Title: Basics of Bipolar Junction Transistor (BJT)
Date: 23/03/2020
Name of Faculty: Ms. Richa Dubey
Lecture:03
Source of Information: Basic Electronics, Mahajan Publications,2nd Edition.

I. INTRODUCTION

- 1904 -1947 - the vacuum tube was undoubtedly the electronic device of interest and development

- 1904 - the vacuum-tube diode was introduced by J. A. Fleming

- 1906 - Lee De Forest added a third element, called the *control grid, to the vacuum diode, resulting in the first amplifier, the triode.*

- early years - radio and television provided great stimulation to the tube industry

- 1937 - production rose from about 1 million tubes in 1922 to about 100 million

- early 1930s - the four-element tetrode and five-element pentode gained prominence in the electron-tube industry.

I. INTRODUCTION

❑ December 23, 1947 - Walter H. Brattain and John Bardeen demonstrated the amplifying action of the first transistor at the Bell Telephone Laboratories.

❑ advantages of this three-terminal solid-state device over tube:

- smaller and lightweight
- had no heater requirement or heater loss
- had rugged construction
- more efficient since less power was absorbed by the device itself
- available for use, requiring no warm-up period
- lower operating voltages are possible

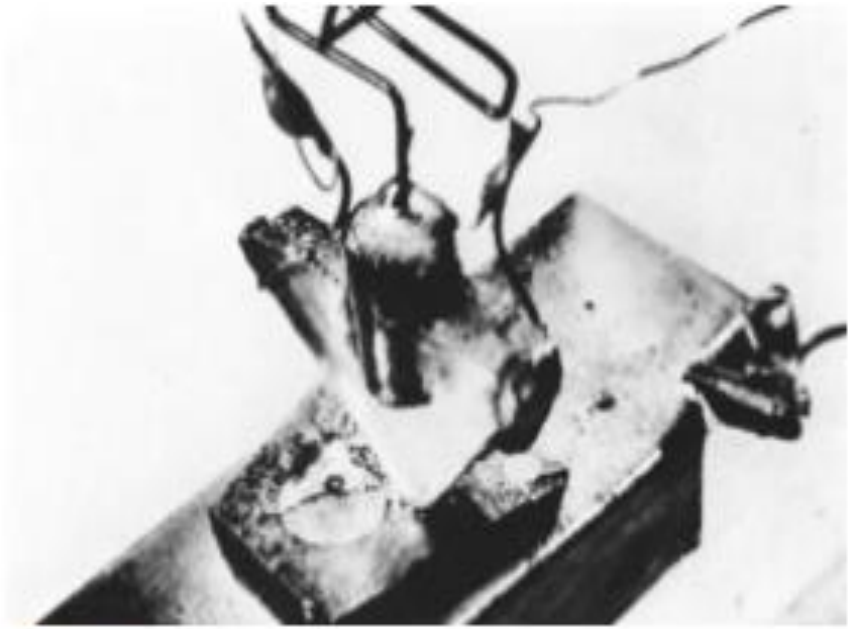
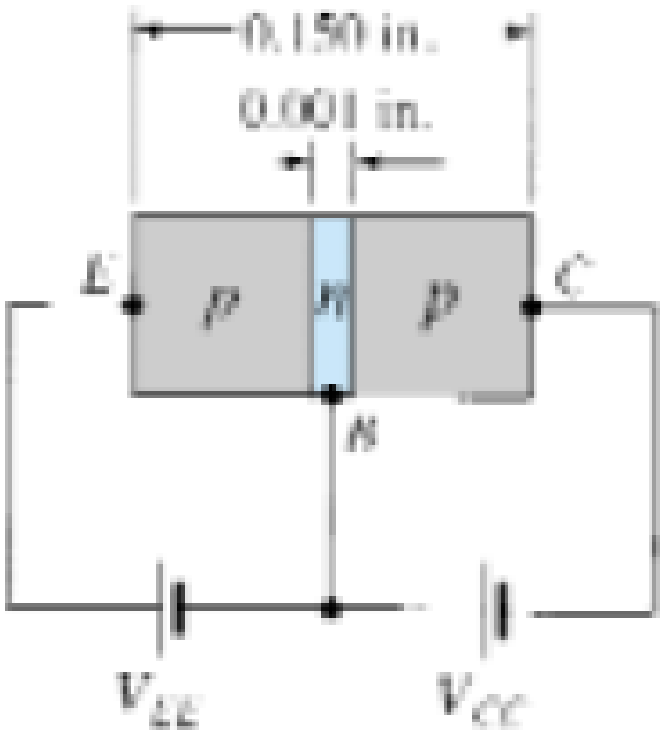


Figure 3.1 The first transistor. (Courtesy Bell Telephone Laboratories.)

