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Low Power Colpitts QVCO Using Coupling

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Abstract- A new low-phase noise low-power quadrature voltage-controlled oscillator (QVCO) using differential Colpitts oscillator is proposed. Power can be reduced by using this technique. The QVCO is a collection of two identical current-switching differential Colpitts VCOs in which the first core VCO is attached to the second in an in-phase manner, and the second core VCO is tightly coupled to the first in an anti-phase manner. To combine the two core VCOs, the Substrates of the cross-connected transistors as well as the substrates of MOS varactors are used; they need not for any extra elements for coupling, which could reduce the noise and decrease the power dissipation. The power is reduced up to 0.18 mW in QVCO and 0.016 mW in colpitts. The coupling method can be generalized to N differential Colpitts VCOs for multiphase signal generation.

Key words- **Current-switching Colpitts-oscillator, multiphase, quadrature oscillator, MOS varactor, low power**

I. INTRODUCTION

The quadrature VCO is one of the important components in direct-conversion of fully-integrated radio-frequency transceiver scheme. The strategy of QVCO largely focuses on small voltage, low phase noise and low-power. Several categories of VCOs are used to generate quadrature signals by altered coupling methods. One of the most common LC-tank oscillators is the corresponding LC-VCO; this can be coupled to generate quadrature signals using simple coupling ways. This structure has the advantage of generating symmetric waveforms and reducing the up-conversion gain of low frequency noise. The quadrature oscillator is another kind of phase shift oscillator. The difference is that the quadrature oscillator uses an op amp integrator to obtain a full 90° phase shift from a particular RC sector, and still create a functional output voltage. Amplitude control can be an issue, and too high amplitude indications to alteration of the waveform. To boundary of the output amplitude, particular circuits practice a couple of back-to-back Zener diodes or selected corresponding circuit to clip the signal fed back from the Cosine output to the Sine integrator. For all RC fragments are also low-pass filters, the distortion formed by the clipping action are considerably reduced, and both the output is good quality sine and cosine waves.

In VCO the input signal has some jitter, those jitter will oscillate in normal VCO due to that the delay is increase and it affects the data matching signal. To overcome this removing jitter by using QVCO. The most democratic design for QVCO employs two differential cross-coupled VCOs with coupling networks to confirm the two VCOs work in quadrature phase. One regularly used QVCO uses four coupling transistors whichever in parallel to or in series by the resonator, and the other is created on synchronization of the second harmonic signals through a transformer. Different procedures used for quadrature signal generation. Injection-locked LC quadrature voltage-controlled oscillators (LCQVCOs) established on First-harmonics and super-harmonics, injection have become generally popular in RF circuits.Through RF circuit design, low power consumption is a very significant consideration; the voltage controlled oscillator (VCO) in a wireless communication also plays an important role. The technology of current reuse and low voltage supply for low power consumption, such as less than 1mW voltage controlled oscillator (Sub-1mW VCOs).

LC-QVCOs have two main parts: a pair of identical LC-VCOs and a coupling system, both of which contribute to the overall QVCO performance. Improving the coupling network by using a selection of active or passive components. In the Colpitts QVCOs extra devices are used for coupling; this can let down the overall operation of the QVCO and increase the chip area. Additionally, any mismatches among coupling devices may interrupt the symmetry 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.In this paper the Section II enclosed the proposed colpitts QVCO. And the Section III indicates the simulation results. Finally, Section IV is the conclusion.

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II. THE PROPOSED QVCO AND COLPITTS

The schematic of the proposed QVCO circuit is shown in Fig.1. The circuit is mainly consists of two identical switching differential Colpitts VCOs which are interconnected in an “in-phase anti-phase” scheme. Fig. 1 shows, no coupling devices are added together, and thus no additional sources of noise and power consumption are introduced.
The main part of the switching transistors of the first core VCO are coupled to the bulks of the MOS varactors of the second core VCO in an “anti-phase” fashion, and the bulks of the switching transistors of the second core VCO are attached in an “in-phase” way to the majorities of the MOS varactors of the first core VCO.

