Lab 1: Common-source Amplifiers TA

Preparation

1. The maximum swing is $V_{DD} - V_{ov}$. This requires $I_D R_D = (V_{DD} - V_{ov})/2$ and thus $R_D = (V_{DD} - V_{ov})/2I_D$. Since $g_m = 2I_D/V_{ov}$, $A_v = -g_m R_D = (-2I_D/V_{ov}) \cdot (V_{DD} - V_{ov})/2I_D = -(V_{DD} - Vov)/V_{ov}$.

2. $V_{ov} = \sqrt{2I_D/\mu C_{ox} W/L}$. $g_m = 2I_D/V_{ov}$. For maximum swing, $V_o = (V_{DD} - V_{ov})/2$. For 0.2 V_{pp} swing, $V_o = V_{ov} + 0.2/2$. $R_D = (V_{DD} - V_o)/I_D$. $A_v = -g_m R_D$. See Table 1 for numerical values.

3. See Figure 1.

4. See Figure 2.

5. Same as the previous step.

6. See Figure 3.

7. N/A

Table 1: Hand analysis table

V_{DD} (V)	Type	Gain	Swing (V_{pp})	V_{ov} (V)	I_D (A)	g_m (A/V)	V_o (V)	R_D (Ω)	A_v (V/V)
5.0	NMOS	-	max	667 m	1 m	3.00 m	2.83	2.17 k	-6.51
5.0	PMOS	-	max	690 m	0.5 m	1.45 m	2.16	4.37 k	-6.34
1.2	NMOS	max	0.2	471 m	0.5 m	2.12 m	488 m	1.26 k	-2.67

Lab

- Emphasize the importance of the 50-Ω termination for correct voltage reading of the signal source.
- Briefly explain how the input bias circuit works.

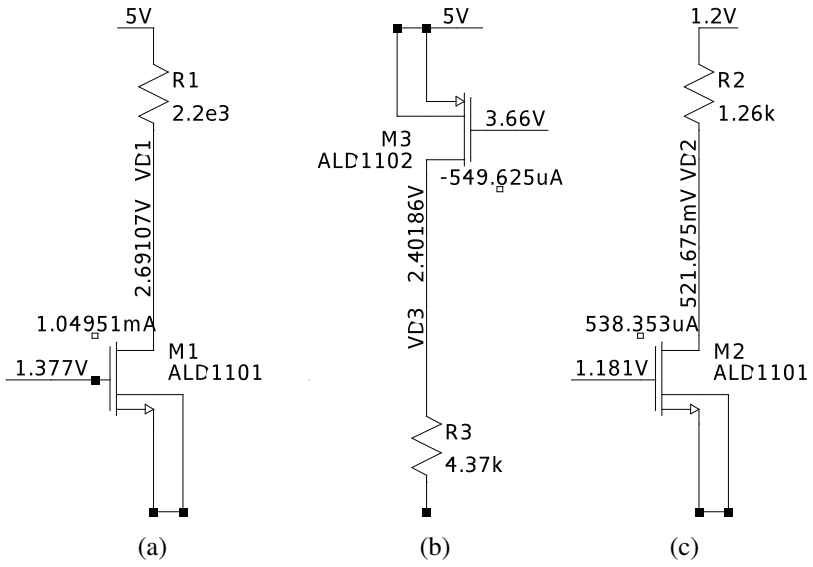

Figure 1: DC operating points of (a) NMOS, V_{DD} = 5 V (b) PMOS, V_{DD} = 5 V, and (c) V_{DD} = 1.2 V.