randul H:

1.a)Caracteristica statica de iesire la poarte ttl cand V0=VL(sau ceva de genul)

b) Aplicatie.

2.Circuite logice cu diode si tranzistori (poarte SI-NU cu diode)

a) Functionare

b)Dimensionarea rezistentelor.

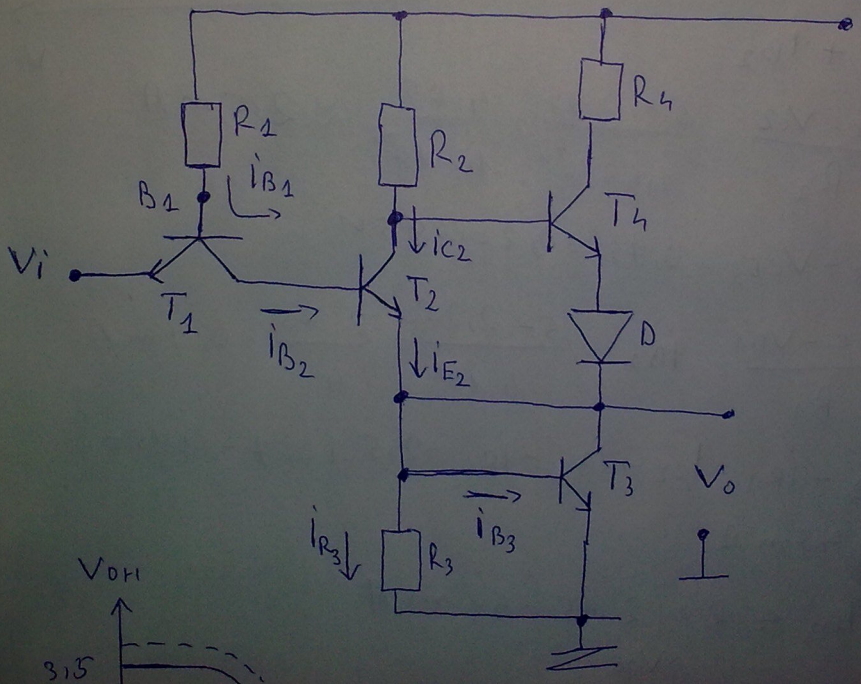
c)Aplicatie (calculul puterii)

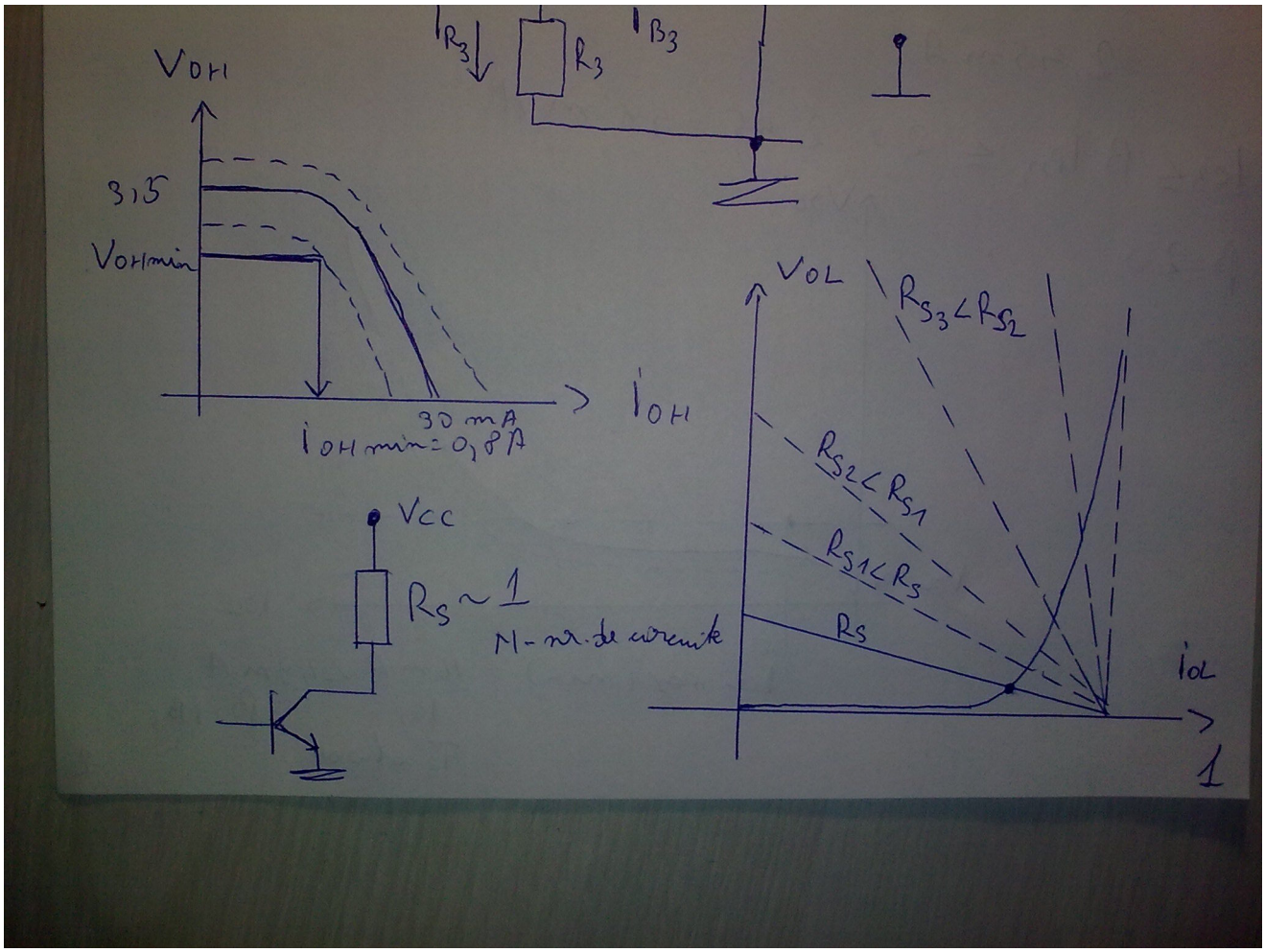
3.Un circuit cu inversor, trece-sus,inversor, semnalul rezultat se aplica la o poarta NAND, impreuna cu semnalul de la intrare (cred ca majoritatea sub erau asemanatoare, doar circuitul diferea un pic).

