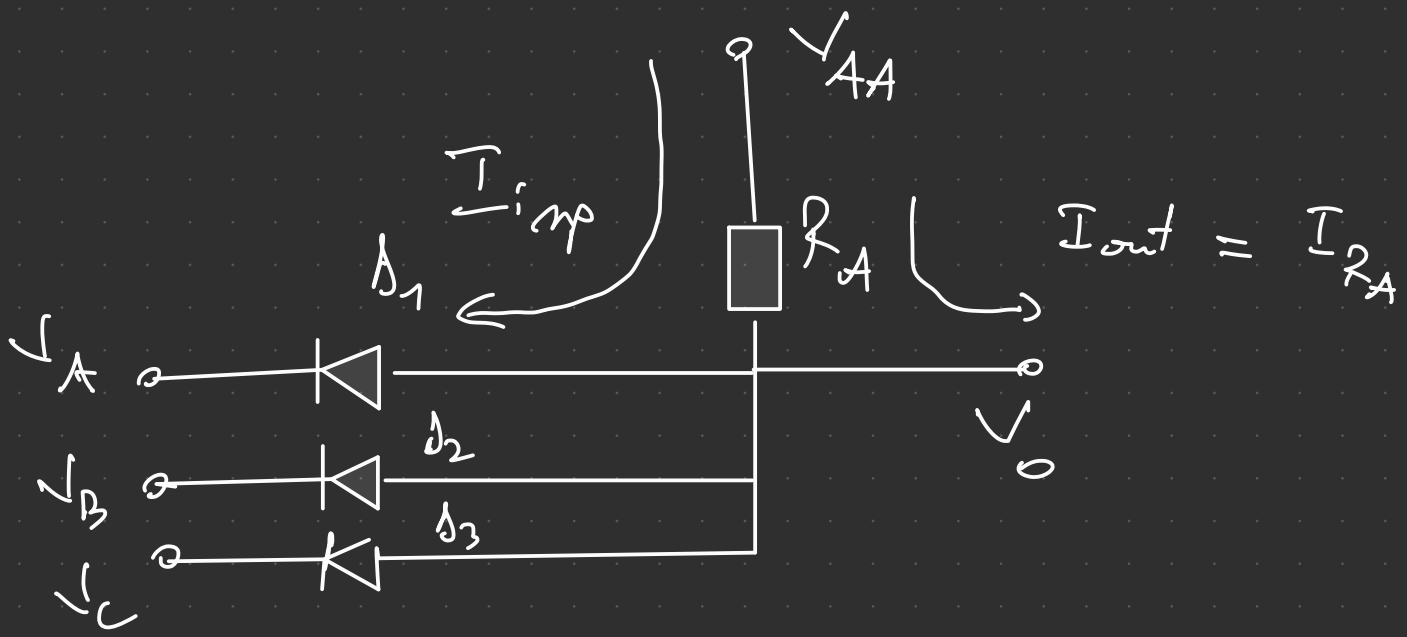
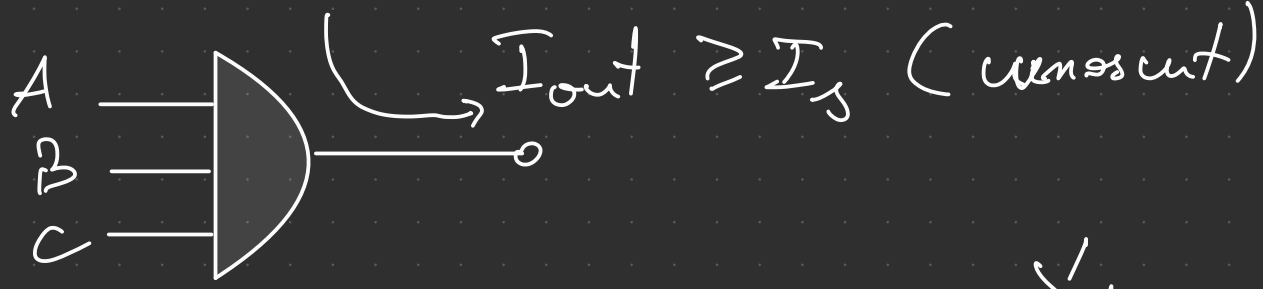
Funcționarea electronică a configurațiilor





