

3.1 - Capacitor Filtering

About capacitor filters

Filter circuits are typically installed in between two circuits, and couple a signal (modifying it along the way) from one circuit to the next. Filter circuits are R-C circuits, and modify signals in different ways depending on the arrangement of the filter's resistor and capacitor, and the relationship of the filter's time constant to the frequency of the signal. In this lab, you will construct and observe a power supply filter, made by putting the capacitor in parallel with the load (as a low-pass filter).

Capacitor filter activity

1. Install capacitor C1 into your CHRP circuit board. **Note: C1 is a polarized capacitor. Be sure to observe the correct polarity during installation!**

Teacher Check

2. Examine the CHRP schematic diagram. How is LED1 connected to the filter capacitor (series or parallel)? Explain how you know.
3. Since LED1 is connected directly to the filter capacitor, it is reasonable to assume that the amount of potential in the capacitor can be inferred from observing the LED brightness.

Assuming this to be true, plug the AC adapter into the CHRP board observing the LED as you do this. How long does it take to charge C1?

4. Unplug the AC adapter from the CHRP board, again observing the LED as you do so. How long does it take to discharge C1?
5. Why is there a difference between C1's charge and discharge times? (Hint: How does the circuit configuration seem to change between charging and discharging?)

Teacher Check

- Obtain an AC output wall adapter. Record the AC output voltage of the adapter first, and then measure the filtered DC output potential across capacitor C1 using a multimeter.

$V_{AC} =$

$V_{C1} =$

- Using an oscilloscope, measure the filtered DC output potential across C1. Trace the wave and record the oscilloscope settings.

| | | |
|--|------------------------|------------------------|
| | Time/Div | |
| | Channel 1 Volts/Div | Channel 2 Volts/Div |

- Next, switch the oscilloscope to measure AC, and increase the sensitivity to measure the AC ripple in the filtered DC output. Trace the wave and record the oscilloscope settings.

| | | |
|--|------------------------|------------------------|
| | Time/Div | |
| | Channel 1 Volts/Div | Channel 2 Volts/Div |

Teacher Check

Filter analysis

- What is AC ripple? How does the ripple frequency compare to the input source frequency?

- Calculate the maximum ripple as a percentage of the filtered DC output.