ELECENG 2EI4: Electronic Devices and Circuits 1

Design Project 2

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Table of Contents

Test Plan

Test Plan for Switch 1

For the closed switch state, Vcontrol will be 0 v, and Vsupply and V1 will be equal to positive DC voltages. I will then measure the voltage access the p-mosfet and confirm that it is 0v, and V1 = V2.

In my test for the open switch state, I will set the V control to 5V, and Vsupply will again be a positive DC voltage equal to V1. Then, I will measure the current I1 at V1 and I2 at V2, and make sure that they are almost equal to 0. I will achieve this by adding a load resistor at both V1 and V2, and measuring the voltage drop across them. Using Ohm's law, I will calculate the current flowing through the resistors.

Test Plan for Switch 2

During my test to identify the closed switch state, I will set V control to 0V, and Vsupply to a positive DC voltage equivalent to V1. Then, I will use AD2 to measure the voltage at VA and check whether it closely matches V1. Similarly, when determining the open switch state, I will set V control to 5V, and Vsupply to a positive DC voltage equivalent to V1. After that, I will utilize AD2 to measure the current at V1 and VB and ensure that both readings are nearly identical.

Switch Type 1

1. **A circuit schematic of your design.**

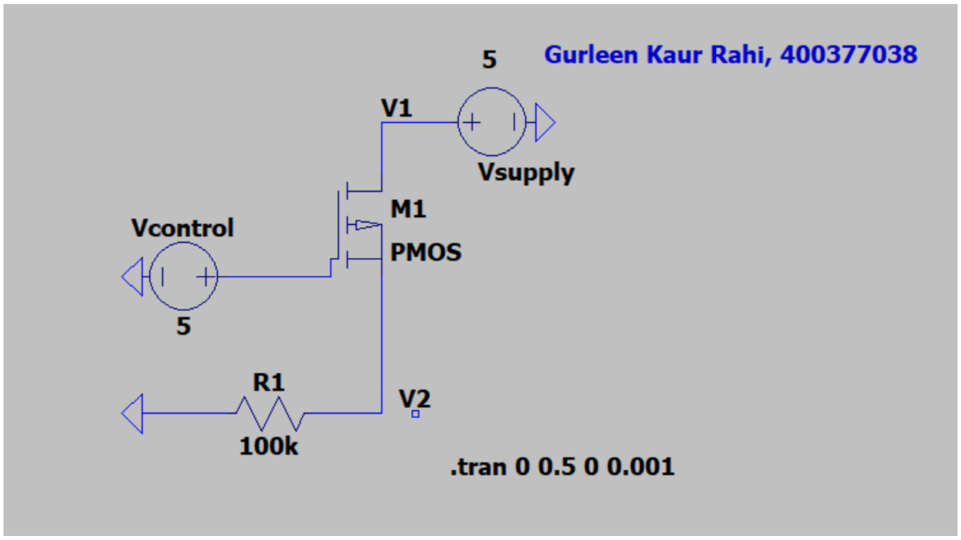

Figure 1: Switch 1 in the ON state

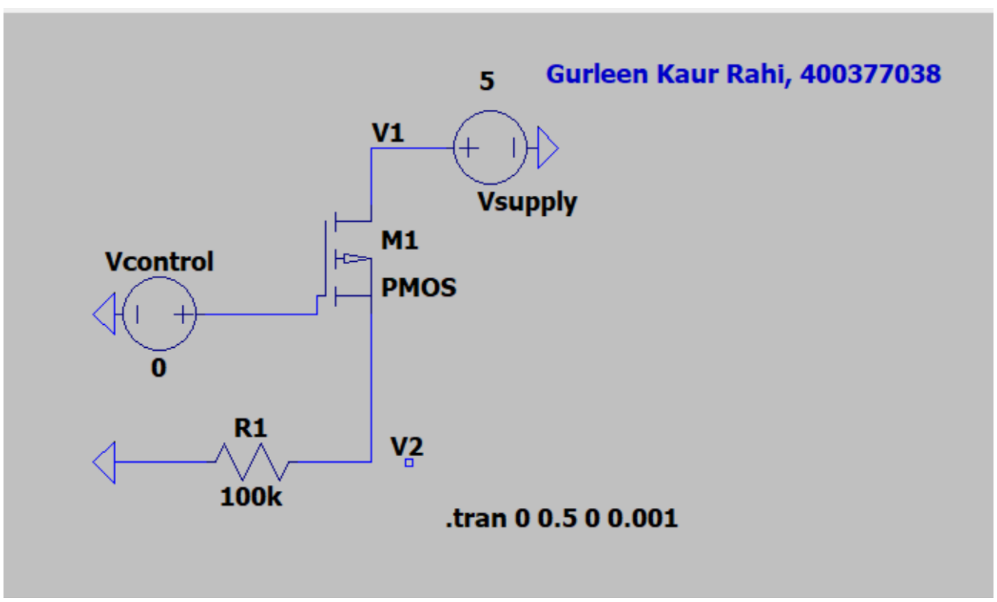

Figure 2: Switch 1 in the OFF state

2. **Measurements performed according to the test plan.**

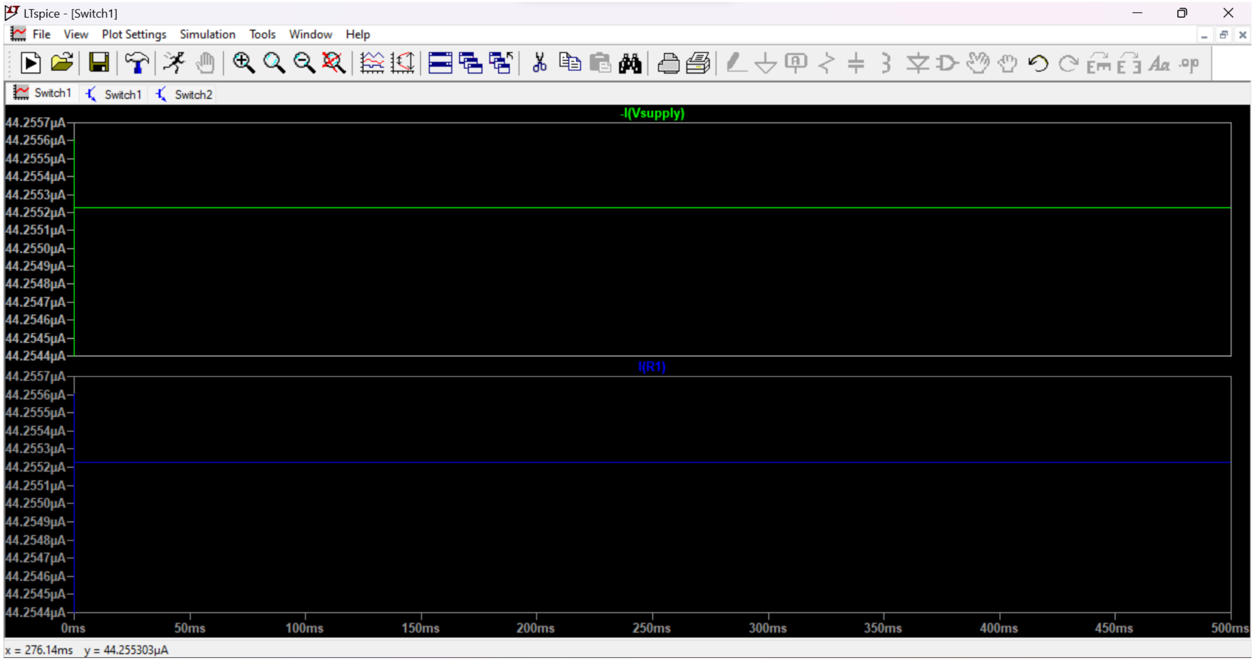

Figure 3: Graph simulation for Switch 1 in the ON state

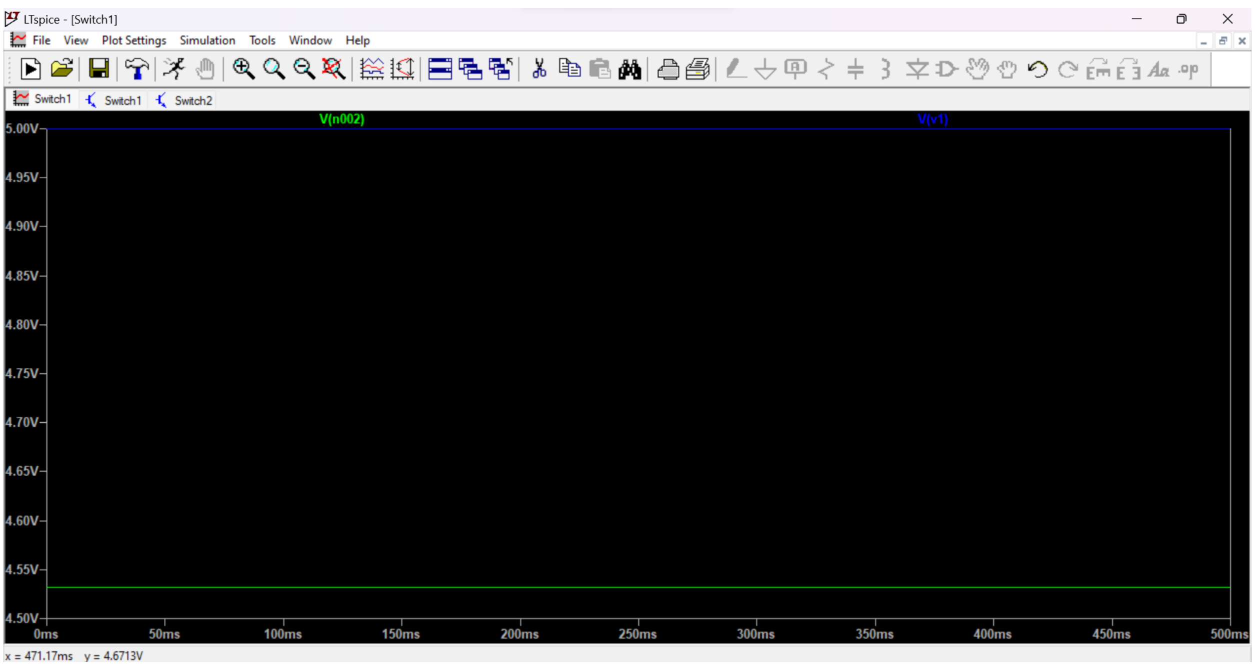

Figure 4: Graph simulation for Switch 1 in the OFF state

3. **Theoretical explanation for the results obtained and comparison of the quantitative results with the theory.**

When the switch is turned on, V_1 and V_2 are nearly equal in theoretical calculations. However, when measured using the AD2, V_2 is slightly lower at 4.3V when V_1 is 5V, which is attributed to the internal resistance of the MOSFET. Conversely, when the switch is turned off, the measured values for I_1 and I_2 are both 0.05 mA instead of being precisely zero as expected in theory. This is because there is no current path when the switch is open. The measured values are close to zero, but there may be some minor inaccuracies caused by extra resistance in the circuit components.

