

because ω_o has not been set yet). Then adjust ω_o by adjusting R_2 and R_5 simultaneously by the *same* percentage: α will remain constant. A trimming scheme involving C_1 would be simpler. The sensitivities to element value changes are

$$S_{R_2}^{\omega_o} = S_{R_5}^{\omega_o} = S_{C_3}^{\omega_o} = S_{C_4}^{\omega_o} = -\frac{1}{2}$$

$$S_{R_2}^{\alpha} = -S_{R_5}^{\alpha} = \frac{1}{2}$$

$$S_{C_3}^{\alpha} = \frac{1}{2} - \frac{1}{\alpha\omega_o R_5 C_3} \left(\frac{C_1}{C_3} + 1 \right)$$

$$S_{C_4}^{\alpha} = \frac{1}{2} - \frac{1}{\alpha\omega_o R_5 C_4} \left(\frac{C_1}{C_3} + 1 \right)$$

$$S_{C_1}^{\alpha} = \frac{1}{\alpha\omega_o R_5} \frac{C_1}{C_3 C_4}$$

$$S_{C_1}^{H_o} = -S_{C_4}^{H_o} = 1$$

DESIGN PROCEDURE

Given: H_o , α , $\omega_o = 2\pi f_o$

Choose: $C = C_1 = C_3$, a convenient value

Calculate: $R_5 = \frac{1}{\alpha\omega_o C} (2H_o + 1)$

$$R_2 = \frac{\alpha H_o}{\omega_o C (2H_o + 1)}$$

$$C_4 = \frac{C_1}{H_o}$$

Again, restrictions on H_o are the same as those for the low-pass case. Note that this realization requires three capacitors, a feature which might make it undesirable when compared with other circuits.

Bandpass 1. There are several configurations of the five elements which may be used to realize a bandpass function. One of the more practical configurations is the one shown in Fig. 8.5. The voltage transfer function is

$$\frac{E_o}{E_1}(s) = \frac{-s(1/R_1 C_4)}{s^2 + s(1/R_5)(1/C_3 + 1/C_4) + (1/R_5 C_3 C_4)(1/R_1 + 1/R_2)}$$

In terms of our bandpass network function

$$H_o = \frac{1}{(R_1/R_5)(1 + C_4/C_3)}$$

$$H(s) = \frac{H_o \alpha \omega_o s}{s^2 + \alpha \omega_o s + \omega_o^2}$$