Tenta Elektronik AK. 17/4-2004

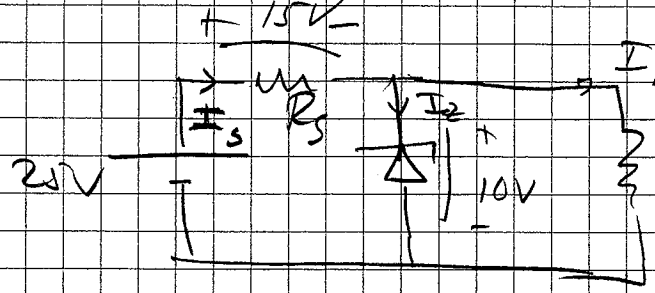
A1. Två pol 2. 20dB/dekad mellan pol 1 och 2

$\Rightarrow$ motkopplingen sänker $|A_v|$ med **20dB**.

A2. $\beta A < 1$ vid $\arg(\beta A) = 180°$

A3. $V_{out,rippel} = V_{rippel} \frac{25\Omega}{25\Omega + 1200\Omega} \Rightarrow \frac{V_{out,rippel}}{V_{rippel}} = \frac{25}{1225} \Rightarrow -33{,}8dB$

A4.



$$\begin{cases} I_{z,max} \text{ då } R_L = 200\Omega \Rightarrow I_L = \frac{10}{200} = 0{,}05A \\ I_{z,max} = \frac{2W}{10V} = 0{,}2A \end{cases}$$

$\Rightarrow I_s = 0{,}25A \Rightarrow R_s = \frac{15V}{0{,}25A} = 60\Omega$

$R_s \geq 60\Omega$ annars blir I_z för stor.

Antag $R_L = 50\Omega \Rightarrow I_L = \frac{10}{50} = 0{,}2A$

och $I_z \geq 0 \Rightarrow R_s = \frac{15V}{0{,}2A} = 75\Omega$

$\therefore \underline{60 \leq R_s \leq 75\Omega}$

A5. $f_{out} = f_r \cdot \frac{M}{N}$

A6. $\frac{6{,}25}{10} \cdot 256 = 160$ dvs räknaren står på 0101000000

A7/

$$R_2 \approx \frac{V_T}{I_{C2}} \cdot \ln\left(\frac{I_{C1}}{I_{C2}}\right)$$

$$I_{C1} = \frac{V_{CC} - V_{BE1}}{R_1} = \frac{10 - 0{,}7}{R_1} \qquad I_{C2} = \overline{I} = 10\,\mu A$$

$$\therefore 14 \cdot 10^3 \approx \frac{0{,}026}{10 \cdot 10^{-6}} \ln x$$

$$\frac{14 \cdot 10^3 \cdot 10^{-5}}{0{,}026} = \ln x \Rightarrow x = 218 = \frac{9{,}3}{R_1 \cdot 10^{-5}}$$

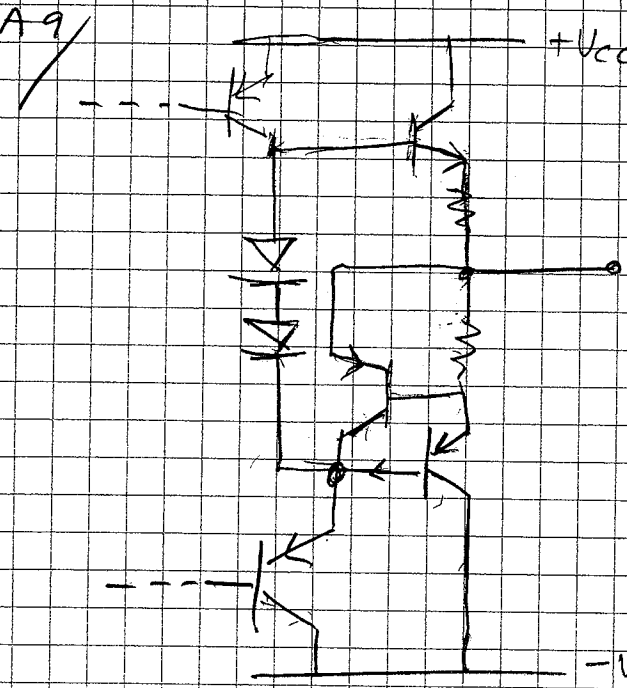
$$= 5{,}385$$

$$\Rightarrow R_1 = \frac{9{,}3}{218 \cdot 10^{-5}} = \underline{4{,}27\ k\Omega}$$

