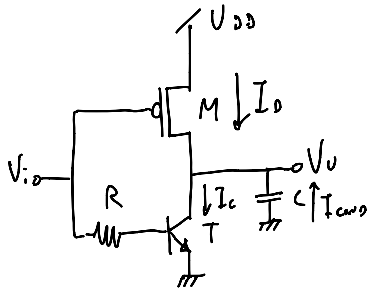


$V_\gamma = 0.75\,V$ $\quad V_{CESAT} = 0.2\,V$ $\quad C = 20\,pF$

$V_{DD} = 3.5\,V$ $\quad \beta_F = 100$

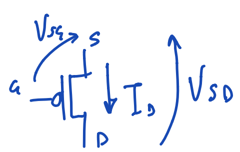
$\beta_P = 500\,\frac{\mu A}{V^2}$ $\quad V_{T_P} = -0.4\,V$ $\quad ? = R \,@\, t_{pHL} = 1\,ns$

→ chiede di dimensionare la resistenza tale per cui il tempo di propagazione sia 1 ns

→ c'è condensatore, analisi dinamica

→ considerazioni preliminari

p-MOS



OFF : $V_{SG} < |V_{TP}|$, $I_D = 0$

SAT: $V_{SD} > V_{SG} - |V_{TP}|$, $I_D = \frac{\beta_P}{2}\left(V_{SG} - |V_{TP}|\right)^2$

LIN : $V_{SD} < V_{SG} - |V_{TP}|$

$$I_D = \beta_P\left[\left(V_{SG} - |V_{TP}|\right)V_{SD} - \frac{V_{SD}^2}{2}\right]$$

→ dimensionare resistenza in base a transizione HIGH-LOW
→ trovare valori con analisi statica

- $V_i < V_\gamma \Rightarrow T = \text{OFF} \rightarrow I_C = 0 \rightarrow I_D = 0$ $\qquad I_C$ = COLLETTORE

ipotizzare se LIN o SAT

IPOTESI

H_P: M=LIN $\rightarrow I_{D_P} = \beta_P\left[\left(V_{SG} - |V_{TP}|\right)V_{SD} - \frac{V_{SD}^2}{2}\right] = 0$

$\rightarrow V_{SD} = 0$

ma $V_{SD} = V_{DD} - V_U \rightarrow V_U = V_{DD} = V_H \longrightarrow$ calcolato valore alto

VERIFICHIAMO IPOTESI LINEARITÀ

$V_{SD} < V_{SG} < |V_{TP}|$

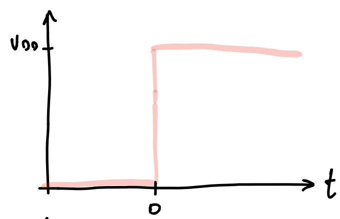
$0 < V_{DD} - V_\gamma < +0.4 \longrightarrow$ OK

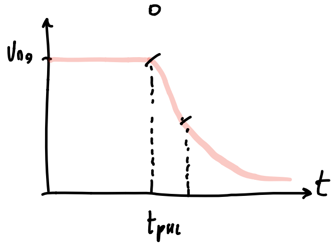
• $V_i = V_{DD} \rightarrow V_{SG} = 0 \rightarrow M = OFF \rightarrow I_{DS} = 0 \rightarrow I_C = 0$ ENTRATA ALTA (HIGH)

MA $V_{BE} > V_\gamma \rightarrow T = ON \rightarrow T = SAT$

$$\left[V_U = V_{CE\,sat} = V_L \right]$$

• TRANSIZIONE - COND. DINAMICHE $\rightarrow$ ANALISI CORRENTI





$V_i = V_{DD} \rightarrow M = OFF$

$V_{CE} \ @\ t = 0^+ = V_{DD} > V_{CE\,sat} \rightarrow T = LIN$

$V_{U\,50\%} = \frac{V_H + V_L}{2} = 1.85\,V > V_{CE\,sat} \rightarrow T = LIN$ PER TUTTO IL TRANSITORIO

$$\left.\begin{aligned} I_C &= \beta_F I_B = \beta_F \frac{V_{DD} - V_\gamma}{} \\ I_{COND} &= -C \frac{dV_U}{dt} \\ I_{COND} &= I_C \end{aligned}\right\} \quad dt = \frac{-RC}{\beta_F \cdot (V_{DD} - V_\gamma)} dV_U$$

$$\int_0^{t_{PHL}} dt = \int_{V_{DD}}^{V_{U\,50\%}} \frac{-RC}{\beta_F (V_{DD} - V_\gamma)} dV_U \longrightarrow t_{PHL} = \frac{-RC}{\beta_F (V_{DD} - V_\gamma)} \left(V_{U\,50\%} - V_{DD} \right)$$

$$= 1.2 \cdot 10^{13} R$$

MA $t_{PHL} = 10^{-9} \rightarrow R = 8.33\,k\Omega$