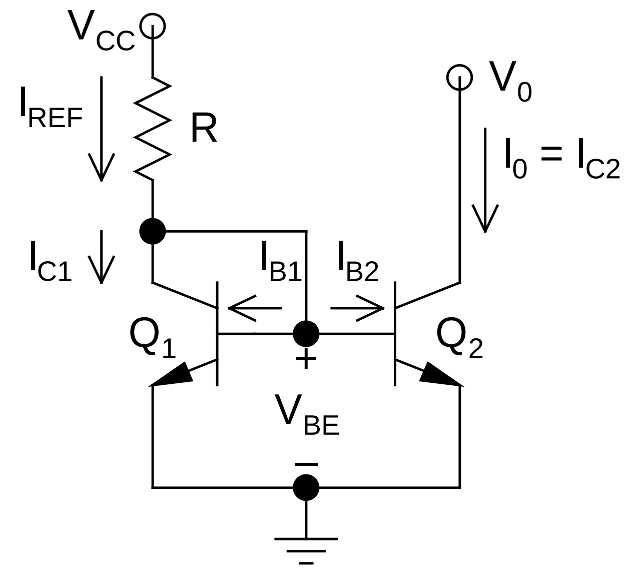
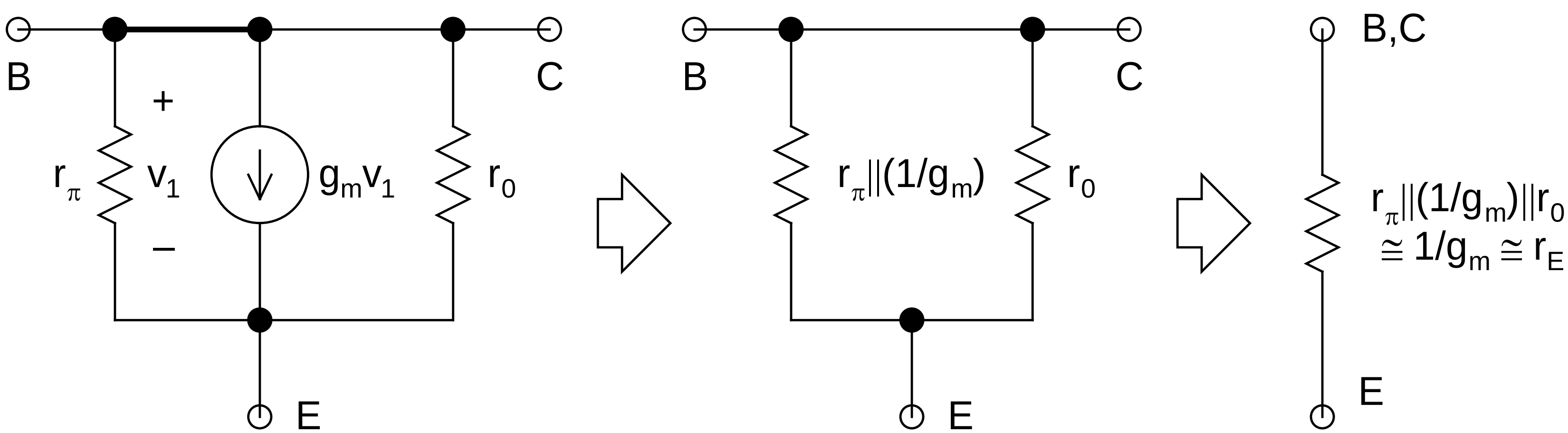
- ***Simple npn CM***:
  - Q_1 has its ***B and C shorted***
    - ***Can never saturate*** ($V_{BC} = 0$)
    - Known as ***diode-connected BJT***
  - Q_1 and Q_2 have ***same*** V_{BE}
  - I_{REF} = ***Reference Current***

$$= (V_{CC} - V_{BE})/R$$

  - I_0 = ***Output Current*** = I_{C2}
  - V_0 = ***Output Voltage***
    - ***Variable***, ***depends on the load connected to it***



- ***Output Resistance R_0:***
  - First, ***investigate Q_1***



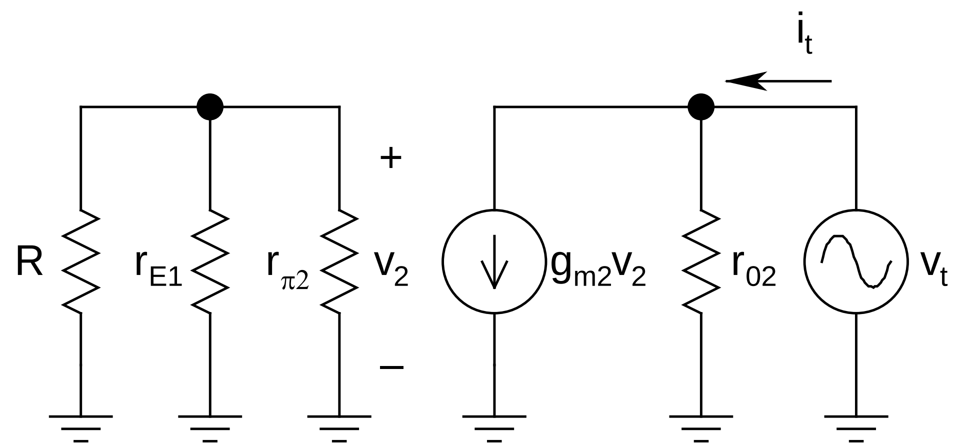
  - The ***small-signal equivalent*** consists simply of r_E, which is the same as that for a ***diode***
    - Hence the name ***diode-connected BJT***

- ***Algorithm to find R_0:***
  - ➢ ***Short all independent DC/ac voltage sources***
  - ➢ ***Open all independent DC/ac current sources***
  - ➢ ***Replace the active device by its low-frequency hybrid-π model***
  - ➢ ***Excite the output terminal by a test voltage source (ac) v_t***
  - ➢ ***Find the current (ac) i_t drawn from v_t***
  - ➢ ***Then, $R_0 = v_t/i_t$***

- ***For the complete circuit***:
  - ***Left part of the circuit has no source***

    $\Rightarrow v_2 = 0$

    $\Rightarrow g_{m2}v_2 = 0$



  - Thus, $R_0 = v_t/i_t = r_{02} = V_{A2}/I_0$
  - For a ***good current source***, ***R_0 should be as large as possible*** (***ideally infinite***)

    $\Rightarrow$ ***V_{A2} should be as large as possible*** and/or ***I_0 should be as small as possible***