Estimation of Leakage Current for 2X2 Multiplier

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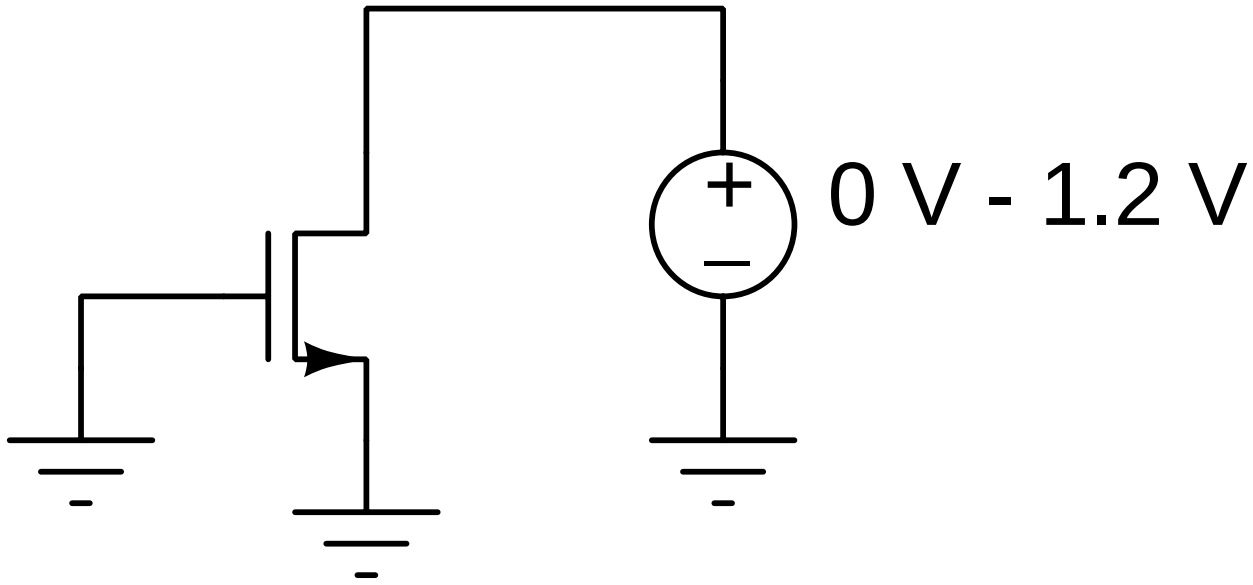
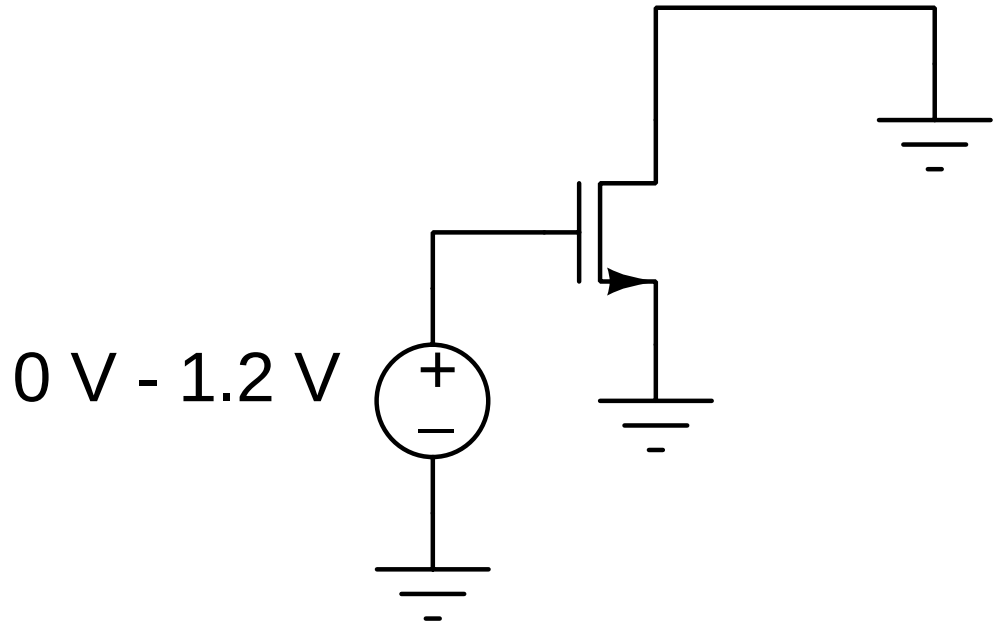
Packages for NMOS leakage current

