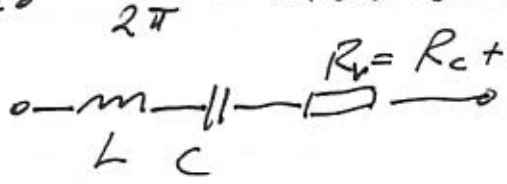
HF 1. Übung / Lösungen

1. a) $\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{10^{-5} \cdot 10^{-9}}} s^{-1} = 10^7 s^{-1}$

$f_0 = \frac{\omega_0}{2\pi} = 1,59155\ MHz$



$R_L = \tan\delta_L \cdot \omega_0 L$

$R_C = \tan\delta_C \cdot \frac{1}{\omega_0 C}$

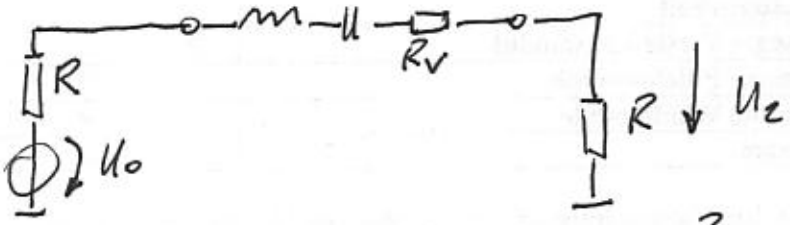
$\omega_0 L = \frac{1}{\omega_0 C} = Z_0 = 100\,\Omega$

$R_V = (1 + 0,2) \cdot 10^{-2} \cdot 100\,\Omega = 1,2\,\Omega$

$\rightarrow Q = \frac{Z_0}{R_V} = \frac{100\,\Omega}{1,2\,\Omega} = 83\frac{1}{3}$

$B = \frac{f_0}{Q} = 19,1\ kHz$

b)



$Q_B = \frac{Z_0}{R_V + 2R} = 10 \rightarrow R_V + 2R = \frac{Z_0}{10}$

$\underline{R = 4,4\,\Omega}$

bei $f = f_0$ und $R_V = 0$ gilt $U_2 = \frac{U_0}{2}$

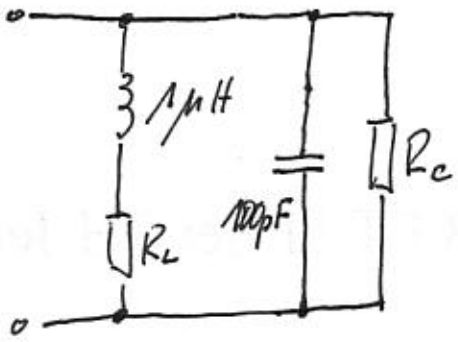
" " " $R_V = 1,2\,\Omega$ " $U_2 = U_0 \cdot \frac{R}{2R + R_V}$

$\rightarrow a_0/dB = 20\ lg\left\{\frac{\frac{U_0}{2}}{U_0 \cdot \frac{R}{2R+R_V}}\right\}$

$= 20\ lg\left\{\frac{2R + R_V}{2R}\right\} = 1,11\ dB$

HF 1. Übung / Lösungen

2. a)



$\omega_0 \approx 10^8\ s^{-1}$, $Z_0 = 100\,\Omega$

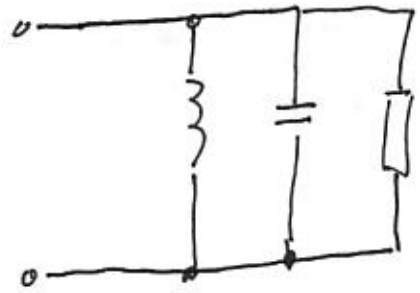
$Y_0 = 10\,mS$

$R_c = \frac{1}{Y_0 \cdot \tan\delta_C} = 20k\Omega$

$R_L = 100\Omega \cdot \tan\delta_L = 2\,\Omega$

$f_0 \approx \frac{1}{2\pi\sqrt{LC}} = 15,9155\,MHz$

Ersatzsystem

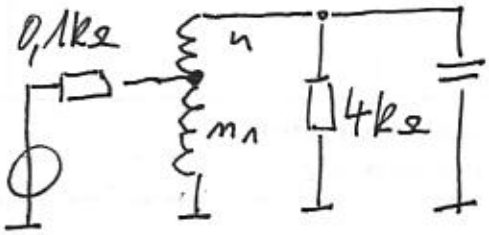


$R_p = R_c \,||\, R_L(1+Q_L^2) = 20k\Omega \,||\, 5k\Omega$

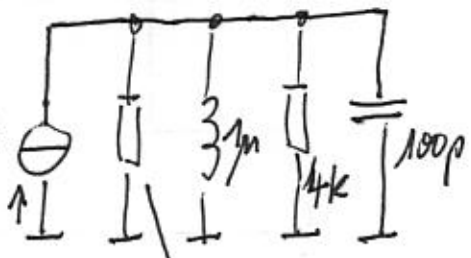
$= 4k\Omega$

b) $L = \frac{n^2}{R_m} \rightarrow n^2 = L \cdot R_m = 10^{-6}\,H \cdot 2,5\,\omega\,10^9\,H^{-1} = 2500$

$n = 50$



$\equiv$



$\frac{U_0}{1k\Omega} \cdot \frac{n_1}{n}$ $\quad 0,1k \cdot \left(\frac{n}{n_1}\right)^2$

