IVCAD Advanced Measurement & Modeling Software

DATA SHEET / 4T-022

AMCAD Engineering
Advanced Modeling for Computer-Aided Design

IVCAD SOFTWARE SUITE MODULES:
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MT930B – IVCAD Visualization Suite
MT930C – IVCAD Vector-Receiver Load Pull
MT930E – IVCAD IV Curves for Load Pull
MT930F – IVCAD Basic S-Parameters
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**Advanced Measurement & Modeling**

The consolidation of industry players and an overall reduction in acceptable time-to-market has led to a demand for streamlined and efficient measurement and modeling device characterization tools. Maury Microwave, along with strategic partner AMCAD Engineering, have succeeded in this challenge by releasing its IVCAD measurement and modeling device characterization software, the most complete commercial solution to cover the design flow from component to circuit to system.

**Pulsed IV, Pulsed RF and Compact Transistor Modeling (III-V and LDMOS)**

The design flow begins with component-level linear and nonlinear model extraction of popular transistor technologies such as GaN FET and LDMOS. First, IVCAD, in conjunction with a BILT pulsed-IV system and pulsed-network analyzer will measure synchronized pulsed-IV and pulsed S-parameter data under varying gate and drain bias conditions. Specific pulse widths will be set in order to eliminate self-heating and operate the transistor under quasi-isothermal conditions. The quiescent gate and drain voltages will be set to isolate and model gate-lag and drain-lag trapping phenomena. Measurements can be repeated under varying chuck temperatures, varying pulse widths and quiescent bias points, to extract an electrothermal model component.

AMCAD III-V and LDMOS model extraction is performed within the IVCAD platform; the same tool used to record relevant measurements is also used to extract the complete compact model. The measured S-parameters are used to extract a linear model consisting of extrinsic (pad capacitances, port metallization inductances, port ohmic resistances) and intrinsic parameters (channel capacitances, ohmic resistances, mutual inductance, output capacitance and resistance). Synchronized pulsed IV and pulsed S-parameter are used to extract nonlinear capacitances, voltage controlled output current source, diodes, breakdown generator, thermal and trapping circuits.

**Vector-Receiver (VNA-Based, Real-Time) Load Pull**

Load pull involves varying the load impedance presented to a device-under-test (DUT) at one or more frequencies and measuring its performance, including output power at AMCAD III-V and LDMOS model extraction is performed within the IVCAD platform; the same tool used to record relevant measurements is also used to extract the complete compact model. The measured S-parameters are used to extract a linear model consisting of extrinsic (pad capacitances, port metallization inductances, port ohmic resistances) and intrinsic parameters (channel capacitances, ohmic resistances, mutual inductance, output capacitance and resistance). Synchronized pulsed IV and pulsed S-parameter are used to extract nonlinear capacitances, voltage controlled output current source, diodes, breakdown generator, thermal and trapping circuits.

Once a nonlinear compact model has been extracted, load pull can be used for model refinement by adjusting nonlinear parameters to better match the nonlinear measurements. Load pull can also be used for model validation by overlaying simulated and measured transistor performance as a function of load impedance presented to the transistor.

IVCAD supports multiple forms of vector-receiver (VNA-based, real-time) load pull including CW and pulsed-CW single-tone and two-tone input signals, fundamental and harmonic impedance control on the source and load, passive, active and hybrid-active impedance generation techniques, time-domain waveform NVNA load pull, under DC and pulsed bias stimulus.

Passive load pull allows engineers to use mechanical impedance tuners to vary the source and load impedance presented to the DUT. Passive load pull is available at the fundamental and harmonic frequencies.
Active load pull replaces passive tuners at one or more frequencies with “active tuners”, which use a magnitude and phase controllable source to inject power into the output of the DUT, thereby creating the “reflection” signal needed to vary the impedance presented. Active load pull overcomes the mechanical and VSWR challenges presented by harmonic passive tuners, as well as tuning isolation challenges between the different frequencies related to the combined movement of the tuner’s slugs. Hybrid-active load pull combines the strengths of active and passive load pull, allowing the passive tuner to act as a prematch, to lower the power required by the “active tuner”, and divide-and-conquer multiple frequencies.

