Rohde & Schwarz Workshops and Seminars

- Free to attend -

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

Location: NCC East, Level 2, Room Budapest

Tutorial Seminars - RF Basics in Test & Measurement

The RF world is rapidly changing as more and more digital communications standards such as 5G and WLAN 801.11ad/ay move into the mmWave world. Traditional methods of designing RF boards and components become design aspects of microwave boards and module development. Today, many mmWave engineers are confronted with new design challenges that are more or less typical for RF design engineers. Such design procedures may differ from the daily routine of mmWave engineers.

These RF basics and fundamentals will familiarize you with using a vector network analyzer for component testing and evaluation, which is still a classical field of mmWave engineering. Insight into digital modulation schemes, signals and the underlying aspects of fading in digital communications systems will help mmWave engineers understand the challenges that the communications industry faces today. A look at the fundamental aspects of signal generators and spectrum analyzers will show mmWave engineers the great flexibility that exists when designing communications systems, radar systems and solutions.

Tuesday 10th October 2017
09:30 – 11:00 Fundamentals of Vector Network Analysis

Tuesday 10th October 2017
11:15 – 12:45 Calibration in Vector Network Analysis

Wednesday 11th October 2017
09:30 – 11:30 Introduction to Digital Signals and Digital Modulation

Wednesday 11th October 2017
11:45 – 13:15 Understanding Fading and its Effects

Thursday 12th October 2017
9:30 – 10:30 Fundamentals of Signal Generators and Oscillators (YIG vs. VCO)

Thursday 12th October 2017
10:45 – 12:15 Fundamentals of Spectrum Analysis

Technical Workshops

Tuesday 10th October 2017 13:30 – 17:30

RF & Microwave Component Testing

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

New wireless communications technologies for commercial and governmental use as well as satellite links aim for higher data rates by using new spectrally efficient waveforms and higher bandwidths. To make room for these applications, carrier frequencies are going up. At the same time, directive antennas are becoming more common to address the increased free-field attenuation that comes with the higher frequencies.

The design of all involved millimeter components is becoming more complex in order to fulfill the stricter requirements associated with higher bandwidths and frequencies. Power amplifiers have a strong impact on the overall system performance and require special attention. The new architectures with beamforming antennas use multiple elements and require many PAs to drive them. They need to become smaller and more efficient to enable the necessary high degree of integration.

This workshop discusses how to verify the performance of components like PAs, converters, mixers and filters for these emerging applications. Experts from the test and measurement world will provide answers on how to verify the demanding requirements placed on new components.

13:30 - 14:00 Components for 5G – What's New?
Everyone is talking about 5G enabling enhanced throughput by using higher signal bandwidth and microwave frequencies. Many field trials are being conducted to understand the new environment. But what does all this mean for people in the component industry? They are the ones who need to supply the right building blocks to enable everything. This workshop session provides an overview of the relevant changes on the way to 5G and various trends to address them.

14:00 - 14:45 Evaluating High-Performance Direct RF Sampling Data Converters
[Presenter: Anthony Collins, Senior Staff Marketing Engineer, Xilinx]
This workshop session briefly outlines the technology trends driving the move to direct RF sampling for 5G and similar applications and explains why these functions will be increasingly integrated in advanced CMOS SoCs in the future. These wireless applications are driving very high levels of data converter performance which are outlined along with how this is achieved in advanced CMOS technology. Another topic is the challenge of testing high performance in a highly integrated solution, and the evaluation and testing platform is presented.

15:00 - 15:45 Improving Phase Noise Performance of DDS-Based Synthesizers
[Presenter: Peter Delos, Radar and Phased Array Applications Manager, Analog Devices, and David Tunkelrott, Business Development, RF & Microwave Components, Rohde & Schwarz]
DDS-based synthesizers offer various advantages such as extremely fast hopping. Thanks to advanced DAC techniques covering higher RF frequencies, these synthesizers are becoming more and more of interest in communications and radar applications. To ensure they meet the requirements, special attention must be devoted to the additive phase noise of the DAC itself and how it is embedded in the design. The workshop session outlines the important facts and discusses test solutions for verifying the overall phase noise of DDS-based synthesizers.

16:00 - 16:30 VNA Accuracy in TVAC Chambers and Multiport Systems
System error correction (also referred to as "user calibration") is a must for achieving accurate S-parameters with vector network analyzers. However, the procedure takes time, is error prone, and – for instance – requires that the operator have access to the reference plane. Regardless whether a manual kit or an automatic calibration unit is used, the calibration equipment must be connected for the calibration and disconnected for the measurement. Which means that calibration inside a TVAC chamber, with vacuum applied and at low temperatures, is impossible with conventional calibration equipment. And even under common ambient conditions, multiport (re)calibration is quite elaborate.

Using in-line calibration units, a solution for satellite TVAC testing and efficient multiport calibration is presented. The units remain connected in the test setup, and a system error correction can be performed at any time without reconnecting calibration equipment. The workshop session introduces technical details about the handling, configuration and typical applications of such in-line calibration units.

16:30 - 17:00 Multiport VNA: Challenges and Solutions
The continuing progress in mobile communications systems and military/civil monitoring systems generates ever increasing requirements regarding the number of test ports and, at the same time, the performance of the measuring system. Conventional solutions, however, which are based on expanding network analyzers with switch matrixes, often lack the required RF measurement performance or cause an unwanted increase in the measurement time. This workshop session examines the reasons behind 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.

17:00 - 17:30 Challenges in Millimeterwave Measurements
Measurements at millimeterwave frequencies are more demanding than at microwave frequencies. In addition to system error correction, active device characterization requires precise power calibration and the ability to perform power sweeps for compression point measurements. The workshop session gives an overview of millimeterwave solutions for on-wafer testing and related calibration techniques.

