Welcome to CST

CST STUDIO SUITE®
Training Class

Part 1

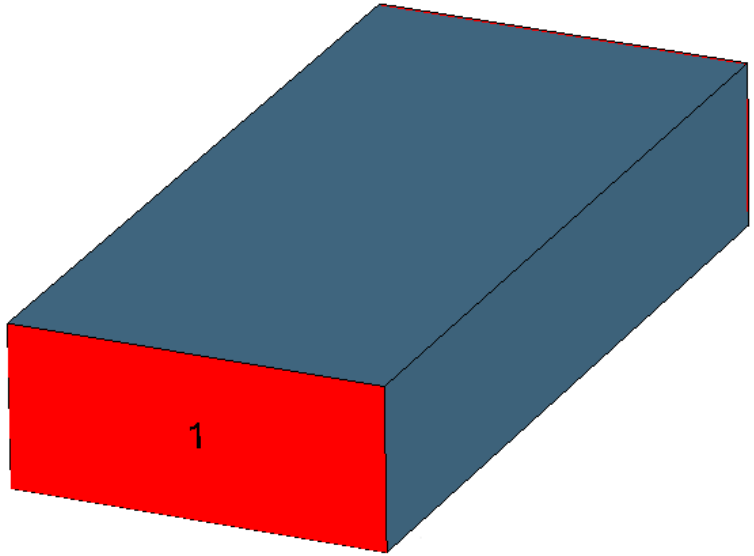
Link Collection

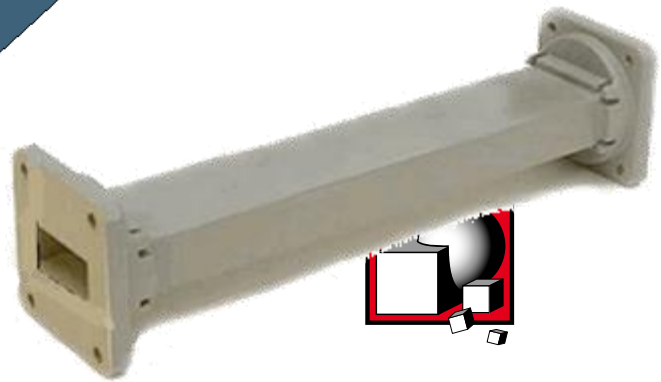
- https://de.wikipedia.org/wiki/Finite-Integral-Methode
- https://de.wikipedia.org/wiki/Finite-Elemente-Methode

