Problemă CET anul trecuți ⇒ STABILIZATOR

Q_1: $V_{BE} = 0{,}6\,V$, $\beta_T = \beta_0 = 50$, $P_{D\,max} = 45\,W$

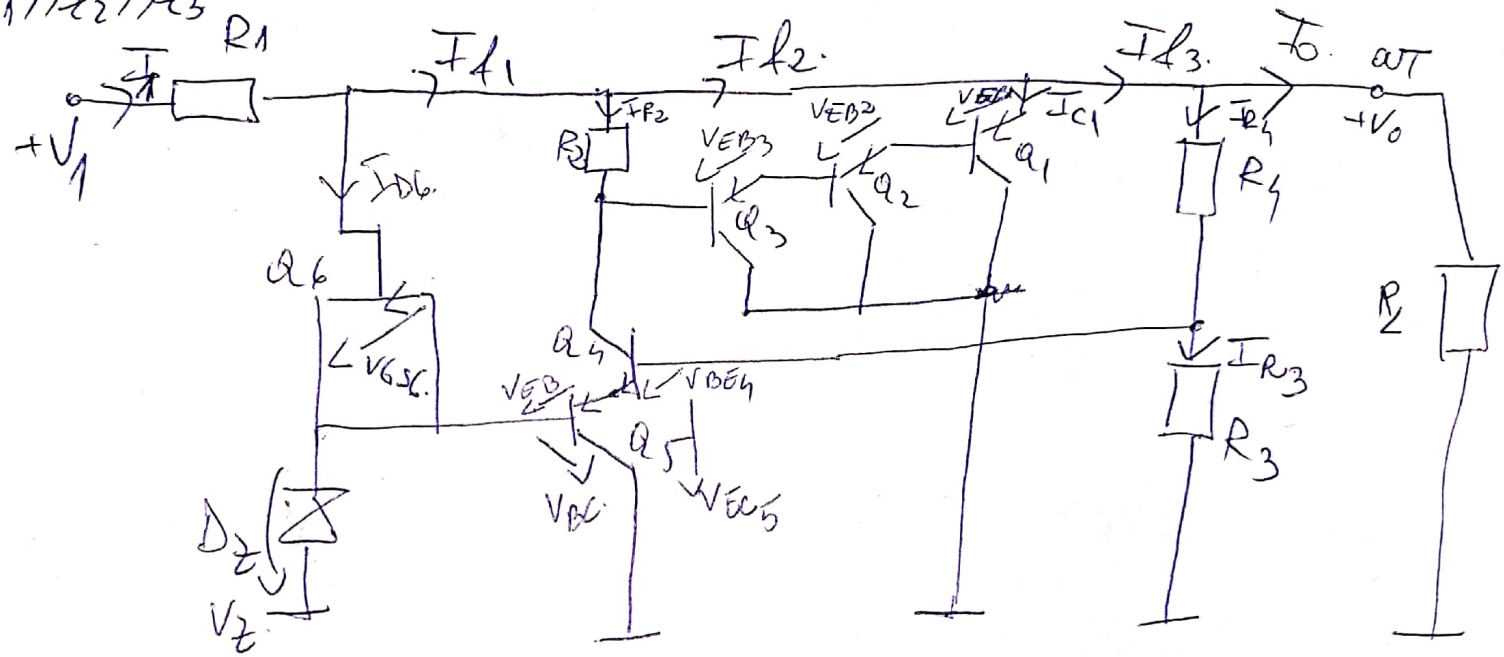
Q_{2-5}: ($|V_{BE}| = 0{,}6\,V$, $\beta_T = \beta_0 = 100$)

Q_6: $V_T = 2\,V$, $I_{DSS} = 5\,mA$, $V_{DS\,max} = 40\,V$, $P_{D\,max} = 100\,mW$

D_Z ($V_Z = 6{,}3\,V$, $I_{Z\,min} = 2\,mA$, $R_Z = 0\,\Omega$, $dV_Z/dT = 4\,mV/°C$)

$R_1 = 3\,\Omega$, $R_2 = 1{,}8\,k\Omega$, $R_3 = R_4 = 7{,}5\,k\Omega$, $R_L = 15\,\Omega$

$I_{C1} \gg I_{E2} \gg I_{B3}$



a) $V_{GS6} = 0 \Rightarrow I_{D6} = I_{DSS} = 5\,mA$.

