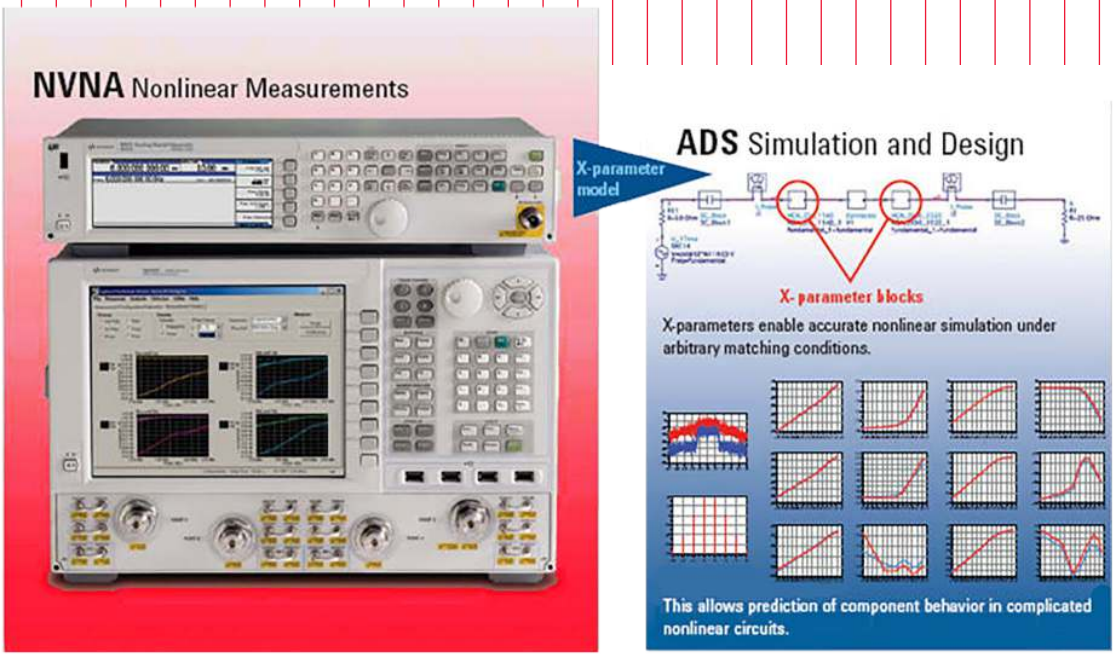
Keysight Technologies
EEsof EDA
Premier Communications Design Software

Technical Overview



KEYSIGHT TECHNOLOGIES

Offering Design Software for Complete Flow Solutions

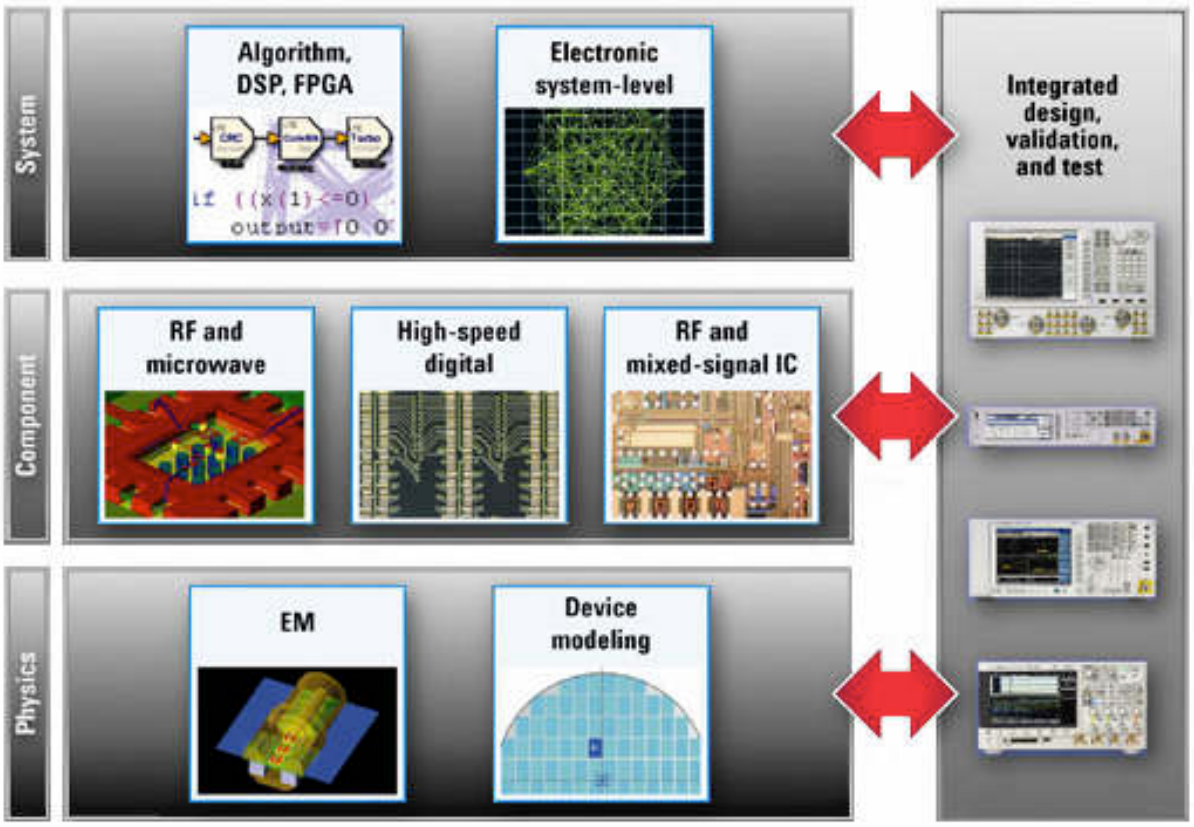


Figure 1. Keysight EEsof EDA is the leading supplier of Electronic Design Automation (EDA) software for communications designs.

