

A Novel Low-Phase Noise CMOS QVCO Using Coupled Substrate

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ABSTRACT: The usage of analog devices are minimized in the proposed quadrature VCO circuitry so, its leads to reduce power and phase noise. The Proposed QVCO is made of two similar differential Colpitts VCOs which are connected in an “in-phase anti-phase” manner. Two core vcocs are used for coupling, the substrates of the cross connected transistors as well as the substrates of MOS varactors are used. Power can be reduced by using this technique. There is no extra connecting devices are used, also a power saving circuitry is used which will reduce power usage and delay. The power is reduced up to 8 nW .

KEYWORDS: quadrature oscillator, low power, multiphase , MOS varactor, , low-phase noise, in-phase injection-coupled

I. INTRODUCTION

The approach of QVCO mostly considerations on low phase noise, small voltage, and low-power. Important characteristics of a VCO is the tuning range, tuning gain and phase noise . Generally low phase noise is preferred in the VCO. The noise present in the tuning gain and the control signal affect the phase noise, high tuning gain or high noise imply more noise . By using transformed coupling methods ,Several types of VCOs are used to create quadrature signals [1]. One of the most common LC-tank oscillators is the equivalent LC-VCO; By using simple coupling ways this can be coupled to generate quadrature signals. Advantage of this structure has the generating symmetric waveforms and reducing the up-conversion gain of low frequency phase noise. The quadrature oscillator is the one kind of phase shift oscillator. In VCO the input signal has some jitter, will oscillate those jitter in normal VCO due to that the delay is increase and it also affects the data matching signal. To incredulous this removing jitters by using QVCO. The most representative design for QVCO utilize two differential cross-coupled VCOs with coupling networks to approve the two VCOs work in quadrature phase.[2] Injection-locked LC quadrature voltage-controlled oscillators (LCQVCOs) conventional on First-harmonics and super-harmonics[3],[4].

Injections have become generally accepted in RF circuits. Through RF circuit design, low power consumption is a very important consideration; the voltage controlled oscillator (VCO) in a wireless communication also shows an important role .

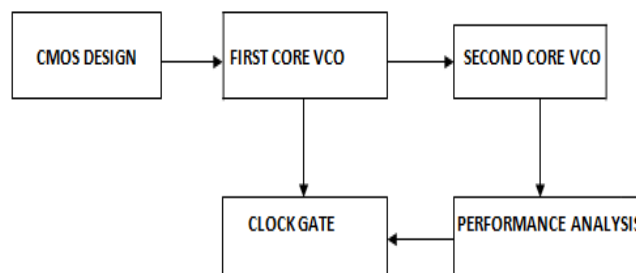


Fig 1: Block Diagram Of QVCO

Power Consumption are reduced by using injection locking technique and also possibly reduce phase noise. Injection locked oscillator is based on cross coupled LC oscillator. LC-QVCOs have two main parts: a pair of identical LC-VCOs and a coupling system, this two pairs are contribute to the overall QVCO performance.

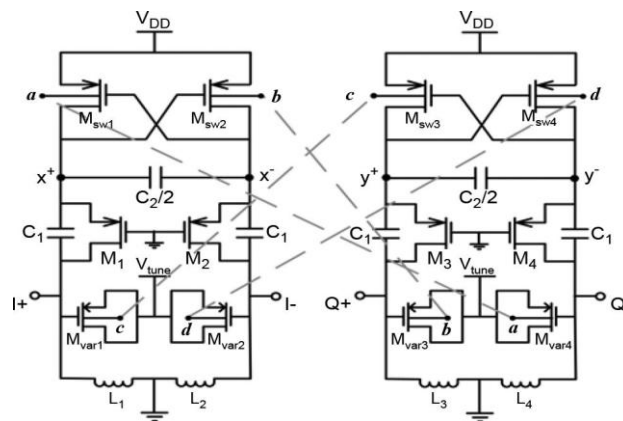


Fig 2. Schematic of existing two core QVCO (In The Proposed System Analog Devices Of L1, L2, L3, L4 and C2 are reduced)

The coupling network are improved by using a variability of active or passive components[3],[4]. In the Colpitts QVCOs extra devices are used for coupling; this can let dispirited the overall operation of the QVCO and increase the chip area. Additionally, any divergences among coupling procedures may disturb the balance of the circuit, leading towards phase inaccuracy. This work delivers a new low-phase noise low-power quadrature voltage-controlled oscillator in which two identical current-switching differential Colpitts VCOs are together without excess coupling devices that could possibly degrade the phase noise and power intake.

