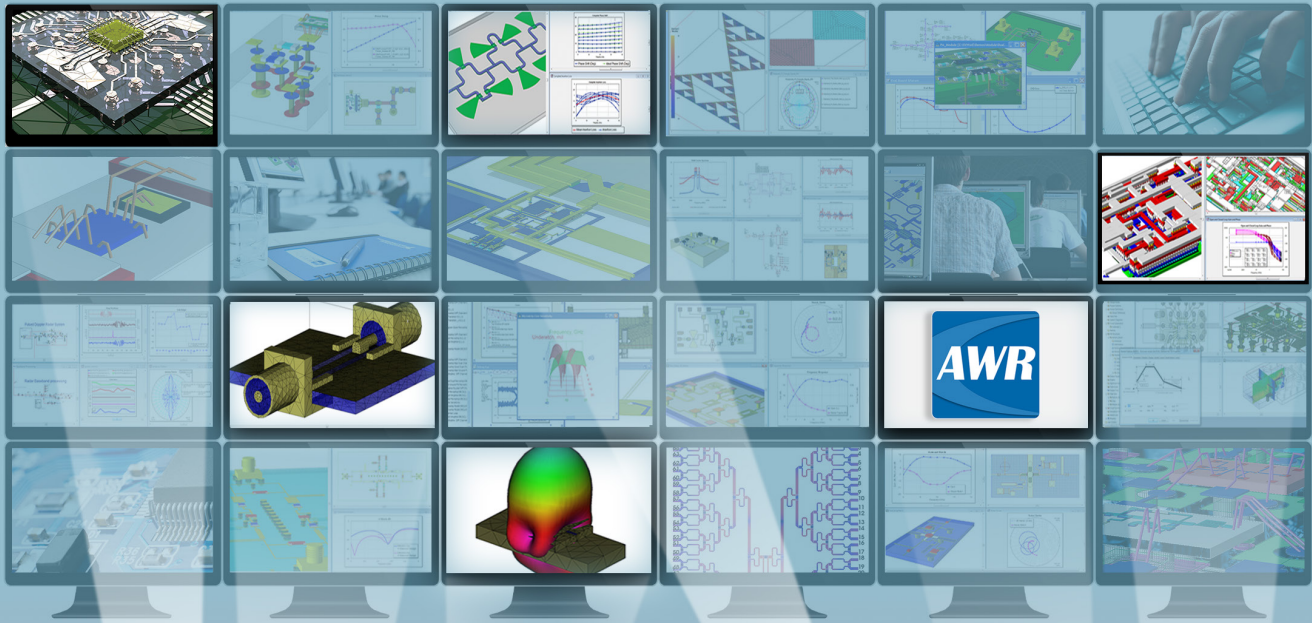


AWR Design Magazine

Vol.7.0



Hot Technologies
Under the Sun

AWR Design Forum 2015
Customer Successes

NI AWR Design
Environment
V12 - Now Playing

Phased Arrays with
Visual System Simulator

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 **NATIONAL
INSTRUMENTS™**

Hot Technologies Under the Sun



Hot Technologies Under the Sun: 5G, Wearables, IoT, and more

I'm not talking about global warming here but rather the coming together of the microwave/RF community in the desert city of Phoenix, Arizona for IMS 2015. What will be way hotter than the weather is the meeting of the minds to discuss, explore, challenge, and collaborate on this industry that is driving the advancement of the wireless revolution.

Trending themes at IMS2015 include: 5G, wearables, Internet of Things (IoT), and more...

As a very active participant at IMS, NI has hot technologies on display under the sunshine in Phoenix too! First one up is V12 NI AWR Design Environment™ software that's being previewed at the show. This high-frequency EDA software has been a hot topic for more than a decade now with its ease of use and emphasis on empowering the productivity of users—so no doubt the additional V12 features for amplifier and antenna designers, as well as ease-

of-use and speed enhancements, will delight all of our users. Read on to learn more about these new features that are coming to a desktop near you.

5G continues to be a hot topic and NI is in hot pursuit of ensuring our platforms (software and hardware) are what feeds our insatiable appetite for more and more wireless content (audio, video, data). Specific to NI AWR software, Visual System Simulator™ (VSS) shares IP libraries with LabVIEW/LabVIEW Communications for a more streamlined flow from design to prototype to test of current and emerging wireless standards. Additionally, VSS now supports phased array antennas that are key to emerging wireless communications. Learn more about this specific capability within VSS on the following pages too.

Wearables, IoT, and more are hot technologies that serve to connect everything to everyone... antennas (yes), greater bandwidth (yes), higher frequencies (yes)... whatever the design

challenge being posed, NI AWR software (Microwave Office, VSS, AXIEM, and Analyst™) will enable you to meet it. If we don't address it fully within NI AWR Design Environment, our AWR Connected™ family of products that provide an eco-system of tools for customers to use surely will.

Stop by our booth, visit our website (ni.com/awr), continue to read on through the pages of this magazine, or simply engage in a dialogue with us to explore what hot technology you are developing and how we can assist!

Best regards,

*Sherry Hess
VP Marketing,
AWR Group, NI*





Learn. Network. Collaborate

AWR Design Forum 2015

Celebrating its fifth year, the AWR Design Forum (ADF) is an open forum that brings together NI AWR software customers, partners, and microwave/RF engineering professionals to learn, network, and collaborate on the design of today's microwave and RF circuits and systems.

This free-to-attend event travels the globe to bring NI AWR software experts to demonstrate the latest design technologies and encourage dialogue and the exchange of technical ideas around the design challenges you face.

Highlights

- Technical presentations featuring NI AWR Design Environment
- Select customer and keynote presentations
- Live demo exhibition area

Locations

Asia

- Tokyo, Japan - July 10, 2015
- Korea - September 9, 2015
- Chengdu, China - September 16, 2015
- Nanjing, China - September 18, 2015
- Hsinchu, Taiwan - September 22, 2015

Europe

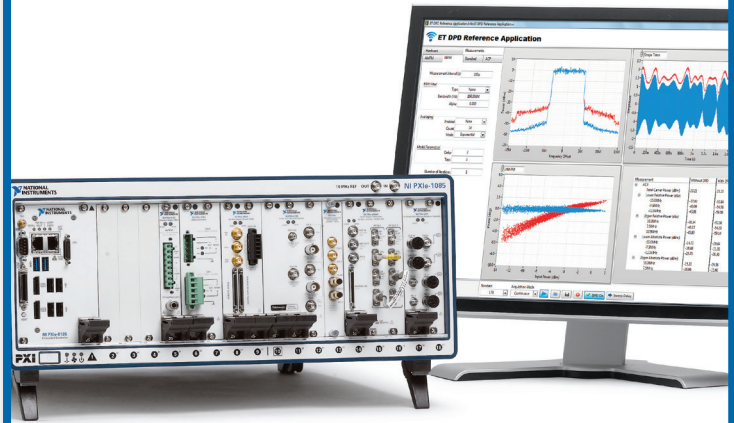
- Moscow, Russia - May 26, 2015
- St. Petersburg, Russia - May 28, 2015
- Tel Aviv, Israel - June 10, 2015
- Paris, France - September 8, 2015 (EuMW)

North America

- Locations and dates have not yet been announced

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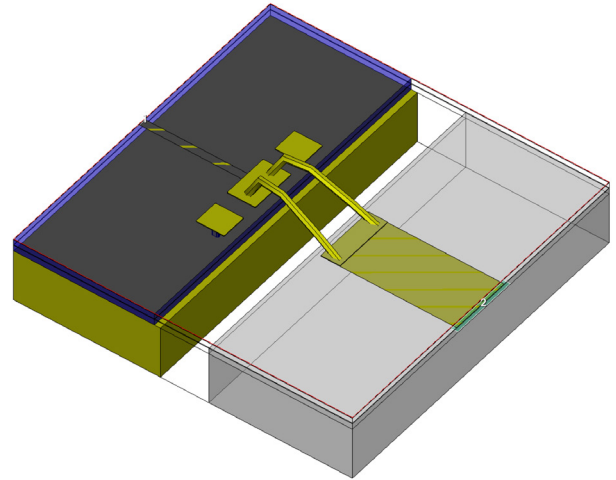


MACOM Designs Ka-Band MMIC Power Amplifier With NI AWR Design Environment

MACOMTM
Partners from RF to Light

The Design Challenge

MACOM designers were developing a high-frequency, four-stage, MMIC design that required extensive EM simulation at a relatively early stage in the design process. A large signal simulation of an extensive array of saturated transistor cells with good convergence in a reasonable time was called for. In particular, a 3D EM simulation of the RF bond wire transition was needed, as well as a 2.5D (3D planar) EM simulation of the IC elements and a full large-signal simulation and optimization of the power amplifier (PA). Foundry models available for the 0.15 μm GaAs process were used for the initial idealized design. Specific design requirements included a competitive size with frequency range of 32 to 38 GHz, Pout greater than 4 W, 18 dB gain fully matched to 50 ohms, continuous wave (CW) and pulsed operation, and on-chip decoupling and electrostatic discharge protection.



3D Analyst layout view showing bond wires.

“NI AWR Design Environment provides a one-stop shop for the entire design phase, from circuit design and EM simulation through to layout and reticle design. The integrated nature reduces the risk of errors in a costly MMIC process and provides an excellent platform for managing and reporting on all aspects of the design.”

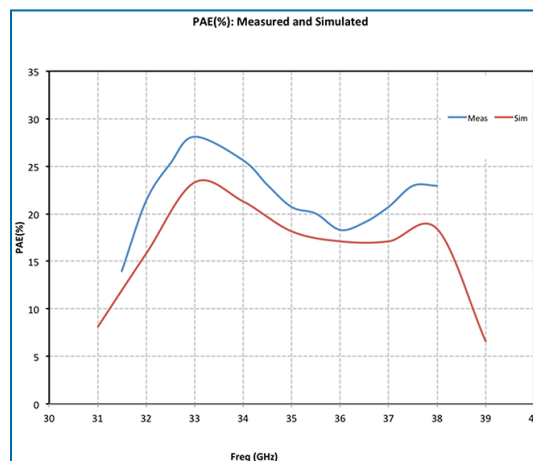
Thomas Young, Senior Design Engineer, MACOM, macom.com



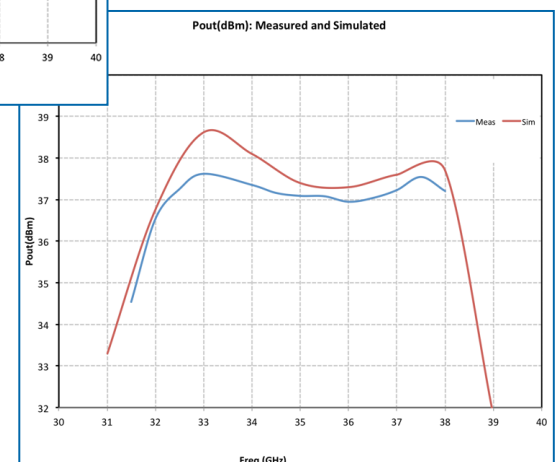
The Solution

MACOM designers used NI AWR Design Environment software, inclusive of Microwave Office circuit design software, AXIEM 3D planar EM simulator, Analyst 3D FEM simulator, and APLAC harmonic balance (HB) simulator, to successfully design and simulate the 4 W Ka-band PA using a 2 mil thick 0.15 μm GaAs pHEMT process. The designers achieved saturated output power in excess of 4 W over the full 32-38 GHz bandwidth, with gain of 19 dB and power-added efficiency (PAE) in the region of 23 percent.

Excellent performance was verified under both CW and pulsed conditions. The results justified the design approach in terms of device modeling, circuit design, EM simulation, and even thermal considerations.



Measured versus simulated for PAE and Pout.



