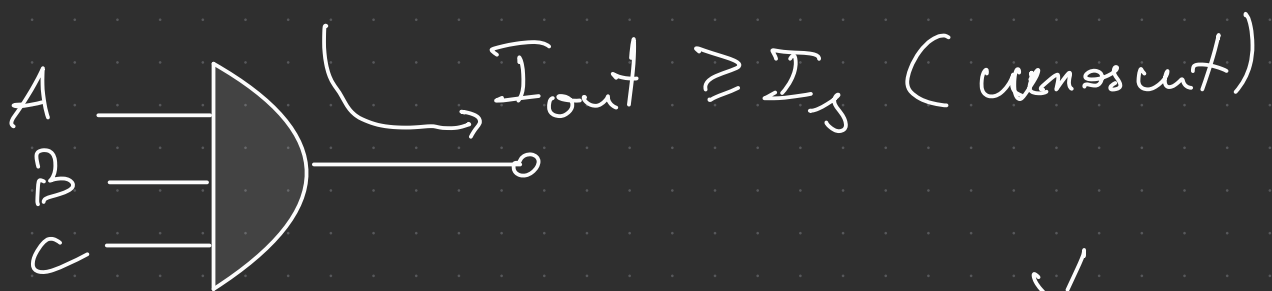
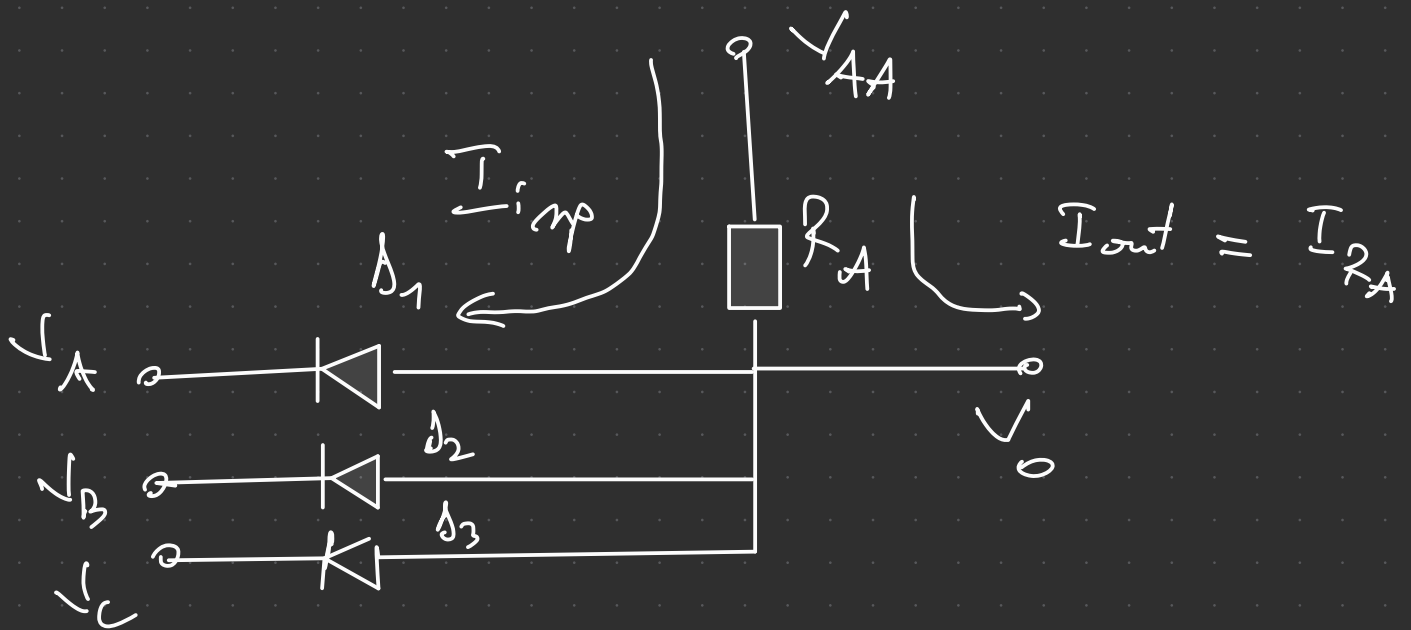


