ECE-LAB-1

I: Cover Page

ECE 101-203

Lab No.5 – Laboratory 5 - Introduction to the Function Generator and Oscilloscope

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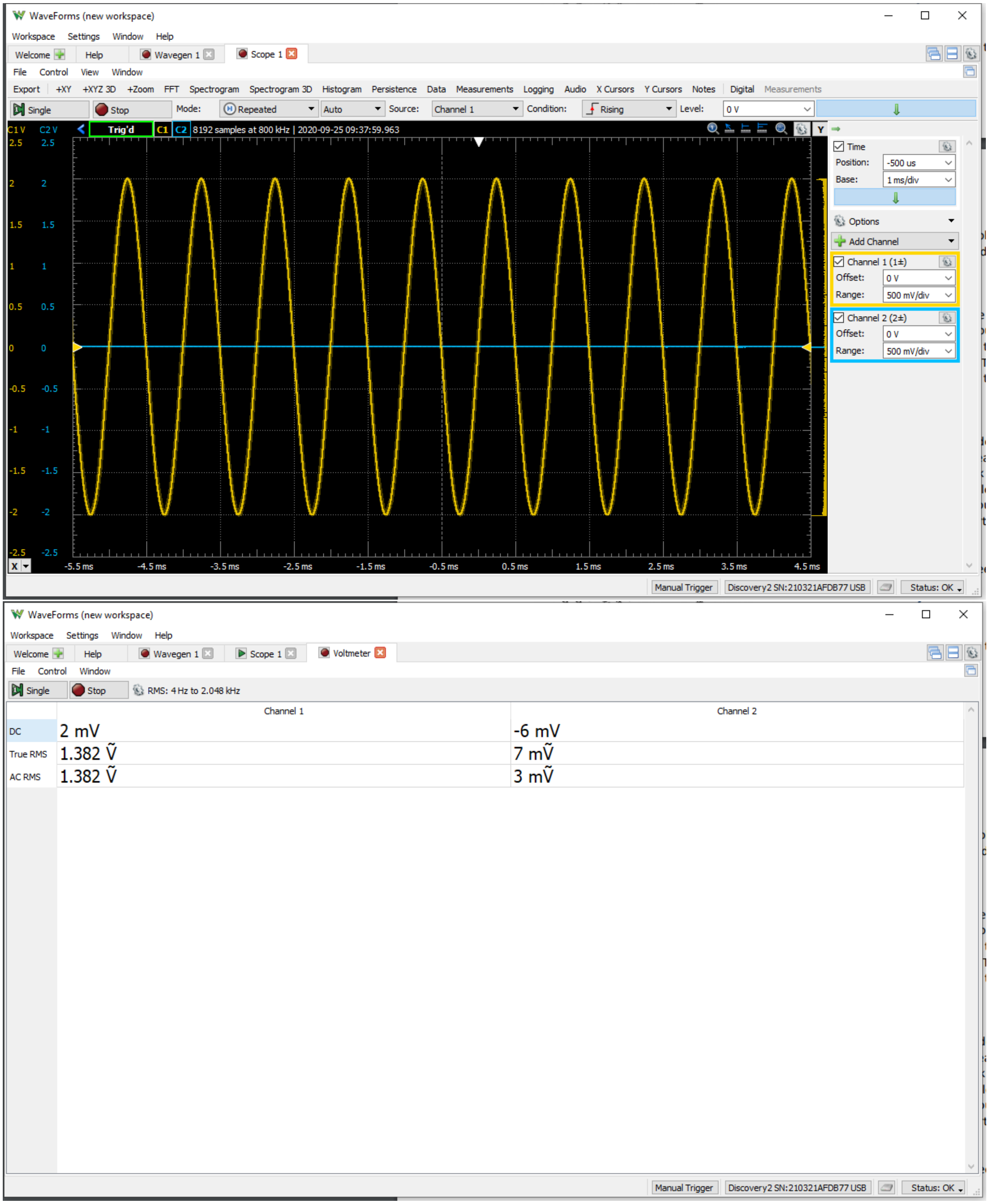
II: Objectives

The purpose of the lab is to learn how to use the function generator to generate sin waves of varying amplitude and frequency and also to learn how to dislplay the generated signals using an oscilloscope. The lab also teaches the about the functionality of LED's.