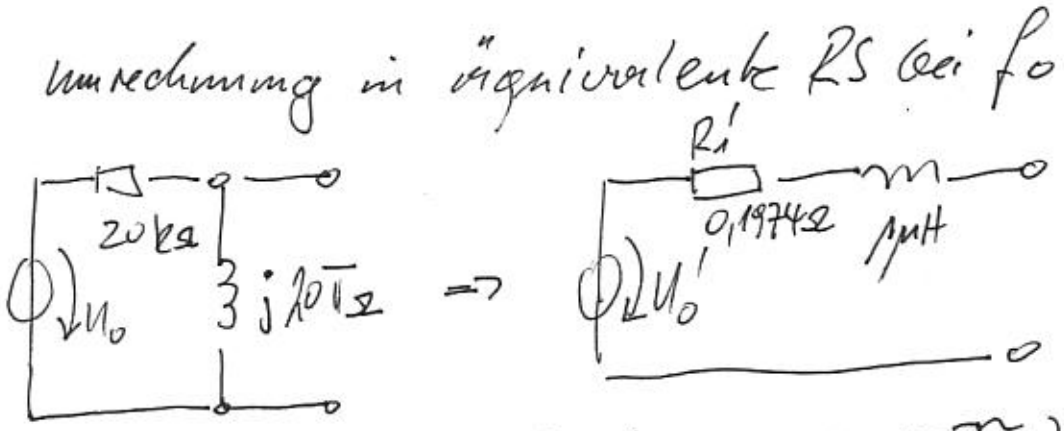
$B = 1,5\,MHz \rightarrow Q_B = \frac{f_0}{B} = 10,61 = \frac{(4k\Omega \,||\, 0,1k \cdot \frac{n^2}{n_1^2})}{100\Omega}$

$\rightarrow 0,1k\Omega \cdot \frac{n^2}{n_1^2} = 1,444k\Omega \rightarrow n_1 = 13,16$ Wdg.

$n_1 = 13$ Wdg gewählt.

HF 1. Übung / Lösungen

3. Umrechnung in äquivalente RS bei f_0

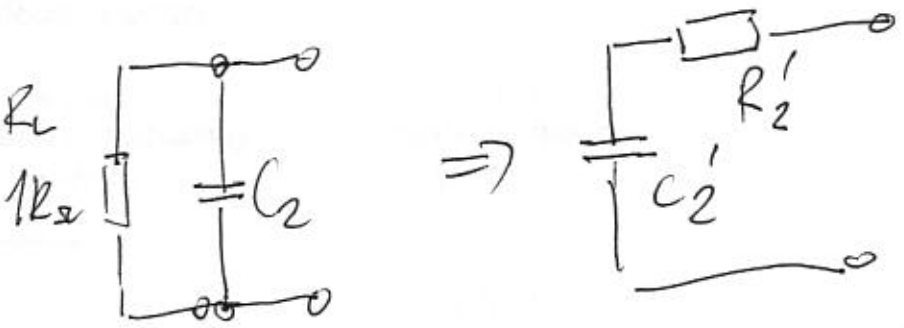


$$\underline{Z}_i = \frac{j\,20\cdot10^3\cdot20\,\Omega\,\Omega^2}{20\cdot10^3\,\Omega + j\,20\,\Omega} = \frac{(20\,k\Omega - j\,20\,\Omega)\,j\,4\cdot10^5\,\Omega^2}{(20\,k\Omega)^2 + (20\,\Omega)^2}$$

$(20\,\Omega)^2 \approx 0$

$$\approx \frac{(20\,k\Omega - j\,20\,\Omega)\cdot j\,20\,\Omega}{20\cdot10^3}$$

$$= j\,20\,\Omega + \frac{20\,\Omega^2}{1000}\,\Omega \approx j\,2\pi f_0 \cdot 1\mu H + 0{,}1974\,\Omega$$



mit $Q_B = \frac{10\,MHz}{0{,}2\,MHz} = 50$ und $Z_0 = \omega_0 L = 20\,\Omega$

$$\rightarrow R_1' + R_2' = \frac{Z_0}{Q_B} = 1.2566\,\Omega$$

$$\rightarrow R_2' = (1.2566 - 0{,}1974)\,\Omega = \underline{1.0592\,\Omega}$$

bei f_0

$$\underline{Z}_2 = \frac{R_L}{1 + j\omega_0 R_L C_2} = \frac{R_L(1 - j\omega_0 R_L C_2)}{1 + (\omega_0 R_L C_2)^2}$$

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weiter zu 3.

$$R_2' = \frac{R_L}{1+(\omega_0 R_L C_2)^2} = 1.0592\,\Omega$$

$$\rightarrow (\omega_0 R_L C_2)^2 = \frac{1k\Omega}{1.0592\Omega} - 1 = 943.0757$$

$$\omega_0 R_L C_2 = 30.7095 \rightarrow C_2 = 488.76\,pF$$

$$Im\{\underline{Z}_2\} = -\frac{(\omega_0 R_L C_2) R_L}{1+(\omega_0 R_L C_2)^2} = -32.5287\,\Omega$$

$$\rightarrow X_1 = \frac{1}{\omega C_1} = Z_0 - 32.5287\,\Omega = 30.3032\,\Omega$$

$$\rightarrow C_1 = 525.21\,pF$$