ECE4435 Design Project 3
Fall 2005
A Cascaded Chebyshev High-Pass Filter and
Elliptic Low-Pass Filter

Input signals to a broadcast transmitter are normally filtered to prevent out-of-band signal components from producing undesired distortion in the transmitter modulator stage and from interfering with the stereo encoding equipment. The object of this design project is to design a band-pass filter that will pass audio signals in the band from 30 Hz to 15 kHz. On the low–frequency end, the filter is to exhibit the response of a 3rd-order 0.85 dB ripple Chebyshev filter with a -3 dB cutoff frequency of 30 Hz. On the high-frequency end, the filter is to exhibit the response of a 3rd-order or higher elliptic filter with the first notch in its response at 19 kHz. This is the frequency of the pilot tone in FM broadcasting. The pilot tone is broadcast with the audio signal and it is used to synchronize the receivers with the stereo encoders at the broadcast stations so that the left and right channel information can be decoded by the receiver. If the audio signal that is being transmitted has any power at 19 kHz, the stereo separation will be altered. Therefore, it is necessary for the filter to have a notch in its response at the pilot tone frequency. The frequency response of the elliptic filter should be as flat as possible above 15 kHz.

Circuit Specifications

1. The circuit input and output are to be dc coupled. The input resistance is to be 10 kΩ. The dc offset at the output is to be less than 10 mV.

2. The low-frequency response of the circuit is to exhibit the transfer function of a 3rd-order Chebyshev high-pass filter. The lower -3 dB cutoff frequency is to be 30 Hz. The dB ripple in the filter response is to be 0.85 dB.

3. The high-frequency response of the circuit is to exhibit the transfer function of a 3rd-order, or higher, elliptic low-pass filter. The frequency of the first notch in the elliptic filter response is to be 19 kHz. The response is to be as flat as possible below 15 kHz.

4. The filter is to have balanced inputs and outputs. The differential input resistance is to be 6 kHz. The differential output resistance is to be 600 Ω.