



Modelithics®, Inc. provides a broad array of highest quality, RF/microwave/mm-wave characterization services. We also specialize in utilizing precision characterization data to develop equivalent circuit and black-box models for linear and non-linear devices. The models can be inserted into most microwave computer-aided-engineering (CAE) software tools currently on the market. Our mission is to help customers achieve rapid RF/MW design and manufacturing success, by providing superior long-term service and quick turn-around.

Measurement Capabilities Include:

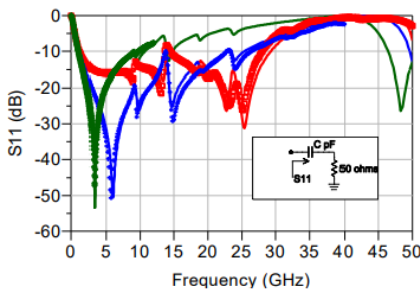
- X-Parameter Testing
- S-Parameters
- Noise Parameters
- Load and Source Pull
- Measurements Over Temperature -50 to +150

- DC and Pulsed IV
- 1/f Noise
- Phase Noise
- Intermodulation
- Assembly and Test Fixture Layout/Hardware Design

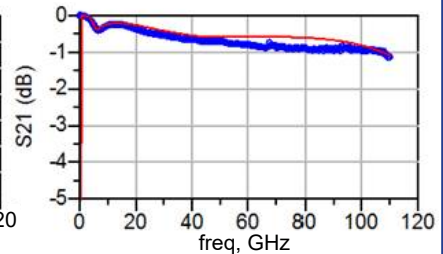
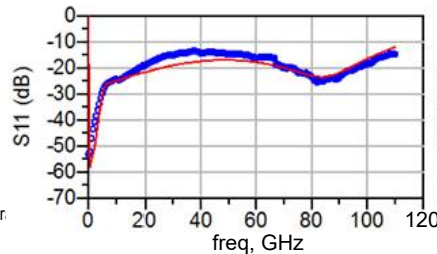
- Distortion
- Power Compression
- C-V, ESR
- Complex RF Measurements Support Available
- Chip and Wire Assembly
- High Power Test Fixture Design

S-Parameter Measurements

Multiple vector network analyzer test platforms cover the frequency range from 5Hz to 170 GHz. True 4-port S-parameter measurements through 67 GHz are available to support mixed-mode circuit design applications.

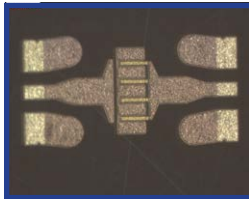


(Left) \square 4 mil Rogers 4350B, \circ +10 mil Rogers 4350B, \diamond 30 mil Rogers 4350B. Solid lines - Model data, Symbols - Measured data. S11 for a 3.9 pF capacitor mounted on various substrates from 0.05 to 50.0 GHz
(Right) Model vs measurement S-Parameters of 550U104 (100nF) AVX capacitor on 5mil Rogers 3003G2 substr.



Wafer-Probe Emphasis - Flexibility Available

Modelithics emphasizes wafer probe measurements of semiconductor wafer and chip, as well as surface mount components assembled on hybrid boards. Other measurement configurations involving microstrip or coplanar test fixtures, and measurements to coaxial or waveguide reference planes are available.

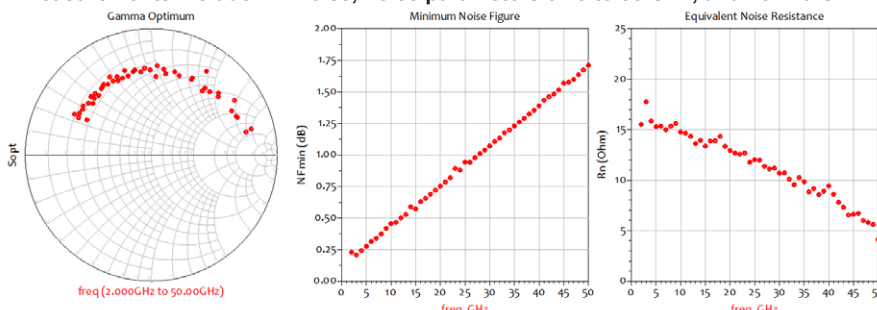


Noise-Parameters Measurements

Noise parameter measurements are performed in a screen room to minimize local electromagnetic interface.

- Custom Test Setup - 10Hz to 100 KHz (extension to 1 MHz)
- Keysight 8510C (multiple) - 300 MHz to 26.5GHz
- Keysight 8970/HP8971 - 10 MHz to 50 GHz (50-110 GHz*)
- Keysight PNA-X - 10MHz to 50GHz
- Maury ATN NP5 - 0.3 to 50 GHz (75-110 GHz*)

Measurements include: 1/f noise, noise parameters 0.25 to 50 GHz, and 75-110 GHz.