$$I_{R_A} \geq I_S$$

$V_0 \begin{cases} V_H \\ V_L \end{cases}$

$$\frac{V_{AA} - V_0}{R_A} \geq I_S$$

MC Cmd

met. cazului celui mai defavorabil

$$V_0 = V_H \rightarrow \frac{V_{AA} - V_H}{R_A} \geq I_S$$

$$\rightarrow \boxed{R_A \leq \frac{V_{AA} - V_o}{I_S}}$$

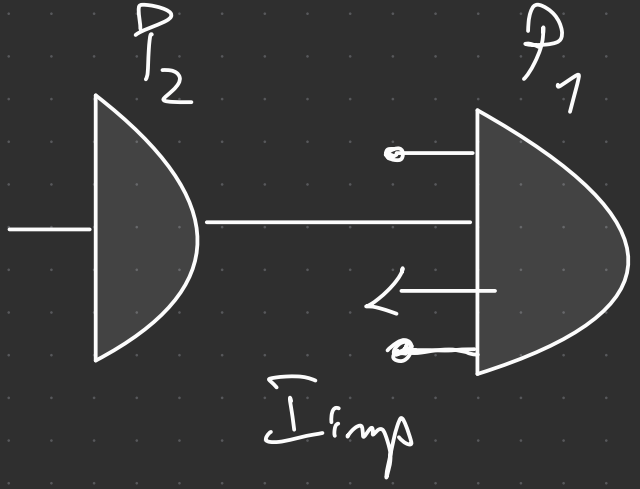
Tolerante: 1%, 5%, 10%

$$R_{A\,N(\text{nominale})} = (1 \pm t_n)$$

$t_n = 0{,}1$ (pt. 10%)

$t_n = 0{,}2$ (pt. 20%)

$$R_A \leq \frac{V_{AA_N}(1 - t_u) - V_H}{I_S(1 + t_n)}$$



$$I_{inp} = I_{R_A} + (n-1)\, I_0$$

n = nr. intrări

$\Rightarrow$ curent rezidual

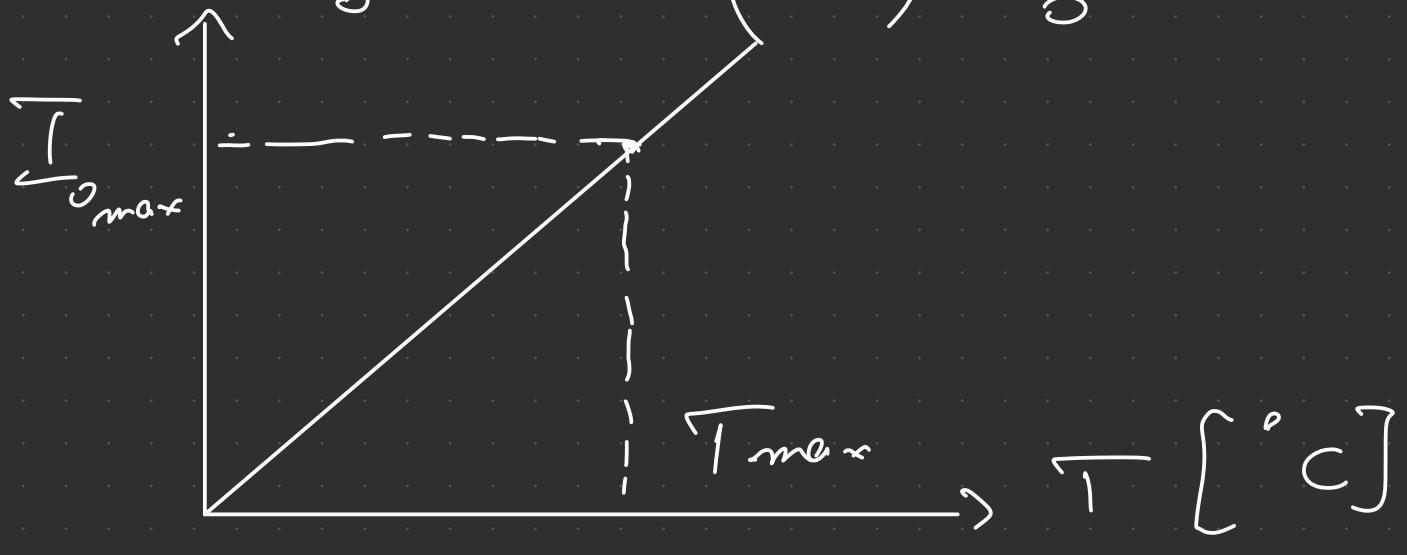
$$\frac{V_{AA} - V_0}{R_A} + (n-1)\, I_0$$

I_{inp} cu val. max (ccmd)

$\rightarrow V_0 = V_2$

$$I_{inp\ max} = \frac{V_{AA_N}(1+t_u) - V_2}{R_{A_N}(1-t_2)}$$

$$I_0 + (n-1)\, I_0$$



$$E = \frac{I_{out}}{I_{imp}} = \frac{\frac{V_{AA} - V_H}{R_A}}{\frac{V_{AA} - V_L}{R_A} + (n-1) I_0} \leq 1$$

