Introduction to PowerWorld Simulator: Interface and Common Tools

I16: TransLineCalc

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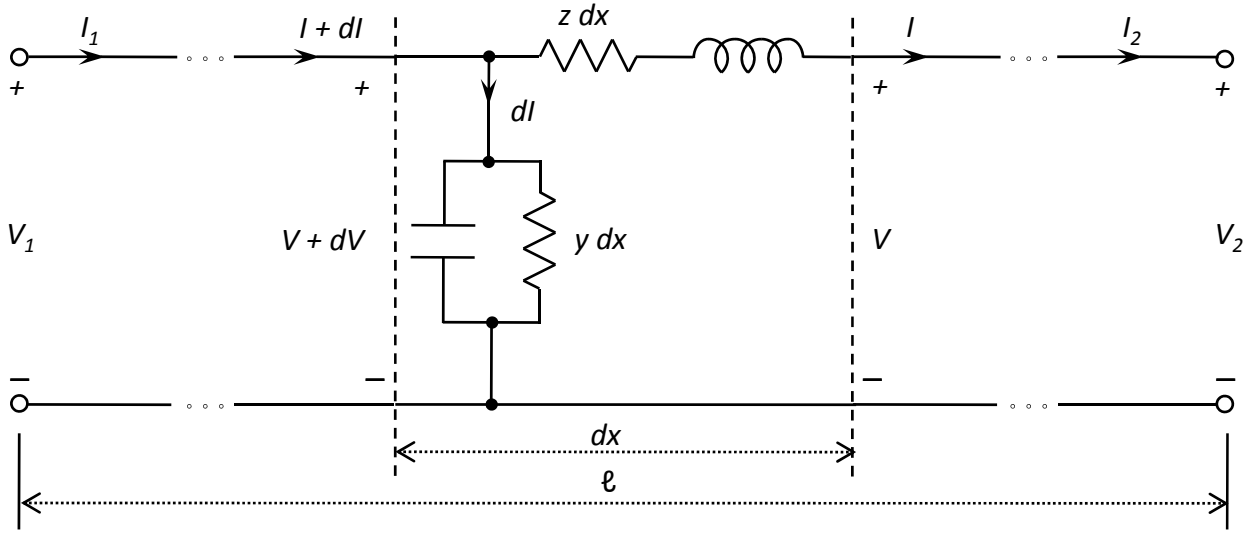
TransLineCalc Tool

- The Transmission Line Parameter Calculator (TransLineCalc) is a tool designed to compute characteristic line parameters
  - Input data: Type of conductor and tower configuration of a three-phase overhead transmission line
  - Output data: Resistance R, reactance X, susceptance B, conductance G
  - Values computed as distributed, lumped or total, and in per-unit
- As a stand-alone program or as an automation server that interacts with Simulator or from an external application

Distributed Transmission Line Model

- Distributed parameter line

  $z = r + j\omega l$ = series impedance per unit length/phase
  $y = g + j\omega c$ = shunt admittance per unit length/phase
  ℓ = length of the line



Distributed Transmission Line Model (cont'd)

- The relationship between the per-phase voltages and currents at the two ends of the transmission line is specified by:

$$V_1 = V_2 \cosh \gamma \ell + Z_C I_2 \sinh \gamma \ell$$

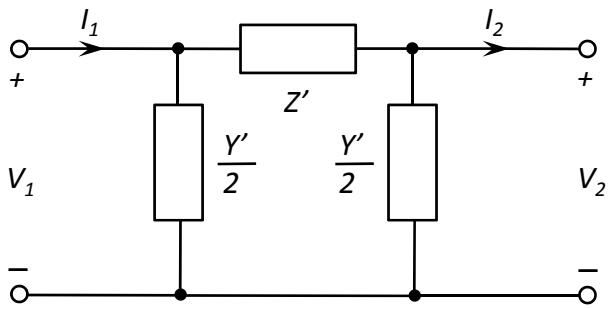
$$I_1 = I_2 \cosh \gamma \ell + \frac{V_2}{Z_C} \sinh \gamma \ell$$

where

- *z* is the series impedance
- *y* is the shunt admittance
- γ is the propagation constant = $\sqrt{zy}$
- Z_C is the characteristic impedance = $\sqrt{z/y}$

