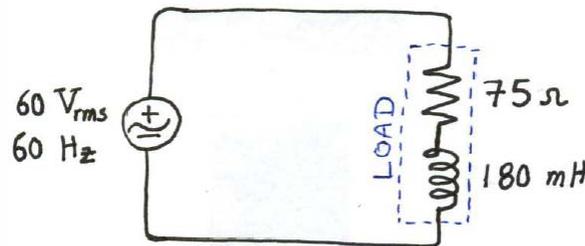


**Laboratory #2****Power Factor Correction****I. Pre-Laboratory Assignments**

1. Copy and paste this entire laboratory assignment into your laboratory notebook. Do all of your pre-lab and laboratory work in your lab book in ink. Do not bring any loose paper to the lab.
2. Two circuits will be analyzed to determine the power factor. These are shown in Figs. 1 and 2 below. A capacitor bank will be added in parallel to the load to correct the power factor to specific values. For each of the circuits, assume that the output from the voltage source is 60 V<sub>rms</sub> at a frequency of 60 Hz.
3. For the circuit of Fig. 1,
  - a. Calculate the complex power absorbed by the load and draw the power triangle.
  - b. Calculate the power factor of the load.
  - c. Calculate the value of capacitor required to give a power factor of 1.
  - d. Calculate the value of capacitor required to give a power factor > 0.95 (lagging).
  - e. Determine and sketch the layout of the switches in the capacitor bank shown in Fig. 3 to correct the power factor to > 0.95 (lagging).

**Figure 1**

4. For the circuit of Fig. 2,
  - a. Calculate the complex power absorbed by the load and draw the power triangle.
  - b. Calculate the power factor of the load.
  - c. Calculate the value of capacitor required to give a power factor of 1.
  - d. Calculate the value of capacitor required to give a power factor > 0.99 (lagging).
  - e. Determine and sketch the layout of the switches in the capacitor bank shown in Fig. 3 to correct the power factor to > 0.99 (lagging).

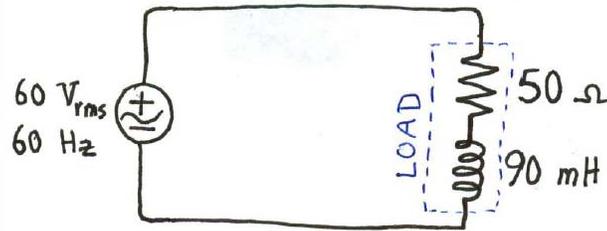


Figure 2

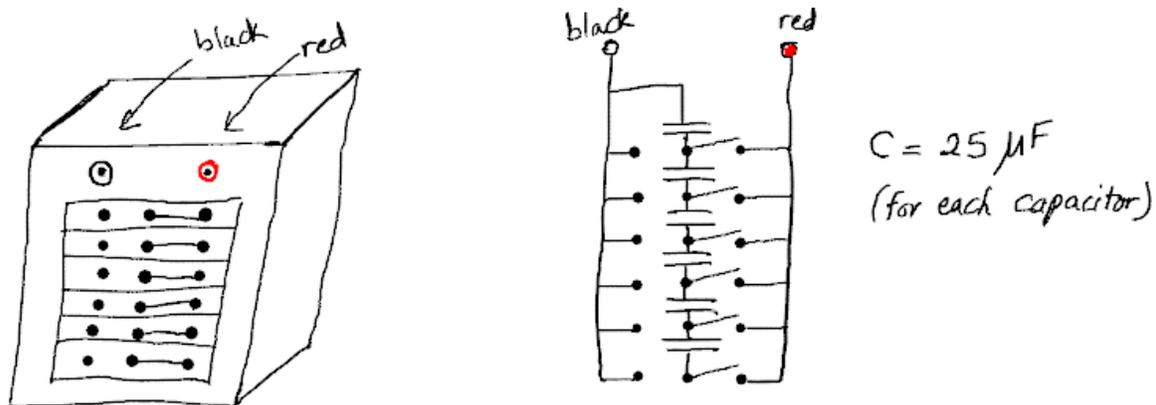


Figure 3

## II. Laboratory Experiments

1. The preliminary should be complete and signed off by the instructor or the TA before proceeding to the experimental portion of this lab.
2. Be aware of the safety comments discussed in Lab Experiment – 1.
3. You will use the variac to supply  $60 V_{rms}$  to the load. Remember:
  - a) Do NOT modify the circuit when the variac is on.
  - b) Turning the variac ON is the LAST step when you are ready to measure.
  - c) Turning the variac OFF is the FIRST step when you finish measurements.
  - d) When the variac is off, always keep the knob at the full CCW position (i.e. 0 output voltage). When you turn the variac on, adjust the knob position slowly until the desired output voltage is measured.
4. For the circuit of Fig. 1,
  - a. Construct the circuit using the same parts as those used in Laboratory #1. Use two inductors to realize the required inductance.
  - b. Use the wattmeter to measure the RMS voltage, RMS current, and average power of the load. From these measured values, calculate the apparent power and power factor.
  - c. Add the capacitance calculated in step 3 of the pre-lab parallel with the load using the capacitor bank described in Laboratory #1. An internal schematic is shown above in Fig. 3.

Measure the new RMS voltage, RMS current, and average power of the load with the capacitor bank attached. Calculate the new apparent power and power factor.

5. For the circuit of Fig. 2,
    - a. Note that only a single inductor will be needed. Choose one of yours, and bring it to the instructor or TA and have them measure its inductance.
    - b. Construct the circuit using this measured inductor.
    - c. Use the wattmeter to measure the RMS voltage, RMS current, and average power of the load. From these measured values, calculate the apparent power and power factor.
    - d. Add the capacitance calculated in step 4 of the pre-lab parallel with the load using the capacitor bank described in Laboratory #1. Measure the new RMS voltage, RMS current, and average power of the load with the capacitor bank attached. Calculate the new apparent power and power factor.
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## II. Analysis and Conclusions

- a) Compare the results of your hand analysis and measurements. Create a table to organize your data.
  - b) Are the currents, voltages, powers, and power factors you expected from your hand analysis close to (or matching with) the outputs of your measurements? Explain notable differences.
  - c) From these measurements, explain the role of the added capacitor. What specifically does power factor correction mean? What is being “corrected”? Illustrate this using results from your measurements.
  - d) From your measurements in part 5 of the laboratory experiments, estimate the inductance value of the inductor. Compare with the measured value from part 5a.
  - e) When you are finished with your lab, make a photocopy of all the right side pages and print them out. Turn in your lab at the beginning of lecture on the due date. If you don't have easy access to a photocopier machine, the app GeniusScan works with your smartphone and allows you to easily create a pdf that can be printed.
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† Adapted from D. Anagnostou, “Lab Experiment – 2,” 2015.