Funcționarea electronică a configurărilor



$$I_{R_A} \geq I_s$$

$$\frac{V_{AA} - V_O}{R_A} \geq I_s$$



mccmd

met. cașului celui mai defavorabil

$$V_O \neq V_H \rightarrow \frac{V_{AA} - V_H}{R_A} \geq I_s$$

$$\rightarrow R_A \leq \frac{V_{AA} - V_0}{I_S}$$

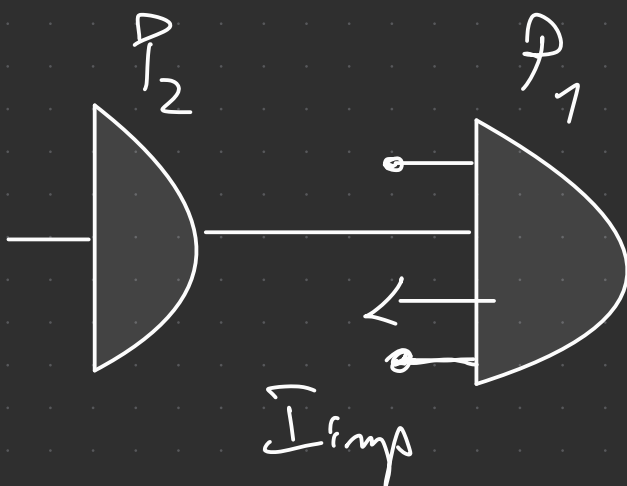
Tolerante: 1%, 5%, 10%

$$R_{A \text{ N(minimal)}} = (1 \pm t_u)$$

$$t_u = 0,1 \text{ (pt. 10\%)}$$

$$t_u = 0,2 \text{ (pt. 20\%)}$$

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



$$I_{imp} = I_{R_A} + (n-1) I_o$$

$n = \text{m. intrari}$

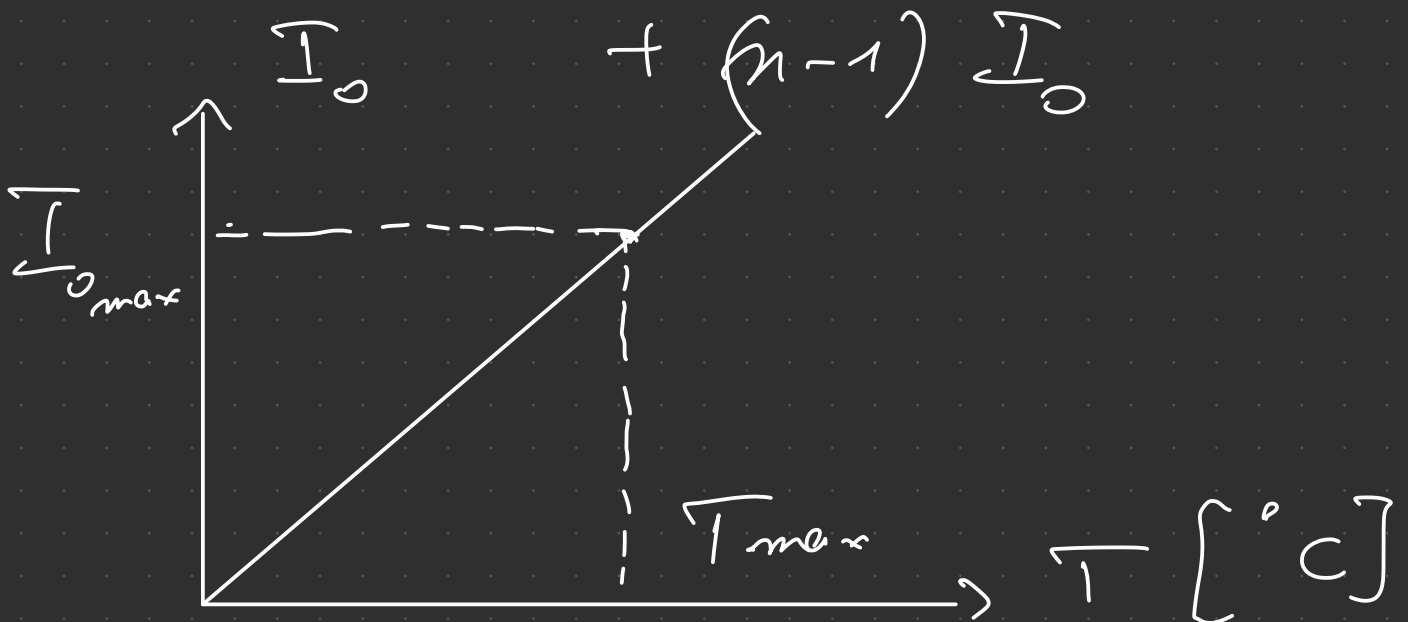
\Rightarrow current residual

$$\frac{V_{AA} - V_o}{R_A} + (n-1) I_o$$

I_{imp} cu val. max (ccmd)