Π Transmission Line Model

- Use of equivalent Π circuit of a transmission line



- The same relationship between terminal voltages and currents in a matrix form:

$$V_1 = AV_2 + BI_2$$
$$I_1 = CV_2 + DI_2$$

Π Transmission Line Model (cont'd)

- The *A*, *B*, *C*, *D* parameters are given by:

$$A = 1 + \left(\frac{Z'Y'}{2}\right) \qquad B = Z'$$

where $$C = Y'\left(1 + \frac{Z'Y'}{4}\right) \qquad D = 1 + \frac{Z'Y'}{2}$$

- $Z = z\ell$ is the total series impedance of the line, and

$$Z' = Z\frac{\sinh \gamma\ell}{\gamma\ell}$$

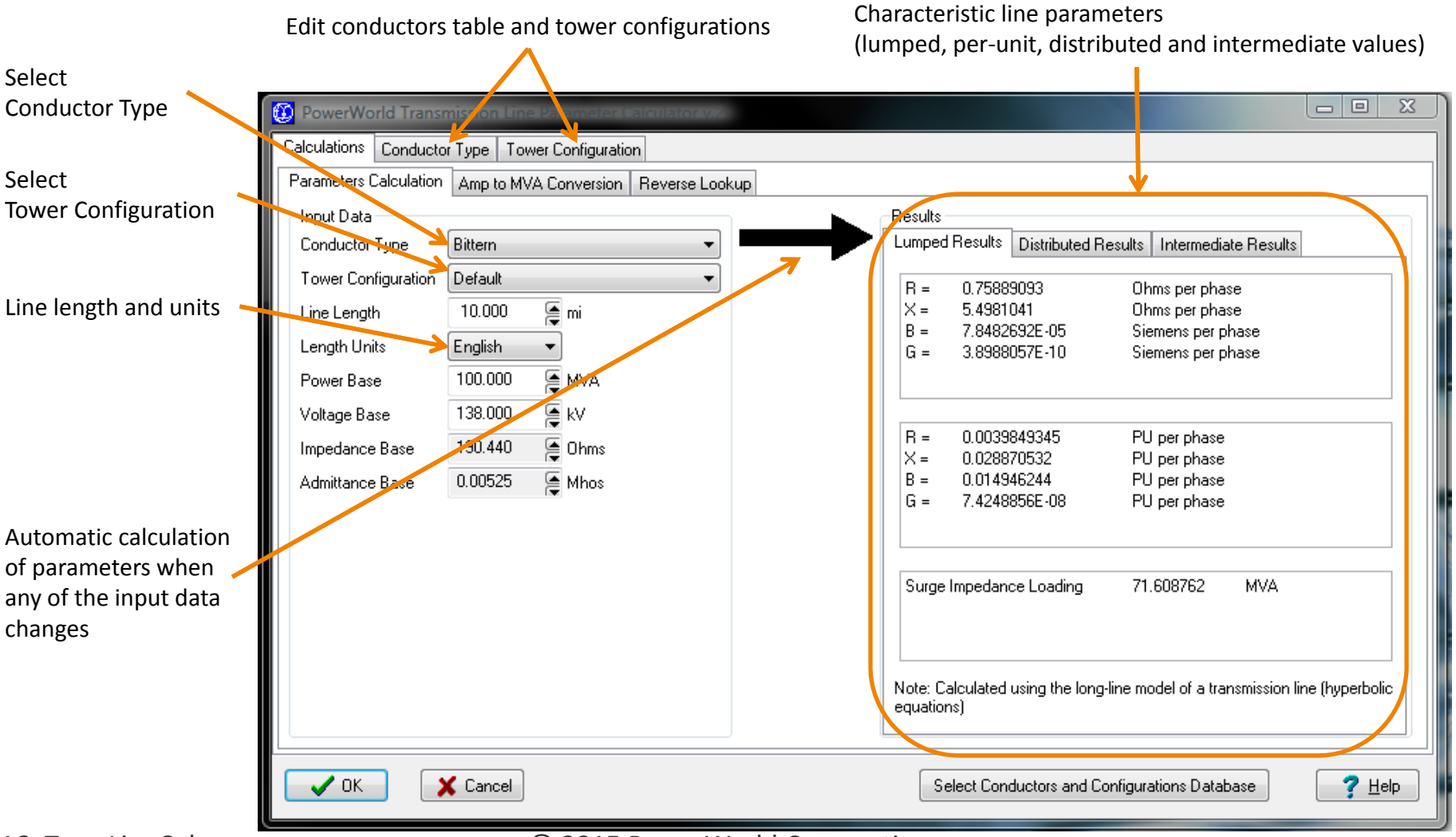
- $Y = y\ell$ is the total line-neutral admittance of the line, and

