

Esha Adhawade
Lab 6: Design & Characterization of a Flip-Flop
ECEN 454 - 503
October 30, 2022

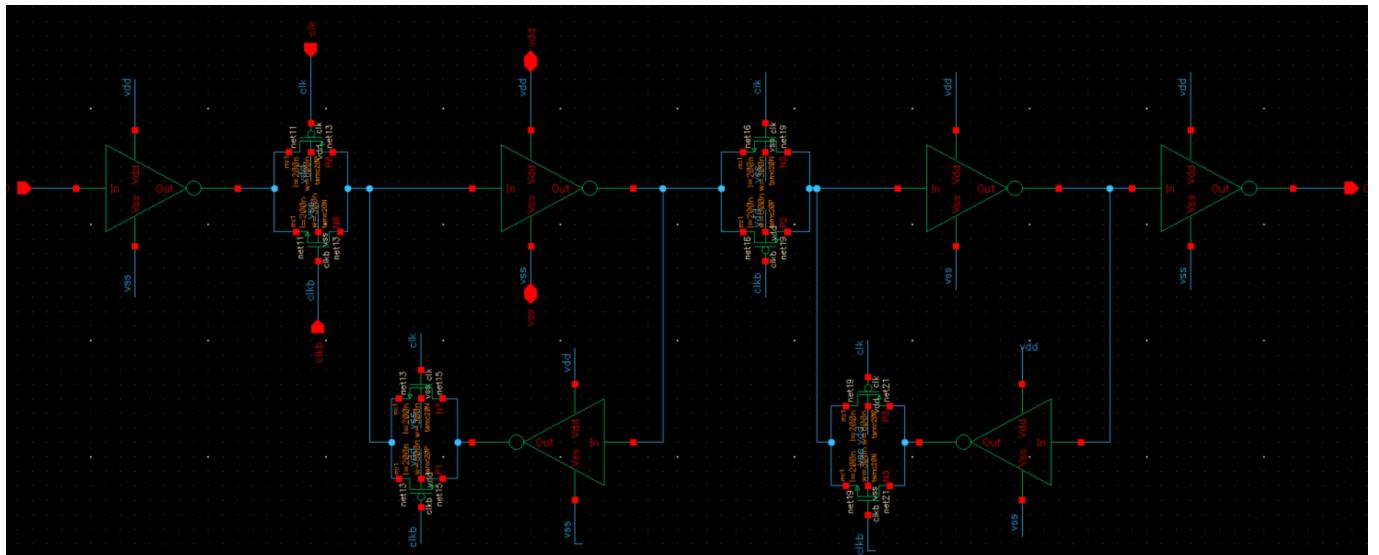
Introduction

The purpose of this lab was to design a Flip-Flop and characterize its delays, input capacitance, and setup.

