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Semiconductor Carriers Formulas

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List of 15 Semiconductor Carriers Formulas

Semiconductor Carriers

1) Carrier Lifetime

Open Calculator

fx $$T_a = \frac{1}{\alpha_r \cdot (p_0 + n_0)}$$

ex $$3.6E\hat{}\text{-}6s = \frac{1}{1.2e\text{-}6m^3/s \cdot (2.3e11/m^3 + 1.4e7/m^3)}$$

2) Conduction Band Energy

Open Calculator

fx $$E_c = E_g + E_v$$

ex $$17.5eV = 0.198eV + 17.302eV$$

3) Distribution Coefficient

Open Calculator

fx $$k_d = \frac{C_{solid}}{C_L}$$

ex $$0.404 = \frac{1.01e15cm^{-1}}{2.5e15cm^{-1}}$$

4) Effective Density State in Valence Band

Open Calculator

$$N_v = \frac{p_0}{1 - f_E}$$

$$2.4E\hat{}11/m^3 = \frac{2.3e11/m^3}{1 - 0.022}$$

5) Electron Current Density

Open Calculator

$$J_e = J_T - J_h$$

$$0.03A/m^2 = 0.12A/m^2 - 0.09A/m^2$$

6) Electron Flux Density

Open Calculator

$$\Phi_n = \left(\frac{L_e}{2 \cdot t}\right) \cdot \Delta N$$

$$0.017718Wb/m^2 = \left(\frac{25.47\mu m}{2 \cdot 5.75s}\right) \cdot 8000/m^3$$

7) Electron Multiplication

Open Calculator

$$M_n = \frac{n_{out}}{n_{in}}$$

$$4 = \frac{60}{15}$$

8) Excess Carrier Concentration

Open Calculator

fx $\delta_n = g_{op} \cdot \tau_n$

ex $1E\hat{}14/m^3 = 2.9e19 \cdot 3.62e\text{-}6s$

9) Fermi Function

Open Calculator

fx $f_E = \frac{n_0}{N_c}$

ex $0.021875 = \frac{1.4e7/m^3}{6.4e8/m^3}$

10) Hole Current Density

Open Calculator

fx $J_h = J_T - J_e$

ex $0.09A/m^2 = 0.12A/m^2 - 0.03A/m^2$

11) Intrinsic Carrier Concentration

Open Calculator

fx $n_i = \sqrt{N_v \cdot N_c} \cdot \exp\left(-\frac{E_g}{2 \cdot [BoltZ] \cdot T}\right)$

ex $2.7E\hat{}8/m^3 = \sqrt{2.4e11/m^3 \cdot 6.4e8/m^3} \cdot \exp\left(-\frac{0.198eV}{2 \cdot [BoltZ] \cdot 300K}\right)$

12) Mean Time Spend by Hole

Open Calculator

$$\delta_p = g_{op} \cdot \tau_p$$

$$8120s = 2.9e19 \cdot 2.8e\text{-}16$$

13) Photoelectron Energy

Open Calculator

$$E_{photo} = [hP] \cdot f$$

$$757.4472eV = [hP] \cdot 183.15PHz$$

14) Quantum State

Open Calculator

$$E_n = \frac{n^2 \cdot \pi^2 \cdot [hP]^2}{2 \cdot M \cdot L^2}$$

$$8.2E\hat{}\text{-}24eV = \frac{(2)^2 \cdot \pi^2 \cdot [hP]^2}{2 \cdot 1.34e\text{-}5kg \cdot (7e\text{-}10)^2}$$

15) Radius of Nth Orbit of Electron

Open Calculator

$$r_n = \frac{[Coulomb] \cdot n^2 \cdot [hP]^2}{M \cdot [Charge\text{-}e]^2}$$

$$4.6E\hat{}\text{-}8\mu m = \frac{[Coulomb] \cdot (2)^2 \cdot [hP]^2}{1.34e\text{-}5kg \cdot [Charge\text{-}e]^2}$$

Variables Used

- C_L Impurity Concentration in Liquid *(1 per Centimeter)*
- C_{solid} Impurity Concentration in Solid *(1 per Centimeter)*
- E_c Conduction Band Energy *(Electron-Volt)*
- E_g Energy Gap *(Electron-Volt)*
- E_n Energy in Quantum State *(Electron-Volt)*
- E_{photo} Photoelectron Energy *(Electron-Volt)*
- E_v Valence Band Energy *(Electron-Volt)*
- f Frequency of Incident Light *(Petahertz)*
- f_E Fermi Function
- g_{op} Optical Generation Rate
- J_e Electron Current Density *(Ampere per Square Meter)*
- J_h Hole Current Density *(Ampere per Square Meter)*
- J_T Total Carrier Current Density *(Ampere per Square Meter)*
- k_d Distribution Coefficient
- L Potential Well Length
- L_e Mean Free Path Electron *(Micrometer)*
- M Mass of Particle *(Kilogram)*
- M_n Electron Multiplication
- n Quantum Number
- n_0 Electron Concentration in Conduction Band *(1 per Cubic Meter)*
- N_c Effective Density of State in Conduction Band *(1 per Cubic Meter)*

- n_i Intrinsic Carrier Concentration *(1 per Cubic Meter)*
- n_{in} Number of Electron in Region
- n_{out} Number of Electron Out of Region
- N_v Effective Density of State in Valence Band *(1 per Cubic Meter)*
- p_0 Holes Concentration in Valance Band *(1 per Cubic Meter)*
- r_n Radius of nth Orbit of Electron *(Micrometer)*
- t Time *(Second)*
- T Temperature *(Kelvin)*
- T_a Carrier Lifetime *(Second)*
- α_r Proportionality for Recombination *(Cubic Meter per Second)*
- δ_n Excess Carrier Concentration *(1 per Cubic Meter)*
- δ_p Mean Time Spend by Hole *(Second)*
- ΔN Difference in Electron Concentration *(1 per Cubic Meter)*
- τ_n Recombination Lifetime *(Second)*
- τ_p Majority Carrier Decay
- Φ_n Electron Flux Density *(Weber per Square Meter)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **[BoltZ]**, 1.38064852E-23 Joule/Kelvin
  Boltzmann constant
- Constant: **[Charge-e]**, 1.60217662E-19 Coulomb
  Charge of electron
- Constant: **[Coulomb]**, 8.9875517923E9 Newton * Meter ^2 / Coulomb ^2
  Coulomb constant
- Constant: **[hP]**, 6.626070040E-34 Kilogram Meter² / Second
  Planck constant
- Function: **exp**, exp(Number)
  Exponential function
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Micrometer (µm)
  Length Unit Conversion
- Measurement: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Energy** in Electron-Volt (eV)
  Energy Unit Conversion
- Measurement: **Frequency** in Petahertz (PHz)
  Frequency Unit Conversion

- Measurement: **Magnetic Flux Density** in Weber per Square Meter (Wb/m²)
  Magnetic Flux Density Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Surface Current Density** in Ampere per Square Meter (A/m²)
  Surface Current Density Unit Conversion
- Measurement: **Carrier Concentration** in 1 per Cubic Meter (1/m³)
  Carrier Concentration Unit Conversion
- Measurement: **Reciprocal Length** in 1 per Centimeter (cm^{-1})
  Reciprocal Length Unit Conversion

Check other formula lists

- **Electrons & Holes Formulas**
- **Energy Band & Charge Carrier Formulas**
- **Semiconductor Carriers Formulas**
- **SSD Junction Formulas**

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