CENTER OF NANOELECTRONICS & DEVICES

CND 101:Analog

Project : Ring Oscillator

Section : 17

Group Name: group_17_101_3

Submitted by:

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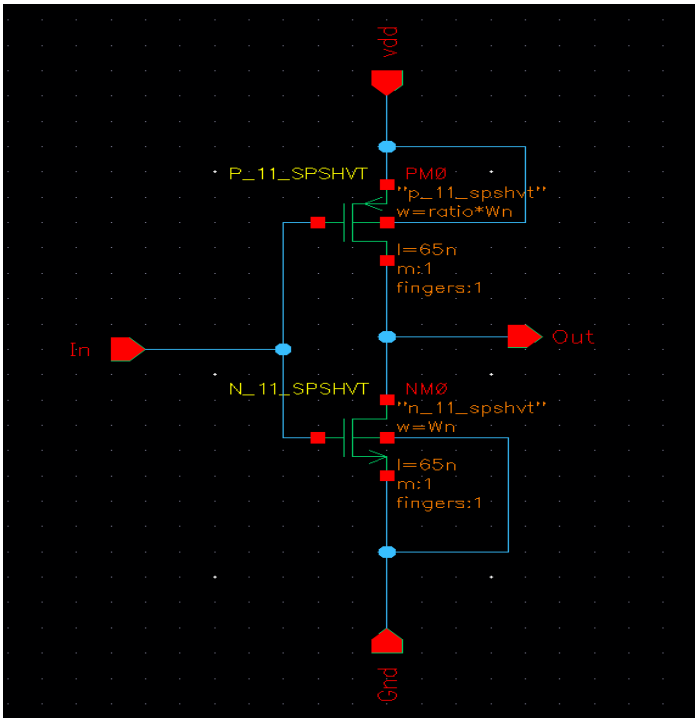
Analog Project Ring Oscillator

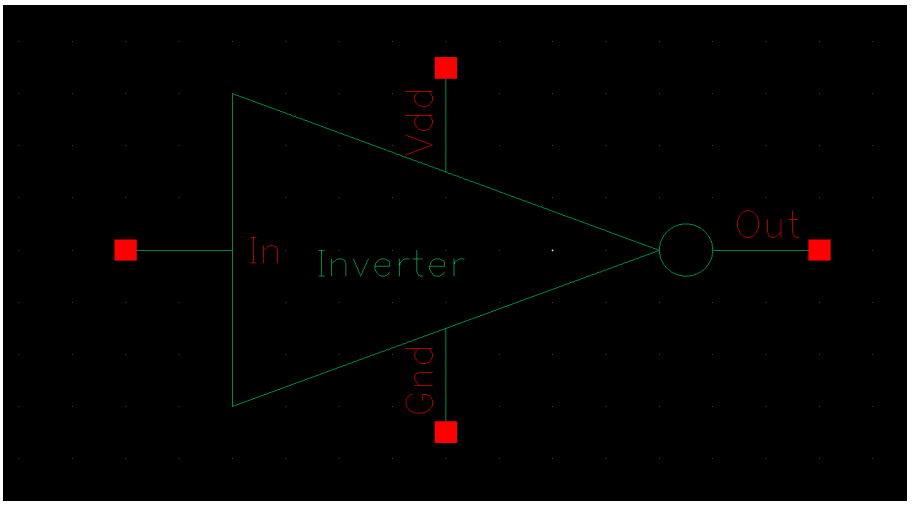
Intro for Ring Oscillator

The definition of the ring oscillator is “an odd number of inverters are connected in a series form with positive feedback & output oscillates between two voltage levels either 1 or zero to measure the speed of the process. In place of inverters, we can define it with NOT gates also. These oscillators have an ‘n’ odd number of inverters. For instance, if this oscillator has 3 inverters then it is called a three-stage ring oscillator. If the inverter count is seven then it is a seven stage ring oscillator. The number of inverter stages in this oscillator mainly depends on the frequency which we want to generate from this oscillator

Schematics of inverter:

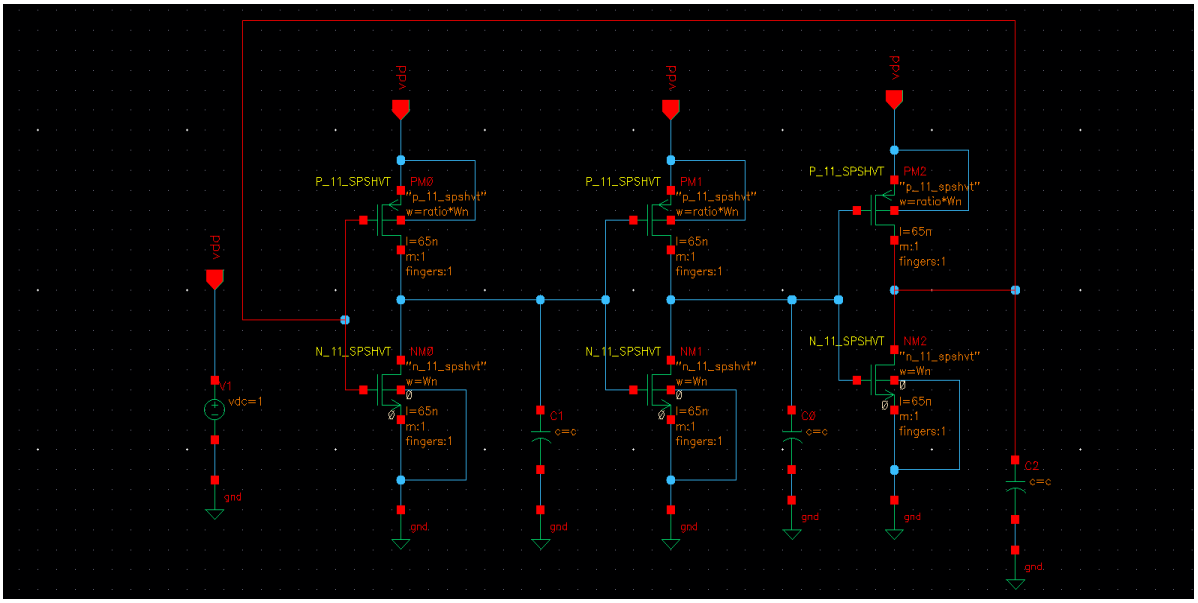


Symbol of inverter:

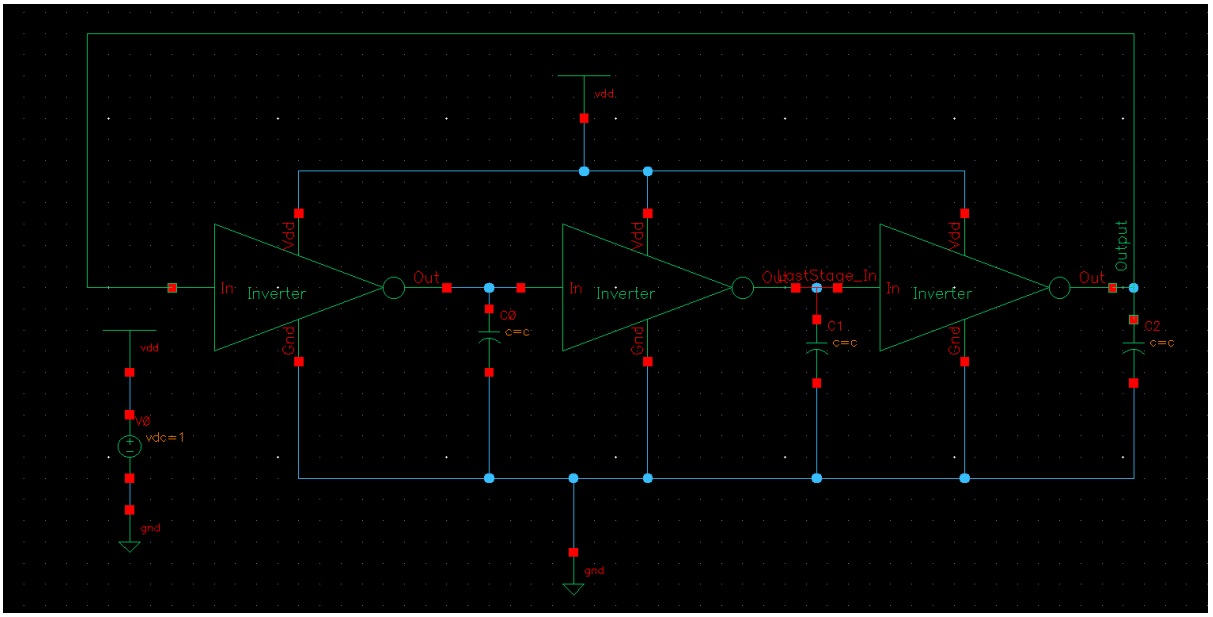


Schematics of Oscillator:

we using three-stage ring oscillator

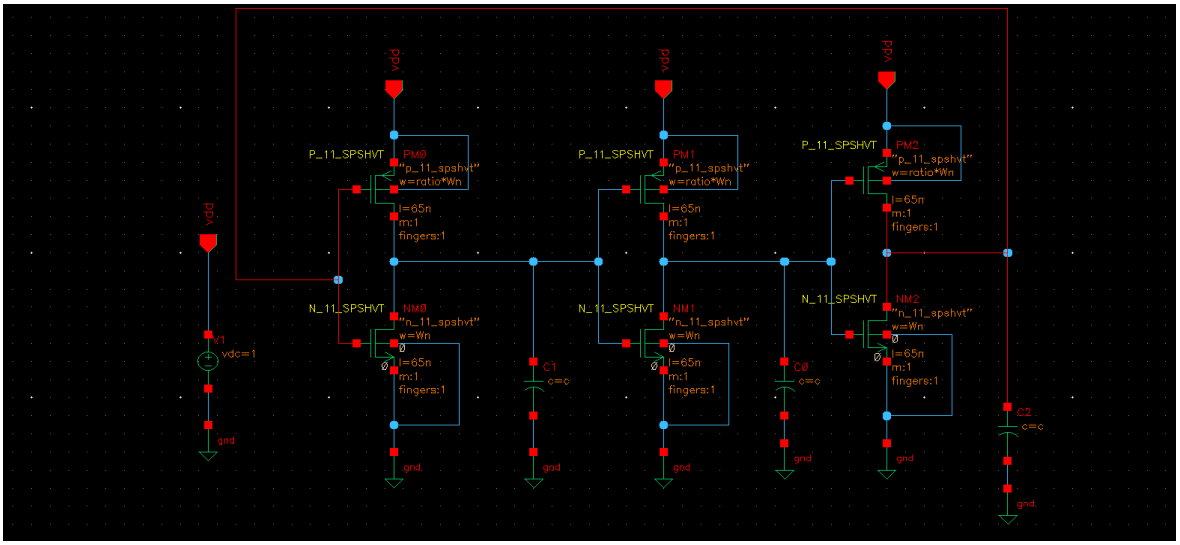


Symbol of Oscillator:

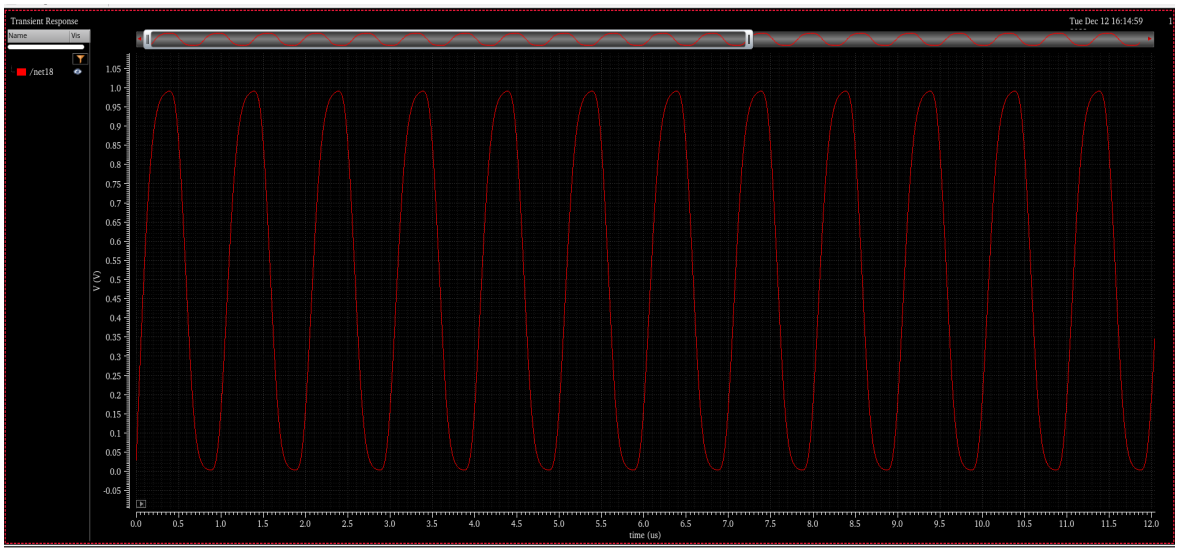


1M Hz Frequency:

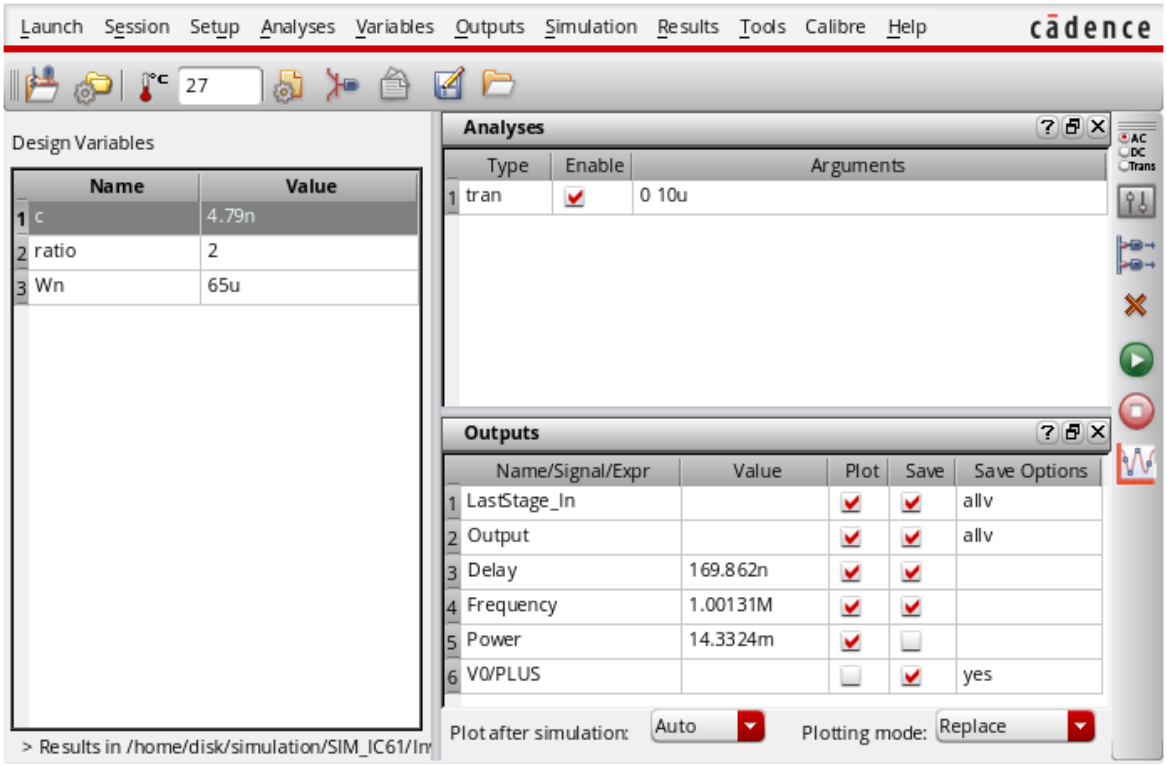
Schematics



Wave



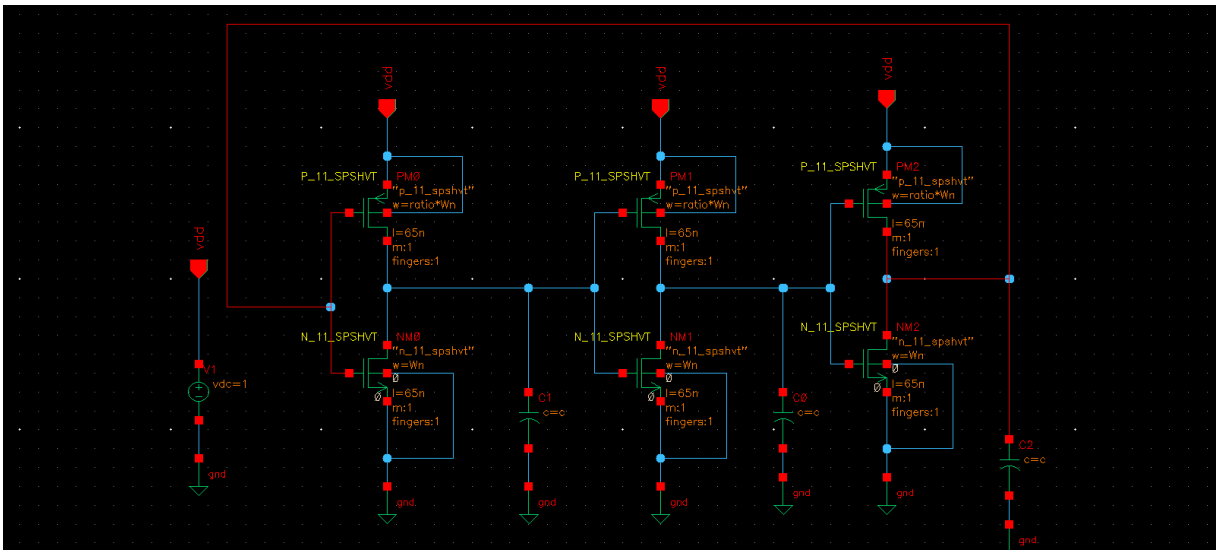
Calculate result



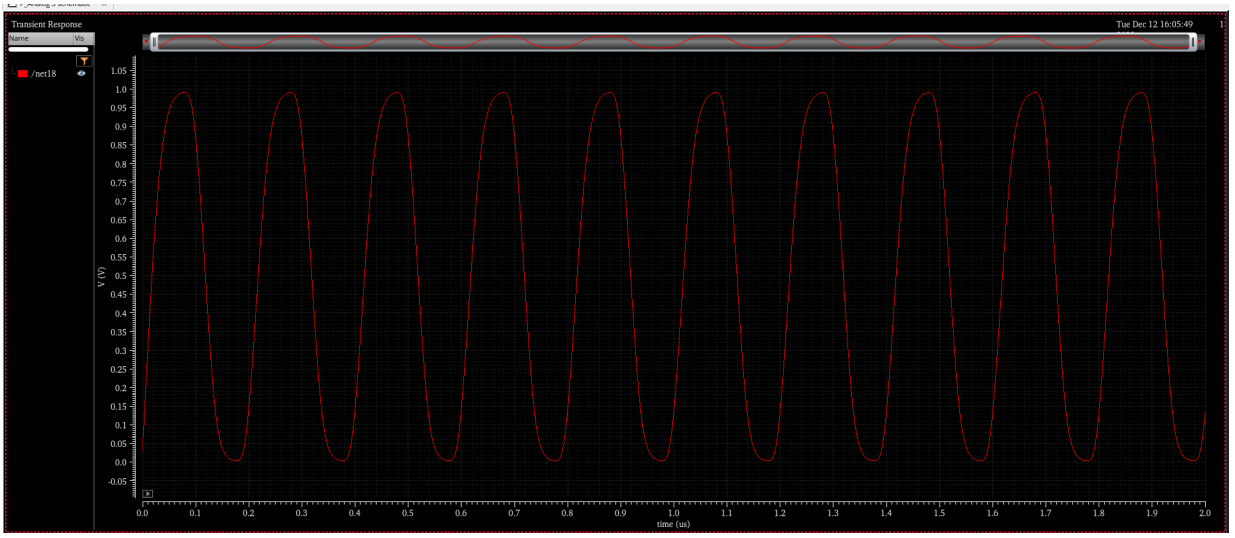
1-Capacitor value : **4.79nF**
2-Pmos size (Ratio *Wn = 2 * 65µm = 130µm)
3-Nmos size (Wn = 65µm)
4-Power : **14.3324mW**
5-Delay : **169.862ns**
6-Number of stage(number of transistor) : **3 stage / 6 transistor**

5M Hz Frequency:

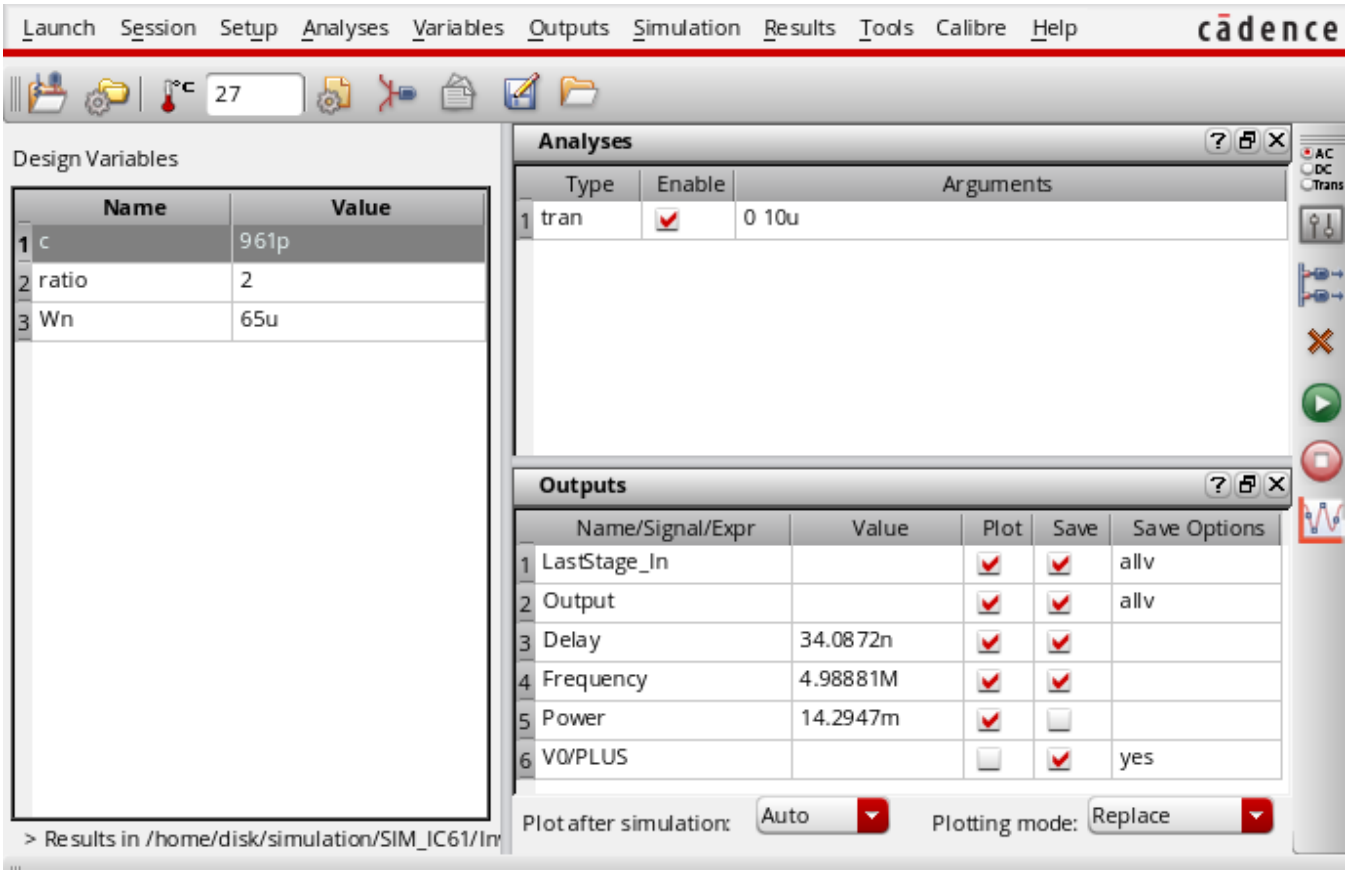
Schematics



Wave



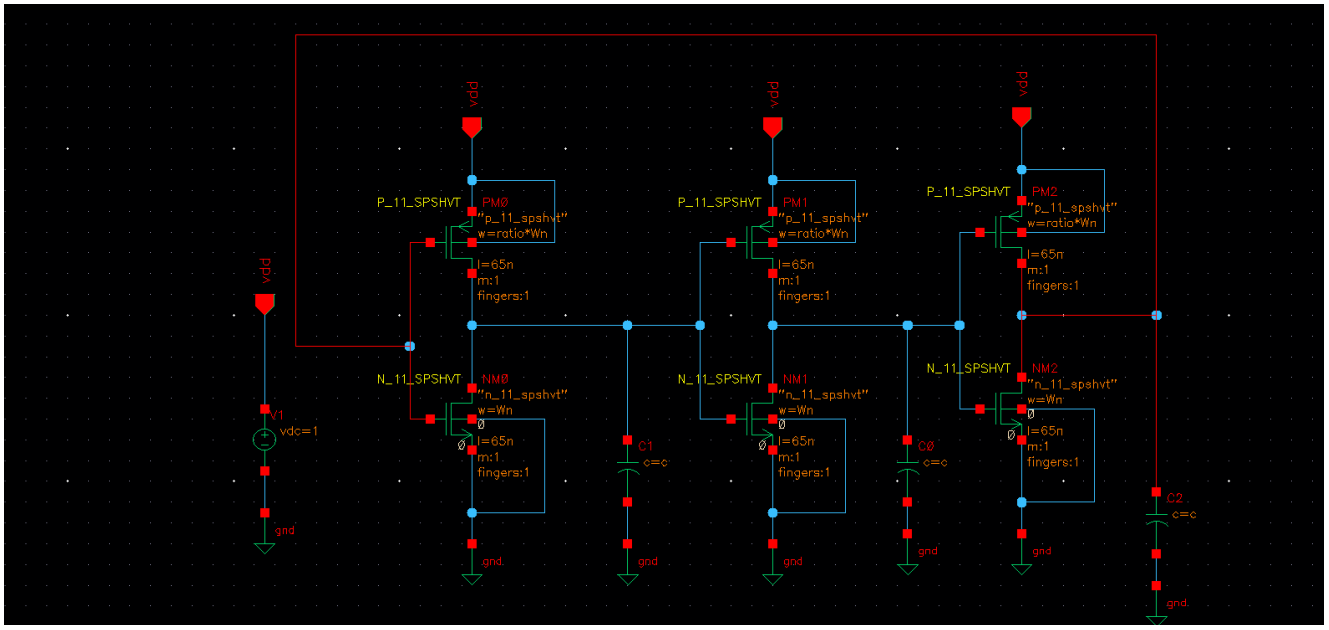
Calculate result



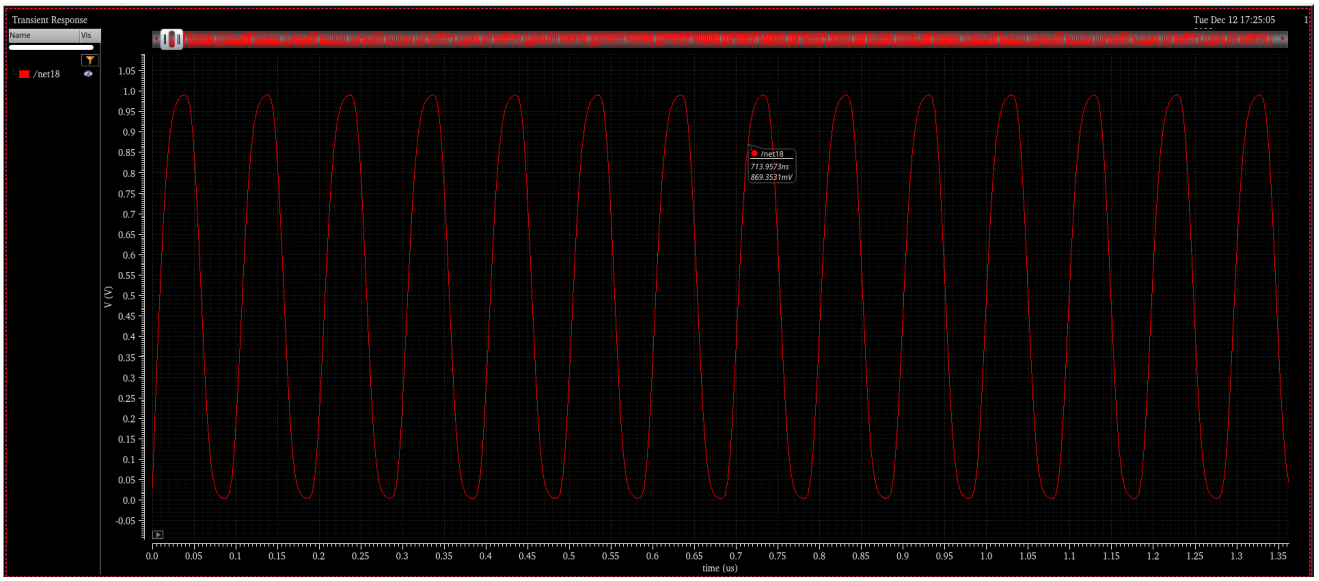
1-Capacitor value : **961pF**
2-Pmos size (Ratio *Wn = 2 * 65µm = 130µm)
3-Nmos size (Wn = 65µm)
4-Power : **14.2947mW**
5-Delay : **34.0872ns**
6-Number of stage(number of transistor) : **3 stage / 6 transistor**

10M Hz Frequency:

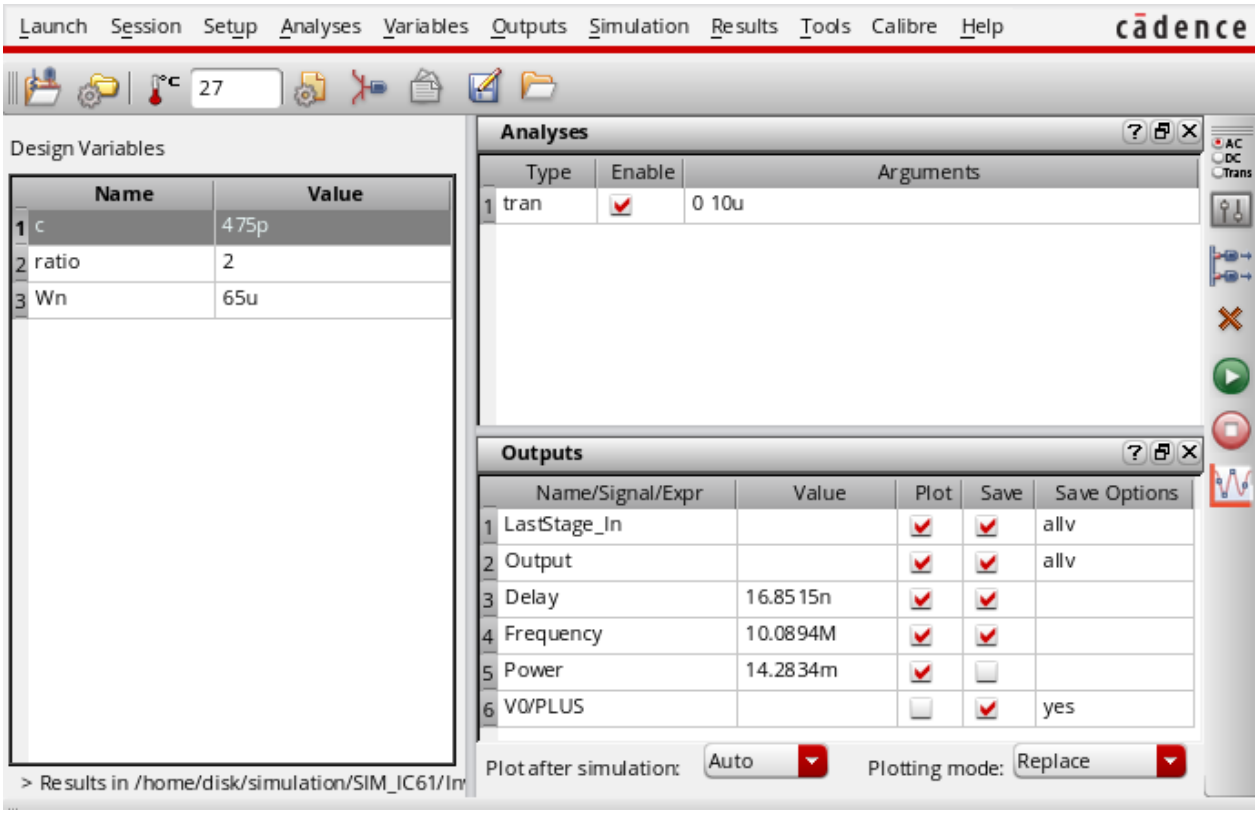
Schematics



Wave



Calculate result

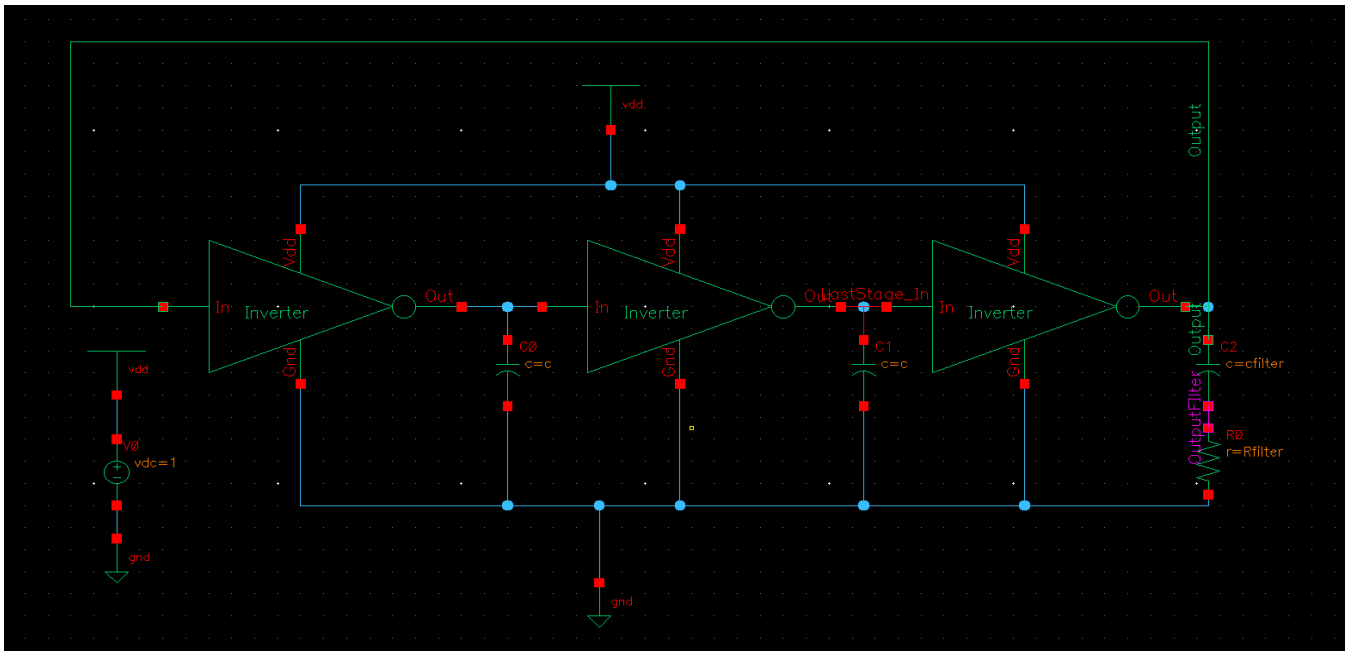


1-Capacitor value : **475pF**
2-Pmos size (Ratio *Wn = 2 * 65µm = 130µm)
3-Nmos size (Wn = 65µm)
4-Power : **14.2834mW**
5-Delay : **16.8515ns**
6-Number of stage(number of transistor) : **3 stage / 6 transistor**