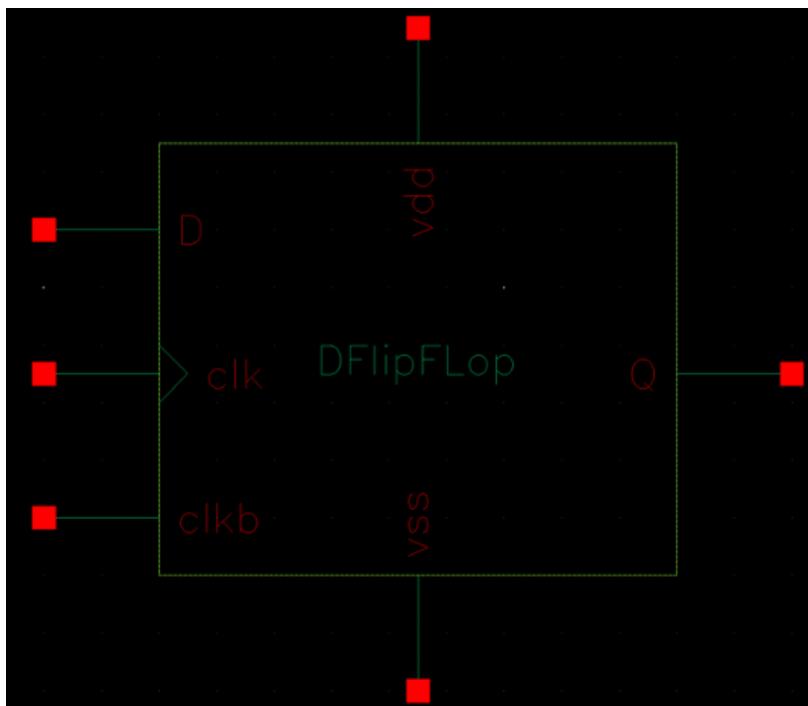
Result

Flip Flop

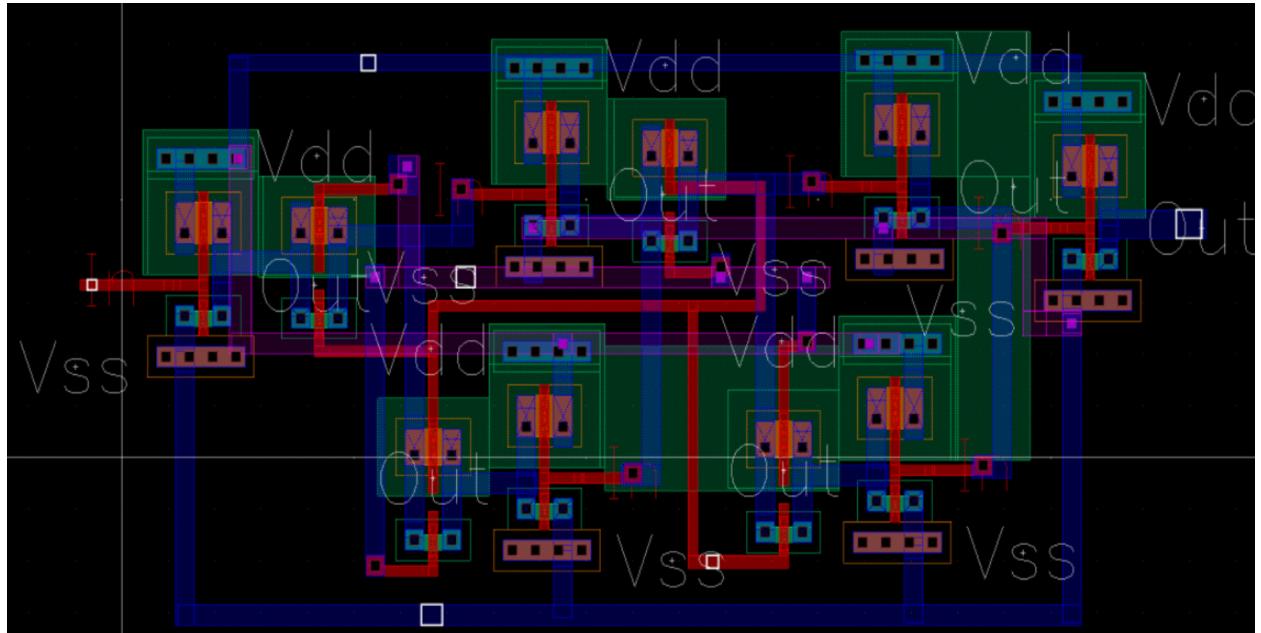
Schematic



Symbol



Layout



LVS

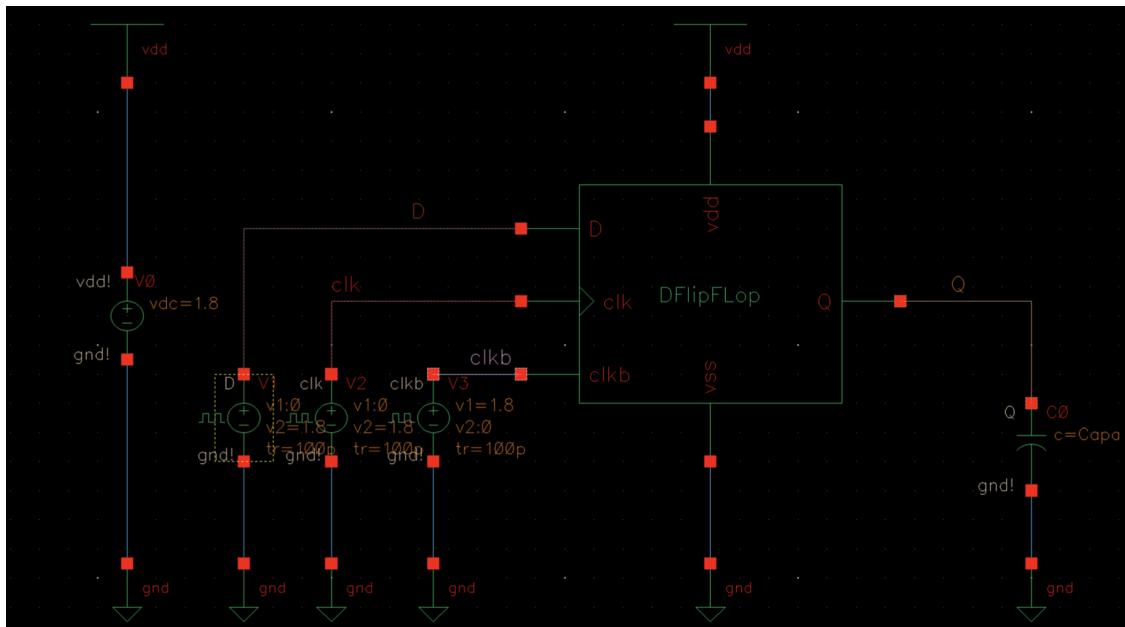