NMOS off

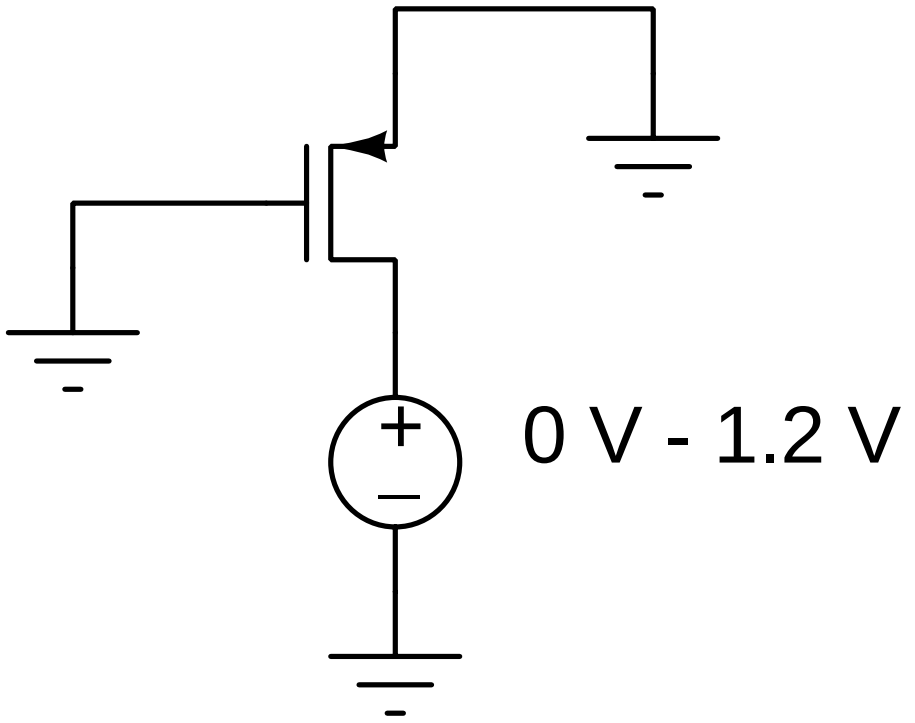


NMOS on

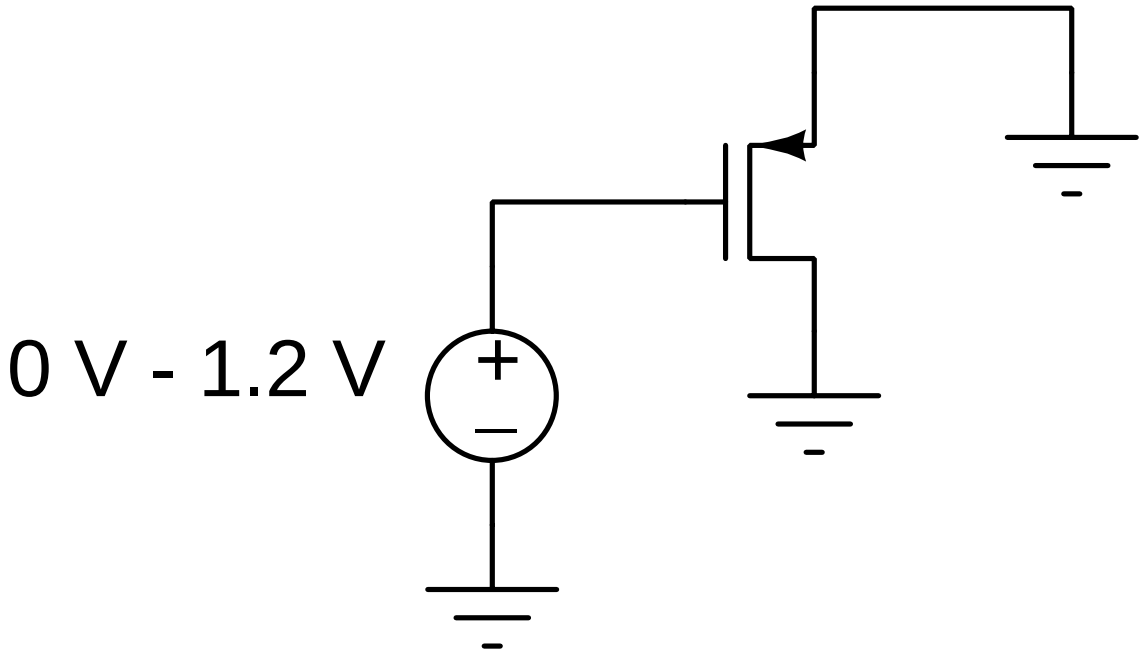


Packages for PMOS leakage current

PMOS off



PMOS on



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