$$\frac{Y'}{2} = \frac{Y}{2}\frac{\tanh\left(\gamma\ell/2\right)}{\gamma\ell/2}$$

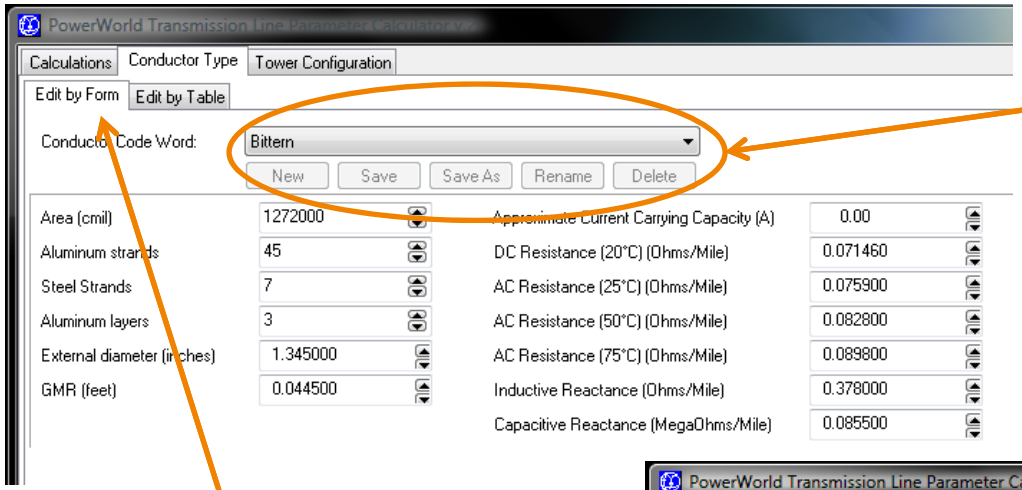
TransLineCalc Calculations

- Three types of calculations available in TransLineCalc:
  - Parameters Calculation. Computes distributed and lumped or total values of R, X, G and B
  - Amp to MVA Conversion. Converts the limits of transmission lines from Amps to MVA's, and viceversa, given the voltage base
  - Reverse Lookup. Given the tower configuration and the characteristic line parameters in per unit, lists the conductors that match those characteristic line parameter given values

