ABSTRACT

A dual-path wide-power-range rectifier for RF energy harvesting is presented in this thesis. The proposed idea focuses on maximizing efficiency in harvesting energy from both ambient source and dedicated source to support extensive applications in wireless charging for low power devices. The harvester consists of a low power rectifier, a high power rectifier and a voltage-aware block. In the low power rectifier, novel DC-boosted gate bias technique is proposed to enhance power conversion efficiency (PCE) by improving forward peak current, reducing diode forward voltage drop and suppressing reverse leakage current. A novel internal body-biasing technique is proposed in the high power rectifier to regulate the transistors' threshold voltage (V_{th}) for optimal efficiency. A voltage-aware block, which consists of a voltage detector, a switch and an adjustable-offset comparator, has been incorporated into the high-power rectification path to minimize overall power consumption.

The proposed circuit is fabricated in 65 nm 6M/1P standard CMOS technology. Peak PCE of 70.4% with DC output voltage of 1.72 V is measured on the low power rectifier with input power of -5.5 dBm at 2.45 GHz when driving a 15 kΩ load. For high power rectifier, maximum PCE of 56.6% with DC output voltage of 3.37 V is measured with input power of 1.3 dBm at 2.45 GHz when driving a 15 kΩ load. The chip is able to achieve PCE greater than 20% over an extended input power range of 19.8 dB from -13.5 dBm to 6.3 dBm.