Frequency Response

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In this lab we learned about the capacitors and the use of Oscilloscope. We payed around with the oscilloscope to find about it different features.

Oscilloscope a device which is used to observe the change of electric signal over time in the form of a wave. Various parameters of the signal, like frequency, phase, amplitude can be viewed on the display of the oscilloscope. We can set the different parameters that we want to measure. The display of the oscilloscope is CRT display which reminds me of the old televisions. Figure 1 shows the picture of oscilloscope.

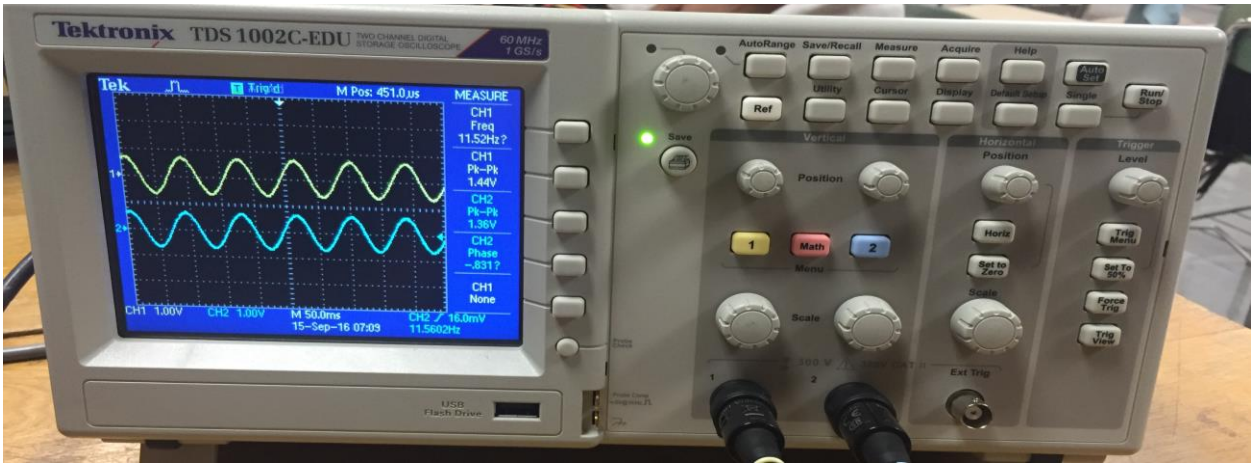

Figure1.Oscilloscope

Capacitors are electronic device that store energy as electrostatic field between its plates. The plates are conductors that are separated by an insulator. If we compare it with the resistors, the resistors consume some energy when the current flows through it; on the other hand, the capacitors store the energy when is current flows through it. Figure 2 shows various types of Capacitors.

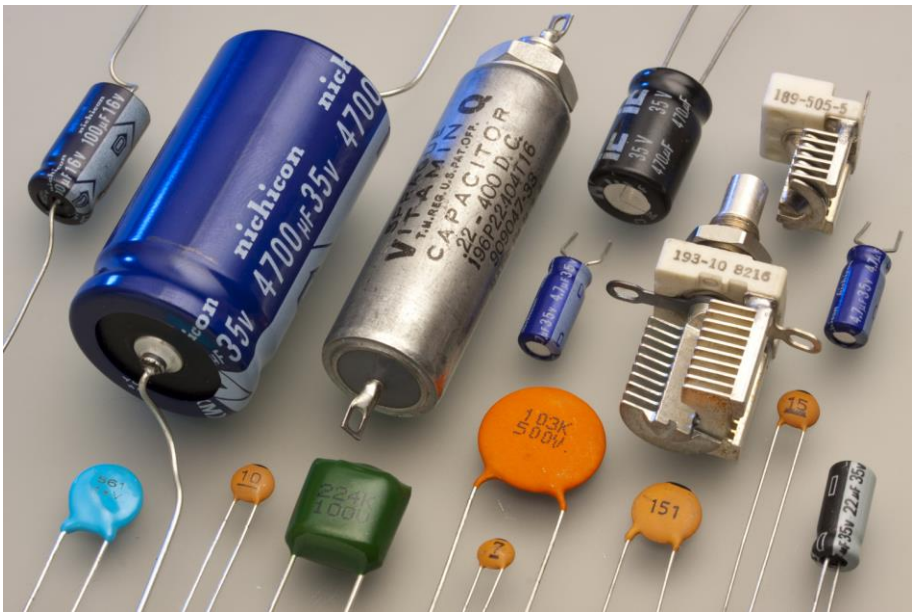

Figure 2: Various Capacitors

Circuit 1:

Figure 3 shows the circuit used for the experiment.

