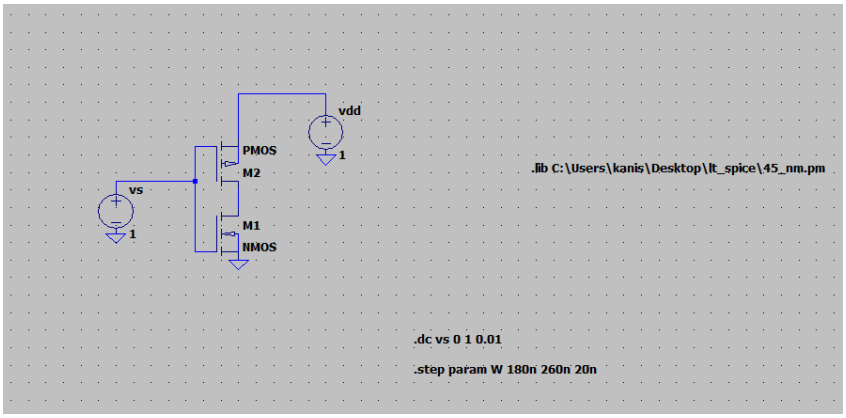
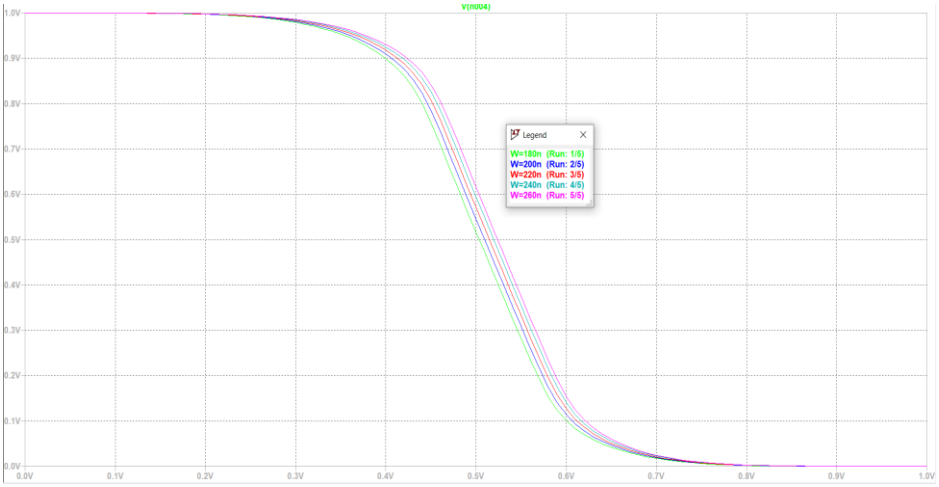
1) INVERTER gate using Static CMOS logic



