# Multi-Phase Transmission Line VTB Model

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Model name: MpTrLine

DLL name: MpTrLine.DLL

Version number: 1.0

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## Pictorial Representation of Model

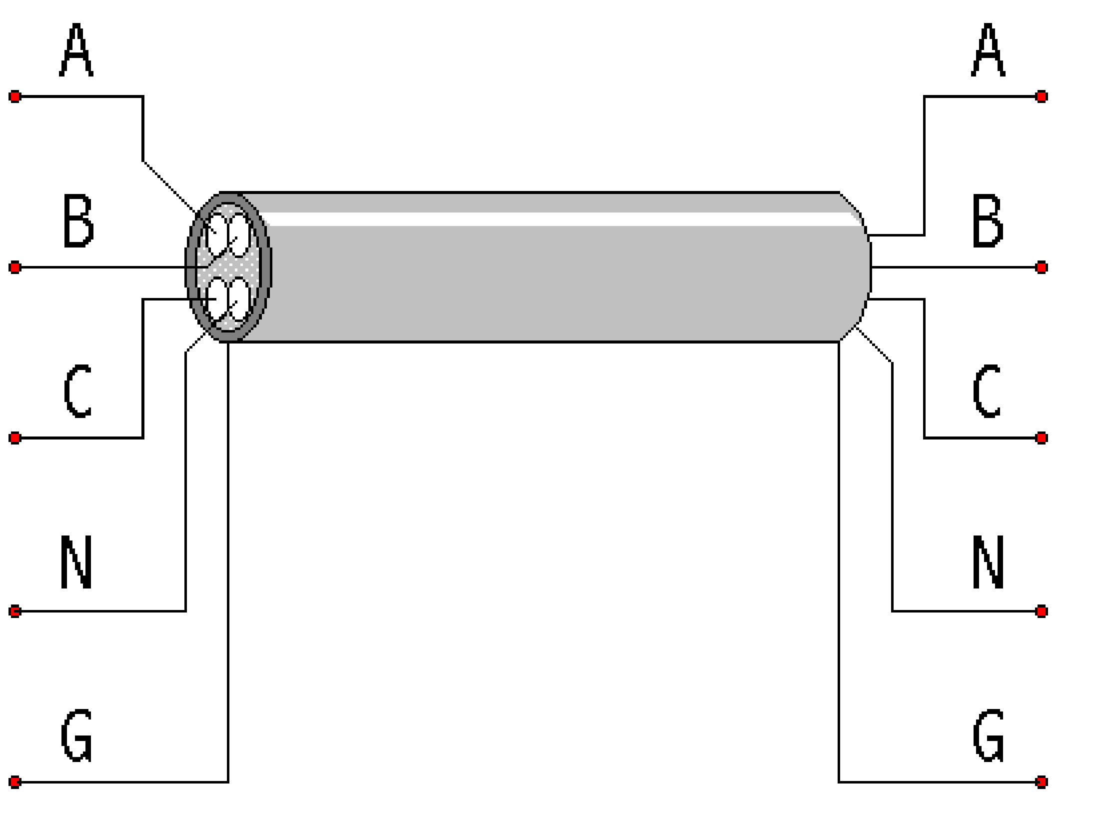


***Figure 1***

## Brief Description of Model

This model represents a multiphase lossy transmission line. The user selectable parameters include the conductor materials, and the size and physical arrangement of the conductors. The model is based on the equivalent series resistance and inductance matrix, and takes into account the mutual inductances among the line conductors.

## Model Validity Range and Limitations

# List of Model Parameters

| Name | Description | Default Value | Units |
|---|---|---|---|
| Number of Conductors | may be 2,3,4, or 5 | 5 | |
| Conductivity | Conductor conductivity, separately specified for each conductor | 3.5360e+007 | Mhos/m |
| O-Radius | Outside radius of each conductor | 0.02 | m |
| I-Radius | Inside radius of each conductor | 0.0 | m |
| X-Coordinate | x-coordinate for each conductor | | m |
| Y-Coordinate | y-coordinate for each conductor | | m |
| Model Type | Pi-Equivalent or Convolution Based<br><br>(Presently only the series impedance version of the Pi-Equivalent model is supported) | Pi-Equivalent | |
| Transposed | Not Supported | false | |
| Frequency Dependence | Not Supported | false | |
| Line Length | Length of line | 100 | m |
| Relative Permitivity | Effective relative permitivity of surrounding material | 1 | |

# List of Accessible Internal Variables

None.

# Assumptions in Model Derivation

Shunt capacitance is ignored. Frequency dependence ins ignored. Line parameters are computed at 60 Hz.

# Mathematical Description of Model

The model derives the line series resistance and inductance matrices based on the formulas:

$$R_m = R_s = 0.001588f$$

$$L_m = 0.0003218 \log\left(\frac{D_e}{D}\right)$$

$$L_s = 0.0003218 \cdot \ln\left(\frac{D_e}{GMR}\right)$$

$$D_e = 658.368\sqrt{\frac{\rho}{f}}$$

$$GMR = 0.786627 \cdot r$$

where:

f is the system frequency (assumed 60 Hz)

$R_m$ Mutual resistance between two conduvtors

$R_s$ Conductor Self Resistance

$L_m$ Mutual inductance between two conductors

$L_s$ Conductor self Inductance

$D_e$ Equivalent depth of earth return

GMR Conductor geometric mean radius

ρ Ground plane resistivity

Using the above formulas the resistance matrix (R) and the inductance matrix (L) are constructed and a model is built based on the equation:

$$V = L\frac{d}{dt}I + RI$$

where:

V is a vector containing the voltage drops across each conductor.

I is a vector containing the current through each conductor.

# Example of Model Use

N/A

# Model Validation

Model was validated by comparing VTB results to analytic solution.