Experiment 10 ~ RLC Series circuit

Resonance in an RLC Series Circuit

Objective:

To experimentally determine the resonance frequency in a series RLC circuit and compare this to the expected resonance value.

Introduction:

The voltage through an RLC series circuit will be measured as a function of frequency for a fixed applied voltage. The frequency for which the rms voltage attains a maximum value is the resonance frequency. The expected resonance frequency is given by equation 1.

$$f_0 = \frac{1}{2\pi} \cdot \frac{1}{\sqrt{LC}} \tag{1}$$

Equipment:

Proto-board, 1 resistor, 1 capacitor, 1 inductor, digital multi-meter, function generator, oscilloscope, and wire leads.

Experimental Procedure:

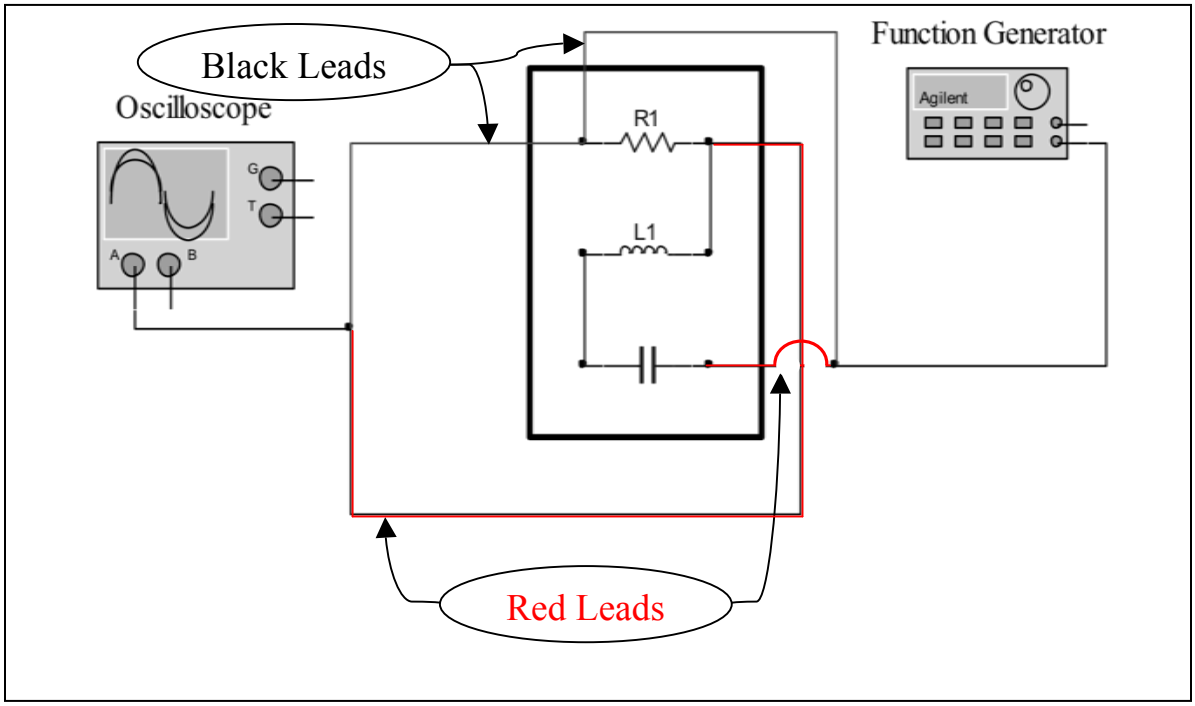

Figure 1: RLC Series Circuit

1. Before you connect the circuit to the function generator set the frequency to 60 Hz. Then, using the voltmeter set the generator's output to 5 volts (rms).
2. Using the proto-board and wire leads connect the resistor, capacitor, and inductor along with the output of the function generator to construct the circuit shown in Figure 1. Here we are measuring the peak to peak voltage across the resistor using the oscilloscope. The three components are connected in series with the function generator acting as the power supply. Connect the black leads together at the end of the resistor as noted in Figure 1.
3. Record the values of R, L, and C for this circuit in the space provided in the data section.
4. Use equation 1 to compute the expected resonance frequency and record your result in data table 1.
5. Change the function generator frequency to 50Hz and record the peak to peak voltage from the oscilloscope in data table 2. Then, adjust the output frequency to 100 Hz and record the voltage. Adjust the output frequency to 200 Hz and record the voltage. Continue adjusting the output frequency to each value below the expected resonance frequency computed in step 4. Record the voltage for each of these values.
6. Determine an experimental value for resonance frequency by finding the frequency that produces the largest voltage on the oscilloscope. Record this frequency and voltage.
7. Record the voltage for frequency values that are above the resonance frequency determined in step 6.
8. Turn all equipment off and disconnect the circuit.

Analysis:

1. Use Excel to produce a plot of frequency vs. voltage. Set the frequency axis to a logarithmic scale. To do this right click on the axis; chose 'format axis' and check the box for 'logarithmic scale'.
2. Draw a smooth curve through all the data points. This curve should be similar to figure 2.

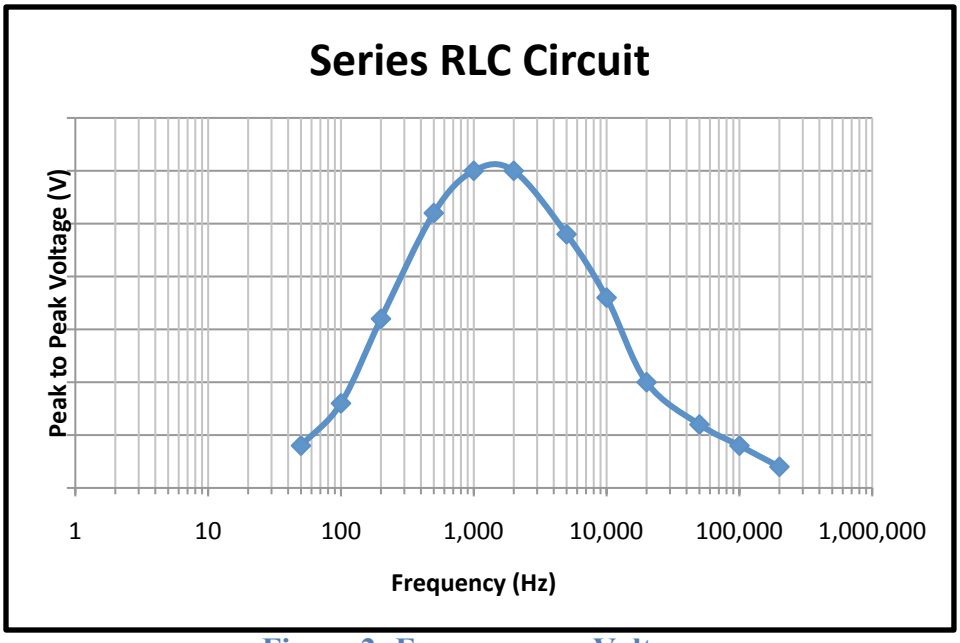

Figure 2: Frequency vs. Voltage

3. Use the graph to determine the resonance frequency.

4. Compare the experimental resonance frequency to the expected value obtained from equation 1.

Data:

Circuit Parameters:

R=_____
L=_____
C=_____

Table 1	
Calculated Resonant Frequency	
Experimental Resonant Frequency	
% Difference	

Table 2	
Frequency (Hz)	Peak to Peak Voltage
50	
100	
200	
500	
1000	
2000	
5000	
10000	
20000	
50000	
100000	
200000	
500000	
(Resonant Frequency)	