Workflow Example

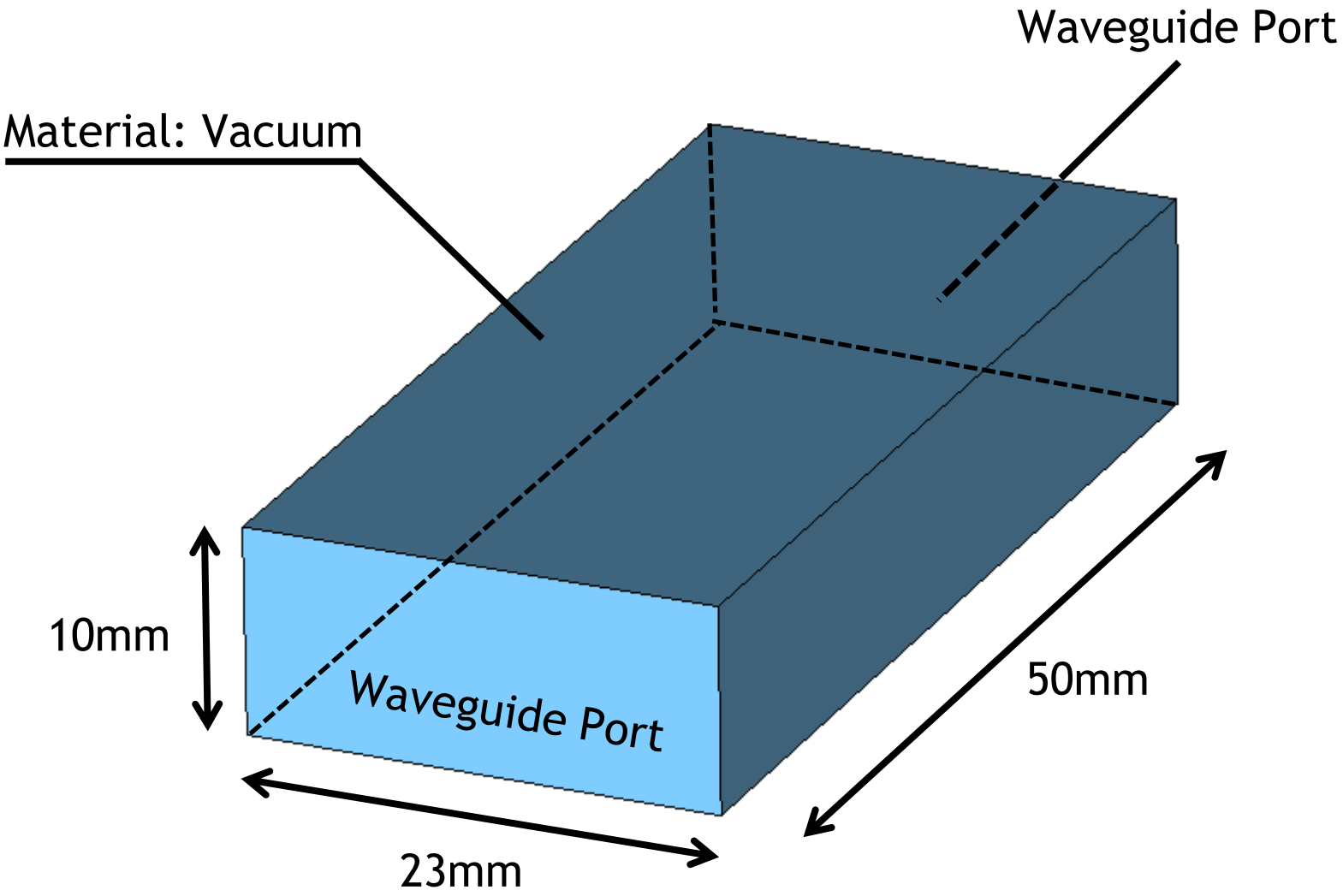
Rectangular Waveguide

Purpose: Create your first model. Test the post processing facilities.





Model

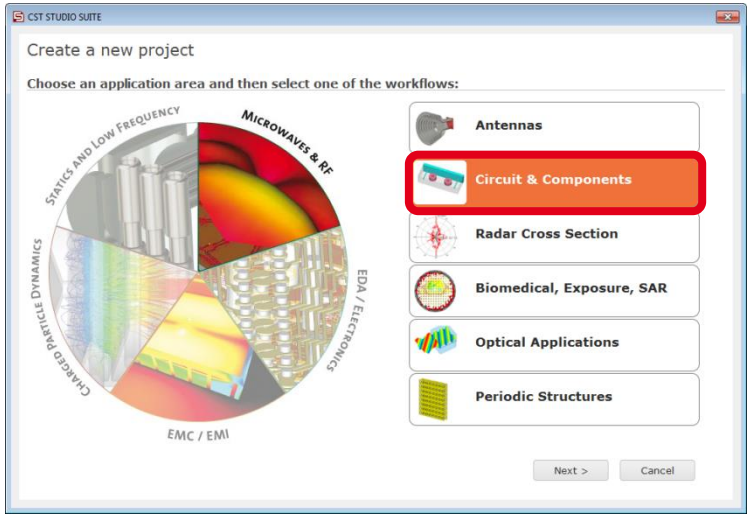

Waveguide Port
Material: Vacuum
10mm
Waveguide Port
50mm
23mm

CST MWS - Standard Workflow

- Choose a project template.
- Create your model.
  - parameters + geometry + materials
- Define ports.
- Set the frequency range.
- Specify boundary and symmetry conditions.
- Define monitors.
- Check the mesh.
- Run the simulation.

