

resonance

by Nathan Rowe

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Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

OME – Electrical & Electronic Principles (ACDA4006)

Resonance – 04/01/2020

Nathan Rowe - 1910544

Declaration

I declare that this report is the product of my own work and is not being submitted for any other degree etc.



Contents

1	Introduction	3
2	Background	3
3	Theoretical Testing	4
3.1	Method.....	4
3.2	Results.....	4
4	Practical Testing.....	6
4.1	Method.....	6
4.2	Results.....	6
5	Discussion	7
6	Conclusion.....	8
7	References	8

1 Introduction

The aim of this study is to determine the resonance of a theoretic and practical RLC circuit. Results are to be compared, discussed and explain using basic theorem.

Both resonant frequency and Q factor from the circuits will be calculated and shown.

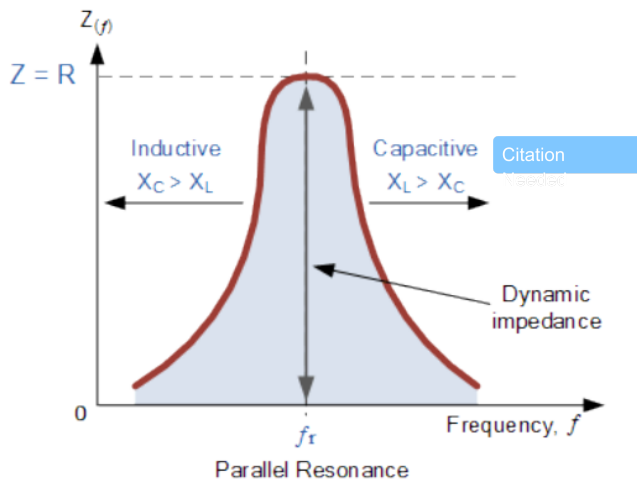
2 Background

A resonant circuit consists of a resistor, inductor, capacitor, and voltage source – thus the term 'RLC circuit' is derived. Resonance occurs when the current and input voltage are in phase with each other; this produces a resistive circuit.

Both series and parallel RLC exist, but for the purpose of this study, parallel will be explained in a little more detail. The circuit is influenced by the currents flowing through each branch within the LC circuit [1].

A resonance between the inductor and capacitor results in no energy draw from the supply. Frequency response can be changed by altering the circuits' resistor value – impedance being the maximum of the circuits' resonance [Fig 1] [1]

Resonance takes place when V_L is equal to V_C . This occurs when both reactances are equal, thus: $X_L = X_C$



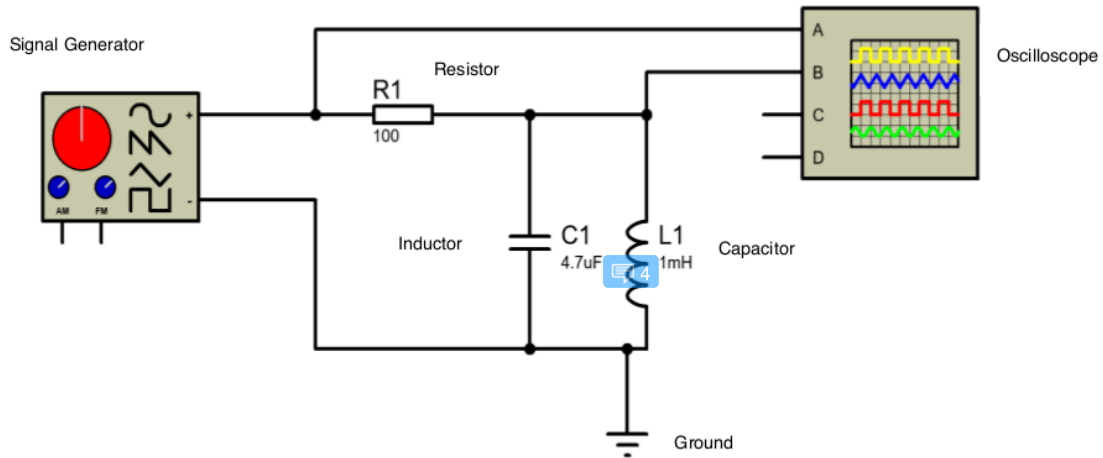
[Fig 1 – impedance in a parallel resonance circuit]

Q factor of the circuit, defined as the overall conservational quality of an electrical circuit [2]. A higher value corresponds to a narrow bandwidth, and a lower value to a high resistance.

