

# 2007 Visual System Simulator Design Suite

For the design of next-generation communications systems

## Key Features

- ◀ RFA™ system-level RF architectural planning tool, including RF Inspector™ system simulation
- ◀ RF centric measurements such as integrated phase noise and carrier-to-interference noise ratio (CINR)
- ◀ Powerful and comprehensive features for dedicated sub-systems engineers, including:
  - ◀ RF cascade measurements with optimization and yield analysis to enhance component specifications
  - ◀ Impedance mismatch to monitor voltage standing wave ratio (VSWR) and impact on overall system design
- ◀ Tight integration with Microwave Office® and Analog Office® design suites, enabling harmonic balance, EM, and/or linear co-simulation

“The seamless integration of Microwave Office and VSS in one platform has really helped our engineers meet the challenges of designing cutting-edge IC products quickly and easily.”

*Dr. Chuck Campbell  
Design Engineering Dir.  
TriQuint Semiconductor, Inc.*



- ◀ WiMAX mobile library, fully compliant with IEEE 802.16e-2005 specifications, WirelessMAN-OFDMA physical layer
- ◀ VSS application-specific test benches are available for the most communications standards
- ◀ One-step signal generators for creating test signals with minimum effort
- ◀ A wide range of easy-to-set-up system measurements that reduce result analysis time
- ◀ Fixed-point library to perform simulations using the same mathematics as hardware
- ◀ Optional TestWave™ module for direct link to leading test and measurement equipment

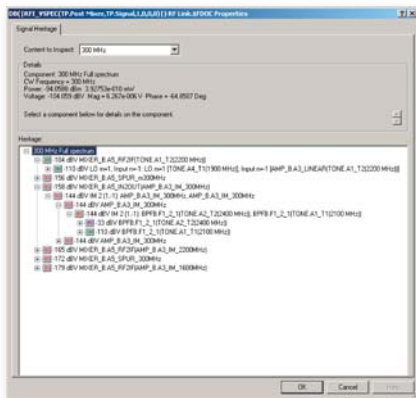
## Overview

Visual System Simulator™ (VSS) is a comprehensive software suite for the design of complete, end-to-end communications systems. VSS 2007 has been enhanced in many areas as part of AWR's ongoing commitment to provide engineers with the unique ability to design the right system architecture and formulate suitable specifications for each of the underlying compo-

nents in today's complex communications designs. The VSS development team has targeted key features that will help designers reduce time-to-market by eliminating iterations and rework, and cut system costs by ensuring that components are not overspecified and thus unnecessarily expensive.

## RFA Architectural planning tool

VSS 2007 software now includes RFA technology, an advanced system-level RF architectural planning and specification tool for RF communication system engineers who need to quickly create and verify the initial specifications of a radio design before committing to hardware and/or a particular circuit design. RFA offers a new simulation tool, RF Inspector, which helps designers find potential problems early in the design process, at the system-level design phase, thus saving significant design cycle time and costly respins. Users can identify sources of intermodulation products and undesired spurs of an RF link, including the effects of conversions, harmonics, and noise. This enables users to isolate the sources of unwanted interferers and to better architect their RF systems. The software works with

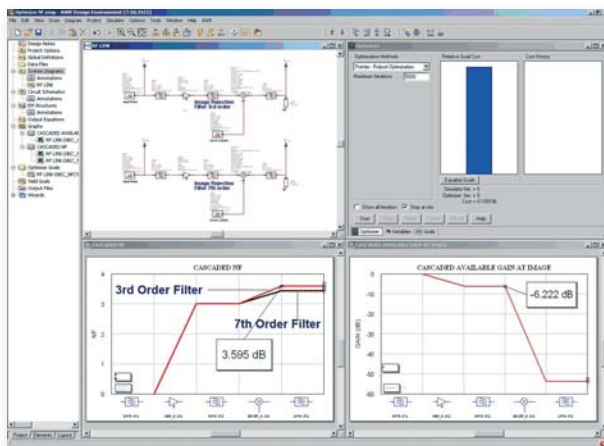


both of AWR's circuit design suites, Microwave Office 2007 and Analog Office 2007, to effectively give the engineering team the "big picture" on how component specifications affect overall system performance.