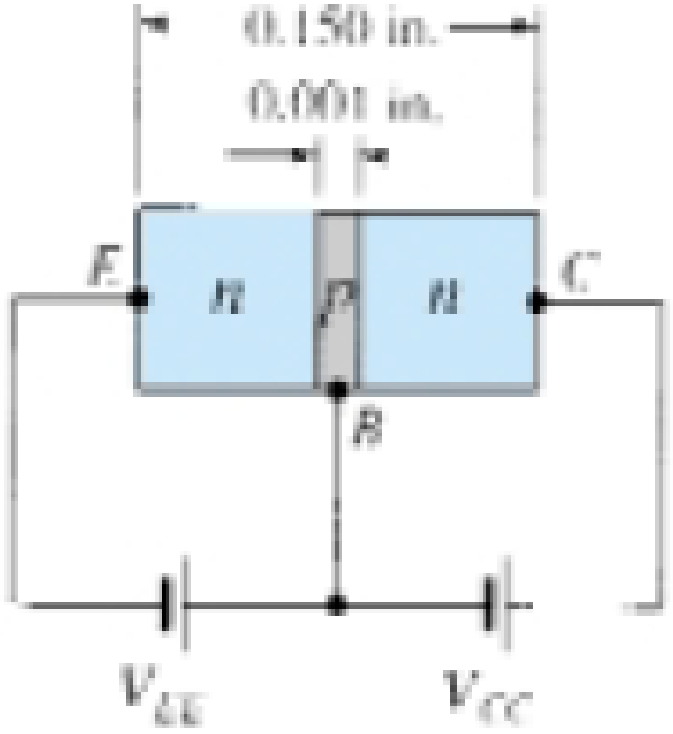
II. TRANSISTOR CONSTRUCTION

• transistor is a three-layer semiconductor device consisting of either two *n- and* one *p-type layers of material or two p- and one n-type layers of material*

a. *the former* is called an *npn transistor*



b. *while the latter is called a pnp transistor*



II. TRANSISTOR CONSTRUCTION

The emitter layer is heavily doped, the base lightly doped, and the collector only lightly doped. The outer layers have widths much greater than the sandwiched *p- or n-type material.* For the transistors, the ratio of the total width to that of the center layer is 0.150/0.001 = 1501. The doping of the sandwiched layer is also considerably less than that of the outer layers (typically, 101 or less). This lower doping level decreases the conductivity (increases the resistance) of this material by limiting the number of "free" carriers. For the biasing, the terminals have been indicated by the capital letters *E for emitter, C for collector, and B forbase.*

• The abbreviation BJT, from *bipolar junction transistor, is often applied to this three-terminal* device.

