EXHIBITOR WORKSHOPS & SEMINARS

Rohde & Schwarz Workshops

– Free to attend –

For more information, details and registration:
http://www.rohde-schwarz.com/eumw

Location: A9.13

Tutorial seminars - RF basics in test & measurement

A sound understanding of RF and mmWave testing methods is a key factor for every mmWave engineer, helping them to successfully implement solutions and designs in mmWave and RF circuits. Moreover, digital communications engineering and mmWave engineering are increasingly merging and becoming a cross-discipline. As a result, mmWave engineers are faced with the challenge of how to master the territory of the former RF and digital communications world.
The Rohde & Schwarz seminars about RF basics in test and measurement will familiarize you with the elementary aspects of signal generators, spectrum analyzers and network analyzers. You will learn how to benefit from the great flexibility of our T&M equipment when designing communications and radar systems. New this year is a seminar on realtime spectrum analysis that will introduce you to methods for debugging RF and mmWave circuits in the time and frequency domains.
Using vector network analyzers for component testing and evaluation and applying various calibration techniques common in advanced network analysis lets you very precisely characterize the mmWave and RF components necessary for mmWave designs and digital communications systems.

Tuesday, September 25, 2018

09:30 to 11:00 Fundamentals of signal generators and oscillators (YIG vs. VCO)

11:15 to 12:45 Fundamentals of spectrum analysis

Wednesday, September 26, 2018

09:30 to 11:30 Introduction to digital signals and digital modulation

11:45 to 13:15 Realtime spectrum analysis embedded in advanced spectrum analyzers

Thursday, September 27, 2018

09:30 to 10:30 Fundamentals of vector network analysis

10:45 to 12:15 Calibration in vector network analysis

Technical workshops

Tuesday, September 25, 2018, 13:30 to 16:50

RF and microwave component testing

Workshop Chair: Markus Lörner, Market Segment Manager RF & Microwave Components, Rohde & Schwarz

Today's world demands higher throughput in communications systems, better radar resolutions for self-driving cars and greater security. These needs are pushing system designs toward higher clock rates and higher frequencies. RF and microwave components must enable the latest trends. For example, RF power amplifiers require high efficiency, and new technologies such as digital Doherty help address these demands. Beamforming enables signal links at higher frequency ranges while improving the directivity of antenna systems. Research on higher frequencies must be affordable but also flexible in the target frequency range. Digital systems have higher data rates that are fueling the high RF data throughput. This is driving the need for minimum-jitter clocks with increasing rates.

This workshop discusses how to verify the performance of components such as power amplifiers, mixers, beamforming integrated circuits and high-speed clocks for these emerging applications. Experts from the test and measurement world and from industry partners will provide answers on how to verify the demanding requirements placed on new components.

13:30 to 13:55 – Introduction – Challenges in modern RF frontends

Multiband RF frontends and beamforming for high-frequency applications in radar, satcom and mobile communications require invisible integration all the way to antenna in package (AiP). This workshop provides an overview of the latest technologies and requirements and how test and measurement is helping to address the latest trends.

14:00 to 14:30 – Verification of beamforming gain/phase tables for a 64-element URA based on SiGe beamforming RFICs

Presenter: Ivan Tsvelykh, Samo Vehovc, Infinineon Technologies AG

Antenna beam pattern measurements of a 64-element uniform rectangular phased array frontend module will be presented. The FEM module operates in the 26.5 GHz to 29.5 GHz range and is based on SiGe quad-channel beamforming RFICs with integrated power amplifiers, low noise amplifiers and TX to RX switching functionality. The accuracy of the beam will be compared to calculated beam patterns. The suitability of calibration using test equipment with internal built-in RFICs will be investigated. Impact of phase drift among parallel integer-N PLL based upconverters on beam synthesis will be measured. Lastly, beam switching among different beams stored in SRAM will be shown.

14:35 to 15:05 – Development and testing of high-performance 5G mmWave frontends

Presenter: Bror Peterson, Qorvo IDP

This presentation will highlight the system requirements, design, and testing of high-performance RF frontends for 5G mmWave active antenna systems. The presentation will first introduce the major system architectures being considered for both fixed wireless access and the mobile infrastructure. Then the analysis and system level tradeoffs used to derive the frontend requirements and specifications will be presented. Details of the design and selecting the semiconductor technology (GaAs or GaN) will be discussed, followed by a look at the measured performance of two new product families: fully integrated 28 GHz and 39 GHz PA+LNA+switch GaN MMICs and 28 GHz 10 W GaN Doherty PA MMICs. The development and production testing requirements and measurement setups will also be discussed.

15:10 to 15:40 – Taking Doherty amplifiers to the next level in efficiency
Since its invention almost 100 years ago, the Doherty amplifier has enjoyed something of a renaissance in the last 20 years. Proliferation of digitally modulated signals that are increasingly noise-like in their signal statistics along with semiconductor device technology advancements have fueled this rediscovery process. There is an increasing awareness that there are significant gains to be made from modifying the industry standard 3 dB 90 degree fixed RF input split network, especially as operating bandwidth, frequency, power output, gain and production volumes increase.
By precision testing the prototype Doherty amplifier as a dual-path/dual-input device and stimulating these two inputs with a range of different signals, including nonlinearly related signals, valuable insight into performance potential can be achieved. This allows the designer to make the best possible design engineering choices for their specific application, production capabilities and field operation requirements.