*The RF Inspector interface provides a clean and efficient means of determining the individual contributions to a particular tone*

## RF budget cascaded measurements

Designers can take their designs one step further by using the VSS link budget analysis tool to calculate cascaded NF, gain, third-order intercept point (IP3), and S21, to name a few. Traditional RF/analog system analysis commonly requires several tools to achieve a complete analysis of end-to-end performance. For example, the engineering team may use one tool for error vector magnitude (EVM) measurements and another for calculating cascaded NF and IP3.

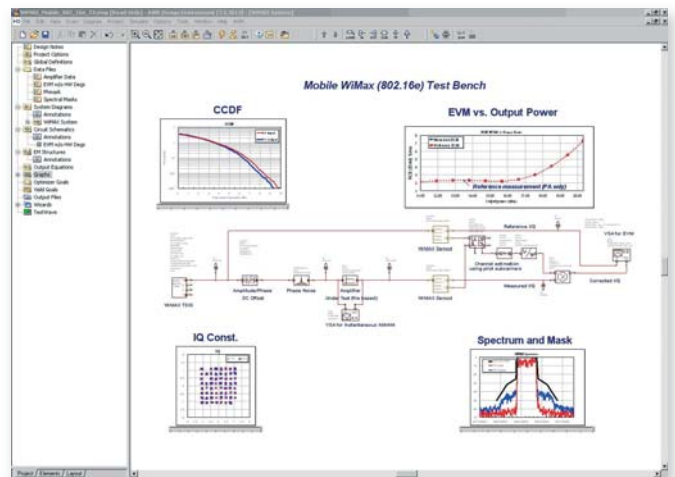


*Optimization of receive link NF*

With VSS 2007 software, engineering teams now have an efficient and comprehensive platform for making RF cascaded calculations at interior points of the RF link to perform an EVM measurement, all within a single system diagram. In addition, optimization and yield analysis simulations can be performed with cascaded measurements.

## A large selection of intuitive-to-use measurement parameter windows

VSS offers a wide array of system-level measurements that are intuitively set up. Choices include: EVM, adjacent channel power ratio (ACPR), complementary cumulative distribution function (CCDF), N'th order intercept point, average channel power, S-parameters, and AM/AM and AM/PM characteristics. All measurements have parameters windows that are understood by all engineers and are straightforward to set up.



*Mobile WiMAX EVM Test Bench*

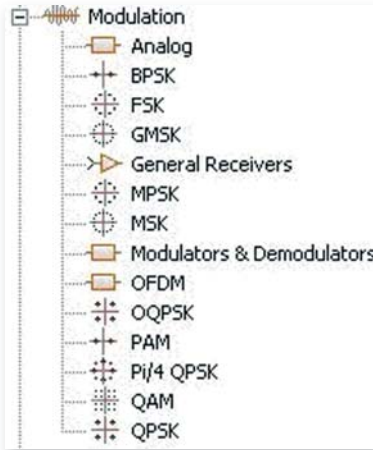
## Mobile WiMAX solution

VSS 2007 software includes a new mobile WiMAX solution that meets the specification defined in the wireless metropolitan area network (WirelessMAN) orthogonal frequency-division multiple access (OFDMA) physical layer (PHY) of the IEEE 802.16e-2005 Air Interface. In addition, it compliments the IEEE 802.16d WirelessMAN-OFDM PHY fixed-wireless solution previously released by AWR. The solution enables RF and baseband system-on-chip (SoC) designers, component suppliers, original equipment manufacturers (OEMs), user equipment companies, and infrastructure and network equipment providers to capture the specifications and accurately simulate their designs to ensure they meet the conformance tests specified in the 802.16 standard. The solution contains all bit-level processing defined in the 802.16e specifications, as well as the receiver functionality and the ability to incorporate circuit and RF interactions.

