

4-1 Bipolar Junction Transistor (BJT)

* The Base material is lightly doped and very narrow compared to the heavily doped emitter and collector materials.

* The term bipolar refers to the use of both holes and electrons as carriers in the transistor structure.

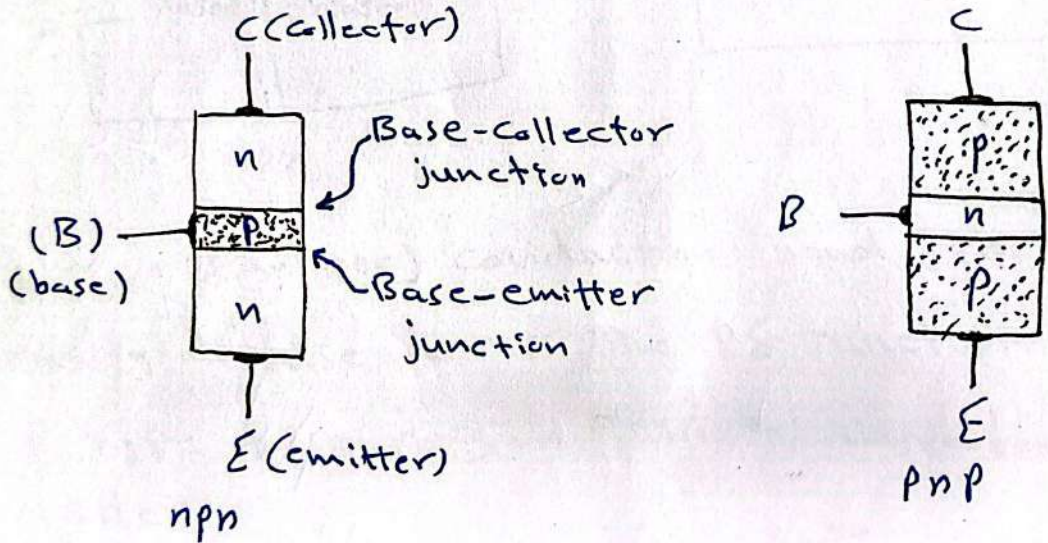


Fig: Bipolar transistor construction.

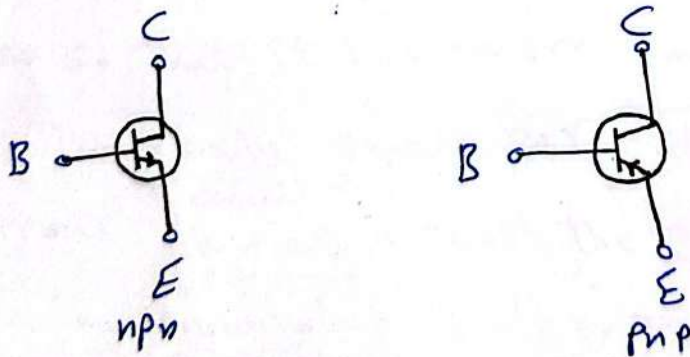
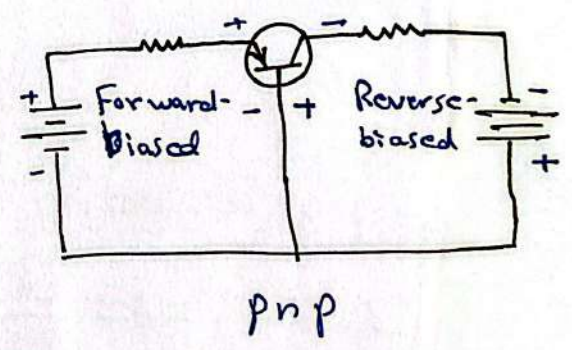
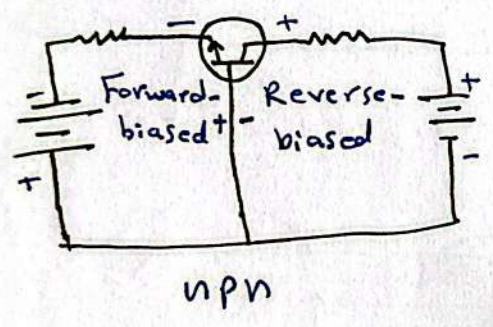


Fig: standard transistor symbols.

