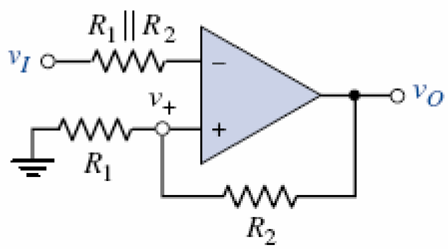
Assignment 3

15.36 A Schmitt trigger is shown in Figure 15.30(a). The parametes are: $V_H = +10\,\text{V}$, $V_L = -10\,\text{V}$, $R_1 = 10\,\text{k}\Omega$, and $R_2 = 40\,\text{k}\Omega$. (a) Determine the crossover voltages V_{TH} and V_{TL}. (b) Assume a sinusoidal voltage $v_I = 5\sin[2\pi(60)t]\,\text{V}$ is applied at the input. Sketch the steady-state output voltage versus time over two periods of the waveform.

15.37 Consider the Schmitt trigger in Figure P15.37. Assume the saturated output voltages are $\pm V_P$. (a) Derive the expression for the crossover voltages V_{TH} and V_{TL}. (b) Let $R_A = 10\,\text{k}\Omega$, $R_B = 20\,\text{k}\Omega$, $R_1 = 5\,\text{k}\Omega$, $R_2 = 20\,\text{k}\Omega$, $V_P = 10\,\text{V}$, and $V_{\text{REF}} = 2\,\text{V}$. (a) Find V_{TH} and V_{TL}. (b) Sketch the voltage transfer characteristics.

15.38 The saturated output voltages are $\pm V_P$ for the Schmitt trigger in Figure P15.38. (a) Derive the expressions for the crossover voltages V_{TH} and V_{TL} (b) If $V_P = 12\,\text{V}$, $V_{\text{REF}} = -10\,\text{V}$, and $R_3 = 10\,\text{k}\Omega$, find R_1 and R_2 such that the switching point is $V_S = -5\,\text{V}$ and the hysteresis width is $0.2\,\text{V}$. (c) Sketch the voltage transfer characteristics.



(a)

Figure 15.30

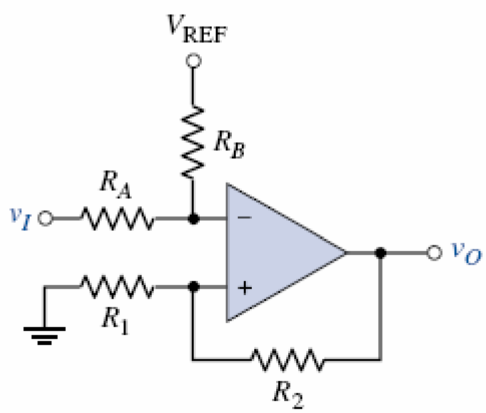


Figure P15.37

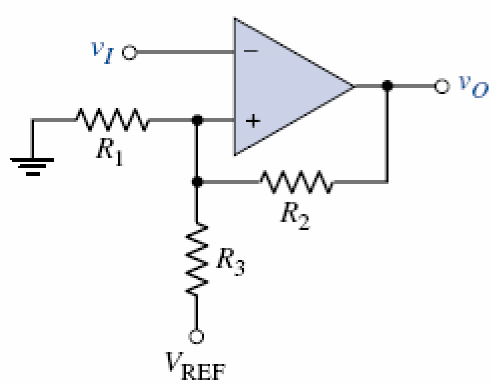


Figure P15.38

15.40 Consider the Schmitt trigger in Figure 15.32(a). (a) Derive the expressions for the switching point and crossover voltages, as given in Equations (15.76) and (15.77). (b) Let $V_H = +10\,\text{V}$, $V_L = -10\,\text{V}$, and $R_1 = 10\,\text{k}\Omega$. Determine R_2 and V_{REF} such that $V_{TH} = 2\,\text{V}$ and $V_{TL} = 1\,\text{V}$.

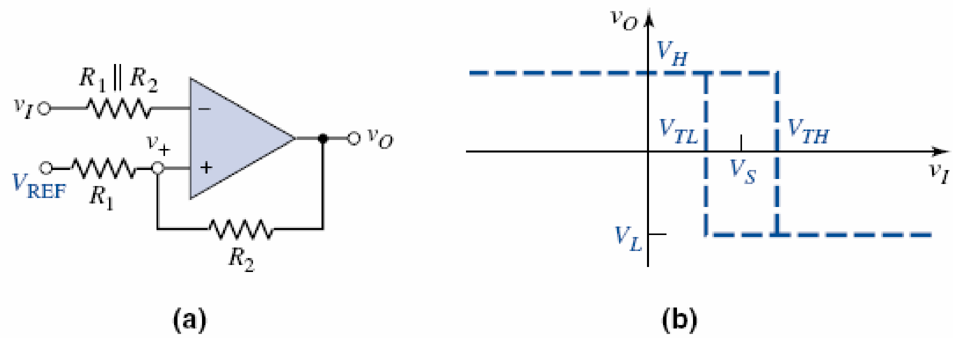


Figure 15.32 (a) Inverting Schmitt trigger circuit with applied reference voltage and (b) voltage transfer characteristics

$$V_S = \left(\frac{R_2}{R_1 + R_2}\right) V_{REF} \tag{15.76}$$

$$V_{TH} = V_S + \left(\frac{R_1}{R_1 + R_2}\right) V_H \tag{15.77(a)}$$

and

$$V_{TL} = V_S + \left(\frac{R_1}{R_1 + R_2}\right) V_L \tag{15.77(b)}$$

15.41 Consider the Schmitt trigger in Figure 15.33(a). (a) Derive the expressions for the switching point and crossover voltages, as given in Equations (15.78) and (15.79). (b) Let $V_H = 12\text{ V}$, $V_L = -12\text{ V}$, and $R_2 = 20\text{ k}\Omega$. Determine R_1 and V_{REF} such that $V_{TH} = -1\text{ V}$ and $V_{TL} = -2\text{ V}$.

$$V_S = \left(1 + \frac{R_1}{R_2}\right) V_{REF} \tag{15.78}$$

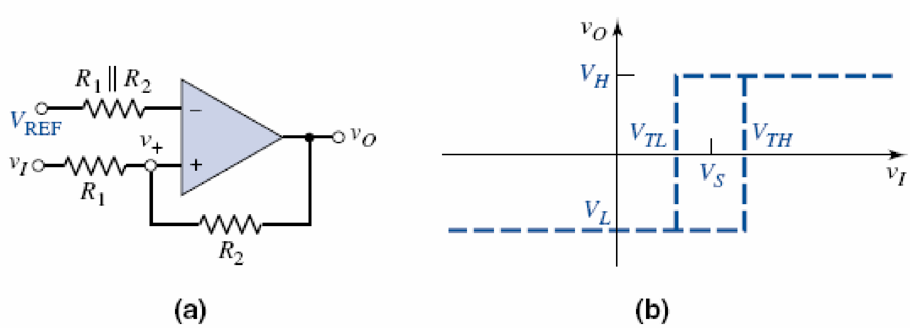


Figure 15.33 (a) Noninverting Schmitt trigger circuit with applied reference voltage and (b) voltage transfer characteristics

$$V_{TH} = V_S - \left(\frac{R_1}{R_2}\right)V_L \qquad \textbf{(15.79(a))}$$

and

$$V_{TL} = V_S - \left(\frac{R_1}{R_2}\right)V_H \qquad \textbf{(15.79(b))}$$