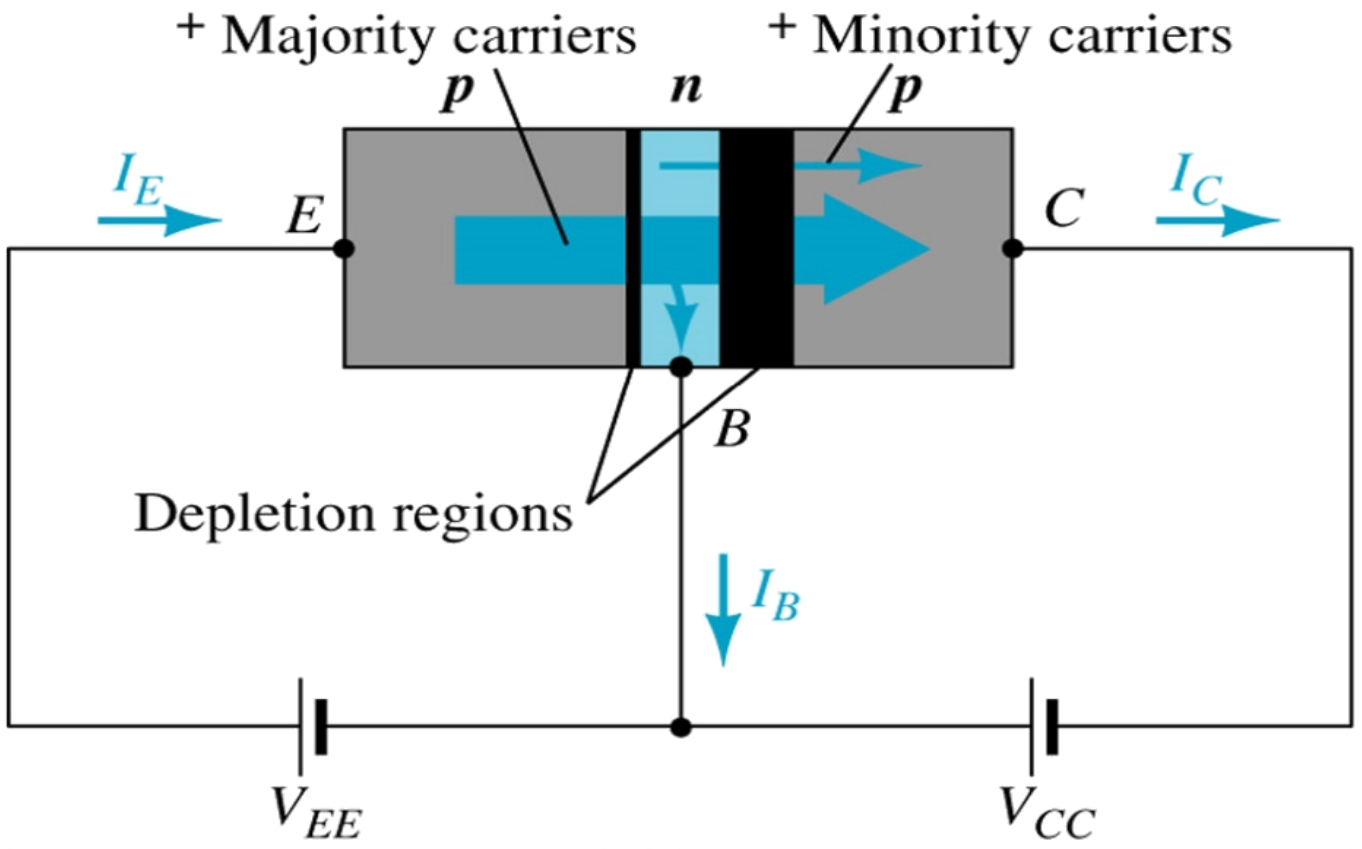
• The term *bipolar reflects the fact that holes and electrons participate* in the injection process into the oppositely polarized material. If only one carrier is employed (electron or hole), it is considered a *unipolar device.*

III. TRANSISTOR OPERATION

The proper bias arrangement for both npn and pnp transistor has the base-emitter (BE) junction that is forward biased and a base collector (BC) juntion that is reversed biased. The connection is considered as forward reverse biased.

The forward biased from base to emitter narrows the BE depletion region while the reverse bias from the base to collector widens the BC depletion region. However, due to the flow of currrent in the base and the abundance of current carriers int the collector (heavily doped), the excess carriers from the emitter to the collector (through the base). This is called Avalanche Effect.

III. TRANSISTOR OPERATION



IV. TRANSISTOR PARAMETERS

- **transistor current** – current flowing across the collector **(I_E , I_C , I_B)**

- **alpha** - the ratio of the dc collector current to the dc emitter current; almost equal to but slightly less than 1 **(I_E / I_C)**

- **beta** – ratio of the dc collector current to the dc base current; also known as current gain of transistor **(I_C / I_B)**

- **current rating** – maximum current a transistor can pass through its collector and emitter **(I_{cmax})**

- **voltage rating** – maximum voltage that can be applied across the collector to emitter terminals of a transistor **(V_{cmax})**