A8/

$$f_{cq} = \frac{1}{2\pi \cdot 120 \cdot 10^{-12} \cdot 33 \cdot 10^{-3}} = \underline{40{,}2\ kHz}$$

A9/



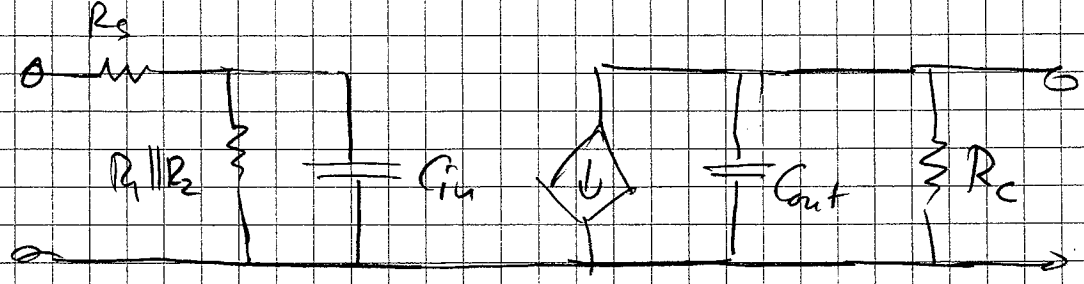
A10/

$$\frac{1}{C_{eq}} = \frac{1}{C_s} + \frac{1}{C_p} = \frac{1}{25 \cdot 10^{-15}} + \frac{1}{6 \cdot 10^{-12}} \Rightarrow C_{eq} = 2{,}4896 \cdot 10^{-14}\ F$$

$$f_p = \frac{1}{2\pi\sqrt{C_{eq} \cdot L_s}} = 10 \cdot 10^6\ Hz \Rightarrow \frac{1}{(2\pi \cdot 10 \cdot 10^6)^2 \cdot C_{eq}} = L_s =$$

$$= 0{,}01017\ H \qquad f_s = \frac{1}{2\pi\sqrt{L_s \cdot C_s}} = \frac{1}{2\pi\sqrt{0{,}01017 \cdot 25 \cdot 10^{-15}}} = \underline{9{,}98136\ MHz}$$

B1/



$$C_{in} = C_{gs} + (1 - A_v) \cdot C_{gd}$$

$$C_{out} = C_{ds} + \frac{A_v - 1}{A_v} \cdot C_{gd}$$

$$A_v = -g_m R_c = -2{,}5 \cdot 15 = -37{,}5 \text{ gqr}$$

$$C_{in} = 1{,}8 + (1 + 37{,}5) \cdot 0{,}5 = 21{,}05 \text{ pF}$$

$$C_{out} = 0{,}6 + \frac{-37{,}5 - 1}{-37{,}5} \cdot 0{,}5 = 1{,}113 \text{ pF}$$

$$f_{g,in} = \frac{1}{2\pi (R_s \| R_1 \| R_2) \cdot C_{in}} = \frac{1}{2\pi \cdot 505 \cdot 10^3 \cdot 21{,}05 \cdot 10^{-12}} =$$

$$(1 \| \frac{1{,}2 \cdot 6{,}8}{1{,}2 + 6{,}8}) = 505 \text{ k}\Omega$$

$$= \underline{14{,}97 \text{ kHz}}$$

$$f_{g,out} = \frac{1}{2\pi R_c \cdot C_{out}} = \frac{1}{2\pi \, 15 \cdot 10^3 \cdot 1{,}113 \cdot 10^{-12}}$$

$$= \underline{9{,}53 \text{ MHz}}$$

$$\frac{1}{f_{g,tot}} = \frac{1}{f_{g,in}} + \frac{1}{f_{g,out}} \Rightarrow f_{g,tot} = \underline{14{,}95 \text{ kHz}}$$

B2/ $A_v = -\dfrac{10R \,/\!/ \left(\frac{1}{sC}+R\right)}{\frac{R}{10}} = -\dfrac{\frac{10R\left(R+\frac{1}{sC}\right)}{10R+R+\frac{1}{sC}}}{\frac{R}{10}}$

