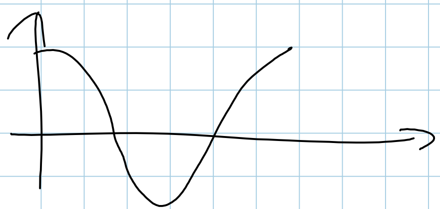
RÜ 3

Dienstag, 26. April 2011
16:02

Zusammenfassung:



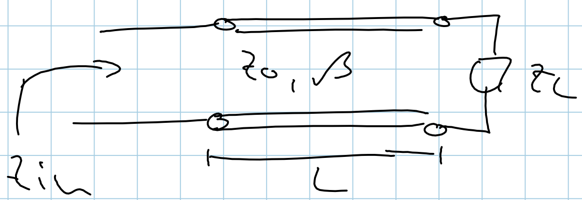
$$E = E_0 \cos(\omega t + \varphi)$$

$$= \mathrm{Re}\{E_0 \underbrace{e^{j\omega t}}_{\text{zeitl. Phasor}} e^{j\varphi}\}$$

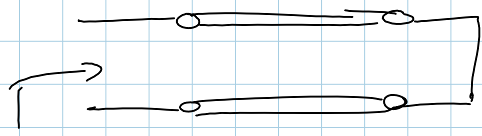
$$E = E_0 \underbrace{e^{-j\beta z}}_{\text{örtl. Phasor}}$$

$$\vec{E} = \vec{e}(x, y, z, t) = \vec{E}(x,y)\, e^{(\gamma z + j\omega t + \varphi)}$$

$$\gamma = \alpha + j\beta$$

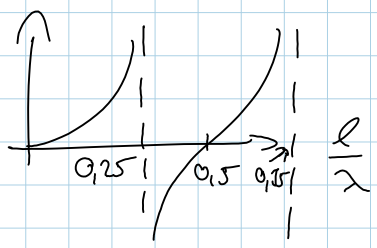


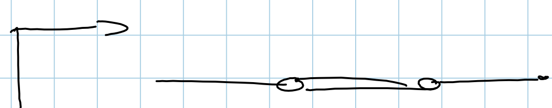
$$Z_{in} = \frac{Z_L + jZ_0 \tan\theta}{Z_0 + jZ_L \tan\theta} \qquad \theta = \beta L$$



Kurzschluss

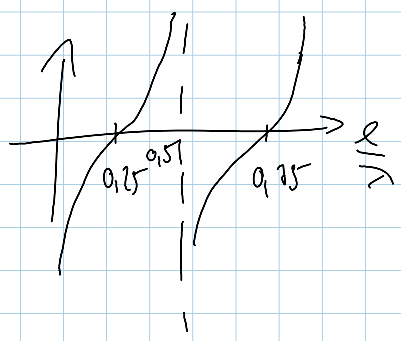
$$Z_{in} = jZ_0 \tan\theta$$





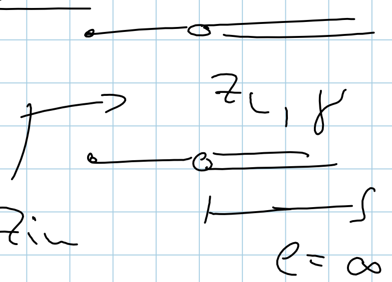
LL

Z_{in} $\quad Z_{in} = -j Z_0 \cot \Theta$



Aufgabe 4 H06

4.1.1

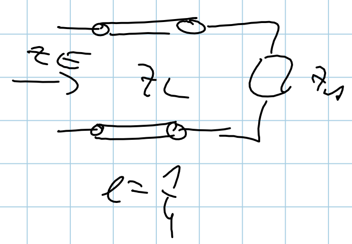


$Z_{in} = Z_L$

4.1.2

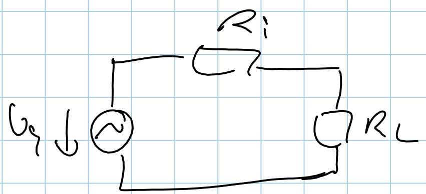
Ein $\frac{\lambda}{4}$-Transformiert eine Impedanz Z_A gemäß der Vorschrift

