January 21, 2024

Frank Martino - Proof of Skills Day 2

Q2 Experimental Measurements and Personal Instrumentation

Prove your skill set using ONE of the following: M1K board, Analog Discovery Board, or M2K board.

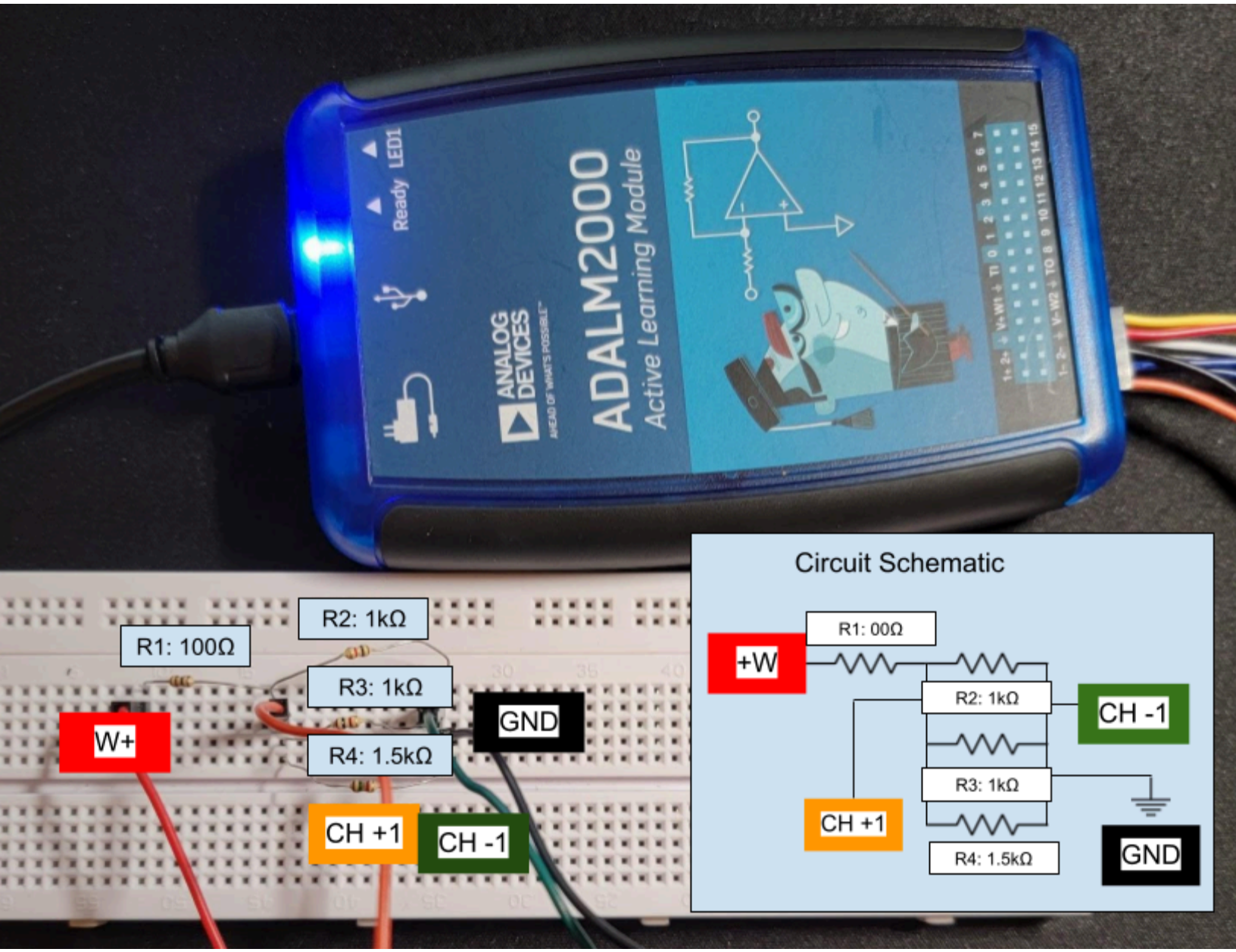
Each of the **Experimental Measurements and Personal Instrumentation** Objectives above should reflect the following goals:

- [x] ~~1. I can use consistent **color coding of wires when I build circuits on my breadboard** to aid in troubleshooting.~~
- [x] ~~2. I can "zoom in" to an oscilloscope output by **changing the time scale (x-axis)** to show important parameters (for example, a sinusoid with 25 cycles would be easier to see if only 3-5 cycles were shown instead!) when needed~~
- [x] ~~3. I can "zoom in" to an oscilloscope output by **changing the voltage scale (y-axis)** to show important parameters (for example, a sinusoid with 500mV amplitude would be difficult to see with 5V/div…) when needed~~
- [x] ~~4. I can **change the THICKNESS** of my trace lines for easy viewing.~~
- [x] ~~5. I **can change the background color of my oscilloscope output to white** and paste in an external document for easy viewing.~~
- [x] ~~6. I **can label the measurement output clearly** with the circuit schematic component names~~

Q2.2 Build a Resistive Circuit and Measure the DC voltage

I can build a resistive circuit and measure dc voltage across ONE resistor using a dc input source and vary dc voltage at least 3 times (-5,+5 and any voltage in between) (Must be two or more resistors, hint: to do something useful to you, try to simulate a homework or class problem!)

To prove my skills in building a resistive circuit and measuring the voltage, I made a circuit with a 100Ω resistor (R1), in series with a parallel set of resistors 1kΩ (R2), 1kΩ (R3), and 1.5kΩ (R4) (shown in the diagram below). Then I varied the voltage across the resistors from -5, 3 and 5 volts. Using the oscilloscope and channels +1 and -1, I was able to measure the voltage across the R2. Channel W1 is the source of the constant voltage and is grounded through another channel. Using the ADALM2000 oscilloscope, we see that with -5 volts, the voltage recorded across R2 is -3.687 volts (shown in figure A1). Figure A2 shows the voltage across R2 when 3 volts is supplied across the circuit reading about 2.429 volts. A3 shows the oscilloscope reading of 2.460 volts, when 5 volts is supplied.



Below we see that all sources of measuring the voltage across R2 are within reasonable tolerances of each other, where the LTSpice simulation is the accurate and real-world test shown to lose some voltage from wire resistance and other non-conservative materials.