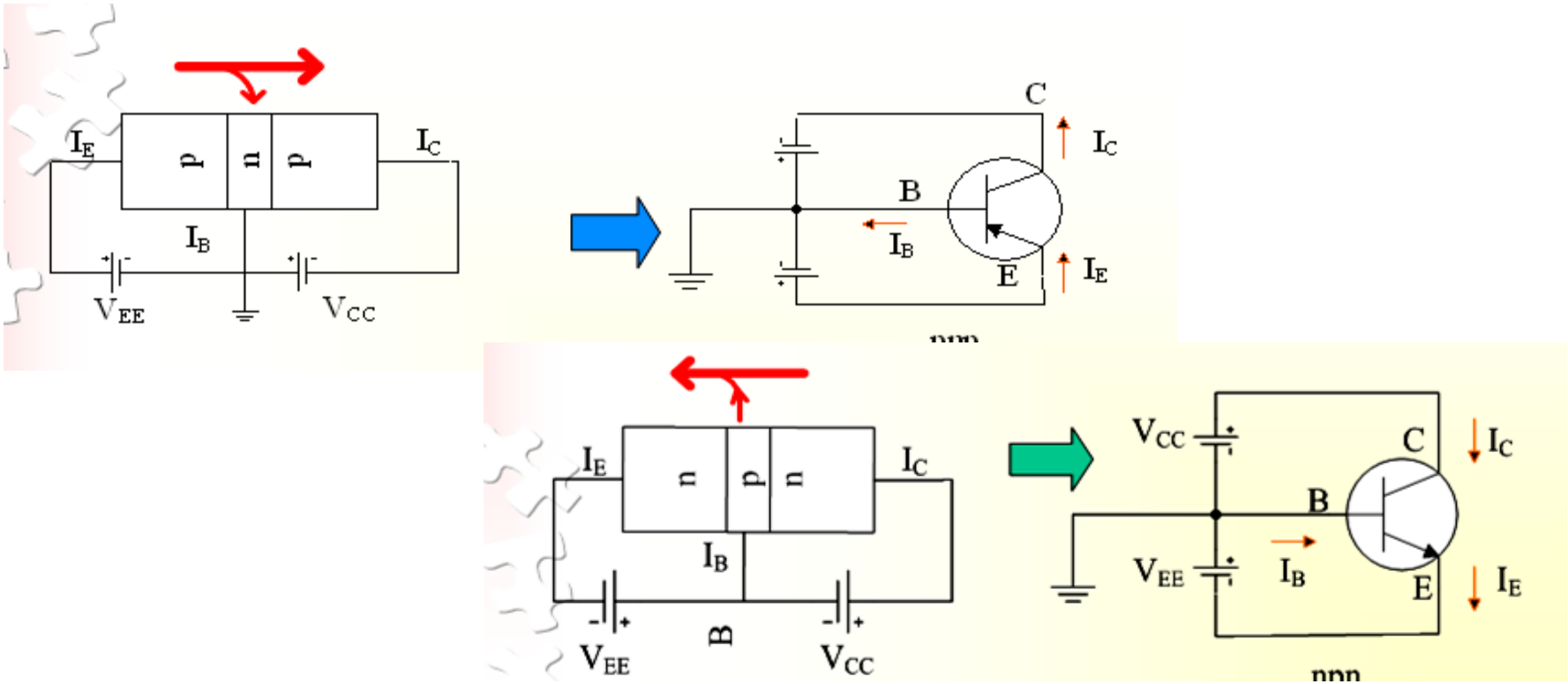
- **power rating** – maximum average power that a transistor can handle, also called total device dissipation or maximum collector dissipation **(P_{cmax})**

IV. TRANSISTOR CONFIGURATION

1. Common Base

~ base is common to both input and output of the configuration.

~ base is usually the terminal closest to or at ground potential.

