A Variable Bandpass Active Filter

— extremely simple design

Clean up those sine waves!

Allan S. Joffe W3KBM
1005 Twining Road
Dresher PA 19025

The op amp configured to produce an "active filter" is of general interest to the present-day ham for several reasons. His activities span a greater range of technology, op amps are rather inexpensive, and the final filter is a small unit that usually does a big job in a simple manner.

The bandpass type is rather useful for voice, CW, or RTTY modes, but the usual versions suffer from the lack of a diddle pot to vary the bandwidth without substantially affecting the design center frequency.

Fig. 1 shows a familiar bandpass filter without the variable bandwidth element. Fig. 2 shows the same circuitry with adjustable bandwidth and values for a center frequency of about 800 Hz. Using 5% value components, the measured peak frequency lucked out to be 820 Hz with the variable pot turned fully clockwise. This position is the broad position of the filter. With the pot turned fully counterclockwise (the sharp position of the filter), there is a slight shift of the center frequency to 865 Hz, but to the ear this is not detectable.

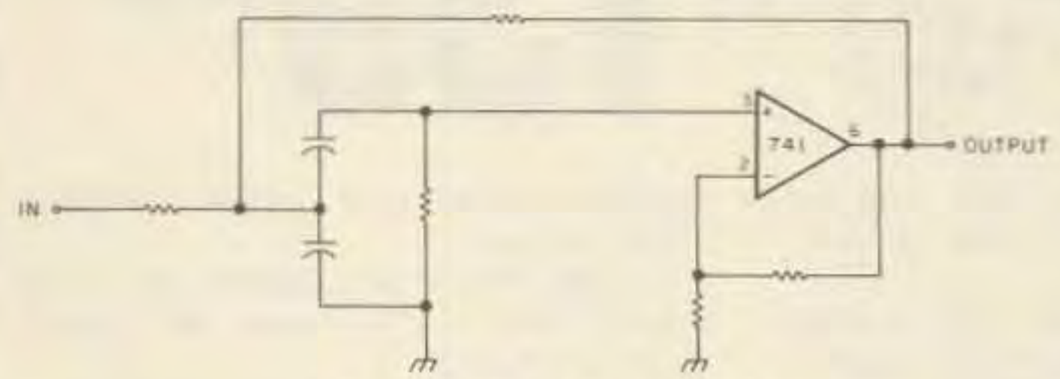

Fig. 1. Fixed bandwidth.

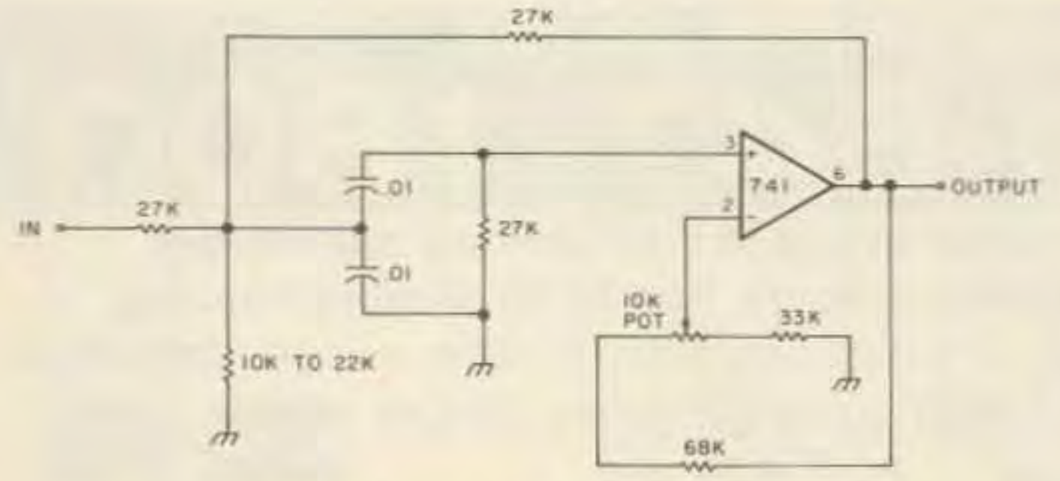

Fig. 2. Variable bandwidth.

In the broad position of the filter, the bandwidth at the 3 dB downpoints is a measured 718 Hz. The bandwidth at the 10 dB downpoints is 1890 Hz. In the sharp position, the bandwidth at the 3 dB downpoints is 275 Hz and 800 Hz at the 10 dB downpoints of the response curve. Naturally, as the pot is rotated, you can generate a series of bandwidths between these maximum and minimum limits.

With a plus and minus nine-volt supply for the 741 op amp, the available output swing is about five volts rms. There is a difference in the input sensitivity between the sharp and broad positions of the bandwidth control pot. In the sharp position, it takes about 1.2 volts in to produce the five volts out. In the broad position, this input voltage rises to about 2.7 volts.

The filter demands an input resistance of no more than 22k Ohms from the input terminal to ground, especially when the bandwidth control is set to the sharp position. If this condition is not met, the filter will oscillate, a fact that may come in handy. To illustrate, set the bandwidth pot to the maximum sharp position without any input termination. A scope on the output will show a sine wave with clipped peaks. If you slowly back off the bandwidth control, the clipped peaks will go away, leaving you with a rather nice clean sine wave that also has excellent frequency stability. The frequency of this oscillation will be close to 77% of the center frequency of the filter. ■