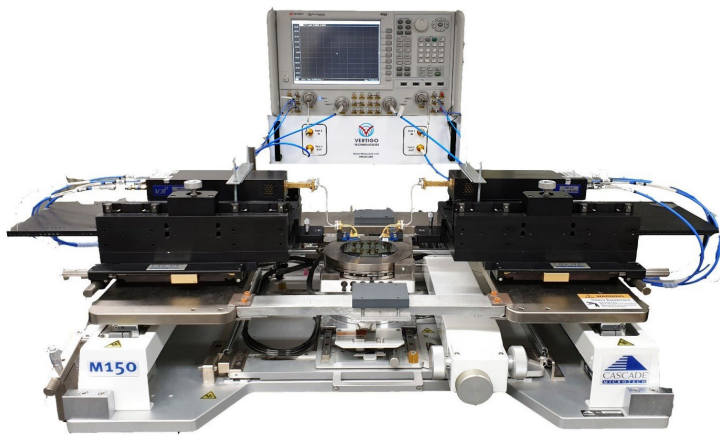


# Active Load Pull Measurements at Millimeter-Wave and Sub-THz Frequencies

Keysight Technologies and Maury Microwave



Upgrade your S-parameter test bench with accurate and repeatable gain compression and active load pull measurements at millimeter-wave and sub-THz frequencies

Performing device characterization measurements at millimeter-wave and sub-THz frequencies can be challenging for several reasons. First, it's difficult to achieve accurate and repeatable power-control at the DUT reference plane when using waveguide extenders between 110 GHz and 1.1 THz, as the extenders typically output a fixed power. However, controlling the power delivered to the input of the DUT is critical in setting the device's operating conditions and characterizing its performance over power, such as the large-signal characteristic gain compression. Second, load pull, which means changing the load impedance presented to the DUT to an arbitrary non-50 $\Omega$  value, is difficult as passive load pull impedance tuners are typically unavailable above 110 GHz, and even then, are limited in their ability to present high mismatches at the DUT reference plane.

Load pull measurements are necessary for transistor designers to properly characterize and model the high-speed behaviors of their devices. For circuit designers, load pull measurements are used to determine the ideal matching conditions and optimize performance, at powers where every fraction of a dB is important. Load pull can also be used to test systems, such as new mm-wave radars, where both contacted and over-the-air performance testing is needed.

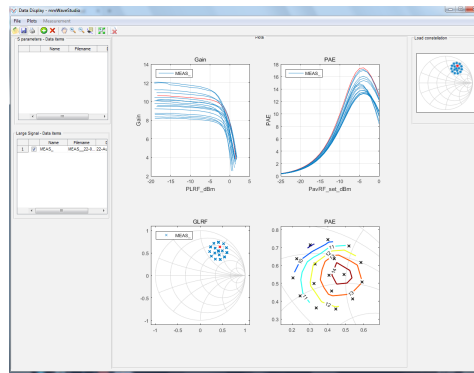
- Measure S-parameters at user-specified power levels
- High-resolution power control for accurate and repeatable vector-corrected 50 $\Omega$  gain compression power sweep measurements
- Arbitrary impedance control / active load pull
- Measure fundamental powers ( $P_{in}$ ,  $P_{av}$ ,  $P_{load}$ ), gain and efficiency at 50 $\Omega$  and arbitrary impedances
- Advanced measurement sequencer sweeps impedance, power, frequency and bias
- Calibrated measurements at DUT reference plane
- Supports most commercial waveguide extenders up to 1.1 THz

## MM-STUDIO and MM-STUDIO LP Millimeter-Wave and Sub-THz Measurement Software

Maury Microwave and strategic development partner Vertigo Technologies offer an upgrade to conventional mm-wave and sub-THz S-parameter measurement systems.

MM-STUDIO is a software suite designed to work with a 4-port PNA or PNA-X using waveguide extender modules and add accurate and repeatable high-resolution power control. The software enables the direct measurement of vector corrected power at the DUT reference plane, as well as control over the power delivered to the DUT. Doing so allows engineers to perform gain compression power sweep measurements over the available level of powers, and to perform S-parameter measurements at any arbitrary power level.

MM-STUDIO LP is a software add-on, which when used in conjunction with a Vector Modulation Unit (VMU), enables control over the magnitude and phase of the signals delivered to the input and output of the DUT. This enables an engineer to set arbitrary impedances, or perform active load pull measurements, where the magnitude of reflection presented to the DUT is achieved by controlling the reflected a2 wave and fulfilling  $\Gamma = a2/b2$ .



### System Components

#### Keysight Technologies

##### PNA

N5222B (or higher frequency)	PNA microwave network analyzer
Option 401 (or better)	4-port with configurable test set
Tx/Rx waveguide extender modules (VDI, OML, Farran)	

OR

##### PNA-X

N5244B (or higher frequency)	PNA-X microwave network analyzer
Option 400 (or better)	4-port, dual source
Tx/Rx waveguide extender modules (VDI, OML, Farran)	

#### Maury Microwave

MM-STUDIO	required for 50Ω measurements
MM-STUDIO LP	required for non-50 Ω active load pull measurements, add-on
VMU-201802 or VMU-201901	required for non-50 Ω active load pull measurements

To learn how this solution can address your specific needs please contact Keysight's solutions partner, Maury Microwave [www.keysight.com/find/maurymw](http://www.keysight.com/find/maurymw)



**Keysight & Solution Partners**  
Accelerating Innovation Together

Keysight and its Solutions Partners work together to help customers meet their unique challenges, in design, manufacturing, installation or support. To learn more about the program, our partners and solutions go to [www.keysight.com/find/solutionspartner](http://www.keysight.com/find/solutionspartner)

Maury Microwave has been in business for 50+ years and has become the world's leading manufacturer of laboratory devices and system components, with an emphasis on device characterization and automated tuning systems. [www.maurymw.com](http://www.maurymw.com)

For information on Keysight Technologies' products, applications and services, go to [www.keysight.com](http://www.keysight.com)

This information is subject to change without notice

© Keysight Technologies, 2019  
Published in USA, June 26, 2019  
5992-4080EN  
[www.keysight.com](http://www.keysight.com)