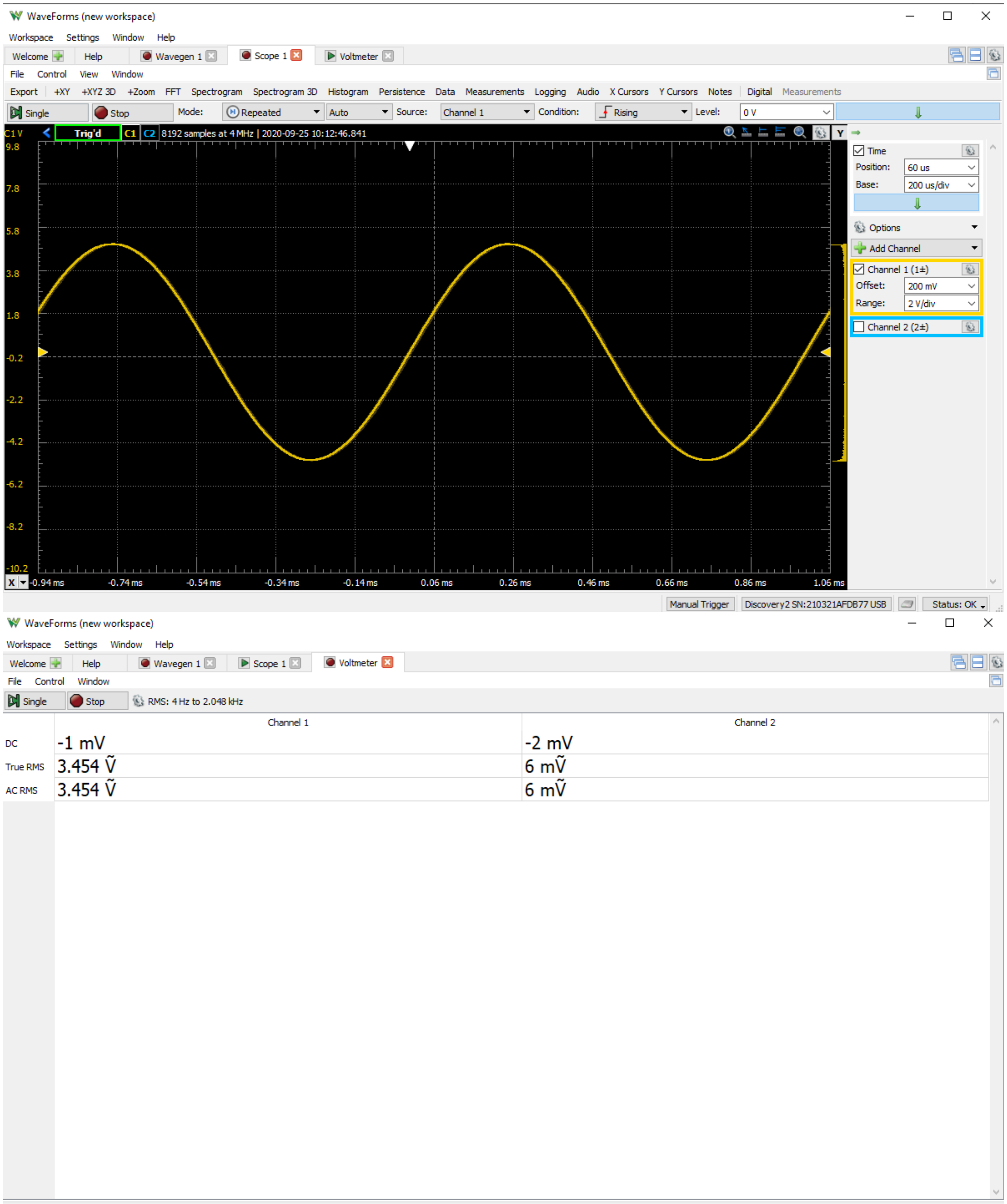
III: Materials and Equipment

- Push button switch
- Brown-Black-Red-Gold resistor(1.0kΩ)
- Red-Black-Brown-Gold Resistor(200Ω)
- 2 LEDs any color
- Analog Discovery 2
- Computer
- Two banana to alligator plug wires (one red one black)
- Multi-meter
- Breadboard
- Wire Jumper