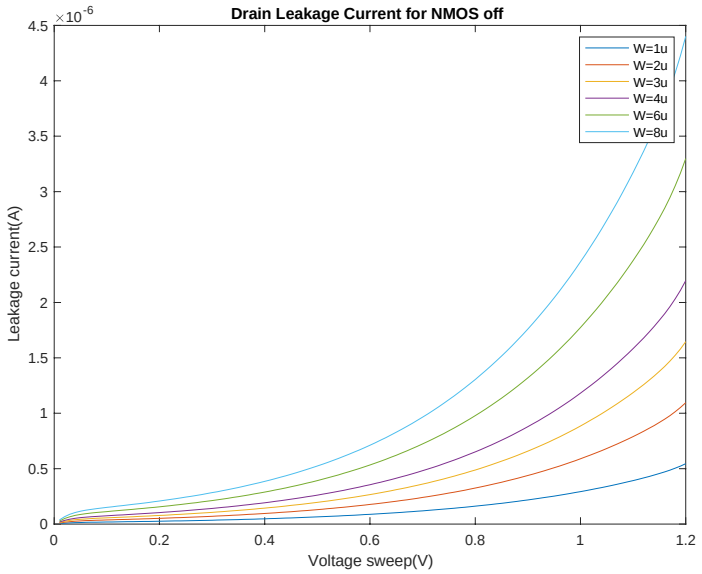
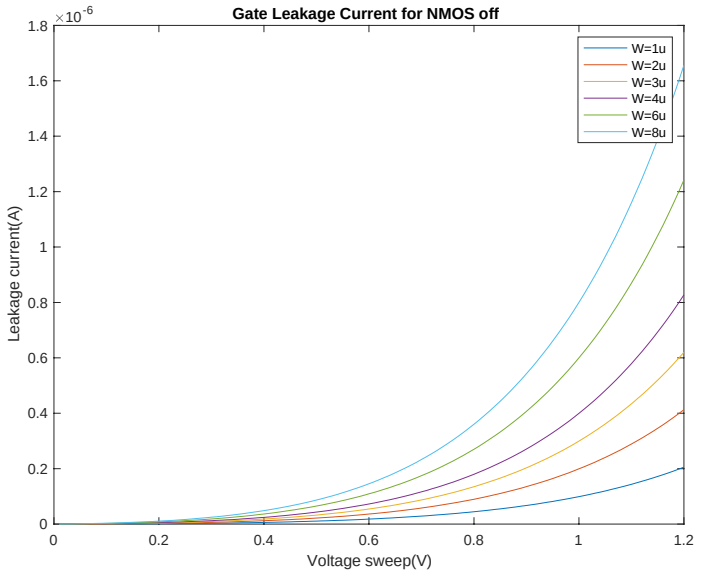
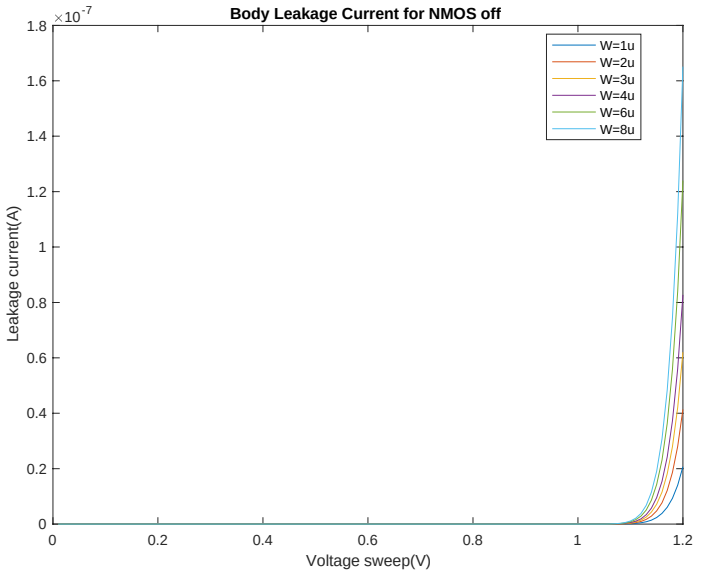
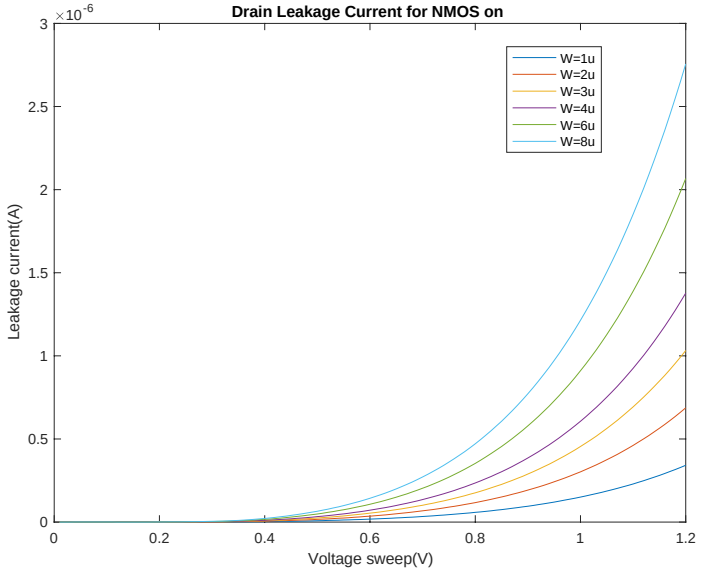
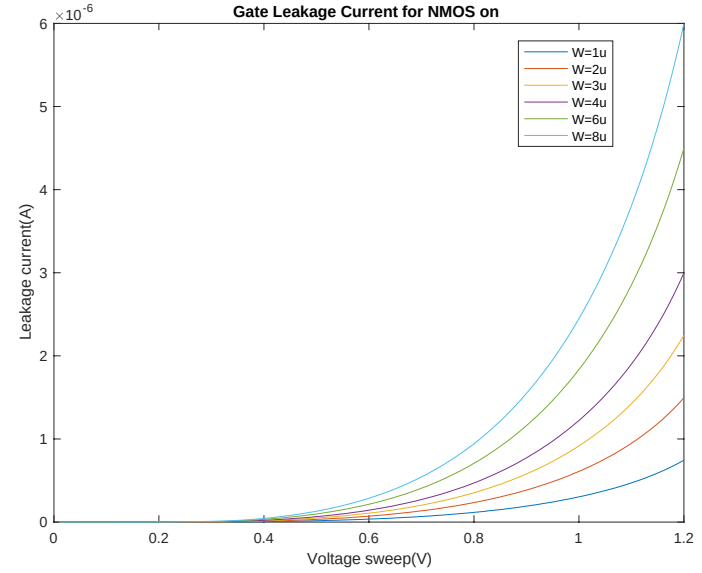
NMOS leakage currents

