COLLEGE OF ENGINEERING AND MINES
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

COURSE CODE	EE F102 F01 (CRN: 34544)		
COURSE NAME	INTRODUCTION TO ELECTRICAL AND COMPUTER ENGINEERING		
SEMESTER	SPRING	**YEAR**	2022
LABORATORY LOCATION	ELIF 331 (ELECTRONICS LAB)		
LAB SESSION DATE AND TIME	MONDAY 31 JAN 2022		
TYPE OF SUBMISSION	LABORATORY REPORT	**NUMBER OF SUBMISSION**	2
TITLE OF SUBMISSION	MEASURING VOLTAGE AND CURRENT		
METHOD OF SUBMISSION	ONLINE TO: maher.albadri@alaska.edu		
DUE DATE OF SUBMISSION	MONDAY 07 FEB 2022	**DUE TIME OF SUBMISSION**	23:59

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MAKE THIS FORM A "COVER PAGE" FOR YOUR REPORT SUBMISSION.

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REMARKS:

1 Objective

The goal of this lab is to gain more experience using a multimeter while exploring some of the properties of a linear voltage regulator. In it we use a multimeter to measure node and differential voltage. Then we break the circuit to measure current. Finally simulate the circuit using OrCad and compare our measured results to the simulation.

2 Equipment

- Agilent 34410A Multimeter
- Agilent E354xA Dual Output Power Supply
- 78L05 Linear Voltage Regulator
- 1k Resistor
- 1u Capacitor
- Prototyping Board

3 Setup

The circuit used in this lab is shown in figure 1. Node A is measured between the voltage source and ground. Node B is measured at the point between the regulator and the 1k resistor and ground. The differential voltage is measured at the input and output of the linear regulator. To measure the current through the 1k resistor the wire between the regulator and the resistor is removed and the probes are placed at the out leg of the regulator and one leg of the resistor.

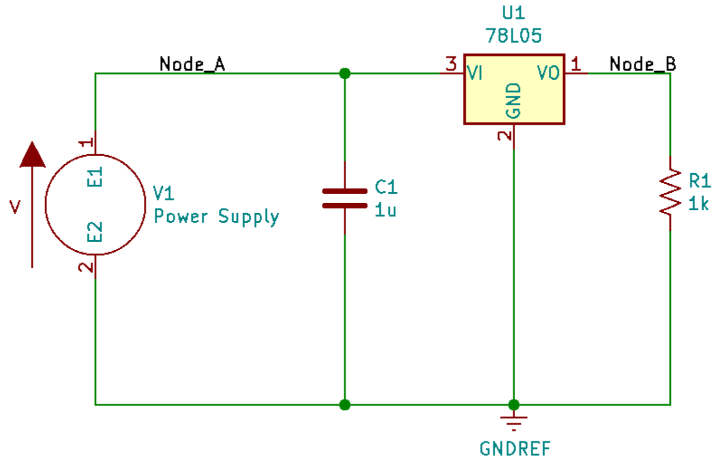

Figure 1: Schematic for the circuit used in this lab.

4 Observations and Results

Measured Node Voltage V_A (V)	**Measured Node Voltage V_B** (V)	**Measured Differential Voltage V_{AB}** (V)	**Measured Current Through 1 kΩ** (mA)	**Calculated Differential Voltage $V_A - V_B$** (V)	**Calculated Resistance** (Ω)
1.5	0.00020238	1.474	0.0015	1.5	134.92
2.0	0.669	1.329	0.661	1.331	1012.103
2.5	1.189	1.396	1.028	1.311	1156.615
3.0	1.611	1.380	1.589	1.389	1013.845
3.5	2.096	1.433	2.065	1.404	1015.012
4.0	2.583	1.439	2.545	1.417	1014.931
4.5	3.072	1.455	3.026	1.428	1015.202
5.0	3.563	1.470	3.510	1.437	1015.1
5.5	4.0563	1.531	3.993	1.444	1015.853
6.0	4.53	1.466	4.470	1.47	1013.423
6.5	4.924	1.574	4.860	1.576	1013.169
7.0	5.067	1.917	5.000	1.933	1013.4
7.5	5.069	2.435	5.014	2.431	1010.969
8.0	5.07	2.981	5.037	2.93	1006.552
8.5	5.066	3.316	5.058	3.434	1001.582
9.0	5.069	3.914	5.060	3.931	1001.778

Table 1: Displays the measured node and differential voltages, and current, as well as calculated differential voltage and resistance.