$-V_Z + V_{BC} = 0 \Rightarrow V_{BC} = V_Z = 6{,}3\,V$.

$V_{BC5} + V_{CE5} + V_{EB5} = 0 \Rightarrow V_{CE5} = -V_{BC} - V_{EB} = -6{,}3 - 0{,}6 = -6{,}9\,V \Rightarrow V_{EC5} = 6{,}9\,V$.

$-V_{EC5} - V_{BE4} + I_{R3} R_3 = 0 \Rightarrow I_R = \frac{V_{EC5} + V_{BE4}}{R_3} = \frac{6{,}9 + 0{,}6}{7{,}5} = \frac{7{,}5\,V}{7{,}5\,k\Omega} = 1\,mA$

Vei neglija I_{B4} și vei considera că $I_{R_3} = I_{R_4} = 1\,mA$.

$$-V_1 + I_1 R_1 + I_{R_3}(R_3 + R_4) = 0 \Rightarrow I_1 = \frac{-I_{R_3}(R_3+R_4) + V_1}{R_1}$$

$$\Rightarrow I_1 = \frac{-1(7{,}5+7{,}5)+21}{3} = \frac{21-15\,V}{3\,\Omega} = 2\,A.$$

$$I_{R_2} R_2 - V_{EB3} - V_{EB2} - V_{EB1} = 0 \Rightarrow I_{R_2} = \frac{V_{EB3}+V_{EB2}+V_{EB1}}{R_2} =$$

$$= \frac{0{,}6\,3}{1{,}8} = \frac{1{,}6\,V}{1{,}8\,k\Omega} = 1\,mA$$

Vei neglija I_{B3} (f_{mic}) $\Rightarrow I_{R_2} = I_{C_4} = I_{C_5} = 1\,mA$.

$$-V_1 + I_1 R_1 + V_0 = 0 \Rightarrow V_0 = V_1 - I_1 R_1 = 21 - 2 \cdot 3 = 21 - 6 = 15\,V$$

$$\Rightarrow \boxed{I_0 = \frac{V_0}{R_L} = \frac{15}{15} = 1\,A.}$$

$$I_{f_1} = I_1 - I_{D_6} = 2 - 5 \cdot 10^{-3} = 1{,}9995\,A$$

$$I_{f_2} = I_{f_1} - I_{R_2} = 1{,}995 - 1 \cdot 10^{-3} = 1{,}994\,A.$$

$$I_{f_3} = I_0 + I_{R_4} = 1 + 1 \cdot 10^{-3} = 1{,}001\,A$$

$$I_{f_2} = I_{C_1} + I_{f_3} \Rightarrow I_{C_1} = I_{f_2} - I_{f_3} = 1{,}994\,A - 1{,}001\,A = 0{,}993\,A$$
$$= 993\,mA$$

$$\Rightarrow I_{C_2} = \frac{I_{C_1}}{\beta} = \frac{0{,}993}{100} = \frac{993\,mA}{100} = 9{,}93\,mA$$

$$\Rightarrow I_{C_3} = \frac{I_{E_2}}{\beta} = \frac{9{,}93\,mA}{100} = 9{,}93 \cdot 10^{-2}\,mA.$$

tipul stabilizatorului: stat. parametric liniar cu ERP
și ref. de tensiune D_Z

$$S_T = \frac{\Delta V_0}{\Delta T} = \frac{\Delta (V_Z + V_{BE5} + V_{BE4})}{\Delta T} = \frac{\Delta V_Z}{\Delta T} + \frac{\Delta V_{BE5}}{\Delta T} + \frac{\Delta V_{BE4}}{\Delta T} =$$