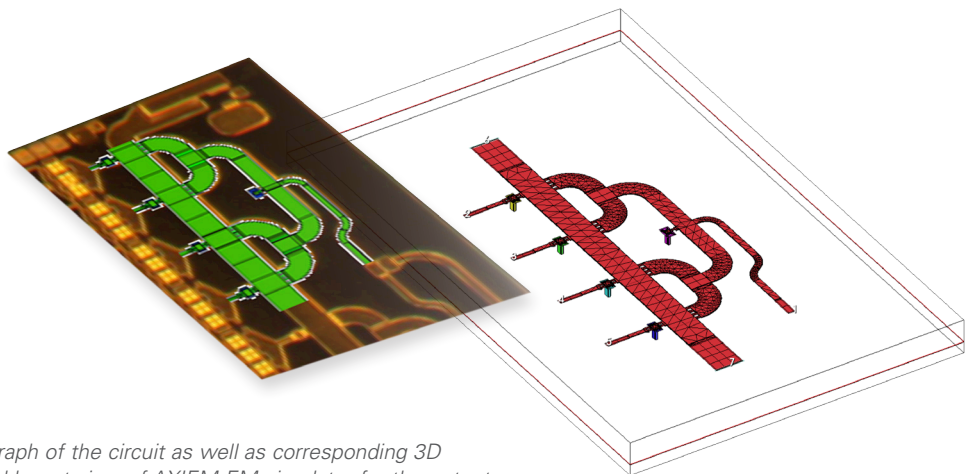
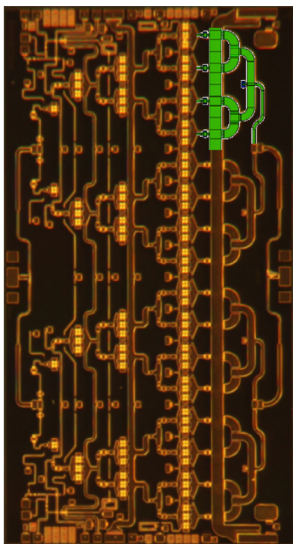


The MACOM's 4W Ka-Band MMIC power amplifier is suitable for point-to-point microwave link applications as well as radars.

Why NI AWR Design Environment?

The MACOM designers chose NI AWR software because of their familiarity with the tool and its intuitive user interface, including high-quality layout. The key benefit was excellent correlation between the simulations and measurements.

NI AWR Design Environment delivered higher productivity thanks to its ease of use, integration with third-party tools, and superior technical support.



Photograph of the circuit as well as corresponding 3D meshed layout view of AXIEM EM simulator for the output matching section (green traces in photo).

Thales Alenia Space Dramatically Cuts Design to Production Times with NI AWR Design Environment



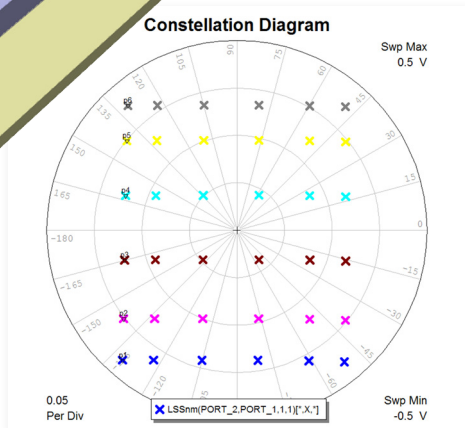
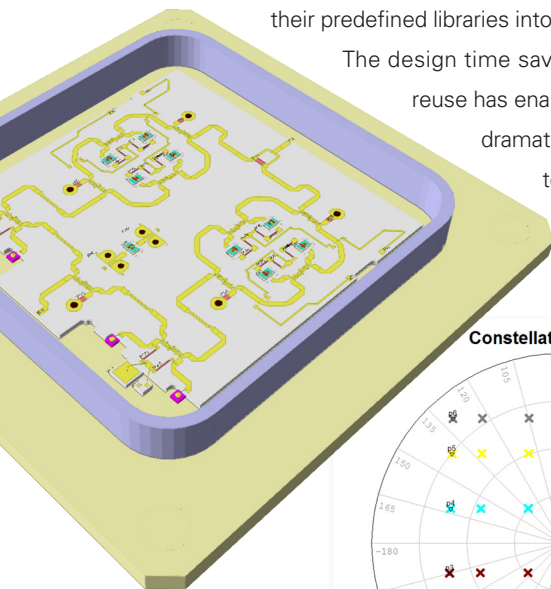
The Design Challenge

Thales Alenia Space (TAS) has more than 40 years of experience in the design, integration, testing, operation, and commissioning of innovative space systems. Because TAS Italy's microwave circuit design process includes input from a number of different sources and must provide outputs to other processes, the team wanted to develop a complete RF/microwave flow that would seamlessly link its process design kits (PDKs) and component libraries to a high-frequency design environment in order to save design time and increase design reuse.

The Solution

TAS designers chose NI AWR Design Environment for this ambitious MIDA (Microwave Integrated Design and Analysis) project because it offers a wide variety of integrated simulation technologies, as well as connections to third-party simulators. TAS successfully developed a complete RF/microwave design flow based on NI AWR software by writing a custom piece of software that links Microwave Office via its comprehensive application programming interface (API) to TAS PDKs and component libraries. This complete design flow enables designers to integrate real components from their predefined libraries into the actual designs.

The design time savings and project reuse has enabled TAS to achieve a dramatic reduction in design-to-production times.



"Microwave Office enabled us to customize NI AWR Design Environment through its comprehensive API to connect with our existing industrial production design flows. Moreover, Microwave Office offers a wide variety of simulation technologies and natively interacts with other available simulators, allowing us to achieve complex designs without ever leaving the same environment. This custom design flow has helped us to achieve a dramatic reduction in design-to-production times and significant increase in project reuse."

*Paolo Valerio Giove and Antonio Salvato,
Microwave Engineers, Thales Alenia Space,
thalesaleniaspace.com*

As a result, TAS engineers have developed a comprehensive component library, covering different part and mounting technologies like chip-and-wire and SMD on MICs, as well as hybrid and LTCC circuits.

Why NI AWR Design Environment?