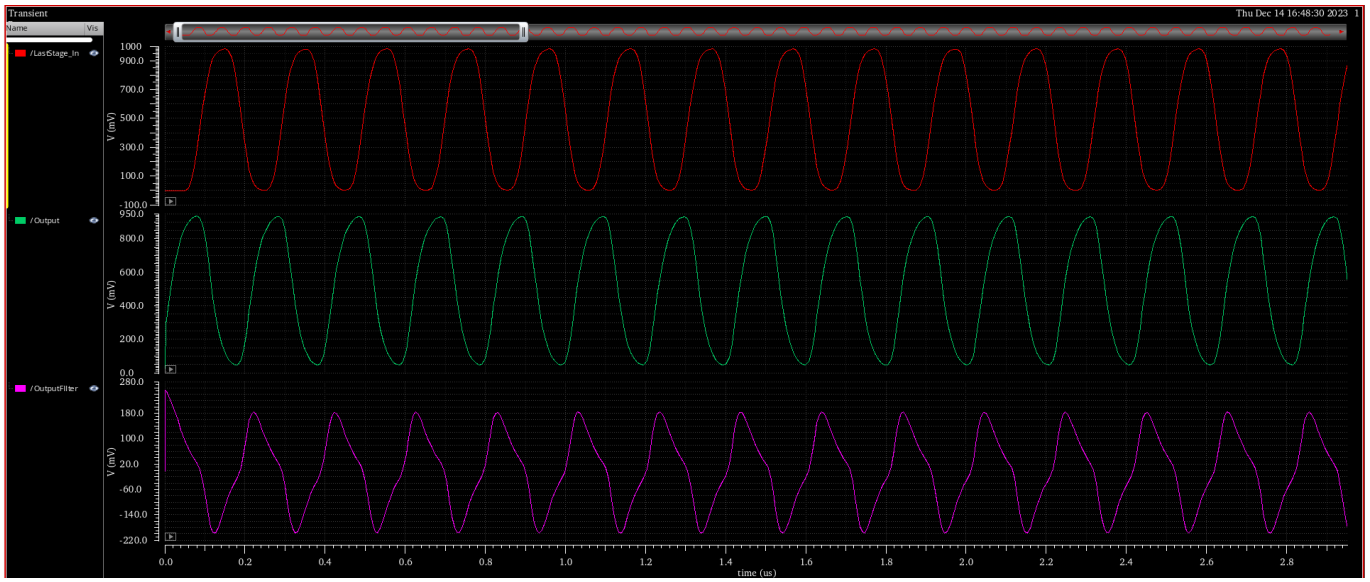
Using Filter :

5MHz using high pass filter

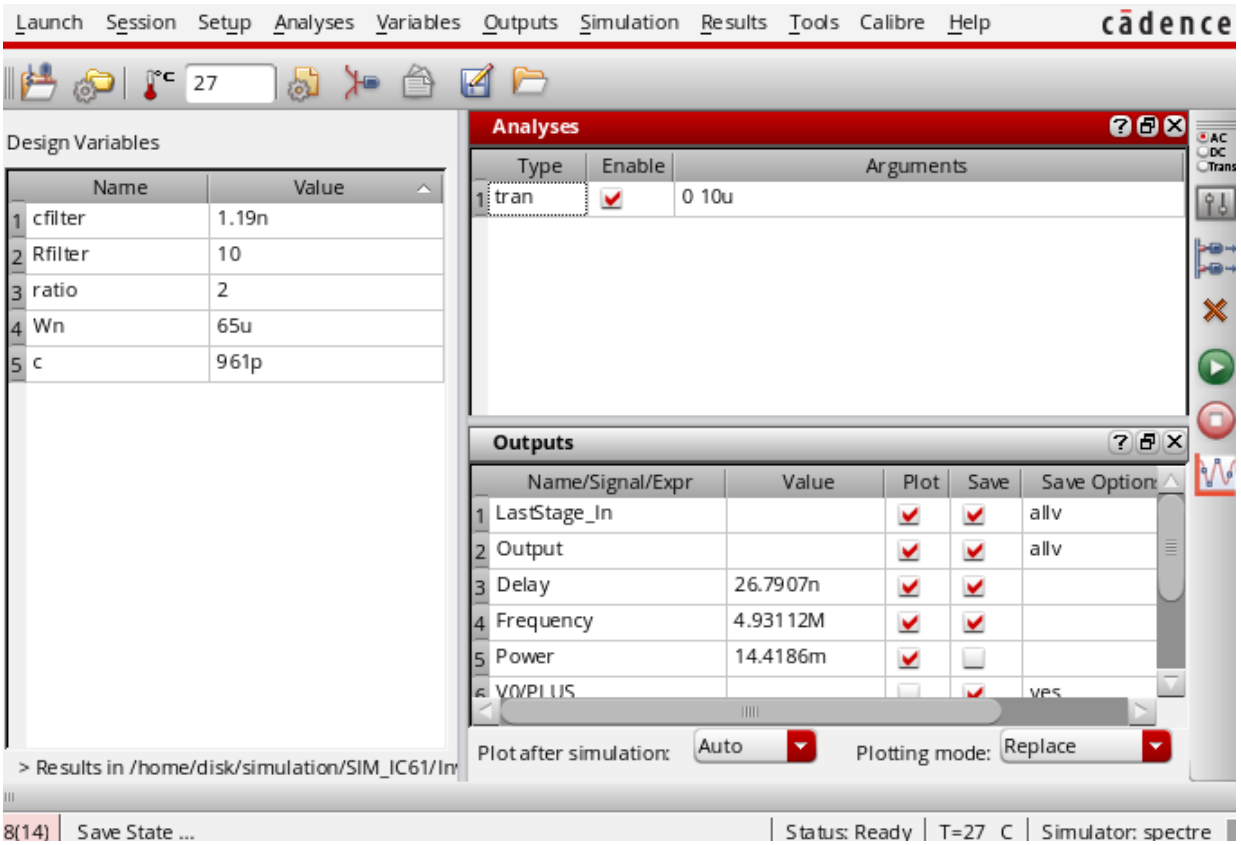
Schematics



Output Wave



Calculate result



Oscillators Parameters:

1-Capacitor value : **961pF**

2-Pmos size (Ratio *Wn = 2 * 65µm = 130µm)

3-Nmos size (Wn = 65µm)

4-Power : **14.4186mW**

5-Delay : **26.79ns**

6-Number of stage(number of transistor) : **3 stage / 6 transistor**

High Pass Filter Parameters:

1-Capacitor value : **961pF**

2-Resistor value : **10Ω**

Application:

Clock signal generator

A clock signal generator is an electronic oscillator that produces a clock signal for use in synchronizing a circuit's operation. The signal can range from a simple symmetrical square wave to more complex arrangements. The basic parts that all clock generators share are a resonant circuit and an amplifier

