ELECTRONICS DEVICES AND CIRCUITS

UNIT -III

BJT BIASING

Presented by

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BIASING

TRANSISTOR BIASING :

The basic function of transistor is amplification. The process of raising the strength of weak signal without any change in its general shape is referred as faithful amplification. For faithful amplification it is essential that:-

.1..Emitter-Base junction is forward biased

2. Collector- Base junction is reversed biased

3. Proper zero signal collector current

Biasing is the process of providing DC voltage which helps in the functioning of the circuit. A transistor is based in order to make the emitter base junction forward biased and collector base junction reverse biased, so that it maintains in active region, to work as an amplifier. If the transistor is not biased properly, it would work inefficiently and produce distortion in output signal.

A transistor is biased either with the help of battery or associating a circuit with the transistor. The later method is more efficient and is frequently used. The circuit used for transistor biasing is called the biasing circuit.

STABILIZATION :

through proper biasing, a desired quiescent operating point of the transistor amplifier in the active region (linear region) of the characteristics is obtained. it is desired that once selected the operating point should remain stable. the maintenance of operating point stable is called stabilization

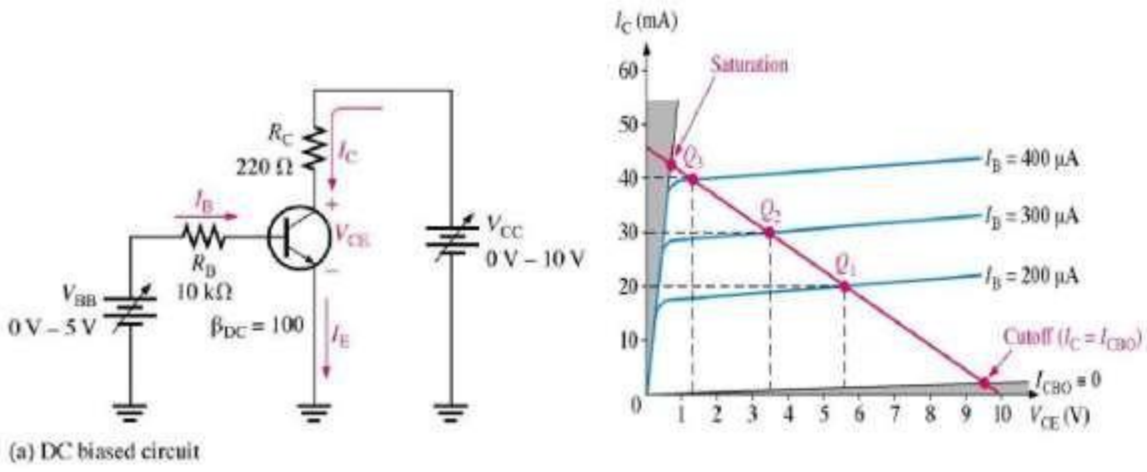
The selection of a proper quiescent point generally depends on the following factors:

(a) the amplitude of the signal to be handled by the amplifier and distortion level in signal

(b) the load to which the amplifier is to work for a corresponding supply voltage

(c) the operating point of a transistor amplifier shifts mainly with changes in temperature, since the transistor parameters — β, ico and vbe (where the symbols carry their usual meaning)—are functions of temperature.

DC OPERATING POINT:



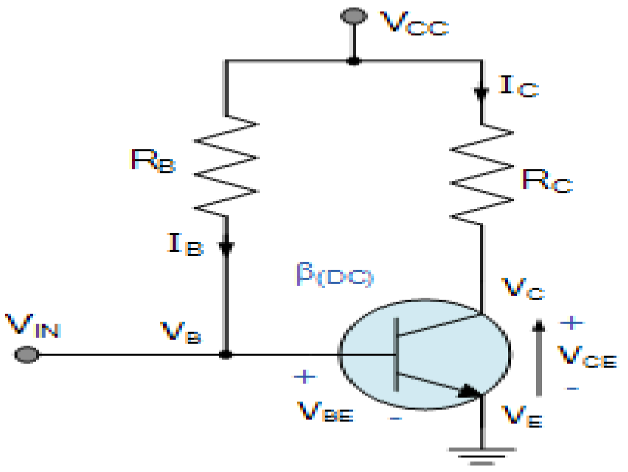
The transistor circuit to amplify it must be properly biased with dc voltages. The dc operating point between saturation and cutoff is called the Q-point. The goal is to set the Q-point such that that it does not go into saturation or cutoff when an a ac signal is applied.