The net-lists match.

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

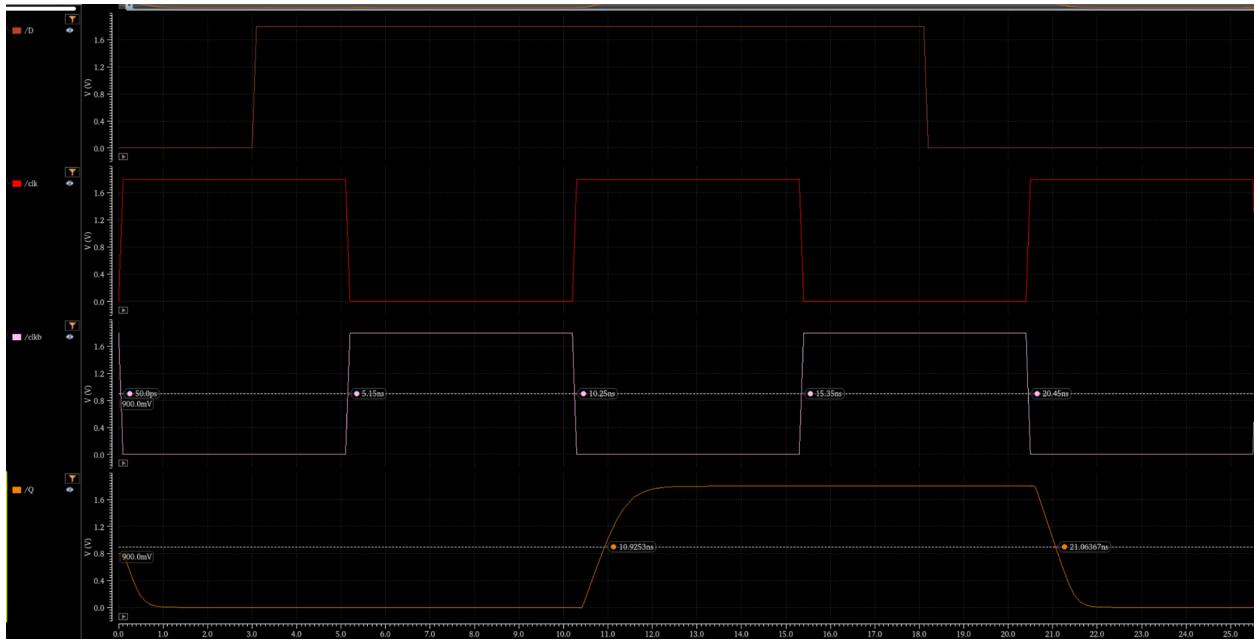
	nets	
un-matched	0	0
merged	0	0
pruned	0	0
active	13	13
total	13	13