a) $I_{imp} > I_{out}$

b) V_T neglijata

TRANZISTOR

Circuit de amplificare și refacere a nivelelor logice

$V_L = 0\ V$ $\quad V_0 = ?$

$V_H = 5\ V$

$R_d = 20\ \Omega$

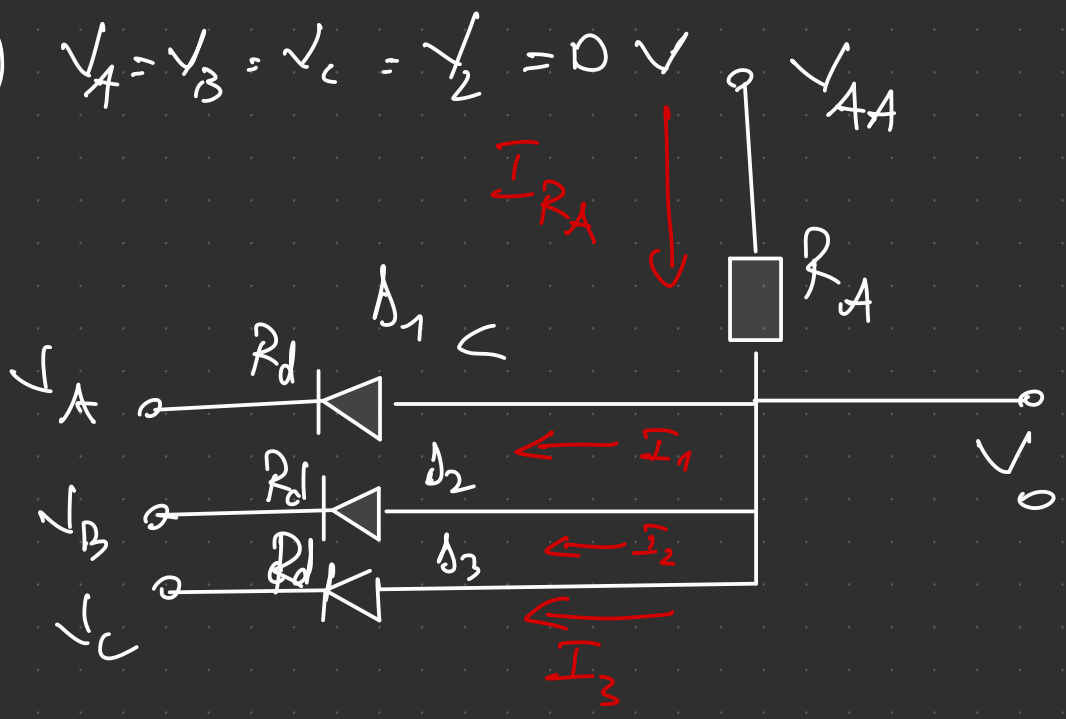
$R_i \to \infty$

$I_0 = 0$

$V_{AA} = 10\ V$

$R_A = 3{,}6\ K\Omega$

a) $V_A = V_B = V_C = V_L = 0\ V$



$$I_{R_A} = I_1 + I_2 + I_3$$

$$I_{R_A} = \frac{V_{AA} - V_o}{R_A}$$

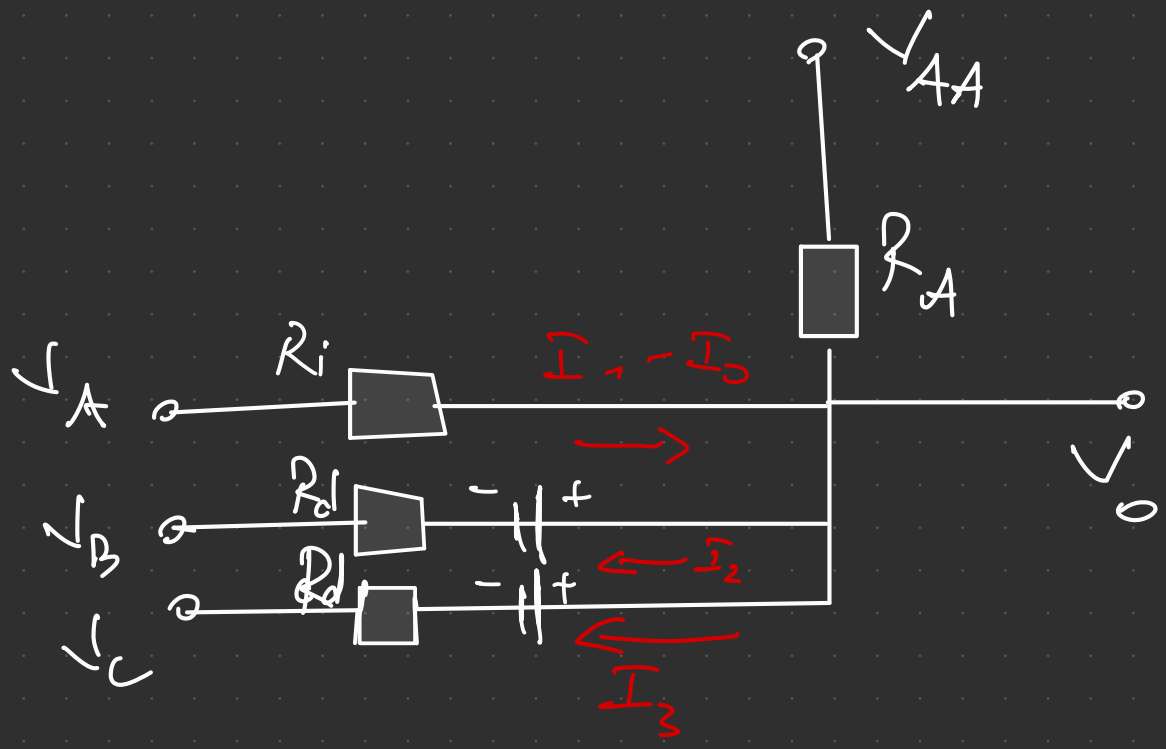
$$V_A = V_B = V_C = V_L = 0$$

$$\begin{cases} I_1 = \dfrac{V_o - V_f - V_A}{R_d} \\ I_2 = \dfrac{V_o - V_f - V_B}{R_d} \\ I_3 = \dfrac{V_o - V_f - V_C}{R_d} \end{cases}$$

