CMOS 3 STAGE RING OSCILLATOR using 0.25u CMOS TECHNOLOGY

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Abstract

Ring oscillator is one of the important component used in Integrated chip(IC) .Ring oscillator circuits a valuable test structure for determining the feasibilityand success of an integrated circuit process fabrication sequence. One of the most useful results obtainable from a ring oscillator test structure is the delay time per gate. This information is especially important for successful design of high speed clock circuits, such as Phase Locked Loops PLL's and Voltage Controlled Oscillators VCO'. Oscillator has 3 inverters then it is called a three-stage ring oscillator.The number of inverter stages in this oscillator mainly depends on the frequency which we want to generate from this oscillator.

1 Circuit Details

CMOS A ring oscillator comprises of an odd number of CMOS inverters. The output of each inverter is used as input for the next one.Ring oscillator is connected as per the reference circuit.The last output is fed back to the first inverter. Because of the delay time of each stage the whole circuit spontaneously starts oscillating at a certain frequency.The frequency depends on the number of stages and the delay time of the inverters A ring oscillator can be made with a mix of inverting and non-inverting stages,provided the total number of inverting stages is odd.Ring oscillator consists of PMOS and NMOS and capacitors C1,C2,C3. NMOS is constructed with the ntype source and drain and a p-type substrate, while PMOS is constructed with the p-type source and drain and an n-type substrate. PMOS device is connected to the supply voltage (+VDD) and NMOS device is also connected with ground (GND) to the circuit.Three stage oscillator has three inverters that are connected in the form of series with a positive feedback system.This is the reason to choose the three-stage oscillator.A ring oscillator only requires power to operate. To increase the frequency of oscillation, two methods are commonly used. First, making the ring from a smaller number of inverters results in a higher frequency of oscillation, with about the same power consumption.Second, the supply voltage may be increased. In circuits where this method can be applied, it reduces the propagation delay through the chain of stages, increasing both the frequency of the oscillation and the current consumed.

2 Implemented Circuit

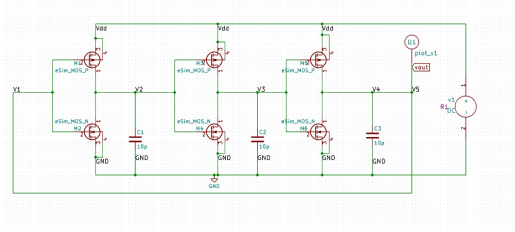

Figure 1: Implemented circuit diagram.

3 Implemented Waveforms

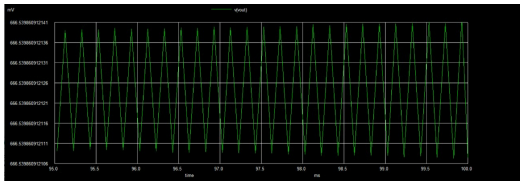

Figure 2: Implemented waveform.

References

[1] S. CHAUHAN. Cmos design and performance analysis of ring oscillator for different stages. www.analogdevices.com/ring oscillator.

[2] M. K. Mandal. Ring oscillators: Characteristics and applications. www.wikipedia.org/ring oscillator.

[3] B. Razavi. A circuit for all seasons. https://www.elprocus.com/ring-oscillator-working-and-its-applications/.