IEEE IMS RF BOOT CAMP COURSE ABSTRACT

This course will provide an introduction to RF basics, targeting newcomers to the microwave industry. The intended audience includes technicians, new engineers, engineers who may be changing their career path, marketing and sales professionals seeking a better understanding of microwave technology, as well as current college students looking to learn more about the practical aspects of RF and Microwave technology. The format of the RF Boot Camp is similar to that of a workshop or short course, with multiple presenters from industry and academia presenting on a variety of topics including: RF/Microwave systems basics, network and spectrum analysis, simulation and matching network design modulation and signal analysis, antennas and radar basics.

RF Boot Camp Agenda

08:00-8:30   Registration, Welcome & Introductions - Speakers and Participants

0830-0945   **The RF/Microwave Signal Chain** **(Joanne Mistler, Keysight Technologies)**

This section will introduce transmit/receive signal chains and important characteristics for design and measurement that will be discussed throughout the following modules.

Network Characteristics, Analysis and Measurement **(Joanne Mistler, Keysight Technologies)**

This section will cover transmission line basics, S-Parameters, and the Smith Chart. Transmit, receive and directivity paths will be described along with how dynamic range and accuracy can be optimized. Calibration and error correction will also be covered.

0945-1000   Break

1000-1035   **Fundamentals of RF Simulation** **(Dr. Ian Rippke, Keysight Technologies)**

This talk will start by covering various RF simulation techniques and discuss why simulation is a must in modern day RF design. Simulation domains (time or frequency), design detail (circuit or system) will be covered. Simulation techniques will be compared to real designs and lab measurements and advantages and disadvantages of each will be covered. Various application areas served by RF simulations will be covered.

1035-12:00   **Device Modeling and Impedance Matching Basics**
(Dr. Larry Dunleavy, Modelithics and University of South Florida)

The basics of device modeling and Impedance Matching basics will be covered. A simple lumped filter design example will be used to illustrate how to compensate for the non-ideal RF behavior of lumped SMT components in simulation-based design. Various types of lumped and distributed matching network topologies and approaches will be introduced and related demonstrations will be performed using Keysight ADS.

1200-1245   Lunch

1245-1345   **Spectral Analysis and Receiver Technology**
(Joanne Mistler, Keysight Technologies, Larry Dunleavy, Modelithics and USF)

This section covers frequency and time domain sweep searching including RBW, VBW and dynamic range criteria for accurate measurements. Included will be an overview of the independent and

integrated functioning of the various system blocks comprising a typical heterodyne down converting receiver, including mixing, amplification, image frequency filtering and adjacent channel filtering.

1345-1430 **Signal Generation (Joanne Mistler, Keysight Technologies)**

This section covers CW signal characteristics, including phase noise, VCO, VCO+PLL and synthesis techniques.

Modulation and Vector Signal Analysis (Joanne Mistler, Keysight Technologies)

This section covers analog amplitude, phase, frequency and pulsed modulation, composite modulation, polar and I-Q format, and digital modulation signal characteristics and measurement.

1430-1510 **Microwave Antenna Basics (Dr. Tom Weller, Oregon State University)**

This tutorial provides an overview of antenna topics that includes the fundamentals of microwave radiation, basic types of antennas that are commonly used for microwave applications, the most important functional requirements for antennas and a discussion of wireless propagation channels. Specific topics of discussion that are relevant to personal communications devices and emerging applications such as IoT include electrically small antennas, antenna arrays and reconfigurable antennas.

1510-1525 Break

1525-1605 **Introduction to Radar Principles and Measurements (Erik Diez - Keysight Technologies)**

We will discuss the fundamentals of RADAR (**R**adio **D**etection **A**nd **R**anging). RADAR, coined by the US Navy in the WWII era, is an object-detection system that uses RF/uWave transmitters and receivers to determine the range, angle, or velocity of aircraft, ships, spacecraft, guided missiles, motor vehicles, weather formations and terrain.

1605-1630 **Recap and Q&A session**

Instructor Biographies

Joanne Mistler, RFMW/EW Applications Engineer, at Keysight Technologies

With Keysight Technologies, Joanne manages specifications, demonstration and configuration of RFMW and Electronic Warfare test systems. Her expertise includes low-noise microwave synthesizer design, test and integration with Raytheon and Frequency Sources Inc. With HP/Agilent, Joanne has provided technical support as well as developed and delivered training in Phase-Noise, Radar and Digital Communications, and DOCSIS Test Solutions. In Business Development and Strategic Marketing with Analog Devices and Lockheed Martin, Joanne has driven strategies and capture efforts for Highspeed Converters and Aerospace Defense RF/MW Systems including low-noise seekers, communications data links and Electronic Warfare Systems. She received her BSEE from Northeastern University, MSEE from Tufts University in Microwave Engineering, and High Technology MBA from Northeastern University. With Northeastern University's Gordon Engineering Leadership Program, Joanne continues as a guest speaker/instructor and has served as an Industry Sponsor and Gordon Mentor

Dr. Ian Rippke, Product Manager for System Simulation Technology, at Keysight Technologies

Dr. Ian Rippke graduated with a Bachelors in Electrical Engineering from Lafayette College in 2000. He attended Cornell University where he received a Masters and Ph.D. in Electrical Engineering for his dissertation on integrated, adaptive power amplifiers using SiGe and CMOS technologies. In 2004 he began working for Xpedion Design Systems as the East Coast Applications Engineer. In 2006 Agilent acquired Xpedion and he continued to work as an Eastern AE focused on RFIC applications. While at Agilent he also worked as the national RFIC specialist calling on all North American RFIC accounts. After Keysight spun off from Agilent, he began working as the Lead AE for major accounts while continuing support of the silicon RFIC flow. In December 2017 Dr. Rippke became the Eastern Applications Engineering District Manager for Keysight design software, leading a team of applications engineers in the Keysight software sales team.   In December 2018 he joined the Keysight DES organization where he is currently the Product Manager for System Simulation Technology

Dr. Larry Dunleavy, President & CEO, Modelithics Inc., Professor University of South

Dr. Dunleavy co-founded Modelithics, Inc. in 2001 to provide improved modeling solutions and high-quality microwave measurement services for radio and microwave frequency circuit designers. He is currently serving as President & CEO at Modelithics. He also is a Full Professor at University of South Florid, where has been a Department of Electrical Engineering faculty member since 1990.   In this role, he has been teaching in the area of RF & Microwave circuits and measurements for over 26 years. Prior to this he worked as a microwave circuit design engineer at Hughes Aircraft and E-Systems companies.

Dr. Tom Weller, EECS School Head, Oregon State University

Thomas M. Weller (S'92–M'95–SM'98-F'18) received the Ph.D. degree in electrical engineering from the University of Michigan, Ann Arbor, MI, USA. From 1995-2018, he was a faculty member in the Electrical Engineering Department and a member of the Center for Wireless and Microwave Information Systems at the University of South Florida. He joined Oregon State University in 2018, where he is a professor and head of the School of Electrical Engineering and Computer Science. He co-founded Modelithics, Inc. in 2001.

Erik Diez, Radar/EW/Satellite Solutions Marketing Manager at Keysight Technologies

Erik Diez is the Radar/EW/Satellite Solutions Marketing Manager at Keysight Technologies, in the Aerospace/Defense & Government Solutions Group, based in Santa Rosa, California. In his 35-year career with the company, he has held numerous roles in marketing, R&D, and application engineering related to a variety of signal analysis and generation products. Erik holds a BSEE from UC Davis and an MSEE from UC Berkeley.