Parameters Calculation

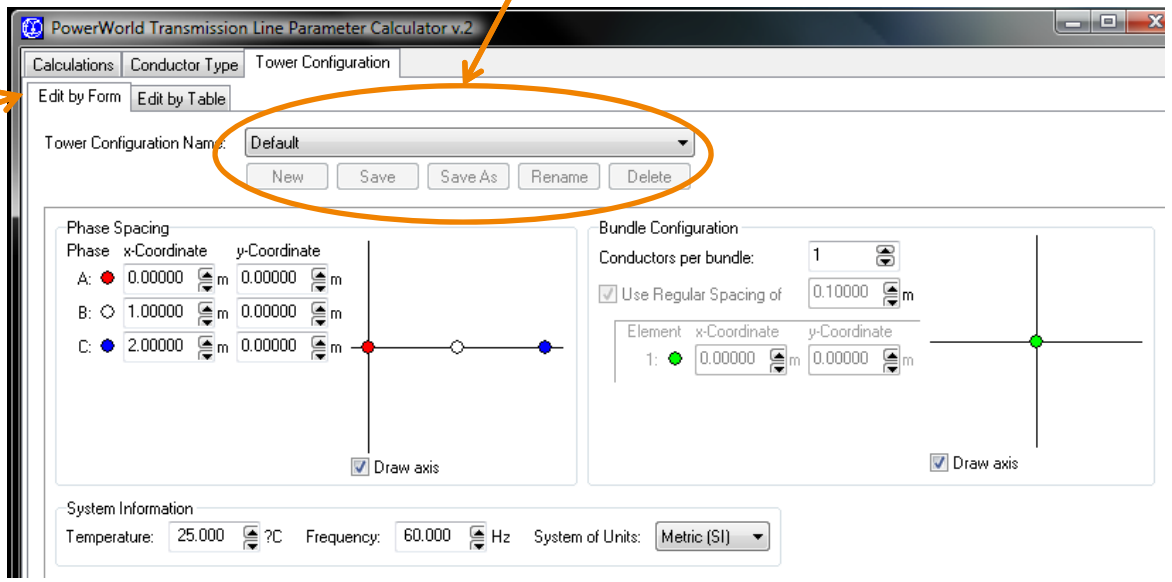


Editing Conductors and Tower Configurations



Create a new conductor, modify or delete an existing one

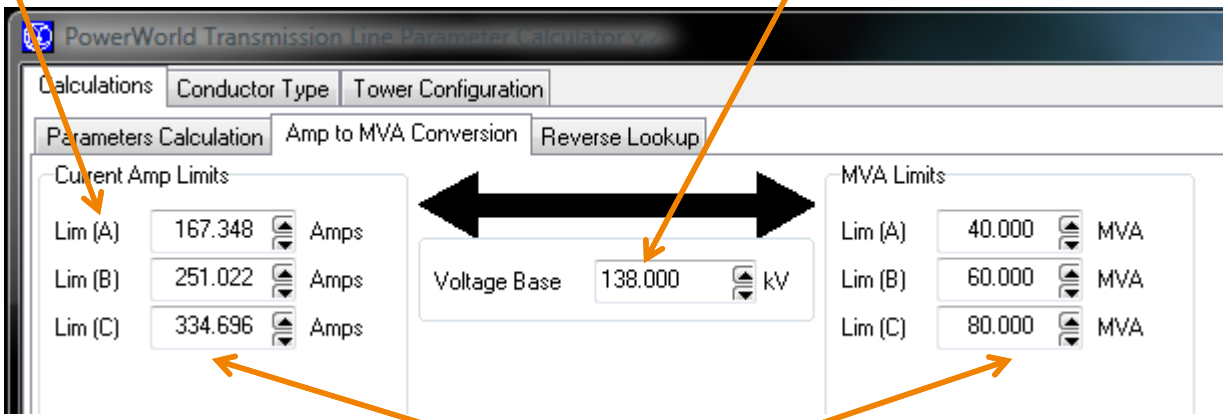
Values can be changed for the specific conductor/tower configuration or as a table form



Amp to MVA Limit Conversion

The stand-alone version displays only three limits. When used from Simulator, it will display the current 8 line limits of a transmission line

