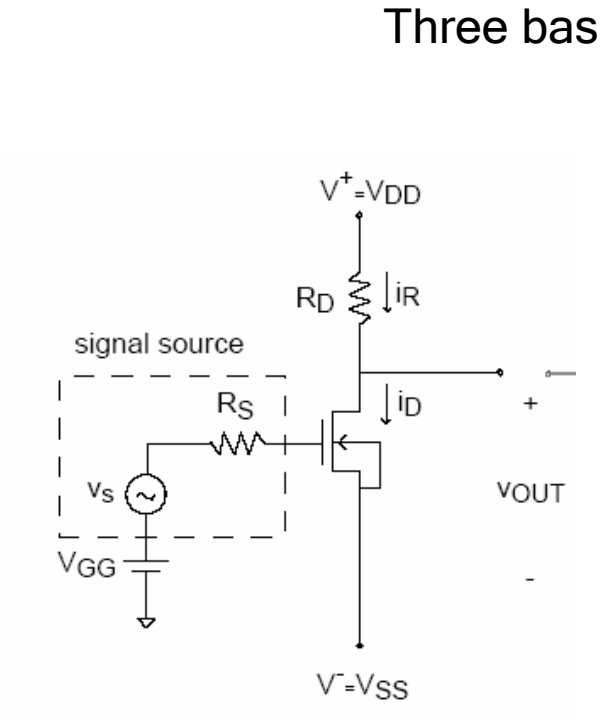
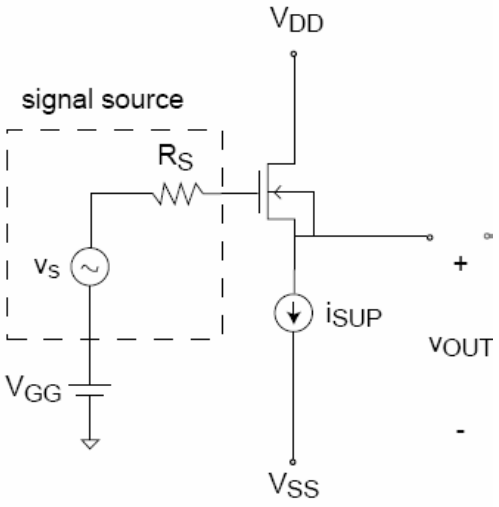
Lect. 8: Current Source and Active Load

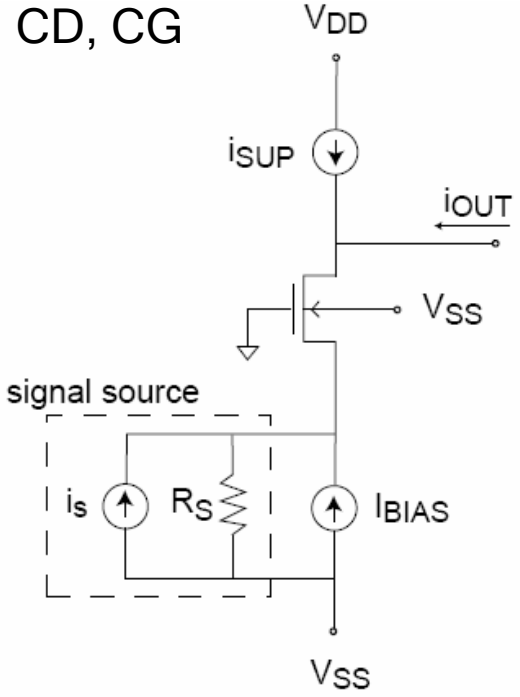
Three basic amplifier configurations: CS, CD, CG



Common Source



Common Drain
(Source Follwer)

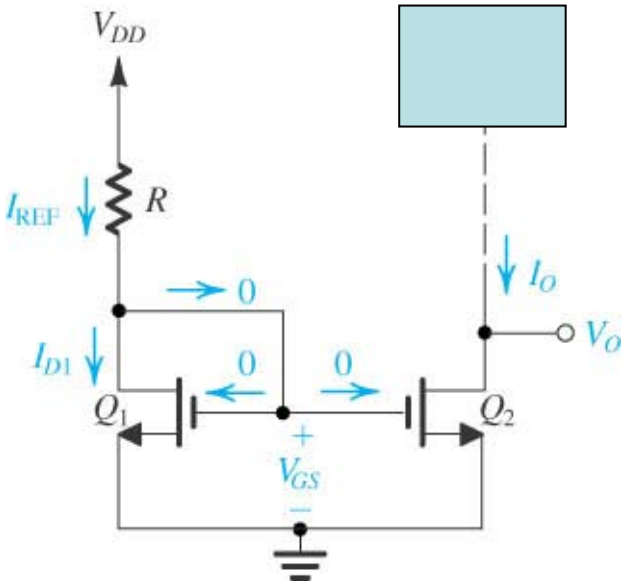


Common Gate

➔ How to implement current sources and active loads?