GARYSMITH EDA
CONSULTING IN ELECTRONIC DESIGN

Keysight EEsof 68%

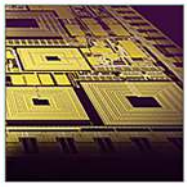
*Figure 2. Keysight EEsof is the leading provider of RF Design and Simulation tools.**

** Gary Smith EDA's December 2012 market share report.*

Keysight Technologies, Inc. EEsof EDA is the leading supplier of Electronic Design Automation (EDA) software for communications product design. High-frequency, high-speed, device modeling, signal-processing and RF circuit design engineers create better products faster using design flows built on our system, component, and physics-level design tools. We offer complete design integration for products such as cellular phones, wireless networks, radar, satellite communications systems and high-speed digital wireline designs. Applications include electronic system level (ESL), high-speed digital, RF-Mixed signal, device modeling, RF and Microwave design for commercial wireless, aerospace, and defense markets. Our software is compatible with and is used to design Keysight's own test and measurement equipment.

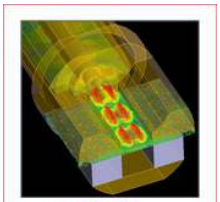
All of our EDA software bundles are scalable to offer you the widest variety and most flexible plans available to work within your design flow and your budget. As your design needs grow, you can add simulators, models and libraries as you require them. We are dedicated to providing the right software and support to increase your design productivity and advance your long-term success.

World-Class Products Enabling the Entire Communications Design Flow



Advanced Design System (ADS) is the industry's leading RF, microwave & high speed digital electronic design automation software for wireless communications and networking, aerospace and defense, and signal integrity applications.

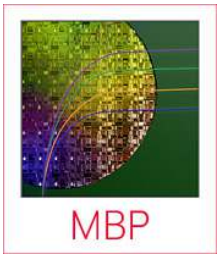
Genesys is an affordable, accurate, easy-touse RF and microwave simulation software created for the circuit board and subsystem designer.



Electromagnetic Professional (EMPro) is the first 3D Electromagnetic EM simulation software platform that completely integrates 3D EM simulation and the ADS circuit simulation software.

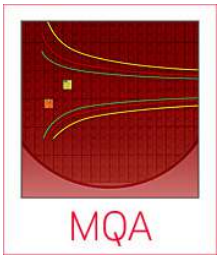
Integrated Circuit Characterization and Analysis Program (IC-CAP) is the industry standard for DC and RF semiconductor device modeling. IC-CAP extracts accurate compact models used in high speed/digital, analog and power RF circuit design applications.

SystemVue is an electronic system-level (ESL) design tool that enables system architects and algorithm developers to innovate the physical layer (PHY) of next-generation wireless and aerospace/defense communications systems.



Model Builder Program (MBP) is a one-stop solution that provides both automation and flexibility for silicon device modeling. MBP includes powerful, built-in characterization and modeling capabilities as well as an open interface for modeling strategy customization.

GoldenGate is an advanced simulation and analysis solution for integrated mixed signal RFIC designs. GoldenGate RFIC software is fully integrated into the Cadence Analog Design Environment (ADE).



Model Quality Assurance (MQA) provides the complete solution and framework to fabless design companies, IDMs, and foundries for SPICE model library validation, comparison, and documentation.

Advanced Design System (ADS) — Premier High-Frequency and High-Speed Design Platform

Advanced Design System is the leading electronic design automation software for RF, microwave, and high-speed digital applications, providing the design simulation software environment that enables the co-design of IC, package, and board in high-frequency and high-speed applications. ADS has pioneered the most innovative and commercially successful technologies, including the industry's most advanced suite of system, circuit, and EM simulation products, plus X-parameters, a breakthrough in nonlinear modeling. ADS offers the industry's only true multi-technology design environment which allows multiple IC's combined with laminate and packaging PCB to all be designed together. ADS seamlessly integrates these powerful tools in a complete front-to-back design platform, taking you every step from concept to manufacturing, making it the choice of leading companies in the wireless communication & networking and aerospace & defense industries.

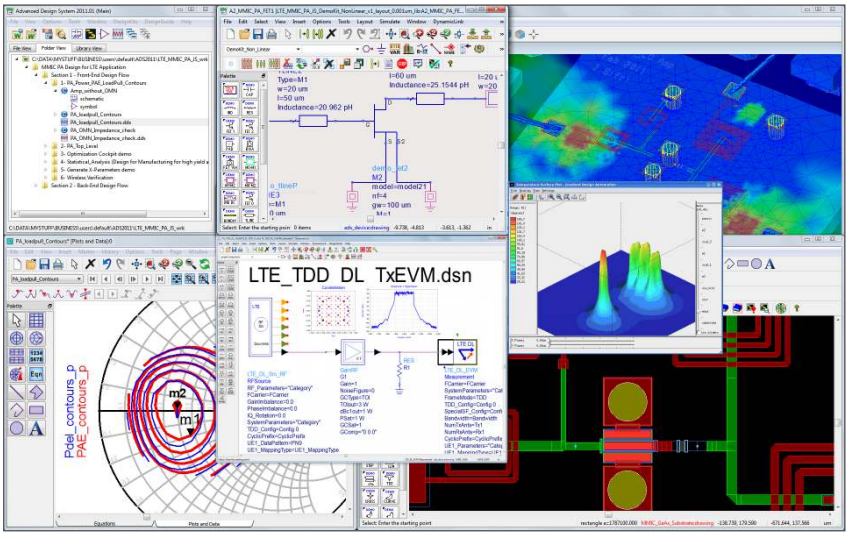


Figure 3. ADS is the industry's leading electronic design automation software for wireless communications & networking, aerospace & defense, and signal integrity applications.

The Industry's Leading Technology, and Much More

ADS puts an unparalleled suite of simulation technology at your fingertips including: S-parameter, AC analysis, harmonic balance, high-frequency SPICE, convolution, circuit envelope, high-speed channel, Keysight Ptolemy system dataflow, Momentum 3D planar EM, and full 3D EM finite element method, but that is only the beginning.

To shorten your design cycles, ADS provides a huge amount of application-specific data. Over 300 examples cover everything from specific application circuits to tutorials on how to get the most out of ADS. Through DesignGuides, we have integrated the experience and best practices of leading designers. They provide wizards, pre-configured set-ups and displays, and step-by-step instructions for design applications such as amplifiers, filters, mixers, RF systems, etc., giving you easy access to the power of ADS from day one.

