



calculatoratoz.com



unitsconverters.com

Fiber Optic Communication Formulas

Calculators!

Examples!

Conversions!

Bookmark calculatoratoz.com, unitsconverters.com

Widest Coverage of Calculators and Growing - **30,000+ Calculators!**
Calculate With a Different Unit for Each Variable - **In built Unit Conversion!**
Widest Collection of Measurements and Units - **250+ Measurements!**

Feel free to SHARE this document with your friends!

[Please leave your feedback here...](#)



List of 36 Fiber Optic Communication Formulas

Fiber Optic Communication

Detectors and Receivers

1) 3 dB Bandwidth of Metal Photodetectors

$$fx \quad DOV = DIV1 + DIV2$$

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2_img.jpg\)](#)

$$ex \quad 5 = 2 + 3$$

2) Detectivity of Photodetector

$$fx \quad DOV = DIV1 + DIV2$$

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa_img.jpg\)](#)

$$ex \quad 5 = 2 + 3$$

3) Electron Rate in Detector

$$fx \quad R_p = \eta \cdot R_i$$

[Open Calculator !\[\]\(f1c5da15572e3e09d343161be98f508d_img.jpg\)](#)

$$ex \quad 1.5m/s = 0.3 \cdot 5m/s$$



4) Incident Photon Rate

$$\text{fx } R_i = \frac{P_i}{[hP] \cdot F_i}$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$\text{ex } 2E^{33m/s} = \frac{6W}{[hP] \cdot 4.5Hz}$$

5) Junction Capacitance of Photodiode

$$\text{fx } DOV = DIV1 + DIV2$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$\text{ex } 5 = 2 + 3$$

6) Long Wavelength Cutoff Point

$$\text{fx } \lambda_c = [hP] \cdot \frac{[c]}{E_g}$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$\text{ex } 1.1E^{-26m} = [hP] \cdot \frac{[c]}{18J}$$


7) Longest Transit Time

$$\text{fx } DOV = DIV1 + DIV2$$

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754_img.jpg\)](#)

$$\text{ex } 5 = 2 + 3$$



8) Maximum 3dB Bandwidth of Metal Photodetector 

$$fx \quad DOV = DIV1 + DIV2$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$ex \quad 5 = 2 + 3$$

9) Maximum Photodiode 3 dB Bandwidth 

$$fx \quad B_m = \frac{v_d}{2 \cdot \pi \cdot w}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$ex \quad 0.282942Hz = \frac{16m/s}{2 \cdot \pi \cdot 9m}$$

10) Multiplication Factor 

$$fx \quad M = \frac{I_o}{I_c}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$ex \quad 2.173913 = \frac{10A}{4.6A}$$

11) Noise Equivalent Power 

$$fx \quad DOV = DIV1 + DIV2$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b_img.jpg\)](#)

$$ex \quad 5 = 2 + 3$$

12) Optical Gain of Phototransistor 

$$fx \quad G_O = \eta \cdot h_{FE}$$

[Open Calculator !\[\]\(40770d9ed6ed4f1222ebf89a1396e8b2_img.jpg\)](#)

$$ex \quad 0.15 = 0.3 \cdot 0.5$$




13) Output Photo Current 

$$fx \quad I_p = \eta \cdot P_i \cdot \frac{[\text{Charge-e}]}{[hP] \cdot f}$$

Open Calculator 

$$ex \quad 2.2E^{13}A = 0.3 \cdot 6W \cdot \frac{[\text{Charge-e}]}{[hP] \cdot 20Hz}$$

14) PhotoConductive Gain 

$$fx \quad DOV = DIV1 + DIV2$$

Open Calculator 

$$ex \quad 5 = 2 + 3$$

15) Quantum Efficiency of Photodetector 

$$fx \quad \eta = \frac{N_e}{N_p}$$

Open Calculator 

$$ex \quad 1.666667 = \frac{5}{3}$$

16) Responsivity in relation to Photon Energy 

$$fx \quad R = \frac{\eta \cdot [\text{Charge-e}]}{[hP] \cdot f}$$

Open Calculator 

$$ex \quad 3.6E^{12}A = \frac{0.3 \cdot [\text{Charge-e}]}{[hP] \cdot 20Hz}$$



17) Responsivity of Photodetector 

$$fx \quad R = \frac{I_p}{P_o}$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

$$ex \quad 1.6666667A = \frac{70A}{42W}$$

18) Responsivity with reference of Wavelength 

$$fx \quad R = \frac{\eta \cdot [\text{Charge-e}] \cdot \lambda}{[hP] \cdot [c]}$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5_img.jpg\)](#)

$$ex \quad 0.375048 = \frac{0.3 \cdot [\text{Charge-e}] \cdot 1.55\mu\text{m}}{[hP] \cdot [c]}$$