Discuss & conclusion

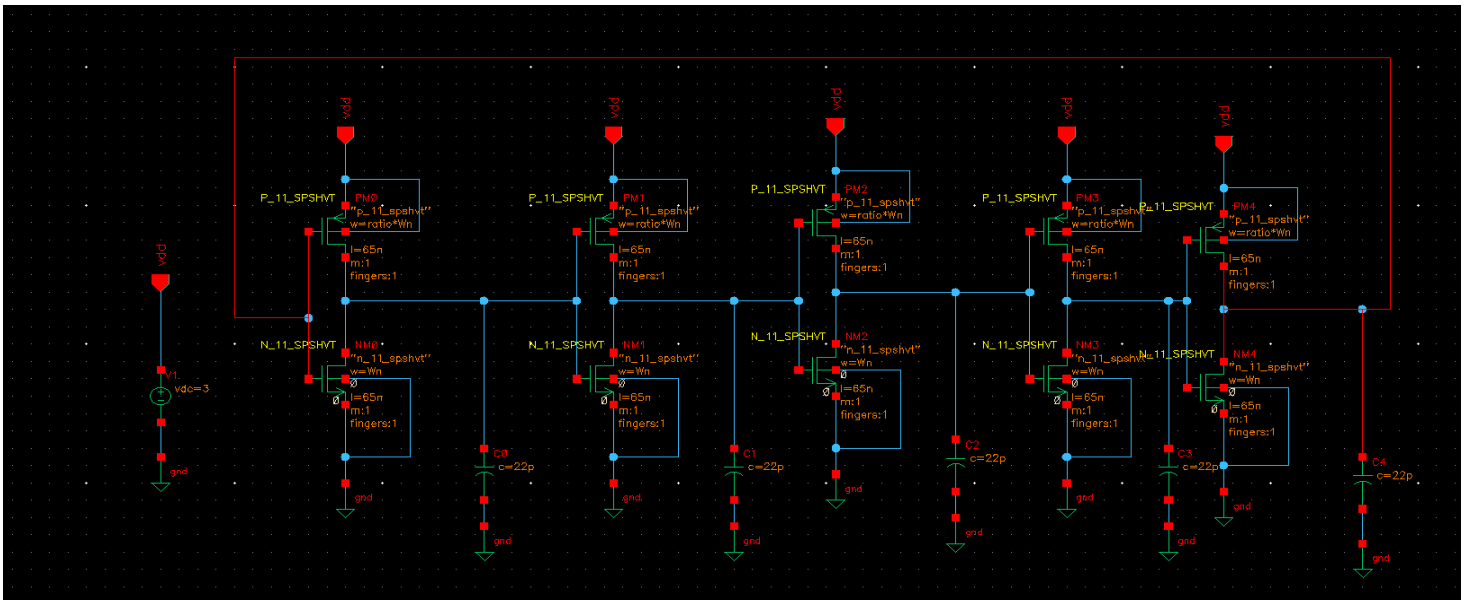
We try using 5 stage ring oscillator and 7 stage but output signal is square wave not sinusoid

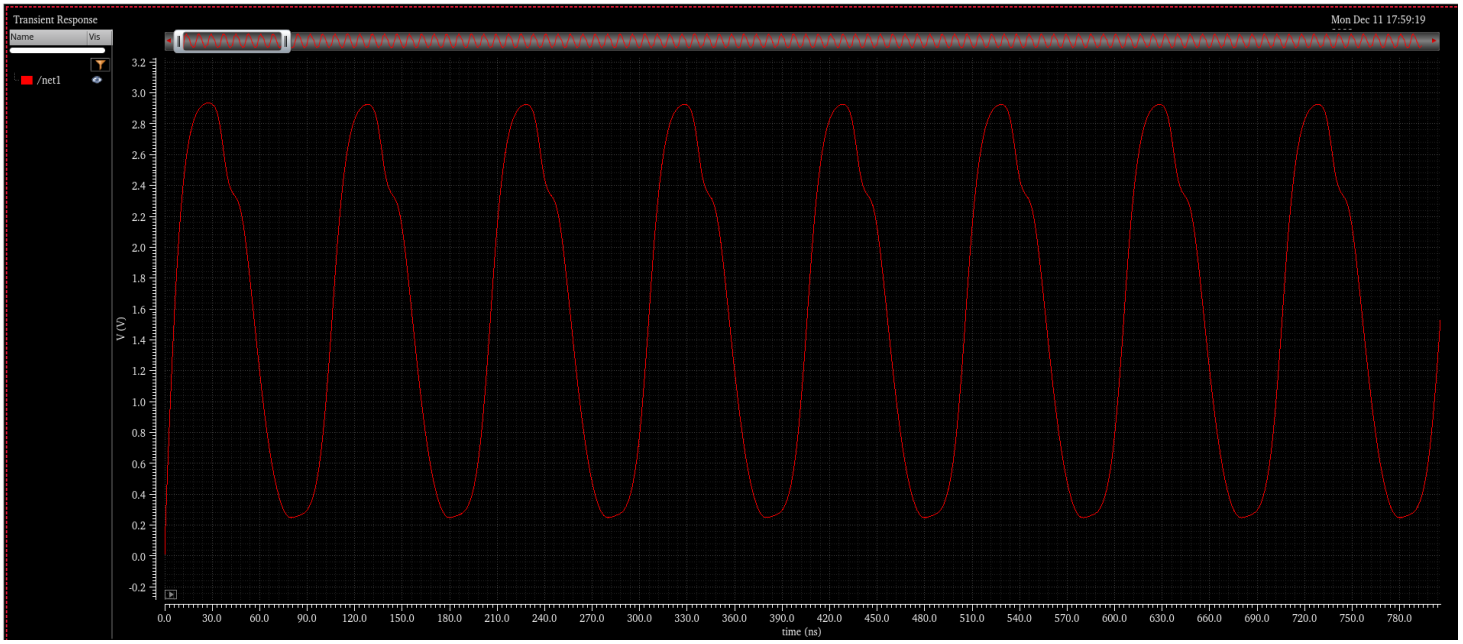
so using 3 stage ring oscillator then change in the value of capacitor and are of transistors

he inverter based delay, td, can be found out, and hence by conventional methods we can find out the ring oscillator frequency, by the age old formula f=1/2 n*td

Let's assume that the delay each inverter gives is td. So, the net delay associated with N stages will be N*td*2. This is because td is nothing but the difference in time of the toggle points of the input and corresponding output. We know the net phase shift should be of the order of 2π. But the net phase shift per oscillator must be of the order of π/N; as the remaining shift is obtained by the DC inversion. Now, this is one of the basic requirements that would come into play while we calculate the delay.

Now, our work involves studying of frequency response in case of an N-stage oscillator. We have seen already that frequency depends on td. We can say that every stage in the ring oscillator has a resistance and capacitance associated with it, which ultimately causes the delay. Now, to start with we use inverter stages using 60nm CMOS technology, with Wpmos=65nm, and Wnmos=65nm





conclusion:

1- 3 stage ring oscillator is the best of the output signal

2-The frequency is inversely proportional to the number of stages