HEWLETT PACKARD

MDS Circuit Envelope Simulation

Technical Data

HP Education Services: Your Key to Higher

Course Overview

This one-day course offers a comprehensive hands-on overview of circuit envelope simulation, a new technique for analyzing transient and digitally modulated high-frequency signals.

After a theoretical and practical overview of circuit envelope simulation and a survey of applications, the course then shows how to set up and run circuit envelope simulations of a wide variety of circuit types. It also shows how to set up and use templates and equations to present the desired information about the performance of the circuit.

Course Features

Upon successful completion of this course, the student will be able to use circuit envelope simulation in the HP Microwave Design System (MDS) to analyze startup transients in amplifiers, oscillators and other circuits, and to examine the behavior of digitally modulated waveforms in circuits such as the following

- amplifiers
- mixers
- oscillators
- phase lock loops (PLLs)

The course also shows how to define input waveform sources, including such digital modulation schemes as NADC, CDMA, PHS, and Pi/4 DQPSK modulation.

Learn How To:

- analyze startup transients in amplifiers, oscillators and other circuits
- examine the behavior of digitally modulated waveforms including Pi/4 DQPSK, CDMA, PHS, and others in circuits such as amplifiers, mixers, and oscillators
- simulate in-channel and adjacent-channel power, intermodulation distortion, bit error ratio
- characterize phase-locked loops (PLLs) and automatic level control (ALC) circuits

Specifications

Course Length
1 day

Audience
High-frequency circuit and system design engineers.

Delivery Method
Classroom, Dedicated

Format
Course content is 50% lecture and 50% lab.

Prerequisites
The MDS User Training (85150B+24D) is required. The Active Circuit Simulation course (85151A+24D) or equivalent, additional hands-on experience using MDS for harmonic balance simulations is highly desirable.

Classroom Training Benefits

Experienced HP Instructors
Learn from an experienced HP instructor who is an expert in using HP EEsof simulation and design software to meet real-world design challenges.

Comprehensive Student Materials
Copies of course materials are provided for future reference on the job.

Available at HP Classrooms or Your Site
Take advantage of HP's learning facilities, equipment, and interactive learning environment by attending class at an HP facility. Or, save travel expenses and time by organizing a dedicated class at your location.

Regularly Scheduled Classes
Plan training months in advance.

Extensive Hands-on Practice
HP classroom training is characterized by extensive hands-on experience and interactive class discussion.

HP classroom training pays off immediately because it is geared to real-world solutions.

Course Number: **85148A+24D (Scheduled)**
85148A+24Y (Dedicated)

MDS Circuit Envelope Simulation (85148A+24D)

Detailed Course Agenda:

Introduction and Overview

- Course Goals
- Typical Course Schedule
- System Example File: Envelope
- Template Library
- Students' Experience and Goals
- Overview: Circuit Envelope Simulation
- Circuit Envelope Simulation Process
- Circuit Envelope Calculation
- Circuit Envelope Theory: Input Waveforms
- Circuit Envelope Theory: Simulator Theory
- Circuit Envelope vs. Carrier
- Time-Domain Outputs
- FFT Outputs
- Summary and Review: Circuit Envelope Theory
- Comparison with SPICE and Harmonic Balance
- Circuit Envelope Simulation Technology
- Relation to Other Simulation Tools
- Applications of Circuit Envelope Simulation
- Simulating Digital Modulation, Transients
- Simulation of Realistic Signals
- Sample of Narrow Modulation Bandwidth
- Waveforms and Harmonic Balance
- Efficiency Compared to SPICE
- Circuit Envelope Simulation and Harmonic Balance
- Efficiency Compared to Harmonic Balance Simulation
- Circuit Envelope, SPICE, Harmonic Balance

Applications of Circuit Envelope Simulation

- Amplifier Applications
- Mixer Applications: Higher-Order Intercepts
- Swept Power Intermodulation Distortion
- Mixer Applications: Spectral Regrowth
- Oscillator Applications: Rise Time, Amplitude Transients
- Oscillator Applications: Frequency Settling
- Phase-Locked Loop Applications
- Phase-Locked Loop Schematic
- Phase-Locked Loop Results
- Additional Applications
- Nonlinear Noise
- Time-Domain Optimization
- Frequency-Domain Defined Devices (FDDs)
- Four-Level FSK Simulation: Overview
- Four-Level FSK Waveforms: Results
- Applications Summary

Using Circuit Envelope Simulation

- Using Templates
- Main Steps in Circuit Envelope Simulation
- Steps in Circuit Envelope Simulation
- Step 1: Defining the Input Waveform
- MDS Sources Plus Equations
- Defining the Output
- Setting Waveform Parameters
- Step 2: Set Up and Run the Simulation
- Setting Time-Domain Parameters: Step Size and Stop Time
- Running the Circuit Envelope Simulation Alternate Method:
- Using the Simulation Setup Dialog Box
- Monitoring the Simulation
- Step 3: Present the Results
- Trace Inserted on Plot
- Presenting Multiple Results
- Using Equations to Present Multiple Results
- Using Equations for Spectral Data, Power
- Presenting Results Using Templates
- Review: Main Steps in Circuit Envelope Simulation
- Circuit Envelope Sources
- Time-Domain Independent voltage Sources
- Tuned Modulators
- Tuned Demodulators
- Time Event Detectors
- Switches and Other Devices
- Amplifier Filters
- Phase-Locked Loop (PLL) Components
- Frequency-Domain Defined Devices (FDDs)
- Triggered Frequence-Domain Defined Devices
- Components Using FDDs
- Simulator Control Elements
- Simulator control for Oscillator Analysis

