Small Signal Models of the Bipolar Transistor

6.301 — Spring 2002

General Thevenin Resistance View with C-B Feedback

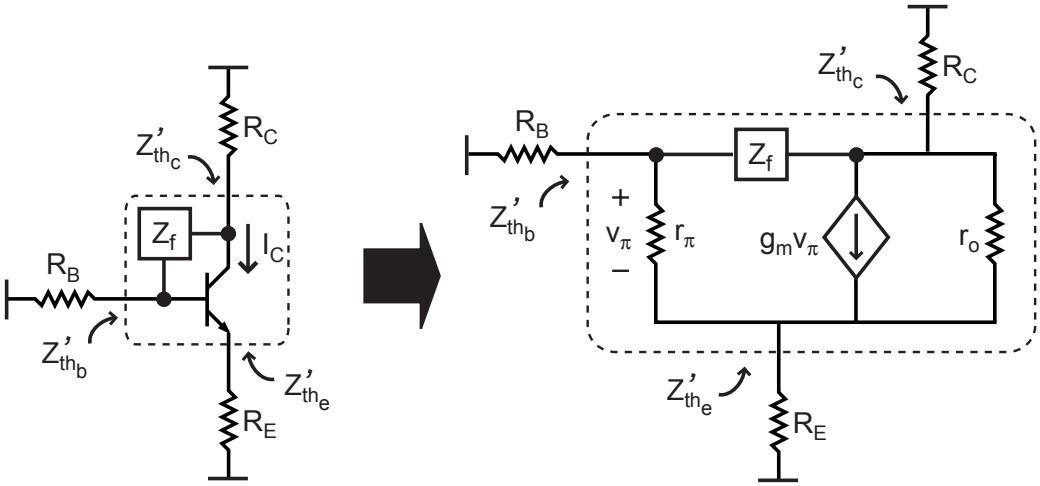

Figure 1 Definition of Thevenin Resistances.

Thevenin resistance at collector:

$$Z'_{th_c} \approx R_{th_c} || \frac{Z_f}{(Z_f || R_{th_b} || R_b)(G_m + 1/(R_{th_b} || R_b))}$$

Thevenin resistance at base:

$$Z'_{th_b} \approx R_{th_b} || \frac{Z_f}{(Z_f || R_{th_c} || R_c)(G_m + 1/(R_{th_c} || R_c))}$$

Thevenin resistance at emitter:

$$Z'_{th_e} \approx \frac{1}{g_m} + \frac{1}{1+\beta_o}(R_b || (R_c + Z_f)) + \frac{1}{1+R_f/R_c}(R_b || (R_c + Z_f))$$

Where:

$$R_{th_c} \approx (1 + g_m(r_\pi || R_E))r_o \quad \text{for } R_B \ll r_\pi, R_E$$

$$R_{th_b} \approx r_\pi + (\beta_o + 1)R_E \quad \text{for } R_C \ll r_o, R_E \ll r_o$$

$$G_m = \frac{1}{1/g_m + R_E}$$