AC Circuits Laboratory **Lab # 6**

Power Factor Correction

Lab Objectives

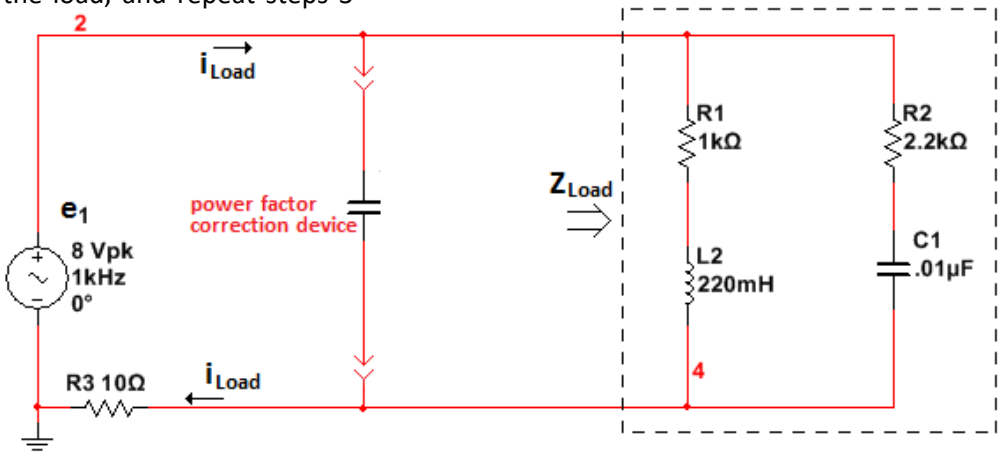
1. To predict the total current, power, and power factor for a given system at a given frequency.
2. To measure and record predicted circuit parameters in the lab and compare with the predicted and simulated responses.
3. To create documentation necessary to show the power factor and the proper correction of that power factor for a specific system.
4. To demonstrate understanding of how power factor affects the current required from a source.
5. To demonstrate understanding of how to correct power factor with the addition of a single correction element.

Pre-Laboratory Preparation

Prior to your laboratory meeting time, the following items need to be completed. As usual, the prelab quiz will be based on this preparation. There are Lab Notes at the end of this document, read them **before** coming to lab.

1) Research
   Review the concept of Power Factor Correction in your textbook and lecture notes.
2) Create a table using Excel. This table should contain all the necessary spaces to record the data taken in the following steps as well as from lab. There should be spaces to compare calculated, simulated, and measured data as well as % error calculations.
3) Study the circuit in Figure 1. On green engineering or quadrille paper, calculate the total impedance $\mathbf{Z}_{Load}$ for this circuit (magnitude and phase angle). Using $\mathbf{e}_1$ = 8Vp/0°, calculate the total load current, $\mathbf{i}_L$ ($\mathbf{I}_{Load}$ in Figure 1) and the load power $\mathbf{P}_L$. Finally, calculate the Apparent Power (**S**) and the Quadrature (reactive) power (Q). **(Hint: show V and I in rms)**
4) NEATLY Sketch the Power triangle for the circuit of figure 1, and label it properly.
5) Calculate the power factor correction device and its value that, when placed in parallel with the load, will correct the power factor seen by the source to unity.
6) Add the power factor correction component you designed in parallel with the load, and repeat steps 3 and 4. (Has $\mathbf{i}_L$ changed?)
7) Capture and simulate the circuit in figure 1. Use the transient analysis function to measure the applied voltage $\mathbf{e}_1$ and the load current $\mathbf{i}_{Load}$, represented by the voltage across the sampling resistor R_{sample} (scale this voltage as necessary so that you can use it to determine the load current (magnitude and angle). Capture this image, and embed it in a WORD document. Add the circuit diagram and label the graph and diagram properly.
8) Place the Power Factor Correction component that you calculated in step 5 in parallel with the load, and repeat step 7.
9) Preparation for prelab quiz: The prelab quiz for this lab will be based on the preceding calculations and/or simulations and may include the following:
   a) The Power Triangle P, S, and Q.
   b) Power Factor effects and Power Factor Correction
   c) Measuring voltage, current and power in the time domain using an oscilloscope.
   d) Using MultiSim simulation software

Figure 1:



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AC Circuits Lab Procedure: Work with your lab partners and make sure you know your assigned roles

1) Build the original circuit shown in Figure 1 without the power factor correction component and using R_3 = 22 Ohms. Display $\mathbf{e}_1$ and $\mathbf{v}_{R\text{sample}}$ for ~ 2 cycles on channels 1 and 2 of the oscilloscope. Capture the image and embed it in a WORD document titled **AC Circuits Lab 6 [your team name].** Print this document, label it properly and record the value of $\mathbf{i}_L$ here and in your data table.
2) Using $\mathbf{e}_1$ and $\mathbf{i}_L$, Calculate P, S, and Q. Record these calculations and the power triangle in your WORD document, below the image from step 1.
3) Have your instructor sign off on your data, calculations and power triangle.
4) Place an R-C substitution box across the load and dial in the capacitance that causes the voltage $\mathbf{e}_1$ and the current $\mathbf{i}_L$, to be in phase.
5) Record the value of this capacitance. Capture the oscilloscope image and embed it in your WORD document on page 2. Print this page, and label it properly. Record the new value of $\mathbf{i}_L$ and calculate the new P, S, and Q values. Record these calculations and the new power triangle in your WORD document, below this image. These are the Unity Corrected Power Factor values.
6) Have your instructor sign off on your data, calculations and power triangle.

AC Lab: Lab 6 Post Lab Requirements

After lab, during a time specified by your instructor, take the Post Lab Quiz on myCourses. You may use your prelab work and lab data as reference material.

Turn in your completed documentation at the beginning of next week's lab before you take that week's prelab quiz. Your submission package will be graded and returned with comments. Submit only the following pages (in order) at the start of lab NEXT week:

1. The attached cover page, completely filled-out with instructor signatures, one per team.
2. The O'Scope plots, calculations for current and the power triangle for each circuit, one per team.
3. Your data table with pre-lab and lab values for load current (I, magnitude and angle), apparent power (S, magnitude and angle), real power (P) and reactive power (Q), including percent error calculations and schematics, one per team. Your Excel data table should have a title, headers, correct units, and be easy to read with gridlines. Your data should be displayed with the circuit diagram on the same page. ** Explain any large errors between your measurements and calculations**

Power Factor Correction

Team Name and Lab Section:.....

Team Members Present (printed)

First Name, Last Name	Role This Lab	RIT Program

TEAM LABORATORY RESULTS GRADE

(all work done neatly, legible and properly organized, all signoffs in place, oscilloscope plots and annotations included, data table accurate and complete no missing or extraneous information)

Instructor signature, original circuit. (step 1) _____	/10
Plots, annotations and calculations (step 2)	/10
Power triangle (steps 2)	/5
Instructor signature, PFC circuit (step 5) _____	/10
Plots, annotations and calculations (step 5)	/10
Power triangle (steps 5)	/5
Schematic and data table (properly titled, accurate, % error calculations, explanations of any large errors, Excel format)	/10
Final Team Grade	**/60**

Instructor comments: