

Our next example is closer to real life with the current lagging the voltage by 30 degrees. Most power systems have all three parts of the power triangle with Watts, VARs, and VA as shown in Figure 1-26.

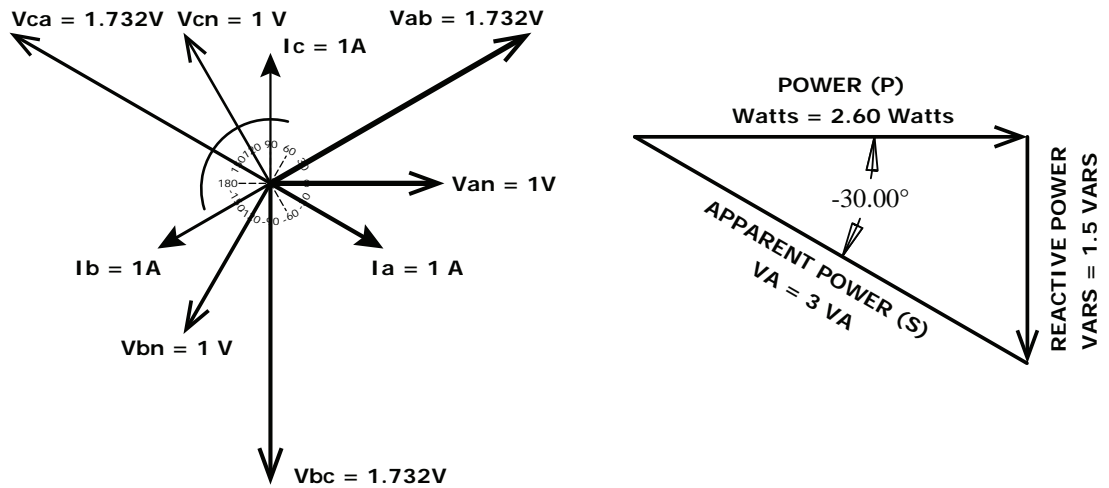


Figure 1-26: Power Triangle

$$\text{WATTS} = \sqrt{3} \times V_{ab} \times I_a \times \cos(\text{Vangle} - 30^\circ - \text{Iangle})$$

$$\text{WATTS} = \sqrt{3} \times 1.732\text{V} \times 1.0\text{A} \times \cos(30^\circ - 30^\circ - -30^\circ)$$

$$\text{WATTS} = 3 \times \cos(30^\circ)$$

$$\text{WATTS} = 3 \times 0.866$$

$$\text{WATTS} = 2.60 \text{ WATTS}$$

$$\text{VA} = \sqrt{3} \times V_{ab} \times I_a$$

$$\text{VA} = \sqrt{3} \times 1.732\text{V} \times 1.0\text{A}$$

$$\text{VA} = 3\text{VA}$$

$$\text{VARs} = \sqrt{3} \times V_{ab} \times I_a \times \sin(\text{Vangle} - 30^\circ - \text{Iangle})$$

$$\text{VARs} = \sqrt{3} \times 1.732\text{V} \times 1.0\text{A} \times \sin(30^\circ - 30^\circ - -30^\circ)$$

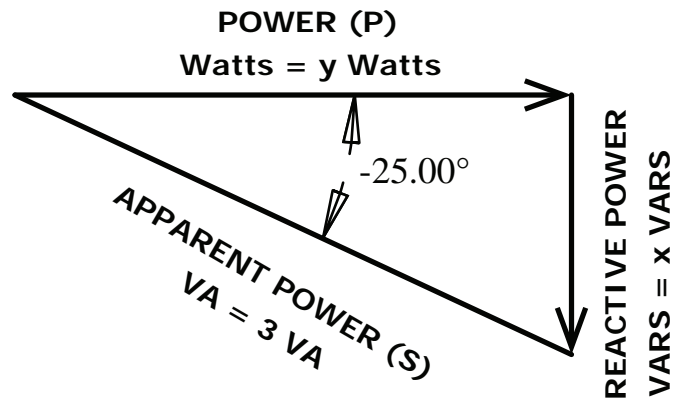
$$\text{VARs} = 3 \times \sin(30^\circ)$$

$$\text{VARs} = 3 \times 0.5$$

$$\text{VARs} = 1.5 \text{ VARs}$$

Figure 1-27: Example Three-Phase Power/VARS/VA Formula Calculations

You can apply the Pythagorean Theorem in nearly every aspect of phasor diagrams and other electrical properties as shown in the following example:



$$\text{WATTS} = \sqrt{3} \times V_{ab} \times I_a \times \cos(\text{Vangle} - 30^\circ - \text{langle})$$

$$\cos \theta = \frac{y}{VA}$$

$$\text{WATTS} = VA \times \cos(30^\circ - 30^\circ - -25^\circ)$$

$$\cos(-25) = \frac{y}{3VA}$$

$$\text{WATTS} = 3 \times \cos(25^\circ)$$

$$y = \cos(-25) \times 3VA = 0.906 \times 3VA$$

$$\text{WATTS} = 3 \times 0.906$$

$$y = 2.72 \text{ WATTS}$$

$$\text{WATTS} = 2.72 \text{ WATTS}$$

$$\text{VARS} = \sqrt{3} \times V_{ab} \times I_a \times \sin(\text{Vangle} - 30^\circ - \text{langle})$$

$$\sin \theta = \frac{x}{VA}$$

$$\text{VARS} = VA \times \sin(30^\circ - 30^\circ - -25^\circ)$$

$$\sin(-25) = \frac{x}{3VA}$$

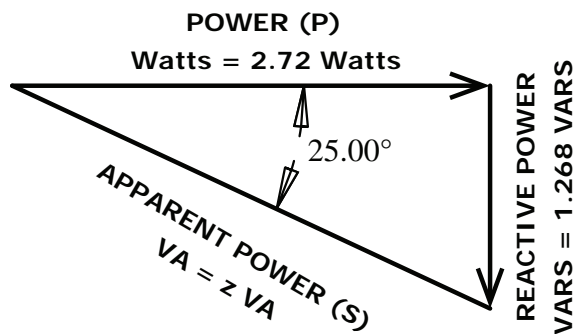
$$\text{VARS} = 3 \times \sin(25^\circ)$$

$$x = \sin(-25) \times 3VA = 0.423 \times 3VA$$

$$\text{VARS} = 3 \times 0.423$$

$$x = 1.268 \text{ VARS}$$

$$\text{VARS} = 1.268 \text{ VARS}$$



$$VA = \sqrt{(\text{WATTS}^2 + \text{VARS}^2)}$$

$$VA = \sqrt{(2.72^2 + 1.268^2)}$$

$$VA = \sqrt{(7.3984^2 + 1.6078^2)}$$

$$VA = \sqrt{(9.00)} = 3 \text{ VA}$$