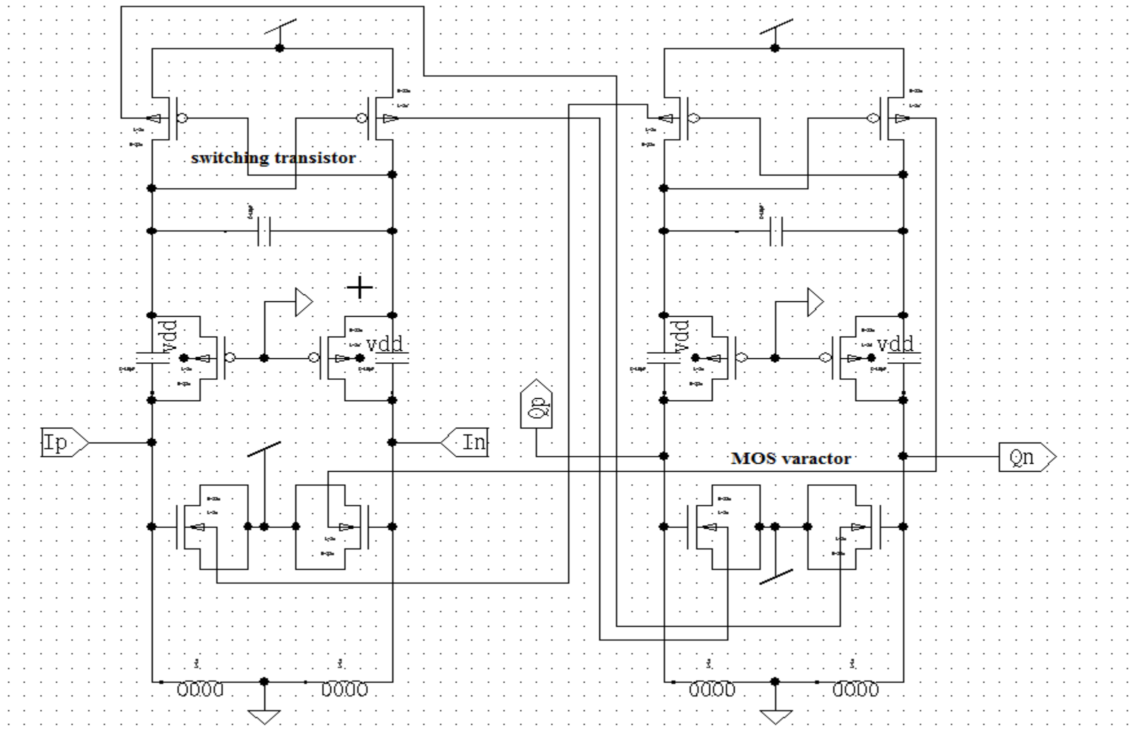

Fig.1 schematic of proposed QVCO circuit

Subsequently in a technology with P-type wafer the PMOSFETs are located in distinct wells, their bulks can be attached to different potentials. Thus, through selecting the switching transistors and MOS varactors as P-type, there is no necessity for the use of the triple-well equipment opportunity.
Switching transistor can be used for controlling high power devices such as motors, solenoids or lamps, but they can also use in digital electronics and logic gate circuits. When using the switching transistor, a small base current controls a much greater Collector load current. When using transistors to control inductive loads such as spreads and solenoids, a "Flywheel Diode" is used. When large currents or voltages essential to be measured, Darlington Transistors can be used.
MOS varactors performance the role of coupling devices and allow for the injection path for coupling signals, hence reducing the requirement for any extra AC coupling capacitors and DC biasing resistors. Moreover, to bring down the noise involvement of the core VCOs to the complete phase noise, the noise-wise superior Colpitts structure changes the conventional cross-connected LC-VCOs. Transistor with the drain, source, and bulk associated together. If a varactor is functioning in the strong inversion manner, a transistor with tied source and drain can be used as an original model since the varactor construction is the same as a MOS transistor.

