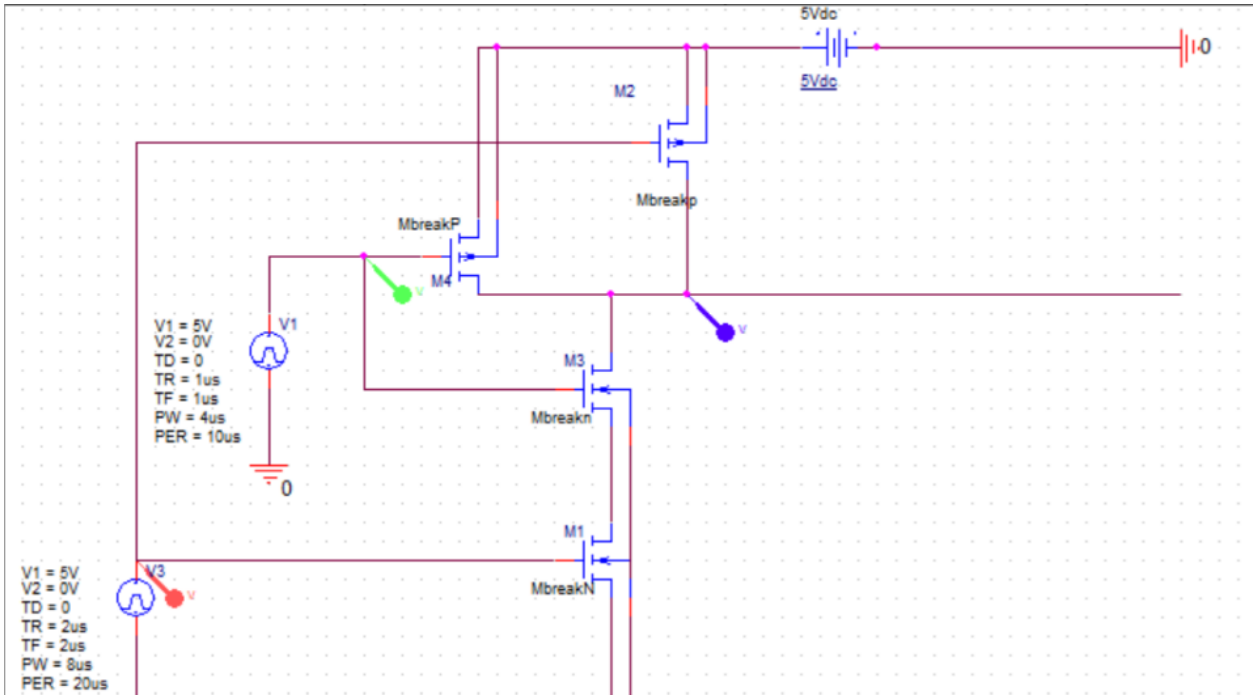
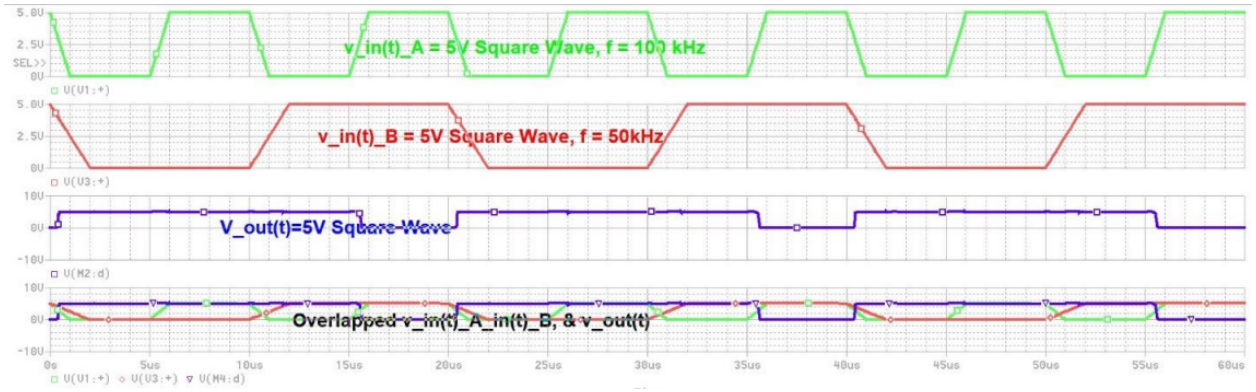
Lab 2 Group

Case 1: 100kHz (Alexis)





Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		0.000		
	X Values	10.000n	10.000n	0.000		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
CURSOR 1,2	V(V1:+)	4.9500	4.9500	0.000		0.000	0.000	4.9500	4.9500	4.9500
	V(V3:+)	4.9500	4.9500	0.000		0.000	0.000	4.9500	4.9500	4.9500
	V(M4:d)	-7.5416m	-7.5416m	0.000		-4.9575	-4.9575	-7.5416m	-7.5416m	-7.5416m
	V(M2:d)	-7.5416m	-7.5416m	0.000		-4.9575	-4.9575	-7.5416m	-7.5416m	-7.5416m
	V(V3:+)	4.9500	4.9500	0.000		0.000	0.000	4.9500	4.9500	4.9500
	V(V1:+)	4.9000	4.9000	0.000		-50.000m	-50.000m	4.9000	4.9000	4.9000

Case 1: 200kHz (Sungmin)

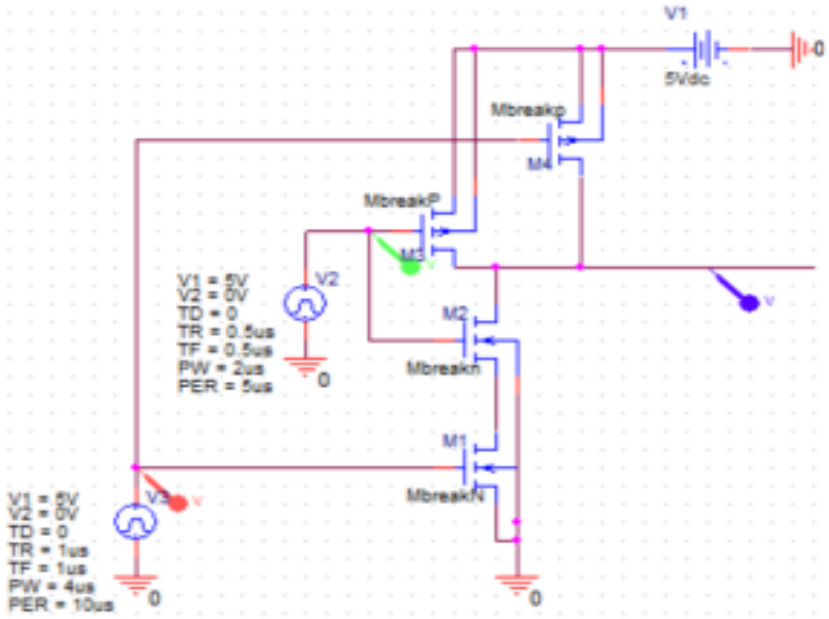
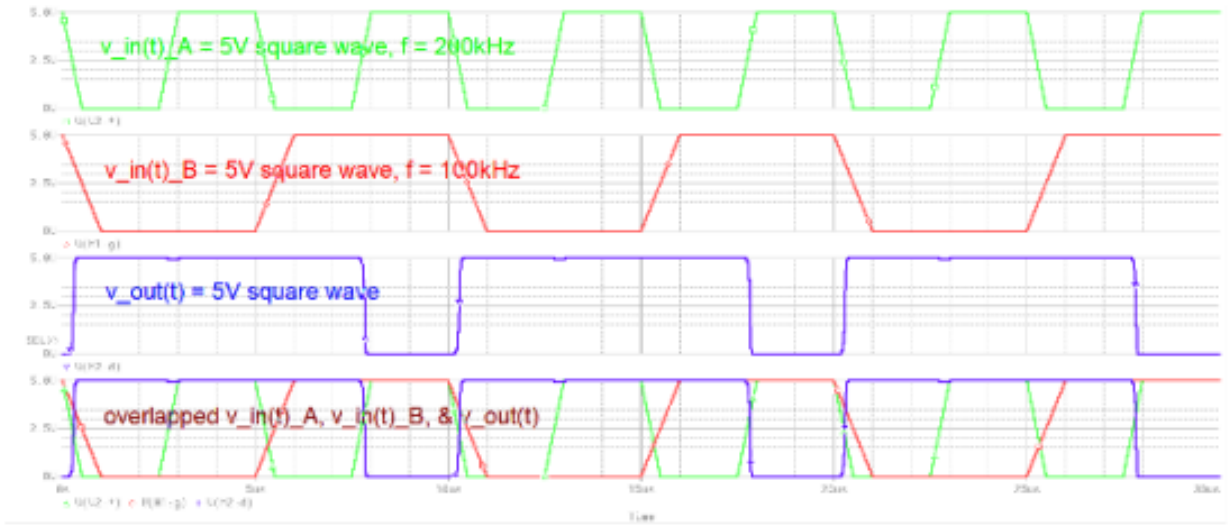


