ECSE 331: Electronics

Laboratory Report

Laboratory Experiment # 1

Measurements Using The NI Elvis-II+$^{+}$Test Instrument

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Abstract

The purpose of laboratory experiment number 1, was to explore the different capabilities of the NI Elvis-II$^+$ test instrument and to familiarize with the various instruments that it contains. In this experiment, the DMM, the Oscilloscope, the Function Generator and the Bode Analyzer were used amongst others to study the properties of DC currents, Sinusoidal and Square signals, in parallel RC circuits. The results showed that the 1micro Farad capacitor placed in parallel with the 10K ohm load resistor acted as a low pass filter, cutting/ "killing" the signal for high frequencies

I. Introduction

The goal of this laboratory was to use, test and explore the measurement capabilities of the NI Elvis-II+ test instrument. The laboratory consisted in the first part with DC measurements using the DMM feature on the instrument (Figure 1). The DC voltage at the output terminal of the circuit was first measured with the DMM. Then the Oscilloscope was used to measure that same voltage and its peak-peak voltage due to background noise and other errors.

In the second part of the lab, sinusoidal signals and square signals were measured at different frequencies and their behaviors were analyzed. The data showed that the 1uF capacitor placed in parallel with the load resistor created a low-pass filter, effectively blocking signals whose frequency were larger than the cut-off frequency.

In the third part of the lab, sinusoidal and square signals were again analyzed at different frequencies, and in this case, their bode plots were drawn, using the bode plot analyzer of the NI Elvis-II instrument. Again, this proved the results of part two were accurate. In the fourth and last part, the I.V characteristics of a simple 10Kohm resistor was tested using the 2 wire I.V analyzer of the NI Elvis-II test instrument.

II. Main body

We conducted a number of experiments on the NI Elvis II to get to know its capabilities and different functions.

I. DC Measurements: Use the DMM Features and Oscilloscope
II. AC Measurements: Use the Function Generator and Oscilloscope Features
III. AC Measurements: Use the Bode Analyzer
IV. DC Measurement: Use 2 wire I.V Analyzer

Part I. DC Measurements of the Vo using the DMM

DC voltage calculated with the DMM, at Vo= 7.80v

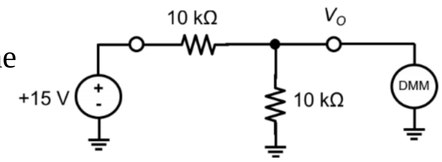


Fig 1. Circuit built in the experiment

Part I. DC measurement of the Vo using the Oscilloscope

DC voltage of Vo calculated with the Oscilloscope, Vo=7.775v

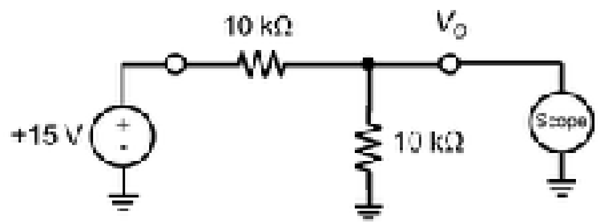


Fig 2. Circuit with Oscilloscope

Vrms= 7.775

$V_{p\text{-}p}$= 83.32mV

The voltage applied is DC voltage, so It should be fixed, but there is a bit of Oscillation due to the noise that the Oscilloscope encounters.

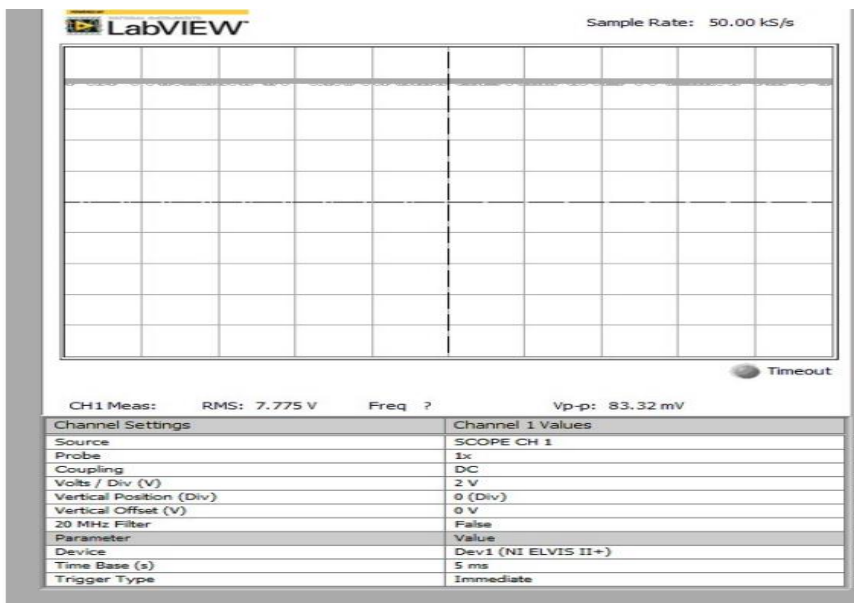


Fig 3. Graph of Vo over time from oscilloscope

Part II. AC Measurements using Oscilloscope with only resistors

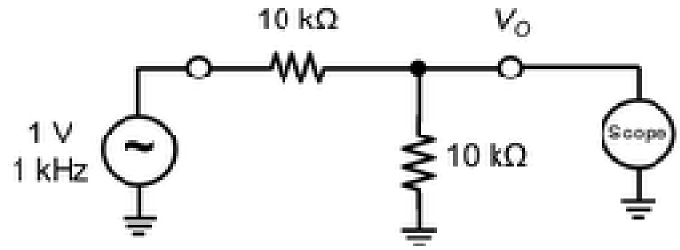


Fig 3. Circuit diagram with Oscilloscope

Vrms= 0.352Volts (for the output)

Amplitude = 0.50V

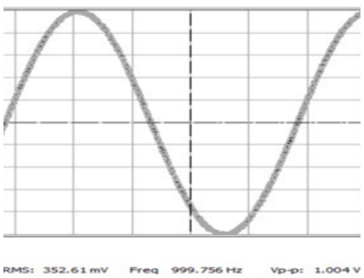


Fig 4. Graph of the output of the sinusoidal signal

Part II. AC Measurements with capacitor in parallel with the resistor and varying frequencies

V_{in} was sinusoidal wave with amplitude 1Volt,

The frequency was varied from 1 to 5KHz

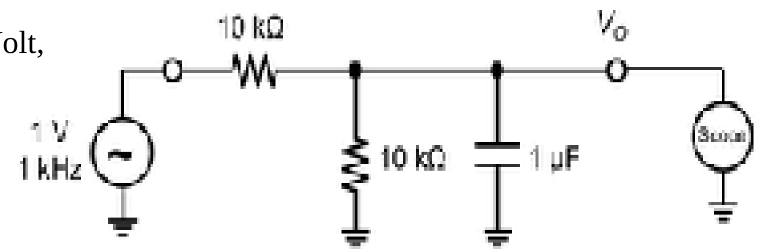


Fig 5. Circuit diagram with Capacitor

Gain in dB= 20log (Vo/Vin)

Table 1. V_{rms} and V_{p-p} at Different frequencies

Frequency of signal	Vrms	V_{p-p}
1KHz	14,26mV	79.15mV
2KHz	9.76mV	54.16mV
3KHz	8.54mV	49.99mV
4KHz	8.07mV	54.16mV
5KHz	7.87mV	45.82mV

Graph of gain vs frequency given on page number 5!

Negative gain in dB means that the signal wasn't amplified. In fact, because the frequencies used were so high, the signals were almost dead. Because of the low pass filter formed thanks to the capacitor.

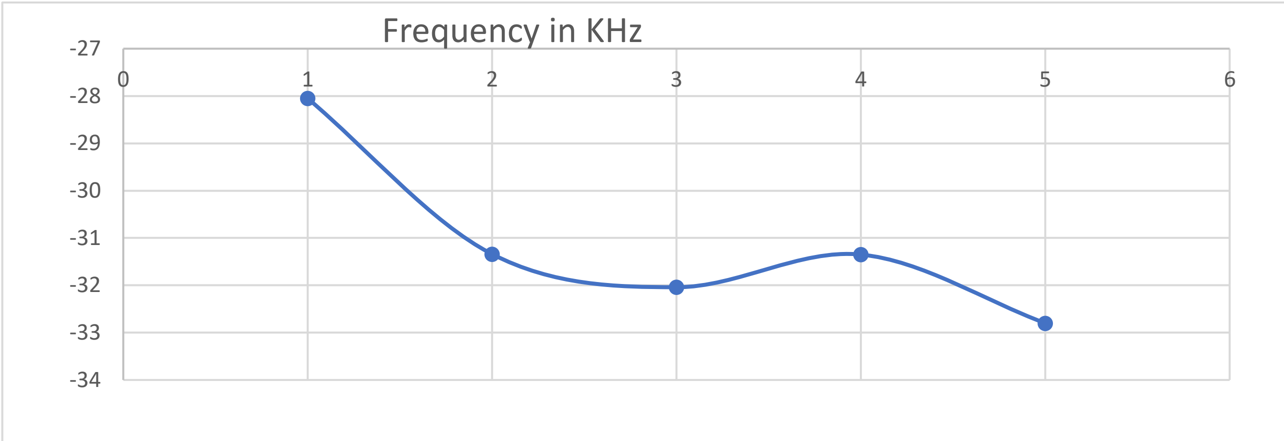


Fig 6. Graph of Gain vs Frequency for Sinusoidal signal(in KHz)

Part II. AC Measurements with the square function

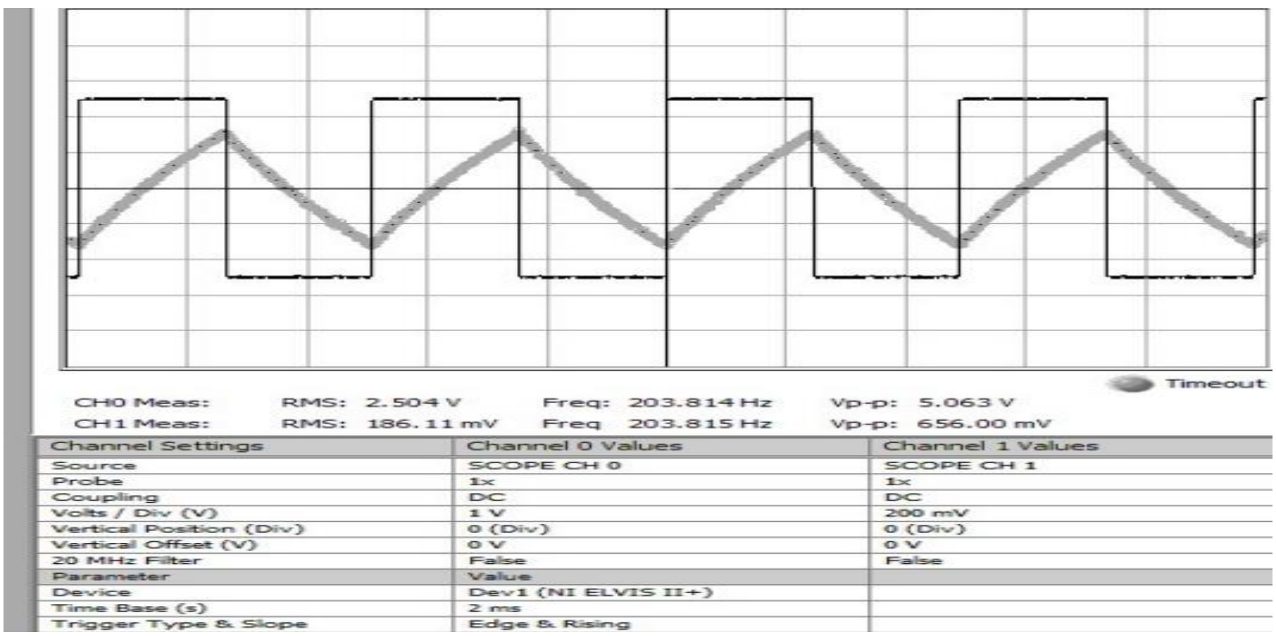


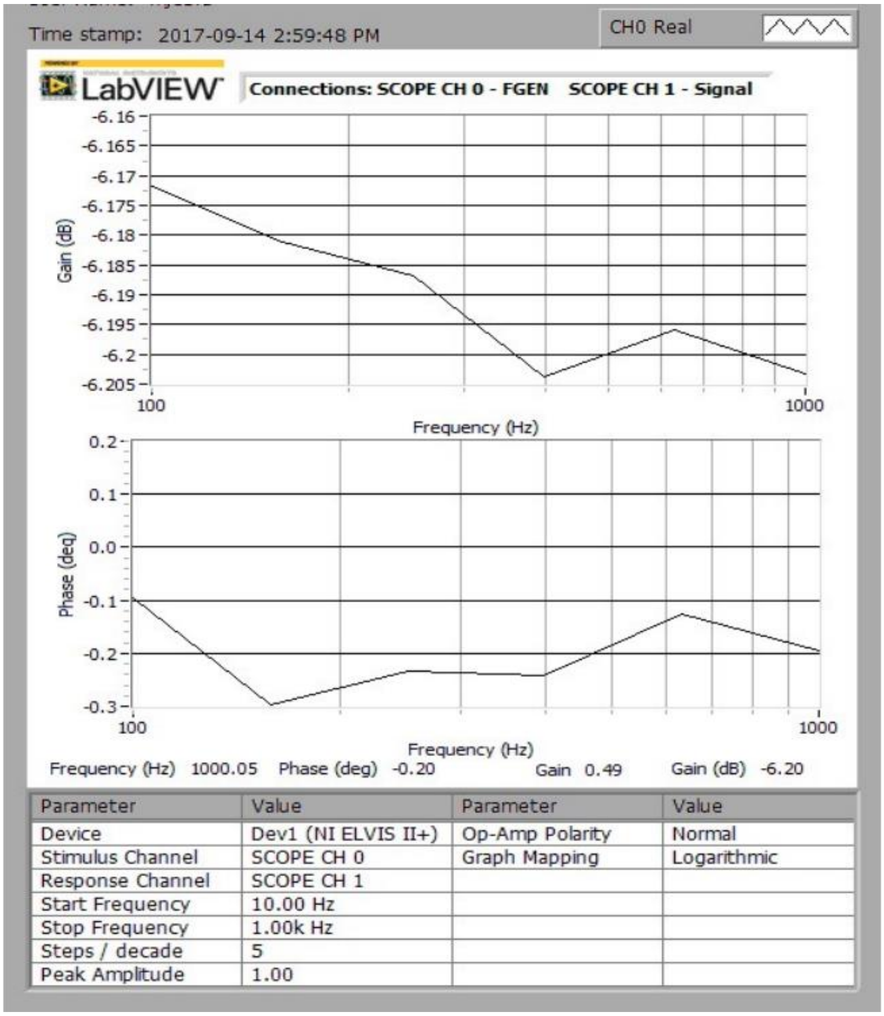
Fig 7. Graph of Vo and Vin for the Square wave taken with oscilloscope

This graph taken from the Oscilloscope of the NI Elvis II test instrument shows the out and input of a signal. In this case, it's a square signal with peak of 5volts, so it goes from 0 to 5 volts. As we can see at the output the Vrms and Vp-p are greatly diminished thanks in part by voltage division but also because of the low pass filter that the capacitor forms, effetely decreasing the gain, up until a point where the gain decrease dramatically when the frequency reaches the cut-off frequency.

The time constant per the data from the oscilloscope is 70n seconds.

Part III. AC Measurements using the Bode Analyzer

1.Bode analysis for circuit without the capacitor



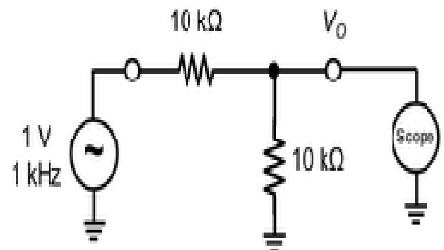


Fig 9. Circuit diagram without capacitor

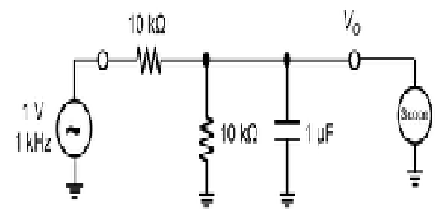


Fig 10. Circuit with capacitor

Fig 8. Bode analysis for circuit with series resistor and no capacitor

We can observe that the gain stabilizes somewhere towards -6.2dB because there are only resistors, and voltage division happens, thus negative gain. It stabilizes once voltage division is complete and the varying frequency has really no impact on the gain. It corresponds to a Vo=2.5v, which is what voltage division gives, and this agrees with the data from the oscilloscope in the previous part.

2. Bode analysis for circuit with capacitor in parallel with resistor

In the circuit where the capacitor is present, we can see that the gain keeps going down, meaning it keeps decreasing, because the capacitor acts a low-pass filter. With increasing frequency, the gain goes down, and this is in complete agreement with the data previously collected with the help of the oscilloscope.

