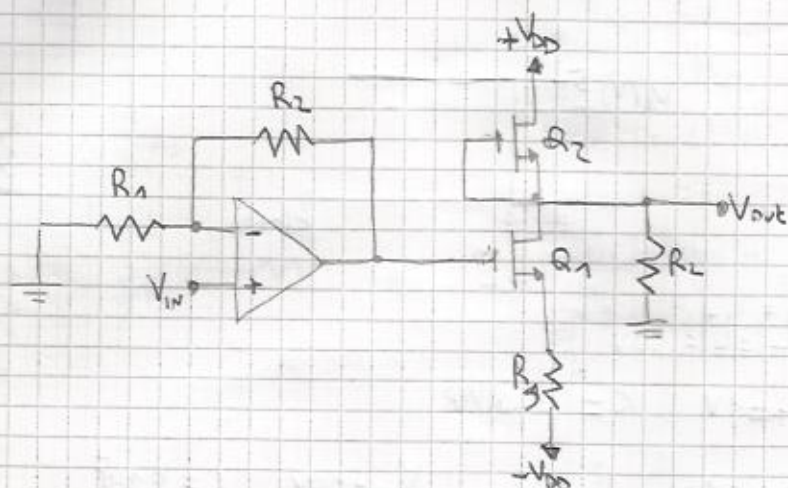


02/06/2011

$$L^+ = L^- = 10V$$



$$Q_1: V_T = 1V \quad K_1 = 0,5 \text{ mA/V}^2$$

$$Q_2: V_T = -2V \quad K_2 = 0,5 \text{ mA/V}^2$$

$$V_{DD} = 5V \quad R_1 = 2 \text{ k}\Omega$$

$$R_2 = 10 \text{ k}\Omega \quad R_3 = 15 \text{ k}\Omega$$

a) Com  $V_{in} = 0V$  calcule  $R_3$  im modo que  $V_{out} = 0V$

$$Q_2: V_{GS2} > V_T \Rightarrow 0 > -2 \text{ ok}$$

$$I_D = K (V_{GS} - V_T)^2 = \frac{1}{2} (-2)^2 \Rightarrow I_D = 2 \text{ mA}$$

$$V_{DD} = V_{DS2} - V_{GS1} + I_D R_3 - V_{DD}$$

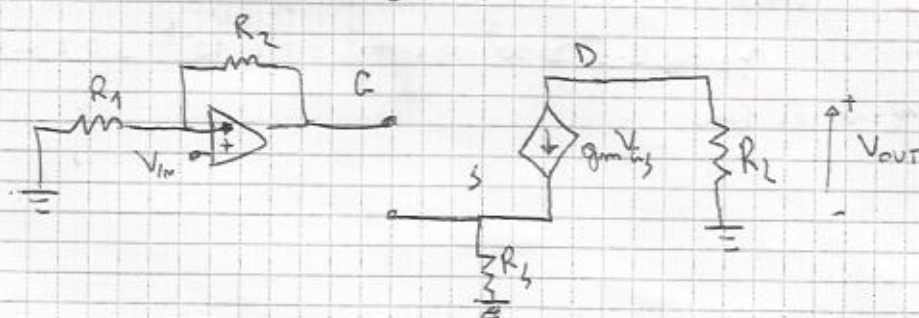
$$\begin{cases} V_{GS1} = V_{GS2} - V_{GS1} \\ I_D = K (V_{GS} - V_T)^2 \end{cases} \Rightarrow \begin{cases} V_{GS} = -I_D R_3 + V_{DD} \\ 2 = 0,5 (V_{GS} - 1)^2 \end{cases} \Rightarrow \begin{cases} 4 = (-2R_3 + 5 - 1)^2 \end{cases}$$

$$\Rightarrow 4 = 4R_3^2 + 16 - 16R_3 \Rightarrow 4R_3^2 - 16R_3 + 12 = 0 \Rightarrow R_3^2 - 4R_3 + 3 = 0 \Rightarrow \frac{2 \pm \sqrt{4 - 3}}{1} = 1$$

b) Com  $R_3$ , calcule  $A_v = \frac{V_{out}}{V_{in}}$

$$(-(-V_{DD} - R_3 I_D))$$

$$g_m = 2K (V_{GS} - V_T) = 2 \cdot \frac{4}{2} (-1)$$



$$V_{out} = -g_m V_{GS} R_2$$