Time-domain NVNA load pull allows for the recording of voltage and current waveforms and load lines in addition to the typical measurement parameters. This additional information can be useful in studying the sensitivity of a transistor as well as class of operation. Synchronized pulsed-RF pulsed-bias load pull uses the BILT PIV system to bias the DUT for a true pulsed measurement. Pulsing the bias can set the thermal state of the transistor and avoid self-heating. It is also useful to MMIC applications in which the bias will be pulsed.

**Behavioral Modeling**

Behavioral modeling is a “black-box” modeling technique which models the DUT’s response to a specific set of stimuli (input power, bias, impedance...). Compared with compact models which completely define the characteristics of the transistor, behavioral models define only the “behavior” and static models are valid under the conditions in which they were extracted. Behavioral models are useful in several applications: to hide the details of the transistor specifics while concentrating on its performance and response (ideal for public distribution), to improve the speed of simulation (behavioral models will generally simulate faster than a compact model containing the same data), to model a packaged component, or even a complete circuit or system (incompatible with compact modeling).

IVCAD supports three behavioral modeling methodologies: Keysight’s X-Parameters and AMCAD’s Multi-Harmonic Volterra (MHV) and Enhanced PHD. X-Parameters are the result of poly-harmonic distortion methodology (harmonic superposition) which uses harmonic extraction tones to quantify the harmonic nonlinearities of a DUT. The MHV modeling technique is based on harmonic superposition combined with dynamic Volterra theory resulting in a model that can handle both low frequency and high frequency memory effects. The strength of MHV modeling is that it enables accurate and reliable simulations in commercial RF circuit or system simulators, even when using complex modulated wideband signals. Thanks to this accuracy, the most important figures of merit of RF systems can be analyzed safely (e.g., EVM, ACPR, IM3, etc.).

Enhanced PHD (EPHD) is ideal for behavioral modeling of amplifiers in which extrapolation of loading conditions may be required beyond those used in the modeling extraction process. Behavioral modeling within IVCAD is transparent to the user. Sweep plans (impedances, power, bias...) are defined and the measurement is run as normal, however the software will communicate with the relevant model extraction application and present a completed model upon completion of the measurement routine.

**Stability Analysis of Circuits**

Once an amplifier or integrated circuit has been designed on a circuit simulator, it is critical to test the design for low- and high-frequency oscillations. IVCAD offers a Stability Analysis module (STAN) which is compatible with commercial circuit simulation tools. Single-node and multi-node analysis identifies the cause and localization of oscillations. Parametric analysis determines oscillations as a function of varying input power, bias, load impedance and stabilization network parameters (resistance values). Monte Carlo analysis discovers oscillations as a function of manufacturing dispersions and tolerances.

Whether being used for a single purpose or across multiple modeling, design and production groups, IVCAD measurement and modeling device characterization software suite offers an intuitive, methodical and efficient solution for first-pass design success and quickest time to market.
MT930B IVCAD Visualization Suite

IVCAD offers a modern and intuitive visualization package for IV, S-Parameters and Load Pull data.

> S-parameters can be viewed in standard and custom formats
> Stability circles, constant operating and available gain circles are optionally plotted on source and load
> Basic load pull visualization allows the plotting of power sweeps or impedance curves with capability of filtering measurement results.
> Extended load pull visualization plots power sweeps and impedance contours simultaneously, where contours are redrawn as the user-defined input/output/source power is changed. Multiple parameters, including frequency, can be viewed on the same Smith Chart. Graphing can be performed in 2D or 3D.
> Advanced filtering allows multiple definitions to be entered in order to limit the measured impedances to those that meet specific criteria.