Keysight also works with top GaAs, GaN, InP, SiGe and Silicon foundries around the world to develop and support process design kits for RFIC and MMIC design in ADS. Finally, all the major surface mount component vendors provide up-to-date component libraries, representing thousands of models, specifically for ADS RF PCB design.

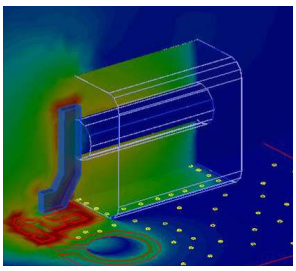


Figure 4. Enhanced Integrated 3D EM Analysis — including Finite Element EM sweeps, optimization and co-simulation with circuit analysis.

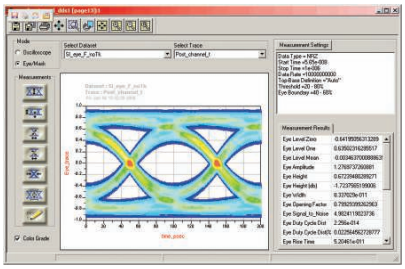
ADS Key Features

- Complete schematic capture and layout environment
- Innovative and industry leading circuit and system simulators
- Direct, native access to 3D planar and full 3D EM field solvers
- Accurate and efficient electrothermal analysis for temperature aware circuit simulation
- Largest number of process design kits (PDKs) developed and maintained by leading foundry and industry partners
- EDA and Design Flow Integration with companies such as Cadence, Mentor, and Zuken
- Optimization Cockpit for real-time feedback and control when using any of 12 powerful optimizers
- X-parameters model generation from circuit schematic and Keysight's NVNA for nonlinear high-frequency design
- Up-to-date Wireless Libraries enable design and verification of the latest emerging wireless standards

ADS Speeds Your Optimized Design from Concept to Implementation

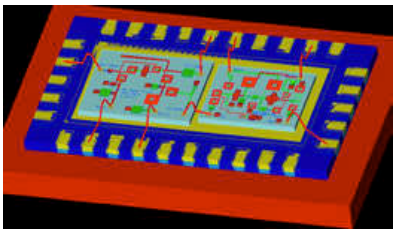
High-Speed Digital Design

Signal integrity engineers who are hurdling the multigigabit/s barrier look to ADS for the correct treatment of high-speed effects like distortion, mismatch, and crosstalk. Uniquely, ADS integrates accurate system, circuit, and EM simulators, so you can not only get the right answers but also get them faster by avoiding error-prone and time-consuming data transfer between a collection of point tools.



Innovative Multi-technology Capability

ADS capabilities enable tradeoffs to be made interactively on the IC, laminate, packaging, and printed circuit boards being designed or co-designed together. Circuits designed in multiple technologies can be combined and simulated at both the circuit and full 3D EM level.



X-parameters Generator

X-parameters models are fast, cascadable, nonlinear behavioral models that accurately account for frequency mixing and impedance mismatch. X-parameters fulfill a long standing need from the high-frequency design community for nonlinear behavioral models that can be created from measurement or simulation with the same speed and convenience as the well known linear S-parameters. The X-parameters Generator enables MMIC, RF-SIP and RF module design houses to provide their customers with an accurate, pre-prototype model of their nonlinear devices (e.g. power amplifiers, front-end modules and transceivers) to further enable concurrent design and secure early design wins.

Boost Productivity with an Integrated Design Environment

ADS integrates all this proven RF, signal integrity, mixed-signal and electromagnetic technology into a single, flexible environment. Additionally, ADS works with other EDA frameworks to fit well with your specific design flow and, with the ADS instrument connectivity, it provides a truly unique integration of design and measurement.

This proven software environment is easily customized to meet your unique design or application needs. ADS runs on Windows and LINUX, with complete file compatibility between platforms and across networks.

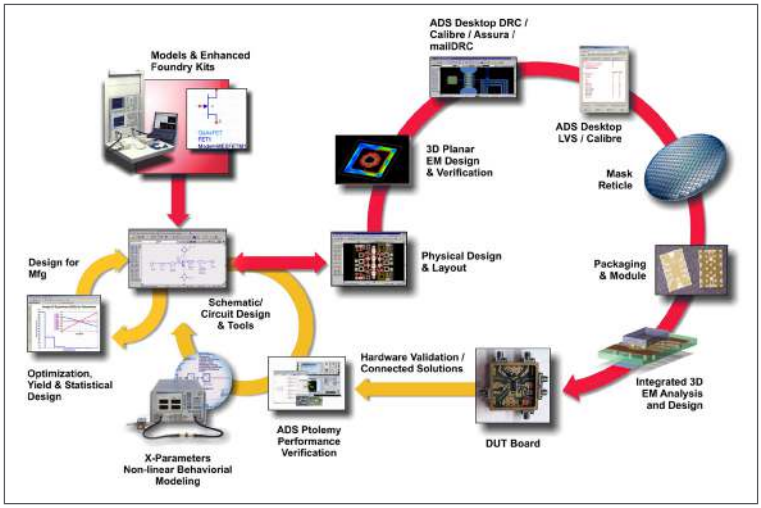


Figure 5. Complete ADS Desktop flow concept, physical design to manufacturing.

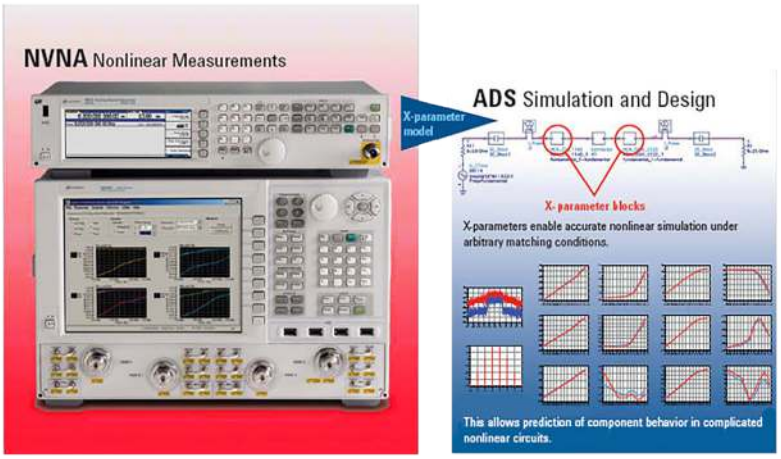


Figure 6. Keysight's X-parameters represent a new category of nonlinear network parameters for high frequency design. They are applicable to both large-signal and small-signal conditions, and for linear and nonlinear components.

