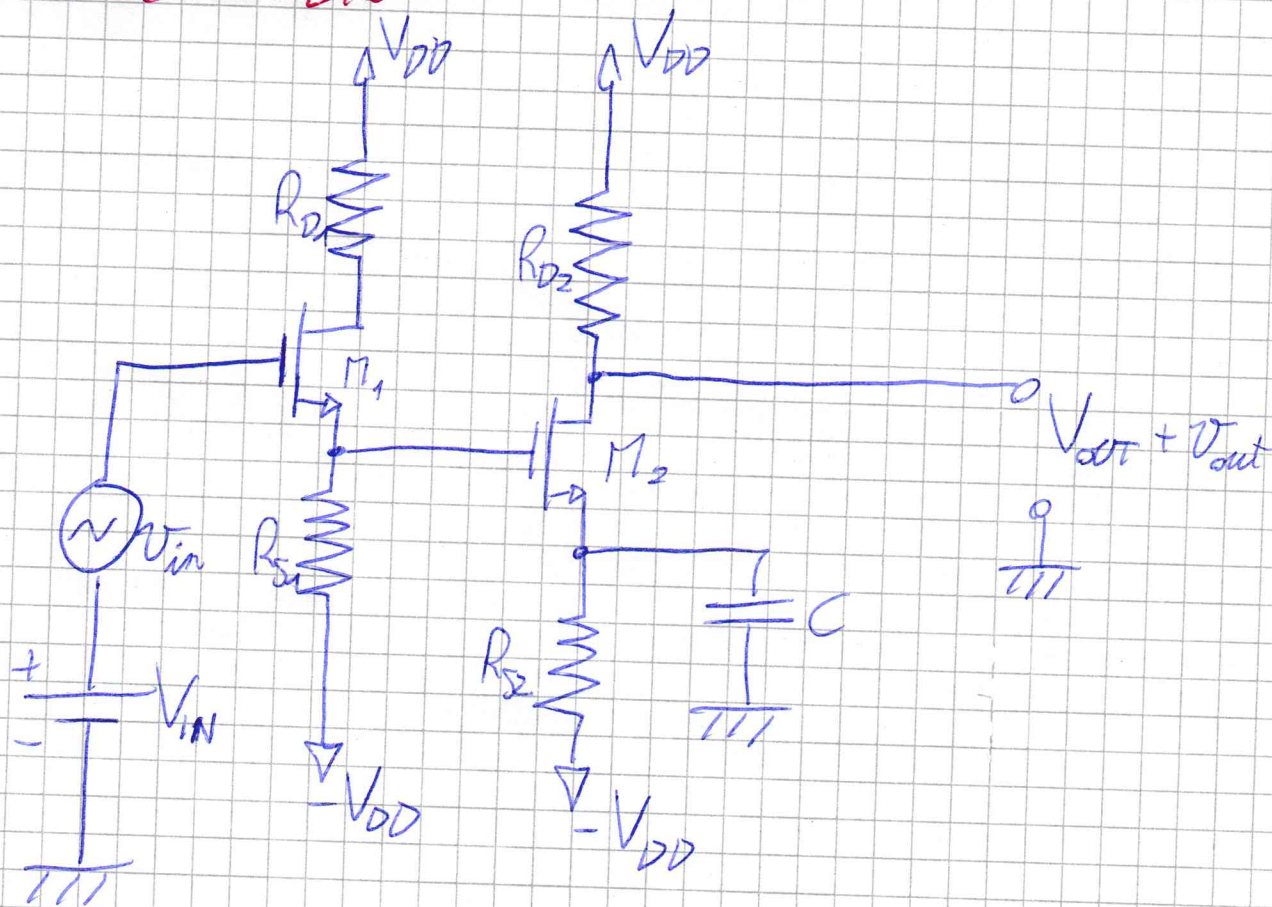


Esercizio



$$M_1 = M_2 = \left\{ V_t = 1V; K = 0,5 \frac{mA}{V^2}; \lambda = 0 \right\}$$

$$V_{DD} = 5V$$

$$V_{in} = 2V$$

$$R_{D2} = 2,5k\Omega$$

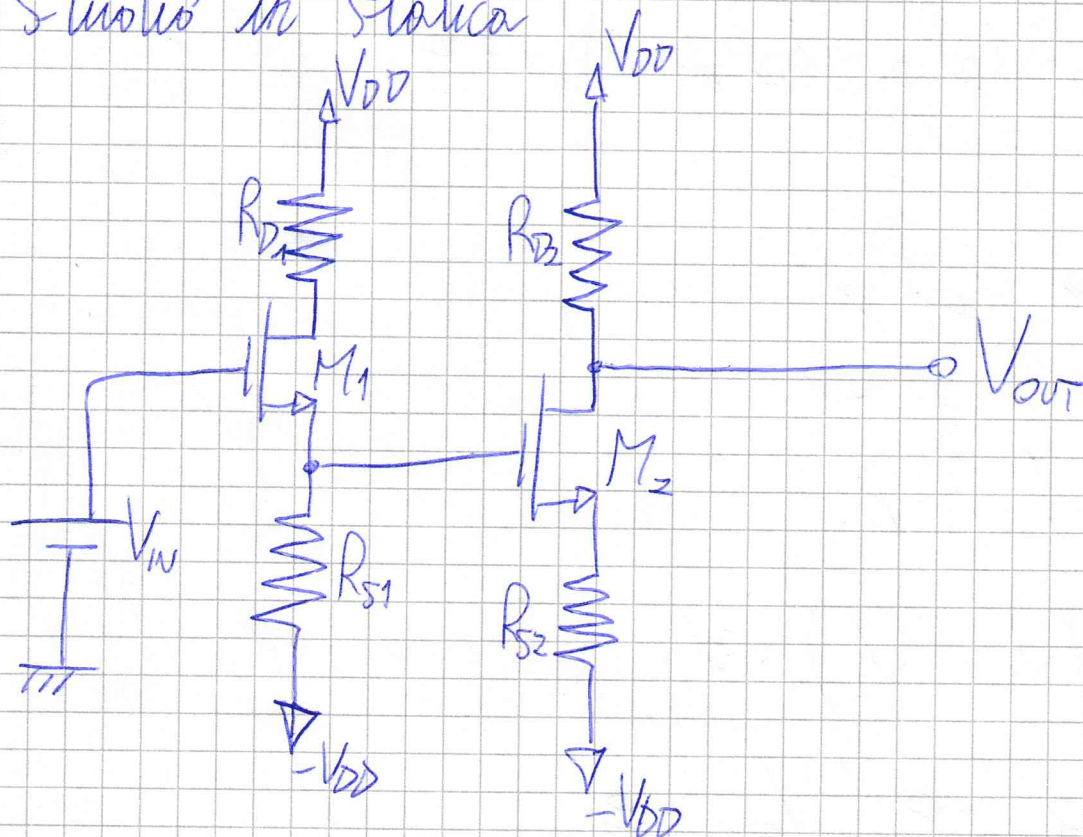
$$R_{S2} = 0,5k\Omega$$

$$C = \infty$$

Determina

- R_{S1} e R_{D1} tali che $g_{m1} = 2 \frac{mA}{V}$ e $V_{DS1} = 4V$
- V_{out} in continua
- $A = \frac{V_{out}}{V_{in}}$

studio in statica



$$V_{G1} = V_{IN} = 2V$$

$$V_{GS1} = V_{G1} - i_{D1}R_{S1} + V_{DD} > V_t = 1V$$

$$i_{D1} = K(V_{GS1} - V_t)^2$$

$$V_{GS1} = 7 - \frac{1}{2}R_S(V_{GS1} - 1)^2$$

$$V_{GS1} - 7 = -\frac{1}{2}R_S(V_{GS1} - 1)^2$$

$$V_{DS1} = V_{DD} - i_{D1}R_{D1} - i_{D1}R_{S1} + V_{DD} = 4V$$