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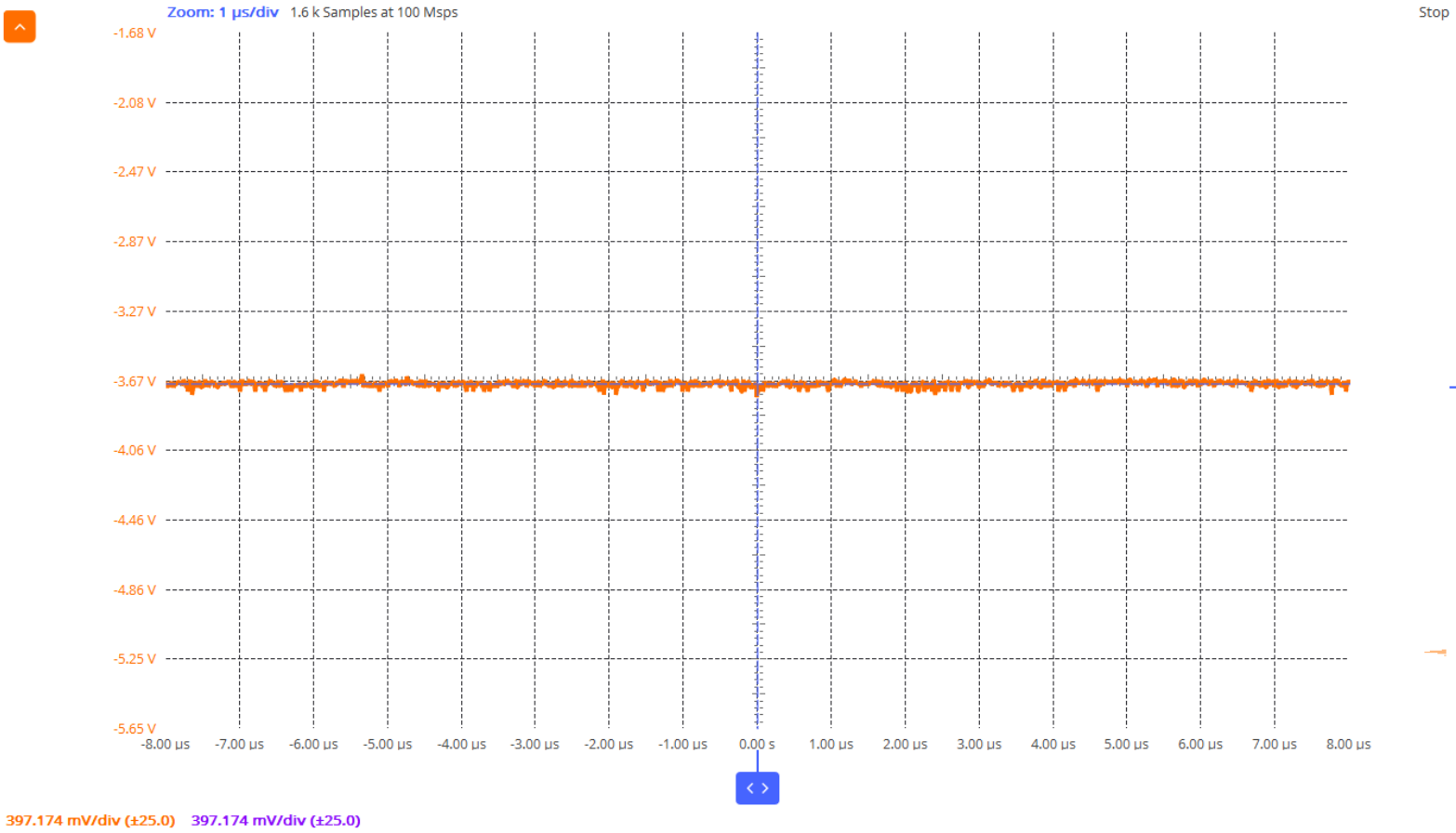
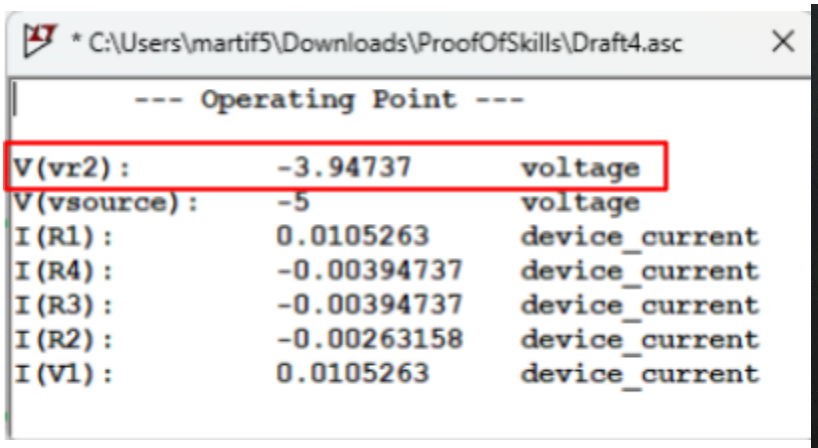
A1: (-5 volts across 1.5kΩ (R2))

Measured Reading: -3.687 volts

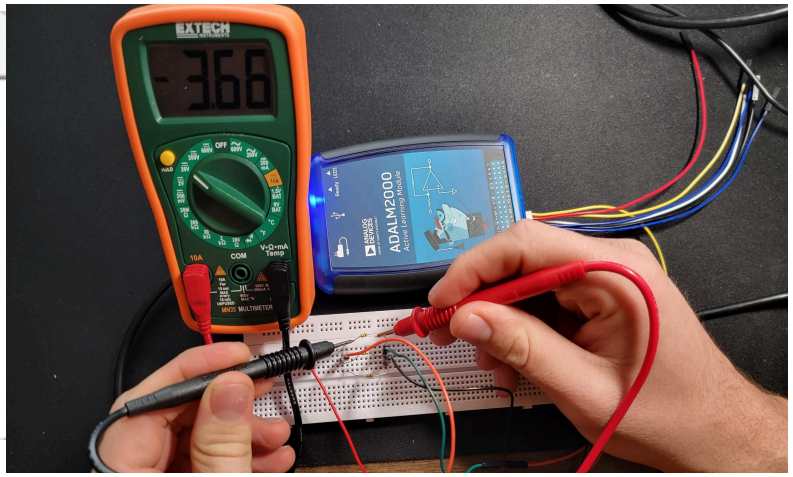
Period: --
Frequency: --
Peak-peak: 130.725 mV
Mean: -3.687 V