$= -\dfrac{100R\left(R+\frac{1}{sC}\right)}{R\left(11R+\frac{1}{sC}\right)} \cdot \dfrac{s}{s} = -\dfrac{100\left(sR+\frac{1}{C}\right)\cdot\frac{R}{R}}{\left(11R\cdot s+\frac{1}{C}\right)\frac{11R}{11R}}$

$= -\dfrac{100\left(s+\frac{1}{RC}\right)\cdot R}{\left(s+\frac{1}{11R\cdot C}\right)\cdot 11R}$

Nullstelle $f_0 = \dfrac{1}{2\pi 11RC} = \dfrac{1}{2\pi\, 18\cdot10^3 \cdot 20\cdot10^{-9}} =$

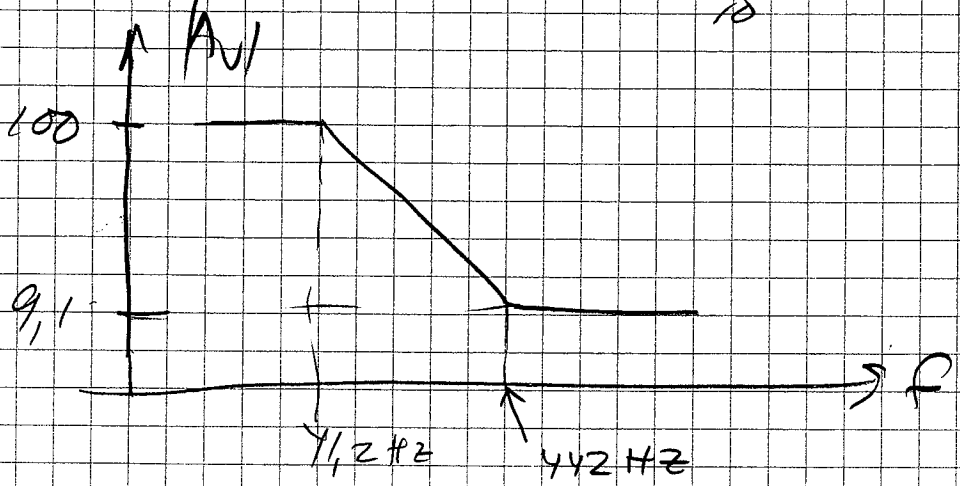
$= \underline{442\,Hz}$

Pol $f_p = \dfrac{1}{2\pi\, 11RC} = \underline{41{,}2\,Hz}$

$f\to\infty \Rightarrow A_v = -\dfrac{R\,/\!/\,10R}{\frac{R}{10}} = -\dfrac{10\,\frac{R\cdot 10R}{11R}}{R}$

$= -\dfrac{100}{11} = \underline{-9{,}09}$

$f\to 0 \Rightarrow A_v = -\dfrac{10R}{\frac{R}{10}} = \underline{-100}$ 99r



B3/ Formelsammlung

$$\omega_0^2 = \frac{1}{R_1 R_2 C_1 C_2} \qquad Q = \frac{\sqrt{C_1 C_2 R_2}}{\sqrt{R_1}\cdot(C_1+C_2)}$$

$$A_v = \frac{\omega_0^2}{s^2 + s\frac{\omega_0}{Q} + \omega_0^2}$$

$$s^2 + s\frac{\omega_0}{Q} + \omega_0^2 = 0$$

$$s_{1,2} = -\frac{\omega_0}{2Q} \pm \sqrt{\left(\frac{\omega_0}{2Q}\right)^2 - \omega_0^2} =$$

$$= -\frac{\omega_0}{2Q} \pm j\sqrt{\omega_0^2\left(1-\left(\frac{1}{2Q}\right)^2\right)} = -\frac{\omega_0}{\sqrt{2}} \pm j\frac{\omega_0}{\sqrt{2}}$$