II. RELATED WORKS

F.Vergin Jeyaseeli 1, S.Udhaya Kumar Proposed the Paper “Low Power Colpitts QVCO Using Coupling” describe this paper a new low-phase noise low-power QVCO using differential Colpitts oscillator. Problem of this paper is area should be more , so Mismatch will be occur. Using this technique power can be reduced. advantages of this technique is good wave purity, good stability and fine performer at high frequency [2][8].

vergin jeyaseeli, udhaya kumar Proposed the paper “low power qvco using adiabatic logic” describe this paper Injection locked LC quadrature voltage controlled oscillators (LCQVCOs) conventional on super harmonics and First harmonics, injection have become generally popular in RF circuit. Main problem of this paper is area should be more, Mismatch is high its leads to reduce Power and phase noise also decrease the power dissipation[4].

fahmidakhatoon, tarana afrin chandel. Proposed the paper “design of low power, high speed differential amplifier ring voltage controlled oscillator in cmos technology” describe this paper increases the demand of portable electronic and wireless communication products, to make the devices are more portable its provide the attention. Problem of this paper is more harmonics its leads to obtain the low power[3].

Xiang Yi. Proposed the paper “A 57.9-to-68.3 GHz 24.6 mW Frequency Synthesizer With In-Phase Injection-Coupled QVCO in 65 nm CMOS Technology” describe the In-phase Injection-coupled Quadrature Voltage-controlled Oscillator (IPIC-QVCO) technique. Problem of this paper is high power is required for the LC components. benefit of this paper is Low Phase noise and phase error is occur.[5][1]

jian chen . proposed the paper “ Low Noise Oscillator in ADPLL toward Direct-to-RF All-digital Polar Transmitter” described the lower oscillator phase noise technique and ADPLL quantization noise. problem of this paper is circuit is very large so required high power in this circuit, so its provide the clear output Swing also provide better oscillating frequency [6][13].

III. ANALYSIS OF THE PROPOSED QVCO

The quadrature VCO is shown in Fig.1. The block is consist of five modules CMOS Design, First core VCO, Second core VCO, Performance Analysis, and finally Clock Gating i.e., Power Saving Circuitry. The proposed Designing circuitry is made of two similar differential Colpitts VCOs which are connected in an “in-phase and anti-phase” manner. In coupling Without any extra connecting devices are used its leads to reduce power and phase noise (usage of analog device’s are minimized).

As shown in Fig. 2, extra connecting devices are used, for coupling part that could potentially increase power usage and delay and phase noise.

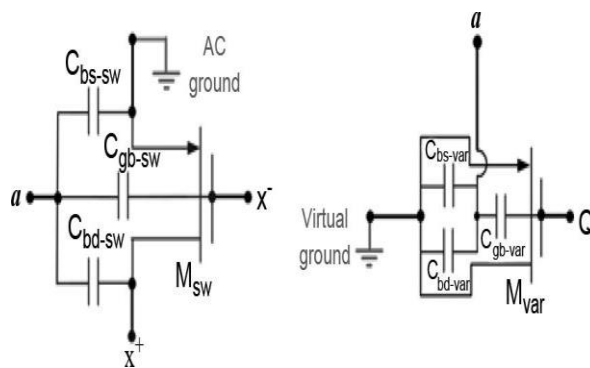


Fig. 3. Intrinsic capacitances that play the role of coupling elements.

As illustrate in Fig.2 the bulks of the switching transistors of the first core VCO are connected in an anti-phase manner to the bulks of the MOS varactors of the second VCO, and the bulks of the switching transistors of the second core VCO are connected to the bulks of the MOS varactors of the first VCO in an in-phase scheme. The PMOSFETs are placed in separate wells, their bulks can be connected to different potentials.

