

A Ku/K Band Power Amplifier for Wireless Communication and Radar Systems

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Abstract : Wide-band devices in Ku band (12-18 GHz) and K band (18-27 GHz) have received significant attention for high-data-rate communications and high-resolution sensing. Especially, devices operating around 24 GHz is attractive due to the 24-GHz unlicensed applications. One of the most important components in RF systems is power amplifier (PA). Various PAs have been developed in the Ku and K bands on GaAs, InP, and silicon (Si) processes. Although the PAs using GaAs or InP process could have better power handling and efficiency than those realized on Si, it is very hard to integrate the entire system on the same substrate for GaAs or InP. Si, on the other hand, facilitates single-chip systems. Hence, good PAs on Si substrate are desirable. Especially, Si-based PA having good linearity is necessary for next generation communication protocols implemented on Si. We report a 16.5 to 25.5 GHz Si-based PA having flat saturated power of 19.5 ± 1.5 dBm, output 1-dB power compression (OP1dB) of 16.5 ± 1.5 dBm, and 15-23 % power added efficiency (PAE). The PA consists of a drive amplifier, two main amplifiers, and lump-element Wilkinson power divider and combiner designed and fabricated in TowerJazz 0.18 μ m SiGe BiCMOS process having unity power gain frequency (fMAX) of more than 250 GHz. The PA is realized as a cascode amplifier implementing both heterojunction bipolar transistor (HBT) and n-channel metal-oxide-semiconductor field-effect transistor (NMOS) devices for gain, frequency response, and linearity consideration. Particularly, a body-floating technique is utilized for the NMOS devices to improve the voltage swing and eliminate parasitic capacitances. The developed PA has measured flat gain of 20 ± 1.5 dB across 16.5-25.5 GHz. At 24 GHz, the saturated power, OP1dB, and maximum PAE are 20.8 dBm, 18.1 dBm, and 23%, respectively. Its high performance makes it attractive for use in Ku/K-band, especially 24 GHz, communication and radar systems. This paper was made possible by NPRP grant # 6-241-2-102 from the Qatar National Research Fund (a member of Qatar Foundation). The statements made herein are solely the responsibility of the authors.

Keywords : power amplifiers, amplifiers, communication systems, radar systems

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