



# Non-Linear Measurements With Keysight PNA-X™



## Hybrid Load-pull & Behavior Modeling with PNA-X™

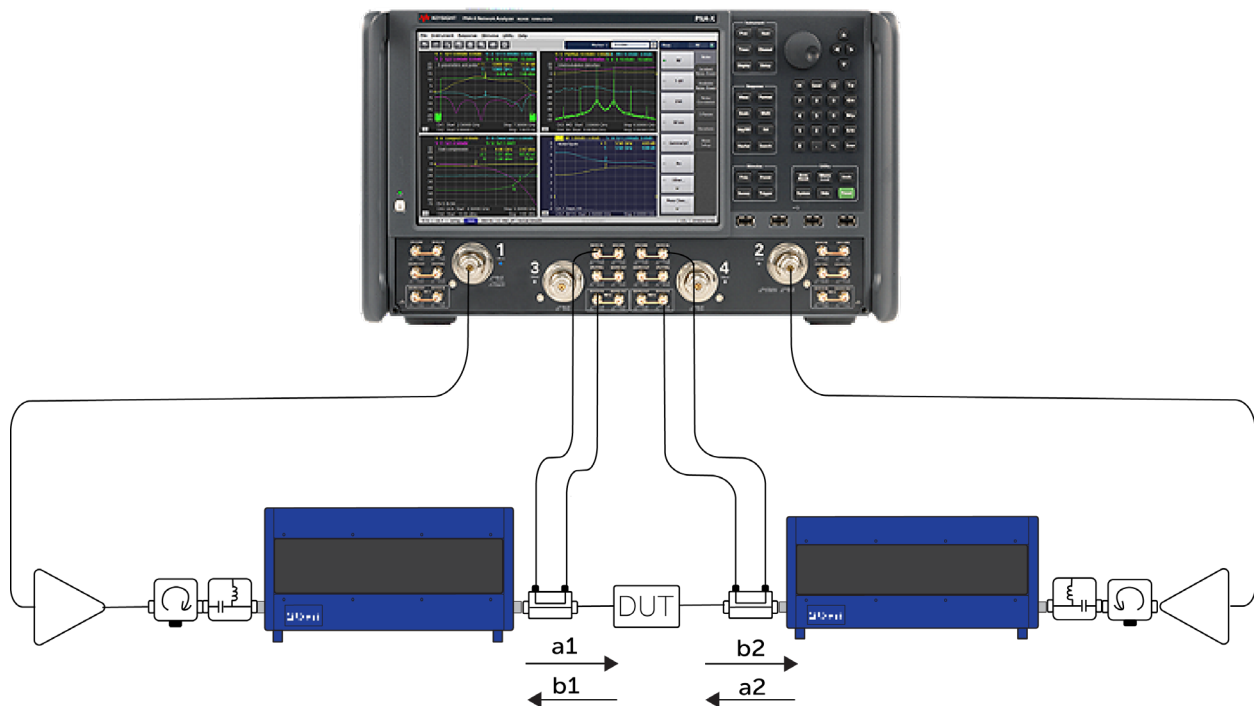
Hybrid active Load-pull combines the benefits of both passive and active Load-pull techniques in one setup. Active Load-pull is the only method that allows reaching the low internal impedance of power transistors, especially on wafer and at very high frequencies. The system relies on the basic concept of using a passive electromechanical tuner as a prematch to get closer to the device's conjugate output impedance, then complementing with active injection, the system can tune impedances anywhere in the Smith Chart and beyond ( $|\Gamma| \geq 1$ ).

The measurements themselves are "travelling wave" based, performed using a Keysight PNA-X. With the introduction of prematching tuners, the feedback injection signal power

er remains close to the DUT output power not only at the fundamental frequency but at the very important harmonic frequencies, whereas in pure 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 ( $50\Omega$ ) and the DUT internal impedance ( $0.5 - 1\Omega$ ).

The user can also add optional signal generators and multiplexers to drive the load not only at the fundamental but at the harmonic frequencies. Keysight's X-series family of signal generators can be used as well as the high end PSG analog or vector signal generator.

