Lab 3 Results – Intro to AC Circuits

ECE202: Fundamentals of Electrical Engineering

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2.1.3 Capacitance (DMM)

DMM	**$C_{1\mu F}$**	**(nF)**	1027.0
	C_{220nF}	**(nF)**	224.8
	C_{100nF}	**(nF)**	101.1

2.1.4 AC Voltage (DMM)

AD2 Wavegen	DMM(V^{AC})	AD2 Voltmeter (AC RMS)
$1V^{peak}$@100Hz	0.704	0.746
$2V^{peak}$@200Hz	1.410	1.4082
$3V^{peak}$@500Hz	2.115	2.1021

2.2 Resistor Circuit

$3V^{peak}$@500Hz	R	(Ω)	220	470	1500
DMM	**R**	(Ω)	215.9	463.6	1469
	I^{RMS}	(mA)	9.52	4.49	1.42
Scope	**V^{MAX}**	(V)	2.9079	2.9515	2.9733
	V^{MIN}	(V)	-2.93393	-2.97389	-2.99569
	V^{AVG}	(mV)	-11.75076	-11.51916	-11.73214
	$V^{Peak2Peak}$	(V)	5.8419	5.9254	5.9690
	V^{RMS}	(V)	2.4074	2.0793	2.0941
	f	(Hz)	499.99	500.02	500.2
	period	(ms)	2.000	1.9999	1.9999

	I^{RMS}	(mA)	**9.3705**	**4.451**	**1.405**
Calculated	**R**	(Ω)	256.9	467.2	1491

2.3 Series Resistors

$3V^{RMS}$	**f**	**(Hz)**	**100**	**1000**	**10000**
DMM	**f_S**	(Hz)	100	1000	10000
Scope	**V_{R1}^{RMS}**	(V)	2.0334	2.0360	2.0671
	V_{R2}^{RMS}	(V)	0.94543	0.94529	0.94503
	V_S^{RMS}	(V)	2.9788	2.9813	3.0121
	I_S^{RMS}	(mA)	4.3264	4.3319	4.3981
Calculated	**R_1**	(Ω)	469.99	470.00	469.99
	R_2	(Ω)	218.53	218.22	214.87

2.4 Series RC (1μF)

$3V^{RMS}$	**f**	**(Hz)**	**100**	**338.6**	**1000**	**10000**
DMM	**f_S**	(Hz)	100	338.6	1000	10000
Scope	**V_{R1}^{RMS}**	(V)	0.85592	2.1115	2.8126	3.0151
	V_{C1}^{RMS}	(V)	2.8583	2.0927	0.94305	0.10293
	V_S^{RMS}	(V)	2.9882	2.9759	2.9714	3.0187
	I_S^{RMS}	(mA)	1.8211	4.4925	5.9843	6.4152
Calculated	**R_1**	(Ω)	470.00	470.00	469.99	470.55
	X_{C1}	(Ω)	1569.5	465.82	157.59	16.045
	C_1	(nF)	1014.0	1009.1	1009.9	991.93

2.5 Series RC (100nF)

$3V^{RMS}$	**f**	**(Hz)**	**100**	**1000**	**3386**	**10000**
DMM	**f_S**	(Hz)	100	1000	3386	10000
Scope	**V_{R1}^{RMS}**	(V)	0.087476	0.83548	1.9593	2.8488
	V_{C2}^{RMS}	(V)	2.9851	2.8663	2.2283	0.99007
	V_S^{RMS}	(V)	2.9900	2.9932	2.9339	3.0278
	I_S^{RMS}	(mA)	0.18612	1.7776	4.1688	6.0614
Calculated	**R_1**	(Ω)	469.99	470.00	469.99	469.99
	X_{C2}	(Ω)	16039	1612.5	534.52	163.34
	C_2	(nF)	99.230	98.701	87.937	97.438

2.6 Series RL (10 mH)

DMM	**R_{10mH}**	**(Ω)**	9.2

$3V^{RMS}$	**f**	**(Hz)**	**100**	**1000**	**7480**	**10000**
DMM	**f_S**	(Hz)	100	1000	7480	10000
Scope	**V_{R1}^{RMS}**	(V)	2.9018	2.8812	2.0954	1.8092
	V_{L1}^{RMS}	(V)	0.070277	0.38997	2.1275	2.4041
	V_S^{RMS}	(V)	2.9604	2.9671	2.9608	3.0378
	I_S^{RMS}	(mA)	6.1741	6.1302	4.4583	3.8494

Calculated	**R_1**	(Ω)	469.99	470.00	469.99	469.99
	Z_{L1}	(Ω)	479.49	484.01	664.11	789.16
	X_{L1}	(Ω)	94.974	115.61	469.20	633.94
	L_1	(mH)	151.16	18.400	9.9834	10.089

1) **Show your work for finding L_1 at 7480 Hz frequency.**

$L_1 = X_{L1}/2\pi f = 469.20\ \Omega/(2\pi(7480\ Hz)) = 9.9834$ mH (correct to 5 s.f.).