Figure 1.1 NAND Gate CMOS Inverter circuit with 5V square wave input case 1 and f = 200kHz, T = 5us, PW = 2us, T_R = 0.5us, and T_F =0.5us



Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		0.000		
	X Values	8.9936u	8.9932u	379.702p		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
	V(V2:+)	5.0000	5.0000	0.000		5.0000	5.0000	5.0000	5.0000	5.0000
	V(M1:g)	5.0000	5.0000	0.000		5.0000	5.0000	5.0000	5.0000	5.0000
CURSOR 1	V(M2:d)	43.905n	43.905n	0.000		0.000	0.000	43.905n	43.905n	43.905n
CURSOR 2	V(M2:d)	43.905n	43.905n	0.000		0.000	0.000	43.905n	43.905n	43.905n
	V(M1:g)	5.0000	5.0000	0.000		5.0000	5.0000	5.0000	5.0000	5.0000
	V(V2:+)	5.0000	5.0000	0.000		5.0000	5.0000	5.0000	5.0000	5.0000

Figure 1.2 NAND Gate with I/p A & B – O/p Waveform of the CMOS Inverter circuit with 5V square wave input case 1 and f = 200kHz T = 5us, PW = 2us, TR = 0-.5us, and TF =0.5us

Case 2: 300kHz (Haroutun)

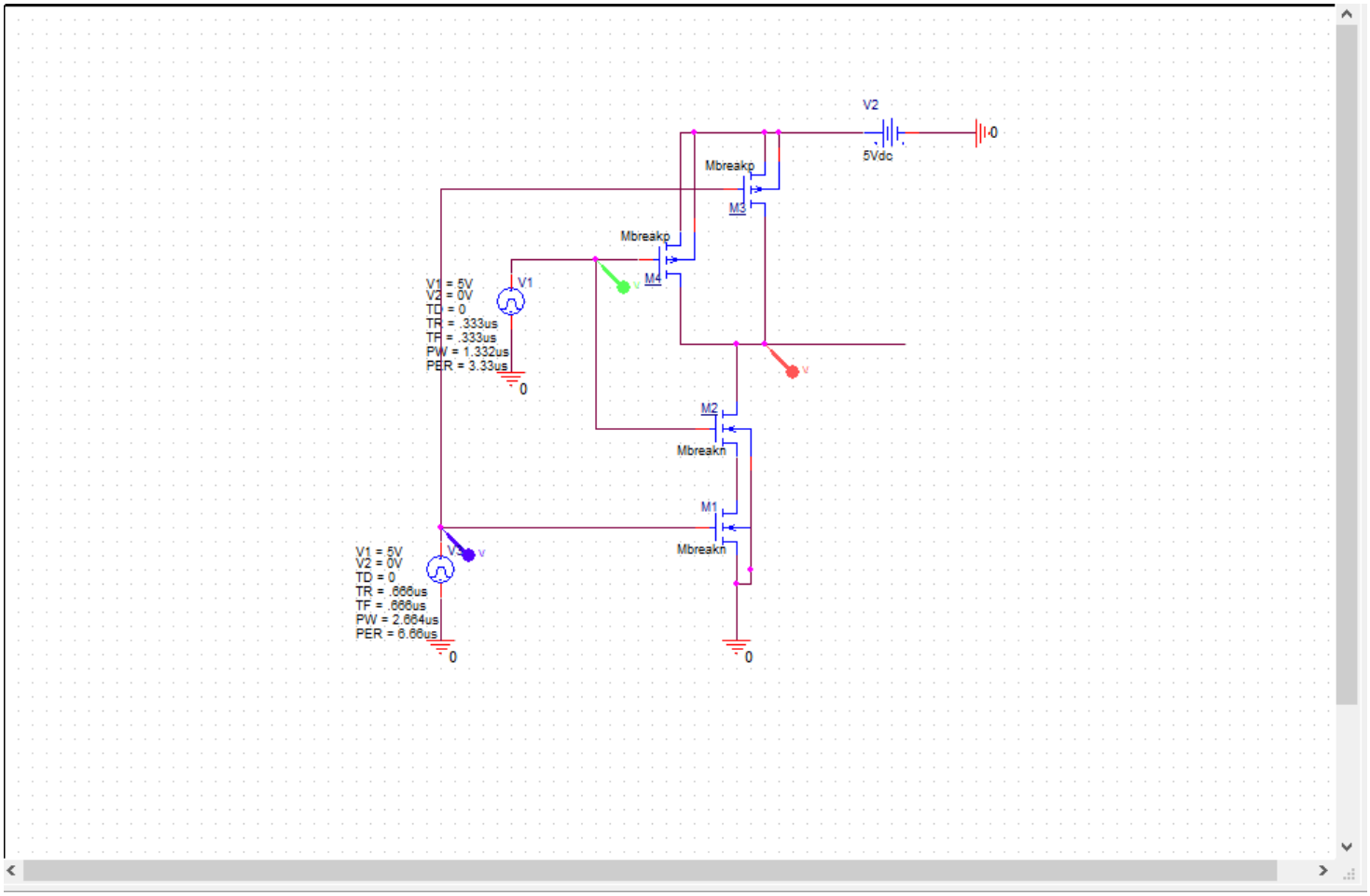
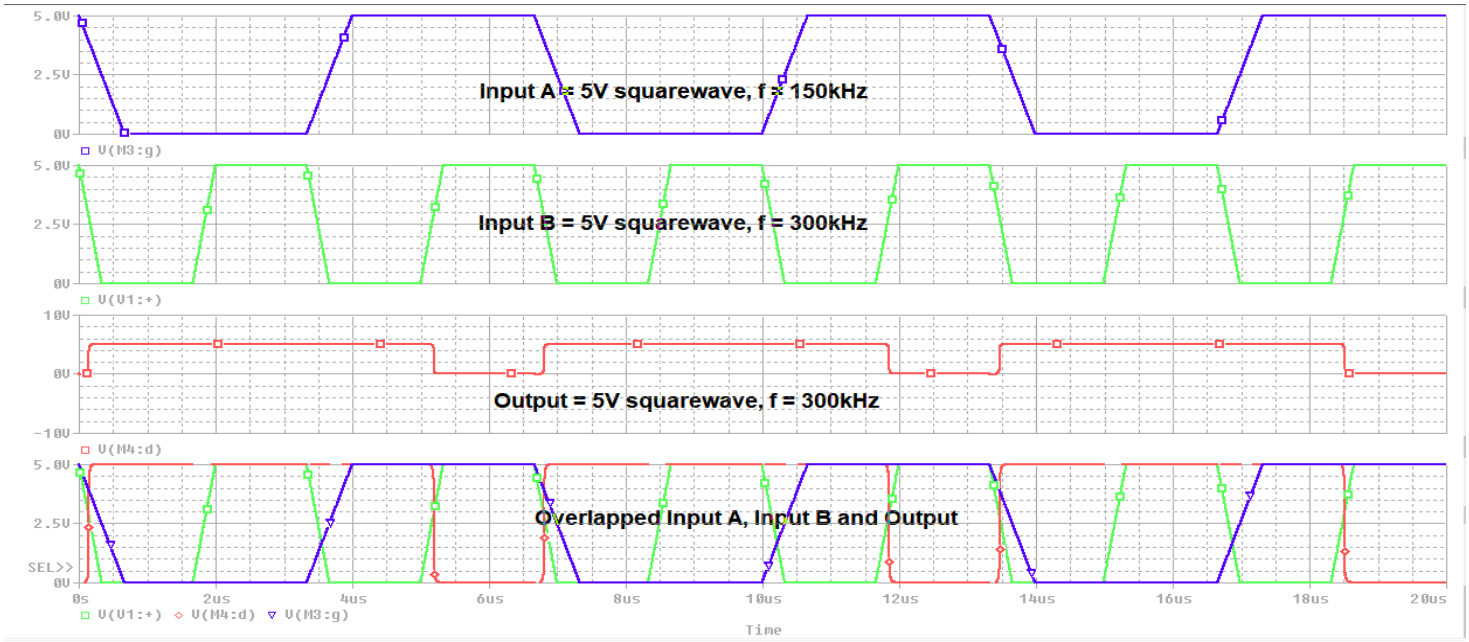