EMPro — 3D Electromagnetic Modeling and Simulation Environment Integrated With Your ADS Design Flow

Electromagnetic Professional (EMPro) is a 3D modeling and simulation environment for analyzing the 3D electromagnetic (EM) effects of high-speed and RF/microwave components. EMPro features a modern design, simulation and analysis environment, high capacity time-and frequency-domain simulation technologies and integration with the industry's leading high-frequency and high-speed design environment. EMPro allows you to create 3D components that can be simulated together with 2D circuit layouts and schematics within Advanced Design System (ADS), using EM-circuit cosimulation. Designers can quickly create arbitrary 3D structures with a modern, simple GUI that saves time and our EMPro EM simulation software provides advanced scripting features.

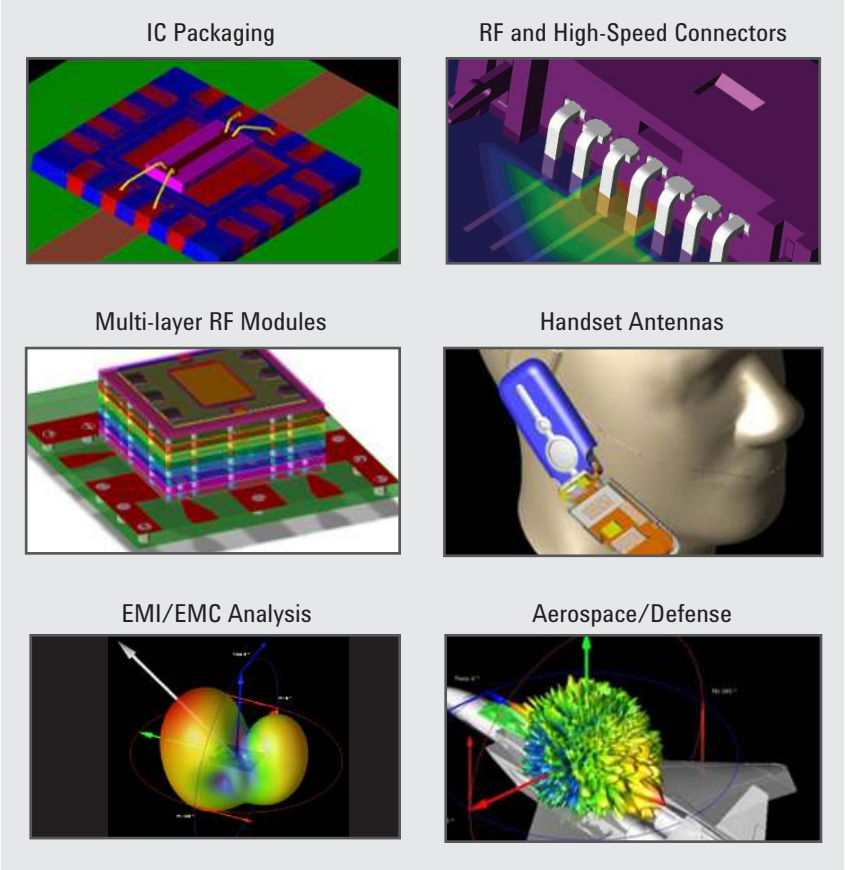


Figure 7. EMPro is used in a wide variety 3D electromagnetic modeling and simulation applications.

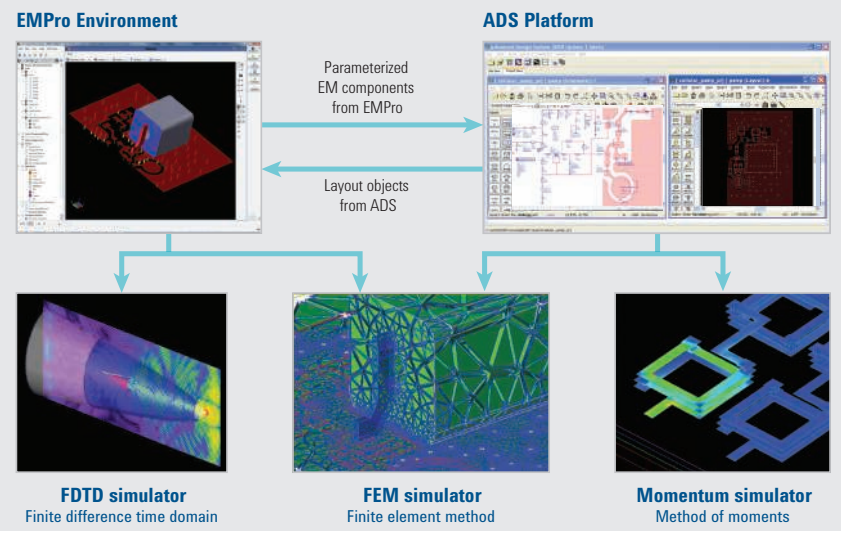


Figure 8. Keysight provides multiple EM simulation technologies integrated with the ADS design flow. EMPro adds a 3D solid modeling environment to this flow.

Features

Modern, efficient 3D solid modeling environment

EMPro provides the flexibility of drawing arbitrary 3D structures and the convenience of importing existing CAD files. You can create 3D shapes, add material properties, set up simulations, and view results—all within the EMPro environment.