4-2. Basic transistor operation

In order for the transistor to operate properly as an amplifier, the two pn junctions must be correctly biased with external voltages.

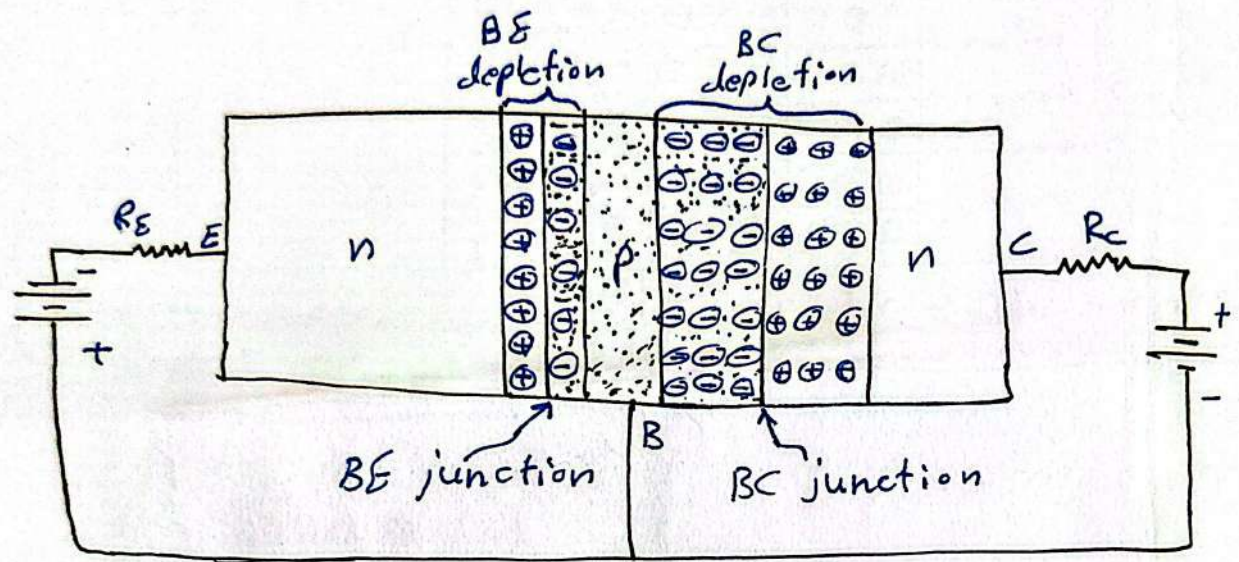
Notice that in both cases the base-emitter (BE) junction is forward-biased and the base collector (BC) junction is reverse-biased.



