

# Analog Electronics Notes

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## 1 Some basic concepts

To manipulate currents externally, we generally need to create a gradient, which generates an electric field which can be controlled externally

Band gap in Si =  $1.12eV$

$\Rightarrow$  For Silicon to function as a semiconductor,  $\frac{1}{2}k_B T \geq 1.12eV$

where  $k_B$  is the Boltzmann constant.

In a simple p-n junction, the p-n junction is a metallurgical junction, and at thermal equilibrium, it forms a depletion layer, which results in a built-in potential  $V_{bi}$ , due to a distribution of charge.

If the p-side is doped with  $N_a$  acceptor atoms( $cm^{-3}$ ) and the n-side is doped with  $N_d$  donor atoms( $cm^{-3}$ ), then:

$$V_{bi} = \frac{k_B T}{q} \ln\left(\frac{N_a N_d}{n_i^2}\right) \quad (1)$$

which at  $T \approx 300K$ :

- $V_T$  called the thermal voltage  $q = e = 1.6 * 10^{-19}$ ,

$$V_T = \frac{k_B T}{q} \approx 26mV$$

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- $n_i = 1.35 * 10^{10} \approx 10^{10}cm^{-3}$