THREE PHASE MEASUREMENTS

The objective of this experiment is to investigate the relationships between different voltages and currents in a three phase circuit.

Laboratory Equipment:

This lab will make use of:

1) 120/208 V three phase supply  
2) load cart  
3) watt meters, amp meters, and volt meters

This lab will consist of 2 parts. The first part is performing power measurements on 4 wire Y to Y circuit. The final part is measuring voltages and currents in a Δ load.

Instructions

Power Measurements

1) On the load cart, wire a Y connected resistor circuit. Wire a Y connected capacitor circuit. Be sure that all the R switches and all the C switches are in the off position. See figure 1 for a schematic.

2) On the left instrumentation panel, connect the digital power meters to all three phases and the connect the current coils of two analog watt meters in line A and in line B. See figure 2. The digital and the analog watt meters should be in series and all shorted by the amp meter shorting switches. The voltage connections of the digital watt meter should be on the right side of the shorting switches. On the analog meters use the 5 A range on the current coils. Connect the phase A watt meter to measure the A-C voltage (A positive), and connect the phase B watt meter to measure voltage B-C (B positive). Use the 300 V range on the voltage coils of the watt meters.

3) Connect the load cart to the instrumentation panel and the instrumentation panel to circuit B. Connect the 120/208 V source to circuit B. Be sure that the amp meter shorting switches are closed. Have your instructor check your circuit. Energize the circuit.

Figure 1

Load Cart

Figure 2
4) Open the amp meter shorting switches for the three phases. Add 300 W of resistance per phase on the load cart. Be sure both analog watt meters are deflecting in the positive direction. If not change the POS/NEG toggle switch. Using the digital watt meter, record the three line voltages, the three line to neutral voltages, the three line currents, the three phase power, and the power factor. Using the analog watt meters, record each indicated power (including the position of the POS/NEG switch, and the multiplication factor).

5) Add 60 µF of capacitance per phase. Be sure both analog watt meters are deflecting in the positive direction. If not change the POS/NEG toggle switch. Using the digital watt meter, record the three line voltages, the three line currents, the three phase power, and the power factor. Using the analog watt meters, record each indicated power (including the position of the POS/NEG switch, and the multiplication factor).

6) Deenergize the circuit by turning off the power at the power pedestal and opening the breaker at the left side of the instrumentation panel. Disconnect the analog watt meters. Disconnect the capacitor load.

\[ \text{Connections Voltage and Current} \]

7) Reconnect the resistor bank as a delta load with 300 W/phase. Disconnect the \( V_n \) connection to the digital wattmeter. Close the amp meter shorting switch. \textbf{Have your instructor check your circuit.} Energize the circuit.

8) Using the digital watt meter, record the three line currents and the three line to line voltages.

9) Using the TekMeter display the phase current in the load from a to b (\( I_{ab} \)) on channel 1 and the voltage ab (\( V_{ab} \)) on channel 2. Record the magnitude of the 2 signals and the phase angle between them. Repeat for the currents \( I_{bc} \) and \( I_{ca} \).
10) Move the current probe to measure the line current $I_a$ leaving the voltage $V_{ab}$ displayed on channel 2. Record the magnitude of the 2 signals and the phase angle between them. Repeat for currents $I_b$ and $I_c$.

11) Deenergize the circuit. Clean up your work bench.

**Report**

1) Calculate the real and reactive power in the balanced Y load three different ways. From Parts 4 and 5, compare the real and reactive power determined by the i) digital power meter, ii) the 2 watt meter method, and iii) using the line voltage, the line current and the power factor. Discuss reasons for any differences.

2) From Part 4, draw a phasor diagram with the three line to neutral voltages and the three line to line voltages. Comment on the needed phase relationship for the recorded magnitudes.

3) From Parts 9 and 10, draw a phasor diagram with the three line currents and the three phase currents using the voltage $V_{ab}$ as the reference (angle of 0°). Comment on the needed phase relationship for the line and phase currents to have the recorded magnitudes.