To calculate the differential voltage we use the following equation.

$$\mathrm{V_{AB}} = \mathrm{V_A} - \mathrm{V_B} \tag{1}$$

To calculate the expected resistance we use Ohm's Law, equation (2).

$$\mathrm{R} = \frac{\mathrm{V_B}}{\mathrm{I}} \tag{2}$$

Note that current is measured in mA so first we must convert it to amps to get our result in ohms.

One irregularity in the results can be seen when the input voltage was 1.5 volts. At this input the current was 0.0015 mA. This lead to the calculated resistance being 135 Ω far less than the 1 kΩ that it should have been.

Next we run a simulation of the circuit using OrCad. The results of the simulation can be found in figures (1) and (2) plotted with my own measurements (figure 1) and with the rest of the classes measurements (figure 2). In figure 1 we can see that the measured results start aligning with the simulation around 3 volts.

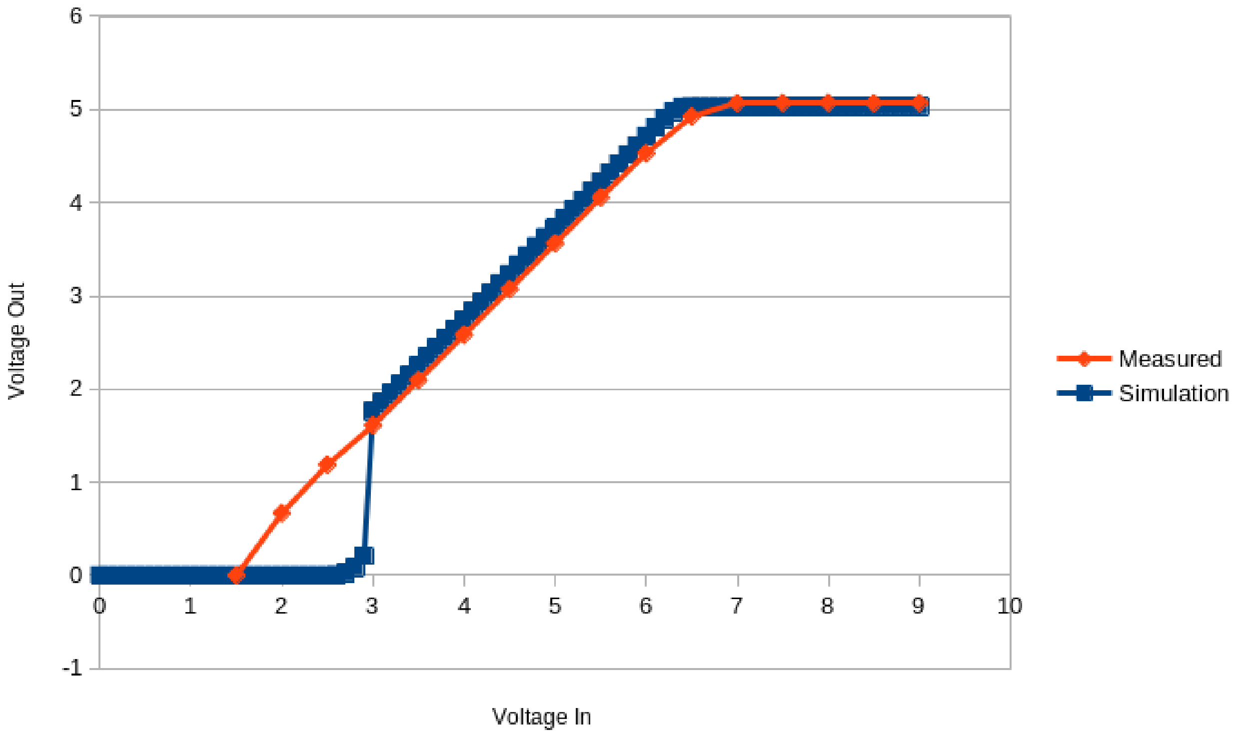

Figure 2: Voltage Out vs Voltage In. Measured output voltage, and simulation output voltage.

