3.0 - Capacitors

About capacitors

Capacitors are very simple electrical devices composed of two conductive plates separated by an insulator. They are found in almost all electronic circuits despite the fact that the insulator prevents capacitors from conducting any current. Capacitors are typically used in charge storage, power supply filtering, and frequency filtering circuits.

Capacitor activity

1. What is a capacitor, and what do capacitors do?

2. Do capacitors conduct current? Explain why or why not.

3. Obtain the large capacitor from your kit of parts. If your multimeter has a capacitance measurement function, measure the value of the capacitor. Otherwise, just record the labelled value. **Note: This may be a polarized capacitor. Be sure to observe the correct polarity during measurement and when connecting polarized capacitors to a power supply!**

   C(labelled) = C(measured) =

4. Draw a schematic diagram of your capacitor in series with a 10 kΩ resistor and connected to a 10 V power supply.

5. Build the capacitor circuit that you drew, above, on a breadboard.

6. The time constant of an R-C (resistor-capacitor) circuit is given by the formula: $\tau = R \times C$. Measure the value of your resistor, and calculate the time constant of your R-C circuit.

   R = τ =

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7. Set the power supply to 10 V, and keep it **disconnected** from your circuit. Record its potential.

   V_T =

8. In the next steps, you will be measuring the charge time of the capacitor. To accurately measure charge time, you must ensure the capacitor is discharged before you begin.

   Keep the power supply off. Connect the power supply to your circuit, verifying the proper polarity. Measure the capacitor potential (it should be close to 0 V, or should drop to near 0 V).

   V_C =

9. Next, you will measure the voltage drop across the capacitor at 10 second intervals. Start the timer as soon as you turn on the power supply, and record the capacitor potential every 10 s.

0 s	V_C = **0 V**	10 s	V_C =	20 s	V_C =
30 s	V_C =	40 s	V_C =	50 s	V_C =
60 s	V_C =	70 s	V_C =	80 s	V_C =

10. Using the measurements from the chart, above, graph the capacitor voltage over time.

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Capacitor analysis

11. Approximately how much time does it take to charge the capacitor up to:

    60% of full charge -

    80% of full charge -

    100% of full charge -

12. The time constant that you calculated in step 6 should represent the time needed to charge the capacitor to approximately 63% of full charge, and full charge should be achieved after a time duration equal to five time constants. How well does your calculation match the measurements?