

Resonance Assignment

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RESONANCE

ELECTRICAL AND ELECTRONIC PRINCIPLES

ACDA4006

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ABSTRACT

This report analyses measurements of a parallel Inductor and Capacitor (RLC) circuit taken in laboratory settings, through comparison with measurements taken from a simulated version of the same circuit and exploration of the implicit properties displayed by the various components.

A circuit was constructed in laboratory settings to test the properties of a parallel resonant R-LC circuit. Simulation of the circuit was carried out via dedicated software and spreadsheet analysis and the results compared.

Differences in results have been analysed below  are hypothesised to be the result of the delta between real-life values and the stated values.

INTRODUCTION

LC circuits consist of a Resistor (R), Inductor (L), and Capacitor (C) connected either in parallel or series. The circuits are widely used in the tuning of radio and signal equipment as bandwidth filtering devices through use of the circuits' properties of resonance, bandwidth and selectivity.

The parallel resonant LC circuit is often called a tank circuit. This refers to the circuit's property of storing energy in the magnetic coil of the Inductor, and in the electric field of the capacitor [1].

Circuits such as these are known as tuned circuits. At their resonant frequency (f_r), the impedance of RLC circuits is at either their maximum, in the case of parallel circuits, or minimum, in the case of series circuits. Parallel and Series RLC circuits are often referred to as rejector or acceptor circuits respectively as a result [1].

A resonant circuit can be used to present a high or low impedance to selected frequencies, which acts as a filter when trying to separate a signal of one frequency from a range. Rejector circuits act as bandstop filters to reject some frequencies but allow all others, while acceptor circuits will selectively allow a range of frequencies and block all others, and therefore act as a bandpass filter [2].

In an ideal parallel resonance circuit, at resonance, the reactance of the Capacitor (X_C) will equal the Reactance of the Inductor (X_L), and Impedance at resonance (Z_r) will be infinite [2]:

$$X_L = X_C$$

$$Z = \infty$$

Also as a result of X_L and X_C being equal, Current in both branches will also be equal, but out of phase by 180° , Current will therefore be zero as the waveforms cancel [1] [2].

The bandwidth of a parallel resonance circuit is the distance between the half-power points, or the region in which the voltage remains above 70.7% of its maximum value. The Q-factor is a measure of efficiency of the circuit and is effectively a ratio of the circulating current against the supply current [1], i.e;

$$Q - \text{Factor at Resonance} = \frac{\text{Circulating Current}}{\text{Supply Current}}$$

Selectivity is a measure of the effectiveness at which a circuit filters out undesirable frequencies. A narrow bandwidth and a high Q-Factor for the circuit leads to a more selective circuit.

METHODOLOGY

LABORATORY EXPERIMENT

A parallel RLC Circuit was created on a breadboard as per figure 1. Input voltage of 2 V alternating current was generated via Function Generator, at frequencies on an approximately logarithmic scale ranging from 100 Hz up to 29 KHz. Input voltage was measured on an oscilloscope between point A and Ground, and output voltage measured between point B and Ground. values were recorded and graphed. Results are p Cap. Error ter in this document. Cap. Error

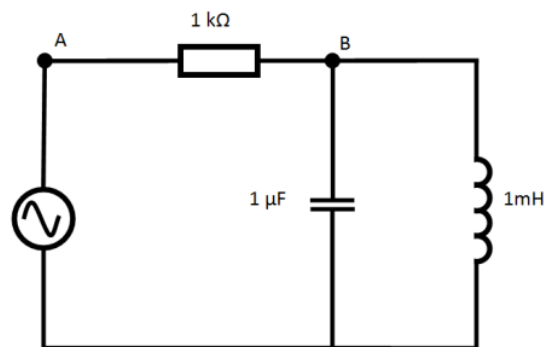


Figure 1: Test Circuit

Equipment used was as follows:

- 1 * 1 μF Capacitor
- 1 * 1 K Ω Resistor
- 1 * 1 mH Inductor
- Metex MS-9150 Universal System (function generator)
- Tektronix TDS 2002 Oscilloscope and 2 * test probes
- Breadboard and wire to connect.

Input voltage generated was set to 2 V. Frequencies sampled were selected on a roughly logarithmic scale to show a range of values from 100Hz-30kHz, with tolerances dictated by the sensitivity of the controls at +/- 4% of intended values. The magnitude of the output voltage waveform was recorded for each frequency.

Components used vary in tolerances and real values were measured for each component as follows:

Component	Stated Value	Measured Value	Additional Measured Values
Resistor	1 k Ω	979 Ω	84.4 μ H - Induction 2 3
Inductor	1mH	0.994 mH	7.32 Ω -Series Resistance
Capacitor	1 μ F	1.064 μ F	ESR @ 1 kHz – $5.9189 * 10^{-5}$ ESR @ 10 kHz – $7.63784 * 10^{-4}$
Signal Generator	N/A	N/A	Internal Resistance of 50 Ω

PROTEUS SIMULATION

A circuit was created in Proteus as per Figure 2 using a generic Resistor, Capacitor and Inductor, and connected to a VSM Signal Generator. Values were set as follows:

Resistor: 1 k Ω

Capacitor: 1 μ F

Inductor: 1 mH

Input Voltage: 2 v a.c. (Alternating Current)

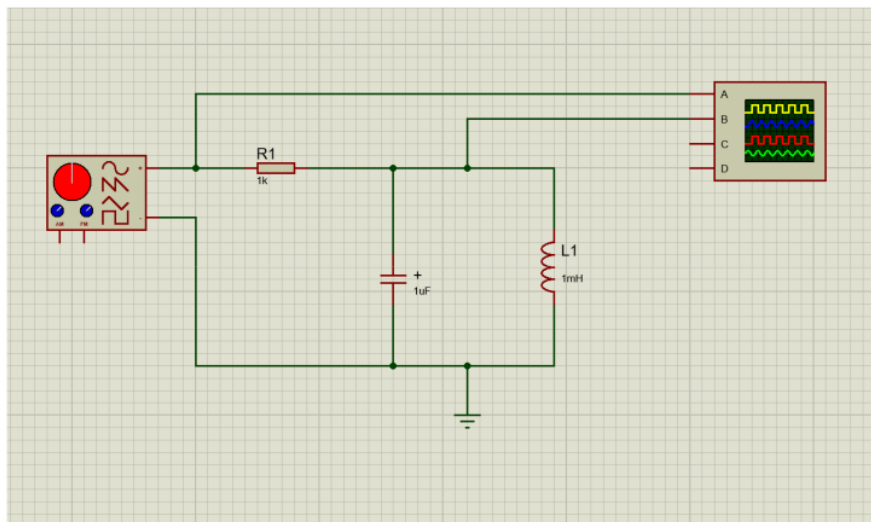


Figure 2: Proteus Circuit Diagram

CALCULATED VALUES

The circuit above was also simulated mathematically on MS Excel through the following method. Results and Sample formula for the spreadsheet can be found at Annex A and B respectively:

1. Firstly the reactance (X_L and X_C) of the different branches of the parallel network are determined as below and converted to a Complex number;

a. For X_L ,

$$X_L = 2\pi fL$$

b. For X_C ,

$$X_C = \frac{-1}{2\pi fC}$$

2. Total reactance of the parallel branches (Z_{LC}) is then calculated by sum over product;

$$Z_{LC} = \frac{(X_C + X_L)}{(X_C * X_L)}$$

3. Current is determined through Ohms law [1] by dividing the input Voltage (V) by the total Impedance of the circuit (Z_T), including R1;

$$I = \frac{V}{Z_T}$$

Or,

$$I = \frac{V}{R1 + Z_{LC}}$$

4. Voltage across the parallel network (V_{LC}) is then determined through Ohms Law and further converted to an Absolute value for Graphing;

$$V_{LC} = I * Z_{LC}$$

5. Resonant frequency (f_r) was calculated using the following formula:

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

Substituting values shows:

$$f_r = \frac{1}{2\pi\sqrt{1mH * 1\mu F}}$$

$$f_r = 5032.921 Hz$$

6. A second series of data was added to each graph, to denote the 70.7% line. This was calculated by multiplying the maximum value recorded by 70.7%. Bandwidth was subsequently determined graphically for all graphs. This can also be calculated
7. Graphs of the absolute values of Current, component Reactance, and Impedance against Frequency were generated for illustrative purposes.

A second set of data as per the above was then produced with measured values from the laboratory components used.

RESULTS

Full results are tabulated at Annex A, with measurements graphed below. Laboratory measurements are graphed at figure 3. Simulated values taken from Proteus are graphed in figure 4, and Calculated Values graphed in figure 5. Figure 7 shows simulated results with the internal resistances of the components included.

Figure 6 shows a graph containing all values plotted against the same Y-Axis for comparison. Also shown are calculated values accounting for the internal resistance of the laboratory signal generator and inductor. This will be discussed later in this document.

As can be seen on Figure 6, the resulting resonant frequency displayed by the different methodologies remains approximately the same, however maximum Voltage varies across all methods by a considerable margin. A guide-line has been added to Figure 6 in orange dashes to illustrate an approximate Resonant Frequency and the minor differences in result.

Bandwidth has been determined for each graph and illustrated in red dotted lines, with Resonant Frequency (F_R) in red dashed lines. A 70.7% line has been added to each Voltage graph in order to aid this process.

Figure's 8 and 9 show total Impedance of the circuit and Current against Frequency. These graphs were generated including values accounting for internal resistances.

Figure 10 shows the Reactance of the Capacitor, plotted with the Reactance of the Inductor, against frequency. As can be seen, at lower frequencies, Capacitive Reactance is much higher than Inductive Reactance. At resonant frequency, Capacitive Reactance is equal to Inductive Reactance, and Inductive Reactance becomes dominant at frequencies above this.

