Important Electrowave Dynamics Formulas PDF

Formulas

Examples

with Units

List of 21
Important Electrowave Dynamics Formulas

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1) Absolute Permeability using Relative Permeability and Permeability of Free Space Formula

Evaluate Formula

Formula

$$\mu_{abs} = \mu_{rel} \cdot [\text{Permeability-vacuum}]$$

Example with Units

$$0.0006 \,\text{H/m} = 500 \cdot 1.3E\text{-}6$$

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2) Characteristic Impedance of Line Formula

Evaluate Formula

Formula

$$Z_o = \sqrt{\mu \cdot \pi \cdot \frac{10^{-7}}{\epsilon'} \cdot \left(\frac{p_d}{p_b}\right)}$$

Example with Units

$$0.8609 \,\Omega = \sqrt{29.31 \,\text{H/cm} \cdot 3.1416 \cdot \frac{10^{-7}}{1.4 \,\mu\text{F/mm}} \cdot \left(\frac{21.23 \,\text{cm}}{20 \,\text{cm}}\right)}$$

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3) Conductance of Coaxial Cable Formula

Evaluate Formula

Formula

$$G_c = \frac{2 \cdot \pi \cdot \sigma_c}{\ln\left(\frac{b_r}{a_r}\right)}$$

Example with Units

$$58.0971 \,\text{S} = \frac{2 \cdot 3.1416 \cdot 0.4 \,\text{S/cm}}{\ln\left(\frac{18.91 \,\text{cm}}{0.25 \,\text{cm}}\right)}$$

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4) Cutoff Wavelength Formula

Evaluate Formula

Formula

$$\lambda_{cm} = \frac{2 \cdot n_r \cdot p_d}{m}$$

Example with Units

$$21.23 \,\text{cm} = \frac{2 \cdot 2 \cdot 21.23 \,\text{cm}}{4}$$

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5) Free Space Magnetic Flux Density Formula

Evaluate Formula

Formula

$$B_o = [\text{Permeability-vacuum}] \cdot H_o$$

Example with Units

$$2.3E\text{-}6 \,\text{Wb/m}^2 = 1.3E\text{-}6 \cdot 1.8 \,\text{A/m}$$

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6) Inductance between Conductors Formula

Evaluate Formula

Formula

$$L = \mu \cdot \pi \cdot 10^{-7} \cdot \frac{p_d}{p_b}$$

Example with Units

$$0.9774 \,\text{mH} = 29.31 \,\text{H/cm} \cdot 3.1416 \cdot 10^{-7} \cdot \frac{21.23 \,\text{cm}}{20 \,\text{cm}}$$

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7) Inductance per unit Length of Coaxial Cable Formula 📱

Formula

$$L_c = \frac{\mu}{2} \cdot \pi \cdot \ln\left(\frac{b_r}{a_r}\right)$$

Example with Units

$$199.1685\,\text{H/cm} = \frac{29.31\,\text{H/cm}}{2} \cdot 3.1416 \cdot \ln\left(\frac{18.91\,\text{cm}}{0.25\,\text{cm}}\right)$$

8) Inner Resistance of Coaxial Cable Formula 📱

Formula

$$R_{in} = \frac{1}{2 \cdot \pi \cdot a_r \cdot \delta \cdot \sigma_c}$$

Example with Units

$$7.9182\,\Omega = \frac{1}{2 \cdot 3.1416 \cdot 0.25\,\text{cm} \cdot 20.1\,\text{cm} \cdot 0.4\,\text{S/cm}}$$

9) Internal Inductance of Long Straight Wire Formula 📱

Formula

$$L_a = \frac{\mu}{8 \cdot \pi}$$

Example with Units

$$116.6208\,\text{H/m} = \frac{29.31\,\text{H/cm}}{8 \cdot 3.1416}$$

10) Magnetic Flux Density using Magnetic Field Strength, and Magnetization Formula 📱

Formula

$$B = [\text{Permeability-vacuum}] \cdot \left(H_o + M_{em}\right)$$

Example with Units

$$0.002\,\text{T} = 1.3\text{E-6} \cdot \left(1.8\,\text{A/m} + 1568.2\,\text{A/m}\right)$$

11) Magnetic Force by Lorentz Force Equation Formula 📱

Formula

$$F_{mag} = Q \cdot \left(E_{lf} + \left(v \cdot B \cdot \sin\left(\theta\right)\right)\right)$$

Example with Units

$$-6\text{E-6}\,\text{N} = -2\text{e-8}\,\text{C} \cdot \left(300\,\text{N/C} + \left(5\,\text{m/s} \cdot 0.001973\,\text{T} \cdot \sin\left(30°\right)\right)\right)$$

