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ECE 442L
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Lab 1 PSPICE Simulation: Author 2

Case 2:
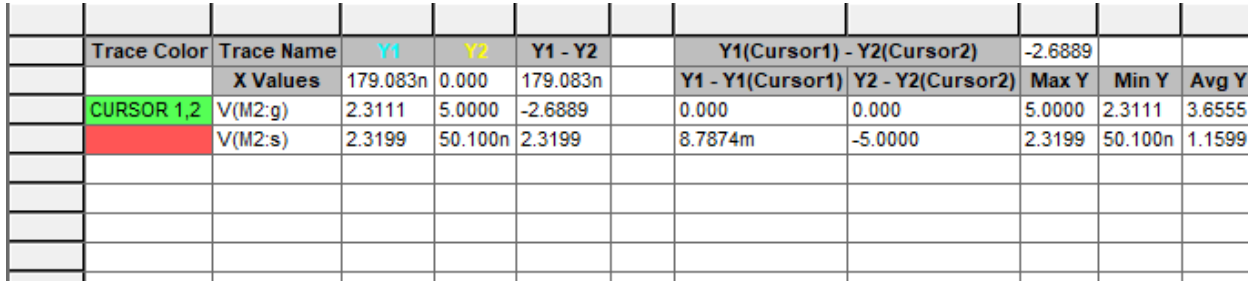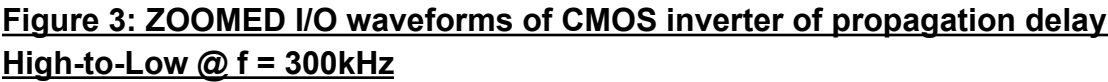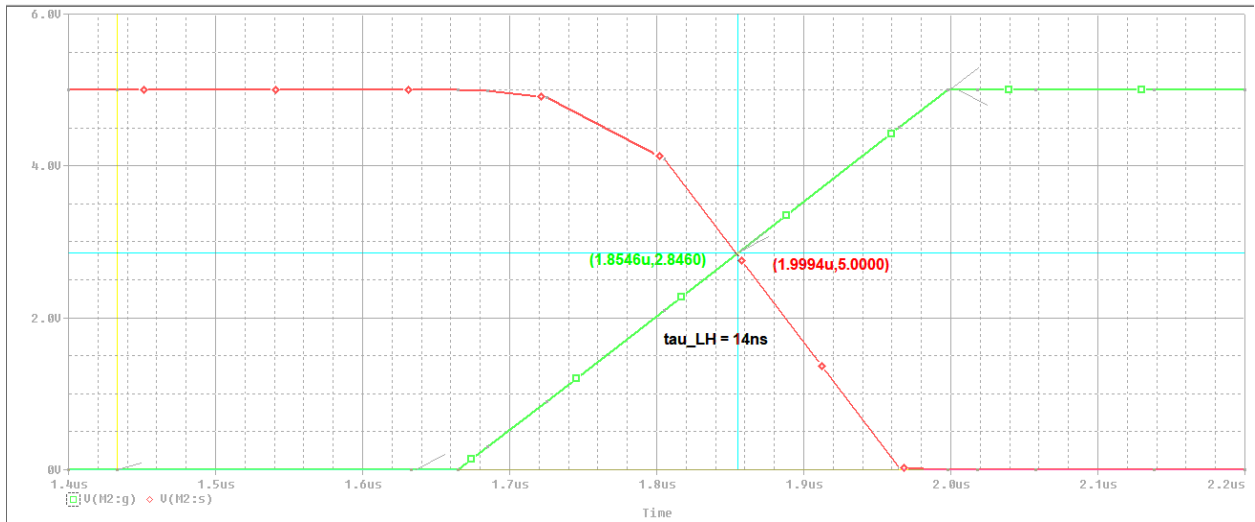**Figure 1: CMOS Inverter circuit with square wave input of 5V @ f = 300 kHz**

V2

M2

5Vdc

5.000V

0V 0

MbreakP

5.000V

50.10nV

V1

V1 = 5V
V2 = 0V
TD = 0
TR = .333us
TF = .333us
PW = 1.332us
PER = 3.33us

M1

MbreakN

0V

0V

0

0

Figure 2: I/O waveforms of CMOS inverter with input of 5V @ f = 300kHz

Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)	0.000			
	X Values	2.0081u	0.000	2.0081u		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
	V(M2:g)	5.0000	5.0000	0.000		0.000	0.000	5.0000	5.0000	5.0000
	V(M2:s)	50.100n	90.776u	-90.726u		-5.0000	-4.9999	90.776u	50.100n	45.413u
CURSOR 1,2	V1(V1)	5.0000	5.0000	0.000		0.000	0.000	5.0000	5.0000	5.0000
	V(M2:s)	50.100n	90.776u	-90.726u		-5.0000	-4.9999	90.776u	50.100n	45.413u