Using the dockable window functionalities, it’s possible to create custom IVCAD environments. Using the template functionalities, users can create, customize and record their preferred visualization formats. Thanks to the Data Editor, using the data contained in the measurement files, specific equations can be created and the corresponding results will be uploaded into the different viewers. Visualization is compatible with Maury Microwave and third-party load pull data formats.
MT930C IVCAD Vector-Receiver Load Pull

IVCAD offers a modern, efficient methodology for load pull measurements, with low-loss couplers between the tuners and DUT. Connecting the couplers to a VNA allows real-time measurement of a- and b-waves at the DUT reference plane, presenting vector information not normally made available. IVCAD measures the actual impedances presented to the DUT without assumptions of pre-characterized tuner positioning or losses. Extremely accurate transistor’s input impedance derived from the a- and b-waves results in properly-defined delivered input power, true power added efficiency and true power gain measurements. Output powers at each frequency, fundamental and multiple harmonics, are made available as are multi-tone carrier and intermodulation powers.

Key Features:

> CW or Pulsed Measurements
> Fundamental or Harmonic Impedance Control
> Single-Tone or Multi-Tone Injection
> DC or Pulsed Bias
> Full Vector Parameters
> Time Domain Waveform Reconstruction
> Real-Time Contouring of Measured Data
> Interactive Bias Control
> Model Validation and Refinement
> Export Data to CSV or MDIF

Impedance Sweep at Fixed Power

Power Sweep at Multiple Impedances
Advanced Sweep Plan – by performing power sweeps at multiple impedances, sufficient data is gathered that target parameters can be changed post-measurement without the need for additional measurement iterations. The same data set can be used to plot selected parameters at a constant input power, parameters at a constant output power, and parameters at constant compression level. This process greatly reduces total measurement time by gathering sufficient data first-pass, and shifting capabilities towards data visualization and analysis. Sweep parameters include DUT biasing, probe map, impedance sweep, frequency sweep, and power sweep. Advanced capabilities include changing setup File, measurement configuration, output File During Sweep and stop conditions throughout the plan, as well as adding nestable loops, wait times and messages.

Source Impedance Matching – Large signal input impedance can be found by measuring DUT a- and b-waves at the DUT reference plane. A patented technique simulates source matching, without varying the source impedance. Even under extremely mismatched conditions this “virtual source matching” is highly reliable, provided the DUT is sufficiently unilateral ($S_{21} > S_{12} + 50$ dB). Simulated source contours are drawn, and trade-offs between maximum gain, efficiency and other parameters can be viewed in real-time without multiple source-load measurement iterations. Direct computation of the input VSWR versus source power and source impedance is also enabled.
**MT930E IVCAD IV Curves**

MT930E is an add-on module for MT930C and MT930D which enables basic DC-IV curves to be generated for a list of drain and gate voltages.

**MT930F IVCAD S-Parameters**

MT930F is an add-on module for MT930C and MT930D, which enables CW S-Parameters to be read from a Vector Network Analyzer (VNA) and saved in SnP format.
MT930G IVCAD Time Domain Waveforms

MT930G is an add-on module for MT930C Vector-Receiver Load Pull which enables time-domain waveform reconstruction in conjunction with appropriate hardware. With the collected data, a- and b-waves, voltage and current waveforms, and load lines can be displayed for each measured impedance de-embedded to the device reference plane.

Currently supported instruments include Agilent PNA-X with NVNA option.

Time-domain analysis, or Waveform Engineering, allows the analysis of currents and voltages and the device input and output terminals in order to identify the DUT’s mode of operation. This tool is useful in the study and design of advanced amplifier classes of operation including E, F, J and K and their inverses.

