measurement & Modeling Track
Room: 307A
Practical Considerations for Load-Dependent X-Parameters Extraction with Harmonic Impedance Control of a 10W GaN Power Transistor
Liu Di, Keysight

This paper presents a high power, load-dependent X-parameters extraction with harmonic impedance control system based on a nonlinear vector network analyzer (NVNA). Arbitrary load-dependent X-parameters, automatically measured with a passive fundamental load-tuner plus active harmonic tuning system working with the NVNA, are used to characterize a packaged 10W GaN power transistor. Practical considerations are described in this paper to reach a 10-Watt GaN transistor X-parameters extraction under fundamental and 2nd harmonic impedance close to VSWR equal to 0.5 and 0.6 respectively; further work will be done to extend the 2nd harmonic impedance region as close as the edge of Smith Chart to explore the behavior of the DUT as well as the X-parameters.

Measurement & Modeling Track
Room: 305A
Introduction to Real-Time Spectrum Monitoring
Fangze Tu, National Instruments

In cellular, wireless, spectrum monitoring and electronic warfare applications, designers often need to analyze portions of spectrum and capture specific events, ranging from transient, elusive signals to continuous wideband interferes. Overlapping frequency bands and higher data throughput requires increasingly complex communication algorithms and protocols, which crowds popular frequency bands with a wide variety of signals. Traditional signal and spectrum analyzers face inherent limitations when analyzing short duration intermittent signals, weak signals masked by stronger ones and wideband burst transmissions due to the sequential nature of both swept-tuned spectrum analyzers (SAs) and FFT-based vector signal analyzers (VSAs). A real-time spectrum analyzer (RTSA) addresses this issue by providing a specification guaranteeing the minimum duration of a signal that can be detected and accurately measured. In this presentation, we will explain the difference between common analyzers and situations where one would be favored. The new architecture of user-programmable in RTSA will be discussed and we will also present its application on radar, spectrum monitoring and efficient radio monitoring systems.