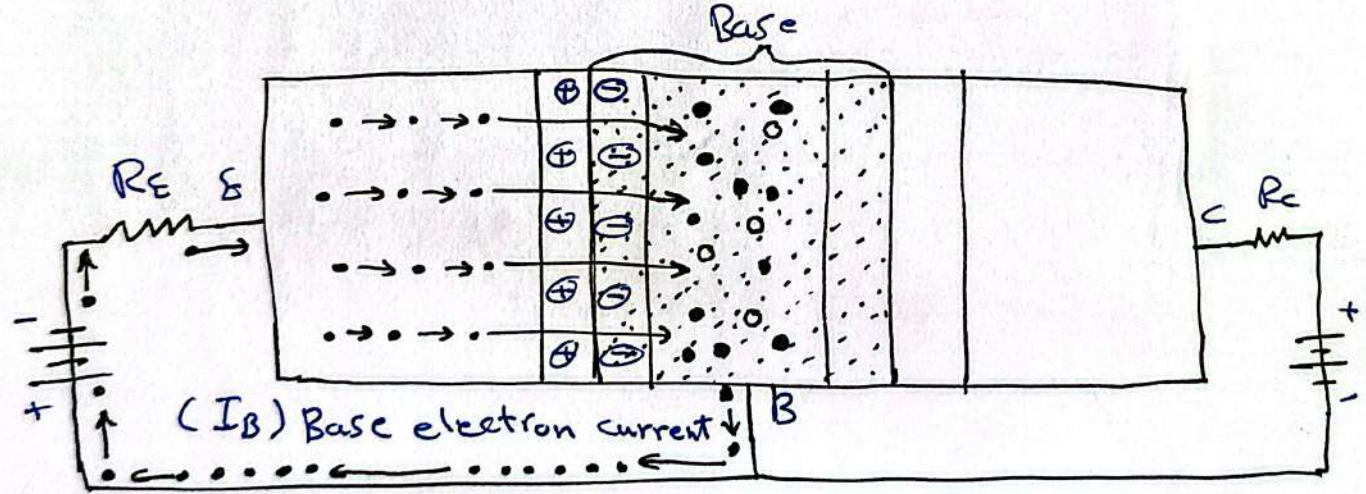
* n-type (emitter) conduction-band free electrons easily diffuse across the BE junction into the P-type base region just as in a forward-biased diode.

* The base region is lightly doped and very thin. ~~It has~~ so that it has a very limited number of holes. Thus, only a small percentage of all the electrons flowing across the BE junction combine with the available holes. These relatively few recombined electrons flow out of the base lead as valence electrons.

forming The small base current, I_B



Internal effects of forward-reverse bias



Electron flow across emitter-base junction

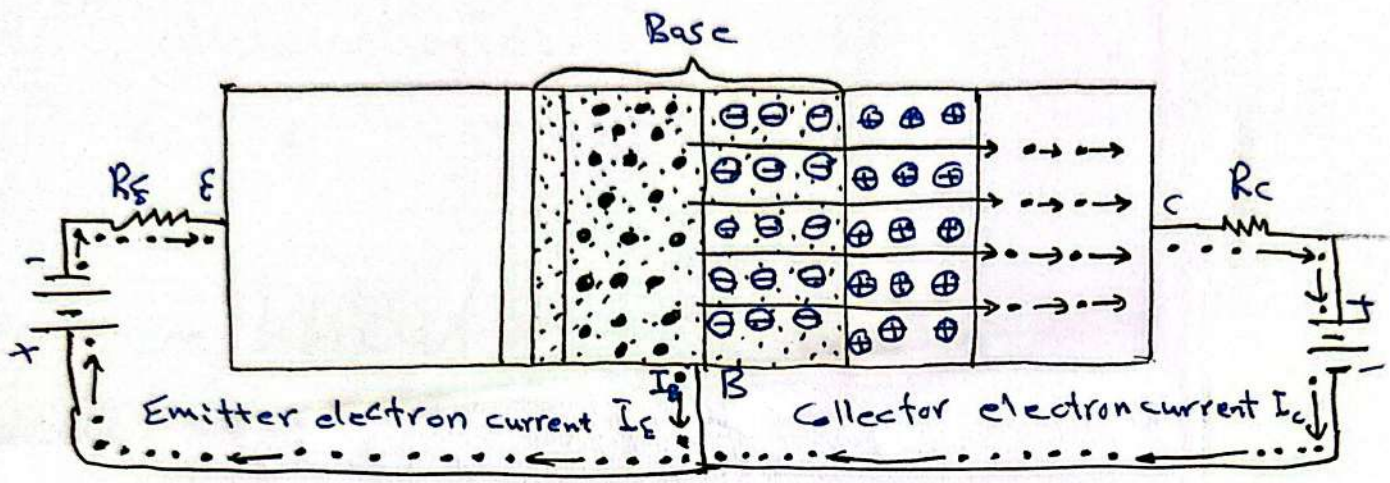
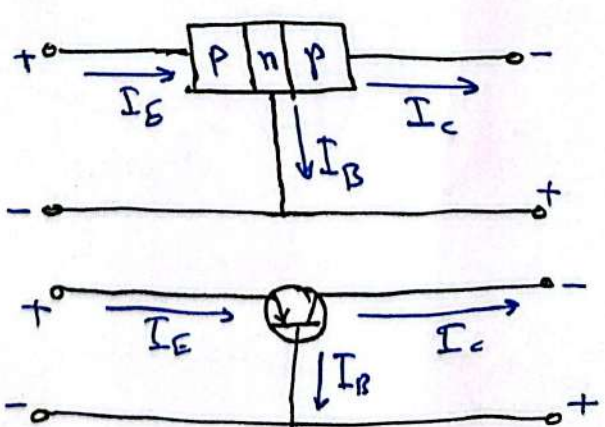
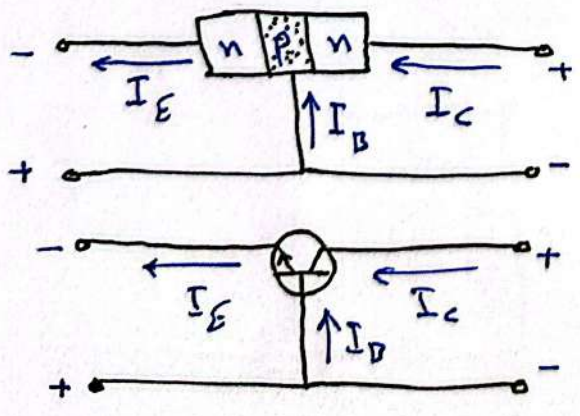