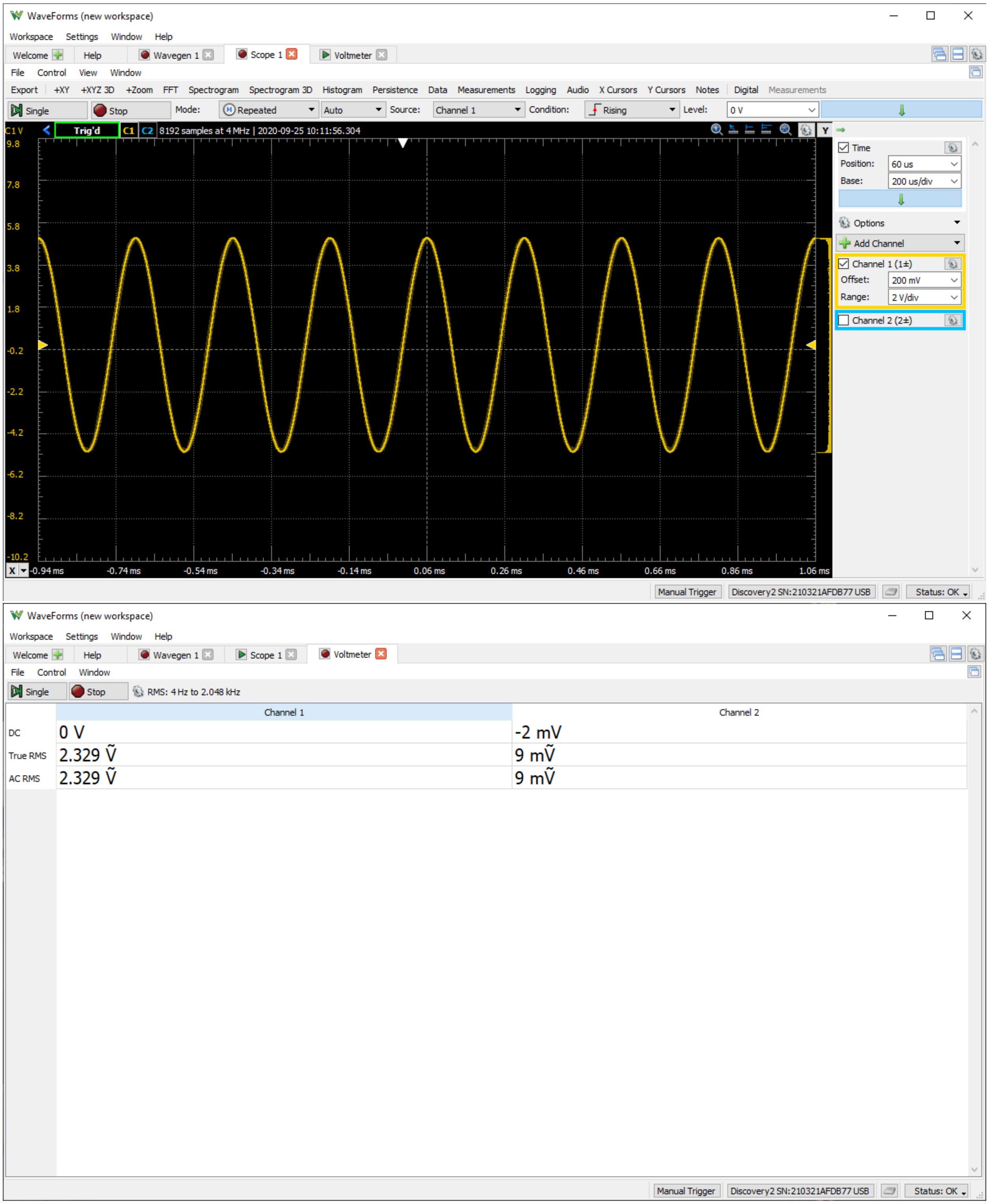
IV: Circuit Simulations



