Abstracts

A high-power and high-gain X-band Si/SiGe/Si heterojunction bipolar transistor

Zhenqiang Ma, S. Mohammadi, P. Bhattacharya, L.P.B. Katehi, S.A. Alterovitz and G.E. Ponchak. "A high-power and high-gain X-band Si/SiGe/Si heterojunction bipolar transistor." 2002 Transactions on Microwave Theory and Techniques 50.4 (Apr. 2002 [T-MTT]): 1101-1108.

A double mesa-type Si/SiGe/Si (n-p-n) heterojunction bipolar transistor (HBT) with record output power and power gain at X-band (8.4 GHz) is demonstrated. The device exhibits collector breakdown voltage BV/sub CBO/ of more than 24 V and a maximum oscillation frequency f/sub max/ of 37 GHz. Under continuous-wave operation and class-AB biasing conditions, 24.2-dBm (263-mW) RF output power with concurrent gain of 6.9 dB is measured at the peak power-added efficiency (28.1%) from a single ten-emitter fingers (780-/spl mu/m/sup 2/ emitter area) common-base HBT. The maximum RF output power achieved is as high as 26.3 dBm (430 mW in saturation) and the maximum collector efficiency is 36.9%. The low collector doping concentration together with the device layout result in negligible thermal effects across the transistor and greatly simplifies the large-signal modeling. The conventional Gummel-Poon model yields good agreement between the modeled and the measured de characteristics and small-signal S-parameters. The accuracy of the model is further validated with the measured power performance of the SiGe power HBT at X-band. These results set a benchmark for power performance for SiGe-based HBTs and indicate promise for their implementation in efficient X-band power-amplifier circuits.

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