Important Long Transmission Line Formulas PDF

Formulas
Examples
with Units

List of 26
Important Long Transmission Line Formulas

1) Current & Voltage Formulas

1.1) Receiving End Current using Sending End Current (LTL) Formula

Evaluate Formula

Formula

$$I_r = \frac{I_s - \left(V_r \cdot \frac{\sinh(\gamma \cdot L)}{Z_0} \right)}{\cosh(\gamma \cdot L)}$$

Example with Units

$$6.19\,\text{A} = \frac{3865.49\,\text{A} - \left(8.88\,\text{kV} \cdot \frac{\sinh(1.24 \cdot 3\,\text{m})}{48.989\,\Omega} \right)}{\cosh(1.24 \cdot 3\,\text{m})}$$

1.2) Receiving End Current using Sending End Voltage (LTL) Formula

Evaluate Formula

Formula

$$I_r = \frac{V_s - \left(V_r \cdot \cosh(\gamma \cdot L) \right)}{Z_0 \cdot \sinh(\gamma \cdot L)}$$

Example with Units

$$6.1857\,\text{A} = \frac{189.57\,\text{kV} - \left(8.88\,\text{kV} \cdot \cosh(1.24 \cdot 3\,\text{m}) \right)}{48.989\,\Omega \cdot \sinh(1.24 \cdot 3\,\text{m})}$$

1.3) Receiving End Voltage using Sending End Current (LTL) Formula

Evaluate Formula

Formula

$$V_r = \left(I_s - I_r \cdot \cosh(\gamma \cdot L) \right) \cdot \left(\frac{Z_0}{\sinh(\gamma \cdot L)} \right)$$

Example with Units

$$8.88\,\text{kV} = \left(3865.49\,\text{A} - 6.19\,\text{A} \cdot \cosh(1.24 \cdot 3\,\text{m}) \right) \cdot \left(\frac{48.989\,\Omega}{\sinh(1.24 \cdot 3\,\text{m})} \right)$$

1.4) Sending End Current (LTL) Formula

Evaluate Formula

Formula

$$I_s = I_r \cdot \cosh(\gamma \cdot L) + \left(\frac{V_r \cdot \sinh(\gamma \cdot L)}{Z_0} \right)$$

Example with Units

$$3865.4909\,\text{A} = 6.19\,\text{A} \cdot \cosh(1.24 \cdot 3\,\text{m}) + \left(\frac{8.88\,\text{kV} \cdot \sinh(1.24 \cdot 3\,\text{m})}{48.989\,\Omega} \right)$$

1.5) Sending End Voltage (LTL) Formula

Evaluate Formula

Formula

$$V_s = V_r \cdot \cosh(\gamma \cdot L) + Z_0 \cdot I_r \cdot \sinh(\gamma \cdot L)$$

Example with Units

$$189.5744\,\text{kV} = 8.88\,\text{kV} \cdot \cosh(1.24 \cdot 3\,\text{m}) + 48.989\,\Omega \cdot 6.19\,\text{A} \cdot \sinh(1.24 \cdot 3\,\text{m})$$

