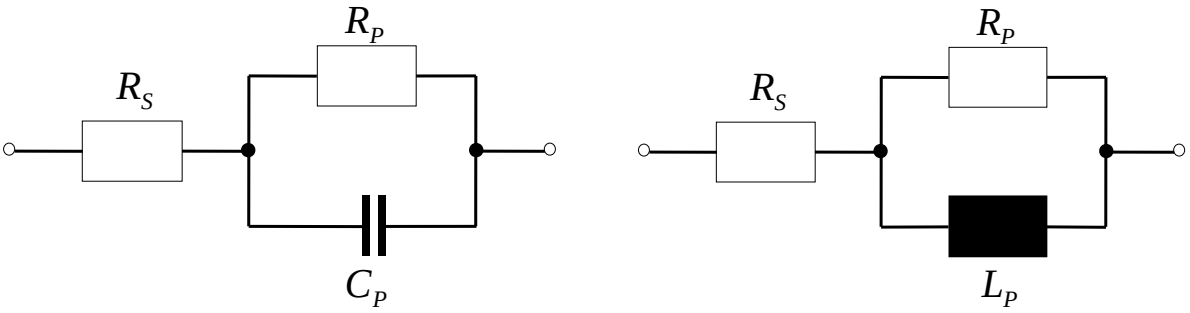
Parameter estimation of equivalent circuits



a) Calculate the impedance of the two equivalent circuits.

b) Draw the nyquist- and bode diagrams of the impedance of the two equivalent circuits.

The following values were measured at a circuit.

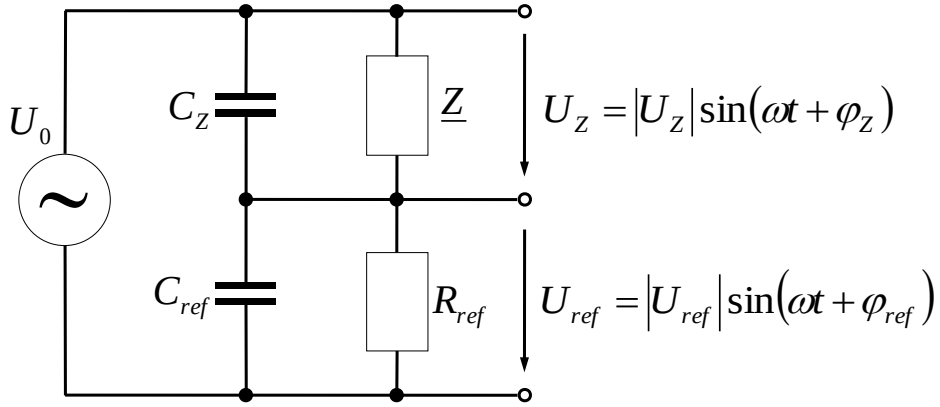
f/kHz	Z/Ω
0	110
10	12 - 15i

c) Which of the two equivalent circuits can generally be used to describe the obtained data? Give a reason for your decision.

d) Calculate the parameters of the suited equivalent circuit.

Errors during impedance measurement

The voltage-current-method should be used to measure the impedance of an unknown object. Therefore the voltage at the unknown impedance $\underline{Z}$ and the voltage at a reference resistor R_{ref} are measured. The absolute values and the phase angles are known from measurement and the impedance can be calculated from these values.



The reference resistor and the parasitic capacitances, for example caused by wires, are known with the following values.

- C_{ref}=200pF
- C_Z=100pF
- R_{ref}=24kΩ

Measuring the voltages at a frequency of f=15kHz gives the following results.

- $|U_Z|$ =2,1V, φ_Z=13°
- $|U_{ref}|$ =2,19V, φ_{ref}=8°

a) Calculate the value of the unknown impedance $\underline{Z}$ while neglecting the influences of all parasitic capacitances.

b) Now the influence of the parasitic capacitances is considered. Calculate the values of the complex voltages $\underline{U}_Z$ und $\underline{U}_{ref}$ depending on the voltage U_0.