In figure 2 we see that many of the measurements do not align with the expected output. I suspect the measurements that are still linear after 6.5 volts had the probes in the wrong place and/or had their circuits wired wrong. The measurements that that follow the curve but are higher than expected might not have nulled their multimeters.

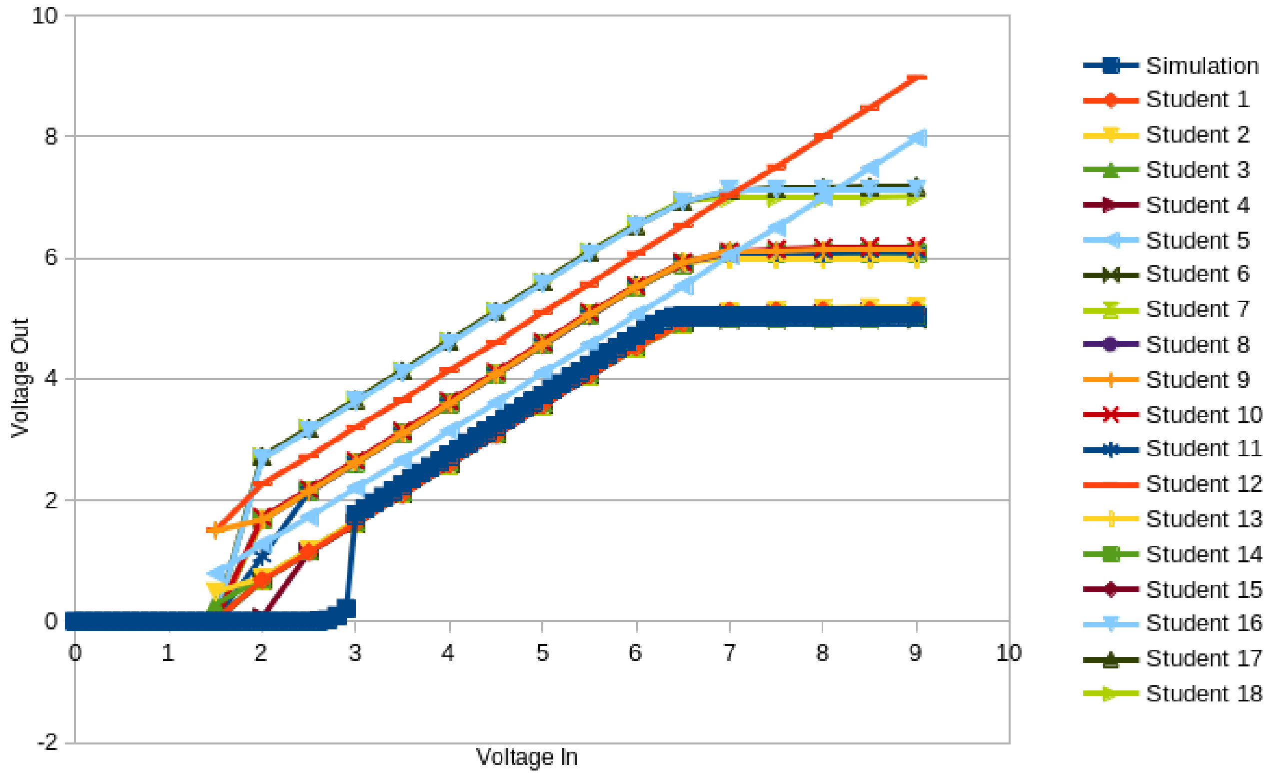

Figure 3: Voltage Out vs Voltage In. Classes measurements outputs and schematic simulation output.

5 Conclusion

In this lab we used a multimeter to measure the input, output, and differential voltage accross a linear regulator. We found that linear regulators are good when The input voltage is close to the output voltage, otherwise they dissipate lots of power in the form of heat.

5.1 Sources of Error

- Temperature is not controlled for. Temperature can effect the efficency of the device.

6 References

[1] Denise Thorsen, Maher Al-Badri, INTRODUCTION TO ELECTRICAL AND COMPUTER ENGINEERING, University of Alaska Fairbanks, 2022.