VOLTAGE DIVIDER BIAS

Voltage Divider Bias:

If the load resistance R_C is very small, e.g. in a transformer coupled circuit, then there is no improvement in stabilization in the collector to base bias circuit over fixed bias circuit. A circuit which can be used even if there is no dc resistance in series with the collector, is the voltage divider bias or self bias. **fig. 3**.

The current in the resistance R_E in the emitter lead causes a voltage drop which is in the direction to reverse bias the emitter junction. Since this junction must be forward biased, the base voltage is obtained from the supply through R_1, R_2 network. If $R_b = R_1 || R_2$ equivalent resistance is very – very small, then V_{BE} voltage is independent of I_{CO} and ¶ I_C / ¶ I_{CO} ® 0. For best stability R_1 & R_2 must be kept small.

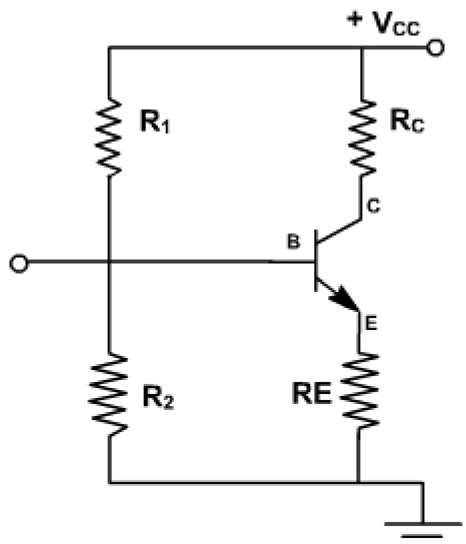

Fig. 3

If I_C tends to increase, because of I_{CO}, then the current in R_C increases, hence base current is decreased because of more reverse biasing and it reduces I_C .

To analysis this circuit, the base circuit is replaced by its thevenin's equivalent as shown in **fig. 4**.

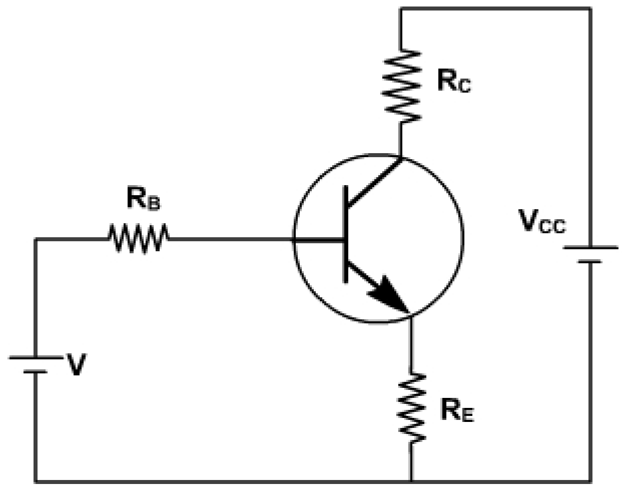

Fig. 4

Thevenin's voltage is

$$V = \frac{R_2}{R_1 + R_2} V_{CC},$$

$$R_b = \frac{R_1 R_2}{R_1 + R_2}$$

R_b is the effective resistance seen back from the base terminal.

$$V = I_B R_b + V_{BE} + (I_B + I_C) R_E$$

If V_{BE} is considered to be independent of I_C, then

$$\frac{\partial I_B}{\partial I_C} = -\frac{R_E}{R_B + R_E}$$

$$S = \frac{1 + \beta_{dc}}{1 + \frac{\beta_{dc} R_E}{R_B + R_E}}$$

$$\text{If} \quad R_b/R_c \to 0 \quad \text{then} \quad S \to 1$$

$$\text{If} \quad R_b/R_c \to \infty \quad \text{then}\ S \to (1 + \beta_{dc}).$$

The smaller the value of R_b, the better is the stabilization but S cannot be reduced be unity.

Hence I_C always increases more than I_{CO}. If R_b is reduced, then current drawn from the supply increases. Also if R_E is increased then to operate at same Q-point, the magnitude of V_{CC} must be increased. In both the cases the power loss increased and reduced h.

In order to avoid the loss of ac signal because of the feedback caused by R_E, this resistance is often by passed by a large capacitance (> 10 m F) so that its reactance at the frequency under consideration is very small.

Emitter Bias:

Fig. 5, shown the emitter bias circuit. The circuit gets this name because the negative supply V_{EE} is used to forward bias the emitter junction through resistor R_E. V_{CC} still reverse biases collector junction. This also gives the same stability as voltage divider circuit but it is used only if split supply is available.

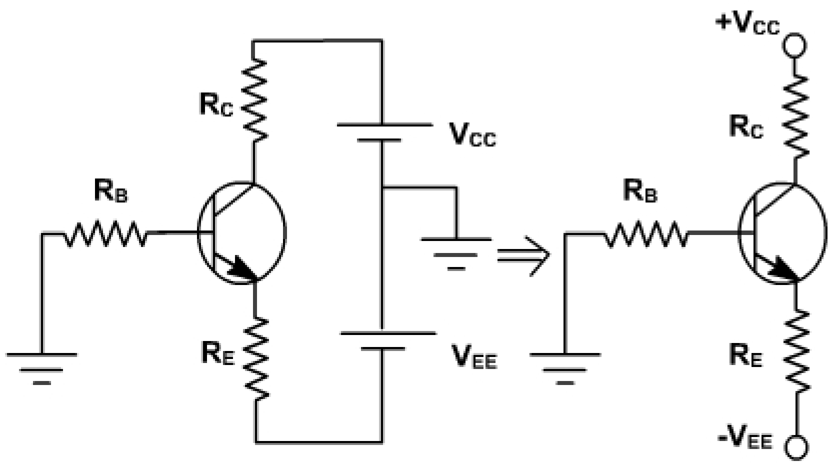

Fig. 5

In this circuit, the voltage equation is given by

$$I_B R_B + V_{BE} + I_E R_E = V_{EE}$$

therefore, $I_B = \frac{I_C}{\beta_{dc}} = \frac{I_E}{\beta_{dc}}$

and $I_E = \frac{V_{EE} - V_{BE}}{R_E + \frac{R_B}{\beta_{dc}}}$

If I_C or I_E is to be independent of β then $R_E >> \frac{R_B}{\beta_{dc}}$

and then $I_E = \frac{V_{EE} - V_{BE}}{R_E}$

This shown that emitter is virtually at ground potential.

$$V_{CE} = V_{CC} - I_C R_C$$

Normally R_B is selected less than $0.01 \ \beta_{dc} R_E$