### System Setup



## Wideband Noise Parameter Extraction with PNA-X™

Focus' noise parameter extraction routines leverage the PNA-X's unique implementation of the cold-source Noise Figure measurement technique. This specific technique requires a noise source to determine the KBG (gain-bandwidth constant) of the system and a passive mechanical tuner is used to characterize the noise receiver across both the impedance and frequency space. This step is imperative to obtain fully vector-source-corrected measurements.

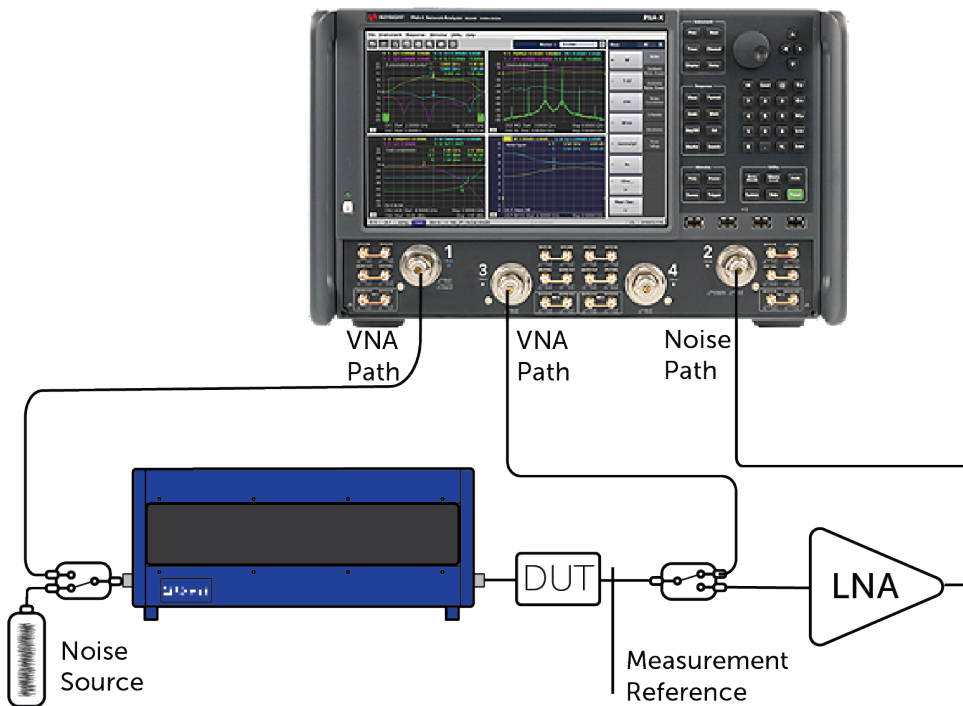
For mm-Wave applications a RF down conversion stage might be required if the frequency of noise measured exceeds the receiver's bandwidth. Focus offers noise mod-

ules which support down conversion for optimal speed and performance.

Focus' system architecture supports all of the X-series analyzers. Keysight's N9069A/W9069A noise figure measurement application uses the Y-factor method to calculate the Noise Figure.

Considered as an industry standard for decades the N897XA family of Noise Figure analyzers is still supported by Focus' FDCS measurement suite.

### Setup |





## Pulsed IV and Compact Modeling with PNA-X™

The Focus Compact Model (FCM) utility is a streamlined software package designed to be used with Focus' AURIGA high-end pulse system, that is used to generate Compact Models for transistors from their Pulsed-IV and wideband pulsed S-parameter data.

The FCM utilises Keysight's PNA-X platform to measure highly accurate pulsed S-parameters of the Device Under Test. Keysight's PNA-X supports both wideband and narrowband detections offering greater flexibility and perfor-

mance. These techniques let the user trade dynamic range for speed, with the result almost always yielding faster measurements than those obtained by conventional filtering.

The PNA-X's four internal pulse generators and pulse modulators, two internal sources with a combining network, and active application options provide fully integrated pulsed active device characterization.

### Setup |

