Product Review

NI AWR Design Environment V14

Accelerating RF/Microwave Design From Concept to Product

Advancing communication and sensor technologies, driven by applications such as 5G, internet of things (IoT), and radar-enabled smart vehicles, are continuing to push component performance requirements as well as size and cost constraints. As a result, designers must develop more capable antennas and RF front-end components, adapting novel designs based on evolving techniques and materials, advanced device integration, and greater exploration of the design space with unique topologies and architectures.

These RF front-end components must meet a range of stringent performance specifications such as improved linearity, lower loss and noise figure, greater efficiency, and more. In turn, designers need to be able to simultaneously optimize numerous circuit parameters and monitor the impact on multiple performance metrics. NI AWR software tools support early conceptual design through detailed design verification, physical realization and manufacturing.

Circuit, system, and electromagnetic (EM) simulation must work seamlessly with design automation to help engineers define and manage complex RF electronics, including chip, package, and board structures. Simulation must accurately predict the response to standards-based signals, and the environment must help engineers create and organize simulation results to gain insight into component behavior. And these capabilities must integrate well with other design tools. These qualities are built into NI AWR Design Environment software, inclusive of Microwave Office, Analog Office, Visual System Simulator™ (VSS), AXIEM, and Analyst™ software, providing a robust and complete platform for RF/microwave engineers to develop these next-generation communication electronics.

The V14 release of NI AWR Design Environment software focuses on all these stages of RF/microwave design with an emphasis on accelerating design starts through powerful network synthesis, enhanced design flow automation for printed circuit board (PCB) and module design, powerful measurement and report management, phased-array antenna system generation, and standards-compliant test benches.

Key Aspects of V14

NI AWR software tackles the design challenges of today's highly-integrated RF/microwave devices within next-generation communications and radar systems such as 5G, IoT, and smart vehicles. As component performance requirements become more stringent due to market demands, designers must deliver novel designs based on greater exploration of the design space.

To meet these challenges, NI AWR Design Environment V14 offers new and enhanced capabilities in design synthesis and automation that guide engineers through early design conceptualization by translating performance requirements into initial designs. Fast and reliable simulation, as well as tuning and optimization, help engineers convert these initial design starts into more detailed RF networks. Powerful data visualization through dynamic data reporting and linked measurements provides a better understanding of how design choices impact performance. And enhanced automation in NI AWR Design Environment software further supports back-end design operations.

Select New/Enhanced Features

Design Environment and Automation

- Advanced report/measurement management
- Simplified power amplifier (PA) measurements

System Simulation

- Phased-array antenna model-generation wizard*
- Enhanced LTE and 5G new radio (NR) libraries
- New spatial channel models

Circuit Simulation

- New network synthesis wizard*
- New tuner (tuning bar)

EM Simulation

- Additional port types of point and internal wave
- Support for conformal structures

Physical Design and Layout

- PCB import wizard* for layout editing
- Enhanced iNet™ intelligent net routing

*Add-on module, additional license cost incurred

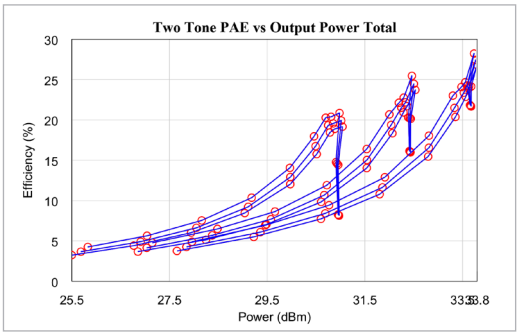
Design Environment and Automation

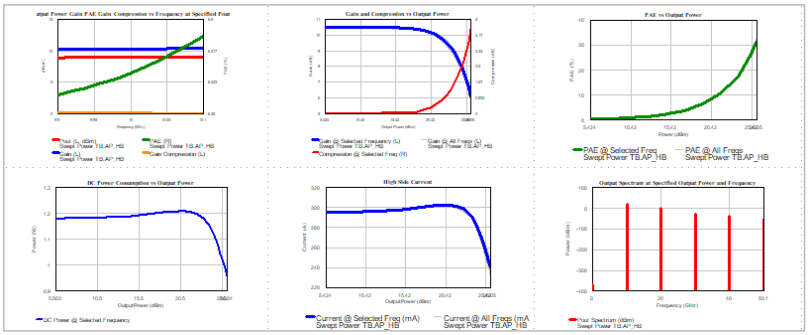
Design flow automation connects simulation models, third-party tools, and layout geometries to PCB, monolithic microwave integrated circuit (MMIC), RFIC, and multi-chip module manufacturing processes, expediting electromagnetic (EM) verification of passive structures and board/package designs and enabling the extracted models to be incorporated into circuit- or system-level analysis. New functionality has also been added to the latest V14 release that assists users with design starts, design entry, analysis/optimization, and report generation, enabling them to manage measurement data sources and parameters from a single location and create sets of linked reports in a single dashboard display.