The voltage base is the only input data

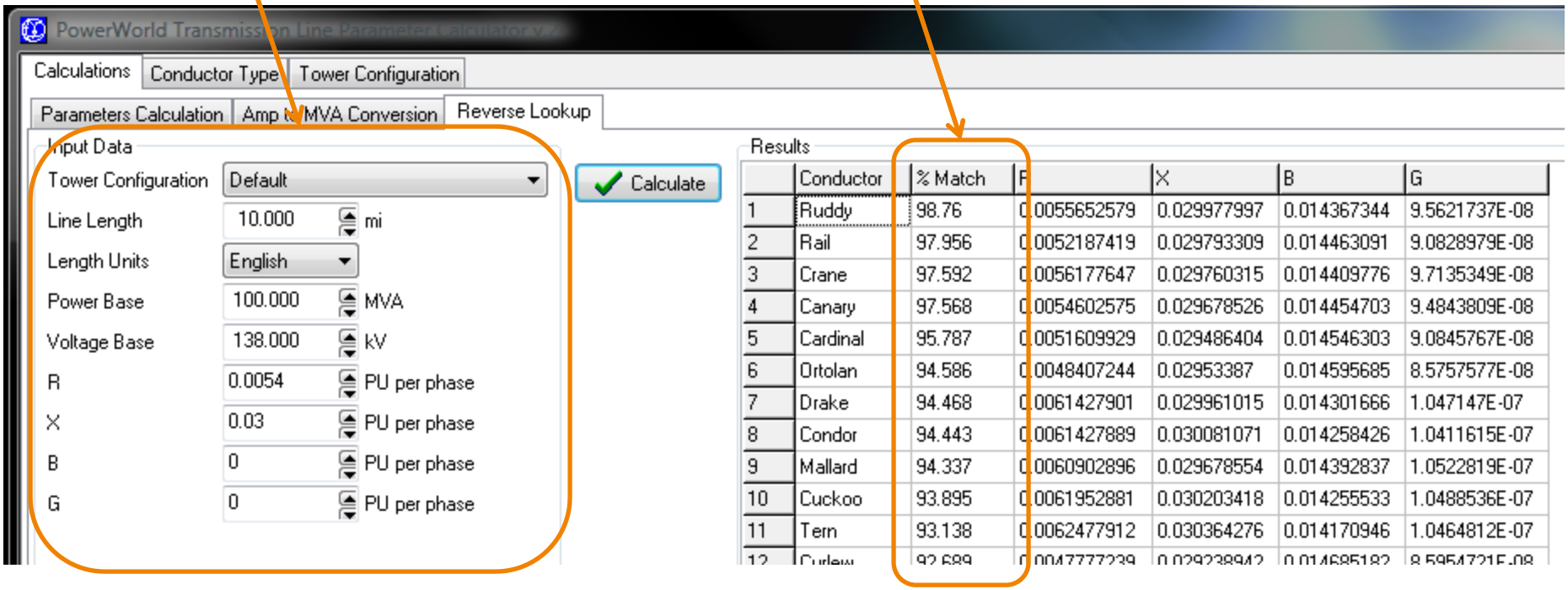


As the user modify either the Amp Limits or the MVA Limits, they are automatically converted

Reverse Lookup

Enter the Tower Configuration, line length and units, and per-unit characteristic line parameter values

Conductors are listed according to the match found



	Conductor	% Match	R	X	B	G
1	Ruddy	98.76	0.0055652579	0.029977997	0.014367344	9.5621737E-08
2	Rail	97.956	0.0052187419	0.029793309	0.014463091	9.0828979E-08
3	Crane	97.592	0.0056177647	0.029760315	0.014409776	9.7135349E-08
4	Canary	97.568	0.0054602575	0.029678526	0.014454703	9.4843809E-08
5	Cardinal	95.787	0.0051609929	0.029486404	0.014546303	9.0845767E-08
6	Ortolan	94.586	0.0048407244	0.02953387	0.014595685	8.5757577E-08
7	Drake	94.468	0.0061427901	0.029961015	0.014301666	1.047147E-07
8	Condor	94.443	0.0061427889	0.030081071	0.014258426	1.0411615E-07
9	Mallard	94.337	0.0060902896	0.029678554	0.014392837	1.0522819E-07
10	Cuckoo	93.895	0.0061952881	0.030203418	0.014255533	1.0488536E-07
11	Tern	93.138	0.0062477912	0.030364276	0.014170946	1.0464812E-07
12	Curlew	92.689	0.0047777239	0.029238942	0.014685182	8.5954721E-08

Interaction with Simulator

- TransLineCalc can be open from Simulator.
  - Transmission/Line/Transformer options dialog for each line in Edit Mode
  - **Parameters** tab,
  - Click on **Calculate Impedances** button,
  - Select **From Conductor Type and Tower Configuration**.