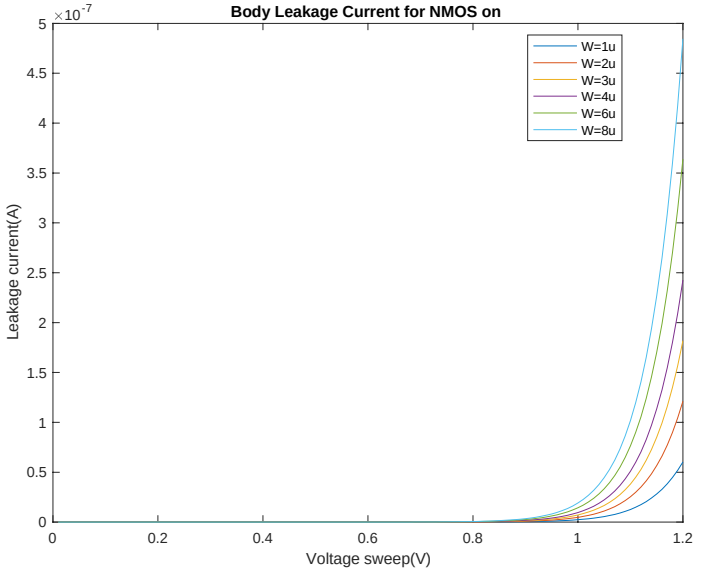












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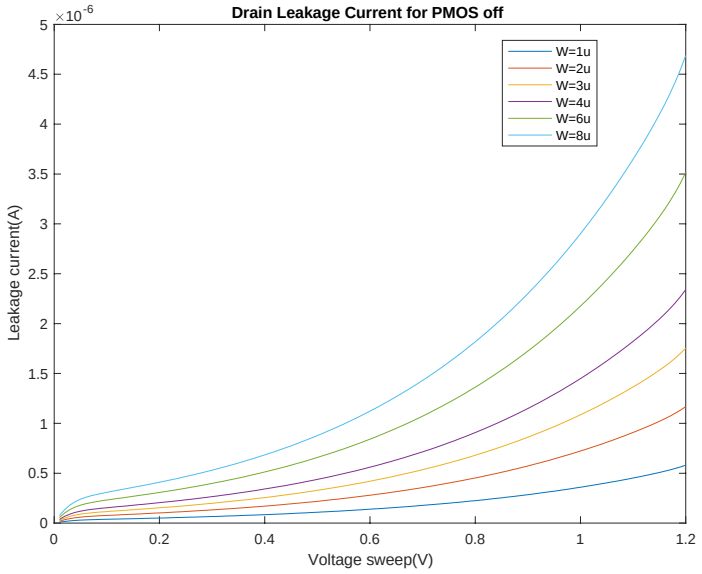
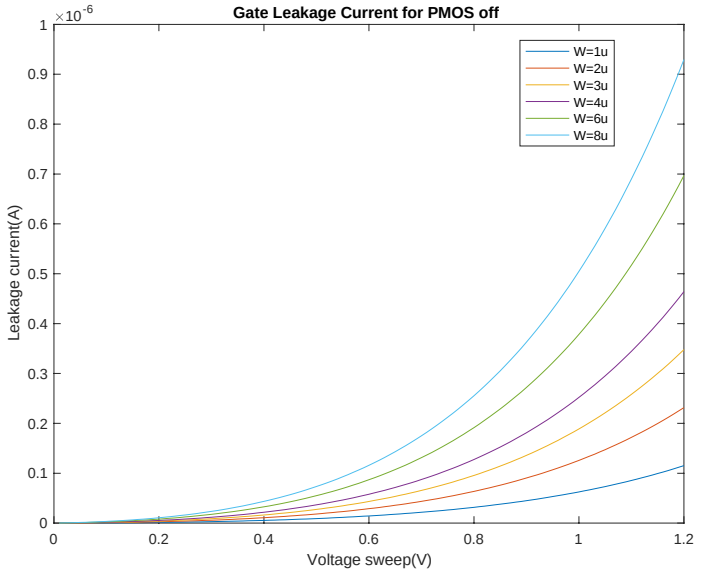
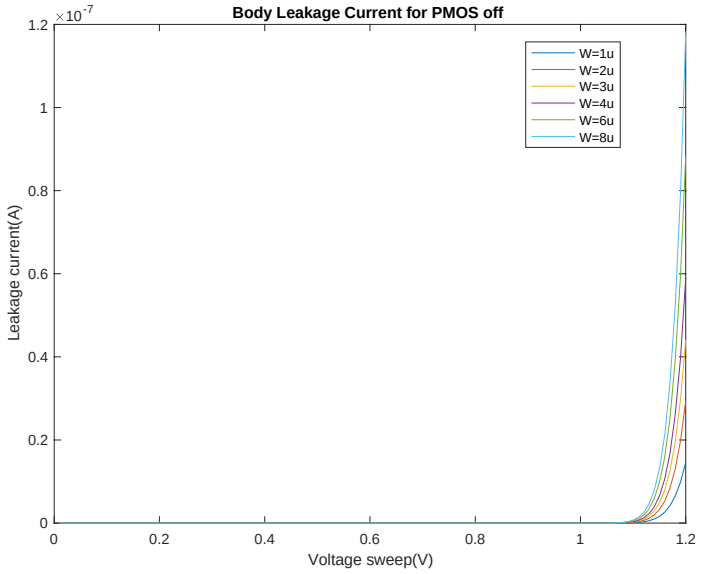
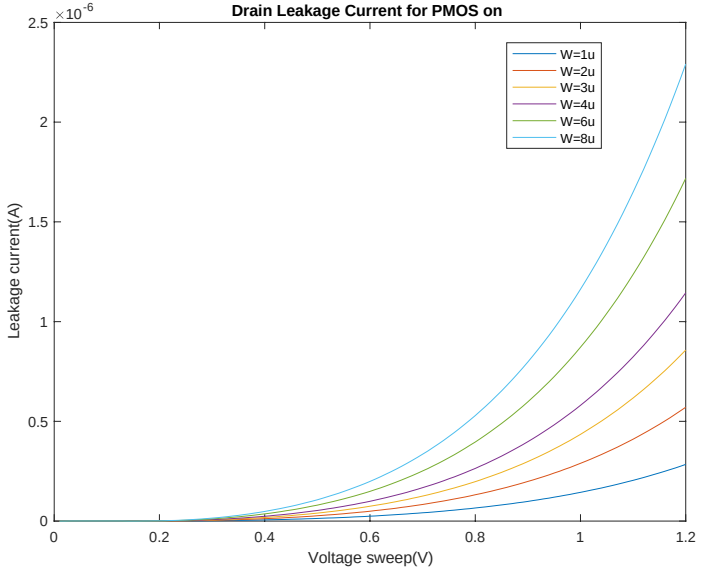
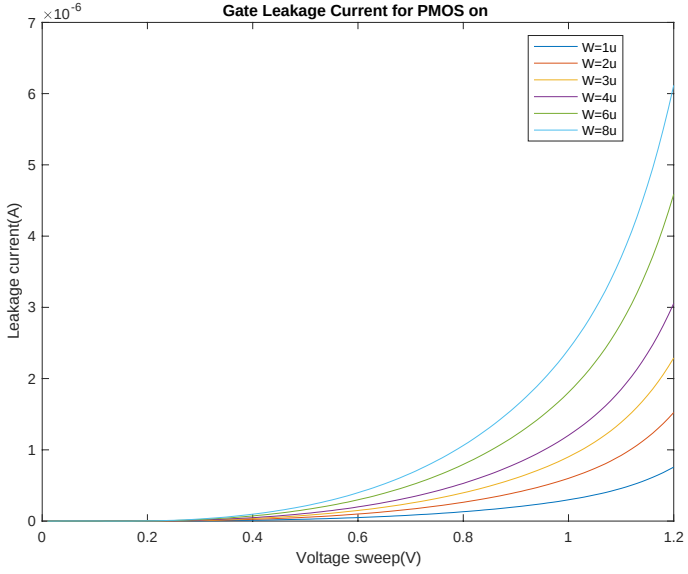
PMOS leakage currents

