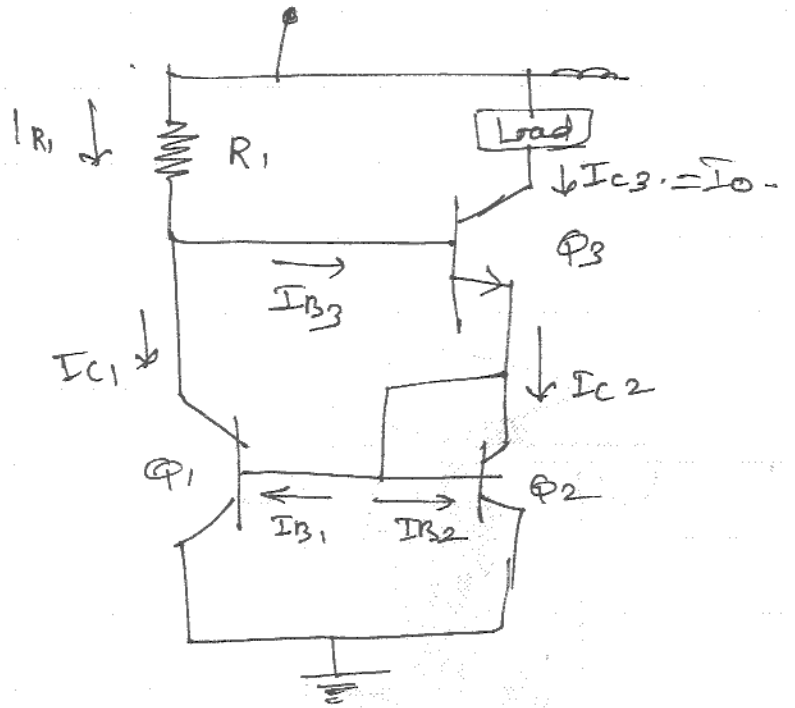
Wilson current Source:

→ It provide constant current source.



Assumption:

→ All transistors have the same current gain β.

→ Q_1 & Q_2 are matched. so collector current are equal.

$\therefore$ $I_{C_1} = I_{C_2} = (I_C)$ and $I_{B_1} = I_{B_2} = I_B$ ——— (1)

Base current of Q_3 is given by

$$I_{B_3} = \frac{I_{C_3}}{\beta} \quad \text{———} \quad (2)$$

and Emitter current by

$$I_{E_3} = \left(\frac{\beta+1}{\beta}\right) I_{C_3} \quad \text{———} \quad (3).$$

From the ckt,

$$I_{E3} = I_{C2} + I_{B1} + I_{B2} \quad \text{——— (3)}.$$

Substitute for I_{C2}, I_{B1} from (1). to (4).

$$I_{E3} = I_C + 2I_B \quad \text{——— (5)}.$$

$$I_{E3} = I_C\left(1 + \frac{2}{\beta}\right) \quad \text{——— (6)}.$$

Substitute for I_{E3} From (3).

$$\left(\frac{\beta+1}{\beta}\right) I_{C3} = I_C\left(1+\frac{2}{\beta}\right).$$

Rearranging,

$$I_C = \left(\frac{\beta+1}{\beta+2}\right) I_{C3} \quad \text{——— (7)}.$$

Current through R_1 is given by,

$$I_{R1} = I_{C1} + I_{B3} \quad \text{——— (8)}.$$

But $I_{C1} = I_{C2} = I_C$.

Substitute for I_C From (7) in (8) and since,

$$I_{R1} = \left(\frac{\beta+1}{\beta+2}\right) \cdot I_{C3} + \frac{I_{C3}}{\beta} \quad \text{——— (9)}$$

$$I_{R1} = \left(\frac{\beta+1}{\beta+2} + \frac{1}{\beta}\right) I_{C3} \quad \text{——— (10)}$$

Finally,

$$I_{C3} = \frac{I_{R1}}{1 + \frac{2}{\beta(\beta+2)}} \qquad \text{(11)}$$

From the above eqn,

$$\frac{2}{\beta(\beta+2)} << 1 \;, \quad I_{C3} \approx I_{R1}$$

And the o/p current,

$$\boxed{I_{C3} \approx I_{R1}} = \frac{V_{CC} - 1.4}{R_1}$$

o/p current depends only on V_{CC} and R_1