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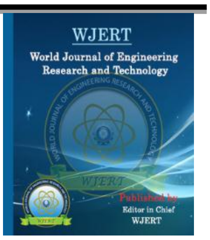

DESIGN OF RING OSCILLATOR FOR HIGH FREQUENCY APPLICATIONS

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ABSTRACT

We propose a ring oscillator designed with CMOS delay cells. It is important block in integrators and analog filters. The ring oscillator based integrators are the key elements in the analog filter design and read channels of disk drives, high-speed data links, loop filters for phase-locked loops, telephony, wireless communication systems, anti aliasing filters for digital audio, digital TV and HDTV, smoothing filters at the output of DAC's. Here we proposed a ring oscillator which can work at high frequencies. Here inverters are connected such that one stage output is connected to another stage form to obtain a three stage ring oscillator. The ring oscillator uses an odd number of inverters to give the effect of a single inverting amplifier with a gain of greater than one. The Ring oscillator is developed by using CADENCE Tool with a CMOS 180nm technology and is simulated using cadence spectre. The supply voltage was varied from 0.9 V in order to examine the frequency and power consumption of the circuit. The measured frequency had a range in MHz and the power consumption is 129uW.

KEYWORDS: Ring Oscillator, Integrator, CMOS, Analog Filter Current Controlled Oscillator**.**

1. INTRODUCTION

Oscillatory is positive feedback systems, especially in electronic and optical. In radio frequency and light wave communication systems oscillators are used for frequency translation of information signals and channel selection.[3,6] It is a electronic circuit which produces ac output without an ac input is called as oscillator Here ring oscillator is designed using delay stages inside the IC has created much more importance compared to other monolithic oscillators like relaxation oscillators. Ring oscillator is a basic building block in integrators. The ring oscillator based integrators are the key elements in the analog filter design.[1,4] Generally, the performance of ring oscillator is better than relaxation oscillators although not as good as that of the sinusoidal oscillators. But the continuous efforts of the scientists and researchers have yielded in improving the performance of ring oscillators so as to attain a good level of satisfaction which can now be used successfully in the communication systems. The level of satisfaction has been achieved in both cases: speed of operation and noise performance

2. MATERIALS AND METHODS

The oscillator works on the principle of the oscillation and it is a mechanical or electronic device. The periodic variation between the two things is based on the changes in the energy. The oscillations are used in the watches, radios, metal detectors and in many other devices use the oscillators.

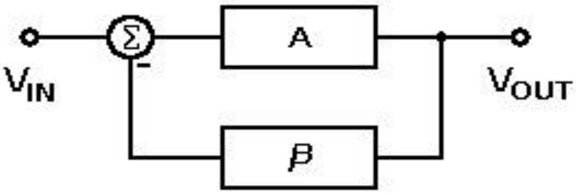
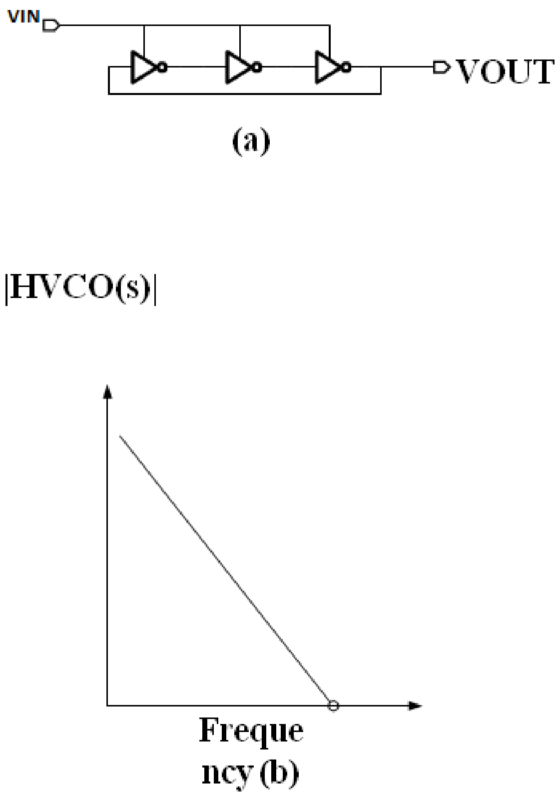


Fig. 1: Block diagram of oscillator.

The oscillator converts the direct current from the power supply to an alternating current and they are used in many of the electronic devices. The signals used in the oscillators are a sine wave and the square wave. The some of the examples are the signals are broadcasted by the radio and television transmitter, clocks which are used in the computers and in the video games.

