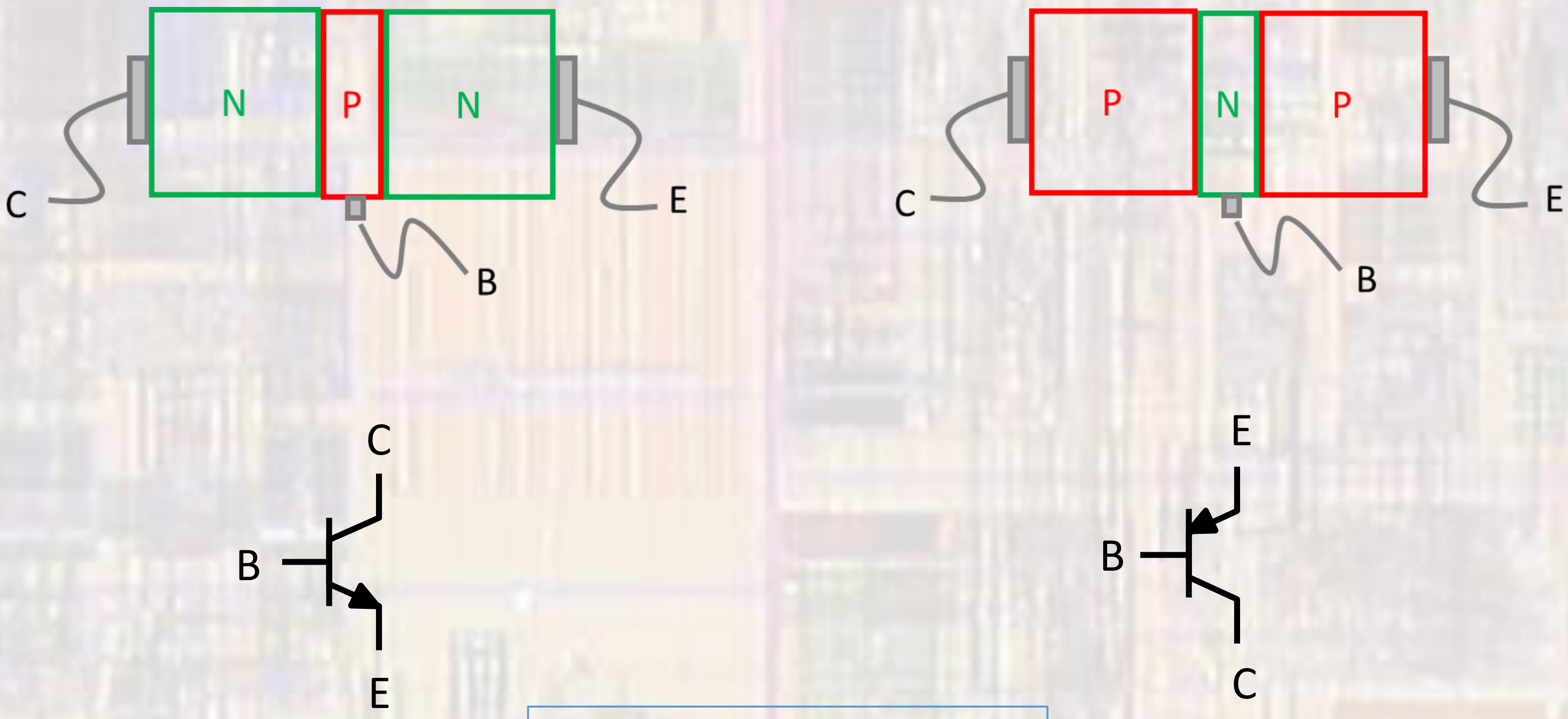
# BJT Reverse Active

Last updated 2/21/22

# BJT Reverse Active

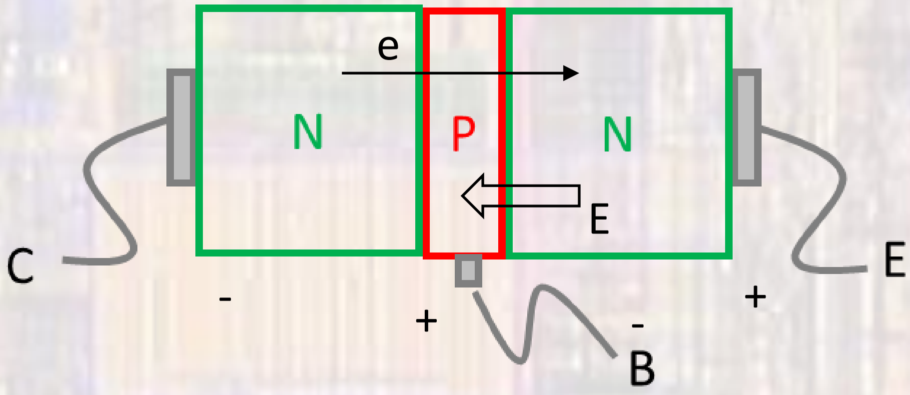
- Review




arrow points in direction
of the P-N junction
of the B/E diode

# BJT Reverse Active

- Reverse Active Mode - NPN
  - B-E junction reverse biased, C-B junction forward biased