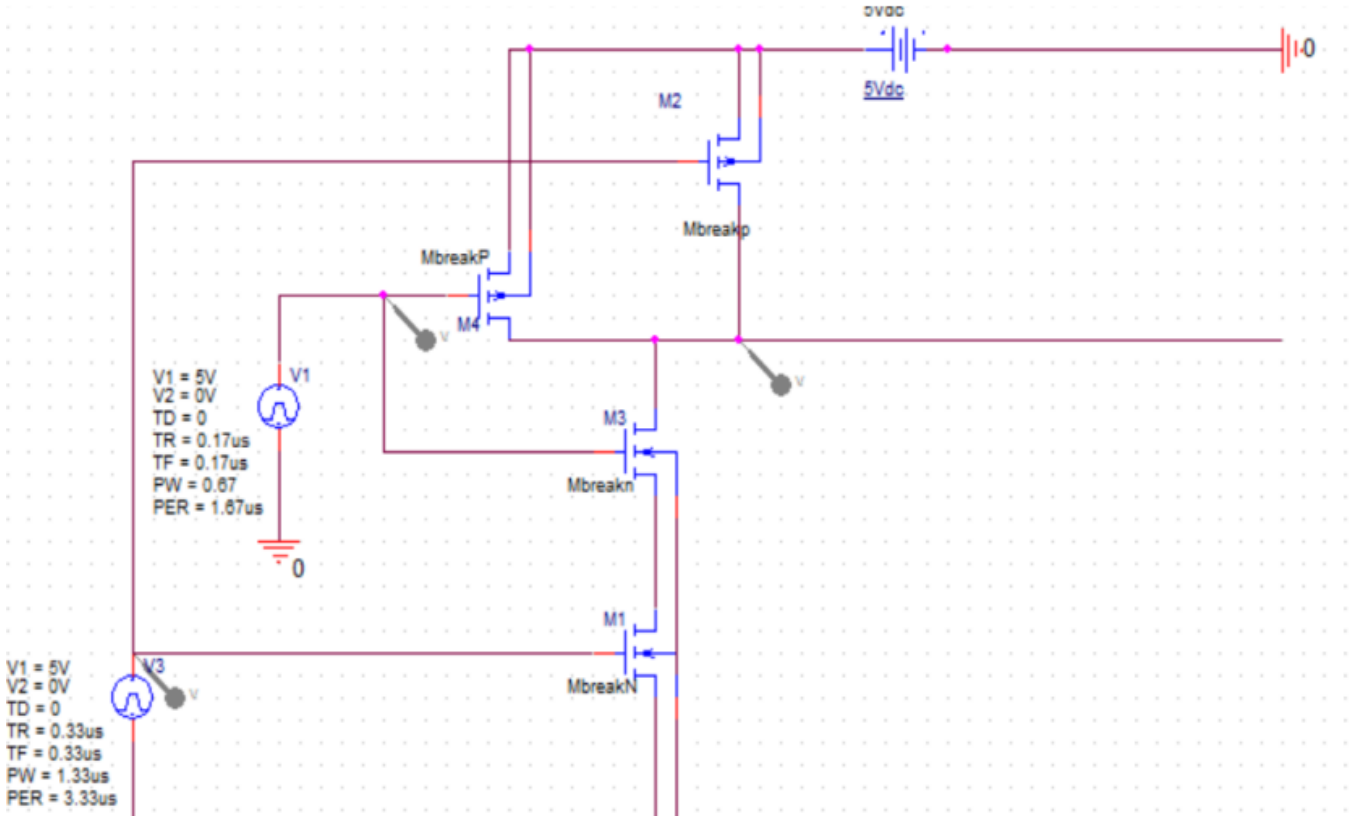
Figure 2.1: Circuit Schematic for 5V squarewave, f = 300kHz

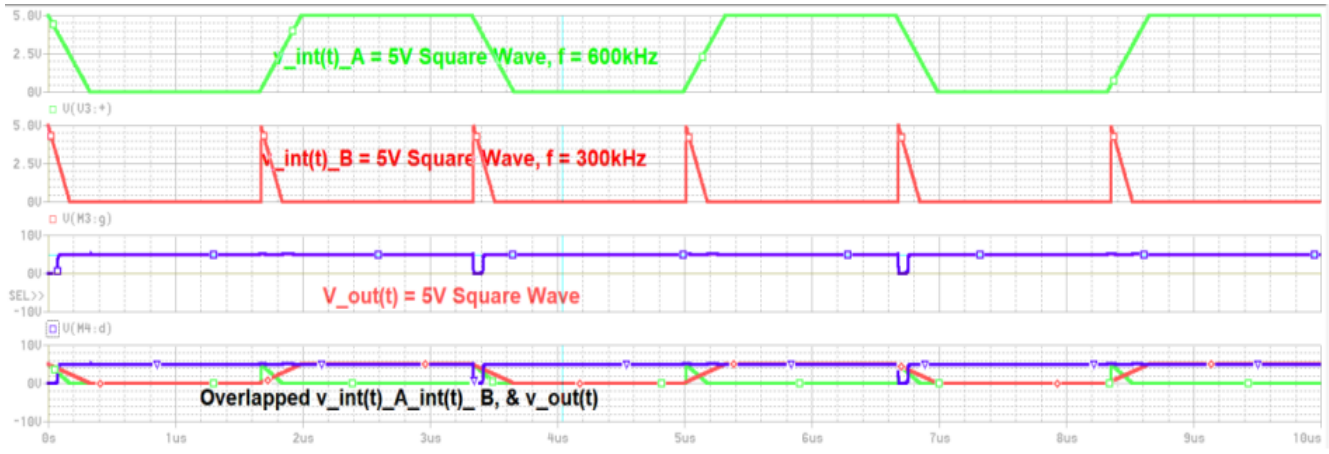


	Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		-1.4791		
		X Values	13.419u	0.000	13.419u		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
	CURSOR 1,2	V(V1:+)	3.5209	5.0000	-1.4791		0.000	0.000	5.0000	3.5209	4.2605
		V(M4:d)	19.960m	-131.683u	20.092m		-3.5010	-5.0001	19.960m	-131.683u	9.914m
		V(M3:g)	4.2605	4.9999	-739.454m		739.529m	-75.075u	4.9999	4.2605	4.6302
		V(M4:d)	19.960m	88.496m	-68.535m		-3.5010	-4.9115	88.496m	19.960m	54.228m
		V(V1:+)	3.5209	4.9999	-1.4789		0.000	-150.150u	4.9999	3.5209	4.2604
		V(M3:g)	4.2605	4.9999	-739.454m		739.529m	-75.075u	4.9999	4.2605	4.6302