Fig:- Electron flow across base-collector junction

* Most of the electrons flowing from the emitter into the base region diffuse into the BC depletion layer. Once in this layer they are pulled across the ~~reverse-biased BC junction by the attraction~~ the BC junction by the depletion field set up by the force of attraction between the positive and negative ions. ~~Attraction~~

- Transistor Currents :- transistor conventional current directions.



$$I_E = I_C + I_B$$

* As mentioned before, I_B is very small compared to I_E or I_C . The capital letter subscripts indicate dc values.

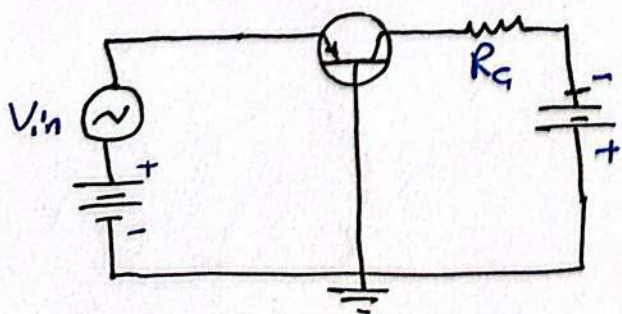
4-3 Amplification :-

* Amplification is the process of increasing the amplitude of an electrical signal and is one of the major properties of a transistor.

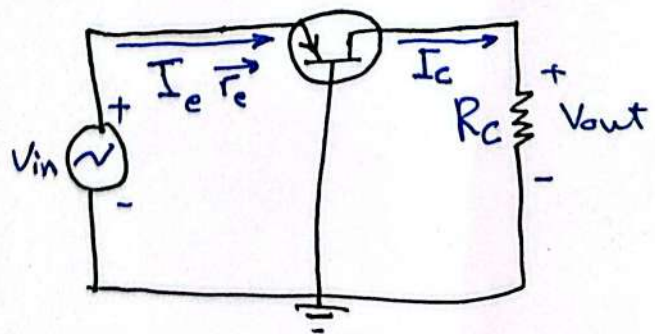
* The BE junction has low resistance due to forward bias and the BC junction has high resistance due to reverse bias.

* Since I_B is extremely small, I_C is approximately equal to I_E . Actually, I_C is always slightly less than I_E . Therefore.

$$I_E \approx I_C$$



ac input and bias



ac equivalent circuit