

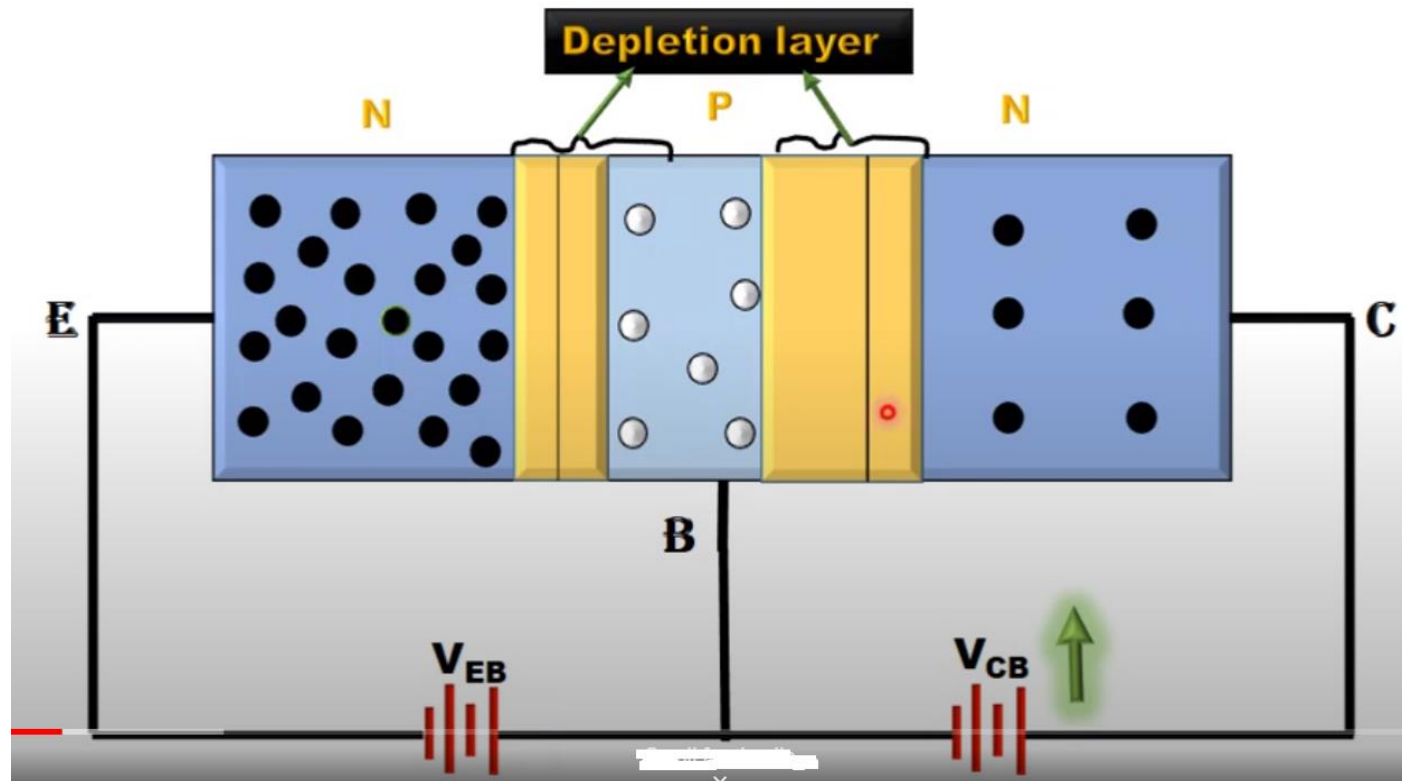


Unit 2 – Bipolar Junction Transistor

Class 4

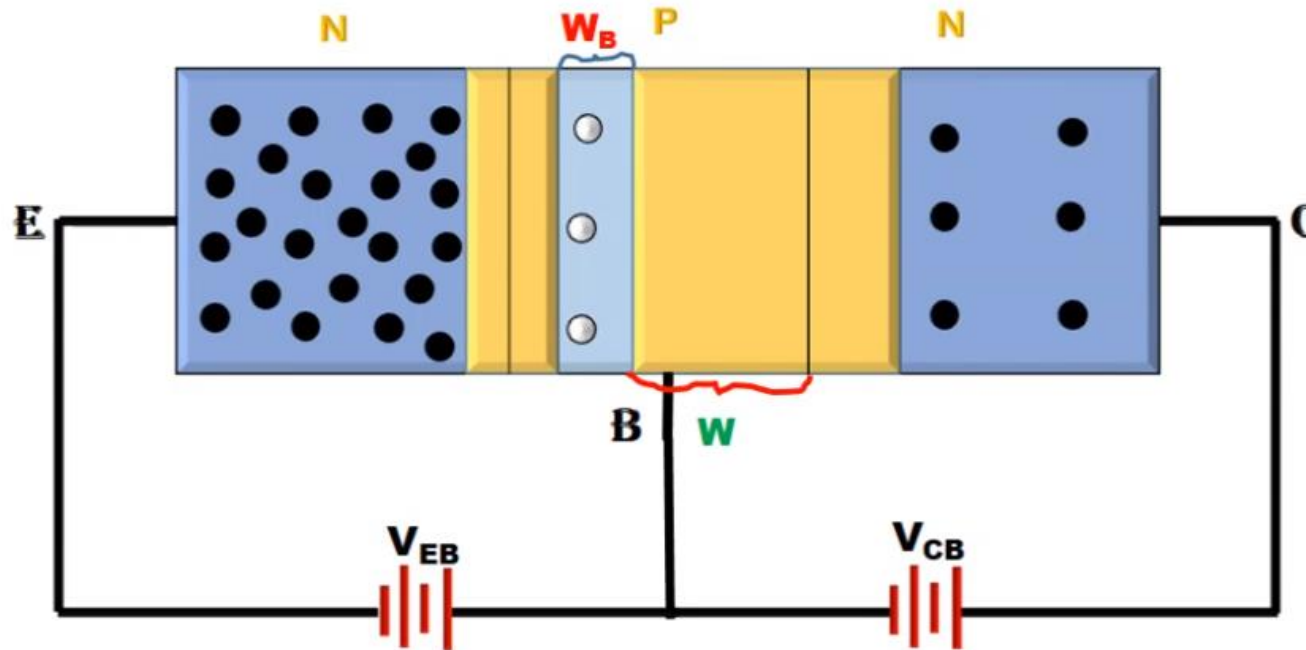
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Base