2) **Make some general observations and conclusions about how each of the different components on the plot Impedance-Frequency of R, L and C behave.**

Impedance of both resistors is always at a constant value respectively. This shows that change in frequency does not affect the impedance of a resistor.

On the other hand, the impedance of the inductor (L) increases with frequency and at higher frequencies a greater positive change in impedance is noticed.

Impedance of capacitors decreases with frequency and at higher frequencies a greater negative change in impedance is noticed.

3) **Looking at your results, does the inductor behave more like an ideal component at 100Hz or at 10 kHz?**

The inductor behaves more ideally at 10 kHz, where its impedance is 789.16 Ω, primarily driven by inductive reactance. At this higher frequency, parasitic resistance (approximately 470 Ω) has less impact, closely aligning with ideal behavior. At 100 Hz, with impedance at 479.49 Ω, parasitic effects are more noticeable.

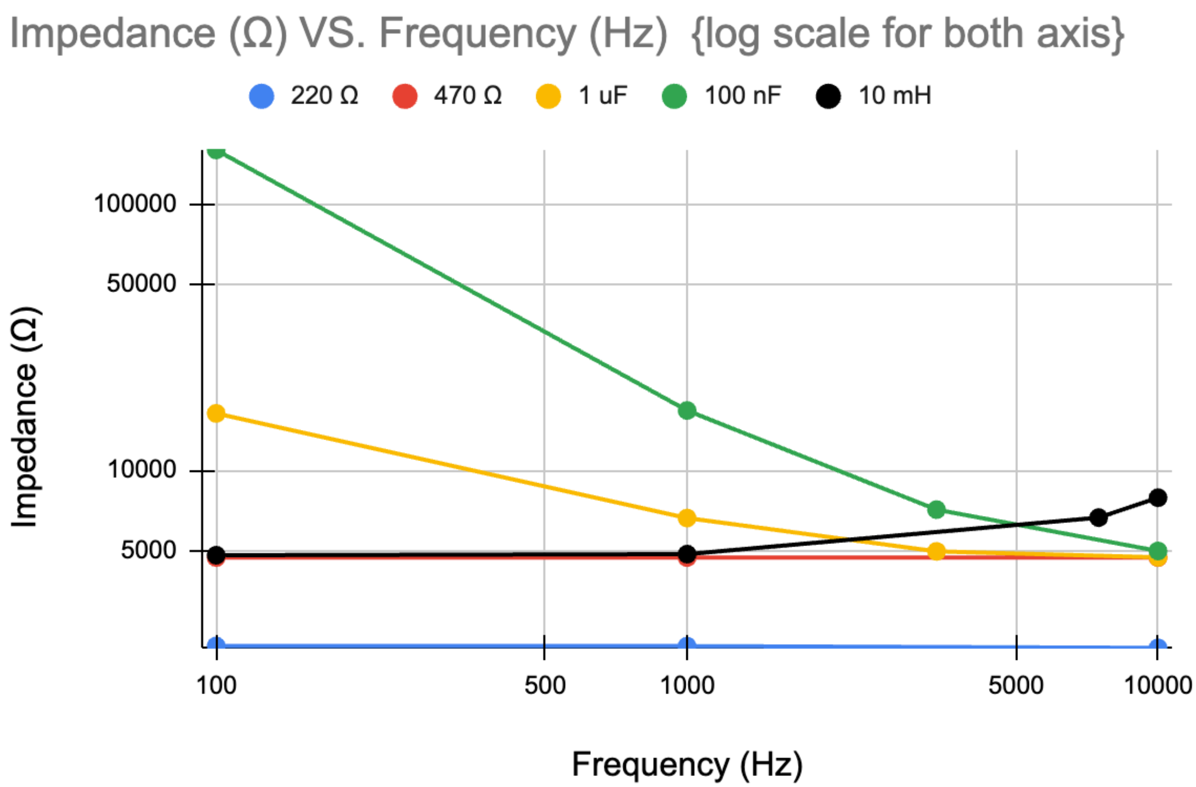
Impedance-Frequency Plot

The following pages have been left for you to include the plots that you are required to create as part of your post-lab.

To create your plots you can use whichever software you would like (Excel, Matlab, etc), export your plot as an image and import it into your Lab 3 - Results sheet in the appropriate place.

Your plots should include:

- A Plot title
- Label your axes and show what unit of measure is used.
- Include a marking for your data-points.
- Include a line between your data-points in the same series.
- Include a legend.
- Make sure your scales are appropriate and visible.



For the 5 components used in the 4 series circuits: 220Ω, 470Ω, 1uF, 100nF and the 10mH, plot each components impedance vs. frequency on the same plot. Use a logarithmic scale for both the x-axis and y-axis.