Power with Sinusoidal Sources

\[ V = V_0 \text{sin}(\omega t + \phi) = I_0 \text{e}^{j\omega t} \]

\[ V = I_0 I_2 e^{j(\phi_2 + \phi)} \]

- For power, we cannot just multiply \( V \) and \( I \)
  \[ P(t) = v(t)i(t) = \text{Re} \left[ V(t)I(t) e^{j\phi} \right] \]

- Go back to the time domain:
  \[ P(t) = V_0 I_0 \cos(\omega t + \phi) \cdot I_0 \cos(\omega t + \phi) \]
  \[ = \frac{V_0 I_0}{2} \cos(2\omega t + \phi_1 + \phi_2) + \frac{V_0 I_0}{2} \cos(\phi_1 - \phi_2) \]

- No time-variation
  \[ \text{DC} \]

Average Power
\[ P = \frac{1}{T} \int_{0}^{T} P(t) \, dt = \frac{V_0 I_0}{2} \cos(\phi_1 - \phi_2) = V_{\text{rms}} I_{\text{rms}} \cos(\phi_1 - \phi_2) \]

**Power with Sinusoidal Sources**

Diagram showing sinusoidal waveforms of voltage \( v(t) \) and current \( i(t) \), with power \( p(t) \) calculated as the product of voltage and current. Diagram includes annotations for phase angle \( \phi \) and AC terms.