12) Magnetic Susceptibility using Relative Permeability Formula 📱

Formula

$$\chi_m = \mu - 1$$

Example with Units

$$2930\,\text{H/m} = 29.31\,\text{H/cm} - 1$$

13) Magnetization using Magnetic Field Strength, and Magnetic Flux Density Formula 📱

Formula

$$M_{em} = \left(\frac{B}{[\text{Permeability-vacuum}]}\right) - H_o$$

Example with Units

$$1568.2635\,\text{A/m} = \left(\frac{0.001973\,\text{T}}{1.3\text{E-6}}\right) - 1.8\,\text{A/m}$$

14) Magnetomotive Force given Reluctance and Magnetic Flux Formula

Formula

$$V_m = \Phi \cdot R$$

Example with Units

$$400_{AT} = 20000_{Wb} \cdot 0.02_{AT/Wb}$$

Evaluate Formula

15) Magnitude of Wavevector Formula

Formula

$$k = \omega \cdot \sqrt{\mu \cdot \epsilon'}$$

Example with Units

$$4.8211 = 2.38_{rad/s} \cdot \sqrt{29.31_{H/cm} \cdot 1.4_{\mu F/mm}}$$

Evaluate Formula

16) Outer Resistance of Coaxial Cable Formula

Formula

$$R_{out} = \frac{1}{2 \cdot \pi \cdot \delta \cdot b_r \cdot \sigma_c}$$

Example with Units

$$0.1047_{\Omega} = \frac{1}{2 \cdot 3.1416 \cdot 20.1_{cm} \cdot 18.91_{cm} \cdot 0.4_{S/cm}}$$

Evaluate Formula

17) Phase Velocity in Microstrip Line Formula

Formula

$$v_p = \frac{[c]}{\sqrt{\epsilon'}}$$

Example with Units

$$8E+11_{cm/s} = \frac{3E+8_{m/s}}{\sqrt{1.4_{\mu F/mm}}}$$

Evaluate Formula

18) Radian Cutoff Angular Frequency Formula

Formula

$$\omega_{cm} = \frac{m \cdot \pi \cdot [c]}{n_r \cdot p_d}$$

Example with Units

$$8.9E+9_{rad/s} = \frac{4 \cdot 3.1416 \cdot 3E+8_{m/s}}{2 \cdot 21.23_{cm}}$$

Evaluate Formula

19) Resistance of Cylindrical Conductor Formula

Formula

$$R_{con} = \frac{L_{con}}{\sigma_c \cdot S_{con}}$$

Example with Units

$$25_{\Omega} = \frac{10_{m}}{0.4_{S/cm} \cdot 10e\text{-}3_{m^2}}$$

Evaluate Formula

20) Skin Effect Resistivity Formula

Formula

$$R_s = \frac{2}{\sigma_c \cdot \delta \cdot p_b}$$

Example with Units

$$124.3781_{\Omega^*cm} = \frac{2}{0.4_{S/cm} \cdot 20.1_{cm} \cdot 20_{cm}}$$

Evaluate Formula

Formula

$$R_t = \frac{1}{2 \cdot \pi \cdot \delta \cdot \sigma_c} \cdot \left(\frac{1}{a_r} + \frac{1}{b_r} \right)$$

Example with Units

$$8.0228\,\Omega = \frac{1}{2 \cdot 3.1416 \cdot 20.1\,\text{cm} \cdot 0.4\,\text{S/cm}} \cdot \left(\frac{1}{0.25\,\text{cm}} + \frac{1}{18.91\,\text{cm}} \right)$$