Figure 2.2: Output waveform for 5V squarewave, f = 300kHz

Case 3: 600kHz (Alexis)





Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		5.0000		
	X Values	4.0396u	0.000	4.0396u		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
	V(M3:g)	0.000	5.1064	-5.1064		-5.0000	5.1064	5.1064	0.000	2.5532
	V(V3:+)	0.000	5.1064	-5.1064		-5.0000	5.1064	5.1064	0.000	2.5532
	V(M4:d)	5.0000	-258.536u	5.0003		0.000	-258.596u	5.0000	-258.536u	2.4999
CURSOR 1,2	V(M4:d)	5.0000	60.180n	5.0000		0.000	0.000	5.0000	60.180n	2.5000
	V(M3:g)	0.000	4.9997	-4.9997		-5.0000	4.9997	4.9997	0.000	2.4999
	V(V3:+)	0.000	4.9999	-4.9999		-5.0000	4.9999	4.9999	0.000	2.4999

Case 3: 800kHz (Sungmin)

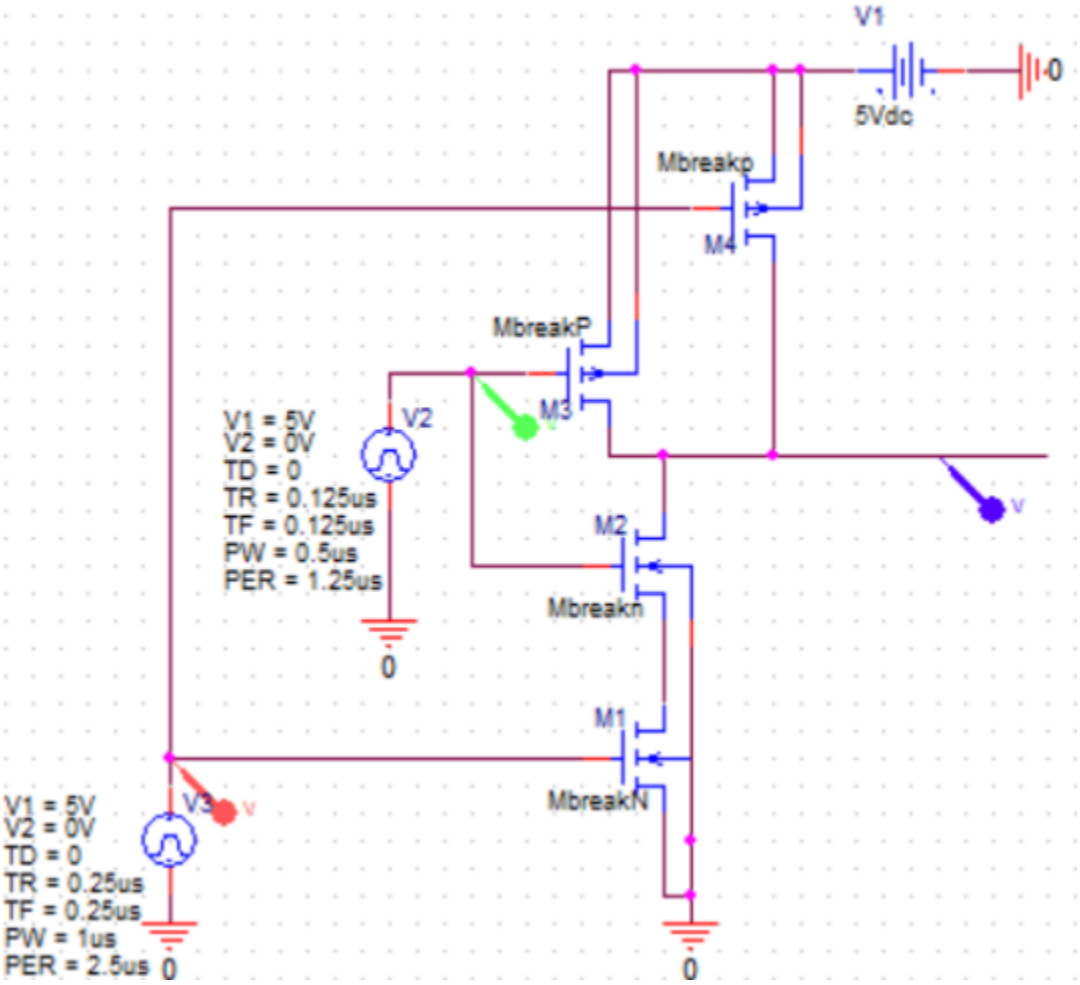
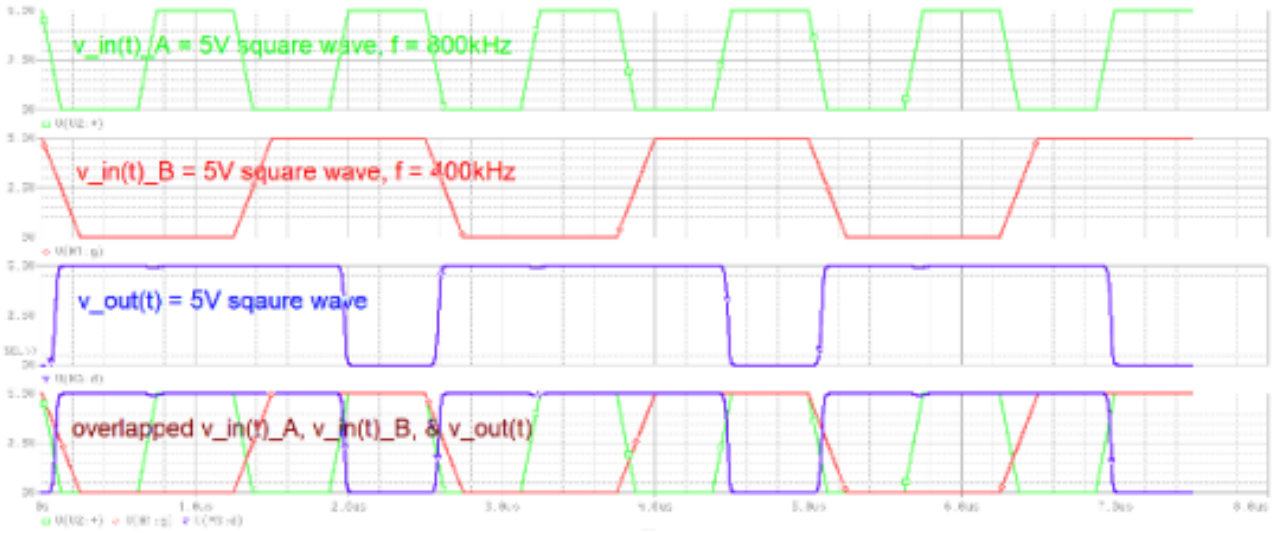


Figure 3.1: NAND Gate CMOS Inverter circuit with 5V square wave input case 3 and f = 800kHz, T = 1.25us, PW = 0.5us, TR = 0.125us, and TF =0.125us



Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		0.000		
	X Values	2.2055u	2.1955u	10.057n		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
	V(V2:+)	5.0000	5.0000	0.000		5.0000	5.0000	5.0000	5.0000	5.0000
	V(M1:g)	5.0000	5.0000	0.000		5.0000	5.0000	5.0000	5.0000	5.0000
CURSOR 1	V(M3:d)	44.430n	44.430n	0.000		0.000	0.000	44.430n	44.430n	44.430n
CURSOR 2	V(M3:d)	44.430n	44.430n	0.000		0.000	0.000	44.430n	44.430n	44.430n
	V(M1:g)	5.0000	5.0000	0.000		5.0000	5.0000	5.0000	5.0000	5.0000
	V(V2:+)	5.0000	5.0000	0.000		5.0000	5.0000	5.0000	5.0000	5.0000

Figure 3.2: NAND Gate with I/p A & B – O/p Waveform of the CMOS Inverter circuit with 5V square wave input case 3 and f = 800kHz, T = 1.25us, PW = 0.5us, TR = 0.125us, and TF =0.125us

Case 4: 900kHz (Haroutun)

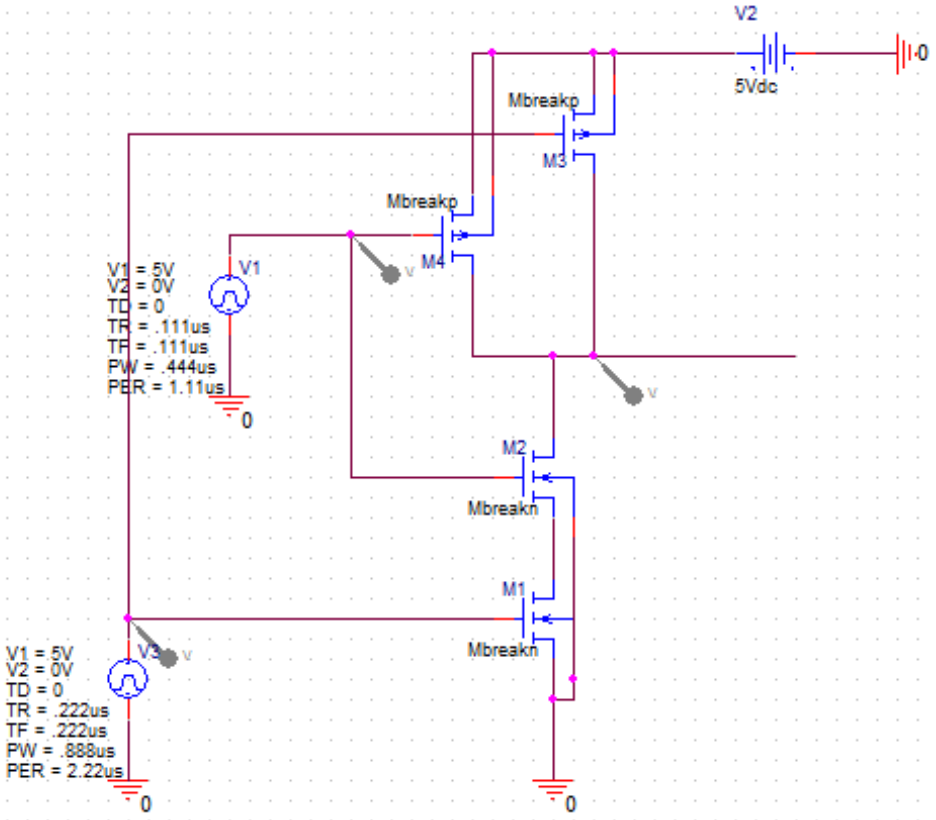
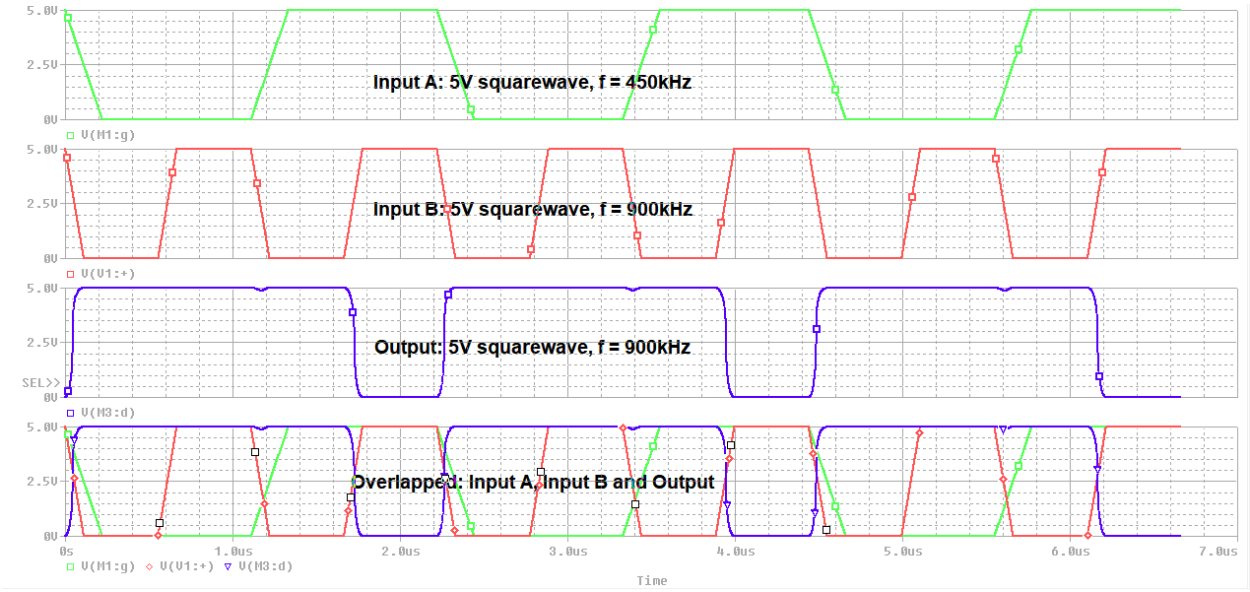


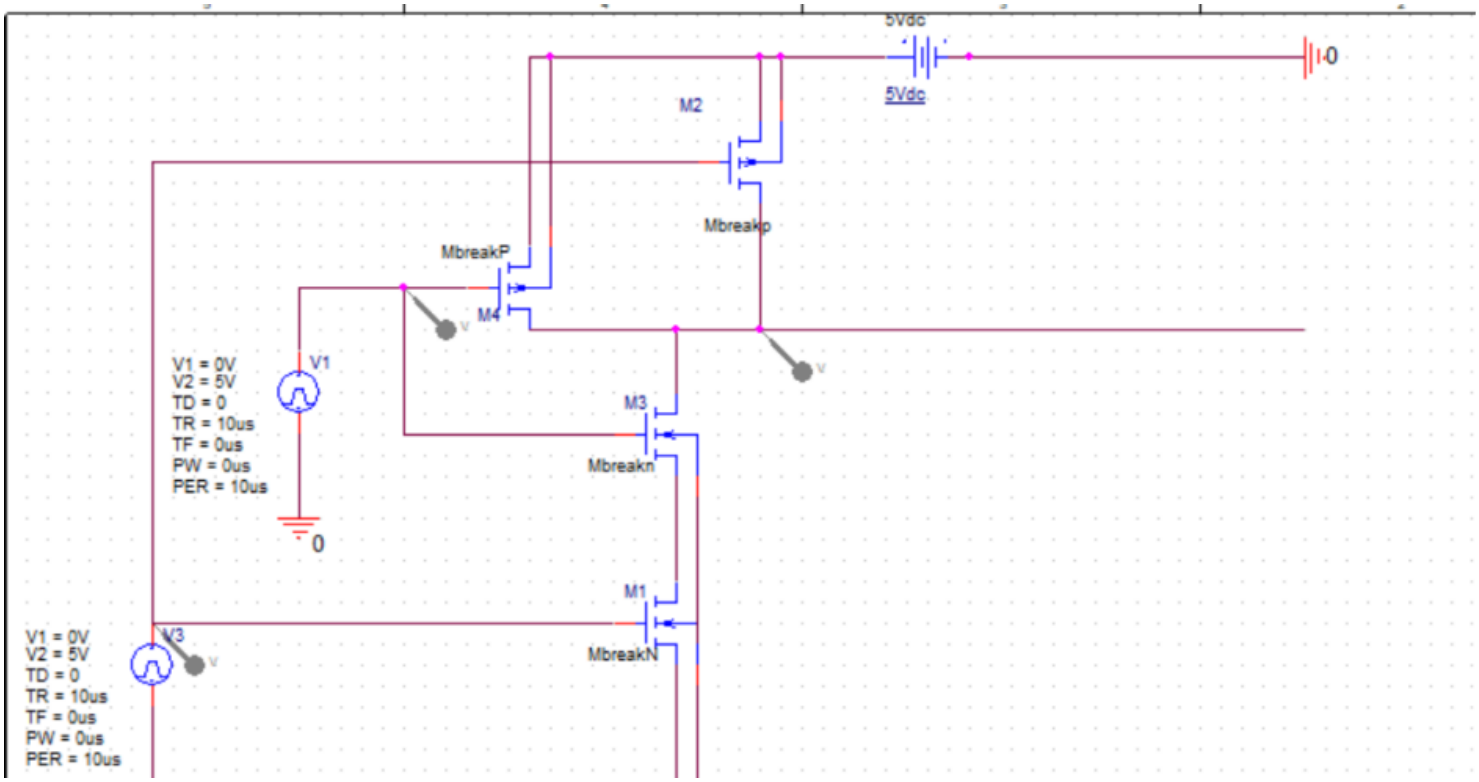
Figure 4: Circuit Schematic for 5V squarewave, f = 900kHz

