VELOCITY SATURATION: HOT ELECTRONS.

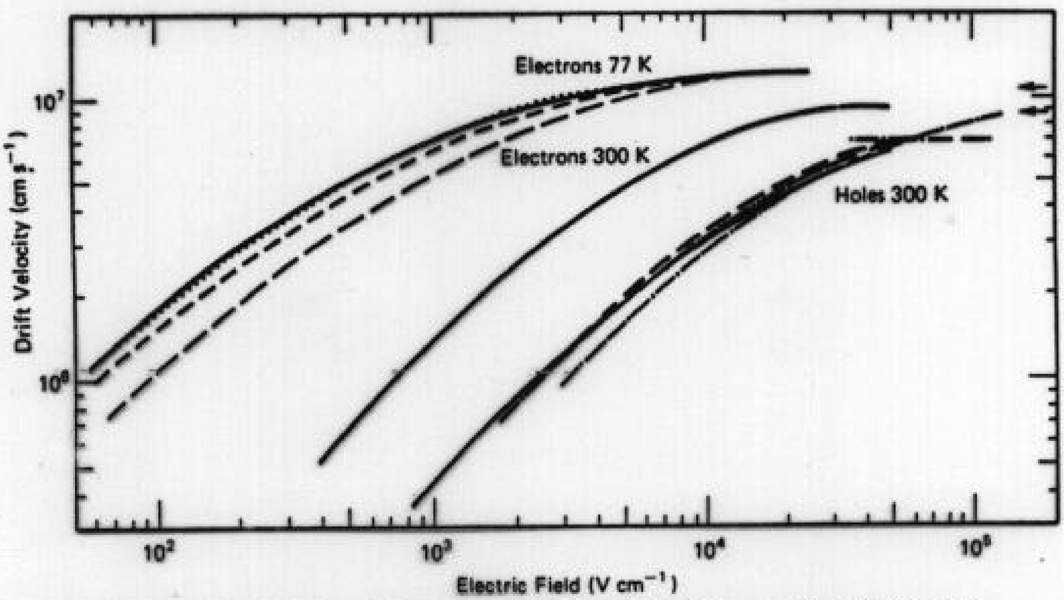


Figure 1.17 Drift velocities of electrons (at 77 K and 300 K) and holes (at 300 K) in silicon as functions of the applied field showing velocity saturation at high fields. The presence of several curves indicates the variation in reported data. An empirical "best fit" to these curves is given in Equation 1.2.12 and Table 1.2.[5]

$$V_d = V_l \frac{\mathcal{E}}{\mathcal{E}_c} \frac{1}{\left[1 + (\mathcal{E}/\mathcal{E}_c)^{\beta}\right]^{1/\beta}}$$

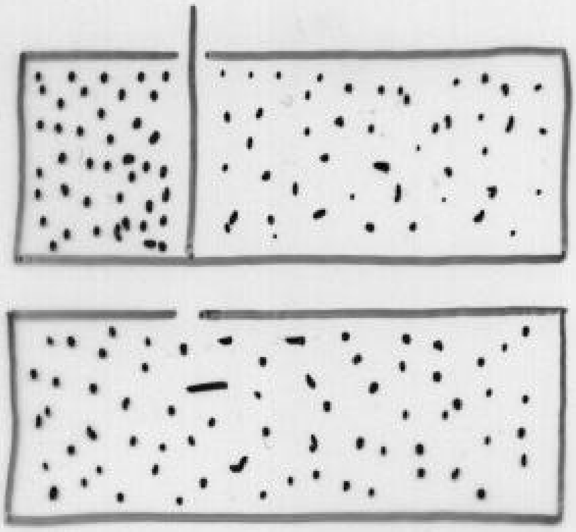
Table 1.2 Parameters for Field Dependence of Drift Velocity

Parameter	Electrons Expression	Electrons at 300 K	Holes Expression	Holes at 300 K
v_l cm s^{-1}	$1.53 \times 10^9\, T^{-0.87}$	1.07×10^7	$1.62 \times 10^8\, T^{-0.52}$	8.34×10^6
$\mathcal{E}_c$ V cm^{-1}	$1.01\, T^{1.55}$	6.91×10^3	$1.24\, T^{1.68}$	1.45×10^4
β	$2.57 \times 10^{-2}\, T^{0.66}$	1.11	$0.46\, T^{0.17}$	2.637

VALID FOR LOW DOPING

DIFFUSION OF CARRIERS – COMPLEMENTARY TO DRIFT

– CAUSED BY A CONCENTRATION GRADIENT



BEFORE

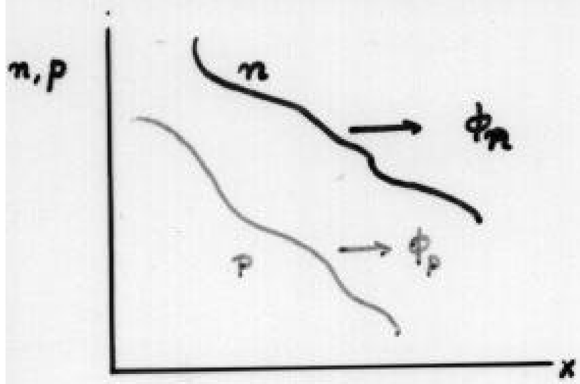
AFTER

DIFFUSION DUE TO RANDOM MOTION OF PARTICLES

$\Downarrow$

THERMAL MOTION

DIFFUSION LAW: FICK'S LAW



FLUX OF ELECTRONS: $\phi_n \propto -\dfrac{dn}{dx}$

$$\phi_n = -D_n \frac{dn}{dx}$$

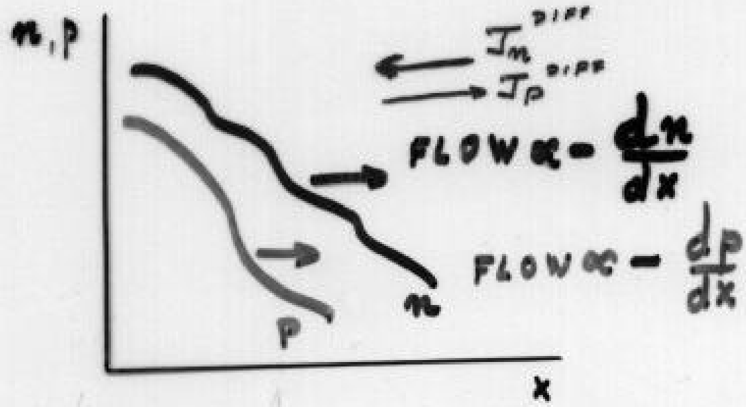
D_n: DIFFUSIVITY FOR e [cm^2/s]

FLUX OF HOLES: $\phi_p \propto -\dfrac{dp}{dx}$

$$\phi_p = -D_p \frac{dp}{dx}$$

D_p: DIFFUSIVITY FOR h^+ [cm^2/s]

DIFFUSION



$$J_n = -(-q) D_n \frac{dn}{dx}$$

$$J_p = -q D_p \frac{dp}{dx}$$

$D_n = \frac{kT}{q} \mu_n$: DIFFUSION CONST

$D_p = \frac{kT}{q} \mu_p$: DIFFUSION CONST.

$[D]$: cm^2/s

$$\bar{J}_n = q \mu_n n \bar{\mathcal{E}} \oplus q D_n \frac{dn}{dx}$$

$$\bar{J}_p = q \mu_p p \bar{\mathcal{E}} \ominus q D_p \frac{dp}{dx}$$