Abstracts

Watt-level Ka- and Q-band MMIC power amplifiers operating at low voltages

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Ka- and Q-band watt-level monolithic power amplifiers (PAs) operating at a low drain bias of 3.6 V are presented in this paper. Design considerations for low-voltage operation have been carefully studied, with an emphasis on the effect of device models. The deficiency of conventional table-based models for low-voltage operation is identified. A new nonlinear device model, which combines the advantages of conventional analytical models and table-based models, has been developed to circumvent the numerical problems and, thus, to predict optimum load impedance accurately. The model was verified with load-pull measurements at 39 GHz. To implement a low-voltage 1-W monolithic-microwave integrated-circuit amplifier, careful circuit design has been performed using this model. A Q-band two-stage amplifier showed 1-W output power with a high power gain of 15 dB at 3.6-V drain bias. The peak power-added efficiency (PAE) was 28.5% and 1-dB compression power (P/sub 1 dB/) was 29.7 dBm. A Ka-band two-stage amplifier showed a P/sub 1 dB/ of 30 dBm with 24.5-dB associated gain and 32.5% PAE. Under very low dc power conditions (P/sub dc/<2 W, V/sub ds/=3.4 V), the amplifiers showed 29-dBm output power and PAE close to 36%, demonstrating ultimate low-power operation capability. To the best of our knowledge, this is the first demonstration of watt-level PA's under 3.6-V operation at 26 and 40 GHz. Compared with the published data, this work also represents state-of-the-art performance in terms of power gain, efficiency, and chip size.

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