$\omega_0 = 5\cdot 10^4$ rad/s

$$\therefore \quad \frac{\omega_0}{2Q} = \frac{\omega_0}{\sqrt{2}} \Rightarrow \underline{\underline{Q = \frac{1}{\sqrt{2}}}} \quad (2Q = \sqrt{2})$$

$$\omega_0\sqrt{1-\left(\frac{1}{2Q}\right)^2} = \frac{\omega_0}{\sqrt{2}} \Rightarrow \sqrt{1-\underbrace{\left(\frac{\sqrt{2}}{2\cdot 1}\right)^2}_{\frac{1}{2}}} = \sqrt{\frac{1}{2}} \quad \text{OK!}$$

$$\therefore \left(5\cdot 10^4\right)^2 = \frac{1}{R_1 R_2 \cdot (15\cdot 10^{-9})^2}$$

$$\Rightarrow 5{,}625\cdot 10^{-7} = \frac{1}{R_1 R_2} \Rightarrow R_1 R_2 = 1{,}777\cdot 10^6$$

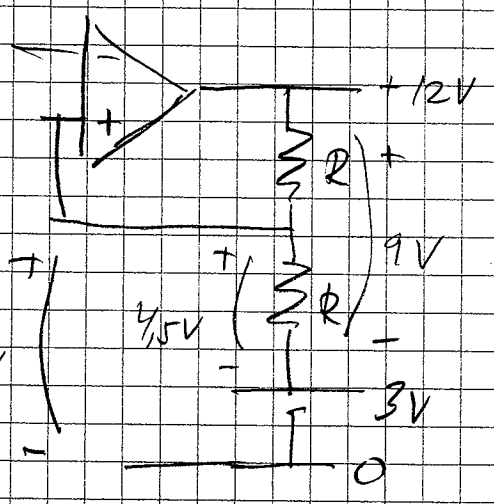
$$\frac{1}{\sqrt{2}} = \frac{\sqrt{R_2}\cdot 4}{\sqrt{R_1}\cdot 2\cdot 4} \Rightarrow \frac{R_2}{R_1} = 2$$

$$\Rightarrow R_1 \cdot R_1 \cdot 2 = 1{,}777\cdot 10^6 \Rightarrow R_1 = \underline{\underline{942\,\Omega}}$$

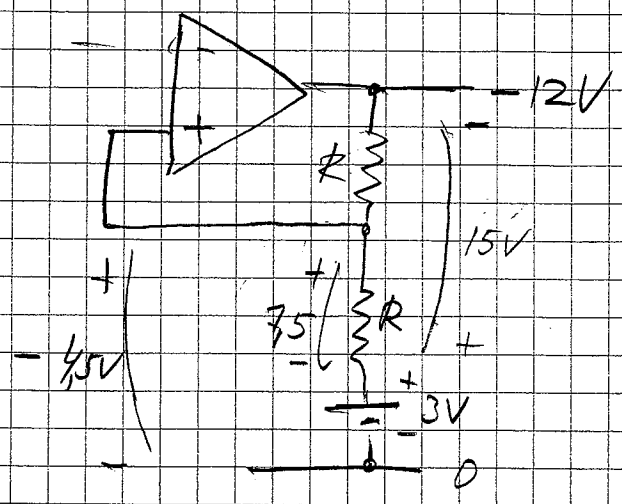
$$\Rightarrow R_2 = 2R_1 = \underline{\underline{1886\,\Omega}}$$