~~scribbled out text~~

$$10 - i_{D1}R_{D1} - i_{D1}R_{S1} = 4$$

$$-i_{D1}(R_{D1} + R_{S1}) = -6$$

$$i_{D1}(R_{D1} + R_{S1}) = 6$$

$$g_{m1} = 2K(V_{GS1} - V_t) = 2$$

$$V_{GS1} - 1 = 2 \rightarrow$$

$$V_{GS1} = 3$$

$$V_{GS1} = 7 - \frac{1}{2}R_S(V_{GS1} - 1)^2$$

$$3 = 7 - \frac{1}{2}R_S(2)^2$$

$$-2R_S + 7 - 3 = 0$$

$$-2R_S = -4$$

$$R_S = 2k\Omega$$

$$i_{D1} = K(V_{GS1} - V_t)^2 = \frac{1}{2}(3 - 1)^2 = 2mA$$

$$2(R_{D1} + 2) = 6$$

$$R_{D1} + 2 = 3$$

$$R_{D1} = 1k\Omega$$

$$V_{G2} = V_{S1} = V_{G1} - V_{GS1} = 2 - 3 = -1V$$

$$\begin{cases} V_{GS2} = V_{G2} - i_{D2} R_{S2} + V_{DD} = -1 + 5 - \frac{1}{2} i_{D2} \\ i_{D2} = K(V_{GS2} - V_t)^2 \end{cases}$$

