

Semiconductor Device Theory: BJT – Simulation Exercise

Dragica Vasileska and Gerhard Klimeck
(ASU, Purdue)

Log in to the BJT Lab and use the default values for the structure of the discrete npn transistor. For the doping values in the first case use (a) the default doping for the emitter, base and collector doping and in the second case (b) use $N_E=10^{20} \text{ cm}^{-3}$, $N_B=5 \times 10^{18} \text{ cm}^{-3}$ and $N_C=10^{17} \text{ cm}^{-3}$. In both cases you will get as an output of the simulation the Gummel plot and the output characteristics for the transistor in a common emitter configuration.

- From the Gummel plot extract the maximum current gain (I_C/I_B). Under what doping conditions you get higher current gain?
- From the output characteristics extract the Early voltage.
- Give recommendations on better transistor design that give higher current amplification factor and larger Early voltage.
- Reduce the base thickness from 0.1 μm to 0.08 μm . Comment on the results obtained.