Experiment #1: Power Measurements

Figure 1 shows the terminals to a wattmeter similar to the one on your station. The two large connectors measure the current through a wire and the third smaller terminal measures the voltage. The wattmeter can read the current, voltage or power. In the sinusoidal case, the power \( P \) is the average power and is given by \( P_{\text{avg}} = P = V_{\text{rms}} I_{\text{rms}} \cos(\theta) \) where \( \theta \) is the phase angle between the current and voltage.

Given a power source \( G \) connected to a network \( N \) as shown in figure 2, we can measure the power into the network by connecting the wattmeter as shown in figure 3.

An electrical resistance load is wired behind the board of your station. It has three banks each of which looks like the one shown in figure 4.
Experiment outline:

1. Connect an AC source of 120V (single phase) to a load of 500 Ohm. Connect a wattmeter so as to measure the power to the load. Compare with the theoretical value.

2. Connect three banks (each 500 Ohm) as a Y-load and configure a three phase AC source of voltages connected as a Y-source with line to line voltage of approximately 208 volts. DO NOT CONNECT THE NEUTRAL. Connect two wattmeters (one to measure current of line ‘a’ and voltage to line ‘b’, the other to measure current of line ‘c’ and voltage to line ‘b’). Compare the sum of the computed powers to each resistor with the total power reading on both wattmeters. What do you note? Did you need both wattmeters? Explain your answers and make observations.

3. Now unbalance the load by making one of the banks smaller in resistance. To do this, remember to power down safely. Repeat part 2. above. What do you think about the results?

4. Repeat part 2. with a balanced delta load using 500 Ohm on each side of the delta.

5. Repeat part 2. with an unbalanced delta load.

The diagrams below may be helpful in your setup of this experiment.

Please follow the safety rules discussed in the lecture in this and all experiments in the lab. This is important for your safety and the safety of others in the lab.