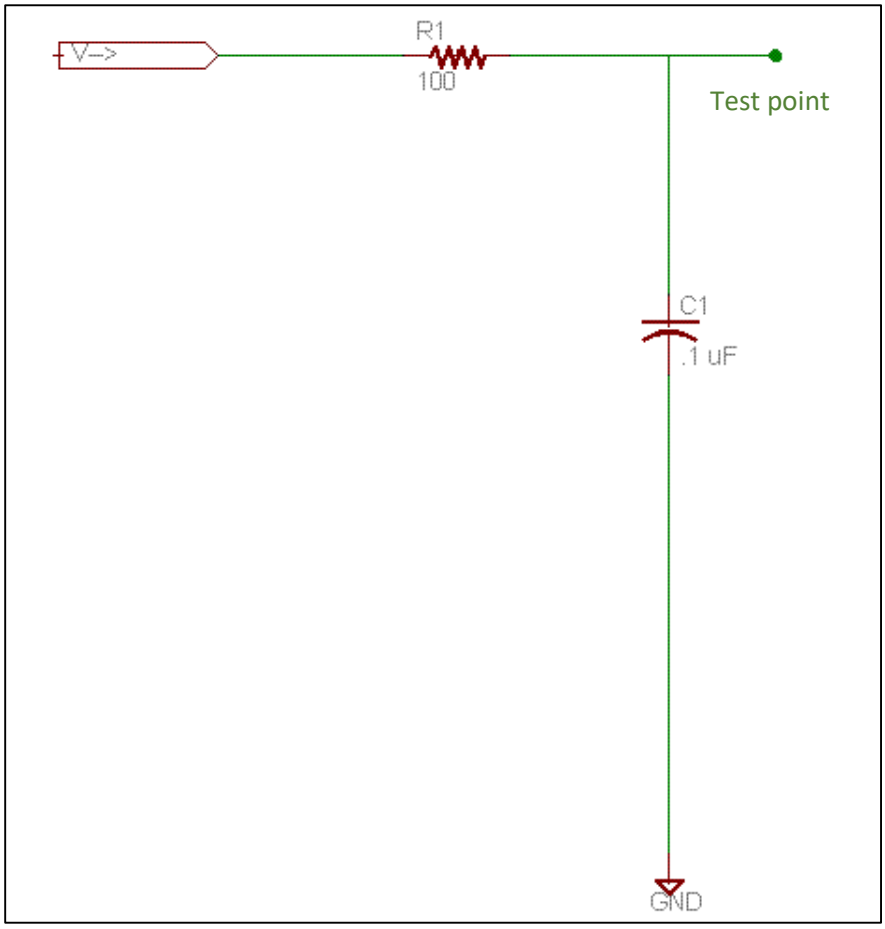

Figure 3

The V_{in} junction was given the supply from the Function Generator on the power supply. After the input from the function generator we connect a 100Ω resistor followed by a .1μF capacitor. One of the input to the oscilloscope was connected to the test point to measure the voltage and phase. The other input was the function generator output. After connecting the circuit, we started changing the input from the function generator to the circuit and noted down the input voltage, output voltage, input frequency, output frequency and the phase.