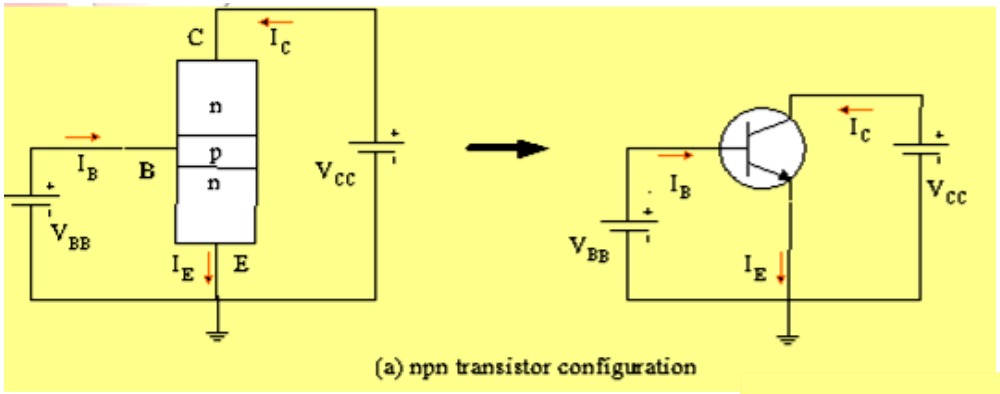


IV. TRANSISTOR CONFIGURATION

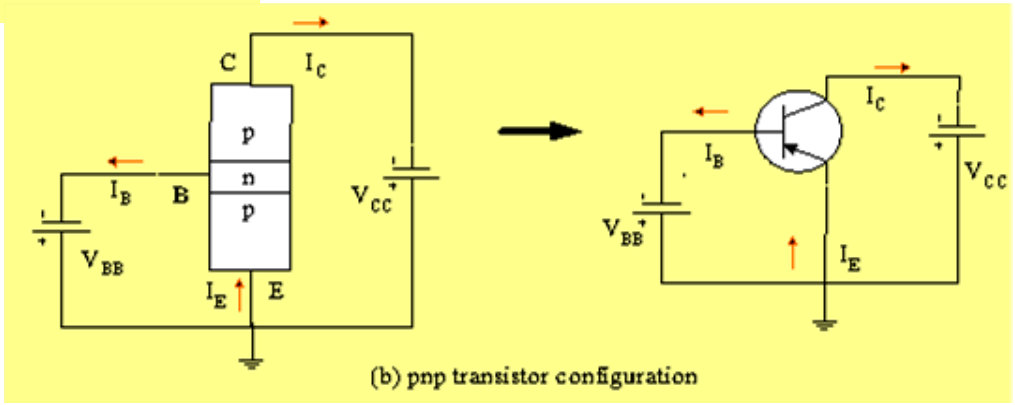
2. Common Emitter

~ emitter is common or reference to both input and output terminals.

~ emitter is usually the terminal closest to or at ground potential.



(a) npn transistor configuration



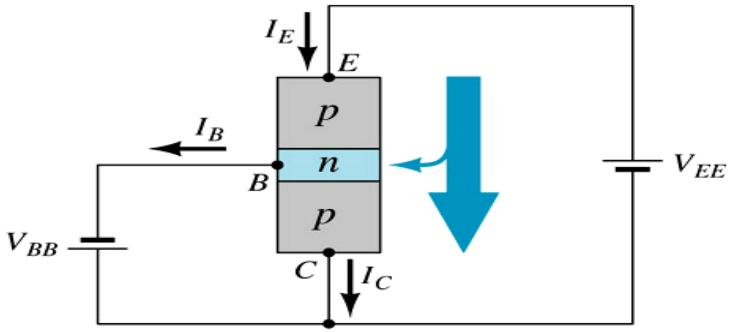
(b) pnp transistor configuration

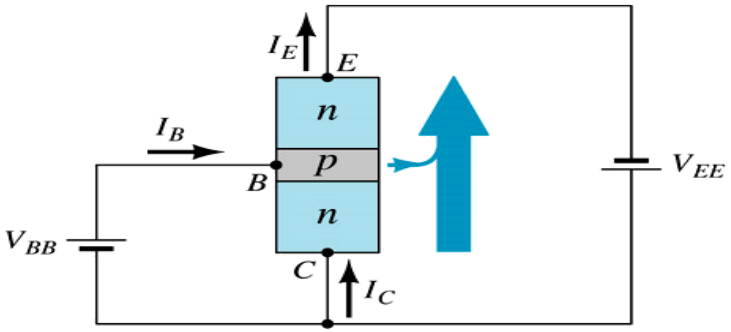
IV. TRANSISTOR CONFIGURATION

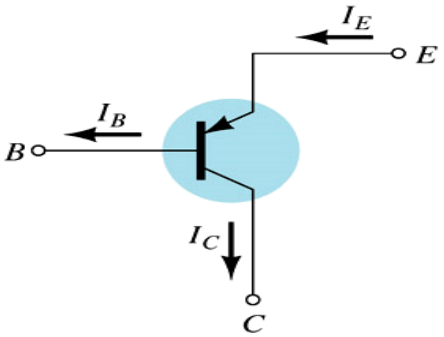
3. Common Collector

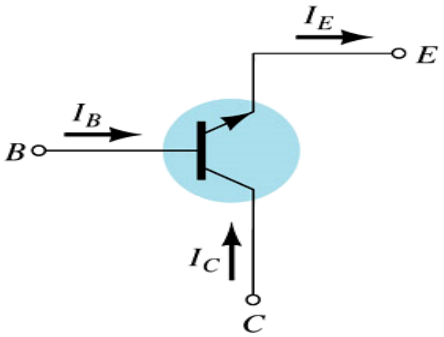
~ also called **emitter-follower** (EF)

~ both the signal source and the load share the collector terminal as a common connection point









Assignment

1. What do you call the ratio of the dc collector current to the dc base current? (aka current gain of transistor)
2. Explain Common Emitter Configuration of BJT?

For any Query pl Contact: Ms Richa Dubey (9998037615)
richa.dubey@srict.in