

# 3.1 - Capacitor Filtering

## About capacitor filters

Filter circuits are most often installed in-line in between one circuit's AC signal output and the next circuit's input. Filter circuits modify the potential of a signal in response to two factors: the arrangement of the resistor and capacitor in the filter (an R-C circuit), and the relationship of their combined time constant to the time period of the input wave. Changing the parameters causes either lower or higher frequencies to be attenuated. Filters are most commonly found in AC signal circuits.

## 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 circuit (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: Does the circuit 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 voltage across capacitor C1 using a multimeter.

$V_{AC} =$

$V_{C1} =$

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

The diagram shows a 10x8 grid for an oscilloscope trace. To the right of the grid are three rounded rectangular boxes for recording settings: a large box labeled "Time/Div", and two smaller boxes labeled "Channel 1 Volts/Div" and "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.

The diagram shows a 10x8 grid for an oscilloscope trace. To the right of the grid are three rounded rectangular boxes for recording settings: a large box labeled "Time/Div", and two smaller boxes labeled "Channel 1 Volts/Div" and "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.