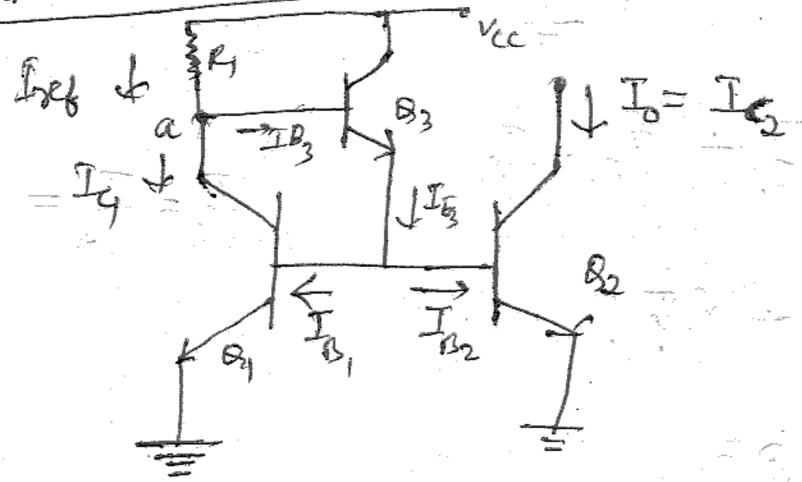
$$I_{ref} \simeq I_c \simeq \frac{V_{cc}}{R}$$

~~25/06/11~~

30/6/11 :-

CURRENT SOURCE WITH GAIN



To find I_0 :

KCL ~~KCL~~ at node a.

$$I_{ref} = I_{C_1} + I_{B_3}$$

$$I_{ref} = I_{C_1} + \frac{I_{C_3}}{\beta}$$

$$\boxed{I_{B_3} = \frac{I_{E_3}}{1+\beta}}$$

$$\beta = \frac{I_C}{I_B} \quad -(1)$$

$$\alpha = \frac{I_C}{I_E} \quad -(2)$$

from (1),

$$I_B = \frac{I_C}{\beta}$$

from

$$I_C = \alpha I_E$$

$$\therefore I_B = \frac{I_C}{\beta}$$

$$= \frac{\alpha I_E}{\beta}$$

$$\left[\because \alpha = \frac{\beta}{1+\beta}\right]$$

$$= \frac{\beta}{1+\beta}\left(\frac{I_E}{\beta}\right)$$

$$I_B = \frac{I_E}{1+\beta}$$

$$\Rightarrow I_{B3} = \frac{I_{E3}}{1+\beta}$$

$$I_{ref} = I_{C1} + I_{B3}$$

$$= I_{C1} + \frac{I_{C3}}{\beta}$$

$$= I_{C1} + \alpha \frac{I_E}{\beta}$$

$$I_{ref} = I_{C1} + \frac{\beta}{1+\beta} \cdot \frac{I_E}{\beta}$$

$$\boxed{I_{ref} = I_{C1} + \frac{I_E}{1+\beta}}$$

It Consist of Transistor Q_1 & Q_2 with and ~~identitical~~ identical → Same bases connected, & collector current are equal

$$I_{E3} = I_{B1} + I_{B2} \quad -①$$

$$\because I_{B1} = I_{B2} = I_B \quad -②$$

$$\Rightarrow I_{E3} = 2I_B$$

$$\therefore \boxed{I_{ref} = I_{C1} + \frac{2I_B}{1+\beta}}$$

$$\because I_B = \frac{I_C}{\beta}$$

$$I_{ref} = I_{C1} + \cancel{\alpha\beta} \cdot \frac{2}{1+\beta} \cdot \frac{I_C}{\beta} \qquad I_{C1} = I_{C2} = I_0$$