LTspice: -3.94737 volts



Multimeter: -3.66 volts



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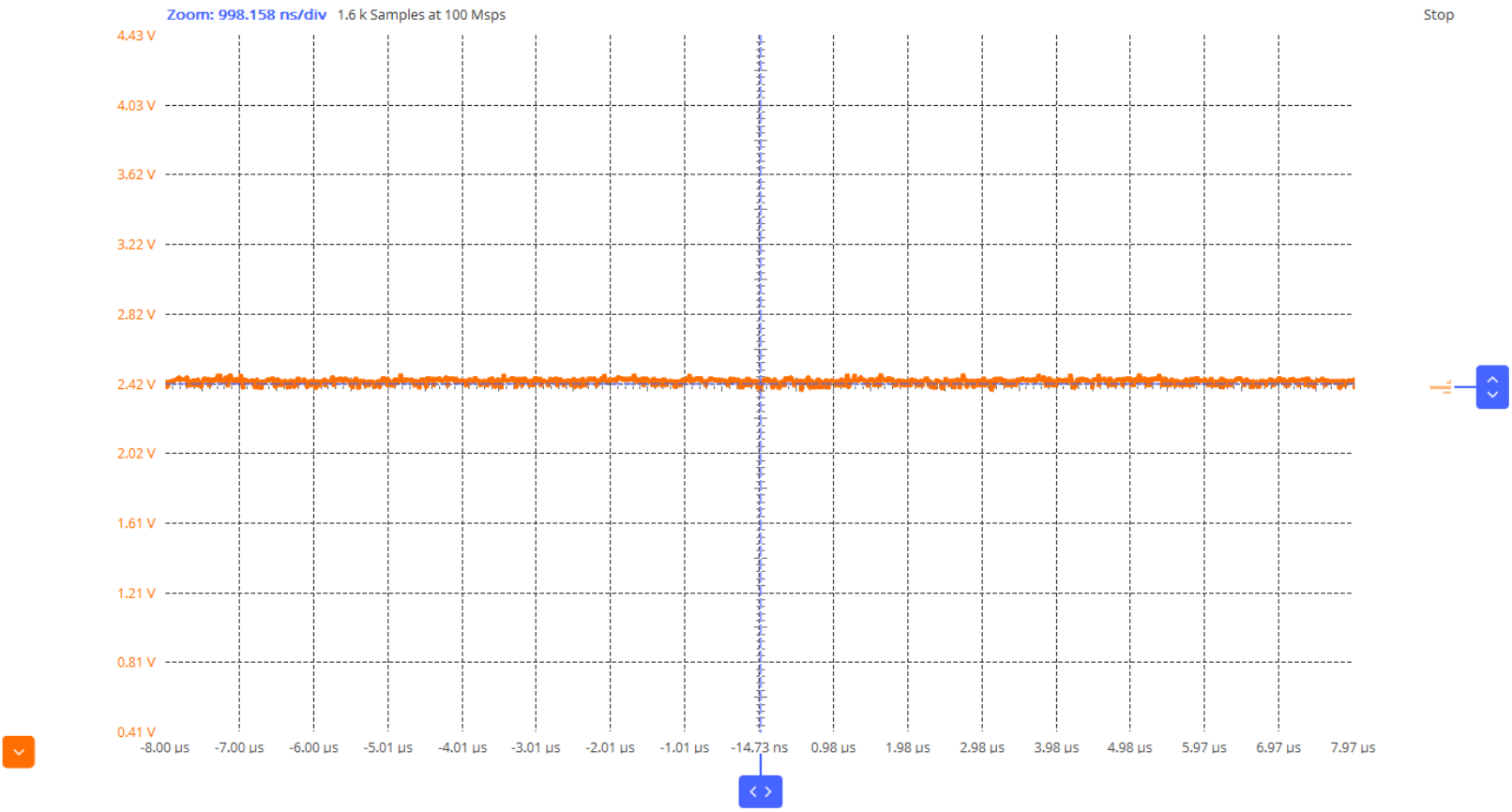
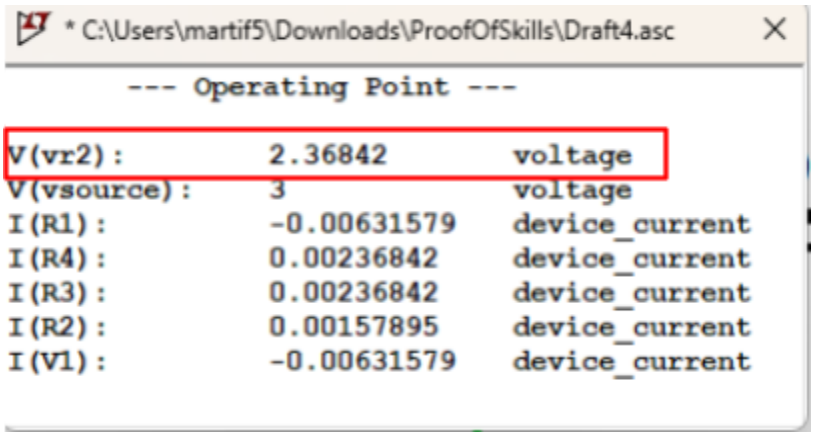
A2: (3 volts across 1.5kΩ (R2))
Measured Reading: 2.429 volts

