Grundlagen der Elektrotechnik II

Wechselstromwiderstände und Brückenschaltungen

Studien- und Versuchsaufgaben

Autor: Richard Grünert

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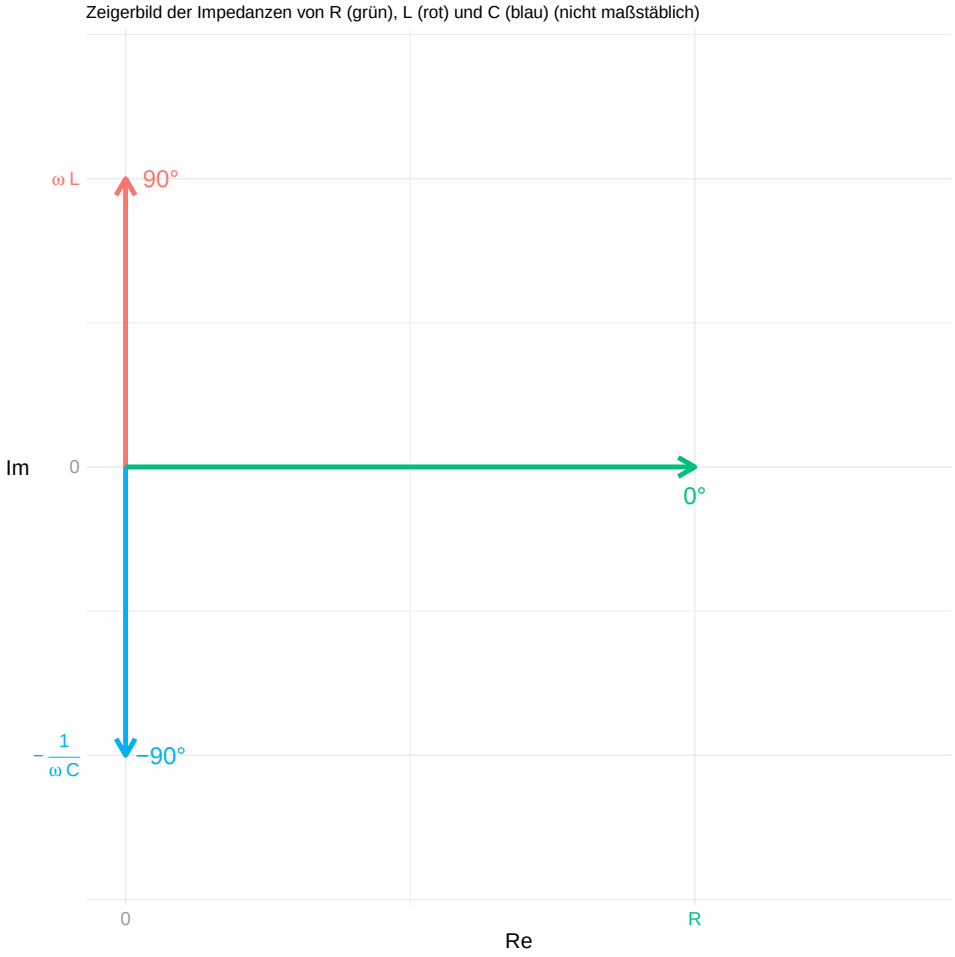
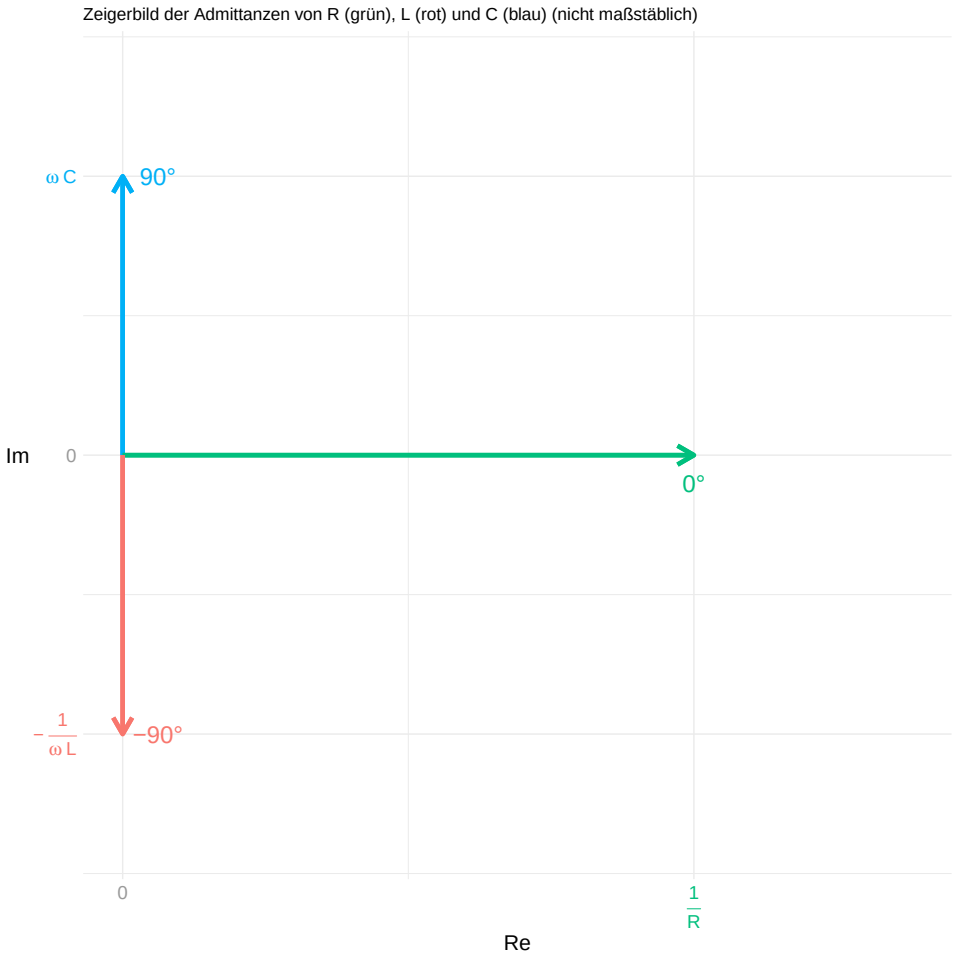
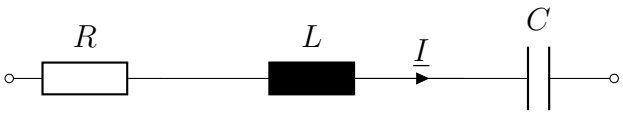
1 Vorbereitungsaufgaben

