ABSTRACT

This thesis discusses new approaches for noise reduction in RF oscillator circuits, Phase Noise extraction and oscillator noise measurement using an enhanced PLL circuit.

First, an efficient low phase noise oscillator design proposed using a high Q resonator and harmonic suppression filter. The oscillator is designed using a combined bandpass filter (BPF), which is used as a feedback element to an amplifier. The filter consists of an embedded spur line filter in the L-shaped input and output section which encloses a perturbed square ring. All of these sections are assembled to form a combined BPF which gives an excellent suppression of second and third harmonics. Low phase noise oscillator results are evaluated at 2 V power supply. The measured results show the fundamental frequency at 2.4 GHz, total output power of 14.92 dBm, phase noise −130.7 dBc/Hz at 1 MHz offset frequency, figure of merit (FOM) −175.64 dBc/Hz, reduction in 2nd and 3rd harmonics to below −45 dBm and DC-to-RF efficiency of 51.73%.

In the second part of this dissertation work, A simple method shown for phase noise extraction using a BJT nonlinear Ebers Moll model on a Colpitts oscillator. Simulation results are consistent with Leeson's theory and the magnitude of the sidebands directly scales with the magnitude of input noise. Furthermore the VCO phase noise is analysed with respect to Power supply noise and varactor non-linearity. The simulation shows phase noise is mostly affected at small offsets and in good agreement with the experimental data.

An Enhanced Phase Locked Loop (EPLL) was used for oscillator noise measurement. The EPLL has two feedback loops: phase locked loop (PLL) for phase estimation and amplitude locked loop (ALL) for amplitude estimation. The presented method was also used for estimating

fundamental signals along with phase noise and amplitude noise simultaneously. This is followed by a circuit simulation, whose results were found to be close with the measured results for 100 MHz operations. Measurement results demonstrate that in steady-state EPLL shows less phase noise especially at close offset frequencies and comparable phase noise at higher frequencies when compared with conventional PLL.

The EPLL is expected to be useful for on-chip use, in particular with complex systems-on-chip, where in-situ monitoring of oscillator noise is required.