A. Colpitts multiphase VCO

A Colpitts oscillatorissingle design for LC oscillators, electronic oscillators that use a arrangement of inductors (L) and capacitors (C) to yield an oscillation at a definite frequency. The differentiatingarticle of the Colpitts oscillator is that the feedback for the active device is taken from a voltage divider made of two capacitors in series across the inductor.Coupling of N matching LC-VCOs in a loop such that the core VCOs are combined to each other in an “in-phase” method, and the core is tied to the first one in an “anti-phase” mode

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is a approximately used technique for multiphase signals generation. Extending the same thought to the suggested structure, the coupling system can be applied to more than a few core Colpitts VCOs to yield multiphase signals. The multiphase VCOs can generate multiphase signals with л/N phase difference.

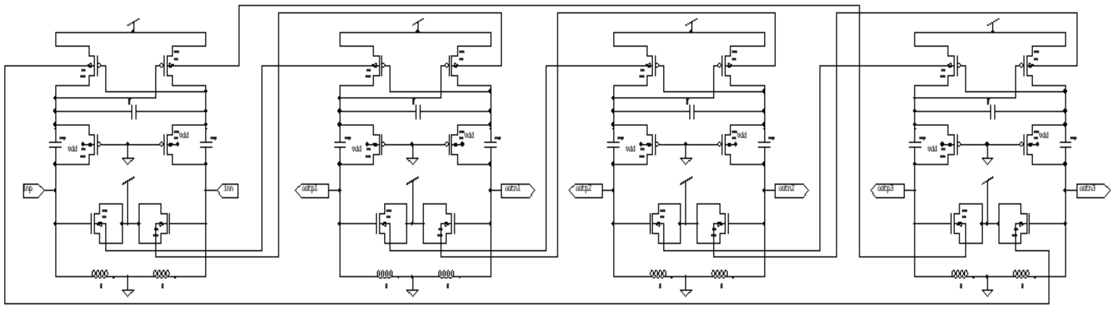

Fig. 2 schematic of colpitts multiphase VCO

The circuit diagram of Fig.2Consists of four stage colpitts VCOs; it has two inputs and six outputs. If the first input is zero means the second input is one and vice versa.It has the advantages of good wave purity, fine performer at high frequency, good stability at high frequency, wide operation range 1 to 60MHz.Application ofradio frequency and audio frequency, to generate the sinusoidal waveform.

III. SIMULATION RESULTS

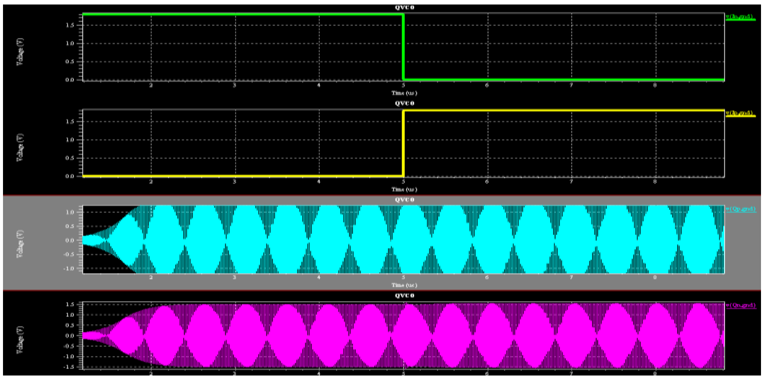

Fig.3 shows output of QVCO

Fig.3 describes the structure of QVCO circuit with Ip, In inputs and Qn, Qp outputs.Based on the given input the output will be changed if Ip is 1 and In is 0 and vice-versa. Finally it gives the sinusoidal waveform of the circuit.

