Block XSNOFX

The XSNOFX block calculates the excess electrons in p-type silicon as a function of the material depth.



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Inputs

1 Depth x / cm
2 Generation rate $G(\lambda)$ / $\mathrm{cm}^{-3}\,\mathrm{s}^{-1}$
3 Absorption coefficient $\alpha(\lambda)$
4 Voltage V / V
5 Temperature T / °C

Outputs

1 Number of excess electrons $n(x)$

Parameters

1 Equilibrium electron concentration in p-type Si n_{po} / cm^{-3}
2 Diffusion constant of electrons D_{n} / $\mathrm{cm}^2\,\mathrm{s}^{-1}$
3 Diffusion length of electrons L_{n} / μm
4 Thickness of basis d_{ba} / cm
5 Thickness of emitter d_{em} / cm
6 Recombination velocity at backside s_{n} / $\mathrm{cm}\,\mathrm{s}^{-1}$

Strings

None

Remarks

Solution from Wagemann/Eschrich Appendix A2, Eqn. A2.11)

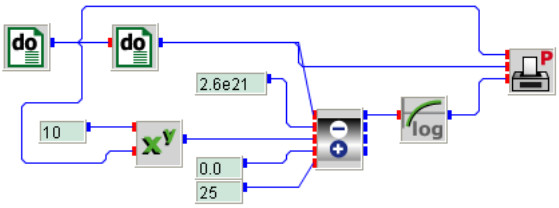
Description

According to Wagemann the number of excess electrons in the basis of a crystalline silicon semiconductor can be calculated after

$$\Delta n(x) = n_{\mathrm{po}} \left(\exp\left(\frac{qV}{kT}\right) - 1 \right) \cdot \frac{\frac{D_\mathrm{n}}{L_\mathrm{n}} \cosh(x') + s_\mathrm{n} \sinh(x')}{\frac{D_\mathrm{n}}{L_\mathrm{n}} \cosh(x_0) + s_\mathrm{n} \sinh(x_0)}$$
$$+ \frac{G_0(\lambda)\tau_\mathrm{n}}{1-\alpha(\lambda)^2 L_\mathrm{n}^2} \exp(-\alpha(\lambda) d_\mathrm{em}) \cdot \Bigg(\exp(-\alpha(\lambda)x)$$
$$+ \frac{(D_\mathrm{n}\alpha(\lambda) - s_\mathrm{n}) \exp(-\alpha(\lambda) d_\mathrm{ba} \sinh(\frac{x}{L_\mathrm{n}}) - \frac{D_\mathrm{n}}{L_\mathrm{n}} \cosh(x') - s_\mathrm{n} \sinh(x')}{\frac{D_\mathrm{n}}{L_\mathrm{n}} \cosh(x_0) + s_n \sinh(x_0)} \Bigg)$$

with the shortcuts $x' = \frac{d_\mathrm{ba} - x}{L_\mathrm{n}}$ and $x_0 = \frac{d_\mathrm{ba}}{L_\mathrm{n}}$.

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For typical values of a doped silicon crystal the PLOT block shows the logarithmic number of excess electrons as a function of the depth in the basis.