H1

H1 Caracteristica statică de ieșire pentru poarta TTL

a) Caracteristica statică de ieșire pentru nivelul inferior la ieșire $V_0 = V_L = 0,2V$.

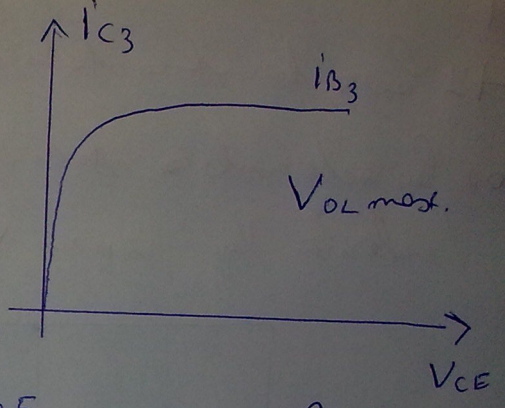



R_3
R_3
B_3
V_{OH}
3,5
V_{OHmin}
30 mA
$i_{OHmin} = 0,8A$
i_{OH}
V_{CC}
$R_S \sim \frac{1}{N}$
N - nr. de circuite
V_{OL}
$R_{S_3} < R_{S_2}$
$R_{S_2} < R_{S_1}$
$R_{S_1} < R_S$
R_S
i_{OL}
1

$i_{C3} \leq \beta \cdot i_{B3}$

$i_{B3} = i_{E2} - i_{R3}$

$i_{R3} = \frac{V_{B3}}{R_3} = \frac{0,75}{10^3} = 0,75\,mA.$



$i_{E2} = i_{C2} + i_{B2}$

$i_{C2} = \frac{V_{CC} - V_{C2}}{R_2} = \frac{5 - 0,95}{1,6 \cdot 10^{-3}} = \frac{4,05}{1,6 \cdot 10^{-3}} \approx 2,5\,mA.$

$V_{C2} = V_{B3} + V_{CE_S} = 0,75 + 0,2 = 0,95\,V$

$i_{B2} = \frac{V_{CC} - V_{B1}}{R_1} = i_{B1} = \frac{5 - 2,25}{4 \cdot 10^3} = \frac{2,75}{4} = 0,7\,mA.$

$i_{B3} = i_{E2} - i_{R3} = i_{C2} + i_{B2} - i_{R3} = 2,5 + 0,7 - 0,75 =$

$= 2,45\,mA.$

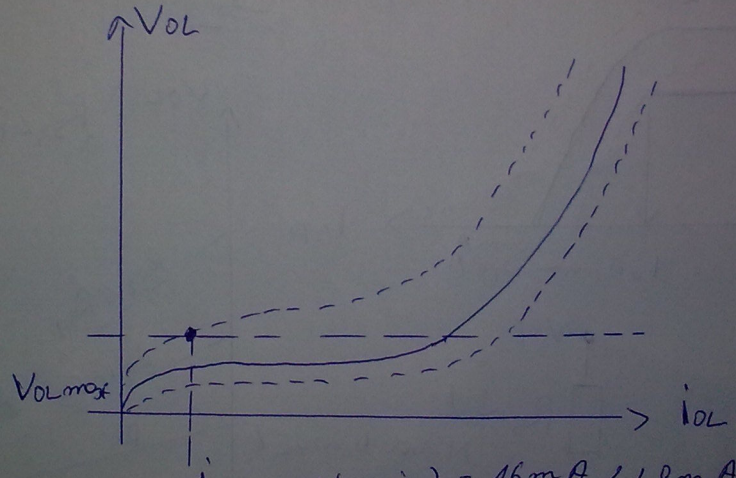
$I_{B2} = \frac{V_{CC} - V_{B1}}{R_1} = I_{B1} = \frac{5 - 2,1}{4 \cdot 10^3} = \frac{2,1 + 5}{4} = 0,7\,mA.$

$I_{B3} = I_{E2} - I_{R3} = I_{C2} + I_{B2} - I_{R3} = 2,5 + 0,7 - 0,75 =$

$= 2,45\,mA.$

$I_{C3} \leq \beta \cdot I_{B3} \leq 20 \cdot 2,45 = 49\,mA.$

$\beta = 20$

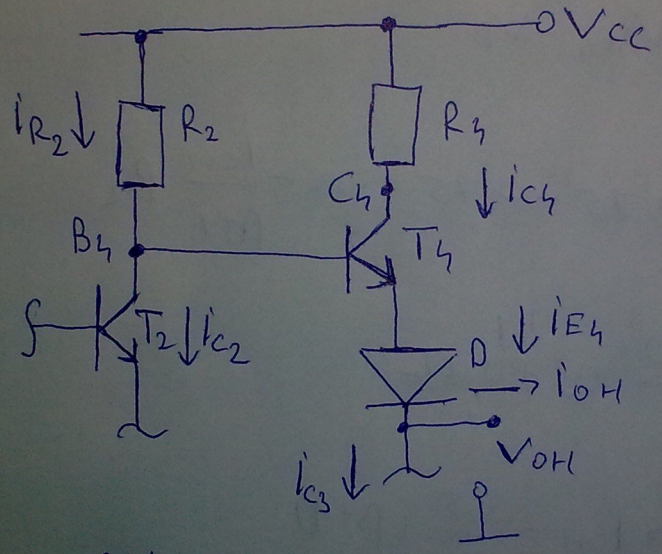


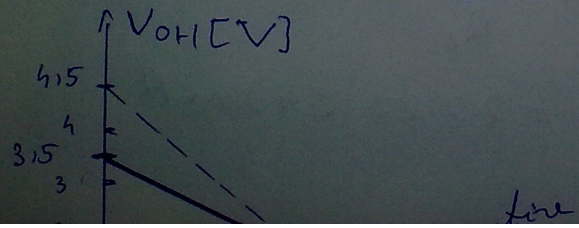
$I_{OL\,max\,(min)} = 16\,mA < 49\,mA.$

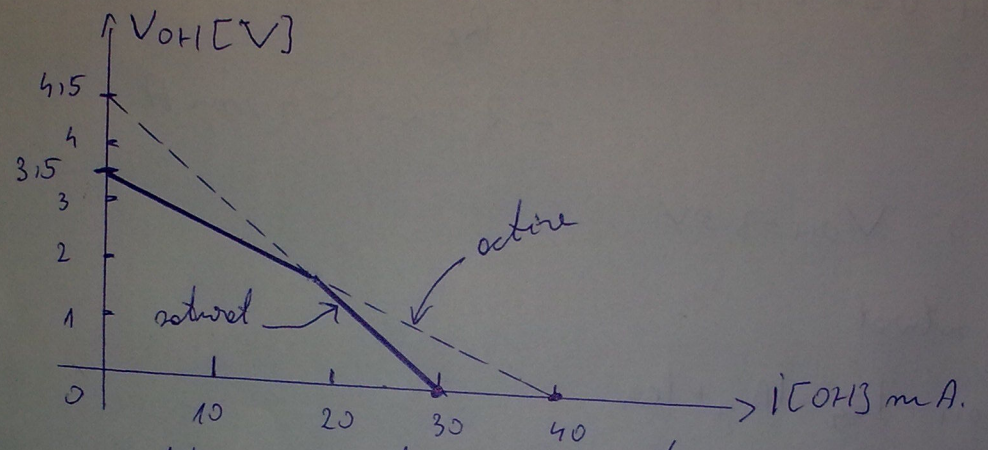
$I_{C3} \qquad \beta \cdot I_{B3}$

T_3 saturat

b) Caracteristica statică de ieșire pentru nivelul superior de ieșire $V_0 = V_{1} = 3{,}5\,V$.







i_{OS} - curent de ieșire de scurtcircuit.

a) T_4 activ.

$V_0 = V_{CC} - i_{R_2} R_2 - V_{BE_4} - V_D$

$i_{R_2} = i_{B_4} + i_{C_2}$ (T_2 blocat)

$i_{C_2} = i_{C_0}$ neglijăm

$i_{R_2} = i_{B_4} = \frac{i_{E_4}}{\beta + 1}$

$i_{E4} = i_{OH} + i_{C3}$ (T_3 blocat)

$i_{C3} = i_{CO}$ (neglijăm)

$$V_O = V_{CC} - \frac{i_{OH}}{\beta+1} R_2 - V_{BE4} - V_D$$

$$V_O = 5 - \frac{i_{OH}}{\beta+1} R_2 - 0,75 - 0,75 = 3,5 - \frac{i_{OH}}{\beta+1} R_2$$

$$\frac{R_2}{\beta+1} = Z_O = \frac{1,6 \cdot 10^3}{20+1} \approx 80\,\Omega$$

$$V_{OH} = 0 \Rightarrow V_{OH\,0} \rightarrow i_{OH} = \frac{3,5}{R_2}(\beta+1)$$

$$= 20 \cdot 20 \approx 40\,mA.$$

$i_{OH} = 0 \quad V_{OH} = 3,5V$

R_2

$= 20.20 \simeq 40 mA.$

$i_{OH} = 0 \quad V_{OH} = 3,5V$

(b) T_4 saturat.

$$i_{OH} = i_{E_4} = i_{B_4} + i_{C_4}$$

$$i_{B_4} = i_{R_2} = \frac{V_{CC} - V_{B_4}}{R_2} = \frac{V_{CC} - (V_{iH} + V_D + V_{BE_4})}{R_2}$$

$$i_{C_4} = \frac{V_{CC} - V_{C_4}}{R_4} = \frac{V_{CC} - (V_{OH} + V_D + V_{CE_4})}{R_4}$$

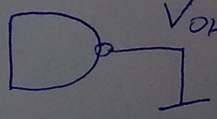
$$i_{OH} = \frac{V_{CC} - (V_{OH} + V_D + V_{CE_4})}{R_2} + \frac{V_{CC} - (V_{OH} + V_D + V_{CE_4})}{R_4}$$

$$i_{OH1} = \frac{5 - (V_{OH1} + 0{,}75 + 0{,}75)}{R_2} + \frac{5 - (V_{OH1} + 0{,}75 + 0{,}21)}{R_4}$$

$$i_{OH1} = \frac{3{,}5 - V_{OH1}}{R_2} + \frac{4{,}05 - V_{OH1}}{R_4 = 150\Omega}$$

