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Lab 5: Body Effect

Introduction

The purpose of this lab is to investigate the body effect and the variation in the threshold voltages of NMOS devices with body effect.

Part A

Set up a string of three series connected NMOS devices M1, M2, M3. The source of M1 is at ground and the drain of M3 is connected to a variable voltage source VDD. Use aspect ratios of 2.4u/0.6u for all the transistors. The drain and the gate of all the transistors are shorted together. Short the bulk terminals to the respective source terminals. Vary the voltage VDD from 0 to 5v.

Obtain plots for the gate voltages of M1, M2 and M3 and the drain current (current flowing from VDD to ground). As VDD is varied from 0 to 5v, current starts to flow once the threshold for all the 3 transistors are reached. At the onset of current flow, identify on the plot Vs1, Vs2, vs3 (the source voltages of the corresponding transistors), and the values of Vt1, Vt2, Vt3.

Part B

Repeat Part A tying the bulk terminal of all devices to ground (instead of tying them to their corresponding source terminals). Obtain plots and identify the voltages as outlined in Part A.

To Turn In

1. Plots for parts A and B with the source and threshold voltages for transistors marked
2. Your spice stimulus files and circuit files for each.
3. Answer to the following question:

> There is a reference voltage of VDD. Show an implementation to obtain VDD/2 from the reference voltage source using a series string of pmos transistors. Turn in a schematic of your circuit with all the terminal connections clearly marked.