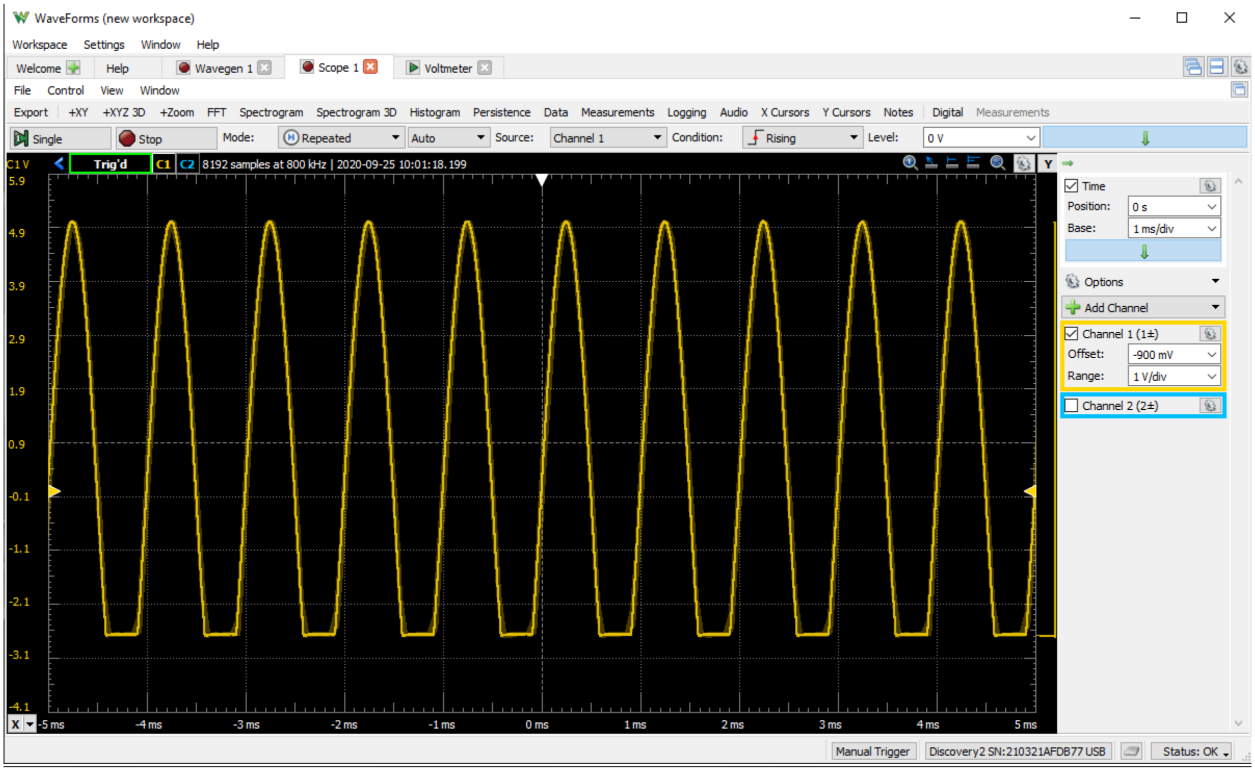
Sine wave and voltage drop across resistor

