Course Number N3201A/B Scheduled, Dedicated

Using Advanced Design System for RF and Microwave Circuit Design

Overview

Learn through a combination of lecture and hands-on exercises

Course Overview

Agilent Technologies offers a medium paced, 4 day, detailed review of microwave/RF circuit simulation techniques. The design of an active "Paging Mixer" circuit is primarily utilized as a vehicle to illustrate how these simulation techniques may be effectively employed in a "real world" situation. In addition, numerous amplifier simulations, basic oscillator, and TDR type microstrip measurements are also covered.

What You Will Learn

- Schematic capture
- Design examples
- Amplifiers
- Filters
- Mixers
- Oscillators
- DC simulation
- AC simulation
- Transient simulation
- S-parameter simulation
- Harmonic balance simulation
- Circuit envelope simulation
- Matching and optimization
- Statistical analysis
- Yield improvement
- Tips and techniques

Specifications

Course Type
User Training

Audience
Technical staff who work in an RF or microwave design environment and want a comprehensive instruction for the RFIC Designer, RF Board Designer, and Microwave Circuit Designer design suites

Prerequisites
Familiarity with basic RF and microwave concepts

Course Length
4 days

Course Format
The course combines lecture presentations with instructor guided hands-on lab sessions.

Delivery Method
Scheduled (at Agilent training locations) or *Dedicated* (at customer site)
To save you time and travel, many Agilent EEsof EDA courses can be delivered at your site. Agilent EEsof EDA will provide required equipment.

Detailed Course Agenda

Day One

- Lab 1–Basics
  A review of ADS basics. A simple low pass filter circuit is constructed and the circuit simulated, the simulation results are displayed in a data display window. Afterward, tuning is used to modify performance. Additional features and example files are also covered.

- Lab 2–DC Simulation
  An introduction to the mixer circuit, including design concept and performance goals. Basics of DC simulation are covered, which includes generating I/V characteristics for the selected transistor and post-processing the DC simulation results to derive the bias circuit component values. The exercise also introduces and makes practical use of hierarchical design concepts.

- Lab 3–AC Simulation
  The fundamentals of AC simulation are introduced and are utilized to simulate the small signal gain and noise performance of the basic mixer circuit. Other topics covered include:
  - Measurement equations
  - Passing parameters through a design hierarchy
  - Parameter sweeps
  - Introduction to the “what” function

Day Two

- Lab 4–S-Parameter Simulation
  The fundamentals of S-parameter simulation are introduced and are utilized to simulate the basic mixer circuit. The simulation results are displayed in various ways. Other topics covered include the use of:
  - Sweep plans
  - Z-port terminations
  - Instrument link to generate “Touchstone” s-parameter file

- Lab 5–Matching and optimization
  A review of the concepts of impedance matching techniques, these are applied to the mixer circuit in order to generate the input and output matching network designs. A review of the optimization features in ADS is also provided. The input matching network is designed using parameter sweep methods and the output matching circuit is realized using the optimization process.

- Lab 6–Harmonic Balance Simulation
  The fundamentals of Harmonic Balance simulation are introduced and are utilized to simulate and test the conversion gain and gain compression characteristics of the mixer circuit. The gain compression figure is derived using both graphical methods and directly by using the XDB simulator. A filter is also built to remove the LO and RF leakage. Optimization techniques are also used to enhance the mixer circuit performance. Other topics covered include the use of:
  - Variable equations/indexing
  - Post processing simulation results
  - XDB simulation
  - E-syn

Day Three

- Lab 7–Advanced Harmonic Balance
  Advanced measurements possible using Harmonic Balance simulations are utilized to simulate performance parameters such as third order intercept point. Other topics covered include the use of:
  - Mix function
  - Krylov solver
  - Non-linear noise analysis
  - Swept power analysis

- Lab 8–Transient Simulation
  The fundamentals of transient simulation are introduced and are utilized to simulate the settling time of the mixer circuit. Other topics covered include the use of:
  - Post processing simulation results (time to frequency domain transformation)
  - Pulsed RF signal source
  - Using Nyquist rules for simulation calculations

- Lab 9–Circuit Envelope Simulation
  The fundamentals of circuit envelope simulation are introduced and are utilized to simulate the performance of a behavioral amplifier, subjected to a pulsed RF source and to a GSM source. The finished mixer design is also simulated with a GSM and a CDMA source applied and the output spectrum observed. Other topics covered include the use of:
  - Measurement markers and variables to manipulate the data display in real-time
  - Demodulation

Day Four

- Lab 10–Transient Delay, TDR, and LineCalc
  Microstrip and ideal transmission lines are used to measure delay and mismatches using a TDR style of simulation which includes calculating Rho, impdeance, and VSWR from the acquired data.
- Lab 11–Amplifier simulations
  Example files are studied to cover Amplifier Measurements such as Load Pull, PAE, and others. The detailed data displays used for these advanced measurements is studied.
- Lab 12–Oscillator Simulations
  This section teaches how to set up and simulate basic oscillator requirements such as frequency of oscillation, spectral content, and phase noise. A simple example file and a more complex stabilized RF oscillator are both used.
- Lab 13–Layout (Optional)
  The fundamentals of using layout for creating physical designs, for generating layouts from schematics and simulating from layout or schematic. Other topics covered include:
  - Creating ground plane clearance
  - Using Boolean Logical commands

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Printed in U.S.A. 5/00
5966-3159E

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