The Table 1 shows reading for the given circuit

Given Frequency	Input frequency(Hz)	Output frequency(Hz)	Input Voltage(V)	Output Voltage(V)	Phase
1.00	3.74	<10	1.40	1.36	0.00
2.00	4.82	<10	1.40	1.36	-1.04
4.00	6.69	<10	1.40	1.36	0.00
8.00	10.89	10.97	1.40	1.40	0.78
10.00	11.76	11.78	1.40	1.40	0.85
20.00	47.62	47.64	1.40	1.36	1.72
40.00	67.11	67.16	1.40	1.36	0.00
80.00	109.90	109.70	1.40	1.36	-1.32
100.00	117.20	117.90	1.40	1.40	-2.80
200.00	468.80	489.00	1.36	1.36	-3.53
400.00	665.20	667.02	1.40	1.36	-4.20
800.00	1103.00	1103.00	1.36	1.36	-7.60
1000.00	3740.00	3750.00	1.24	1.12	-25.20
2000.00	4695.00	4680.00	1.25	1.04	-28.60
4000.00	6570.00	6570.00	1.16	0.80	-40.30
8000.00	10930.00	10930.00	1.04	0.60	-58.70
10000.00	38570.00	38640.00	0.96	0.22	-74.50
20000.00	46130.00	46470.00	0.98	0.21	-99.00
40000.00	65140.00	65240.00	0.98	0.16	-118.00
80000.00	102700.00	1720000.00	0.96	0.14	-133.00

Table 1

Figure 4 shows graph for output power(V_{out}/V_{in}) versus frequency

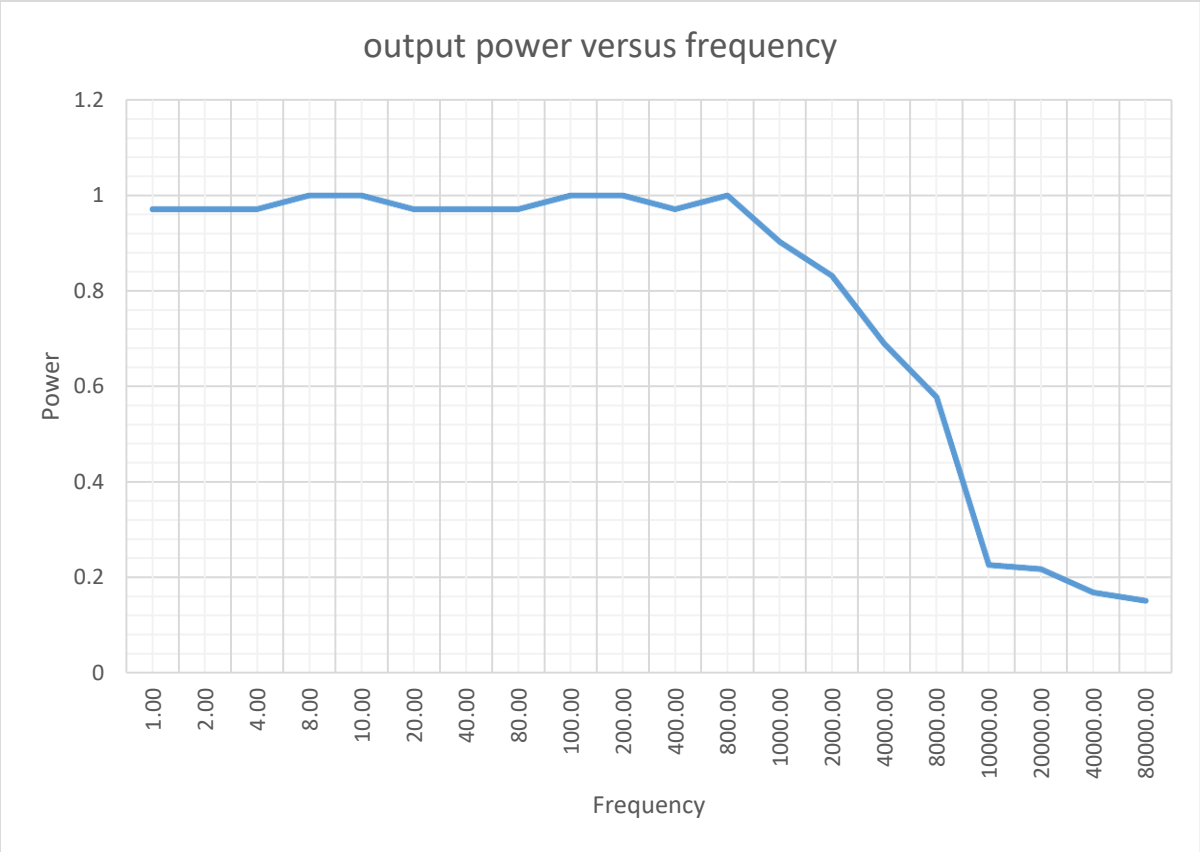

Figure 4

From the graph in Figure 4, the value 3dB down is not seen for any of the frequency values.