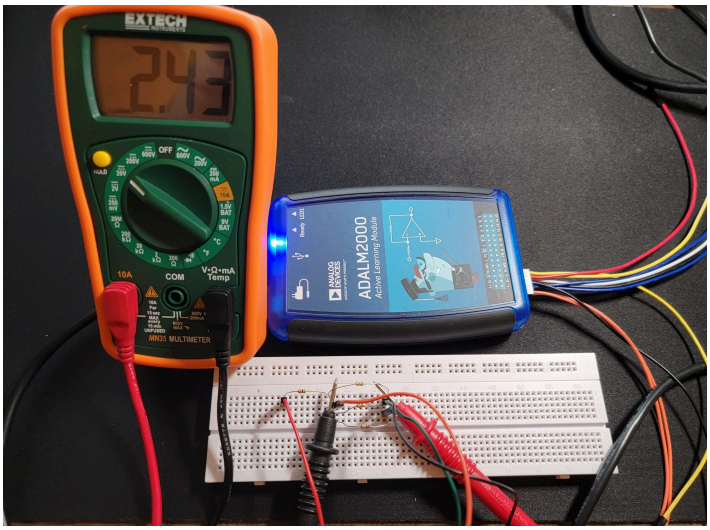
Period: --
Frequency: --
Peak-peak: 101.675 mV
Mean: 2.429 V