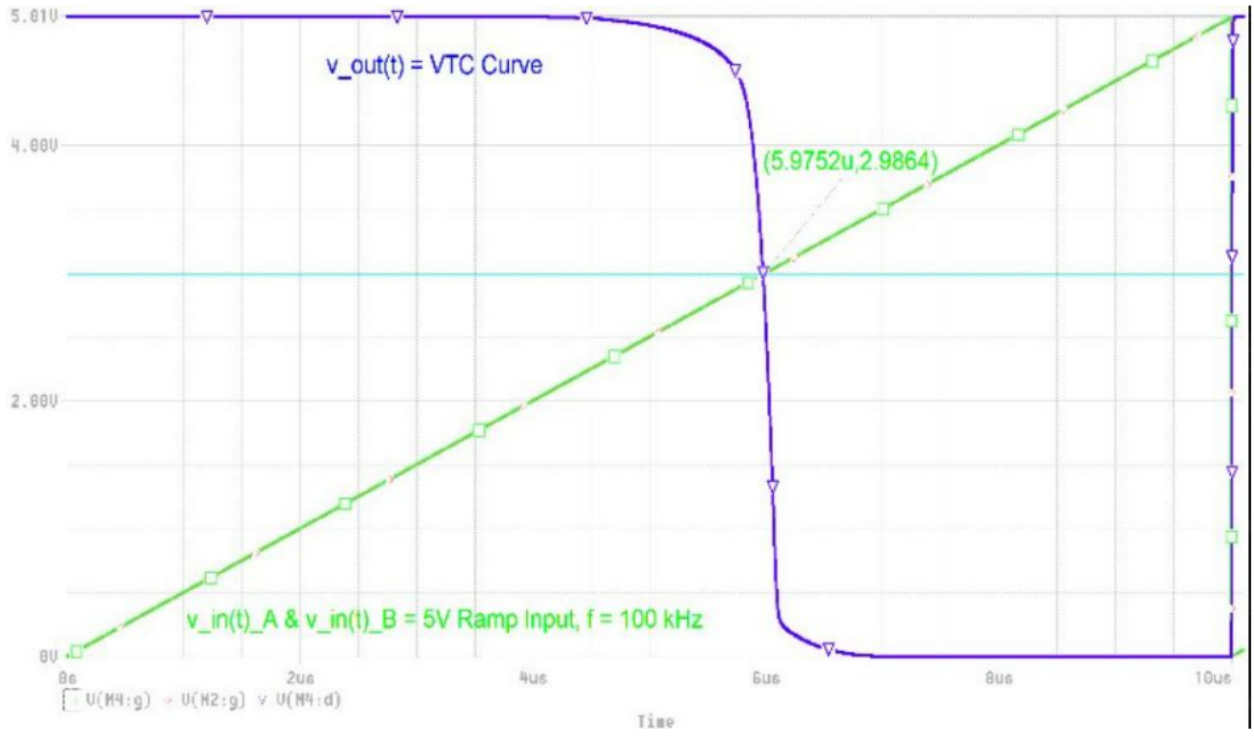


	Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		0.000		
		X Values	1.7185u	0.000	1.7185u		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
	CURSOR 1,2	V(M1:g)	5.0000	5.0000	0.000		0.000	0.000	5.0000	5.0000	5.0000
		V(V1:+)	2.3650	4.9996	-2.6346		-2.6350	-450.450u	4.9996	2.3650	3.6823
		V(M3:d)	4.1224	251.143n	4.1224		-877.617m	-5.0000	4.1224	251.143n	2.0612
		V(M3:d)	4.1224	251.143n	4.1224		-877.617m	-5.0000	4.1224	251.143n	2.0612
		V(V1:+)	2.3650	4.9996	-2.6346		-2.6350	-450.450u	4.9996	2.3650	3.6823
		V(M1:g)	5.0000	4.9998	225.225u		0.000	-225.225u	5.0000	4.9998	4.9999

Figure 4.2: Output waveform for 5V squarewave, f = 900kHz

Ramp Case 1: 100kHz (Alexis)





Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		3.0492		
	X Values	6.0983u	0.000	6.0983u		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
CURSOR 1,2	V(M3:g)	3.0492	0.000	3.0492		0.000	0.000	3.0492	0.000	1.5246
	V(V3:+)	3.0492	5.0000u	3.0492		0.000	5.0000u	3.0492	5.0000u	1.5246
	V(M4:d)	4.6454	5.0000	-354.656m		1.5962	5.0000	5.0000	4.6454	4.8227

Ramp Case 1: 100kHz (Sungmin)

