

## A Fourth Order Chebychev High-Pass Filter

The object of this design project is to design, assemble, and evaluate a 4th order Chebychev high-pass filter. The specifications are:

|                         |                       |
|-------------------------|-----------------------|
| dB ripple:              | 1.25 dB               |
| gain constant:          | $H_0 = 1.0$           |
| -3 dB cutoff frequency: | $f_3 = 5 \text{ kHz}$ |

The filter is to be realized with one second-order KRC filter and one second-order state-variable or Tow-Thomas type filter. Preferably, the resistor values should be in the  $1 \text{ k}\Omega$  to  $100 \text{ k}\Omega$  range.

A basic reference for the design is the filter potpourri located at:

<http://users.ece.gatech.edu/~mleach/ece4435/filtrpot.pdf>

There is an example on pages 14 and 15 that you can follow to determine the transfer function. Page 12 shows how to determine the cutoff frequency  $f_c$  from the  $-3 \text{ dB}$  frequency  $f_3$ . The second-order KRC filter is covered on page 23. The textbook covers state-variable type circuits that may be used. All you have to do is to determine the resonance frequency and quality factor of each second-order filter section, select suitable component values for each section, assemble the filter, and test it. As part of the report, you should include theoretical plots similar to Fig. 8 in the filter potpourri and a standard Bode plot on log-log scales. These can easily be done with Mathcad or any other math software.

It is suggested that you test each second-order section by itself before testing the overall filter. Check the resonance frequency by determining the frequency at which the phase shift between the input and output voltages is  $90^\circ$ . The quality factor is the relative gain at the resonance frequency. Each section must have the correct resonance frequency and quality factor for the overall filter to be correct.