Design #4

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1 Problem statement and Specifications

Design a single-ended amplifier using common-source configuration with a diode-connected load to meet the following specifications:

Specification	**Value**
DC Gain	6 dB
Bandwidth	$\geq 10\,\text{GHz}$
Power Consumption	$\leq 1.5\,\text{mW}$
Capacitive Load	50 fF

2 Analysis

$$I_D \leq \frac{P_{cons}}{V_{DD}} \leq \frac{1.5 \cdot 10^{-3}}{1.8} \leq 0.83mA$$

$$GBW = \frac{g_{m1}}{2\pi C_{out}} \geq 2 \cdot 10 \cdot 10^9 \implies g_{m1} \geq 6.28\text{mS}$$

We assume $g_{m1} = 15\text{mS}$, thus $(\frac{g_m}{I_D})_1 = 18.07$

$$A_v = g_{m1}R_{out} \Rightarrow R_{out} = \frac{2}{15m} = 133.33\Omega$$

We assume $r_{o1} >> \frac{1}{gm2}$

$$\frac{1}{g_{m2}} = 150 \Rightarrow g_{m2} = 6.7mS \Rightarrow (\frac{g_m}{I_D})_2 = 8$$

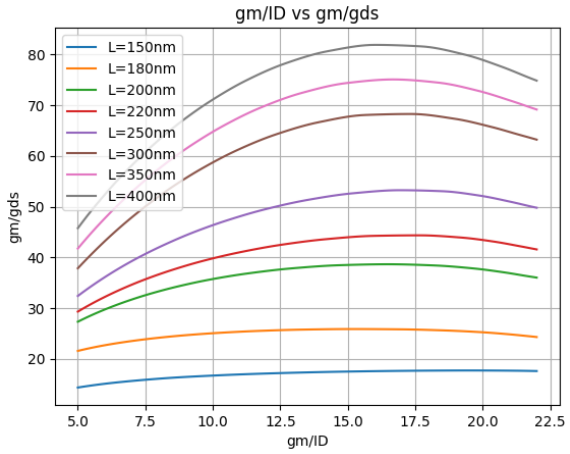
$$r_{o1} = \frac{R_{out} \cdot (\frac{1}{g_{m2}})}{(\frac{1}{g_{m2}}) - R_{out}} = 1200\Omega$$

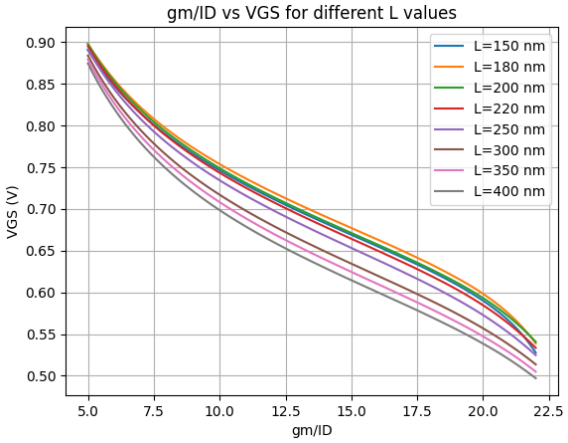
$$\frac{g_m}{g_{ds}} = g_{m1} r_{o1} = 18$$

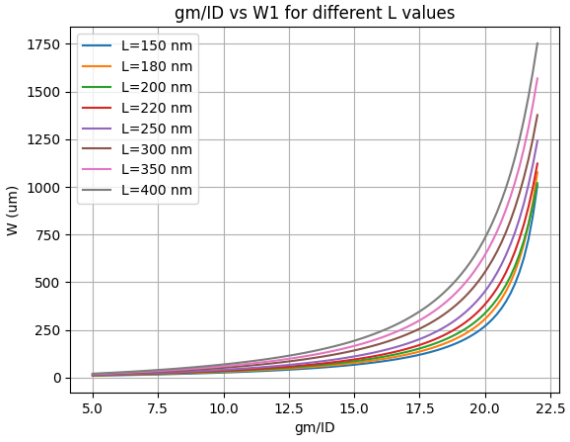
From charts:

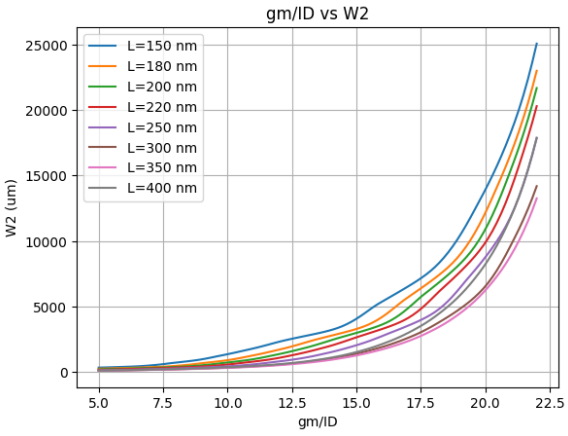
- $g_m/g_{ds} = 17.67$ (intrinsic gain).
- $V_{GS} = 0.63V$
- $W_1 = 138\,\mu\text{m}, L_1 = 150\text{nm}.$
- $W_2 = 216\,\mu\text{m}, L_2 = 350\text{nm}.$

3 gm/ID Charts



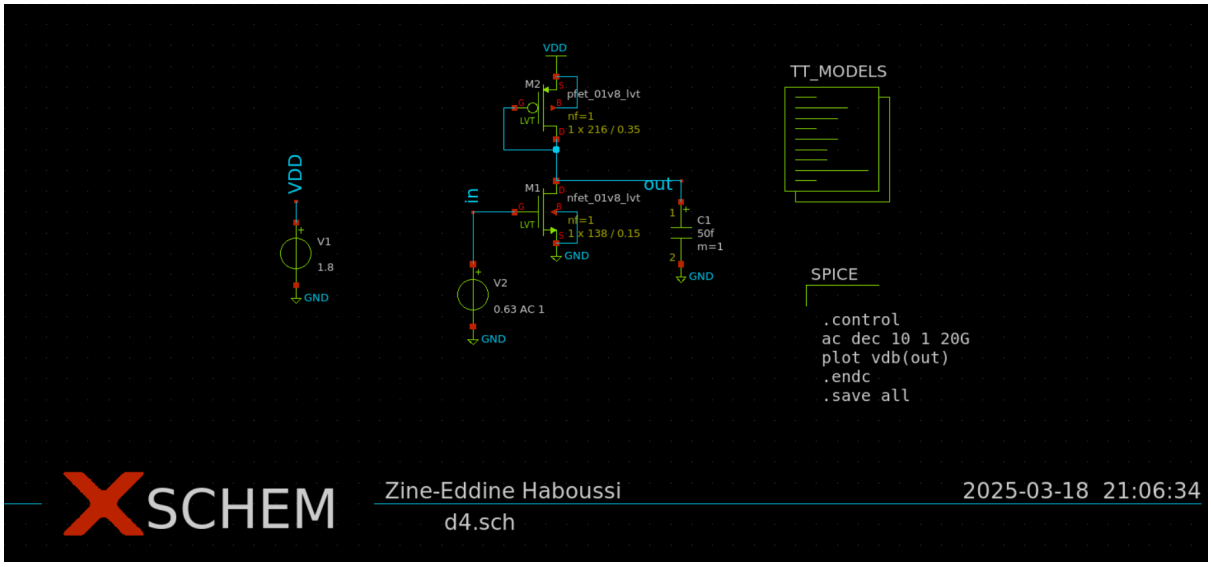






4 Simulation Results

4.1 Test bench



4.2 AC Analysis