84/

$U_{out} = 12V$

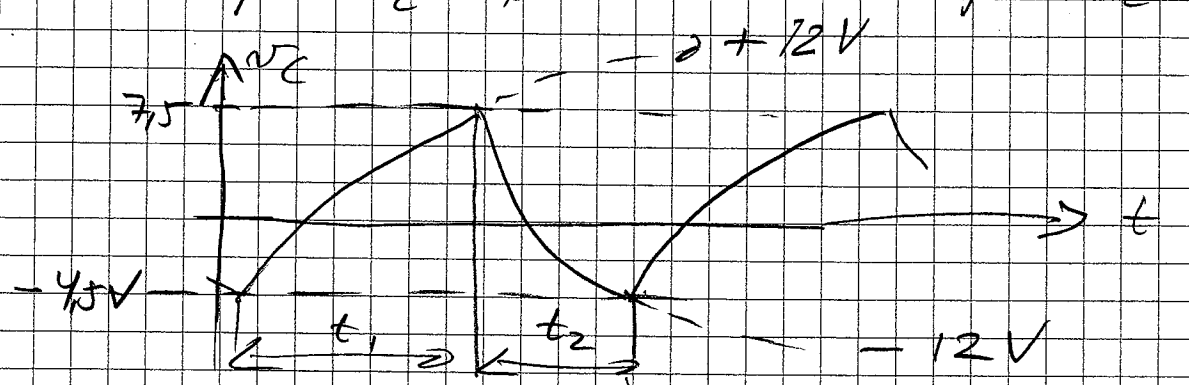


$U_{out} = -12V$



Umschlag da $U_C = +7,5V$

Umschlag da $U_C = -4,5V$

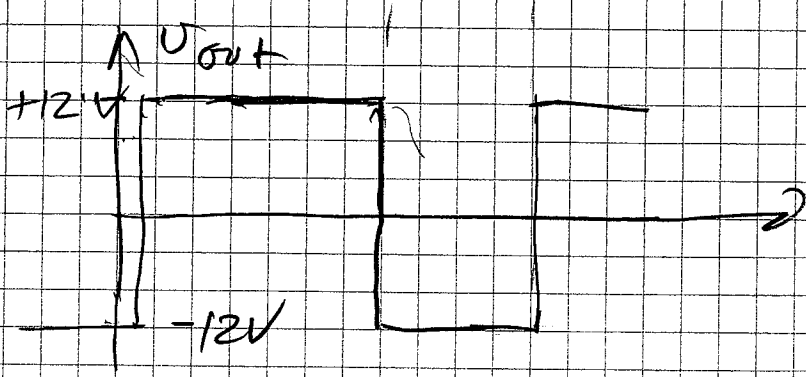


$$t_1 = \tau \ln \frac{A}{B} = R_f \cdot C \ln \frac{12+4,5}{12-7,5} = \underbrace{4 \cdot 10^3 \cdot 150 \cdot 10^{-9}}_{600 \cdot 10^{-6}} \ln \frac{16,5}{4,5}$$

$$= 7,7956 \cdot 10^{-4} \, s$$

$$t_2 = R_f \cdot C \ln \frac{12+7,5}{12-4,5} = 6 \cdot 10^{-4} \ln \frac{19,5}{7,5} = 5,733 \cdot 10^{-4} \, s$$

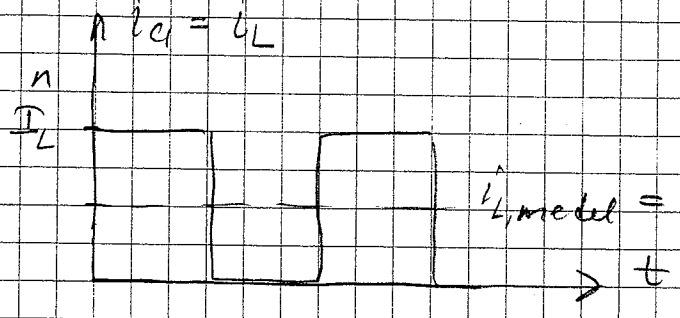
$$f = \frac{1}{t_1 + t_2} = \underline{\underline{739 Hz}}$$



B3/

a/ $P_{Diss,max} = \frac{150° - 40°C}{4,4\,°C/W} = 25W$ för en transistor.

b/



För båda matningsspänningarna fås

$P_{Batt} = 2 \cdot V_{CC} \frac{\hat{I}_L}{2}$ och båda transistorerna

$P_{Diss} = P_{Batt} - P_E - P_L = V_{CC} \cdot \hat{I}_L - \hat{I}_L^2 (R_E + R_L)$

Sökt: $P_{Diss,max}$

$\frac{dP_{Diss}}{d\hat{I}_L} = V_{CC} - 2\hat{I}_L \cdot (R_E + R_L) = 0$

$\Rightarrow \hat{I}_L = \frac{V_{CC}}{2(R_E + R_L)}$

$\therefore \quad 2 \cdot 25W = V_{CC} \frac{V_{CC}}{2(R_L + R_E)} - \frac{V_{CC}^2 \cdot (R_E + R_L)}{4(R_E + R_L)^2}$

$= \frac{V_{CC}^2}{4(R_E + R_L)} = \frac{30^2}{4(R_E + R_L)} \Rightarrow R_E + R_L = 4,5\Omega$

$\Rightarrow R_L = 4,5 - 0,4 = 4,1\Omega$

$\hat{I}_{L,max} = \frac{(30 - 4)V}{4,5\Omega} = 5,78\,A$

$P_{ut,max} = \hat{I}_L^2 \cdot R_L = 5,78^2 \cdot 4,1 = \underline{137W}$