2) Impedance & Admittance Formulas

2.1) Admittance using Characteristic Impedance (LTL) Formula

Evaluate Formula

Formula

$$Y = \frac{Z}{Z_0^2}$$

Example with Units

$$0.025\,\text{S} = \frac{60\,\Omega}{48.989\,\Omega^2}$$

2.2) Admittance using Propagation Constant (LTL) Formula

Evaluate Formula

Formula

$$Y = \frac{\gamma^2}{Z}$$

Example with Units

$$0.0256\,\text{S} = \frac{1.24^2}{60\,\Omega}$$

2.3) Capacitance using Surge Impedance (LTL) Formula

Evaluate Formula

Formula

$$C_{Farad} = \frac{L_{Henry}}{Zs^2}$$

Example with Units

$$13.0612\,\text{F} = \frac{40\,\text{H}}{1.75\,\Omega^2}$$

2.4) Characteristic Impedance (LTL) Formula

Evaluate Formula

Formula

$$Z_0 = \sqrt{\frac{Z}{Y}}$$

Example with Units

$$48.9898\,\Omega = \sqrt{\frac{60\,\Omega}{0.025\,\text{S}}}$$

2.5) Characteristic Impedance using B Parameter (LTL) Formula

Evaluate Formula

Formula

$$Z_0 = \frac{B}{\sinh(\gamma \cdot L)}$$

Example with Units

$$50.9212\,\Omega = \frac{1050\,\Omega}{\sinh(1.24 \cdot 3\,\text{m})}$$

2.6) Characteristic Impedance using C Parameter (LTL) Formula

Evaluate Formula

Formula

$$Z_0 = \frac{1}{C} \cdot \sinh(\gamma \cdot L)$$

Example with Units

$$48.9788\,\Omega = \frac{1}{0.421\,\text{S}} \cdot \sinh(1.24 \cdot 3\,\text{m})$$

2.7) Characteristic Impedance using Sending End Current (LTL) Formula

Evaluate Formula

Formula

$$Z_0 = \frac{V_r \cdot \sinh(\gamma \cdot L)}{I_s - I_r \cdot \cosh(\gamma \cdot L)}$$

Example with Units

$$48.989\,\Omega = \frac{8.88\,\text{kV} \cdot \sinh(1.24 \cdot 3\,\text{m})}{3865.49\,\text{A} - 6.19\,\text{A} \cdot \cosh(1.24 \cdot 3\,\text{m})}$$

2.8) Characteristic Impedance using Sending End Voltage (LTL) Formula

Evaluate Formula

Formula

$$Z_0 = \frac{V_s - V_r \cdot \cosh(\gamma \cdot L)}{\sinh(\gamma \cdot L) \cdot I_r}$$

Example with Units

$$48.9547\,\Omega = \frac{189.57\,\text{kV} - 8.88\,\text{kV} \cdot \cosh(1.24 \cdot 3\,\text{m})}{\sinh(1.24 \cdot 3\,\text{m}) \cdot 6.19\,\text{A}}$$

2.9) Impedance using Characteristic Impedance (LTL) Formula

Evaluate Formula

Formula

$$Z = Z_0^{\,2} \cdot Y$$

Example with Units

$$59.9981\,\Omega = 48.989\,\Omega^{\,2} \cdot 0.025\,\text{S}$$

2.10) Impedance using Propagation Constant (LTL) Formula

Evaluate Formula

Formula

$$Z = \frac{\gamma^2}{Y}$$

Example with Units

$$61.504\,\Omega = \frac{1.24^2}{0.025\,\text{S}}$$

2.11) Inductance using Surge Impedance (LTL) Formula

Evaluate Formula

Formula

$$L_{Henry} = C_{Farad} \cdot Zs^2$$

Example with Units

$$39.8125\,\text{H} = 13\,\text{F} \cdot 1.75\,\Omega^{\,2}$$

2.12) Surge Impedance (LTL) Formula

Evaluate Formula

Formula

$$Zs = \sqrt{\frac{L_{Henry}}{C_{Farad}}}$$

Example with Units

$$1.7541\,\Omega = \sqrt{\frac{40\,\text{H}}{13\,\text{F}}}$$

3) Line Parameters Formulas

3.1) Length using A Parameter (LTL) Formula

Evaluate Formula

Formula

$$L = a\frac{\cosh(A)}{\gamma}$$

Example with Units

$$3.0022\,\text{m} = a\frac{\cosh(20.7)}{1.24}$$

3.2) Length using B Parameter (LTL) Formula

Evaluate Formula

Formula

$$L = a\frac{\sinh\left(\frac{B}{Z_0}\right)}{\gamma}$$

Example with Units

$$3.0312\,\text{m} = a\frac{\sinh\left(\frac{1050\,\Omega}{48.989\,\Omega}\right)}{1.24}$$

