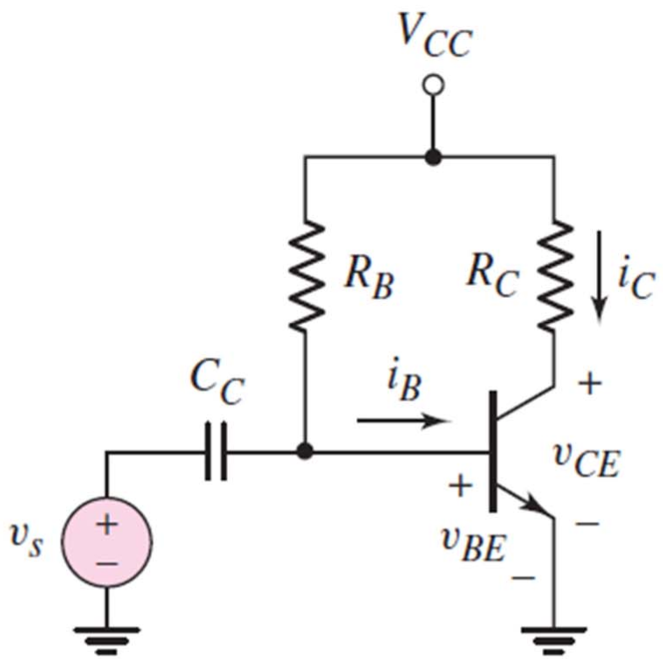
Bipolar Transistor Biasing

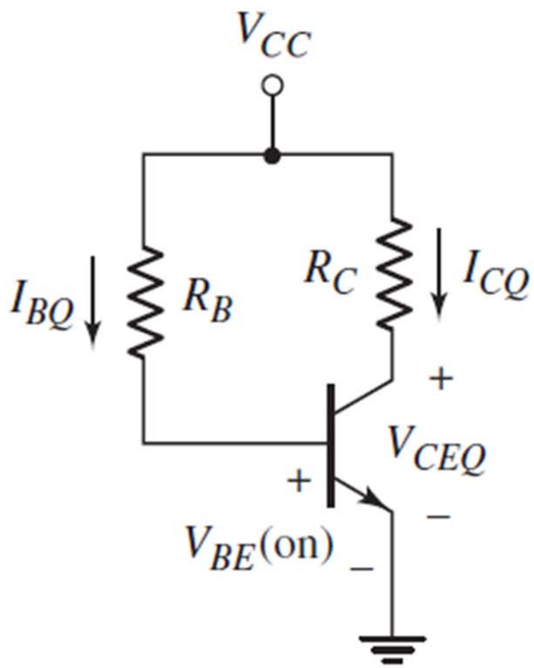
Linear amplifier - keep the transistor in the forward-active mode,

- The signal source is not connected to ground
- May not want DC base current flowing through signal source

Single Base Resistor Biasing:

- Decoupling signal source from DC bias by using a capacitor.
- The signal is connected to ground





DC equivalent

$$R_B = \frac{V_{CC} - V_{BE}(\text{on})}{I_{BQ}} \qquad R_C = \frac{V_{CC} - V_{CEQ}}{I_{CQ}}$$

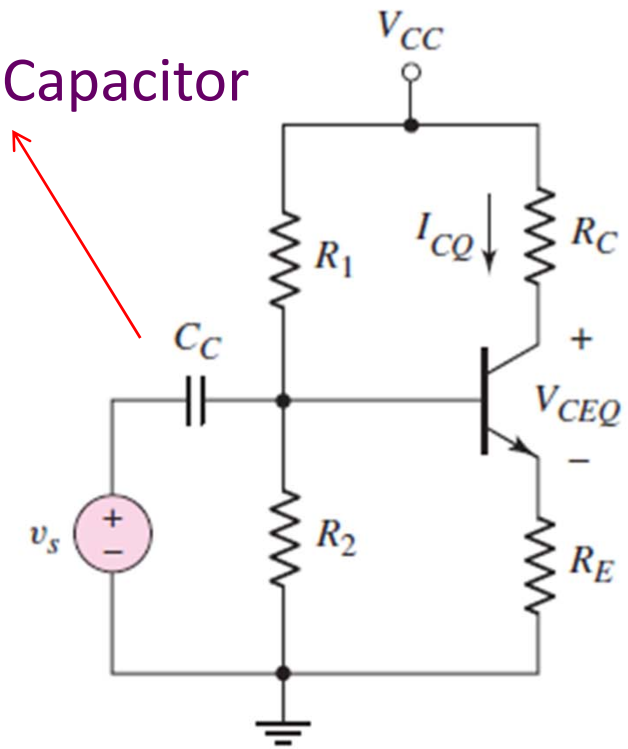
$$I_{BQ} = \frac{I_{CQ}}{\beta}$$

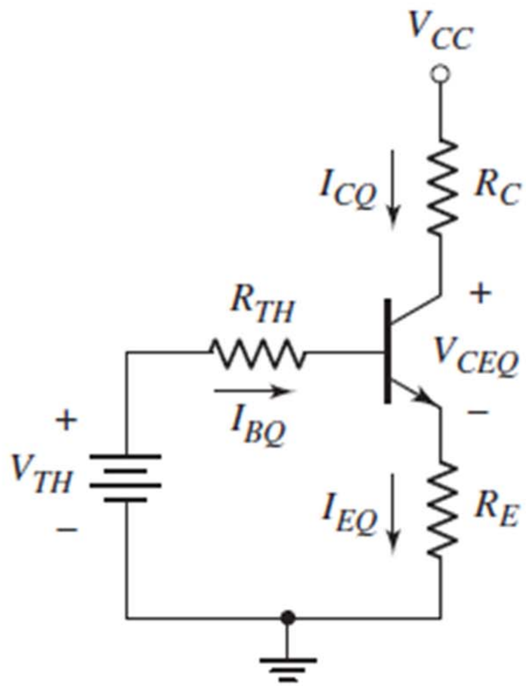
β	50	100	150
Q-point values	$I_{CQ} = 0.50$ mA $V_{CEQ} = 9$ V	$I_{CQ} = 1$ mA $V_{CEQ} = 6$ V	$I_{CQ} = 1.5$ mA $V_{CEQ} = 3$ V

Voltage Divider Biasing and Bias Stability

Single bias resistor R_B is replaced by a pair of resistors R_1 and R_2, and an emitter resistor R_E is added

Coupling Capacitor





DC equivalent

$$V_{TH} = [R_2/(R_1 + R_2)]V_{CC}$$

$$R_{TH} = R_1 \| R_2$$

Kirchhoff's law in BE loop:

$$V_{TH} = I_{BQ}R_{TH} + V_{BE}(\text{on}) + I_{EQ}R_E$$

$$I_{EQ} = (1 + \beta)I_{BQ}$$

$$I_{BQ} = \frac{V_{TH} - V_{BE}(\text{on})}{R_{TH} + (1 + \beta)R_E}$$

$$I_{CQ} = \beta I_{BQ} = \frac{\beta(V_{TH} - V_{BE}(\text{on}))}{R_{TH} + (1 + \beta)R_E}$$

Bias stability:

$$R_{TH} \ll (1+\beta)R_E$$

$$I_{CQ} \cong \frac{\beta(V_{TH} - V_{BE}(\text{on}))}{(1+\beta)R_E}$$

$$\beta \gg 1 \qquad \beta/(1+\beta) \cong 1$$

$$I_{CQ} \cong \frac{(V_{TH} - V_{BE}(\text{on}))}{R_E}$$

General rule → $R_{TH} \cong 0.1(1+\beta)R_E$