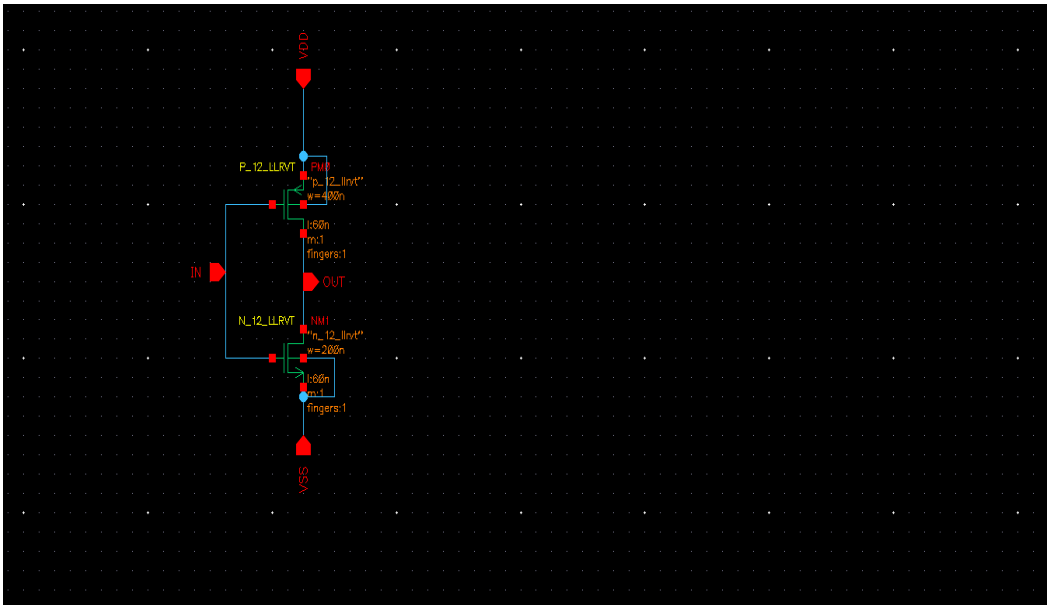
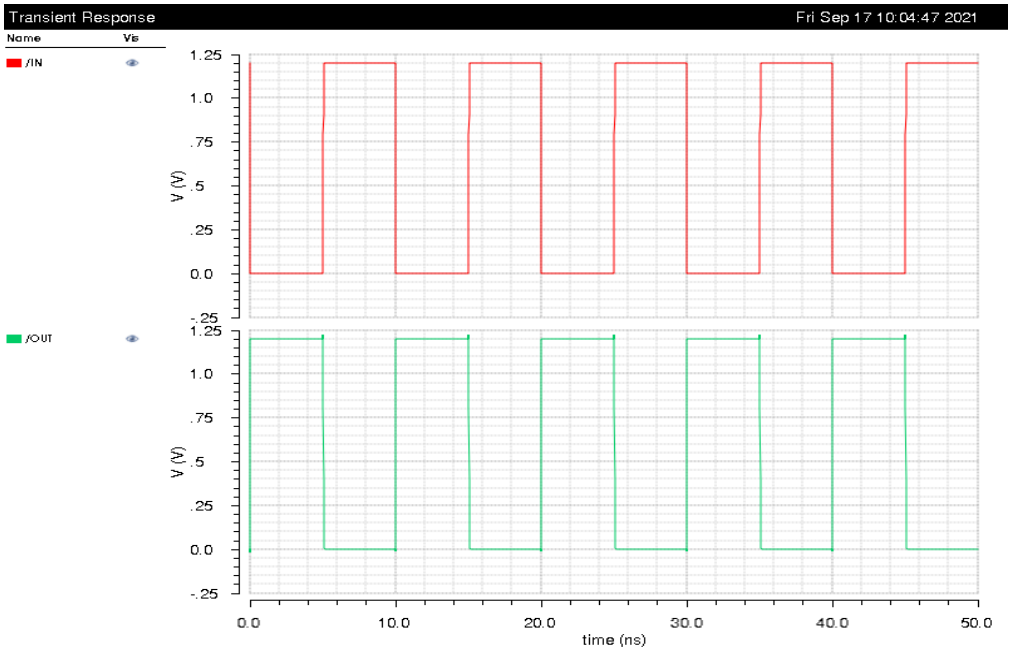
Task-1(Mod-5 Counter)