Lect. 8: Current Source and Active Load

Constant current source:



➔ Current mirror

$$I_{D1} = \frac{1}{2} k_n' \left(\frac{W}{L}\right)_1 (V_{GS} - V_t)^2$$

$$I_{D1} = I_{REF} = \frac{V_{DD} - V_{GS}}{R}$$

Assuming Q_1, Q_2 have same characteristics

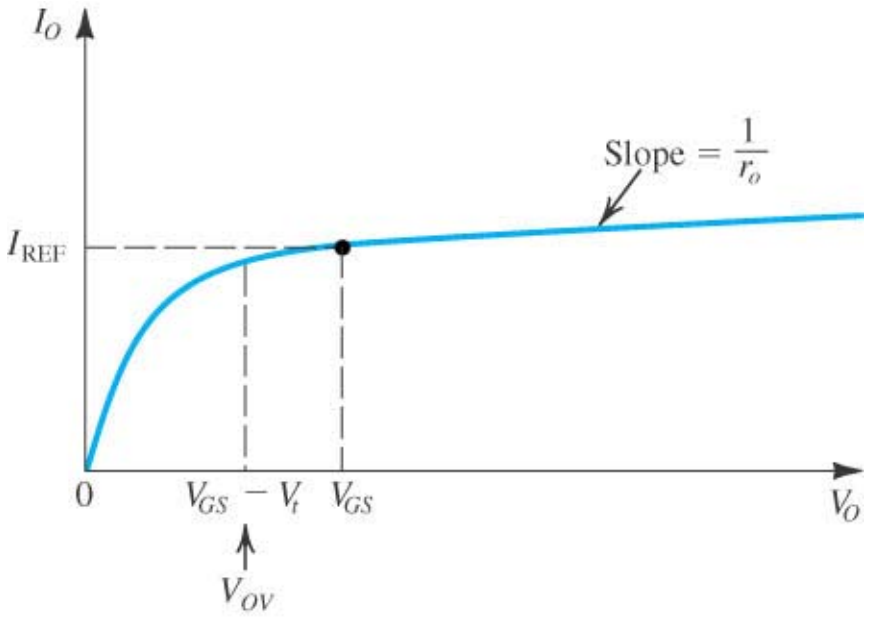
$$I_O = I_{D2} = \frac{1}{2} k_n' \left(\frac{W}{L}\right)_2 (V_{GS} - V_t)^2$$