Enhanced Data Processing and Display

With the growing complexity of component performance specifications, designers often need to track multiple simulation results simultaneously. NI AWR software V14 lets users manage measurement data sources and parameters from a single location, allowing them to create sets of linked reports in a single dashboard display. Variables can be used to define and control groups of measurement parameters together.

Users can now combine measurement variables, document sets that create a symbolic link of one or more simulation documents that can be used by measurements, and embedded plots within the new window-in-windows feature together in an output equation document. This document can be used to create a dynamic data display that automatically updates graphs and embedded windows with a single mouse click. For PA designers, new capabilities allow users to directly plot measurements versus output power (or voltage or current) and/or define the output power measurement on the schematic more easily.



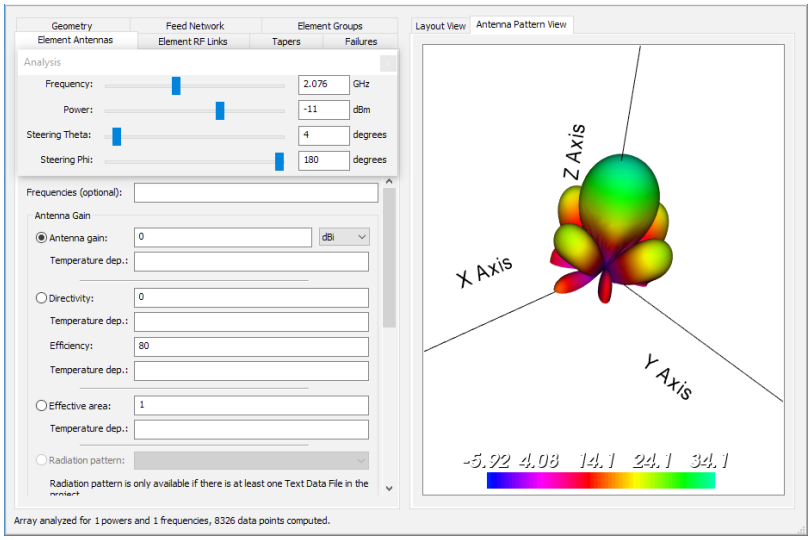


System Simulation

Phased-Array Generator Wizard

The newly-enhanced phased array generator wizard lets users interactively design phased-array antenna systems and then generate schematics or system diagrams that represent the design in a format that is suitable for further analysis. Users can easily define the array geometry (configuration), feed structures, gain tapers, and characteristics of individual elements and their respective RF links.

The array response is immediately displayed and reflects any changes due to the operating signal power level, beam steering, or element failures. Once the design is complete, the wizard generates a system diagram implementation that can be further analyzed in VSS software or be incorporated into a larger, complete VSS communication system. It can also generate schematics/layouts that may be used for full EM analysis with AXIEM or Analyst simulators or third-party EM tools such as ANSYS HFSS.



Phased-Array Antenna Design Flow

- VSS Software: Third Generation Partnership Project (3GPP) spatial channel models support accurate end-to-end link analysis for determining antenna requirements.
- AntSyn™ Software: Synthesizes optimal individual antenna elements based on performance requirements and size constraints and exports the physical design to an EM simulator.
- AXIEM and Analyst Simulators: Perform EM verification and generate far-field radiation data in a format ready for use with the phased-array generator wizard.
- Phased-Array Generator Wizard: Reads simulated radiation patterns during optimization of the configuration and feed network. EM structures (physical attributes) can be inserted for each element during array generation of circuit data.

5G

The updated VSS model library offers data encoding/decoding and signal generation/analysis for the latest 5G NR specifications. With new VSS projects that support LTE, 5G TX and RX, and narrowband IoT (NB-IoT) standards-compliant signals and test benches, engineers can simulate systems or perform measurements on components based on the corresponding specifications. VSS V14 supports an NB-IoT uplink coexistence RX test bench, an NB IoT uplink enriched narrowband (eNB) RX test bench in the guard band of an LTE signal, and an in-band uplink eNB RX test bench. Component designers and system architects can use the default configurations to perform what-if analyses or modify them as needed. It also adds new data encoding and decoding capabilities for LTE, NR, and DVB-S2, including support for various low-density parity check (LDPC) codes.

