

UHF AND L-BAND 4H-SiC RF BIPOLAR TRANSISTORS

F. Zhao¹, I. Perez-Wurfl¹, J. Torvik¹, B. Van Zeghbroeck^{1,2}

¹Boulder Advanced Technology Center, Advanced Power Technology, Boulder, CO 80301, USA

²Department of Electrical and Computer Engineering, University of Colorado, Boulder, CO 80309, USA

4H-SiC BJTs are promising RF power devices for radar, avionics and communication applications due to their ability to handle larger bias voltage and power density compared to their silicon counterparts, because of the 10 times larger breakdown field of SiC. The combination of these performance advantages with the superior thermal conductivity of SiC leads to compact and rugged RF power amplifiers for high power level and long pulse applications. Researchers at Advanced Power Technology have made significant progress towards developing high power RF 4H-SiC BJTs, and in this paper we will describe devices with potential for high power UHF and L-band operations.

UHF high power amplification was demonstrated using 4H-SiC BJTs fabricated on a conductive substrate with optimized design. Devices with the f_T/f_{MAX} of 2.5/2.4 GHz and blocking voltage larger than 200 V without junction termination were operated in class A. Under pulsed conditions at 450 MHz a maximum output power of 215 W was achieved with a power gain of 7.5 dB, corresponding to a power density of 4.13 W/mm.

4H-SiC BJTs with L-band performance were designed and fabricated on a semi-insulating substrate which completely removes the effect of the parasitic capacitance of the base-collector pads. A record f_T/f_{MAX} of 7/5.2 GHz was obtained. In class A operation at 1 GHz, devices exhibited 10 dB of power gain with less than 0.1 dB pulse droop and a peak power density of 2.3 W/mm under pulsed conditions, and 8 dB power gain at a power density of 1.6 W/mm under CW conditions. The RF performance remained practically unchanged from room temperature up to 75°C and the power gain decreased by slightly 1 dB at 125°C.

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1. (a) Feng Zhao
APT-CO
1855 S. 57th Ct.
Boulder, CO
80301 USA
fzhao@advancedpower.com
(b) 303-442-4250
(c) 303-442-4251
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