DATASHEET

RF ANALYSIS IN VIRTUOSO SPECTRE CIRCUIT SIMULATOR XL

The Cadence® Virtuoso® Spectre® Circuit Simulator XL comprises a comprehensive solution for fast and accurate simulation and analysis of RF and high-speed integrated circuits, such as RF transceivers, frequency synthesizers, and power amplifiers, and of heavily non-linear time-variant analog circuits such as switched-capacitor circuits, data converters, and switching power supplies. With the RF analysis capability of Virtuoso Spectre Simulator XL, designers of everything from simple blocks to complete systems benefit from faster, high-performance, silicon-accurate simulation and analysis.

RF ANALYSIS IN VIRTUOSO SPECTRE CIRCUIT SIMULATOR XL

Tightly integrated with the Virtuoso custom design platform, Virtuoso Spectre Simulator XL complements the SPICE-level analog simulation capabilities of the Virtuoso Spectre Simulator L with world-class RF simulation and analysis technologies. Virtuoso Spectre Simulator XL includes the only RF simulator that addresses the needs of the entire RF design spectrum. It offers a frequency-domain harmonic balance engine for faster and more accurate simulation of high dynamic-range, weakly non-linear RF circuits, and it uses a patented time domain shooting algorithm optimized for highly non-linear circuits.

Additionally, the Virtuoso Spectre RF Simulation Option is now included in the Cadence Virtuoso Spectre Circuit Simulator XL. (Please refer to the Cadence Virtuoso Multi-Mode Simulation datasheet for more details on other Virtuoso Spectre Circuit Simulator L and XL capabilities).

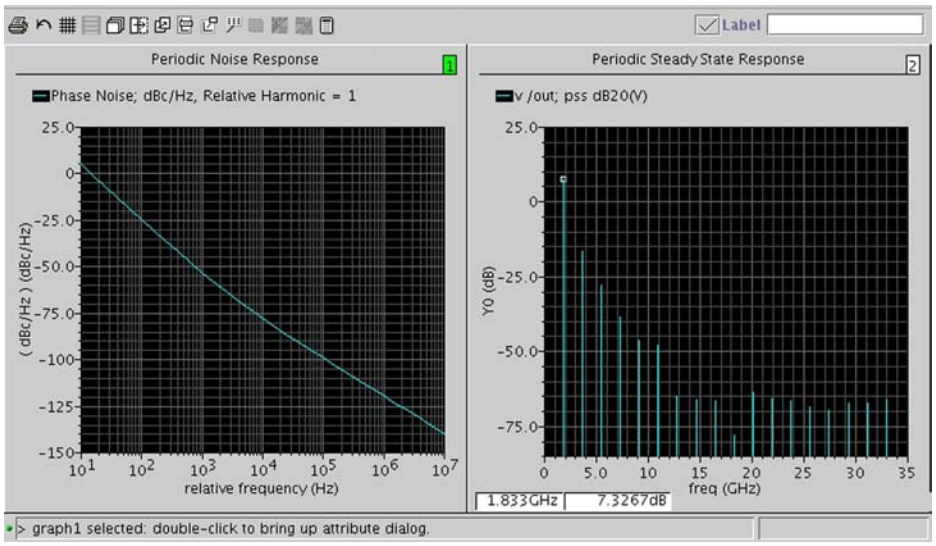

Figure 1: Voltage-controlled oscillator (VCO) spectral content and phase noise

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BENEFITS

- Provides high-performance, silicon accurate simulation of RF and high frequency circuits, from simple blocks (mixers, oscillators) to complete systems (RF transceivers, frequency synthesizers)
- Offers a faster alternative to transient analysis for heavily non-linear time variant analog circuits (frequency multipliers and dividers, switched-capacitor circuits, switching power supplies)
- Enables accurate and efficient postlayout simulation with RLCK parasitics, S-Parameter models (n-port) and lossy coupled transmission lines (mtline)
- Performs application-specific analysis of RF performance parameters (spectral response, gain compression, inter-modulation distortion, impedance matching, stability, isolation)
- Detailed analysis of time-variant noise enables accurate calculation of noise figure, phase noise, and jitter
- Offers designer-friendly visualization of simulation results using time and frequency plots, Smith charts, eye diagrams, and constellation diagrams with a rich set of post-processing functions dedicated to communicating product specific performance metrics such as adjacent channel power ratio (ACPR) and error vector magnitude (EVM)
- Ensures higher design quality using silicon-accurate foundry-certified device models shared within Virtuoso Multi-Mode Simulation