Figure 3: ZOOMED I/O waveforms of CMOS inverter of propagation delay High-to-Low @ f = 300kHz

	Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)	-2.6889		
		X Values	179.083n	0.000	179.083n		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
	CURSOR 1,2	V(M2:g)	2.3111	5.0000	-2.6889		0.000	0.000	5.0000	2.3111	3.6555
		V(M2:s)	2.3199	50.100n	2.3199		8.7874m	-5.0000	2.3199	50.100n	1.1599

Figure 4: ZOOMED I/O waveforms of CMOS inverter of propagation delay Low-to-High @ f = 300kHz

	Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		2.8558		
		X Values	1.8552u	1.4330u	422.152n		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
	CURSOR 1,2	V(M2:g)	2.8558	0.000	2.8558		0.000	0.000	2.8558	0.000	1.4279
		V(M2:s)	2.8168	5.0000	-2.1832		-38.936m	5.0000	5.0000	2.8168	3.9084

Case 4:
Figure 5: CMOS Inverter circuit with square wave input of 5V @ f = 900 kHz

V2

M2

MbreakP

5Vdc
5.000V

0V ·0

V1 = 5V
V2 = 0V
TD = 0
TR = .111us
TF = .111us
PW = .444us
PER = 1.11us

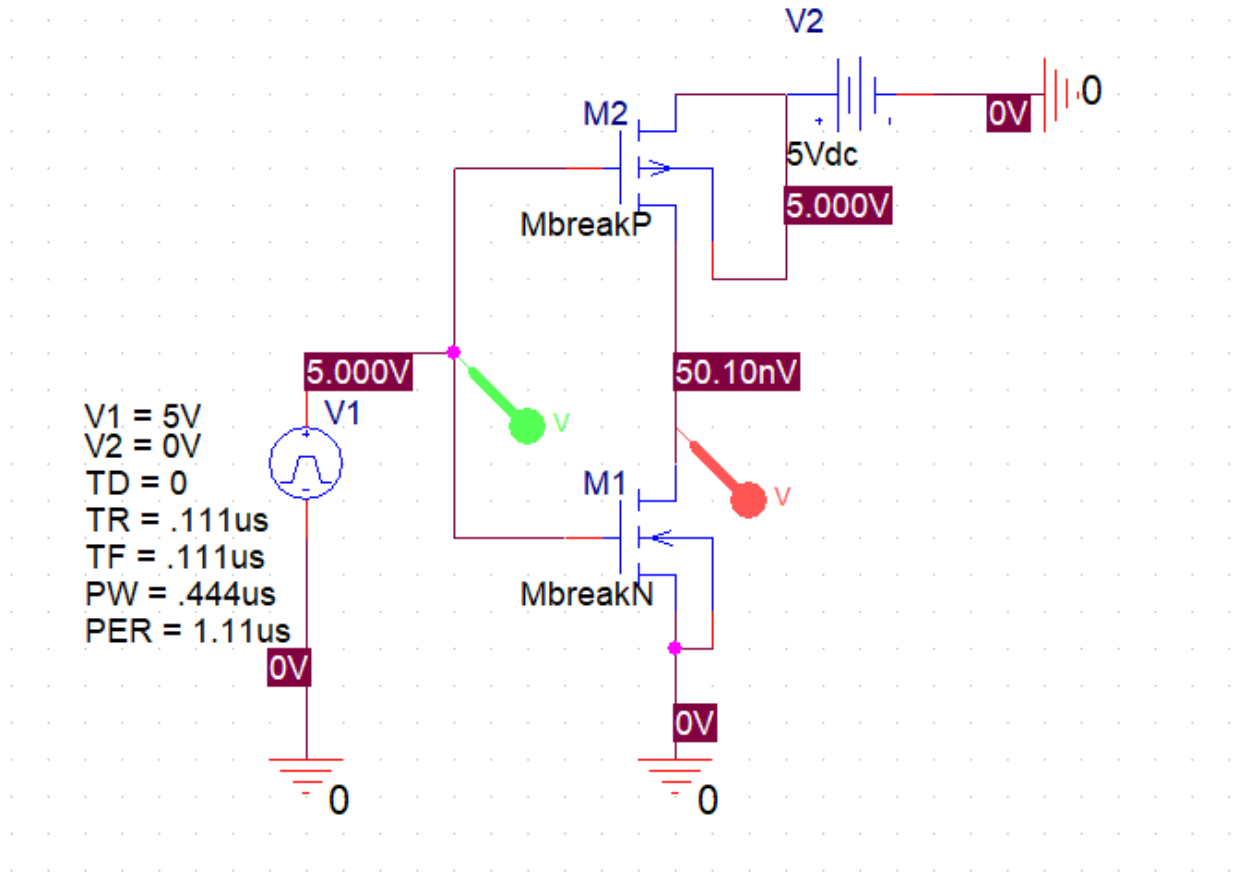5.000V
V1

50.10nV

M1

MbreakN

0V

0V

0

0

Figure 6: I/O waveforms of CMOS inverter with input of 5V @ f = 900kHz

	Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		0.000		
		X Values	1.7784u	0.000	1.7784u		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
	CURSOR 1,2	V(M2:g)	5.0000	5.0000	0.000		0.000	0.000	5.0000	5.0000	5.0000
		V(M2:s)	50.100n	90.595u	-90.544u		-5.0000	-4.9999	90.595u	50.100n	45.322u
		V(M2:s)	50.100n	90.595u	-90.544u		-5.0000	-4.9999	90.595u	50.100n	45.322u
		V1(V1)	5.0000	5.0000	0.000		0.000	0.000	5.0000	5.0000	5.0000

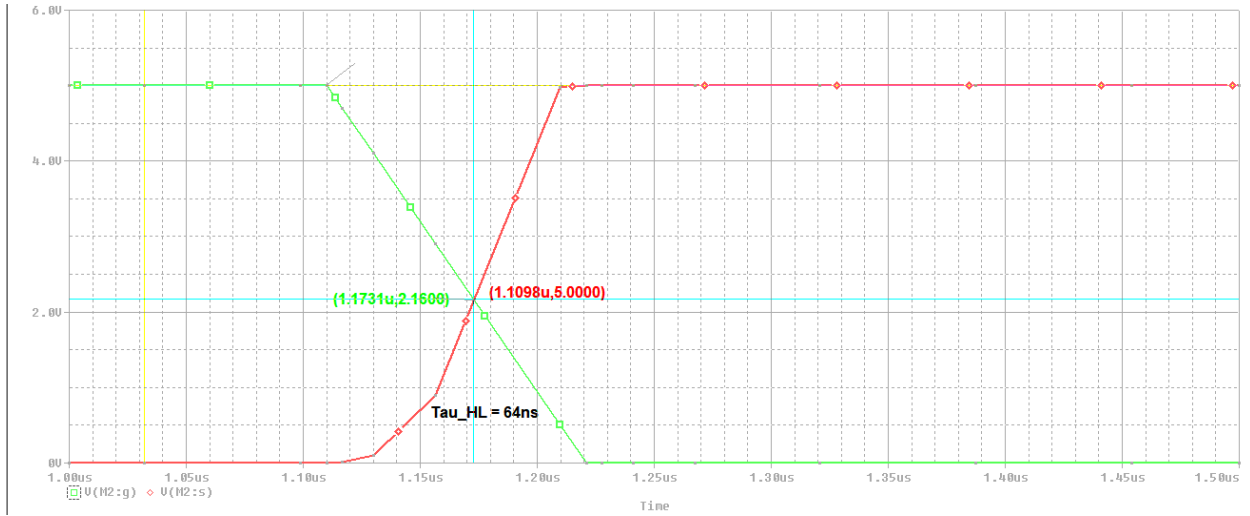**Figure 7: ZOOMED I/O waveforms of CMOS inverter of propagation delay Low-to-High @ f = 900kHz**