Broad-band 2-50 GHz noise parameters measurements of a low noise pHEMT.

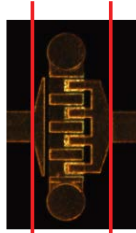
• Maury ATS -
Fundamental
tuning
0.25 to 50 GHz

• Maury ATS -
Fundamental
tuning
75 to 110 GHz

• Maury ATS -
Harmonic tuning
915 MHz, 2.45
GHz, 5.25 GHz
fundamental

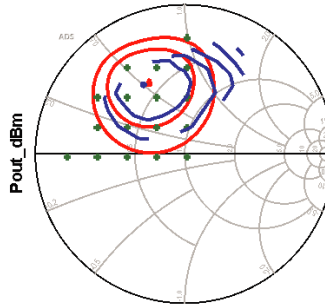
Load and Source Pull Measurements

Load and source pull measurements can be performed to generate impedance contours for optimizing the tradeoff between various amplifier performance parameters, such as output power and 1 dB compression, power-added-efficiency (PAE), transducer gain, and third-order-intermodulation distortion (IM3 or TOI).

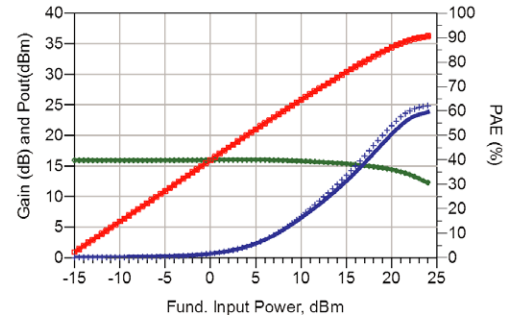


Model and Measurement Reference
Planes

Load Pull Validation:
Frequency = 11 GHz



Red Solid lines – Model,
Blue Solid lines – Measured



□ Output Power (dBm), + PAE (%), ◇ Transducer Gain (dB)
Solid lines - Model data, Symbols - Measured data

DC and Pulsed IV

For transistor and diode characterization, DC and pulsed measurements are made using the following:

• DC IV characterization

- Accent DIVA
- AMCAD AM3200
- HP4142B DC Modular
DC Source/Monitor

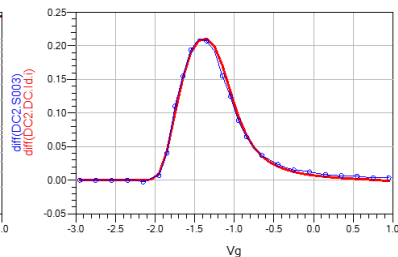
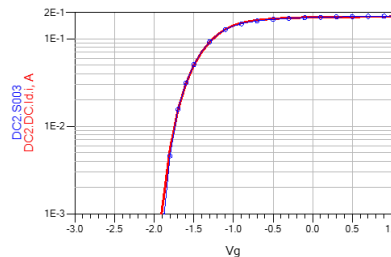
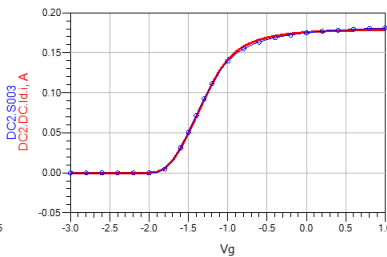
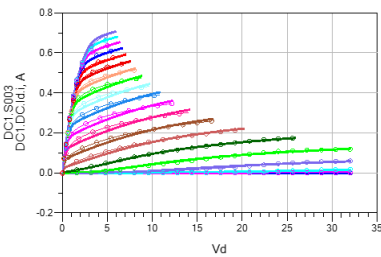
• Pulsed IV Measurements

- Accent DIVA
- AMCAD AM3200
- Auriga AU-5

Plots from Left to Right:

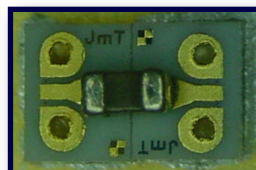
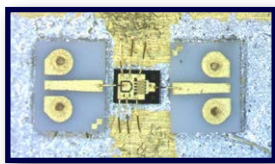
- Output Curves
- Transfer Curve - Linear
- Transfer Curve - Log
- Transconductance

Measured (symbols)
to Modeled (solid)
comparison of pulsed I-V
data for a GaN HEMT



Test Fixtures and Accessories

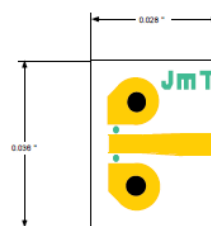
Modelithics offers custom RF probable and coaxial test fixtures with in-fixture calibration standards and associated calibration coefficient information. Additional legacy J Micro Technology parts are available.



