ECEN 454

LAB 6

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SECTION: 511

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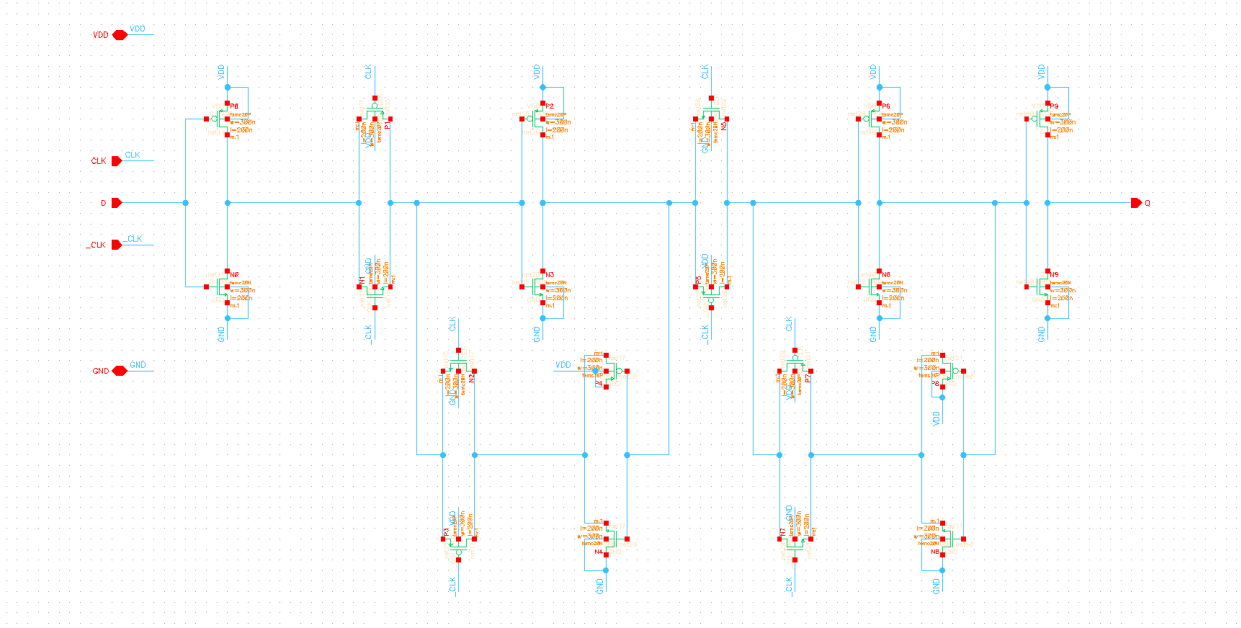
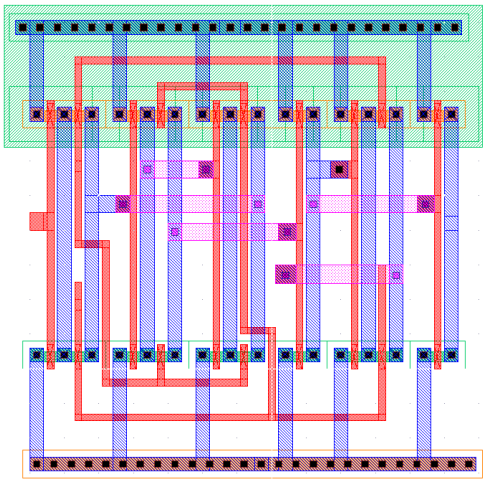
Flip-Flop Schematic