Time and frequency-domain simulation technology

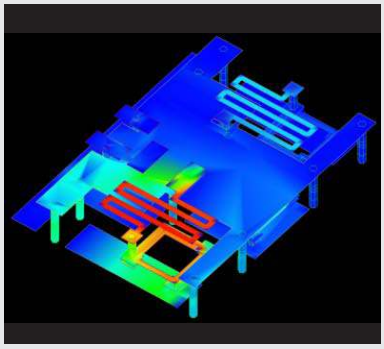
3D structures can be analyzed in EMPro using the same FEM simulator available in ADS. FEM is a frequency-domain technology widely used for RF/microwave applications. For electrically large problems, such as antennas and EMI, the finite difference time domain (FDTD) simulator can be used.

Parameterized 3D EM component generation

Parameterized 3D components can be created in EMPro and placed on a layout design in ADS. The FEM simulator can then be used to simulate the combination of the 2D layout and the 3D EM component.

Keysight Offers the Broadest Selection of EM Simulation Technologies

Momentum Simulator



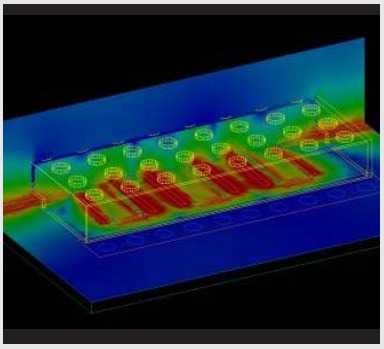
The Keysight Momentum Simulator is the leading 3D planar electromagnetic (EM) simulator used for passive circuit modeling and analysis. It uses frequency-domain Method of Moments (MoM) technology to accurately simulate coupling and parasitic effects of complex multi-layer designs. Accurate EM simulation enables RF/MMIC designers, RF/High-Speed Board Designers, RF Module/SiP Designers and Antenna Designers to improve design performance and increase confidence that the manufactured product will meet spec.

Momentum is integrated with ADS, Genesys, and GoldenGate, along with third-party tools from Cadence, Mentor and Zuken.

Features:

- Frequency-domain solver based on Method of Moments technology
- Most efficient EM simulation technology for planar structures
- Handles multi-layer IC/Board/Module designs, including vias
- Supports CPU multi-threading
- Generates multi-port S-parameter models from a single simulation
- Very efficient for high-Q applications
- "Microwave Mode" provides high accuracy full-wave solvers
- "RF Mode" provides high-speed quasi-static solvers

Finite Element Method (FEM) Simulator



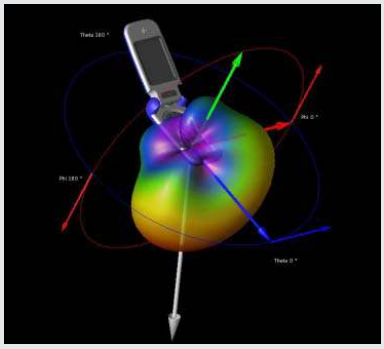
The Keysight FEM Simulator is based on the industry-proven Finite Element Method. Unlike 3D planar simulators, this technology can handle arbitrarily shaped 3D structures such as bondwires, conical shaped vias and solder balls/bumps where z-dimensional changes appear in the structure. FEM solvers can also simulate dielectric bricks or finite-size substrates.

Keysight FEM is integrated with ADS so layout designs do not need to be exported to third-party EM simulators. Keysight FEM is also available in EMPro for simulating 3D models imported from other CAD tools or created natively.

Features:

- Frequency-domain solver based on Finite Element Method technology
- Most accurate EM simulation technology for 3D structures such as packaging, bondwires, connectors and other components
- Supports CPU multi-threading
- Generates multi-port S-parameter models from a single simulation
- Very efficient for high-Q applications
- Adaptive mesh refinement automates the setup process
- Adaptive frequency sweeps ensures accurate results at resonant frequencies

Finite Difference Time Domain (FDTD) Simulator



The Keysight FDTD Simulator is based on Finite Difference Time Domain technology. Like FEM, FDTD can handle arbitrarily shaped 3D structures. Whereas FEM produces a large matrix during the solution process, FDTD uses an iterative process to update field values at each time step. FDTD is an inherently parallel method and therefore lends itself very well to the processing capabilities of the most recent advances in CPU (general-purpose processors) and GPU (graphics processors) hardware.

The Keysight FDTD simulator is available in EMPro for simulating 3D models imported from other CAD tools or created natively.

Features:

- Time-domain solver based on Finite Difference technology
- Highest capacity EM simulation technology for electrically large 3D structures
- Most efficient solution for antenna, EMI/EMC, radar cross section and biomedical applications
- Supports both CPU multi-threading and GPU acceleration
- Very efficient for broadband applications
- Best for time-domain analyses such as TDR

Features

Keysight SystemVue (standalone environment)

- RF/DSP co-design for superior system-level partitioning
- Polymorphic modeling in C++, math, VHDL, or behavioral blocks
- Distortion-true RF models, with X-parameters support
- Fixed-point and HW design kits for HDL (FPGA) and C++ (DSP)
- PHY reference libraries for LTE, 60GHz WPAN, OFDM, more
- Creative of integration RF/BB simulation with measurements

Keysight Spectrasys

- Accurate and Fast RF System Analysis
- Quickly diagnose root causes of poor system performance
- Easy like a spreadsheet, but handles many more effects
- Full nonlinear RF and noise modeling, with X-parameters

SystemVue – System Design

SystemVue is a focused EDA environment for electronic system-level (ESL) design that enables system architects and algorithm developers to innovate the physical layer (PHY) of next-generation wireless and aerospace/defense systems. It provides unique value to RF, DSP and FPGA/ASIC implementers who rely on both RF and baseband DSP to architect and implement the full value of their hardware platforms, cutting both design and verification time compared to general-purpose alternatives.

SystemVue brings core Keysight competencies in RF modeling, IP reference libraries, and measurement science to bear on algorithm and system design challenges, flowing from architecture into realization and verification. SystemVue connects to both RF platforms and measurement equipment, leveraging your expertise and uniting your workgroups.

