Simplified T Model

Figure 1 shows the T model with a Thévenin source in series with the base. We wish to solve for an equivalent circuit in which the source i_c' connects from the collector node to ground rather than from the collector node to the B' node. The first step is to replace the source i_c' with two identical series sources with the common node grounded. The circuit is shown in Fig. 2(a).

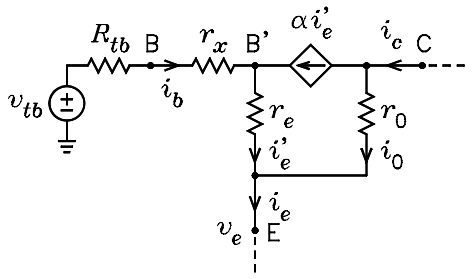

Figure 1: T model with Thévenin source connected to the base.

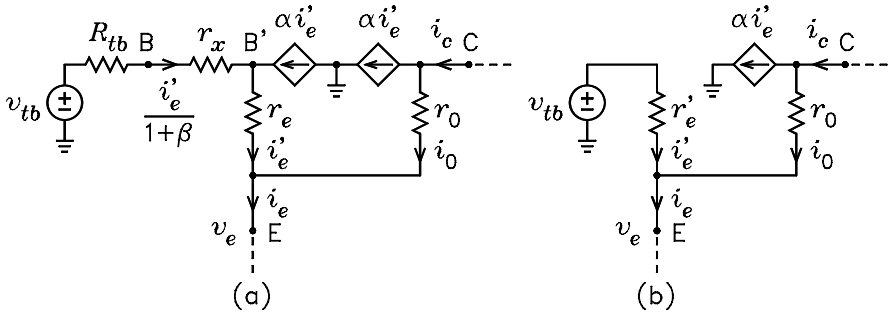

Figure 2: (a) Circuit with the i_c' source replaced by identical series sources. (b) Simplified T model.

For the circuit in Fig. 2(a), we can write

$$v_e = v_{tb} - \frac{i_e'}{1+\beta}\left(R_{tb} + r_x\right) - i_e' r_e = v_{tb} - i_e'\left(\frac{R_{tb}+r_x}{1+\beta} + r_e\right) \tag{1}$$

Let us define the resistance r_e' by

$$r_e' = \frac{R_{tb}+r_x}{1+\beta} + r_e = \frac{R_{tb}+r_x+r_\pi}{1+\beta} \tag{2}$$

With this definition, v_e is given by

$$v_e = v_{tb} - i_e' r_e' \tag{3}$$

The circuit which models this equation is shown in Fig. 2(b). This will be called the simplified T model. It predicts the same emitter and collector currents as the circuit in Fig. 1. Note that the resistors R_{tb} and r_x do not appear in this circuit. They are part of the resistor r_e'.