$$\frac{V_{AA} - V_o}{R_A} = 3\left(\frac{V_o - V_f}{R_d}\right) \longrightarrow V_o \sim 9{,}618\ V$$

b) $V_A = V_B = V_C = V_H = 5\,V \rightarrow V_0 = 5{,}62\,V$

c) $V_A = V_H$, $V_B = V_C = V_2 \rightarrow V_0 =$



$$I_{R_A} = I_2 + I_3 - I_1 = 0$$

$$I_{R_A} = \frac{V_{AA} - V_0}{R_A} = \frac{V_0 - V_T - V_B}{R_d} + \frac{V_A - V_T - V_C}{R_d}$$

$$\rightarrow V_0 = 0{,}626\,V$$

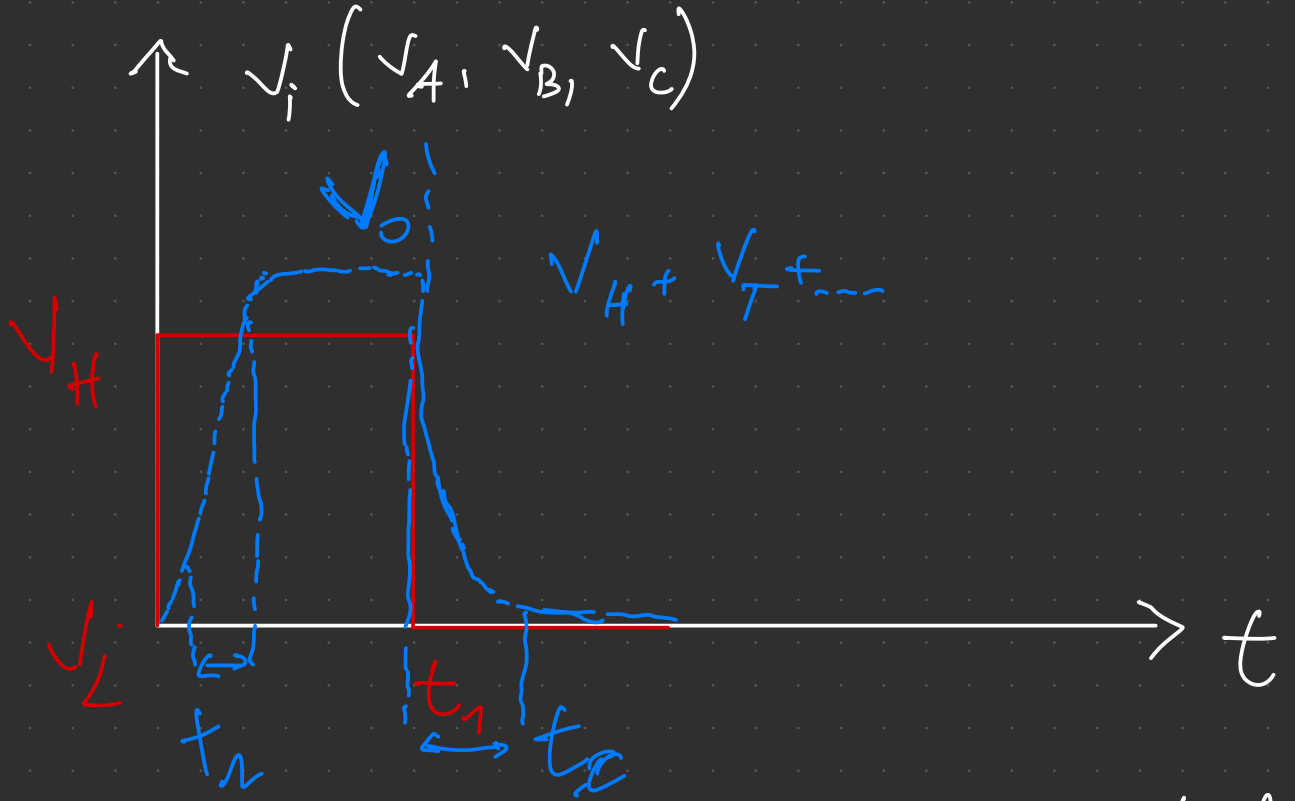
d) $V_A = V_B = V_H$; $V_C = V_2$

S_3 cond. D_1, D_2 bl.

