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A Low-Voltage and Low-Power 3-GHz CMOS LC VCO for S-Band Wireless Applications

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Abstract: In this paper presents integrated low-power CMOS LC voltage-controlled oscillator (VCO) by using complementary cross-coupled pair of CMOS. A fully integrated 0.13-μm CMOS LC-tank voltage-controlled oscillator (VCO) suitable for low voltage and low-power S-band wireless application. This structure can be widely used in wireless communication. Technique is employed two cross-coupled pairs by adopting admittance-transforming. Using forward-body-biased metal oxide semiconductor field effect transistors. Despite the low power supply near threshold voltage. Proposed VCO achieves phase noise of −110.1 to -130dBc/Hz at 1MHz offset. Tuning range 29.2% to 45.1 % while consuming only 594 μW in 0.4V supply. Tuning range of the proposed VCO is −192.1db to -225.4 dB at 3GHz.

Keywords: ADS (Advance Design System) VCO, phase noise

1. INTRODUCTION

Integrated LC VCO used as an input for mixers to up- and down-convert signals and importance in fully integrated transceivers. . The strong combination of very low phase noise specifications with very low power consumption pushes designers to use LC-VCO. Therefore, this phase noise affects selectivity and sensitivity and dynamic range of the wireless receiver system. A fully integrated CMOS LC voltage controlled oscillator (VCO) is proposed to achieve low phase noise and low-power consumption[1].

Low-power design techniques to enhance and to improve their portability. This work aims at the optimized design of all integrated VCOs providing differential outputs with power consumption lower than external VCO modules and lower phase noise. A great research effort has been invested in the design of integrated voltage controlled oscillators (VCOs) integrated external resonators, but as their power consumption is still unacceptable, commonly mobile phones use external LC-VCO modules [1].. Oscillators are one of the most common functional blocks in communication stems Proper amplitude and low phase noise are two key criteria to achieve suitable performance for a VCO in any transceiver The transmitter its phase noise results in energy being transmitted outside of the desired band. complementary structure can ensure bigger range of control voltage and oscillation amplitude, thus control sensitivity Kvco will be smaller.

2 PROPOSED WORK

2.1 Introduction to Voltage-Controlled Oscillator

Oscillators play critical role in communication systems, providing periodic signals Required for timing in digital circuits radio frequency (RF) circuits frequency translation . While oscillators can be anything that exhibits periodically time-varying characteristic, this dissertation is concerned with an electrical signal at a specific frequency. it is used for frequency translation, often refer tank oscillator as the When used with a mixer, allows frequency translation channel selection of RF signals. The typical transceiver is mixers and are used to down-convert the RF signal to a intermediate frequency (IF) to up-convert the IF signal to a higher RF frequency. Because the IF frequency fixed, the channel of interest is selected by varying the frequency is often implemented as (PLL) in which a voltage controlled oscillator (VCO) is phase-locked to a high-stability.

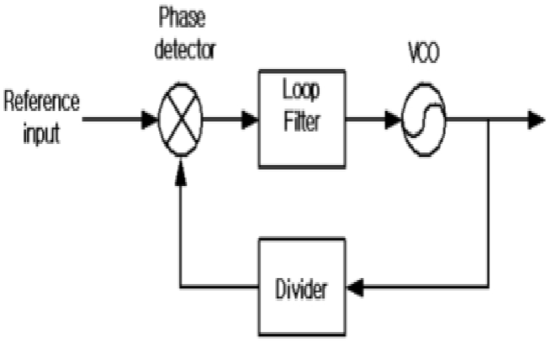

Fig 1- Simplified block diagram of a Typical VCO

2.2 Admittance-Transforming Technique

Several differential cross-coupled LC VCO topology proposed. The complementary cross-coupled VCO topology is to reduce1/f noise .However, this topology is not suitable low supply voltage because of the voltage cut down by the PMOS and the tail current source. The modified topology as in better suited for near threshold supply voltage since no longer limited by the current source NMOS. Q factor of the resonator degrades significantly at high frequencies and the output voltage swing will be limited due to the degraded MOSFET trans-conductance. For a sustained oscillation, transistor switch

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large aspect ratios of required cross-coupled pair resulting in capacitive loading to tank. To overcome the limitation, a negative conductance enhance cross-coupled pair, which consists of the MOSFET switch enlarged device size and forward-body bias is proposed, . The equivalent circuit is shown in, where M 3 and M4.