4. **Design tradeoffs. What tradeoffs did you make in your design for performance, complexity, and cost?**

   In my design, to increase the performance, I used a resistor of relatively higher resistance that will help the switch gain the properties of an ideal switch. To reduce complexity, I used only 1 MOSFET in my design so that there is a minimal amount of time delay (if any). Using only 1 MOSFET could be reasonable in terms of cost, however, using a resistor of higher value could be expensive.

Switch Type 2

1. **A circuit schematic of your design.**

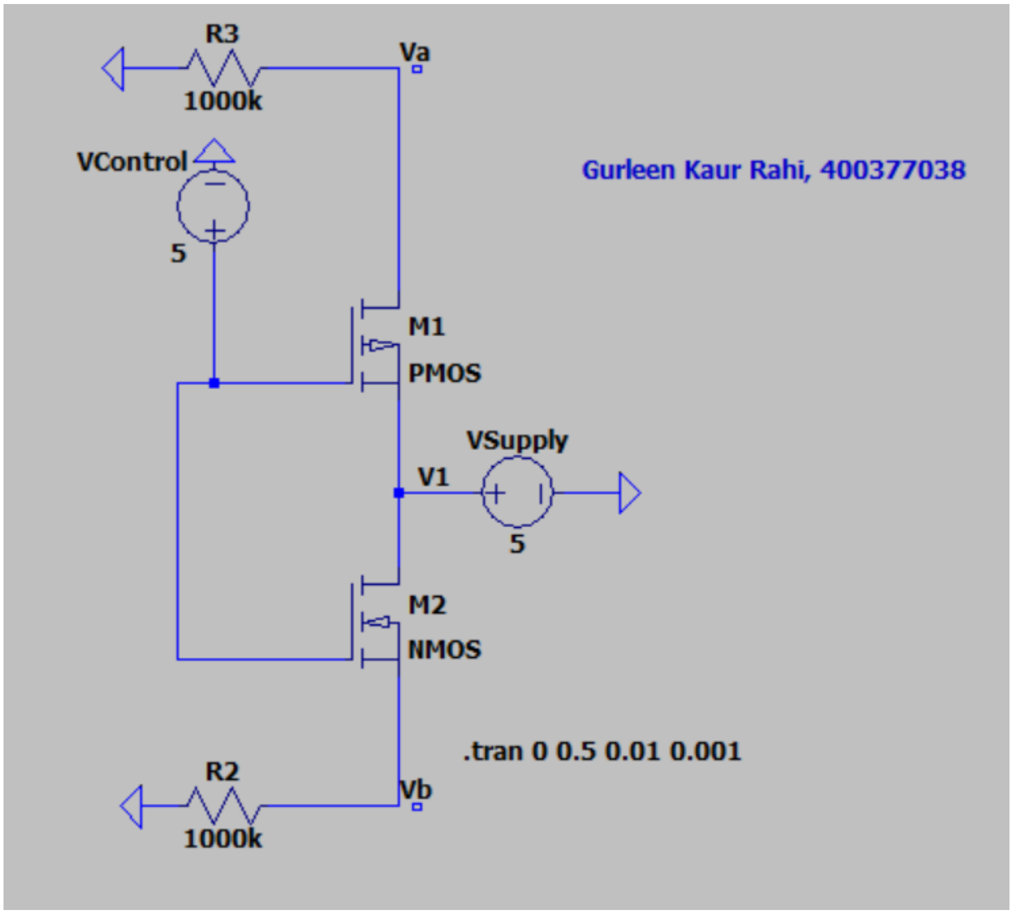

Figure 5: Switch 2 in the ON state

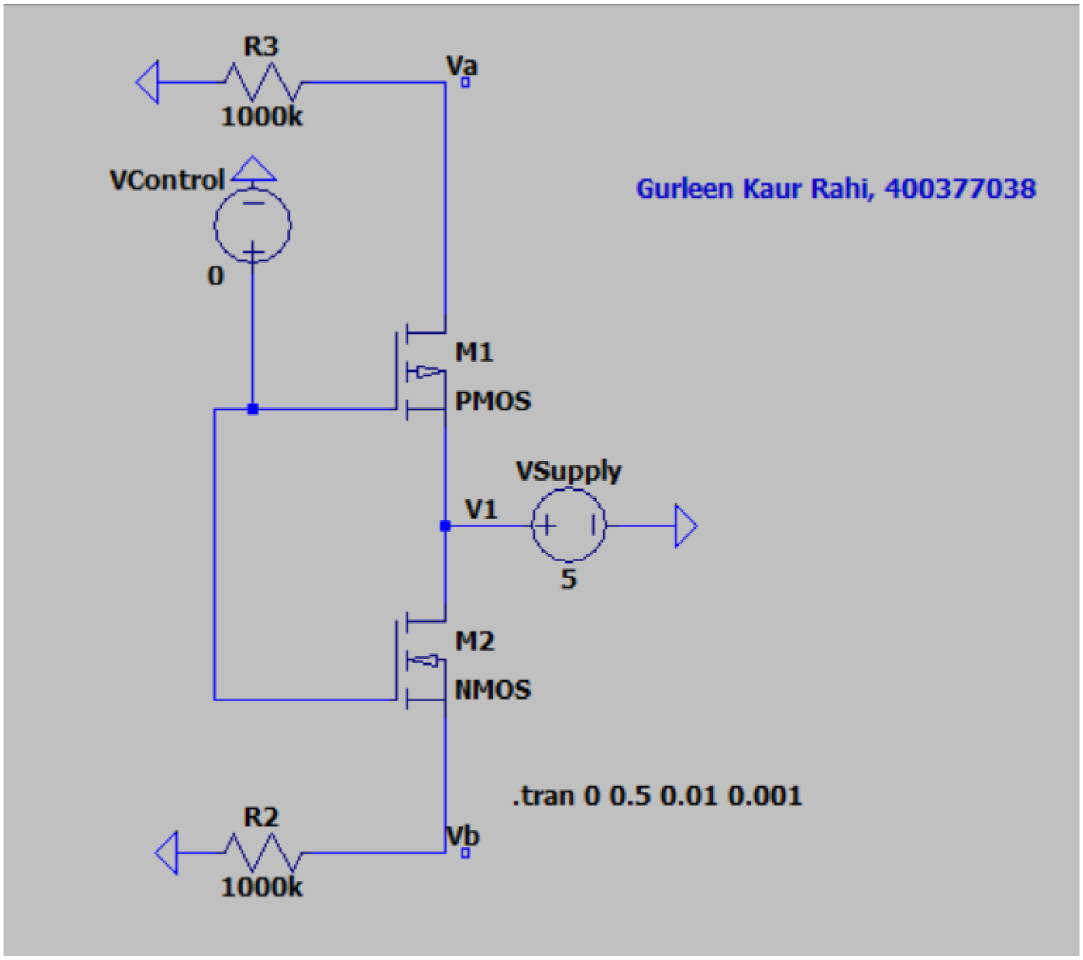

Figure 6: Switch 2 in the OFF state

2. Measurements performed according to the test plan.

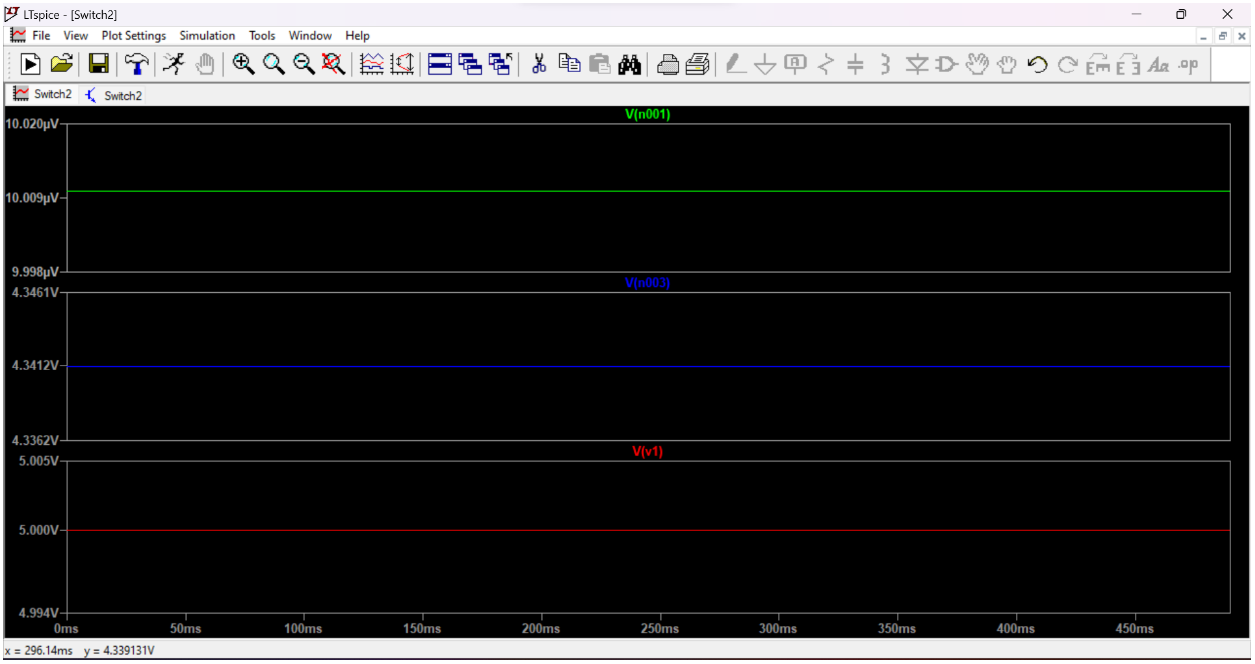