19) Transit Time with respect to Minority Carrier Diffusion 

$$fx \quad t_{\text{dif}} = \frac{d^2}{2 \cdot D_c}$$

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60_img.jpg\)](#)

$$ex \quad 2.571429s = \frac{(6m)^2}{2 \cdot 7m^2/s}$$



Optical Fiber Parameters

20) Diameter of Fiber

$$\text{fx } D = \frac{\lambda \cdot N_M}{\pi \cdot NA}$$

[Open Calculator !\[\]\(83f22ed94ec5517769dd76d702c6bfd8_img.jpg\)](#)

$$\text{ex } 25.90247\mu\text{m} = \frac{1.55\mu\text{m} \cdot 21}{\pi \cdot 0.4}$$

21) Fiber Attenuation Coefficient

$$\text{fx } \alpha_p = \frac{\alpha}{4.343}$$

[Open Calculator !\[\]\(3cb60d42b10e53f9522bb0b392c1c4cd_img.jpg\)](#)

$$\text{ex } 0.640111 = \frac{2.78\text{dB}}{4.343}$$

22) Fiber Length

$$\text{fx } L = V_g \cdot T_d$$

[Open Calculator !\[\]\(0d7ca0919e6c47bbd874bfa0189fe22e_img.jpg\)](#)

$$\text{ex } 1.25\text{m} = 2.5\text{e}8\text{m/s} \cdot 5\text{e-}9\text{s}$$


23) Gaussian Pulse

$$\text{fx } \sigma_g = \frac{\sigma_\lambda}{L \cdot D_{\text{opt}}}$$

[Open Calculator !\[\]\(683dba75afe26e28cd4de5730b776760_img.jpg\)](#)

$$\text{ex } 5.3\text{E}^{-18}\text{s/m} = \frac{2\text{e-}11\text{s}}{1.25\text{m} \cdot 3\text{e}6\text{s}^2/\text{m}}$$




24) Number of Modes 

$$fx \quad N_M = \frac{2 \cdot \pi \cdot r_{\text{core}} \cdot NA}{\lambda}$$

[Open Calculator !\[\]\(6605b201d6f14d9b3bcb8ab5f274d107_img.jpg\)](#)

$$ex \quad 21.07907 = \frac{2 \cdot \pi \cdot 13\mu\text{m} \cdot 0.4}{1.55\mu\text{m}}$$

25) Number of Modes using Normalized Frequency 

$$fx \quad N_M = \frac{V^2}{2}$$

[Open Calculator !\[\]\(e8fb589d58dad1692debababa5e928b6_img.jpg\)](#)


$$ex \quad 21 = \frac{(6.48\text{Hz})^2}{2}$$

26) Optical Dispersion 

$$fx \quad D_{\text{opt}} = \frac{2 \cdot \pi \cdot [c] \cdot \beta}{\lambda^2}$$

[Open Calculator !\[\]\(4688aadfd656ded00cd6bdfae55089a9_img.jpg\)](#)

$$ex \quad 3E^6\text{s}^2/\text{m} = \frac{2 \cdot \pi \cdot [c] \cdot 3.8e-15\text{rad}/\text{m}}{(1.55\mu\text{m})^2}$$

