ECE2101L
Electrical Circuit Analysis II Laboratory

Lab 10
Resonance Circuits

Report

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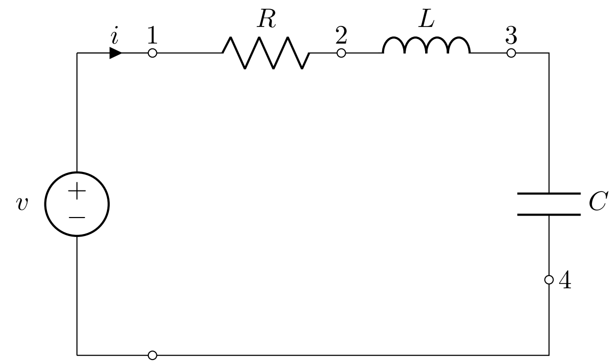
1 Series resonance



Procedure

The above circuit was simulated with MATLAB R2019a with the RMS value of source voltage.

Result

	Frequency	$\lvert i(t)\rvert$ RMS calculated	$\lvert i(t)\rvert$ RMS measured	$\lvert V_{12}\rvert$ RMS calculated	$\lvert V_{12}\rvert$ RMS measured	$\lvert V_{23}\rvert$ RMS measured	$\lvert V_{34}\rvert$ RMS measured
$f_0 - 110 =$	54.155 79 Hz	6.126 741 mA	6.127 mA	0.919 011 1 V	0.9190 V	0.4170 V	3.831 V
$f_0 - 80 =$	84.155 79 Hz	10.636 45 mA	10.64 mA	1.595 467 V	1.595 V	1.125 V	4.280 V
$f_0 - 50 =$	114.155 79 Hz	16.490 73 mA	16.49 mA	2.473 610 V	2.474 V	2.366 V	4.892 V
$f_0 =$	164.155 79 Hz	23.570 23 mA	23.57 mA	3.535 534 V	3.536 V	4.862 V	4.862 V
$f_0 + 50 =$	214.155 79 Hz	18.947 09 mA	18.95 mA	2.842 064 V	2.842 V	5.099 V	2.996 V
$f_0 + 80 =$	244.155 79 Hz	15.691 80 mA	15.69 mA	2.353 770 V	2.354 V	4.814 V	2.176 V
$f_0 + 110 =$	274.155 79 Hz	13.236 96 mA	13.24 mA	1.985 544 V	1.986 V	4.560 V	1.635 V

Analysis

From the plot below it can be observed that the current and voltage of the resistor is at its maximum at the resonance frequency. This is due to that the magnitude of the impedance is at its maximum at resonance frequency when the impedance is purely real and thus all the power is dissipated through the resistor. At the resonance frequency, as the reactive impedance cancel each other out, with the voltage of inductor and capacitor being equal and opposite, the impedance of the RLC circuit is equal to that of the resistor, hence the voltage of the resistor is the same as the one of the voltage sourve.

