Stability of Voltage-Divider Bias To analyze a voltage-divider biased transistor circuit for base current loading effects, apply Thevenin's theorem. We will use this method to evaluate the circuit. First, let's get an equivalent base-emitter circuit for the circuit in Figure 5–13(a) using Thevenin's theorem. Looking out from the base terminal, the bias circuit can be redrawn as shown in Figure 5–13(b). Apply Thevenin's theorem to the circuit left of point *A*, with V_{CC} replaced by a short to ground and the transistor disconnected from the circuit. The voltage at point *A* with respect to ground is

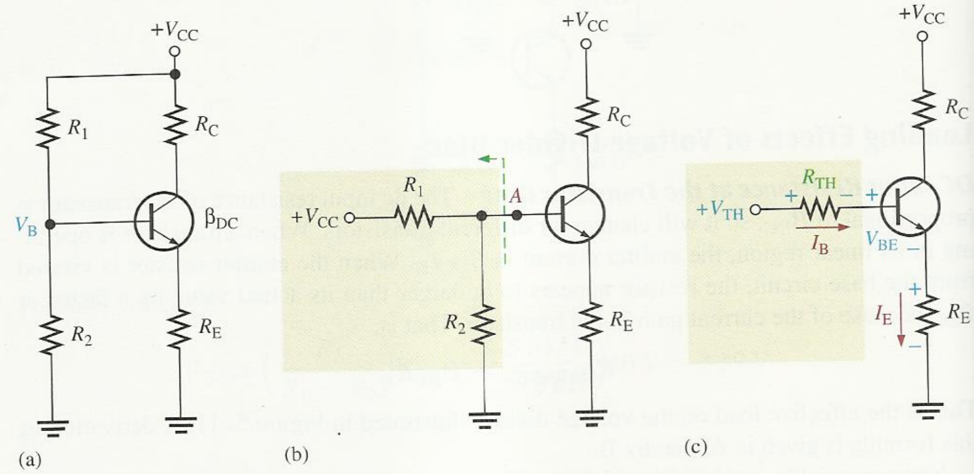
$$V_{TH} = \left(\frac{R_2}{R_1 + R_2}\right)V_{CC}$$

and the resistance is

$$R_{TH} = \frac{R_1R_2}{R_1 + R_2}$$

▶ FIGURE 5–13

Thevenizing the bias circuit.



The Thevenin equivalent of the bias circuit, connected to the transistor base, is shown in the beige box in Figure 5–13(c). Applying Kirchhoff's voltage law around the equivalent base-emitter loop gives

$$V_{TH} - V_{R_{TH}} - V_{BE} - V_{R_E} = 0$$

Substituting, using Ohm's law, and solving for V_{TH},

$$V_{TH} = I_BR_{TH} + V_{BE} + I_ER_E$$

Substituting I_E/β_{DC} for I_B,

$$V_{TH} = I_E(R_E + R_{TH}/\beta_{DC}) + V_{BE}$$

Then solving for I_E,

Equation 5–6

$$I_E = \frac{V_{TH} - V_{BE}}{R_E + R_{TH}/\beta_{DC}}$$

If R_{TH}/β_{DC} is small compared to R_E, the result is the same as for an unloaded voltage divider.

Voltage-divider bias is widely used because reasonably good bias stability is achieved with a single supply voltage.

Voltage-Divider Biased PNP Transistor As you know, a *pnp* transistor requires bias polarities opposite to the *npn*. This can be accomplished with a negative collector supply voltage, as in Figure 5–14(a), or with a positive emitter supply voltage, as in Figure 5–14(b). In a schematic, the *pnp* is often drawn upside down so that the supply voltage line can be drawn