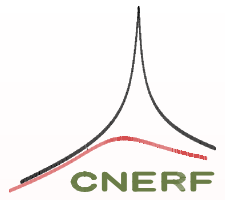


Symmetric HEMT Drain Current Model for Intermodulation Distortion Prediction

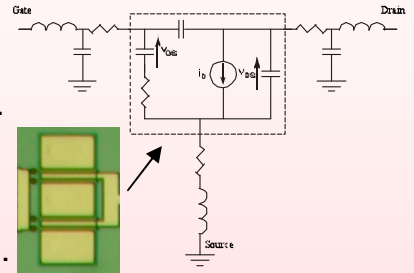


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1. Introduction

High Electron Mobility Transistors (HEMTs) used in MMICs cause distortion. The drain current nonlinearity is the most significant contributor to distortion.

Aim : To model the nonlinear drain current using a large-signal description. Accuracy with low-signal input is required to predict intermodulation distortion.



2. Drain current model

- Symmetry with respect to gate-drain and gate-source potentials guarantees continuity near $V_{DS} = 0$ (important for mixer and high-power amplifier simulations)

- The drain current (including self heating) is implemented as

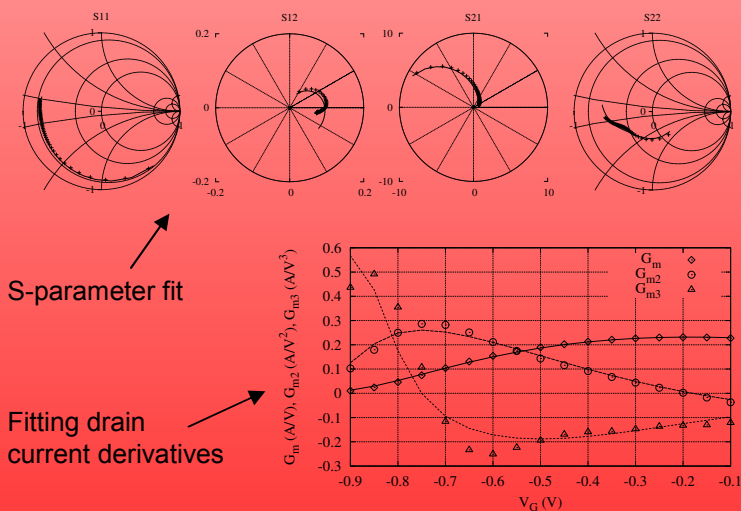
$$i_D = \beta [F(v_{GS}, v_{GD}) - F(v_{GD}, v_{GS})] (1 - \delta P)$$

- All functions are infinitely differentiable and smooth, and model HEMT derivative behaviour well

3. Model fitting

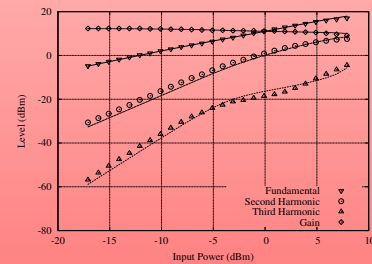
- The linear components are extracted analytically from S-parameter measurements over a grid of biases. Bias dependent intrinsic parameters are implemented as look-up tables.

- The nonlinear drain-current model parameters are extracted by comparing simulated and measured drain-current derivatives (ensuring accurate intermodulation distortion prediction)

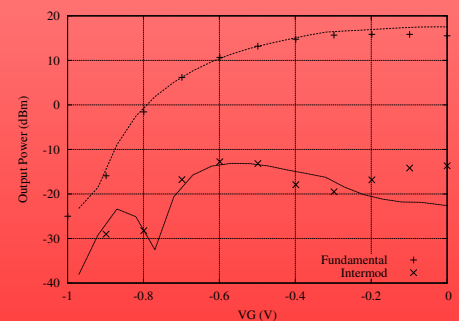
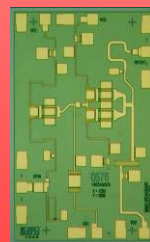


4. Nonlinear model verification

- 45MHz power compression measurements and simulations compared for a sample HEMT:



- Intermodulation distortion measurements and simulations compared for a 14GHz 2-stage amp



Department of Electronics