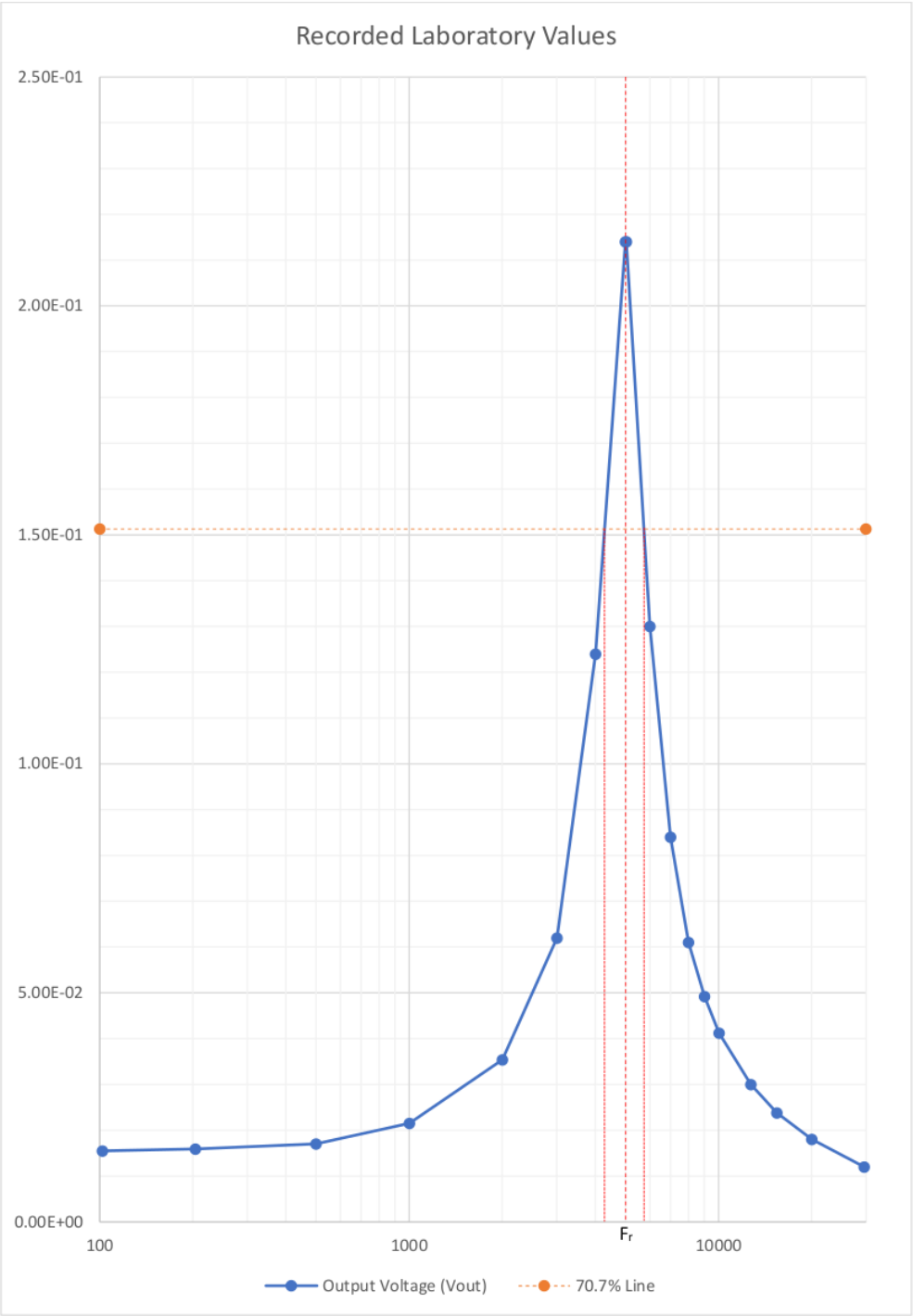


Figure 3: Laboratory Recorded Values

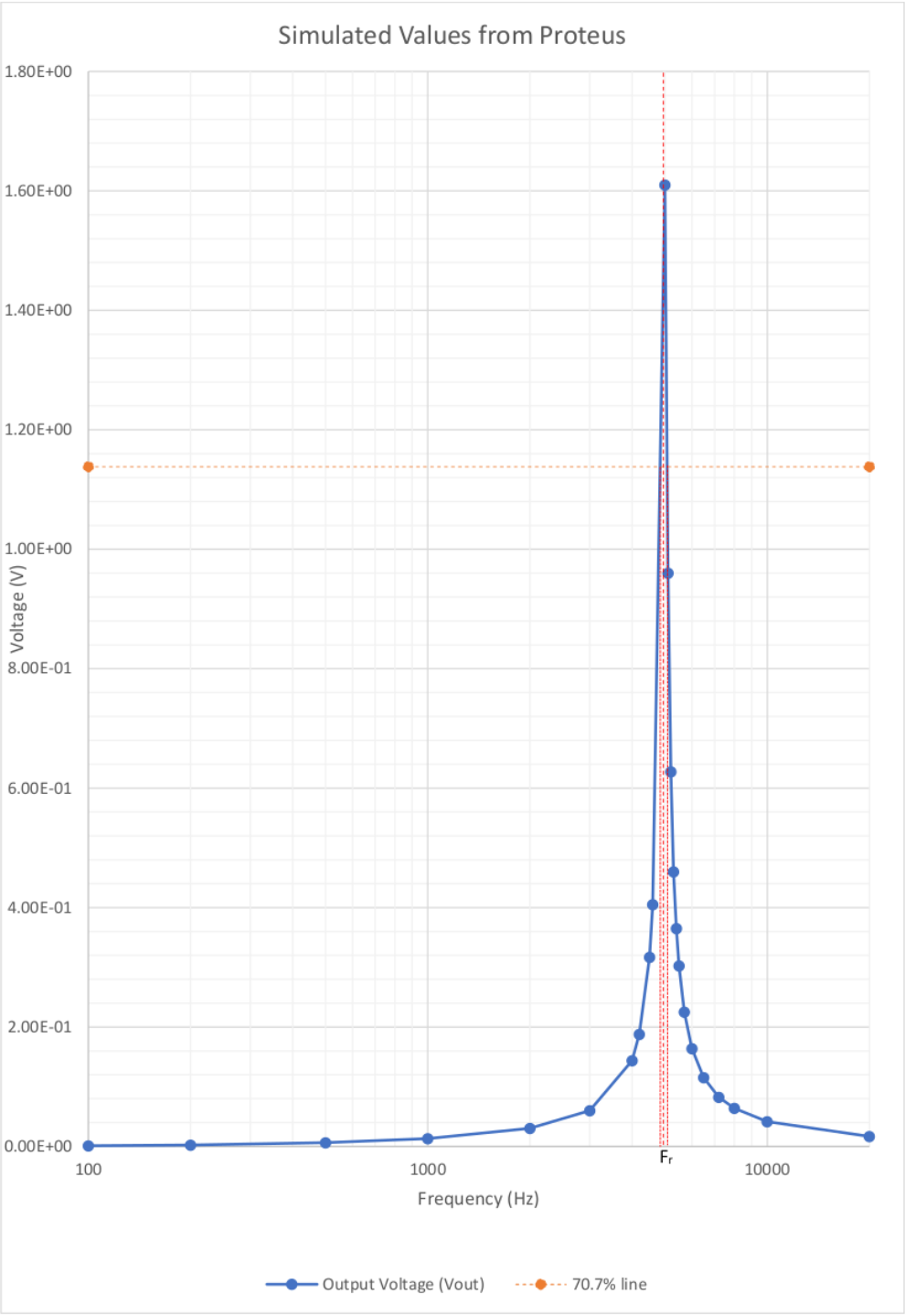


Figure 4: Simulated Values from Proteus

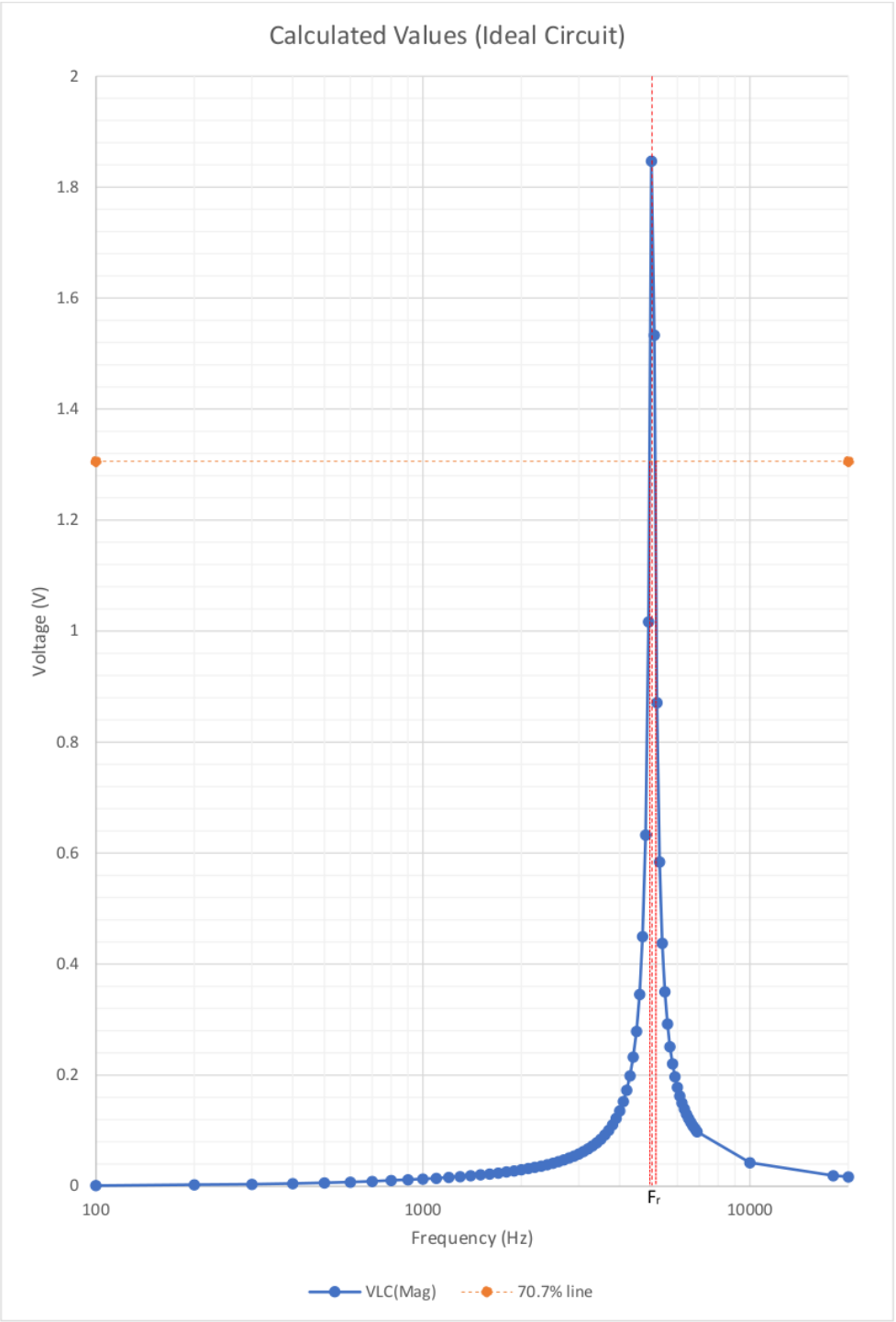


Figure 5: Calculated (Ideal) Values

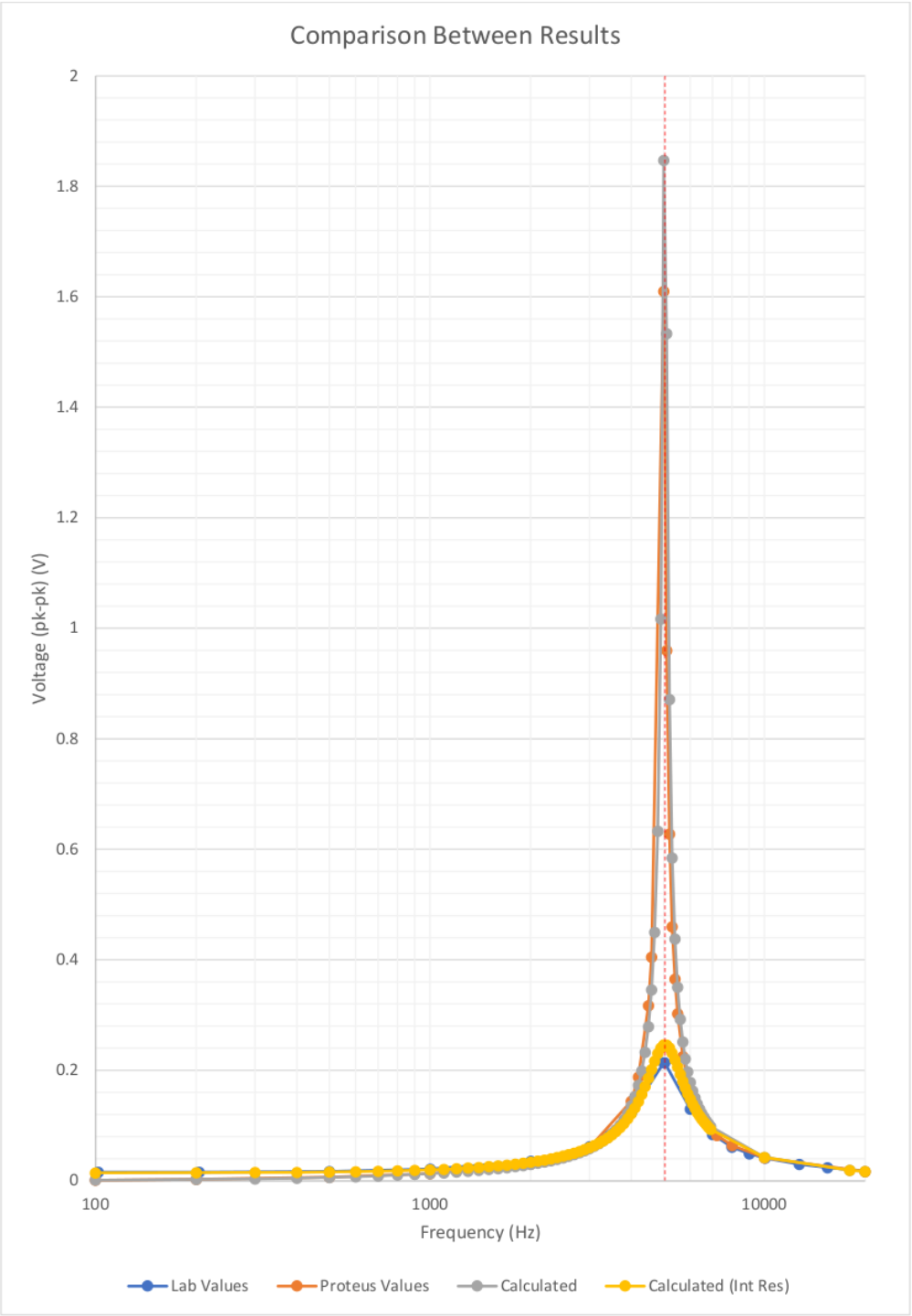


Figure 6: Comparison between Results

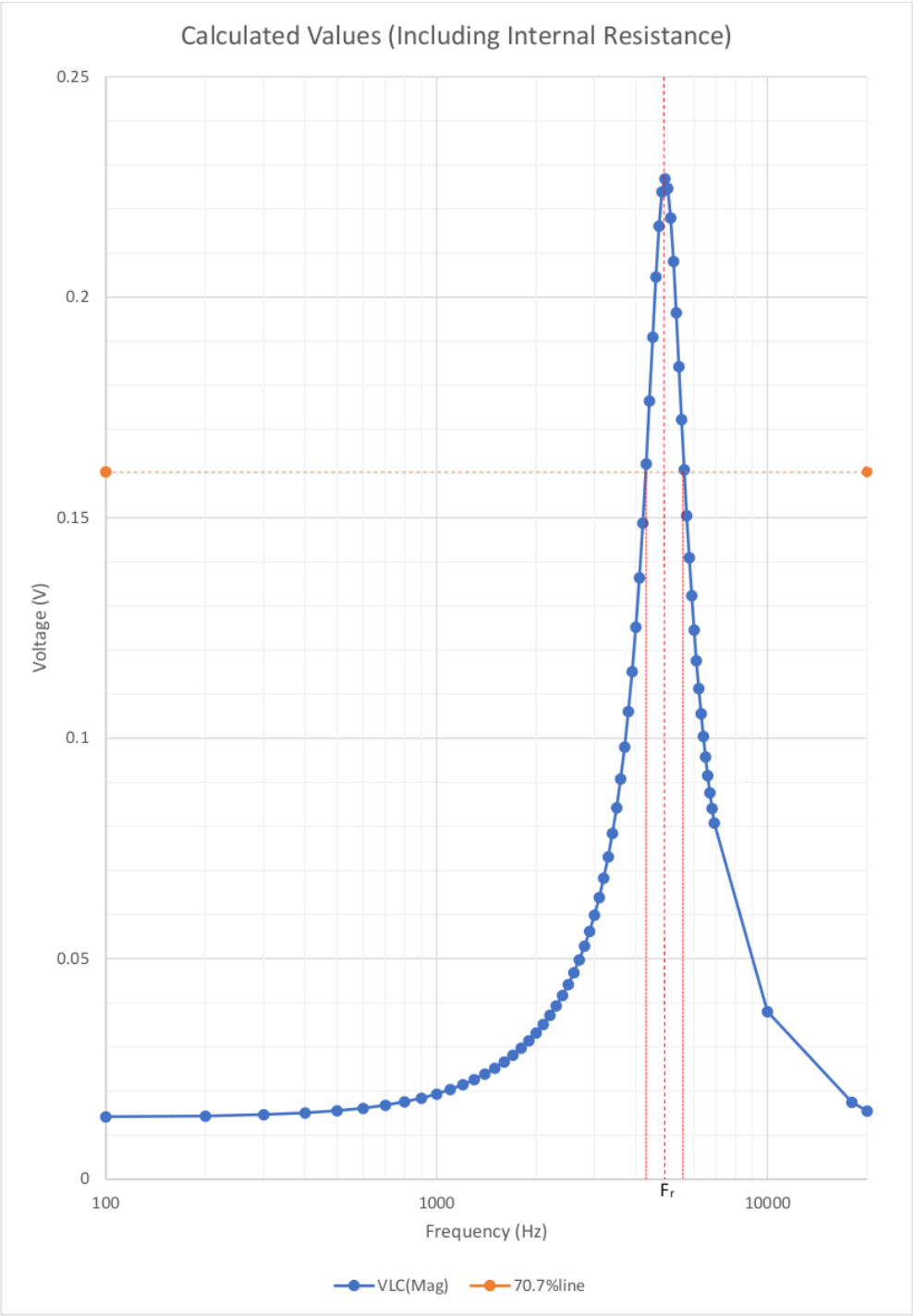


Figure 7: Calculated Values Including Internal Resistances

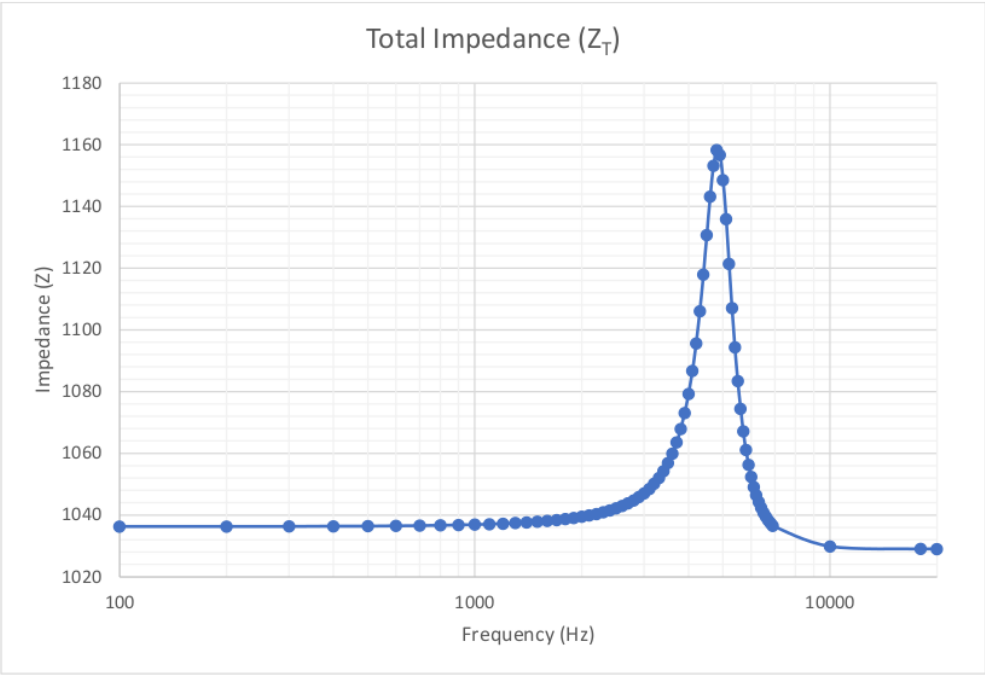


Figure 8: Total Impedance against Frequency (calculations include internal resistances)

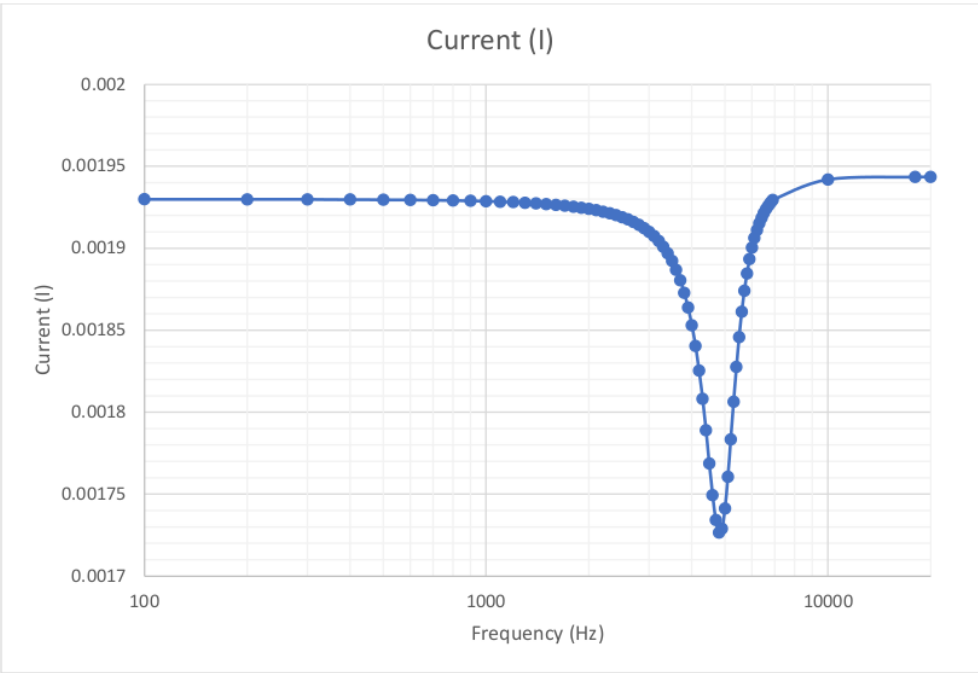


Figure 9: Current against Frequency (calculations include internal resistances)

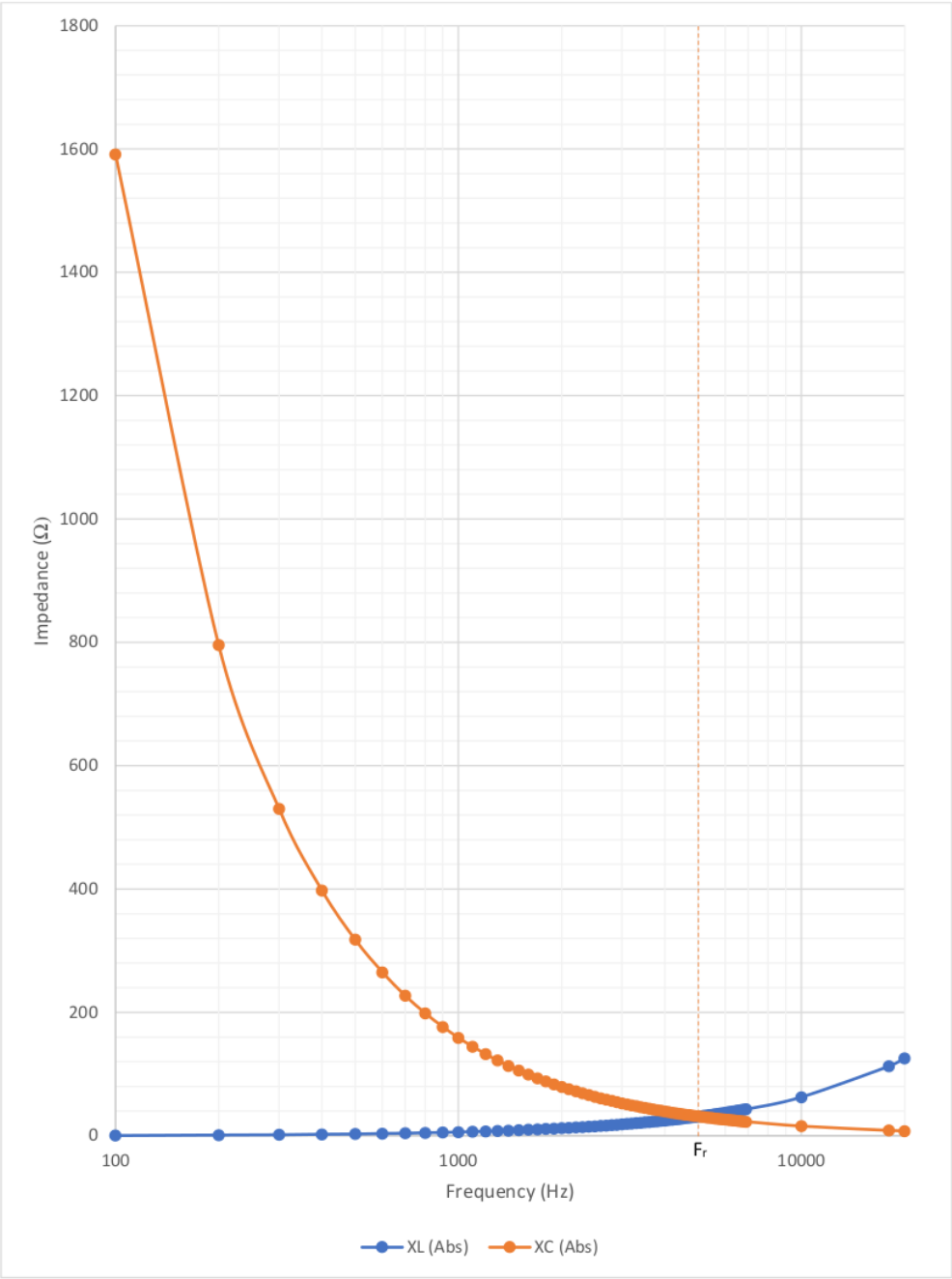


Figure 10: Reactance of Capacitor and Inductor against Frequency

DISCUSSION

All simulations display behaviour typical of a rejector circuit. As frequency increases up to the circuit's Resonant Frequency, Inductive Reactance nears the value of Capacitive Reactance and the circuit becomes purely resistive at Resonance, at which point Voltage and Current are in phase. Approaching resonance, total impedance of the circuit increases, which results in a drop in Current and an increase in the Voltage flowing through the circuit.

Results from the test and simulations show a variety in results, with simulated and calculated (ideal) results largely similar. Due to the tolerances of the various components within the various experimental test and simulations, some variation is to be expected. Results calculated that took into account real-life measurements and internal resistances displayed values closer to real-life laboratory conditions.

Bandwidth for the simulated and calculated (ideal) results was determined graphically to be approximately 100 Hz. The laboratory results however displayed a much wider bandwidth of approximately 1.1 kHz. This is a result of the lower Q-Factor of the laboratory-tested circuit, due to the higher internal resistance. Calculating bandwidth for a parallel LC circuit with resistance of 7.32Ω , as per the measured value of the inductor's resistance, gives the following:

$$B.W = \frac{R}{2\pi L}$$

Substituting values shows:

$$B.W = \frac{7.32\Omega}{2\pi * 0.994mH}$$

$$B.W = 1172 \text{ Hz}$$

Taking this into account, the circuit's Q-Factor can be determined:

$$Q - \text{Factor at resonance} = \frac{2\pi f r L}{R}$$

Substituting values shows:

$$Q - \text{Factor} = \frac{2\pi * 5032.921 * 0.994mH}{7.32\Omega}$$

$$Q - \text{Factor} = 4294.13 \text{ (2 d.p.)}$$

This is an extremely high Q-Factor in practice. At mains frequencies, the Q-Factor of a circuit such as this will be limited by the resistive load being powered by the circuit, and is typically less than 10. High Q-Factors such as this are desirable in communication applications, where signal strength and clarity is highly valued [1].

In an ideal LC Parallel circuit, R is solely the sum of the Capacitive and Inductive Reactance of the circuit, which, as $X_L = X_C$, means that the sum of the two phasor reactances becomes zero. This leads to the Bandwidth becoming 0 and the Q-Factor infinity, as you can neither divide zero, or divide anything by zero. As can be seen however from results, this is reflected in laboratory-obtained values and the Proteus-simulated results, as all components will feature at least minimal internal resistance. Circuit simulation programs therefore are forced to introduce at least a nominal amount of internal resistance in order to make their calculations. This (and the

varying degree to which this is applied, may account for some of the difference in results between the spreadsheet calculated and those simulated via dedicated software.

Resonant Frequency for each simulation remained roughly similar, however for calculated results including internal resistances and laboratory results, the Resonant frequency was marginally lower than predicted. This is visible on Figures 7, 8, and 9, plotted using results calculated with internal resistances:

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

Substituting values shows:

$$f_r = \frac{1}{2\pi\sqrt{0.994mH * 1.064\mu F}}$$
$$f_r = 4893.912 \text{ Hz (3 d.p.)}$$

As can be seen from Figure 10, at frequencies below F_R , the circuit is inductive, while above this frequency, the circuit is capacitive. This means that below F_R , Current lags Voltage, and above F_R , Current leads Voltage.



From figure 10, at zero Hz (F_0):

$$X_L \cong 0$$

Therefore the inductor will act as a short circuit, and all the available current will flow through that branch.

At higher frequencies (F_∞):

$$X_C \cong 0$$

At higher frequencies therefore, the capacitor will allow higher currents to flow through the capacitor. This effect can be seen in figure 9.

CONCLUSIONS

As seen above, the circuit functioned as predicted through mathematical modelling. Variances in results between the different test methods can be attributed largely to internal resistances and capacitance of the inductor.

The circuit presented the highest impedance at its resonant frequency. At this frequency, the circuit displays the highest impedance, and therefore current drops across the parallel network. Voltage conversely spikes at resonant frequency, with the magnitude determined by the Q-Factor of the circuit.

Q-Factor is a function of the resistance of the circuit. Higher Q factors result through overall low circuit resistance, however real-life conditions make achieving this difficult.

The circuit tested showed minor differences in resonant frequency between simulated methods and real-life measurements. As demonstrated, this can be largely attributed to the difference between measured and stated values of components used.



BIBLIOGRAPHY

[1] T. Floyd, "Principles of Electric Circuits," Prentice Hall, 2003.

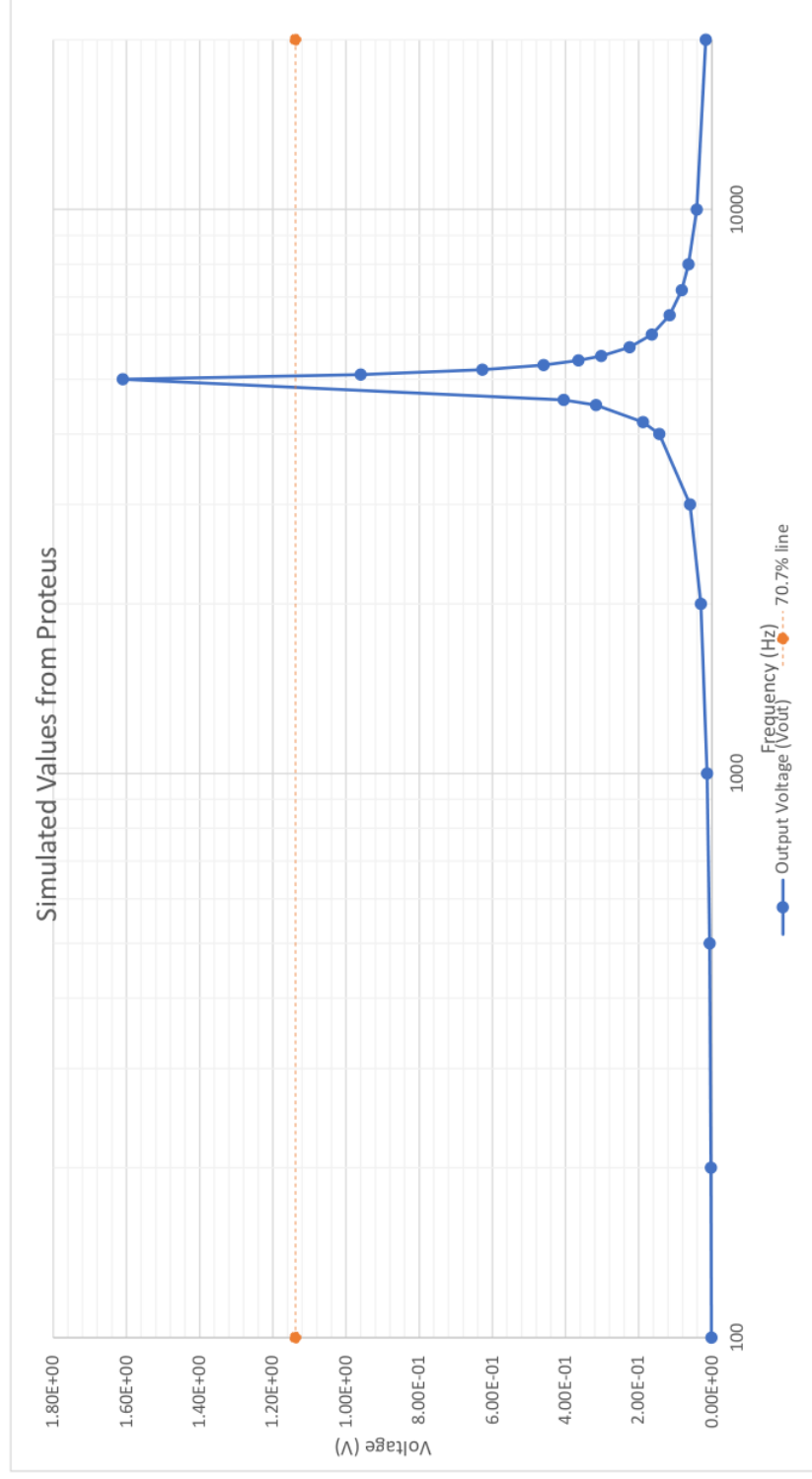
[2] J. Bird, "Electrical and Electronic Principles," Routledge, Oxon, 2017.



Frequency	Input Voltage (Vin pk-pk)	Output Voltage (Vout)
100	2	1.30E-03
200	2	2.50E-03
500	2	6.50E-03
1000	2	1.32E-02
2000	2	3.03E-02
3000	2	6.00E-02
4000	2	1.44E-01
4200	2	1.88E-01
4500	2	3.17E-01
4600	2	4.05E-01
5000	2	1.61E+00
5100	2	9.60E-01
5200	2	6.28E-01
5300	2	4.60E-01
5400	2	3.65E-01
5500	2	3.03E-01
5700	2	2.25E-01
6000	2	1.64E-01
6500	2	1.16E-01
7200	2	8.25E-02
8000	2	6.40E-02
10000	2	4.15E-02
20000	2	1.68E-02

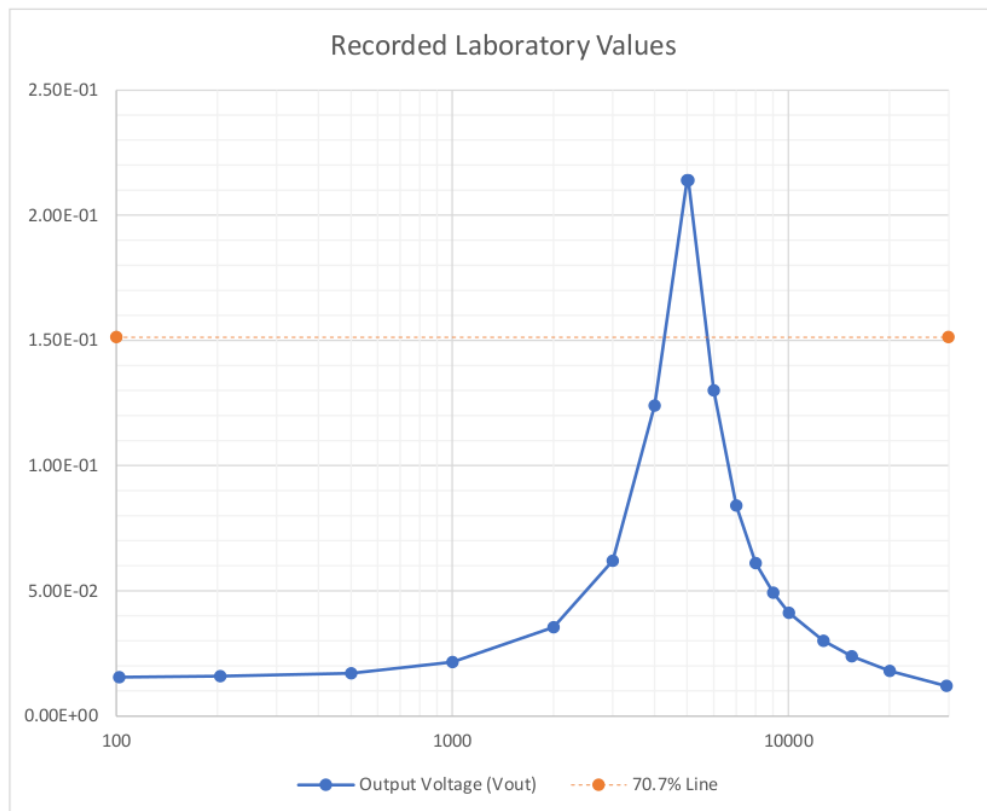
f 70.7% line
 100 1.14E+00
 20000 1.14E+00

