Experiment 3

Capacitors and Inductors

EGT 243 - AC Circuit Analysis

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Fall 2021

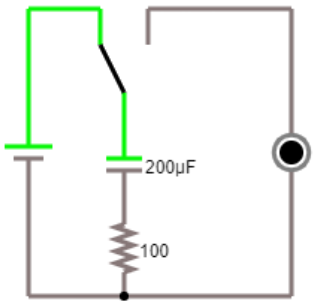
Introduction

The purposes of this experiment are as follows: allow students to build a physical circuit using multiple different components, build familiarity with lab equipment and the mentioned components, and utilize the learned formulae to compute theoretical circuit values, then test those values against real-world models.

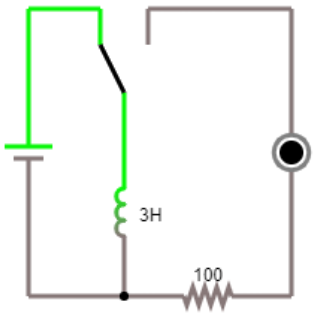
Required Components

- 100Ω resistor, 200uF Capacitor, 470mH Inductor
- White LED
- SPDT Switch
- Breadboard with Jumper Wires
- Multimeter
- Oscilloscope

Schematic Design



^ Used in part 1



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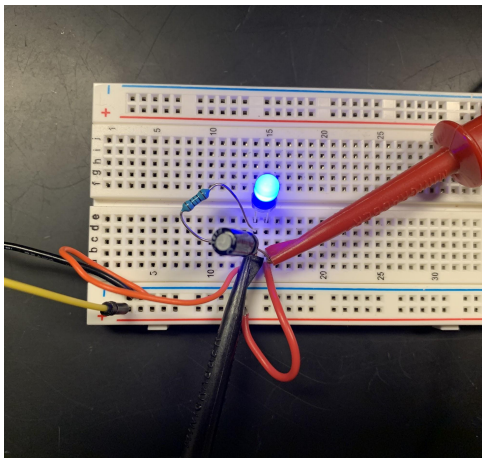
Component Layout



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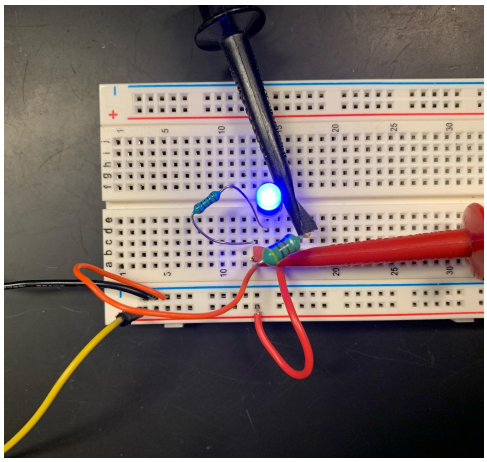


^ Used in part 2

Procedure

Part 1:

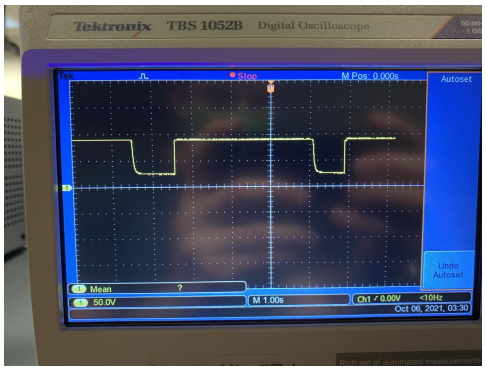
1. Build the given circuit with a 100Ω resistor, 200uF capacitor, LED, and SPDT switch.
2. Connect the oscilloscope to the capacitor's leads.
3. Turn on the circuit via the power supply.
4. Watch the capacitor charge on the oscilloscope display, take a photo.
5. Press (and hold) the button to discharge the capacitor into the LED.
6. Watch the capacitor discharge on the oscilloscope display, take a photo.

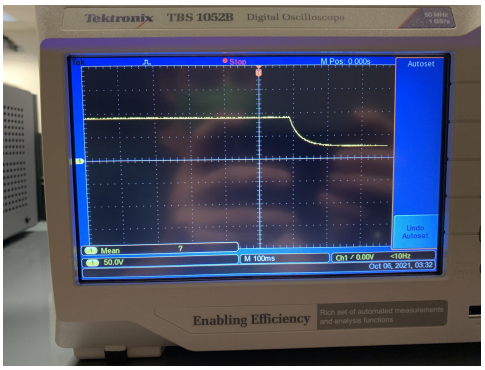
Part 2:

1. Build the given circuit with a 100Ω resistor, 470mH inductor, LED, and SPDT switch.
2. Connect the oscilloscope to the inductor's leads.
3. Turn on the circuit via the power supply.
4. Watch the inductor charge on the oscilloscope display, take a photo.
5. Press (and hold) the button to discharge the inductor into the LED.
6. Watch the inductor discharge on the oscilloscope display, take a photo.

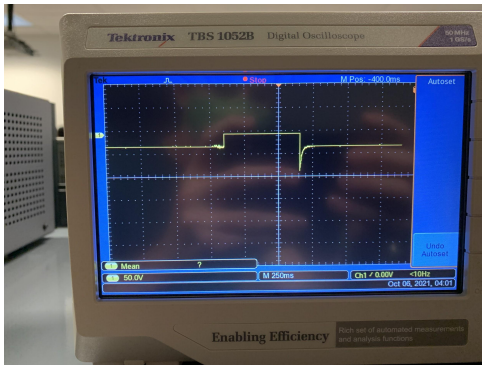
Experimental Results

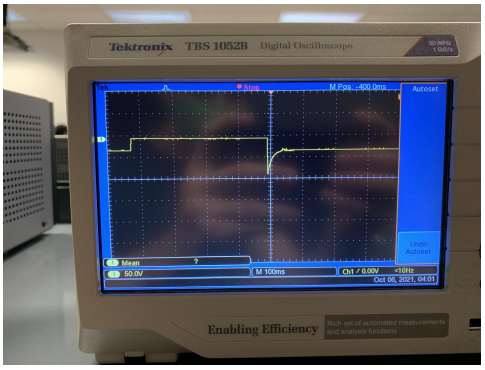
- Part 1: Using a capacitor as a temporary battery to power a circuit





- Part 2: Using an inductor as a temporary current source to power a circuit





Discussion

The main goal for this lab was to see how capacitors and inductors stored voltage and would react when needing to supply energy to a circuit. We hypothesized that the shown graph on the oscilloscope was going to be similar to the examples we discussed in class, the capacitor and inductor would discharge over a short period of time with a smooth curve. There is not much room for improvement in our experiment since it was just to see how the components worked.

Conclusion

In conclusion, we were able to get a better understanding of how capacitors and inductors store energy and would supply if the circuit required them to do so. Through actual experiment testing with a physical circuit and simulated circuit we were able to visualize how the loss of the power source would affect the circuit by relying on the temporary power storage of the components.There is not much room for error in this experiment when we are just observing but overall I think we learned a lot from this.

References

Principles of Electric Circuits: Conventional Current Version, 10th Edition, Thomas L. Floyd, Pearson, 2019. (ISBN-13: 9780134879482)

Appendices

1A. Ohm's Law - a law stating that electric current is proportional to voltage and inversely proportional to resistance. (Oxford Languages, 2021)
1B. Breadboard - a construction base for practicing electronic circuits.
1C. Falsad Online Circuit Simulator: https://www.falstad.com/circuit/