Figure 5 shows graph for Output phase versus frequency

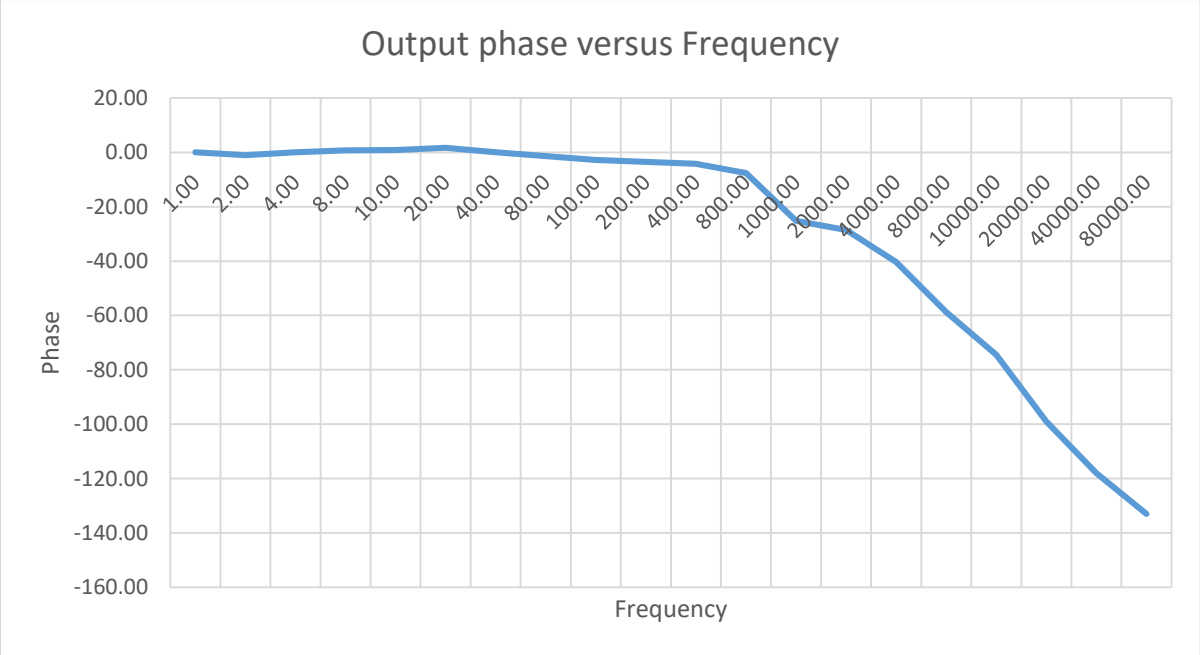

Figure 5

From the graph in Figure 5, the value 3dB down is seen for 200Hz of frequency.

It is observed that in this circuit as the frequency increases the output power(V_{out}/V_{in}) and the phase decreases.

Circuit 2:

Figure 6 shows the circuit used for the experiment

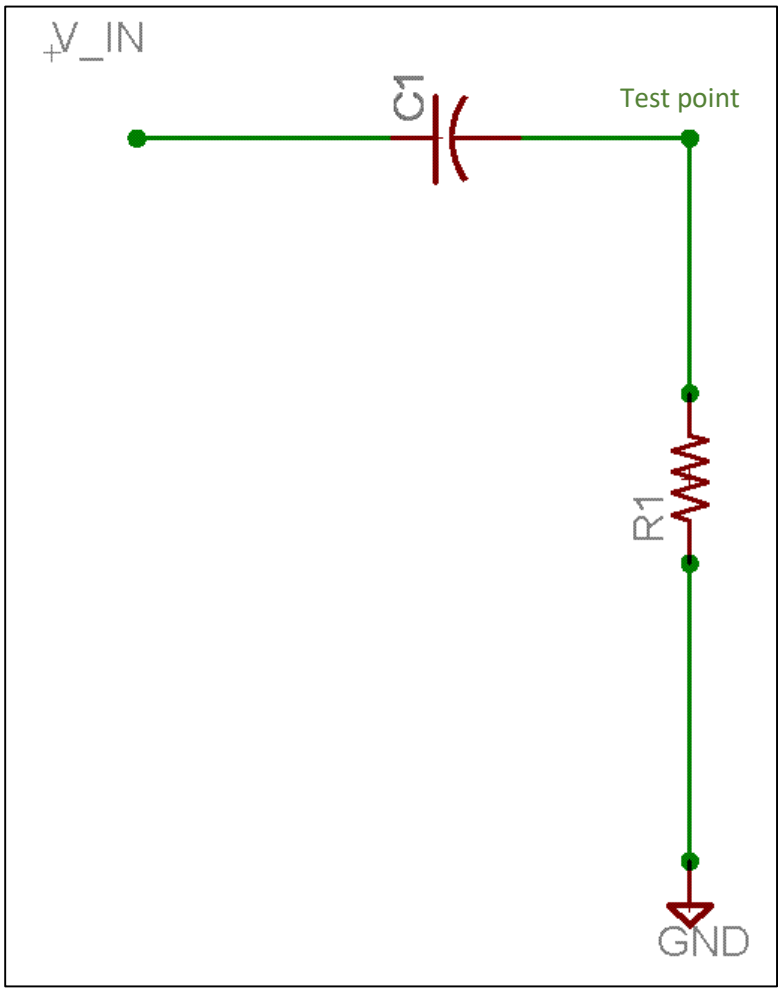

Figure 6

For this experiment we interchange the position of the Resistor and the Capacitor from the previous circuit. The V_{in} junction was given the supply from the Function Generator on the power supply. After the input from the function generator we connect a .1µF capacitor followed by a 100Ω resistor. One of the input to the oscilloscope was connected to the test point to measure the voltage and phase. The other input was the function generator output. After connecting the circuit, we started changing the input from the function generator to the circuit and noted down the input voltage, output voltage, input frequency, output frequency and the phase.

The Table 2 shows reading for the given circuit

Given Frequency	Input frequency(Hz)	Output frequency(Hz)	Input Voltage(V)	Output Voltage(V)	Phase
1	<10	0	1.4	0.08	7
10	39.46	0	1.4	0.08	-8
100	396.97	0	1.36	0.16	5
1000	3950	3950	1.24	0.56	63.8
2000	4760	4710	1.2	0.64	58.67
8000	10930	10960	1.08	0.88	37.67
10000	35940	35590	1.04	1	17.37
20000	46780	46080	1.04	1	8.53
40000	64360	64520	1.04	1	6.86
80000	101740	101500	1.04	1.04	3.64