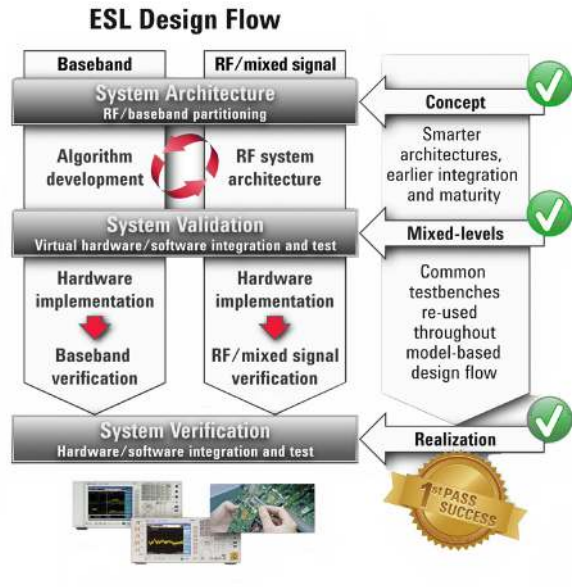


Figure 10. SystemVue unites a top-down system-level design approach that crosses the RF/Baseband gap and connects to major digital and RF design flows. A platform that sits above the "A-to-D converter divide" is able to create superior architectures.

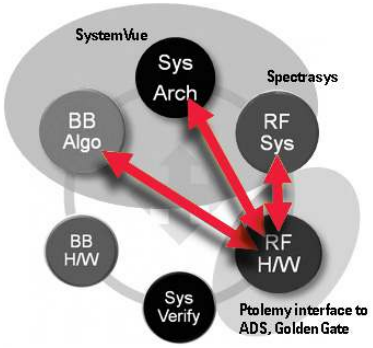


Figure 9. SystemVue unites a top-down system-level design approach to Baseband and RF, and connects to major Keysight RF design flows, such as ADS and GoldenGate.

Spectrasys – RF Architecture

Keysight Spectrasys provides RF subsystem design, analysis, and debug tools for RF System Architects that are unmatched by any other technology. Unlike spreadsheet-based tools, Spectrasys is graphical and accounts for a much greater level of physical detail and analog performance issues such as mismatch effects, intermodulation terms, reverse propagation, SSB noise, phase noise, nonlinear effects, and X-parameters.

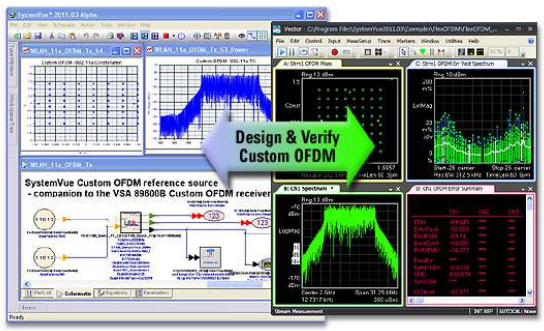
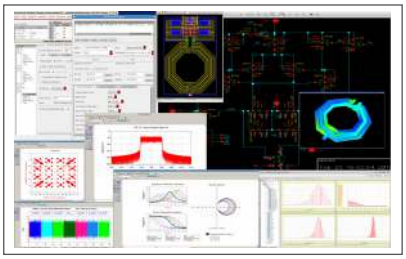


Figure 11. SystemVue also connects system architects to the latest communications equipment, for accelerated functional verification.

GoldenGate – Advanced Simulation and Analysis Solutions for RF-Mixed Signal IC Design

Features

- GoldenGate is fully compatible with Cadence® IC5 and IC6 platforms.
- Speed and capacity enables full characterization of complete RF transceivers, including parasitics, prior to tape-out.
- Performs both small and large signal analysis including DC, Transient, AC, Harmonic Balance, Envelope, Convolution, Noise, Yield, fast Mismatch and Verilog-AMS co-simulation.
- Includes a suite of automation tools to quickly analyze circuit performances and diagnose problematic issues with mixed-signal RFICs earlier in the design cycle.
- Part of Keysight's unique RF-MS IC flow that links the RF system, subsystem and component-level design and analysis as part of a comprehensive design flow.



GoldenGate provides the framework for RF-Mixed Signal (RF-MS) designers to rapidly simulate circuits, verify specs and validate potential yield of complex highly integrated RFICs. Designers can confidently simulate blocks, combinations of blocks and full receive/transmit chains to understand the influences introduced by noise, distortion, parasitics and numerous other effects confronted in modern RF-MS IC design. Additionally, designers can analyze the manufacturability of circuits using industry standard techniques such as Process and Mismatch Monte Carlo as well as unique Keysight statistical mismatch and process analyses.

These tools provide a comprehensive circuit simulation, verification and analysis methodology that has been seamlessly integrated into the Cadence Analog Design Environment. Designers can move smoothly through schematic capture, test bench setup, simulation and analysis to achieve insight into design performance and manufacturability prior to tape out, avoiding costly mistakes and design re-spins.