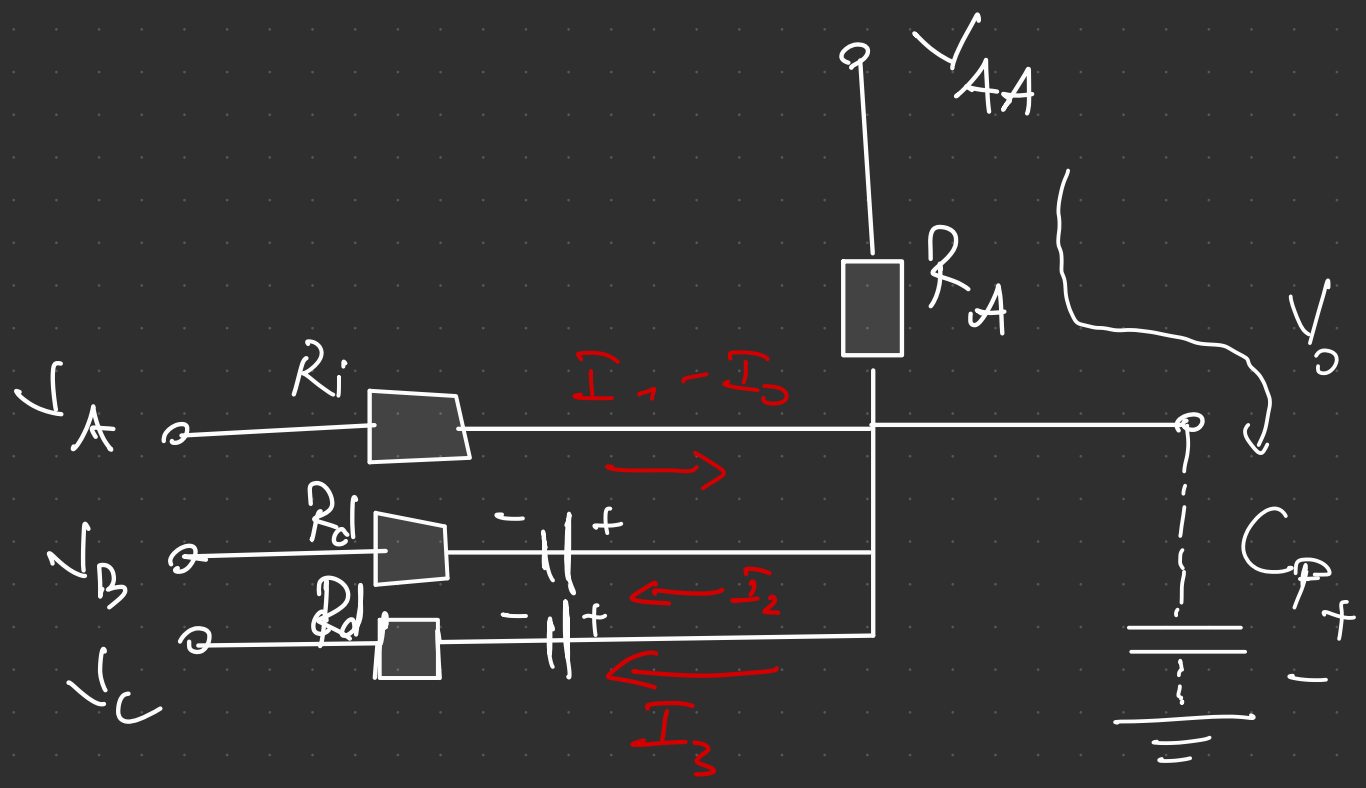
$V_0 = V_2 + V_T + \dots$ $I_1 = 0$ $I_2 = 0$

$I_{R_A} = I_C$

$$\rightarrow \frac{V_{AA} - V_0}{R_A} = \frac{V_0 - V_T - V_C''}{R_d} \qquad V_0 \sim 0{,}658V$$



Circuitul trebuie să fie însoțit de un dispozitiv (tranzistor)



$$C_p = C_{out} + \sum C_{inp} + C_{fin}$$

$$t_1 = RC \ln \frac{V_{AA} - V_2}{V_{AA} - V_H} = \frac{V_{AA} - 9{,}1\,V}{V_{AA} - 9{,}9\,V}$$

