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SSD Junction Formulas

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List of 16 SSD Junction Formulas

SSD Junction

1) Absorbed Power

Open Calculator

fx $P_{abs} = P_i \cdot \exp(-b \cdot \alpha)$

ex $0.107301\text{W} = 0.22\text{W} \cdot \exp(-0.46\mu\text{m} \cdot 15608.42\text{cm}^{-1})$

2) Absorption Coefficient

Open Calculator

fx $\alpha = \left(-\frac{1}{b}\right) \cdot \ln\left(\frac{P_{abs}}{P_i}\right)$

ex $15068.42\text{cm}^{-1} = \left(-\frac{1}{0.46\mu\text{m}}\right) \cdot \ln\left(\frac{0.11\text{W}}{0.22\text{W}}\right)$

3) Acceptor Concentration

Open Calculator

fx $N_a = \frac{|Q|}{[\text{Charge-e}] \cdot x_{no} \cdot A_j}$

ex $7.9\text{E}\hat{}35/\text{m}^3 = \frac{13\text{C}}{[\text{Charge-e}] \cdot 0.019\mu\text{m} \cdot 5401.3\mu\text{m}^2}$

4) Cross-Sectional Area of Junction

Open Calculator

fx $$A_j = \frac{|Q|}{[\text{Charge-e}] \cdot x_{no} \cdot N_a}$$

ex $$5405.704\mu m^2 = \frac{13C}{[\text{Charge-e}] \cdot 0.019\mu m \cdot 7.9e35/m^3}$$

5) Donor Concentration

Open Calculator

fx $$N_d = \frac{|Q|}{[\text{Charge-e}] \cdot x_{po} \cdot A_j}$$

ex $$2.5E\hat{}35/m^3 = \frac{13C}{[\text{Charge-e}] \cdot 0.06\mu m \cdot 5401.3\mu m^2}$$

6) Junction Capacitance

Open Calculator

fx $$C_j = \left(\frac{A_j}{2}\right) \cdot \sqrt{\frac{2 \cdot [\text{Charge-e}] \cdot k \cdot N_B}{V - V_1}}$$

ex $$0.02304\mu F = \left(\frac{5401.3\mu m^2}{2}\right) \cdot \sqrt{\frac{2 \cdot [\text{Charge-e}] \cdot 1.59\mu m \cdot 1e28/m^3}{120V - 50V}}$$

7) Junction Transition Width

Open Calculator

fx $$W_j = x_{no} \cdot \left(\frac{N_a + N_d}{N_a}\right)$$

ex $$0.025013\mu m = 0.019\mu m \cdot \left(\frac{7.9e35/m^3 + 2.5e35/m^3}{7.9e35/m^3}\right)$$

8) Junction Voltage

Open Calculator

fx $$V_j = V - \left(R_{se(p)} + R_{se(n)}\right) \cdot I$$

ex $$119.9V = 120V - (23.3\Omega + 476.7\Omega) \cdot 0.2mA$$

9) Length of P-Side Junction

Open Calculator

fx $$L_p = \left(\frac{I_{opt}}{[Charge\text{-}e] \cdot A_j \cdot g_{op}}\right) - (W_j + L_{dif})$$

ex $$5.4E\hat{}9\mu m = \left(\frac{0.135mA}{[Charge\text{-}e] \cdot 5401.3\mu m^2 \cdot 2.9e19}\right) - (0.025\mu m + 0.0056\mu m)$$

10) Net Distribution of Charge

Open Calculator

fx $$x = \frac{N_d - N_a}{G}$$

ex $$-0.075 = \frac{2.5e35/m^3 - 7.9e35/m^3}{7.2e36}$$

11) N-Type Width

Open Calculator

fx $$x_{no} = \frac{|Q|}{A_j \cdot N_a \cdot [Charge\text{-}e]}$$

ex $$0.019015\mu m = \frac{13C}{5401.3\mu m^2 \cdot 7.9e35/m^3 \cdot [Charge\text{-}e]}$$

