Introduction, Butter worth filters – 1st and 2nd order LPF filters

A filter is often a frequency selective circuit that passes electric signals at certain frequencies or frequency ranges while attenuating other frequencies . filters may be classified in number of ways.

1. Analog or digital filter
2. Passive or active filters
3. Audio or radio frequency filters.

In the lower frequency range (1 Hz to 1 MHz), however, the inductor value becomes very large and the inductor itself gets quite bulky, making economical production difficult. In these cases, active filters become important. Active filters are circuits that use an operational amplifier (op amp) as the active device in combination with some resistors and capacitors to provide an LRC-like filter performance at low frequencies

Active filters are most extensively used in the field of communications and signal processing. The most commonly used filters are

1. Low pass filter
2. High pass filter
3. Band-pass filter
4. Band reject filter
5. All pass filter

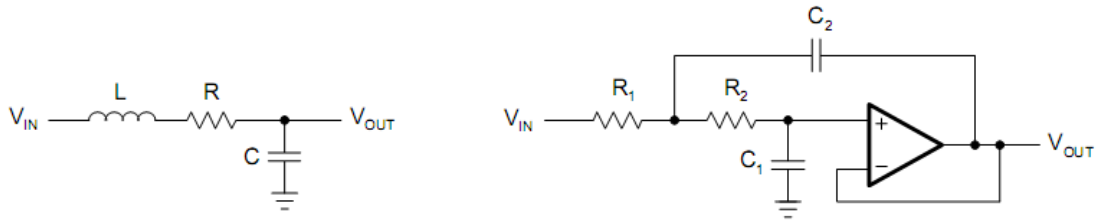

Figure 3.1

Fundamentals of Low-Pass Filters

The most simple low-pass filter is the passive RC low-pass network shown

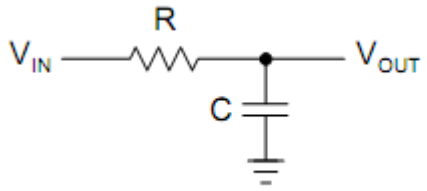

Figure 3.2

Its transfer function is:

$$A(s) = \frac{\frac{1}{RC}}{s + \frac{1}{RC}} = \frac{1}{1 + sRC}$$

$$s = \frac{s}{\omega_C} = \frac{j\omega}{\omega_C} = j\frac{f}{f_C} = j\Omega$$

$$A(s) = \frac{1}{1 + s}$$

In comparison to the ideal low-pass, the RC low-pass lacks in the following characteristics:, thus amplifying the upper pass band frequencies less than the lower pass band. The pass band gain varies long before the corner frequency, f_C The transition from the pass band into the stop band is not sharp, but happens gradually, moving the actual 80-dB roll off by 1.5 octaves above f_c. The phase response is not linear, thus increasing the amount of signal distortion Significantly. The gain and phase response of a low-pass filter can be optimized to satisfy one of the following three criteria:

1) A maximum pass band flatness,

2) An immediate pass band-to-stop band transition,

3) A linear phase response.