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Generation of carrier signal using different oscillators for ISM and Wi-Fi band applications

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Abstract : *Oscillator is one of the Basic blocks in communication system. Oscillators generate the carrier signals which are to be modulated with the original message signal for transmission. The oscillators are designed mainly for ISM & Wi-Fi band applications using different technologies viz. 45nm, 65nm, 90nm.This paper deals with the most efficient design process of different types of oscillators using microwind 3.5. The different types of oscillators viz. Ring oscillator, voltage controlled oscillator are designed with minimum power consumption and minimum area on chip.*
Keywords –*Microwind 3.5, Ring Oscillator, VCO, Frequency, Power Consumption.*

1. INTRODUCTION

Nowadays communication plays a vital role in human life and had become an integrated part of it. Communication includes transmission of signal from source to destination. We cannot transmit the message signal directly from the source to destination, as there is a need to modulate the signal before transmission. So we need a carrier signal of relatively high frequency to carry out the modulation process conveniently. This carrier signal will be generated by a device known as an oscillator. The communication process mainly consists of two phases, i.e. modulation at transmitter end and demodulation at receiver end. Modulation is a process of mixing a signal with a sinusoid to produce a new signal which is having certain benefits over the un-modulated signal, especially during the transmission. The sinusoid signal that is used in the modulation is called carrier signal or simply the “carrier”. Whereas the act of extracting the original information-bearing signal from a modulated carrier wave at the receiver is called demodulation. Hence we can say that a demodulator is an electronic circuit that is used to recover the information content from the modulated carrier wave.

Hence there is a need of the carrier signal at both the ends of a communication system. i.e. at the transmitter as well as the receiver end. So we can say that an oscillator which generates such a carrier signal is required at both ends of communication system.

For generation of carrier waves, various types of oscillators are available, we will study following oscillators:

1) Ring oscillator
2) Voltage controlled oscillator

While designing oscillators we must be specific about the specifications of the signal to be generated and its applications. Here we focus on designing the oscillators for ISM(Industrial Scientific & Medical) and WI-FI(Wireless Fidelity) frequency band applications. Applications based on ISM frequency band correspond to a frequency of 2.4GHz while Wi-Fi frequency corresponds to 4.8GHz of frequency. We have designed each type of above mentioned oscillators in different technologies.

These oscillators can be designed using various technologies i.e. 45nm, 60nm, 90nm, 120nm etc. Every technology has its own effect on the overall performance of the system. Every class of different technology enjoys its own set of advantages and applications.

2. PROPOSED SYSTEM

2.1 RING OSCILLATOR

Ring oscillator constitutes of odd number of inverters connected in cascade. Every inverter produces certain delay and depending on that delay of each inverter we obtain a output with certain frequency at output node.

If we connect even number of inverters then we do not obtain inverted output but have the same output as applied to the input and thus we do not get desired output.

The basic structure and layout of a 3 inverter ring oscillator is as shown below.

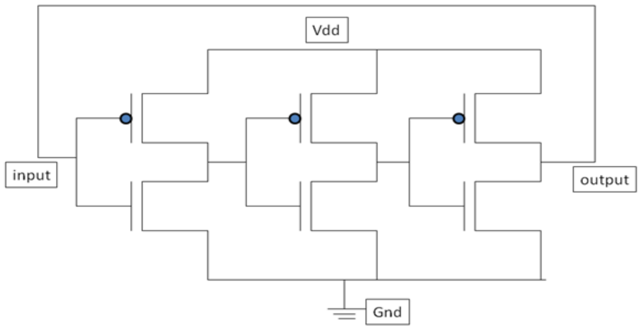

Fig.1 ring oscillator

2.2 VCO

A VCO is an electronic oscillator. Nowadays VCO is commonly used for clock recovery with controllable frequency and mainly for communication. An Oscillator whose output varies with change in its input control voltage is known as voltage control oscillator.