Flip-Flop Layout

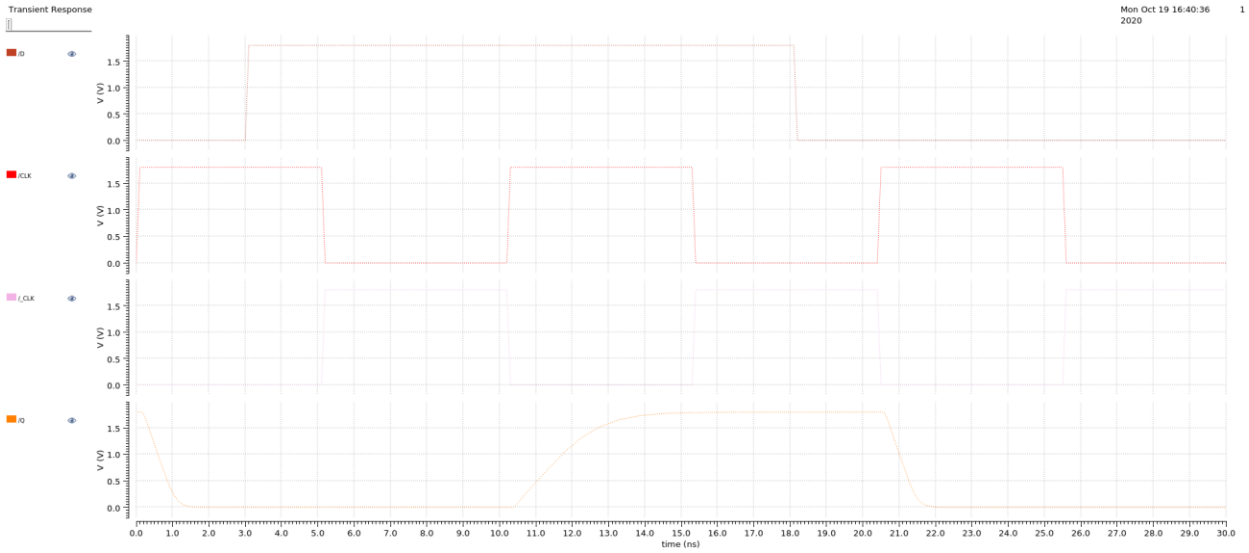


LVS

```
@(#)$CDS: LVS version 6.1.8-64b 08/04/2020 19:19 (cpgsrv11) $

Command line: /opt/coe/cadence/IC618/tools.lnx86/dfII/bin/64bit/LVS -dir /home/ugrads/j
Like matching is enabled.
Net swapping is enabled.
Using terminal names as correspondence points.
Compiling Diva LVS rules...

    Net-list summary for /home/ugrads/j/jasongilman/ecen454/LVS/layout/netlist
       count
        13              nets
        6               terminals
        10              pmos
        10              nmos

    Net-list summary for /home/ugrads/j/jasongilman/ecen454/LVS/schematic/netlist
       count
        13              nets
        6               terminals
        10              pmos
        10              nmos


    Terminal correspondence points
    N10         N6          CLK
    N11         N2          D
    N7          N1          GND
    N8          N3          Q
    N12         N8          VDD
    N9          N7          _CLK

Devices in the rules but not in the netlist:
        cap nfet pfet nmos4 pmos4

The net-lists match.

                              layout  schematic
                                 instances
        un-matched               0       0
        rewired                  0       0
        size errors              0       0
        pruned                   0       0
        active                   20      20
        total                    20      20
```