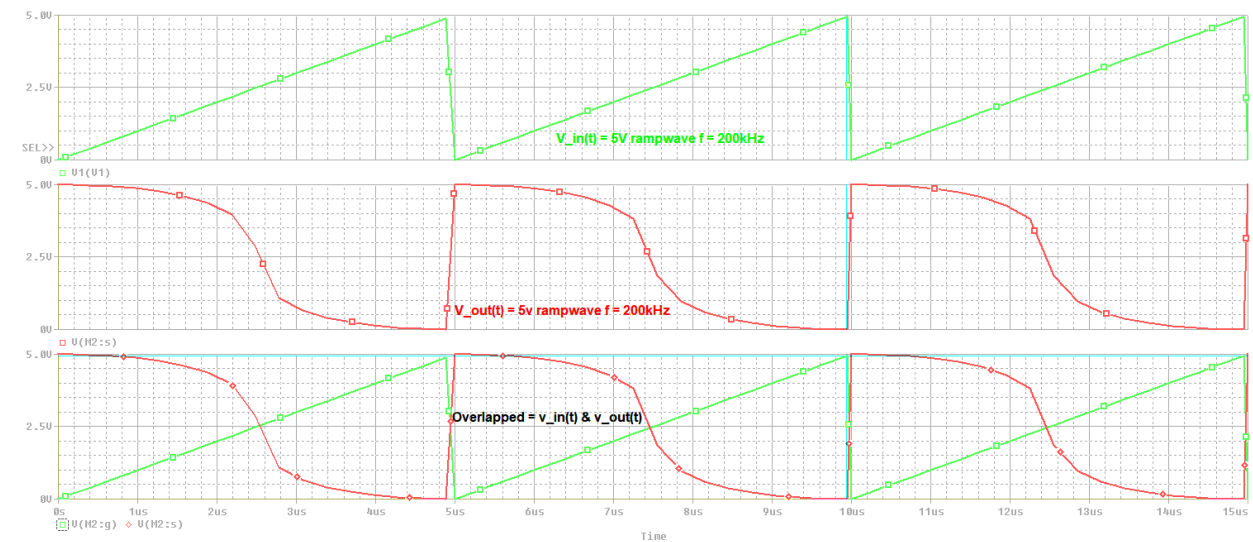|	Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		2.8547		
		X Values	618.375n	543.912n	74.463n		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
	CURSOR 1,2	V(M2:g)	2.8547	0.000	2.8547		0.000	0.000	2.8547	0.000	1.4274
		V(M2:s)	2.8295	5.0000	-2.1705		-25.263m	5.0000	5.0000	2.8295	3.9147

Figure 8: ZOOMED I/O waveforms of CMOS inverter of propagation delay Low-to-High @ f = 900kHz

Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)	-2.8295			
	X Values	1.1728u	1.0323u	140.505n		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
CURSOR 1,2	V(M2:g)	2.1705	5.0000	-2.8295		0.000	0.000	5.0000	2.1705	3.5852
	V(M2:s)	2.1353	50.100n	2.1353		-35.149m	-5.0000	2.1353	50.100n	1.0677

Ramp case:
Figure 9: CMOS Inverter circuit with ramp wave input of 5V @ f = 200 kHz

