



calculatoratoz.com



unitsconverters.com

Digital 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 25 Digital Communication Formulas

Digital Communication

Modulation Parameters

1) Attenuation given Power of 2 Signals

$$fx \quad dB = 10 \cdot \left(\log_{10} \left(\frac{P_2}{P_1} \right) \right)$$

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

$$ex \quad -10.888424dB = 10 \cdot \left(\log_{10} \left(\frac{14.67W}{180W} \right) \right)$$

2) Attenuation given Voltage of 2 Signals

$$fx \quad dB = 20 \cdot \left(\log_{10} \left(\frac{V_2}{V_1} \right) \right)$$

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

$$ex \quad -10.881361dB = 20 \cdot \left(\log_{10} \left(\frac{20V}{70V} \right) \right)$$

3) Bit Rate

$$fx \quad R = f_s \cdot \text{BitDepth}$$

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

$$ex \quad 360kb/s = 0.3kHz \cdot 1200$$



4) Bit Rate of Raised Cosine Filter given Time Period

$$fx \quad R_s = \frac{1}{T}$$

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

$$ex \quad 142.8571 \text{ kb/s} = \frac{1}{7 \mu\text{s}}$$

5) Bit Rate of Raised Cosine Filter using Rolloff Factor

$$fx \quad R_s = \frac{2 \cdot f_b}{1 + \alpha}$$

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

$$ex \quad 142.8533 \text{ kb/s} = \frac{2 \cdot 107.14 \text{ kb/s}}{1 + 0.5}$$

6) Bit Rate using Bit Duration

$$fx \quad R = \frac{1}{T_b}$$

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

$$ex \quad 360.036 \text{ kb/s} = \frac{1}{2.7775 \mu\text{s}}$$

7) Number of Quantization Levels

$$fx \quad N_{lvl} = 2^N - \{res\}$$

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

$$ex \quad 4 = 2^{0.002 \text{ kb}}$$



8) Number of Samples

$$fx \quad N_s = \frac{f_m}{f_s}$$

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

$$ex \quad 0.51 = \frac{0.153\text{kHz}}{0.3\text{kHz}}$$

9) Nyquist Sampling Frequency

$$fx \quad f_s = 2 \cdot F_m$$

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

$$ex \quad 0.3\text{kHz} = 2 \cdot 0.15\text{kHz}$$

10) Quantization Step Size

$$fx \quad \Delta = \frac{V_{\max} - V_{\min}}{N_{|v|}}$$

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

$$ex \quad 0.9\text{V} = \frac{5\text{V} - 1.4\text{V}}{4}$$

11) Signal to Noise Ratio

$$fx \quad \text{SNR} = (6.02 \cdot N_{\text{res}}) + 1.76$$

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

$$ex \quad 13.8 = (6.02 \cdot 0.002\text{kb}) + 1.76$$



Modulation Techniques

12) Bandwidth Efficiency in Digital Communication

$$\text{fx } S = \frac{R}{\text{BW}}$$

[Open Calculator !\[\]\(74d4806277d7e73349d8e8c0897931e9_img.jpg\)](#)

$$\text{ex } 9 = \frac{360\text{kb/s}}{40\text{kHz}}$$

13) Bandwidth of ASK given Bit Rate

$$\text{fx } \text{BW}_{\text{ASK}} = (1 + \alpha) \cdot \left(\frac{R}{n_b} \right)$$

[Open Calculator !\[\]\(8bba887393ca45b761e5cb49e755e762_img.jpg\)](#)

$$\text{ex } 33.75\text{kHz} = (1 + 0.5) \cdot \left(\frac{360\text{kb/s}}{16} \right)$$

14) Bandwidth of FSK

$$\text{fx } \text{BW}_{\text{FSK}} = R \cdot (1 + \alpha) + (2 \cdot \Delta f)$$

[Open Calculator !\[\]\(0fb13ad0bfa3d86868cdd3883e5665b3_img.jpg\)](#)

$$\text{ex } 545.98\text{kHz} = 360\text{kb/s} \cdot (1 + 0.5) + (2 \cdot 2.99\text{kHz})$$

15) Bandwidth of Multilevel FSK

$$\text{fx } \text{BW}_{\text{MFSK}} = R \cdot (1 + \alpha) + (2 \cdot \Delta f \cdot (L - 1))$$

[Open Calculator !\[\]\(e50091943b385fe16d3277389202856f_img.jpg\)](#)

$$\text{ex } 551.96\text{kHz} = 360\text{kb/s} \cdot (1 + 0.5) + (2 \cdot 2.99\text{kHz} \cdot (3 - 1))$$



16) Bandwidth of Multilevel PSK [Open Calculator !\[\]\(eafc244b53721dd1ec133f0772f70fc7_img.jpg\)](#)

$$fx \quad BW_{MPSK} = R \cdot \left(\frac{1 + \alpha}{\log_2(L)} \right)$$

$$ex \quad 340.7021\text{kHz} = 360\text{kb/s} \cdot \left(\frac{1 + 0.5}{\log_2(3)} \right)$$

17) Bandwidth of Raised Cosine Filter [Open Calculator !\[\]\(10f8862fc183b400327470ea85afe9ae_img.jpg\)](#)

$$fx \quad f_b = \frac{1 + \alpha}{2 \cdot T}$$

$$ex \quad 107.1429\text{kb/s} = \frac{1 + 0.5}{2 \cdot 7\mu\text{s}}$$

18) Baud Rate [Open Calculator !\[\]\(35dc653d59570f8f891c312eeece91a2_img.jpg\)](#)

$$fx \quad r = \frac{R}{n_b}$$

$$ex \quad 22.5\text{kbaud} = \frac{360\text{kb/s}}{16}$$




19) Probability Error of BPSK for Raised Cosine Filter 

$$\text{fx } e_{\text{BPSK}} = \left(\frac{1}{2}\right) \cdot \text{erfc}\left(\sqrt{\frac{\epsilon_s}{N_0}}\right)$$