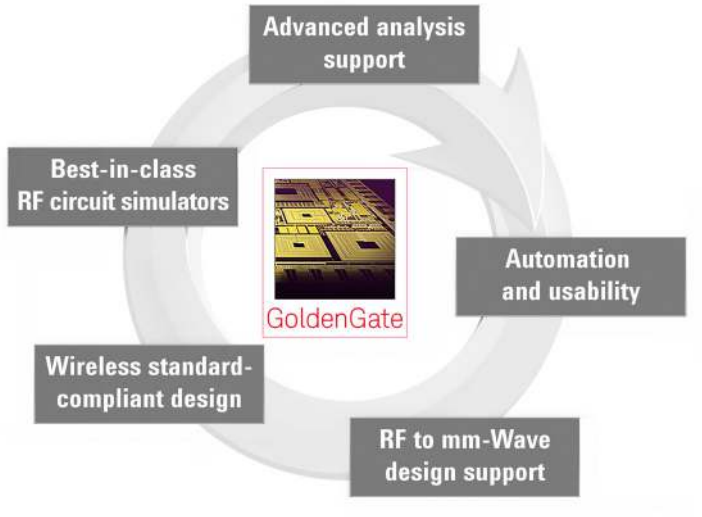


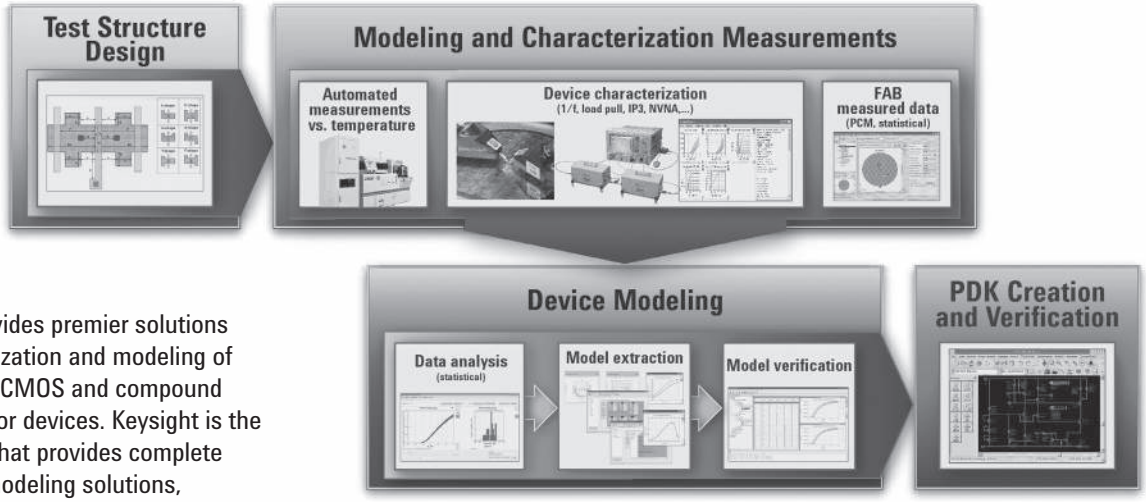
Figure 12. While GoldenGate offers traditional analog simulators, it also goes beyond innovative RF simulation technology to provide a variety of solutions for designing, analyzing and verifying integrated RF circuits.

Comprehensive RFIC Design and Verification Solution

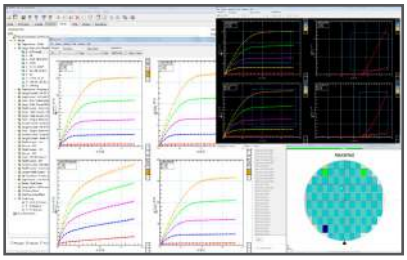
GoldenGate is part of a comprehensive RF-MS IC design flow which originates at design capture and flows seamlessly to prototype test. Designs initially are created in Cadence Virtuoso Schematic Capture. Circuits are then simulated in GoldenGate directly from the schematic, enabling a smooth capture to simulation. Advanced simulation analyses including Carrier, Envelope, Fast Envelope, Noise and Transient can be used in combination with specific tasks such as Load Pull, optimization, parameter sweeping, Monte Carlo/Corners, including Fast Mismatch, provide "real world" view of performance and yield. Simulation results can be viewed using either Cadence results viewer or Keysight's rich set of RF-oriented Data Display capabilities.

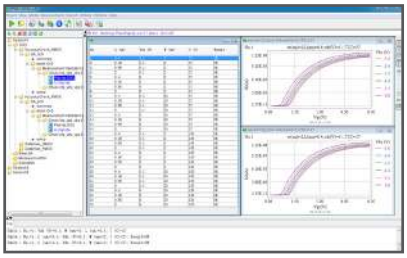
After the IC layout is complete, extracted parasitics can be simulated and performances analyzed with GoldenGate. Additional EM based parasitic and RF passive component modeling is performed using Momentum and EMPro simulators. Co-simulation with the Keysight SystemVue system simulator is used to verify that overall system behavior matches the relevant wireless specification. Final prototype measurements, and additional circuit and device modeling are performed with Keysight test equipment and IC-CAP software.

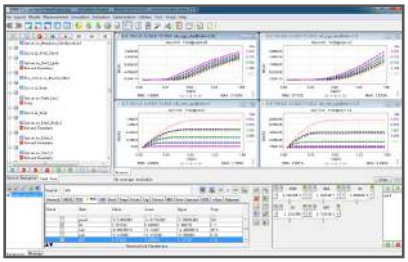
Premier Si/III-V Device Modeling and Characterization Solutions



Keysight provides premier solutions for characterization and modeling of cutting-edge CMOS and compound semiconductor devices. Keysight is the only vendor that provides complete end-to-end modeling solutions, from automated measurements, accurate device model extraction, comprehensive qualification to final process design kit (PDK) validation. Comprehensive modeling services are offered, supported by Keysight's expert engineers and advanced labs.







Integrated Circuit Characterization and Analysis Program (IC-CAP)

IC-CAP is the platform of choice for customers developing their own custom modeling solutions as well as customers modeling compound semiconductor devices. IC-CAP strengths build on its flexibility. IC-CAP user can simulate custom sub-circuits on a variety of commercial simulators, like ADS. IC-CAP allows users to write custom extraction routines, create user interface dialogs and automate extraction flows. IC-CAP gives access to cutting edge model technology for compound semiconductor devices, such as the Keysight HBT model and the Keysight NeuroFET based on neural network technology. Additionally, Keysight's IC-CAP WaferPro software is a fast single and multi-wafer automated measurement solution.

Model Builder Program (MBP)

MBP is a complete silicon turnkey device modeling platform that integrates device simulation, model parameter extraction and optimization. MBP supports all popular compact models including the latest BSIM-CMG, BSIM-IMG, and BSIM6 for DC, AC and RF applications. MBP also supports the macro (subcircuit) model and Verilog-A model.

MBP provides automatic extraction. The open interface enables optimization flow customization, device target definition and the ability to define GUI operations. With its superior optimization technology and advanced features, MBP provides the most comprehensive, accurate and efficient modeling solutions, especially for silicon devices.