$$Z_E = \frac{Z_L^2}{Z_A}$$



4.1.3

$$P_{verf} = \frac{|U_q|^2}{8 \operatorname{Re}\{Z_i\}}$$

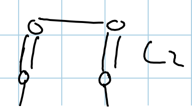


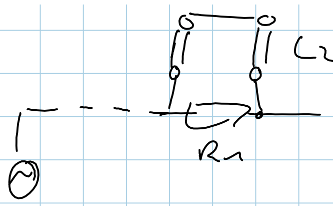
$$P_L = \frac{1}{2} R_L I^2$$
$$= \frac{1}{2} R_L \frac{|U_q|^2}{(R_i + R_L)^2}$$

$$R_i = R_L \Rightarrow P_L = \frac{1}{2} R_L \frac{|U_q|^2}{(2R_L)^2}$$

4.1.4

$$P = \frac{1}{2} \frac{|U|^2}{\operatorname{Re}\{Z\}}$$



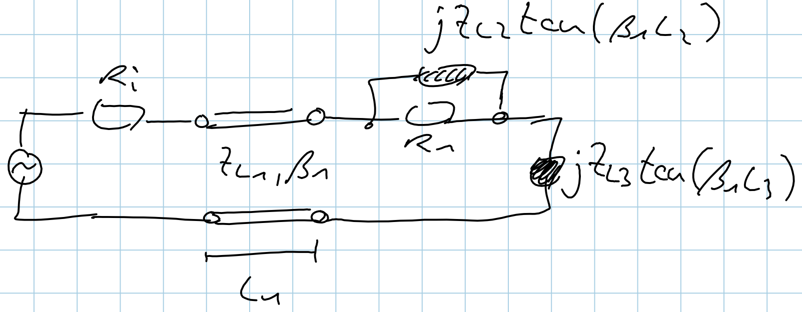


4.2.1 $\frac{L_2}{\lambda} = \frac{1}{2} \Rightarrow L_2 = \frac{1}{2} \frac{c_0}{f_2} = 62{,}5\,mm$

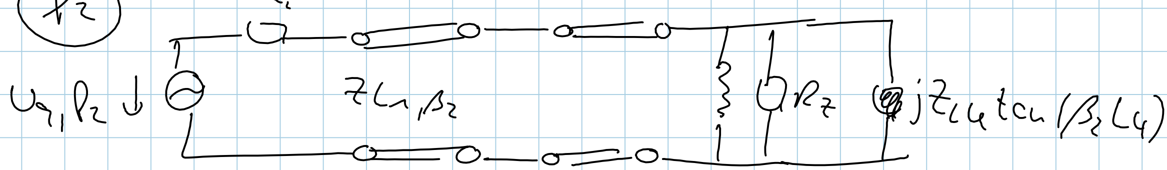
$\frac{L_4}{\lambda_1} = \frac{1}{2} \Rightarrow L_4 = \frac{1}{2} \frac{c_0}{f_1} = 50\,mm$

