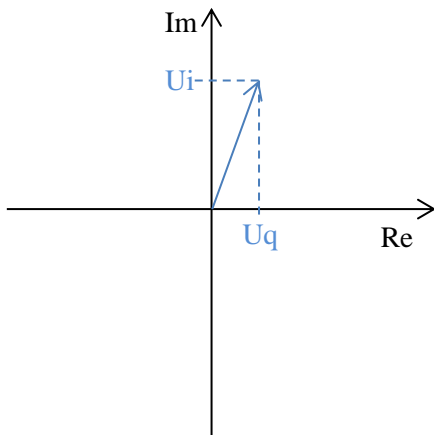


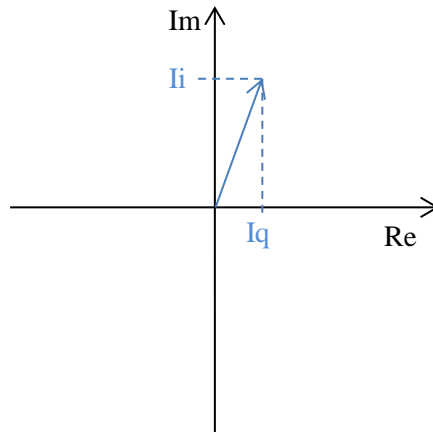
Basic formulas for LCR measurement

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Voltage signal in complex plane:



Current signal in complex plane:



For basics of complex math or conversion of angle + amplitude to complex plane, see:

http://en.wikipedia.org/wiki/Complex_number

Voltage signal: $U = U_q + i \cdot U_i, \quad I = \text{sqrt}(-1)$

Current signal: $I = I_q + i \cdot I_i$

$$\begin{aligned} \text{Complex impedance:} \quad U &= Z \cdot I \Leftrightarrow & Z &= U / I \\ &=> & Z &= (U_q + i \cdot U_i) / (I_q + i \cdot I_i) \\ &\Leftrightarrow & Z &= (U_q + i \cdot U_i) \cdot (I_q - i \cdot I_i) / ((I_q + i \cdot I_i) \cdot (I_q - i \cdot I_i)) \\ &\Leftrightarrow & Z &= (U_q \cdot I_q - i \cdot U_q \cdot I_i + i \cdot U_i \cdot I_q + U_i \cdot I_i) / (I_q^2 + I_i^2) \\ &\Leftrightarrow & Z &= (U_q \cdot I_q + U_i \cdot I_i) / (I_q^2 + I_i^2) \\ && &+ i \cdot (U_i \cdot I_q - U_q \cdot I_i) / (I_q^2 + I_i^2) \end{aligned}$$

Resistance: $R = \text{real}(Z) = (U_q \cdot I_q + U_i \cdot I_i) / (I_q^2 + I_i^2)$

Reactance: $X = \text{imag}(Z) = (U_i \cdot I_q - U_q \cdot I_i) / (I_q^2 + I_i^2)$

$R \Rightarrow$ series resistance (ESR)

X positive \Rightarrow inductor (see: http://en.wikipedia.org/wiki/Electrical_reactance)

$$X = 2 \cdot \pi \cdot f \cdot L \Leftrightarrow \underline{L = X / (2 \cdot \pi \cdot f)}$$

X negative \Rightarrow capacitor

$$X = 1 / (2 \cdot \pi \cdot f \cdot C) \Leftrightarrow \underline{C = 1 / (2 \cdot \pi \cdot f \cdot X)}$$

$X = 0 \Rightarrow$ resistor