LTspice: 2.36842 volts



Multimeter: 3.65 volts



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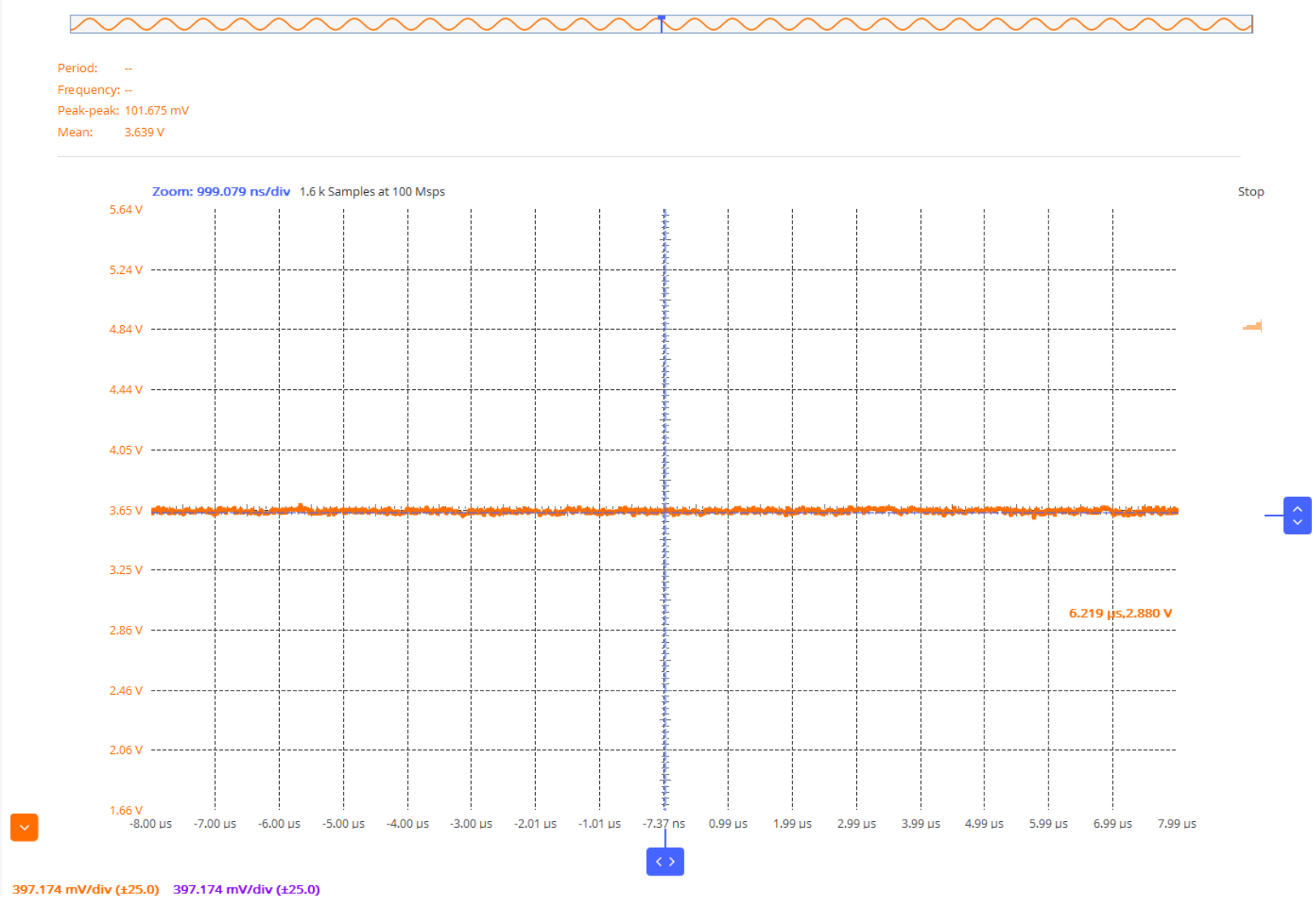
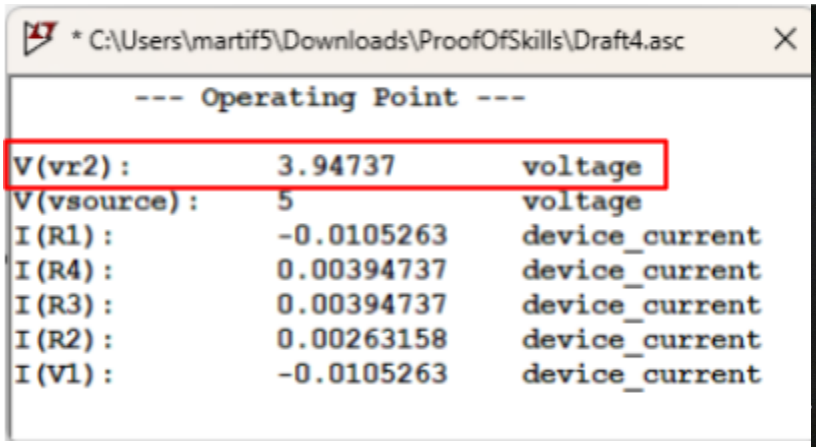
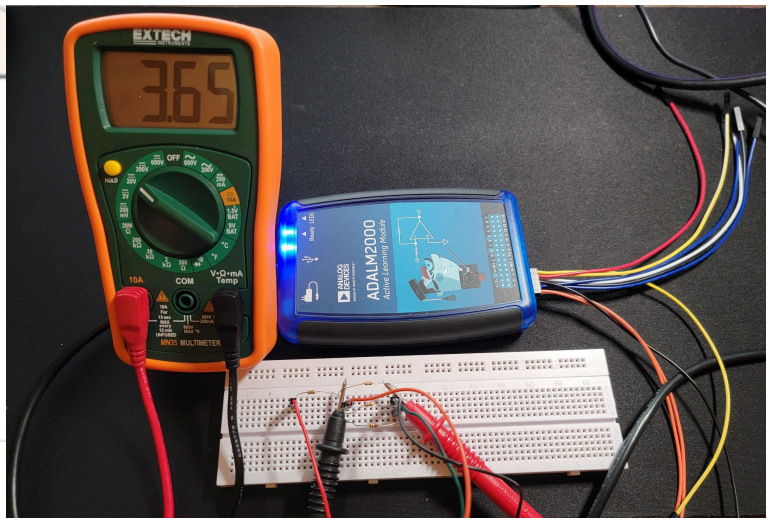
A3: (5 volts across 1.5kΩ (R2))
Measured Reading: 3.639 volts



LTspice: 3.94737 volts



Multimeter: 3.65 volts



When testing all of the circuits with the varying voltages -5, 3, and 5 voltages, we get voltage readings across R2 as -3.94737, 2.36842, and 3.94737 volts respectively. This matches very closely to the real-word testing done using the ADALM2000 and the multimeter, as it only varies a few millivolts.