3 Theoretical Testing

3.1 Method

A RLC circuit is constructed to the following diagram using Proteus simulation software [Fig 2]

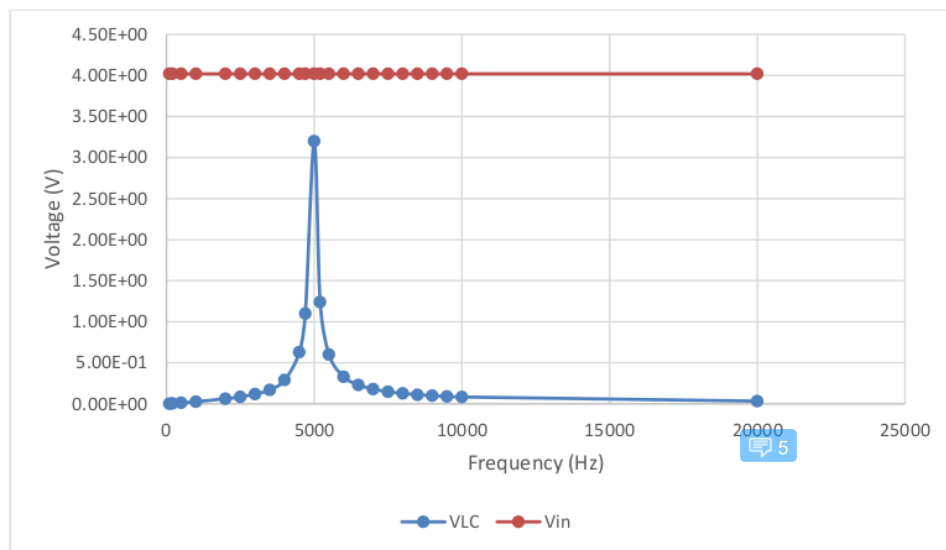


[Fig 2 – Circuit layout]

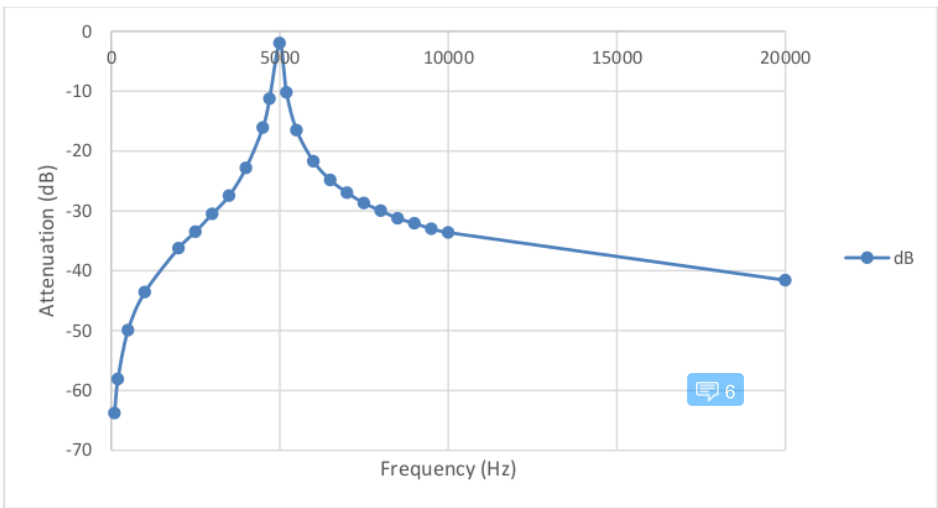
Signal generator set to 4V peak to peak at 100Hz

Voltage across the resistor and inductor/capacitor will be measured at a range of frequencies between 100Hz and 20kHz.

