

Design #1

Zineddine Haboussi

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1 Problem statement and Specifications

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

Specification	Value
DC Gain	10 dB
Bandwidth	>5 GHz
Power Consumption	<2 mW
Capacitive Load	100 fF

2 Theoretical Analysis

Parameters of the sky130_fd_pr__nfet_01v8 cell from the Sky130nm PDK:

- $V_{DD} = 1.8 V$
- $V_{th} = 0.77 V$
- $\mu_n C_{ox} = 77.2 \mu A/V^2$

Using the power consumption formula, we obtain the value of I_D :

$$I_D > \frac{P}{V_{DD}} = 1.11 mA$$

By applying the Gain-Bandwidth Product (GBW) formula, we can derive the transconductance (g_m):

$$\begin{aligned} GBW &= g_m \cdot R_{out} \cdot \frac{1}{2\pi C_L R_{out}} = \frac{g_m}{2\pi C_L} > 3.16 \cdot 5 GHz \\ \implies g_m &= 3.16 \cdot 5 \cdot 10^9 \cdot 2\pi \cdot 100 \cdot 10^{-15} = 9.92 mS \end{aligned}$$

thus R_D is:

$$R_D = \frac{3.16}{9.92 \cdot 10^{-3}} = 318.54 \Omega$$

and V_{OV} is:

$$V_{OV} = \frac{2I_D}{g_m} = 0.22 V$$

the W/L ratio can be obtained from:

$$\frac{W}{L} = \frac{g_m^2}{2\mu_n C_{ox} I_D} = 574.18$$

we conclude the width of the MOSFET:

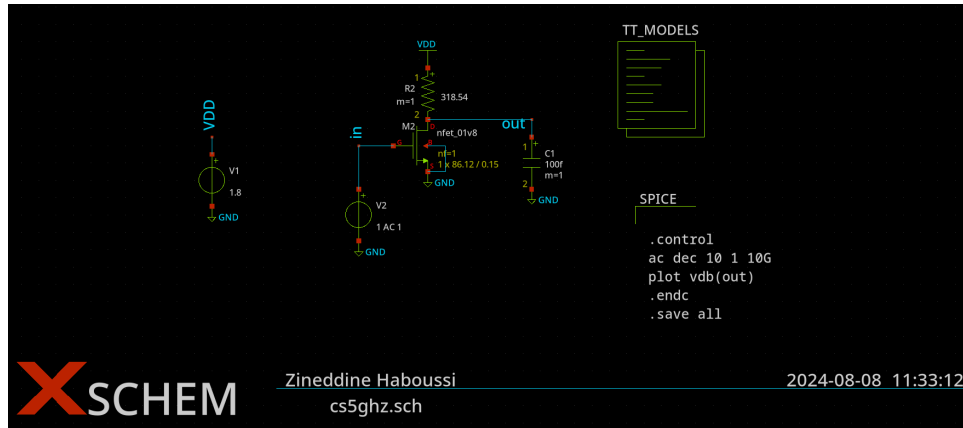
$$W = 86.12 \mu m$$

the gate-source voltage V_{GS} can be calculated from:

$$V_{GS} = V_{OV} + V_{TH} \approx 1 V$$

3 Simulation Results

3.1 Test bench



3.2 AC Analysis