Model Quality Assurance (MQA)

MQA is a collection of comprehensive SPICE model validation procedures, interfaces and utilities that provide the ability to thoroughly check SPICE model quality and automate QA and reporting procedures for both silicon and III-V technologies. Given today's deep submicron process technologies and increasing model complexities, validating SPICE models is a significant challenge and can be very time consuming. However, SPICE modeling engineers and model users still want the models to be thoroughly checked and the model characteristics to be easily obtained. MQA satisfies this critical industry requirement by rigorously checking the model quality, plotting model characteristics, and customizing the output targets with its comprehensive checking rules while employing easy-to-use interfaces and utilities.

Genesys — Affordable, High-Performance RF/Microwave Design Software

Key Strengths

- Industry's widest coverage of RF/microwave circuit synthesis capabilities to reduce hours of manual design into minutes.
- RF system architecture and frequency planning simulators with root-cause analysis to catch errors and prevent costly rework downstream.
- Accurate circuit simulators to tune and optimize designs for performance and yield to minimize bench top hardware iterations.
- Fast, high capacity Momentum planar electromagnetic simulator to account for RF board layout effects before RF PCB hardware fabrication.
- Support for X-parameters nonlinear simulation in circuit and system simulation with breakthrough accuracy and convenience.

Lowest Cost of Ownership

- A node-locked license of Genesys including the first year of support and upgrades costs typically 1/3 less than any competing equivalent capabilities in the industry.
- The cost of a perpetual Genesys license is even less than a 1 year rental of many other RF/microwave design tools of lesser capabilities.
- For projects with tight budgets or where cash flow conservation is critical, Genesys is also available as time-based licenses to lower ownership costs further.

Industry's Broadest Coverage RF Circuit Synthesis

Genesys provides the industry's widest coverage of passive and active circuit synthesis capabilities. The following 11 synthesis modules are included in the Genesys Synthesis building block:

- Lumped filters
- Distributed microwave filters
- Narrow/broadband lumped/distributed matching networks
- Transmission lines
- Customized shaped-response filters
- Active filters
- Group-delay equalization networks
- Oscillators
- Phase locked loops
- Signal control couplers, baluns & attenuators
- Mixers

Keysight Genesys is an affordable, high-performance RF and microwave tool specifically created for the RF and microwave circuit board and subsystem designer. Providing the optimal balance of design capabilities and ease-of-use, designers can quickly attain the skill set necessary to operate the tool while realizing unbeatable engineering productivity in the shortest time possible. Genesys is available in six different languages (English, Japanese, Russian, Korean, Chinese simplified, and Chinese traditional), further adding to its ease of learning and enabling global collaboration by engineers and technicians alike.

Genesys is endorsed by an installed base of over 5,000 satisfied RF and microwave designers worldwide, many of whom have been loyal repeat customers over the past 20 years. Genesys is also backed by Keysight's extensive industry wide expertise in RF/microwave design, development and support. As a proven safe investment, it literally pays for itself through cost savings within its first year of deployment. Further protecting the user's investment, as the designer's needs grow beyond RF board applications, Keysight provides a full trade-in credit that can be applied towards the purchase of ADS for designing MMIC and multi-technology RF system-in-package (SIP) modules.

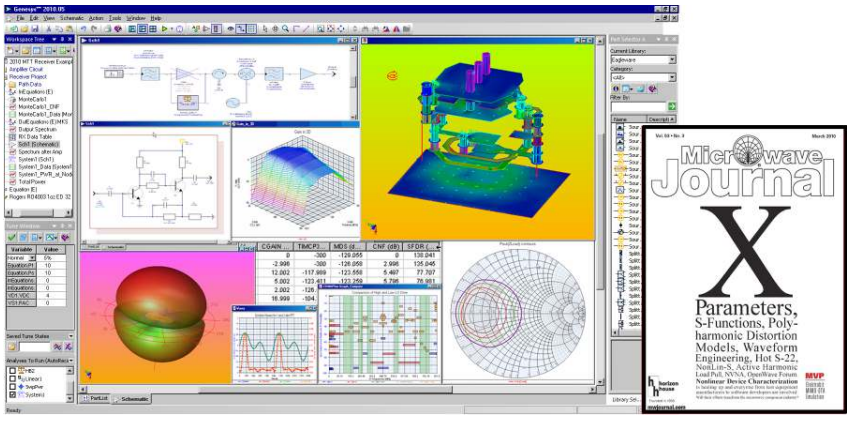


Figure 13. Easy-to-use and easy-to-learn, Genesys is the low-cost, high-performance integrated electronic design automation software for RF/microwave circuit board and subsystem designers.

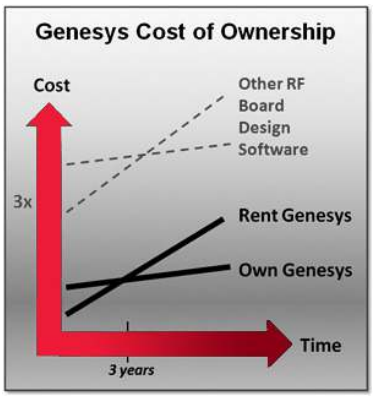


Figure 14. As a proven safe investment with an installed base of 5,000 satisfied designers, Genesys literally pays for itself through cost savings within its first year of deployment.

Training, Support, and Service — When and Where You Need It

Keysight's EEsof EDA products are backed by a world-class team of experienced application and technical support engineers who are dedicated to providing the right software, support, and consulting solutions to increase engineering productivity and long-term success. We offer worldwide, local-language, technical support via the worldwide web, e-mail, telephone and fax.

In addition, our web-based Keysight EEsof EDA Knowledge Center is an around-the-clock resource for comprehensive support information and downloadable examples for all our products. It hosts software updates and has a tracking feature that makes it easy for you to submit and manage support cases and related enhancement requests. The search feature makes it easy to find and sort through available solutions by date, popularity, or user ratings. The Knowledge Center also contains product discussion forums that put you in touch with other users, support engineers, and product developers.

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Our Customer Education group offers a comprehensive set of instructor-led and e-Learning courses designed to quickly enable engineers to apply Keysight EEsof EDA tools to their design challenges. Our instructor-led courses are hands-on for maximum learning, and they are available at Keysight sites around the world or they can be delivered at your site.

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