Abstracts

Nonlinear Modeling and Verification of MMIC Amplifiers Using the Waveform-Balance Method

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An accurate nonlinear MESFET model, a new amplifier large-signal simulation algorithm, and a reliable model verification approach are presented. The MESFET model is derived from S-parameter characterization of the MESFET using a wide range of bias voltages. This model is shown to be accurate at various frequencies, bias voltages, and input power levels. The nonlinear simulation utilizes a circuit analysis algorithm which we call the waveform-balance method. The algorithm is a hybrid method which uses both time-and frequency-domain analysis. Unlike the popular harmonic balance method, the solution is optimized in the time domain, where the closed-form error gradient matrix (Jacobian matrix) is calculated. This new algorithm is shown to have good convergence speed. To verify the MESFET model, two MMIC single-stage power amplifiers and test patterns of their matching circuits are designed. The load and source impedances presented to the MESFETs in the amplifier circuits are accurately determined by on-wafer S-parameter measurements of the amplifiers' matching circuits. These S-parameter data are directly used in the simulation of the MMIC amplifiers. The simulation results agree well with the measurement data.

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