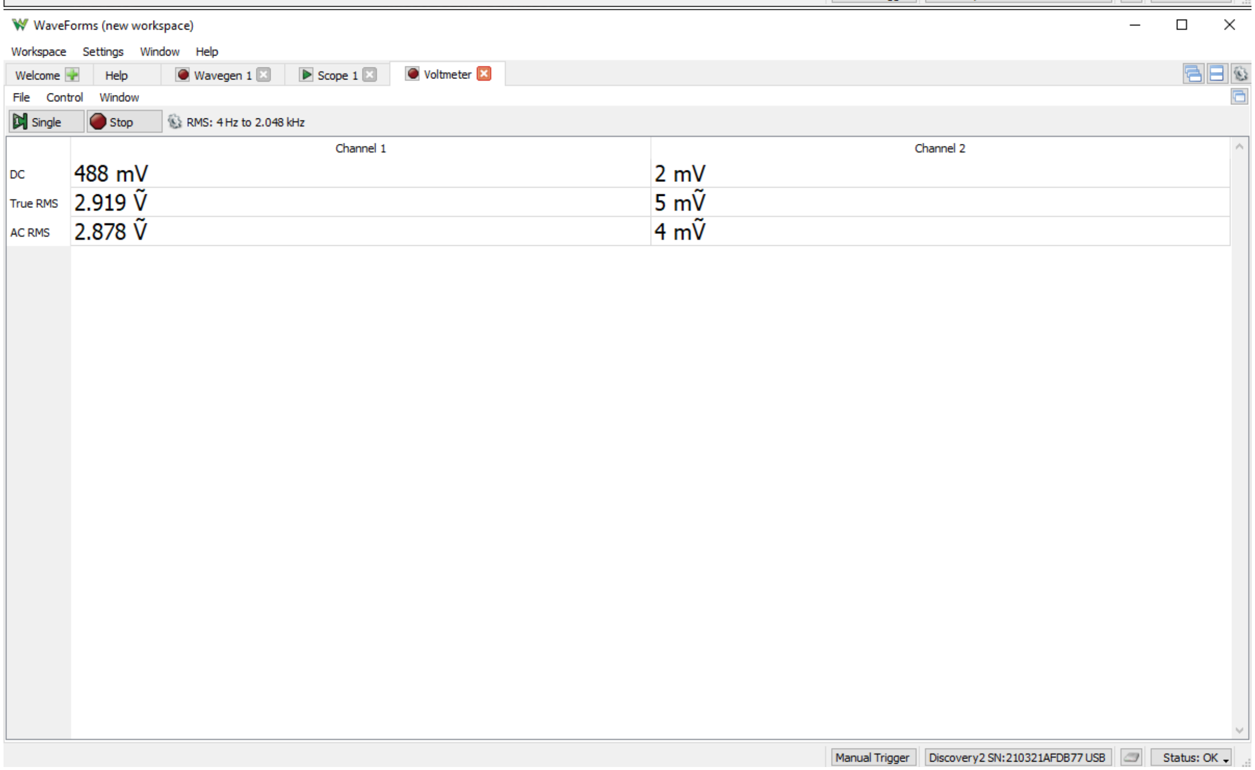


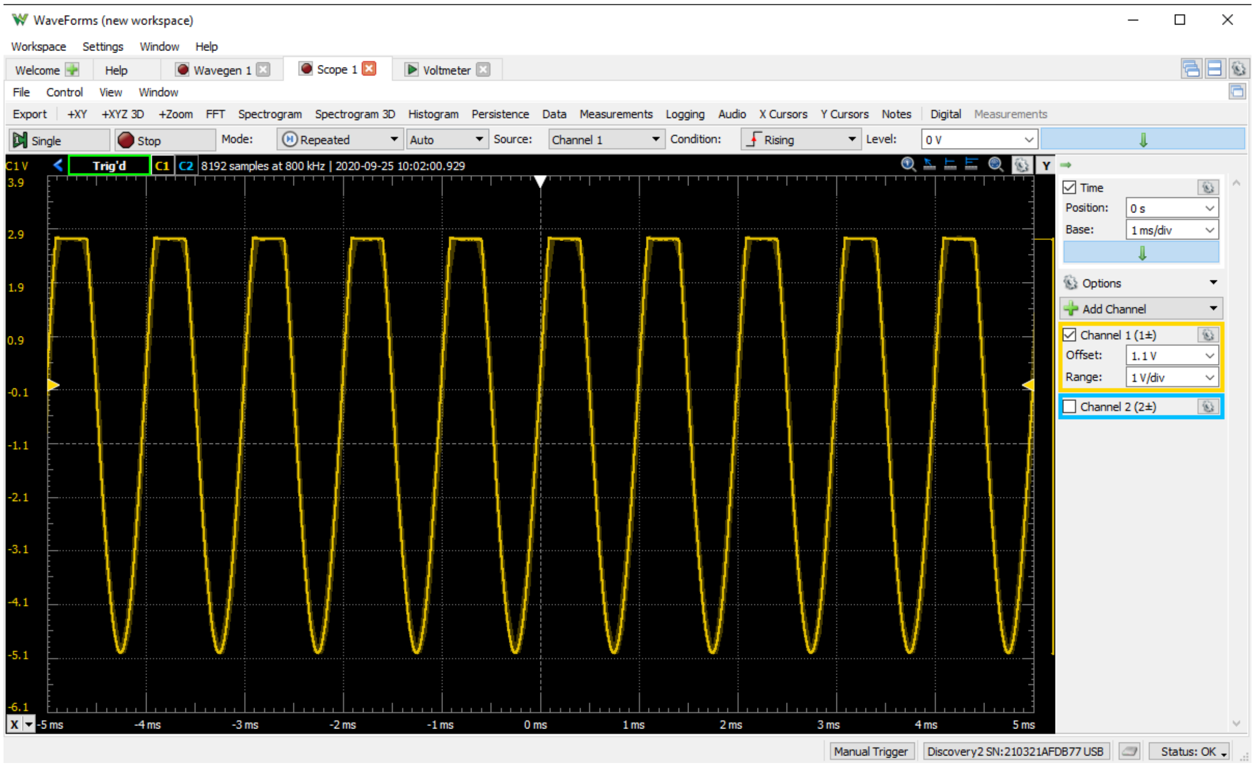
Sine wave with 5 volts being applied and the voltage drop