Output Current Waveforms at Constant Input Power Under Varying Load Impedances

DC and RF Load Lines at Constant Input Power Under Varying Load Impedances
MT930H IVCAD Active Load Pull

MT930H is an add-on module for MT930C Vector-Receiver Load Pull which enables active load pull in conjunction with internal and external sources for fundamental and harmonic load pull measurements. Considering our DUT as a two-port device shown below, $\Gamma_L$ is nothing more than $a^2/b^2$, or the ratio between the reflected- and forward-traveling waves. A generalized form of the formula can be written as

$$\Gamma_{x,n}(f_n) = \frac{a_{x,n}(f_n)}{b_{x,n}(f_n)}$$

A closer examination of the formula $\Gamma_L = a^2/b^2$ reveals that there is no limitation on separating the sources of $a^2$ and $b^2$. It is obvious that $b^2$ is the wave coming from the device, of which we have no direct control; however, $a^2$ need not be a reflected version of $b^2$ but can be a new signal entirely!

**Active Load Pull** – Active injection load pull, more commonly referred to as active load pull, relies on external sources to inject a signal into the output of the DUT, thereby creating $a^2$. Because $a^2$ is no longer limited to a fraction of the original reflected signal, as is the case with the traditional passive mechanical tuner, external amplifiers may be used to increase $a^2$ nearly indefinitely so that $\Gamma_L$ can achieve unity. The simple active tuning chain consists of a signal source, a variable phase shifter and a variable gain stage, shown in the diagram below. Common signal generators that have built-in amplitude and phase control of the injected signal and are ideal for active load pull.

Harmonic load pull, or tuning impedances at multiple frequencies simultaneously, becomes simple when using active load pull techniques. A multiplexer can be used to merge multiple active tuning paths, one per frequency, so that

$$\Gamma_{x,n}(f_n) = \frac{a_{x,n}(f_n)}{b_{x,n}(f_n)}$$

is satisfied.

Any loses inherent to multiplexers are easily overcome by the amplifiers used in each active tuning chain.

**Hybrid-Active Load Pull** – Both traditional passive mechanical tuner systems and active injection load pull systems have their advantages and disadvantages. While mechanical tuners are simple, less expensive and can handle high power, there is no physical way to overcome the losses involved with the system that limit achievable $\Gamma_L$. While active load pull systems are extremely quick, capable of $\Gamma_L = 1$ and easily integrated for harmonic measurements on-wafer, high-power setups require more-expensive band-limited amplifiers.

It is possible to obtain the advantages of both systems while minimizing the disadvantages, using a technique referred to as hybrid load pull. Hybrid load pull refers to a combination of active and passive tuning in the same system. Traditional passive mechanical tuners can be used to reflect high power at the fundamental frequency allowing a much smaller active injection signal, using much smaller amplifiers, to overcome losses and achieve $\Gamma_L = 1$. Additionally, since the powers at harmonic frequencies are often well below the power of the fundamental signal, less-expensive wideband amplifiers may be used with active tuning to accomplish active harmonic load pull with $\Gamma_{L,n}=1$. In both cases, only a low power is required for active tuning.
MT930H IVCAD Active Load Pull (continued)

Hybrid-Active Load Pull at 30–50 GHz

Output Power and PAE Contours at High-Gamma Enabled by Hybrid-Active Load Pull
MT930J IVCAD Pulsed IV Curves

MT930J is a stand-alone module for advanced Pulsed IV measurements using dedicated pulsing hardware (e.g., AMCAD’s BILT Pulsed IV system).

Current-voltage (IV) measurements are used to describe the relationship between the input and output currents and voltages of a device. Standard GaN Field Effect Transistors (FETs) are characterized by measuring the output current as a function of output voltage for swept input voltages. Because GaN devices tend to self-heat and are susceptible to trapping effects, it is important to pulse voltages between a quiescent and hot value and define appropriate pulse-widths. By pulsing the voltage, a lower average power will be delivered to the device thereby reducing self-heating. Such a measurement allows for near-isothermal performance.

IVCAD enables the visualization of trapping phenomena, gate lag and drain lag, on GaN transistors. It is a simple task to view trapping effects as a function of varying quiescent bias.

IVCAD has implemented full wafer control by interfacing with Cascade Nucleus software.