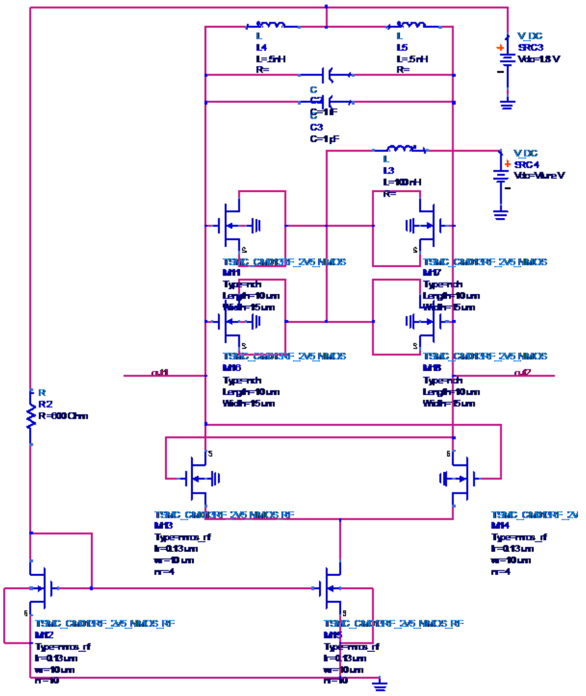

Fig-2 Schematic Of Purposed VCO

2.3 Forward-Body-Biased Technique

At a low supply voltage (like0.4V),the NMOS transistors are still in weak inversion region, which can lead to increased noise figure (NF). In order to solve this problem, a forward body-biased technology is used to further reduce VTH. The threshold voltage of MOSFET

$$V_{th} = V_{tho} + [(2\psi f - V_{bs})^{1/2} - (2\psi f)^{1/2}].$$

Where V_{tho} is the threshold voltage at $V_{bs} = 0$, γ is the body effect coefficient, ϕf is the bulk Fermi potential, V_{bs} is the voltage between body and source terminal.

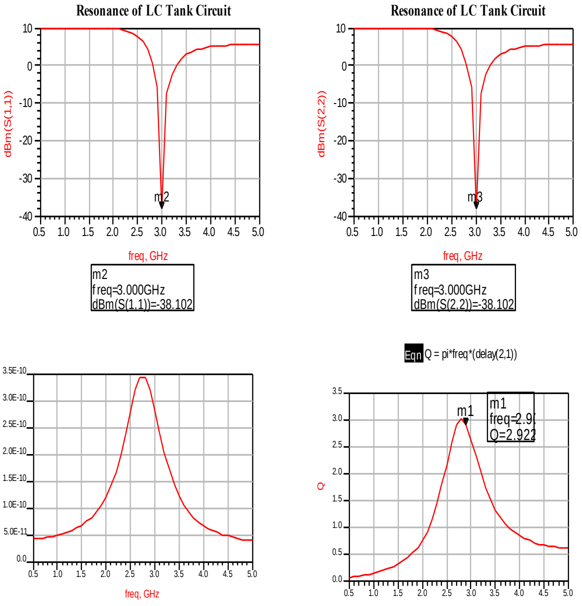

Fig 3- LC tank VCO out put waveform

$$W = 1/2\Pi(LC)^{1/2}$$
$$R_{tank}(f) = (R_s{*}Q^2)||(R_s{*}Q^2)$$
$$Q_L(f) = w\, L_s/R_{s\text{-}C}$$
$$Q_c(f) = 1/\, W\, R_{s\text{-}C}$$

where Rs -L and Rs-C are the parasitic capacitance C and inductance L.Q is quality factor.

