POWER IN AC CIRCUITS

*****All calculations for power are done with rms values of V and I, not phasors*****

Average (Real) Power **Symbol: P** **Units: Watts (W)**	**Resistors** $P = V_{R\,rms}\, I_{R\,rms}$ $= V_{R\,rms}^2 / R$ $= I_{R\,rms}^2 R$	**Capacitors** $P = 0$	**Inductors** $P = 0$	**System** $P = V_{rms}\, I_{rms} \cos(\theta_Z)$ $= V_{rms}^2 / Z_T \cos(\theta_Z)$ $= I_{rms}^2 Z_T \cos(\theta_Z)$
Reactive Power **Symbol: Q** **Units:** **Volts-Amps-Reactive (VAR)**	$Q = 0$	$Q_C = V_{C\,rms}\, I_{C\,rms}$ $= V_{C\,rms}^2 / X_C$ $= I_{C\,rms}^2 X_C$ $X_C = 1/(\omega C)$	$Q_L = V_{L\,rms}\, I_{L\,rms}$ $= V_{L\,rms}^2 / X_L$ $= I_{L\,rms}^2 X_L$ $X_L = \omega L$	$Q = V_{rms}\, I_{rms} \sin(\theta_Z)$ $= V_{rms}^2 / Z_T \sin(\theta_Z)$ $= I_{rms}^2 Z_T \sin(\theta_Z)$
Apparent Power **Symbol: S** **Units: Volt-Amps (VA)**	$S = P$	$S = Q$	$S = Q$	$S = V_{rms}\, I_{rms}$ $= V_{rms}^2 / Z_T$ $= I_{rms}^2 Z_T$

$V_{R,C,L\,rms}$ = rms voltage across respective component
$I_{R,C,L\,rms}$ = rms current thru respective component

V_{rms} = |source voltage|
I_{rms} = |total current from source|
Z_T = |total impedance|

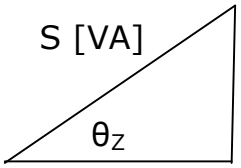
Power Triangle

$Q = S \sin \theta_Z$

$P = S \cos \theta_Z$

$S = \sqrt{P^2 + Q^2}$

$\theta_Z = \tan^{-1}(Q/P)$
$= \cos^{-1}(P/S)$
$= \sin^{-1}(Q/S)$



θ_Z **=** angle of $\bar{\mathbf{Z}}_\mathbf{T}$ vector

Power Factor

$F_P = \cos(\theta_Z)$

Leading → Capacitive
Lagging → Inductive