Important Radio Wave Propagation Formulas PDF

Formulas
Examples
with Units

List of 14
Important Radio Wave Propagation Formulas

1) Distribution of Rain Attenuation Formula

Evaluate Formula

Formula

$$PR = 1 + \left(\frac{2 \cdot L_G}{\pi \cdot D} \right)$$

Example with Units

$$34.3938\,\text{dB} = 1 + \left(\frac{2 \cdot 10.49098\,\text{km}}{3.1416 \cdot 0.2\,\text{km}} \right)$$

2) Earth Station Altitude Formula

Evaluate Formula

Formula

$$h_o = h_{rain} - L_{slant} \cdot \sin\left(\angle\theta_{el} \right)$$

Example with Units

$$199.9939\,\text{km} = 209.44\,\text{km} - 14.117\,\text{km} \cdot \sin\left(42° \right)$$

3) Effective Path Length Formula

Evaluate Formula

Formula

$$L_{eff} = \frac{A}{\alpha}$$

Example with Units

$$12\,\text{km} = \frac{360\,\text{dB}}{0.03\,\text{dB}}$$

4) Effective Path Length using Reduction Factor Formula

Evaluate Formula

Formula

$$L_{eff} = L_{slant} \cdot r_p$$

Example with Units

$$11.9994\,\text{km} = 14.117\,\text{km} \cdot 0.85$$

5) Horizontal Projection of Slant Length Formula

Evaluate Formula

Formula

$$L_G = L_{slant} \cdot \cos\left(\angle\theta_{el} \right)$$

Example with Units

$$10.491\,\text{km} = 14.117\,\text{km} \cdot \cos\left(42° \right)$$

6) Plasma Frequency Terms of Electronic Density Formula

Evaluate Formula

Formula

$$f_p = 9 \cdot \sqrt{N}$$

Example with Units

$$45\,\text{Hz} = 9 \cdot \sqrt{25\,\text{m}^3}$$

7) Rain Attenuation in Decibels Formula

Evaluate Formula

Formula

$$A_p = \alpha \cdot R_p^{\ b} \cdot L_{slant} \cdot r_p$$

Example with Units

$$0.7803\,\text{dB} = 0.03\,\text{dB} \cdot 10\,\text{mm}^{1.332\,(\text{dB/km})/(\text{g/m}^3)} \cdot 14.117\,\text{km} \cdot 0.85$$

8) Rain Height Formula

Evaluate Formula

Formula

$$h_{rain} = L_{slant} \cdot \sin\left(\angle\theta_{el}\right) + h_o$$

Example with Units

$$209.4461\,\text{km} = 14.117\,\text{km} \cdot \sin\left(42°\right) + 200\,\text{km}$$

9) Reduction Factor using Slant Length Formula

Evaluate Formula

Formula

$$r_p = \frac{L_{eff}}{L_{slant}}$$

Example with Units

$$0.85 = \frac{12\,\text{km}}{14.117\,\text{km}}$$

10) Regression of Nodes Formula

Evaluate Formula

Formula

$$n_{reg} = \frac{n \cdot SCOM}{a_{semi}^{\ 2} \cdot \left(1 - e^2\right)^2}$$

Example with Units

$$0.009\,\text{rad/s}^2 = \frac{0.045\,\text{rad/s} \cdot 66063.2\,\text{km}^2}{581.7\,\text{km}^{\ 2} \cdot \left(1 - 0.12^2\right)^2}$$

11) Slant Length Formula

Evaluate Formula

Formula

$$L_{slant} = \frac{L_{eff}}{r_p}$$

Example with Units

$$14.1176\,\text{km} = \frac{12\,\text{km}}{0.85}$$

12) Specific Attenuation Formula

Evaluate Formula

Formula

$$\alpha = \frac{A}{L_{eff}}$$

Example with Units

$$0.03\,\text{dB} = \frac{360\,\text{dB}}{12\,\text{km}}$$

13) Specific Attenuation in Clouds or Fogs Formula

Evaluate Formula

Formula

$$A_c = \frac{L \cdot b}{\sin\left(\angle\theta_{el}\right)}$$

Example with Units

$$15.9251\,\text{dB} = \frac{8\,\text{kg} \cdot 1.332\,(\text{dB/km})/(\text{g/m}^3)}{\sin\left(42°\right)}$$

14) Total Attenuation Formula

Evaluate Formula

Formula

$$A = L_{eff} \cdot \alpha$$

Example with Units

$$360\,\text{dB} = 12\,\text{km} \cdot 0.03\,\text{dB}$$

Variables used in list of Radio Wave Propagation Formulas above

- $\angle\theta_{el}$ Angle of Elevation *(Degree)*
- **A** Total Attenuation *(Decibel)*
- A_c Specific Attenuation due to Clouds *(Decibel)*
- A_p Rain Attenuation *(Decibel)*
- a_{semi} Semi Major Axis *(Kilometer)*
- **b** Specific Attenuation Coefficient *(Decibel per Kilometer per Gram per Cubic Meter)*
- **D** Diameter of Rain Cell *(Kilometer)*
- **e** Eccentricity
- f_p Plasma Frequency *(Hertz)*
- h_o Earth Station Altitude *(Kilometer)*
- h_{rain} Height of Rain *(Kilometer)*
- **L** Total Content of Liquid Water *(Kilogram)*
- L_{eff} Effective Path Length *(Kilometer)*
- L_G Horizontal Projection Length *(Kilometer)*
- L_{slant} Slant Length *(Kilometer)*
- **n** Mean Motion *(Radian per Second)*
- **N** Electron Density *(Cubic Meter)*
- n_{reg} Regression Node *(Radian per Square Second)*
- **PR** Distribution of Rain Attenuation *(Decibel)*
- r_p Reduction Factor
- R_p Rain Rate *(Millimeter)*
- **SCOM** SCOM Constant *(Square Kilometer)*
- **α** Specific Attenuation *(Decibel)*

Constants, Functions, Measurements used in list of Radio Wave Propagation Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **cos**, cos(Angle) *Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.*
- Functions: **sin**, sin(Angle) *Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.*
- Functions: **sqrt**, sqrt(Number) *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- Measurement: **Length** in Kilometer (km), Millimeter (mm) *Length Unit Conversion*
- Measurement: **Weight** in Kilogram (kg) *Weight Unit Conversion*
- Measurement: **Volume** in Cubic Meter (m³) *Volume Unit Conversion*
- Measurement: **Area** in Square Kilometer (km²) *Area Unit Conversion*
- Measurement: **Angle** in Degree (°) *Angle Unit Conversion*
- Measurement: **Frequency** in Hertz (Hz) *Frequency Unit Conversion*
- Measurement: **Angular Velocity** in Radian per Second (rad/s) *Angular Velocity Unit Conversion*
- Measurement: **Sound** in Decibel (dB) *Sound Unit Conversion*
- Measurement: **Angular Acceleration** in Radian per Square Second (rad/s²) *Angular Acceleration Unit Conversion*
- Measurement: **Specific Attenuation Coefficient** in Decibel per Kilometer per Gram per Cubic Meter ((dB/km)/(g/m³)) *Specific Attenuation Coefficient Unit Conversion*

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