To: Professor Darish
From: Trever Wagenhals
Subject: Power Analysis in AC Circuits

Date: 4/07/2015
Course & Section Number:
Partner(s):
TA:

SUMMARY

EXPERIMENTAL APPROACH

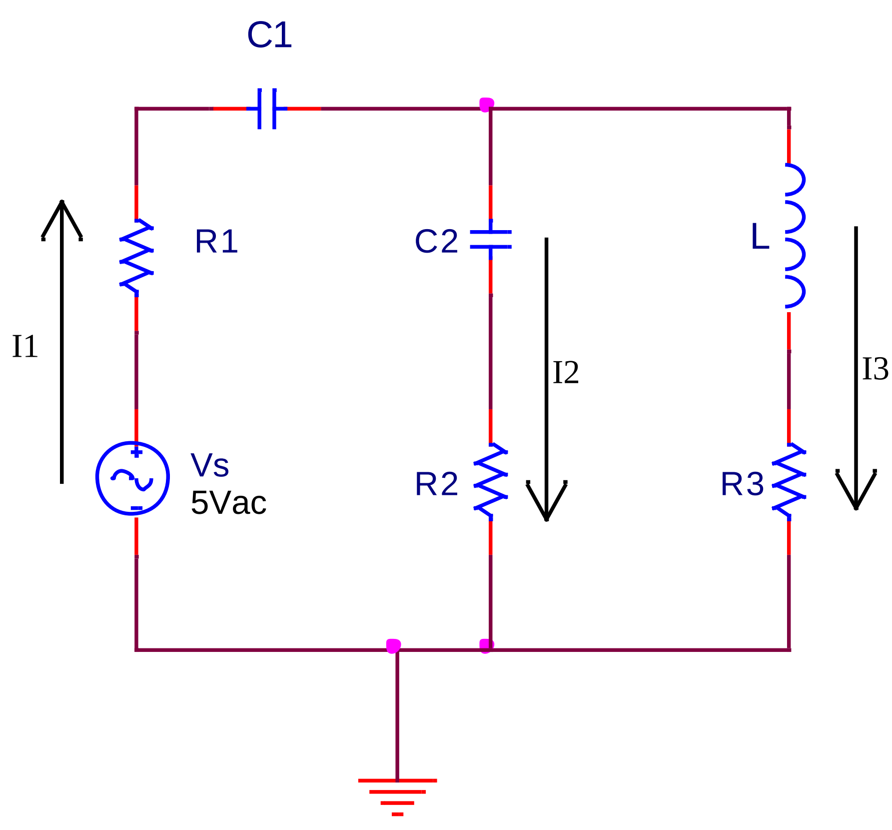
Equipment and Materials

- Oscilloscope
- Function Generator
- Protoboard
- Inductors, resistors, and capacitors
- Banana clips, BNC cables, probes
- Power supply

Procedure

This experiment involved calculating complex power through different measurements. Calculating voltage drop and current across a resistor allowed the active power to be calculated at each resistor. Taking the conjugate of the current and the effective current, the reactive power could then be calculated across each inductor and capacitor. Adding the active powers and reactive powers up and combining them will give the complex power S, throughout the circuit.

DISCUSSION OF RESULTS



Calculating I2 and I3 equivalent by either nodal analysis or simply combining the parallel circuit, I1 can be calculated. Once I1 is calculated I2 and I3 can then be calculated by just doing current division across each branch. Once all there currents were calculated, the voltage drop across each material could be calculated by ohms laws. Power at each material can finally be calculated by the complex power rules.

Table 6.1.

	Calculations			**Measurements**		
	Phasor		RMS-value	Phasor		RMS-value
	Rectangular	Polar		Rectangular	Polar	
I_1	.20478 – j.13674 A	.246<-33.73 A	.174<-33.73 A	.206 – j.13596 A	.246822<-33.42 A	.1744<-33.42 A
I_2	.178 – j.0920	.2006<27.31 A	.141<27.31 A	*No data are needed in this cell*		
I_3	.0343 –j.8485	.8492<-87.68 A	.600<-87.68 A			

After the currents have been calculated, plugging them into the equations below allow for the active and reactive powers to be calculated. In order to ensure that the procedure was done properly, the equation for the source power and the equation for the summation of the power should cancel out to equal 0. When comparing the results, there was minimal error to conclude that the data was accurate. The error in data can easily be complimented to the internal impedance and resistance of the equipment used to take all the measurements.

Table 6.2.

		Calculations		**Measurements**	
		Active	Reactive	Active	Reactive
Power generated by source	$\dot{S}_{source} = \frac{1}{2}\dot{V}_S \cdot \hat{I}_1$, mVA	511.95 mW	-j341.85 mVAR	515.05	-j339.9
Active power consumed by circuit	${I_{1,\,eff}}^2 \cdot R_1$, mW ………… ${I_{2,\,eff}}^2 \cdot R_2$, mW ………… ${I_{3,\,eff}}^2 \cdot R_3$, mW …………	171 mW 238 mW 117.6 mW		168.9 mW 244.04 mW 103.67 mW	
	$\sum I^2_{n,\,eff} \cdot R_n$, mW	526.6 mW		516.61 mW	
Reactive power consumed by circuit	${I_{3,\,eff}}^2 \cdot X_L$, mVAR……. ${I_{1,\,eff}}^2 \cdot X_{C1}$, mVAR……. ${I_{2,\,eff}}^2 \cdot X_{C2}$, mVAR…….	173 mVAR -505 mVAR -8.38 mVAR		169.7 mVAR -502 mVAR -9.8 mVAR	
	$\sum I^2_{n,\,eff} \cdot X_n$, mVAR	-340.38 mVAR		-342.1 mVAR	

Questions

4.1. Why don't we need to get additional information about the phase of the branch currents for evaluating the power in the discrete components? (By using Fluke meter we are measuring only the effective (RMS) values of currents in those components.)

The phase of the current is not needed in the calculation of the reactive or the active power, so by just determining the effective current, both powers can be calculated, regardless of the phase that the current is at.

4.2. Explain the physical meaning of the principle of conservation of power in AC-circuits.

Because power cannot be created nor destroyed, just like the components that make it up, then if the individuals powers of components that make up a circuit are found, then the complex power is simply the combination of all of the powers.