$$V = V_H - V_2$$

$R_A = 4\,k$

$C_p = 50\,pF$

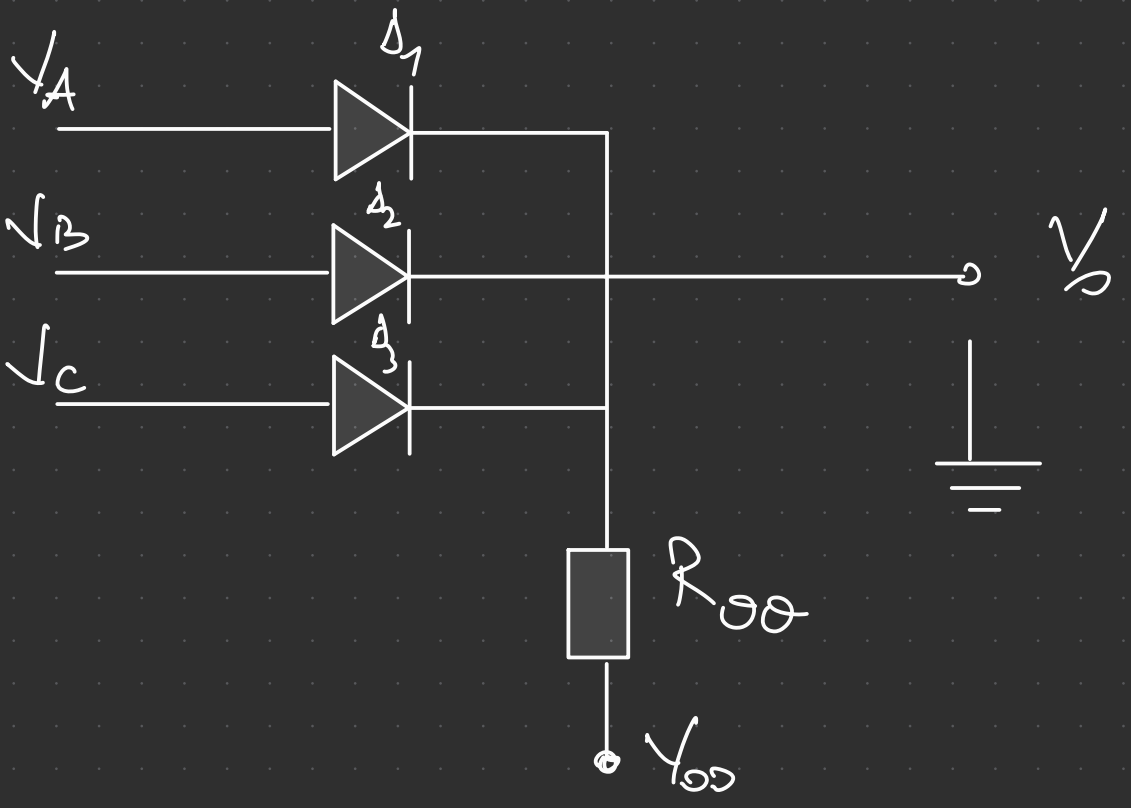
$V_{AA} = 10\,V$

$V_H = 5\,V$, $V_2 = 0\,V$

$$t_1 = 4 \cdot 10^3 \cdot 50 \cdot 10^{-12} \ln\left(\frac{10 - 9{,}5}{10 - 4{,}5}\right) = 100\,ns$$

$$t_c = R_d C_p \ln \frac{V_2 - 9{,}4}{V_2 - 9{,}1\,V}$$

Poarta SAU cu diode



$|V_{00}| > V_H > V_L$ ex $V_{00} = -10V$, $V_H = 5V$, $V_L = 0V$

(A) F. logică

→ dacă $V_A = V_B = V_C = V_L$

D_1, D_2, D_3 → pol. direct → conduc deoarece $V_L > V_{00}$

$V_0 = V_L - V_T$

b) $V_A = V_B = V_C = V_H$

D_1, D_2, D_3 → pol. direct $V_H > V_{on}$

→ conduc

$V_0 = V_H - V_T$

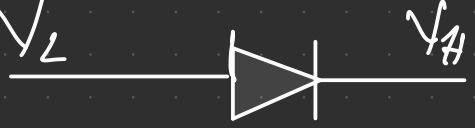
c) Dacă la cel puțin o intrare avem V_H

⟹ dioda coresp. conduce. ex. $V_A = V_H$

$V_B = V_C = V_L$

D_1 conduce → $V_0 = V_H - V_T$

D_2, D_3 sunt bl. (polarizate invers)



(B) Funcționarea electronică

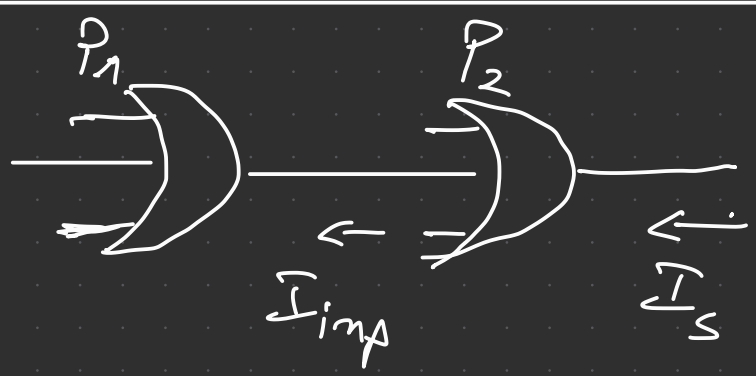
← I_S (curent)

$$I_{R_{00}} \geq I_S$$

$$I_{R_{00}} = \frac{V_0 - (-V_{00})}{R_{00}} \geq I_S$$

$$V_0 < \begin{matrix} V_H \\ V_L \end{matrix}$$

$$R_{00} \leq \frac{V_L + V_{00}}{I_S}$$



$I_{imp} > I_{R_{00}}$ ccmd (n-1) diode sunt bl.

