Complex Power

Average Power P in sinusoidal steady state

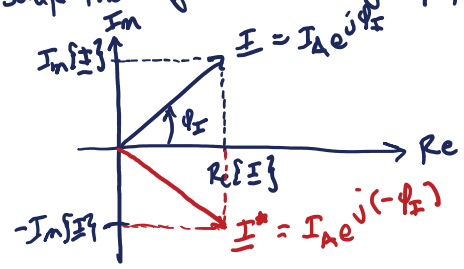
$$P = \frac{V_A I_A}{2}\cos(\phi_V - \phi_I) = \frac{1}{2}\mathrm{Re}\{\underline{V}\cdot\underline{I}^*\}$$

complex conjugate (swap the sign of the imaginary part)

$$\frac{1}{2}\mathrm{Re}\{\underline{V}\,\underline{I}^*\} = \frac{1}{2}\mathrm{Re}\{V_A e^{j\phi_V} I_A e^{-j\phi_I}\}$$

$$= \frac{1}{2}\mathrm{Re}\{V_A I_A e^{j(\phi_V - \phi_I)}\}$$

$$= \frac{1}{2} V_A I_A \cos(\phi_V - \phi_I) \checkmark$$



$$P = \frac{V_A I_A}{2}\cos(\phi_V - \phi_I) = V_{rms} I_{rms}\cos(\phi_V - \phi_I) = \frac{1}{2}\mathrm{Re}\{\underline{V}\,\underline{I}^*\} = \mathrm{Re}\{\underline{V}_{rms}\,\underline{I}_{rms}^*\}$$

rms phasor expression

What about the imaginary part of $\underline{V}\underline{I}^*$

$$\frac{1}{2}\underline{V}\underline{I}^* = \underline{V}_{rms}\underline{I}_{rms}^* = S = P + jQ$$

- S: Complex Power, [V·A]
- P: Real or Average Power, [W]
- Q: Reactive or Quadrature Power, [VAR]

Apparent Power & Power Factor

Apparent Power $|S| = \frac{V_A I_A}{2} = V_{rms} I_{rms}$

→ Maximum value of real power that can be obtained from V_A & I_A

Power Factor $PF = \frac{P}{|S|}$

$$= \frac{P}{V_{rms} I_{rms}} = \frac{\frac{V_A I_A}{2}\cos(\phi_V - \phi_I)}{\frac{V_A I_A}{2}} = \cos(\phi_V - \phi_I)$$

$0 \le PF \le 1$

general for non-sinusoids

1. How over-stressed is the circuit
2. Regulated for connection to the grid for any loads above 65W