4.2.2

f_1



f_2



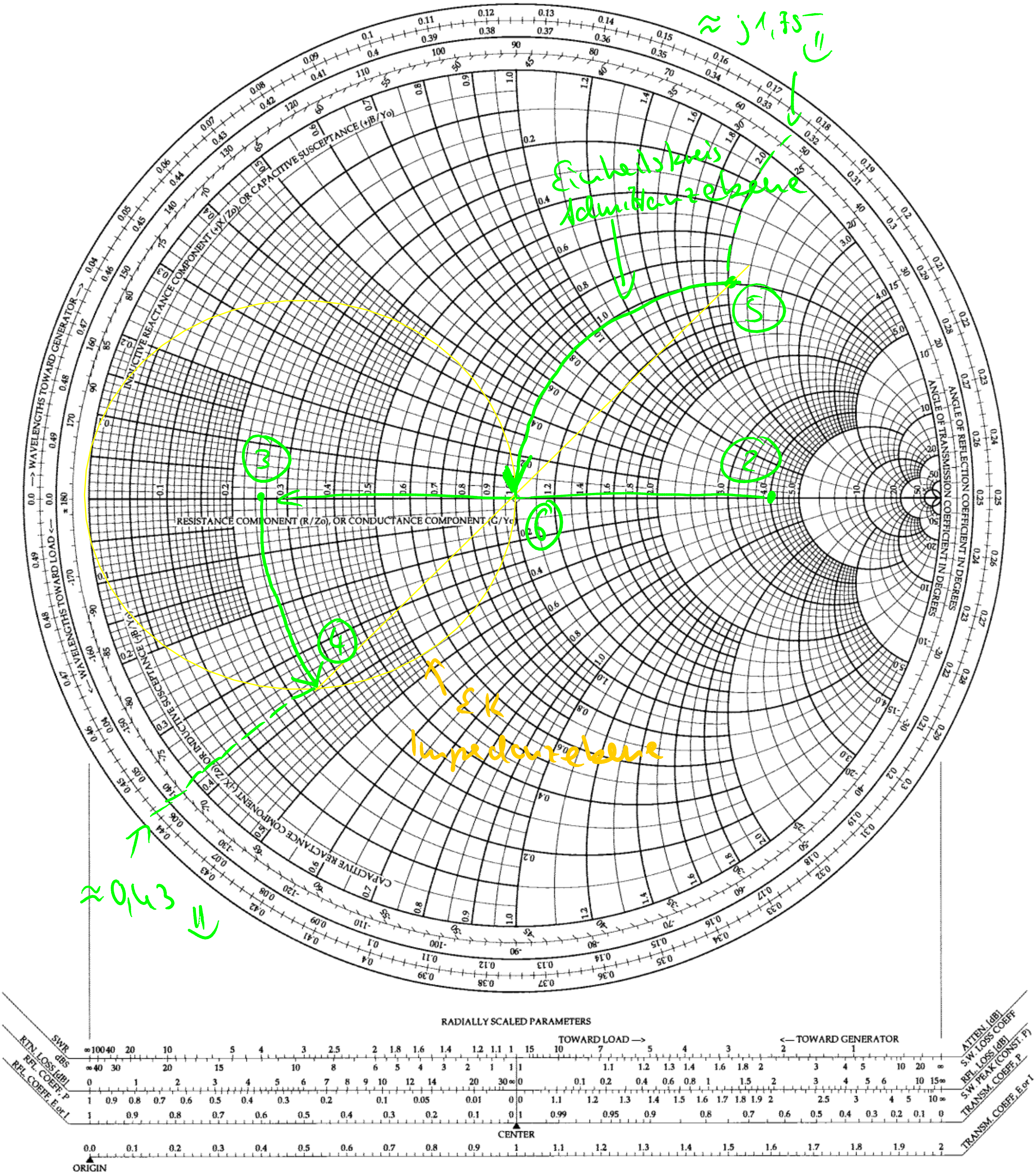
4.2.3

(1) Wähle $R_{ref} = 25\,\Omega$

(2) Start $\frac{R_1}{R_{ref}} = 4$

The Complete Smith Chart

Black Magic Design



③ $z \mapsto y \Rightarrow 0{,}25$

④ Addition von $-\frac{1}{Z_{L2}} \cot(\beta_1 L_2) \cdot R_{ref}$

sodass der invertierte Zielkreis geschnitten wird

⑤ $y \to z$

⑥ Addition von $j \frac{Z_{L3}}{R_{ref}} \tan(\beta_1 L_3)$ sodass

Ziel im Zentrum erreicht wird

Berechnung von Z_{L2} und Z_{L3}:

a)

$$-\frac{R_{ref}}{Z_{L2}} \underbrace{\cot(\beta_1 L_2)} = -j0{,}43$$

$$\cot\left(\frac{2\pi}{\lambda_1} \frac{\lambda_2}{2}\right) = \cot\left(\pi \frac{f_1}{f_2}\right) = 1$$

$$Z_{L2} = \frac{R_{ref}}{0{,}43} = 58{,}14\,\Omega$$

b)

$$j \frac{Z_{L3}}{R_{ref}} \underbrace{\tan(\beta_1 L_3)} = -j1{,}75$$

$$\tan\left(\frac{2\pi}{\lambda_1} 1{,}5\lambda_2\right) = \tan\left(3\pi \frac{f_1}{f_2}\right) = -1$$

$$\Rightarrow Z_{L3} = 1{,}75 \cdot R_{ref}$$

$$\underline{= 43{,}75\,\Omega}$$

4.2.4)

$$L_3 = 1{,}5\,\lambda_2$$

$$j\omega_2 L \overset{!}{=} -j Z_{L4} \tan(\beta_2 L_4)$$

$$= -j Z_{L4} \tan\left(\frac{2\pi}{\lambda_2} \underbrace{\frac{L_4}{\lambda_1}}_{\text{von } 4.2.1} \cdot \lambda_1\right)$$

$$= -j Z_{L4} \tan\left(2\pi \frac{L_4}{\lambda_1} \frac{f_2}{f_1}\right)$$

$$= -j\, 50 \tan\left(2\pi \cdot \frac{1}{2} \cdot 0{,}8\right) = j\, 36{,}327$$

$$L = \frac{36{,}327}{\omega_2} = 2{,}4\,\mathrm{nH}$$

4.2.5)

f_2 : $\underbrace{Z_E = R_i}_{\text{von } 4.2.4.}$ $\cdot$ $\frac{L_1}{\lambda_2} = 1$ ist Bedingung bereits erfüllt

f_1 : $Z_E = \underbrace{\frac{R_i}{4}}_{\text{von } 4.2.3} \cdot \frac{L_1}{\lambda_1} = \frac{L_1}{\lambda_2} \cdot \frac{\lambda_2}{\lambda_1} = 1{,}25$

L_1 ist $\frac{\lambda}{4}$-Transformator

$$Z_{L1} = \sqrt{Z_E \cdot R_i} = \frac{R_i}{2} = 50\,\Omega$$

4.2.6

$f_1)$ $|U_L|_{f_1} = 0$ $\qquad |I_L|_{f_1} = 0$

$f_2)$ $|U_L|_{f_2} = \sqrt{P_{ref} \cdot 2R_2} = \sqrt{\frac{|U_q|^2}{8R_i} \cdot 2R_2}$

$$= \sqrt{\frac{|U_q|^2}{4} \cdot \frac{R_2}{R_i}} = 5\,V$$

$$|I_L|_{f_2} = \frac{|U_L|_{f_2}}{\omega_2 L} = \frac{5}{36{,}19} = 138\,\mathrm{mA}$$

4.2.7 $\qquad f_2)$ $U_E(f_2) = \frac{U_q}{2} = 5\,V$

$a_2)\quad U_E(l_2) \quad \frac{\ }{2} = 5\,V$

$$\text{weil}\begin{cases} Z_E = R_i \\ \dfrac{L_1}{\lambda_2} = 1 \end{cases}$$

$$l_1)\quad U' = 10\,V \cdot \frac{R_i}{2R_i} = \frac{10}{2}\,V = 5\,V$$

$$U_E(l_1) = U'\sqrt{\frac{\frac{1}{4}R_i}{R_i}} = 2{,}5\,V$$