15:45 to 16:15 – Network analysis in the mmWave range – going 5G and beyond
With 5G as the most popular driving force to extend to higher frequencies and bandwidth, even in the mobile communications arena, frequency ranges up to 70 GHz to 80 GHz, 100 GHz or even up to 325 GHz are being considered for mobile devices and backhaul systems. However, measurements at millimeterwave frequencies are generally more demanding than at microwave frequencies. And active device characterization in particular requires precisely calibrated stimulation and measurement power levels, e.g. to perform calibrated power sweeps for compression point measurements. This workshop provides an overview of millimeterwave solutions, with a focus on on-wafer testing and related calibration techniques.

16:20 to 16:50 – Addressing beamforming in 5G NR applications with network analyzer based multiport solutions
The continuing progress in mobile communications systems and military/civil monitoring systems generates ever increasing requirements regarding the number of test ports and the performance of the measuring system. Especially the design and production of mobile phone frontends and of 5G phased array antenna components requires an enhanced number of test ports combined with the RF test performance of a high-end two-port VNA. But using conventional solutions based on network analyzers combined with switch matrixes means a trade-off for the operator since the increased number of test ports lowers RF performance and test throughput. This workshop examines the reasons for this and the pros and cons of multiport network analysis systems with switch matrixes as compared with "true" multiport network analyzers with integrated test ports.

Wednesday, September 26, 2018, 13:30 to 17:00

OTA testing of 5G DUTs and beamforming antennas operating in the cmWave and mmWave spectrum
Workshop Chair: Meik Kottkamp, 5G Technology Manager, Rohde & Schwarz

5G has been a research topic for many years and is developing toward concrete implementations on end user devices and infrastructure equipment. Coverage of the triangle of use cases spanning enhanced mobile broadband services, massive IoT connectivity and ultra-reliable, low-latency applications has led to a versatile, flexible and completely configurable technology. Managing system flexibility will be crucial. In particular, verifying that key technology components achieve the intended performance is of utmost importance when turning 5G visions into product reality.

This workshop will provide insight into the 5G New Radio (NR) technology as specified in 3GPP release 15. It will also discuss the key technology components relevant to using the cmWave and mmWave spectrum. R&D measurement aspects will be explained in detail, with a focus on verifying DUTs with beamforming capabilities. Implementing this technology requires application of over-the-air (OTA) test methods. Experts from the test and measurement world will provide answers on how to most efficiently perform the main verification tasks resulting from 5G NR.

13:30 to 14:15 – Demystifying 5G: Main technology components, test challenges and solutions

3GPP approved the completion of the standalone (SA) 5G specifications in June 2018. The 5G NR specifications for non-standalone (NSA) operation were previously released in December 2017. Consequently, 5G is complete in 3GPP Release 15. Now, the entire industry is taking the final sprint towards 5G commercialization. Expected initial commercial deployments will focus on NSA operation, i.e. adding NR technology components to an existing LTE-A network based on the dual connectivity feature. Revolutionary aspects of NR include the use of the cmWave and mmWave spectrum with advanced antenna implementation. This enables dynamic beam steering in combination with spatial multiplexing known as massive MIMO. Covering multiple use case families also resulted in a flexible air interface design using flexible numerology and the introduction of a network slicing mechanism.

This workshop illustrates the most important 5G technology components, explains how it differs from the well-known LTE/LTE-A technology and summarizes the relevant Rohde & Schwarz test and measurement solutions. Selected solutions are discussed in detail in the follow-up workshops.

14:15 to 15:00 – From conducted to OTA measurements: Isn't wireless easier to test?

One of the main challenges when developing end user devices and base stations is the adoption of cmWave and mmWave frequencies, which means a significant increase in signal bandwidth. As detailed in the previous workshop, NR adopts the concept of flexible numerology, e.g. applying different subcarrier spacing and channel bandwidths. This requires flexible test solutions for generating and analyzing 5G NR waveforms. Additionally, and potentially more significant, high integration and advanced antenna implementation require over-the-air testing rather than the well-established cabling of the devices under test. This not only impacts the accuracy of measurement results, it also significantly affects simple tasks such as calibrating the test setup.

This workshop illustrates physical layer measurements and relevant test solutions with a focus on over-the-air test solutions. It illustrates the available test solutions for detailed 5G waveform characterization using integrated test solutions on Rohde & Schwarz signal generators and analyzers. Over-the-air calibration methods are explained and performed during live measurements.

15:30 to 16:15 – Massive MIMO antenna verification in a shielded environment

Advanced antenna technologies using massive MIMO and beamforming are essential technology components in 5G. While massive MIMO is applicable both below and above 6 GHz, beamforming is of utmost importance in the cmWave and mmWave spectrum in order to achieve satisfactory cell coverage. From a testing perspective, over-the-air (OTA) measurements become essential and introduce new challenges for verifying the performance of both base stations and end user devices. Obviously, a shielded environment is required to enable reproducible measurement results.