27) Power Loss in Fiber 

$$fx \quad P_\alpha = P_{\text{in}} \cdot \exp(\alpha_p \cdot L)$$

[Open Calculator !\[\]\(4146d17f71dced09c6ad789cacceaa6d_img.jpg\)](#)

$$ex \quad 12.24048\text{W} = 5.5\text{W} \cdot \exp(0.64 \cdot 1.25\text{m})$$



Wave Propagation Parameters

28) Graded Index Length of Fiber

$$fx \quad n_{gr} = L \cdot \eta_{core}$$

[Open Calculator !\[\]\(d66ff64371a51729ac8c1cdaa685ba6f_img.jpg\)](#)

$$ex \quad 1.66875 = 1.25m \cdot 1.335$$

29) Group Delay

$$fx \quad V_g = \frac{L}{T_d}$$

[Open Calculator !\[\]\(faf942dc3e59ce8eb64b4ac481eca7e0_img.jpg\)](#)

$$ex \quad 2.5E^8m/s = \frac{1.25m}{5e-9s}$$

30) Normalized Frequency

$$fx \quad V = \sqrt{2 \cdot N_M}$$

[Open Calculator !\[\]\(95b425611cbd2b8716a140cf67c81822_img.jpg\)](#)

$$ex \quad 6.480741Hz = \sqrt{2 \cdot 21}$$

31) Numerical Aperture

$$fx \quad NA = \sqrt{\left(\eta_{core}^2\right) - \left(\eta_{clad}^2\right)}$$

[Open Calculator !\[\]\(56549452e01ca28bdf2500ced9653143_img.jpg\)](#)

$$ex \quad 0.402114 = \sqrt{\left((1.335)^2\right) - \left((1.273)^2\right)}$$



32) Optical Pulse Duration

$$fx \quad \sigma_{\lambda} = L \cdot D_{opt} \cdot \sigma_g$$

[Open Calculator !\[\]\(0f848bbd71cef6b345273b16f905912a_img.jpg\)](#)

$$ex \quad 19.9875s = 1.25m \cdot 3e6s^2/m \cdot 5.33e-6s/m$$

33) Plane Wave Velocity

$$fx \quad V_{plane} = \frac{\omega}{\beta}$$

[Open Calculator !\[\]\(3211b5d1d968fc1665909b34f9f16010_img.jpg\)](#)

$$ex \quad 1E^{17}m/s = \frac{390rad/s}{3.8e-15rad/m}$$

34) Ray Optics Critical Angle

$$fx \quad \theta = \sin\left(\frac{\eta_r}{\eta_i}\right)^{-1}$$

[Open Calculator !\[\]\(9c2e8d1b5bd77cb5c9f83b7a9cff79fd_img.jpg\)](#)

$$ex \quad 64.34865^{\circ} = \sin\left(\frac{1.23}{1.12}\right)^{-1}$$

35) Refractive Index of Cladding

$$fx \quad \eta_{clad} = \sqrt{\eta_{core}^2 - NA^2}$$

[Open Calculator !\[\]\(235bfe13ebf007ce2eea9e689707fac7_img.jpg\)](#)

$$ex \quad 1.273666 = \sqrt{(1.335)^2 - (0.4)^2}$$



36) Refractive Index of Fiber Core

[Open Calculator !\[\]\(4729e517bc6a7cd81c8025b9646574fb_img.jpg\)](#)

$$\text{fx } \eta_{\text{core}} = \sqrt{\text{NA}^2 + \eta_{\text{clad}}^2}$$

$$\text{ex } 1.334365 = \sqrt{(0.4)^2 + (1.273)^2}$$



Variables Used

- **B_m** Maximum 3db Bandwidth (Hertz)
- **d** Distance (Meter)
- **D** Diameter of Fiber (Micrometer)
- **D_c** Diffusion Coefficient (Square Meter Per Second)
- **D_{opt}** Optical Fiber Dispersion (Square Second per Meter)
- **$DIV1$** Dummy Input Variable1
- **$DIV2$** Dummy Input Variable2
- **DOV** Dummy Output Variable
- **E_g** Bandgap Energy (Joule)
- **f** Frequency of incident light (Hertz)
- **F_i** Frequency Of Light Wave (Hertz)
- **G_O** Optical Gain of Phototransistor
- **h_{FE}** Common Emitter Current Gain
- **I_c** Initial Photocurrent (Ampere)
- **I_o** Output Current (Ampere)
- **I_p** Photocurrent (Ampere)
- **L** Length of Fiber (Meter)
- **M** Multiplication Factor
- **N_e** Number of Electrons
- **n_{gr}** Grade Index Fiber
- **N_M** Number of Modes
- **N_p** Number of Incident Photons









