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ECSE 331 Electronics

Laboratory No. 1:

Measurements Using the NI Elvis II++ Test Instrument

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Measurements Using the NI Elvis-II+ Test

***Abstract*—The purpose of this laboratory is to explore the different measurement capabilities of the NI Elvis-II+ test instrument and to familiarize with the various instruments that it contains. In this experiment, the DMM, Oscilloscope, Function Generator, and Bode Analyzer were applied to conduct a study of the properties and behaviors of DC circuits and AC signals (sinusoidal and square) in parallel RC circuits.**

Result: The measurements indicated that the experiment was conducted adequately and successfully.

***Index Terms*—Electronics, NI Elvis-II+**

I. Introduction

THE laboratory consisted of four parts.

In the first part, DC voltage at the output terminal of the voltage-divider circuit was first measured with the DMM. The Oscilloscope was used to measure that same voltage averageand its peak-peak value due to background noise and other errors.

In the second part, a sinusoidal signal was generated by the instrument launcher and applied to the same circuit in part 1. The amplitude of its output voltage was measured. The circuit was later modified to an RC circuit and its gain was measured at various frequencies and their behaviors were analyzed. Additionally, the sinusoidal input waves were replaced by square signals and the corresponding output signals were measured.

In the third part, the 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 instead of function generator. This is to verify the accuracy of the results from part two.

In the fourth and last part, the I.V characteristics of a simple 10kΩ resistor was tested using the 2 wire I.V analyzer of the NI Elvis-II+ test instrument.

[1] Experiment was conducted in the laboratory section of course ECSE 331 offered at McGill University.

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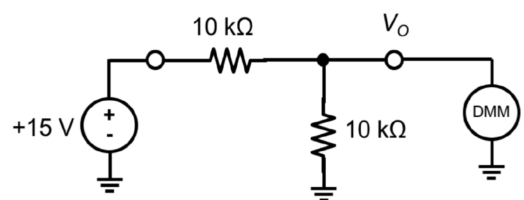
II. Experiment Procedures and Analysis

National Instruments Educational Laboratory Virtual Instrumentation Suite (NI ELVIS-II+) is a hands-on design and prototyping platform that integrates the 12 most commonly used instruments – including oscilloscope, digital multimeter, function generator, bode analyzer, and more. It was the core simulation and measurement tool for this laboratory. Its functions and usage are familiarized in the beginning of the experiment. The plots of measurements shown below are generated by NI Elvis-II+ test instrument.

A. Part 1: DC Measurements of the Vo using the DMM

In the following circuit, the voltage at point V_o was measured by DMM.



Result: DC voltage calculated with the DMM, at Vo= 7.80V

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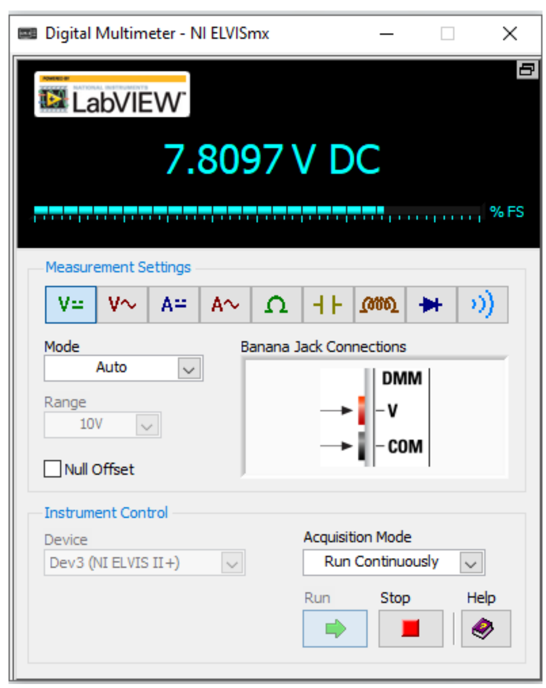
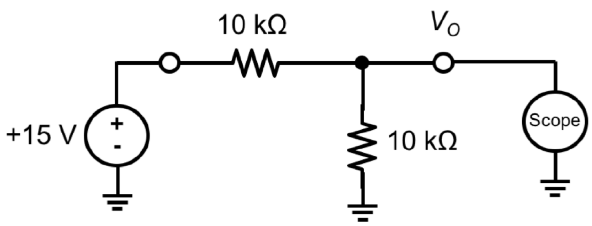
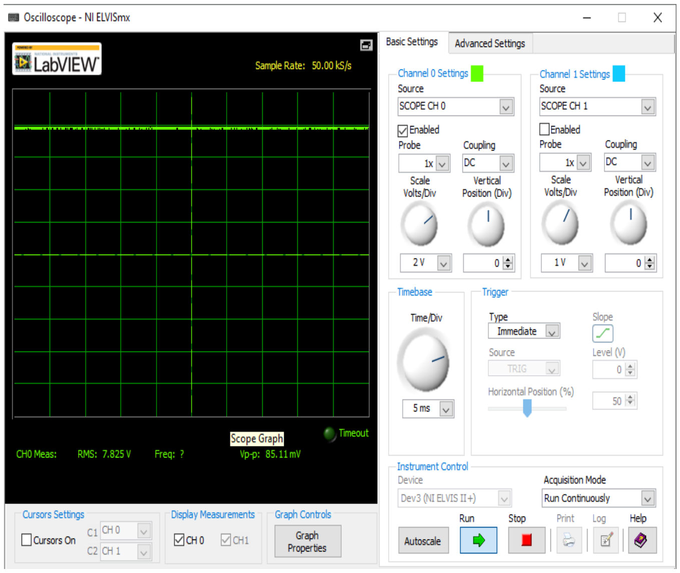


Additionally, the DMM in the circuit was replaced by the Oscilloscope as shown below.



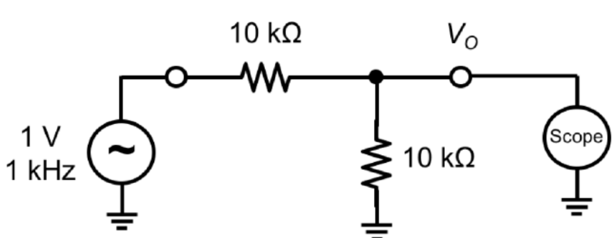


The measuring result, as appeared in the above oscilloscope output, is as following:

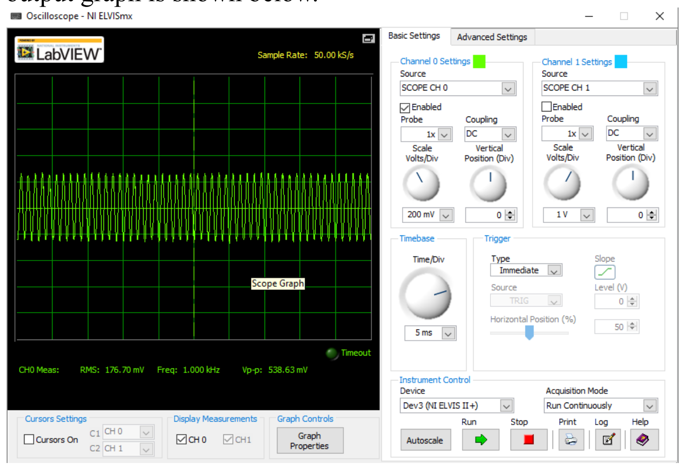
V_o	7.825V
V_{rms}	7.825V
$V_{p\text{-}p}$	85.11mV

It is believed that the reason behind the measurement differences is the noise that Oscilloscope encounters.

B.Part 2: AC Measurements using Oscilloscope with resistors and capacitors

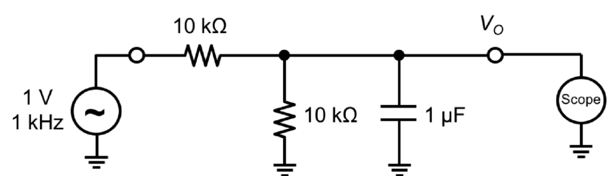


In the circuit presented above, the output is measured by the Oscilloscope while the input is set up to be 1 V peak, 1 kHz sinusoidal signal. The measurement result and the sinusoidal output graph is shown below.



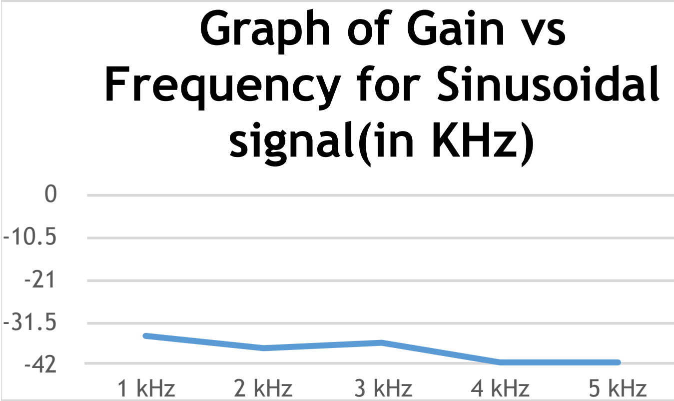
V_{rms}	0.1767V
Amplitude	269 mV

Next, a 1 μF capacitor is placed across the grounded 10-kΩ resistor and the amplitude of the signal at the output was measured.

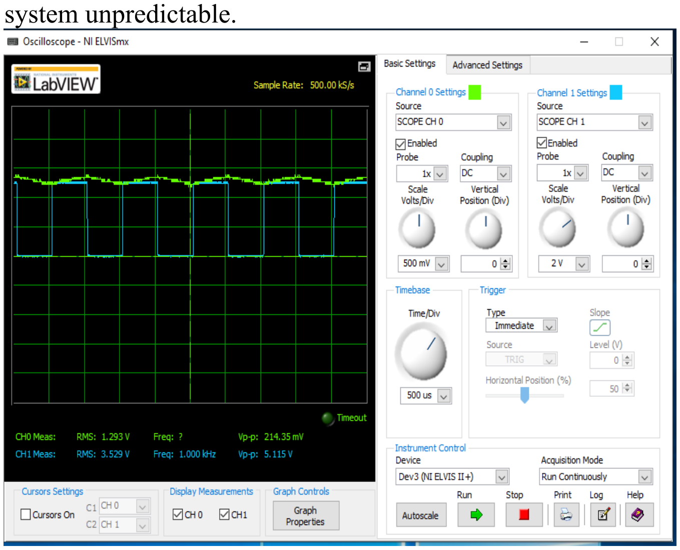


As the input frequency was increased from 1kHz to 5 kHz with 1 kHz increment each time, the following result was obtained.

Frequency of Signal	V_{rms}	$V_{p\text{-}p}$	Gain (dB) = 20log (Vo/Vin)
1 kHz	7.62 mV	37.59 mV	-34.8945499
2 kHz	7.37 mV	25.36 mV	-37.9376149
3 kHz	7.34 mV	29.59 mV	-36.5977006
4 kHz	7.09 mV	16.91 mV	-41.4577278
5 kHz	6.84 mV	16.91 mV	-41.4577278



Here, the negative gain value means that the signal wasn't amplified. When the input frequency reached 4kHz to 5 kHz, since the signal frequency is significantly high, the amplifier system stopped responding to the such increase. It is believed that the irregular case of high frequency input makes the system unpredictable.



This graph is taken in the scenario that a square signal with peak of 5 volts is input.

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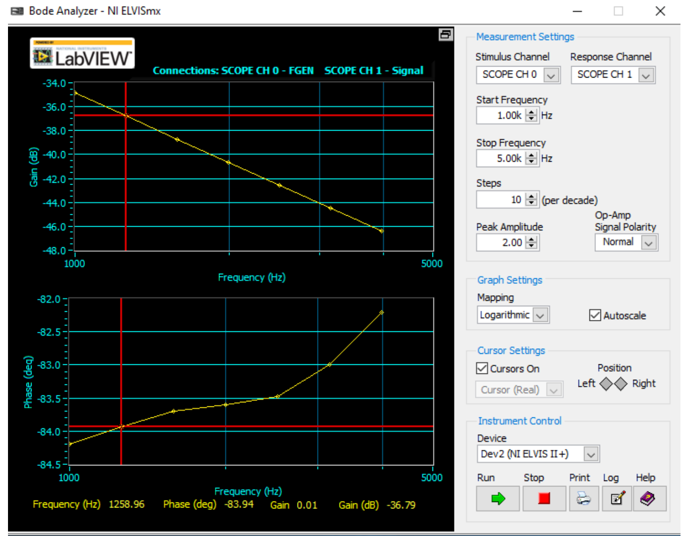
The time constant per the data from the oscilloscope is 0.02 seconds.

C.Part 3: AC Measurements of using the Bode Analyzer

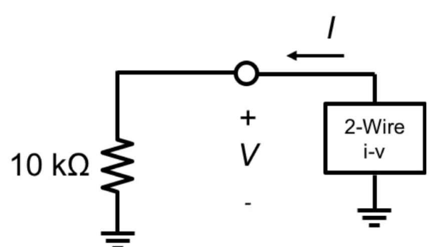
In this part we use Bode Analyzer to replace both function generator and the oscilloscope to repeat the process in part 2. Here are the results we obtained.



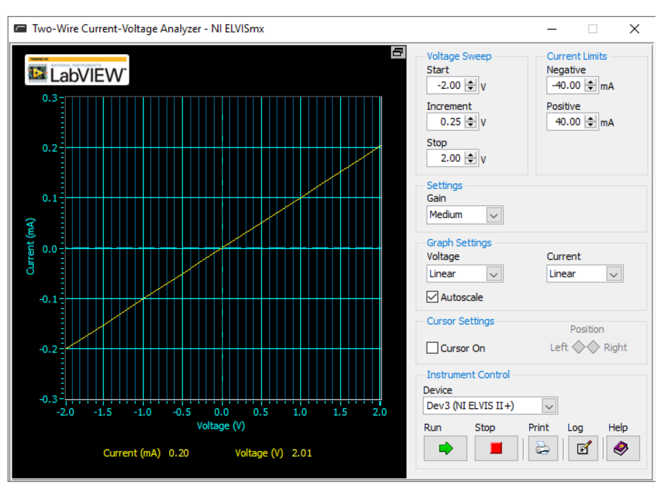
From this graph we observe that the gain decreases with a constant slope as the frequency increases logarithmic; the phase is increasing when the frequency is set between 1000Hz and 5000Hz. Each value of gain we get from the Bode Analyzer is a bit lower than we compute from the previous part of experiment; however, the overall tendency matches.

D.Part 4: DC Transfer Curve Measurements of using the 2-wire i-v Analyzer

During this section of the experiment, we reconstructed the circuit by connecting the 10 K ohms resister with a 2-wire i-v analyzer as shown below



Circuit with the instrument attached we have the following result



As we can see from this graph the relationship between the current and voltage is linear, and the slope of the graph is 10K which is equal to the value of the resistance of the resistor. The graph intercepts the i-v axis simultaneously at point (0,0).

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III. Conclusion

In conclusion, the usage of various tools of NI Elvis-II+ Test Instrument is familiarized.

For DC or AC conditions, analyzing the behaviour of output signals becomes straight forward.

As for further improvement, it is believed that more accurate results with smaller error may be achieved by increasing the number of times conducting each experiment.