Figure 7: Graphical simulation for Switch 2 in ON state

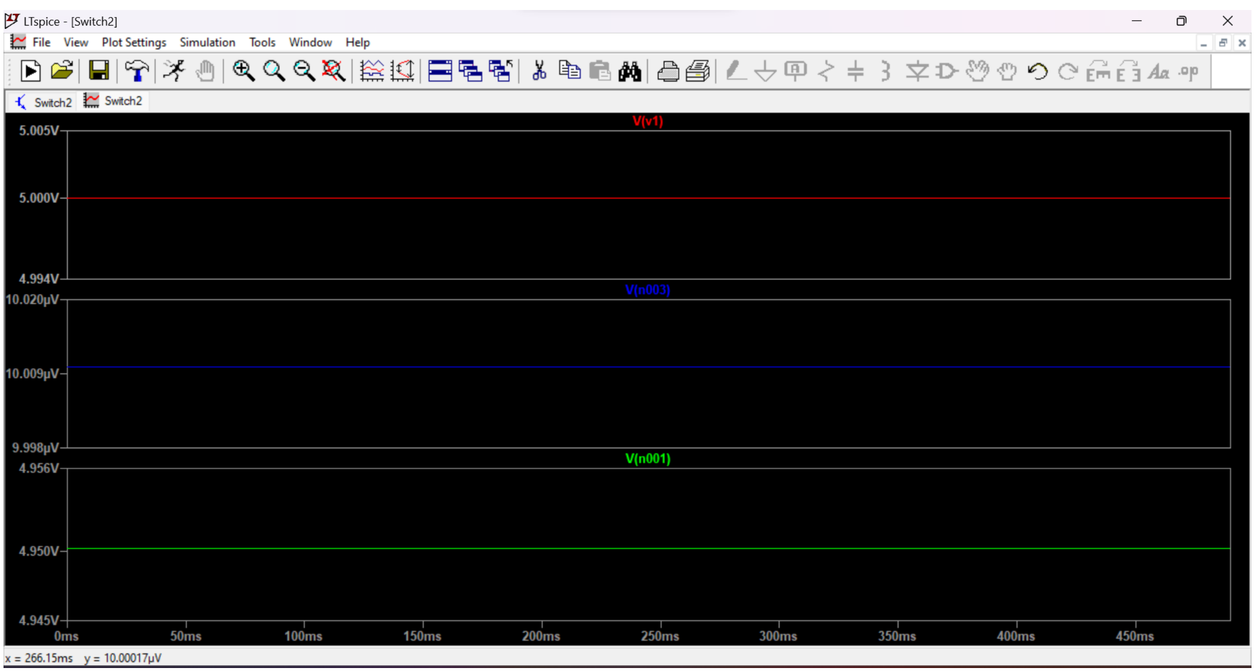

Figure 7: Graphical simulation for Switch 2 in OFF state

3. **Theoretical explanation for the results obtained and comparison of the quantitative results with the theory.**

   When Vcontrol is at 0V, the switch links to the output VA, and Vsupply and VA have values of 5V and 4.34V, respectively. In theory, Vsupply and VA should be identical since they belong to the same node. However, due to the internal resistance present in the MOSFET and wiring, they have a slight difference. The voltage values on either side of a closed switch should be equal. When Vcontrol is at 5V, the switch links to output VB, and both Vsupply and VB have values of 5V and 4.34V, respectively. Vsupply and VB should be the same as they are part of the same node. Nonetheless, there is still a small variation in their values due to the internal errors and resistances in the circuit components.

4. **Design tradeoffs. What tradeoffs did you make in your design for performance, complexity, and cost?**

   The tradeoffs for this circuit design are quite similar to the previous circuit. The only difference is that in this design, I used two MOSFETS instead of one. I also removed one of the resistors because this will give me more accuracy as the value of Va is 4.95 V which is very close to 5V. This will not only increase the cost of the design but also increase the complexity of the circuit. The circuit design seems to work very well with some minor simulation errors which might give rise to some uncertainties in the voltage values.