Requirements of Biasing Network:

1. Ensuring proper zero signal collector current.
2. Ensuring VcE not falling below 0.5V for Ge transistor and 1V for Silicon transistor a• Ensuring Stabilization of operating point. (zero signal IC and VcE)

BIASING CIRCUITS:

The circuit shown is called as a "fixed base bias circuit", because the transistors base current, I_B remains constant for given values of Vcc, and therefore the transistors operating point must also remain fixed. This two resistor biasing network is used to establish the initial operating region of the transistor using a fixed current bias

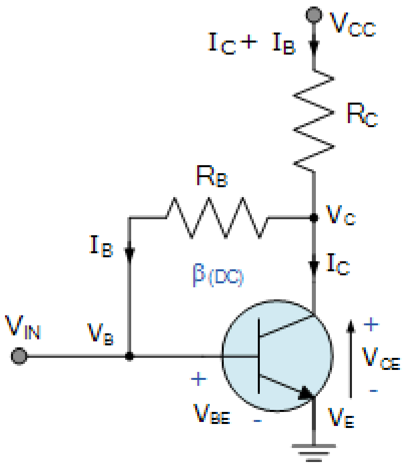


The emitter diode of the transistor is forward biased by applying the required positive base bias voltage via the current limiting resistor R_B. Assuming a standard bipolar transistor, the forward base-emitter voltage drop would be 0.7V. Then the value of R_B is simply: $(V_{CC} - V_{BE})/I_B$ where I_B is defined as I_C/β

$$V_C = V_{CC} - (I_C R_C)$$
$$V_{CE} = V_C - V_E$$
$$V_E = 0V$$
$$V_B = V_{BE}$$
$$I_B = \frac{V_{CC} - V_{BE}}{R_B}$$
$$I_C = \beta_{(DC)} I_B$$
$$I_E = (I_C + I_B) \cong I_C$$

Collector Feedback Biasing

This self biasing collector feedback configuration is another beta dependent biasing method which requires two resistors to provide the necessary DC bias for the transistor. The collector to base feedback configuration ensures that the transistor is always biased in the active region regardless of the value of Beta (β). The DC base bias voltage is derived from the collector voltage V_C, thus providing good stability

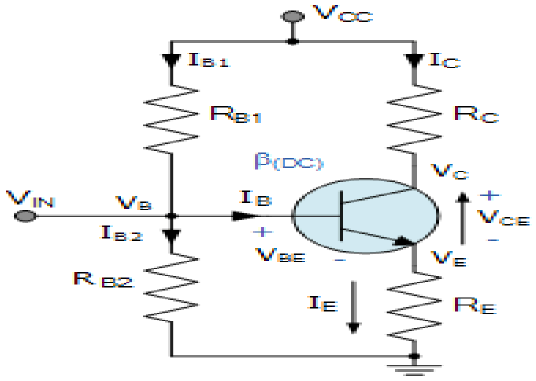


In this circuit, the base bias resistor, R_B is connected to the transistors collector C, instead of to the supply voltage rail, Vcc. Now if the collector current increases, the collector voltage drops, reducing the base drive and thereby automatically reducing the collector current to keep the transistors Q-point fixed. Therefore this method of collector feedback biasing produces negative feedback round the transistor as there is a direct feedback from the output terminal to the input terminal via resistor, R_B

$$V_C = V_{CC} - R_C(I_C + I_B)$$
$$V_E = 0v$$
$$V_B = V_{BE}$$
$$I_B = \frac{V_C - V_B}{R_B}$$
$$I_C = \beta_{(DC)} I_B$$
$$I_E = (I_C + I_B) \cong I_C$$

The biasing voltage is derived from the voltage drop across the load resistor, R_L, if the load current increases there will be a larger voltage drop across R_L, and a corresponding reduced collector voltage, V_C. This effect will cause a corresponding drop in the base current, I_B which in turn, brings I_C back to normal

Voltage Divider Transistor Biasing



The common emitter transistor configuration is biased using a voltage divider network to increase stability. The name of this biasing configuration comes from the fact that the two resistors R_{B1} and R_{B2} form a voltage or potential divider network across the supply with their center point junction connected the transistors base terminal.

voltage divider biasing configuration is the most widely used transistor biasing method. The emitter diode of the transistor is forward biased by the voltage value developed across resistor R_{B2}. Also, voltage divider network biasing makes the transistor circuit independent of changes in beta as the biasing voltages set at the transistors base, emitter, and collector terminals are not dependant on external circuit values.

$$V_C = V_{CC} - R_C I_C = (V_E + V_{CE})$$

$$V_E = I_E R_E = V_B - V_{BE}$$

$$V_{CE} = V_C - V_E = V_{CC} - (I_C R_C + I_E R_E)$$

$$V_B = V_{BE} + V_E = V_{RB2} = \left(\frac{R_{B2}}{R_{B1} + R_{B2}}\right) V_{CC}$$

$$I_{B2} = \frac{V_B}{R_{B2}}$$

$$I_{B1} = I_B + I_{B2} = \frac{V_{CC} - V_B}{R_{B1}}$$

$$R_B = \frac{R_{B1} \times R_{B2}}{R_{B1} + R_{B2}} \qquad I_B = \frac{V_B - V_{BE}}{R_B + (1+\beta) R_E}$$

$$I_C = \beta_{(DC)} I_B$$

$$I_E = I_C + I_B = \frac{V_E}{R_E}$$