Ohm's Law – Watt's Law

$$I = \sqrt{\frac{P}{R}} \qquad E = \sqrt{P \times R}$$

$$I = \frac{P}{E} \qquad E = \frac{P}{I}$$

$$I = \frac{E}{R} \qquad E = I \times R$$

Amps **I**   Volts **E**

$$P = E \times I \qquad R = \frac{E}{I}$$

Power **P**   Ohms(Ω) **R**

$$P = I^2 \times R \qquad R = \frac{E^2}{P}$$

$$P = \frac{E^2}{R} \qquad R = \frac{P}{I^2}$$

Ohm's Law Circle

Voltage **E** / Current **I**   Resistance **R**

PIE Circle

Power **P** / Current **I**   Voltage **E**

Power Factor

Apparent Power (kVA)

Reactive Power (kVAr)

Power Factor Angle

Θ

Real Power (kW)

$$PF = \frac{\text{Real Power (KW)}}{\text{Apparent Power (kVA)}}$$

$$Cos \; \theta = PF$$

$$Tan \; \theta = \frac{kVAR}{kW}$$

Resistors in series

$$R_{total} = R_1 + R_2 + R_3 \ldots \ldots$$

R_1

$+$ Battery $-$

R_2

R_3

Resistors in parallel

$$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots \ldots$$

$+$ Battery $-$

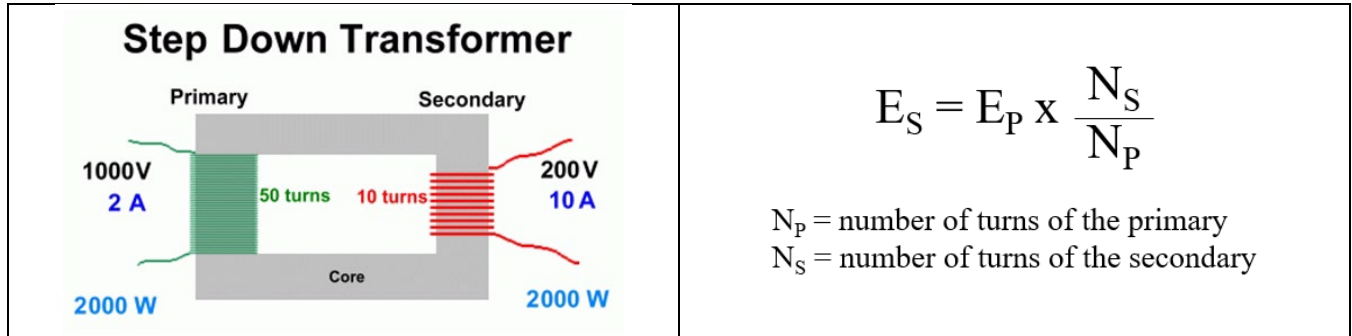R_1 R_2 R_3

AC Circuits
Single-Phase AC
The Watt's Law formulas for DC circuits also apply to single-phase (1φ) AC circuits containing only resistance.

If inductance or capacitive reactance puts the circuit out of phase, the power factor must be added to the basic power formula: **P = I x E x PF**

Three-Phase AC
The formula for a three-phase (3φ) system includes another term called the "three-phase factor", which is a constant equal to the square root of 3, or 1.73. **P₃φ = I x E x PF x 1.73**

Transformer

Step Down Transformer

Primary   Secondary

1000V   200V
2 A   10 A

50 turns   10 turns

Core

2000 W   2000 W

$$E_S = E_P \; x \; \frac{N_S}{N_P}$$

N_P = number of turns of the primary
N_S = number of turns of the secondary

Reactance Formulas
Inductor
$X_L = 2\Pi \, f \, L \; (\Omega)$ Where L is in Henrys

Capacitor
$X_C = 1 \, / \, 2\Pi \, f \, C \; (\Omega)$ Where C is in Farads

Impedance Formula

$Z = \sqrt{R^2 + (X_L - X_C)^2}$ in Ohms (for series circuit)