$$\rightarrow V_o = V_L$$

$$I_{imp \max} = \frac{V_{AA_N} (1 + t_u) - V_L}{R_{A_N} (1 - t_u)}$$



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

- a) $I_{inp} > I_{out}$
 b) V_T neglijat

TRANZISTOR



Circuit de amplificare
 și refacere a nivelului logice

$$V_L = 0 \text{ V}$$

$$V_O = ?$$

$$V_H = 5 \text{ V}$$

$$R_d = 20 \text{ } \Omega$$

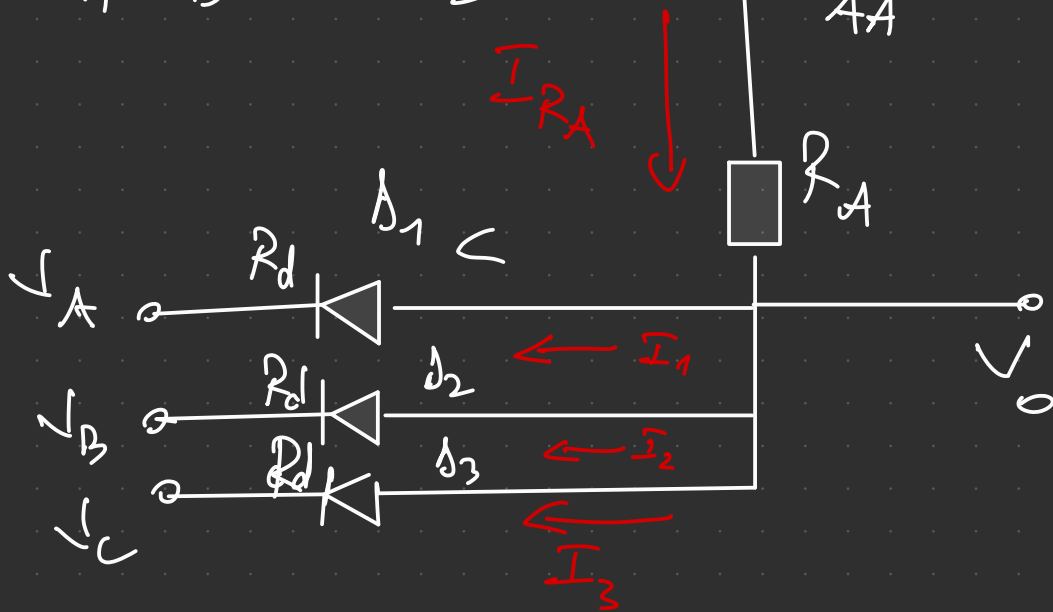
$$R_i \rightarrow \infty$$

$$I_0 = 0$$

$$V_{AA} = 10 \text{ V}$$

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

a) $V_A = V_B = V_C = V_L = 0 \text{ V}$



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

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

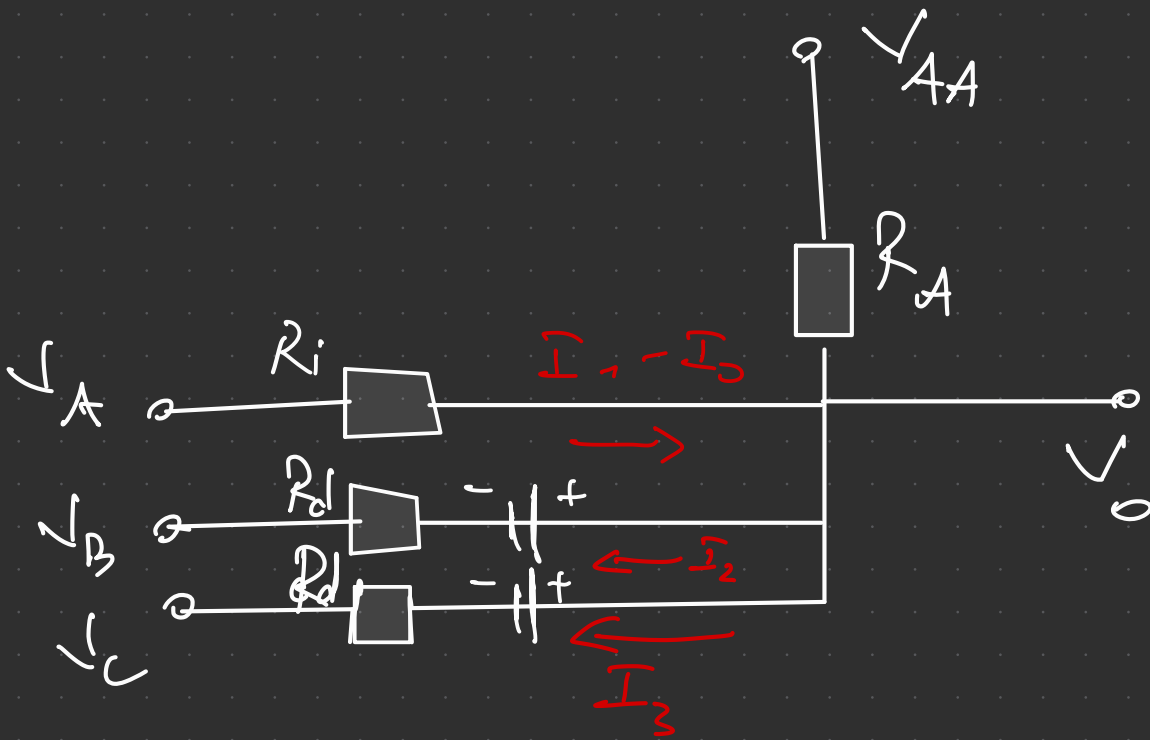