Key Features:

- Easy Data Management
- Cohesion Between Pulsed IV and Corresponding Pulsed S-Parameter Data (Requires MT930K)
- Automated Probe Station Control
- Import/Export Data to/from ICCAP, ADS, Microwave Office

MT930K IVCAD Pulsed S-Parameters

MT930K is an add-on module to MT930J which enables synchronized Pulsed S-Parameter measurement in conjunction with Pulsed IV.

Pulsed IV Curves Plotted at Different Times with Pulse

Pulsed S-Parameters Under Varying Bias Conditions
MT930L IVCAD Scripting Language

MT930L is an add-on module to MT930C/D/J/K which enables complex test sequencing through a dedicated scripting language.

Scripting is available both internally to IVCAD and as an external script server. The script server allows users to run IVCAD as slave software, controlled by an external application, through TCP/IP sockets.

TCP/IP sockets allow programs to talk through a network, but a communication between two programs on the same computer can also be established.

Internal scripting is managed by the script editor, which includes functions divided into several categories:

Concurrency – functions related to threading

User interfaces – functions related to creating windows, docking windows, fonts, labels, 2D and 3D graphs, wafer maps

I/O – functions related to logging events, printing messages, reading and writing characters, managing files and directories

Math – functions related to math, values, vectors, arrays, rows, factorial operations, complex numbers, conversions, exponents, interpolation, trigonometry

Measurements – functions related to impedance control, IV control, probe station control, tuner control, setup management

Scripting – functions related to loops, conditions, if/else

SQL – functions related to database management
MT930M1 IVCAD Linear Model Extraction

MT930M1 is an add-on module to MT930J and MT930K for Linear Model Extraction using dedicated pulsing hardware (e.g., AMCAD’s BILT Pulsed IV system).

Linear Model Extraction is used to determine the extrinsic parameters (parasitic elements) and intrinsic parameters of III-V or LDMOS transistors. Linear modeling compares measured data to default model data. The model is manually tuned or automatically optimized by varying the values of the extrinsic (Rg, Lg, Cpg, Rd, Ld, Cpd, Rs, Ls) and intrinsic parameters.

To verify the linear model behavior, it is essential to compare intrinsic elements through a multi-bias extraction. The resulting linear model can be used with MT930M2A/B to generate a Nonlinear Model or exported to commercial circuit simulators.
MT930M2A IVCAD Nonlinear Model Extraction, III-V

MT930M2A is an add-on module to MT930M1 for Nonlinear Model Extraction of III-V device technologies. The extrinsic parameters measured through linear modeling (MT930M1) are used to extract intrinsic parameters.

In quasi-isothermal conditions, MT930M2 uses synchronized pulsed IV/RF measurements to extract the parameters of the AMCAD nonlinear equations that describe the nonlinear capacitances, diodes, and current sources of the transistor. Pulse widths are kept sufficiently short in order to avoid a strong temperature variation during the pulse duration and the duty cycle is kept sufficiently low in order to avoid a mean variation of the temperature, so that the transistor’s pulsed IV measurements are obtained under quasi-isothermal operating conditions. S-parameters are measured in the steady-state region of the signal.

Nonlinear Capacitance Model Extraction – For III-V or LDMOS transistors, thanks to a selection of the IV plots close to the expected RF load line, the capacitance values will be extracted according to the instantaneous Vgs and Vds values. In order to extract an accurate and robust model regarding the convergence of the simulation, the nonlinear models will be provided under the form of a “one dimension” formulation. Thus Cgd will be a function of intrinsic Vgd while Cgs will be a function of the intrinsic Vgs voltage. The comprehensive parameters of these equations can be tuned manually or optimized automatically. For III-V transistors Cds is provided as a linear model; for LDMOS transistors Cds is provided as a nonlinear capacitance model.

Diode Parameter Extraction – For III-V transistors, the gate current will be accurately modeled by two diodes (Dgs and Dgd), biased in forward mode. The manual or automatic tuning of the diode’s parameters provides an accurate fit of the positive gate current at low Vds and high Vgs voltages. The negative gate current for high Vds voltages in pinch-off conditions is provided by a breakdown generator.