$$i_{OH1} = 0 \Rightarrow V_{OH1} \simeq 4{,}5V$$

$$V_{OH1} = 0 \Rightarrow i_{OH1} = 30mA.$$

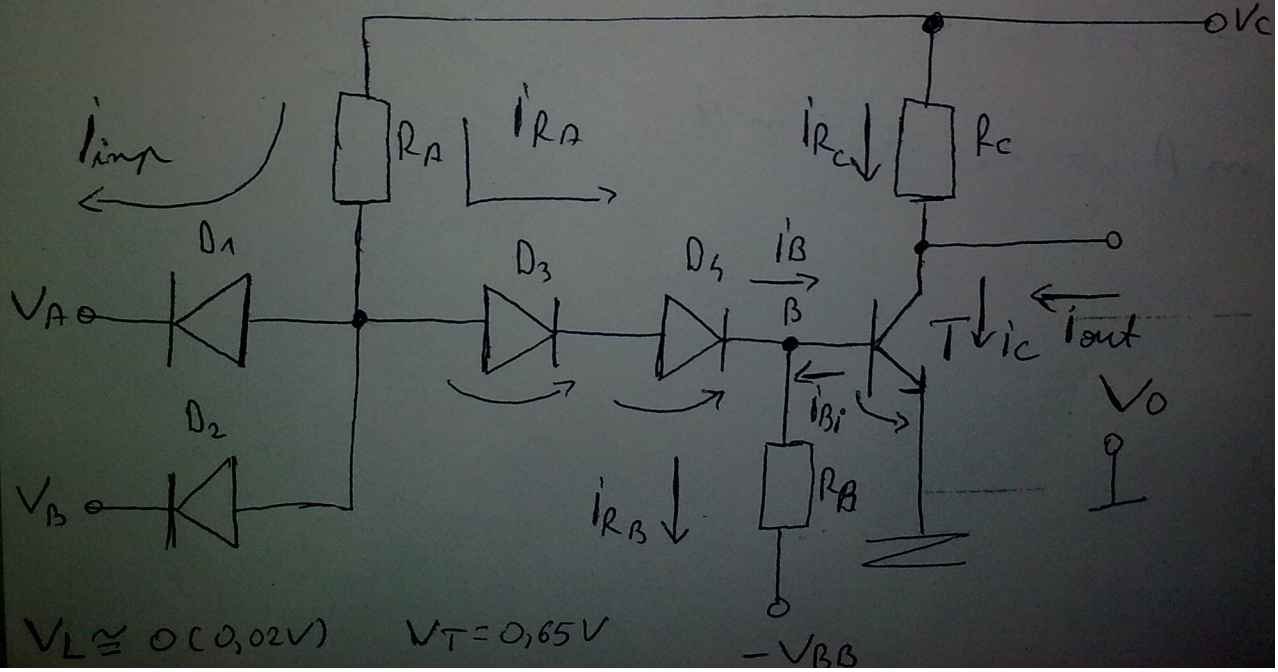


$$18mA \leq i_{OS} \leq 55mA$$

H

2. Circuite logice cu diode și tranzistoare.

a) Funcționare.



$V_L \cong 0 (0,02V)$ $V_T = 0,65V$

$-V_{BB}$

$\Rightarrow V_H = V_{CC}$, $V_B \leq 0V$

a) $V_A = V_B = V_L$; D_1 și D_2 - conductie

$V_P = V_L + V_D = 0,2 + 0,75 = 0,95V \rightarrow$ T e blocat.

$V_{P\,min} = 3 V_T = 1,95V$

$V_O = V_{CC} - i_C R_C \cong V_{CC} = V_H$

$i_C = i_{CO} = 0$

c) $V_A = V_L$; $V_B = V_H$
$V_A = V_H$; $V_B = V_L$
$\Rightarrow V_0 = V_{CC} = V_H$

d) $V_A = V_B = V_H$; D_1, D_2 - blocate.

$V_p \nearrow V_{CC}$

$V_p = V_{D_3} + V_{D_4} + V_{BE} = 0,75 + 0,75 + 0,75 = 2,25V$

D_1 și D_2 polarizate invers.

$\Rightarrow D_3$, R_{42}, T - conducție

$V_0 = V_{CES} = 0,2V = V_L$

V_A	V_B	V_0
V_L	V_L	V_H

A	B	F
0	0	1

$F = \overline{A \cdot B}$

$V_0 = V_{CES} = 0,2V = V_L$

V_A	V_B	V_0
V_L	V_L	V_H
V_L	V_H	V_H
V_H	V_L	V_H
V_H	V_H	V_L

A	B	F
0	0	1
0	1	1
0	1	1
1	0	1
1	1	0

$\Rightarrow F = \overline{A \cdot B}$

b) Dimensionare / construcție.

a) R_C - limitează curentul prin tranzistor

i_{out} - curent, T - saturat

$i_{out} = i_C - i_{R_C}$

i_C - curentul pe care îl dorim prin circuitul nostru.

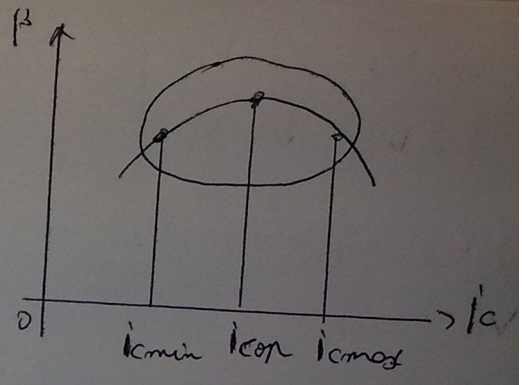
- se alege cât β e maxim.

$P = i \cdot V$ (mică) (I_{cmin})

RC - mare.

RC - mic

$P = i \cdot V$ mare (I_{cmax})



$i_{cop} = i_{out} + i_{Rc}$

$$R_c = \frac{V_{CC} - V_{CES}}{i_{Rc}}$$

Exemplu: $i_{out} = 5mA$; $i_{cop} = 10mA$; $V_{CC} = 5V$.

$$R_c = \frac{5 - 0,2}{5 \cdot 10^{-3}} = 1 k\Omega.$$

b) R_B - T -> blocat.

$$i_{Bi} = \frac{V_{BE} + V_{BB}}{R_B} \Rightarrow V_{BE} \leq 0$$

$5 \cdot 10^{-3}$

b) R_B - T -> blocat.

$$i_{Bi} = \frac{V_{BE} + V_{BB}}{R_B} \Rightarrow V_{BE} \leq 0$$

$$i_{Bi} \cdot R_B = V_{BE} + V_{BB} \leq 0$$

$$R_B \leq \frac{V_{BB}}{i_{Bi}} = \frac{V_{BB}}{i_{CO}}$$

- avem o infinitate de valori

$$i_{Bi} = i_{CO}$$

Exemplu: $V_{BB} = -2V$; $i_{CO} = 50\mu A$

$$R_B = \frac{2}{50 \cdot 10^{-6}} = 40 \cdot 10^3 = 40 k\Omega$$

c) R_A -> ambii T - saturati

$$i_{RA} = i_B + i_{RB} \; ; \; i_B \cdot \beta \geq i_C$$

$$i_B = i_{R_A} - i_{R_B}$$

$$i_{R_A} = \frac{V_{CC} - V_P}{R_A} \quad = 2{,}25$$

$$i_{R_P} = 2{,}25\,V$$

$$i_{R_B} = \frac{V_{BE_S} + V_{BB}}{R_B}$$

$$i_B = \frac{V_{CC} - 2{,}25}{R_A} - \frac{0{,}75 + V_{BB}}{R_B} \geq \frac{i_C}{\beta}$$

$$R_A \leq \frac{V_{CC} - 2{,}25}{\frac{i_C}{\beta} + \frac{0{,}75 + V_{BB}}{R_B}}$$

Exemplu: $\beta = 20$, $V_{BB} = -2\,V$; $R_B = 40\,k\Omega$; $i_C = 10\,mA$.