Table 2

Figure 7 shows graph for V_{out}/V_{in} versus frequency

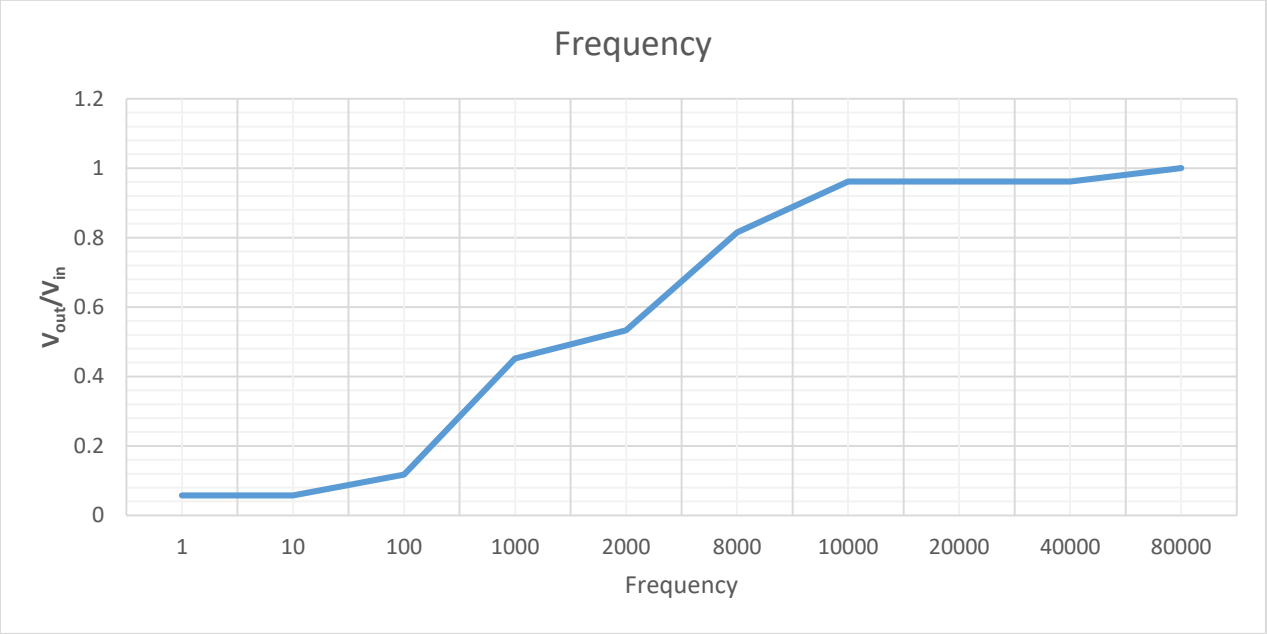

Figure 6

From the graph in Figure 6, the value 3dB down is not seen for any of the frequency values.

Figure 7 shows graph for Output phase versus frequency

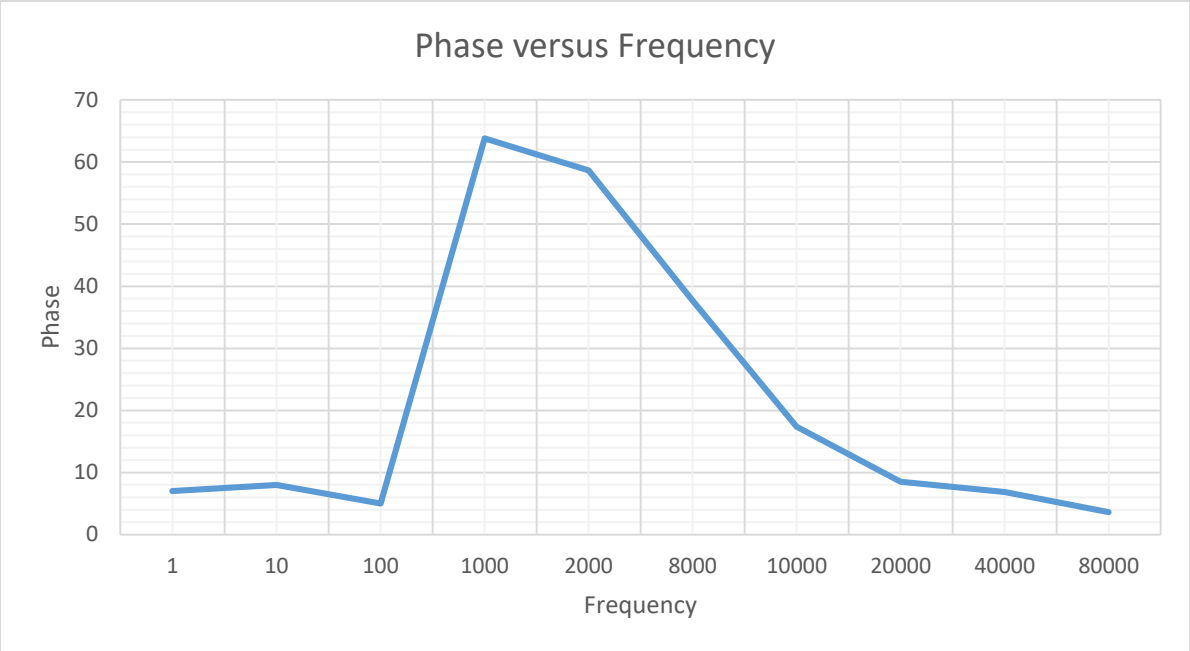

Figure 7

From the graph in Figure 7, the value 3dB down is not seen for any of the frequency values.

It is observed that in this circuit as the frequency increases the V_{out}/V_{in} also increases; the phase increases to certain frequency and then starts decreasing.

References:

- http://computersystemsartists.net/spring16/csc7011/assign/lab2/lab2.htm
- https://www.google.com/webhp?sourceid=chrome-instant&rlz=1C1CHZL_enUS689US690&ion=1&espv=2&ie=UTF-8#q=capacitor+in+layman%27s+terms
- https://en.wikipedia.org/wiki/Oscilloscope
- Digital Design and Computer Architecture by David Harris and Sarah Harris