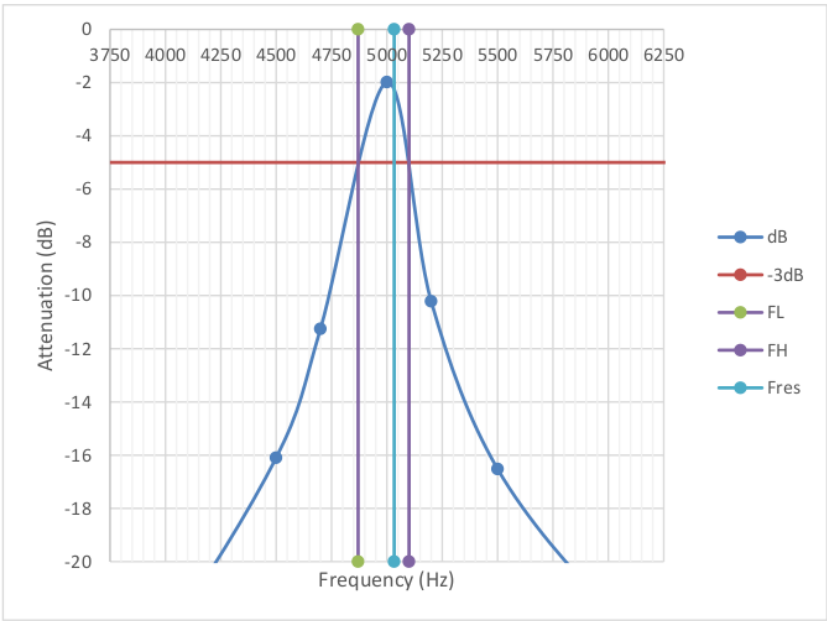
3.2 Results



[Graph 1 – Theoretical VLC]



[Graph 2 – Theoretical Attenuation]

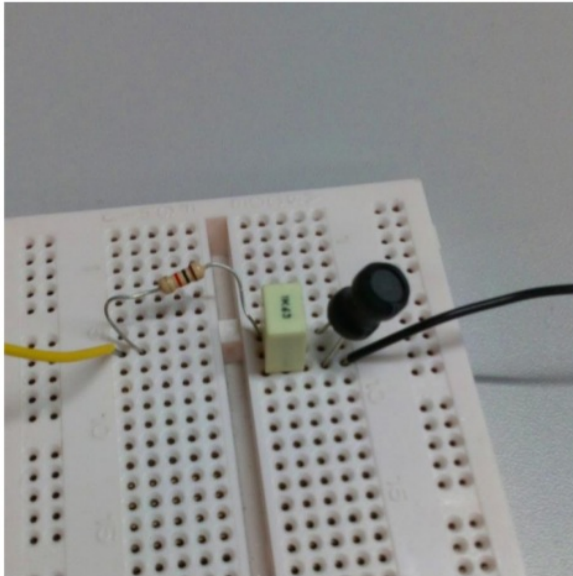


Bandwidth 230
Centre 5.03E+03
Q Factor 4.57E-02

[Graph 3 – Theoretical Q Factor]

4 Practical Testing

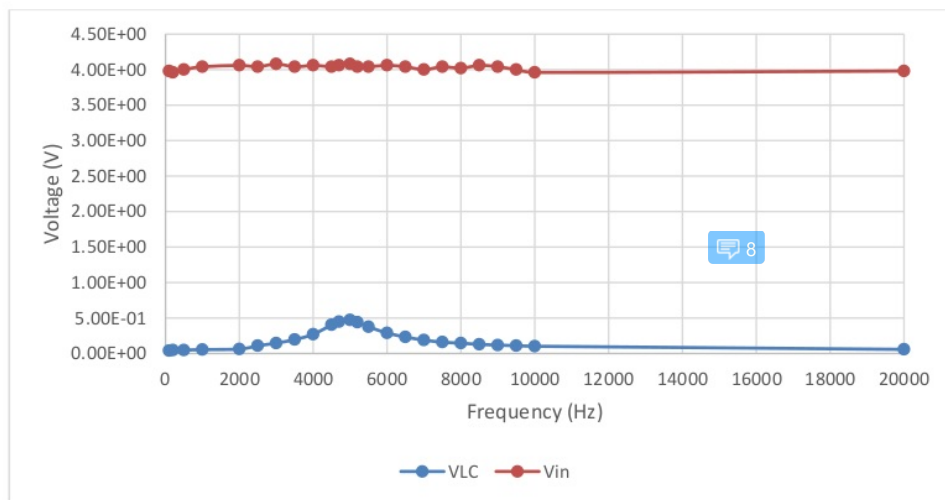
4.1 Method



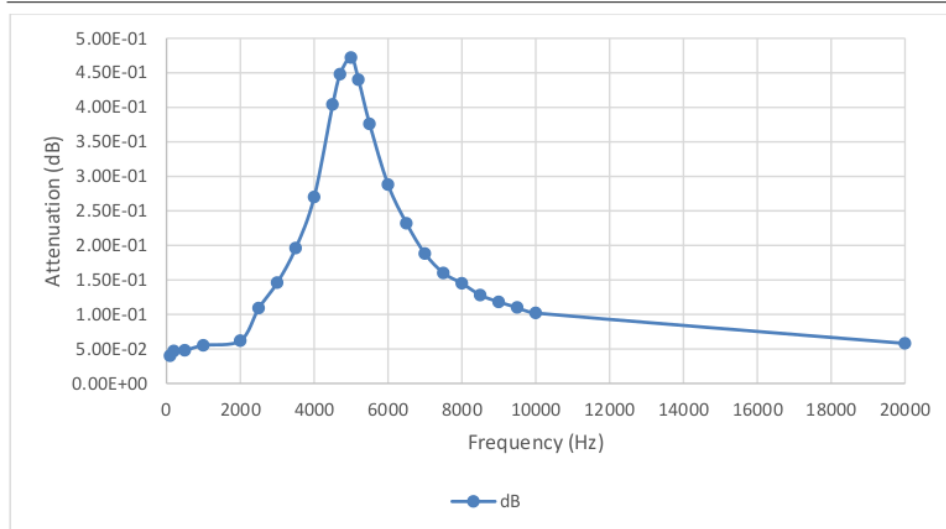
[Fig 3 – RLC Breadboard configuration]