AD2 Observations

Switch 1

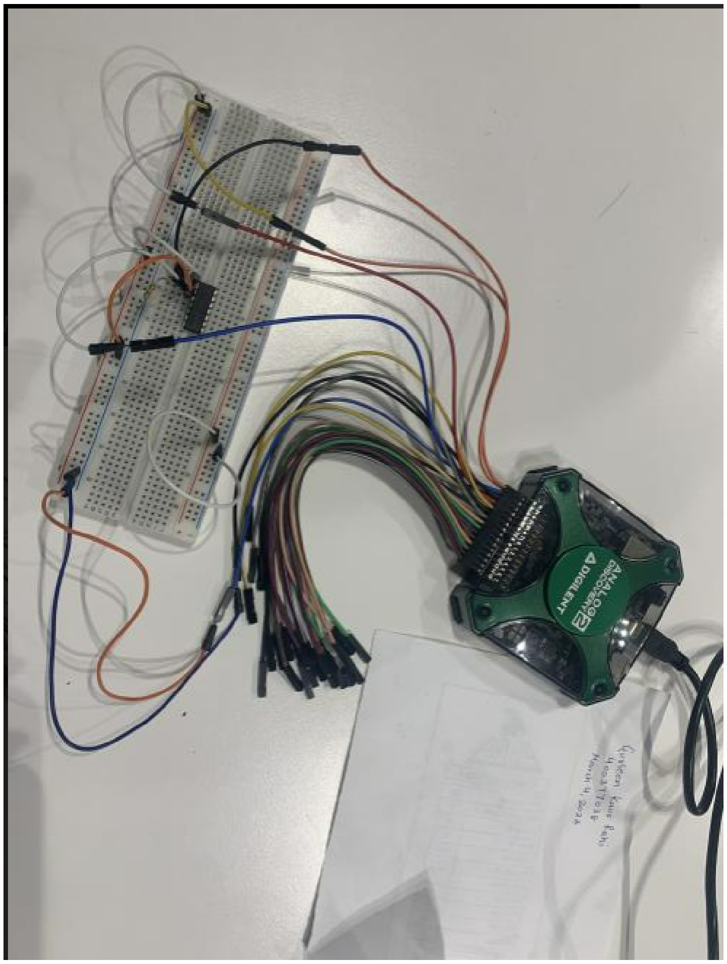

Figure 8: Physical circuit for Switch 1

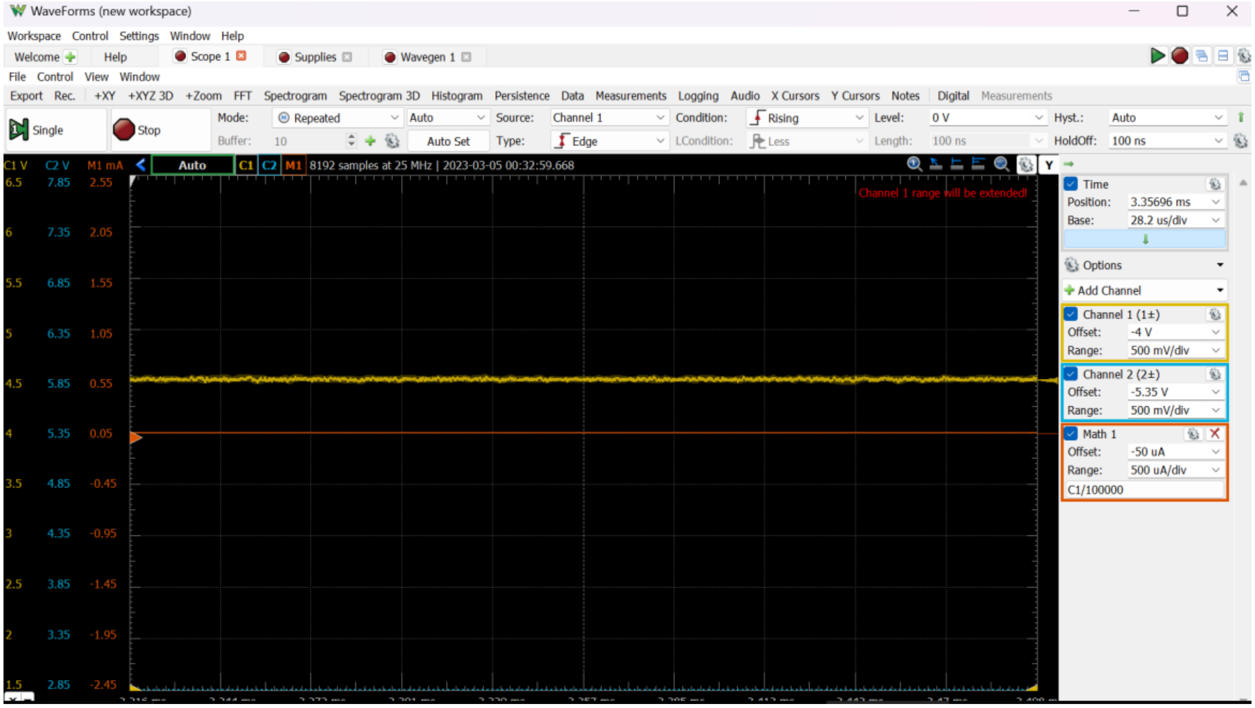

Figure 9: AD2 Waveform for Switch 1

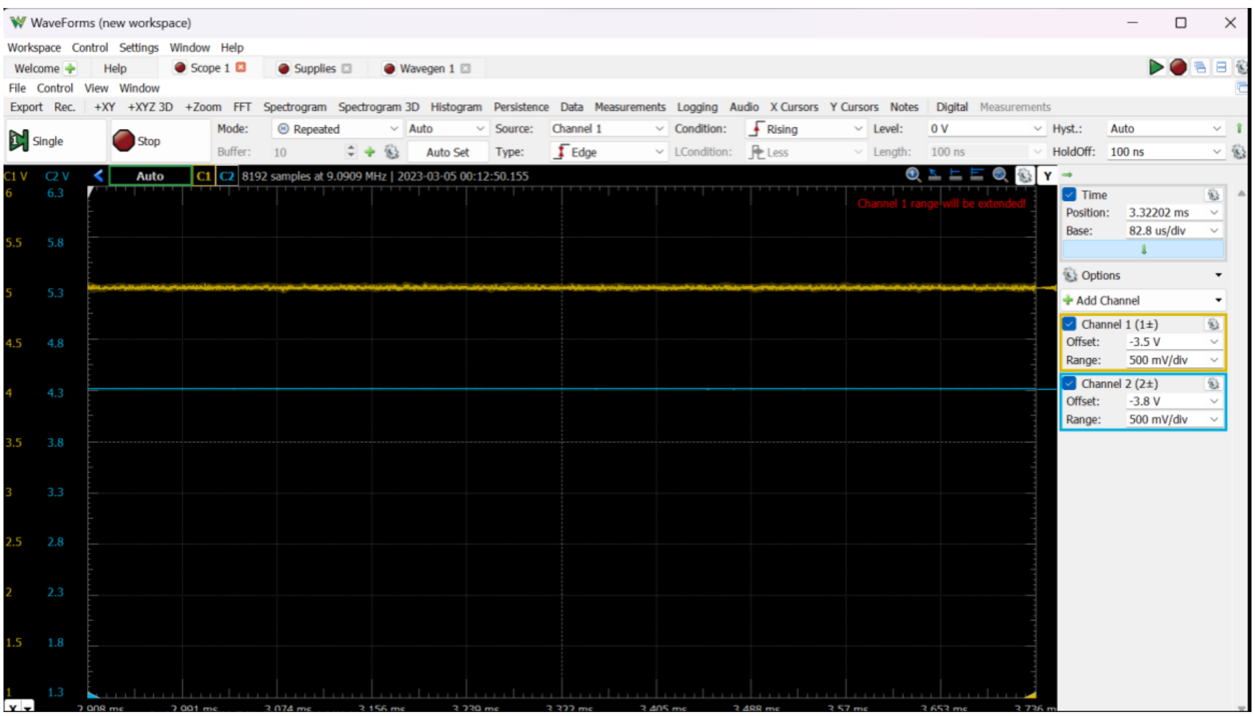

Figure 10: AD2 Waveform for Switch 1

Switch 2

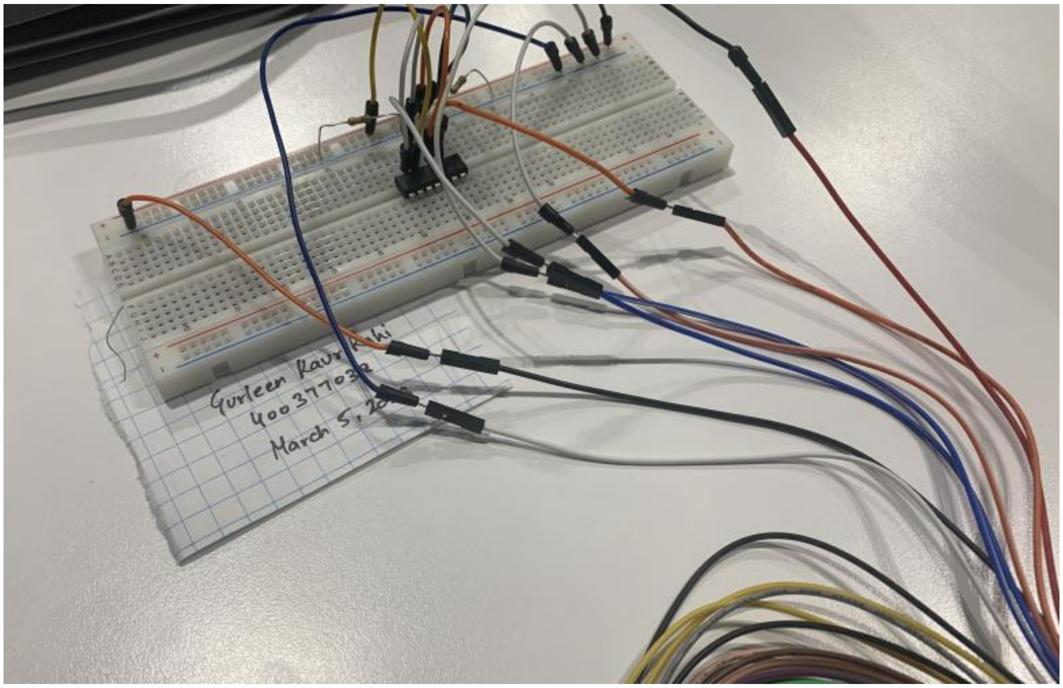

Figure 11: Physical circuit for Switch 2