Variables used in list of Electrowave Dynamics Formulas above

- $\in'$ Dielectric Permitivitty *(Microfarad per Millimeter)*
- a_r Inner Radius of Coaxial Cable *(Centimeter)*
- B Magnetic Flux Density *(Tesla)*
- B_o Free Space Magnetic Flux Density *(Weber per Square Meter)*
- b_r Outer Radius of Coaxial Cable *(Centimeter)*
- E_{lf} Electric Field *(Newton per Coulomb)*
- F_{mag} Magnetic Force *(Newton)*
- G_c Conductance of Coaxial Cable *(Siemens)*
- H_o Magnetic Field Strength *(Ampere per Meter)*
- k Wave Vector
- L Conductor Inductance *(Millihenry)*
- L_a Internal Inductance of Long Straight Wire *(Henry per Meter)*
- L_c Inductance per unit Length of Coaxial Cable *(Henry per Centimeter)*
- L_{con} Length of Cylindrical Conductor *(Meter)*
- m Mode Number
- M_{em} Magnetization *(Ampere per Meter)*
- n_r Refractive Index
- p_b Plate Width *(Centimeter)*
- p_d Plate Distance *(Centimeter)*
- Q Charge of Particle *(Coulomb)*
- R Reluctance *(Ampere-Turn per Weber)*
- R_{con} Resistance of Cylindrical Conductor *(Ohm)*
- R_{in} Inner Resistance of Coaxial Cable *(Ohm)*
- R_{out} Outer Resistance of Coaxial Cable *(Ohm)*
- R_s Skin Effect Resistivity *(Ohm Centimeter)*
- R_t Total Resistance of Coaxial Cable *(Ohm)*
- S_{con} Cross Sectional Area of Cylindrical *(Square Meter)*
- V_m Magnetomotive Voltage *(Ampere-Turn)*

Constants, Functions, Measurements used in list of Electrowave Dynamics Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- constant(s): **[c]**, 299792458.0 *Light speed in vacuum*
- constant(s): **[Permeability-vacuum]**, 1.2566E-6 *Permeability of vacuum*
- Functions: **ln**, ln(Number) *The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural exponential function.*
- 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 Centimeter (cm), Meter (m) *Length Unit Conversion*
- Measurement: **Area** in Square Meter (m²) *Area Unit Conversion*
- Measurement: **Speed** in Meter per Second (m/s), Centimeter per Second (cm/s) *Speed Unit Conversion*
- Measurement: **Electric Charge** in Coulomb (C) *Electric Charge Unit Conversion*
- Measurement: **Force** in Newton (N) *Force Unit Conversion*
- Measurement: **Angle** in Degree (°) *Angle Unit Conversion*
- Measurement: **Magnetic Flux** in Weber (Wb) *Magnetic Flux Unit Conversion*
- Measurement: **Electric Resistance** in Ohm (Ω) *Electric Resistance Unit Conversion*
- Measurement: **Electric Conductance** in Siemens (S)

- **v_p** Phase Velocity *(Centimeter per Second)*
- **Z_o** Characteristic Impedance *(Ohm)*
- **δ** Skin Depth *(Centimeter)*
- **θ** Incidence Angle *(Degree)*
- **$λ_{cm}$** Cutoff Wavelength *(Centimeter)*
- **μ** Magnetic Permeability *(Henry per Centimeter)*
- **$μ_{abs}$** Absolute Permeability of Material *(Henry per Meter)*
- **$μ_{rel}$** Relative Permeability of Material
- **v** Speed of Charged Particle *(Meter per Second)*
- **$σ_c$** Electrical Conductivity *(Siemens per Centimeter)*
- **Φ** Magnetic Flux *(Weber)*
- **$χ_m$** Magnetic Susceptibility *(Henry per Meter)*
- **ω** Angular Frequency *(Radian per Second)*
- **$ω_{cm}$** Cutoff Angular Frequency *(Radian per Second)*

Electric Conductance Unit Conversion

- Measurement: **Inductance** in Millihenry (mH)
  Inductance Unit Conversion
- Measurement: **Magnetic Flux Density** in Weber per Square Meter (Wb/m²), Tesla (T)
  Magnetic Flux Density Unit Conversion
- Measurement: **Magnetomotive Force** in Ampere-Turn (AT)
  Magnetomotive Force Unit Conversion
- Measurement: **Magnetic Field Strength** in Ampere per Meter (A/m)
  Magnetic Field Strength Unit Conversion
- Measurement: **Wavelength** in Centimeter (cm)
  Wavelength Unit Conversion
- Measurement: **Electric Field Strength** in Newton per Coulomb (N/C)
  Electric Field Strength Unit Conversion
- Measurement: **Electric Resistivity** in Ohm Centimeter (Ω*cm)
  Electric Resistivity Unit Conversion
- Measurement: **Electric Conductivity** in Siemens per Centimeter (S/cm)
  Electric Conductivity Unit Conversion
- Measurement: **Magnetic Permeability** in Henry per Meter (H/m), Henry per Centimeter (H/cm)
  Magnetic Permeability Unit Conversion
- Measurement: **Angular Frequency** in Radian per Second (rad/s)
  Angular Frequency Unit Conversion
- Measurement: **Reluctance** in Ampere-Turn per Weber (AT/Wb)
  Reluctance Unit Conversion
- Measurement: **Permittivity** in Microfarad per Millimeter (μF/mm)
  Permittivity Unit Conversion

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