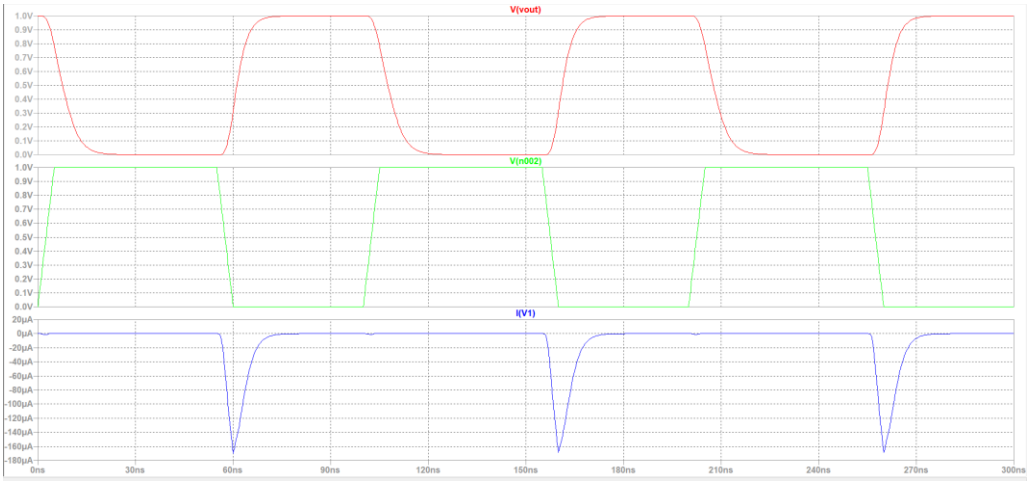
Schematics

(1) VTC

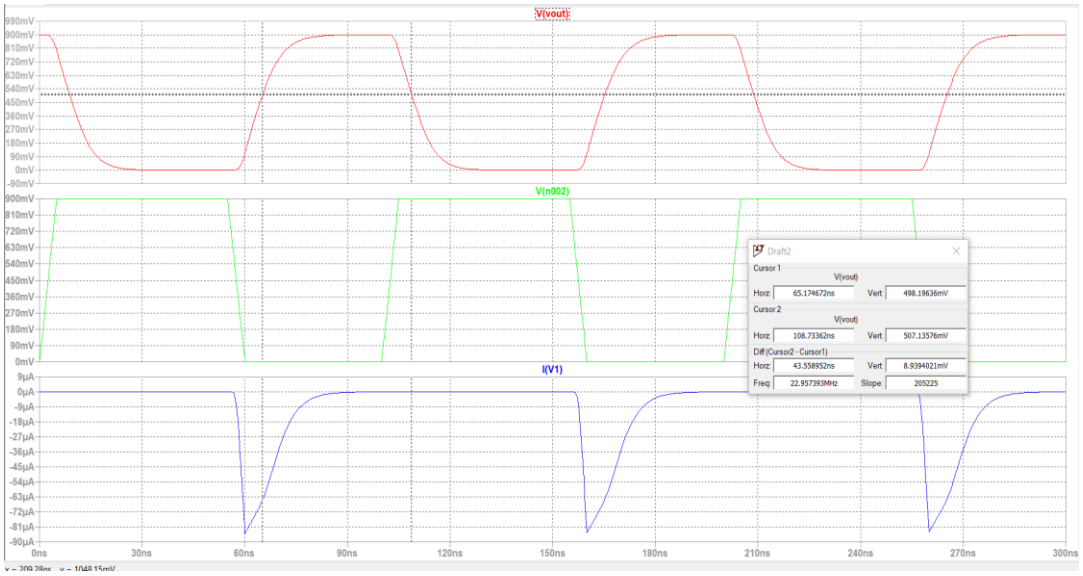
(a) 45nm (width of PMOS is varied from 180nm to 260nm)



(2) Delay calculations/power dissipation



45nm



32nm

(a) Observation and Calculation

C_load=1pF

Output Delay= (Tlh + Thl) / 2

Power Dissipation= Vdd * $I_{D(avg)}$

- 45nm Technology
  Tlh=3.9445ns
  Thl=1.38ns
  Tavg=2.66ns
  Iavg=10.078uA

- 32nm Technology
  Tlh=5.705ns
  Thl=5.402ns
  Tavg=5.553ns
  Iavg=8.992uA

Node	TpHL(ns)	TpLH(ns)	Tdelay(ns)	P=Vdd*Iavg(uW)
45	1.38	3.9445	2.66	10.0178
32	5.402	5.705	5.55	8.0928

NAND and NOR gate using Static CMOS logic

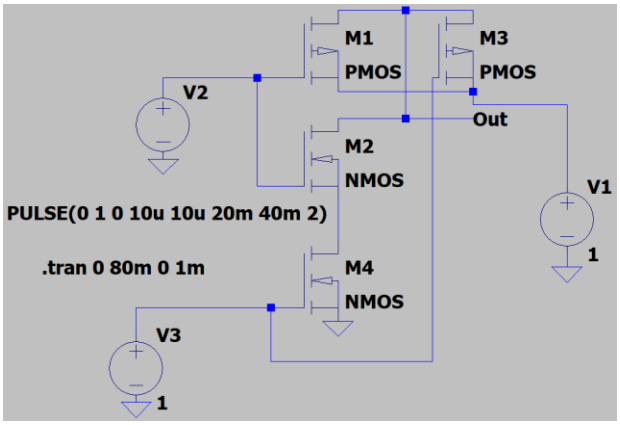
Schematic:

NAND NO

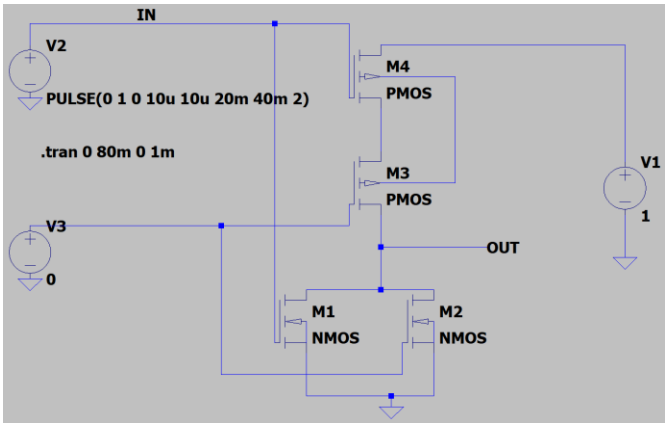
R

2) NAND and NOR gate using Static CMOS logic

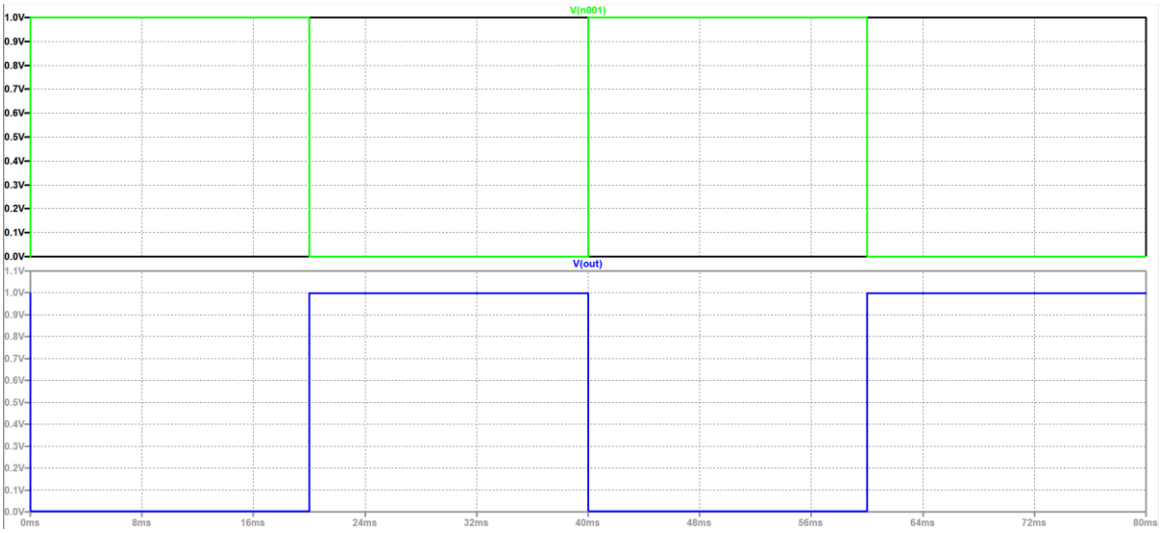
NAND GATE



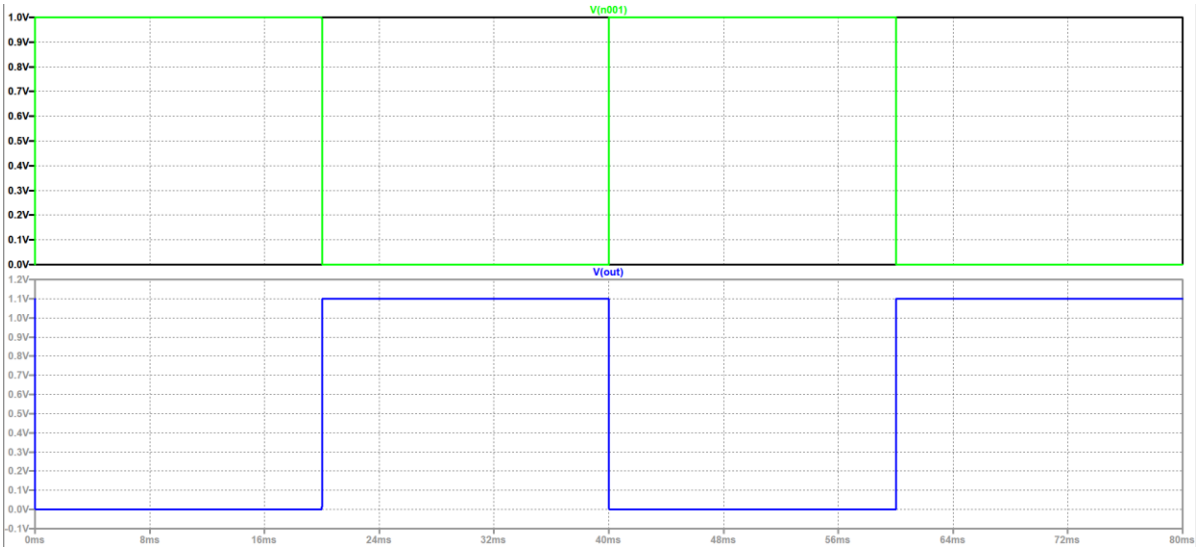
NOR GATE



