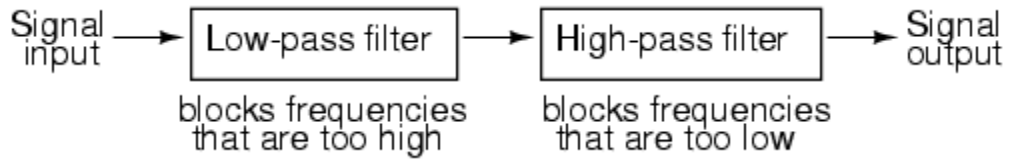
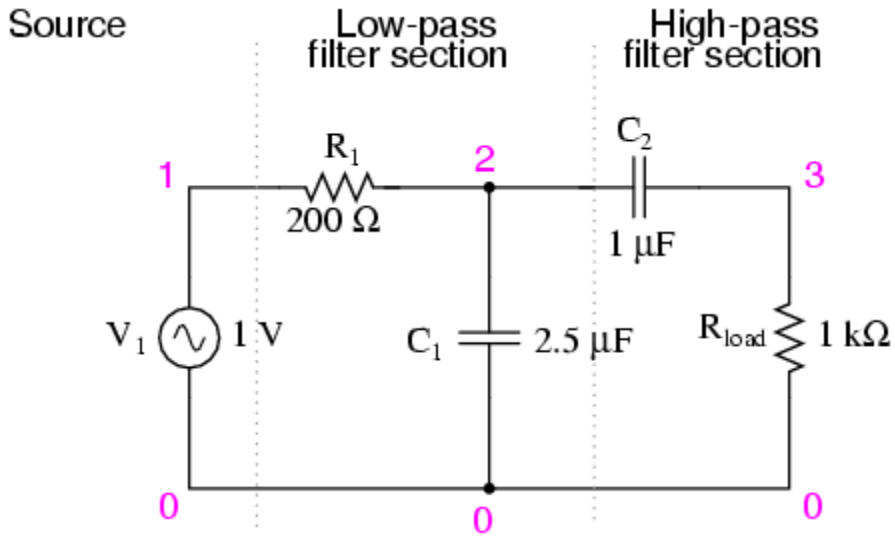
Band-pass filters

There are applications where a particular band, or spread, or frequencies need to be filtered from a wider range of mixed signals. Filter circuits can be designed to accomplish this task by combining the properties of low-pass and high-pass into a single filter. The result is called a *band-pass* filter. Creating a bandpass filter from a low-pass and high-pass filter can be illustrated using block diagrams:
(Figure below)



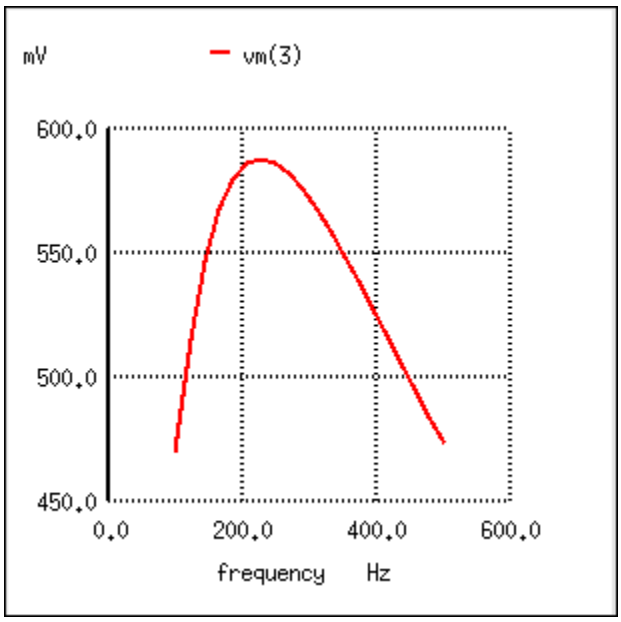
System level block diagram of a band-pass filter.
What emerges from the series combination of these two filter circuits is a circuit that will only allow passage of those frequencies that are neither too high nor too low. Using real components, here is what a typical schematic might look like Figure below. The response of the band-pass filter is shown in (Figurebelow)



Capacitive band-pass filter.

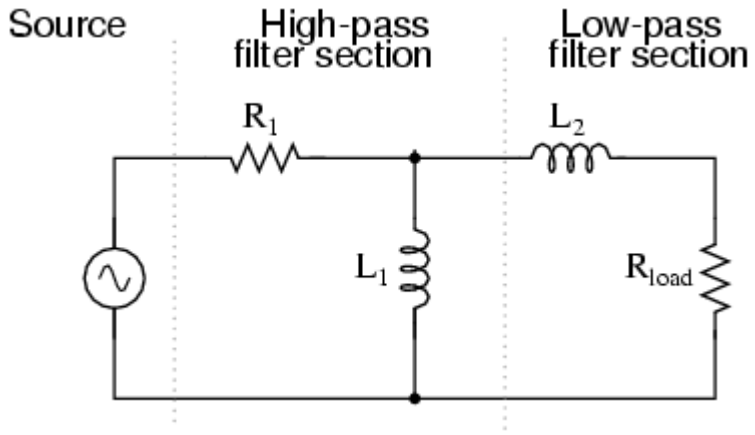
```
capacitive bandpass filter
v1 1 0 ac 1 sin
r1 1 2 200
c1 2 0 2.5u
c2 2 3 1u
```

```
rload 3 0 1k
.ac lin 20 100 500
.plot ac v(3)
.end
```



The response of a capacitive bandpass filter peaks within a narrow frequency range.

Band-pass filters can also be constructed using inductors, but as mentioned before, the reactive "purity" of capacitors gives them a design advantage. If we were to design a bandpass filter using inductors, it might look something like Figure below.



Inductive band-pass filter.

The fact that the high-pass section comes "first" in this design instead of the low-pass section makes no difference in its overall operation. It will still filter out all frequencies too high or too low.

While the general idea of combining low-pass and high-pass filters together to make a bandpass filter is sound, it is not without certain limitations. Because this type of band-pass filter works by relying on either section to *block* unwanted frequencies, it can be difficult to design such a filter to allow unhindered passage within the desired frequency range. Both the low-pass and high-pass sections will always be blocking signals to some extent, and their combined effort makes for an attenuated (reduced amplitude) signal at best, even at the peak of the "pass-band" frequency range. Notice the curve peak on the previous SPICE analysis: the load voltage of this filter never rises above 0.59 volts, although the source voltage is a full volt. This signal attenuation becomes more pronounced if the filter is designed to be more selective (steeper curve, narrower band of passable frequencies).

There are other methods to achieve band-pass operation without sacrificing signal strength within the pass-band. We will discuss those methods a little later in this chapter.

REVIEW:

- A *band-pass* filter works to screen out frequencies that are too low or too high, giving easy passage only to frequencies within a certain range.
- Band-pass filters can be made by stacking a low-pass filter on the end of a high-pass filter, or vice versa.
- "Attenuate" means to reduce or diminish in amplitude. When you turn down the volume control on your stereo, you are "attenuating" the signal being sent to the speakers.

Source: http://www.allaboutcircuits.com/vol_2/chpt_8/4.html