Res freq: 5032.921



R

Frequency (sig gen)	Input Voltage (Vin pk-pk)	Output Voltage (Vout)
102	2.00E+00	1.55E-02
204	2.00E+00	1.59E-02
500	2.00E+00	1.70E-02
1002	2.00E+00	2.15E-02
2003	2.00E+00	3.54E-02
3004	2.00E+00	6.20E-02
4002	2.00E+00	1.24E-01
4999	2.00E+00	2.14E-01
5038	2.00E+00	2.14E-01
6004	2.00E+00	1.30E-01
6995	2.00E+00	8.40E-02
7998	2.00E+00	6.10E-02
9006	2.00E+00	4.92E-02
10040	2.00E+00	4.12E-02
12720	2.00E+00	3.00E-02
15427	2.00E+00	2.38E-02
20030	2.00E+00	1.80E-02
29550	2.00E+00	1.20E-02



fres

f	70.7% Line
100	1.51E-01
29950	1.51E-01

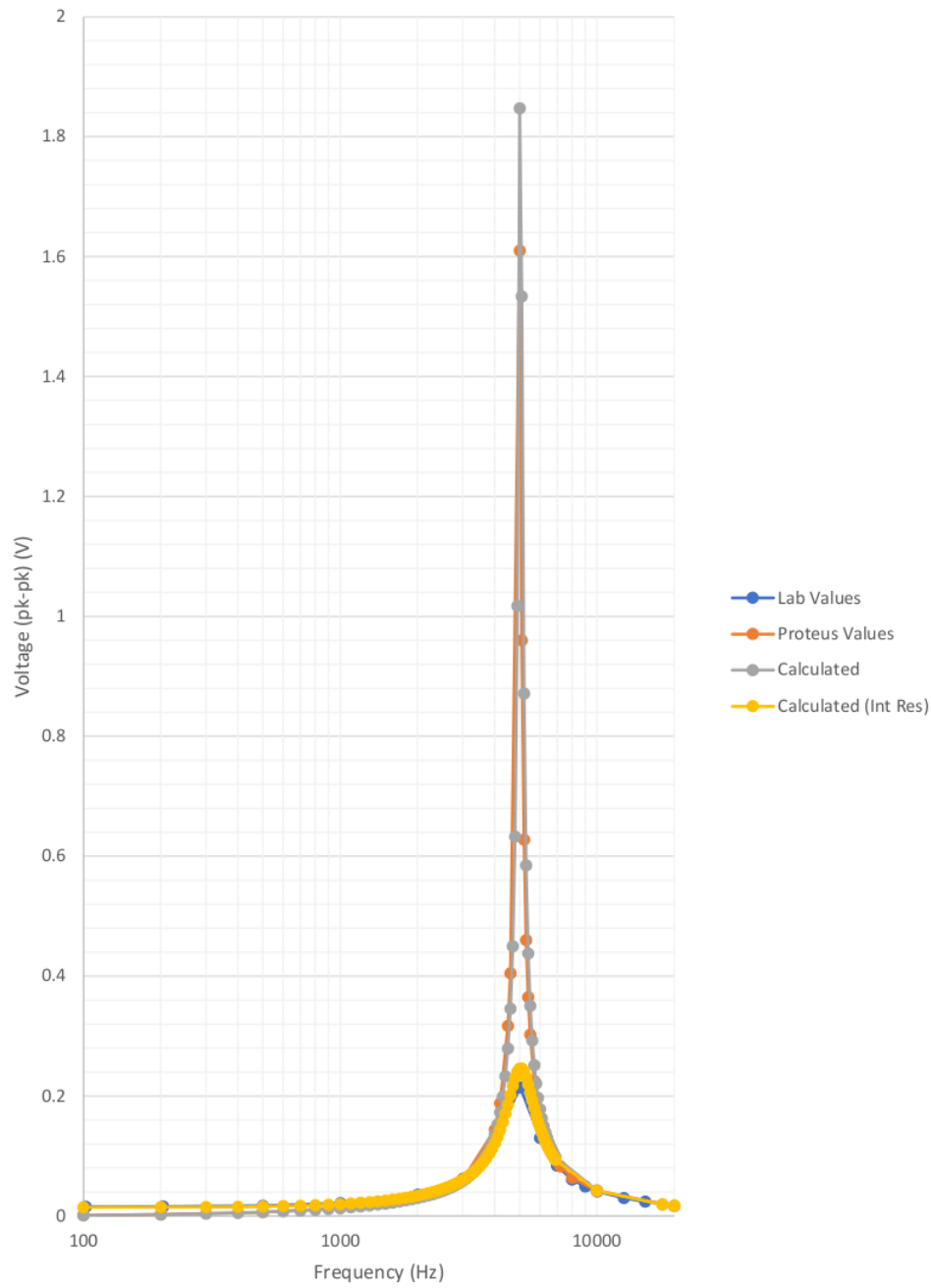
Freq	Lab Values	Proteus Values	Calculated	Calculated (Int Res)
	100		0.001257133	
	200		0.002517247	
	300		0.003783347	
	400		0.005058484	
	500		0.006345784	
	600		0.007648469	
	700		0.008969888	
	800		0.010313547	
	900		0.011683138	
	1000		0.013082581	
	1100		0.01451606	
	1200		0.015988067	
	1300		0.017503461	
	1400		0.01906752	
	1500		0.020686012	
	1600		0.022365277	
	1700		0.024112315	
	1800		0.0259349	
	1900		0.02784171	
	2000		0.029842479	
	2100		0.031948184	
	2200		0.034171275	
	2300		0.036525939	
	2400		0.039028447	
	2500		0.041697558	
	2600		0.044555042	
	2700		0.047626324	
	2800		0.050941307	
	2900		0.054535419	
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	3100		0.06273896	
	3200		0.067461369	
	3300		0.072694392	
	3400		0.078532732	
	3500		0.085095607	
	3600		0.092535249	
	3700		0.101049182	
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	3900		0.122435177	
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	4500		0.279190317	
	4600		0.345819776	
	4700		0.449871834	
	4800		0.632837056	
	4900		1.017153476	

5000		1.847204425
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5200		0.871402991
5300		0.584613467
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6400		0.130064579
6500		0.122056373
6600		0.115052129
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6800		0.103378496
6900		0.09846069
10000		0.042619374
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204	0.0159	
500	0.017	
1002	0.0215	
2003	0.0354	
3004	0.062	
4002	0.124	
4999	0.214	
5038	0.214	
6004	0.13	
6995	0.084	
7998	0.061	
9006	4.92E-02	
10040	0.0412	
12720	0.03	
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20030	0.018	
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4200		0.188
4500		3.17E-01

4600	0.405	
5000	1.61E+00	
5100	0.96	
5200	0.6275	
5300	0.46	
5400	0.365	
5500	3.03E-01	
5700	0.225	
6000	0.164	
6500	0.1155	
7200	0.0825	
8000	0.064	
10000	0.0415	
20000	0.01676	
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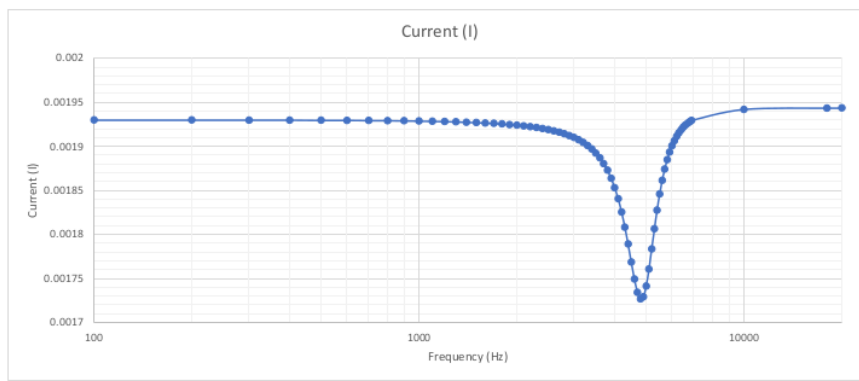
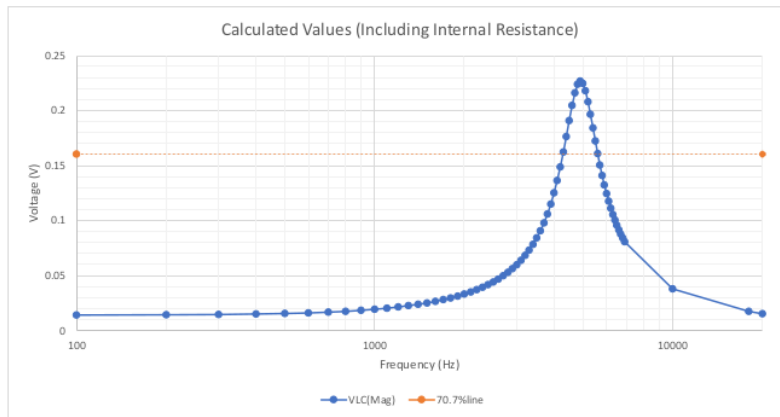
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Comparison Between Results

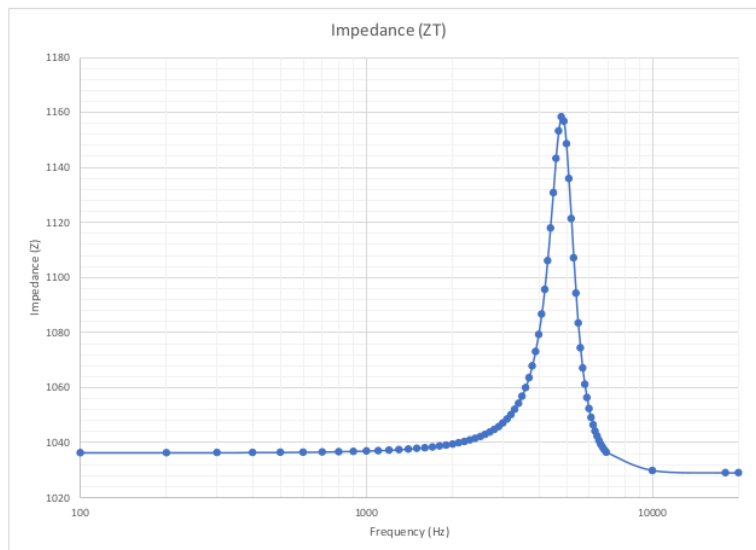


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Cap	1.06E-06	Ind Res	
Ind	9.94E-04		7.32
V	2		

Freq	XL	XC	ZLC	ZT
100	7.32+0.624548619533651i	-1495.81713432232i	7.32594088397091+0.58894395	1036.32594088397+0.588943957i
200	7.32+1.2490972390673i	-747.908567161162i	7.3438061232226+1.179190649	1036.34380612322+1.179190649i
300	7.32+1.87364585860095i	-498.605711440775i	7.3737241451723+1.772051628	1036.37372414517+1.772051628i
400	7.32+2.4981944781346i	-373.954283580581i	7.41591123133605+2.36885619	1036.41591123134+2.368856190i
500	7.32+3.12274309766825i	-299.163426864465i	7.47067493414599+2.97096052	1036.47067493415+2.97096052i
600	7.32+3.74729171720191i	-249.302855720387i	7.53841898929737+3.57975720	1036.5384189893+3.5797572043i
700	7.32+4.37184033673556i	-213.688162046046i	7.61964985871285+4.19668510	1036.61964985871+4.196685104i
800	7.32+4.99638895626921i	-186.977141790291i	7.71498508718754+4.82323994	1036.71498508719+4.823239940i
900	7.32+5.62093757580286i	-166.201903813592i	7.82516371151496+5.46098549	1036.82516371151+5.460985494i
1000	7.32+6.24548619533651i	-149.581713432232i	7.95105902699286+6.11156572	1036.95105902699+6.111565729i
1100	7.32+6.87003481487016i	-135.983375847484i	8.09369409590165+6.77671787	1037.0936940959+6.7767178707i
1200	7.32+7.49458343440381i	-124.651427860194i	8.25426047989946+7.45828674	1037.2542604799+7.4582867427i
1300	7.32+8.11913205393746i	-115.062856486333i	8.43414079848967+8.15824042	1037.43414079849+8.158240423i
1400	7.32+8.74368067347111i	-106.844081023023i	8.63493586550133+8.87868747	1037.6349358655+8.8786874740i
1500	7.32+9.36822929300476i	-99.721142288155i	8.8584973435857+9.621895929	1037.85849734359+9.621895929i
1600	7.32+9.99277791253841i	-93.4885708951453i	9.10696709450607+10.3903142	1038.10696709451+10.39031424i
1700	7.32+10.617326520721i	-87.9892431954309i	9.38282470549402+11.1865943	1038.38282470549+11.18659439i
1800	7.32+11.2418751516057i	-83.1009519067958i	9.68894505097354+12.0136173	1038.68894505097+12.01361731i
1900	7.32+11.8664237711394i	-78.7272175959118i	10.0286683119637+12.8745207	1039.02866831196+12.87452070i
2000	7.32+12.490972390673i	-74.7908567161162i	10.4058852933029+13.7727293	1039.4058852933+13.772729359i
2100	7.32+13.1155210102067i	-71.2293873486821i	10.8251421708541+14.7119876	1039.82514217085+14.71198768i
2200	7.32+13.7400696297403i	-67.991687923742i	11.2917693297046+15.6963939	1040.2917693297+15.696393980i
2300	7.32+14.364618249274i	-65.0355275792315i	11.8120408469526+16.7304356	1040.81204084695+16.73043563i
2400	7.32+14.9891668688076i	-62.3257139300969i	12.393372843308+17.81902334	1041.39337284331+17.81902334i
2500	7.32+15.6137154883413i	-59.832685372893i	13.0445715033073+18.9675215	1042.04457150331+18.96752152i
2600	7.32+16.2382641078749i	-57.5314282431663i	13.7761448866148+20.1817701	1042.77614488661+20.18177011i
2700	7.32+16.8628127274086i	-55.4006346045305i	14.6006970761915+21.4680898	1043.60069707619+21.46808987i
2800	7.32+17.4873613469422i	-53.4220405115116i	15.5334290764967+22.8332586	1044.5334290765+22.833258694i
2900	7.32+18.1119099664759i	-51.5799011835284i	16.5927786220618+24.2844388	1045.59277862206+24.28443886i
3000	7.32+18.7364585860095i	-49.8605711440775i	17.801241182831+25.82902369	1046.80124118283+25.82902369i
3100	7.32+19.3610072055432i	-48.2521656233008i	19.1864274329794+27.4743527	1048.18642743298+27.47435274i
3200	7.32+19.9855558250768i	-46.7442854475726i	20.7824284915766+29.2272152	1049.78242849158+29.22721522i
3300	7.32+20.6101044446105i	-45.3277919491613i	22.6315786857516+31.0930126	1051.63157868575+31.09301265i
3400	7.32+21.2346530641441i	-43.9946215977154i	24.7867235189222+33.0743739	1053.78672351892+33.07437394i
3500	7.32+21.8592016836778i	-42.7376324092093i	27.314109710825+35.16889046	1056.31410971083+35.16889046i
3600	7.32+22.4837503032114i	-41.5504759533979i	30.2969943635094+37.3654365	1059.29699436351+37.36543654i
3700	7.32+23.1082989227451i	-40.4274901168196i	33.8399750201643+39.6382199	1062.83997502016+39.63821990i
3800	7.32+23.7328475422787i	-39.3636087979559i	38.0737695049005+41.9372110	1067.0737695049+41.937211042i
3900	7.32+24.3573961618124i	-38.3542854954442i	43.1595081134224+44.1728810	1072.15950811342+44.17288100i
4000	7.32+24.981944781346i	-37.3954283580581i	49.2901066121155+46.1922668	1078.29010661212+46.19226685i
4100	7.32+25.0664934080797i	-36.4833447395689i	56.6831623008202+47.7426565	1085.68316230082+47.74265659i
4200	7.32+26.2310420204133i	-35.6146936743411i	65.5538109826386+48.4200231	1094.55381098264+48.42002310i
4300	7.32+26.855590639947i	-34.7864449842401i	76.046047020067+47.60564823	1105.04604702007+47.60564823i
4400	7.32+27.48013392594806i	-33.995843961871i	88.0896774210494+44.4148562	1117.08967742105+44.41485622i
4500	7.32+28.1046878790143i	-33.2403807627183i	101.153879334387+37.7289168	1130.15387933439+37.72891681i
4600	7.32+28.7292364985479i	-32.5177637896157i	113.934874409545+26.4501844	1142.93487440955+26.45018444i
4700	7.32+29.3537851180816i	-31.8258964749431i	124.206299358823+10.1210711	1153.20629935882+10.12107118i
4800	7.32+29.9783337376152i	-31.1628569650484i	129.281824473816-10.2424575	1158.28182447382-10.242457515i
4900	7.32+30.6028823571489i	-30.5268802922923i	127.293711904441-31.8485449	1156.29371190444-31.848544902i
5000	7.32+31.2274309766825i	-29.9163426864465i	118.465618660537-51.1347696	1147.46561866054-51.134769656i
5100	7.32+31.8519795962162i	-29.3297477318103i	105.046510052076-65.5253290	1134.04651005208-65.525329002i
5200	7.32+32.4675282157498i	-28.7657141215832i	89.9305842019132-74.3552878	1118.93058420191-74.355287803i
5300	7.32+33.1010768352835i	-28.229647985344i	75.3523381387988-78.4384221	1104.3523381388-78.4384221307i
5400	7.32+33.7256254548172i	-27.7003173022653i	62.4863197824473-79.1346522	1091.48631978245-79.134652276i
5500	7.32+34.3501740743508i	-27.1966751694968i	51.6854342776907-77.7064699	1080.68543427769-77.706469910i
5600	7.32+34.9747226938845i	-26.7110202557558i	42.8539664671137-75.0897671	1071.85396646711-75.089767137i
5700	7.32+35.5992713134181i	-26.2424058653039i	35.7181358929524-71.8994812	1064.71813589295-71.899481221i
5800	7.32+36.2238199329518i	-25.7899505917642i	29.9707529496156-68.5100216	1058.97075294962-68.510021675i
5900	7.32+36.8483685524854i	-25.3528327851241i	25.3327658131747-65.1361272	1054.33276581317-65.136127251i
6000	7.32+37.4729171720191i	-24.9302855720387i	21.5719295141633-61.8932315	1050.57192951416-61.893231582i
6100	7.32+38.0974657915527i	-24.5215923659397i	18.5028311210619-58.8374521	1047.50283112106-58.837452108i
6200	7.32+38.7220144110864i	-24.1260828116504i	15.9803427533093-55.9905622	1044.98034275331-55.990562287i
6300	7.32+39.34656303062i	-23.7431291162274i	13.8917862032865-53.3550919	1042.89178620329-53.355091954i
6400	7.32+39.9711116501537i	-23.3721427237863i	12.1498097520112-50.9232785	1041.14980975201-50.923278589i
6500	7.32+40.5956602696873i	-23.0125712972665i	10.6865382734676-48.6822916	1039.68653827347-48.682291689i
6600	7.32+41.220208889221i	-22.6638959745807i	9.4489897547514-46.6172307	1038.44898975476-46.617230765i
6700	7.32+41.8447575087546i	-22.3256288704825i	8.3955658588043-44.7128046	1037.39556585884-44.712804637i
6800	7.32+42.4693061282883i	-21.9973107988577i	7.49339194013644-42.9542349	1036.49339194014-42.954234951i
6900	7.32+43.0938547478219i	-21.6785091930772i	6.71631134253705-41.3277070	1035.71631134254-41.327707041i
10000	7.32+62.4548619533651i	-14.9581713432232i	0.709164085708346-19.5596661	1029.70916408571-19.559666858i
18000	7.32+112.418751516057i	-8.31009519067958i	0.046409584635583-8.9701552	1029.04640958464-8.9701552312i
20000	7.32+124.90972390673i	-7.47908567161162i	0.029577470177118-7.953580	1029.02957747018-7.9535803711i



Z (Abs)	I	I(Mag)
1036.326108	0.00192989413385197-1.09675869764419E-06i	0.001929894
1036.344477	0.00192985898968943-2.19586556369531E-06i	0.001929886
1036.375239	0.00192980013502349-3.29968368708729E-06i	0.001929803
1036.418618	0.00192971714370166-4.41060615905971E-06i	0.001929722
1036.474933	0.0019296094098678-5.53107147891282E-06i	0.001929617
1036.5446	0.00192947613842773-6.66357944931381E-06i	0.001929488
1036.628145	0.00192931633236145-7.81070773075439E-06i	0.001929332
1036.726205	0.00192912877653642-8.97512922960428E-06i	0.00192915
1036.839545	0.00192891201757295-0.0000101596304993162i	0.001928939
1036.969069	0.00192866433918904-0.0000113671313388527i	0.001928698
1037.115835	0.00192838373230631-0.0000126007057750584i	0.001928425
1037.281074	0.00192806785901869-0.0000138636046145352i	0.001928118
1037.466218	0.00192771400930757-0.0000151592797427872i	0.001927774
1037.672921	0.00192731904911585-0.0000164914103297414i	0.00192739
1037.903098	0.00192687935805602-0.0000178639310650227i	0.001926962
1038.158964	0.00192639075460492-0.0000192810624844265i	0.001926487
1038.44308	0.0019258484061043-0.0000207473433473883i	0.00192596
1038.758418	0.00192524672021245-0.0000222676648640347i	0.001925375
1039.108429	0.00192457921359365-0.0000238473063202082i	0.001924727
1039.49713	0.00192383835253602-0.0000254919712661057i	0.001924007
1039.929213	0.00192301535878502-0.0000272078228541119i	0.001923208
1040.41018	0.00192209997207479-0.000029001516037211i	0.001922319
1040.946498	0.0019210801585165-0.000030880223025983i	0.001921328
1041.54581	0.00191994175100843-0.0000328516464308397i	0.001920223
1042.217183	0.00191866800397499-0.0000349240115555803i	0.001918986
1042.971424	0.0019172390397884-0.0000371060248540557i	0.001917598
1043.821486	0.00191563115790456-0.0000394067788418556i	0.001916036
1044.782964	0.0019138159697705-0.0000418355735828026i	0.001914273
1045.87475	0.00191175931270752-0.000044401609414533i	0.001912275
1047.119848	0.00190941988423536-0.0000471134820059978i	0.001910001
1048.546435	0.00190674752524389-0.00004997837477019i	0.001907402
1050.18921	0.00190368106791806-0.0000530007883319141i	0.001904419
1052.091133	0.0019001456570718-0.0000561805618580167i	0.001900976
1054.305635	0.00189604946205865-0.0000595098111586838i	0.001896983
1056.899404	0.00189127974293478-0.0000629682113524041i	0.001892328
1059.9558	0.00188569836437842-0.0000665157580632359i	0.001886871
1063.578864	0.00187913715364392-0.0000700817183045822i	0.001880444
1067.897542	0.00187139414595474-0.0000735479153233171i	0.001872839
1073.069082	0.00186223306479128-0.0000767238446756959i	0.001863813
1079.279055	0.00185139087044085-0.0000793106981199893i	0.001853089
1086.732391	0.0018386026189187-0.0000808521090624638i	0.001840379
1095.624271	0.00182365979638795-0.0000806736485649827i	0.001825443
1106.071003	0.00180652658534276-0.0000778255977509068i	0.001808202
1117.972284	0.00178754078997394-0.0000710716147473644i	0.001788953
1130.783473	0.00176770044466988-0.0000590126922071124i	0.001768685
1143.240893	0.00174894430343981-0.0000404746591011992i	0.001749413
1153.250712	0.00173416149426965-0.000015219802330202i	0.001734228
1158.32711	0.00172656047920054+0.0000152676334737143i	0.001726628
1156.732241	0.00172835312063666+0.00004760514686153i	0.001729009
1148.604419	0.00173951713858535+0.0000775184953245673i	0.001741244
1135.937963	0.00175772785178883+0.000101561703831i	0.00176066
1121.398395	0.00177956264071368+0.000118255675716789i	0.001783487
1107.134442	0.00180192589974401+0.000127984719632791i	0.001806465
1094.35126	0.00182278232291441+0.000132154881544941i	0.001827567
1083.475567	0.00184115795901126+0.000132388094633258i	0.001845911
1074.48099	0.00185681289005341+0.000130080824342558i	0.001861364
1067.143029	0.00186990431541579+0.000126272997218744i	0.001874163
1061.184564	0.00188075451596515+0.00012167525146116i	0.001884686
1056.342888	0.00188972180381331+0.000116746025423559i	0.001893325
1052.393534	0.00189714028324502+0.000111767828167422i	0.00190043
1049.153958	0.00190329783932792+0.000106906818905383i	0.001906298
1046.479269	0.00190843273932538+0.000102254767664878i	0.00191117
1044.255737	0.00191273807539214+0.0000978570521385317i	0.00191524
1042.39441	0.00191636871368246+0.0000937307743539273i	0.00191866
1040.825664	0.00191944835668827+0.0000898762668775026i	0.001921551
1039.494815	0.00192207579213511+0.0000862843063393066i	0.001924012
1038.358702	0.00192433008185287+0.0000829405849164713i	0.001926117
1037.383062	0.00192627473139166+0.0000798284466041537i	0.001927928
1036.540524	0.00192796098279888+0.0000769305318578236i	0.001929495
1029.894919	0.00194159543761483+0.000036881248859385i	0.001941946
1029.085505	0.00194339926963049+0.000016940531508131i	0.001943473
1029.060314	0.00194346262703132+0.0000150214207062436i	0.001943521