$$V_{GS2} = 4 - \frac{1}{4} (V_{GS2} - 1)^2$$

$$V_{GS2} - 4 = -\frac{1}{4} (V_{GS2} - 1)^2$$

$$16 - 4V_{GS2} = V_{GS2}^2 - 2V_{GS2} + 1$$

$$V_{GS2}^2 + 2V_{GS2} - 15 = 0$$

$$\Delta = 4 + 60 = 64$$

$$V_{GS2} = \frac{-2 \pm 8}{2} = \begin{cases} +3V > V_t = 1V \\ -5V < V_t = 1V \end{cases}$$

$$V_{GS2} = 3V$$

$$i_{D2} = \frac{1}{2} (3 - 1)^2 = 2mA$$

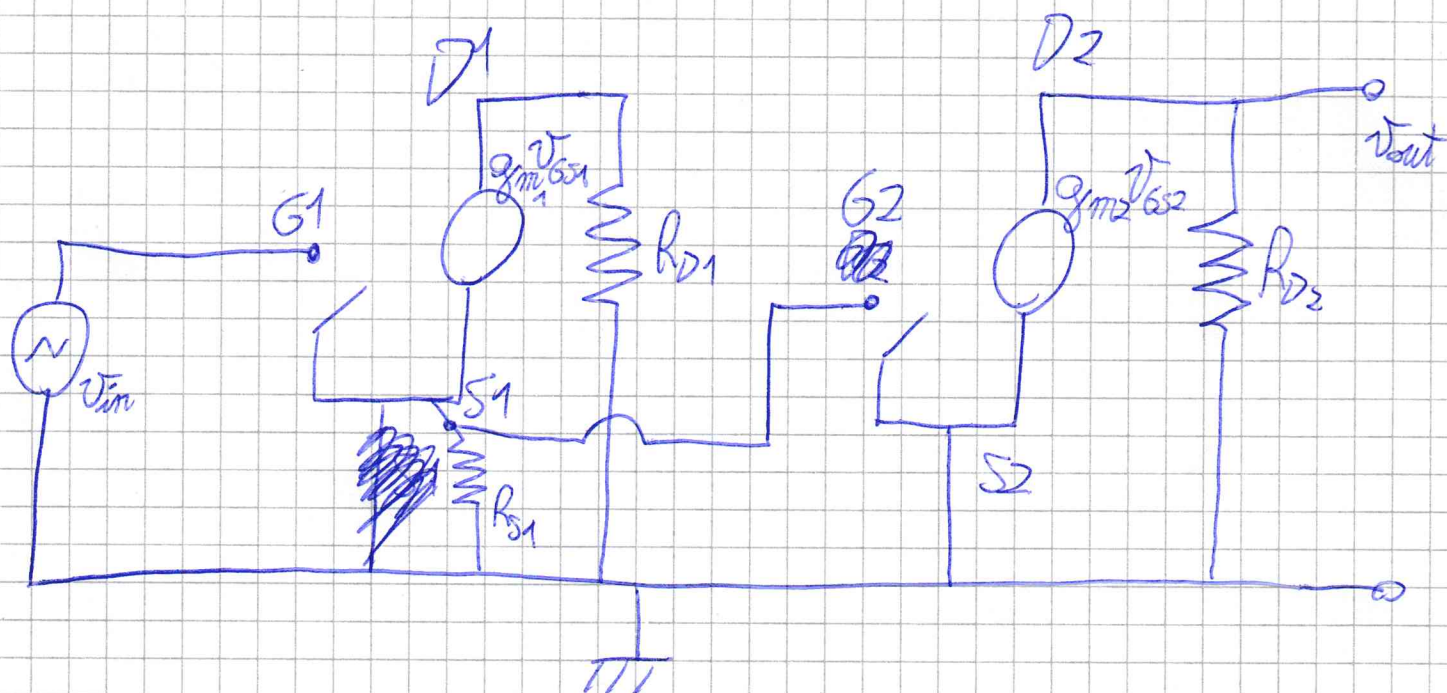
$$V_{DS2} = V_{DD} - i_{D2} R_{D2} - i_{D2} R_{S2} + V_{DD} = 10 - 5 - 1 = 4V$$

$$V_{DS2} = 4V > V_{GS2} - V_t = 3 - 1 = 2V$$

M_2 in saturazione

$$\underline{V_{out} = V_{D2} = V_{DD} - i_{D2} R_{D2} = 5 - 5 = 0V}$$

studio per piccoli segnali



$$g_{m1} = 2 \frac{mA}{V} \quad v_{GS1} = v_{in}$$

$$v_{out1} = g_{m1} R_{S1} v_{in} = 4 v_{in} = v_{G2} = v_{GS2}$$

$$g_{m2} = 2K(V_{GS2} - V_t) = 2 \frac{mA}{V}$$

$$v_{out} = g_{m2} R_{D2} v_{GS2} = g_{m2} R_{D2} 4 v_{in} = 20 v_{in}$$

$$A = \frac{v_{out}}{v_{in}} = 20$$