Example 5.4 Consider a bipolar transistor with a base doping of 10^{17} cm^{-3} and a quasi-neutral base width of 0.2 μm. Calculate the Early voltage and collector current ideality factor given that the base-emitter capacitance and the base-collector capacitance are 0.2 nF and 0.2 pF. The collector area equals 10^{-4} cm^{-2}.

Solution The Early voltage equals:

$$|V_A| = \frac{Q_B}{C_{j,BC}} = \frac{qA_C N_B w_B^{'}}{C_{j,BC}} = 160 \text{ V}$$

The saturation voltage equals:

$$n \cong 1 + \frac{V_t}{Q_B} C_{j,BE} = 1.16$$