Exemplu: $\beta = 20$, $V_{BB} = -2V$; $R_B = 40 k\Omega$; $i_C = 10 mA$.

$$R_A \leq \frac{5 - 2{,}25}{\frac{10 \cdot 10^{-3}}{20} + \frac{0{,}75 + 2}{40 \cdot 10^3}} = \frac{2{,}75}{(0{,}5 + 0{,}07) \cdot 10^{-3}} = \frac{2{,}75}{0{,}57} \cdot 10^3 =$$

$$= 4{,}3 k\Omega$$

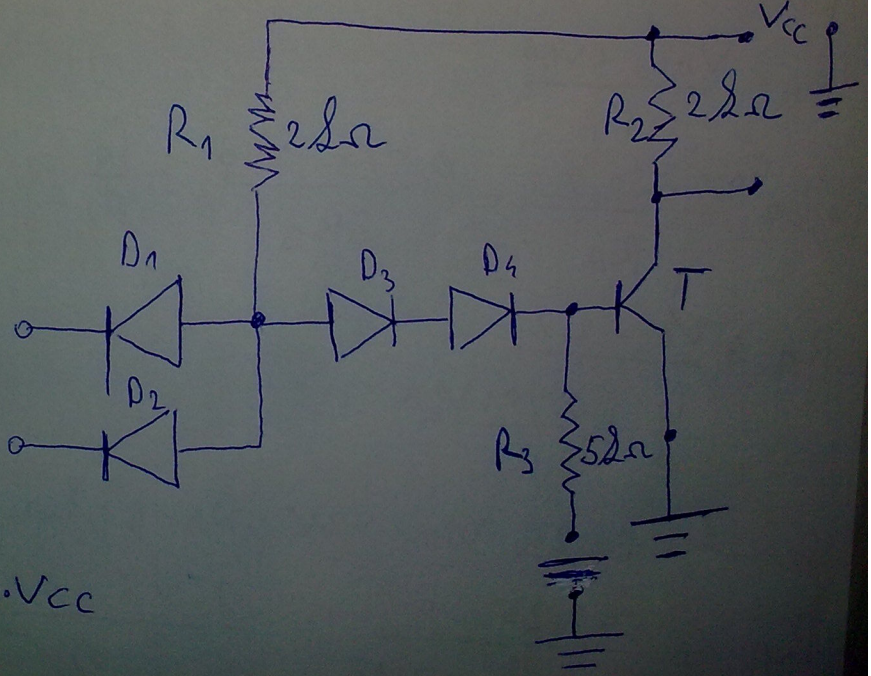
Verificare: este?

$$N = \frac{i_{out}}{i_{inp}}$$

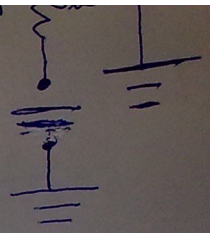
$$i_{inp} = \frac{V_{CC} - V_P}{R_A} = \frac{5 - 0{,}45}{4{,}3 \cdot 10^3} = \frac{4{,}05}{4{,}3 \cdot 10^3} = 0{,}9 mA.$$

$$N = \frac{5}{0{,}9} = 5 \text{ (valoare întreagă).}$$

c) Pentru $V_L = 0,2\,V$, $V_H = V_{CC} = 5V$, $\beta = 20$, $V_{BB} = -2V$, se cere pentru circuitul dat să se determine puterea statică consumată de la sursa de alimentare V_{CC}



$$P_{CC} = \frac{i_{CCL} + i_{CCH}}{2} \cdot V_{CC}$$



$$P_{CC} = \frac{i_{CCL} + i_{CCH}}{2} \cdot V_{CC}$$

$$i_{CCH} = i_{IL} = \frac{V_{CC} - V_P}{R_1} = \frac{5 - 0{,}95}{2 \cdot 10^3} = 2\ mA.$$

$$i_{CCL} = i_{R_1} + i_{R_2} = \frac{V_{CC} - V_P}{R_1} + \frac{V_{CC} - V_{CES}}{R_2} =$$

$$= \frac{5{,}125 - 2{,}125}{2 \cdot 10^3} + \frac{5 - 0{,}2}{2 \cdot 10^3} = 3{,}75\ mA.$$