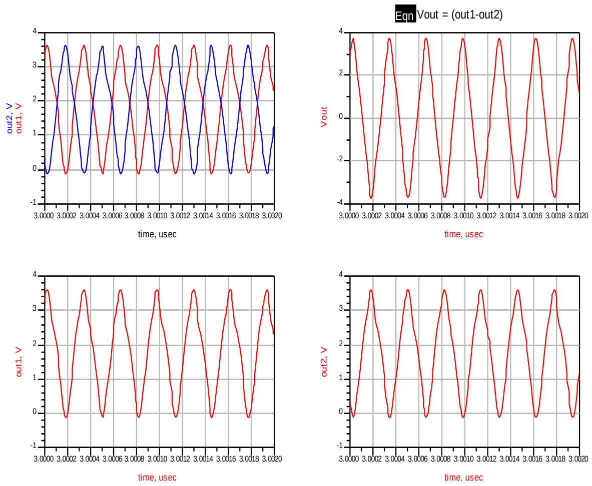

Fig 4- VCO input output waveform.

3 SIMULATION RESULTS

Schematic of differential cross-coupled CMOS LC-tank VCO circuit shown in Fig.. The LC VCO is comprise of two cross-coupled pair configuration of capacitive feedback structures, one voltage two buffers, all of NMOS device adopt forward body biased technology is to minimize the power consumption. The VCO is tuned by the standard mode NMOS low losses, low noise and high tuning range. The proposed VCO is designed by 0.13 technology. The layout is shown in fig.

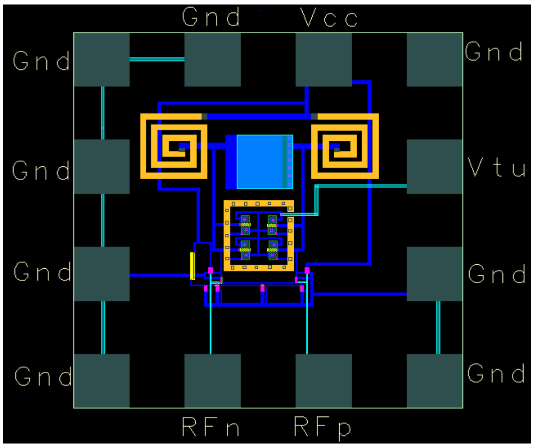

Fig 5-The layout purposed LC VCO.

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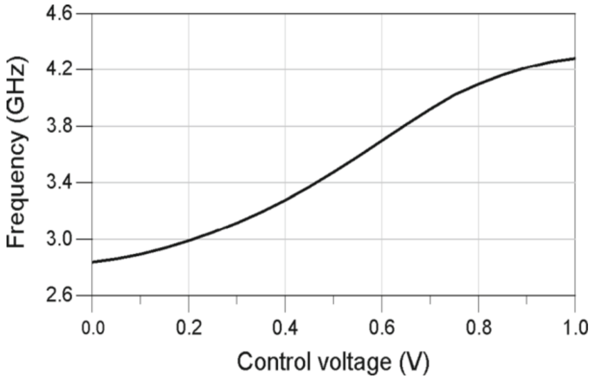

Fig- Tuning range of the proposed VCO

4. CONCLUSION

A 3GHz, low-power, differential, fully LC VCO with two cross-coupled pair configuration implemented using 0.13-µmCMOSprocesses has been presented. He VCO is operated from 2.84 to 4.23GHz with a 9.3%tuning range and exhibits the phase noise of−120.1 dBc/Hz at the offset frequency of 1MHz at a low-power consumption of 562 µW. In comparison with the published VCOs, this differential CMOS LC VCO achieve excellent performance of the power consumption with a comparable FOM and FOMT of −192.1 and −205.2 dBc/Hz, respectively. It provide an improved technique to realize the low-power VCOs and is suitable for S-band wireless applications.

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