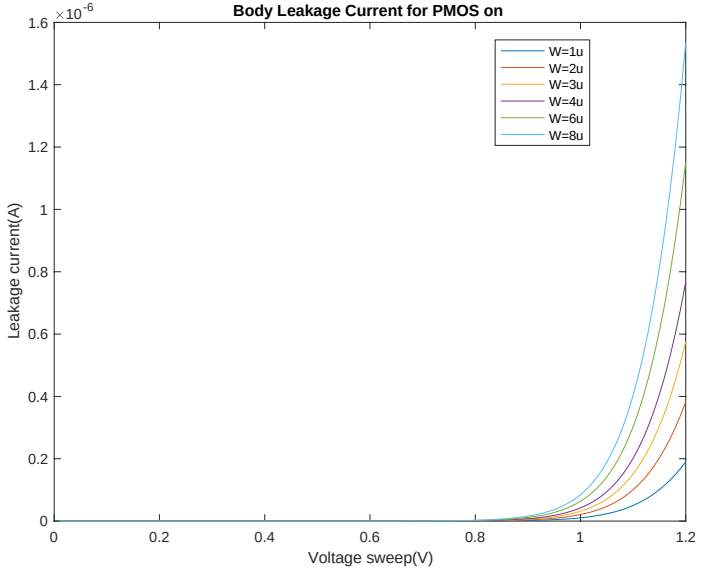












Model Used for Estimation

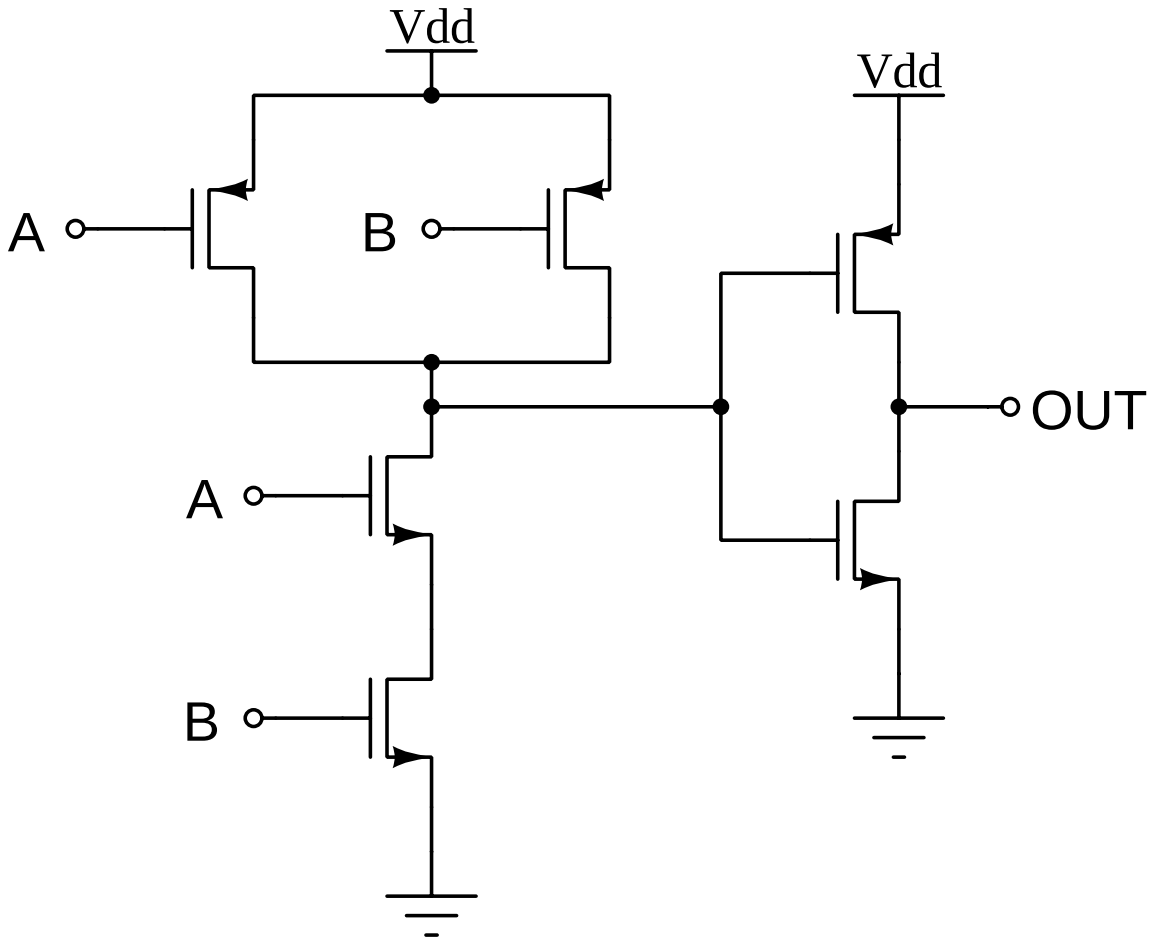
Multiplier = 6*(AND GATES) + 2*(XOR GATES)