$$= 4 - 2 - 2 = 0 \text{ mV/°C}.$$

~~$V_0 =$~~

$$-V_Z - V_{BE5} - V_{BE4} + I_{R4} R_4 + V_0 = 0$$

b) $V_{1\,max}$ pt $R_L = 15\,\Omega$

c) $R_{L,min}$ pt $V_1 = 21\,V$

a) $V_{1\,max} = R_1 I_{1\,max} + V_0$

$V_0 = ct.$

$R_L = 15\,\Omega \Rightarrow I_0 = \frac{V_0}{R_L} = ct.$

Calculez $I_{1\,max}$

Alternativ cat 1

Cat I)

$$I_{1\,max} = I_{D6\,max} + I_{R1\,max} = I_{D6\,max} + I_{R1}$$

$$I_{D6\,max} = \frac{P_{D\,max\,6}}{V_{DS\,max\,6}} = \frac{100\,m \cdot 10^{-3}\,max.}{40\,V} = 2,5$$

$V_0 = ct \Rightarrow V_{DS6} = ct \Rightarrow I_{D6\,max} = \frac{P_{D6\,max}}{V_{DS6}} = \frac{100\,mV}{8,7} = 11,5\,mA$

$V_Z = ct$

$= V_0 - V_Z$

$= 15 - 6,3$

$= 8,7\,V$

$I_{1\,max} = 11,5 \cdot 10^{-3} + 1,995 = 2,0065\,A$

$\Rightarrow V_{1\,max} = 3 \cdot 2,0065 + 15 = 21,0195\,V$

Cat II)

$P_{Dmax1} = 45\ W$ $\Rightarrow I_{C1max} = \frac{P_{Dmax1}}{V_{EC1}} = \frac{45}{15} = 3\ A$

$V_{EC1} = V_0 = 15\ V$

$I_{f2max} = I_{C1max} + I_{f3}^{ct} = 3 + 1,001 = 4,001\ A.$

$I_{f2max} = I_{f1max} - I_{R2} \Rightarrow I_{f1max} = I_{f2max} + I_{R2} = 4,001 + 1 \cdot 10^{-3} = 4,002\ A.$

$I_{f1max} = I_{max} - I_{D6} \Rightarrow I_{max} = I_{f1max} + I_{D6} = 4,002 + 5 \cdot 10^{-3} = 4,007\ A.$

Deci $V_{1max} = 3 \cdot 4,007 + 15 = 27,021\ V.$

Cat I) $I_{D6max} = \frac{P_{D6max}}{V_{D5min}} = \frac{100\ mW}{2} = 50\ mA$

$\Rightarrow I_{imax} = 50 \cdot 10^{-3} + 1,995 = 2,045\ A$

$\Rightarrow V_{imax} = 2,045 \cdot 3 + 15 = 21,135\ V$

c) $R_{Lmin} = \frac{V_0 = ct.}{I_{0max}}$

$I_0 = I_{f1} - I_{D6} - I_{R2} - I_{C1} - I_{R1}$

$I_{f1} = ct \left(I_{f1} = \frac{V_{f1} - V_0^{ct}}{R_1} \right)$

$I_{R2} = ct$

$I_{C1} = ct ; I_{R1} = ct.$

$\Rightarrow$ pt I_{0max} avem nevoie de I_{D6min}

2 cazuri pentru a calcula I_{D6min}

Caz I) $I_{D6min} = I_{Zmin} = 2mA$

$$\Rightarrow I_{Dmax} = 2 - 2\cdot10^{-3} - 1\cdot10^{-3} - 0,993 - 1\cdot10^{-3}$$

$$\overline{I_{Dmax}} = 1,003\ A$$

$$\Rightarrow R_{Lmin} = \frac{15}{1,003} = 14,95\ \Omega$$

Caz II $I_{D6min} = \frac{P_{Dmax}}{V_{Dmax}} = \frac{100mW}{40V} = 2,5mA > I_{Zmin}$

$$\Rightarrow \overline{I_{Dmax}} = 2 - 2,5\cdot10^{-3} - 1\cdot10^{-3} - 0,993 - 1\cdot10^{-3} = 1,0025A$$

$$\Rightarrow R_{Lmin} = \frac{15}{1,0025} = 14,96\ \Omega$$