Experiment 1:Characterization of a CMOS Inverter

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The purpose this experiment was to study the Transfer characteristic, Output characteristics., Delay characteristics of a CMOS inverter. Used ring oscillator to find the delay time of the CMOS

1 Plot the transfer characteristics of inverter and tabulate the input and corresponding output voltages. Find the switching point on the transfer characteristic.

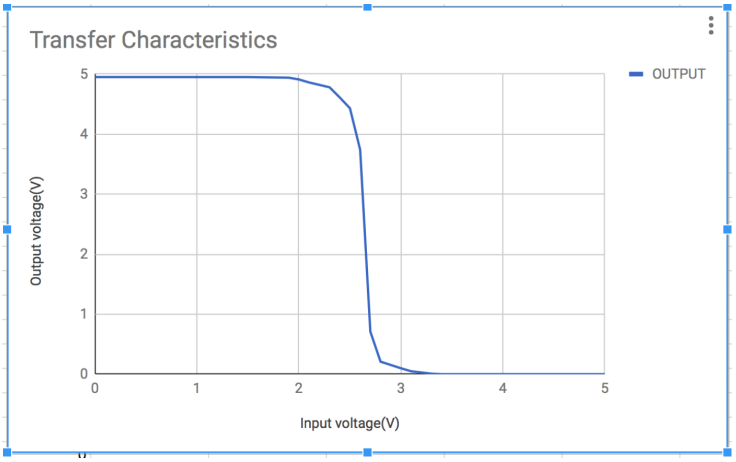


figure : transfer characteristic

Input Voltage	output Voltage
0	4.95
0.4	4.95
0.7	4.95
0.9	4.95
1.5	4.95
1.9	4.94
2	4.91
2.1	4.86
2.3	4.78
2.4	4.61
2.5	4.43
2.6	3.74
2.7	0.71
2.8	0.21
3	0.1
3.1	0.05
3.2	0.03
3.3	0.01
3.4	0
4	0
5	0

switching point is :2.5 V

2 Part 2: 2. Plot the output characteristics of the inverter in the two cases: output- high and output-low. Tabulate the input and corresponding output voltages for both the cases.

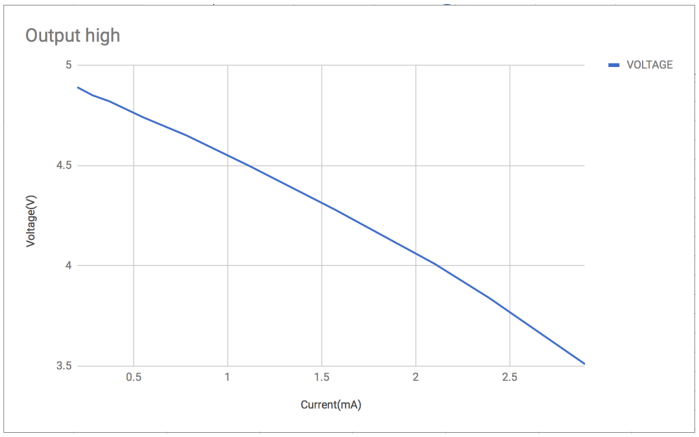


figure : output high

current(mA)	Voltage(v)
0.2	4.89
0.28	4.85
0.37	4.82
0.55	4.74
0.78	4.65
1.11	4.5
1.57	4.28
2.1	4.01
2.39	3.84
2.9	3.51