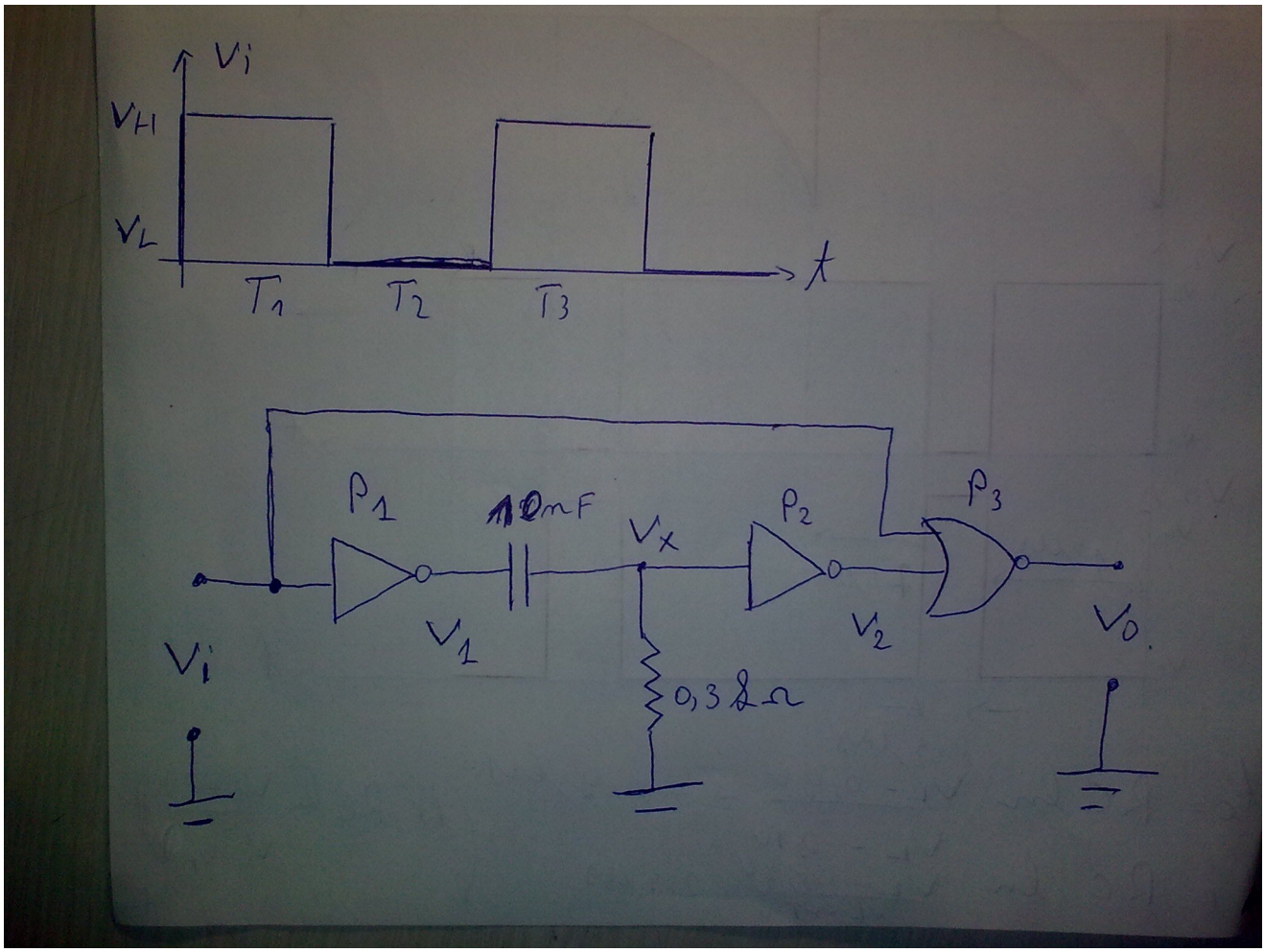
$$\Rightarrow P_{CC} = \frac{i_{CCL} + i_{CCH}}{2} \cdot V_{CC} = \frac{2+4}{2} \cdot 5 = 15\ mV.$$

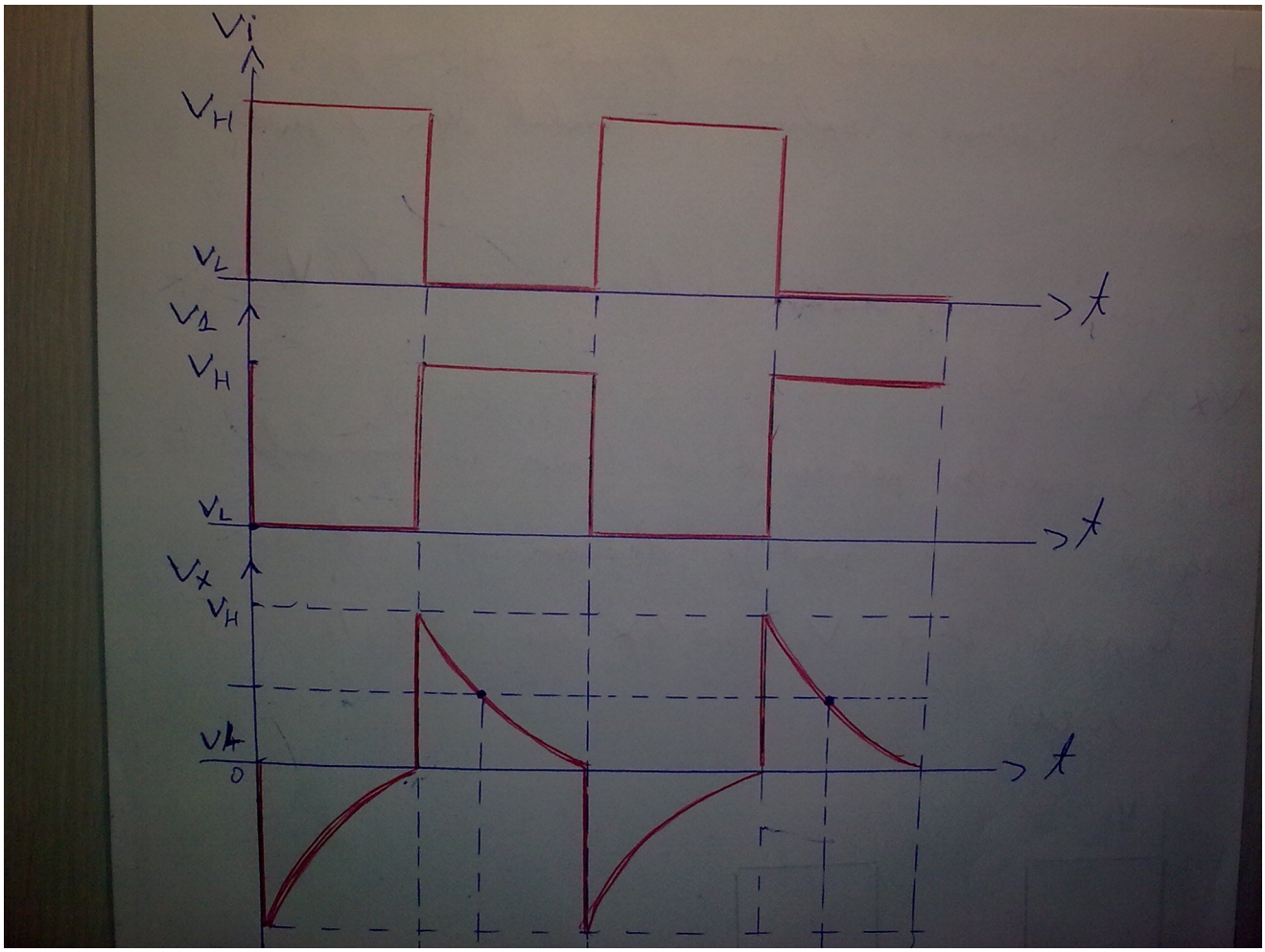
H3. Se dă circuitul din figura de mai jos la intrare căruia se aplică semnalul din figură:

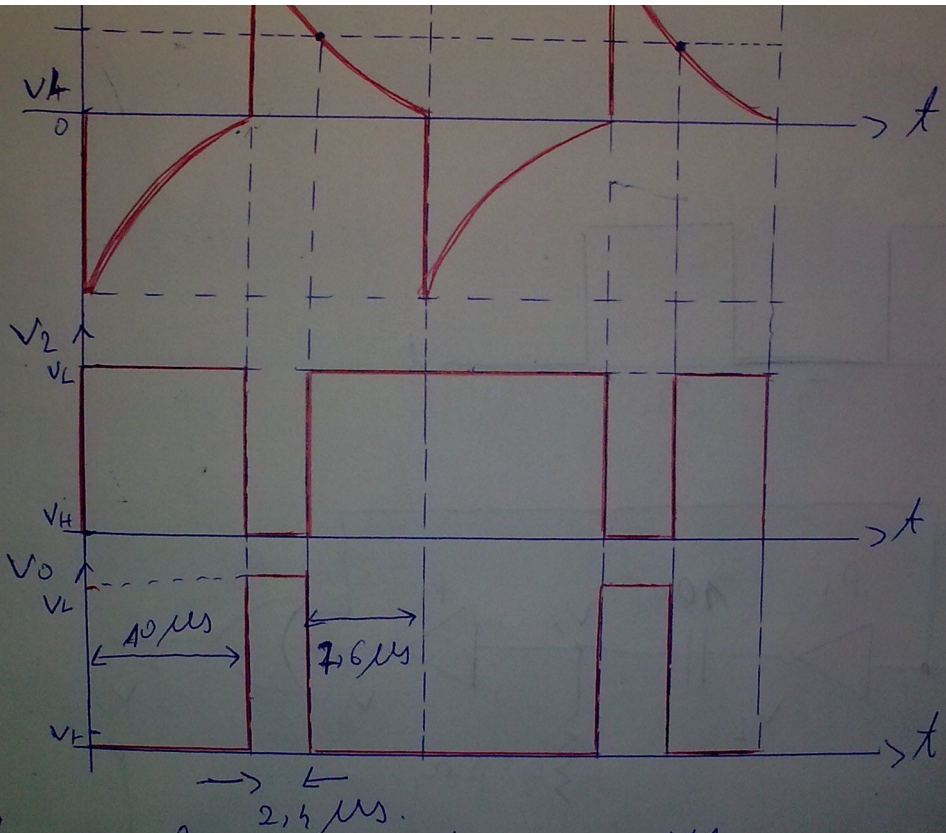
se cere:

a) Ridicare diagramelor de timp în punctele V_i, V_{x1}, V_{x1}, V_2 și V_0.

b) Să se calculeze perioadele de timp a semnalului de la ieșire. Se vor neglija timpii de întârziere ai porții. Unde $V_{H1} = 3,5V$ și $V_L = 0,2V$, $T_1 = T_2 = T_3 = 10\mu s$.