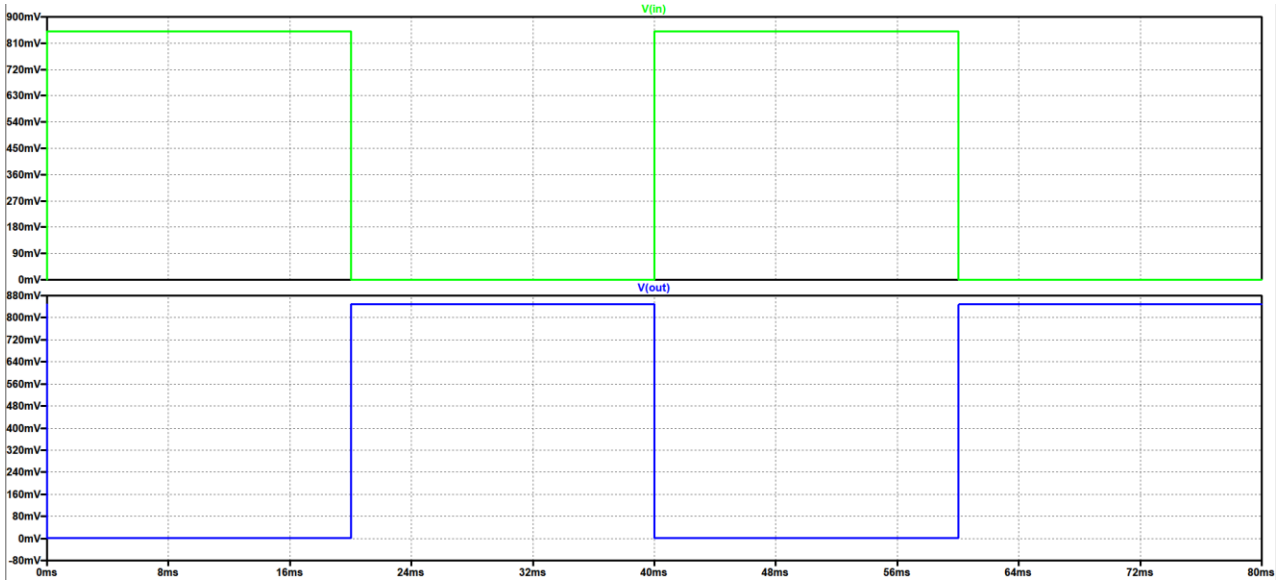
- 32nm Technology



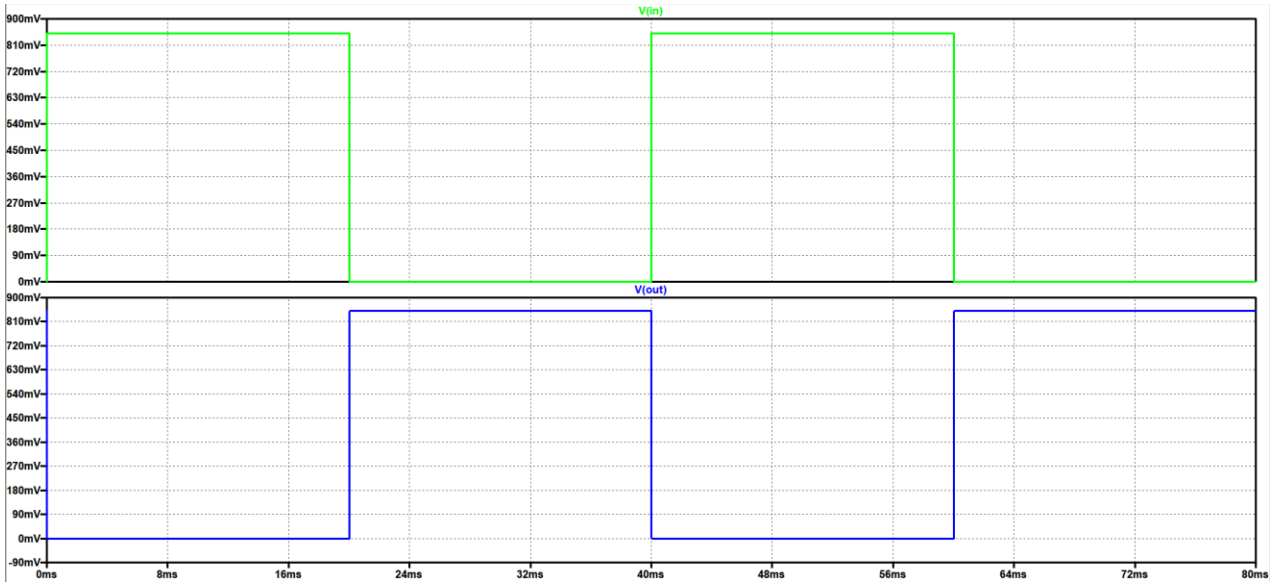
- 45nm Technology



- 32nm Technology



- 45nm Technology



Observations and Calculations:

Formulas Used:

- Output Delay= (Tlh + Thl) / 2
- Power Dissipation= Vdd * $I_{D(avg)}$

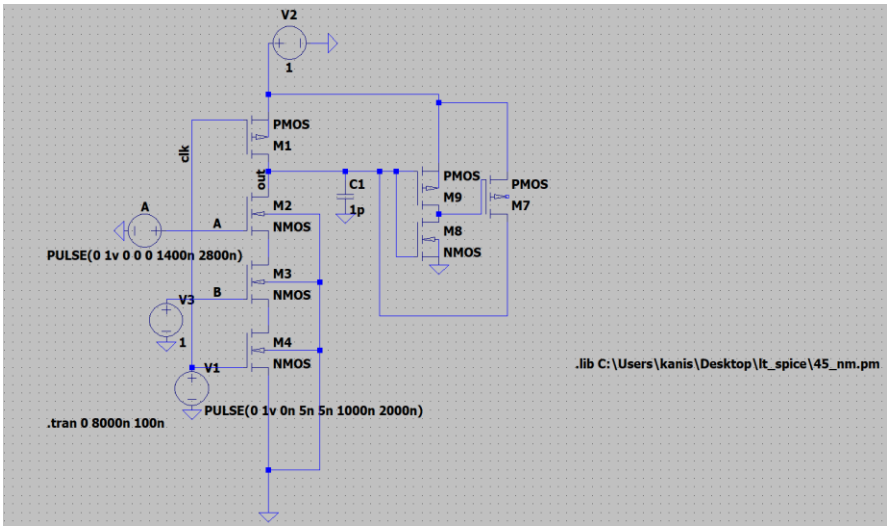
NAND

Technology	Tlh	Thl	Output Delay	$I_{D(avg)}$	Power Dissipation
45 nm	54.649123ns	1.5113573ns	28.08024015ns	48.031nA	48.031nW
32 nm	6.2516376ns	3.65781ns	4.9547238ns	297.19pA	297.19pW

NOR

Technology	Tlh	Thl	Output Delay	$I_{D(avg)}$	Power Dissipation
45 nm	82.2584 ns	29.9875 ns	56.12295 ns	147.96nA	147.96nW
32 nm	33.41985 ns	17.568 ns	25.493925 ns	27.047nA	27.047nW

3) NAND and NOR gate using Dynamic logic (45nm)



NAND gate

Observations and calculations

Formulas Used:

- Output Delay= (Tlh + Thl) / 2
- Power Dissipation= Vdd * $I_{D(avg)}$

- 45nm

ID(avg) =5.6215µA

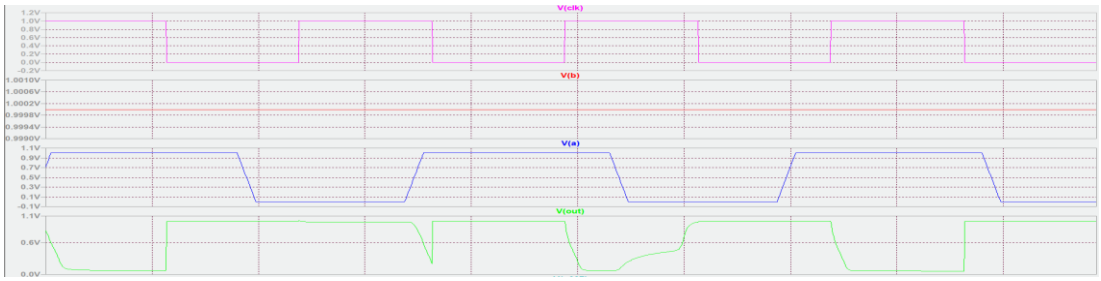
Power Dissipation =5.6215µW

Tlh=0ns

Thl=5.9301-5.90250 µs=27.6ns

Tavg=13.8ns