$$V_A = V_B = V_C = V_L = 0$$

$$\begin{cases} I_1 = \frac{V_o - \frac{V}{T} - V_A}{R_d} \\ I_2 = \frac{V_o - \frac{V}{T} - V_B}{R_d} \\ I_3 = \frac{V_o - \frac{V}{T} - V_C}{R_d} \end{cases}$$

$$\frac{V_{AA} - V_o}{R_A} = 3 \left(\frac{V_o - \frac{V}{T}}{R_d} \right) \rightarrow V_o \sim 0,618 \text{ V}$$

$$b) \quad V_A = V_B = V_C = V_H = 5V \rightarrow V_O = 5,62V$$

$$c) \quad V_A = V_H, \quad V_B = V_C = V_L \rightarrow V_O =$$



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

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

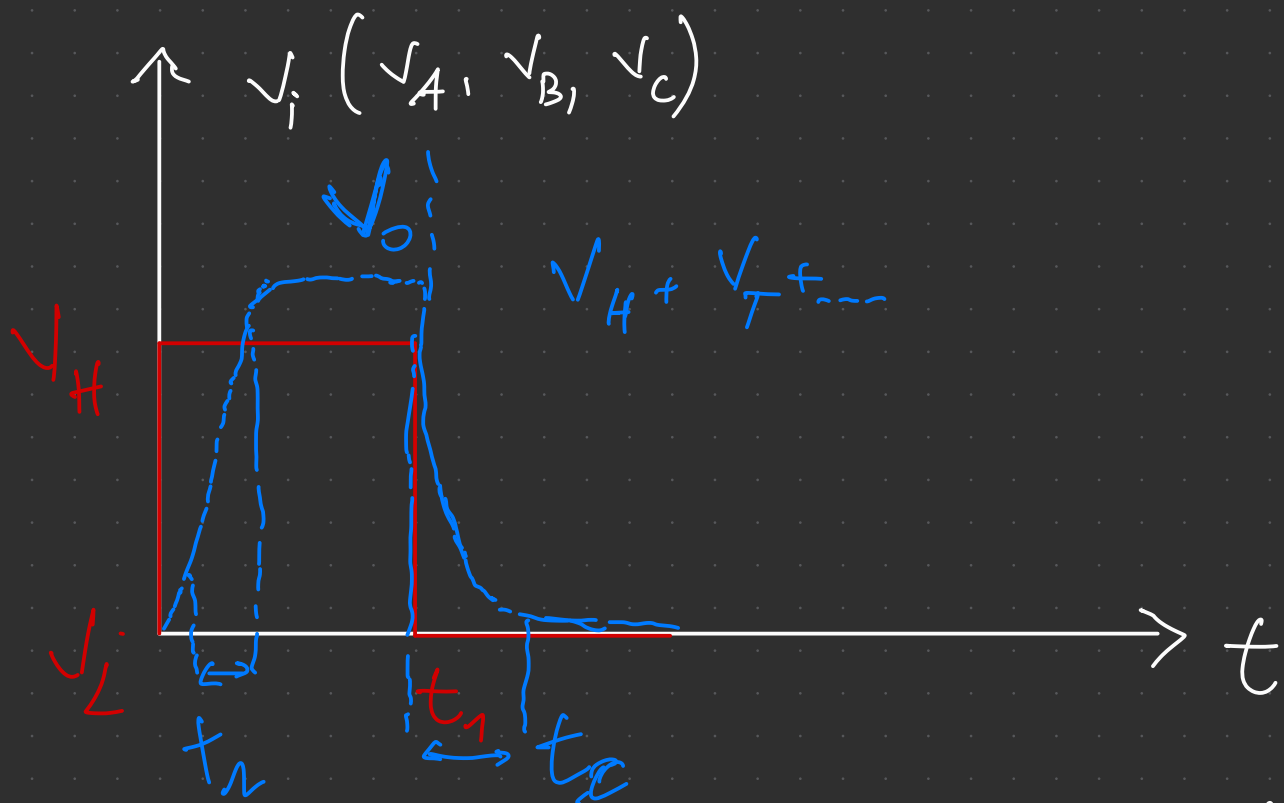
$$\rightarrow V_O = 0,628V$$

d) $V_A = V_B = V_H$; $V_C = \frac{V}{2}$
 I_3 cond. I_1, I_2 bl.

