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Electrowave Dynamics Formulas

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List of 21 Electrowave Dynamics Formulas

Electrowave Dynamics

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

Open Calculator

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

ex $0.000628\text{H/m} = 500 \cdot [\text{Permeability-vacuum}]$

2) Characteristic Impedance of Line

Open Calculator

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

ex $0.860872\Omega = \sqrt{29.31\text{H/cm} \cdot \pi \cdot \frac{10^{-7}}{1.4\mu\text{F/mm}}} \cdot \left(\frac{21.23\text{cm}}{20\text{cm}}\right)$

3) Conductance of Coaxial Cable

Open Calculator

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

ex $58.09715\text{S} = \frac{2 \cdot \pi \cdot 0.4\text{S/cm}}{\ln\left(\frac{18.91\text{cm}}{0.25\text{cm}}\right)}$

4) Cutoff Wavelength

Open Calculator

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

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

5) Free Space Magnetic Flux Density

Open Calculator

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

ex $$2.3\text{E}\hat{}\text{-}6\text{Wb/m}^2 = [\text{Permeability-vacuum}] \cdot 1.8\text{A/m}$$

6) Inductance between Conductors

Open Calculator

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

ex $$0.97743\text{mH} = 29.31\text{H/cm} \cdot \pi \cdot 10^{-7} \cdot \frac{21.23\text{cm}}{20\text{cm}}$$

7) Inductance per unit Length of Coaxial Cable

Open Calculator

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

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

8) Inner Resistance of Coaxial Cable

Open Calculator

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

ex $$7.918156\Omega = \frac{1}{2 \cdot \pi \cdot 0.25\text{cm} \cdot 20.1\text{cm} \cdot 0.4\text{S/cm}}$$

9) Internal Inductance of Long Straight Wire

Open Calculator

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

ex $$116.6208\text{H/m} = \frac{29.31\text{H/cm}}{8 \cdot \pi}$$

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

Open Calculator

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

ex $$0.001973\text{T} = [\text{Permeability-vacuum}] \cdot (1.8\text{A/m} + 1568.2\text{A/m})$$

11) Magnetic Force by Lorentz Force Equation

Open Calculator

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

ex $$\text{-6E^-6N} = \text{-2e-8C} \cdot (300\text{N/C} + (5\text{m/s} \cdot 0.001973\text{T} \cdot \sin(30^\circ)))$$

12) Magnetic Susceptibility using Relative Permeability

Open Calculator

fx $\chi_m = \mu - 1$

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

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

Open Calculator

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

ex $1568.264\text{A/m} = \left(\frac{0.001973\text{T}}{[\text{Permeability-vacuum}]}\right) - 1.8\text{A/m}$

14) Magnetomotive Force given Reluctance and Magnetic Flux

Open Calculator

fx $V_m = \Phi \cdot R$

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

15) Magnitude of Wavevector

Open Calculator

fx $k = \omega \cdot \sqrt{\mu \cdot \in'}$

ex $4.82113 = 2.38\text{rad/s} \cdot \sqrt{29.31\text{H/cm} \cdot 1.4\mu\text{F/mm}}$

16) Outer Resistance of Coaxial Cable

Open Calculator

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

ex $$0.104682\Omega = \frac{1}{2 \cdot \pi \cdot 20.1\text{cm} \cdot 18.91\text{cm} \cdot 0.4\text{S/cm}}$$

17) Phase Velocity in Microstrip Line

Open Calculator

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

ex $$8\text{E}\hat{}11\text{cm/s} = \frac{[c]}{\sqrt{1.4\mu\text{F/mm}}}$$

18) Radian Cutoff Angular Frequency

Open Calculator

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

ex $$8.9\text{E}\hat{}9\text{rad/s} = \frac{4 \cdot \pi \cdot [c]}{2 \cdot 21.23\text{cm}}$$

19) Resistance of Cylindrical Conductor

Open Calculator

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

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

20) Skin Effect Resistivity

Open Calculator

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

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

21) Total Resistance of Coaxial Cable

Open Calculator

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

ex $$8.022839\Omega = \frac{1}{2 \cdot \pi \cdot 20.1cm \cdot 0.4S/cm} \cdot \left(\frac{1}{0.25cm} + \frac{1}{18.91cm} \right)$$

Variables Used

- ϵ' 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)*
- 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)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **[c]**, 299792458.0
  Light speed in vacuum
- Constant: **[Permeability-vacuum]**, 1.2566E-6
  Permeability of vacuum
- Function: **ln**, ln(Number)
  The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural exponential function.
- Function: **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.
- Function: **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)
  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

Check other formula lists

- **Electromagnetic Radiation and Antennas Formulas**
- **Electrowave Dynamics Formulas**

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