There are many ways to implement VCO one of them is Ring inverter VCO.
This Oscillator is current-starved VCO. Input voltage is used to fix thecurrent in N1, N2, N3, N4 and P1, P2, P3, P4. A change on Input voltage will modify the currentsin the inverters and act directly on the delay.

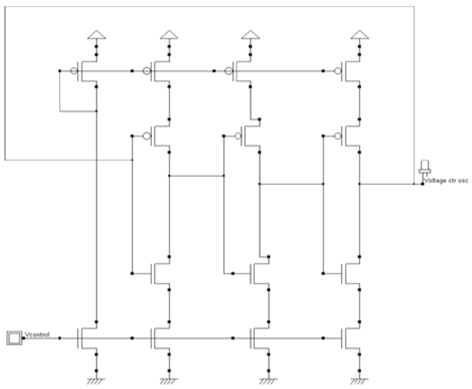

Fig.2 voltage control oscillator

3. SYSTEM DEVELOPMENT

3.1 RING OSCILLATOR

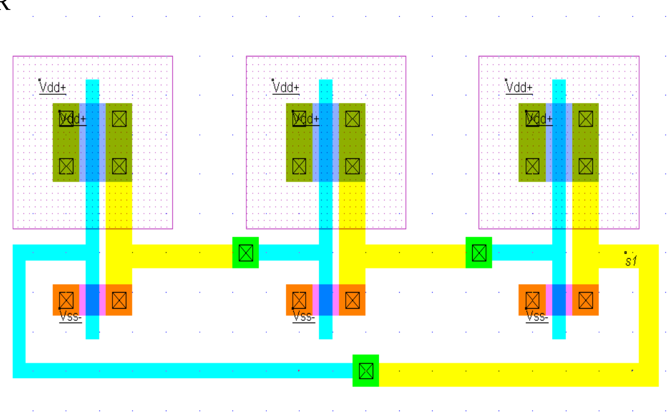

Fig.3implementation of 3-inverter ring oscillator

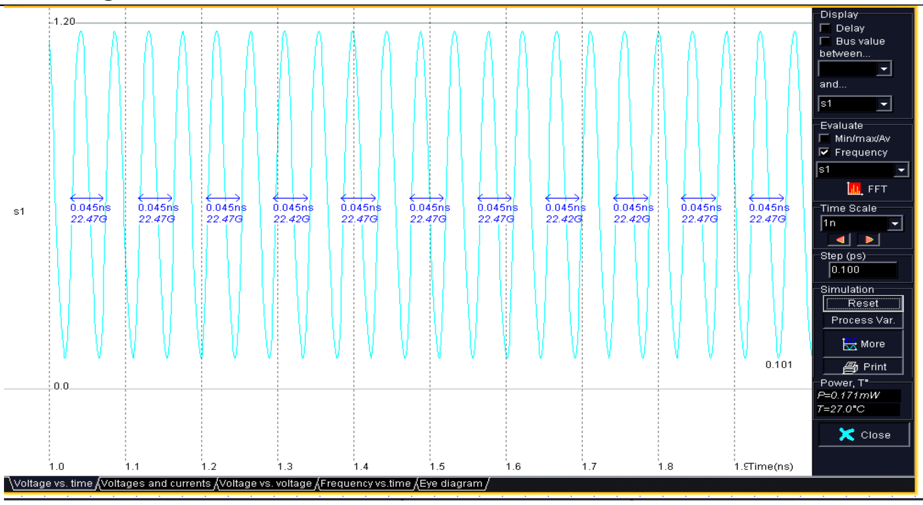

Fig.4 Output 3 Inverter Ring Oscillator(90nm)