## Modulated signal sources with easy-to-define parameters

VSS software contains all the necessary features of a complete system tool, and more. It offers an extensive set of signal generators for the most common modulation

schemes. Engineers need only to select a modulation scheme and then choose the appropriate pulse shaping, symbol rate, center frequency, and average signal power. In turn, the complex modulated signal is generated. A large selection of primitive models is available for systems engineers who want to construct a modulated signal from the basic elements.



VSS offers a variety of complex modulated signal sources

### Simulation architecture

The underlying architecture of the VSS simulation engine incorporates years of research and development at AWR in system-level simulation technology. VSS models have been validated over many years in conjunction with significant system development efforts. Block interconnects are not merely wires but are “elastic buffers” that control the flow of data and make VSS a very fast, data-driven simulation tool.

### Auto-configurable I/Q demodulator

RF/microwave engineers can understand the effect of component impairments on the overall system. VSS software simplifies the system analysis process by providing a general I/Q demodulator or an “intelligent receiver” that automatically configures it self to demodulate phase shift keying (PSK), and quadrature signals. This enables engineers to concentrate on the nonlinear effects of the RF link, such as phase noise, as the modulated signal format and/or pulse shaping are modified without having to make changes to the receiver. Self-contained receivers for AM, FM, pulse-width modulation (PWM), multiple frequency-shift keying (MFSK), orthogonal frequency-division multiplexing (OFDM), and Gaussian minimum shift keying (GMSK) are also available in VSS.

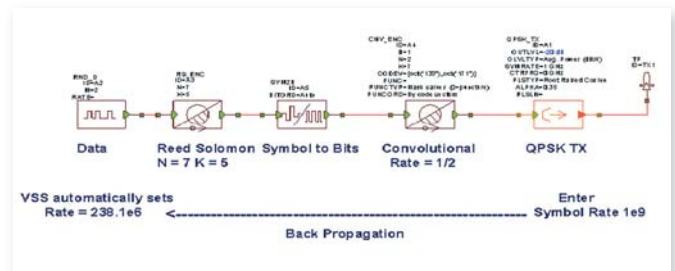
### Auto data alignment to facilitate BER simulations

Using VSS signal generators and intelligent receivers, engineers are no longer required to manually adjust the transmitted data to align with the received data before performing a bit error rate (BER) simulation, which can be a laborious task depending upon the complexity of the system. Systems engineers can effectively do component tradeoff studies, for example, to determine the impact of a filter’s passband ripple on symbol error rate (SER). The VSS engine automatically compensates for the group delay and phase rotation of the filter before the receiver starts detecting incoming symbols.

### Back and forward propagation of time step

The VSS simulation engine makes system design one step easier by “back propagation” and “forward propagation” of time step, so models automatically adjust their rates. Back propagation is invoked when encoding schemes or multiple encoding schemes are used in a system. The rate of a digital signal changes as the source is encoded.

With VSS, users enter a symbol rate in any of the transmitters, and connect the appropriate encoders and a digital source to its input. VSS in turn back propagates the transmitter’s symbol rate to automatically adjust the bit rate of the digital source. There is no need to manually figure the correct bit rate to obtain the correct symbol rate at the output of the transmitter—VSS does the work for you.



VSS automatically sets the correct bit rate based on encoding scheme and symbol rate of transmitter

### Import custom code

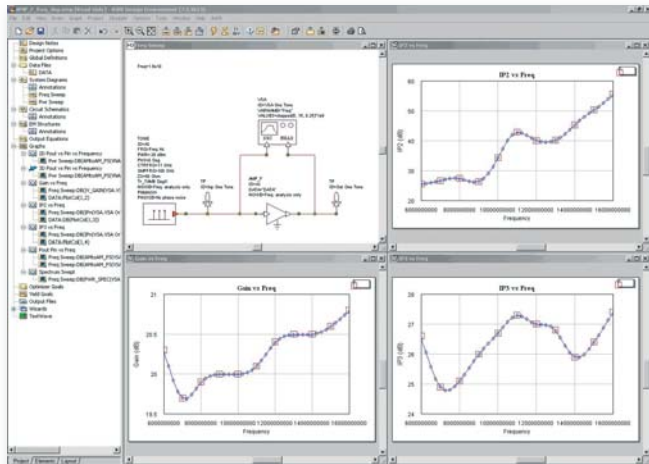
Users are given several methods to incorporate their own algorithms or legacy code into VSS software:

- ◀ By using primitive models and VSS support for hierarchical designs, engineers can create their own models or sub-circuits.
- ◀ VSS supports bi-directional co-simulations with Mathworks MATLAB, giving engineers a means to incorporate MATLAB models into VSS simulations.
- ◀ Engineers can use the VSS modeling design kit (MDK) to create their own C++ base models in VSS.

### A variety of RF chain impairment analysis methods

VSS software offers three methods for analyzing RF chain impairments in the presence of complex modulated signals. The first method enables the designer to work with VSS behavioral blocks. Starting at the RF behavioral level gives the engineer a benchmark for comparison as the system design process matures. The second design method enables users to perform harmonic balance and/or linear co-simulations with Microwave Office and Analog Office software at the system level. The third design method enables designers to read in device measurements such as large and small signal S-parameters, Touchstone data, spur tables, and N-port data.

In addition, a frequency file-based amplifier and file-based variable gain amplifier are available. This feature closes the circle, enabling the engineering team to start a design at the behavioral level, progress to a component-level design using Microwave Office or Analog Office software, and finally use actual device measurements to validate the entire design. Simultaneously, as the simulation is running, the designer can tune on both circuit-level as well as system-level parameters. VSS 2007 is a system tool that enables the engineering team to make cost effective “tradeoffs” between system specifications and circuit specifications.

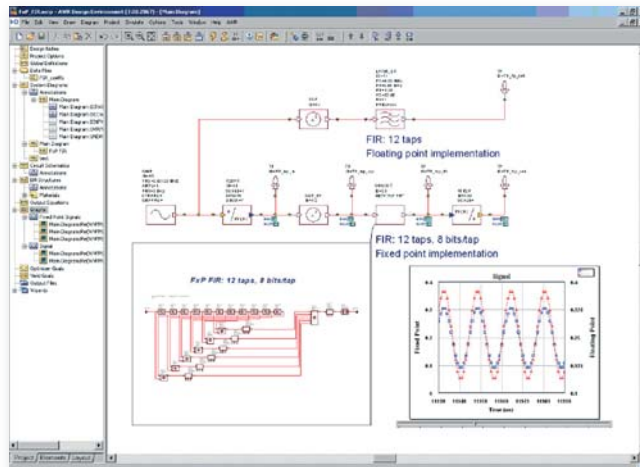


File based frequency dependent amplifier

### New fixed-point DSP models

Fixed-point digital signal processing (DSP) components have become an essential part of any end-to-end simulation, and as a result AWR has included in VSS 2007 software a set of fixed-point DSP models. Under the fixed-point node in the element browser, models such as a floating-point-to-fixed-point converter and a set of basic math functions can be found. The VSS fixed-point block set was designed to enable designers to work at the gate level, and have complete control of the

fixed-point algorithm implementation. Engineers can select a fixed-point format from five choices. Fixed-point models support two's complement, unsigned, sign & magnitude, one's complement, or offset binary. In addition, where appropriate, users can set how a fixed-point model is going to handle overflow (saturate vs. rollover) and underflow (truncate vs. roundoff).



VSS automatically sets the correct bit rate based on encoding scheme and symbol rate of transmitter

### Integration with industry-leading test instrumentation

The AWR TestWave software is an optional module that seamlessly integrates VSS with instruments from leading test equipment vendors. TestWave software can directly import S-parameters, I/Q data, spectrum plots, and oscilloscope traces to VSS. The TestWave interface is also bi-directional so users can export I/Q data from VSS and drive test equipment with modulated wave-forms created in VSS. TestWave provides a means for virtual hardware prototyping (for more information please see the TestWave datasheet).



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