FEATURES

ADVANCED RF SIMULATION TECHNIQUES

- Periodic and quasi-periodic steady-state analysis based on harmonic balance technology, optimized for high dynamic range, high-capacity RF circuits with distributed components
- Periodic and quasi-periodic steady-state analysis based on the Cadence patented time-domain shooting Newton algorithm, optimized for strongly non-linear circuits
- Envelope following analysis supporting all analog and digital modulation techniques
- Rapid IP2 and IP3 calculation based on perturbation technology
- Periodic noise analysis for the accurate calculation of noise in non-linear time variant circuits with detailed analysis options (modulated noise, sampled noise, and jitter)
- Noise and distortion summary to identify the contribution of each device to the total output noise, harmonic, or inter-modulation distortion
- Small signal analysis: ac, transfer function, S-parameters, and stability based on a periodic or quasi-periodic operating point
- Monte Carlo, corner-case, and parametric sweep analysis

RESULT VISUALI ZATION AND POST PROCESSING CAPABILITIES

- The Direct Plot Form in the Virtuoso Analog Design Environment supports a rich set of RF performance metrics (phase noise, conversion gain, stability circles, gain compression, IP3)
- Tight integration with Virtuoso Visualization and Analysis allows visualization of results in different forms such as time and frequency plots, Smith charts, eye diagrams, and constellation diagrams
- The Waveform Calculator is a handy post-processing tool with built-in RF functions; algebraic expressions can be composed of any combination of design data including voltages, currents, parameters, and operating points
- Waveforms can be saved in portable graphics formats, such as PNG, TIFF, and BMP, allowing the creation of professional plots for design reports
- The MATLAB Toolbox exports Virtuoso Spectre results to MATLAB for detailed post processing and provides a MATLAB function library for RF-specific measurements, such as IP3 and compression point

MULTI-MODE SIMULATION SHARED TECHNOLOGY

- Superior design use model via tight integration with the Virtuoso Analog Design Environment
- Shared syntax, device models, and equations with other Virtuoso multi-mode simulators: Virtuoso UltraSim Full-chip Simulator (FastSPICE) and Virtuoso AMS Designer Simulator (mixed-signal)
- Compiled-model interface (CMI) allows for rapid inclusion of user-defined models for a "model once, use everywhere" capability
- Behavioral modeling capabilities in full compliance with Verilog-A 2.0

APPLICATIONS

The RF analysis in Virtuoso Spectre Simulator XL covers the full line of RF applications, from RF to microwave and from blocks to complete systems.

AMPLIFIER

- Small signal measurements (gain, S-parameter, stability factor)
- Inter-modulation and total harmonic distortion
- Compression point, intercept point, and distortion summary
- Noise figure and noise summary
- Power dissipation and efficiency measurements
- Large-signal S-Parameter supported by the LSSP wizard
- Load-pull measurements
- Envelope following analysis for digital modulation
- ACPR measurement

MIXER

- Conversion gain, compression point, and intercept point
- Noise, SSB and DSB noise figures, and noise summary
- Impedance matching
- Port-to-port isolation for RF, IF, and LO ports
- Mixer performance in the presence of a blocking signal