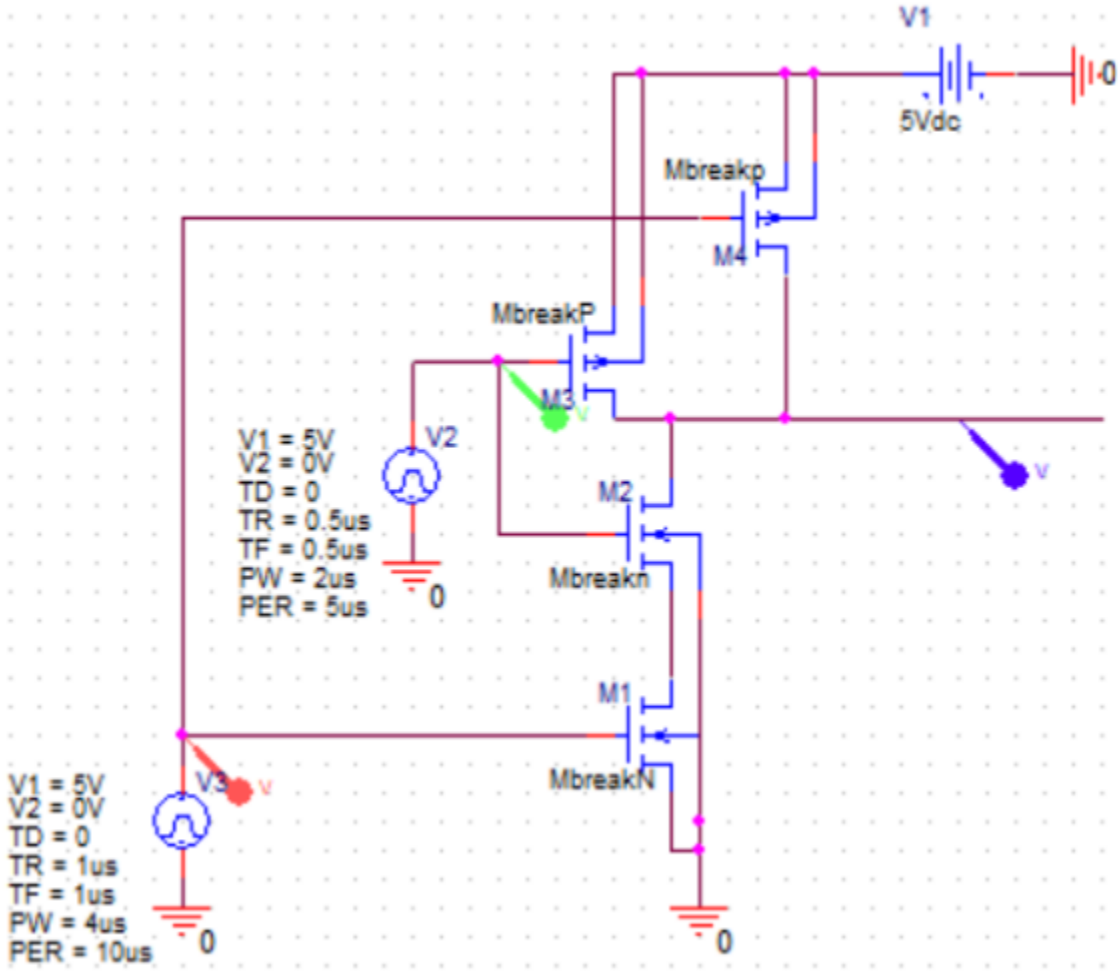
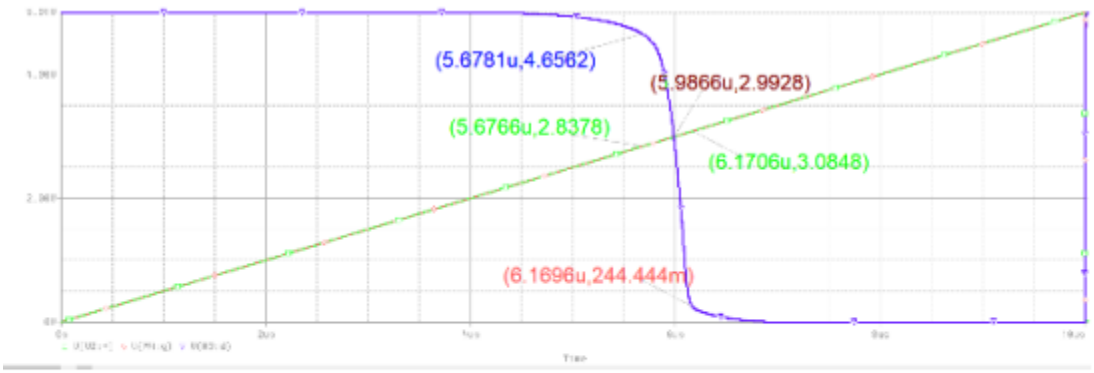
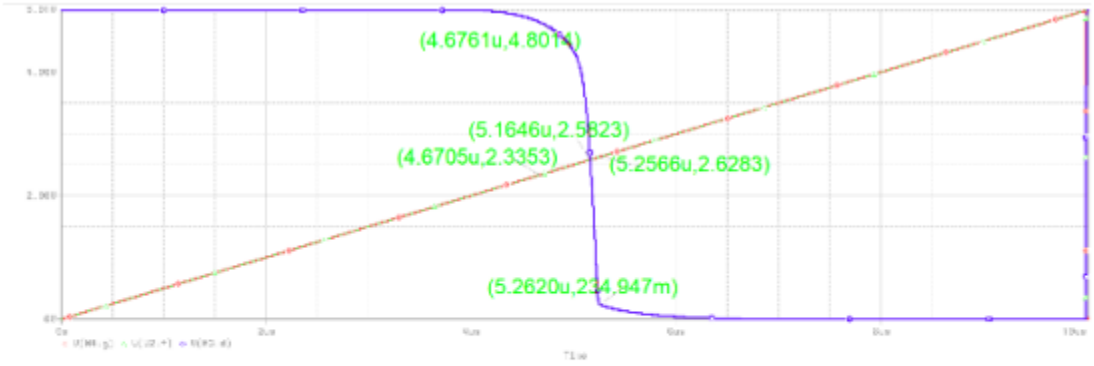


Figure 5.1: NAND Gate CMOS Inverter 5V Ramp wave input case 1 for f = 100kHz



Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		-364.018u		
	X Values	5.9856u	5.9866u	-1.0426n		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
CURSOR 2	V(V2:+)	2.9928	2.9928	0.000		364.018u	0.000	2.9928	2.9928	2.9928
	V(M4:g)	2.9928	2.9928	0.000		364.018u	0.000	2.9928	2.9928	2.9928
CURSOR 1	V(M3:d)	2.9924	2.9918	613.543u		0.000	-977.561u	2.9924	2.9918	2.9921

Figure 5.2: Zoomed NAND Gate CMOS Inverter I/p – O/p voltage transfer characteristics curve for 5V Ramp case 1, f = 100kHz with normal width and length of NMOS and PMOS



Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		-10.566m		
	X Values	5.1632u	5.1646u	-1.3181n		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
CURSOR 2	V(M4:g)	2.5823	2.5823	0.000		10.566m	0.000	2.5823	2.5823	2.5823
	V(V2:+)	2.5823	2.5823	0.000		10.566m	0.000	2.5823	2.5823	2.5823
CURSOR 1	V(M3:d)	2.5717	2.5430	28.686m		0.000	-39.251m	2.5717	2.5430	2.5574

Figure 5.3: Zoomed CMOS Inverter I/p – O/p voltage transfer characteristics curve for 5V Ramp case 1, f = 100kHz with increased NMOS width from 30um to 450um

Ramp Case 2: 200kHz (Haroutun)