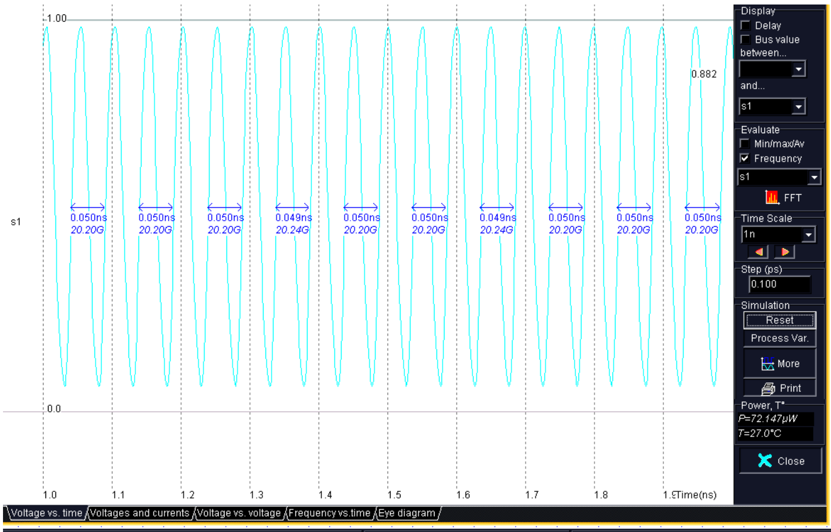

FIG.5 Output 3 Inverter Ring Oscillator (65nm)

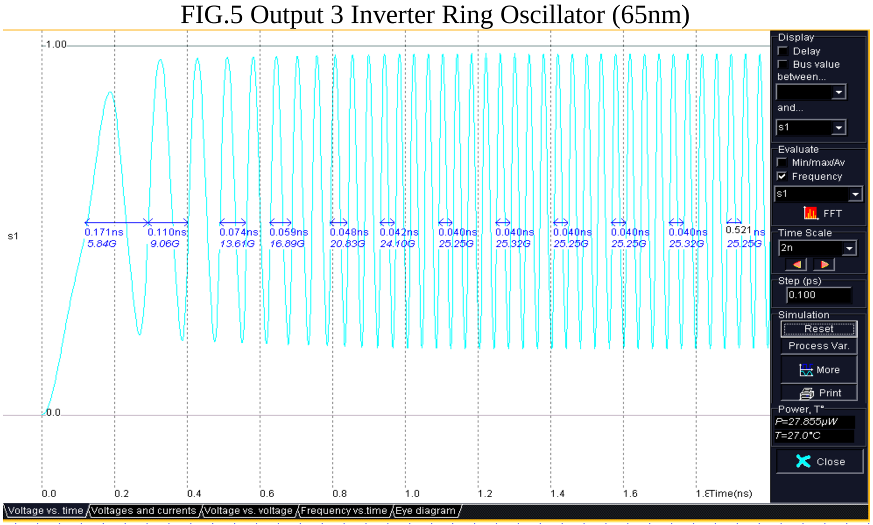

Fig.6Output 3 Inverter Ring Oscillator (45nm)

Similarly 25 inverter ring oscillator is shown below. In this way we can implement an oscillator by simply varying number of inverters depending upon the desired frequency. Here we have obtained desired frequency at 25 inverter ring oscillator i.e. 2.4GHz for ISM band frequency.

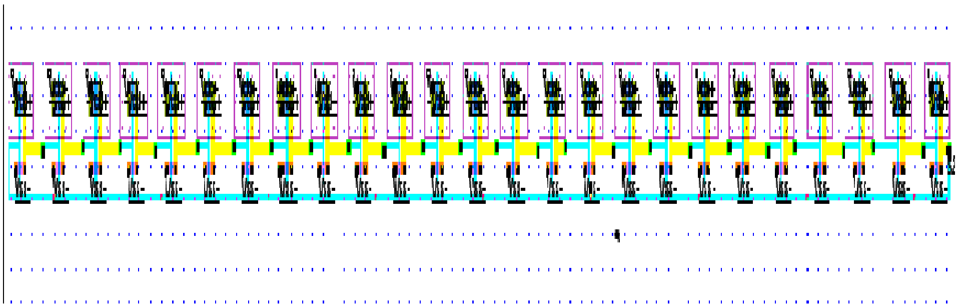

Fig.7Implementation of 25-inverter ring oscillator

3.2 VCO

In this Research Work it is focused on reducing in power consumption at maximum frequency of 2.4GHz for ISM and 4.8GHz for WI-FI band application.

