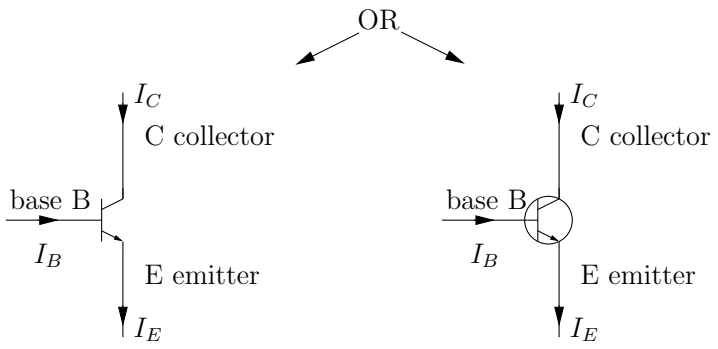
Topic 8

Transistors

We will only consider bipolar NPN transistors:



8.1 Models of transistor behavior

8.1.1 The "simplest model" of transistor behavior

- $I_B \simeq 0$.
- Current will flow in at the collector and out at the emitter (with $I_C \simeq I_E$) if
  - the collector is more positive than the emmiter, and
  - the base-emitter junction is forward biased (like a silicon diode).
- the magnitude of the collector-emitter current is determined by the rest of the circuit.

8.1.2 The "simple model" of transistor behavior

- Current will flow in at the collector and out at the emitter if
  - the collector is more positive than the emmiter, and
  - the base-emitter junction is forward biased (like a silicon diode).
- The base current is small, but not zero. The magnitude of the base current is determined by the rest of the circuit along with base-emitter junction considered as a silicon diode ($\Delta V_{BE} = 0.6\,\mathrm{V}$).

  When the rules above are obeyed, the relationship between the collector current and the base current is given by

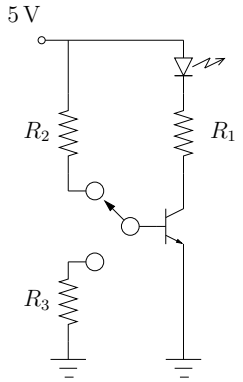
$$I_C = \beta I_B,$$

  where β is a number in the range of 75–100 for many common transistors. KCL sitll applies:

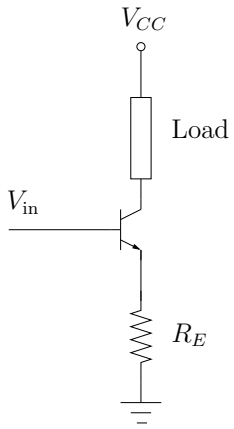
$$I_B + I_C = I_E \qquad \longrightarrow \qquad I_B(1+\beta) = I_E.$$

8.2 Transistor Applications

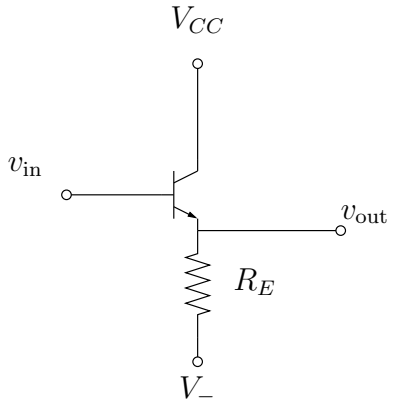
8.2.1 Transistor as a switch



8.2.2 Constant crrent source



8.2.3 Emitter follower



8.2.4 Common emitter amplifier