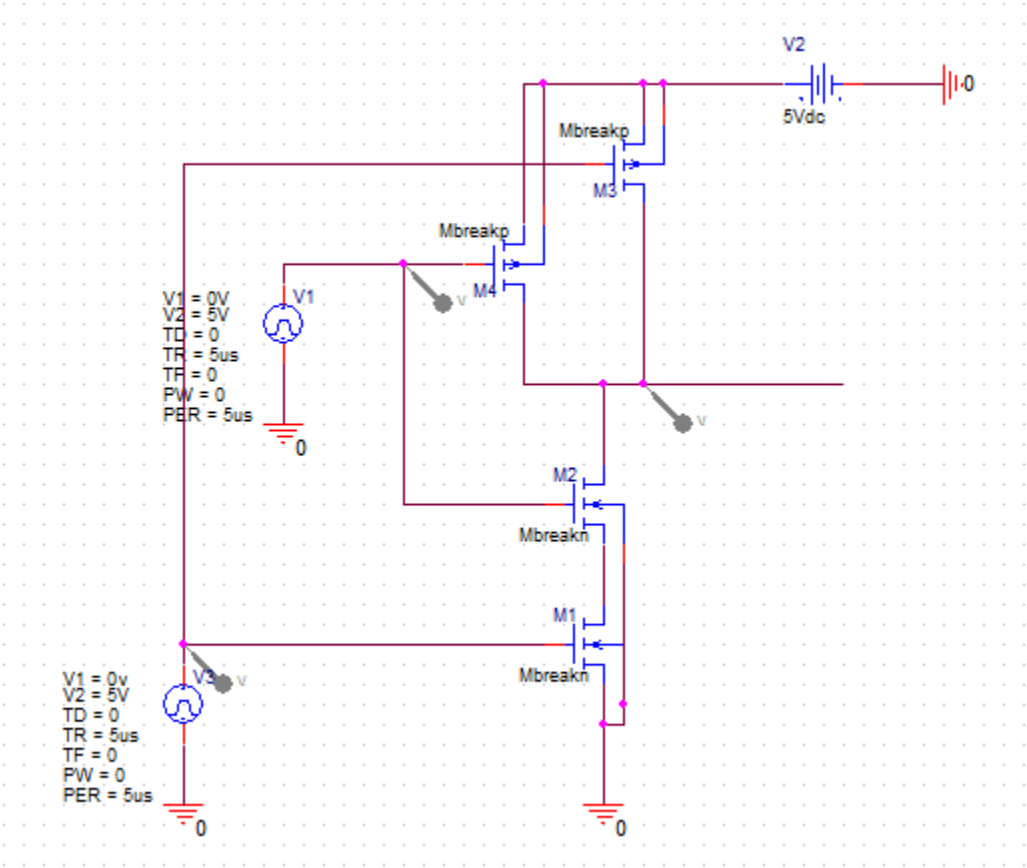
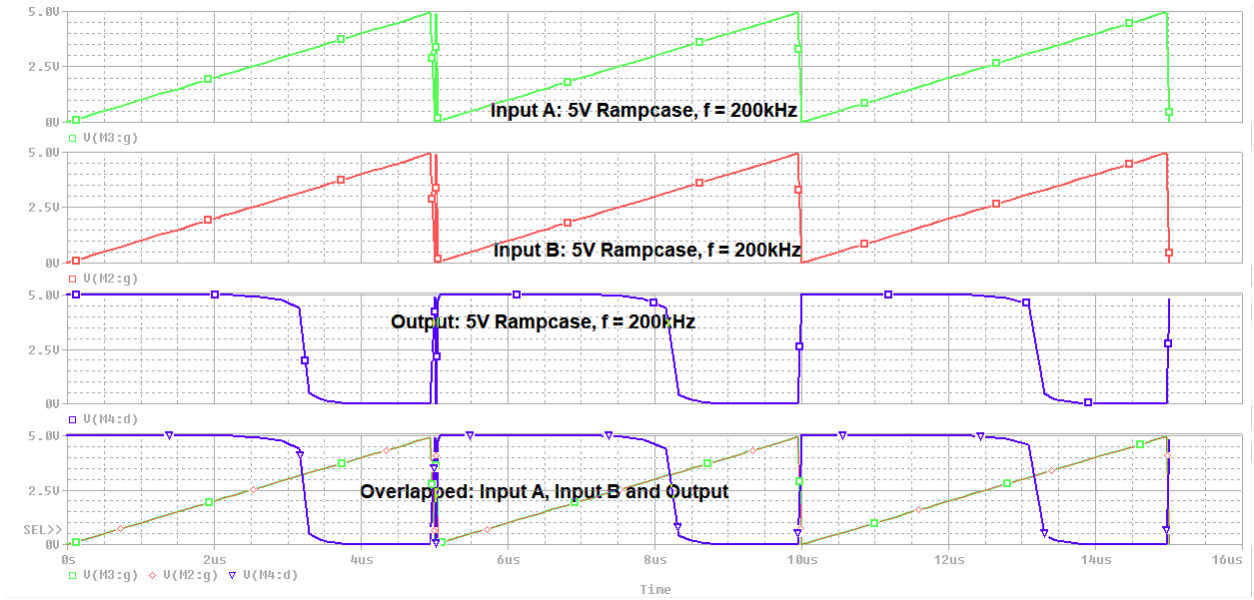
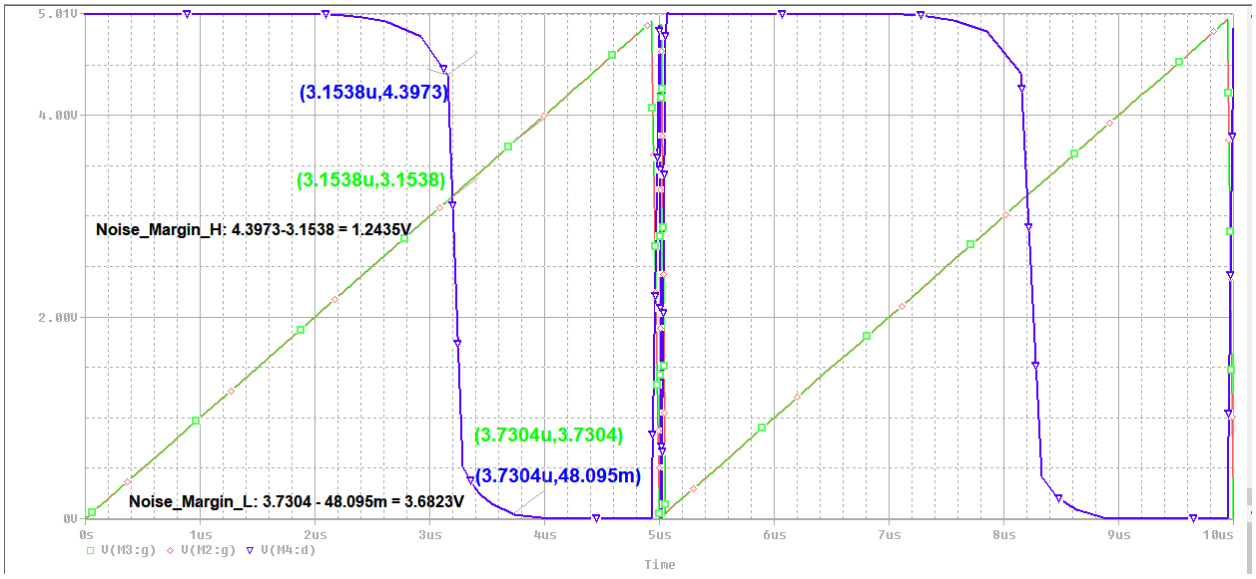


Figure 6.1: Circuit Schematic for 5V Ramp Case, f = 200kHz



	Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		4.9331		
		X Values	4.9331u	0.000	4.9331u		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
	CURSOR 1,2	V(M3:g)	4.9331	0.000	4.9331		0.000	0.000	4.9331	0.000	2.4665
		V(M2:g)	4.9331	3.0000m	4.9301		0.000	3.0000m	4.9331	3.0000m	2.4680
		V(M4:d)	1.7694m	5.0005	-4.9987		-4.9313	5.0005	5.0005	1.7694m	2.5011
		V(M4:d)	1.7694m	5.0005	-4.9987		-4.9313	5.0005	5.0005	1.7694m	2.5011
		V(M2:g)	4.9331	3.0000m	4.9301		0.000	3.0000m	4.9331	3.0000m	2.4680
		V(M3:g)	4.9331	3.0000m	4.9301		0.000	3.0000m	4.9331	3.0000m	2.4680

Figure 6.2: Output waveform for 5V Ramp case, f = 200kHz



	Trace Color	Trace Name	Y1	Y2	Y1 - Y2		Y1(Cursor1) - Y2(Cursor2)		3.1826		
		X Values	3.1826u	0.000	3.1826u		Y1 - Y1(Cursor1)	Y2 - Y2(Cursor2)	Max Y	Min Y	Avg Y
	CURSOR 1,2	V(M3:g)	3.1826	0.000	3.1826		0.000	0.000	3.1826	0.000	1.5913
		V(M2:g)	3.1826	3.0000m	3.1796		0.000	3.0000m	3.1826	3.0000m	1.5928
		V(M4:d)	3.6167	5.0005	-1.3838		434.045m	5.0005	5.0005	3.6167	4.3086

Figure 6.3: Noise Margin waveform for ramp case, f = 200kHz