$$I_{imp} = \frac{V_H - V_{00}}{R_{00}} + (n-1)\, I_0$$

$I_{imp\ max} \longleftrightarrow V_0 = V_H$

$$I_{Impmax} = \frac{V_H + V_{00}}{R_{00}} + (n-1) I_0$$

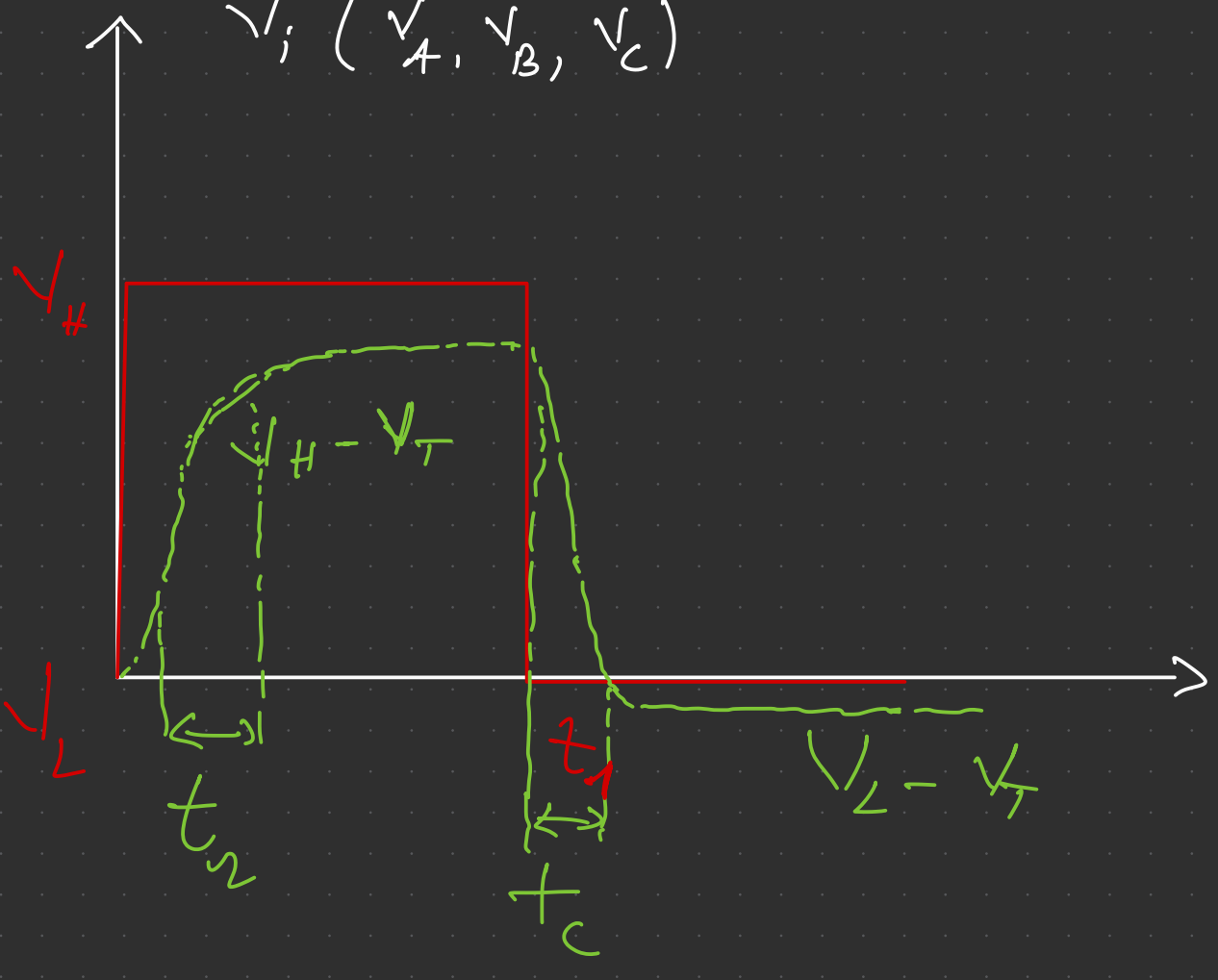
$$E = \frac{I_{out}}{I_{inp}}$$

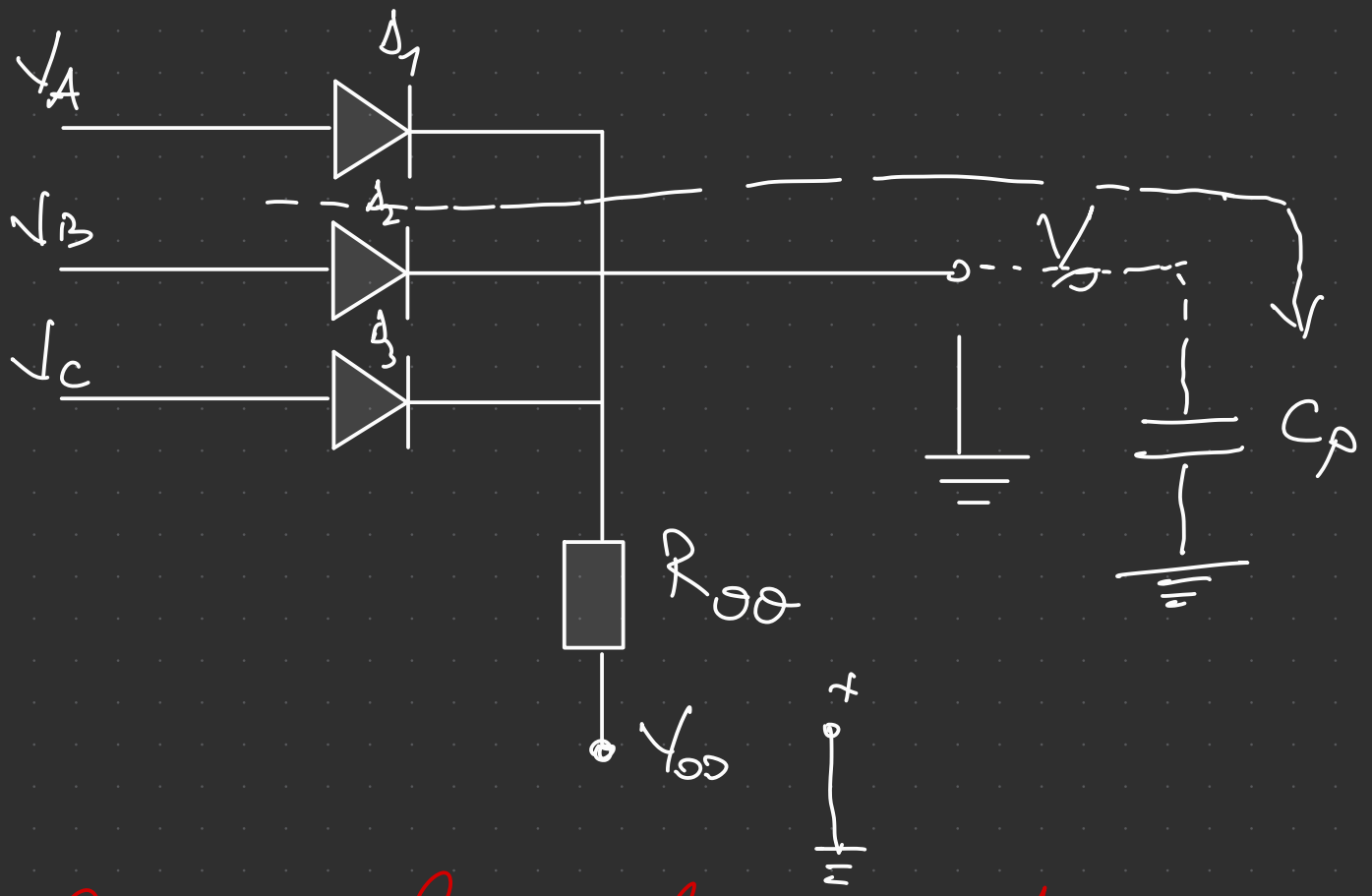
$$F = A + B + C$$

$$E = \frac{\frac{V_L + V_{DD}}{R_{DD}}}{\frac{V_H + V_{DD}}{R_{DD}} + (n-1) I_D} < 1$$

a) $I_{out} < I_{inp}$ [realitate $I_{out} > I_{inp}$]

b) $V_D < \begin{matrix} V_H - V_T \\ V_L - V_T \end{matrix}$





C_p se plasează la ieșirea porții (cel mai catastrofal efect)

$$t_1 = R_d C_p \ln \frac{V_H - 0{,}1U}{V_H - 0{,}9U}$$

încărcare cap.

$$t_c = R_{00} C_p \ln \frac{V_{00} - 0{,}9U}{V_{00} - 0{,}1U}$$

desc. cap.

$V_H = 5V$

$V_L = 0V$

$V_{DD} = 10V$

$R_{ON} = 20\ \Omega$

$R_{OFF} = 4k\ \Omega$

$C_p = 50pF$

$$t_r = 20 \cdot 50 \cdot 10^{-12} \ln \frac{5 - 0,5}{5 - 4,5} \approx 2,3ns$$

$$t_c = 4000 \cdot 50 \cdot 10^{-12} \underbrace{\ln - \frac{10 - 4,5}{10 - 0,5}}_{5} = 100ns$$