Without a doubt, the key feature offered by NI AWR Design Environment that enabled TAS to create this design flow was the software's well-developed API, which allowed designers to easily extend its functionalities to connect Microwave Office to different company data sources and to interact with other applications. While the API was certainly key, there are several motivating factors that positively impacted our decision to choose NI AWR Design Environment:

1. The ability to extend and integrate capabilities through an API.
2. The ability to mix electrical models/sub-circuits with EM documents within a single circuit, while keeping a synchronized layout view.
3. The EM extraction capability, which allowed seamless EM simulation of critical components/parts of the circuits.
4. The ability to use EM simulators from other vendors, if needed, directly from within NI AWR Design Environment software.

3D layout of hybrid coupler within Microwave Office and constellation pattern at 26 GHz.

Phil Jobson Consulting Designs UHF Cavity- Based Helical Resonator Bandpass Filters with NI AWR Software



“Being able to create tightly integrated, reusable parameterized 3D EM building blocks in the Microwave Office simulation environment has changed the way I design high-performance RF/microwave circuitry. I am able to solve problems and create solutions for new challenges with a confidence, efficiency, and effectiveness that I had only dreamed of in the past.”

Phil Jobson, Founder, Phil Jobson Consulting

The Design Challenge

Phil Jobson Consulting was asked to design a family of low-cost, ultra high-frequency cavity-based helical resonator bandpass filters for the CATV test market that could be combined into a switched filter bank. Cavity-based filter performance is determined entirely by geometry. Even though the devices are tuned, it can be challenging to size all the components such that the tuning elements are effective to meet desired synthesized response. 3D EM geometry creation and simulation for cavity-based filters is generally very time intensive.

The designer wanted to create a complete “synthesis to implementation” process for helical cavity-based bandpass filters in a single, integrated project that could be quickly applied to new designs by changing a small number of key global parameters.

The Solution

The designer used NI AWR Design Environment Microwave Office circuit design software and Analyst 3D EM simulator to capture and automate the entire filter design process within a single

Microwave Office project. The tightly integrated environment enabled a single, simple flow from synthesis to design to verification and then to implementation.

The design and manufacture of the filter presented a number of challenges, as is typical of this type of filter design. First, the filter was designed using ideal elements and traditional filter theory. Optimizations were carried out to get the required response.

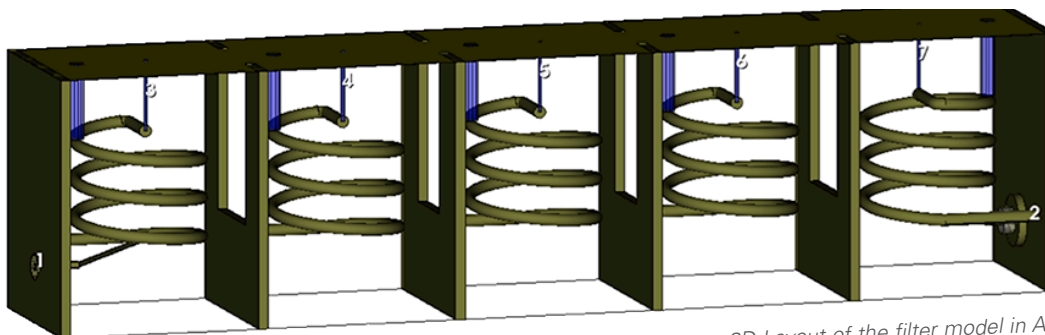
The next challenge was to get the ideal filter response into an actual, physical cascaded, cavity filter topology. Analyst was used for the EM simulation because of its ability to create 3D parts as PCells that can be repeatedly used in the final layout. This made model creation easier, as the steps from individual cavity design to the final five cascaded sections essentially involved connected similar shapes. The shapes were created using parameters so that the actual geometries could be quickly changed without having to redraw the structures in a 3D layout editor. The final filter was created using only three basic 3D components: the cavity with the

coil, the end plates with the coaxial feeds, and the interior separation walls with the coupling slots.

The designer achieved first pass success on three filter designs, despite never having designed cavity-based filters before. His success also yielded at least a 5x reduction in time for 3D EM structure creation of the filter family due to the cascaded building block nature of Analyst 3D finite element method (FEM) EM PCells. He noted that the innovative integration of Analyst is an exceptional feature within NI AWR Design Environment that differentiates it from the competition. Agreement between simulated and measured results was considered excellent. First pass design, construction, and verification of the filters was achieved.

Why NI AWR Design Environment?

Phil Jobson Consulting chose NI AWR Design Environment because he was an early adopter and expected that the integrated environment would fulfill his needs. He has always enjoyed the ease of use, customer care and constant innovation of AWR (now National Instruments).



3D Layout of the filter model in Analyst.

NI AWR Design Environment

V12 - Now Playing



Introduction

The wireless revolution that brought smart phones and wifi-enabled everything to consumers is largely thanks to our community of microwave/RF engineers, as well as NI AWR software. NI AWR Design Environment software – inclusive of Microwave Office, VSS, Analog Office, AXIEM, and Analyst, is what you—microwave and RF engineers—use to design wireless products that range from base stations to smart phones to satellite communications.

NI AWR Design Environment software accelerate the design and product development cycle of high-frequency

ICs and systems found within the aerospace/defense, semiconductor, computer, consumer electronics, and telecommunications markets by reducing the time it takes from concept through to manufacturing. The NI AWR software advantage is simple:

- An intuitive use model that delivers an exceptional user experience
- An open design flow that supports best-in-class third-party tools, resulting in more compelling solutions

Combined, these unique aspects of NI AWR software solutions maximize user productivity – eliminating errors and design redundancies and quickening the pace to market.

Emphasis on User Productivity

With the imminent release of V12 NI AWR Design Environment, we are once again redefining the meaning of user productivity for designers of MMICs, RF PCBs, modules, and more. With the addition of new amplifier, antenna- and radar-specific features, and expanded third-party flows for EM, stability analysis, and improved DRC/LVS, as well as multiple speed and ease-of-use improvements, it's never been easier to streamline your design process, improve end-product performance, and accelerate your time to market.

