

NONLINEAR APPLICATIONS USING ROHDE & SCHWARZ VECTOR NETWORK ANALYZERS



Product Flyer
Version 01.00

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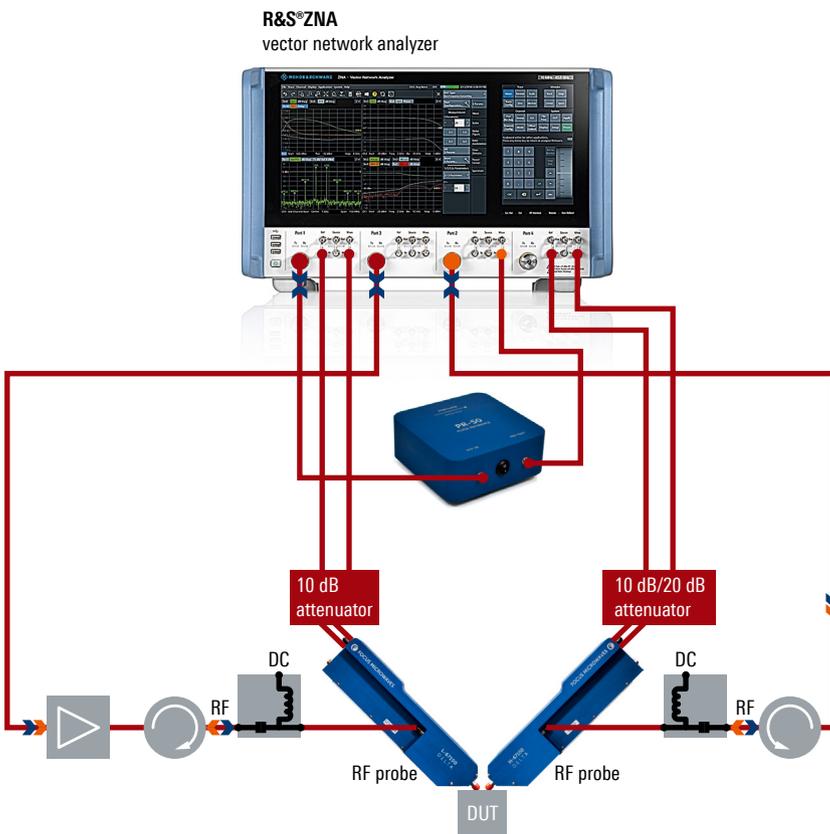
HYBRID LOAD PULL AND BEHAVIORAL MODELING WITH R&S®ZNA AND R&S®ZVA

Hybrid active load pull combines the benefits of passive as well as active load pull techniques in one setup. Active load pull is the only method that allows the extremely low internal impedance of power transistors to be reached, especially when the measurement reference plane is far from the tuner reference plane and at high frequencies.

The system relies on the basic concept of using a passive electromechanical tuner as a prematch to get closer to the device's conjugate output impedance. By adding active injection, the system can tune impedances anywhere in the Smith chart and beyond (≥ 1). The measurements themselves are wave quantity based, and are performed using an R&S®ZNA/ZVA vector network analyzer. With the introduction of prematching tuners, the feedback injection signal power remains close to the DUT output power not only at the fundamental frequency but also at the very important harmonic frequencies. In purely active systems, the power amplifier has to produce very high power (up to 20 times the DUT power) to compensate for the strong mismatch between the impedance of the feedback injection amplifier (50Ω) and the DUT internal impedance (0.5Ω to 1Ω).

The R&S®ZNA/ZVA hardware platform with up to four independent vector signal sources and two independent receivers per test port is ideal for not only fundamental but also hybrid harmonic load pull. For these applications, up to four source signals are DDS generated which provide full control of the phase of each source signal. The R&S®ZNA/ZVA architecture leverages Focus Microwaves' all-in-one MPT for simple and scalable advanced load pull setups. Focus' Delta series of tuners enables a direct connection between the probe tip and the tuner, eliminating all possible insertion loss between the DUT and the tuner.

A key benefit of the Delta tuner setups is the shortened electrical delay, resulting in reduced impedance skew for modulated signals. Legacy high frequency setups suffer from significant impedance skews due to the long electrical delay caused by the low-loss cable inserted between the tuner and DUT. The Delta tuner drastically reduces this skew, making wideband modulated load pull possible with passive tuners.