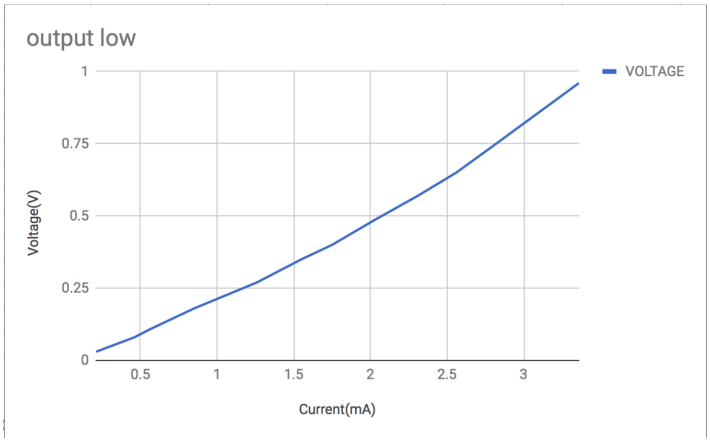
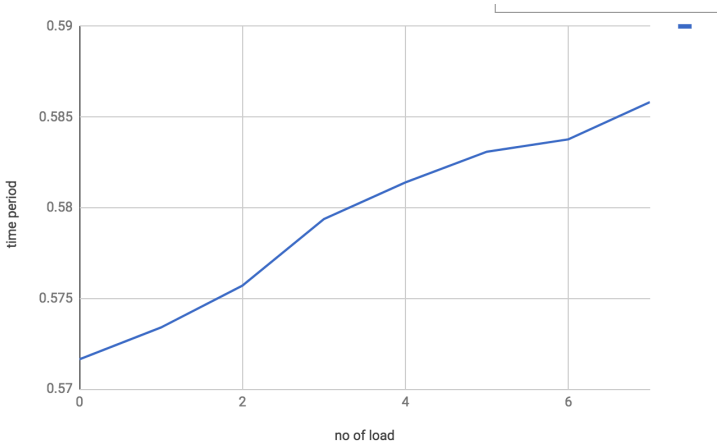


figure : output low

current(mA)	Voltage(v)
0.21	0.03
0.36	0.06
0.46	0.08
0.57	0.11
0.85	0.18
1.26	0.27
1.55	0.35
1.75	0.4
2.04	0.49
2.31	0.57
2.56	0.65
2.82	0.75
3.36	0.96

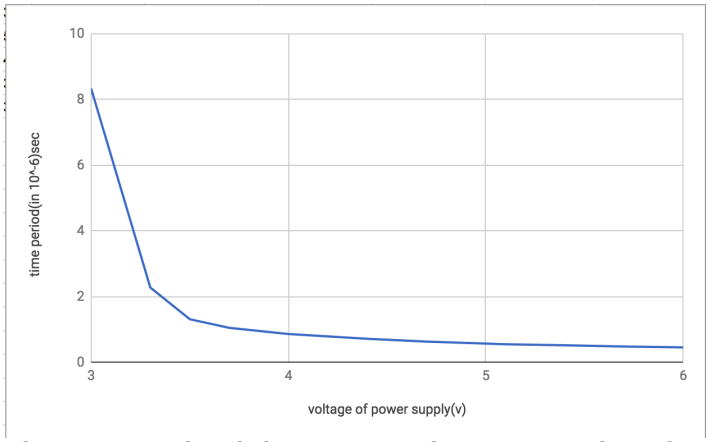
3 Part 3: Plot the oscillation period of the ring oscillator as a function of the load at the output. Find pinv and . A snap-shot of the DSO (get help from Laboratory staff if you do not have a camera) showing the ring-oscillator output with load = 2 should also be included in the report.



No. of load	time period($10^{-6} sec$)
0	0.5716402392
1	0.5724098454
2	0.5757052389
3	0.5793742758
4	0.5813953488
5	0.583090379
6	0.5837711617
7	0.5858230814

slope = t = 0.001020244765x$10^{-6} sec$ $Pin = 7.247774223$

4 Plot the ring oscillator period as a function of the power supply voltage (varied from 3V to 6V). Record your observations in a table. How does the delay vary with the power supply voltage?



power supply voltage	time period(10^{-6})sec
6	0.456412597
5.7	0.4830917874
5.4	0.5208333333
5.1	0.5540166205
5	0.5743825388
4.7	0.634115409
4.4	0.7178750897
4	0.8643042351
3.7	1.052631579
3.5	1.314060447
3.3	2.277904328
3	8.333333333

The time period and the power supply vary inversely with each other i.e. t =c*1/vdd

5 Observe the power-supply current drawn by the ring oscillator. Mea- sure the peak and average value. Include a snapshot of the DSO measurement.