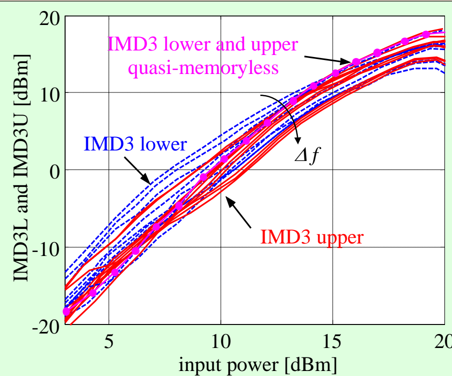
Effect of the Short Envelope Termination on the Measured Memory Effect in GaN HEMT Power Device

A. Ahmed, B. Bunz, E. R. Srinidhi, and G. Kompa

University of Kassel, Department of High Frequency Engineering, Wilhelmshöher Allee 73, D-34121 Kassel, Germany

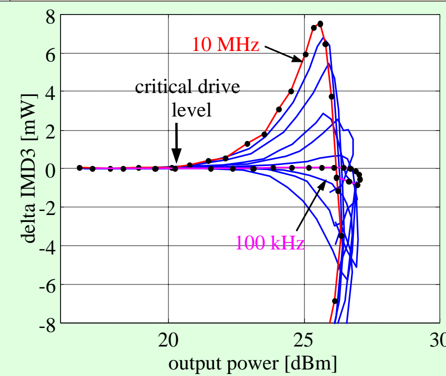
CHALLENGES AND AIMS

- Today's mobile communication requirements: high-power, efficiency, linearity data rate and broadband for high capacity with better service quality and multi-carrier capability
- In such applications power amplifier (PA) with wideband input signals are used wherein the memory effect cannot be neglected
- Dynamic characterization of memory effect is required to study and improve the nonlinearity in PA design (quasi-memoryless)
- Aim is to measure the memory effect in active power device without any influence of the external components used in the measurement setup
- Bias tee could be the main external component influencing memory effect [1]-[3]



DEFINITION OF MEMORY EFFECT AND ORIGIN

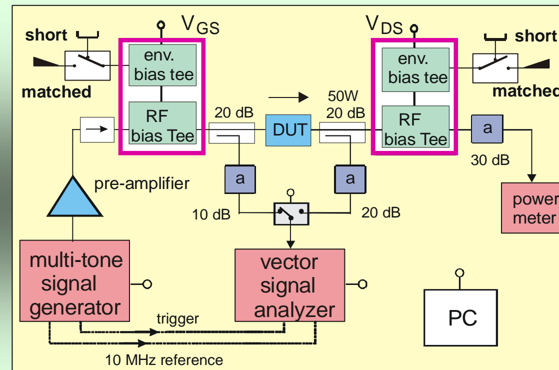
- **Definition:** Variation in the amplitude and phase of output signal as function of input signal envelope frequency
- **Location:** Active power device and bias networks
- **Indication:** Intermodultion distortion (IMD) dependent on the input signal envelope frequency and in some cases the asymmetry arising between lower and upper sideband
- **Cause:** The current variation from the dc power supply causes dc voltage variations, which results in an additional modulation in the RF signal
- **Solution:** Envelope bias tee should isolate the current variations in the power supply and terminated by Short [1], [3]



Combination of RF and Envelope Bias Tees with Short Envelope Termination to Reduce Memory Effect

SPECIFICATIONS

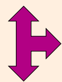
- Dynamic range: 70 dB
- RF bandwidth: 250 kHz - 2.7 GHz
- Envelope bandwidth: DC-36 MHz
- Maximum P_{out}: 50W (CW)
- Fully automatic
- Can be used for both active power device and power amplifier in 50-Ohm environment



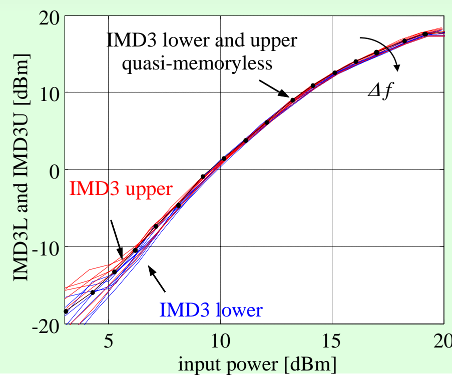
MEASURED CONDITION

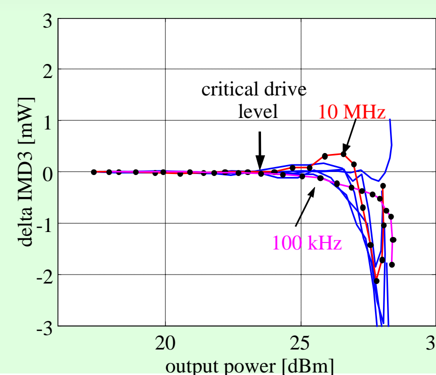
- Operating point: V_{DS} = 24V; I_D = 0.2A, 8x125 μm GaN device, wafer N707-4
- Two-tone stimulus with f_{center}: 2.15 GHz
- Input power sweep: 0 - 20 dBm
- Frequency spacing of tones: 100 kHz - 10 MHz (300 kHz step)
- Short envelope frequency termination was used

- IMD3 variation as a function of envelope frequency limited to 1.5 dB

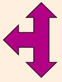


- Measured IMD3 of the GaN power device are treated as quasi-memoryless





- Asymmetry between lower and upper IMD is reduced and limited to < 1 mW at P_{1dB}



- More than 3 dB improvement in the critical drive level, above which the asymmetry occurs [3]

CONCLUSION

Combination of RF- and envelope-frequency bias tees with short envelope termination can effectively reduce IMD3 variations as function of envelope frequency and is much better than the measurement without envelope frequency termination

ACKNOWLEDGEMENT

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