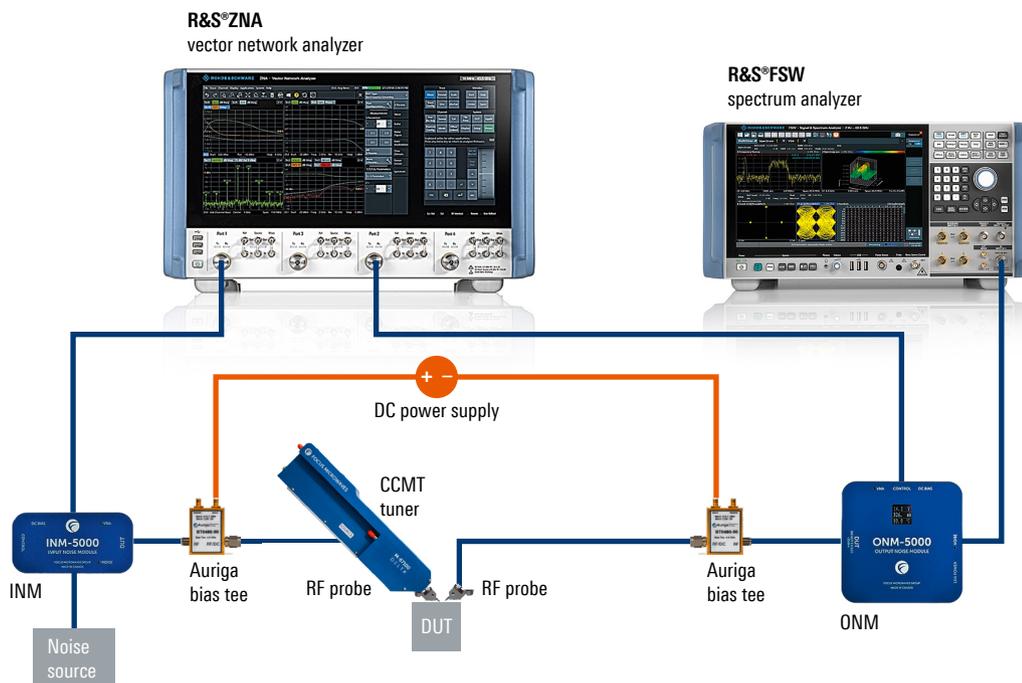
WIDEBAND NOISE PARAMETER EXTRACTION WITH THE R&S®ZNA

Focus Microwaves' noise parameter extraction uses the cold-source noise measurement method. This technique requires a noise source to determine the gain-bandwidth constant (kBG) of the noise receiver, and a passive mechanical tuner to characterize the noise receiver across both the impedance and frequency space. Using a Focus Microwaves wideband tuner and advanced characterization software, the user can extract the four noise parameters in a single sweep.

For millimeterwave applications, an RF downconversion stage might be required if the noise measurement frequency exceeds the receiver's measurement bandwidth. Focus Microwaves offers noise modules that include appropriate downconversion for such high frequency measurements.

The Focus Microwaves system supports all network analyzers of the R&S®ZNA family and all Rohde&Schwarz spectrum analyzers capable of noise figure (NF) measurements.

Another unique advantage of Focus noise measurement solutions is their broadband passive tuners, which cover a frequency range of 1 GHz to 50 GHz in a single tuner.

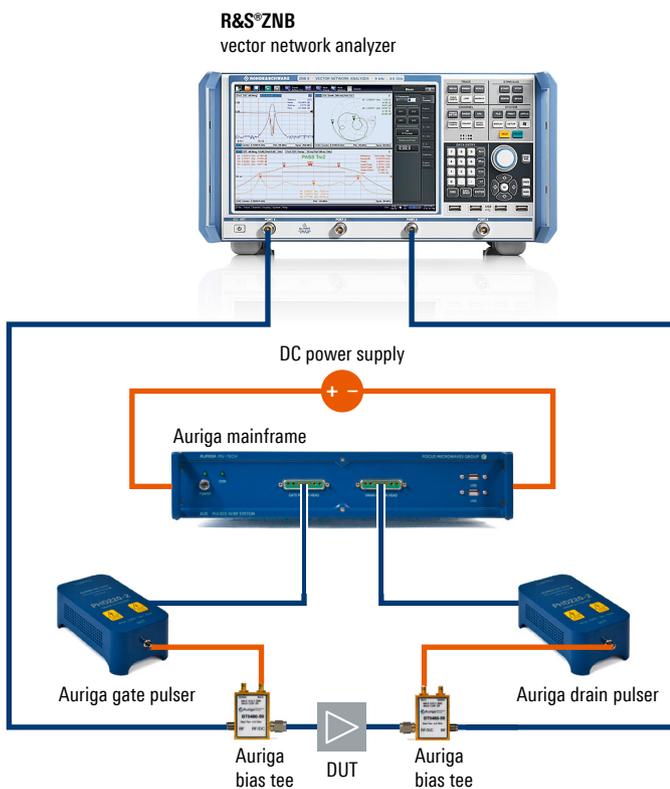


PULSED IV AND COMPACT MODELING WITH THE R&S®ZNA AND R&S®ZNB

The R&S®ZNA and R&S®ZNB vector network analyzers combine high dynamic range, repeatable raw data, high temperature stability and fast synthesizers. One setup for pulsed IV and compact modeling based on the R&S®ZNB vector network analyzer is shown below.

Additionally, the R&S®ZNA includes RF pulse modulators and pulse generators. This combination makes this analyzer ideally suited for pulsed IV, pulsed S-parameter and pulsed load pull applications.

Focus Microwaves has developed its own compact modeling capabilities (FCM). This integrated system enables complete DC and RF characterization, extraction and modeling of a semiconductor device such as a GaAs or GaN HEMT. The generated model can predict both the linear and nonlinear performance of these devices.



Focus Microwaves manufactures electromechanical impedance tuners from 10 MHz to 110 GHz in coaxial and up to 170 GHz in waveguide, focusing on a high VSWR (> 100:1), multi-harmonic (2fo, 3fo, 4fo) and high power (500 W) for:

- ▶ Designing power and low-noise amplifiers
- ▶ Improving mobile phone performance
- ▶ Validating transistor large-signal models
- ▶ Optimizing transistor technology

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Nonlinear applications using Rohde & Schwarz vector network analyzers

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