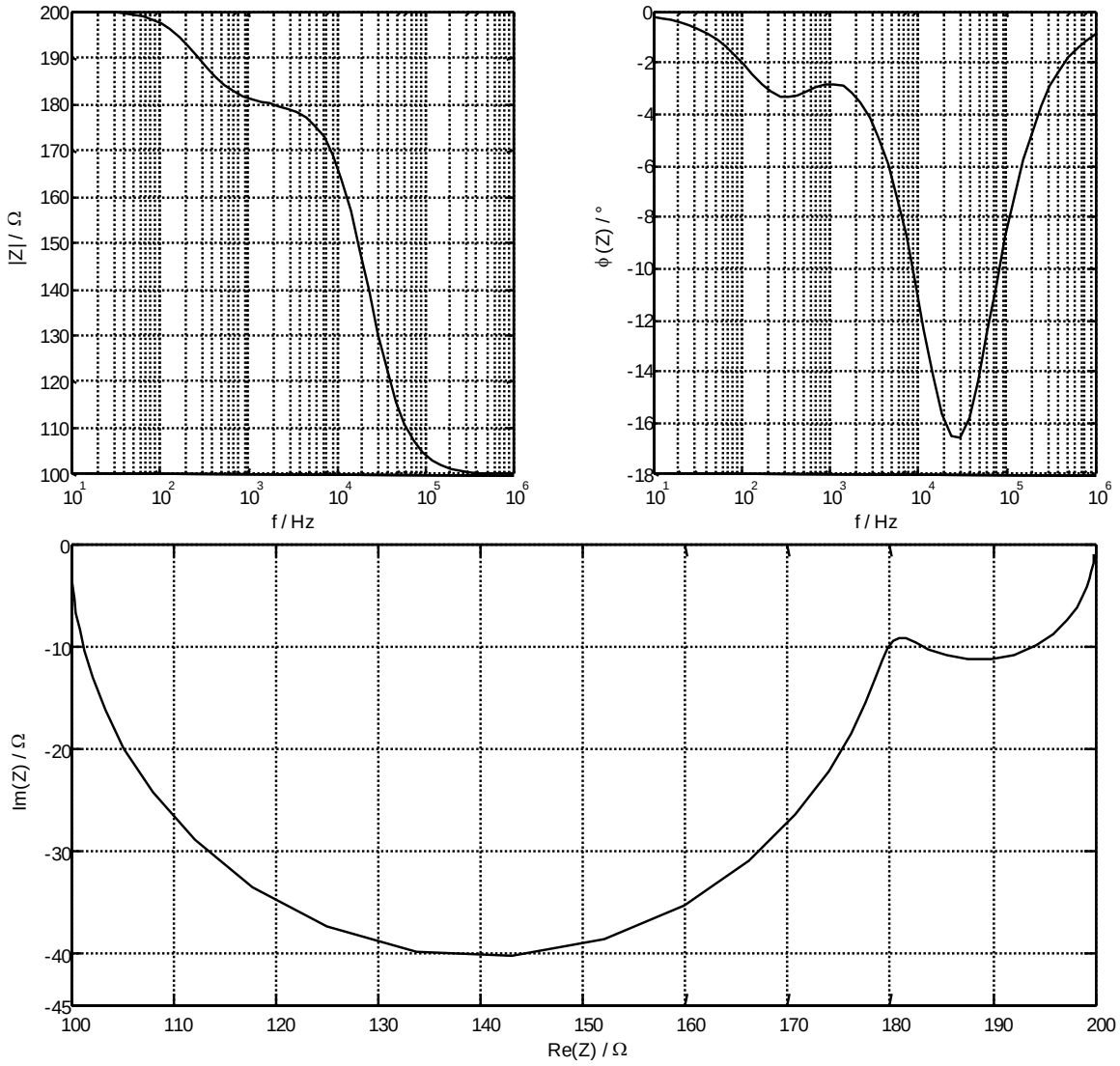
c) The complex voltage ratio of $\underline{U}_Z$ / $\underline{U}_{ref}$ is known from measurement. How the unknown impedance can be calculated from this ration by considering the parasitic capacitances? Calculate the corresponding formula.

d) Calculate the numerical value of the unknown impedance $\underline{Z}$ while considering the influence of the parasitic capacitances. What is the difference between the value without considering the parasitic capacitances?

e) Calculate the ration between the impedance with and without considering parasitic capacitances. Calculate the numerical value for the given example.

Modeling impedance data

The shown impedance spectrum was measured at an unknown object. Information about the unknown object and its parameters are required.



a) Propose an equivalent circuit suitable for describing the data. Give a reason for your decision.

b) Calculate estimate values of component values of your equivalent circuit.

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