V2

M2

5Vdc

5.000V

MbreakP

0V

5.000V

V1 = 0V
V2 = 5V
TD = 0
TR = 5us
TF = 0
PW = 0
PER = 5us

V1

M1

MbreakN

0V

0V

0V

0

0

Figure 10: I/O waveforms of CMOS inverter with input of 5V @ f = 200kHz

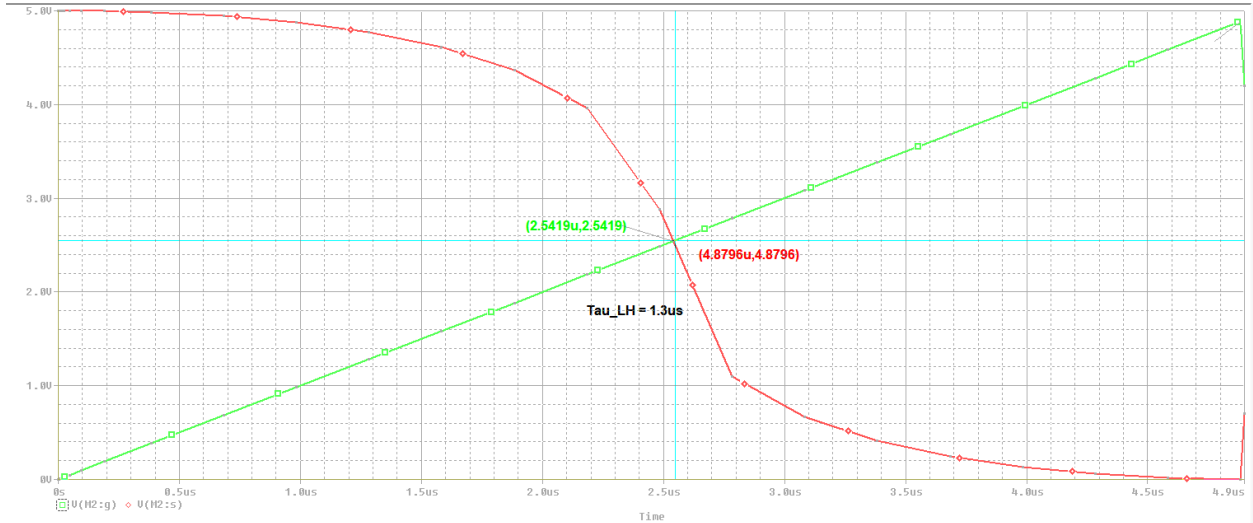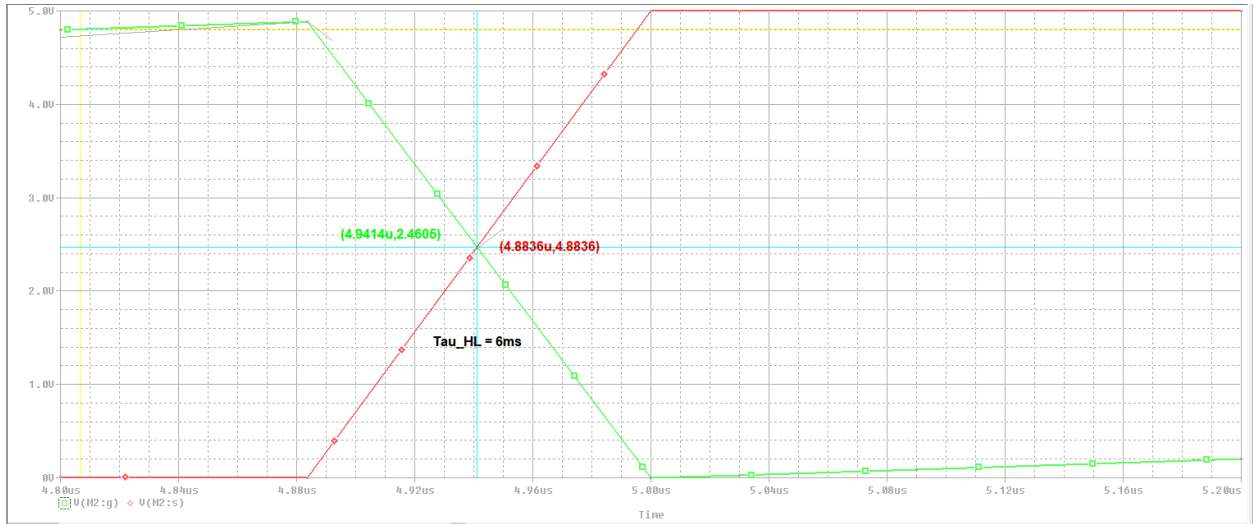| Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		4.9375		
	X Values	9.938u	0.000	9.938u		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
CURSOR 1,2	V(M2:g)	4.9375	0.000	4.9375		0.000	0.000	4.9375	0.000	2.4688
	V(M2:s)	781.321u	5.0000	-4.9992		-4.9367	5.0000	5.0000	781.321u	2.5004
	V(M2:s)	781.321u	5.0000	-4.9992		-4.9367	5.0000	5.0000	781.321u	2.5004
	V1(V1)	4.9375	3.0000m	4.9345		0.000	3.0000m	4.9375	3.0000m	2.4703

Figure 11: ZOOMED I/O waveforms of CMOS inverter of propagation delay Low-to-High @ f = 200kHz

	Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		2.5487		
		X Values	2.5487u	0.000	2.5487u		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
	CURSOR 1,2	V(M2:g)	2.5487	0.000	2.5487		0.000	0.000	2.5487	0.000	1.2743
		V(M2:s)	2.4956	5.0000	-2.5044		-53.074m	5.0000	5.0000	2.4956	3.7478

Figure 12: ZOOMED I/O waveforms of CMOS inverter of propagation delay High-to-Low @ f = 200kHz

	Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		-2.3374		
		X Values	4.9412u	4.8067u	134.504n		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
	CURSOR 1,2	V(M2:g)	2.4692	4.8067	-2.3374		0.000	0.000	4.8067	2.4692	3.6380
		V(M2:s)	2.4692	5.8930m	2.4634		0.000	-4.8008	2.4692	5.8930m	1.2376