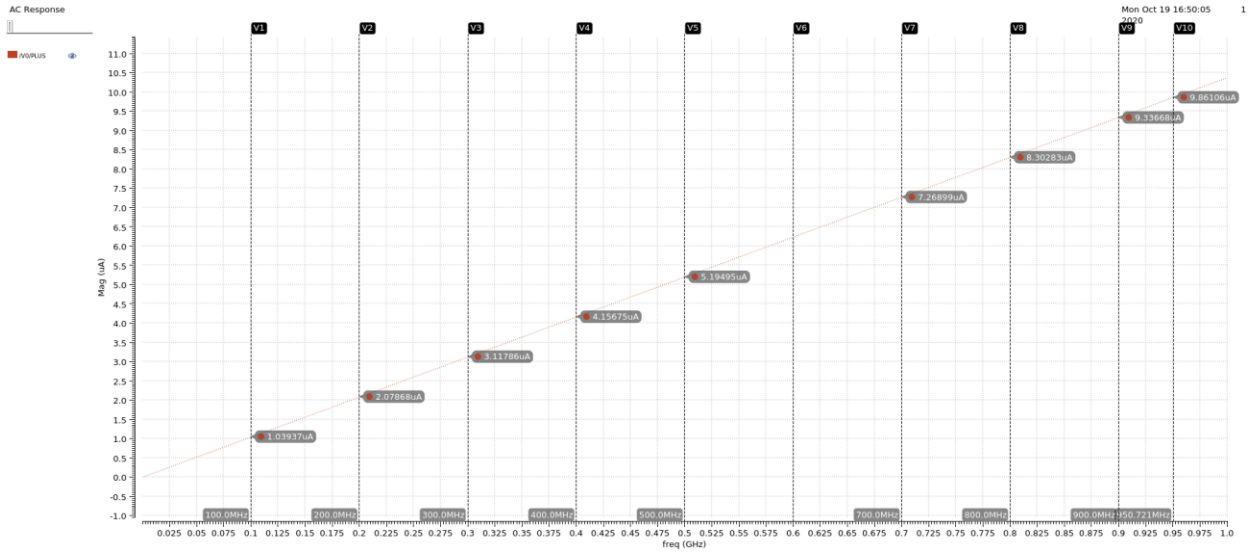
```
    N8          N3          Q
    N12         N8          VDD
    N9          N7          _CLK

Devices in the rules but not in the netlist:
        cap nfet pfet nmos4 pmos4

The net-lists match.

                              layout  schematic
                                 instances
        un-matched               0       0
        rewired                  0       0
        size errors              0       0
        pruned                   0       0
        active                   20      20
        total                    20      20

                                   nets
        un-matched               0       0
        merged                   0       0
        pruned                   0       0
        active                   13      13
        total                    13      13

                                 terminals
        un-matched               0       0
        matched but
        different type           0       0
        total                    6       6


Probe files from /home/ugrads/j/jasongilman/ecen454/LVS/schematic

devbad.out:

netbad.out:

mergenet.out:

termbad.out:

prunenet.out:
```

Waveform



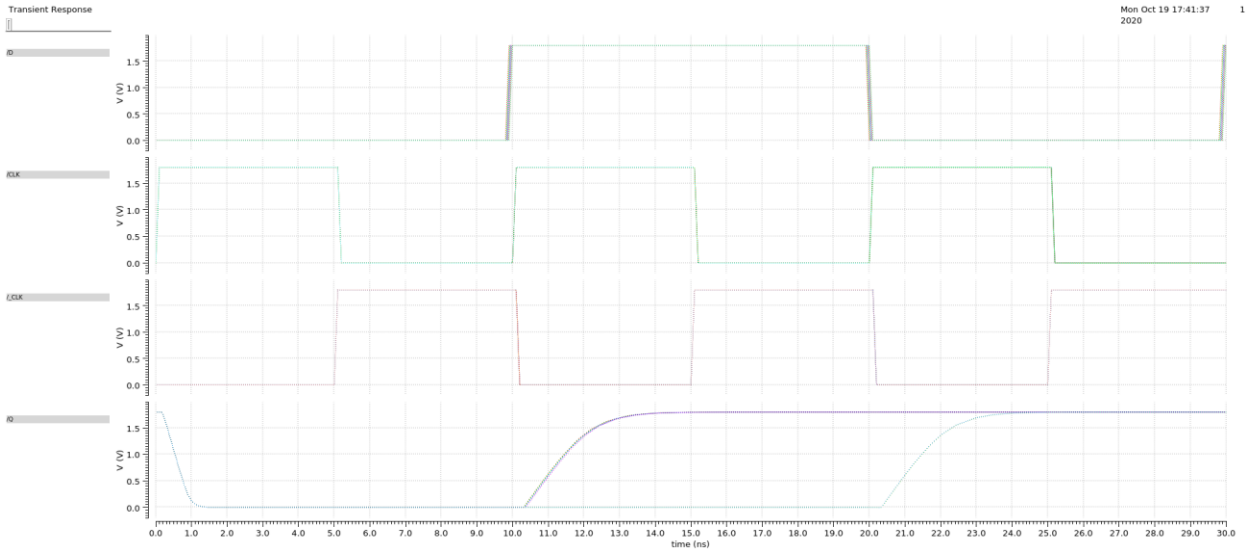
C = 100f F			Delay (ns)	C = 50f F			Delay (ns)
Rising	11.58229	10.25	1.33229	**Rising**	10.9964	10.25	0.7464
Falling	21.05861	20.45	0.60861	**Falling**	20.8393	20.45	0.3893
		% error	0.543185			**% error**	0.47843
C = 90f F			**Delay (ns)**	**C = 40f F**			**Delay (ns)**
Rising	11.46	10.25	1.21	**Rising**	10.8803	10.25	0.6303
Falling	21.0148	20.45	0.5648	**Falling**	20.7955	20.45	0.3455
		% error	0.5332231			**% error**	0.451848
C = 80f F			**Delay (ns)**	**C = 30f F**			**Delay (ns)**
Rising	11.34	10.25	1.09	**Rising**	10.7645	10.25	0.5145
Falling	20.97	20.45	0.52	**Falling**	20.7514	20.45	0.3014
		% error	0.5229358			**% error**	0.414189
C = 70f F			**Delay (ns)**	**C = 20f F**			**Delay (ns)**
Rising	11.231	10.25	0.981	**Rising**	10.6475	10.25	0.3975
Falling	20.92699	20.45	0.47699	**Falling**	20.7066	20.45	0.2566
		% error	0.5137717			**% error**	0.354465
C = 60f F			**Delay (ns)**	**C = 10f F**			**Delay (ns)**
Rising	11.11338	10.25	0.86338	**Rising**	10.53027	10.25	0.28027
Falling	20.88304	20.45	0.43304	**Falling**	20.65892	20.45	0.20892
		% error	0.4984364			**% error**	0.254576

