

Exercise for PN Junction Lab:

Long vs. Short Diode

The forward biased I - V characteristics of real p - n diodes are affected by generation-recombination mechanisms in the depletion region, by the high injection and the series resistance of the diode. They are also affected by the length of the n - and p -regions. In another exercise you have the opportunity to investigate generation-recombination, high level injection and series resistance effect. The purpose of this exercise is to examine the behavior of long and short diodes. The doping of the p - and n -regions is $N_A=10^{18} \text{ cm}^{-3}$ and $N_D=10^{14} \text{ cm}^{-3}$. The user is required to vary the minority carrier lifetime such that:

$$(a) \tau_n = \tau_p = 1\mu s \quad (b) \tau_n = \tau_p = 0.1\mu s$$

For each of the two values for the minority carrier lifetimes, vary the length of the n -region. For that purpose consider n -region lengths of 0.2, 0.5, 1 and 5 μm . Comment on the results obtained and try to explain the diode behavior starting from general mathematical expressions for the diode. Vary the anode voltage from $V_A=0 \text{ V}$ to $V_A=1 \text{ V}$.