Abstracts

Methods for measurement and simulation of weak substrate coupling in high-speed bipolar ICs

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On-wafer measurements of very weak substrate coupling in high-speed integrated circuits (ICs) at high frequencies suffer from the direct crosstalk between the input and output RF probes. Two alternative methods to reduce this effect are presented and compared. The first one is based on an advanced deembedding method that eliminates the crosstalk between the RF probes after measurement. The second method utilizes an on-chip broad-band amplifier between the input probe and the substrate test structure. Thus, for a given signal amplitude at the output probe, the amplitude of the input signal can be reduced, resulting in less distortion of the output signal by the crosstalk via the probes. Both methods are compared and verified by measurements up to about 20 GHz even at substrate coupling impedances as high as 0.5 M/spl Omega/ (corresponding to -80 dB in a 50-/spl Omega/ system). For this, several substrate test structures (some with the 20-GHz on-chip amplifier) have been designed and fabricated in an SiGe bipolar production technology with 20-/spl Omega/cm substrate resistivity. The measurement results agree well with simulation results using our substrate simulator SUSI. As a consequence, the inflexible, expensive, and time-consuming way to determine substrate coupling experimentally is no longer required in future IC designs-not even at very weak coupling and high frequencies. In this work, however, the proposed measuring methods had to be applied to verify the suitability of substrate simulation (with SUSI) under extreme conditions.

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