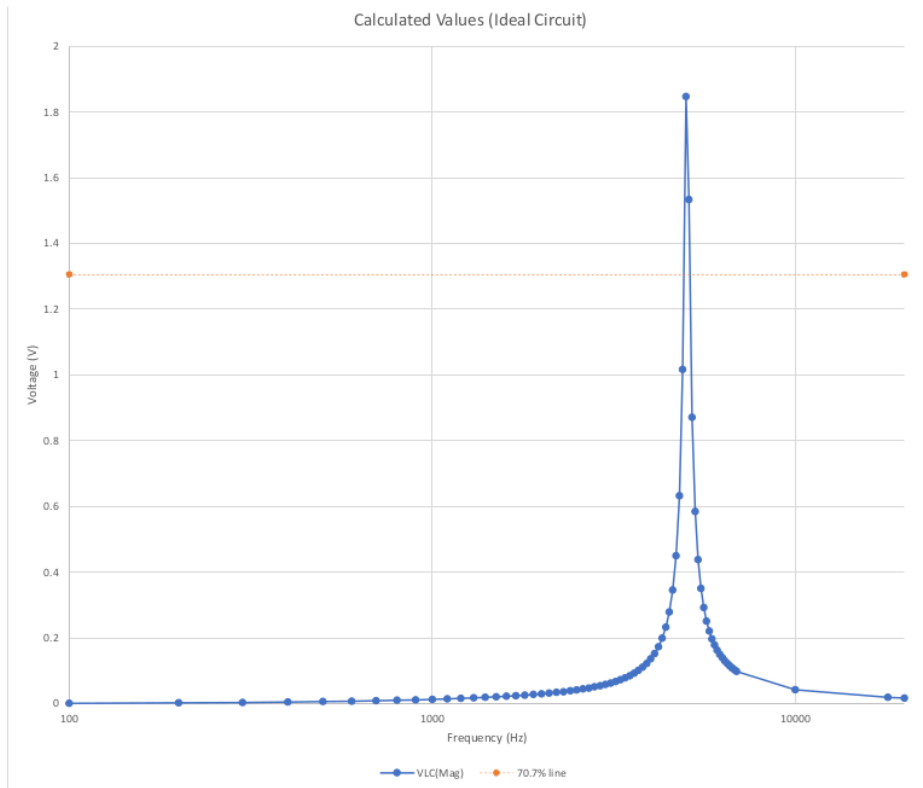
70.7%line

0.160401402
0.160401402

VLC	VLC(Mag)	VLC(dB)
0.0141389362663299+0.00112856469987588i	0.014183906	-42.98468329
0.0141750996095783+0.00225954566504247i	0.014354059	-42.88110567
0.0142356610608296+0.0033953745140128i	0.014634979	-42.71275777
0.0143210591309818+0.00453851373767245i	0.01502301	-42.48546055
0.0144319172460264+0.00569147255180132i	0.015513642	-42.20632448
0.0145690535578604+0.00685682325334393i	0.016101967	-41.88302118
0.014733494000076+0.00803721825494626i	0.016783108	-41.523152
0.0149264889440145+0.0092354079772628i	0.017552573	-41.13378396
0.0151495339174431+0.0104542597837963i	0.018406519	-40.72116685
0.0154043949744864+0.0116967781476794i	0.019341923	-40.2906067
0.0156931394568108+0.0129661262425351i	0.020356696	-39.84645426
0.0160181730697656+0.0142656491483567i	0.021449723	-39.39216618
0.0163822844225051+0.015598898855328i	0.022620895	-38.93040425
0.016788698459798+0.016969661229304i	0.023871108	-38.46314835
0.0172411405603476+0.0183819850659084i	0.025202268	-37.99180747
0.017743913511529+0.0198402132964749i	0.026617298	-37.51732071
0.018301990118685+0.0213490163044625i	0.028120159	-37.04024449
0.0189211249013937+0.0229134271450916i	0.02971589	-36.56082511
0.0196079892121453+0.0245388782034942i	0.031410664	-36.0790577
0.0203703352404456+0.0262312384328227i	0.033211872	-35.59473286
0.0212171958102208+0.02796849716881i	0.035128236	-35.10747298
0.022159128735052+0.02984256000229i	0.037169953	-34.61675978
0.0232085168865222+0.0317757494937364i	0.039348869	-34.12195478
0.0243799382123164+0.033804344177334i	0.041678712	-33.62231403
0.0256906239097318+0.0359368078906922i	0.044175359	-33.11699822
0.0271610280577472+0.0381820995748232i	0.046857168	-32.60507922
0.0288155385162146+0.0405495754282694i	0.049745385	-32.08554399
0.0306833671061543+0.0430488052167041i	0.052864626	-31.55729669
0.0327996672239646+0.045689256087543i	0.056243456	-31.01916
0.0352069391218192+0.0484797729841717i	0.059915081	-30.46987687
0.0379567965240336+0.0514277476385255i	0.063918164	-29.90811414
0.0411121811123144+0.0545378111935399i	0.068297762	-29.33247046
0.0447501188731231+0.0578097981518991i	0.073106401	-28.7414918
0.04896510354165+0.0612355956822854i	0.078405227	-28.13369964
0.0538731445201063+0.0647942894816242i	0.084265151	-27.50763986
0.0596163830546061+0.0684447150470698i	0.090767792	-26.86196445
0.066367868900415+0.0721140881354148i	0.098005794	-26.19556485
0.0743354238125773+0.0756808048676934i	0.106081758	-25.50778572
0.083762176329779+0.078948836171291i	0.115104391	-24.79876206
0.0949187943163549+0.0816107083654693i	0.125179412	-24.06994176
0.108077905132653+0.083196820225275i	0.136391145	-23.3248764
0.123454069516795+0.0830131843733672i	0.148768599	-22.57037445
0.141084143682297+0.0800825400856835i	0.162228077	-21.81807953
0.160620527116809+0.0731326915750378i	0.176486102	-21.08638968
0.181036242434692+0.060724060281119i	0.190949031	-20.40225072
0.200336311760432+0.0416484242151343i	0.204619718	-19.80165027
0.215547822396539+0.0156611765977778i	0.216116025	-19.3268605
0.223369266902641+0.0157103948444521i	0.223921071	-19.01870067
0.221524638864882+0.0489856961205144i	0.226876098	-18.90482501
0.210036864395667+0.0797665316889799i	0.224673505	-18.98956269
0.191298040509282+0.104506993242099i	0.217983146	-19.25214159
0.168830042705623+0.121685090312575i	0.208112577	-19.65463339
0.145818249163417+0.131696276502143i	0.196486313	-20.15395386
0.124356989721064+0.135987373109744i	0.184274867	-20.71127779
0.105448460177419+0.136227349377623i	0.172270916	-21.29636066
0.0893395361350506+0.133853168248492i	0.16092925	-21.88790019
0.0758684594371588+0.129934914138087i	0.150462969	-22.47200737
0.0647036030718473+0.125203833753534i	0.140934581	-23.04024851
0.0554762638761112+0.120131660160841i	0.132322453	-23.58792903
0.0478426485408855+0.115009095184277i	0.124563281	-24.11279913
0.0415065233315766+0.110007116653639i	0.117577027	-24.61415045
0.0362227112341855+0.10522015592716i	0.111280573	-25.09221282
0.0317925204214769+0.100694906650549i	0.105594643	-25.54776221
0.0280565936207558+0.0964489668101913i	0.10044688	-25.98187091
0.0248876409677681+0.0924826786169505i	0.095772859	-26.39575087
0.0221840098929671+0.0887865512231467i	0.09151602	-26.79065739
0.0198643457733925+0.0853458618790487i	0.087627098	-27.16783129
0.0178633013979765+0.0821434715556745i	0.084063354	-27.52846566
0.0161281486999418+0.0791615172817005i	0.080787765	-27.8768803
0.00209829469434101+0.0379508050763073i	0.038008768	-34.42292405
0.000242151550212588+0.0174318069218669i	0.017433489	-41.1929138
0.000176956784767923+0.0154570419067247i	0.015458055	-42.23750306

Res	1000			fres
Cap	1.00E-06	Ind Res		VLC(Mag) at half-power points
Ind	1.00E-03		0	Q-Factor at resonance
V	2			Bandwidth

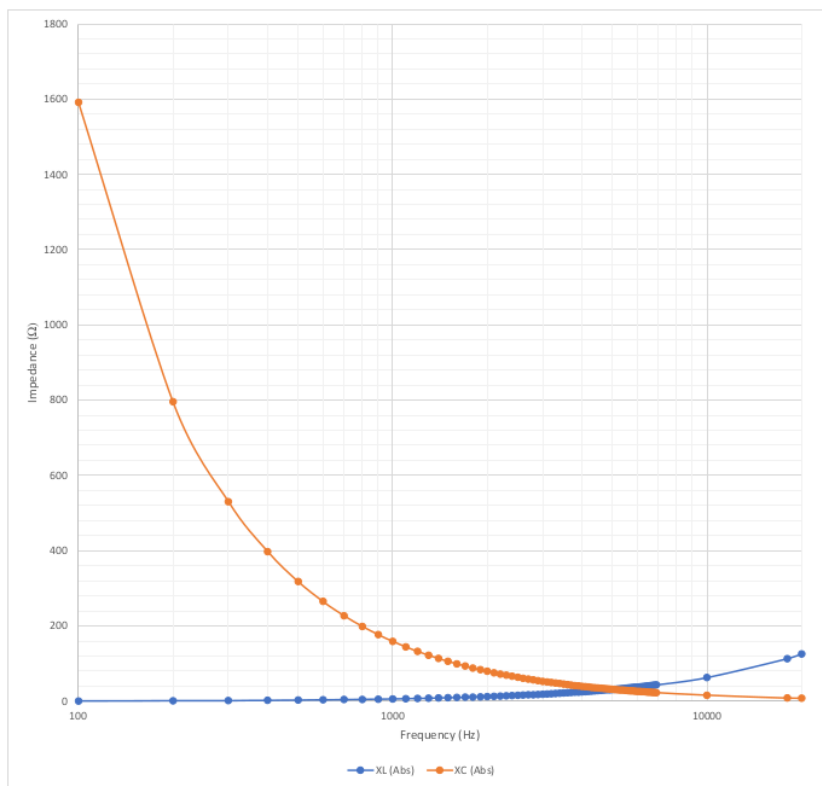
Freq	XL	XL (Abs)	XC	XC (Abs)	ZLC
100	0.628318530717959i		0.628318531 -1591.54943091895i		1591.549431 0.628566678896376i
200	1.25663706143592i		1.256637061 -795.774715459477i		795.7747155 1.2586246017413i
300	1.88495559215388i		1.884955592 -530.516476972984i		530.516477 1.89167682885787i
400	2.51327412287183i		2.513274123 -397.887357729738i		397.8873577 2.52925025049019i
500	3.14159265358979i		3.141592654 -318.309886183791i		318.3098862 3.17290800035434i
600	3.76991118430775i		3.769911184 -265.258238486492i		265.2582385 3.82426248359594i
700	4.39822971502571i		4.398229715 -227.364204416993i		227.3642044 4.48498925155138i
800	5.026548245474367i		5.026548246 -198.943678864869i		198.9436789 5.15684198093933i
900	5.65486677646163i		5.654866776 -176.838825657661i		176.8388257 5.8416688487383i
1000	6.28318530717959i		6.283185307 -159.154943091895i		159.1549431 6.54143063762157i
1100	6.91150383789755i		6.911503838 -144.686311901723i		144.6863119 7.25822096254885i
1200	7.5398223686155i		7.539822369 -132.629119243246i		132.6291192 7.99428907976224i
1300	8.16814089933346i		8.168140899 -122.426879301458i		122.4268793 8.75206582870341i
1400	8.7964594300515i		8.79645943 -113.682102208497i		113.6821022 9.53419337012921i
1500	9.42477796076938i		9.424777961 -106.103295394597i		106.1032954 10.3435595263907i
1600	10.0530964941873i		10.05309649 -99.4718394324346i		99.47183943 11.1833377109808i
1700	10.6814150222055i		10.68141502 -93.6205547599385i		93.62055476 12.0570336654342i
1800	11.3097335529233i		11.30973355 -88.4194128288307i		88.41941283 12.9685405177459i
1900	11.9380520836412i		11.93805208 -83.7657595220502i		83.76575952 13.92220405083361i
2000	12.5663706143592i		12.56637061 -79.5774715459477i		79.57747155 14.9229006253889i
2100	13.1946891450771i		13.19468915 -75.7880681389978i		75.78806814 15.9761306399056i
2200	13.8230076757951i		13.82300768 -72.3431559508615i		72.34315595 17.0881316858534i
2300	14.451326206513i		14.45132621 -69.1978013443023i		69.19780134 18.2660161678562i
2400	15.079644737231i		15.07964474 -66.3145596216231i		66.31455962 19.5179401050324i
2500	15.707963267949i		15.70796327 -63.6619772367581i		63.66197724 20.8533116883695i
2600	16.3362817986669i		16.3362818 -61.213439650729i		61.21343965 22.2830510634498i
2700	16.9646003293849i		16.96460033 -58.9462752192205i		58.94627522 23.8199167285275i
2800	17.5929188601028i		17.59291886 -56.8410511042483i		56.8410511 25.4789194497061i
2900	18.2212373908208i		18.22123739 -54.8810148592743i		54.88101486 27.2778524326974i
3000	18.8495559215388i		18.84955592 -53.0516476972984i		53.0516477 29.2379777984439i
3100	19.4778744522567i		19.47787445 -51.340304223192i		51.34030422 31.3849259830206i
3200	20.1061929829747i		20.10619298 -49.7359197162173i		49.73591972 33.7498893932783i
3300	20.7345115136926i		20.73451151 -48.2287706339077i		48.22877063 36.3712291947067i
3400	21.3628300444106i		21.36283004 -46.8102773799692i		46.81027738 39.2966723464898i
3500	21.9911485751286i		21.99114858 -45.4728408833987i		45.47284088 42.5863684300048i
3600	22.6194671105846i		22.61946711 -44.2097064144154i		44.20970641 46.3172263034209i
3700	23.2477856365645i		23.24778564 -43.014849484296i		43.01484948 50.589202711295i
3800	23.8761041672824i		23.87610417 -41.8828797610251i		41.88287976 55.5346510980842i
3900	24.5044226980004i		24.5044227 -40.8089597671527i		40.80895977 61.3326214512383i
4000	25.1327412287183i		25.13274123 -39.7887357729738i		39.78873577 68.2314664474239i
4100	25.7610597594363i		25.76105976 -38.8182788029013i		38.8182788 76.5859863935184i
4200	26.3893782901543i		26.38937829 -37.8940340694989i		37.89403407 86.921331605192i
4300	27.0176968208722i		27.01769682 -37.0127774632315i		37.01277746 100.049217788397i
4400	27.6460153515902i		27.64601535 -36.1715779754308i		36.17157798 117.294311721274i
4500	28.274338823081i		28.2743388 -35.3677651315323i		35.36776513 140.975497592842i
4600	28.9026524130261i		28.90265241 -34.5989006721512i		34.59890067 175.554146257241i
4700	29.5309709437441i		29.53097094 -33.8627538493394i		33.86275385 230.851827479238i
4800	30.159289474462i		30.15928947 -33.1572798108115i		33.15727981 333.55677897803i
4900	30.78760800518i		30.78760801 -32.480600630999i		32.48060063 590.670026998044i
5000	31.4159265358979i		31.41592654 -31.8309886183791i		31.83098862 2409.27813502525i
5100	32.0442450666159i		32.04424507 -31.2068515866461i		31.20685159 -1194.18173644732i
5200	32.6725635973338i		32.6725636 -30.6067198253645i		30.60671983 -484.063709738676i
5300	33.3008821280518i		33.30088213 -30.0292345456406i		30.02923455 -305.656393242391i
5400	33.9292006587698i		33.92920066 -29.4731376096102i		29.47313761 -224.413341770062i
5500	34.5575191894877i		34.55751919 -28.9372623803446i		28.93726238 -177.927812546428i
5600	35.1858377202057i		35.18583772 -28.4205255521242i		28.42052555 -147.812839253444i
5700	35.8141562509236i		35.81415625 -27.9219198406834i		27.92191984 -126.706797417079i
5800	36.4424747816416i		36.44247478 -27.4405074296371i		27.44050743 -111.086828122891i
5900	37.0707933123596i		37.07079331 -26.9754140833721i		26.97541408 -99.0552189588517i
6000	37.6991118430775i		37.69911184 -26.5258238486492i		26.52582385 -89.4991698503307i
6100	38.3274303737955i		38.32743037 -26.0909742773599i		26.09097428 -81.7230080440769i
6200	38.9557489045134i		38.9557489 -25.670152111596i		25.67015211 -75.2694828532732i
6300	39.5840674352314i		39.58406744 -25.2626893796659i		25.26268938 -69.8256827045624i
6400	40.2123859659494i		40.21238597 -24.8679598581086i		24.86795986 -65.1702444243915i
6500	40.8407044966673i		40.8407045 -24.4853758602916i		24.48537586 -61.1421526422839i
6600	41.4690230273853i		41.46902303 -24.1143853169538i		24.11438532 -57.62148520098i
6700	42.0973415581032i		42.09734156 -23.7544691181933i		23.75446912 -54.5170884917799i
6800	42.7256600888212i		42.72566009 -23.4051386899846i		23.40513869 -51.7584375367952i
6900	43.3539786195391i		43.35397862 -23.0659337814341i		23.06593378 -49.290111885094i
10000	62.8318530717959i		62.83185307 -15.9154943091895i		15.91549431 -21.3145270940554i
18000	113.097335529233i		113.0973355 -8.84194128288307i		8.841941283 -9.59182982548656i
20000	125.663706143592i		125.6637061 -7.95774715459477i		7.957747155 -8.4957465925194i



5032.9212104487
1.305973528
3.16E-02
159154.9430918950

f	70.7% line
100	1.305973528
20000	1.305973528

ZT	I	VLC	VLC (Mag)
1000+0.628566678896376i	0.00199999920980817-0.0000012571328611045i	7.90191827435955E-07+0.0012571328611045i	0.001257133
1000+1.2586246017413i	0.00199999683173324-2.51724521582411E-06i	3.16826675725181E-06+0.00251724521582411i	0.002517247
1000+1.89167682885787i	0.00199999284314316-3.78334011925549E-06i	7.15685683928398E-06+0.00378334011925549i	0.003783347
1000+2.52925025049019i	0.00199998720586819-5.05846814141929E-06i	0.0000127941318137814+0.0050584681414193i	0.005058484
1000+3.17290800035434i	0.00199997986551234-6.34575211583717E-06i	0.0000201344876565879+0.0063457521158371i	0.006345784
1000+3.824262483559594i	0.00199997075046069-7.64841310927602E-06i	0.0000292495393128477+0.00764841310927603i	0.007648469
1000+4.48498925155138i	0.00199995977055205-0.0000089697980744611i	0.0000402294479525443+0.00896979807446111i	0.008969888
1000+5.15684198093933i	0.00199994681537591-0.0000103134096971764i	0.000053184624093026+0.0103134096971764i	0.010313547
1000+5.8416688487383i	0.00199993175213909-0.0000116829390160735i	0.0000682478609119059+0.0116829390160735i	0.011683138
1000+6.54143063762157i	0.00199991442303229-0.0000130823014794447i	0.0000855769677082416+0.0130823014794447i	0.013082581
1000+7.25822096254885i	0.00199989464200736-0.000014515677213507i	0.000105357992636669+0.0145156772135069i	0.01451606
1000+7.99428907976224i	0.00199987219085233-0.000015987556416251i	0.000127809147670518+0.015987556416251i	0.015988067
1000+8.75206582870341i	0.00199984681442127-0.0000175027909671378i	0.000153185578730425+0.0175027909671378i	0.017503461
1000+9.53419337012921i	0.00199981214837799-0.000019066653565372i	0.00018178516201352+0.019066653565372i	0.01906752
1000+10.3435592563907i	0.00199978604444359-0.000020684905907476i	0.000213955556413093+0.020684905907477i	0.020686012
1000+11.1833377109808i	0.0019997498971949-0.0000223638784378297i	0.000250102805097571+0.0223638784378297i	0.022365277
1000+12.0570336654342i	0.00199970929813831-0.0000241105623287354i	0.000290701861690112+0.0241105623287354i	0.024112315
1000+12.9685405177459i	0.00199966369047524-0.0000259327195917934i	0.000336309524761516+0.0259327195917934i	0.0259349
1000+13.9222040583361i	0.00199961241959216-0.0000278390121431452i	0.000387580407839364+0.0278390121431452i	0.02784171
1000+14.9229006253889i	0.00199955471323608-0.00002983915628065i	0.000445286763921589+0.02983915628065i	0.029842479
1000+15.9761306399056i	0.0019994896567579-0.0000319441079695043i	0.00051034324209605+0.0319441079695042i	0.031948184
1000+17.0881316858534i	0.00199941616199415-0.0000341662866709796i	0.000583838005850317+0.0341662866709796i	0.034171275
1000+18.2660161678562i	0.0019993292787356-0.0000365198475854657i	0.000667072126443761+0.0365198475854657i	0.036525939
1000+19.5179401050324i	0.00199923839016337-0.00003902101515489i	0.000761609836630705+0.0390210151548901i	0.039028447
1000+20.8533116883695i	0.00199913065682636-0.0000416884946925749i	0.000869343173643202+0.0416884946925749i	0.041697558
1000+22.2830510634498i	0.00199900742411864-0.000044543984507851i	0.000992575881357961+0.0445439845078509i	0.044555042
1000+23.8199167825275i	0.0019988586662825-0.0000476128184945808i	0.00113413337175141+0.0476128184945809i	0.047626324
1000+25.4789194497061i	0.00199870249163778-0.0000509247797883658i	0.00129750836222179+0.0509247797883659i	0.05094307
1000+27.278524326974i	0.00199851294402377-0.0000545151411719159i	0.00148705597623519+0.054515141171916i	0.054535419
1000+29.237977984439i	0.00199829174162915-0.0000584260095765668i	0.00170825837085133+0.0584260095765669i	0.058450977
1000+31.3849259830206i	0.00199803191143604-0.0000627080836521333i	0.00196808856395927+0.0627080836521333i	0.06273896
1000+33.7498893932783i	0.00199772448187226-0.000067422980301433i	0.00227551812773855+0.067422980301433i	0.067461369
1000+36.3712291947067i	0.00199735776270045-0.0000726463569710046i	0.00264223729955289+0.0726463569710047i	0.072694392
1000+39.2966723464898i	0.00199691630501454-0.0000784721657415193i	0.00308369498546393+0.0784721657415195i	0.078532732
1000+42.5863684300048i	0.0019963793682016-0.0000850185473266359i	0.00362063117983592+0.0850185473266358i	0.085095607
1000+46.3172263034209i	0.00199571861389045-0.0000924361506775136i	0.00428138610954751+0.0924361506775134i	0.092535249
1000+50.589202711295i	0.00199489453139758-0.000100920123836526i	0.00510546860241501+0.100920123836526i	0.101049182
1000+55.5346510980842i	0.001994070698799-0.000110727806846927i	0.00614923012010015+0.110727806846927i	0.110898432
1000+61.3326214512383i	0.0019925081366273-0.000122205543476147i	0.00749518633726537+0.122205543476146i	0.122435177
1000+68.2314664474239i	0.00199073208107539-0.000135830569195706i	0.0092679189246113+0.135830569195706i	0.136146384
1000+76.5859863935184i	0.00198833757829975-0.000152278794717386i	0.0116624217002471+0.152278794717386i	0.152724731
1000+86.921331605192i	0.00198500267379094-0.000172539075645775i	0.0149973262090597+0.172539075645775i	0.173189643
1000+100.049217788397i	0.00198017871603943-0.000198115331620978i	0.0198122839605677+0.198115331620977i	0.199104415
1000+117.294311721274i	0.00197285751399201-0.000231404964227836i	0.0271424860079901+0.231404964227837i	0.232991356
1000+140.975497592842i	0.00196102638335759-0.000276456670186528i	0.038973616642406+0.276456670186528i	0.279190317
1000+175.55416257241i	0.00194020434131219-0.000340610916703655i	0.0597956586878064+0.340610916703654i	0.345819776
1000+230.851827479238i	0.0018988076666292-0.000438343219872938i	0.101192333370801+0.438343219872939i	0.449871834
1000+333.55677897803i	0.0017997586301911-0.000600321691624456i	0.200241369808896+0.600321691624455i	0.632837056
1000+590.670026998044i	0.00148269940284795-0.000875786096310184i	0.517300597152048+0.875786096310182i	1.017153476
1000+2409.27813502525i	0.000293917906850223-0.00070812998646663i	1.70608209314978+0.70812998646663i	1.847204425
1000-1194.18173644732i	0.000824378514960056+0.000984457766484863i	1.17562148503994-0.984457766484863i	1.53337633
1000-484.063709738676i	0.00162032841331605+0.000784342182744748i	0.379671586683953-0.78434218274475i	0.871402991
1000-305.656393242391i	0.00182911354734033+0.00055908024971084i	0.170886452659671-0.559080249710841i	0.584613467
1000-224.413341770062i	0.00190410662375952+0.000427306930524383i	0.0958933762404845-0.427306930524384i	0.437934644
1000-177.927812546428i	0.00193862637216454+0.000344935549744054i	0.0613736278354591-0.344935549744054i	0.350353044
1000-147.812839253444i	0.00195273704139688+0.000289304764180883i	0.0427629586031244-0.289304764180883i	0.292448144
1000-126.706797417079i	0.00196839813074219+0.000249409423188108i	0.0316018692578061-0.249409423188108i	0.251403537
1000-111.086828122891i	0.00197562028581699+0.000219465391126649i	0.0243797141830091-0.219465391126649i	0.220815372
1000-99.0552189588517i	0.00198056680447265+0.000196185478479671i	0.0194331955273509-0.196185478479672i	0.197145609
1000-89.4991698503307i	0.00198410710092539+0.000177575938426969i	0.0158928990746072-0.177575938426969i	0.178285721
1000-81.7230080440769i	0.00198673131680406+0.000162361659384598i	0.013268683159372-0.162361659384598i	0.162902935
1000-75.2694828532732i	0.00198873284391899+0.000149690892695102i	0.0112671560810051-0.149690892695102i	0.15011433
1000-69.8256827045624i	0.00199029606084738+0.00013897378123287i	0.00970393915261965-0.13897378123287i	0.139312161
1000-65.1702444243915i	0.00199154160265661+0.000129789253026475i	0.00845839734339457-0.129789253026476i	0.130064579
1000-61.1421526422839i	0.00199255112095309+0.000121828864784868i	0.00744887904691256-0.121828864784868i	0.122056373
1000-57.62148520098i	0.00199338150385271+0.000114861602824156i	0.00661849614729295-0.114861602824156i	0.115052129
1000-54.5170884917799i	0.00199407338868293+0.000108711075389931i	0.00592661131706942-0.108711075389931i	0.108872506
1000-51.7584375367952i	0.00199465644333305+0.00010324030092962i	0.00534355666494568-0.10324030092962i	0.103378496
1000-49.290111885094i	0.00199515274627171+0.000098341302088894i	0.00484725378288741-0.0983413020888939i	0.09846069
1000-21.3145270940554i	0.00199909179447552+0.0000426096962168522i	0.000908205524483566-0.0426096962168523i	0.042619374
1000-9.59182982548656i	0.00199981601052882+0.0000191818948552759i	0.000183989471182183-0.0191818948552759i	0.019182777
1000-8.4957465925194i	0.0019998565499816+0.000016990266864813i	0.000144345001836904-0.016990266864813i	0.01699088