AC Simulation

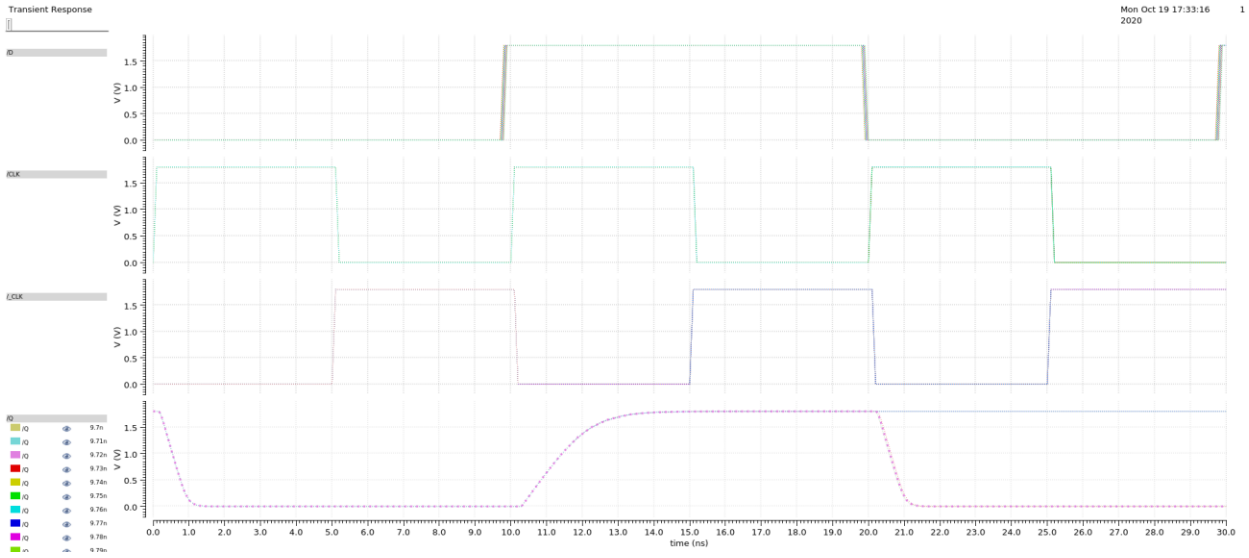


Mag (uA)	Freq (GHz)	Capacitance (fF)
1.03937	0.1	1.654208732
2.07868	0.2	1.654160986
3.11786	0.3	1.654076103
4.15675	0.4	1.653918274
5.19495	0.5	1.653603943
6.23274	0.6	1.653285633
7.26899	0.7	1.652708128
8.3028	0.8	1.651789577
9.33668	0.9	1.651087527
9.86106	1	1.569436443
	Mean	1.644827535

Setup Time



Setup_r = .15ns



Setup_f = .28 ns

The Setup time is .28ns since it is the greatest value out of the setup rise and setup fall times.