Output Current Extraction – A specific algorithm is used to extract the output current source model, which provides a reliable description of the Ids current for different Vds and Vgs voltages.

The formulation used enables an accurate description of the output current sources and its derivatives (gm, gd). The comprehensive parameters of these equations can be tuned manually or optimized automatically.

MT930M2A uses a modified Tajima current source model for III-V transistors, while MT930M2B uses a proprietary AMCAD current source model for LDMOS transistors.

MT930M2B IVCAD Nonlinear Model Extraction, LDMOS

MT930M2B is an add-on module to MT930M1 for Nonlinear Model Extraction of LDMOS transistors. The extrinsic parameters measured through linear modeling (MT930M1) are used to extract intrinsic parameters.

Capacitance Model Extraction Showing Excellent Match Between Measured And Modeled Data
Current Source Extraction Showing Excellent Match Between Measured And Modeled Data

AMCAD III-V Model Template
MT930P Toolbox

MT930P is a stand-alone module which enables useful mathematical tools post-measurement.

> IV Tools – compute gm/gd, convert IV data sets, interpolate/extrapolate IV points.
> S-parameters – TRL fixture extraction, interpolate/extrapolate S-parameters.
> De-embedding – de-embedding S-parameters, intrinsic de-embedding of S-parameters based on linear model.
> Converter – mathematical calculator for converting phase, power, VSWR, impedance.

MT930Q IVCAD Stability Analysis Tool

Stability Analysis Tool (STAN) is a revolutionary stability analysis technique for microwave circuits, which is valid for both small-signal and large-signal regimes. This tool is able to detect and determine the nature of oscillations, such as parametric oscillations in power amplifiers, that may be functions of the input drive signal. Knowledge of the type of oscillation mode facilitates the insertion of stabilization networks, with a better balance between the required oscillation avoidance and maintaining the original circuit performances.

The STAN approach calculates a single-input, single-output (SISO) transfer function for a circuit of interest linearized around a given steady state. A simulated frequency response of the linearized circuit is fitted to a rational polynomial transfer function by means of frequency-domain identification algorithm. If no poles on the right-half plane (RHP) are found, it is considered stable.

Key Features:

> Single-node analysis
> Multi-node analysis
> Parametric analysis under varying load impedances
> Parametric analysis under varying input signal power
> Monte Carlo analysis
> Compatible with IC, MMIC and hybrid-amplifier designs
> Templates supplied

STAN is compatible with major commercial circuit simulator tools.
MT930R1 IVCAD Behavioral Model Extraction, Short-term Memory Effects

MT930R1 is a stand-alone module for behavioral model extraction of short-term memory effects using simulated circuit or measurement data. Two behavioral modeling methodologies are included: Multi-Harmonic Volterra (MHV) and Enhanced PHD (EPHD).

Common Features of MT930R1 and R2

MHV and EPHD use Dynamic Volterra Series theory to extract behavioral models compatible with each stage of the design flow. A component’s behavioral model can be extracted for circuit-level simulation and a circuit’s behavioral model can be extracted for system-level simulation.

MHV and EPHD models are ideal for use with simulated complex wideband modulated signals needed for signal integrity analysis.

The Multi-Harmonic Volterra (MHV) behavioral model has been designed for simulation requirements where RF signals with wide bandwidths (RFBW>10 MHz) are required. This approach is also valid for loading conditions which are slightly different from the reference impedance, such as the simulation of the effect of an antenna on the power amplifier.

The Enhanced PHD (EPHD) behavioral model has been designed for simulation requirements where the loading conditions are much different than those used during the measurement. In this case, accurate interpolation/extrapolation is required and provided by the EPHD method. This approach has been designed for behavioral model extraction of a packaged transistor which will be used in the design of a power amplifier.