$$\cancel{I_C}$$

$$= I_C \left[1 + \frac{2}{\beta(1+\beta)}\right]$$

$$\boxed{I_{ref} = I_0 \left[1 + \frac{2}{\beta(1+\beta)}\right]}$$

Conclusion :- O/P Current I_o is independent of β. If $\beta << 1$

$\therefore$ O/P current is approximately equal to I_o

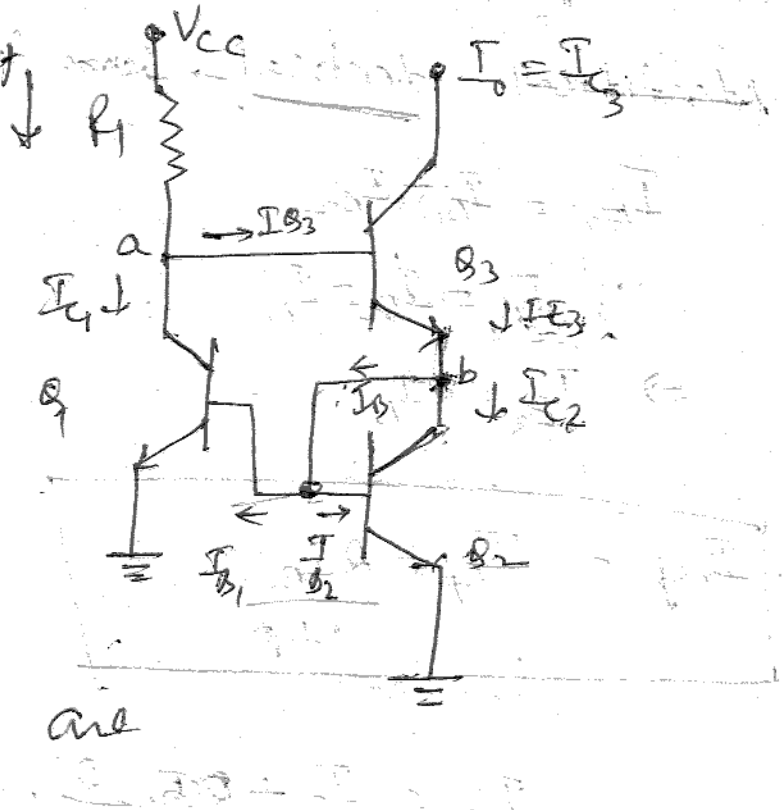
$\Rightarrow I_o = I_{ref}$

WILSON CURRENT SOURCE :-

$Q_1 = Q_2$

$I_{C_1} = I_{C_2}$

$I_{B_1} = I_{B_2}$



Since Q_1 & Q_2 are identical.

Apply KCL at 'a',

$I_B = \frac{I_C}{\beta}$

$$I_{ref} = I_{C_1} + I_{B_3}$$

$$I_{ref} = I_{C_1} + \frac{I_{C_3}}{\beta} \quad \cancel{= I_{C_1} + \frac{I_{C_1}}{\beta}}$$

$\cancel{I_{ref} = I_{C_1} + \frac{2 I_{B_3}}{\beta}}$

Apply KCL at node B,

$$I_{B_1} = I_{B_2} = I_B$$

$$I_{E_3} = I_{C_2} + I_{B_1} + I_{B_2}$$
$$= I_{C_2} + 2I_B$$
$$= I_{C_2} + \frac{2I_C}{\beta}$$

from Q_3

$$I_{E_3} = I_{C_3} + I_{B_3}$$
$$= I_{C_3} + \frac{I_{C_3}}{\beta} = I_{C_3}\left(1 + \frac{1}{\beta}\right)$$

$$\Rightarrow I_{C_2} + \frac{2I_C}{\beta} = I_{C_3}\left(1 + \frac{1}{\beta}\right)$$

$$\because I_{C_3} = I_0$$

$$\Rightarrow I_{C_2} + \frac{2I_C}{\beta} = I_0\left(1 + \beta\right)$$

$$\Rightarrow I_C\left(1 + \frac{2}{\beta}\right) = I_0\left(1 + \frac{1}{\beta}\right)$$

$$\Rightarrow \boxed{I_C = \frac{I_0\left(1 + \frac{1}{\beta}\right)}{1 + \frac{2}{\beta}}}$$

$$I_C = \frac{I_0\left(\frac{\beta+1}{\beta}\right)}{\frac{2+\beta}{\beta}}$$

$$\boxed{I_C = I_0\left(\frac{1+\beta}{2+\beta}\right)}$$

$$\boxed{I_C = \frac{V_{CC} - V_{BE}}{R}}$$