Abstracts

An MOS transistor model for RF IC design valid in all regions of operation

C. Enz. "An MOS transistor model for RF IC design valid in all regions of operation." 2002 Transactions on Microwave Theory and Techniques 50.1 (Jan. 2002, Part II [T-MTT] (Special Issue on Silicon-Based RF and Microwave Integrated Circuits)): 342-359.

This paper presents an overview of MOS transistor modeling for RF integrated circuit design. It starts with the description of a physical equivalent circuit that can easily be implemented as a SPICE subcircuit. The MOS transistor is divided into an intrinsic part, representing mainly the active part of the device, and an extrinsic part responsible for most of the parasitic elements. A complete charge-based model of the intrinsic part is presented. The main advantage of this new charge-based model is to provide a simple and coherent description of the DC, AC, nonquasi-static (NQS), and noise behavior of the intrinsic MOS that is valid in all regions of operation. It is based on the forward and reverse charges q/sub f/ and q/sub r/ defined as the mobile charge densities, evaluated at the source and at the drain. This intrinsic model also includes a new simplified NQS model that uses a bias and frequency normalization allowing one to describe the high-order frequency behavior with only two simple functions. The extrinsic model includes all the terminal access series resistances, and particularly the gate resistance, the overlap, and junction capacitances as well as a substrate network. The latter is required to account for the signal coupling occurring at RF from the drain to the source and the bulk, through the junction capacitances. The noise model is then presented, including the effect of the substrate resistances on the RF noise parameters. All the aspects of the model are validated for a 0.25-/spl mu/m CMOS process.

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