Measurement Types

Transistor:

Non-LSNA Measurement Capabilities:
1.1 I-V Characteristics
1.2 Electro-Thermal Characteristics (I-V-T) (min device area of 1 mm²)
1.3 Iso-thermal IV Characteristics (min device area of 1 mm²)
1.4 Pulsed-IV Characteristics (50 V, 2 A)
1.5 CW Load-pull (up to 20 GHz)

Native LSNA Measurement Capabilities:
2.1 CW dynamic load-line (50 ohms)

OSU Developed LSNA Measurement Capabilities:
3.1 CW dynamic load-line with input/output tuners & deembedding
3.2 Pulsed-IV pulsed-RF small-signal S-parameters
3.3 Pulsed-IV pulsed-RF large-signal dynamic load-lines

System:

Native LSNA Measurement Capabilities:
4.1 Harmonic (amplitude & phase) acquisition
4.2 Dynamic AM/PM & AM/AM
4.3 Time domain waveforms (CW & modulated)
4.4 Vectorial Multitone & Intermodulation
4.5 Pulsed RF/IV measured

OSU Developed LSNA Measurement Capabilities:
5.1 Swept power harmonics
5.2 Swept power AM/PM & AM/AM
5.3 Swept power dynamic AM/PM & AM/AM
5.4 Swept frequency vectorial intermodulation
5.5 EVM from acquired digitally-modulated RF signal
5.6 EVM in the presence of input/output interference (RFI)

Other Advanced Measurements:
6.1 Real-time load-pull with variable offset frequency
6.2 Active load-pull (2nd and 3rd harmonic control)
6.3 Pulsed-IV pulsed-RF loadpull
6.4 Modulator/mixer characterisation (K-modeling, group delay, reciprocity)
**Transistor: Non-LSNA Measurement Capabilities:**

1.1 I-V-T Electro–Thermal IV Characteristics (Current-Voltage-Temperature)

![Graph showing I-V-T characteristics](image)

1.2 Iso-thermal IV Characteristics (min device area of 1 mm$^2$)

1.3 Pulsed-IV Characteristics (50 V, 2 A)

![Graph showing pulsed-IV characteristics](image)

1.4 CW Load-pull (up to 20 GHz)
Transistor: Native LSNA Measurement Capabilities:

2.1 CW Dynamic load-line (50 ohms)
**OSU Developed LSNA Measurement Capabilities:**

3.1 CW Dynamic load-line with input/output tuners & deembedding

3.2 Pulsed-IV pulsed-RF small-signal S-parameters
3.2 Pulsed-IV pulsed-RF large-signal load-lines

![Graph showing Pulsed-IV and Pulsed-RF load-lines with different voltage and current values for various drain voltages and gate voltages.](image)
System: Native LSNA Measurement Capabilities:

4.1 Harmonic (amplitude & phase) acquisition
4.2 Dynamic AM/PM & AM/AM (two-tones)

See 5.3 for OSU group delay corrected data
4.3 Time-domain waveforms (CW & modulated)

3\textsuperscript{rd} harmonic envelope  \hspace{3cm} \text{Fundamental envelope}
4.3 Time-domain waveforms (Square wave & Digital modulated)
4.4 Vectorial Multitone & Intermodulation
4.5 Pulsed RF Measurement

The pulse for the drain (1μs pulse width and 1% duty rate)

The RF pulse applied to the gate (0.33μs pulse width and 0.33% duty rate)
System: OSU Developed LSNA Measurement Capabilities:

5.1 Swept power harmonics & intermodulation

![Graph showing Pin vs Pout for IMD0, IMD3, and IMD5](image)

DUT: PD04-N-2x150E-P1(X10-Y2)-C-A
Bias: Vgs=-4.8 Vds=10
f0: 3GHz
5.2 Swept power AM/PM & AM/AM

5.3 Swept power dynamic AM/PM & AM/AM

Corrected for group delay.
5.4 Swept frequency vectorial intermodulation (Memory effect analysis)

\[ Y_{m3-} = \frac{b_2(\omega - \omega_m)}{a_1^2(\omega)a_1^*(\omega + \omega_m)} \]

\[ Y_{m3+} = \frac{b_2(\omega + 2\omega_m)}{a_1^*(\omega)a_1^2(\omega + \omega_m)} \]

\[ |Y_{m3+} - Y_{m3-}| \]

\[ \angle(Y_{m3+} - Y_{m3-}) \]
5.5 EVM from acquired digitally-modulated RF signal

5.6 EVM in the presence of input/output interference (EMI)
Other Advanced Measurements:

6.1 Real-time load-pull with variable offset frequency

6.2 Active load-pull (2nd and 3rd harmonic control)

6.3 Pulsed-IV pulsed-RF load pull (impedance sweep)

6.4 Modulator/mixer characterisation (K-modeling, group delay, reciprocity)