45nm



- 32nm

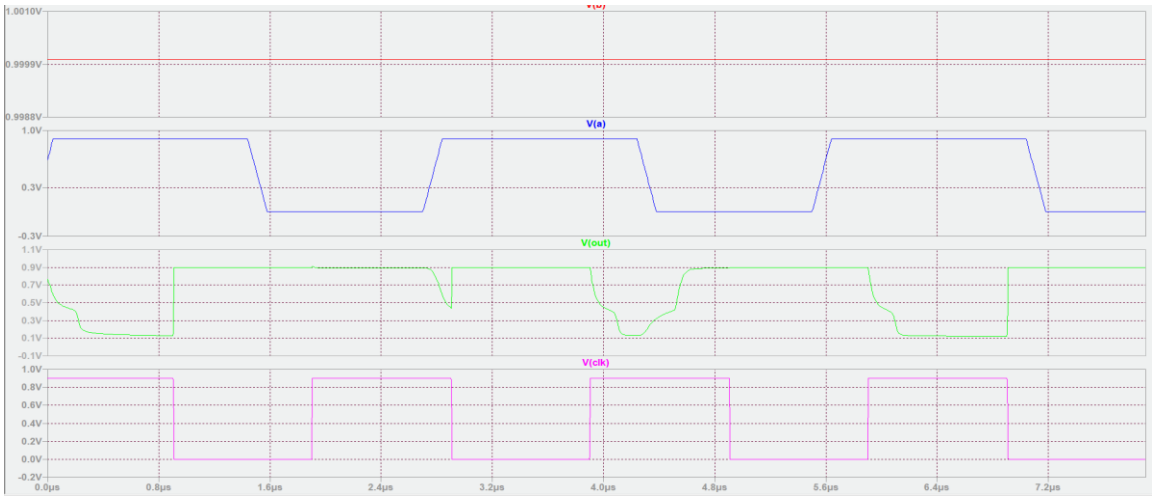
ID(avg) =8.694µA

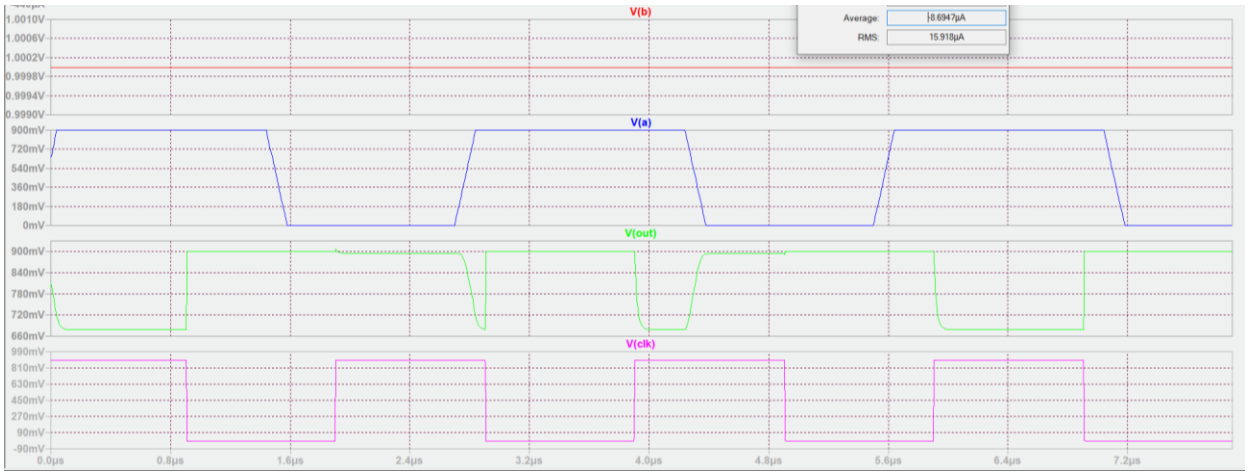
Power Dissipation =7.8246µW

Tlh=0ns

Thl= 4.9602637µs -4.9077753µs =52.5ns

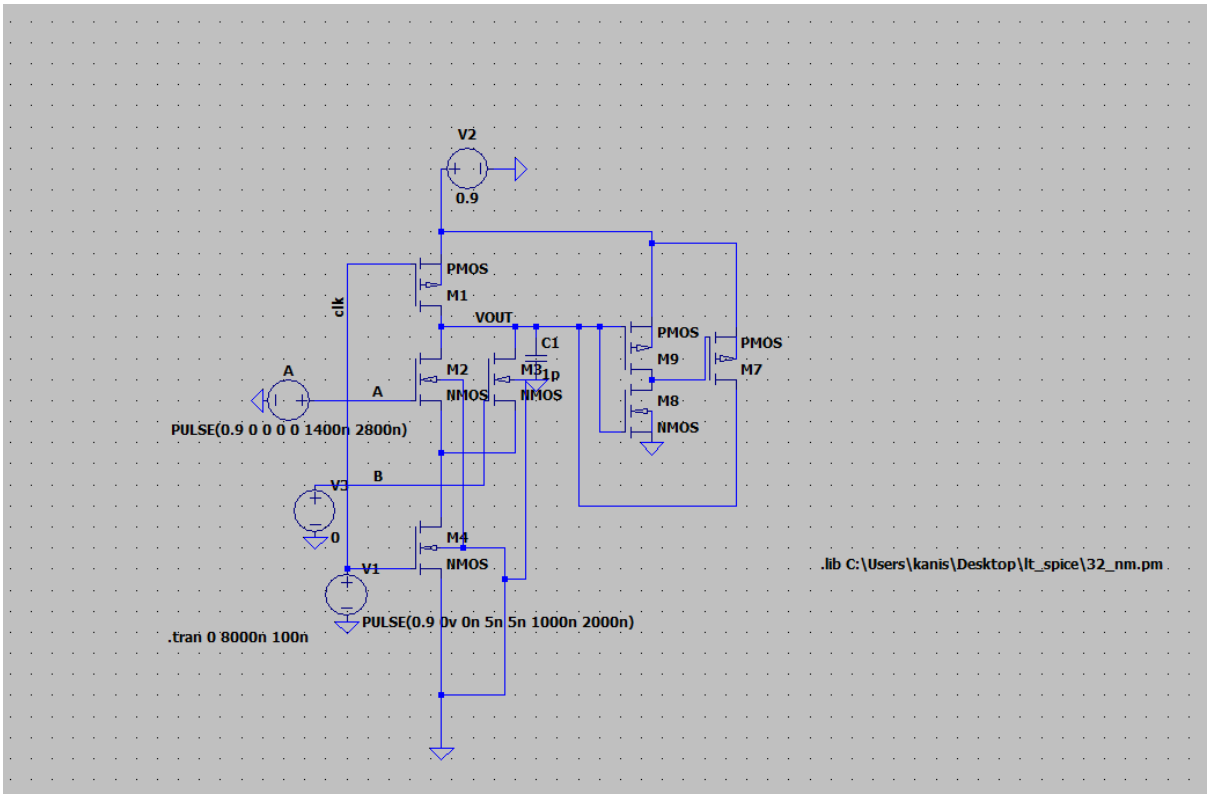