Width Modulation (Early Effect)



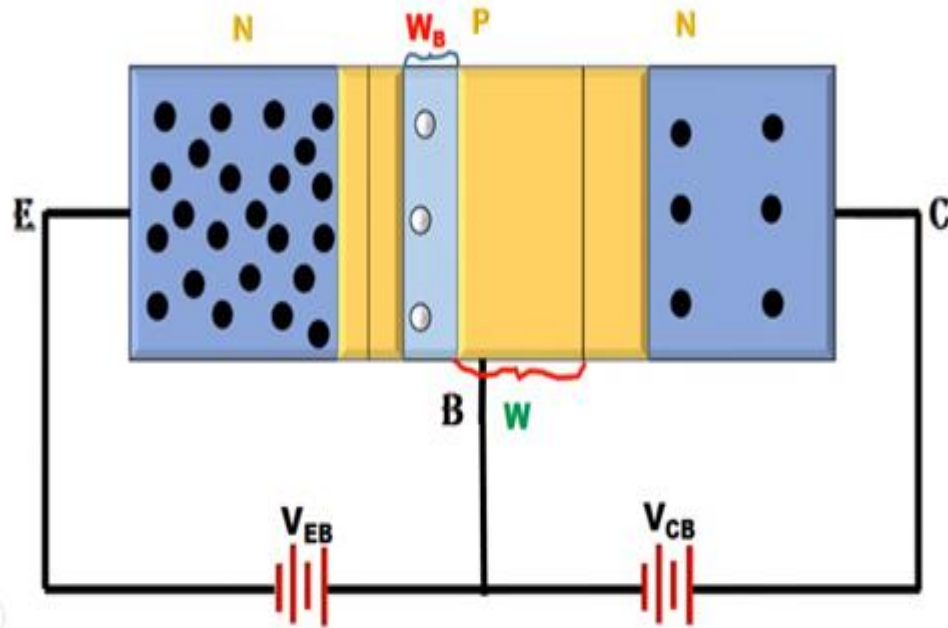
• In Active region emitter base junction is forward biased and collector base junction is reverse biased.