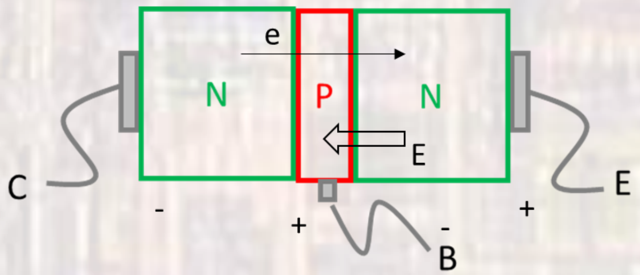



  - With a short base – the electrons injected into the base get swept into the emitter by the electric field
  - In the ideal case all of the electrons would be swept into the emitter, leaving only a small hole current in the base
  - In the real case – additional factors lead to a small (relative to collector) base current

# BJT Reverse Active

- Reverse Active Mode - NPN
  - B-E junction reverse biased, C-B junction forward biased
  - The Emitter acts as the Collector and the Collector acts as the Emitter
  - Emitter Current
    - By convention we reference all the the currents to the emitter




$$I_E = I_S \left[ e^{\left(\frac{V_{BC}}{nV_T}\right)} \right]$$

for $V_{BE}$ > few $V_T$, n and $I_S$ device dependent

$$I_B = \frac{I_E}{\beta} = \frac{1}{\beta} I_S \left[ e^{\left(\frac{V_{BC}}{nV_T}\right)} \right]$$

$\beta_R$ is much smaller than $\beta_F$
due to the relative doping of C and E

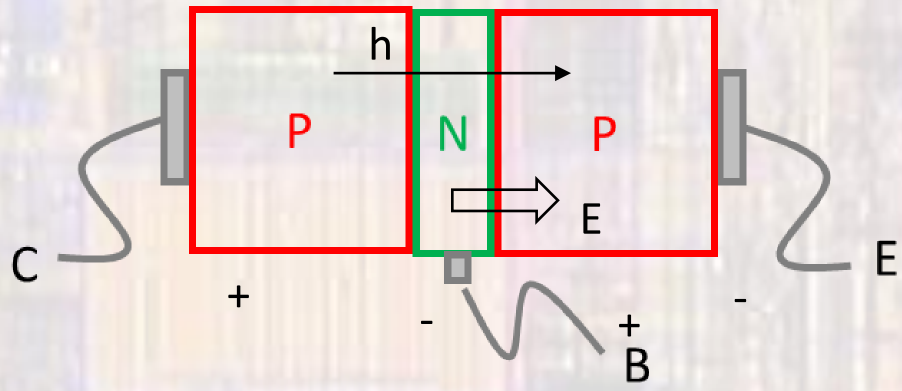
$$I_C = \frac{1}{\alpha} I_E = \frac{1}{\alpha} I_S \left[ e^{\left(\frac{V_{BC}}{nV_T}\right)} \right]$$

$I_E = \beta I_B$

$I_C = I_E + I_B$

# BJT Reverse Active

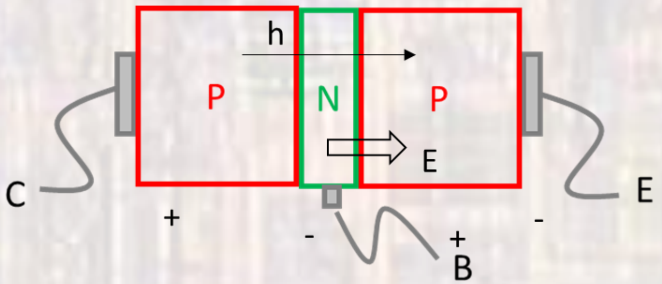
- Reverse Active Mode - PNP
  - B-E junction reverse biased, C-B junction forward biased




  - With a short base – the holes injected into the base get swept into the emitter by the electric field
  - In the ideal case all of the holes would be swept into the emitter, leaving only a small electron current in the base
  - In the real case – additional factors lead to a small (relative to emitter) base current

# BJT Forward Active

- Forward Active Mode - PNP
  - B-E junction reverse biased, C-B junction forward biased
  - The Emitter acts as the Collector and the Collector acts as the Emitter
  - Emitter Current
    - By convention we reference all the the currents to the emitter




$$I_E = I_S\left[e^{\left(\frac{V_{CB}}{nV_T}\right)}\right]$$ for $V_{BE}$ > few $V_T$ , n and $I_S$ device dependent

$$I_B = \frac{I_E}{\beta} = \frac{1}{\beta} I_S\left[e^{\left(\frac{V_{CB}}{nV_T}\right)}\right]$$

$\beta_R$ is much smaller than $\beta_F$
due to the relative doping of C and E

$$I_C = \frac{1}{\alpha} I_E = \frac{1}{\alpha} I_S\left[e^{\left(\frac{V_{CB}}{nV_T}\right)}\right]$$

$I_E = \beta I_B$

$I_C = I_E + I_B$