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A Source Coupled CMOS Voltage Controlled Oscillator (VCO) Using 0.18 µm CMOS Technology

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Abstract

This paper present a source coupled Voltage controlled oscillator with a high oscillation frequency and low power consumption. The VCO is used to operate as a frequency synthesizer in a PLL to generate local oscillator frequency (LO). The performance of the proposed circuit is evaluated in T-spice simulation by using Tanner software, the VCO we use S-Edit, T-Spice, W-Edit in a 0.18-µm standard CMOS process. The results show that the oscillation frequency of VCO may vary between 265.25 MHz to 69.58 MHz. For the 1.8v supply voltage, the average power consumption is 3.0849e-004 at the same oscillation frequency.

Keywords: *Voltage Control Oscillator (VCO), Current Starved VCO, Source Coupled VCO, Phase Look Loop, CMOS, Area (W/L ratio), Power*

1. Introduction

A phase-locked loop is a system that makes an output signal whose phase is linked with the phase of an input signal. The oscillator produces a continuous periodic oscillations. The phase detector compares the phase of that signal with the phase of the input periodic signal and regulates the oscillator to keep the phases matched. Feeding back the output signal toward the input signal for comparison is called a feedback loop since the output is 'fed back' toward the input forming a loop. The most effective way to reduce power dissipation in VLSI and other electronic circuits is to reduce their supply voltage because of their linear dependence of the power dissipation on the supply voltage.

Voltage controlled oscillators play an important and effective role in communication systems, providing continuous periodic signals required for timing in digital circuits and frequency translation in radio frequency circuits. Their output frequency is a function of a control input usually a voltage. when output frequency is a linear function of its control voltage then this indicates the ideal characteristics of a voltage control oscillator. Most application required that oscillator be tuneable, their output frequency be a function of a control input, usually a voltage. While oscillators consists of periodically time -Varying Characteristics, this is concerned with an electrical signal at a specific Frequency. When it is used for frequency translation, we often refer to an oscillator as the Local oscillator (LO).

The oscillation frequency, tuning range, phase noise, and power consumption are the key metrics of a VCO. The voltage controlled oscillator (VCO) is a key component in successful broadband receivers, mainly in the receiver front end where noise can have a dramatic effect upon the quality of a broadband signal coming from an antenna or digital TV cable. Careful VCO design is needed to cope with tuning over a wide range of frequencies for broadband requirement. RF circuits implemented using CMOS technology have provides significant cost savings compared to bipolar technologies.

A voltage controlled oscillator is an oscillator in which the oscillation frequency is controlled by input voltage. Voltage controlled oscillator (VCO) forms an important element in the design of desirable high frequency component using phased locked loops (PLL).

2. The Source Coupled CMOS Topology

VCOs utilize a variable control input voltage to give a variable frequency input. The control input may be tuned so that a desired operational frequency can be produce by the VCO. The output control voltage can be adjustable up or down to control the frequency of the periodic output signal. A voltage control oscillator can make a change in oscillating frequency in response to the change in voltage. A VCO employs one or more variable capacitor (called as varactor) to allow the adjustment of the frequency of the oscillation for the VCO. The operation of the CMOS source coupled VCO in fig 1 is, load MOSFETs NMOS1 and NMOS2 pull the output with 0.9 Pf as its capacitor value. The MOSFETs NMO3 and NMOS4 behave as constant-current source sinking a current Id. MOSFETs PMOS1 and PMOS2 act as switches. MOSFET M1 is off and M2 is on, because the voltage of terminal out1 is larger than voltage of terminal out.

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Therefore, current through MOSFET M2 is 2 Id and the capacitor will be changed by current Id, because constant current source M6 sinking current Id. When the voltage of capacitor terminal is same then capacitor is fully charged. The current Id through C, causes to discharge down towards ground. When point X gets down, M1 turn on and M2 turns off fig 1 shows the designed single stage Source Coupled VCO.