Base Width Modulation (Early Effect)



- As the voltage applied across the Collector base junction increases the transition region penetrates deeper into the base than that of collector.

Base Width Modulation (Early Effect)

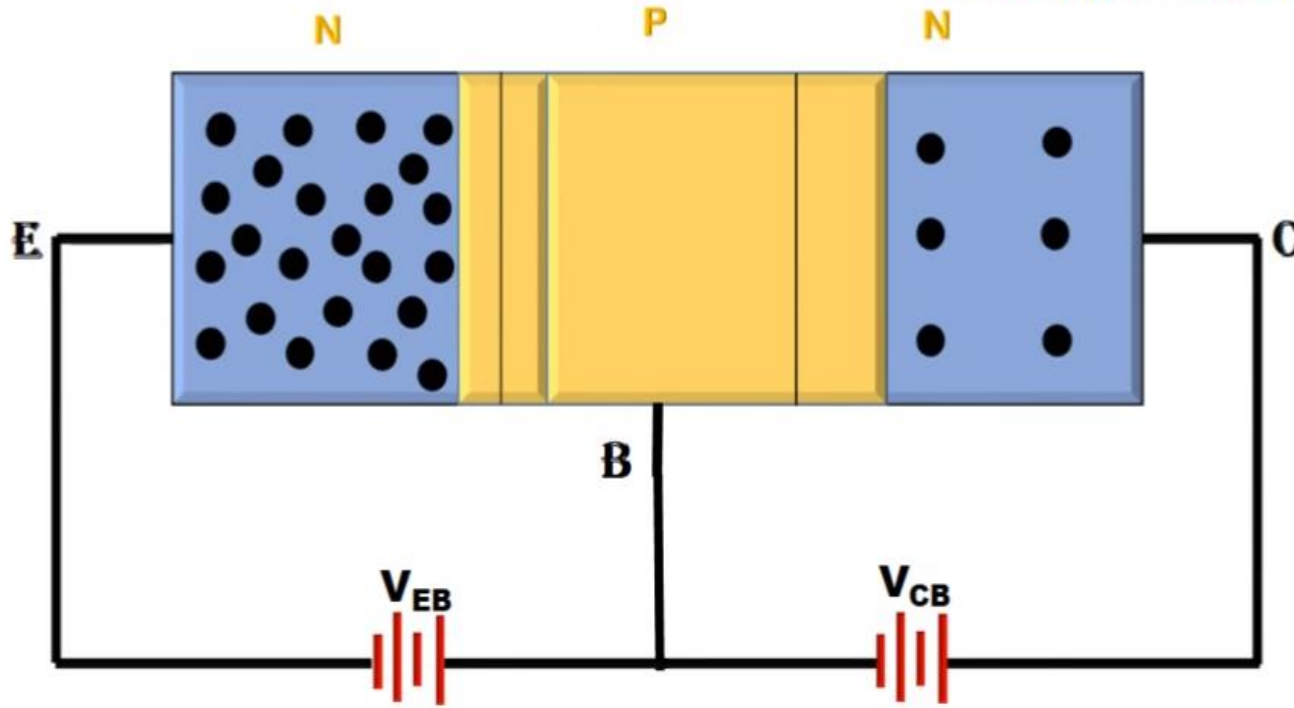


With the increase in V_{CB} , the depletion layer width increases. Due to which the effective base width W_B reduces