MT930R2 IVCAD Behavioral Model Extraction, Long-term Memory Effects

MT930R2 is an add-on module to MT930R1 for long-term memory effects using simulated circuit or measurement data. Two behavioral modeling methodologies are included: Multi-Harmonic Volterra (MHV) and Enhanced PHD (EPHD).

Visualization of Behavioral Model Terms

Behavioral Modeling Methodologies as Function of RF Bandwidth and VSWR
Recommended Reading

The following literature is recommended for those who wish to learn more about the IVCA Advanced Measurement & Modeling Software Suite and the test and measurement applications it supports.

5A-050  Tracing The Evolution of Load-Pull Methods

Abstract – The evolution of load-pull tuning has led to hybrid and mixed-signal approaches that use the best features of mechanical and active tuners to speed measurements on nonlinear devices.

5A-051  Vector-Receiver Load Pull Measurement

Abstract – The following special report considers the improvements in large-signal device characterization brought on by a new class of vector receiver load pull systems compared to older scalar techniques using calibrated automated load pull tuners. Recent improvements to nonlinear device measurement systems have greatly enhanced load pull characterization, which in turn impacts RF board level circuit design, particularly power amplifiers using discrete transistors.

5A-057  Assets of Source Pull for NVNA Based Load Pull Measurements

Abstract – This study deals with Vector Network Analyzer based source/load-pull measurements. While a lot of papers demonstrated the influence of harmonic load impedances on PAE performances and time domain RF waveforms shaping, the harmonic source-pull topic has been a little bit less addressed. When using a traditional power meter based source/load-pull bench, source pull measurements are mandatory. Indeed, for a fixed power level and a given set of load impedances, the source pull optimization highlights the conditions to match the transistor’s input access.

Nowadays, modern Vector Network Analyzer based source-load pull systems provide the direct measurements of the transistor input impedance. Thus, from the theoretical definition of any arbitrary source impedance, the mismatch calculus between input and source impedances is possible. It gives rise to a new kind of virtual source pull measurements. Some of us have called this method “magic source pull”. This traditional source pull and Vector Network Analyzer based “magic source pull” will be provided.

5A-043  Pulse-Bias Pulsed-RF Harmonic Load Pull for Gallium Nitride (GaN) and Wide Band-Gap (WBG) Devices

Abstract – For the first time ever, a commercially available pulse-bias pulsed-RF harmonic load pull system is being offered for high power and wide band-gap devices. Pulsing DC bias in conjunction with pulsing RF reduces slow (long-term) memory effects by minimizing self-heating and trapping, giving a more realistic observance of transistor operating conditions. IV, S-Parameter and Load Pull measurements taken under pulsed-bias pulsed-RF conditions give more accurate and meaningful results for high-power pulsed applications.

5A-052  Compact Transistor Models: The Roadmap to First-Pass Amplifier Design Success

Abstract – Amplifier designers have been making use of modern transistor models since their first appearance in the mid-1970s. Models have allowed engineers to create advanced designs with first-pass success, without the need for multiple prototypes and design iterations. But with so many different modeling techniques, how does one select which one to use? The three most common types of models used in industry today are: physical models, compact models and behavioral models.

5A-054  Software Simplifies Stability Analysis

Abstract – Stability analysis software helps to reveal any unwanted oscillations in an amplifier or other high-frequency design before committing the design to an expensive foundry run. Stability can be difficult to achieve in microwave circuits with gain (nonlinear behavior), such as amplifiers and oscillators. Amplifier designers, for example, have long dreaded the appearance of oscillations in a carefully considered circuit. When that circuit is in monolithic-microwave-integrated-circuit (MMIC) form, a "fix" requires another foundry run. But help in achieving microwave circuit stability has arrived, by way of the stability analysis (STAN) software developed by AMCAD Engineering and sold by Maury Microwave Corporation.
SEE THE IVCAD MEASUREMENT & MODELING DEVICE CHARACTERIZATION SOFTWARE SUITE IN ACTION!

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