The projected quadrature Colpitts VCO is designed and simulated in a standard 0.18- m RF-CMOS technology.According to simulations, oscillation frequency range is 2MHz in both QVCO and colpitts when V_{turn} is swept from 0 to 1.8V. By using Tanner EDA tool the circuit was simulated Tanner EDA provides easy-to-use, PC-based electronic design automation (EDA) software solutions for the design, confirmation and layout of analog/mixed-signal incorporated circuits, ASICs and MEMS. Its tools automate and simplify the design process. Tanner EDA software tools for A/MS and MEMS design offer designers a seamless, efficient path from design capture through verification.

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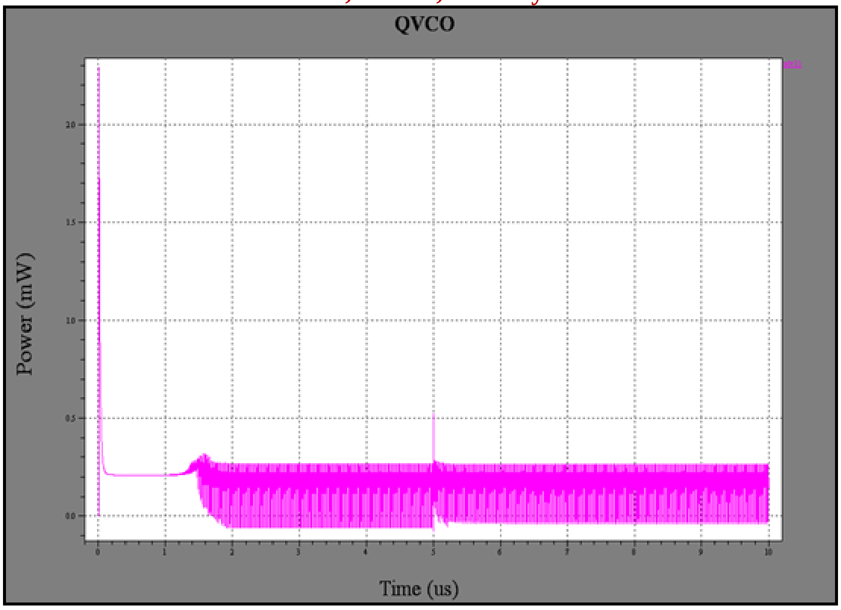

Fig. 4 shows power output of QVCO

Fig.4 describes power waveform of Quadrature voltage controlled oscillator circuit; the minimum power consumed is up to 0.185mW. The power waveform is obtained power verses time, power in terms of mW and time in terms of µs. Compared to existing system the proposed system power is reduced.