	terminals	
un-matched	0	0
matched but different type	3	3
total	16	16

Waveforms



Verifying Corrections



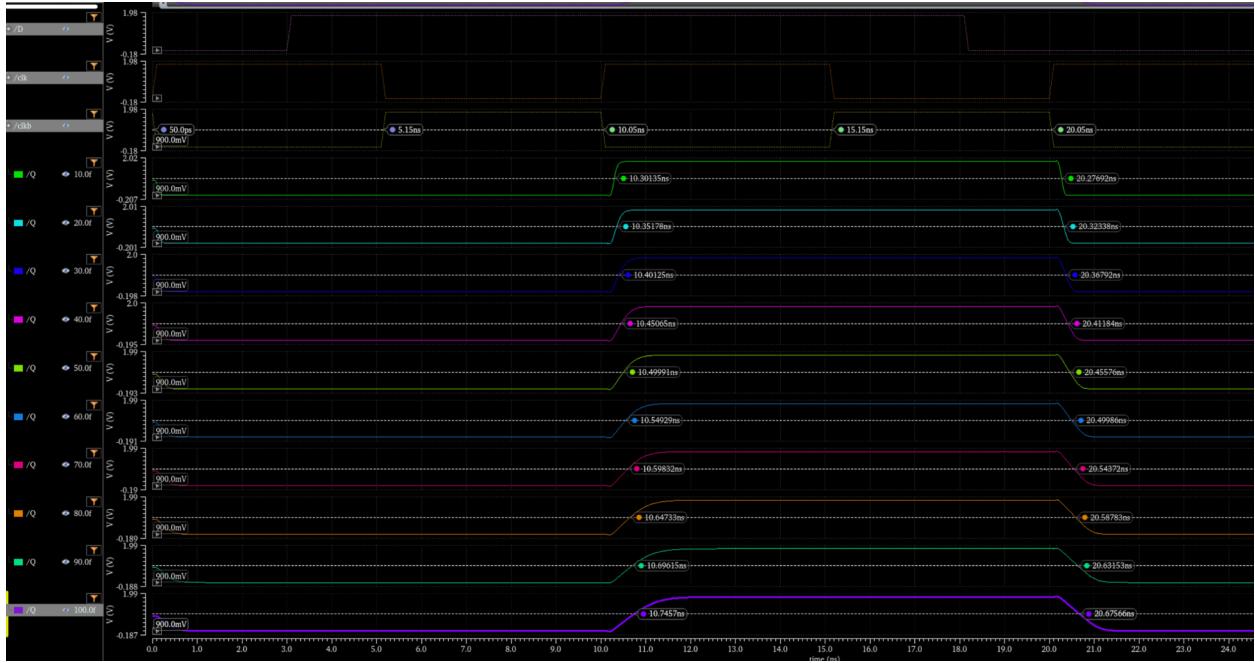
Reflections

$$\text{Rise Delay Time: } 10.925 - 10.25 = 0.675\text{ns}$$

$$\text{Fall Delay Time: } 21.063 - 20.25 = 0.613\text{ns}$$

$$\text{Percent Change} = 9.12\%$$

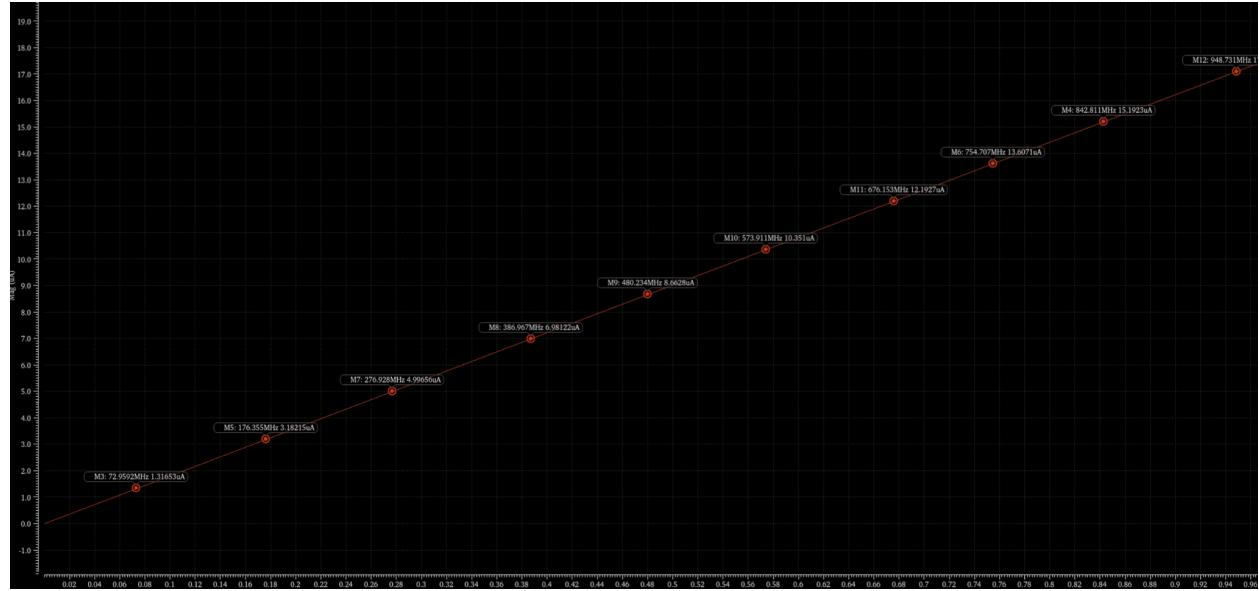
Clock-to-Q Delays



Clock-to-Q Delays Table

Cap	Rise Clock	Output	Fall Clock	Output	Rise Delay	Fall Delay	Percentage
10fF	10.05	10.302	20.05	20.277	0.251	0.227	9.7%
20fF	10.05	10.352	20.05	20.323	0.301	0.273	9.4%
30fF	10.05	10.401	20.05	20.368	0.351	0.318	9.5%
40fF	10.05	10.451	20.05	20.411	0.401	0.362	9.7%
50fF	10.05	10.499	20.05	20.456	0.449	0.406	9.8%
60fF	10.05	10.549	20.05	20.500	0.499	0.449	9.9%
70fF	10.05	10.598	20.05	20.548	0.548	0.494	10%
80fF	10.05	10.647	20.05	20.597	0.597	0.538	10%
90fF	10.05	10.696	20.05	20.646	0.646	0.582	10%
100fF	10.05	10.745	20.05	20.696	0.696	0.626	10%