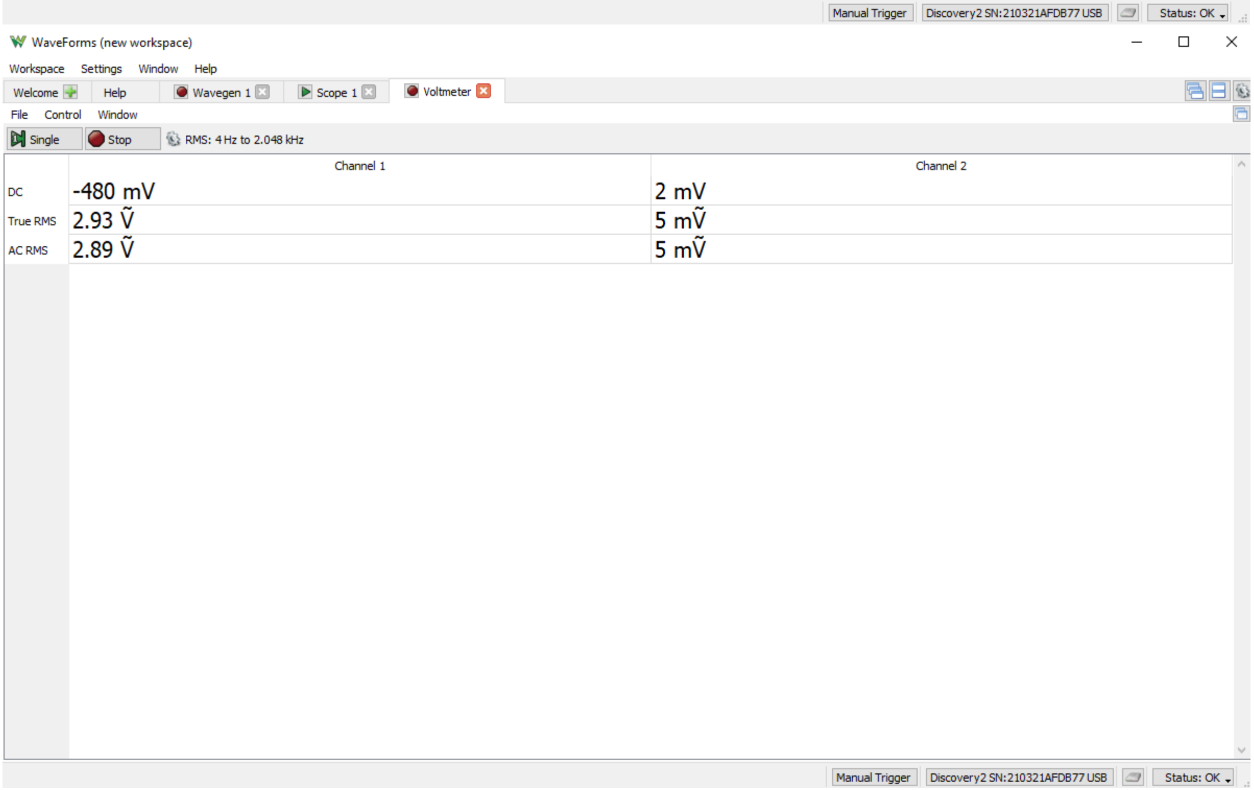


Sine wave with 5 volts and frequency 4KHz being applied and the voltage drop


WaveForms (new workspace)
Workspace Settings Window Help
Welcome Help Wavegen 1 Scope 1 Voltmeter
File Control View Window
Export +XY +XYZ 3D +Zoom FFT Spectrogram Spectrogram 3D Histogram Persistence Data Measurements Logging Audio X Cursors Y Cursors Notes Digital Measurements
Single Stop Mode: Repeated Auto Source: Channel 1 Condition: Rising Level: 0 V
C1 V Trig'd C1 C2 8192 samples at 800 kHz | 2020-09-25 10:01:18.199
5.9
4.9
3.9
2.9
1.9
0.9
-0.1
-1.1
-2.1
-3.1
-4.1
-5 ms -4 ms -3 ms -2 ms -1 ms 0 ms 1 ms 2 ms 3 ms 4 ms 5 ms
Time
Position: 0 s
Base: 1 ms/div
Options
Add Channel
Channel 1 (1±)
Offset: -900 mV
Range: 1 V/div
Channel 2 (2±)
Manual Trigger Discovery2 SN:210321AFDB77 USB Status: OK


WaveForms (new workspace)
Workspace Settings Window Help
Welcome Help Wavegen 1 Scope 1 Voltmeter
File Control Window
Single Stop RMS: 4 Hz to 2.048 kHz
Channel 1
Channel 2
DC 488 mV 2 mV
True RMS 2.919 V 5 mV
AC RMS 2.878 V 4 mV
Manual Trigger Discovery2 SN:210321AFDB77 USB Status: OK





Sine wave with 5 volts and frequency 4KHz being applied and the voltage drop

V: Laboratory Data

Source Voltage	Voltage across LED (V_D)	Current through circuit (I_f)	LED lit? Y/N
0.5 V	498 mV	0 A	N
1.0 V	1v	0 A	N
1.1 V	1.1v	0 A	N
1.2 V	1.2v	0 A	N
1.3 V	1.3v	0 A	N
1.4 V	1.4v	0 A	N
1.5 V	1.5 v	.4 mA	N
1.6 V	1.6v	2.5mA	N
1.7 V	1.696v	15.3 mA	N
1.8 V	1.768v	52.4mA	Y
1.9 V	1.815v	108.3mA	Y
2.0 V	1.847v	173.0 mA	Y
2.5 V	1.935v	1.897 mA	Y
3.0 V	1.989v	4.69 mA	Y
3.5 V	2.033v	6.83 mA	Y
4.0 V	2.072v	8.99 mA	Y
4.5 V	2.109v	11.17 mA	Y
5.0 V	2.145v	13.35 mA	Y