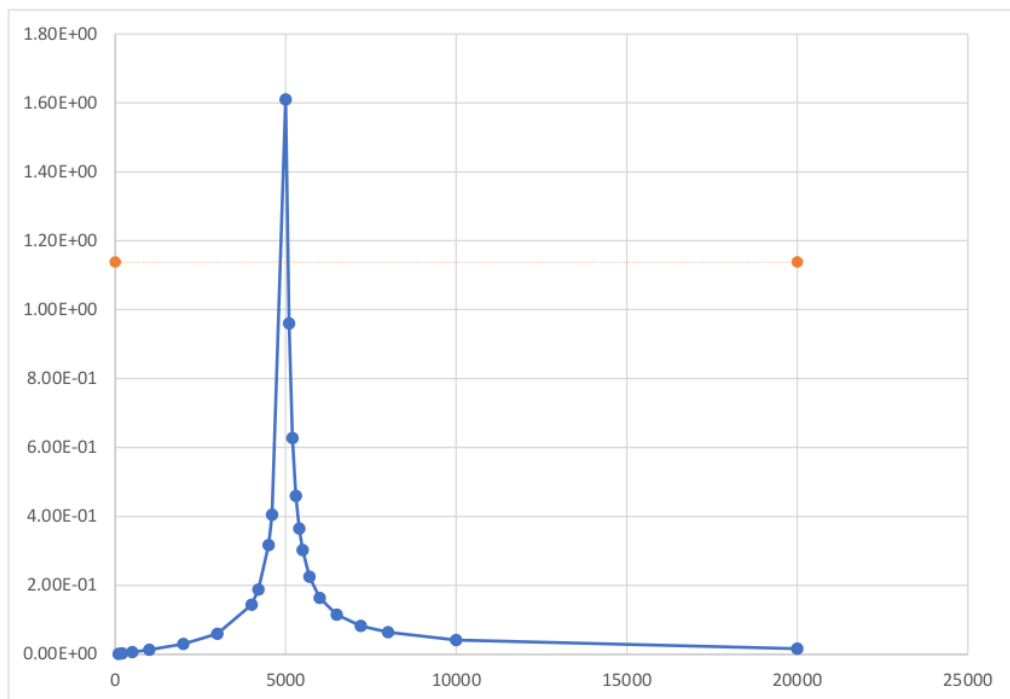
VLC(dB)

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-44.66940952
-43.68673102
-42.78362508
-41.94468057
-41.15812114
-40.41471564
-39.70706426
-39.02911433
-38.37582183
-37.74290828
-37.1266818
-36.5239021
-35.93167627
-35.34737633
-34.76857202
-34.19297451
-33.61838747
-33.04266278
-32.46365866
-31.8791983
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-30.68476438
-30.06985358
-29.43949696
-28.79058177
-28.11958581
-27.42245709
-26.694456
-25.92994386
-25.1220925
-24.26247561
-23.3404777
-22.34241255
-21.25016158
-20.03898212
-18.67380373
-17.10259287
-15.24360341
-12.95882385
-9.994761881
-5.872870159
-0.69030071
-2.307624813
-7.216218984
-10.68322361
-13.19241386
-15.130482
-16.69962251
-18.01317224
-19.14001386
-20.12485775
-20.9982687
-21.78202171
-22.49215685
-23.14081931
-23.73741913
-24.28939073
-24.80270675
-25.2822355
-25.73199576
-26.15534237
-33.42845856
-40.36237024
-41.41628245

Frequency	Input Voltage (Vin pk-pk)	Output Voltage (Vout)
100	2	1.30E-03
200	2	2.50E-03
500	2	6.50E-03
1000	2	1.32E-02
2000	2	3.03E-02
3000	2	6.00E-02
4000	2	1.44E-01
4200	2	1.88E-01
4500	2	3.17E-01
4600	2	4.05E-01
5000	2	1.61E+00
5100	2	9.60E-01
5200	2	6.28E-01
5300	2	4.60E-01
5400	2	3.65E-01
5500	2	3.03E-01
5700	2	2.25E-01
6000	2	1.64E-01
6500	2	1.16E-01
7200	2	8.25E-02
8000	2	6.40E-02
10000	2	4.15E-02
20000	2	1.68E-02

Peak	1.61E+00
70.70%	1.14E+00 ** 70.7% of greatest value in lists

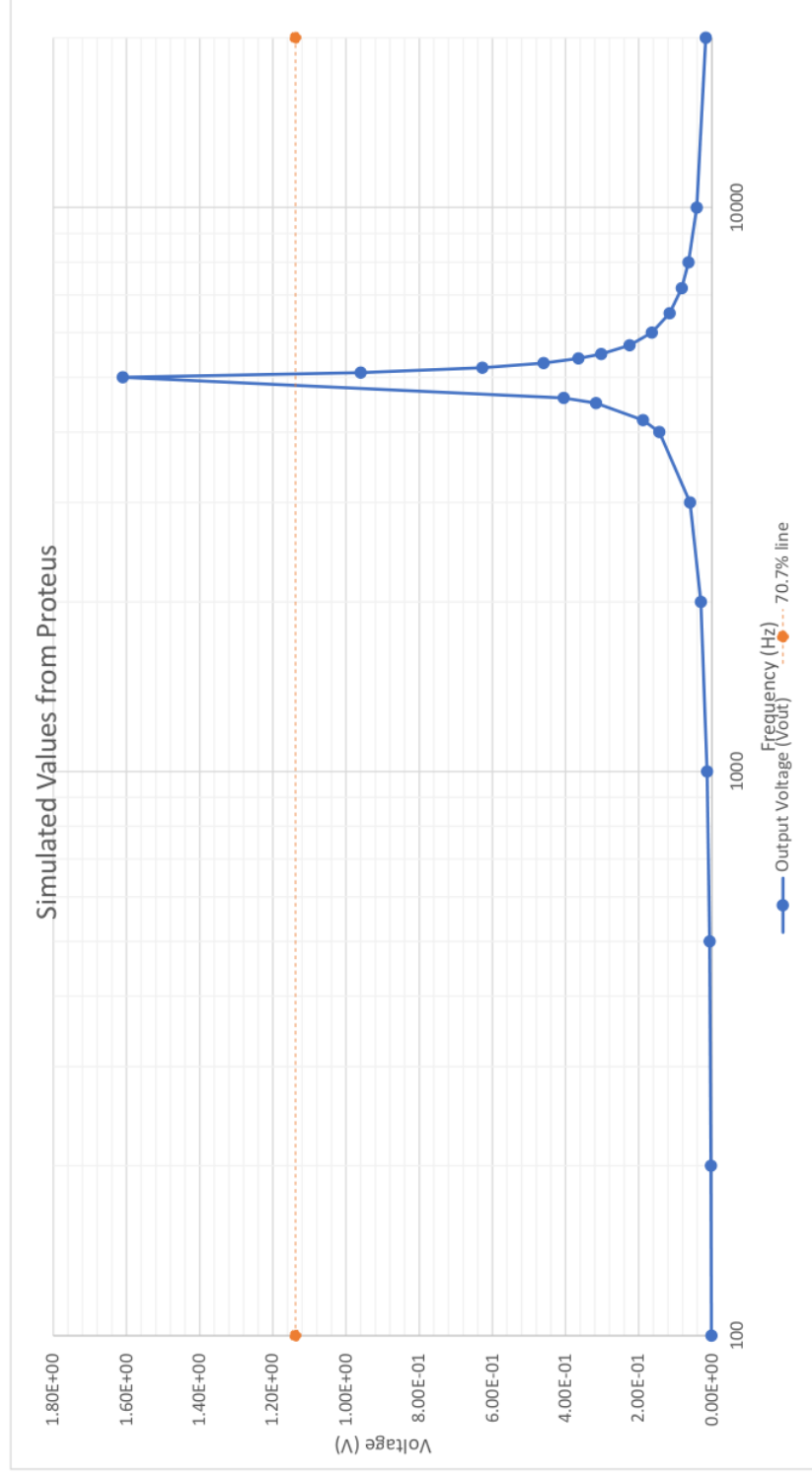
f	70.7% Line
0	1.13827
20000	1.13827



Frequency	Input Voltage (Vin pk-pk)	Output Voltage (Vout)
100	2	1.30E-03
200	2	2.50E-03
500	2	6.50E-03
1000	2	1.32E-02
2000	2	3.03E-02
3000	2	6.00E-02
4000	2	1.44E-01
4200	2	1.88E-01
4500	2	3.17E-01
4600	2	4.05E-01
5000	2	1.61E+00
5100	2	9.60E-01
5200	2	6.28E-01
5300	2	4.60E-01
5400	2	3.65E-01
5500	2	3.03E-01
5700	2	2.25E-01
6000	2	1.64E-01
6500	2	1.16E-01
7200	2	8.25E-02
8000	2	6.40E-02
10000	2	4.15E-02
20000	2	1.68E-02

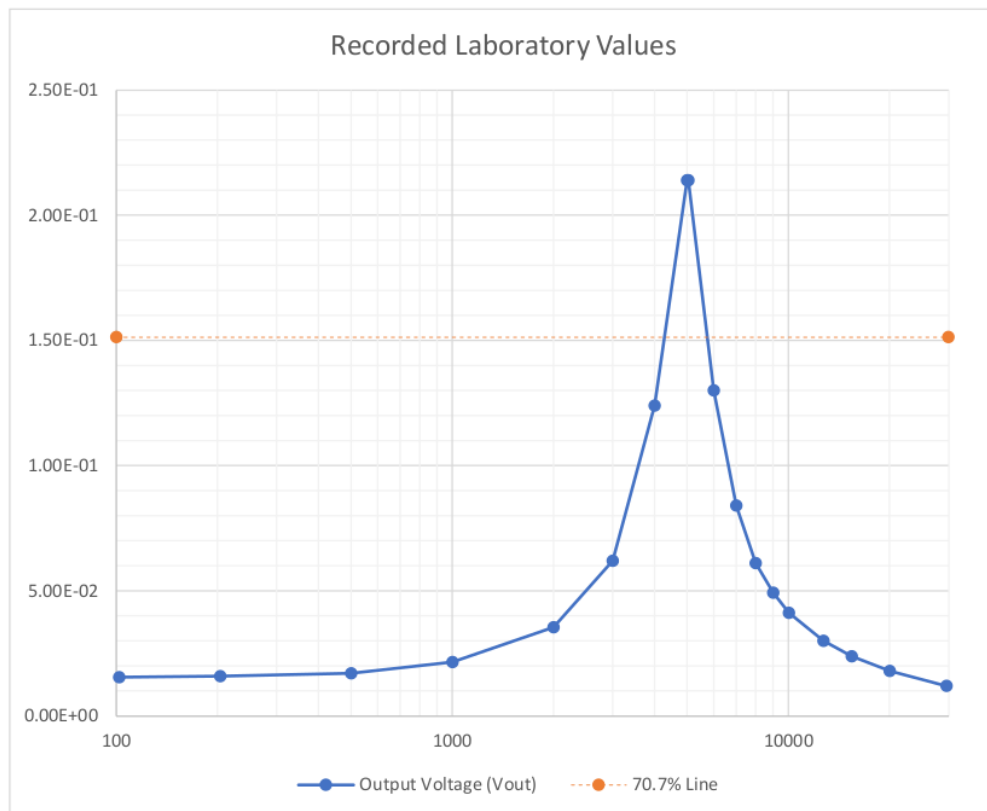
f 70.7% line
 100 1.14E+00
 20000 1.14E+00

Res freq: 5032.921



R

Frequency (sig gen)	Input Voltage (Vin pk-pk)	Output Voltage (Vout)
102	2.00E+00	1.55E-02
204	2.00E+00	1.59E-02
500	2.00E+00	1.70E-02
1002	2.00E+00	2.15E-02
2003	2.00E+00	3.54E-02
3004	2.00E+00	6.20E-02
4002	2.00E+00	1.24E-01
4999	2.00E+00	2.14E-01
5038	2.00E+00	2.14E-01
6004	2.00E+00	1.30E-01
6995	2.00E+00	8.40E-02
7998	2.00E+00	6.10E-02
9006	2.00E+00	4.92E-02
10040	2.00E+00	4.12E-02
12720	2.00E+00	3.00E-02
15427	2.00E+00	2.38E-02
20030	2.00E+00	1.80E-02
29550	2.00E+00	1.20E-02



fres

f	70.7% Line
100	1.51E-01
29950	1.51E-01

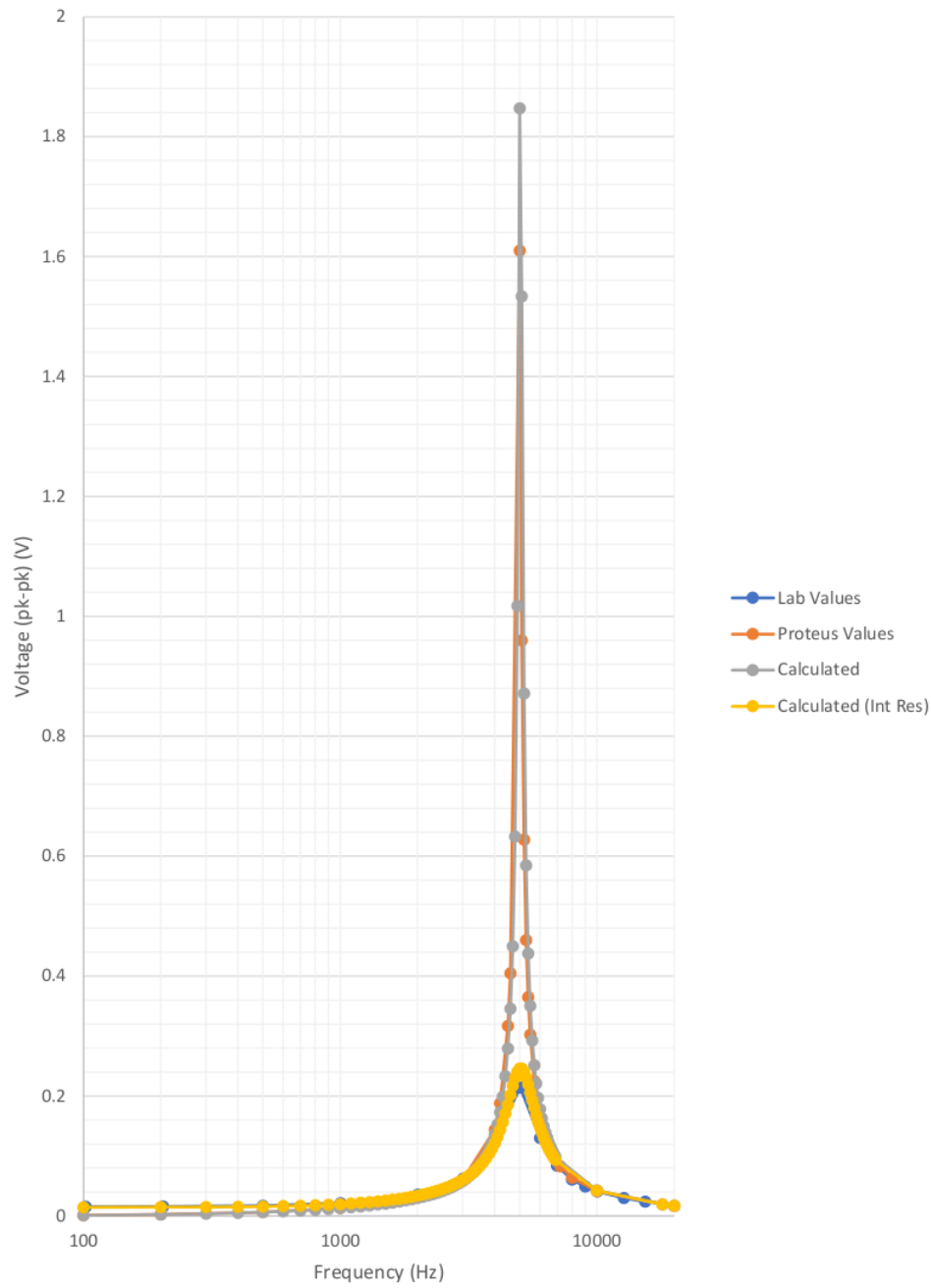
Freq	Lab Values	Proteus Values	Calculated	Calculated (Int Res)
	100		0.001257133	
	200		0.002517247	
	300		0.003783347	
	400		0.005058484	
	500		0.006345784	
	600		0.007648469	
	700		0.008969888	
	800		0.010313547	
	900		0.011683138	
	1000		0.013082581	
	1100		0.01451606	
	1200		0.015988067	
	1300		0.017503461	
	1400		0.01906752	
	1500		0.020686012	
	1600		0.022365277	
	1700		0.024112315	
	1800		0.0259349	
	1900		0.02784171	
	2000		0.029842479	
	2100		0.031948184	
	2200		0.034171275	
	2300		0.036525939	
	2400		0.039028447	
	2500		0.041697558	
	2600		0.044555042	
	2700		0.047626324	
	2800		0.050941307	
	2900		0.054535419	
	3000		0.058450977	
	3100		0.06273896	
	3200		0.067461369	
	3300		0.072694392	
	3400		0.078532732	
	3500		0.085095607	
	3600		0.092535249	
	3700		0.101049182	
	3800		0.110898423	
	3900		0.122435177	
	4000		0.136146384	
	4100		0.152724731	
	4200		0.173189643	
	4300		0.199104415	
	4400		0.232991356	
	4500		0.279190317	
	4600		0.345819776	
	4700		0.449871834	
	4800		0.632837056	
	4900		1.017153476	

5000		1.847204425
5100		1.53337633
5200		0.871402991
5300		0.584613467
5400		0.437934644
5500		0.350353044
5600		0.292448144
5700		0.251403537
5800		0.220815372
5900		0.197145609
6000		0.178285721
6100		0.162902935
6200		0.15011433
6300		0.139312161
6400		0.130064579
6500		0.122056373
6600		0.115052129
6700		0.108872506
6800		0.103378496
6900		0.09846069
10000		0.042619374
18000		0.019182777
20000		0.01699088
102	0.0155	
204	0.0159	
500	0.017	
1002	0.0215	
2003	0.0354	
3004	0.062	
4002	0.124	
4999	0.214	
5038	0.214	
6004	0.13	
6995	0.084	
7998	0.061	
9006	4.92E-02	
10040	0.0412	
12720	0.03	
15427	0.0238	
20030	0.018	
29550	0.012	
100		0.0013
200		0.0025
500		0.0065
1000		0.0132
2000		0.03026
3000		0.06
4000		1.44E-01
4200		0.188
4500		3.17E-01

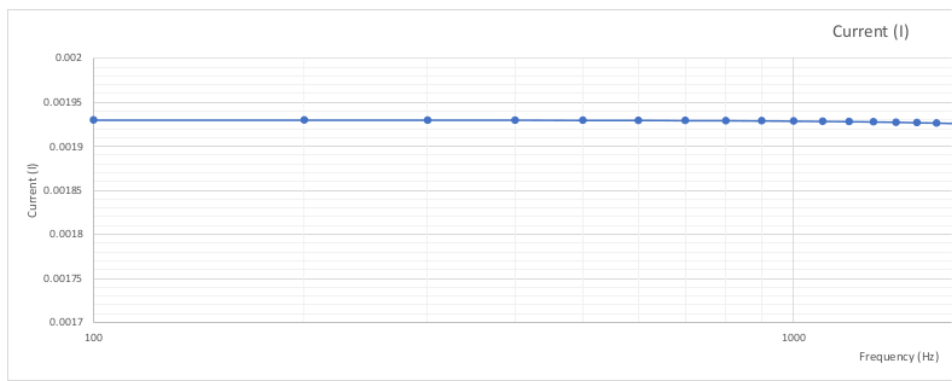
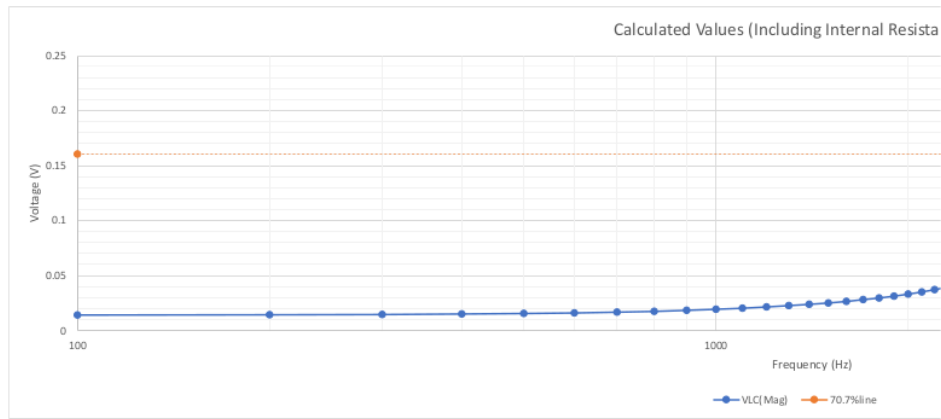
4600	0.405	
5000	1.61E+00	
5100	0.96	
5200	0.6275	
5300	0.46	
5400	0.365	
5500	3.03E-01	
5700	0.225	
6000	0.164	
6500	0.1155	
7200	0.0825	
8000	0.064	
10000	0.0415	
20000	0.01676	
100		0.014592579
200		0.014768576
300		0.015059029
400		0.015459992
500		0.015966595
600		0.01657352
700		0.017275465
800		0.018067507
900		0.018945381
1000		0.019905659
1100		0.020945853
1200		0.022064464
1300		0.023260992
1400		0.024535939
1500		0.025890797
1600		0.027328045
1700		0.028851158
1800		0.030464632
1900		0.032174026
2000		0.033986025
2100		0.035908532
2200		0.037950785
2300		0.040123505
2400		0.042439083
2500		0.04491181
2600		0.047558154
2700		0.050397099
2800		0.05345055
2900		0.056743827
3000		0.060306244
3100		0.064171809
3200		0.068380047
3300		0.072976956
3400		0.078016099
3500		0.083559803
3600		0.089680396

