

List of formulae

$$f^e(E) = \frac{1}{\exp\left(\frac{E - E_{Fn}}{kT}\right) + 1}$$

$$I_d = I_s \left[ \exp\left(\frac{qV}{kT}\right) - 1 \right]$$

$$V_{OC} = \frac{kT}{q} \ln\left(1 + \frac{I_{ph}}{I_s}\right)$$

$$I_{tot} = I_s \left[ 1 - \exp\left(\frac{q(V - I_{tot}R_s)}{kT}\right) \right] + I_{ph}$$

$$L_{e(h)} = \sqrt{D_{e(h)} \tau_{e(h)}}$$

$$\eta = \left( \frac{I_{ph}}{q} \right) \left( \frac{P_{opt}}{h\nu} \right)^{-1}$$

$$\eta = (1 - R) [1 - \exp(-\alpha W)]$$

$$R_{res} = \frac{\eta q \lambda}{hc}$$

$$f_{3dB-tr} = \frac{0.4}{t_r} = \frac{0.4\nu_s}{W}$$

$$f_{IMP} = \frac{\nu_{sat}}{2(w - x_a)}$$

$$M = \frac{1}{1 - \left( \frac{V - IR}{V_b} \right)^{n_m}}$$

$$SNR = \frac{I_{ph}^2}{\langle i_s^2 \rangle + \langle i_{th}^2 \rangle} = \frac{(q\eta P_{opt}/h\nu)^2}{2qI_T B + 4kTB/R_{eq}}$$

$$g(h\nu) = G_{las} [f^e(E^e) + f^h(E^h) - 1] \quad cm^{-1} \text{ where } G_{las} = 5.6 \times 10^4 \frac{(h\nu - E_g)^{1/2}}{h\nu} \text{ for GaAs}$$

$$J_{th} = \frac{qd_{las} n_{th}}{\tau_r(J_{th})}$$

$$f^h(E) = \frac{1}{\exp\left(\frac{E_{Fp} - E}{kT}\right) + 1}$$

$$I_s = qAN_c N_v \left[ \frac{1}{N_A} \sqrt{\frac{D_e}{\tau_e}} + \frac{1}{N_D} \sqrt{\frac{D_h}{\tau_h}} \right] \exp\left(-\frac{E_g}{kT}\right)$$

$$I_{SC} = I_{ph}$$

$$W = \sqrt{\frac{2\varepsilon_s}{q} \left( \frac{N_A + N_D}{N_A N_D} \right)} V_{bi}$$

$$D_{e(h)} = \frac{kT}{q} \mu_{e(h)}$$

$$t_{diff} = \frac{4x^2}{\pi^2 D_p}$$

$$f_{RC} = \frac{1}{2\pi RC}$$

$$V_B = E_m x_a + \left( E_m - \frac{qQ_c}{\varepsilon_s} \right) (w - x_a)$$