Capacitance Plot



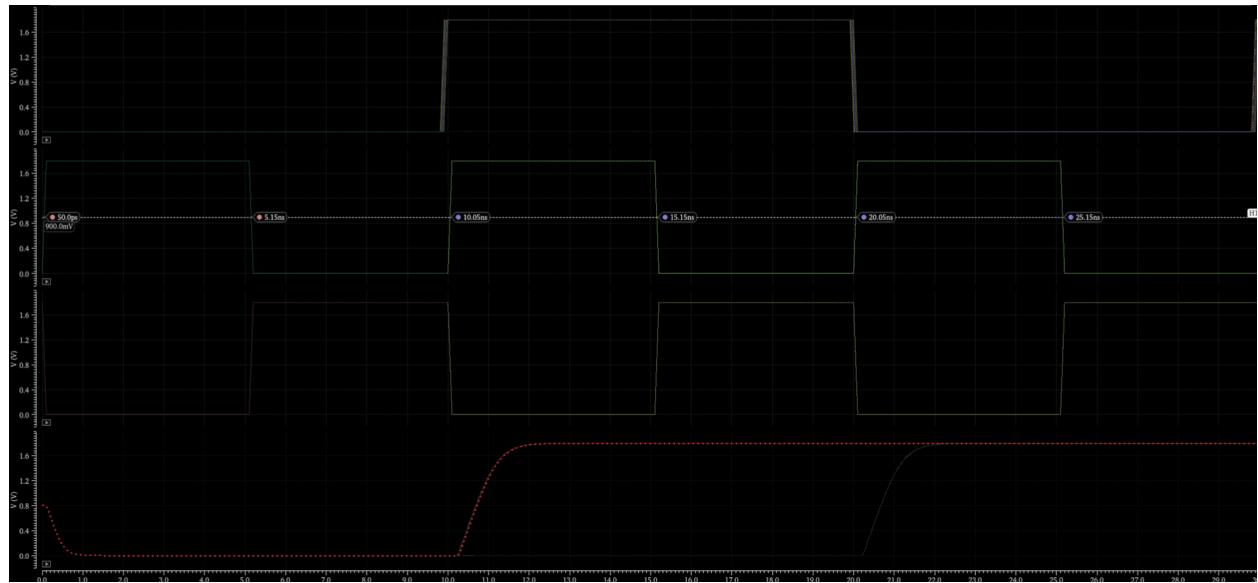
Table

Frequency (Mhz)	Current	Capacitance
7.30E+01	1.32E+00	0.0028708
1.76E+02	3.18E+00	0.0028706
2.77E+02	5.00E+00	0.0028704
3.87E+02	6.98E+00	0.0028701
4.80E+02	8.66E+00	0.0028698
5.74E+02	1.04E+01	0.0028693
6.76E+02	1.22E+01	0.0028688
7.55E+02	1.36E+01	0.0028684
8.43E+02	1.52E+01	0.0028677
9.49E+02	1.71E+01	0.0028669

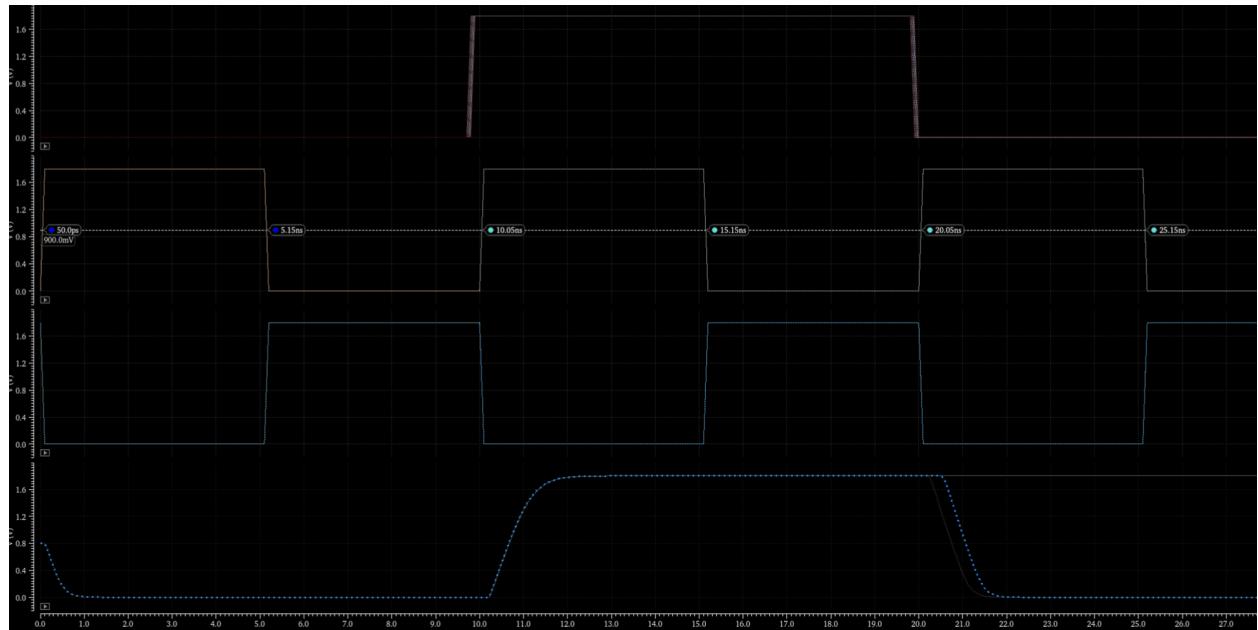
Average: 0.0028693

Setup Time

Setup rise time



Setup fall time



Reflections

- Setup Rise Time: $10\text{ns} - 9.83\text{ns} = 0.17\text{ns}$
- Setup Fall Time: $20\text{ns} - (10+9.72)\text{ns} = 0.28\text{ns}$
- Set up time is the maximum of setup fall time and setup rise time which is 0.28ns.