As shown in Fig. 3, the bulk-drain and the gate-bulk capacitances of the switching transistors, and the gate-bulk capacitances of the MOS varactors play the role of coupling devices and provide the injection path for coupling signals, thus reduce the required for any extra AC coupling capacitors and DC biasing resistors [11]. Further-more, to reduce the noise contribution of the core VCOs to the overall phase noise, First core VCOs are produced by 90° phase Shift similarly Second core VCOs are Produced. proposed QVCO Output are getting on “In Phase and Anti Phase manner” i.e., I+, I- and Q+, Q-. Due to the symmetry of the existing QVCO circuit in Fig. 2 the amplitude of all the output voltages (i.e., I± and Q±) are equal. Because of the differential structure of the two core VCOs, there is a 180° phase difference between the potentials of the nodes I+ and I- also Q+ and Q-. The potentials at nodes I+ and Q+ are denoted with V and $V e^{j\phi}$ in phasor domain, respectively, with V is the voltage amplitude and ϕ is the phase difference between potentials of nodes I+ and Q+[1]. Next describe the QVCO result and discussion of phase noise and power.

IV. RESULT AND DISSCUSSION OF QVCO

The proposed of two core quadrature VCO is designed and simulated in a standard 0.18- μ m RF-CMOS technology. The performance is compared to previous report. In the tank circuit part without parasitic element are imposed so get the result in a wide tuning range. This QVCO design’s are done in TANNER EDA and usage of analog devices are reduced so, its leads to reduce power up to 8nw and Phase noise up to -67.5 dBc/Hz at 1Mhz. Design of two core VCO is given below.

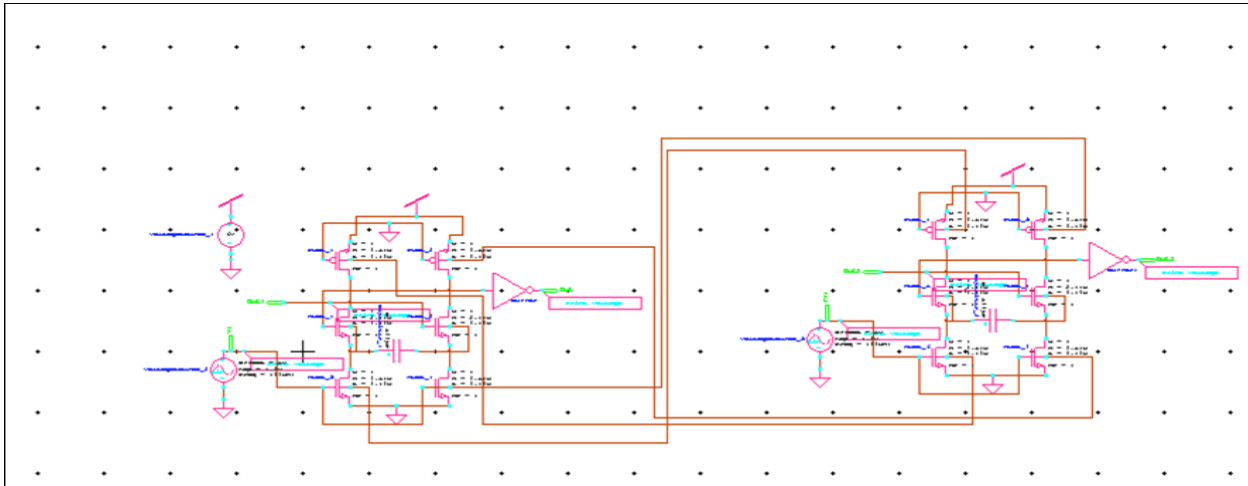


Fig 4. Schematic diagram of proposed QVCO

The Schematic diagram shows the two core VCO design. First core VCO design are connected to the second core VCO design. As well as same the second core VCO. First VCO design are produced by 90° phase difference also the second VCO design. Two core VCO's are design without any extra connecting devices also minimize the usage of analog devices so, its leads to reduce power up to 8nw and phase noise up to -67.5 dBc/Hz.