A breadboard is configured in the layout [Fig 3]. Much like the theoretical test, the voltage is measured across the resistor and the inductor/capacitor at a number of frequencies.

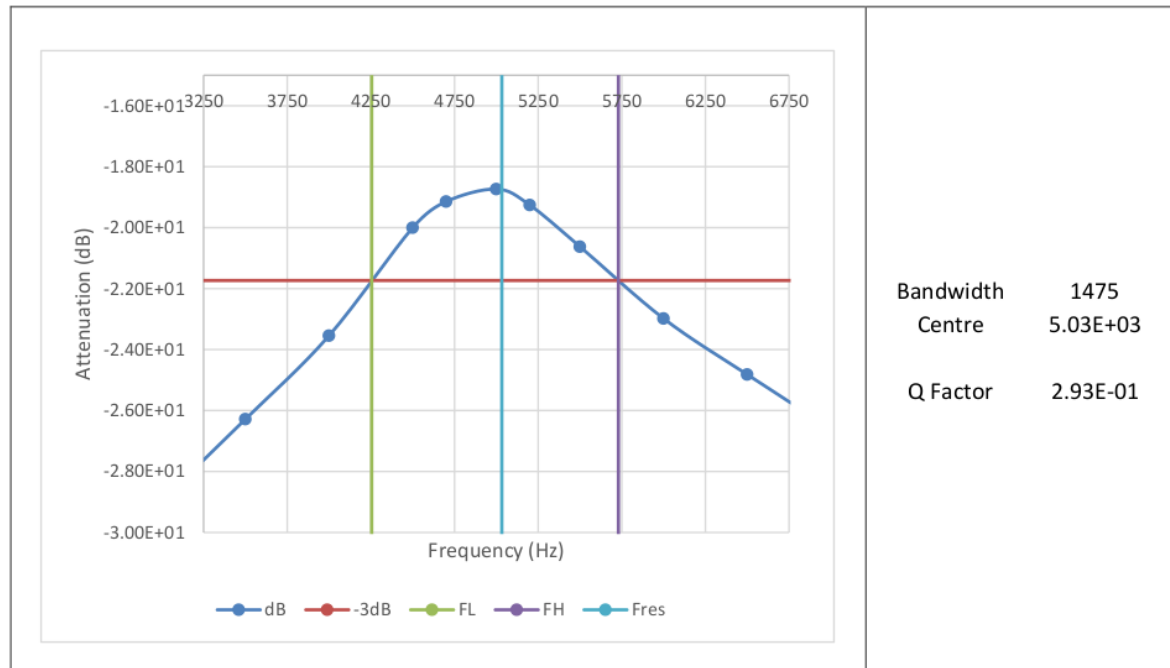
4.2 Results



[Graph 4 – Practical VLC]



[Graph 5 – Practical Attenuation]