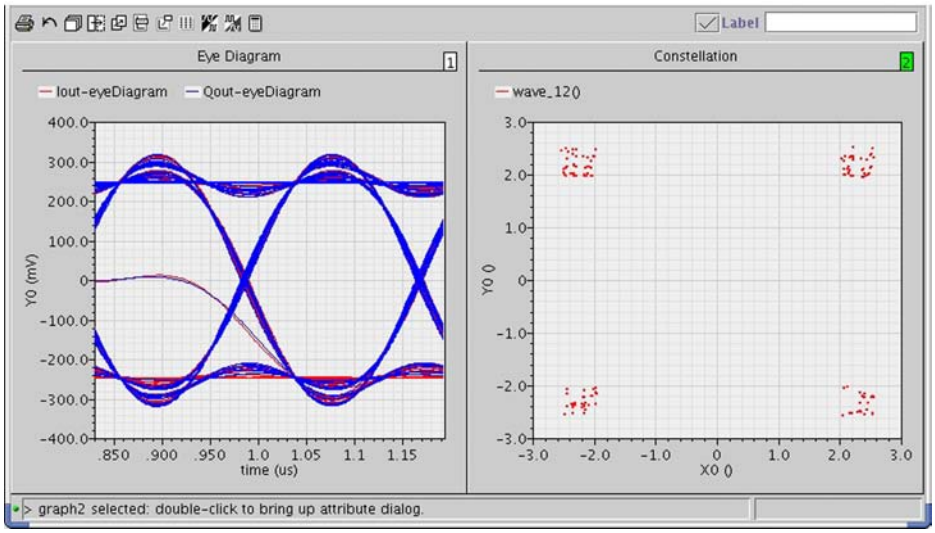

Figure 2: WLAN 802.11 eye diagram and constellation measured with RF analysis in Virtuoso Spectre Circuit Simulator XL

OSCILLATOR

- Support for all oscillator types (LC, ring, high Q crystal)
- Output frequency, output power, phase noise, and jitter measurement
- Frequency pushing and frequency pulling effect
- Tuning sensitivity and linearity
- Sensitivity of the output frequency and phase noise to the noise from the power supply and ground rails

RECEIVER AND TRANSMITTER CHAINS

- I/Q amplitude and phase imbalance
- Leakage and feedthrough
- Constellation diagrams
- EVM
- Bit error rate (BER) and eye diagrams

PHASED-LOCKED LOOPS

- An automated flow for Jitter analysis and modeling of critical PLL blocks used in frequency synthesizers, clock and data recovery circuits such as voltage-controlled oscillators, high-Q reference oscillators, phase detectors, charge pumps, filters, and dividers
- Large-signal and jitter analysis of the complete PLL in closed loop using transistor-calibrated nonlinear models

HEAVILY NONLINEAR TIME-VARIANT ANALOG CIRCUITS

- Sample and hold circuits, switched-capacitor filters, and chopper-stabilized amplifiers
- Frequency multipliers and dividers
- Phase detectors
- Parametric amplifiers, switching-mode power supplies, and low drop-out regulators

SPECIFICATIONS

COMPREHENSIVE DEVICE MODEL SUPPORT

- MOSFET models, including BSIM3 (up to v3.30), BSIM4 (up to v4.5); PSP (up to 102), HISIM (up to v2.3.1), high-voltage MOS (HVMOS), MOS9, MOS 11 and EKV
- Silicon-on-insulation (SOI) models, including BTASOI, SSIMSOI (v1.4.0.2 and 2000), BSIMSOI (up to v4.0) and BSIMSOI PD (v2.2.3)
- Bipolar junction transistor (BJT) models, including VBIC (v1.2), HICUM (up to v2.22), HICUM Level0 (v1.11), Mextram, HBT and Gummel-Poon models
- Diode models level 1, 2 and 3, JFET and GaAS MESFET models

COMPREHENSIVE CIRCUIT ANALYSES

- Periodic and quasi-periodic steady state analysis (PSS and QPSS) based on harmonic balance and shooting Newton
- Periodic and quasi-periodic noise analysis (PNoise, QPNoise)
- Periodic and quasi-periodic small signal analysis (PAC, PXF, PSP, QPAC, QPSF, QPSP)
- Periodic stability analysis (PSTB)
- Time-domain and frequency-domain envelope analysis
- Perturbation-based rapid IP2 and IP3
- Noise and distortion summaries

DESIGN INPUTS/OUTPUTS

- Virtuoso Spectre netlist format
- HSPICE
- SPICE 2/3
- S-Parameter data files
- PSF Waveform format

PLATFORM/OS

- Sun/Solaris (32-bit, 64-bit)
- HP-UX (32-bit, 64-bit)
- IBM (32-bit, 64-bit)
- Linux (32-bit, 64-bit)

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