bass_equalizer.sqproj

Description

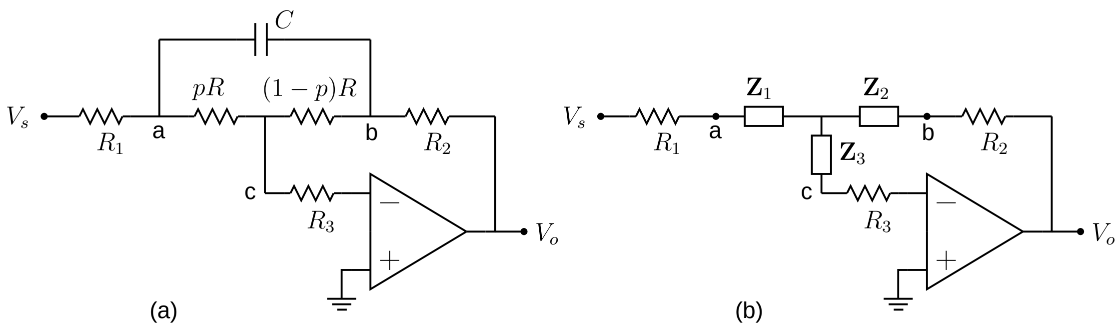

Figure 1: (a) Circuit schematic for bass equalizer, (b) simplified circuit.

The bass equalizer shown in Fig. 1 (a) can be simplified using $\triangle \rightarrow \mathsf{Y}$ transformation (see Fig. 1 (b)). The gain is then obtained as (show this),

$$\frac{V_o(s)}{V_i(s)} = -\frac{R_2 + \mathbf{Z}_2}{R_1 + \mathbf{Z}_1} \tag{1}$$

$$= -\frac{R_2}{R_1} \left\{ \frac{\left[1 + (1-p)\frac{R}{R_2}\right] + sRC}{\left[1 + p\frac{R}{R_1}\right] + sRC} \right\} . \tag{2}$$

The above transfer function has one zero and one pole. By changing the value of p (which is < 1) with a pot, we can obtain $|z| > |p|$ or $|z| < |p|$. This circuit is used to boost or cut low frequencies in an audio amplifier.

Exercise Set

1. Derive the transfer function given in the above equation.

2. Simulate the circuit with $R_1 = R_2 = R_3 = 11\,\text{k}$, $R = 100\,\text{k}$, and $C = 22\,\text{n}F$, for various values of p (between 0 and 1). Plot $\log|V_o|$ versus $\log f$ for the different p values on the same plot so that the effect of changing p can be clearly observed.

3. What is $|H(j\omega)|$ for $\omega \rightarrow 0$ for (a) $p \approx 0$, (b) $p \approx 1$? Verify your answers with simulation results.

References:

1. J. M. Fiore, *Op amps and linear integrated circuits,* Delmar, 2001.