Complex Power

$x = 2 - j1 \quad x^* = 2 + j1$

$y = 10 \angle 30^\circ \quad y^* = 10 \angle -30^\circ$

$\hat{S} \equiv$ complex power

$\hat{S} = \hat{V} \cdot \hat{I}^*$

$\hat{V} = V_{rms} \angle \theta$

$\hat{I} = I_{rms} \angle \phi$

$\hat{S} = (V_{rms} \angle \theta)(I_{rms} \angle -\phi)$

$\hat{S} = (V_{rms} I_{rms}) \angle (\theta - \phi)$ [volt-amperes, VA]

$\hat{S} = P + jQ$

$P = Re[\hat{S}]$

$Q = Im[\hat{S}]$

$P = V_{rms} I_{rms} \cos(\theta - \phi)$ [Watts, W]

$Q = V_{rms} I_{rms} \sin(\theta - \phi)$ [volt-amperes, reactive VAR]

↑ quadrature power

Sources:

$\hat{S} = \hat{V} \cdot \hat{I}^* = (V_{rms} I_{rms}) \angle (\theta - \phi)$ ← apparent power

$P = V_{rms} I_{rms} \cos(\theta - \phi)$

$Q = V_{rms} I_{rms} \sin(\theta - \phi)$

Impedances

Resistor: $P = \frac{(V_{rms})^2}{R}$ or $P = (I_{rms})^2 \cdot R$

$Q = 0$

$\hat{S} = P + jQ$

$\hat{S} = P$

$= (I_{rms})^2 \cdot R \angle 0^\circ$

capacitor: $P = 0$

$Q = -\frac{(I_{rms})^2}{\omega C}$ or $Q = -(V_{rms})^2 \cdot \omega C$

$\hat{S} = 0 + jQ$

$= \frac{(I_{rms})^2}{\omega C} \angle -90^\circ$

inductor: $P = 0$

$Q = (I_{rms})^2 \cdot \omega L$

$= \frac{(V_{rms})^2}{\omega L}$

$\hat{S} = 0 + jQ$

$= (I_{rms})^2 \cdot \omega L \angle 90^\circ$