1.1





1.2



$$\underline{I} = \frac{\underline{U}}{\underline{Z}}, \quad \underline{U} = \hat{U} \cdot e^{j(\omega t + \phi_u)}$$

$$\underline{Z} = R + j\omega L + \frac{1}{j\omega C}$$

$$\underline{I} = \frac{\hat{U} \cdot e^{j(\omega t + \phi_u)}}{R + j(\omega L - \frac{1}{\omega C})}$$

Betrag:

$$| \underline{I} |= \hat{I} = \frac{\hat{U}}{\sqrt{R^2 + (\omega L - \frac{1}{\omega C})^2}}$$

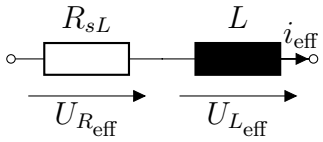
Phase:

$$\phi_i = \phi_u - \arctan\left(\frac{\omega L - \frac{1}{\omega C}}{R}\right)$$

Gesamt:

$$i(t) = \frac{\hat{U}}{\sqrt{R^2 + (\omega L - \frac{1}{\omega C})^2}} \cdot \cos\left(\omega t + \phi_u - \arctan\left(\frac{\omega L - \frac{1}{\omega C}}{R}\right)\right)$$

1.3



$$I = 1.5 \text{ mA}, \quad R_{sL} = 200\Omega, \quad L = 60 \text{ mH}$$

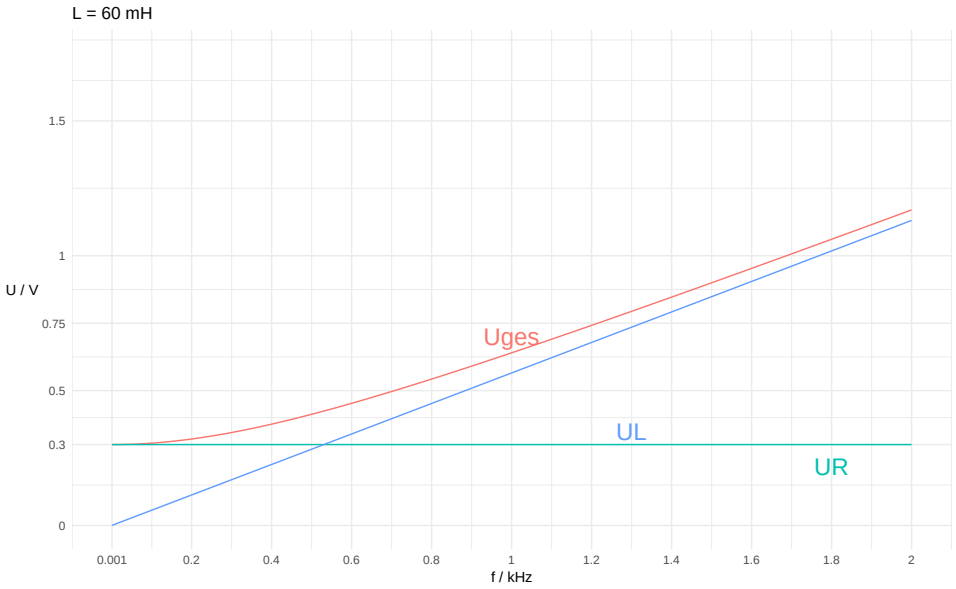
$$\underline{U}_{\text{ges}} = \underline{I} \cdot (R + j\omega L)$$

$$\hat{U}_{\text{ges}} = \hat{I} \cdot \sqrt{R^2 + \omega^2 L^2}$$

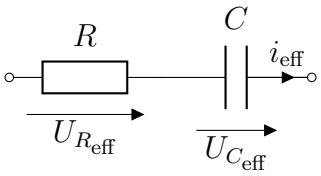
$$\hat{U}_{\text{ges}_{\text{eff}}} = I_{\text{eff}} \cdot \sqrt{R^2 + \omega^2 L^2} = 1.5\text{mA} \cdot \sqrt{(200\Omega)^2 + 4\pi^2 f^2 \cdot (60\text{mH})^2}$$

$$U_{R_{\text{eff}}} = I_{\text{eff}} \cdot R = 1.5\text{mA} \cdot 200\Omega = 0.3 \text{ V}$$

$$U_{L_{\text{eff}}} = I_{\text{eff}} \cdot \omega L = 1.5\text{mA} \cdot 2\pi f \cdot 60\text{mH}$$



1.4



$$I = 1.5\ \text{mA},\quad R = 200\Omega,\quad C_1 = 0.5\ \mu\text{F},\quad C_2 = 1\ \mu\text{F}$$

