A 52GHz MMIC Power Amplifier with 28dBm Output Power using 90-nm GaN-on-SiC Technology

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This paper presents the design and performance of a 52-GHz power amplifier MMIC using the 90-nm gallium nitride (GaN) HEMT process from Qorvo on a 50-µm silicon carbide (SiC) substrate. The amplifier is designed with 4x40µm HEMT devices with an 18V drain supply voltage.

The two-stage MMIC amplifier is designed to give a minimum output power of 27dBm over the 49 to 55GHz frequency range, and peak power of 28dBm at 52GHz. Peak efficiency and large signal gain of the amplifier were simulated to be 9% and 9dB, respectively. Figure 1 shows the simulated output power, gain, and efficiency curves for the amplifier at 52GHz.

The amplifier is a two-stage architecture with a 2:1 drive ratio and a 4-way power combined output stage. Both the input driver stage and output power stage are biased in class A. Nonlinear models of the 4x40µm devices are used in a harmonic balance analysis with the 3MI Qorvo process design kit (pdk). The output stage of the amplifier is optimized for maximum output power through load-pull simulations. Stabilization networks are required due to very high low-frequency gain of the device, and two effective circuit topologies are used on the gate bias lines of the amplifier for low frequency stability. The fabricated die size for the amplifier is 2.3x2.3mm^2 and is shown in Figure 2.

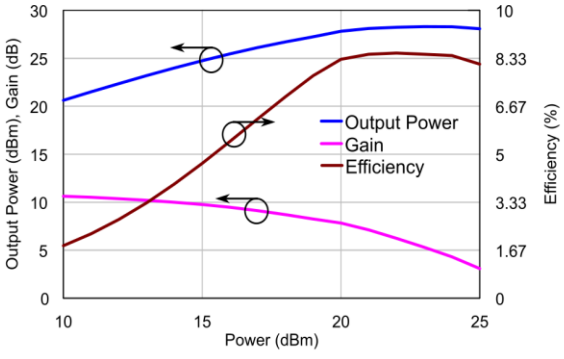

Figure 1. Simulated performance of amplifier at 52GHz.

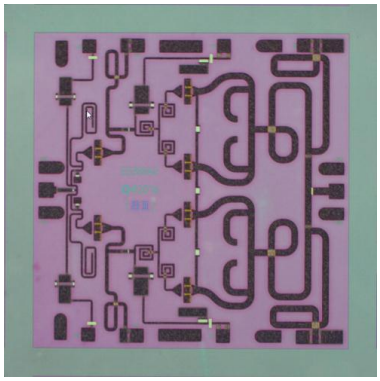

Figure 2. Fabricated power amplifier MMIC