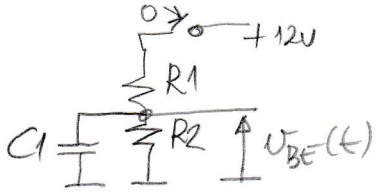
AE – 20160707 – 1

① $0 < v_{BE} < V_{BE} = 0{,}6\,V$



$v_{BE}(0) = 0$

$v_{BE}(\infty) = \frac{R_2}{R_1+R_2} \cdot 12 = \underline{2{,}86\,V}$

$\tau = (R1 \| R_2) \cdot C = (47k \| 150k) \cdot 10n =$

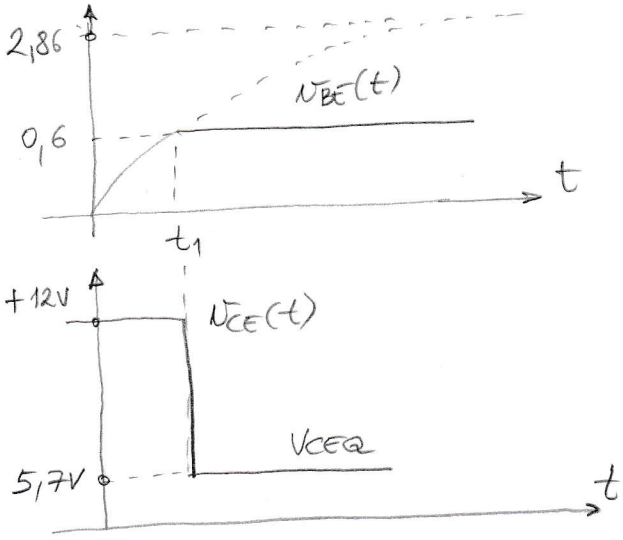
$= \frac{47 \cdot 150}{47+150} 10^3 \cdot 10^{-8} = \underline{358\,\mu s}$

$v_{BE}(t) = v_{BE}(\infty) \cdot (1 - e^{-\frac{t}{\tau}})$

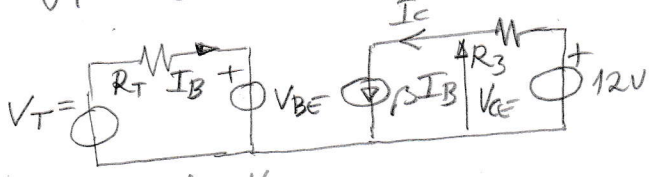
$v_{BE}(t_1) = V_{BE}$

$0{,}6 = 2{,}86 \cdot (1 - e^{-\frac{t_1}{\tau}}) \Rightarrow \frac{0{,}6}{2{,}86} - 1 = -e^{-\frac{t_1}{\tau}} \Rightarrow e^{-\frac{t_1}{\tau}} = 1 - \frac{0{,}6}{2{,}86}$

$-\frac{t_1}{\tau} = \ln\left(1 - \frac{0{,}6}{2{,}86}\right) \Rightarrow t_1 = -\tau \cdot \ln\left(1 - \frac{0{,}6}{2{,}86}\right) = \underline{91\,\mu s}$



$V_T = v_{BE}(\infty) = 2{,}86\,V$; $R_T = R_1 \| R_2 = 35{,}8k\Omega$



$I_B = \frac{V_T - V_{BE}}{R_T} = 63\,\mu A$

$I_C = \beta I_B = 100 \cdot 63 \cdot 10^{-6} = 6{,}3\,mA$

$V_{CEQ} = 12 - R_3 \cdot I_C = \underline{5{,}7\,V}$

② $I_D = \beta (V_{GS} - V_t)^2$

$I_D = 100\,mA$;

$V_{GS} = 3{,}3\,V$

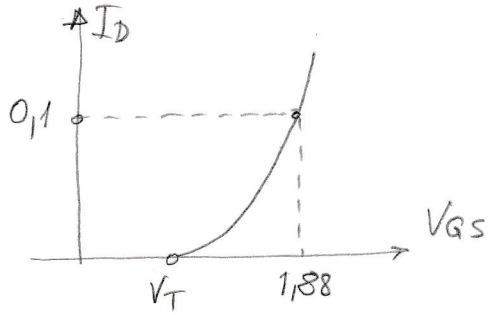
$\beta = 50\,mA/V^2$

$0{,}1 = 50 \cdot 10^{-3} (3{,}3 - V_t)^2$

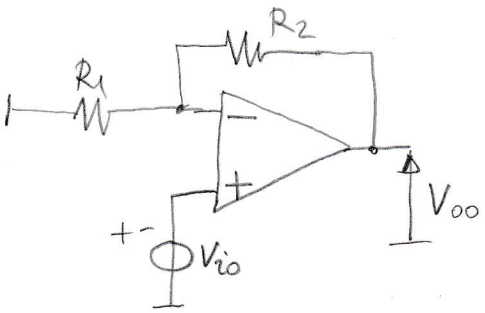
$\frac{0{,}1}{50 \cdot 10^{-3}} = (3{,}3 - V_t)^2$

$\sqrt{\frac{0{,}1}{50 \cdot 10^{-3}}} = 3{,}3 - V_t$

$V_t = 3{,}3 - \sqrt{\frac{0{,}1}{50 \cdot 10^{-3}}} = \underline{1{,}88\,V}$



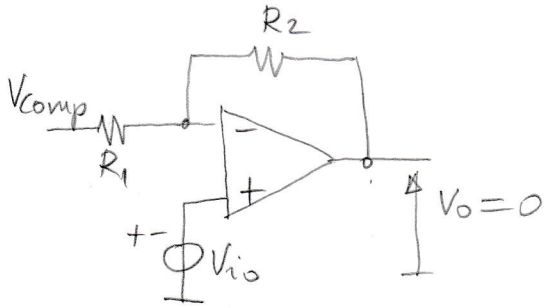
(3)



$$V_{oo} = \left(1 + \frac{R_2}{R_1}\right) \cdot V_{io}$$

$$V_{io} = \frac{V_{oo}}{1 + \frac{R_2}{R_1}} = \frac{0,2}{1 + \frac{10^6}{104}}$$

$$V_{io} = 1,98\,mV$$



$$V_o = 0 = \underbrace{V_{io}\left(1 + \frac{R_2}{R_1}\right)}_{200mV} - V_{comp} \cdot \frac{R_2}{R_1} = 0$$

$$V_{comp} \cdot \frac{R_2}{R_1} = 0,2$$

$$V_{comp} = \frac{R_1}{R_2} \cdot 0,2 = \frac{10^4}{10^6} \cdot 0,2 = 2\,mV$$