AL-Mustaqbal University
College of Technical Engineering
Department of Electrical Engineering
Techniques

Subject: Electronic Circuits (Practical)
Lecturer: Mr. Ali Emad+Esraa Essa
Stage:2

Experiment No. (1)

Characteristics of Bipolar Junction Transistor

1- Aim of experiment

Object The purpose of this experiment is **to determine and graph the input and output characteristics (current amplification factor) of a bipolar junction transistor (BJT- NPN) in the common emitter configuration**.

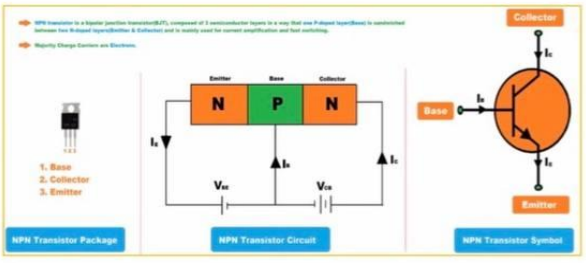
2- Required Parts and Equipment's

- Electronic Test Board. (M90)
- Dual DC Power Supply.
- Digital Multi-meters.
- NPN Transistors (BC337).
- Dual Resistors 100Ω
- Leads and Wires.

3- Theory

A bipolar junction transistor (BJT) is a three-terminal device capable of amplifying a small AC signal. **The three terminals are called the base, emitter, the collector. BJTs consist of a very thin base material sandwiched between two of the opposite type materials**. Bipolar transistors are available in two forms, either NPN or PNP. The middle letter indicates the type of material used for the base, while the outer letters indicate the emitter and collector terminals. The emitter is heavily doped, the base is lightly doped, and the collector is intermediately doped. Figure.1 shows BJT-NPN transistor construction and symbols.

Figure.1: BJT-NPN transistor construction



As shown in Fig.1, two P-N junctions are formed when a transistor is made, the junction between the base and emitter, and the junction between the base and collector. These two junctions form two diodes, the emitter-base diode and the collector-base diode.

There are three configurations in connecting the BJT depending on which of the three terminals is used as the common terminal. These configurations are:
1-The common emitter (CE)
2- The common base (CB)
3- The common collector (CC).

Common emitter configuration is most effective because of its high current gain, **high voltage gain and power gain.** In common emitter configuration, emitter terminal is made common to both input and output circuits as shown in Fig.2. Input junction (Emitter-Base Junction) is forward biased and output junction (Collector Base Junction) is reverse biased so that the input junction is having low resistance (since it is forward biased) and the output junction is having high resistance (since it is reverse biased).

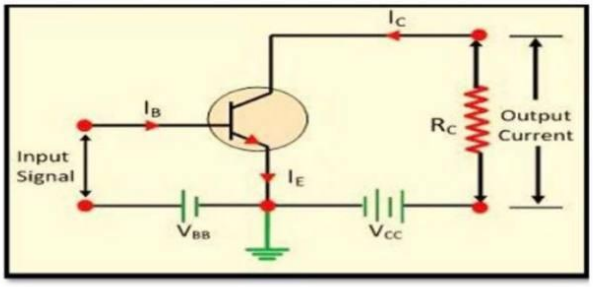


Figure 2: Common Emitter Transistor Configuration

The current amplification factor can be calculated from the ratio of the DC collector current I_C to the DC base current $I_B$is called the DC beta (β_{dc}) of the transistor. As in the following equation

$$\boldsymbol{\beta = \frac{I_{collector}}{I_{bace}}}$$

Typical values of β_{dc} range from 20 to 250 or higher.

4- Experiment Setup

Connect the DC power supplies, transistor and the resistor as shown in the following Figure No. 3

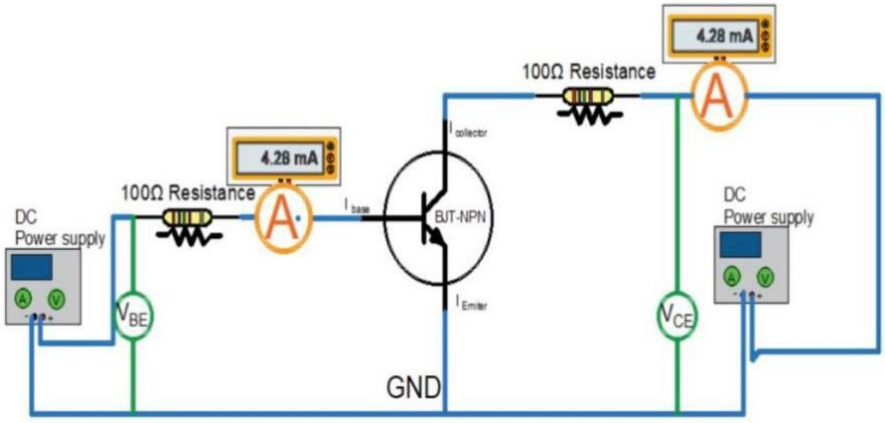


Figure 3: Experiment Setup

5- Experiment Procedure

1- Set V_{CE} =5 and change V_{BE} from 1 to 5 V

2- Measure I_B and I_c then put the collected Records in the following table

No.	V_{BE}	I_B	I_c
1	0		
2	.5		
3	1		
4	1.5		

3- Draw a Graph for the relationship between I_b and I_c , then calculate the slope of the curve from the following equation to find the amplification factor

$$\beta = \frac{\Delta I_{collector} = (I_{c2} - I_{c1})}{\Delta I_{bace} = (I_{b2} - I_{b1})}$$

The obtained Graph should be look like the following Figure 4

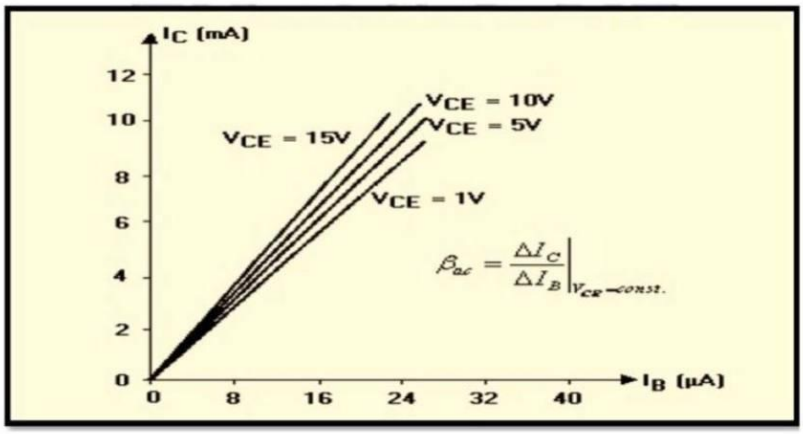


Figure 3: The relationship between I_b and I_c

4- Now Set V_{CE}= 10 and repeat steps 2 and 3
5- Compare between results

6- Discussion

1- Does the experimental data indicate that βdc is constant at all points? Does this have any effect on the linearity of the transistor?
2- What effect would a higher βdc have on the characteristic curves you measured?
3- What is the maximum power dissipated in the transistor for the data taken in the experiment?
4- Show that the DC alpha of the transistor is given by:

$$\alpha_{dc} = \frac{\beta_{dc}}{\beta_{dc} + 1}$$

Compute αdc for your transistor at VCE = 5.0V and IB = 40μA.

5- What value of VCE would you expect if the base terminal of the transistor is opened? Explain your answer.