This workshop discusses the challenges resulting from OTA measurements for antenna verification. Measurement solutions offered by Rohde & Schwarz are explained in detail.

16:15 to 17:00 – Measuring 5G networks in the field

Based on the finalized 3GPP Release 15 specifications, extensive trial activities are ongoing or planned in near future. Pre-5G networks based on the 5GTF (www.5gtf.org) specification are targeted for commercial launch as early as the end of 2018, with ongoing trials in particular in the US market. Generally, the coverage of cellular networks operating in the cmWave spectrum and applying beamforming techniques is of high interest.

This workshop discusses and identifies the key signal components in 5G waveforms for performing coverage measurements in the field. Test solutions fulfilling this task are introduced and sample measurement results are explained in detail.

Thursday, September 27, 2018, 12:30 to 16:45

Radar applications

Workshop Chair: Dr. Steffen Heuel, Technology Manager A&D, Rohde & Schwarz

Radar has been around for more than one hundred years, ever since Christian Hülsmeyer from Germany patented his “Telemobiloskop” in 1904. Since then, radar has been used for a variety of purposes, including presence detection, air traffic control, military and even automotive applications. The different applications, which call for different radar systems that utilize various frequencies, signals and types of processing, require versatile test and measurement methods.
This workshop presents the latest radar test and measurement developments – from signal generation, wideband analysis and phase noise testing to simulation of RF environments for testing the many radar requirements.

12:30 to 13:30 – Signal generation of radar scenarios using pulse descriptor words

Modern multifunctional radars have become quite complex since these systems follow the same trend as telecommunications equipment, which is more and more software defined. These radars use several modes depending on the radar task, and each radar mode typically uses different radar signals. Today’s early warning receiver equipment needs to identify these radar signals not only in artificial anechoic environments, but also in highly populated electromagnetic spectra. With a peak pulse load of up to some million pulses per second, early warning receivers operate at very high speed – from reception of the radar signal to the classification result. In addition, modern early warning equipment needs to follow the trend of pure analog evaluation of pulsed radar signal envelopes to the analysis of the complex samples in multiple domains.
This workshop provides insight into testing radar warning receivers by generating radar signal environments using vector signal generators that simulate radar scenarios and stream pulse descriptor words to synthetically generate realistic RF environments.

13:35 to 14:35 – Phase noise and pulse-to-pulse stability measurements

Low phase noise or high phase stability is a prerequisite for range and velocity resolution of modern radar systems. Improving the performance of these systems requires accurate measurement of phase noise and AM noise of synthesizers, high-end oscillators such OCXOs, DROs and VCOs, and components. In this workshop, a new measurement technique will be introduced that provides state-of-the-art measurement sensitivity, speed and flexibility for absolute phase noise as well as for residual/additive phase noise measurements on CW and pulsed signals. In addition, the setup can measure the pulse-to-pulse phase and amplitude stability of a radar transmitter and components for radar applications since two-port devices like amplifiers can deteriorate the performance. Sensitivity of –80 dBc or better is needed to characterize these components.

14:40 to 15:40 – Automotive radar interference test and integration verification

Drivers increasingly rely on advanced driver assistance systems (ADAS) based on radar technology. The radar sensor delivers information about the surrounding traffic environment. It is a must for every radar sensor to detect wanted signals from real objects, even in the presence of unwanted interferers. Due to its safety-relevant nature, the robustness of automotive radar sensors against interferers has also moved into the focus of the standardization authorities. With the radio equipment directive (RED) and the related applicable standards, such as ETSI EN 303396 and ETSI EN 303091-1/2, an obligatory standard became law in Europe. These radars are covered by an enclosure known as a radome, which is constructed from a transparent RF material. Radomes can be an emblem or a car bumper with integrated radar units. Although

an emblem may be underestimated as a simple plastic cover, it is actually a sophisticated element that often negatively impacts radar detection performance and accuracy.
This workshop explains the impact of mutual radar interference, demonstrates a powerful solution for testing the immunity of radar sensors against interferers and shows how to measure spatially resolved radome reflectivity and transparency very intuitively.

15:45 to 16:45 - Automotive radar signal analysis in the E band
Automotive FMCW radars typically operate between 76 GHz and 77 GHz with a signal bandwidth of less than 1 GHz. The frequency range between 77 GHz and 81 GHz has recently become available in some countries for automotive radar applications. The range resolution of an FMCW radar is proportional to its signal bandwidth. Therefore, automotive radar manufacturers are already developing radars with wider signal bandwidths to get the most out of the available frequency range.
The first part of the workshop presents test and measurement solutions to overcome the challenges of RF measurements in the E band with measurement bandwidths between 500 MHz and 5 GHz. In addition to signal bandwidth, the signal linearity and chirp duration determine the radar performance. Therefore, it is important to analyze automotive radar signal parameters such as chirp direction, chirp rate, frequency deviation, etc.
The second part of the workshop shows an application that automatically demodulates FMCW signals and displays the main performance parameters.