SiC JFET Transistor Circuit Model for Extreme Temperature Range

Simple modifications of common silicon model provide reasonable approximation from 25 to 500 °C.

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A technique for simulating extreme-temperature operation of integrated circuits that incorporate silicon carbide (SiC) junction field-effect transistors (JFETs) has been developed. The technique involves modification of NGSPICE, which is an open-source version of the popular Simulation Program with Integrated Circuit Emphasis (SPICE) general-purpose analog-integrated-circuit-simulating software. NGSPICE in its unmodified form is used for simulating and designing circuits made from silicon-based transistors that operate at or near room temperature.

Two rapid modifications of NGSPICE source code enable SiC JFETs to be simulated to 500 °C using the well-known “Level 1” model for silicon metal oxide semiconductor field-effect transistors (MOSFETs). First, the default value of the MOSFET surface potential must be changed. In the unmodified source code, this parameter has a value of 0.6,