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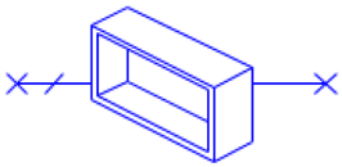
Rectangular Waveguide (TEmn): RWG_TEmn

Symbol



Summary

RWG_TEmn models a transmission line equivalent to a transverse electric waveguide mode of the order mn (TEmn) existing in a section of rectangular waveguide. The mode may be either propagating or evanescent (non-propagating); waveguide metal has a final conductivity and is filled with lossy dielectric.

Parameters

Name	Description	Unit Type	Default
Wa	Width of rectangular waveguide	Length	22860 um
Wb	Height of rectangular waveguide t	Length	10160 um
L	Length of rectangular waveguide l	Length	10000 um
M	Mode order (along Wa)		1
N	Mode order (along Wb		0
Er	Relative dielectric constant filling the waveguide		1
Rho	Metal bulk resistivity of waveguide metal normalized to copper		1
Tand	Loss tangent of dielectric filling the waveguide		0
*Mur	Relative permeability of dielectric filling the waveguide		1

Name	Description	Unit Type	Default
*Tanm	Magnetic loss tangent of dielectric filling the waveguide		0
*Sigma	Dielectric conductivity of dielectric filling the waveguide	Siemens/m	0
*ZCalc	Switch - selector of TE10 characteristic impedance definition ("Power-Voltage"/"Voltage-Current"/"Normalized")		Power-Voltage

** indicates a secondary parameter*

Parameter Details

M, N. Parameters M and N make a pair of indices that define the TEmn mode selected for modeling. M represents the number of field variation along the Wa dimension; N provides the same relative to Wb.

Rho. The bulk resistivity of the waveguide metal. Note that this parameter is dimensionless because it represents the resistivity normalized to that of copper (i.e. to 1.7E-8 ohm/m.)

Er, Tand, Mur, Tanm, Sigma. The material properties of media filling the waveguide.

Zcalc. Allows you to select a definition of characteristic impedance of the TE10 mode propagating in a rectangular waveguide with dimensions Wa*Wb. Options include "Power-Voltage" ,"Voltage-Current", and "Normalized." The default option is "Power-Voltage." This model uses the value of characteristic impedance to denormalize the computed normalized y-matrix of modeled discontinuity. Note that this selection must match the selection of the same parameter in theRWGIRIS_TE10 and RWGT_TEmn elements used around the same schematic.

The following characteristic impedance definitions are used [1]:

$$Z_{\text{power-voltage}} = Z\frac{2W_b}{W_a}$$

$$Z_{\text{voltage-current}} = Z\pi\frac{W_b}{2W_a}$$

$$Z = \frac{\eta}{\sqrt{1-(\frac{f_c}{f})^2}}$$

Here, f_c is the cutoff frequency for TE10 and f is the operational frequency; η is the wave impedance of the open space filled with the waveguide dielectric.

$Z_{Normalized}=1$

Implementation Details

Circuit Model Synthesis

RWG_TEmn supports synthesis of physical parameters based on electrical specifications using the Transmission Line Calculator. To open the Transmission Line Calculator, right-click a transmission line element in a schematic and choose **Synthesize**.

To perform transmission line synthesis:

1. In the Electrical property grid, select **Target** check boxes for desired electrical parameters and enter a corresponding value.
2. In the Physical property grid, update frequency and substrate parameters if needed, then select **Synthesize** check boxes for transmission line physical parameters to synthesize based on the targets.
3. Click the **Synthesize** left arrow to run the synthesis program. The values in both property grids update with the synthesized results. An analysis is also performed with the final physical values. If synthesis cannot achieve the target values, it shows how close it came.
4. Click **OK** to update the selected transmission line element with the synthesized physical parameters. Expressions are overwritten with the new, evaluated values. You can click the **Undo** button on the program toolbar to revert all parameters in the schematic document to their pre-synthesized state. Parameters from substrate elements are never updated since typically substrate elements are used by more than one transmission line element. Click **Cancel** to close the dialog box without setting the parameters into the element.

Layout

This element does not have an assigned layout cell. You can assign artwork cells to any element. See "Assigning Artwork Cells to Layout of Schematic Elements" for details.

Recommendations for Use

NOTE: Results depend on the selected definition of waveguide characteristic impedance.

Normalized characteristic impedance implies that waveguide mode is propagating. **This means: Never set ZCalc to "Normalized" if your operational frequency gets into below-cutoff region.**

Ensure that the bulk resistivity of waveguide metal is normalized to correct the value of **copper** resistivity (**not gold**).

References

[1] K. C. Gupta, Ramesh Garg, Rakesh Chadha, Computer Aided Design of Microwave Circuits, Artech House, Mass., 1981.