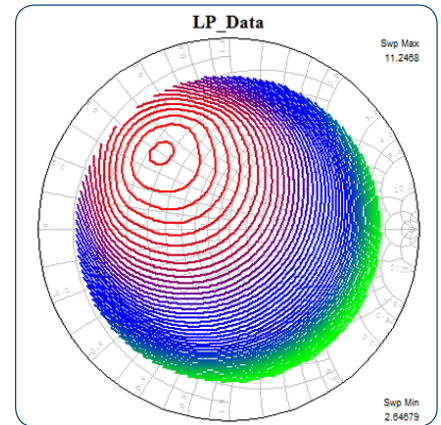
Display NI AWR Design Environment on your desktop today! Stop by the booth #2431 for a demonstration or request your trial copy online at awrcorp.com/tryawr.

User Productivity Highlights

The V12 release boasts numerous new features and usability enhancements, helping designers to focus on their designs rather than driving EDA software. Select highlights of the V12 release include:

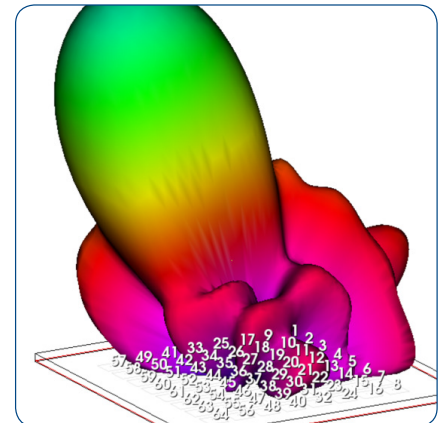
Amplifier Designer

From enhanced load-pull analysis to integrated stability analysis with AWR Connected for AMCAD STAN, plus new support for Maury SPL and CST files and Focus LPD files, it's never been easier to view and analyze swept load-pull data for your next great amplifier design.



Antenna Designer

Design your antenna or arrays of antennas (planar or fully 3D) within AXIEM and Analyst in V12 and you can now see the impact of circuits on antenna patterns with our new in-situ analysis option. Export select data files and then use either the EM simulated results or measurements directly within VSS for further system analysis of structures like phased arrays.

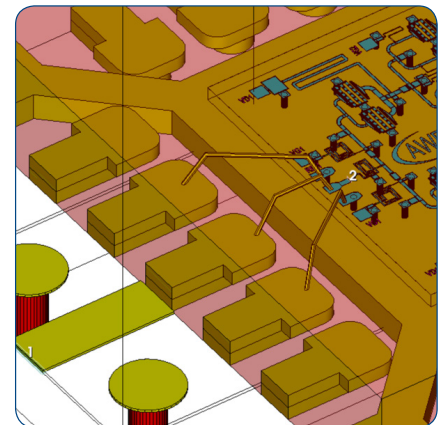


Radar Designer

Take the antenna feature noted above into VSS and combine it with its phased-array models plus co-simulation with LabVIEW and connectivity to NI hardware to empower designers of all types of radar systems with a one-stop concept-to-deployment radar platform.

EM Expertise

A key R&D objective for V12 was streamlining EM analysis. EM set-ups for AXIEM and Analyst have been made easier, and an improved and expanded AWR Connected flow for ANSYS HFSS provides insights more readily to designers looking to explore the impact of EM effects from within circuit designs.



Productivity Gains

New threading, adaptive mesh refinement, and frequency sweep algorithms within Analyst result in faster 3D FEM EM simulations. Coupled with tuning and optimization technique improvements inside APLAC HB engine, designers across the board (pun intended) will see a significant decrease in simulation times.

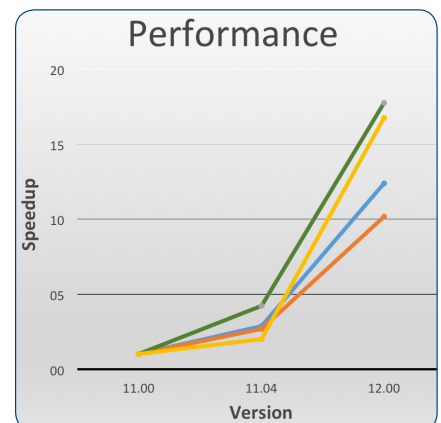
User Voice

We hear you! Whether it comes to editing a schematic or layout, running a faster and more robust DRC/LVS engine by accessing DWT, constructing equations, exposing a ground node within a circuit, or marking up notes on a measurement graph, dozens upon dozens of "user voice" usability features have either been added or enhanced in V12. The full version of what's new documentation details the extent of all improvements and can be found online at awrcorp.com/whatsnew.



And Finally

With the release of V12, a new software icon that installs on your desktop is making its debut.



OneTree Microdevices Designs Ultra-Linear Amplifiers Quickly and Easily Using NI AWR Software

The Design Challenge

As a start-up company, OneTree Microdevices is constantly challenged with saving time and completing designs more quickly. Because it is a small company, the designers typically place a large number of designs on a reticle, which makes it critical that their software tools don't get in the way or slow them down.

The most difficult challenge of designing broadband ultra-linear amplifiers is maintaining extremely high levels of linearity as the amplifier approaches compression. For example, typical OIP3 is 25 dB above P1dB spanning 40 – 1200 MHz and is maintained across a wide range of output powers right up to compression. High data rates today use orthogonal frequency-division multiplexing (OFDM) with high peak-to-average ratios, which places added pressure on active components for good bit-error-rate (BER) performance. At the same time customers demand reduced power consumption and lower cost.

The Solution

OneTree uses NI AWR Design Environment Microwave Office circuit design software for extensive nonlinear design and optimization of broadband amplifiers. Designer Chris Day makes heavy use of the Microwave Office optimizer to gain insights on underlying circuit behavior that he might not have otherwise considered. He likes that the software has a wide range of capabilities, from simulation through layout and design documentation, which enables him to quickly focus on completing design jobs and tape-outs.

Why NI AWR Design Environment?