$$\underline{U}_{\text{ges}} = \underline{I} \cdot (R - j\frac{1}{\omega C})$$

$$\hat{U}_{\text{ges}} = \hat{I} \cdot \sqrt{R^2 + \frac{1}{\omega^2 C^2}}$$

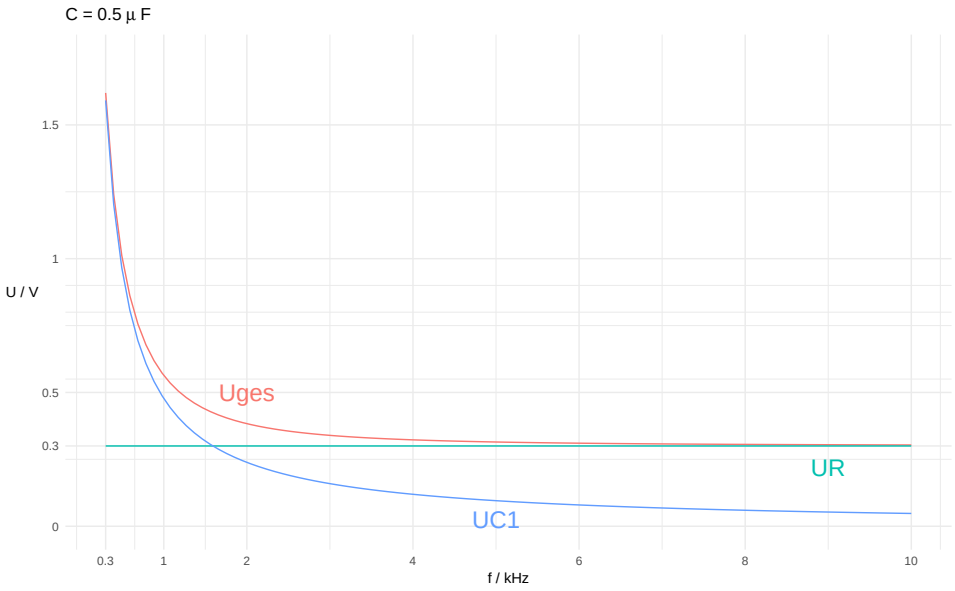
$$\hat{U}_{\text{ges}_{\text{eff}}} = I_{\text{eff}} \cdot \sqrt{R^2 + \frac{1}{\omega^2 C^2}} = 1.5\text{mA} \cdot \sqrt{(200\Omega)^2 + \frac{1}{4\pi^2 f^2 C^2}}$$

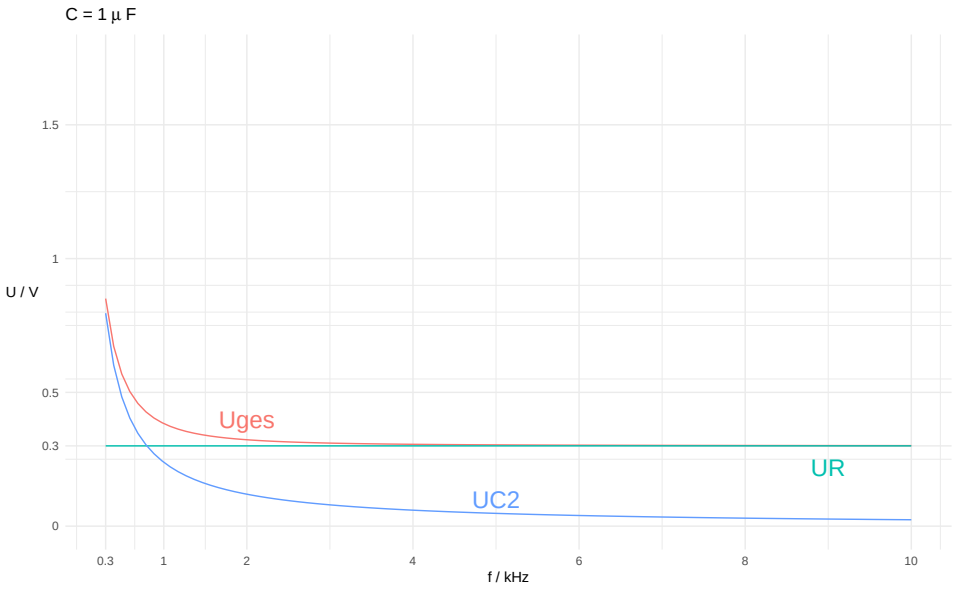
$$U_{R_{\text{eff}}} = I_{\text{eff}} \cdot R = 1.5\text{mA} \cdot 200\Omega = 0.3\ \text{V}$$

$$U_{C_{\text{eff}}} = I_{\text{eff}} \cdot \frac{1}{\omega C}$$

$$U_{C_{\text{eff}_1}} = I_{\text{eff}} \cdot \frac{1}{\omega C_1} = 1.5\text{mA} \cdot \frac{1}{2\pi f \cdot 0.5\mu\text{F}}$$

$$U_{C_{\text{eff}_2}} = I_{\text{eff}} \cdot \frac{1}{\omega C_2} = 1.5\text{mA} \cdot \frac{1}{2\pi f \cdot 1\mu\text{F}}$$





2 Versuchsaufgaben