Lab 1: Introduction to Electrical Measurements

ECEN 214 - 517

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Due Date: September 9, 2020

Procedure

Task 1: DC Voltage Measurement

In the first task of this lab, we utilized a household battery of 1.5V and measured its voltage. This part of the lab included connecting the batter to the +/- ends of the half-size breadboard. The voltage was determined by the voltmeter and we recorded the reading and noted whether the reading was close if not exactly 1.5V.

Task 2: AC Voltage Measurement

The second task of this lab required us to use a Wave generator in the PMD to generate an AC Voltage source, however because of the lack of materials, we resorted to using Multisim. In Multisim, we utilized the Agilent function generator (XFG1) and the voltage source and Agilent multimeter (XMM1) to measure the voltage. We set the generator to 2kHz sinusoid with 3V peak-to-peak amplitude and recorded our measurements, and repeated the same steps for 2V and recorded the measurements.

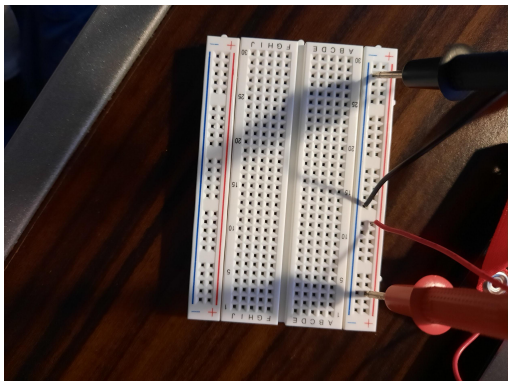
Task 3: Measuring Resistance With a Voltmeter

In the third task of this lab, we calculated the unknown resistor that was randomly selected from the total resistors we were given in our lab kit while using a known resistor and voltage source values. We then proceeded to connect the resistors in series and calculate the voltage across the unknown resistor using the voltmeter. After recording all the values down, we then used the equation given to calculate the unknown resistor.

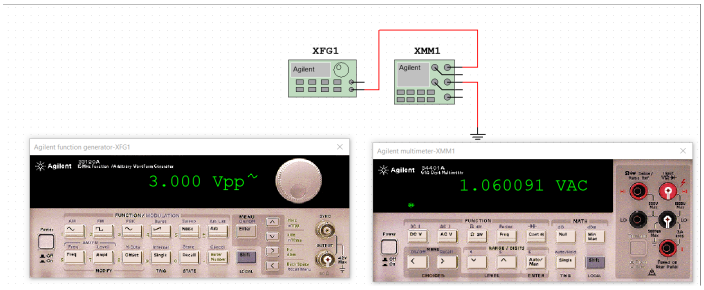
<u>Data Tables</u>

Task 1

Measured voltage: 1.41 V



Task 2



Frequency (kHz)	Peak-to-peak Voltage (V)	Wave type	Measured Voltage (V)
2.00	3.00	sine	1.06009
2.00	2.00	sine	0.70676
2.00	3.00	square	1.5

Task 3

V_{in} = 1.34 V
R_1 = 1 kΩ
V_2 = 0.12 V
Calculated R_2 value: 98.36 Ω
Actual R_2 value: 100 Ω ± 5%

Sample calculations

$$V_2 = V_{in} \frac{R_2}{R_1 + R_2}$$

V_{in} = 1.34 V
R_1 = 1 kΩ, 1000 Ω
V_2 = 0.12 V

$$0.12 = 1.34 \frac{R_2}{1000 + R_2}$$

$$120 + 0.12R_2 = 1.34R_2$$

$$120 = 1.22R_2$$

$$R_2 = 98.36\ \Omega$$

Discussion

In the first part of the lab, the expected value was 1.5 V. However, the actual value measured was closer to 1.41 V. This offset may have been caused by the combined effects of the age of the battery and the quality of the multimeter used. In this case, the battery had been slightly used beforehand.

In the second part of the lab, the measured value for the AC voltage is nowhere near the given peak-to-peak voltage value because the multimeter is displaying the root-mean-square (RMS) value. For the two sine wave measurements, $V_{RMS} = \frac{V_{pp}\sqrt{2}}{4}$, where V_{pp} is the peak-to-peak voltage. Alternatively, this can be written as $V_{RMS} = \frac{V_p\sqrt{2}}{2}$, where V_p is the peak voltage ($V_p = \frac{V_{pp}}{2}$). For the square wave measurement, $V_{RMS} = V_p$, and since $V_{pp} = 3\text{V}$ for this particular measurement, $V_{RMS} = 1.5\text{V}$.

In the third part of the lab, the random resistor used was color-coded brown-black-brown-gold, so its actual resistance is 100 Ω ± 5%. Based on our measurements, the calculated value of R_2 was 98.36 Ω, which is within the tolerance range. In measuring the voltages, some errors may be caused by the age of the battery used and the resistance within the wires themselves.

Conclusion

This lab was used to introduce us to the different parts and familiarize ourselves with using PMD functions such as the function generators or voltmeters, whether the student used Multisim or had the actual parts. Another purpose of this lab was to the propagation of error in order to calculate the uncertainty of any unknowns and even get us comfortable with some calculations. In this lab, we learned not only how to properly use the equipment but also gain an understanding of voltage behavior through a resistor and power source. Overall, the lab instructions were pretty clear and the screenshots were very helpful to follow along.