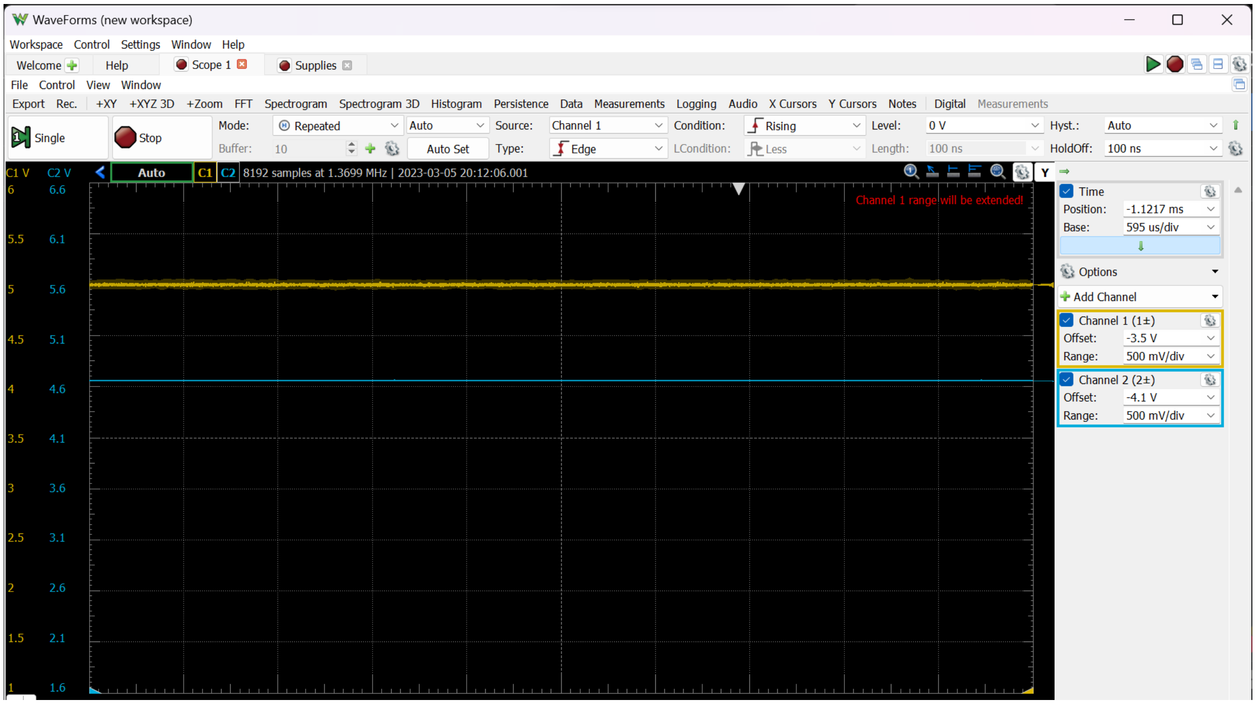

Figure 12: AD2 Waveform for Switch 2

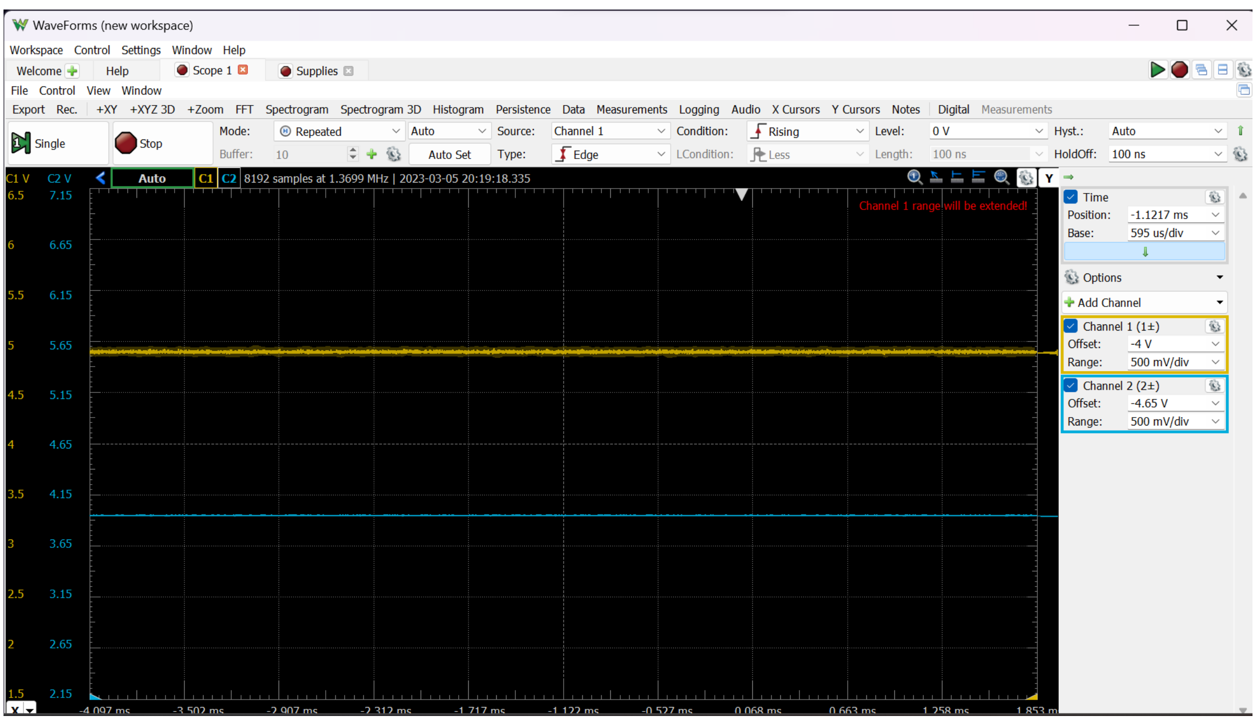

Figure 13: AD2 Waveform for Switch 2