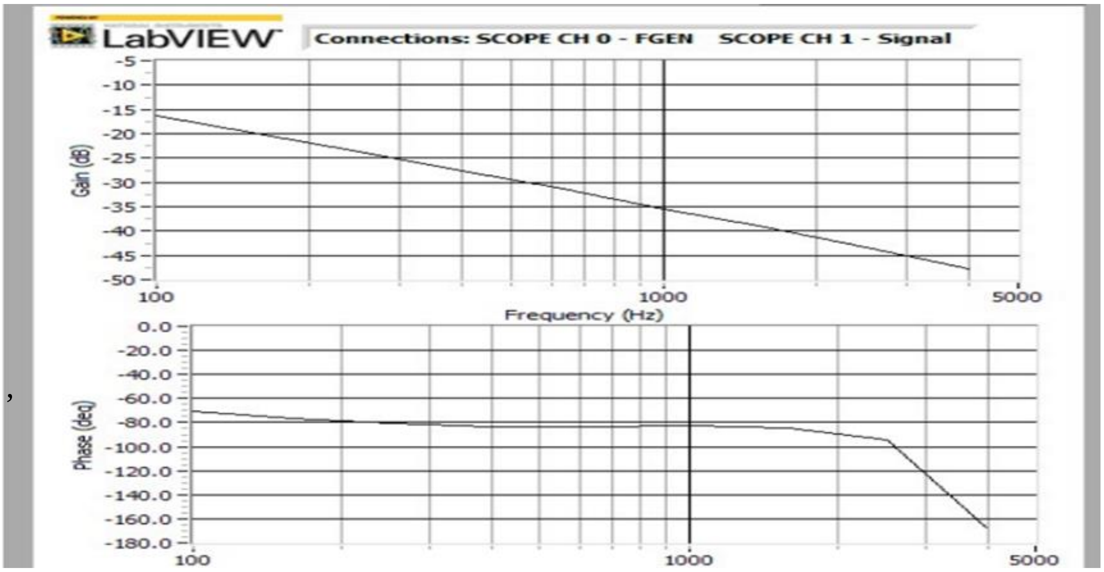


Fig 11. Bode plot for circuit with capacitor, low-pass filter

<u>PART IV. DC Measurements: I.V characteristics of the Resistor using the two wire I.V Analyzer</u>

Slope of the I.V curve is (i2-i1)/(4)

<u>Slope=(0.17--0.23)/4000=0.0001</u>

(R=4000/0.4=10000ohms)

The I.V curve doesn't pass exactly over origin because in real life there are factors that contribute to error.

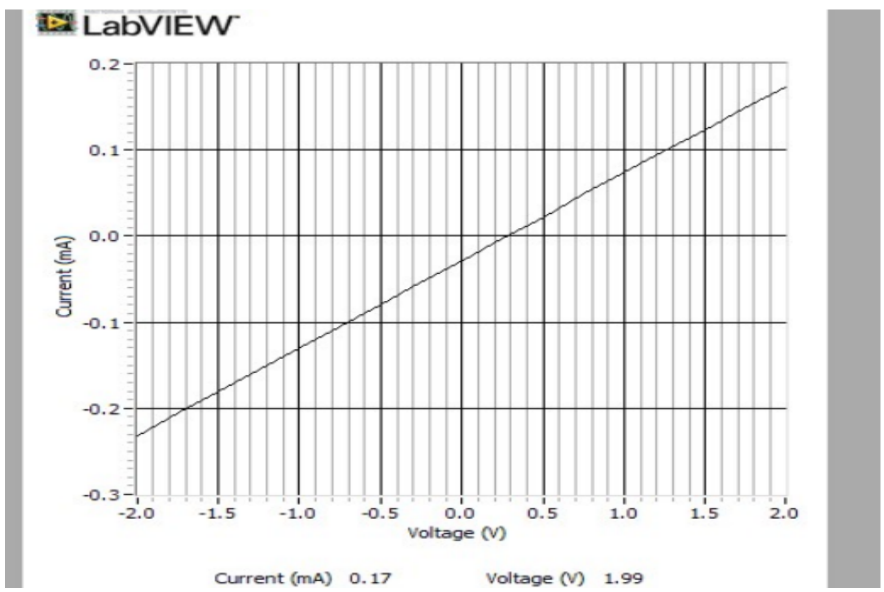


Fig 12. I.V plot for a 10Kohm Resistor using 2 wire I.V analyzer

Conclusion

To conclude, this lab was very helpful in preparing the students for future labs by familiarizing the students with the different components and functions of NI Elvis-II Test Instrument. It showed that with the help of a computer, a lot of signals can be processed and analyzed along with their circuits.

In this lab, it was also shown that, a capacitor in parallel with a load resistor creates a low-pass filter, which subsequently blocks off signals with a certain frequency that is higher then the cut-off frequency.