Template

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Abstract

An RLC circuit is an electrical circuit with a resistor, inductor or capacitor connected in series or parallel but in this lab, they are connected in series. RLC circuits form harmonic oscillators with a peak resonant frequency. The purpose of the lab was to experimentally measure the resonant frequency of an RLC circuit (175Hz) and compare it to the theoretical resonant frequency (175.75Hz). The resulting percent difference was 0.42%.

Introduction

The purpose of this lab was to experimentally measure the resonant frequency of an RLC circuit by recording peak voltages in an RLC circuit generated by a frequency generator. Comparing the experimental frequency to the theoretical resonant frequency is done to verify that RLC circits have a resonant frequency which is $f_{resonant} = \frac{1}{2\pi\sqrt{LC}}$.

Equipment

- RLC circuit board
- digital multimeter
- function generator
- function generator powersupply
- wire leads

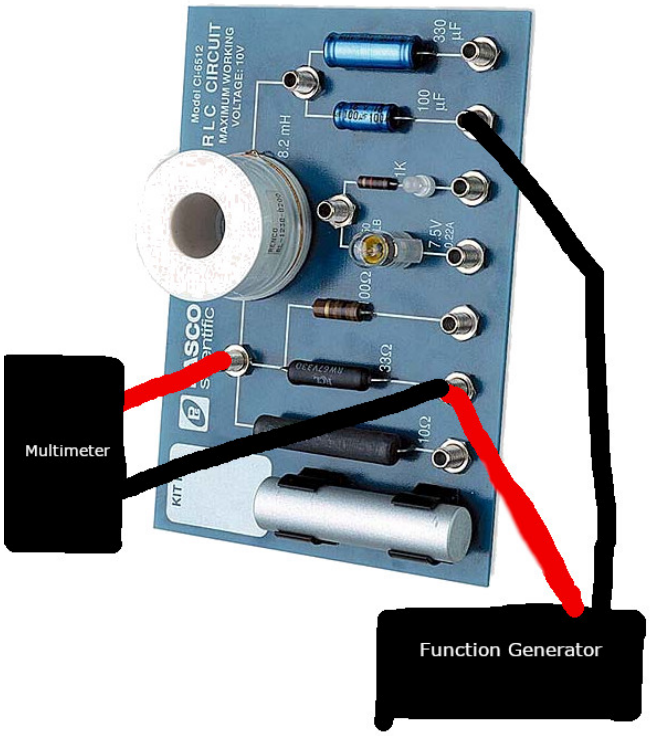

Figure 1: apparatus

Theory

Variable	Definition
X_c	capacitive reactance
X_l	inductive reactance
L	inductance
C	capacitance
f	frequency
$f_{resonant}$	resonant frequency

$$X_c = \frac{1}{2\pi fC}$$
$$X_l = 2\pi fL$$

f is resonant when $X_c = X_l$

$$f^2 = \frac{1}{4\pi^2 LC} \tag{1}$$

$$f_{resonant} = \frac{1}{2\pi\sqrt{LC}} \tag{2}$$

$$\frac{|Theoretical - Experimental|}{Theoretical} 100 = PercentDifference \tag{3}$$

Procedure

1. Set frequency of the function generator to 60hz, then, adjust the output voltage to 5V (measured on voltmeter)
2. Connect leads to circuit as shown in Figure 1
3. measure peak voltage across the resistor for a variety of frequencies ranging from 10-500000hz
4. create a graph of voltage vs frequency to determine the experimental resonant frequency

Analysis

Theoretical Resonant frequency: $f_{resonant} = \frac{1}{2\pi\sqrt{8.2mH * 100\mu f}}$

$$f_{theory} = 175.75hz$$

Experimental Resonant frequency: $\frac{150+200}{2}$

$$f_{exp} = 175hz$$

Percent Difference: $\frac{|175.75-175|}{175.75} 100 = 0.42\%$

Data

Hz	Peak V
10	1.085
50	3.385
100	4
150	4.14
200	4.14
350	3.92
500	3.626
600	3.385
700	3.15
800	2.927
900	2.721
1000	2.532
2000	1.258

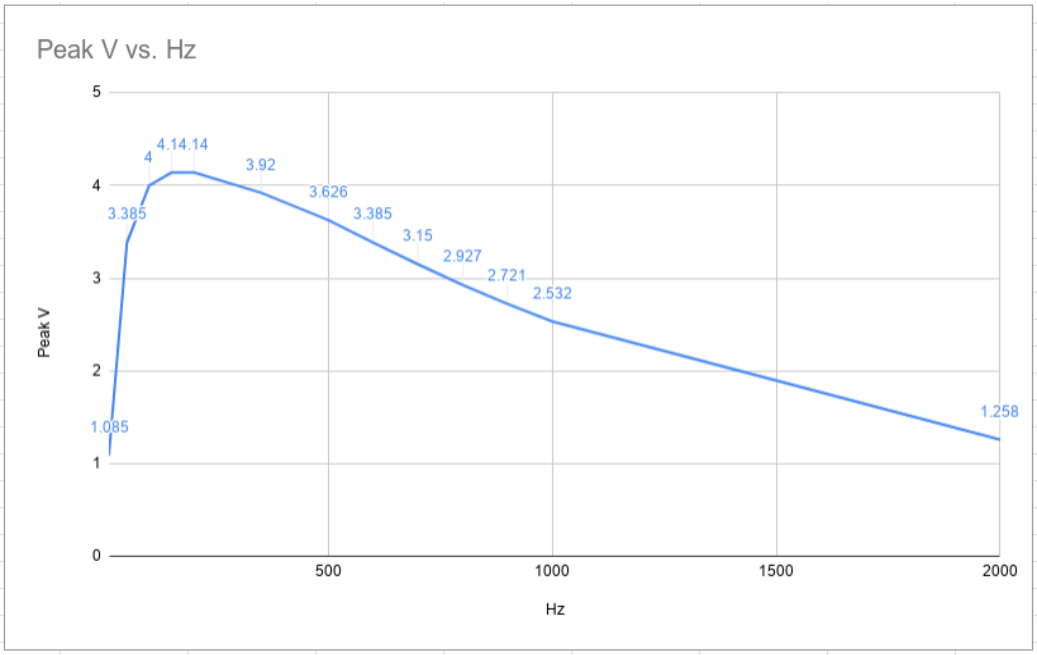

Figure 2: Voltage vs frequency

Conclusion

The purpose of the experiment was met, the resonant frequency was measured (175Hz) and compared to the theoretical value (175.75Hz) with a 0.42% difference. The graph shows voltage vs frequency, no trendline was found to fit the data very well but a moving average fit best. The peak voltage was 4.14V between 150-200Hz, therefore, the resonant frequency was estimated to be 175Hz. Possible sources of error include starting measurement before the capacitor has fully charged, causing its capacitive reactance to change while measurements are taken. Trying to measure peak to peak voltage across the inductor resulted in data which varied greatly from the theoretical and the lack of resolution on the multimeter which resulted in an average of two values with the same peak voltage (150,200), having more resolution would make it easier to more accurately pinpoint the resonant frequency.