This table displays the experimental data collected from performing part 1 a of the lab. A circuit is built on the breadboard as shown in figure 3.1. There is a multimeter in series with a 200 ohm resistor and forward biased led. A voltmeter is in parallel with the led. The waveforms software is used to pass a voltage of 0.5 volts into the circuit, the voltage drop across the led is then found out using the channels feature of the waveforms software and the data is noted in the table. The multimeter is then used to find the value of the current travelling throught the circuit, which is then also noted in the table. This is repeated multiple times for all given values of the source voltage. It is also noted for all values whether the led is glowing or not.

Source Voltage	Voltage across LED (V_D)	Current through circuit (If)	LED lit? Y/N
0.5 V	0.5 v	0 A	N
1.0 V	1.0 v	0 A	N
1.1 V	1.1 v	0 A	N
1.2 V	1.2 v	0 A	N
1.3 V	1.3 v	0 A	N
1.4 V	1.4 v	0 A	N
1.5 V	1.5 v	0 A	N
1.6 V	1.6 v	0 A	N
1.7 V	1.7 v	0 A	N
1.8 V	1.8 v	0 A	N
1.9 V	1.9 v	0 A	N
2.0 V	2.0 v	0 A	N
2.5 V	2.5 v	0 A	N
3.0 V	3.0 v	0 A	N
3.5 V	3.5 v	0 A	N
4.0 V	4.0 v	0 A	N
4.5 V	4.5 v	0 A	N
5.0 V	~~0~~4.99v	0 A	N

Figure 1:

This table displays the experimental data collected from performing part 1 a of the lab. A circuit is built on the breadboard as shown in figure 3.1. There is a multimeter in series with a 200 ohm resistor and reverse biased led. A voltmeter is in parallel with the led. The waveforms software is used to pass a voltage of 0.5 volts into the circuit, the voltage drop across the led is then found out using the channels feature of the waveforms software and the data is noted in the table. The multimeter is then used to find the value of the current travelling throught the circuit, which is then also noted in the table. This is repeated multiple times for all given values of the source voltage. It is also noted for all values whether the led is glowing or not.

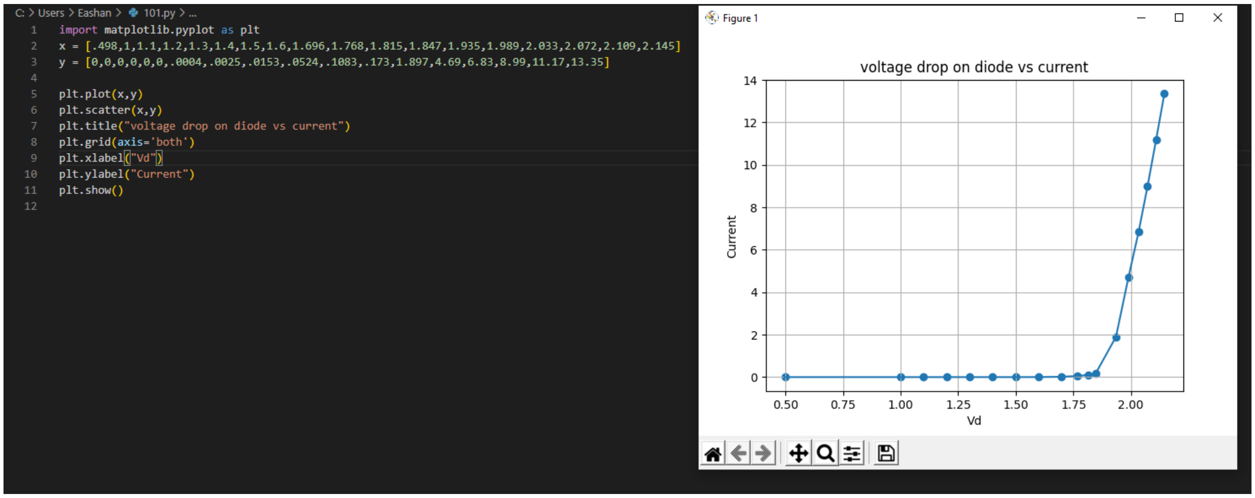
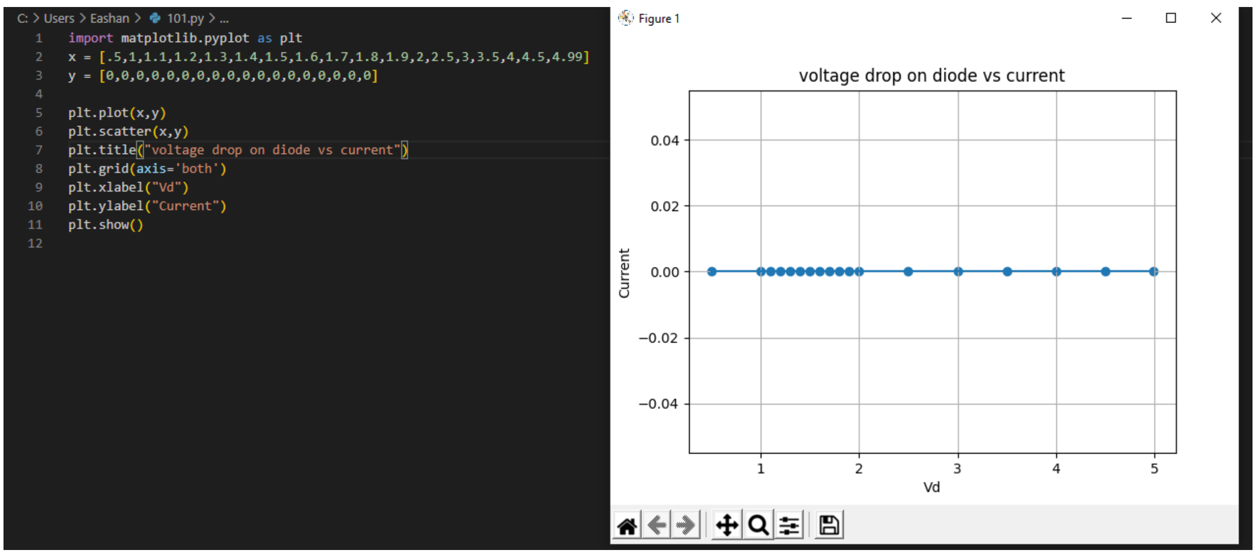