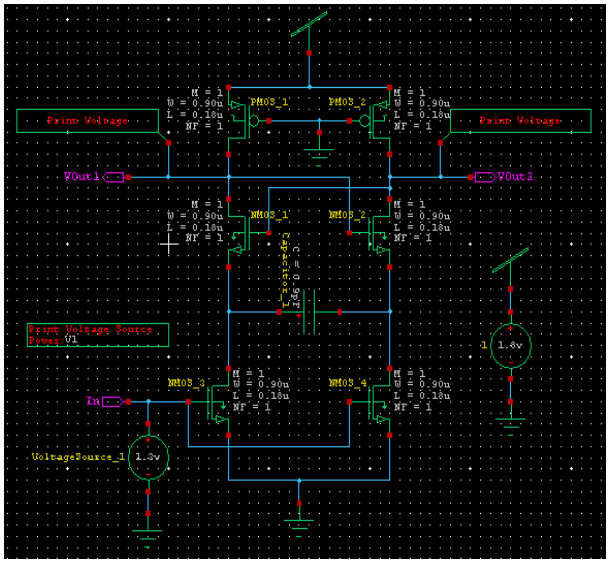


Fig. 1 Source coupled voltage controlled oscillator

3. Simulation Result

Spice simulation is used for proposed circuit by using Tanner software, we use S-Edit, T-Spice, W-Edit as a simulator. The result as compared in table I. Source coupled VCO was simulated in a 0.18µm standard CMOS process with 1.8V as the power supply voltage. The frequency of the VCO ranges from 69.58 MHz to 265.25 MHz. The oscillation frequency of VCO versus the control voltage (Vc) is shown in table I. The out1 and out2 both are in 180° phase shift shown in Figure 1. The average power consumption of VCO is 3.0849e-004 and peak power consumption is 6.0497e-004 as observed from the results. The oscillator is very compact due to the minimum stage number as compared to current starved technique. The difference between carrier power and noise power is defined as phase noise, phase noise performance can be improved reducing noise power. These configurations useful When the VCO centre frequency is set by external capacitor.

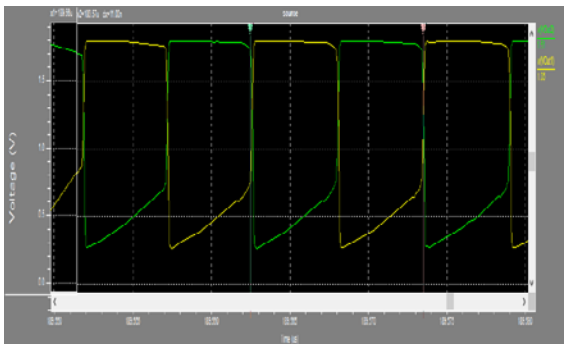
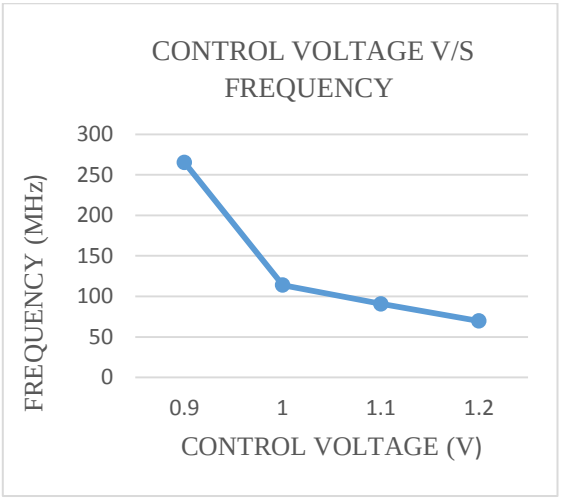


Table 1: control voltage v/s frequency

Control voltage	*Oscillation frequency*
0.9v	265.25 MHz
1.0v	113.89 MHz
1.1v	90.90 MHz
1.2v	69.58 MHz



4.Conclusion

A simple source coupled voltage control oscillator has been designed. The complete circuitry of the designed VCO has been implemented using the 0.18um CMOS technology. The simulated results of the voltage source VCO proposed is in 0.1V step change starting from 0.9 to 1.2V. This paper adopts the standard CMOS technology by A simple source coupled voltage control oscillator has been designed. The complete circuitry of the designed VCO has been implemented using the 0.18um CMOS technology. The simulated results of the voltage source VCO proposed is in 0.1V step change starting from 0.9 to 1.2V. This paper adopts the standard CMOS technology by using tanner tool, therefore, the design

of source coupled can be used for PLL and other applications that require a power consumption VCO at frequency ranging from 69.58 to 265.25 MHz.

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