Bandwidth	1475
Centre	5.03E+03
Q Factor	2.93E-01

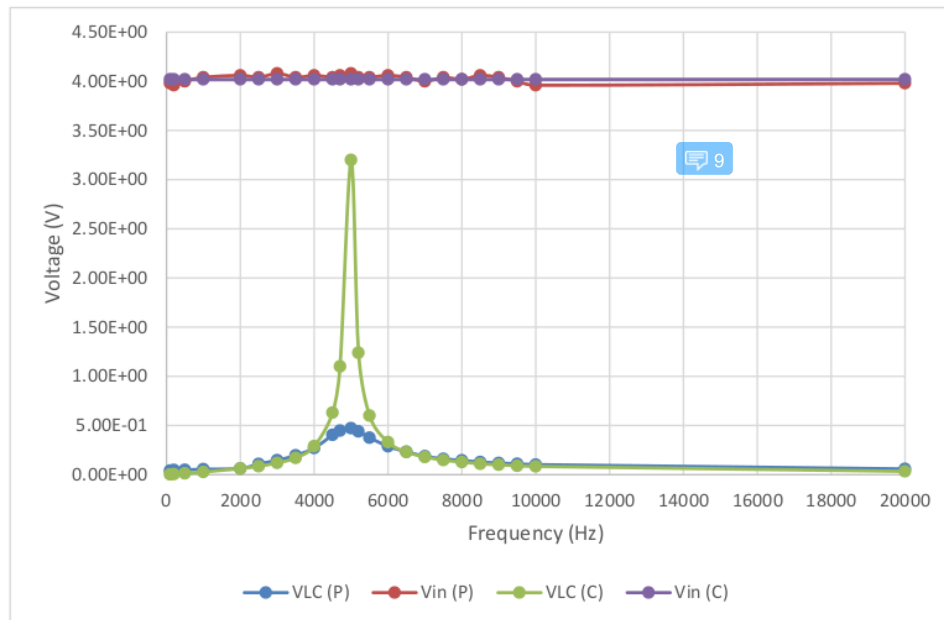
[Graph 6 – Practical Q Factor]

5 Discussion

The first point to discuss is the differences in V_{in} . Theoretically, the voltage in never differs, but due to the equipment used, (whilst minute) the practical results show small differences. This has an adverse effect on resultant calculations.

The shape of the VLC line differs greatly [Graph 7]. Whilst the trend of the practical VLC line follows that of the theoretical, the peak difference is vastly

different. This can be attributed to a number of different variables. Component tolerancing, whereby components used for the practical have a manufacturing tolerance – theoretical values are an exact figure.



[Graph 7 – VLC comparison]

It is important to also consider the resistance of any wires used in the practical study, including that of the measuring apparatus. Altering the circuits' resistance has a large effect on the response

6 Conclusion

To conclude, it is important to bear in mind the differences between theoretical and practical results. When designing circuitry these differences could prove to be counterproductive.

Given the results from this study, it is recommended to conduct practical studies alongside theoretical prototyping.

7 References

- [1] Electronics Tutorials , [Online]. Available: <https://www.electronics-tutorials.ws/ac/circuits/parallel-resonance.html>. [Accessed 06 01 2020].
- [2] D. Fenna, in *Weights, Measures and Units*, Oxford University Press, 2002.

resonance

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

Instructor

45/100

PAGE 1



Comment 1

Not needed for assignment work

PAGE 2



Comment 2

No abstract?

PAGE 3



Comment 3

Citation needs to be in figure caption



Citation Needed

Cite Source:

Please use the link below to find links to information regarding specific citation styles:

http://www.plagiarism.org/plag_article_citation_styles.html

PAGE 4



Comment 4

inductor and capacitor labelled wrong



Comment 5

x-axis should be logarithmic

x-axis should not extend beyond data. i.e. stop at 20kHz

No need to plot V_{in} - only there to allow dB calculation for comparison between circuits.

PAGE 5



Comment 6

Nice graph



Comment 7

Where do these numbers come from? How did you calculate them?

PAGE 6



Comment 8

See comments for graph 1

PAGE 7

PAGE 8



Comment 9

See comments for graph 1



Comment 10

What about the resistance of the inductor? or the resistance of the signal generator?



Comment 11

Very basic, general conclusions.

What about the source of the differences?



Comment 12

I was expecting more references.

GRADING FORM: SMU GENERIC_SMOSEY

NATHAN ROWE

44.50

ENGAGEMENT WITH LITERATURE

including reading, referencing, academic conventions and academic honesty



References to a limited range of mostly relevant sources. Some omissions and minor errors. Referencing conventions evident though not always applied consistently.

2

KNOWLEDGE & UNDERSTANDING

Knowledge of the basic underlying concepts and principles of a subject.



Evidence of basic knowledge and understanding of the relevant concepts and underlying principles.

12

COGNITIVE & INTELLECTUAL

Evaluate underlying concepts and principles of a subject and interpret qualitative and quantitative data in order to develop lines of argument and make sound judgements.



"Evidence of some logical, analytical thinking and some attempts to synthesise, albeit with some weaknesses. Analysis has gaps Some evidence to support findings/ views, but evidence not consistently

13.5

interpreted. Basic conclusions

PRACTICAL APPLICATION SKILLS

Different approaches to solving problems in particular contexts.



A good and appropriate application of standard methods, materials, tools and/or techniques.

15

TRANSFERABLE SKILLS

Communicate the results of their study/work accurately and reliably, and with structured and coherent arguments; the qualities needed for employment requiring the exercise of some personal responsibility within a structured and managed environment.



Can communicate in a suitable format but with some room for improvement. Work lacks coherence in places and could be better structured.

2