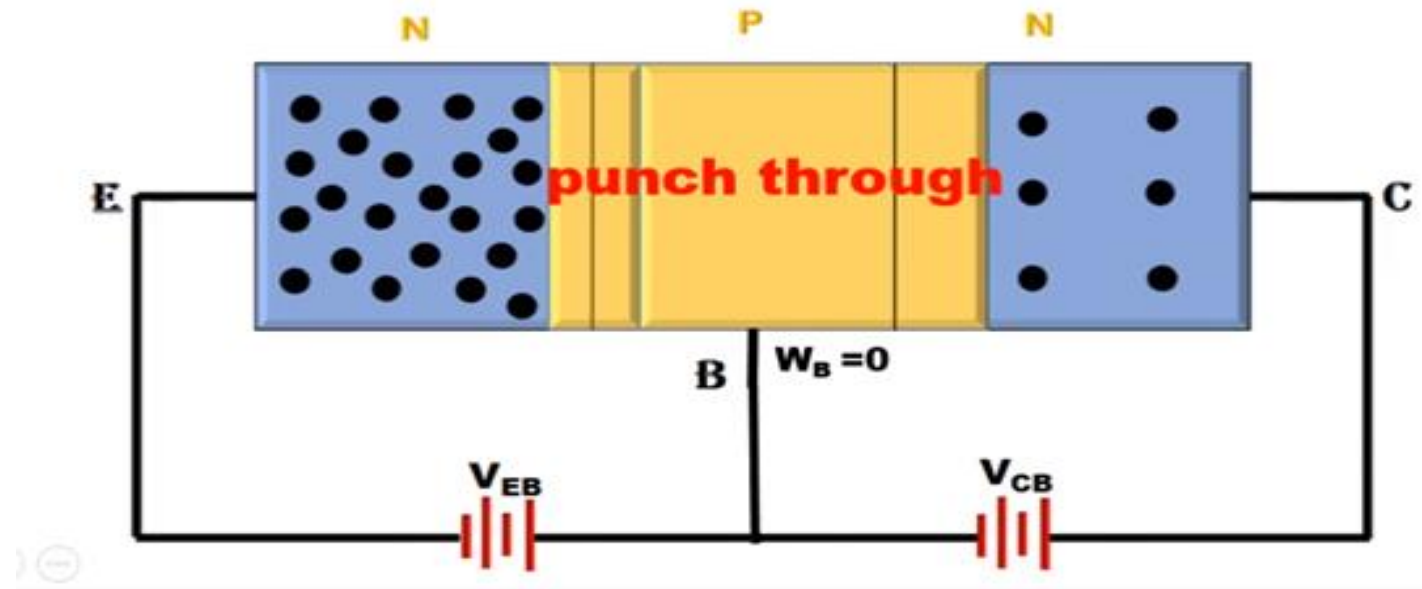
This modulation of effective base width W_B by collector to base reverse bias voltage V_{CB} is known as Base width modulation or Early effect.

Base Width Modulation (Early Effect)

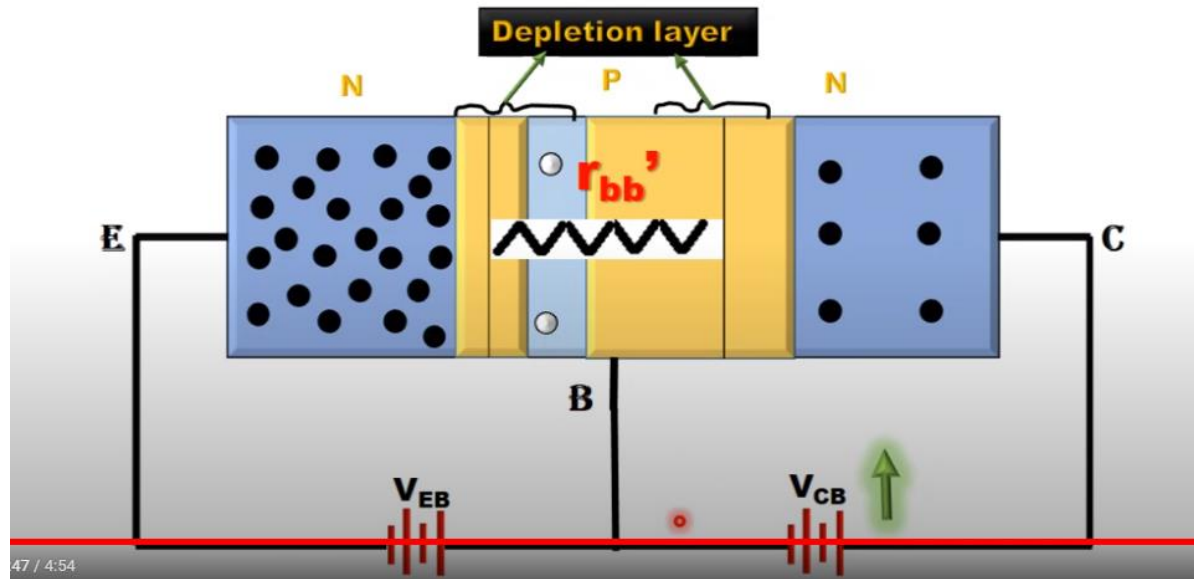
For extremely large collector to base voltage the effective base width W_B may be reduced to zero causing voltage breakdown transistor. This phenomenon is called punch through.



