11.1: Introduction to Active Filters

Generally speaking, a filter is a circuit that inhibits the transfer of a specific range of frequencies. Conversely, you can think of a filter as a circuit that allows only certain frequencies to pass through. Filters are used to remove undesirable frequency components from a complex input signal. The uses for this operation are many, including the suppression of power-line hum, reduction of very low or high frequency interference and noise, and specialized spectral shaping. One very common use for filters is bandwidth limiting, which, as you'll see in Chapter Twelve, is an integral part of any analog-to-digital conversion system.

There are numerous variations on the design and implementation of filters. Indeed, an in-depth discussion of filters could easily fill more than one textbook. Our discussion must by necessity be of a limited and introductory nature. This chapter deals with the implementation of a number of popular op amp filter types. Due to the finite space available, every mathematical proof for the design sequences will not be detailed here, but may be found in the references listed at the end of the chapter.

Filter implementations may be classified into two very broad, yet distinct, camps: digital filters and analog filters. Digital filters work entirely in the digital domain, using numeric data as the input signal. The design of digital filters is an advanced topic and will not be examined here.

The second category, analog filters, utilizes standard linear circuit techniques for their construction. Analog filter implementations can be broken into two subcategories: passive and active. Passive filters utilize only resistors, inductors, and capacitors, whereas active filters make use of active devices (i.e., discrete transistors or op amps) as well. Although we will be examining only one subcategory in the world of filters, it is important to note that many of the circuits that we will design can be realized through passive analog filters or digital filters.