Figure 2:



VI: Theoretical vs Experimental Data

Theoretically it is expected that when the diode is forward biased no current will pass through the circuit till the led starts to glow. The led will glow when the forard voltage of the diode is reached. In our experimental data we can see that as the value for the source voltage keeps increasing till it reaches 1.5 volts the the current is 0 Amps. Once the voltage reaches 1.5v the current starts increasing. This is because the voltage surpasses the max forward voltage of the diode. This is also when the LED starts glowing. In this case the experimental data matches the theoretical data. It was expected that the current would be 0v till the voltage reached the max forward voltage of the diode and that it exactly what happens. In the second case the diode is flipped and turned into a reverse diode. In this case the voltage will be blocked by the diode till it reaches it's breakdown point where it will be broken. The diode doesn't allow current to pass through it from when it's 0.5v to 5v thus stopping all the voltage. This makes the voltage drop across the to be equal to the voltage supplied as long as it's below the breakdown voltage. The current is also expected to be 0. The theoretical data matches the experimental data as the voltage drop across the diode is equal the the source voltage and the current is 0 at all times.

VII: Conclusions and Comments

The theoretical data matches the experimental data which was expected. We were able the verify how a diode works and how a forward based diode will stop the current flow till it's forward voltage is reached and how a reverse based diode will block the current travelling through the circuit till the voltage reaches it's breakdown voltage. We were also able to confirm the functioning of a button/switch and how it stops and allows current to flow.

VIII: Answers to Questions

1. The led is forward biased. The led starts to light up after a source voltage of 1.6 volts.
2. In part 2 the led is reverse biased. No, the led does not light up at all for all voltages.
3. When the led is forward biased it starts to glow once it's forward voltage is reached which in this case is about 1.6 v, whereas in part b when it is in reverse bias the led does not turn on and all the current flow is blocked
4. When the button is pressed the switch is closed and LED1 starts to glow.
5. When the button the measured current is 3.5/1000 which is 3.5 mA approximately. When the switch isn't pressed the current is 0A because the circuit isn't closed
6. When the button is pressed the switch is closed and LED2 starts to glow. Yes it is different from part a.
7. In part a when the button is pressed the current flowing through LED2 is zero because it is in reverse bias with the flow of the current, whereas LED1 is in forward bias with the flow of the current and thus it glows. In part b when the terminals are switched the current starts to flow in the opposite direction, and LED2 is now in forward bias with the current flow whereas LED1 is in reverse bias. This makes LED2 glow and not LED1. Both the LED's do not glow when the button is not pressed.
8. The value of the current is the same in both parts but the direction is reversed. This is because both the resistors have the same value but only the terminals for positive and negative are switched.