The figure1 shows block diagram represents a three stage inverter based ring oscillator . A circular chain composed of an even number of inverters cannot be used as a ring oscillator. The last output in this case is the same as the input. However, this configuration of inverter feedback can be used as a storage element and it is the basic building block of static random access memory. The stages of the ring oscillator are often differential stages, that are more immune to external disturbances. This renders available also non-inverting stages. A ring oscillator can be made with a mix of inverting and non-inverting stages, provided the total number of inverting stages is odd as shown in figure2. The oscillator period is in all cases equal to twice the sum of the individual delays of all stages. A real ring oscillator only requires power to operate. Above a certain threshold voltage, oscillations begin spontaneously. To increase the frequency of oscillation, two methods are commonly used. Firstly, the applied voltage may be increased. This increases both the frequency of the oscillation and the current consumed. The maximum permissible voltage applied to the circuits limits the speed of a given oscillator. Secondly, making the ring from a smaller number of inverters results in a higher frequency of oscillation given a certain power consumption



(a)

Freque
ncy (b)

Figure 2: Inverter-Based Ring Oscillator (a) Block Diagram and (b) Magnitude Response of Input Voltage to Phase Output Transfer Function.

From Figure 2 we can see that input voltage, V_{IN}, controls the oscillator frequency, ω_{out}, such that:

Where K_{VCO} is referred to as the oscillator gain. Since ω_{out} indicates the output frequency of the ring oscillator, and phase is the integral of frequency, the oscillator can be viewed as an integrator with the following transfer function:

$$\boxed{\frac{\phi_{out}(s)}{v_{in}(s)} \quad \frac{K_{VCO}}{s} =}$$

Equation (3.2) reveals that ROI has infinite DC gain as $\frac{\phi(s)}{} \rightarrow \infty$ as $s = j\omega \rightarrow 0$. And this expression also $vin(s)$

Indicates that infinite DC gain is obtained independent of transistor dimensions and supply voltage. Given with the above reasoning, ring oscillator acts as an integrator in phase domain. Therefore, a phase-to- voltage/current converter is needed in order to connect ROI with other building blocks which usually take voltage or current as input signals. In this case, a phase detector (PD) is used, as illustrated in Figure 3. in order to convert VCO output phase to a PWM signal.

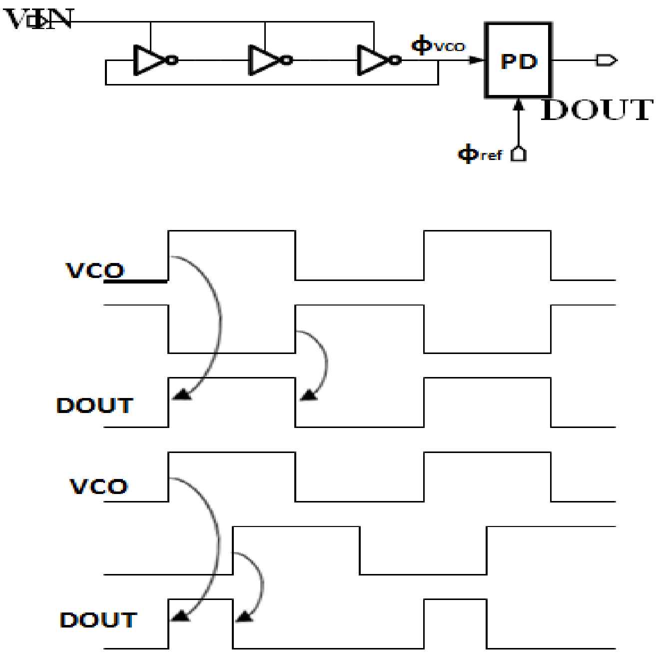


Figure 3: Convert Phase to PWM Using PD.

PD operates only on rising edges of the VCO and reference signal. If the two input phase signals are π radians out of phase, the PWM output signal DOUT has 50% duty cycle. Different phase errors correspond to varying duty cycle ratio of the output. Since the phase difference could only vary from 0 to 2π radians, input signals have to be checked carefully so that the phase difference would not exceed the limit.

Finally, charge pump is added to accomplish a current input and current output ring oscillator based integrator. Notice that VCO now is replaced with CCO as the input control signal is current. The schematicis shown in Figure 3.

Table 1: Function of Inverter.

Input	Logic input	Output	Logic output
0v	0	Vdd	0.5
Vdd	0.5	0v	0

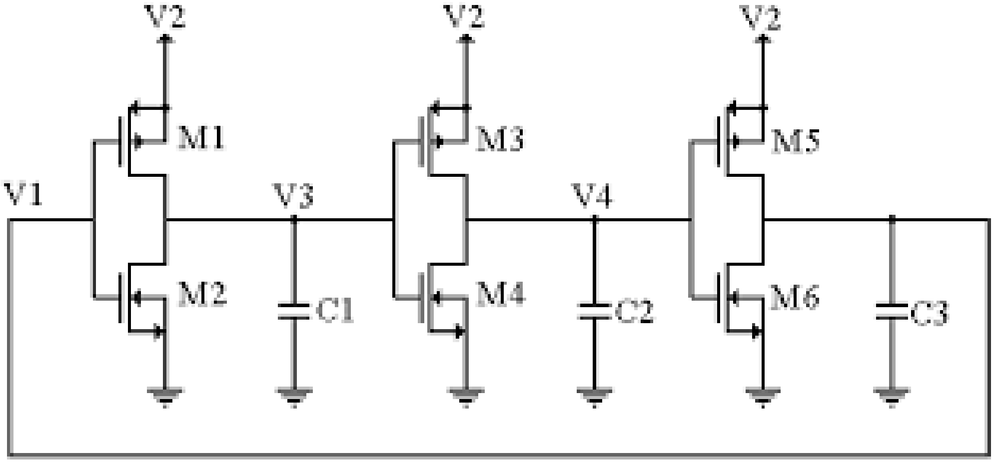


Fig. 4: Schematic of three cascaded inverters.