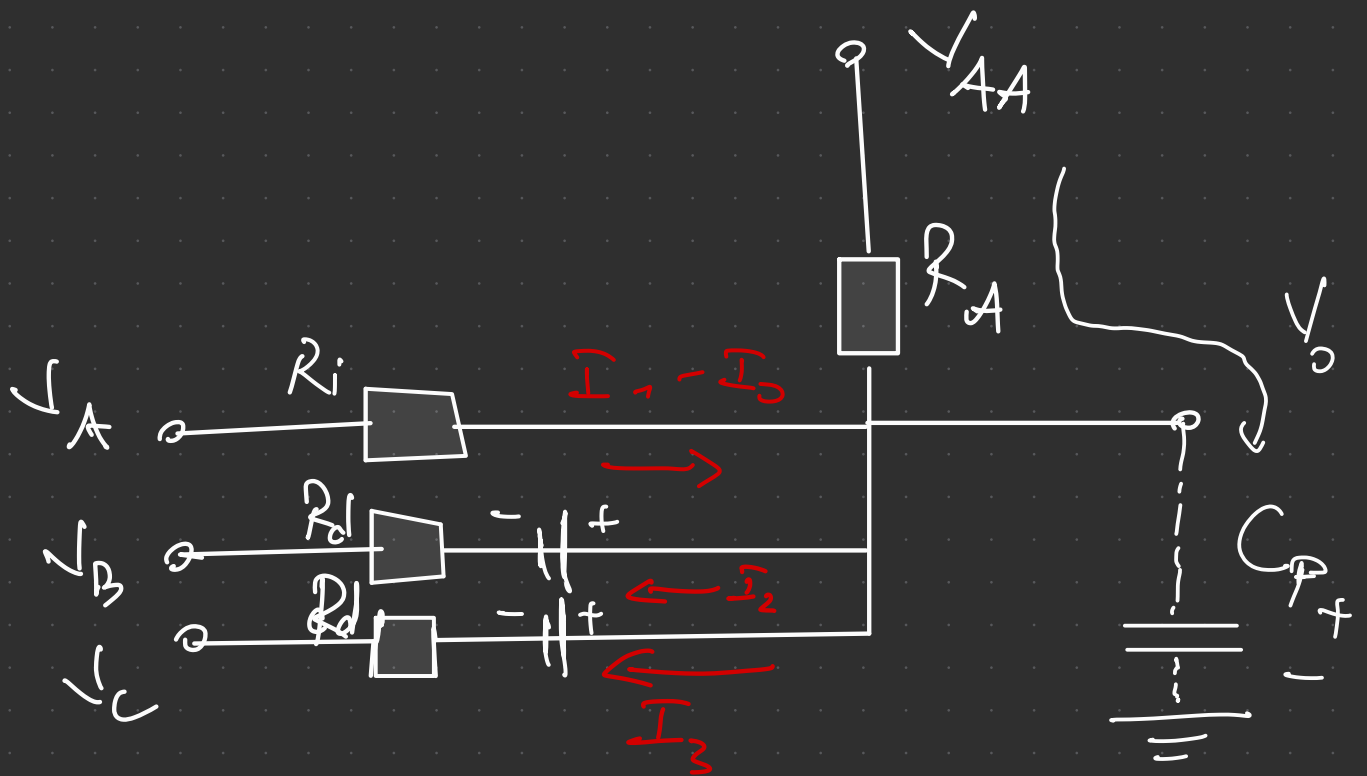
$$V_0 = V_2 + V_T \dots \quad I_1 = 0 \quad I_2 = 0$$

$$I_{R_A} = I_C$$

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



Circuitul trebuie să fie insușit de
 un dispozitiv (transistor)