3.3) Length using C Parameter (LTL) Formula

Evaluate Formula

Formula

$$L = a\frac{\sinh\left(C \cdot Z_0\right)}{\gamma}$$

Example with Units

$$3.0002\,\text{m} = a\frac{\sinh\left(0.421\,\text{s} \cdot 48.989\,\Omega\right)}{1.24}$$

3.4) Length using D Parameter (LTL) Formula

Evaluate Formula

Formula

$$L = a\frac{\cosh\left(D\right)}{\gamma}$$

Example with Units

$$3\,\text{m} = a\frac{\cosh\left(14.59\right)}{1.24}$$

3.5) Propagation Constant (LTL) Formula

Evaluate Formula

Formula

$$\gamma = \sqrt{Y \cdot Z}$$

Example with Units

$$1.2247 = \sqrt{0.025\,\text{s} \cdot 60\,\Omega}$$

3.6) Propagation Constant using A Parameter (LTL) Formula

Evaluate Formula

Formula

$$\gamma = a\frac{\cosh\left(A\right)}{L}$$

Example with Units

$$1.2409 = a\frac{\cosh\left(20.7\right)}{3\,\text{m}}$$

3.7) Propagation Constant using B Parameter (LTL) Formula

Evaluate Formula

Formula

$$\gamma = a\frac{\sinh\left(\frac{B}{Z_0}\right)}{L}$$

Example with Units

$$1.2529 = a\frac{\sinh\left(\frac{1050\,\Omega}{48.989\,\Omega}\right)}{3\,\text{m}}$$

3.8) Propagation Constant using C Parameter (LTL) Formula

Evaluate Formula

Formula

$$\gamma = a\frac{\sinh\left(C \cdot Z_0\right)}{L}$$

Example with Units

$$1.2401 = a\frac{\sinh\left(0.421\,\text{s} \cdot 48.989\,\Omega\right)}{3\,\text{m}}$$

3.9) Propagation Constant using D Parameter (LTL) Formula

Evaluate Formula

Formula

$$\gamma = a\frac{\cosh\left(D\right)}{L}$$

Example with Units

$$1.1241 = a\frac{\cosh\left(14.59\right)}{3\,\text{m}}$$

Variables used in list of Long Transmission Line Formulas above

- **A** A Parameter
- **B** B Parameter *(Ohm)*
- **C** C Parameter *(Siemens)*
- C_{Farad} Capacitance *(Farad)*
- **D** D Parameter
- I_r Receiving End Current *(Ampere)*
- I_s Sending End Current *(Ampere)*
- **L** Length *(Meter)*
- L_{Henry} Inductance *(Henry)*
- V_r Receiving End Voltage *(Kilovolt)*
- V_s Sending End Voltage *(Kilovolt)*
- **Y** Admittance *(Siemens)*
- **Z** Impedance *(Ohm)*
- Z_0 Characteristic Impedance *(Ohm)*
- **Zs** Surge Impedance *(Ohm)*
- **γ** Propagation Constant

Constants, Functions, Measurements used in list of Long Transmission Line Formulas above

- Functions: **acosh**, acosh(Number)
  Hyperbolic cosine function, is a function that takes a real number as an input and returns the angle whose hyperbolic cosine is that number.
- Functions: **asinh**, asinh(Number)
  The inverse hyperbolic sine, also known as the area hyperbolic sine, is a mathematical function that is the inverse of the hyperbolic sine function.
- Functions: **cosh**, cosh(Number)
  The hyperbolic cosine function is a mathematical function that is defined as the ratio of the sum of the exponential functions of x and negative x to 2.
- Functions: **sinh**, sinh(Number)
  The hyperbolic sine function, also known as the sinh function, is a mathematical function that is defined as the hyperbolic analogue of the sine function.
- 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 Meter (m)
  Length Unit Conversion
- Measurement: **Electric Current** in Ampere (A)
  Electric Current Unit Conversion
- Measurement: **Capacitance** in Farad (F)
  Capacitance 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 Henry (H)
  Inductance Unit Conversion
- Measurement: **Electric Potential** in Kilovolt (kV)
  Electric Potential Unit Conversion

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