Abstracts

Performance of MODFET and MESFET, a comparative study including equivalent circuits using combined electromagnetic and solid-state simulator

S.M.S. Imtiaz and S.M. El-Ghazaly. "Performance of MODFET and MESFET, a comparative study including equivalent circuits using combined electromagnetic and solid-state simulator." 1998 Transactions on Microwave Theory and Techniques 46.7 (Jul. 1998 [T-MTT]): 923-931.

A combined electromagnetic and solid-state (CESS) simulation model for the analysis of submicrometer semiconductor devices including the electromagnetic-wave propagation effects is presented. The performance comparison of two important high-frequency devices-modulation doped field-effect transistor (MODFET) and metal-semiconductor field-effect transistor (MESFET)-are illustrated using this model. The CESS simulator couples a semiconductor model to the three-dimensional (3-D) time-domain solution of Maxwell's equations. The semiconductor model is based on the moments of the Boltzmann's transport equation. The simulation uses the electromagnetic-wave concept to emphasize the better performance of MODFET over MESFET. The electromagnetic-wave propagation effects on the two devices are thoroughly analyzed. The use of the electromagnetic model over the conventional quasi-static model provides the actual device response along the gatewidth at high frequencies. The exchange of energy between the electrons and the electromagnetic wave is observed. The CESS model also facilitates the optimum choice of the device width in terms of the output voltage. This model is capable of predicting the large-signal behaviour of the submicrometer devices as well. The equivalent-circuit parameters are extracted at high frequencies for MODFET and MESFET, using a time-domain approach as well as a quasi-static approach.

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