University of Victoria

ELEC 250

Linear Circuits I

Lab 4 - Resonance and Power

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1 Object

This lab will study series resonance as well as the measurement of power in a circuit using a wattmeter.

2 Series Resonance

2.1 Procedure

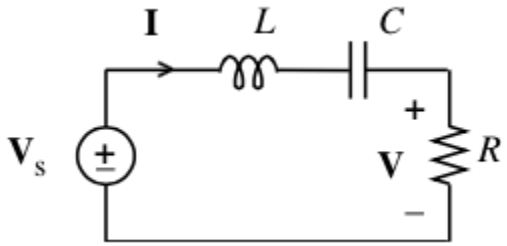

Figure 1: Circuit diagram of resonant RLC circuit
$L = 1.00$ mH, $C = 22$ nF, $R = 43.50\ \Omega$

2.2 Results

Table **??** is located at the end of this report.

find f_0, f_1, f_2, B by interpolating the graph. (hint, using the data table will be the best way to find f_1 and f_2 since we know they occur at $\theta = \pm 45°$)

2.3 Discussion

How do f_0, f_1, f_2, B compare with expected values?

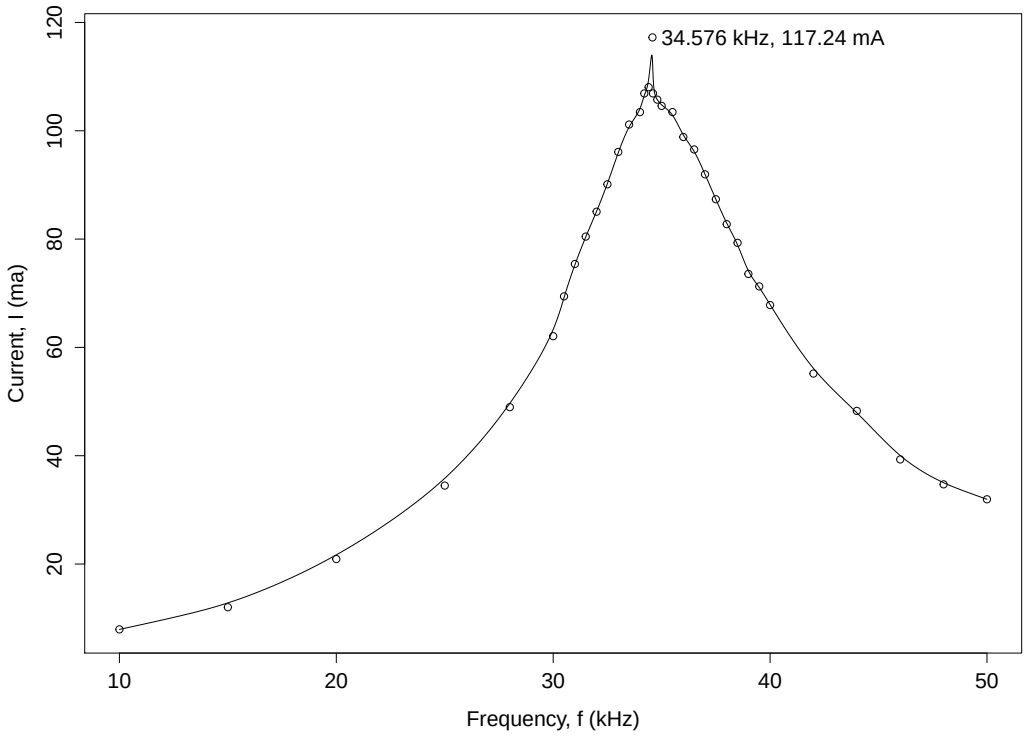

Figure 2: Current through RLC circuit as frequency passes through resonance

3 Power Measurement

3.1 Procedure

3.2 Results

Here are some useful equations.

$$pf = \frac{P}{S} = \frac{P_{rms}}{V_{rms} I_{rms}}$$

$$\begin{aligned} S^2 &= P^2 + Q^2 \\ Q &= \sqrt{S^2 - P^2} \\ &= P\sqrt{\left(\frac{1}{pf}\right)^2 - 1} \end{aligned}$$