- Designed mod-5 synchronous counter using Master Slave JK Flip-flop.
- Frequency of Operation-250MHz.
- For Schematic:
  Nmos:W=200nm,L=60nm
  Pmos:W=400nm,L=60nm
  Simulated the circuit and achieved the desired output.
  (The simulated output waveform and schematic are given below)
- For layout:
  Length=1.4um
  Width=63.735um
  Area =89.229um^2
- Cleared the DRC errors and also verified the LVS(The reports are attached in the repository).
- Performed the PEX analysis(pex report attached).
- Counter has 5 states:000,001,010,011,100,000…….
- The timing parameters of counter is in the spec file in the repository as well as given below.
- Setup and Hold time is same for the counter as well as for the ff.
- The Rise time, Fall time, Delay time($T_{phl,}T_{plh}$) is calculated for the inverter.
- Minimum frequency can be nearly to zero and to find maximum freq, I operated at 2Mhz and achieved correct output(Simulated waveform attached),After that operated at 3.125Mhz and was not able to achieve the output(waveform attached).So the Maximum freq is less than 3.125MHz.

Inverter Schematic:



Inverter Simulation:

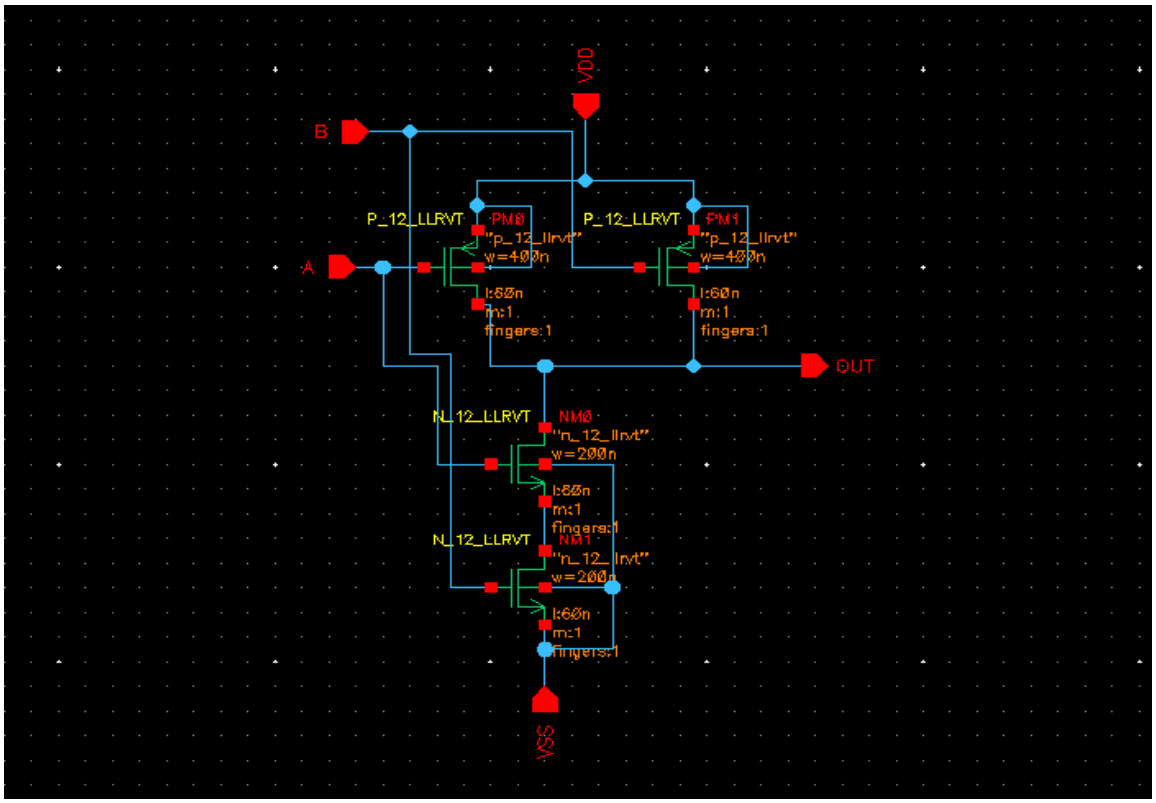


Time period for input:10ns

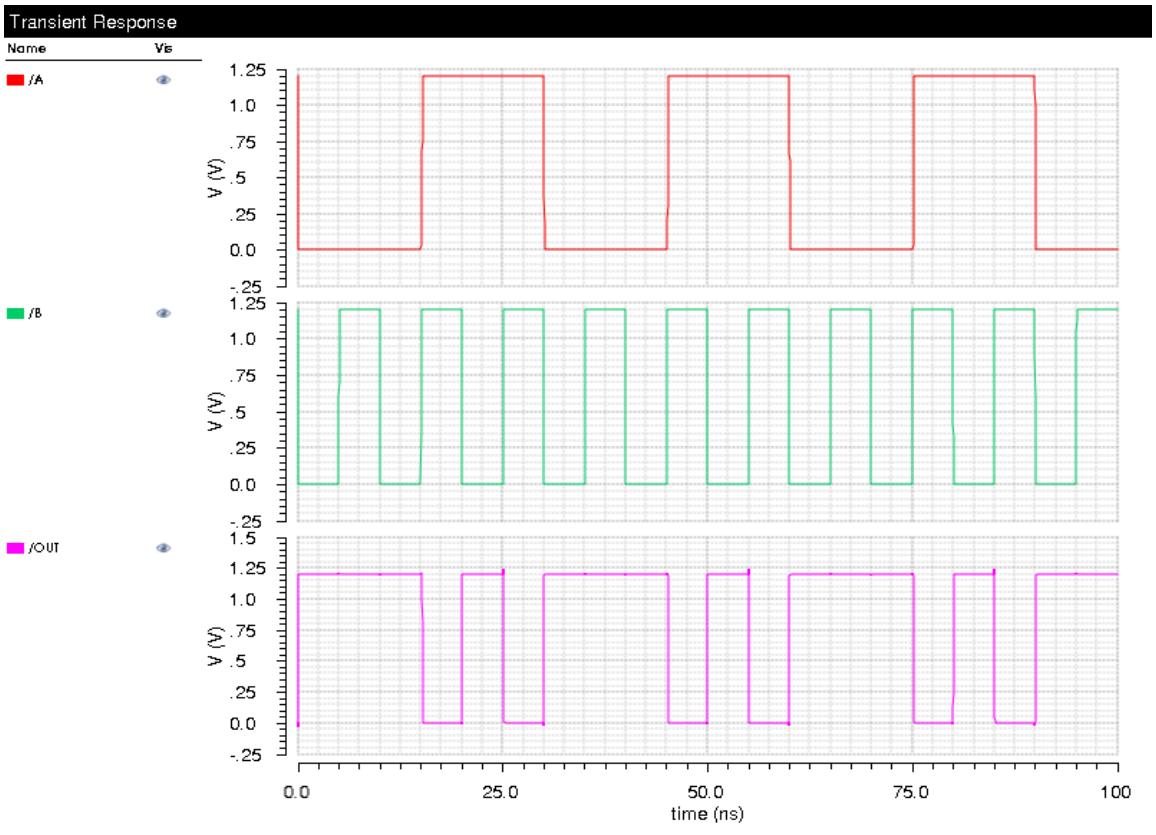
Rise time=falltime=13.8ps

delay(high to low)=10.26ps ;delay (low to high)=12.4ps

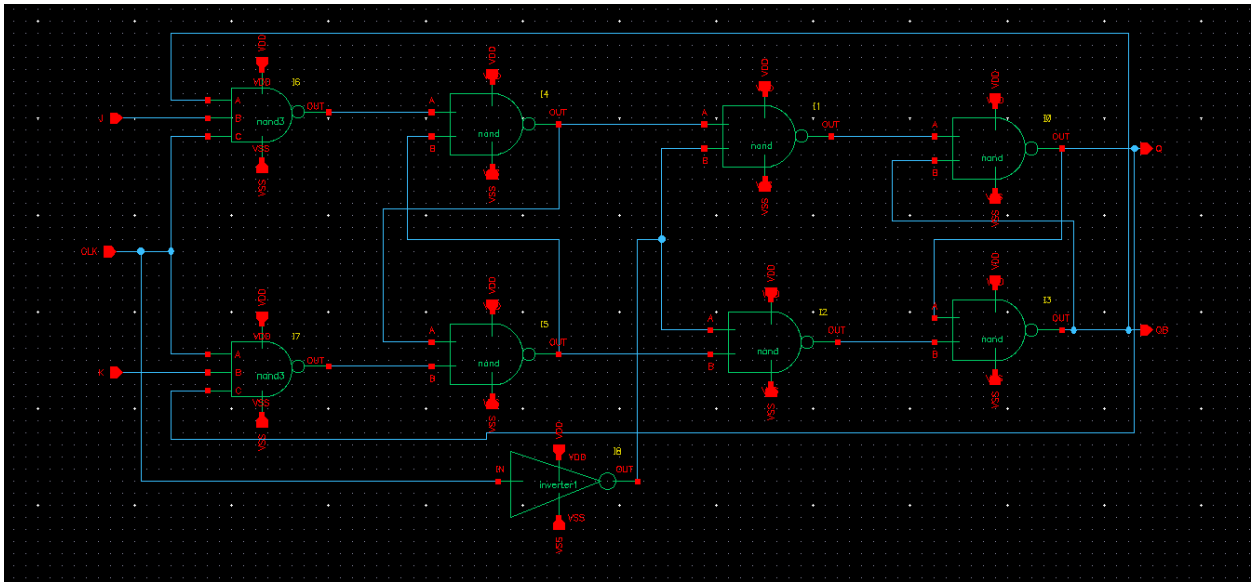
Nand Schematic:



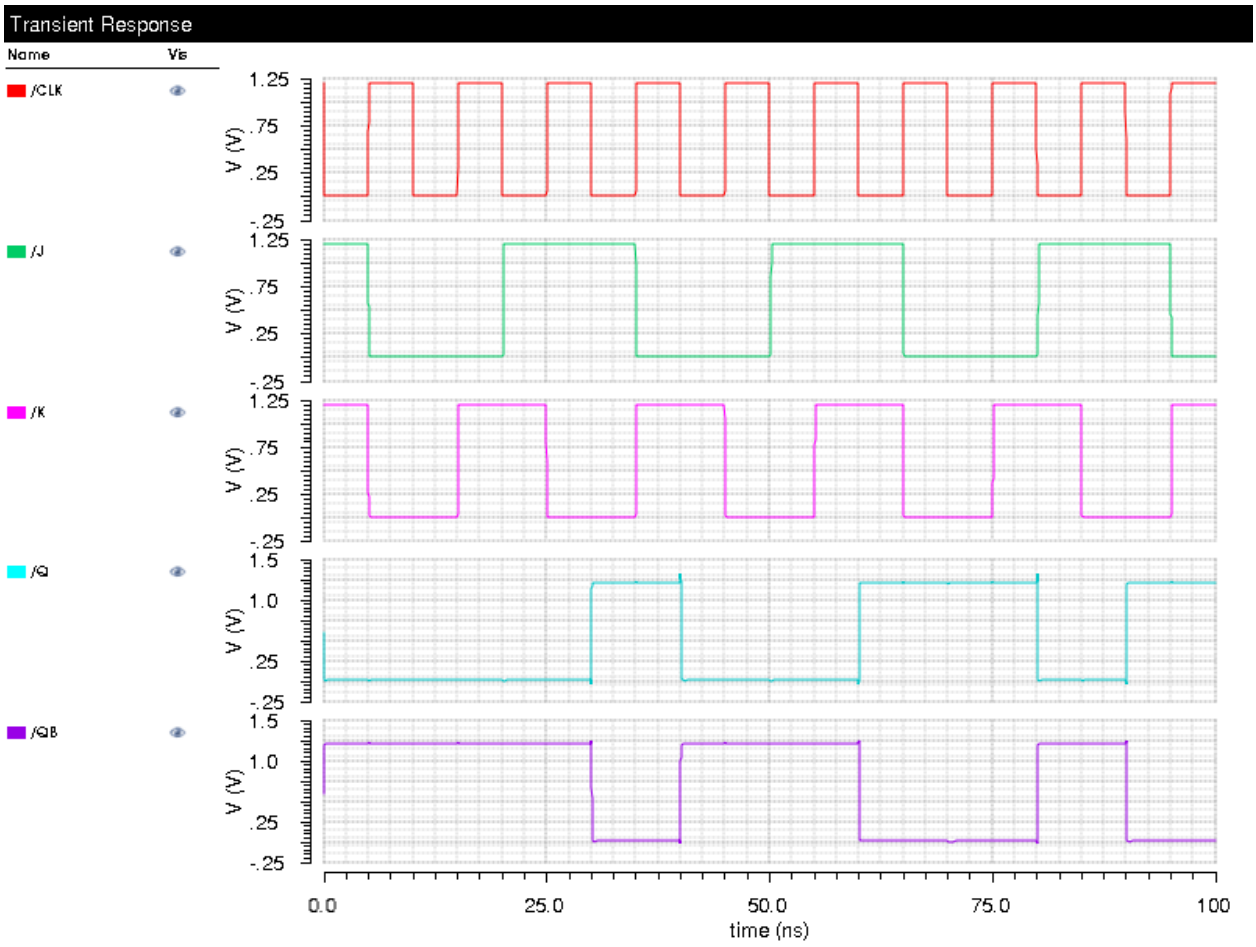
Nand Simulation:



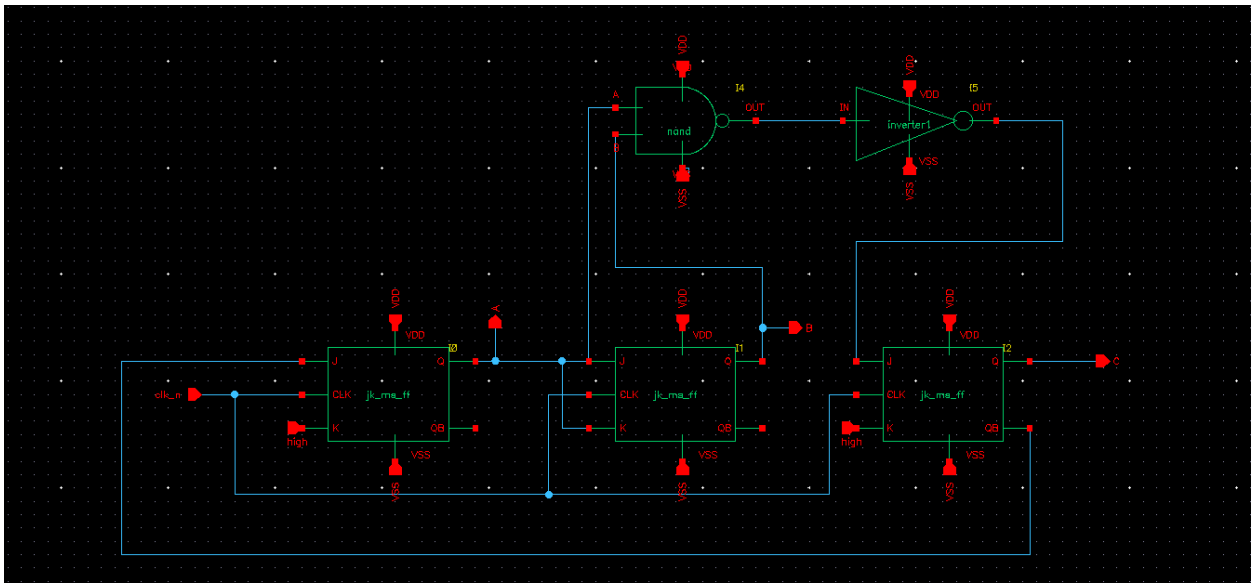
JK flip-flop Schematic:



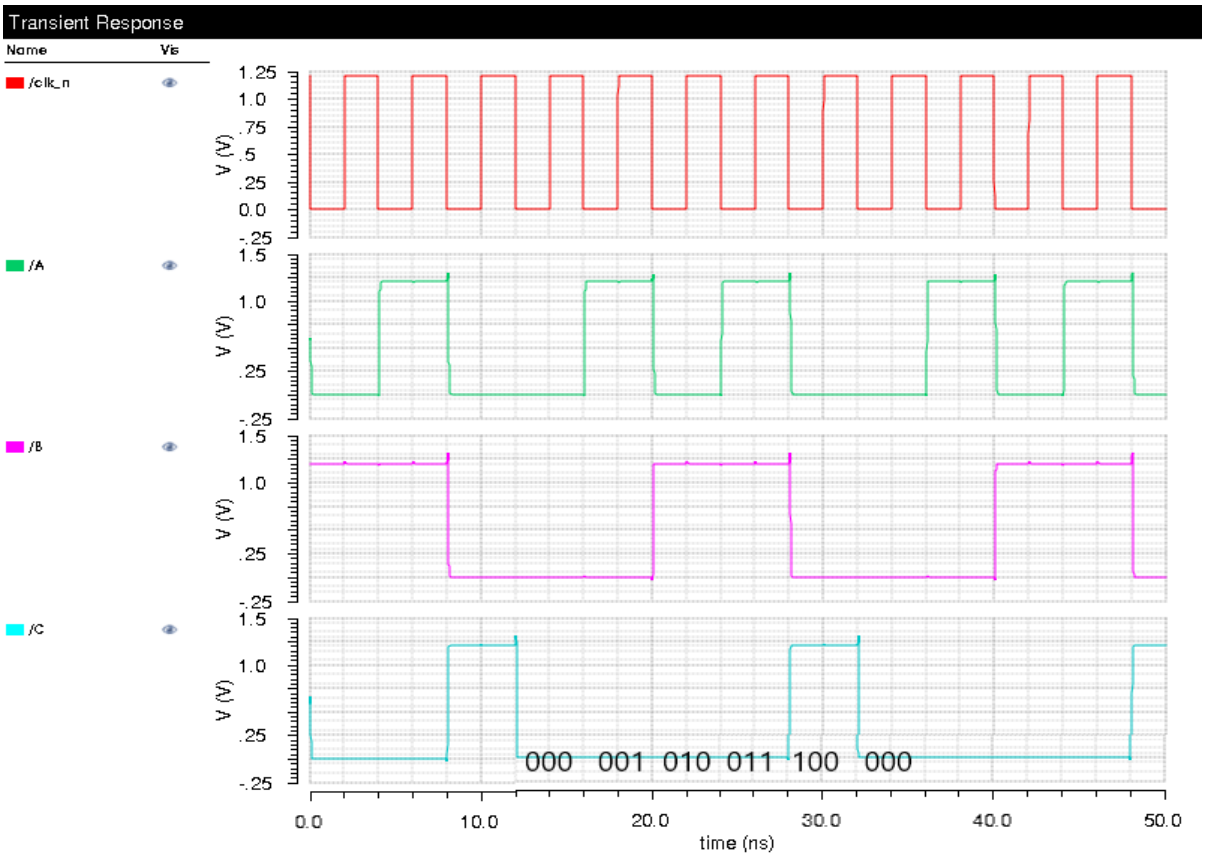
JK flip-flop simulation:



MOD-5 COUNTER Schematic:



MOD-5 COUNTER Simulation:



Specification:

Operating Frequency:2MHz

For A

Rise time:50.89ps;Fall time:50.89ps

For B

Rise time:37.76ps;Fall time:37.76ps

For C

Rise time:28.67ps;Fall time:28.67ps

Delay time (From clk to output A):32.29ps

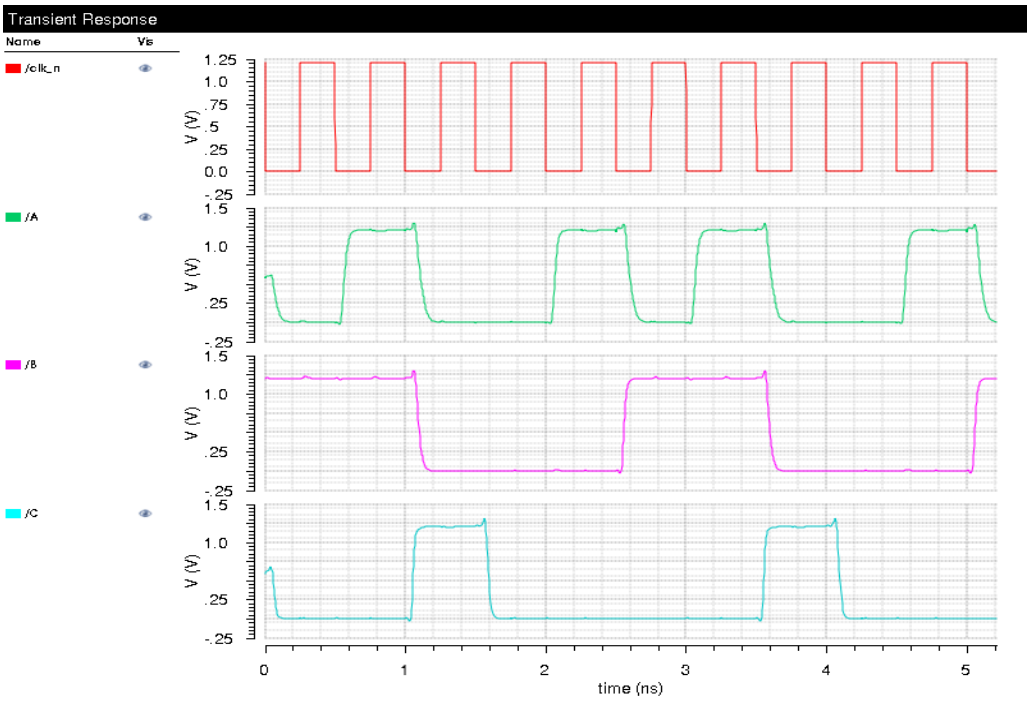
Delay time (From clk to output B):64.37ps

Delay time (From clk to output C):10.02ps

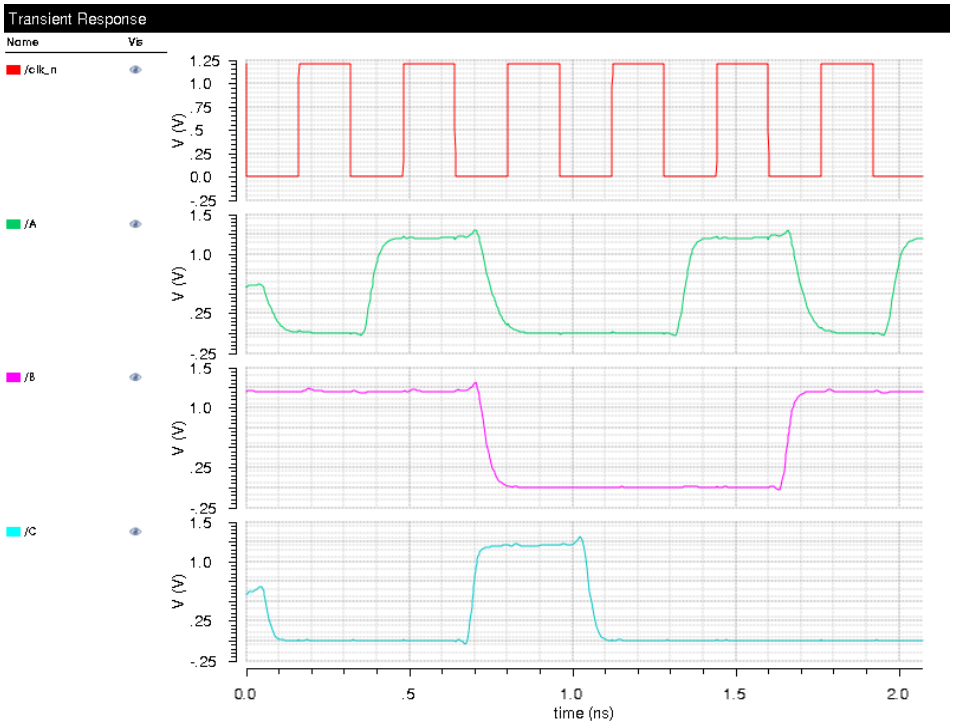
Frequency:Min:(approx 0)

Max:(close or less than 3.125Mhz)

Simulation Output for F=2GHz:



Simulation Output for F=3.125GHz:



Here we can observe that the output is much distorted at f=3.125Hz,So max frequency is below 3.125Hz.