3700	0.096461298
3800	0.103997648
3900	0.112395786
4000	0.121770411
4100	0.13223726
4200	0.143897724
4300	0.156809711
4400	0.170936903
4500	0.186068415
4600	0.20170861
4700	0.216962824
4800	0.230495918
4900	0.240689665
5000	0.246078277
5100	0.245918931
5200	0.240520873
5300	0.231069127
5400	0.219100817
5500	0.206015954
5600	0.192838977
5700	0.180202397
5800	0.168434433
5900	0.157662738
6000	0.147897201
6100	0.139085705
6200	0.131148089
6300	0.123995387
6400	0.117539992
6500	0.111700524
6600	0.106403766
6700	0.101585032
6800	0.097187764
6900	0.093162788
10000	0.042360019
18000	0.019174703
20000	0.0169863

Comparison Between Results



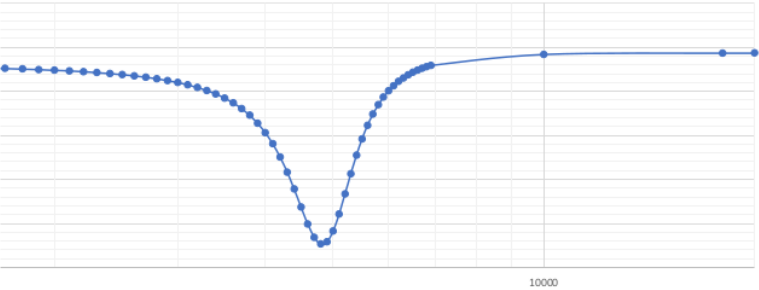
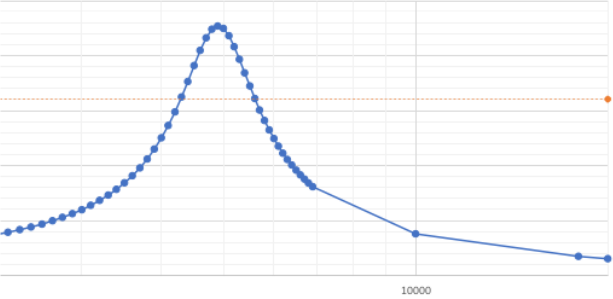
Res	1029	
Cap	0.000001064	Ind Res
Ind	0.000994	7.32
V	2	



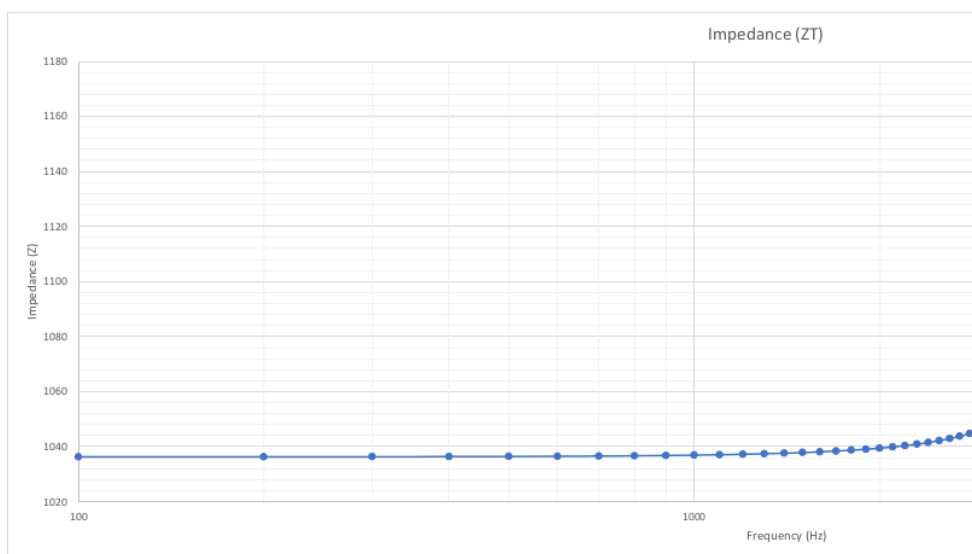
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=IMDIV(IMPRODUCT(B18,C18), IMSUM(B18, C18))	=IMSUM(COMPLEX(\$B\$3,0),D18)
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=IMDIV(IMPRODUCT(B28,C28), IMSUM(B28, C28))	=IMSUM(COMPLEX(\$B\$3,0),D28)
=IMDIV(IMPRODUCT(B29,C29), IMSUM(B29, C29))	=IMSUM(COMPLEX(\$B\$3,0),D29)
=IMDIV(IMPRODUCT(B30,C30), IMSUM(B30, C30))	=IMSUM(COMPLEX(\$B\$3,0),D30)
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=IMDIV(IMPRODUCT(B67,C67), IMSUM(B67, C67))	=IMSUM(COMPLEX(\$B\$3,0),D67)
=IMDIV(IMPRODUCT(B68,C68), IMSUM(B68, C68))	=IMSUM(COMPLEX(\$B\$3,0),D68)
=IMDIV(IMPRODUCT(B69,C69), IMSUM(B69, C69))	=IMSUM(COMPLEX(\$B\$3,0),D69)
=IMDIV(IMPRODUCT(B70,C70), IMSUM(B70, C70))	=IMSUM(COMPLEX(\$B\$3,0),D70)
=IMDIV(IMPRODUCT(B71,C71), IMSUM(B71, C71))	=IMSUM(COMPLEX(\$B\$3,0),D71)
=IMDIV(IMPRODUCT(B72,C72), IMSUM(B72, C72))	=IMSUM(COMPLEX(\$B\$3,0),D72)
=IMDIV(IMPRODUCT(B73,C73), IMSUM(B73, C73))	=IMSUM(COMPLEX(\$B\$3,0),D73)
=IMDIV(IMPRODUCT(B74,C74), IMSUM(B74, C74))	=IMSUM(COMPLEX(\$B\$3,0),D74)
=IMDIV(IMPRODUCT(B75,C75), IMSUM(B75, C75))	=IMSUM(COMPLEX(\$B\$3,0),D75)
=IMDIV(IMPRODUCT(B76,C76), IMSUM(B76, C76))	=IMSUM(COMPLEX(\$B\$3,0),D76)
=IMDIV(IMPRODUCT(B77,C77), IMSUM(B77, C77))	=IMSUM(COMPLEX(\$B\$3,0),D77)
=IMDIV(IMPRODUCT(B78,C78), IMSUM(B78, C78))	=IMSUM(COMPLEX(\$B\$3,0),D78)
=IMDIV(IMPRODUCT(B79,C79), IMSUM(B79, C79))	=IMSUM(COMPLEX(\$B\$3,0),D79)
=IMDIV(IMPRODUCT(B80,C80), IMSUM(B80, C80))	=IMSUM(COMPLEX(\$B\$3,0),D80)
=IMDIV(IMPRODUCT(B81,C81), IMSUM(B81, C81))	=IMSUM(COMPLEX(\$B\$3,0),D81)
=IMDIV(IMPRODUCT(B82,C82), IMSUM(B82, C82))	=IMSUM(COMPLEX(\$B\$3,0),D82)

nce)



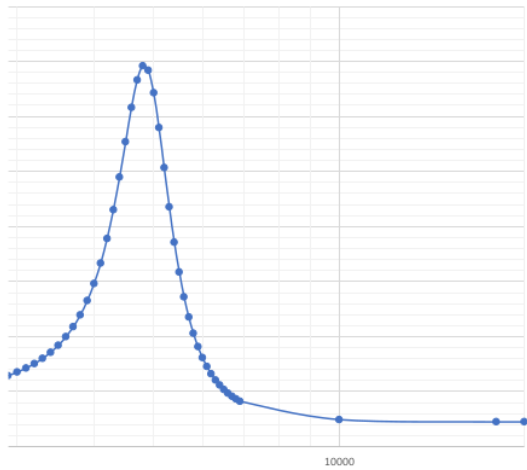
Z (Abs)	I
=IMABS(E11)	=IMD IV(COM PLEX(\$B\$6,0),E11)
=IMABS(E12)	=IMD IV(COM PLEX(\$B\$6,0),E12)
=IMABS(E13)	=IMD IV(COM PLEX(\$B\$6,0),E13)
=IMABS(E14)	=IMD IV(COM PLEX(\$B\$6,0),E14)
=IMABS(E15)	=IMD IV(COM PLEX(\$B\$6,0),E15)
=IMABS(E16)	=IMD IV(COM PLEX(\$B\$6,0),E16)
=IMABS(E17)	=IMD IV(COM PLEX(\$B\$6,0),E17)
=IMABS(E18)	=IMD IV(COM PLEX(\$B\$6,0),E18)
=IMABS(E19)	=IMD IV(COM PLEX(\$B\$6,0),E19)
=IMABS(E20)	=IMD IV(COM PLEX(\$B\$6,0),E20)
=IMABS(E21)	=IMD IV(COM PLEX(\$B\$6,0),E21)
=IMABS(E22)	=IMD IV(COM PLEX(\$B\$6,0),E22)
=IMABS(E23)	=IMD IV(COM PLEX(\$B\$6,0),E23)
=IMABS(E24)	=IMD IV(COM PLEX(\$B\$6,0),E24)
=IMABS(E25)	=IMD IV(COM PLEX(\$B\$6,0),E25)
=IMABS(E26)	=IMD IV(COM PLEX(\$B\$6,0),E26)
=IMABS(E27)	=IMD IV(COM PLEX(\$B\$6,0),E27)
=IMABS(E28)	=IMD IV(COM PLEX(\$B\$6,0),E28)
=IMABS(E29)	=IMD IV(COM PLEX(\$B\$6,0),E29)
=IMABS(E30)	=IMD IV(COM PLEX(\$B\$6,0),E30)
=IMABS(E31)	=IMD IV(COM PLEX(\$B\$6,0),E31)
=IMABS(E32)	=IMD IV(COM PLEX(\$B\$6,0),E32)
=IMABS(E33)	=IMD IV(COM PLEX(\$B\$6,0),E33)
=IMABS(E34)	=IMD IV(COM PLEX(\$B\$6,0),E34)
=IMABS(E35)	=IMD IV(COM PLEX(\$B\$6,0),E35)
=IMABS(E36)	=IMD IV(COM PLEX(\$B\$6,0),E36)
=IMABS(E37)	=IMD IV(COM PLEX(\$B\$6,0),E37)
=IMABS(E38)	=IMD IV(COM PLEX(\$B\$6,0),E38)
=IMABS(E39)	=IMD IV(COM PLEX(\$B\$6,0),E39)
=IMABS(E40)	=IMD IV(COM PLEX(\$B\$6,0),E40)
=IMABS(E41)	=IMD IV(COM PLEX(\$B\$6,0),E41)
=IMABS(E42)	=IMD IV(COM PLEX(\$B\$6,0),E42)
=IMABS(E43)	=IMD IV(COM PLEX(\$B\$6,0),E43)
=IMABS(E44)	=IMD IV(COM PLEX(\$B\$6,0),E44)
=IMABS(E45)	=IMD IV(COM PLEX(\$B\$6,0),E45)
=IMABS(E46)	=IMD IV(COM PLEX(\$B\$6,0),E46)
=IMABS(E47)	=IMD IV(COM PLEX(\$B\$6,0),E47)
=IMABS(E48)	=IMD IV(COM PLEX(\$B\$6,0),E48)
=IMABS(E49)	=IMD IV(COM PLEX(\$B\$6,0),E49)
=IMABS(E50)	=IMD IV(COM PLEX(\$B\$6,0),E50)
=IMABS(E51)	=IMD IV(COM PLEX(\$B\$6,0),E51)
=IMABS(E52)	=IMD IV(COM PLEX(\$B\$6,0),E52)
=IMABS(E53)	=IMD IV(COM PLEX(\$B\$6,0),E53)
=IMABS(E54)	=IMD IV(COM PLEX(\$B\$6,0),E54)
=IMABS(E55)	=IMD IV(COM PLEX(\$B\$6,0),E55)
=IMABS(E56)	=IMD IV(COM PLEX(\$B\$6,0),E56)
=IMABS(E57)	=IMD IV(COM PLEX(\$B\$6,0),E57)
=IMABS(E58)	=IMD IV(COM PLEX(\$B\$6,0),E58)
=IMABS(E59)	=IMD IV(COM PLEX(\$B\$6,0),E59)
=IMABS(E60)	=IMD IV(COM PLEX(\$B\$6,0),E60)
=IMABS(E61)	=IMD IV(COM PLEX(\$B\$6,0),E61)
=IMABS(E62)	=IMD IV(COM PLEX(\$B\$6,0),E62)
=IMABS(E63)	=IMD IV(COM PLEX(\$B\$6,0),E63)
=IMABS(E64)	=IMD IV(COM PLEX(\$B\$6,0),E64)
=IMABS(E65)	=IMD IV(COM PLEX(\$B\$6,0),E65)
=IMABS(E66)	=IMD IV(COM PLEX(\$B\$6,0),E66)
=IMABS(E67)	=IMD IV(COM PLEX(\$B\$6,0),E67)
=IMABS(E68)	=IMD IV(COM PLEX(\$B\$6,0),E68)
=IMABS(E69)	=IMD IV(COM PLEX(\$B\$6,0),E69)
=IMABS(E70)	=IMD IV(COM PLEX(\$B\$6,0),E70)
=IMABS(E71)	=IMD IV(COM PLEX(\$B\$6,0),E71)
=IMABS(E72)	=IMD IV(COM PLEX(\$B\$6,0),E72)
=IMABS(E73)	=IMD IV(COM PLEX(\$B\$6,0),E73)
=IMABS(E74)	=IMD IV(COM PLEX(\$B\$6,0),E74)
=IMABS(E75)	=IMD IV(COM PLEX(\$B\$6,0),E75)
=IMABS(E76)	=IMD IV(COM PLEX(\$B\$6,0),E76)
=IMABS(E77)	=IMD IV(COM PLEX(\$B\$6,0),E77)
=IMABS(E78)	=IMD IV(COM PLEX(\$B\$6,0),E78)
=IMABS(E79)	=IMD IV(COM PLEX(\$B\$6,0),E79)
=IMABS(E80)	=IMD IV(COM PLEX(\$B\$6,0),E80)
=IMABS(E81)	=IMD IV(COM PLEX(\$B\$6,0),E81)
=IMABS(E82)	=IMD IV(COM PLEX(\$B\$6,0),E82)



f
100
20000

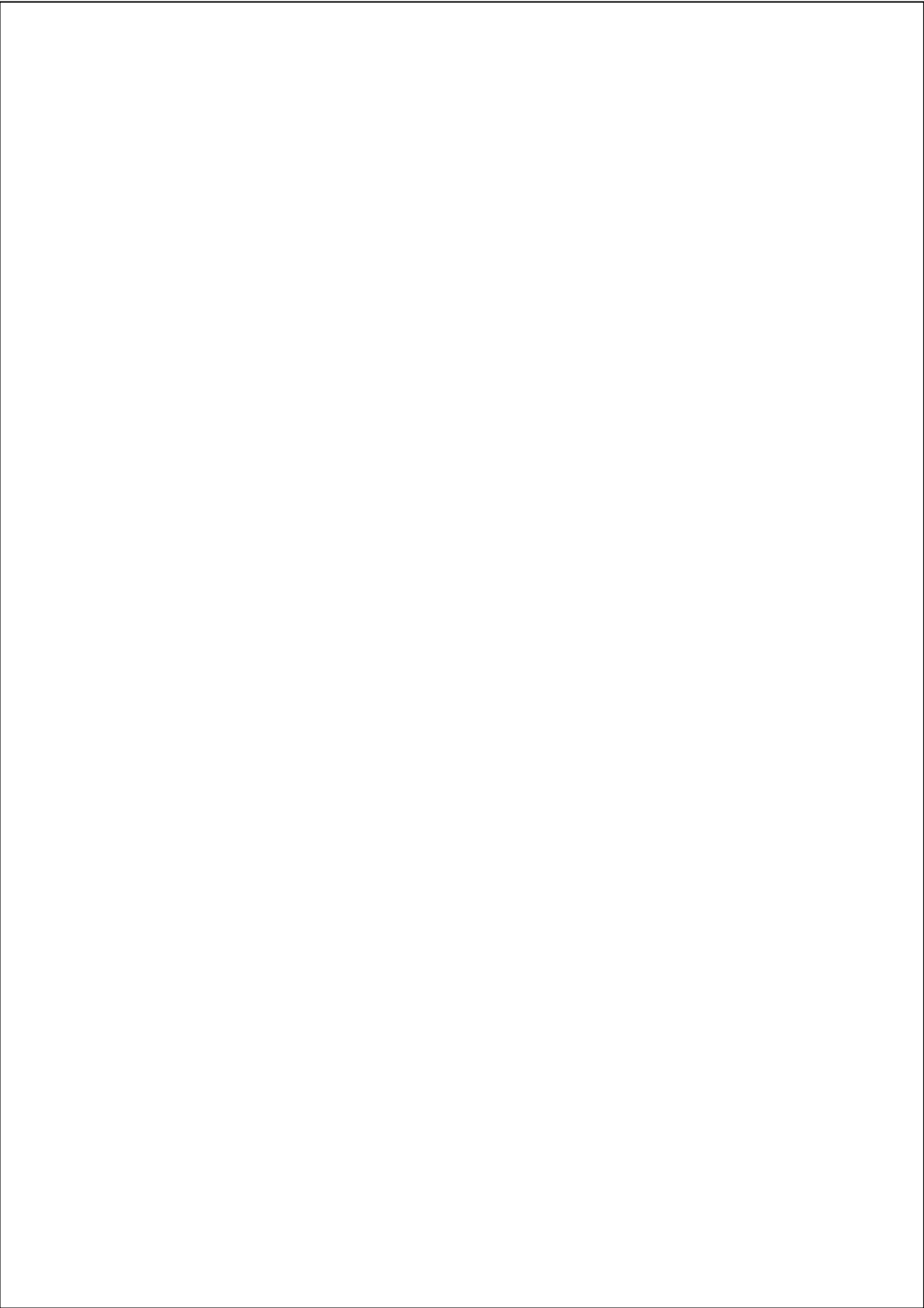
l(Mag)

=IMABS(G11)
=IMABS(G12)
=IMABS(G13)
=IMABS(G14)
=IMABS(G15)
=IMABS(G16)
=IMABS(G17)
=IMABS(G18)
=IMABS(G19)
=IMABS(G20)
=IMABS(G21)
=IMABS(G22)
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=IMABS(G76)
=IMABS(G77)
=IMABS(G78)
=IMABS(G79)
=IMABS(G80)
=IMABS(G81)
=IMABS(G82)



70.7%line
=MAX(J11:J82)*0.707
=I4

VLC	VLC(Mag)
=IMPRODUCT(G11,D11)	=IMABS(I11)
=IMPRODUCT(G12,D12)	=IMABS(I12)
=IMPRODUCT(G13,D13)	=IMABS(I13)
=IMPRODUCT(G14,D14)	=IMABS(I14)
=IMPRODUCT(G15,D15)	=IMABS(I15)
=IMPRODUCT(G16,D16)	=IMABS(I16)
=IMPRODUCT(G17,D17)	=IMABS(I17)
=IMPRODUCT(G18,D18)	=IMABS(I18)
=IMPRODUCT(G19,D19)	=IMABS(I19)
=IMPRODUCT(G20,D20)	=IMABS(I20)
=IMPRODUCT(G21,D21)	=IMABS(I21)
=IMPRODUCT(G22,D22)	=IMABS(I22)
=IMPRODUCT(G23,D23)	=IMABS(I23)
=IMPRODUCT(G24,D24)	=IMABS(I24)
=IMPRODUCT(G25,D25)	=IMABS(I25)
=IMPRODUCT(G26,D26)	=IMABS(I26)
=IMPRODUCT(G27,D27)	=IMABS(I27)
=IMPRODUCT(G28,D28)	=IMABS(I28)
=IMPRODUCT(G29,D29)	=IMABS(I29)
=IMPRODUCT(G30,D30)	=IMABS(I30)
=IMPRODUCT(G31,D31)	=IMABS(I31)
=IMPRODUCT(G32,D32)	=IMABS(I32)
=IMPRODUCT(G33,D33)	=IMABS(I33)
=IMPRODUCT(G34,D34)	=IMABS(I34)
=IMPRODUCT(G35,D35)	=IMABS(I35)
=IMPRODUCT(G36,D36)	=IMABS(I36)
=IMPRODUCT(G37,D37)	=IMABS(I37)
=IMPRODUCT(G38,D38)	=IMABS(I38)
=IMPRODUCT(G39,D39)	=IMABS(I39)
=IMPRODUCT(G40,D40)	=IMABS(I40)
=IMPRODUCT(G41,D41)	=IMABS(I41)
=IMPRODUCT(G42,D42)	=IMABS(I42)
=IMPRODUCT(G43,D43)	=IMABS(I43)
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=IMPRODUCT(G48,D48)	=IMABS(I48)
=IMPRODUCT(G49,D49)	=IMABS(I49)
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=IMPRODUCT(G51,D51)	=IMABS(I51)
=IMPRODUCT(G52,D52)	=IMABS(I52)
=IMPRODUCT(G53,D53)	=IMABS(I53)
=IMPRODUCT(G54,D54)	=IMABS(I54)
=IMPRODUCT(G55,D55)	=IMABS(I55)
=IMPRODUCT(G56,D56)	=IMABS(I56)
=IMPRODUCT(G57,D57)	=IMABS(I57)
=IMPRODUCT(G58,D58)	=IMABS(I58)
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=IMPRODUCT(G62,D62)	=IMABS(I62)
=IMPRODUCT(G63,D63)	=IMABS(I63)
=IMPRODUCT(G64,D64)	=IMABS(I64)
=IMPRODUCT(G65,D65)	=IMABS(I65)
=IMPRODUCT(G66,D66)	=IMABS(I66)
=IMPRODUCT(G67,D67)	=IMABS(I67)
=IMPRODUCT(G68,D68)	=IMABS(I68)
=IMPRODUCT(G69,D69)	=IMABS(I69)
=IMPRODUCT(G70,D70)	=IMABS(I70)
=IMPRODUCT(G71,D71)	=IMABS(I71)
=IMPRODUCT(G72,D72)	=IMABS(I72)
=IMPRODUCT(G73,D73)	=IMABS(I73)
=IMPRODUCT(G74,D74)	=IMABS(I74)
=IMPRODUCT(G75,D75)	=IMABS(I75)
=IMPRODUCT(G76,D76)	=IMABS(I76)
=IMPRODUCT(G77,D77)	=IMABS(I77)
=IMPRODUCT(G78,D78)	=IMABS(I78)
=IMPRODUCT(G79,D79)	=IMABS(I79)
=IMPRODUCT(G80,D80)	=IMABS(I80)
=IMPRODUCT(G81,D81)	=IMABS(I81)
=IMPRODUCT(G82,D82)	=IMABS(I82)

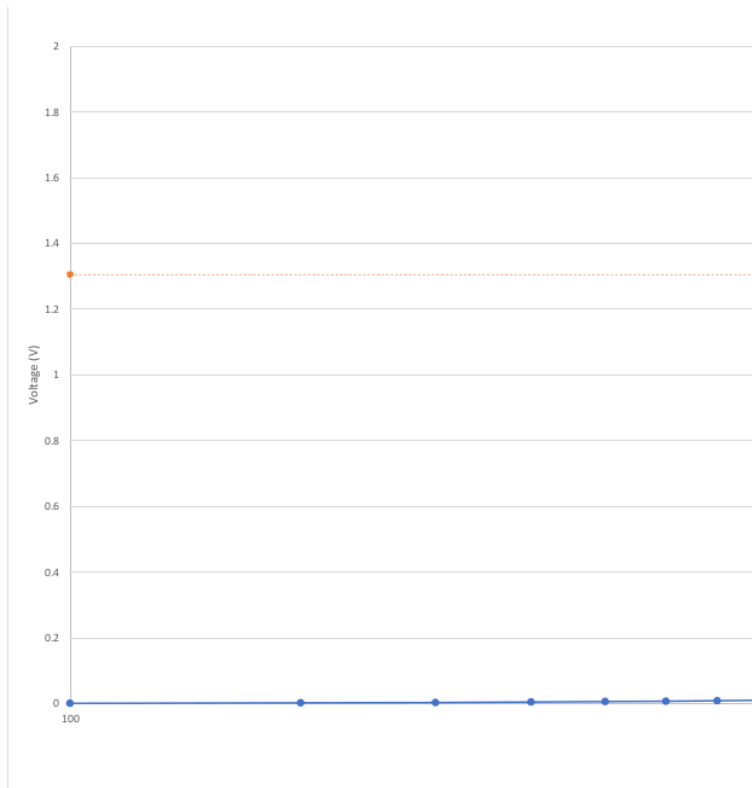


VLC(dB)

