RING OSCILLATOR

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ABSTRACT

Oscillators are the indespensible components in "VERY LARGE SCALE INTEGRATION (VLSI)" circuits for generating PERIODIC SIGNAL required in clocking frequency sysnthesis and testing. There are various types of oscillators are known to us. Among all of these, RING OSCILLATOR is one of the simplest and most widely used due to its compact design and easy integration in "COMPLEMENTARY METAL OXIDE SEMICONDUCTOR (CMOS)" technology. It consisits of an odd number of inverters connected in a feedback loop, which is going to produce stable oscillating output without help of any external components. Implementing Ring Oscillator in SG13G2 technology enables exploration of high frequency and low power performance, which is considered to be the most critical for MODERN COMMUNICATION and SIGNAL PROCESSING SYSTEM.

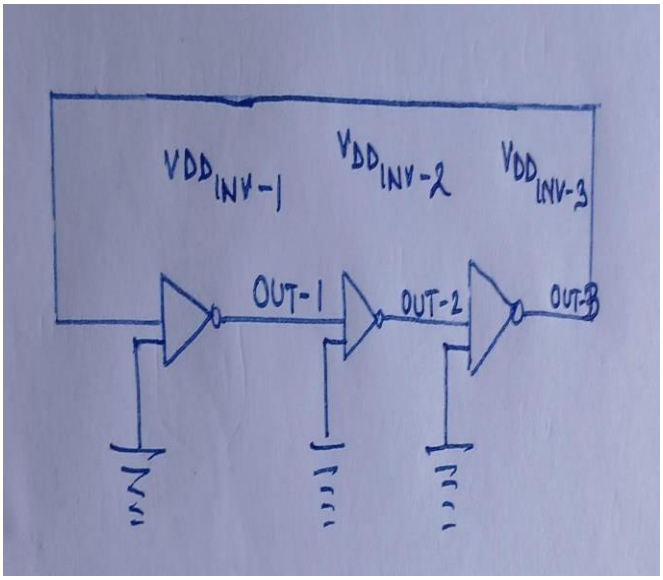
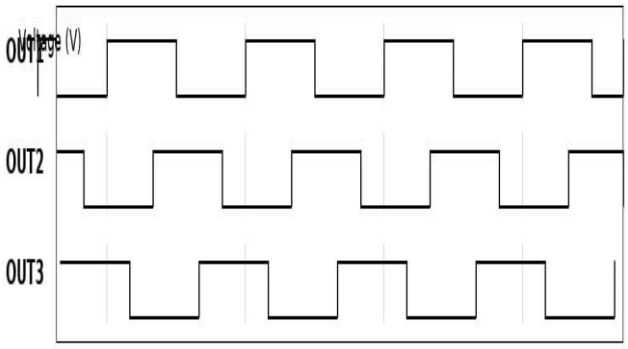


FIG-1: REFERENCE CIRCUIT DIAGRAM

FIG -2 : REFERENCE WAVEFORM



REFERENCE CIRCUIT DETAILS

A ring oscillator operates by passing a signal through an odd number of inverter stages, creating a phase shift of 180° and introducing a feedback delay. The oscillation frequency is determined by the propagation delay of the inverters, expressed as :

$$f = \frac{1}{2N \cdot \tau d}$$

where N is the number of stages and τd is the delay per inverter. For a 3-stage design, the circuit achieves oscillation at a fundamental frequency determined by device characteristics and supply voltage. Ring oscillators are widely used in PHASE-LOCKED LOOPS (PLLs), clock recovery circuits, and as process monitors in IC fabrication.

REFRENCE

1. K. Watanabe, H. Yamauchi, "Design of High-Frequency Ring Oscillators in 130nm CMOS," IEEE Transactions on Circuits and Systems, vol. 63, no. 7, pp. 1024-1030, 2016.

2. R. Gupta, P. Sharma, "Low-Power Ring Oscillator Design for VLSI Applications," Proceedings of IEEE ICCIC, pp. 45-49, 2019.