Multiple-in-multiple-out (MIMO) and beam-steering phased-array antennas are enabling technologies for achieving the over-the-air spatial efficiency called for by 5G and emerging radar applications such as self-driving cars. In addition to the enhanced phased-array generator wizard, new standards-compliant WINNER II and 5G spatial channel models are available as an add on-module. This module provides highly-accurate modeling of channel-specific propagation effects that support more realistic link-budget analysis for rapid validation of end-to-end system performance and specification of individual component requirements.

Circuit Simulation

Network Synthesis Wizard

The new network synthesis wizard is a tool for creating optimized two-port impedance-matching networks composed of discrete and distributed components. The user specifies the maximum number of sections and the types of components to include in the search space. Using the evolutionary algorithms employed within AntSyn antenna design and synthesis software, the network synthesis wizard searches for the best circuit typologies and optimizes the component parameter values.

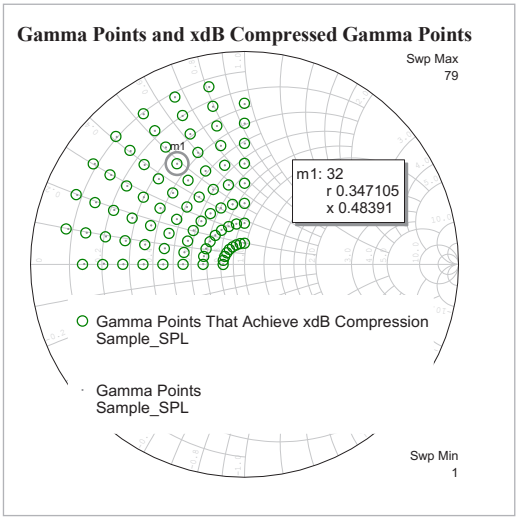
The network synthesis user interface lets designers interactively develop an unlimited number of networks optimized for noise, power, or matching networks between amplifier stages or between different components, such as an amplifier and an antenna. The optimum reflection coefficients are specified over frequency and can be provided in the form of load-pull data, network-parameter data files, or circuit schematics. On the synthesis definition tab, users can specify a default impedance or the impedance of the desired source/load network, as well as the desired match frequencies.

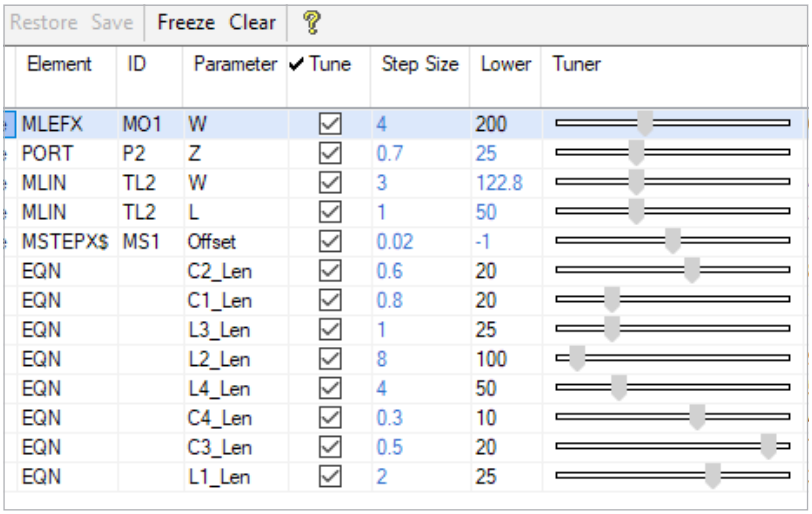
PA Design Flow

- Load Pull: Simulate or import measured load-pull data and use the built-in measurements to understand the performance impacts of load or source impedances on a device.
- Network Synthesis: Generate impedance-matching structures in Microwave Office software.
- Harmonic Balance Simulation: Look at steady-state nonlinear behavior with harmonic balance. Measure gain, output power, efficiency, or other performance metrics, including the latest modulated signals, to verify system-level performance metrics such as adjacent-channel power ratio (ACPR).
- EM Analysis: Characterize the electrical behavior of the metalized structures in the PA. Analyze 3D planar metal structures with the AXIEM simulator or use the Analyst simulator to simulate fully-arbitrary 3D structures.

Expanded Tuning

NI AWR software V14 offers significant new functionality to help guide designers developing circuit-level components—from generating circuit topologies that achieve specified performance goals to interactively optimizing element parameter values to improve overall circuit behavior. The new tuner interface utilizes space-efficient horizontal sliders to support parametric tuning of complex designs with a large number of variable design properties, while the updated property dialog provides greater control and organization of element parameters.