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

$$t_2 = RC \ln \frac{V_{AA} - V_L}{V_{AA} - V_H} = \frac{V_{AA} - 3.14}{V_{AA} - 0.94}$$

$$V = V_H - V_L$$

$$R_A = 2k$$

$$C_P = 50pF$$

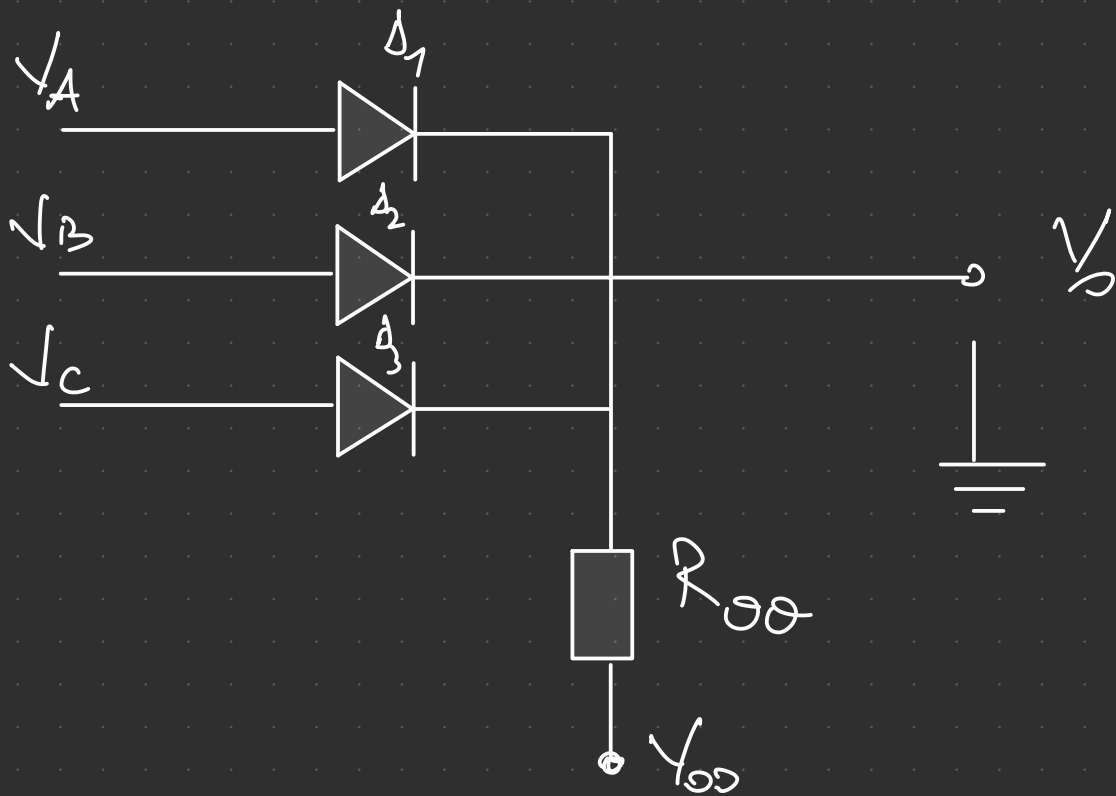
$$V_{AA} = 10V$$

$$V_H = 5V, V_L = 0V$$

$$t_1 = 4 \cdot 10^3 \cdot 50 \cdot 10^{-12} \ln \left(\frac{10 - 0.94}{10 - 5} \right) = 100 ns$$

$$t_c = R_d C_P \ln \frac{V_L - 0.94}{V_L - 3.14}$$

Poarta SAU cu diode



$$|V_{OO}| > V_H > V_L \quad \text{ex} \quad \begin{aligned} V_{OO} &= -10V \\ V_H &= 5V \\ V_L &= 0V \end{aligned}$$

(A) F. logică

$$\rightarrow \text{dacă } V_A = V_B = V_C = V_L$$

$D_1, D_2, D_3 \rightarrow$ pol. direct deoarece $V_L > V_{OO}$
 \rightarrow conduc

$$V_O = V_L - V_T$$

b) $V_A = V_B = V_C = V_H$
 $\Delta_1, \Delta_2, \Delta_3 \rightarrow$ pol. direct $V_H > V_{so}$
 \searrow conduc

$$V_o = V_H - V_T$$

c) Dacă la cel puțin o intrare avem V_H
 \Rightarrow dioda coresp. conduce . ex. $V_A = V_H$
 $V_B = V_C = V_L$

$$\Delta_1 \text{ conduce} \rightarrow V_o = V_H - V_T$$

Δ_2, Δ_3 sunt bl. (polarizate invers)