Steps Followed:-

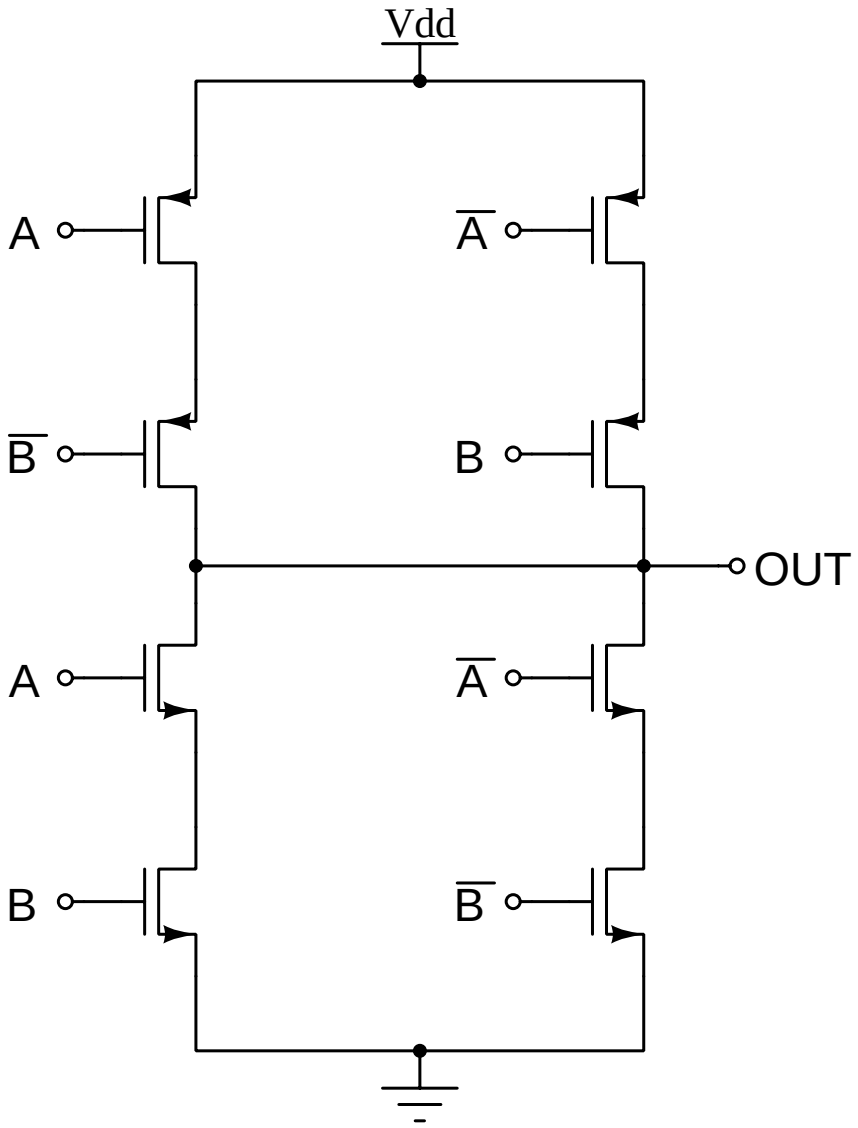
1. For both ON and OFF configuration for PMOS and NMOS we have calculated the respective Terminal current and Terminal Voltage for different width (24 Packages)
2. Simulated AND gate and XOR gate for different input combination and width value and found the Intermediate Node voltage respectively.
3. Using the Intermediate Node voltages and M (part-1) , we find the leakage current for AND gate and XOR gate for different Combination.
4. Combine all the above result to estimate the leakage current for the 2x2 multiplier for all combination and all width sizes.