Punch Through Effect

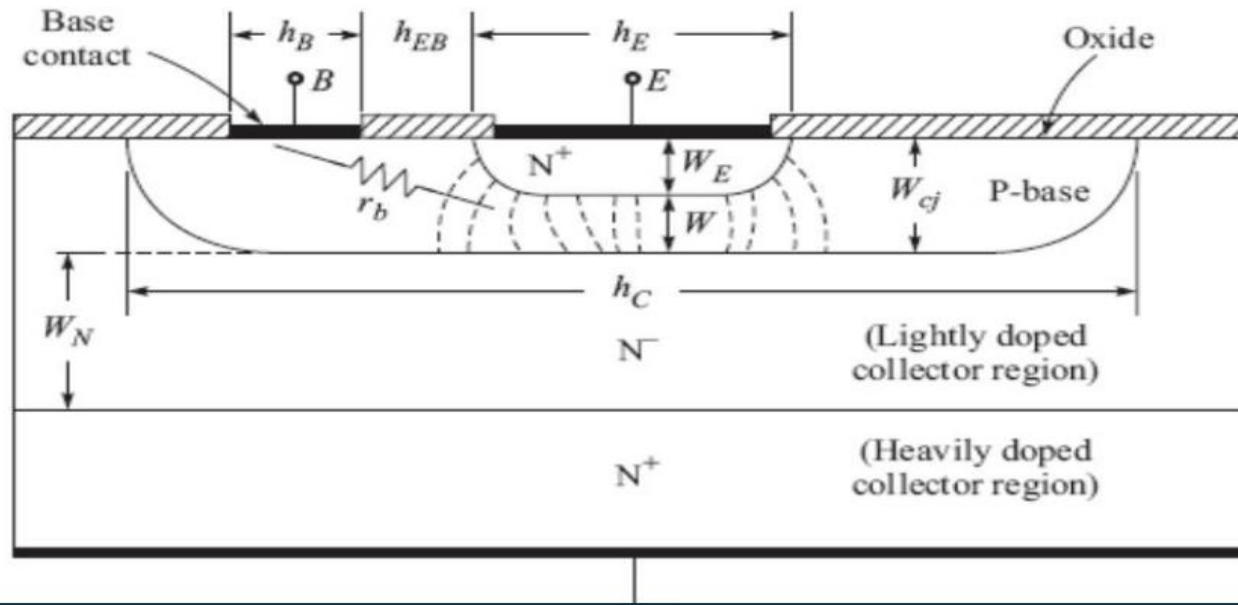


Base Spread Resistance

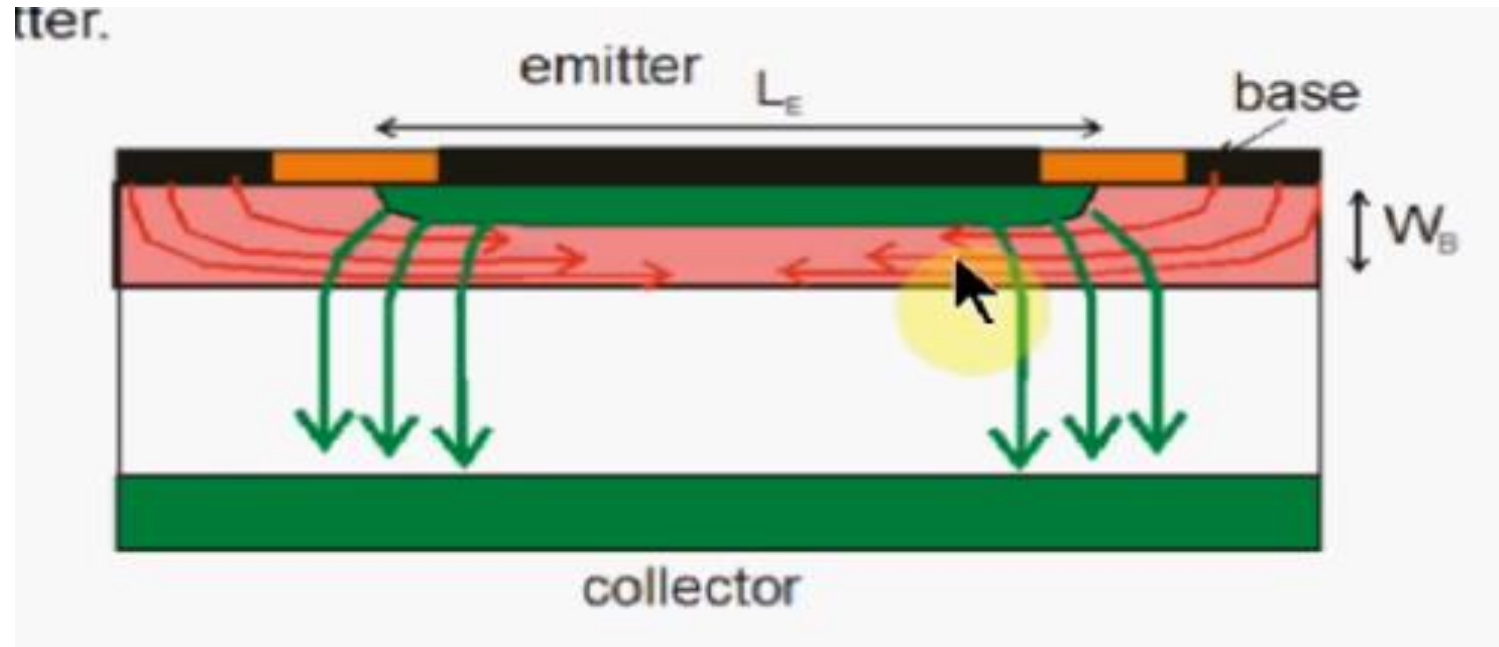


Base Spread Resistance

Base spreading resistance $r_{bb'}$ (r_b in figure below) depends upon base region doping concentration N_A and base width W



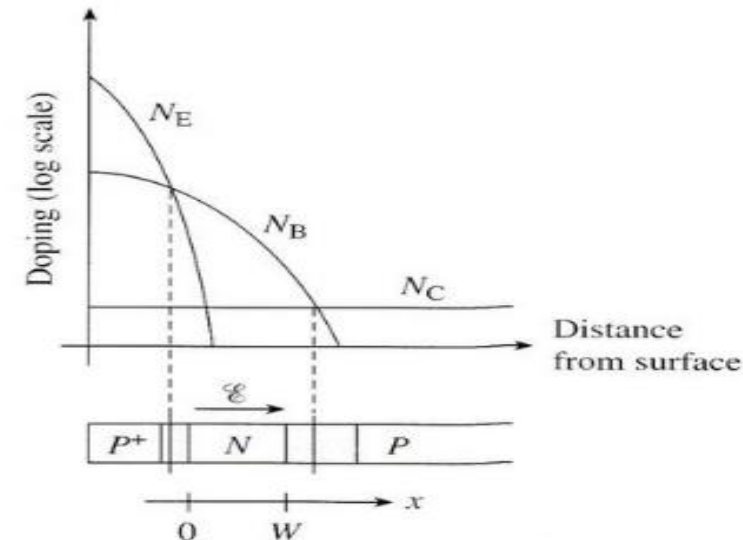
Emitter Crowding



Emitter Crowding

Drift in the Base region

- Dopants are injected through diffusion.
 - More or less falling exponential distribution with distance into beneath of the semiconductor.
- The doping within the base is not constant as assumed in ideal analysis.
 - A function of position, having maximum at E-B junction and minimum at C-B junction.
 - Creating a built-in electric field.
- The electric field enhances the transport of minority carrier across the quasineutral width of the base.
 - Increase of I_E and I_C .



$$\epsilon = \frac{kT/q}{x_{\text{diff}}}$$

x_{diff} : exponential decay constant



Thank You

HAVE A NICE DAY