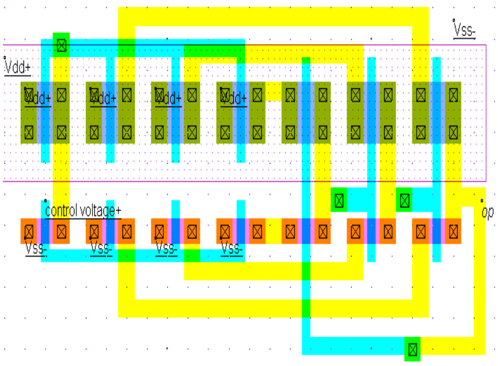

Fig.8 implementation voltage control oscillator

As shown in Analysis report desired Frequency are obtained for different technologies.
As for 45nm technology we get best result for ISM band as well as WI-FI.

4. RESULTS

Table 1. Ring Oscillator Analysis

Sr. No.	No. of Inverters	45nm		65nm		90nm	
		Frequency (GHz)	Power consumption(w)	Frequency (GHz)	Power consumption(µw)	frequrncy (GHz)	power consumption(w)
1	3	21.93	19.216u	19.53	37.809u	21.60	90.937u
2	5	14.58	29.336u	11.89	56.56u	13.91	
3	7	16.64	57.31u	10.50	91.357u	11.64	
4	9	8.22	35.038u	6.68	67.353u	7.39	
5	11	6.71	30.76u	5.46	59.739u	6.04	
6	13	**4.90**	32.210u	3.99	61.920u	4.42	0.147m
7	15	**4.91**	32.209u	4.00	61.917u	4.42	
8	17	4.32	32.920u	3.52	63.753u	3.9	
9	19	3.87	33.406u	3.15	64.735u	3.49	
10	21	3.50	34.297u	2.85	66.443u	3.15	
11	23	3.37	34.015u	2.69	66.589u	2.96	
12	25	3.10	34.491u	**2.41**	67.834u	2.72	

13	27	2.88	35.207u			2.52 0.165m
14	29	2.68	35.463u			2.35
15	31	2.51	36.020u			
16	33	2.35	36.613u			

Table 2.VCO Analysis for 45nm, 65nm, 90nm.

	45nm			**65nm**			**90nm**		
S.No.	Input Voltage	Output frequency	Power consumption	Input voltage	Output frequency	Power consumption	Input voltage	Output frequency	Power consumption
1	0.360	4.79Ghz	8.61uw	0.459	4.81Ghz	21.66uw	0.33	2.44Ghz	42.6uw
2	0.260	2.46Ghz	5.46uw	0.382	2.40Ghz	15.927uw	0.422	4.84Ghz	48.70uw

5. CONCLUSION

Oscillators are one of the most important building blocks in any communication system. Their main function is to generate the carrier signal which is to be modulated with the original message signal. Mainly two type of oscillators are discussed in this paper viz. ring oscillator and voltage controlled oscillator. Voltage controlled oscillator enjoys its own set of advantages over ring oscillator. Numbers of inverters in ring oscillators are varied in odd number unless we obtain desired frequency which leads to increase in area on chip, whereas in voltage controlled oscillator, we vary the input signal to obtain the desired output frequency signal. So, there is a constant area on chip in case of a voltage controlled oscillator. We have simulated the designs using microwind version 3.5 for 45nm, 65nm and 90nm & have obtained comparatively better results in terms of power consumption and frequency.

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