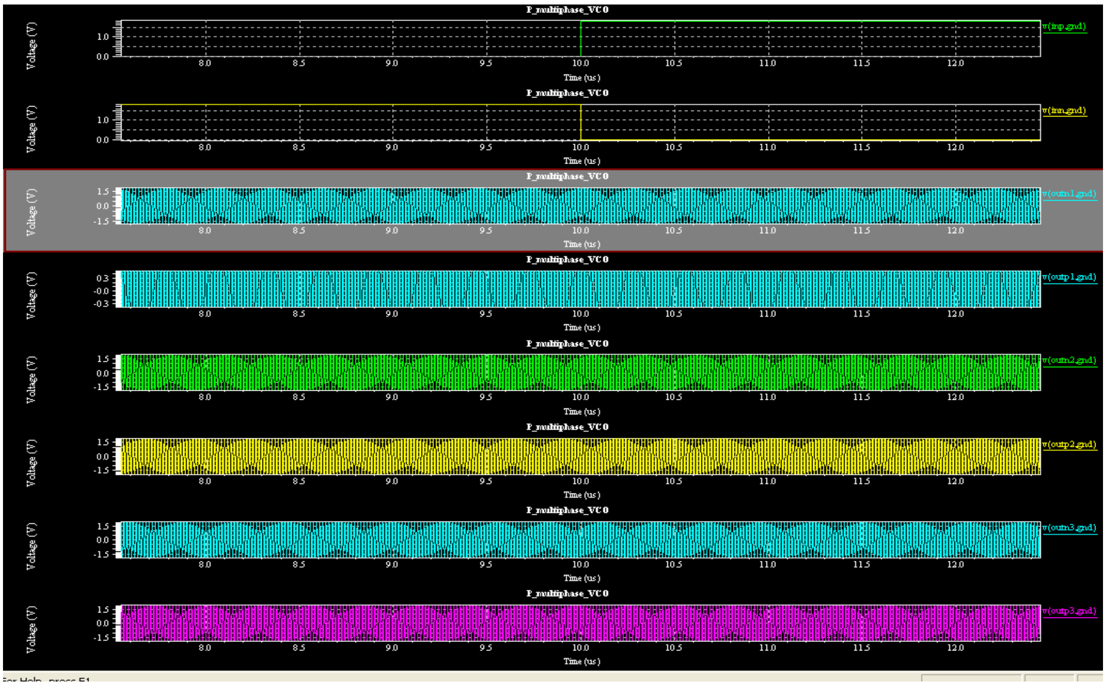

Fig.5 shows the output of colpitts

Fig.5 shows the operation of the colpitts multiphase Voltage controlled oscillator circuit. It has two inputs such as Ip, In and six outputs such as Qn1, Qn2, Qn3, Qp1, Qp2, Qp3 outputs depending on the input the output will be produced. Finally it gives the sinusoidal waveform.

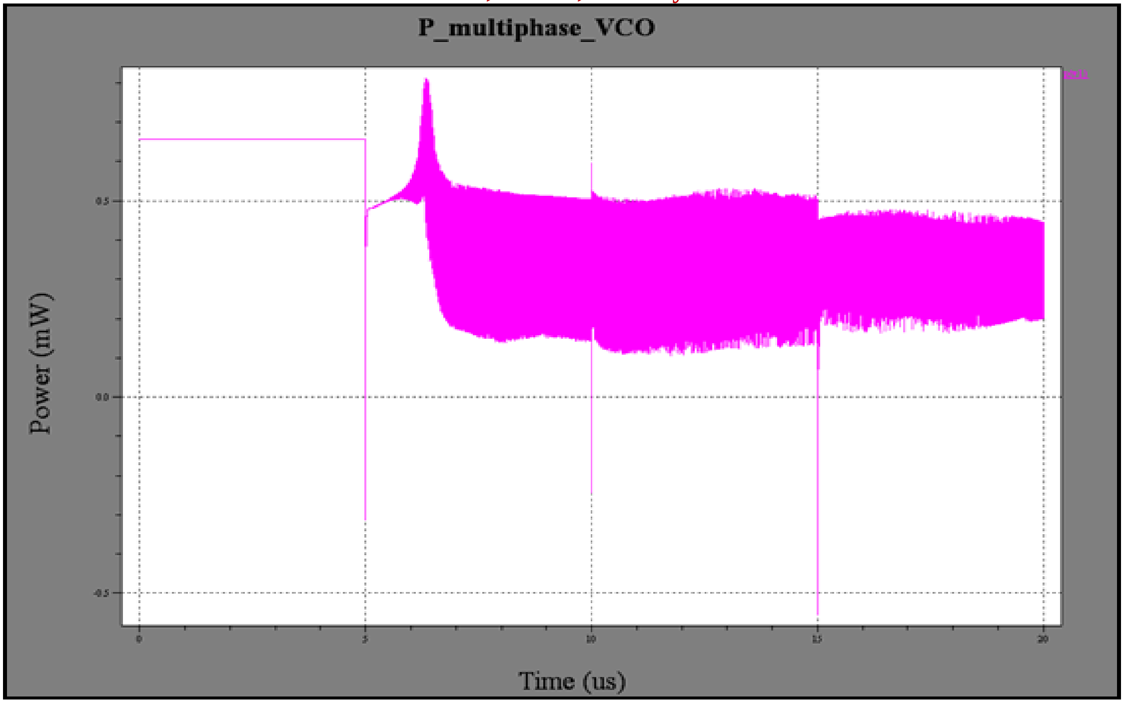

Fig.6 shows the power output of colpitts

Fig.6 describes the power wave form of colpitts multiphase voltage controlled oscillator circuit; it depicts the minimum power consumed is up to 0.016mW. Power is reduced compared to existing method.