=20*LOG10(I11/\$B\$6)
=20*LOG10(I12/\$B\$6)
=20*LOG10(I13/\$B\$6)
=20*LOG10(I14/\$B\$6)
=20*LOG10(I15/\$B\$6)
=20*LOG10(I16/\$B\$6)
=20*LOG10(I17/\$B\$6)
=20*LOG10(I18/\$B\$6)
=20*LOG10(I19/\$B\$6)
=20*LOG10(I20/\$B\$6)
=20*LOG10(I21/\$B\$6)
=20*LOG10(I22/\$B\$6)
=20*LOG10(I23/\$B\$6)
=20*LOG10(I24/\$B\$6)
=20*LOG10(I25/\$B\$6)
=20*LOG10(I26/\$B\$6)
=20*LOG10(I27/\$B\$6)
=20*LOG10(I28/\$B\$6)
=20*LOG10(I29/\$B\$6)
=20*LOG10(I30/\$B\$6)
=20*LOG10(I31/\$B\$6)
=20*LOG10(I32/\$B\$6)
=20*LOG10(I33/\$B\$6)
=20*LOG10(I34/\$B\$6)
=20*LOG10(I35/\$B\$6)
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=20*LOG10(I40/\$B\$6)
=20*LOG10(I41/\$B\$6)
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=20*LOG10(I56/\$B\$6)
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=20*LOG10(I61/\$B\$6)
=20*LOG10(I62/\$B\$6)
=20*LOG10(I63/\$B\$6)
=20*LOG10(I64/\$B\$6)
=20*LOG10(I65/\$B\$6)
=20*LOG10(I66/\$B\$6)
=20*LOG10(I67/\$B\$6)
=20*LOG10(I68/\$B\$6)
=20*LOG10(I69/\$B\$6)
=20*LOG10(I70/\$B\$6)
=20*LOG10(I71/\$B\$6)
=20*LOG10(I72/\$B\$6)
=20*LOG10(I73/\$B\$6)
=20*LOG10(I74/\$B\$6)
=20*LOG10(I75/\$B\$6)
=20*LOG10(I76/\$B\$6)
=20*LOG10(I77/\$B\$6)
=20*LOG10(I78/\$B\$6)
=20*LOG10(I79/\$B\$6)
=20*LOG10(I80/\$B\$6)
=20*LOG10(I81/\$B\$6)
=20*LOG10(I82/\$B\$6)

Res	1000	
Cap	0.000001	
Ind	0.001	
V	2	

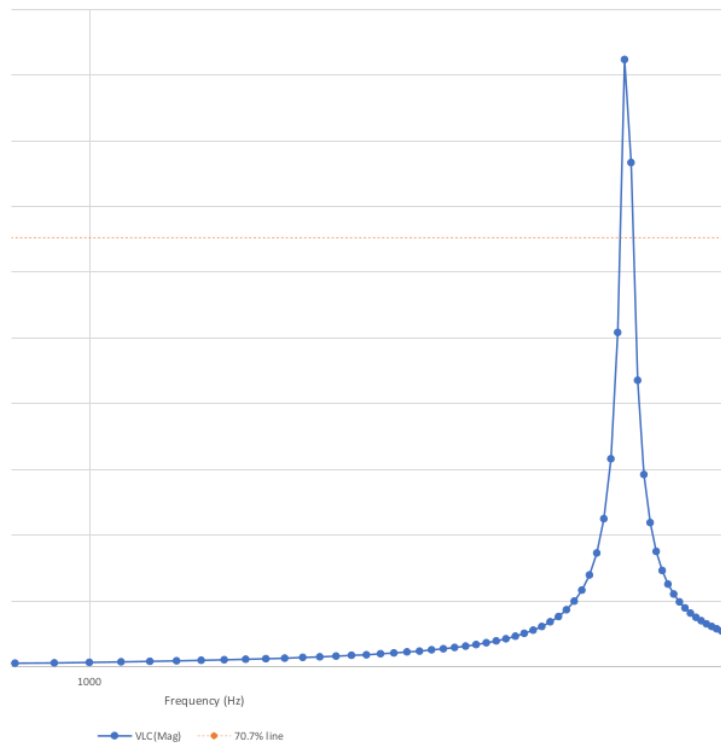
Freq	XL	XL (Abs)
100	=COMPLEX(\$D\$5,2*PI()*A11*\$B\$5)	=IMABS(B11)
200	=COMPLEX(\$D\$5,2*PI()*A12*\$B\$5)	=IMABS(B12)
300	=COMPLEX(\$D\$5,2*PI()*A13*\$B\$5)	=IMABS(B13)
400	=COMPLEX(\$D\$5,2*PI()*A14*\$B\$5)	=IMABS(B14)
500	=COMPLEX(\$D\$5,2*PI()*A15*\$B\$5)	=IMABS(B15)
600	=COMPLEX(\$D\$5,2*PI()*A16*\$B\$5)	=IMABS(B16)
700	=COMPLEX(\$D\$5,2*PI()*A17*\$B\$5)	=IMABS(B17)
800	=COMPLEX(\$D\$5,2*PI()*A18*\$B\$5)	=IMABS(B18)
900	=COMPLEX(\$D\$5,2*PI()*A19*\$B\$5)	=IMABS(B19)
1000	=COMPLEX(\$D\$5,2*PI()*A20*\$B\$5)	=IMABS(B20)
1100	=COMPLEX(\$D\$5,2*PI()*A21*\$B\$5)	=IMABS(B21)
1200	=COMPLEX(\$D\$5,2*PI()*A22*\$B\$5)	=IMABS(B22)
1300	=COMPLEX(\$D\$5,2*PI()*A23*\$B\$5)	=IMABS(B23)
1400	=COMPLEX(\$D\$5,2*PI()*A24*\$B\$5)	=IMABS(B24)
1500	=COMPLEX(\$D\$5,2*PI()*A25*\$B\$5)	=IMABS(B25)
1600	=COMPLEX(\$D\$5,2*PI()*A26*\$B\$5)	=IMABS(B26)
1700	=COMPLEX(\$D\$5,2*PI()*A27*\$B\$5)	=IMABS(B27)
1800	=COMPLEX(\$D\$5,2*PI()*A28*\$B\$5)	=IMABS(B28)
1900	=COMPLEX(\$D\$5,2*PI()*A29*\$B\$5)	=IMABS(B29)
=A12*10	=COMPLEX(\$D\$5,2*PI()*A30*\$B\$5)	=IMABS(B30)
2100	=COMPLEX(\$D\$5,2*PI()*A31*\$B\$5)	=IMABS(B31)
2200	=COMPLEX(\$D\$5,2*PI()*A32*\$B\$5)	=IMABS(B32)
2300	=COMPLEX(\$D\$5,2*PI()*A33*\$B\$5)	=IMABS(B33)
2400	=COMPLEX(\$D\$5,2*PI()*A34*\$B\$5)	=IMABS(B34)
2500	=COMPLEX(\$D\$5,2*PI()*A35*\$B\$5)	=IMABS(B35)
2600	=COMPLEX(\$D\$5,2*PI()*A36*\$B\$5)	=IMABS(B36)
2700	=COMPLEX(\$D\$5,2*PI()*A37*\$B\$5)	=IMABS(B37)
2800	=COMPLEX(\$D\$5,2*PI()*A38*\$B\$5)	=IMABS(B38)
2900	=COMPLEX(\$D\$5,2*PI()*A39*\$B\$5)	=IMABS(B39)
3000	=COMPLEX(\$D\$5,2*PI()*A40*\$B\$5)	=IMABS(B40)
3100	=COMPLEX(\$D\$5,2*PI()*A41*\$B\$5)	=IMABS(B41)
3200	=COMPLEX(\$D\$5,2*PI()*A42*\$B\$5)	=IMABS(B42)
3300	=COMPLEX(\$D\$5,2*PI()*A43*\$B\$5)	=IMABS(B43)
3400	=COMPLEX(\$D\$5,2*PI()*A44*\$B\$5)	=IMABS(B44)
3500	=COMPLEX(\$D\$5,2*PI()*A45*\$B\$5)	=IMABS(B45)
3600	=COMPLEX(\$D\$5,2*PI()*A46*\$B\$5)	=IMABS(B46)
3700	=COMPLEX(\$D\$5,2*PI()*A47*\$B\$5)	=IMABS(B47)
3800	=COMPLEX(\$D\$5,2*PI()*A48*\$B\$5)	=IMABS(B48)
3900	=COMPLEX(\$D\$5,2*PI()*A49*\$B\$5)	=IMABS(B49)
4000	=COMPLEX(\$D\$5,2*PI()*A50*\$B\$5)	=IMABS(B50)
4100	=COMPLEX(\$D\$5,2*PI()*A51*\$B\$5)	=IMABS(B51)
4200	=COMPLEX(\$D\$5,2*PI()*A52*\$B\$5)	=IMABS(B52)
4300	=COMPLEX(\$D\$5,2*PI()*A53*\$B\$5)	=IMABS(B53)
4400	=COMPLEX(\$D\$5,2*PI()*A54*\$B\$5)	=IMABS(B54)
4500	=COMPLEX(\$D\$5,2*PI()*A55*\$B\$5)	=IMABS(B55)
4600	=COMPLEX(\$D\$5,2*PI()*A56*\$B\$5)	=IMABS(B56)
4700	=COMPLEX(\$D\$5,2*PI()*A57*\$B\$5)	=IMABS(B57)
4800	=COMPLEX(\$D\$5,2*PI()*A58*\$B\$5)	=IMABS(B58)
4900	=COMPLEX(\$D\$5,2*PI()*A59*\$B\$5)	=IMABS(B59)
=A15*10	=COMPLEX(\$D\$5,2*PI()*A60*\$B\$5)	=IMABS(B60)
5100	=COMPLEX(\$D\$5,2*PI()*A61*\$B\$5)	=IMABS(B61)
5200	=COMPLEX(\$D\$5,2*PI()*A62*\$B\$5)	=IMABS(B62)
5300	=COMPLEX(\$D\$5,2*PI()*A63*\$B\$5)	=IMABS(B63)
5400	=COMPLEX(\$D\$5,2*PI()*A64*\$B\$5)	=IMABS(B64)
5500	=COMPLEX(\$D\$5,2*PI()*A65*\$B\$5)	=IMABS(B65)
5600	=COMPLEX(\$D\$5,2*PI()*A66*\$B\$5)	=IMABS(B66)
5700	=COMPLEX(\$D\$5,2*PI()*A67*\$B\$5)	=IMABS(B67)
5800	=COMPLEX(\$D\$5,2*PI()*A68*\$B\$5)	=IMABS(B68)
5900	=COMPLEX(\$D\$5,2*PI()*A69*\$B\$5)	=IMABS(B69)
6000	=COMPLEX(\$D\$5,2*PI()*A70*\$B\$5)	=IMABS(B70)
6100	=COMPLEX(\$D\$5,2*PI()*A71*\$B\$5)	=IMABS(B71)
6200	=COMPLEX(\$D\$5,2*PI()*A72*\$B\$5)	=IMABS(B72)
6300	=COMPLEX(\$D\$5,2*PI()*A73*\$B\$5)	=IMABS(B73)
6400	=COMPLEX(\$D\$5,2*PI()*A74*\$B\$5)	=IMABS(B74)
6500	=COMPLEX(\$D\$5,2*PI()*A75*\$B\$5)	=IMABS(B75)
6600	=COMPLEX(\$D\$5,2*PI()*A76*\$B\$5)	=IMABS(B76)
6700	=COMPLEX(\$D\$5,2*PI()*A77*\$B\$5)	=IMABS(B77)
6800	=COMPLEX(\$D\$5,2*PI()*A78*\$B\$5)	=IMABS(B78)
6900	=COMPLEX(\$D\$5,2*PI()*A79*\$B\$5)	=IMABS(B79)
10000	=COMPLEX(\$D\$5,2*PI()*A80*\$B\$5)	=IMABS(B80)
=A28*10	=COMPLEX(\$D\$5,2*PI()*A81*\$B\$5)	=IMABS(B81)
=A30*10	=COMPLEX(\$D\$5,2*PI()*A82*\$B\$5)	=IMABS(B82)



Ind Res	
0	

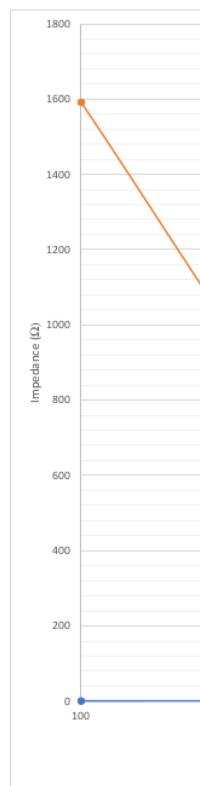
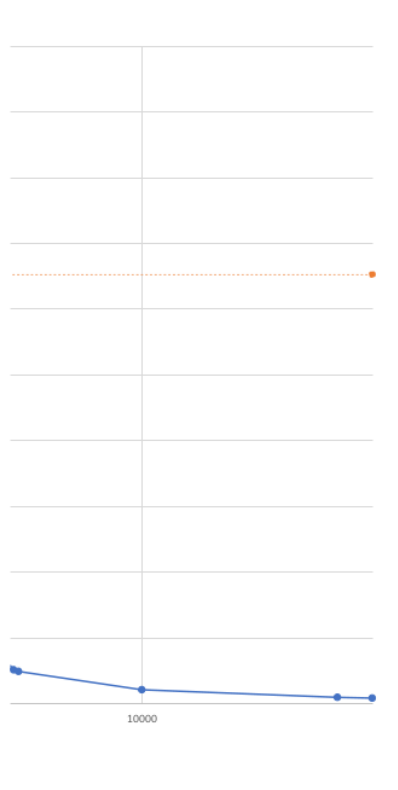
XC	XC (Abs)
=COMPLEX(0,-1/(2*PI()*A11*\$B\$4))	=IMABS(D 11)
=COMPLEX(0,-1/(2*PI()*A12*\$B\$4))	=IMABS(D 12)
=COMPLEX(0,-1/(2*PI()*A13*\$B\$4))	=IMABS(D 13)
=COMPLEX(0,-1/(2*PI()*A14*\$B\$4))	=IMABS(D 14)
=COMPLEX(0,-1/(2*PI()*A15*\$B\$4))	=IMABS(D 15)
=COMPLEX(0,-1/(2*PI()*A16*\$B\$4))	=IMABS(D 16)
=COMPLEX(0,-1/(2*PI()*A17*\$B\$4))	=IMABS(D 17)
=COMPLEX(0,-1/(2*PI()*A18*\$B\$4))	=IMABS(D 18)
=COMPLEX(0,-1/(2*PI()*A19*\$B\$4))	=IMABS(D 19)
=COMPLEX(0,-1/(2*PI()*A20*\$B\$4))	=IMABS(D 20)
=COMPLEX(0,-1/(2*PI()*A21*\$B\$4))	=IMABS(D 21)
=COMPLEX(0,-1/(2*PI()*A22*\$B\$4))	=IMABS(D 22)
=COMPLEX(0,-1/(2*PI()*A23*\$B\$4))	=IMABS(D 23)
=COMPLEX(0,-1/(2*PI()*A24*\$B\$4))	=IMABS(D 24)
=COMPLEX(0,-1/(2*PI()*A25*\$B\$4))	=IMABS(D 25)
=COMPLEX(0,-1/(2*PI()*A26*\$B\$4))	=IMABS(D 26)
=COMPLEX(0,-1/(2*PI()*A27*\$B\$4))	=IMABS(D 27)
=COMPLEX(0,-1/(2*PI()*A28*\$B\$4))	=IMABS(D 28)
=COMPLEX(0,-1/(2*PI()*A29*\$B\$4))	=IMABS(D 29)
=COMPLEX(0,-1/(2*PI()*A30*\$B\$4))	=IMABS(D 30)
=COMPLEX(0,-1/(2*PI()*A31*\$B\$4))	=IMABS(D 31)
=COMPLEX(0,-1/(2*PI()*A32*\$B\$4))	=IMABS(D 32)
=COMPLEX(0,-1/(2*PI()*A33*\$B\$4))	=IMABS(D 33)
=COMPLEX(0,-1/(2*PI()*A34*\$B\$4))	=IMABS(D 34)
=COMPLEX(0,-1/(2*PI()*A35*\$B\$4))	=IMABS(D 35)
=COMPLEX(0,-1/(2*PI()*A36*\$B\$4))	=IMABS(D 36)
=COMPLEX(0,-1/(2*PI()*A37*\$B\$4))	=IMABS(D 37)
=COMPLEX(0,-1/(2*PI()*A38*\$B\$4))	=IMABS(D 38)
=COMPLEX(0,-1/(2*PI()*A39*\$B\$4))	=IMABS(D 39)
=COMPLEX(0,-1/(2*PI()*A40*\$B\$4))	=IMABS(D 40)
=COMPLEX(0,-1/(2*PI()*A41*\$B\$4))	=IMABS(D 41)
=COMPLEX(0,-1/(2*PI()*A42*\$B\$4))	=IMABS(D 42)
=COMPLEX(0,-1/(2*PI()*A43*\$B\$4))	=IMABS(D 43)
=COMPLEX(0,-1/(2*PI()*A44*\$B\$4))	=IMABS(D 44)
=COMPLEX(0,-1/(2*PI()*A45*\$B\$4))	=IMABS(D 45)
=COMPLEX(0,-1/(2*PI()*A46*\$B\$4))	=IMABS(D 46)
=COMPLEX(0,-1/(2*PI()*A47*\$B\$4))	=IMABS(D 47)
=COMPLEX(0,-1/(2*PI()*A48*\$B\$4))	=IMABS(D 48)
=COMPLEX(0,-1/(2*PI()*A49*\$B\$4))	=IMABS(D 49)
=COMPLEX(0,-1/(2*PI()*A50*\$B\$4))	=IMABS(D 50)
=COMPLEX(0,-1/(2*PI()*A51*\$B\$4))	=IMABS(D 51)
=COMPLEX(0,-1/(2*PI()*A52*\$B\$4))	=IMABS(D 52)
=COMPLEX(0,-1/(2*PI()*A53*\$B\$4))	=IMABS(D 53)
=COMPLEX(0,-1/(2*PI()*A54*\$B\$4))	=IMABS(D 54)
=COMPLEX(0,-1/(2*PI()*A55*\$B\$4))	=IMABS(D 55)
=COMPLEX(0,-1/(2*PI()*A56*\$B\$4))	=IMABS(D 56)
=COMPLEX(0,-1/(2*PI()*A57*\$B\$4))	=IMABS(D 57)
=COMPLEX(0,-1/(2*PI()*A58*\$B\$4))	=IMABS(D 58)
=COMPLEX(0,-1/(2*PI()*A59*\$B\$4))	=IMABS(D 59)
=COMPLEX(0,-1/(2*PI()*A60*\$B\$4))	=IMABS(D 60)
=COMPLEX(0,-1/(2*PI()*A61*\$B\$4))	=IMABS(D 61)
=COMPLEX(0,-1/(2*PI()*A62*\$B\$4))	=IMABS(D 62)
=COMPLEX(0,-1/(2*PI()*A63*\$B\$4))	=IMABS(D 63)
=COMPLEX(0,-1/(2*PI()*A64*\$B\$4))	=IMABS(D 64)
=COMPLEX(0,-1/(2*PI()*A65*\$B\$4))	=IMABS(D 65)
=COMPLEX(0,-1/(2*PI()*A66*\$B\$4))	=IMABS(D 66)
=COMPLEX(0,-1/(2*PI()*A67*\$B\$4))	=IMABS(D 67)
=COMPLEX(0,-1/(2*PI()*A68*\$B\$4))	=IMABS(D 68)
=COMPLEX(0,-1/(2*PI()*A69*\$B\$4))	=IMABS(D 69)
=COMPLEX(0,-1/(2*PI()*A70*\$B\$4))	=IMABS(D 70)
=COMPLEX(0,-1/(2*PI()*A71*\$B\$4))	=IMABS(D 71)
=COMPLEX(0,-1/(2*PI()*A72*\$B\$4))	=IMABS(D 72)
=COMPLEX(0,-1/(2*PI()*A73*\$B\$4))	=IMABS(D 73)
=COMPLEX(0,-1/(2*PI()*A74*\$B\$4))	=IMABS(D 74)
=COMPLEX(0,-1/(2*PI()*A75*\$B\$4))	=IMABS(D 75)
=COMPLEX(0,-1/(2*PI()*A76*\$B\$4))	=IMABS(D 76)
=COMPLEX(0,-1/(2*PI()*A77*\$B\$4))	=IMABS(D 77)
=COMPLEX(0,-1/(2*PI()*A78*\$B\$4))	=IMABS(D 78)
=COMPLEX(0,-1/(2*PI()*A79*\$B\$4))	=IMABS(D 79)
=COMPLEX(0,-1/(2*PI()*A80*\$B\$4))	=IMABS(D 80)
=COMPLEX(0,-1/(2*PI()*A81*\$B\$4))	=IMABS(D 81)
=COMPLEX(0,-1/(2*PI()*A82*\$B\$4))	=IMABS(D 82)

Calculated Values (Ideal Circuit)



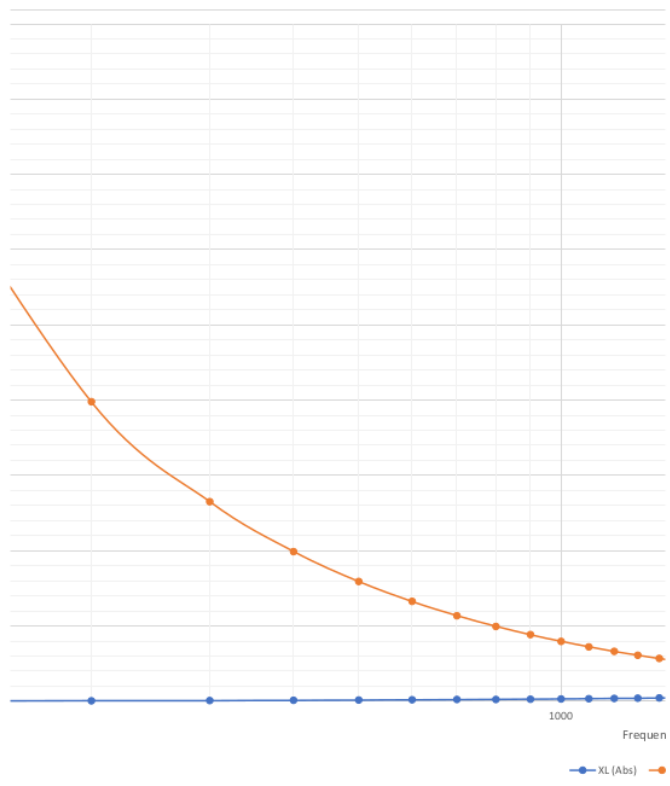
fres	=1/(2*PI())*SQRT(B4*B5))
VLC(Mag) at half-power points	=MAX(J11:J82)*0.707
Q-Factor at resonance	=(2*PI())*\$G\$3*\$B\$5)/\$B\$3
Bandwidth	=G3/G5