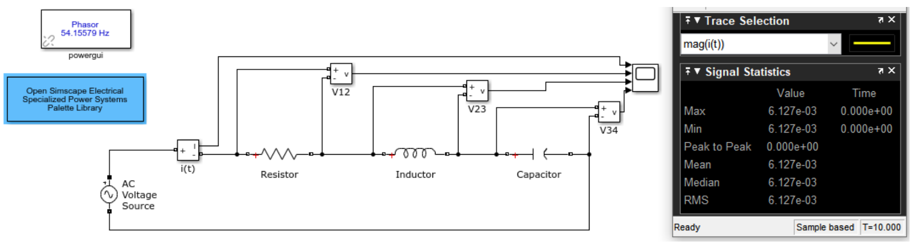


Figure 1: Simulation of the circuit

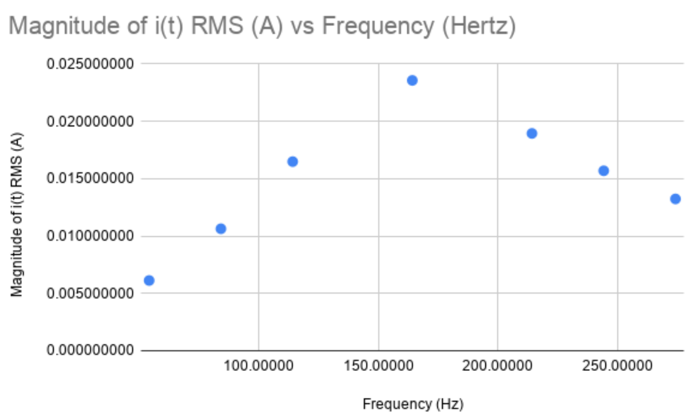


Figure 2: Measured RMS magnitude of i(t) versus frequency

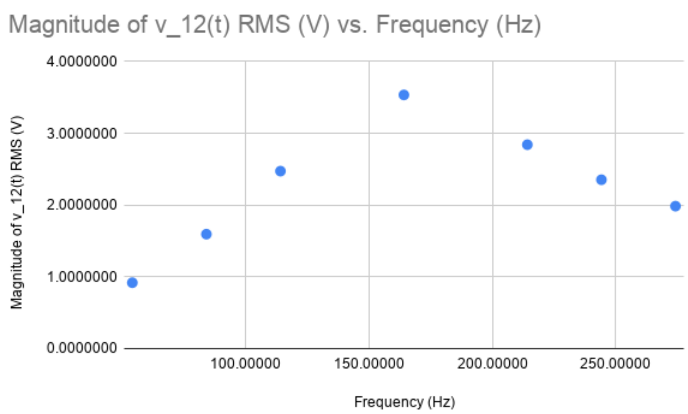
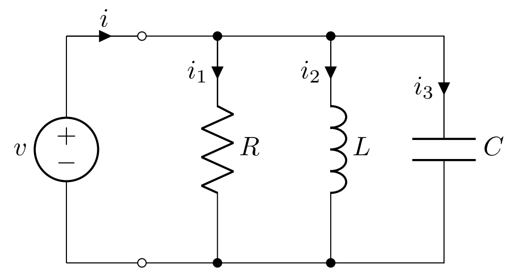


Figure 3: Measured V_{12} RMS versus frequency

2 Parallel resonance



Procedure

The above circuit was simulated with MATLAB R2019a with the RMS value of source voltage. A very small resistor was put in series to the circuit such that the simulation can go forward.

Result

	Frequency	$\lvert i_1(t)\rvert$ RMS calculated	$\lvert i_2(t)\rvert$ RMS calculated	$\lvert i_3(t)\rvert$ RMS calculated	$\lvert i(t)\rvert$ RMS calculated	$\lvert i(t)\rvert$ RMS measured
$f =$	60 Hz	23.570 23 mA	46.891 47 mA	6.264 465 mA	46.969 24 mA	46.84 mA
$f_0 =$	164.155 79 Hz	No calculation				23.31 mA

Analysis

The total current is not the same in normal frequency than when the circuit is in resonance. In resonance, the impedance is purely resistive as the two reactive component cancel each other out. However, in normal frequency, there is a non-zero reactive impedance, therefore the magnitude of the impedance is smaller at normal frequency than at resonance frequency, which further implies that there is a larger current at normal frequency than at resonance frequency.

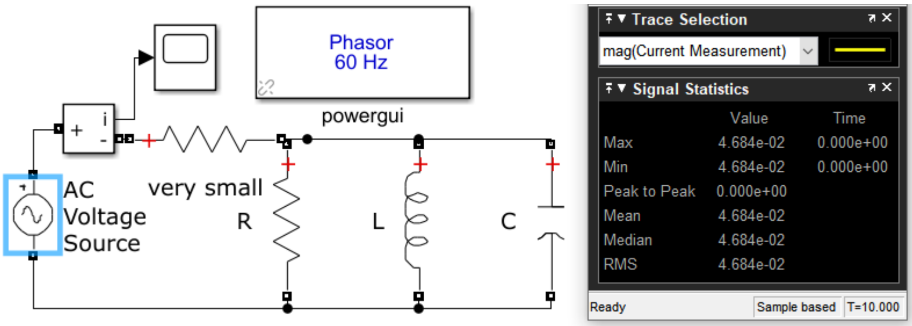


Figure 4: Simulation of the circuit at 60 Hz

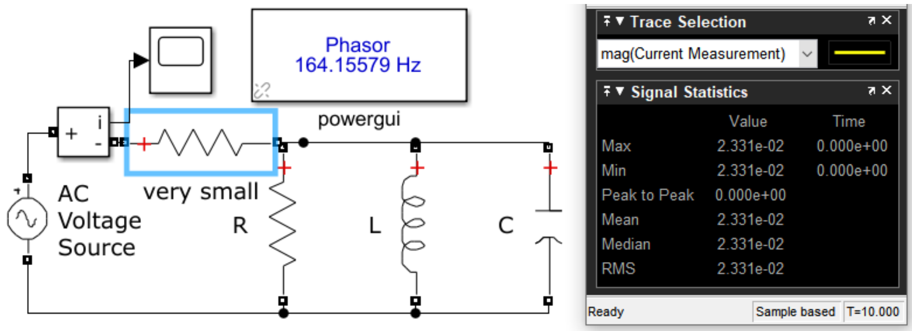


Figure 5: Simulation of the circuit in resonance