All Pass Filter

As the name suggests , an all pass filter passes all frequency components of the input signal with out attenuation, while providing predictable phase shifts for different frequencies of the input signal. When signal transmitted through transmission lines, such as telephone wires, they undergo change in phase. To compensate these changes all-pass filters are used. The all-pass filters are also called as delay equilizers or phase correctors.

An all-pass filter has a constant gain across the entire frequency range, and a phase response that changes linearly with frequency.Because of these properties, all-pass filters are used in phase compensation and signal delay circuits. Similar to the low-pass filters, all-pass circuits of higher order consist of cascaded first-order and second-order all-pass stages. To develop the all-pass transfer function from a low-pass response, replace A with the conjugate complex denominator. The general transfer function of an all pass is then:

$$A(s) = \frac{\prod_i \left(1 - a_i s + b_i s^2\right)}{\prod_i \left(1 + a_i s + b_i s^2\right)}$$

First-Order All-Pass Filter

shows a first-order all-pass filter with a gain of +1 at low frequencies and a gain of –1 at high frequencies. Therefore, the magnitude of the gain is 1, while the phase changes from 0° to –180°.

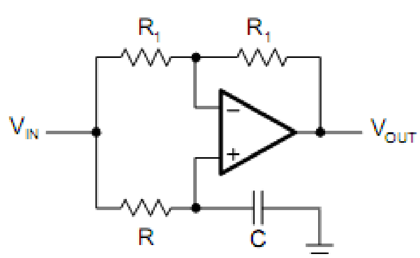

Figure 3.6

The transfer function of the circuit above is:

$$A(s) = \frac{1 - RC\omega_c \cdot s}{1 + RC\omega_c \cdot s}$$

The coefficient comparison with Equation results in:

$$a_i = RC \cdot 2\pi f_c$$

To design a first-order all-pass, specify fC and C and then solve for

$$R = \frac{a_i}{2\pi f_c \cdot C}$$

The maximum group delay of a first-order all-pass filter

$$t_{gr0} = 2RC$$