Open Calculator 

$$\text{ex } 0.499999 = \left(\frac{1}{2}\right) \cdot \text{erfc}\left(\sqrt{\frac{1.2\text{e-}11\text{J}}{10}}\right)$$

20) Probability Error of DPSK 

$$\text{fx } e_{\text{DPSK}} = \left(\frac{1}{2}\right) \cdot e^{-\left(\frac{\epsilon_b}{N_0}\right)}$$

Open Calculator 

$$\text{ex } 0.5 = \left(\frac{1}{2}\right) \cdot e^{-\left(\frac{55\text{e-}12\text{J}}{10}\right)}$$


21) Rolloff Factor 

$$\text{fx } \alpha = \left(\frac{\text{BW}_{\text{ASK}} \cdot n_b}{R}\right) - 1$$

Open Calculator 

$$\text{ex } 0.5 = \left(\frac{33.75\text{kHz} \cdot 16}{360\text{kb/s}}\right) - 1$$




22) Sampling Period 

$$fx \quad T_s = \frac{1}{f_s}$$

Open Calculator 

$$ex \quad 3333.333\mu s = \frac{1}{0.3kHz}$$

23) Sampling Theorem 

$$fx \quad f_s = 2 \cdot f_m$$

Open Calculator 


$$ex \quad 0.306kHz = 2 \cdot 0.153kHz$$

24) Signal Time Period 

$$fx \quad T = \frac{1 + \alpha}{2 \cdot f_b}$$

Open Calculator 

$$ex \quad 7.000187\mu s = \frac{1 + 0.5}{2 \cdot 107.14kb/s}$$

25) Symbol Time 

$$fx \quad T_{syb} = \frac{R}{N}$$

Open Calculator 

$$ex \quad 40000\mu s = \frac{360kb/s}{9000kb}$$



Variables Used









- **BitDepth** Bit Depth
- **BW** Signal Bandwidth (Kilohertz)
- **BW_{ASK}** Bandwidth of ASK (Kilohertz)
- **BW_{FSK}** Bandwidth of FSK (Kilohertz)
- **BW_{MFSK}** Bandwidth of Multilevel FSK (Kilohertz)
- **BW_{MPSK}** Bandwidth of Multilevel PSK (Kilohertz)
- **dB** Attenuation (Decibel)
- **e_{BPSK}** Probability Error of BPSK
- **e_{DPSK}** Probability Error of DPSK
- **f_b** Bandwidth of Raised Cosine Filter (Kilobit per Second)
- **f_m** Maximum Frequency (Kilohertz)
- **F_m** Message Signal Frequency (Kilohertz)
- **f_s** Sampling Frequency (Kilohertz)
- **L** Number of Level
- **N** Bits Conveyed Per Symbol (Kilobit)
- **N₀** Noise Density
- **n_b** Number of Bits
- **N_{|V|}** Number of Quantisation Levels
- **N_{res}** Resolution of ADC (Kilobit)
- **N_s** Number of Samples
- **P₁** Power 1 (Watt)



- P_2 Power 2 (Watt)
- r Baud Rate (Kilobit per Second)
- R Bit Rate (Kilobit per Second)
- R_s Bit Rate of Raised Cosine Filter (Kilobit per Second)
- S Bandwidth Efficiency
- SNR Signal to Noise Ratio
- T Signal Time Period (Microsecond)
- T_b Bit Duration (Microsecond)
- T_s Sampling Period (Microsecond)
- T_{syb} Symbol Time (Microsecond)
- V_{max} Maximum Voltage (Volt)
- V_{min} Minimum Voltage (Volt)
- V_1 Voltage 1 (Volt)
- V_2 Voltage 2 (Volt)
- α Rolloff Factor
- Δ Quantization Step Size (Volt)
- Δf Difference in Frequency (Kilohertz)
- ϵ_b Energy per Bit (Joule)
- ϵ_s Energy per Symbol (Joule)



Constants, Functions, Measurements used

- **Constant:** **e**, 2.71828182845904523536028747135266249
Napier's constant
- **Function:** **erfc**, erfc(Number)
Gauss complementary error function (non-elementary special function)
- **Function:** **log10**, log10(Number)
Common logarithm function (base 10)
- **Function:** **log2**, log2(Number)
Binary logarithm function (base 2)
- **Function:** **sqrt**, sqrt(Number)
Square root function
- **Measurement:** **Time** in Microsecond (μs)
Time Unit Conversion 
- **Measurement:** **Energy** in Joule (J)
Energy Unit Conversion 
- **Measurement:** **Power** in Watt (W)
Power Unit Conversion 
- **Measurement:** **Frequency** in Kilohertz (kHz)
Frequency Unit Conversion 
- **Measurement:** **Data Storage** in Kilobit (kb)
Data Storage Unit Conversion 
- **Measurement:** **Data Transfer** in Kilobit per Second (kbps)
Data Transfer Unit Conversion 
- **Measurement:** **Electric Potential** in Volt (V)
Electric Potential Unit Conversion 
- **Measurement:** **Sound** in Decibel (dB)
Sound Unit Conversion 









- **Measurement: Bandwidth** in Kilobit per Second (kb/s)

Bandwidth Unit Conversion 



Check other formula lists

- [Digital Communication Formulas](#) 
- [Embedded System Formulas](#) 
- [Information Theory And Coding Formulas](#) 
- [Optical Fiber Design 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](#)

12/18/2023 | 3:28:22 PM UTC

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