Wednesday 11th October 2017 **13:30 – 17:00**

5G Communications

Workshop Chair: Meik Kottkamp, 5G Technology Manager, Rohde & Schwarz

LTE, including all its enhancements in LTE-Advanced and LTE-Advanced Pro, has become the dominant cellular technology. It provides the evolutionary path towards 5G, namely New Radio (NR) in 3GPP, which will be specified in 3GPP within the Release 15 time frame. In particular, non-standalone (NSA) operation with LTE-A Pro will be completed by the end of 2017, whereas standalone (SA) operation is aimed for completion in mid-2018. This workshop discusses the key technology components relevant to using the cmWave and mmWave spectrum. R&D measurement aspects are explained in detail. Experts from the test and measurement world provide answers on how to most efficiently solve the main verification tasks resulting from NR.

13:30 - 14:15 Continuing the Success of LTE-Advanced Pro
5G main technology components, test challenges and solution overview
Expected initial commercial deployments will focus on non-standalone (NSA) operation, i.e. adding New Radio (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. Furthermore, the required coverage of multiple use cases has resulted in a flexible air interface design using flexible numerology and the introduction of network slicing mechanisms. This workshop session illustrates the most important 5G technology components, explains differences to pre-5G as specified in 5GTF specifications and summarizes the available test and measurement solutions. Selected solutions are detailed in the follow-up presentations.

14:15 - 15:00 Physical Layer (Pre-) 5G Measurements
One of the main challenges for component or transmitter and receiver development of end user device and base stations is the adoption of cmWave and mmWave frequencies as well as significantly increasing the signal bandwidth. Although waveform details are known from pre-5G specifications such as those published by 5GTF (www.5gtf.org), the detailed 5G waveform design for NR in 3GPP has not been finalized. Furthermore, NR adopts the concept of flexible numerology, e.g. applying different subcarrier spacing and channel bandwidth. This requires flexible test solutions for generating and analyzing pre-5G and NR waveforms. This workshop session focuses on physical layer measurement tasks and relevant test solutions.

15:15 - 16:00 Massive MIMO Antenna Verification in a Shielded Environment
Advanced antenna technologies applying massive MIMO and beamforming are key technology components in 5G. While massive MIMO is applicable to both below and above 6 GHz operation, beamforming is of utmost importance at cmWave and mmWave spectrum in order to implement satisfactory cell coverage. From a testing perspective, over-the-air (OTA) measurements are 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 session discusses the challenges resulting from OTA measurements for antenna verification. Measurement solutions offered by Rohde & Schwarz will be explained in detail.

16:00 - 16:45 Measuring (Pre-) 5G Networks in the Field
Although 3GPP standardization has not yet finalized the first set of NR specifications, extensive trial activities are in progress or are planned for the near future. In addition, pre-5G networks based on the 5GTF (www.5gtf.org) specification are aimed for commercial launch as early as 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 session discusses and identifies the key signal components in pre-5G and 5G waveforms to perform coverage measurements in the field. Test solutions fulfilling this task are introduced and sample measurement results are explained in detail.

Thursday 12th October 2017 **12:30 – 16:30**

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 applied in a variety of applications such as presence detection, air traffic control, military use and even automotive. These different applications need different radar systems that make use of various frequencies, signals and processing and 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 simulated RF environments for testing the many radar requirements.

12:30 - 13:45 High-Quality Radar Signals for the Most Demanding Applications
There are two key parameters for radar signals: the first is the purity of the local oscillator (LO) signal, the second is the quality of the pulsed radar signal. The purity of the LO signal is essential for the performance of each radar system. The phase noise performance of the radar limits the capability to resolve small, slowly moving objects in the vicinity of large reflections that could come from clutter echoes. Often signal sources act as a replacement for the actual local oscillator. In this workshop session, phase noise performance of LO signals coming from analog signal sources is discussed and effects on radar performance shown. The second part of this workshop session discusses the quality of the pulsed radar signals. For proper testing of the functionality or sensitivity of radar receivers, the challenge is always the same: accurate short pulses with high level repeatability, high on/off ratio and low duty cycle are needed from a signal source to measure the true performance of the radar receiver, since these products are designed to work at the utmost technological limit.

13:45 - 14:30 Automotive Radar Signal Analysis in the E Band
Automotive FMCW radars operate typically between 76 GHz and 77 GHz with a signal bandwidth of around 500 MHz. The frequency range between 77 GHz and 81 GHz for automotive radar applications recently became available in some countries. The distance resolution of an FMCW radar is proportional to its signal bandwidth. Therefore, automotive radar manufacturers are already developing FMCW radars with wider bandwidths to get the most out of the available frequency range. The first part of the workshop session 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 radar performance. Therefore, it is important to analyze the automotive radar signal parameters such as chirp direction, chirp rate, frequency deviation, etc. The second part of the workshop session shows an application that automatically demodulates FMCW signals, and displays the main performance parameters.

14:45 - 15:30 An Innovative Phase Noise Measurement Method
Low phase noise is a prerequisite for range and velocity resolution of advanced radar systems. Accurate measurements of phase noise and AM noise of synthesizers, high-end oscillators (OCXO, DRO, etc.), voltage-controlled oscillators (VCO) and components are needed to improve the performance of these systems. 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 measurement on continuous wave and pulsed signals featured in the new R&S FSWP phase noise and VCO tester. In addition, extension to frequencies > 50 GHz up to 500 GHz is presented and transient measurements (frequency/phase over time) are shown for characterization of settling effects of phase-locked loops and VCOs or frequency agile radar systems.