Due to continued scaling device dimensions, CMOS transistors in the nanometer regime have resulted in major reliability and variability challenges. Reliability issues such as channel hot electron injection, gate dielectric breakdown, and negative bias temperature instability (NBTI) needed to be accounted for in the design of robust RF circuits. In addition, process variations in the nanoscale CMOS transistors are another major concern in today’s circuits design.

An adaptive gate-source biasing scheme to improve the RF circuit reliability is presented in this work. The adaptive method automatically adjusts the gate-source voltage to compensate the reduction in drain current subjected to various device reliability mechanisms. A class-AB RF power amplifier shows that the use of a source resistance makes the power-added efficiency robust against threshold voltage and mobility variations, while the use of a source inductance is more reliable for the input third-order intercept point.

Injection locked voltage-controlled oscillators (VCOs) have been examined. The VCOs are implemented using TSMC 0.18 Åµm mixed-signal CMOS technology. The injection locked oscillators have improved phase noise performance than free running oscillators.

A differential Clapp-VCO has been designed and fabricated for the evaluation of hot electron reliability. The differential Clapp-VCO is formed using cross-coupled nMOS transistors, on-chip transformer/inductor, and voltage-controlled capacitor. The experimental data demonstrate that the hot carrier damage increases the oscillation frequency and degrades the phase noise of Clapp-VCO.

A p-channel transistor only VCO has been designed for low phase noise. The simulation results show that the phase noise degrades after NBTI stress at elevated temperature. This is due to increased interface states after NBTI stress. The process variability has also been evaluated.

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The public is welcome to attend.