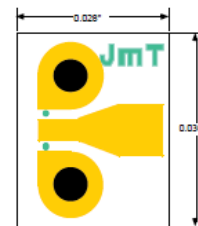
Contact Modelithics sales to verify available
inventory and pricing.

Ask about our quantity discounts!

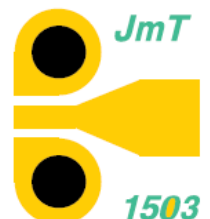
Sales@Modelithics.com



Probe Point 0503



Probe Point 1003

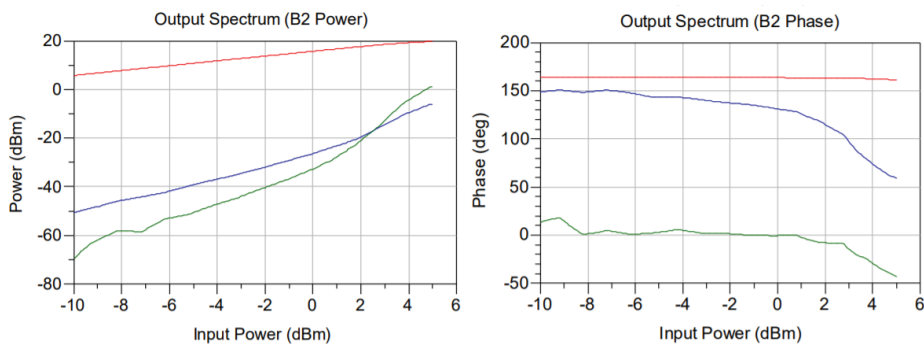


Probe Point 1503

www.Modelithics.com/Home/Fixtures

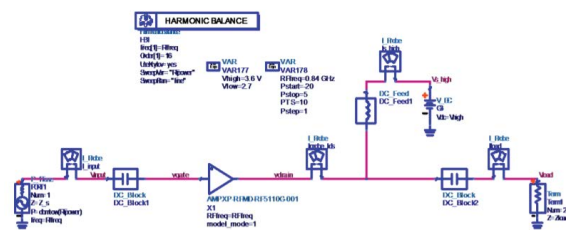
X-Parameter Measurements

- Provide mathematically correct extensions of S-parameters to large-signal conditions with fully nonlinear framework that provides both the magnitude and phase of the distortion.
- Cover both large-signal and small-signal conditions, and capture complete linear and nonlinear behavior at all loads.
- Characterize the amplitudes and relative phase of harmonics generated by components under large input power levels at all ports.
- Correctly characterize impedance mismatches and frequency mixing behavior to allow accurate simulation of cascaded nonlinear X-Parameter blocks, such as amplifiers and mixers in wireless design.
- Apply to individual transistor modeling as an alternative to, supplement to, or validation of traditional compact equivalent circuit modeling.
- Can be measured using a non-linear vector network analyzer, such as a suitably optioned Keysight PNA-X series instrument.
- Can be measured as a function of impedance and bias.
- Can be simulated in multiple circuit simulation tools, such as Keysight ADS and Keysight Genesys software.



Red: Fundamental, Blue: 2nd Harmonic, Green: 3rd Harmonic
X-Parameter Model results for Flat Gain High Linearity Amplifier mounted on 20mil Rogers 4003C substrate. DC Voltage: +5V, model_mode=1 used

Example X-Parameters Simulation Schematic



Contact us at
Sales@Modelithics.com or visit
www.Modelithics.com for more
information!

Other Instrumentation

Many other measurements and tools are available to support model development, including:

Equipment	Frequency Range	Measurement Type
E5061B ENA	5 Hz - 3 GHz	Impedance
Boonton Resonant Coaxial Line	Measurement of high Q capacitors	Impedance
Keithley 590 CV Analyzer	CV at 100kHz or 1MHz	Capacitance vs Voltage
Keysight 429aA Impedance Analyzer	Impedance analyzer (1-1800 MHz)	Impedance
Keysight 4287A RF LCR Meter	LCR meter (1-3000 MHz)	Impedance
Keysight E4991A RF Impedance Analyzer	Impedance analyzer (1-3000 MHz)	Impedance

Other Software

CAE and Electromagnetic Simulation Software:		
Keysight Technologies PathWave ADS	Cadence® AWR Design Environment™	Ansys® HFSS™
Keysight Technologies PathWave RF Synthesis (Genesys)	NIST Multical	Cadence Spectre RF® Option
ICCAP	Maury Microwave Test Software	PSPIICE
Momentum	Sonnet® Suites™	... And other software tools!