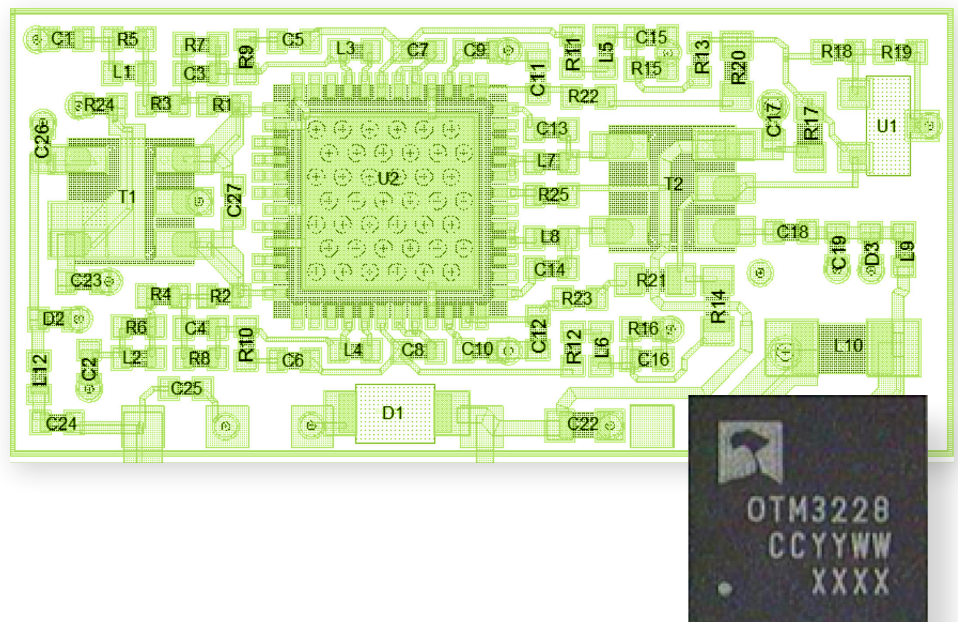
Day has used Microwave Office software since 1997. He immediately liked its ease of use and continues today to appreciate the ease of use and fast learning curve, as well as its nicely integrated solution set (simulations, layout, EM simulation). He also cited the good example files and excellent technical support as key factors in the success of OneTree's amplifier designs.



onetree
microdevices

"We've found NI AWR software to bring a strong combination of integrated tools that help us get our projects done faster. It has extensive capabilities - but it's also a quick learn and easy to use - so engineers can quickly get up to speed. We use it for most everything in our design process - from IC design and layout to PCB design and layout, and through to customer suitable documentation. Over the years we have also found support to be outstanding."

Chris Day, Chairman & CTO, OneTree Microdevices,
onetreemicro.com



AWR Connected Welcomes AMCAD, ANSYS, and DWT

AMCAD

AWR Connected for AMCAD provides access to stability analysis (STAN) software from AMCAD Engineering. Stability can be difficult to achieve in microwave circuits but with the link to STAN from Microwave Office, users are now able to locate and characterize the unwanted oscillations in components such as power amplifiers (PAs).

ANSYS

AWR Connected for ANSYS provides an RF/microwave design flow between Microwave Office and ANSYS HFSS. With this automated design flow, Microwave Office users can quickly call upon HFSS for EM analysis of fields and coupling of 3D layered structures like bumps, bond wires, and pins commonly found within MMICs, densely-populated RF printed circuit boards, and multifunction modules.

DWT

AWR Connected for DWT (Design Workshop Technologies) provides an integrated DRC/LVS flow from within Microwave Office. The DWT DRC module is a full-featured DRC tool capable of complex layout rule checks that can be used as a sign-off tool and DWT LVS module provides designers with an efficient tool for detecting network mismatches occurring in the physical layout of MMIC, PCB, and module designs.



The AWR Connected product family integrates NI AWR Design Environment with third-party software/hardware products to provide breadth and depth solutions for the design of high-frequency products. AWR Connected offerings span application areas such as synthesis, PCB layout, verification, EM, and thermal, as well as test and measurement.

Synthesis

- AMCAD
- AMPSA
- Antenna Magus
- Optenni Lab

PCB Layout

- Cadence
- Mentor Graphics
- Zuken

EM/Thermal

- ANSYS
- CapeSym

Test/Measurement

- Anritsu
- National Instruments
- Rohde & Schwarz

Verification

- DWT

Recent Technical Resources

White Papers

- [Design of Class F Power Amplifiers to Optimize Gain, Efficiency, and Stability](#)
- Understanding S-parameter vs. Equivalent Circuit-Based Models in RF Simulation
- Modeling a Printed VHF Balun Leveraging EM Simulation Techniques
- EDA Software Design Flow Considerations for the RF/Microwave Module Designer
- RF/MWAVE EDA Software Design Flow Considerations for PA MMIC Design
- Understanding and Correctly Predicting Critical Metrics for Wireless RF Links
- VSS Co-Simulates With LabVIEW for Enhanced Signal Processing Capabilities

Application Notes

- [Load-Pull Simulation Supports the Design of Wideband High-Efficiency PAs](#)
- Design and Simulation of a 2.4 GHz/5.6 GHz WLAN Antenna on PCB Technology
- Design and Simulation of an ISM Band Antenna on PCB Technology
- Improving the Second-Harmonic Passband Rejection of Microstrip Side-Coupled Filters
- A Seamless and Efficient Flow for IC and PCB Designers With Cadence Software
- Streamlined Design Flow With HFSS: An RF Module Example
- A 3D Microwave Component Design Example for an Iris-Coupled Waveguide Bandpass Filter
- LTE Small-Cell Base Station Antenna Matched for Maximum Efficiency
- Optimizing a Coaxial Connector to Microstrip Transition

Webinars

- Modern Trends in Broadband Diode Mixers
- Marchand Balun and its Evolution into Modern Microwave Systems
- RF PCB Design, Inclusive of EM Analysis
- Simulating Dynamic Load Modulated Amplifiers
- Practical Antenna Design for Advanced Wireless Products
- Design and Simulation of Modern Radar Systems
- Recent Developments in Continuous Mode RF PA Design

Visit awrcorp.com/solutions/technical-papers for the latest white papers, application notes, and web events/archives.