Tavg=26.25ns



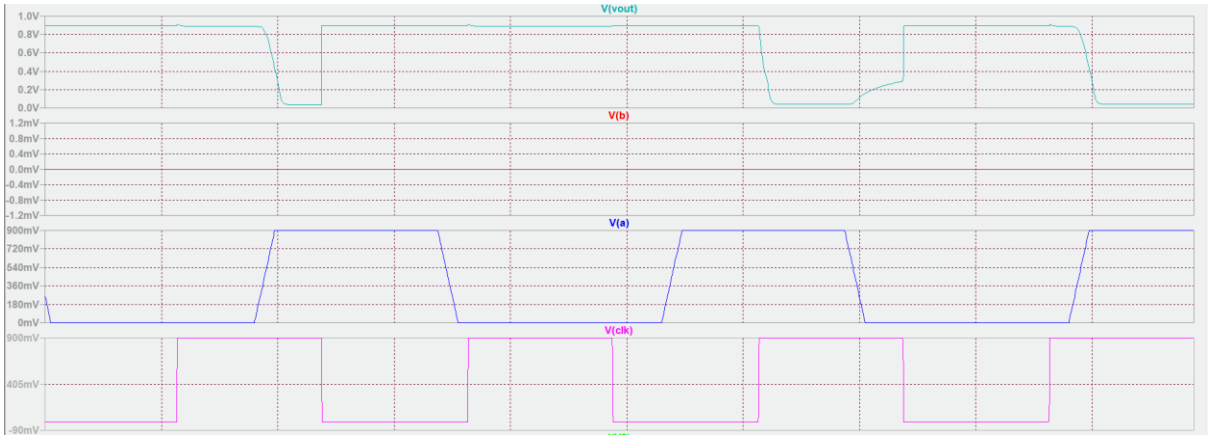


Bleeder circuit strong

NOR GATE



- **32nm**



ID(avg) =2.4823µA

Power Dissipation =2.234µW

Tlh=0ns

Thl= 4.9602637µs -4.9077753µs =32.5ns

Tavg=16.25ns