Table 2: Performance Evalution.

S. No.	Item	Value
1	technology	180nm CMOS
2	Supply voltage	0.5V
3	Frequency	38Mhz
4	Power	129uW

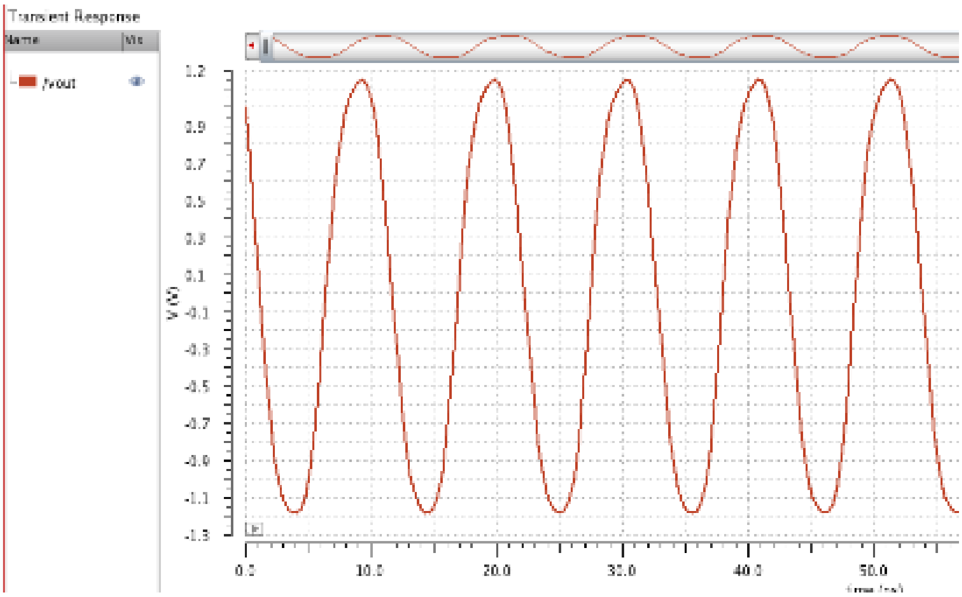


Fig. 5: Resultant Wave form of the Ring Oscillator.

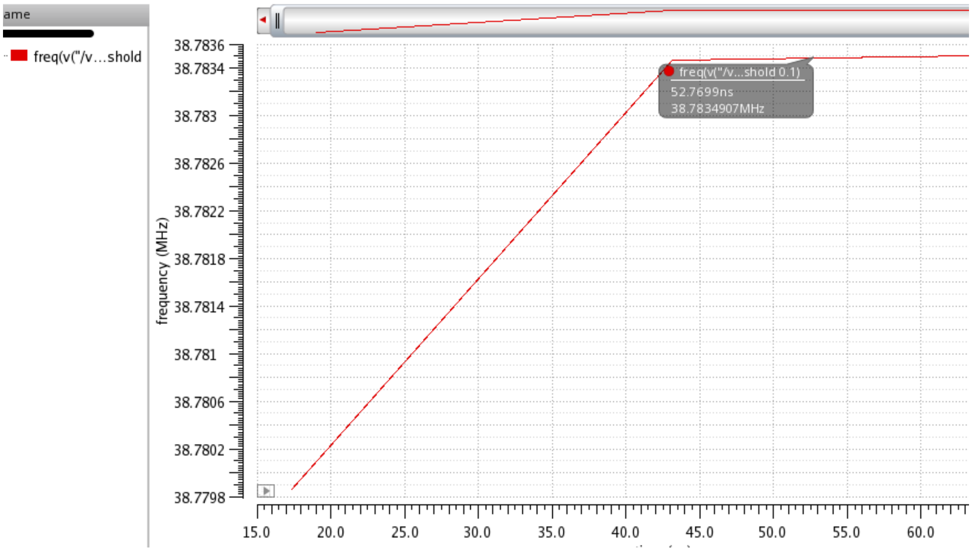


Fig. 6: Achieved frequency of the ring oscillator.

3. CONCLUSION AND DISCUSSION

In this paper, the 3-stage inverter based ring oscillator has been successfully designed and simulated using cadence virtuoso tool with 180nm CMOS technology. The main motive of this proposal is to reduce average power consumption and leakage power which is stable at high frequency also. We improvised the previous research paper work by reducing the supply voltage and using CCO technique and the simulation results in table2.

This building block is an ambitious attempt to design an analog filter using ring oscillator integrators. According to the obtained simulation results, we can conclude that the proposed ring oscillator perform better performance in term of power consumption and Frequency. The achieved power is around 129uw and the frequency of the ouput wave is 38 Mhz . Thus, this method provide the easy technique to control average power and leakage power for circuit designers.

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