E-Learning Portal

The NI AWR Design Environment E-Learning Portal gives current customers of NI AWR software the ability to learn more about the powerful tools, technologies, and applications of the software as their time and interest allows. Current modules include:

Microwave Office Overview

- Environment UI
- Hotkeys
- Drawing
- EM Extract

Harmonic Balance

- HB Basics
- Measurements
- 2 Tone Example
- Sweeps/Power
- Mixer Example

Layout

- Introduction
- Drawing Basics
- Import/Export
- Layout Cells

Electromagnetic Simulation (EM1)

- EM Overview
- Project Creation
- Properties/Setup
- Simulation (AXIEM)
- EMSight
- Analyst

Electromagnetic Simulation (EM2)

- Process Creator
- Data Sets
- Shape Modifiers
- EM Extraction

Analyst 3D FEM EM

- Introduction to Analyst
- 3D Cells
- An Example - Coil
- Setup Through Simulation

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Academic Community

Our Philosophy

Our philosophy when it comes to working with students and faculty members at universities worldwide is to first listen and then respond with a proposed solution that meets their needs. To this end, we've initiated several innovative programs such as:

- Software donations to qualified teaching programs.
- Student self-help license creation and software download.
- Graduate gift initiative to award new graduates with free software.
- Professors in Partnership to bring new teaching materials and methods to the academic community.
- Student design competitions and sponsorships to bring forth fresh ideas and fun into the world of microwave/RF engineering.

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Design Phased Arrays with Visual System Simulator

Introduction

Phased-array antenna systems are well known for their radar and aerospace applications. Based on that rich heritage, phased arrays are now seeing greater use in automotive, satellite, public safety, and advanced wireless communications systems. This article highlights how NI AWR Design Environment/Visual System Simulator (VSS) supports the design and analysis of phased arrays and their implementation in a system of antenna elements, power divider/combiners, phase shifters, and other typical components.

Defining Tasks

Phased arrays with hundreds of elements can be simulated in VSS. Configuration of the array hardware can be done interactively using the VSS GUI, entered as equations, or imported as a data file (from EM simulations tools or T&M hardware). Beamforming algorithms involving current taper, phase shift, and geometry may be implemented similarly. A typical implementation will use discrete blocks (Figure 1), including power dividers, attenuators, phase shifters, and amplifiers. Each block contributes to the final definition of gain and relative phase for each antenna element. The entire system can then be analyzed for optimum performance, evaluated for the effects of hardware impairments, and evaluated in a complete end-to-end system.

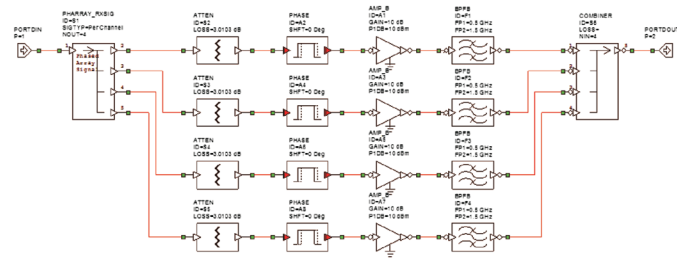


Figure 1. Phased arrays are typically implemented using discrete blocks.

Phased Array Configurations

The antenna designer has a wide range of options within VSS. Array definitions include:

- TX/RX modes and signal distribution method (e.g., power divider)
- Distance units (metric, imperial, or in wavelength, λ)
- Signal frequency (when units are not λ)
- Steering angles
- Angles of incidence
- Gain taper settings
- Array imperfections (if desired)

Standard architectures include rectangular and triangular lattice structure, or a circular geometry with elements in multiple

concentric circles (Figure 2). Custom architectures may be defined by x-y locations, pseudo-random distribution, or as multiple panels of element groups.

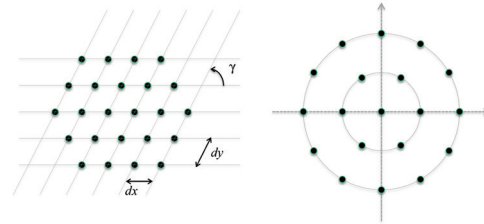


Figure 2. Standard array geometries include rectangular or triangular lattice and concentric circle configurations.

The choice of gain taper affects sidelobe performance. Standard tapers in VSS are a uniform taper, Dolph-Chebyshev for low sidelobe ratio, and Taylor for near-equal sidelobes. User-defined tapers can be used to define gain and phase for each element.

To analyze the performance of the array with imperfections, the user may choose geometry errors (offset from defined x-y locations), gain and phase errors, and failed elements as either a percentage of elements at random or a selection of specific array elements.

RF links for each element can be provided as a configuration file that includes either measured data or the results of design and simulation using external design tools. Typical or individual performance characteristics may be defined for the array elements. VSS can individually characterize the RF link for each element, where an analysis is run once and the results stored in a file, as is done with data from external tools.

Finally, the array is characterized for antenna pattern, array response, half-power bandwidth (HPBW), and other typical parameters. This is done in the Phased Array Test Bench, which supports RF analysis and planning, including system level simulations with modulated signals.

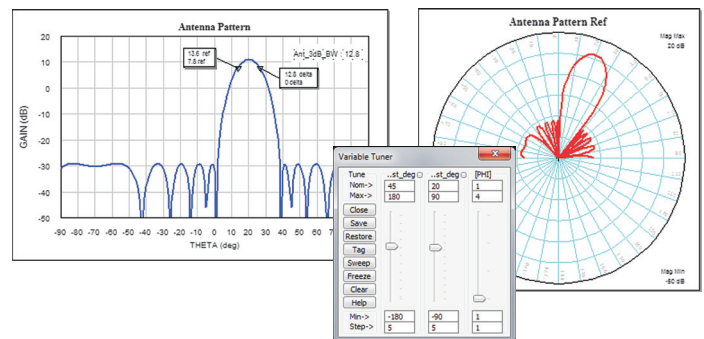


Figure 3. Linear array example: VSS tuner, rectangular and polar pattern plots.

A Few Examples

Linear Array—Figure 3 shows the rectangular and polar pattern plots for a linear array with 16 elements and $\lambda/2$ spacing, $N_x = 16$, $d_x = \lambda/2$. The array uses a Dolph-Chebyshev taper to achieve 40 dB sidelobe ratio, and has steering angles defined as: $\theta = 15^\circ$ and $\phi = 45^\circ$, where θ is the x axis, in line with the elements' linear arrangement. The HPBW of the array is 12.8° .