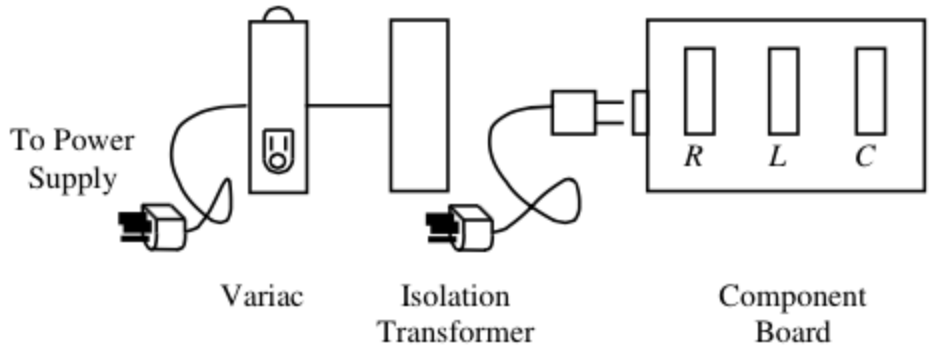

Figure 3: Block diagram of circuit components
$R = 200\ \Omega$, $L = 300$ mH, $C = 10\ \mu$F

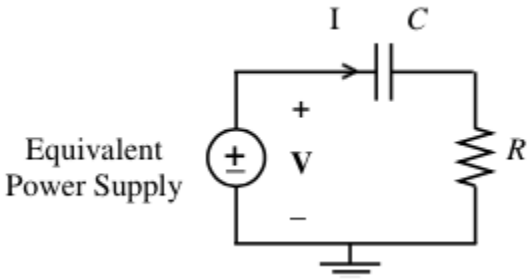

Figure 4: Equivalent circuit setup

$$pf = \frac{V_R}{V_{rms}}$$

					P (W)		pf	
Circuit	V_{rms} (V)	I_{rms} (mA)	V_R (V)	Q (VAR)	*measured*	$\frac{V_R^2}{R}$	$\frac{P}{S}$	$\frac{V_R}{Vrms}$
RC	49.94	151.0	30.06	6.014	4.55	4.54	0.6034	0.6019
RL	50.09	181.5	36.10	5.602	7.16	6.55	0.7876	0.7207

Table 1: Power measurements in RC and RL circuits

3.3 Discussion

4 Conclusion

Frequency f (kHz)	Resistor Voltage V_r (V)	Current I (mA)	Phase Shift θ (°)
10.000	0.345	7.931	−85.0
15.000	0.523	12.023	−82.0
20.000	0.910	20.920	−76.0
25.000	1.500	34.483	−69.0
28.000	2.130	48.966	−61.0
30.000	2.700	62.069	−51.5
30.500	3.020	69.425	−47.0
31.000	3.280	75.402	−43.5
31.500	3.500	80.460	−38.0
32.000	3.700	85.057	−34.5
32.500	3.920	90.115	−28.0
33.000	4.180	96.092	−22.0
33.500	4.400	101.149	−15.0
34.000	4.500	103.448	−8.0
34.200	4.650	106.897	−5.0
34.400	4.700	108.046	−2.3
34.576	5.100	117.241	−0.1
34.600	4.650	106.897	0.8
34.800	4.600	105.747	3.8
35.000	4.550	104.598	6.8
35.500	4.500	103.448	13.5
36.000	4.300	98.851	20.0
36.500	4.200	96.552	25.8
37.000	4.000	91.954	31.5
37.500	3.800	87.356	35.7
38.000	3.600	82.759	40.0
38.500	3.450	79.310	43.5
39.000	3.200	73.563	47.2
39.500	3.100	71.264	50.0
40.000	2.950	67.816	53.0
42.000	2.400	55.172	61.0
44.000	2.100	48.276	66.0
46.000	1.710	39.310	69.5
48.000	1.510	34.713	72.0
50.000	1.390	31.954	74.7

Table 2: Change in current through resistor in RLC circuit as source frequency passes through resonance