

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

0800-0830 Registration

0830-0840 Introductions - Speakers and Participants

0840-0940 **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.

0940-0955 Break

0955-1030 **Fundamentals of RF Simulation (Nilesh Kamdar, 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.

1030-1105 **Impedance Matching and Device Modeling Basics (Dr. Larry Dunleavy, Modelithics)**

Impedance Matching basics will be covered in the latter half of this talk. Various types of lumped and distributed matching network topologies and approaches will be outlined. Several examples will be demonstrated using Keysight ADS, including how scalable parasitic SMT component models can be used in a lumped matching example.

1105-12:00 **Introduction to RF and Microwave Filters (Dan Swanson, SW Filter Design)**

In this presentation we will review several of the technologies and filter topologies available to the RF/microwave engineer. The fundamental trade off facing the designer is between available volume for the filter and unloaded Q (insertion loss). Given a desired filter topology, there are many filter design programs that can give us a reasonable starting point. Applying EM simulation and port tuning to that starting point is then a good strategy to minimize design cycle time. In the absence of a good starting point, we can apply Dishal's method and EM simulation to rapidly design a custom narrow band filter.

This later approach is surprisingly simple and intuitive: it requires only simple algebra and no knowledge of filter synthesis techniques.

1200-1245 Lunch

1245-1345 **Spectral Analysis and Receiver Technology**
([Joanne Mistler, Keysight Technologies](#), [Larry Dunleavy, Modelithics, Inc.](#))

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, University of South Florida](#))

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 and Radar Measurements** ([Brooks Hanley, 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, Business Development, Aerospace & Defense Solutions, at Keysight Technologies

Joanne has 30 years of experience with RF/MW technologies. As a design and program engineer with Raytheon, her technical focus was in low-noise microwave synthesizer design, test and integration. As an RF/MW Applications Engineer with HP/Agilent, Joanne provided technical support as well as developed and delivered training in Phase-Noise, Radar and Digital Communications technologies, as well as DOCSIS Test Solutions. In Business Development and Strategic Marketing at start-up level and also with Analog Devices and Lockheed Martin, Joanne has driven strategies and capture efforts for Highspeed Converters, 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.

Nilesh Kamdar, District Manager, Applications Engineering, Western Region at Keysight Technologies

Nilesh has over 17 years of experience working on high frequency and high speed digital design and he has published various technical papers related to these topics. Previously, Mr. Kamdar was Senior Applications Engineer at Agilent EEsof and before that he was R&D Manager of the Simulation Architecture team at Agilent EEsof. He received his Masters of Science degree in Electrical Engineering from Utah State University.

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

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 maintains a position as a Professor within University of South Florida's Department of Electrical Engineering, where has been a 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, Chairman, Department of Electrical Engineering, University of South Florida

Thomas M. Weller received the B.S., M.S. and Ph.D. degrees in Electrical Engineering in 1988, 1991, and 1995, respectively, from the University of Michigan, Ann Arbor. From 1988-1990 he worked at Hughes Aircraft Company in El Segundo, CA. He joined the University of South Florida in 1995 where he is currently professor and chair in the Electrical Engineering Department. He co-founded Modelithics, Inc. in 2001.

Daniel G. Swanson, Jr., SW Filter Design, Boulder, Colorado, USA.

Mr. Swanson received his BSEE degree from the University of Illinois and his MSEE degree from the University of Michigan. He has designed broadband amplifiers, various types of oscillators, thin-film filters and high Q cavity filters for both military and commercial applications. He is currently developing software tools for filter design and optimization with his partner Bob Wenzel. Mr. Swanson is the principal author of Microwave Circuit Modeling Using Electromagnetic Field Simulation. He is presently teaching several continuing education courses on filter design and EM simulation. Mr. Swanson is a Fellow of the IEEE and has served the IEEE MTT Society in many capacities.

Brooks Hanley, Solutions Marketing Engineer, Aerospace & Defense Industry Solutions Group at Keysight Technologies

Previously, Brooks worked as a Signal Sources Applications Support Engineer and was involved with the New Product Introduction (NPI) test team and the Signal Analysis firmware team. He is a Sonoma County (home of Keysight) native and attended Sonoma State (earning a BSEE, BS Physics and BA Mathematics) before continuing on for the MSEE and MBA degrees from Cal Poly, SLO in 2014. He is currently developing and marketing solutions for the Aerospace and Defense industry. His responsibilities include creating and delivering Radar and Electronic Warfare papers at events worldwide.