Gates

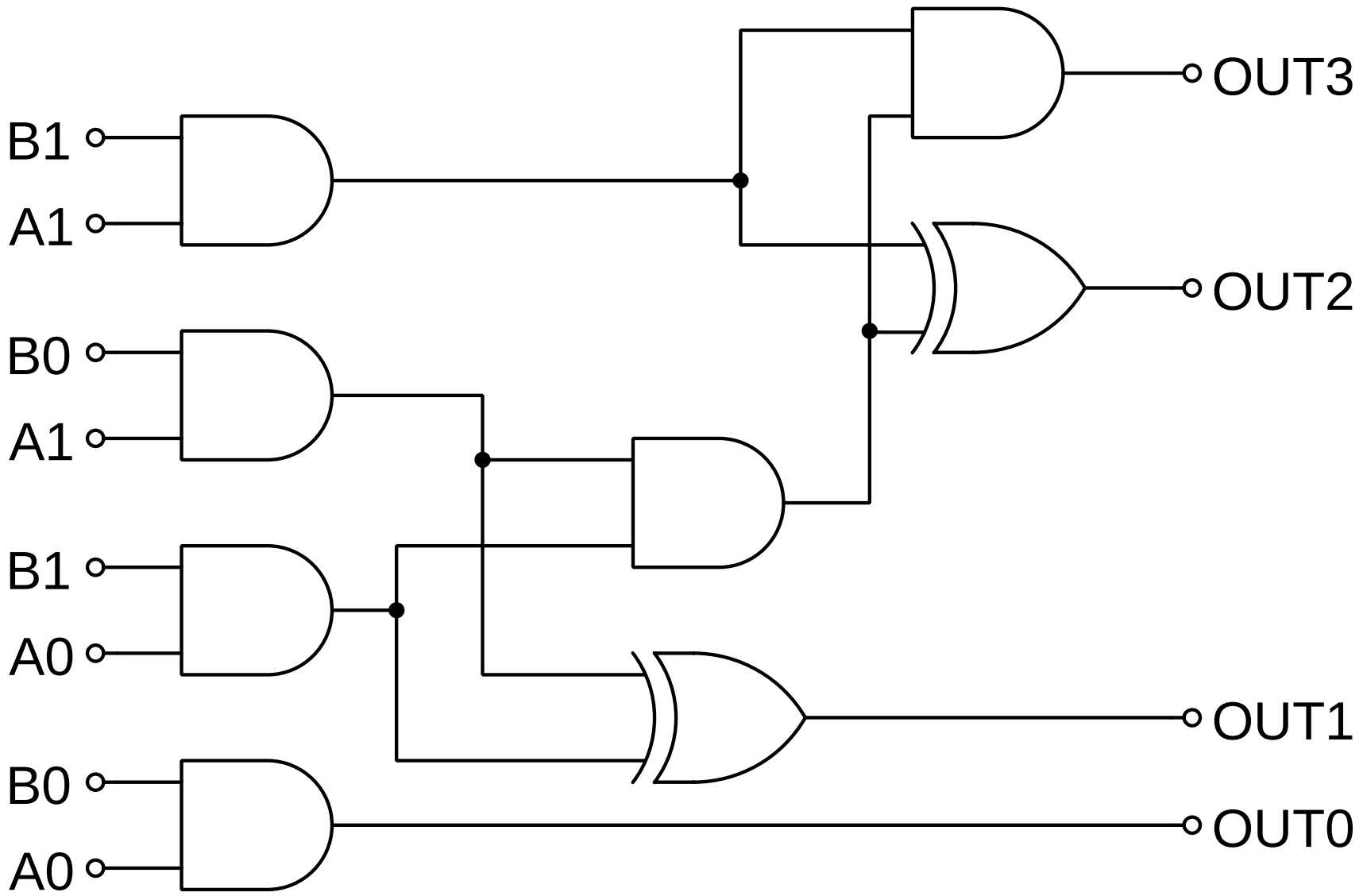
AND



XOR



Multiplier Circuit Used



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Intermediate Node Voltage

AND

Width / Inputs	00	01	10	11
1*Wmin	0.0863	0.0001740	1.002459	0.0005923
2 *Wmin	0.0864	0.0001219	1.002459	0.0005940
3*Wmin	0.0864	0.0001220	1.002458	0.0005945
4*Wmin	0.08641	0.0001221	1.002456	0.0005947
6*Wmin	0.086426	0.0001221	1.002452	0.0005950
8*Wmin	0.086449	0.0001222	1.002445	0.0005950

XOR

Width / Input	00	01	10	11
1*Wmin	INV A = 0.1403495 INV B= 0.6927653	INV A= 1.00217 INV B= 1.198743	INV A = 0.000121 INV B= 1.198215	INV A= 0.0004064 INV B= 1.199374
2 *Wmin	INV A= 0.1407 INV B= 0.6929	INV A= 1.00217 INV B= 1.198743	INV A= 0.0001218 INV B= 1.1989	INV A= 0.0004075 INV B= 1.199374
3*Wmin	INV A= 0.1408 INV B= 0.6929	INV A= 1.00217 INV B= 1.199214	INV A= 0.0001219 INV B= 1.1989	INV A= 0.0004079 INV B= 1.199374
4*Wmin	INV A= 0.1408 INV B= 0.6929	INV A= 1.00217 INV B= 1.199214	INV A= 0.0001219 INV B= 1.1989	INV A= 0.0004079 INV B= 1.199374
6*Wmin	INV A= 0.1408 INV B= 0.6929	INV A= 1.00217 INV B= 1.199214	INV A = 0.0001219 INV B= 1.1989	INV A= 0.0004079 INV B= 1.199374
8*Wmin	INV A= 0.1408 INV B= 0.6929	INV A= 1.00217 INV B= 1.199214	INV A= 0.0001219 INV B= 1.1989	INV A= 0.0004079 INV B= 1.199374

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Estimated Leakage Current Values (W=1)

W	A0	A1	B0	B1	Leakage current	Subthreshold current	Body current	Gate current
1	0	0	0	0	23.7302	4.0381	3.9178	15.7743
1	0	0	0	1	21.1814	2.9121	3.6321	14.6372
1	0	0	1	0	21.1814	2.9121	3.6321	14.6372
1	0	0	1	1	18.6327	1.7862	3.3464	13.5
1	0	1	0	0	23.8111	3.9506	3.6578	16.2028
1	0	1	0	1	22.4989	3.4491	3.3995	15.6502
1	0	1	1	0	21.9161	3.2495	3.1483	15.5184
1	0	1	1	1	20.6039	2.7481	2.89	14.9658
1	1	0	0	0	23.8111	3.9506	3.6578	16.2028
1	1	0	0	1	25.3602	4.2726	3.3644	17.7233
1	1	0	1	0	21.9161	3.2495	3.1483	15.5184
1	1	0	1	1	23.4652	3.5715	2.8549	17.0388
1	1	1	0	0	23.892	3.863	3.3977	16.6313
1	1	1	0	1	26.6776	4.8096	3.1317	18.7363
1	1	1	1	0	22.6508	3.5869	2.6644	16.3996
1	1	1	1	1	27.6011	6.0223	2.5622	19.0166

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Estimated Leakage Current Values (W=2)

