Three-Phase Power

The same types of AC power that were discussed earlier for single-phase AC circuits also exist in three-phase circuits. There is no new theory to learn. The only difference is that there is one additional conductor supplying power (two conductors for single-phase, three conductors for three-phase). This additional conductor allows more power to be carried for a given voltage, current, and phase angle. To be exact, 1.73 times more power may be carried (1.73 equals the square root of 3).

> NOTE: The math behind the derivation of the square root of three can be found in other publications. The relationship is the result of trigonometric parameters at 120° angles.

Formulas

The equation that is used to calculate three-phase power depends on the circuit and parameters used in the calculation. Care must be taken to avoid confusing the quantities. When working with wye connections, the following formulas are available to solve for power. Remember that $I_L = I_P$.

$$P_{3\phi va} = E_P \times I_P \times 3 \qquad P_{3\phi va} = E_L \times I_L \times \sqrt{3}$$

$$P_{3\phi watt} = E_P \times I_P \times 3 \times \cos\phi \qquad P_{3\phi watt} = E_L \times I_L \times \sqrt{3} \times \cos\phi$$

$$P_{3\phi var} = E_P \times I_P \times 3 \times \sin\phi \qquad P_{3\phi var} = E_L \times I_L \times \sqrt{3} \times \sin\phi$$

When working with delta connections, the following formulas are available to solve for power. Remember that $E_L = E_P$.

$$P_{3\phi va} = E_P \times I_P \times 3 \qquad P_{3\phi va} = E_L \times I_L \times \sqrt{3}$$

$$P_{3\phi watt} = E_P \times I_P \times 3 \times \cos\phi \qquad P_{3\phi watt} = E_L \times I_L \times \sqrt{3} \times \cos\phi$$

$$P_{3\phi var} = E_P \times I_P \times 3 \times \sin\phi \qquad P_{3\phi var} = E_L \times I_L \times \sqrt{3} \times \sin\phi$$