- **NA** Numerical Aperture
- **P_i** Incident Optical Power (Watt)
- **P_{in}** Input Power (Watt)
- **P_o** Incident Power (Watt)
- **P_α** Power Loss Fiber (Watt)
- **R** Responsivity of Photodetector (Ampere)
- **R** Responsivity
- **r_{core}** Radius of Core (Micrometer)
- **R_i** Incident Photon Rate (Meter per Second)
- **R_p** Electron Rate (Meter per Second)
- **T_d** Group Delay (Second)
- **t_{dif}** Diffusion Time (Second)
- **V** Normalized Frequency (Hertz)
- **V_g** Group Velocity (Meter per Second)
- **V_{plane}** Plane Wave Velocity (Meter per Second)
- **w** Depletion Layer Width (Meter)
- **α** Attenuation Loss (Decibel)
- **α_p** Attenuation Coefficient
- **β** Propagation Constant (Radian per Meter)
- **η** Quantum Efficiency
- **η_{clad}** Refractive Index of Cladding
- **η_{core}** Refractive Index of Core
- **η_i** Refractive Index Incident Medium
- **η_r** Refractive Index Releasing Medium












- θ Critical Angle (Degree)
- λ Wavelength of Light (Micrometer)
- λ_c Wavelength Cutoff Point (Meter)
- σ_g Gaussian Pulse (Second per Meter)
- σ_λ Optical Pulse Duration (Second)
- U_d Carrier Velocity (Meter per Second)
- ω Angular Velocity (Radian per Second)



Constants, Functions, Measurements used


- **Constant:** **pi**, 3.14159265358979323846264338327950288
Archimedes' constant
- **Constant:** **[Charge-e]**, 1.60217662E-19 Coulomb
Charge of electron
- **Constant:** **[c]**, 299792458.0 Meter/Second
Light speed in vacuum
- **Constant:** **[hP]**, 6.626070040E-34 Kilogram Meter² / Second
Planck constant
- **Function:** **exp**, exp(Number)
Exponential function
- **Function:** **sin**, sin(Angle)
Trigonometric sine function
- **Function:** **sqrt**, sqrt(Number)
Square root function
- **Measurement:** **Length** in Meter (m), Micrometer (μm)
Length Unit Conversion 
- **Measurement:** **Time** in Second (s)
Time Unit Conversion 
- **Measurement:** **Electric Current** in Ampere (A)
Electric Current Unit Conversion 
- **Measurement:** **Speed** in Meter per Second (m/s)
Speed Unit Conversion 
- **Measurement:** **Energy** in Joule (J)
Energy Unit Conversion 
- **Measurement:** **Power** in Watt (W)
Power Unit Conversion 



- **Measurement: Angle** in Degree ($^{\circ}$)
Angle Unit Conversion 
- **Measurement: Noise** in Decibel (dB)
Noise Unit Conversion 
- **Measurement: Frequency** in Hertz (Hz)
Frequency Unit Conversion 
- **Measurement: Wavelength** in Meter (m)
Wavelength Unit Conversion 
- **Measurement: Angular Velocity** in Radian per Second (rad/s)
Angular Velocity Unit Conversion 
- **Measurement: Diffusivity** in Square Meter Per Second (m^2/s)
Diffusivity Unit Conversion 
- **Measurement: Propagation Constant** in Radian per Meter (rad/m)
Propagation Constant Unit Conversion 
- **Measurement: Presement** in Second per Meter (s/m)
Presement Unit Conversion 
- **Measurement: Presity** in Square Second per Meter (s^2/m)
Presity Unit Conversion 



Check other formula lists

- [Digital Communication Formulas](#) 
- [Digital Image Processing Formulas](#) 
- [Embedded System Formulas](#) 
- [Fiber Optic Communication Formulas](#) 
- [Information Theory And Coding Formulas](#) 
- [Opto Electronics Devices Formulas](#) 
- [Television Engineering Formulas](#) 

Feel free to SHARE this document with your friends!

PDF Available in

[English](#) [Spanish](#) [French](#) [German](#) [Russian](#) [Italian](#) [Portuguese](#) [Polish](#) [Dutch](#)

10/10/2023 | 6:56:06 AM UTC

[Please leave your feedback here...](#)

