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PMOS SOI Transistor Device Modelling and Circuit Implementation

Vaibhav R. Ramachandran, Sutton R. Hathorn, and Saeed Mohammadi
Department of Electrical and Computer Engineering, Purdue University, West Lafayette, IN, 47906

ABSTRACT

Complementary Metal Oxide Semiconductor (CMOS) technology at the nanometre scale is an excellent platform to implement monolithically integrated systems because of the low cost of manufacturing and ease of integration. Newly developed CMOS Silicon on Insulator (SOI) transistors that are currently developed are suitable for use in radio frequency circuits. They find applications in many areas such as 5G telecommunication systems, high speed Wi-Fi and airport body-scanners. Unfortunately, the models for CMOS SOI transistors that are currently used in these circuits are inaccurate because of their complexity. The models currently used require the optimization of more than 200 variables. This paper aims to accurately create a scalable model of a P-type MOS transistor using a Virtual Source (VS) model with much less complexity. The VS model's DC characteristics will require the optimization of only ten parameters and is supplemented with parasitic resistances, inductances and capacitances to accurately predict behaviour at radio frequencies. These parameters were optimized two at a time using a multivariate optimization algorithm while fixing the remaining parameter's values within a certain range. A simulation of the voltage and current at the drain of the transistor was performed and the resulting I-V curves were plotted. A frequency simulation was also conducted in order to test the high frequency performance of the MOSFET. A typical I-V characteristic curve for a PMOS was obtained with no change in shape when the transistor width was scaled. The model's performance under high frequencies also matched those displayed by a standard 45nm PMOS. The I-V characteristic plots that were obtained displayed the general behaviour of a p-type MOSFET under those voltage conditions. This demonstrates that the Virtual source model is able to predict the general behaviour of the I-V characteristic curves of the p-type MOSFET as well as function properly at high frequencies typically seen in RF circuits.

KEYWORDS

CMOS SOI, microwave frequency circuits, Virtual Source model, high frequency model, noise