

Simultaneous measurement of high and low frequency response of non-linear microwave devices

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Aim

❑ Characterization of Microwave Power Devices

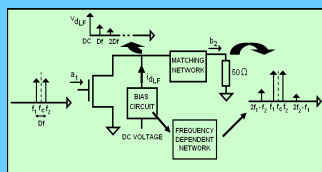
❑ Two-tone test

...and issues

❑ Spectral re-growth

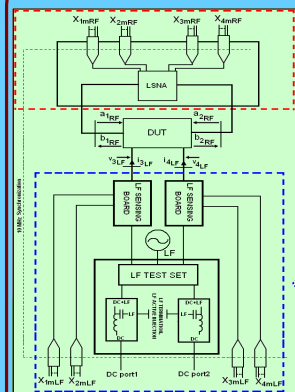
❑ Variation and asymmetry of IM3

❑ Long Term Memory Effects (LTMs)



RF response depends on input frequency offset

Measurement Set-Up



'LSNA'
CALIBRATED RF MEASUREMENTS
600 MHz-50 GHz

'DYNAMIC BIAS'
CALIBRATED LF MEASUREMENTS
10 kHz-24 MHz

DYNAMIC BIAS

- ❑ Four additional ADC channels to sample Low Frequency Voltage/Current
- ❑ LF Test Set
- ❑ LF Bias-Tees to separate DC&LF terminations
- ❑ LF Sensing Board to 'probe' Low Frequency Components

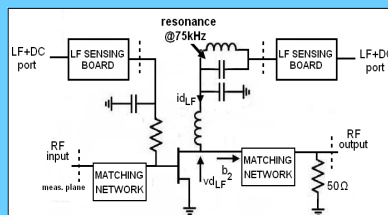
'3-STEPS' CALIBRATION

- ✓ RF SOLT+POWER&PHASE
- ✓ LF SOLT+POWER&PHASE
- ✓ PHASE ALIGNMENT
Correction for mismatch between RF and LF path

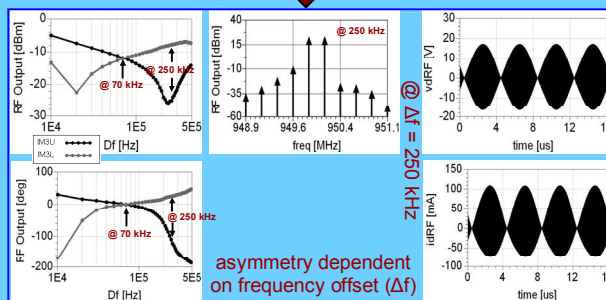
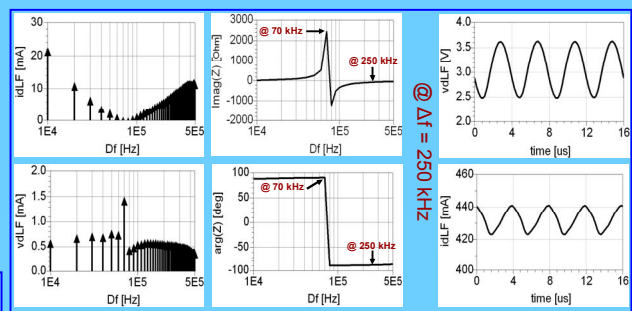
Case Study

- Two-Tone Measurement
- $V_{DD} = 3\text{ V}$
- GaAs transistor
- $I_{DDC} = 430\text{ mA}$
- $f_c = 950\text{ MHz}$
- 50 Ohm termination @RF
- $P_{in} = 0\text{ dBm}$ (for each tone)
- Short termination @LF

Experimental Results

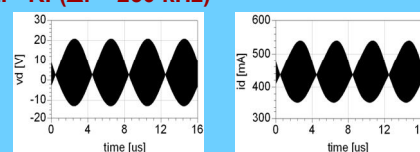


LF



asymmetry dependent on frequency offset (Δf)

DC+LF+RF($\Delta f = 250\text{ kHz}$)



Combined Low- and High Frequency Response