Basic Lab Exercises: Circuit Envelope Simulation

- Setup: Setting Up the Design Environment
- Lab: Using Circuit Envelope Simulation
- Lab: Circuit Envelope Simulation Using Pulsed RF Input Signals
- Lab: Plotting the Modulation Spectrum
- Lab: Creating a "SPICE-Like" Simulation of the Waveform
- Lab: Viewing the Input Waveform
- Lab: Using a Pulsed RF Input Signal and Pulsed Bias
- Lab: Phase and Frequency Modulation Through a Filter

Defining Input Waveform Sources

- Theory: Time-Varying Signals
- One-Tone Frequency Shifting
- Cosine Modulation
- Cosine Modulation Using Equations
- Generating Tones Using IFREQ and VFREQ
- Components
- Multiple Interfering Tones
- Stop Values

Course Number: **85148A+24D (Scheduled)**
85148A+24Y (Dedicated)

MDS Circuit Envelope Simulation (85148A+24D)

- Digital Modulation
- Defining a Digitally Modulated Source
- Lab: Using Equations to Create Time-Varying Spectrums

Mixers

- Mixer Intermodulation Distortion (IMD): Simulation
- Mixer Intermodulation Distortion (IMD): Presenting the Results
- Lab: Using the Current-to-Frequency Components IFREQ
- Lab: Intermodulation Distortion in Mixers Discussion
- Lab: Sweeping Power in Mixer Simulations Templates
- Lab: Spectral Regrowth in Mixer Simulations

Oscillators

- VCO Oscillator Example
- VCO Oscillator Schematic
- VCO Oscillator Results
- Oscillator Simulation
- Noise Generation and Calculations
- Lab: Oscillator Turn-on Transients
- Lab: Oscillation Frequency Deviation
- Lab: Creating a Noisy VCO Signal Noise Spectrum Effects

Digitally Modulated Circuits

- Setting Up and Testing the Digitally Modulated Source
- Setting Up and Running the Waveform Simulation
- Examining the Waveform: Output Spectrum
- Examing the Waveform: In-Channel Power
- Examining the Waveform: Adjacent Channel Power
- Applying the Modulated Signal to an Amplifier
- Presenting the Results: Transmitted Power Spectrum
- Presenting the Results: Adjacent-Channel Power
- Presenting the Results: In-Channel and Adjacent
- Channel Power Spectrums
- Presenting the Results: Constellation and Trajectory
- Plots, Eye Diagrams
- Calculating Error Vector Magnitude
- Lab: Pi/4 DQPSK Modulation

Phase-Locked Loops (PLLs)

- Simple_PLL Phase-Locked Loop Example
- Phase-Locked Loop, Divide-by-N Frequency Synthesizer
- Lab: Phase-Locked Loop Including Noise
- Lab: Phase-Locked Loop Simulation Changing Values of N
- Lab: Phase-Locked Loop Input Spurs

Automatic Level Control Circuits (ALCs)

- ALC Schematic
- Effects of Different Risetimes
- Changing the Reference Voltage
- Effects of Different Reference Voltages

Course Evaluation and Comments

Ordering Information

To order the MDS Circuit Envelope Simulation (85148A+24D) training in the U.S. call 1-800-HPCLASS (800-472-5277).

HP's Customer Registration Center can provide you with price and enrollment information, as well as provide information about dedicated delivery or customizing a course for your specific needs.

Outside the U.S., contact your nearest local HP sales office.

Course Number: **85148A+24D (Scheduled)**
85148A+24Y (Dedicated)

Region Sales Headquarters:

United States:
Hewlett-Packard Company
Test and Measurement Organization
5301 Stevens Creek Blvd.
Bldg. 51L-SC
Santa Clara, CA 95052-8059
(408) 246-4300

Canada:
Hewlett-Packard Ltd.
5150 Spectrum Way
Mississauga, Ontario L4W 5G1
(905) 206-4725

European Headquarters:
Hewlett-Packard S.A.
150, Route du Nant d'Avril
1217 Meyrin 2 - Geneva, Switzerland
(41) 22/780 8111

Japan:
Hewlett-Packard Japan Ltd.
NAF Bldg.
3-8-20 Takaido-higasi
Suginami-ku
Tokyo 168
(03) 3335-8111

Latin America:
Latin America Region Headquarters
Monte Pelvoux No. 111
Lomas de Chapultepec
11000 Mexico, D.F. Mexico
(525) 202 0155

Australia/New Zealand:
Hewlett-Packard Australia Ltd.
31-41 Joseph Street, Blackburn
Victoria 3130, Melbourne, Australia
(03) 895-2895

Far East:
Hewlett-Packard Asia Ltd.
17-21/F Shell Tower, Times Square
1 Matheson Street, Causeway Bay
Hong Kong
(852) 2506-9285

Printed 5/97

Publication Number 5965-6720E