ZLC	ZT
=IMD IV(IMPRODUCT(B11,D11), IMSUM(B11,D11))	=IMSUM(COMPLEX(\$B\$3,0),F11)
=IMD IV(IMPRODUCT(B12,D12), IMSUM(B12,D12))	=IMSUM(COMPLEX(\$B\$3,0),F12)
=IMD IV(IMPRODUCT(B13,D13), IMSUM(B13,D13))	=IMSUM(COMPLEX(\$B\$3,0),F13)
=IMD IV(IMPRODUCT(B14,D14), IMSUM(B14,D14))	=IMSUM(COMPLEX(\$B\$3,0),F14)
=IMD IV(IMPRODUCT(B15,D15), IMSUM(B15,D15))	=IMSUM(COMPLEX(\$B\$3,0),F15)
=IMD IV(IMPRODUCT(B16,D16), IMSUM(B16,D16))	=IMSUM(COMPLEX(\$B\$3,0),F16)
=IMD IV(IMPRODUCT(B17,D17), IMSUM(B17,D17))	=IMSUM(COMPLEX(\$B\$3,0),F17)
=IMD IV(IMPRODUCT(B18,D18), IMSUM(B18,D18))	=IMSUM(COMPLEX(\$B\$3,0),F18)
=IMD IV(IMPRODUCT(B19,D19), IMSUM(B19,D19))	=IMSUM(COMPLEX(\$B\$3,0),F19)
=IMD IV(IMPRODUCT(B20,D20), IMSUM(B20,D20))	=IMSUM(COMPLEX(\$B\$3,0),F20)
=IMD IV(IMPRODUCT(B21,D21), IMSUM(B21,D21))	=IMSUM(COMPLEX(\$B\$3,0),F21)
=IMD IV(IMPRODUCT(B22,D22), IMSUM(B22,D22))	=IMSUM(COMPLEX(\$B\$3,0),F22)
=IMD IV(IMPRODUCT(B23,D23), IMSUM(B23,D23))	=IMSUM(COMPLEX(\$B\$3,0),F23)
=IMD IV(IMPRODUCT(B24,D24), IMSUM(B24,D24))	=IMSUM(COMPLEX(\$B\$3,0),F24)
=IMD IV(IMPRODUCT(B25,D25), IMSUM(B25,D25))	=IMSUM(COMPLEX(\$B\$3,0),F25)
=IMD IV(IMPRODUCT(B26,D26), IMSUM(B26,D26))	=IMSUM(COMPLEX(\$B\$3,0),F26)
=IMD IV(IMPRODUCT(B27,D27), IMSUM(B27,D27))	=IMSUM(COMPLEX(\$B\$3,0),F27)
=IMD IV(IMPRODUCT(B28,D28), IMSUM(B28,D28))	=IMSUM(COMPLEX(\$B\$3,0),F28)
=IMD IV(IMPRODUCT(B29,D29), IMSUM(B29,D29))	=IMSUM(COMPLEX(\$B\$3,0),F29)
=IMD IV(IMPRODUCT(B30,D30), IMSUM(B30,D30))	=IMSUM(COMPLEX(\$B\$3,0),F30)
=IMD IV(IMPRODUCT(B31,D31), IMSUM(B31,D31))	=IMSUM(COMPLEX(\$B\$3,0),F31)
=IMD IV(IMPRODUCT(B32,D32), IMSUM(B32,D32))	=IMSUM(COMPLEX(\$B\$3,0),F32)
=IMD IV(IMPRODUCT(B33,D33), IMSUM(B33,D33))	=IMSUM(COMPLEX(\$B\$3,0),F33)
=IMD IV(IMPRODUCT(B34,D34), IMSUM(B34,D34))	=IMSUM(COMPLEX(\$B\$3,0),F34)
=IMD IV(IMPRODUCT(B35,D35), IMSUM(B35,D35))	=IMSUM(COMPLEX(\$B\$3,0),F35)
=IMD IV(IMPRODUCT(B36,D36), IMSUM(B36,D36))	=IMSUM(COMPLEX(\$B\$3,0),F36)
=IMD IV(IMPRODUCT(B37,D37), IMSUM(B37,D37))	=IMSUM(COMPLEX(\$B\$3,0),F37)
=IMD IV(IMPRODUCT(B38,D38), IMSUM(B38,D38))	=IMSUM(COMPLEX(\$B\$3,0),F38)
=IMD IV(IMPRODUCT(B39,D39), IMSUM(B39,D39))	=IMSUM(COMPLEX(\$B\$3,0),F39)
=IMD IV(IMPRODUCT(B40,D40), IMSUM(B40,D40))	=IMSUM(COMPLEX(\$B\$3,0),F40)
=IMD IV(IMPRODUCT(B41,D41), IMSUM(B41,D41))	=IMSUM(COMPLEX(\$B\$3,0),F41)
=IMD IV(IMPRODUCT(B42,D42), IMSUM(B42,D42))	=IMSUM(COMPLEX(\$B\$3,0),F42)
=IMD IV(IMPRODUCT(B43,D43), IMSUM(B43,D43))	=IMSUM(COMPLEX(\$B\$3,0),F43)
=IMD IV(IMPRODUCT(B44,D44), IMSUM(B44,D44))	=IMSUM(COMPLEX(\$B\$3,0),F44)
=IMD IV(IMPRODUCT(B45,D45), IMSUM(B45,D45))	=IMSUM(COMPLEX(\$B\$3,0),F45)
=IMD IV(IMPRODUCT(B46,D46), IMSUM(B46,D46))	=IMSUM(COMPLEX(\$B\$3,0),F46)
=IMD IV(IMPRODUCT(B47,D47), IMSUM(B47,D47))	=IMSUM(COMPLEX(\$B\$3,0),F47)
=IMD IV(IMPRODUCT(B48,D48), IMSUM(B48,D48))	=IMSUM(COMPLEX(\$B\$3,0),F48)
=IMD IV(IMPRODUCT(B49,D49), IMSUM(B49,D49))	=IMSUM(COMPLEX(\$B\$3,0),F49)
=IMD IV(IMPRODUCT(B50,D50), IMSUM(B50,D50))	=IMSUM(COMPLEX(\$B\$3,0),F50)
=IMD IV(IMPRODUCT(B51,D51), IMSUM(B51,D51))	=IMSUM(COMPLEX(\$B\$3,0),F51)
=IMD IV(IMPRODUCT(B52,D52), IMSUM(B52,D52))	=IMSUM(COMPLEX(\$B\$3,0),F52)
=IMD IV(IMPRODUCT(B53,D53), IMSUM(B53,D53))	=IMSUM(COMPLEX(\$B\$3,0),F53)
=IMD IV(IMPRODUCT(B54,D54), IMSUM(B54,D54))	=IMSUM(COMPLEX(\$B\$3,0),F54)
=IMD IV(IMPRODUCT(B55,D55), IMSUM(B55,D55))	=IMSUM(COMPLEX(\$B\$3,0),F55)
=IMD IV(IMPRODUCT(B56,D56), IMSUM(B56,D56))	=IMSUM(COMPLEX(\$B\$3,0),F56)
=IMD IV(IMPRODUCT(B57,D57), IMSUM(B57,D57))	=IMSUM(COMPLEX(\$B\$3,0),F57)
=IMD IV(IMPRODUCT(B58,D58), IMSUM(B58,D58))	=IMSUM(COMPLEX(\$B\$3,0),F58)
=IMD IV(IMPRODUCT(B59,D59), IMSUM(B59,D59))	=IMSUM(COMPLEX(\$B\$3,0),F59)
=IMD IV(IMPRODUCT(B60,D60), IMSUM(B60,D60))	=IMSUM(COMPLEX(\$B\$3,0),F60)
=IMD IV(IMPRODUCT(B61,D61), IMSUM(B61,D61))	=IMSUM(COMPLEX(\$B\$3,0),F61)
=IMD IV(IMPRODUCT(B62,D62), IMSUM(B62,D62))	=IMSUM(COMPLEX(\$B\$3,0),F62)
=IMD IV(IMPRODUCT(B63,D63), IMSUM(B63,D63))	=IMSUM(COMPLEX(\$B\$3,0),F63)
=IMD IV(IMPRODUCT(B64,D64), IMSUM(B64,D64))	=IMSUM(COMPLEX(\$B\$3,0),F64)
=IMD IV(IMPRODUCT(B65,D65), IMSUM(B65,D65))	=IMSUM(COMPLEX(\$B\$3,0),F65)
=IMD IV(IMPRODUCT(B66,D66), IMSUM(B66,D66))	=IMSUM(COMPLEX(\$B\$3,0),F66)
=IMD IV(IMPRODUCT(B67,D67), IMSUM(B67,D67))	=IMSUM(COMPLEX(\$B\$3,0),F67)
=IMD IV(IMPRODUCT(B68,D68), IMSUM(B68,D68))	=IMSUM(COMPLEX(\$B\$3,0),F68)
=IMD IV(IMPRODUCT(B69,D69), IMSUM(B69,D69))	=IMSUM(COMPLEX(\$B\$3,0),F69)
=IMD IV(IMPRODUCT(B70,D70), IMSUM(B70,D70))	=IMSUM(COMPLEX(\$B\$3,0),F70)
=IMD IV(IMPRODUCT(B71,D71), IMSUM(B71,D71))	=IMSUM(COMPLEX(\$B\$3,0),F71)
=IMD IV(IMPRODUCT(B72,D72), IMSUM(B72,D72))	=IMSUM(COMPLEX(\$B\$3,0),F72)
=IMD IV(IMPRODUCT(B73,D73), IMSUM(B73,D73))	=IMSUM(COMPLEX(\$B\$3,0),F73)
=IMD IV(IMPRODUCT(B74,D74), IMSUM(B74,D74))	=IMSUM(COMPLEX(\$B\$3,0),F74)
=IMD IV(IMPRODUCT(B75,D75), IMSUM(B75,D75))	=IMSUM(COMPLEX(\$B\$3,0),F75)
=IMD IV(IMPRODUCT(B76,D76), IMSUM(B76,D76))	=IMSUM(COMPLEX(\$B\$3,0),F76)
=IMD IV(IMPRODUCT(B77,D77), IMSUM(B77,D77))	=IMSUM(COMPLEX(\$B\$3,0),F77)
=IMD IV(IMPRODUCT(B78,D78), IMSUM(B78,D78))	=IMSUM(COMPLEX(\$B\$3,0),F78)
=IMD IV(IMPRODUCT(B79,D79), IMSUM(B79,D79))	=IMSUM(COMPLEX(\$B\$3,0),F79)
=IMD IV(IMPRODUCT(B80,D80), IMSUM(B80,D80))	=IMSUM(COMPLEX(\$B\$3,0),F80)
=IMD IV(IMPRODUCT(B81,D81), IMSUM(B81,D81))	=IMSUM(COMPLEX(\$B\$3,0),F81)
=IMD IV(IMPRODUCT(B82,D82), IMSUM(B82,D82))	=IMSUM(COMPLEX(\$B\$3,0),F82)



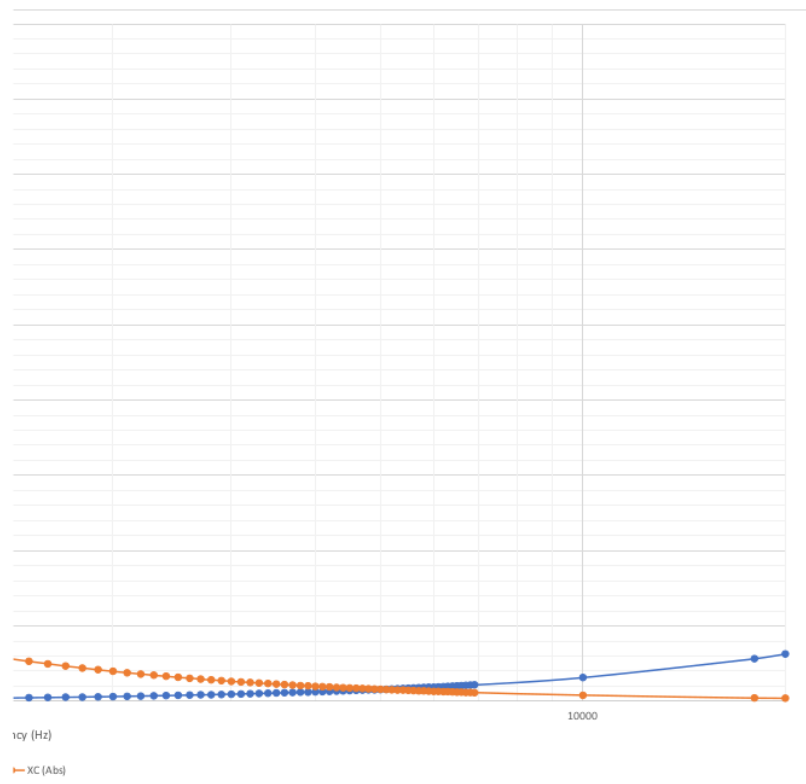
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=IMD IV(COMPLEX(\$B\$6,0),G11)
=IMD IV(COMPLEX(\$B\$6,0),G12)
=IMD IV(COMPLEX(\$B\$6,0),G13)
=IMD IV(COMPLEX(\$B\$6,0),G14)
=IMD IV(COMPLEX(\$B\$6,0),G15)
=IMD IV(COMPLEX(\$B\$6,0),G16)
=IMD IV(COMPLEX(\$B\$6,0),G17)
=IMD IV(COMPLEX(\$B\$6,0),G18)
=IMD IV(COMPLEX(\$B\$6,0),G19)
=IMD IV(COMPLEX(\$B\$6,0),G20)
=IMD IV(COMPLEX(\$B\$6,0),G21)
=IMD IV(COMPLEX(\$B\$6,0),G22)
=IMD IV(COMPLEX(\$B\$6,0),G23)
=IMD IV(COMPLEX(\$B\$6,0),G24)
=IMD IV(COMPLEX(\$B\$6,0),G25)
=IMD IV(COMPLEX(\$B\$6,0),G26)
=IMD IV(COMPLEX(\$B\$6,0),G27)
=IMD IV(COMPLEX(\$B\$6,0),G28)
=IMD IV(COMPLEX(\$B\$6,0),G29)
=IMD IV(COMPLEX(\$B\$6,0),G30)
=IMD IV(COMPLEX(\$B\$6,0),G31)
=IMD IV(COMPLEX(\$B\$6,0),G32)
=IMD IV(COMPLEX(\$B\$6,0),G33)
=IMD IV(COMPLEX(\$B\$6,0),G34)
=IMD IV(COMPLEX(\$B\$6,0),G35)
=IMD IV(COMPLEX(\$B\$6,0),G36)
=IMD IV(COMPLEX(\$B\$6,0),G37)
=IMD IV(COMPLEX(\$B\$6,0),G38)
=IMD IV(COMPLEX(\$B\$6,0),G39)
=IMD IV(COMPLEX(\$B\$6,0),G40)
=IMD IV(COMPLEX(\$B\$6,0),G41)
=IMD IV(COMPLEX(\$B\$6,0),G42)
=IMD IV(COMPLEX(\$B\$6,0),G43)
=IMD IV(COMPLEX(\$B\$6,0),G44)
=IMD IV(COMPLEX(\$B\$6,0),G45)
=IMD IV(COMPLEX(\$B\$6,0),G46)
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=IMD IV(COMPLEX(\$B\$6,0),G79)
=IMD IV(COMPLEX(\$B\$6,0),G80)
=IMD IV(COMPLEX(\$B\$6,0),G81)
=IMD IV(COMPLEX(\$B\$6,0),G82)



f	70.7% line
100	=MAX(J11:J82)*0.707
20000	=J4

VLC	VLC(Mag)
=IMPRODUCT(H11,F11)	=IMABS(I11)
=IMPRODUCT(H12,F12)	=IMABS(I12)
=IMPRODUCT(H13,F13)	=IMABS(I13)
=IMPRODUCT(H14,F14)	=IMABS(I14)
=IMPRODUCT(H15,F15)	=IMABS(I15)
=IMPRODUCT(H16,F16)	=IMABS(I16)
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=IMPRODUCT(H19,F19)	=IMABS(I19)
=IMPRODUCT(H20,F20)	=IMABS(I20)
=IMPRODUCT(H21,F21)	=IMABS(I21)
=IMPRODUCT(H22,F22)	=IMABS(I22)
=IMPRODUCT(H23,F23)	=IMABS(I23)
=IMPRODUCT(H24,F24)	=IMABS(I24)
=IMPRODUCT(H25,F25)	=IMABS(I25)
=IMPRODUCT(H26,F26)	=IMABS(I26)
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=IMPRODUCT(H28,F28)	=IMABS(I28)
=IMPRODUCT(H29,F29)	=IMABS(I29)
=IMPRODUCT(H30,F30)	=IMABS(I30)
=IMPRODUCT(H31,F31)	=IMABS(I31)
=IMPRODUCT(H32,F32)	=IMABS(I32)
=IMPRODUCT(H33,F33)	=IMABS(I33)
=IMPRODUCT(H34,F34)	=IMABS(I34)
=IMPRODUCT(H35,F35)	=IMABS(I35)
=IMPRODUCT(H36,F36)	=IMABS(I36)
=IMPRODUCT(H37,F37)	=IMABS(I37)
=IMPRODUCT(H38,F38)	=IMABS(I38)
=IMPRODUCT(H39,F39)	=IMABS(I39)
=IMPRODUCT(H40,F40)	=IMABS(I40)
=IMPRODUCT(H41,F41)	=IMABS(I41)
=IMPRODUCT(H42,F42)	=IMABS(I42)
=IMPRODUCT(H43,F43)	=IMABS(I43)
=IMPRODUCT(H44,F44)	=IMABS(I44)
=IMPRODUCT(H45,F45)	=IMABS(I45)
=IMPRODUCT(H46,F46)	=IMABS(I46)
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=IMPRODUCT(H72,F72)	=IMABS(I72)
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=IMPRODUCT(H74,F74)	=IMABS(I74)
=IMPRODUCT(H75,F75)	=IMABS(I75)
=IMPRODUCT(H76,F76)	=IMABS(I76)
=IMPRODUCT(H77,F77)	=IMABS(I77)
=IMPRODUCT(H78,F78)	=IMABS(I78)
=IMPRODUCT(H79,F79)	=IMABS(I79)
=IMPRODUCT(H80,F80)	=IMABS(I80)
=IMPRODUCT(H81,F81)	=IMABS(I81)
=IMPRODUCT(H82,F82)	=IMABS(I82)



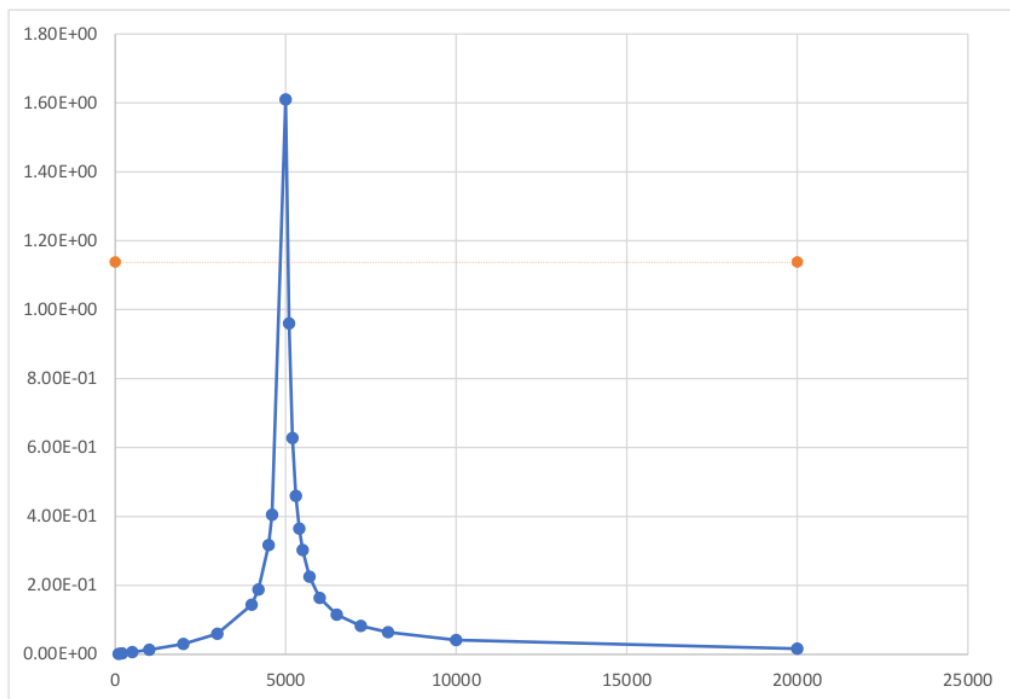
VLC(dB)

=20*LOG10(I11/\$B\$6)
=20*LOG10(I12/\$B\$6)
=20*LOG10(I13/\$B\$6)
=20*LOG10(I14/\$B\$6)
=20*LOG10(I15/\$B\$6)
=20*LOG10(I16/\$B\$6)
=20*LOG10(I17/\$B\$6)
=20*LOG10(I18/\$B\$6)
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=20*LOG10(I20/\$B\$6)
=20*LOG10(I21/\$B\$6)
=20*LOG10(I22/\$B\$6)
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=20*LOG10(I72/\$B\$6)
=20*LOG10(I73/\$B\$6)
=20*LOG10(I74/\$B\$6)
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=20*LOG10(I76/\$B\$6)
=20*LOG10(I77/\$B\$6)
=20*LOG10(I78/\$B\$6)
=20*LOG10(I79/\$B\$6)
=20*LOG10(I80/\$B\$6)
=20*LOG10(I81/\$B\$6)
=20*LOG10(I82/\$B\$6)

Frequency	Input Voltage (Vin pk-pk)	Output Voltage (Vout)
100	2	1.30E-03
200	2	2.50E-03
500	2	6.50E-03
1000	2	1.32E-02
2000	2	3.03E-02
3000	2	6.00E-02
4000	2	1.44E-01
4200	2	1.88E-01
4500	2	3.17E-01
4600	2	4.05E-01
5000	2	1.61E+00
5100	2	9.60E-01
5200	2	6.28E-01
5300	2	4.60E-01
5400	2	3.65E-01
5500	2	3.03E-01
5700	2	2.25E-01
6000	2	1.64E-01
6500	2	1.16E-01
7200	2	8.25E-02
8000	2	6.40E-02
10000	2	4.15E-02
20000	2	1.68E-02

Peak	1.61E+00
70.70%	1.14E+00 ** 70.7% of greatest value in lists

f	70.7% Line
0	1.13827
20000	1.13827



Resonance Assignment

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

Instructor

58/100

PAGE 1

PAGE 2



Comment 1

You should include a statement on your results. State what the resonant frequencies were, state what the Q factors were, state what the peak amplitudes were.

PAGE 3



Cap. Error
Capitalization



Cap. Error
Capitalization

PAGE 4



Comment 2

Inductance



Comment 3

These values are only typical values and may not be the actual values of your components.

PAGE 5



Comment 4

Should be product over sum

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

PAGE 13

PAGE 14



Comment 5

The Q factor will not change with excitation frequency



Comment 6

R is never the sum of reactances, it is always resistance. Do you mean Z (Impedance) ?



Comment 7

The bandwidth would not be zero unless there was no resistor in circuit and the system supplying it had zero output resistance, which is impossible.



Comment 8

$$0/10 = 0$$

$$0/5 = 0$$

PAGE 15



Comment 9

You have this the wrong way around. At low frequencies the circuit is capacitive because $X_C > X_L$ but as frequency increases they swap so that $X_L > X_C$, with resonance occurring in the middle when $X_C = X_L$.



Comment 10

...and the internal resistance of the signal generator supplying the current.

PAGE 16



Comment 11

You should have included more sources.

PAGE 17

PAGE 18

PAGE 19

PAGE 20

PAGE 21

PAGE 22

PAGE 23

PAGE 24

PAGE 25

PAGE 26

PAGE 27

PAGE 28

PAGE 29

PAGE 30

PAGE 31

PAGE 32

PAGE 33

PAGE 34

PAGE 35

PAGE 36

PAGE 37

PAGE 38

PAGE 39

PAGE 40

PAGE 41

PAGE 42

PAGE 43

PAGE 44

PAGE 45

PAGE 46

PAGE 47

PAGE 48

PAGE 49

PAGE 50

PAGE 51

PAGE 52

PAGE 53

PAGE 54

PAGE 55

PAGE 56

PAGE 57

PAGE 58

PAGE 59

PAGE 60

PAGE 61

PAGE 62

PAGE 63

GRADING FORM: SMU GENERIC_SMOSEY

RYAN THOMAS GARRY

57.65

ENGAGEMENT WITH LITERATURE

including reading, referencing, academic conventions and academic honesty



Inclusion of a range of research-informed literature, including sources retrieved independently. Referencing conventions mostly consistently applied.

2.5

KNOWLEDGE & UNDERSTANDING

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



Knowledge is accurate with a good understanding of the field of study. Some small mistakes - see

17.4

comment bubbles in text

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 synthesis. Can analyse new and/or abstract data and situations without guidance. Valid conclusions

16.5

PRACTICAL APPLICATION SKILLS

Different approaches to solving problems in particular contexts.



A good application of a range of methods, materials, tools and techniques.

18

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 well, confidently and consistently in a suitable format. Work is coherent and fluent and is well structured and organised.

3.25