12) P-N Junction Length

Open Calculator

$$L_j = k + L_{eff}$$

$$1.76\mu m = 1.59\mu m + 0.17\mu m$$

13) Quantum Number

Open Calculator

$$n = [Coulomb] \cdot \frac{L}{3.14}$$

$$2.003594 = [Coulomb] \cdot \frac{7e\text{-}10}{3.14}$$

14) Series Resistance in N-type

Open Calculator

$$R_{se(n)} = \left(\frac{V - V_j}{I}\right) - R_{se(p)}$$

$$476.7\Omega = \left(\frac{120V - 119.9V}{0.2mA}\right) - 23.3\Omega$$

15) Series Resistance in P-type

Open Calculator

$$R_{se(p)} = \left(\frac{V - V_j}{I}\right) - R_{se(n)}$$

$$23.3\Omega = \left(\frac{120V - 119.9V}{0.2mA}\right) - 476.7\Omega$$

16) Total Acceptor Charge

Open Calculator

fx $$|Q| = [\text{Charge-e}] \cdot x_{no} \cdot A_j \cdot N_a$$

ex $$12.98941\text{C} = [\text{Charge-e}] \cdot 0.019\mu\text{m} \cdot 5401.3\mu\text{m}^2 \cdot 7.9\text{e}35/\text{m}^3$$

Variables Used

- **|Q|** Total Acceptor Charge *(Coulomb)*
- A_j Junction Area *(Square Micrometer)*
- **b** Sample Thickness *(Micrometer)*
- C_j Junction Capacitance *(Microfarad)*
- **G** Graded Constant
- g_{op} Optical Generation Rate
- **I** Electric Current *(Milliampere)*
- I_{opt} Optical Current *(Milliampere)*
- **k** Constant Length Offset *(Micrometer)*
- **L** Potential Well Length
- L_{dif} Diffusion Length of Transition Region *(Micrometer)*
- L_{eff} Effective Channel Length *(Micrometer)*
- L_j Junction Length *(Micrometer)*
- L_p Length of P-Side Junction *(Micrometer)*
- **n** Quantum Number
- N_a Acceptor Concentration *(1 per Cubic Meter)*
- N_B Doping Concentration of Base *(1 per Cubic Meter)*
- N_d Donor Concentration *(1 per Cubic Meter)*
- P_{abs} Absorbed Power *(Watt)*
- P_i Incident Power *(Watt)*
- $R_{se(n)}$ Series Resistance in N Junction *(Ohm)*
- $R_{se(p)}$ Series Resistance in P Junction *(Ohm)*

- **V** Source Voltage *(Volt)*
- V_1 Source Voltage 1 *(Volt)*
- V_j Junction Voltage *(Volt)*
- W_j Junction Transition Width *(Micrometer)*
- **x** Net Distribution
- x_{no} Charge Penetration N-type *(Micrometer)*
- x_{po} Charge Penetration P-type *(Micrometer)*
- **α** Absorption Coefficient *(1 per Centimeter)*

Constants, Functions, Measurements used

- Constant: **[Charge-e]**, 1.60217662E-19 Coulomb
  Charge of electron
- Constant: **[Coulomb]**, 8.9875517923E9 Newton * Meter ^2 / Coulomb ^2
  Coulomb constant
- Function: **exp**, exp(Number)
  Exponential function
- Function: **ln**, ln(Number)
  Natural logarithm function (base e)
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Micrometer (µm)
  Length Unit Conversion
- Measurement: **Electric Current** in Milliampere (mA)
  Electric Current Unit Conversion
- Measurement: **Area** in Square Micrometer (µm²)
  Area Unit Conversion
- Measurement: **Electric Charge** in Coulomb (C)
  Electric Charge Unit Conversion
- Measurement: **Power** in Watt (W)
  Power Unit Conversion
- Measurement: **Capacitance** in Microfarad (µF)
  Capacitance Unit Conversion
- Measurement: **Electric Resistance** in Ohm (Ω)
  Electric Resistance Unit Conversion
- Measurement: **Electric Potential** in Volt (V)
  Electric Potential Unit Conversion

- Measurement: **Carrier Concentration** in 1 per Cubic Meter ($1/m^3$)
  Carrier Concentration Unit Conversion
- Measurement: **Reciprocal Length** in 1 per Centimeter (cm^{-1})
  Reciprocal Length Unit Conversion

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