$$\frac{I_O}{I_{REF}} = \frac{(W/L)_2}{(W/L)_1}$$

Limitation on V_o? $\quad V_O \geq V_{GS} - V_{tn}$

Lect. 8: Current Source and Active Load

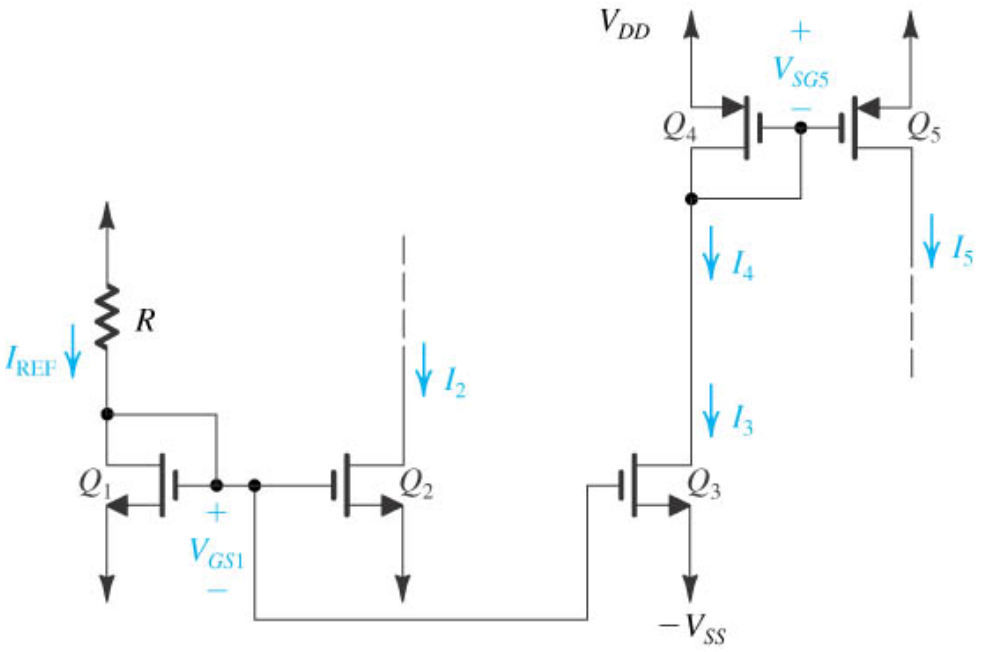
Mismatches between I_{REF} and I_O



Channel-length modulation

$$I_O = I_{REF} + \frac{V_O - V_{GS}}{r_0} \simeq I_{REF} + \frac{V_O}{r_0}$$

Circuit Model



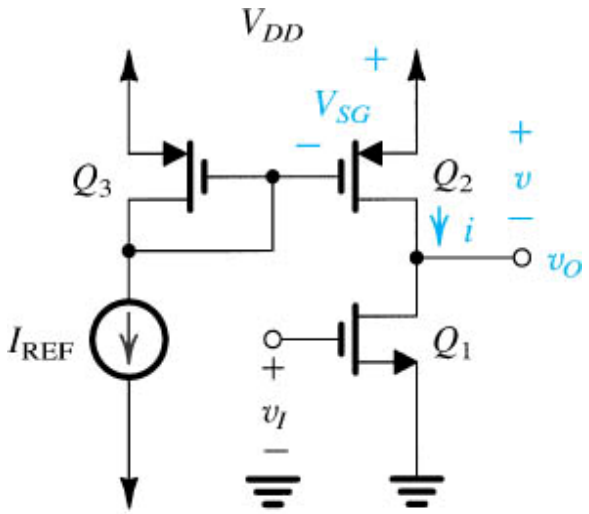
$$I_2 = I_{REF}\frac{(W/L)_2}{(W/L)_1}$$

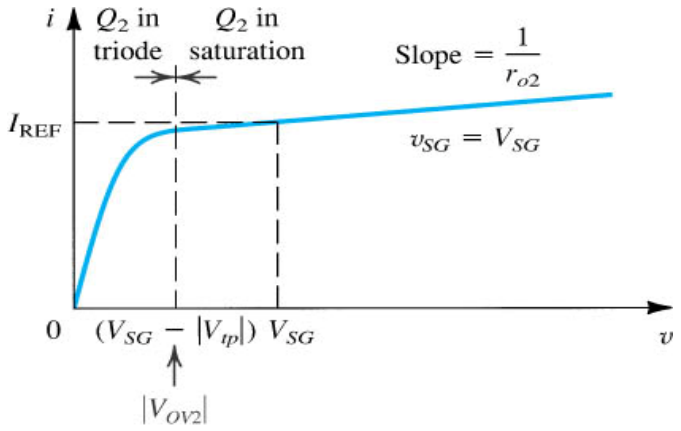
$$I_3 = I_{REF}\frac{(W/L)_3}{(W/L)_1}$$

$$I_5 = I_4\frac{(W/L)_5}{(W/L)_4}$$

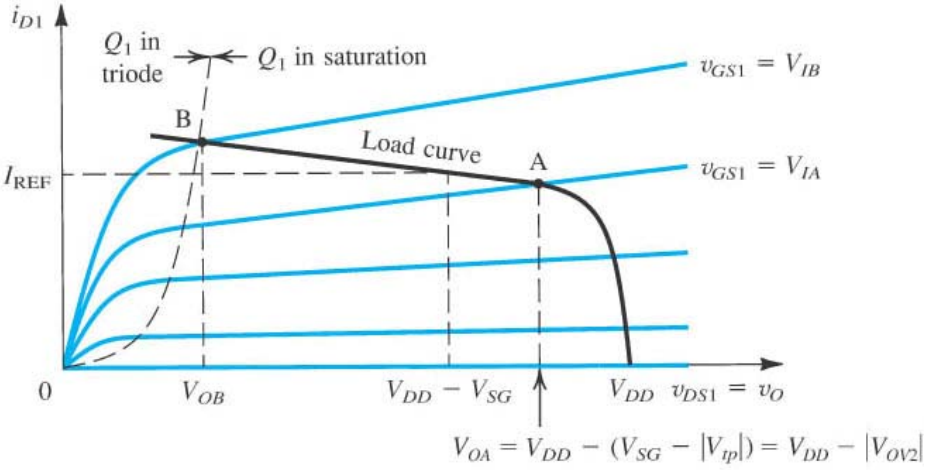
Lect. 8: Current Source and Active Load

CS amplifier with an active load





$v = V_{DD} - v_o$



Large change in v_O with v_I change!

Effective Load: r_{o2}

A_{vo}: $-g_m (r_{o1} \| r_{o2})$