TABLE.1 Power Consumption

PARAMETERS		**CMOS Technology (µm)**	**Frequency (Hz)**	**Power (mW)**
Existing method		0.18	5.44GHz	9.9
Proposed method	**QVCO**	0.18	2 MHz	0.18
	COLPITTS	0.18	2 MHz	0.016

Table.1 describes the power consumption of the project from that the power can be reduced compared to existing method, by using 0.18 µm CMOS technology.

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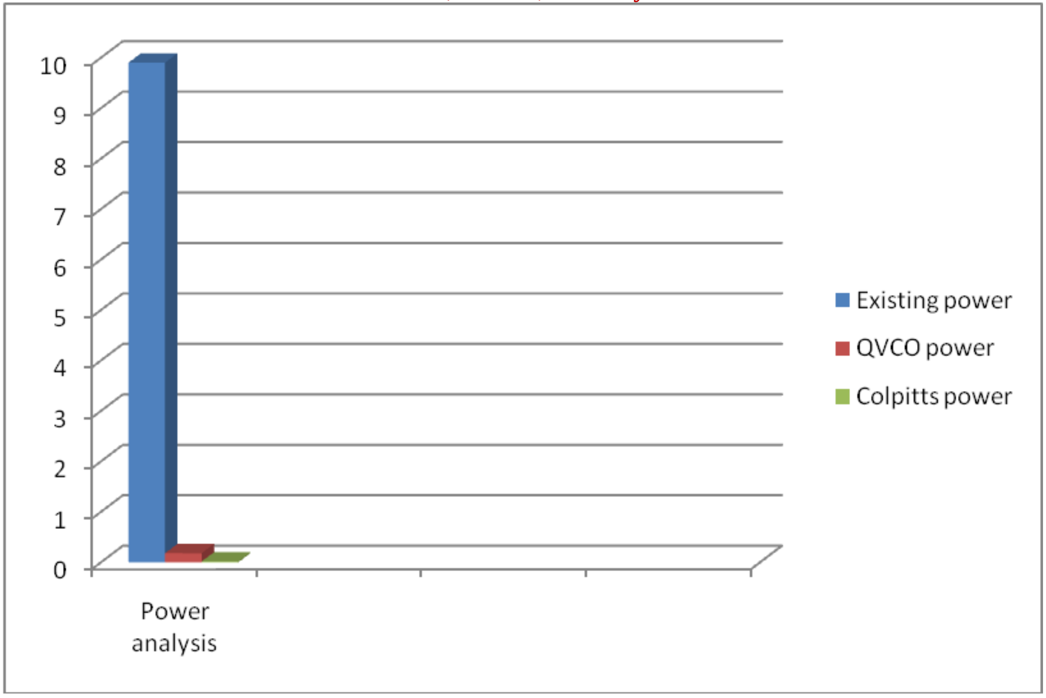

Fig.7 power analysis of QVCO and colpitts

Fig.7 describes the comparison of power analysis of existing and proposed method from this comparison the power can be reduced up to 0.18 mW in Quadrature voltage controlled oscillator and 0.016 mW in colpitts voltage controlled oscillator.

IV. CONCLUSION

Injection-locked quadrature oscillators are characteristically consist of two different parts: two core VCOs and various coupling devices, in which every part bring to the phase noise presentation. Conventional LC-VCOs are exchanged with the noise-wise superior current-switching Colpitts VCOs. In addition, to reduce the power dissipation due to the combinational circuitry, coupling devices were eradicated by employing the main part of switching transistors and the majorities of the MOS varactors in the Colpitts fundamental. An exploration of the action of the proposed QVCO using a liberalized perfect of the circuit is obtainable and displays arrangement with simulation outcomes. The suggested technique can also be used to couple N matching Colpitts VCOs for generation of multiphase signals.

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