Below fig 5. Shows the four stage outputs are getting on” in phase and out phase manner” also minimize the noise because the usage of analog devices are minimized.

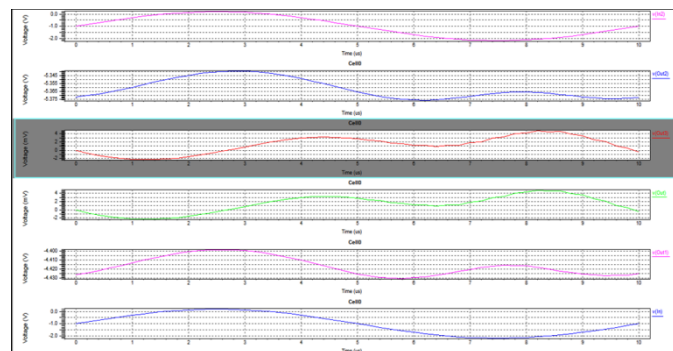


Fig 5. Output voltage of two core VCO

First one and last one both are input, middle of the four stage are output. Using the differential structure of the two core VCOs, provide the amplitude of all the output voltages (i.e., I_{\pm} and Q_{\pm}) are equal. There is a 180° phase difference between the potentials of the nodes I_{+} and I_{-} . power output are given below

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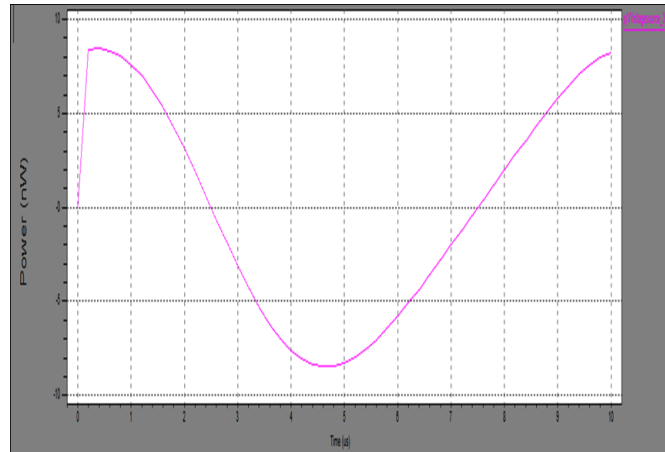


Fig 6.output power of two core VCO

Fig 6 shows the QVCO output power, in the proposed method 8nw power is achieved because analog devices of inductor and capacitor are reduced (extra connecting device are reduced in the coupling part) compared to existing method. Two core VCO Phase noise output are given by

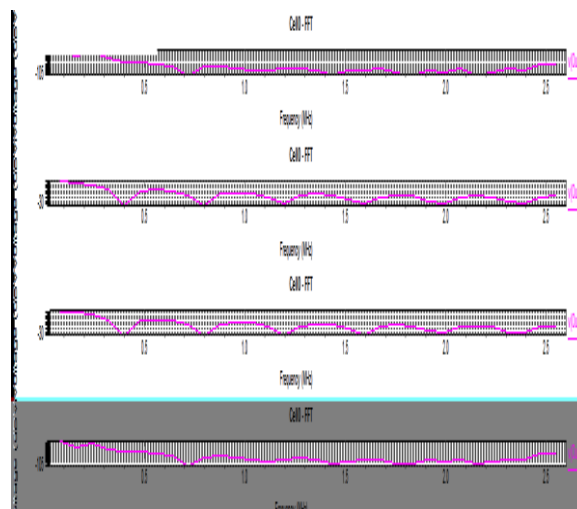


Fig 7. Two core VCO phase noise output

Fig 7.illustrate the output of phase noise, -67.5 dBc/Hz output
phase noise are getting because the usage of analog devices are
phase noise are getting because the usage of analog devices are minimized.

V. CONCLUSION

Injection- locked quadrature oscillators are typically comprised of two distinct parts: two core VCOs and several coupling devices, in which each part contributes to the phase noise performance. To enhance the phase noise performance of the overall QVCO, the noise contribution of each part should be minimized. Two core VCOs are connected without any extra coupling devices, its lead to reduce the power and phase noise.

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