W	A0	A1	B0	B1	Leakage current	Subthreshold current	Body current	Gate current
2	0	0	0	0	47.6976	8.117	7.8735	31.7071
2	0	0	0	1	42.5734	5.854	7.298	29.4214
2	0	0	1	0	42.5734	5.854	7.298	29.4214
2	0	0	1	1	37.4491	3.591	6.7224	27.1357
2	0	1	0	0	47.8601	7.9411	7.3507	32.5683
2	0	1	0	1	45.2221	6.9335	6.8309	31.4577
2	0	1	1	0	44.05	6.5324	6.3249	31.1927
2	0	1	1	1	41.412	5.5248	5.8052	30.082
2	1	0	0	0	47.8601	7.9411	7.3507	32.5683
2	1	0	0	1	50.9719	8.5884	6.759	35.6245
2	1	0	1	0	44.05	6.5324	6.3249	31.1927
2	1	0	1	1	47.1618	7.1797	5.7332	34.2489
2	1	1	0	0	48.0226	7.7651	6.8279	33.4296
2	1	1	0	1	53.6206	9.6678	6.292	37.6608
2	1	1	1	0	45.5266	7.2107	5.3519	32.964
2	1	1	1	1	55.479	12.1064	5.1485	38.2242

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Estimated Leakage Current Values (W=3)

W	A0	A1	B0	B1	Leakage current	Subthreshold current	Body current	Gate current
3	0	0	0	0	71.6626	12.1961	11.8282	47.6383
3	0	0	0	1	63.9627	8.7959	10.9628	44.2041
3	0	0	1	0	63.9627	8.7959	10.9628	44.2041
3	0	0	1	1	56.2629	5.3956	10.0974	40.7698
3	0	1	0	0	71.9064	11.9317	11.0426	48.932
3	0	1	0	1	67.9424	10.4178	10.2614	47.2633
3	0	1	1	0	66.1812	9.8152	9.5006	46.8654
3	0	1	1	1	62.2172	8.3012	8.7193	45.1966
3	1	0	0	0	71.9064	11.9317	11.0426	48.932
3	1	0	0	1	76.5807	12.9043	10.1526	53.5238
3	1	0	1	0	66.1812	9.8152	9.5006	46.8654
3	1	0	1	1	70.8555	10.7878	8.6106	51.4572
3	1	1	0	0	72.1502	11.6673	10.2571	50.2258
3	1	1	0	1	80.5604	14.5262	9.4511	56.583
3	1	1	1	0	68.3997	10.8345	8.0384	49.5268
3	1	1	1	1	83.3533	18.1903	7.7336	57.4294

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Estimated Leakage Current Values (W=4)

W	A0	A1	B0	B1	Leakage current	Subthreshold current	Body current	Gate current
4	0	0	0	0	95.6239	16.2754	15.7814	63.5671
4	0	0	0	1	85.3482	11.7376	14.6262	58.9844
4	0	0	1	0	85.3482	11.7376	14.6262	58.9844
4	0	0	1	1	75.0725	7.1999	13.471	54.4017
4	0	1	0	0	95.9487	15.9226	14.7331	65.293
4	0	1	0	1	90.6585	13.902	13.6903	63.0662
4	0	1	1	0	88.3086	13.0979	12.6749	62.5358
4	0	1	1	1	83.0184	11.0774	11.6321	60.3089
4	1	0	0	0	95.9487	15.9226	14.7331	65.293
4	1	0	0	1	102.185	17.2205	13.5445	71.4201
4	1	0	1	0	88.3086	13.0979	12.6749	62.5358
4	1	0	1	1	94.545	14.3958	11.4863	68.6629
4	1	1	0	0	96.2734	15.5698	13.6847	67.0189
4	1	1	0	1	107.495	19.3849	12.6086	75.5019
4	1	1	1	0	91.2689	14.4582	10.7236	66.0872
4	1	1	1	1	111.222	24.2738	10.317	76.6312

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Estimated Leakage Current Values (W=6)

W	A0	A1	B0	B1	Leakage current	Subthreshold current	Body current	Gate current
6	0	0	0	0	143.53	24.4348	23.6816	95.4141
6	0	0	0	1	128.102	17.6208	21.9466	88.5348
6	0	0	1	0	128.102	17.6208	21.9466	88.5348
6	0	0	1	1	112.674	10.8068	20.2117	81.6554
6	0	1	0	0	144.016	23.9051	22.1075	98.003
6	0	1	0	1	136.072	20.8703	20.5415	94.6602
6	0	1	1	0	132.546	19.6629	19.0173	93.866
6	0	1	1	1	124.603	16.6281	17.4513	90.5232
6	1	0	0	0	144.016	23.9051	22.1075	98.003
6	1	0	0	1	153.375	25.8538	20.3213	107.2
6	1	0	1	0	132.546	19.6629	19.0173	93.866
6	1	0	1	1	141.905	21.6116	17.2311	103.063
6	1	1	0	0	144.501	23.3754	20.5334	100.592
6	1	1	0	1	161.345	29.1033	18.9162	113.325
6	1	1	1	0	136.99	21.7051	16.0879	99.1973
6	1	1	1	1	166.936	36.4396	15.4763	115.02

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Estimated Leakage Current Values (W=8)

W	A0	A1	B0	B1	Leakage current	Subthreshold current	Body current	Gate current
8	0	0	0	0	191.408	32.5957	31.5702	127.242
8	0	0	0	1	170.825	23.5033	29.2556	118.066
8	0	0	1	0	170.825	23.5033	29.2556	118.066
8	0	0	1	1	150.243	14.4109	26.9409	108.891
8	0	1	0	0	192.05	31.8892	29.47	130.691
8	0	1	0	1	181.451	27.8382	27.3807	126.233
8	0	1	1	0	176.753	26.2271	25.3484	125.177
8	0	1	1	1	166.154	22.1761	23.2591	120.719
8	1	0	0	0	192.05	31.8892	29.47	130.691
8	1	0	0	1	204.529	34.4889	27.0852	142.955
8	1	0	1	0	176.753	26.2271	25.3484	125.177
8	1	0	1	1	189.232	28.8268	22.9636	137.441
8	1	1	0	0	192.693	31.1826	27.3699	134.14
8	1	1	0	1	215.156	38.8238	25.2103	151.121
8	1	1	1	0	182.68	28.951	21.4413	132.288
8	1	1	1	1	222.606	48.6028	20.6218	153.381

End of Report