(B) Funcționarea electronică

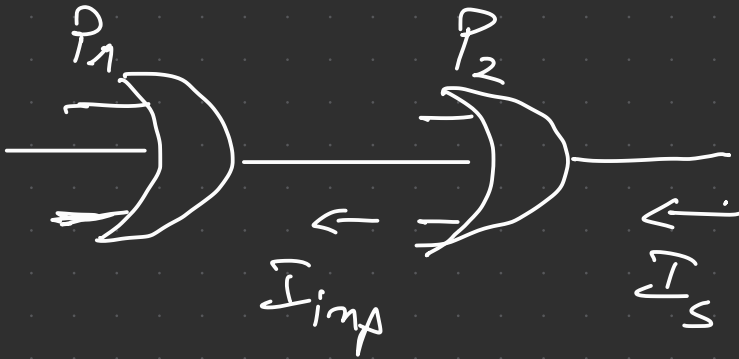


$$I_{R_{\infty}} \geq I_S$$

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

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

$$R_{\infty} \leq \frac{V_L + V_{DD}}{I_S}$$



$$I_{imp} > I_{R_{\infty}} \quad \underline{\text{cmd } (n-1) \text{ disks sum bl.}}$$

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

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

$$I_{imp \max} = \frac{V_H + V_{DD}}{R_{\infty}} + (n-1) I_0$$

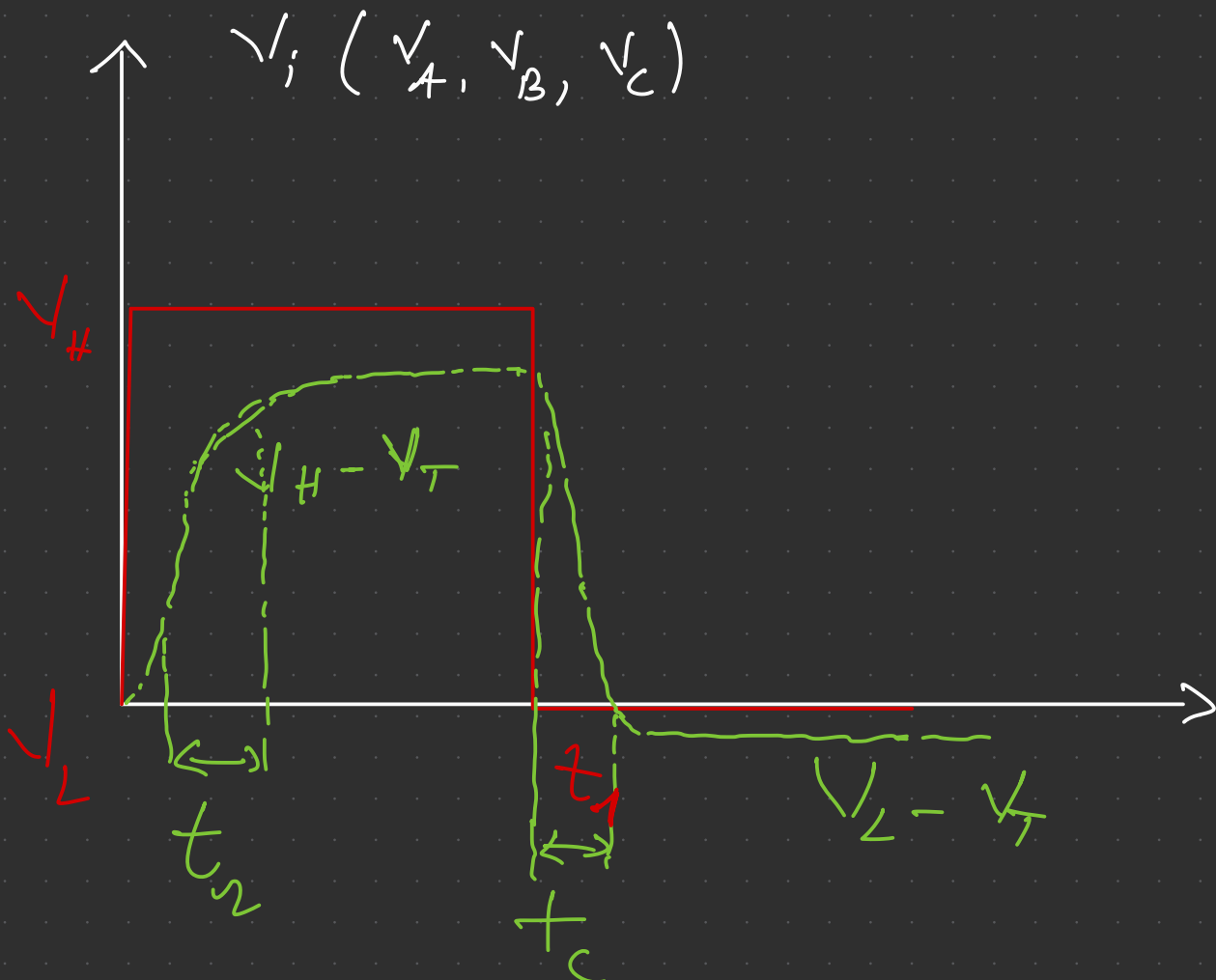
$$F = \frac{I_{out}}{I_{inp}}$$

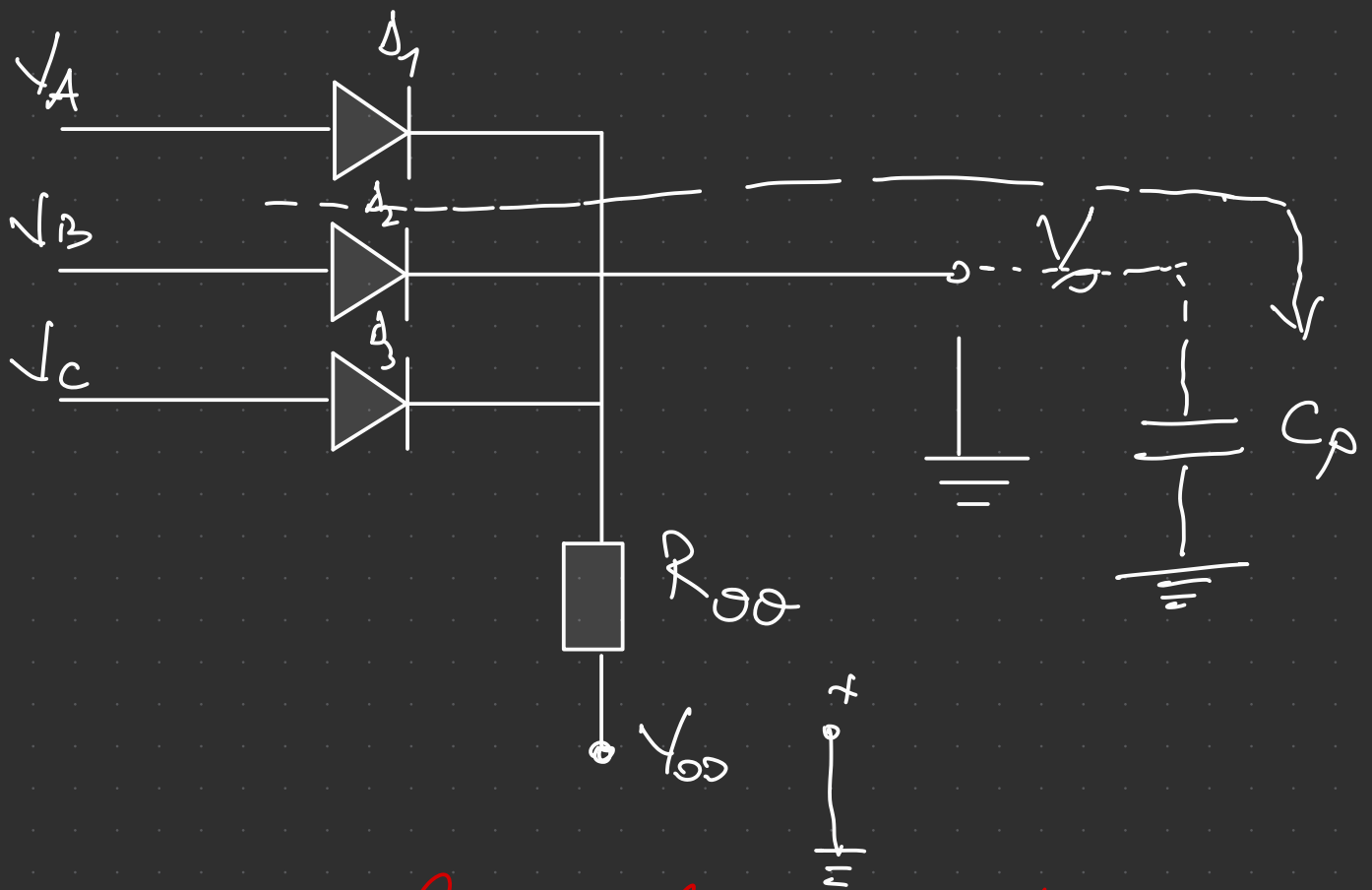
$$F = A + B + C$$

$$F = \frac{\frac{V_L + V_{so}}{R_{so}}}{\frac{V_H + V_{so}}{R_{so}} + (n-1)I_g} < 1$$

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

b) $V_o < \frac{V_H - V_T}{V_L - V_T}$





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

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

încărcare
cap.

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

desc.
cap.

$$V_H = 5V$$

$$V_L = 0V$$

$$V_{DD} = 10V$$

$$R_{ol} = 20 \Omega$$

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

$$C_p = 50pF$$

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

$$t_c = 4000 \cdot 50 \cdot 10^{-12} \ln \frac{10 - 4,5}{10 - 0,5} = 400ns$$