Planar Array—This example is a rectangular 4×16 element lattice with $\lambda/2$ spacing, $N_x = 16$, $N_y = 4$, $d_x = d_y = \lambda/2$. This array also uses a Dolph-Chebyshev taper for 40 dB sidelobe ratio in the x direction. The layout of the elements and results of the VSS simulation are shown in Figure 4, showing a HPBW of 12.1° .

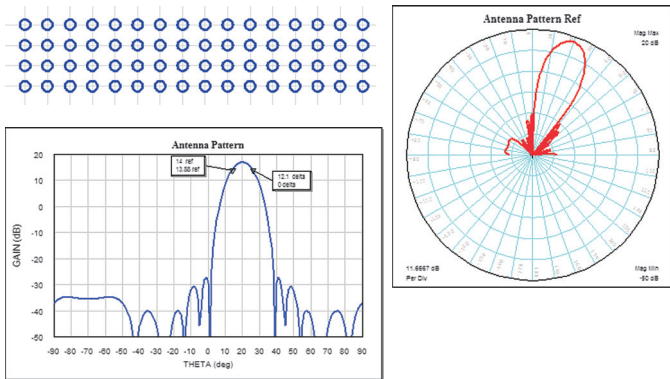


Figure 4. Planar array example: element configuration, rectangular and polar plots.

Circular Array—Figure 5 illustrates three standard circular array configurations in VSS Phased Array, defined in vector notation as: number of elements N_c , radius R , and angular increment θ_0 .

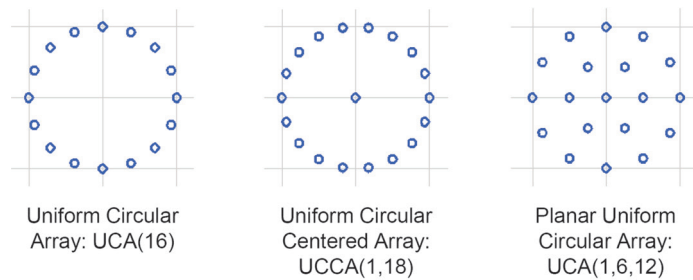


Figure 5. Circular array configuration types.

Analysis of a phased array begins with the antenna patterns and related explorations of current taper algorithms and beam steering. Modification and optimization may be applied to reach the design goals. Once the desired pattern behavior is obtained, the effect of impairments is typically examined to identify the loss of performance in the event of element failure and electronic failure or errors. Figure 6 is an example of element failure analysis in VSS for the linear array example of Figure 3. The plots with 2% and 5% failure rates clearly show the extent of pattern degradation, demonstrated by increased

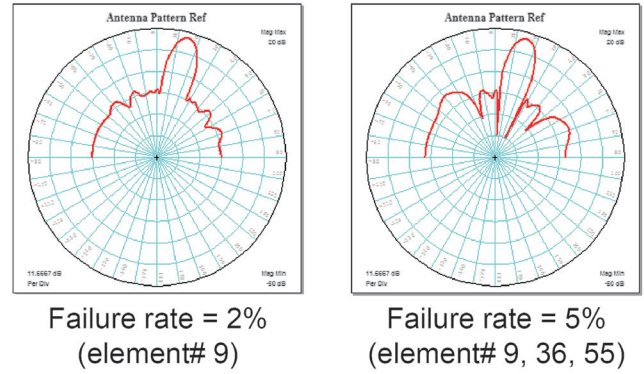


Figure 6. Linear array: element failure analysis results.

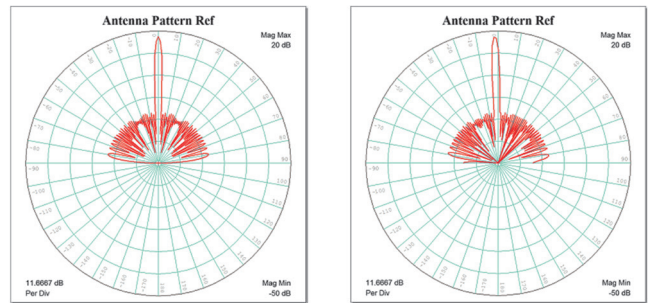


Figure 7. Linear array: 5 degree phase error (signal distribution delay error) results.

sidelobe amplitude. Phase error analysis for the same array is shown in Figure 7, where the applied 5° offsets between elements results in a shift in position of the main lobe, changing the sidelobes, as well.

Summary

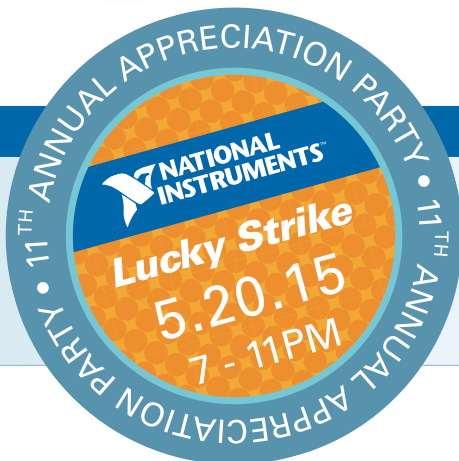
To enhance the capabilities that are already available, V12 of NI AWR Design Environment offers VSS phased-array capabilities that incorporate the following features:

- Improved array steering control, based on feedback and/or control algorithms
- Simplified usage with multiple signals
- Additional element pattern definition for individual or groups of array elements
- Support for modeling mutual coupling between elements
- Enable the use of individual RF link models for each element

These new features give VSS the capability for the design, simulation, and evaluation of very large arrays. Configuration is easy so antenna designers spend less time in setup. With VSS, users can produce designs that match real-world results, including accounting for hardware imperfections. From modeling the RF architecture of a single element to characterization of the whole array, VSS provides antenna designers with a highly capable and easy-to-use tool.

11th Annual Appreciation Party

Join us Wednesday night for food, fun, and friendship



11TH Annual Appreciation Party

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