Vi
VH
VL
t
T1
T2
T3
P1
10mF
Vx
P2
P3
Vi
V1
V2
Vo
0,3Ω


V_i
V_H
V_L
t
V_L
V_H
V_L
t
V_x
V_H
V_A
0
t

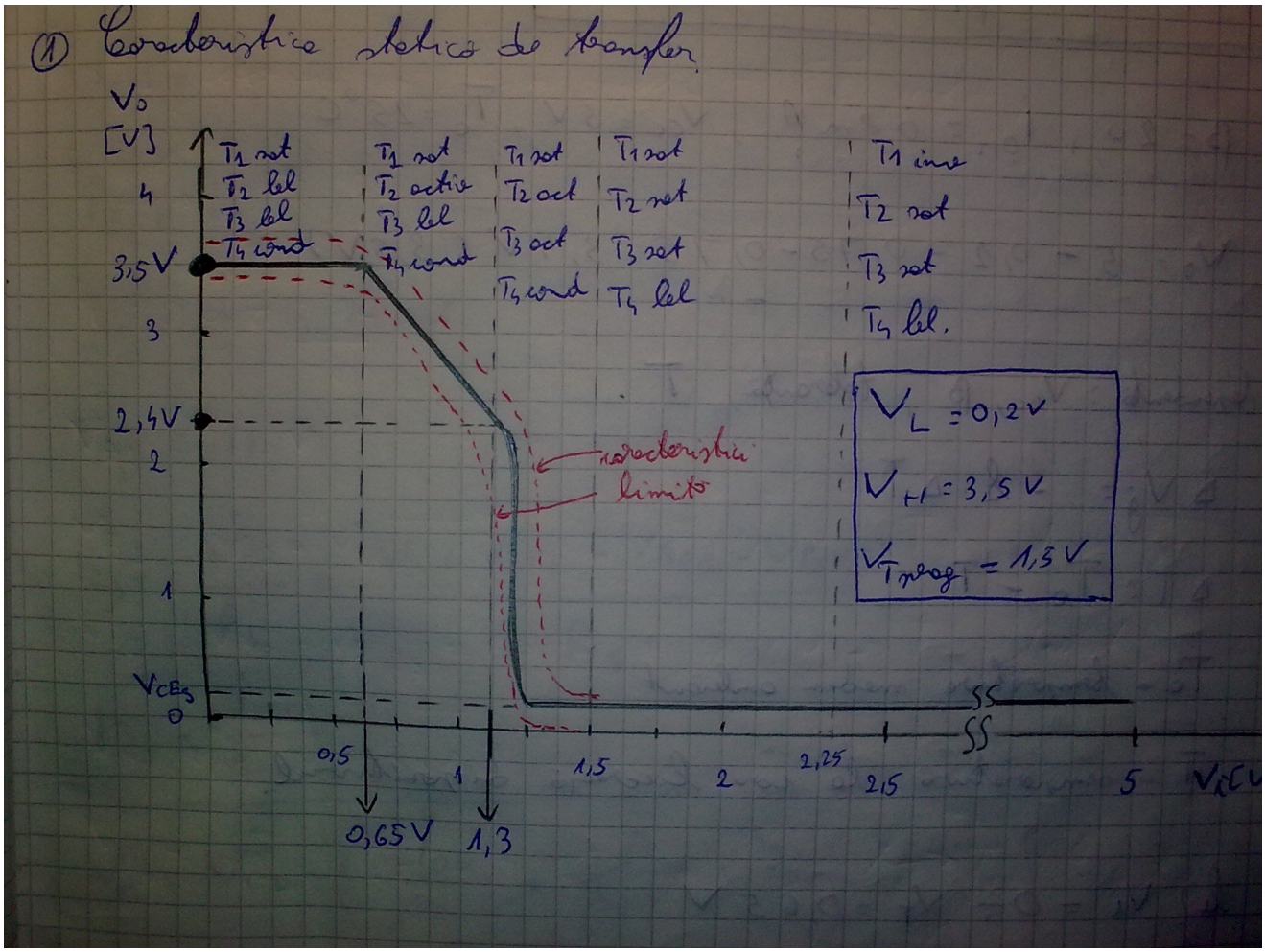


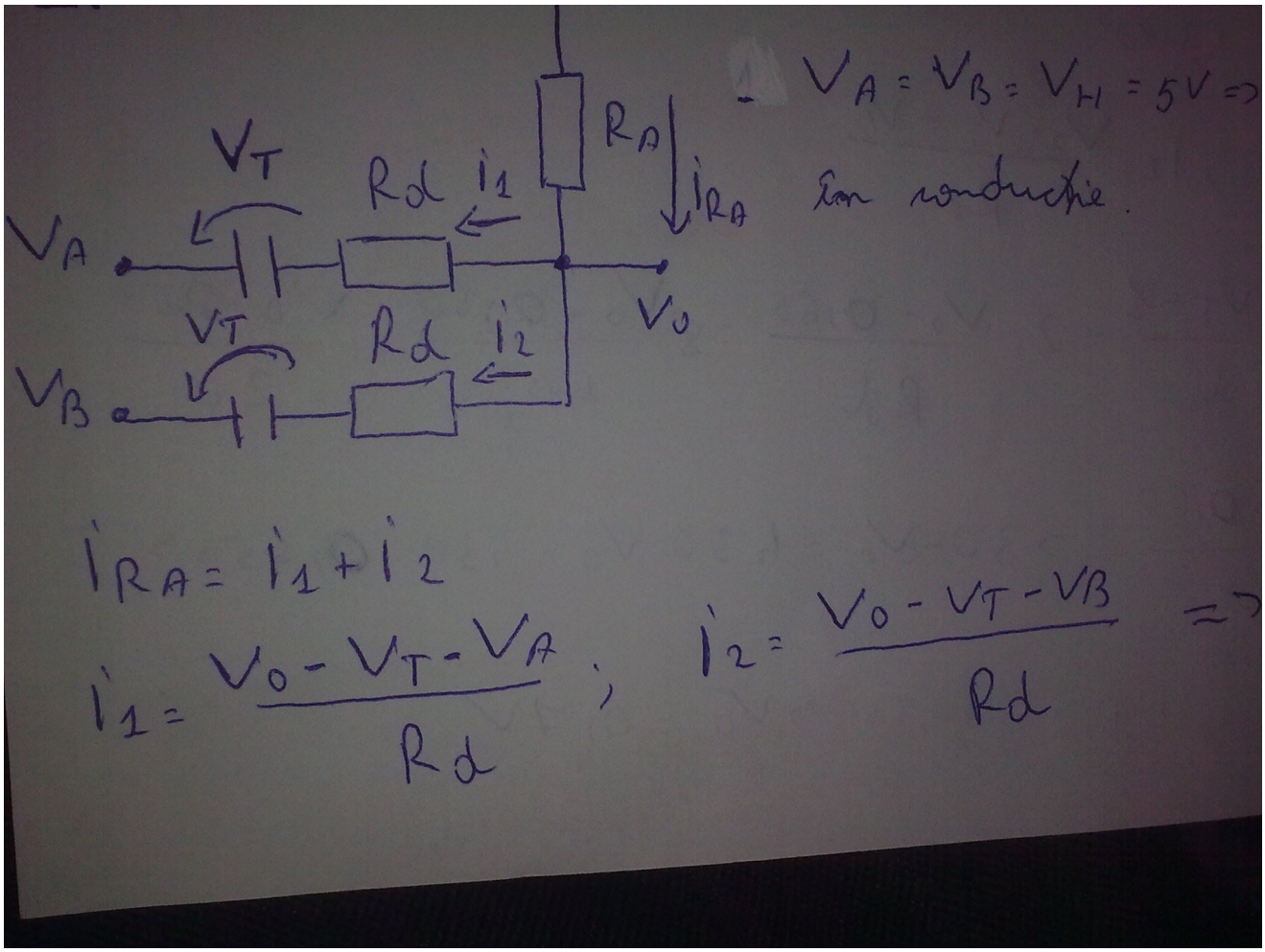
$t_c = RC \ln \frac{V_L - 0,9V}{V_L - 0,1V} = -8,9\,\mu s.$

$t_x = RC \ln \frac{V_L - 0,9V}{V_L - V_T} = 2,4\,\mu s$

($t_x = RC \ln \frac{V_L - 0,9V}{V_L - V_T}$)

① Caracteristica statica de transfer





- $V_A = V_B = V_{H1} = 5V \Rightarrow$ ton conductie.

$$i_{R_A} = i_1 + i_2$$

$$i_1 = \frac{V_0 - V_T - V_A}{R_d} \; ; \quad i_2 = \frac{V_0 - V_T - V_B}{R_d} \Rightarrow$$

$$I_{R_A} = 2 \cdot \frac{V_0 - V_1 - V_A}{R_d} = 2 \cdot \frac{V_0}{}$$

$$I_{R_A} = \frac{V_{cc} - V_0}{R_A} = \frac{15 - V_0}{4{,}3 \cdot 10^3}$$

$$\frac{V_0 - 5{,}65}{2\Phi} = \frac{15 - V_0}{430\Phi} \Rightarrow 430$$

$$430\,V_0 + 2V_0 = 30 + 430$$