USING THE ANALOG DEVICES ACTIVE FILTER DESIGN TOOL

INTRODUCTION

The Analog Devices Active Filter Design Tool is designed to aid the engineer in designing all-pole active filters.

The filter design process is a two part effort. First, the response of the filter is determined. By this it is meant that the attenuation and/or phase response of the filter is defined. In step two the topology of the filter, how it is built, is defined. This application note is intended to help in step one. Several different standard responses are discussed, and their attenuation, group delay, step response and impulse response are presented. The filter tool is then employed to design the filter.

An example will be worked out.

STANDARD RESPONSES

There are many transfer functions that may satisfy the attenuation and/or phase requirements of a particular filter. The one that you choose will depend on the particular system. The importance of the frequency domain response vs. the time domain response must be determined. Also, both of these might be traded off against filter complexity, and thereby cost.

BUTTERWORTH

The Butterworth filter is the best compromise between attenuation and phase response. It has no ripple in the passband or the stopband and because of this is sometimes called a maximally flat filter. The Butterworth filter achieves its flatness at the expense of a relatively wide transition region from passband to stopband, with average transient characteristics.

The values of the elements of the Butterworth filter are more practical and less critical than many other filter types.

The frequency response, group delay, impulse response and step response are shown in fig. 1. The pole locations and corresponding ω_o and α terms are tabulated in fig. 12.

CHEBYSHEV

The Chebyshev (or Chevyshev, Tschebychev, Tschebyscheff or Tchevysheff, depending on how you translate from Russian) filter has a smaller transition region than the same-order Butterworth filter, at the expense of ripples in its passband. This filter gets its name from the Chebyshev criterion, which minimizes the height of the maximum ripple.

Chebyshev filters have 0 dB relative attenuation at DC. Odd order filters have an attenuation band that extends from 0 dB to the ripple value. Even order filters have a gain equal to the passband ripple. The number of cycles of ripple in the passband is equal to the order of the filter.