EM Simulation and Modeling

Faster EM

The AXIEM and Analyst EM simulators use Maxwell's equations to compute the electrical behavior of a structure from its physical geometry. The AXIEM simulator provides responses for 3D planar structures such as transmission lines, spiral inductors, and metal-insulator-metal (MIM) capacitors, whereas the Analyst simulator addresses 3D objects such as wire bonds, ball grids, finite substrates, and 3D horn antennas. Multiple NI AWR software V14 improvements address EM analysis and supporting design flows with enhanced layout editing, new EM-port types and faster, more powerful solver technology. Additionally, the new planar body wrapping feature supports modeling and EM analysis of conformal structures such as embedded antennas found in consumer electronics and mobile and IoT devices.

Expanded Port Types

New port technology helps design engineers characterize substrates more effectively. 3D EM internal wave ports support characterization of complex MMIC and RFIC structures with excitation ports that are not located on a defined simulation boundary. For PCB modeling new features support, port points allow exact placement of surface-mount components, frequency-dependent materials, and the ability to solve inside metal structures, providing users with greater accuracy.

Physical Design and Layout

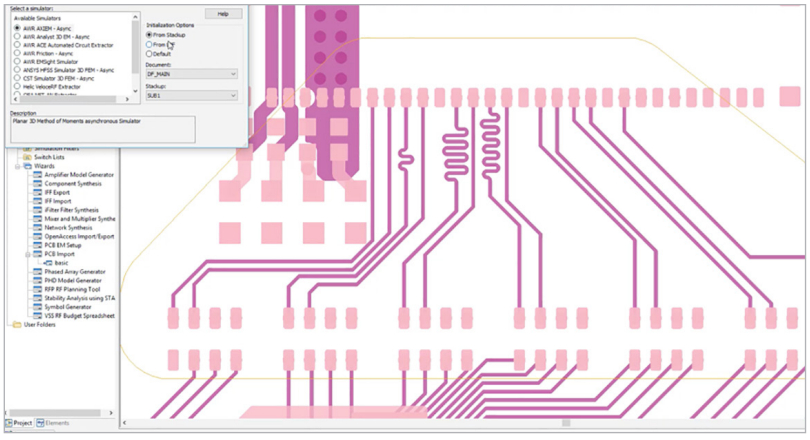
PCB Import Wizard

New functionality added to the PCB import wizard accelerates EM verification of designs created in board layout tools from leading CAD vendors such as Cadence, Zuken, and Mentor Graphics with powerful geometry selection and editing capabilities. RF design engineers can easily isolate areas of interest with powerful net and area selection for faster, more reliable EM analysis and optimization. Broadband S-parameters can be extracted for critical traces and densely-populated circuit boards, where unintended coupling and parasitics can be detected and addressed before they cause design failures.

The powerful new editing capabilities within NI AWR software V14 enable RF designers to easily set up complex imported PCB designs for analysis in the AXIEM or Analyst simulator. The new smart editing tool lets users interactively isolate board sections and multi-layer traces and vias, automatically define unlimited EM ports from the imported data, generate an EM structure with schematic view for surface mount component insertion, and more.

PCB EM Verification Flow

- PCB Wizard: Imported PCB data is read directly from industry-standard IPC2581 or ODB ++ files. Proprietary data formats are used to exchange PCB design information between design and manufacturing and design tools from different EDA/CAD vendors
- Design Clean-Up: The specific trace(s)/area can be selected, or further geometries can be cleaned up with shape preprocessing.
- EM Structure Generation: EM structures can be generated for analysis.



Net Routing

Lastly, enhanced iNet functionality with improved trace routing addresses the need for rapid EM modeling and analysis of advanced modules, MMICs, and PCBs utilizing heterogeneous structures and dense networks of high-frequency interconnects.

Conclusion

The NI AWR Design Environment V14 platform provides new and enhanced innovative solutions in design automation and simulation technology for the advancement of high-frequency electronic products serving the communication and aerospace/defense industries. As component requirements for these applications drive advances in semiconductor, PCB, and multi-chip module integration, NI AWR software offers powerful enhancements in design flow automation and greater speed and accuracy for its system, circuit, and EM simulation technologies. These new solutions enable device manufacturers and system integrators to meet challenging performance, size, and cost metrics, as well as time-to-market goals.

For more detail, refer to the what's new documentation.

Try AWR

Try NI AWR Design Environment software today and see for yourself how easy and effective it is to streamline your design process, improve end-product performance, and accelerate time to market for MMICs, RFICs, RF PCBs, microwave modules, antennas, communication systems, radar systems, and more.
Download your trial at awrcorp.com/tryawr