New Project Wizard

Create Project



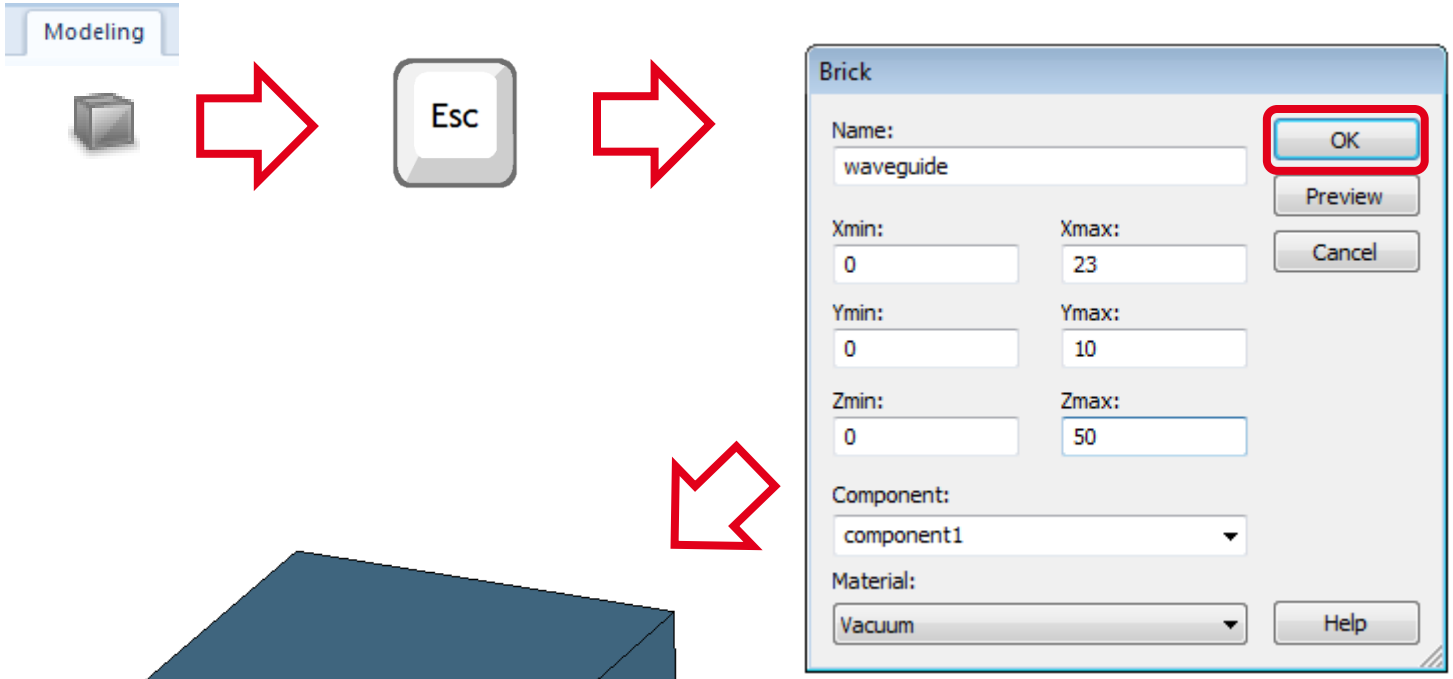
Waveguide Couplers & Dividers

Time Domain

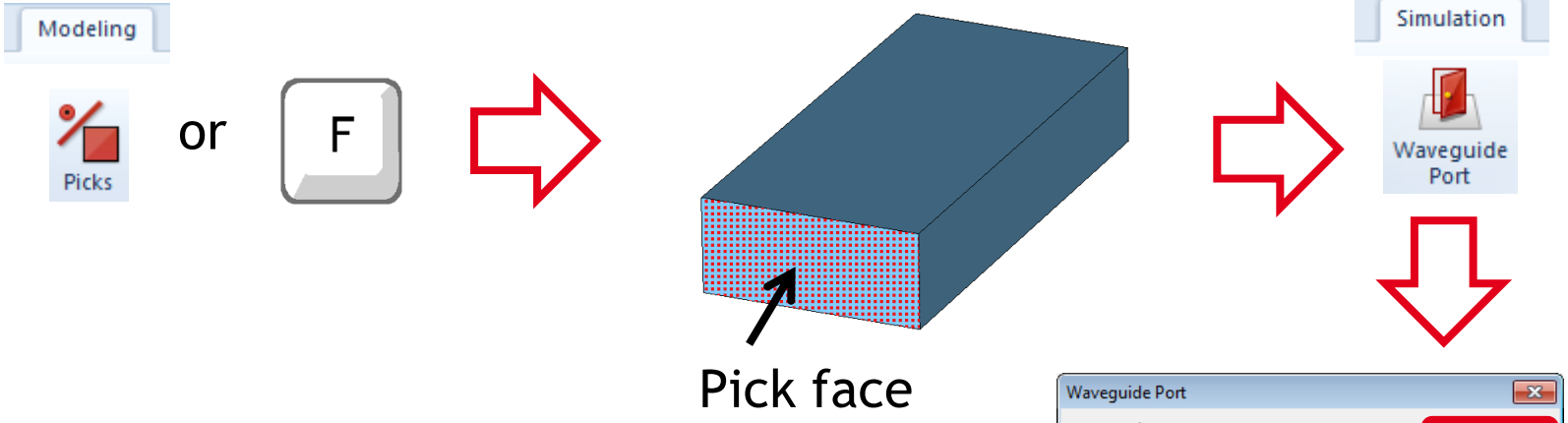
Leave the default settings for units, background materials, etc.

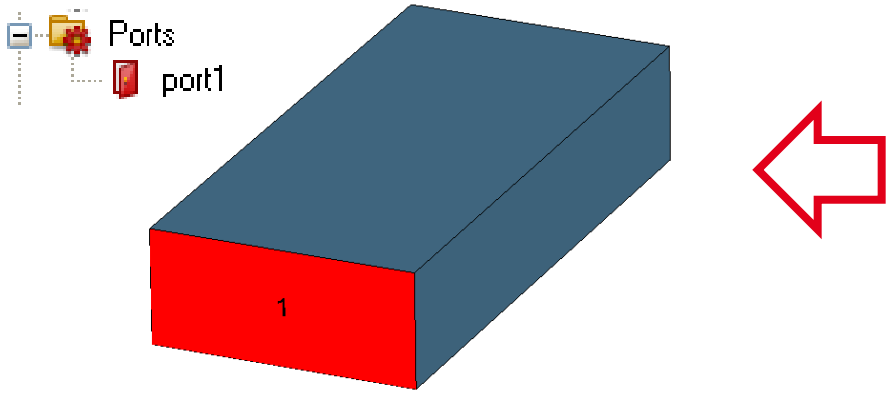
The new project wizard customizes the default settings for particular types of applications.

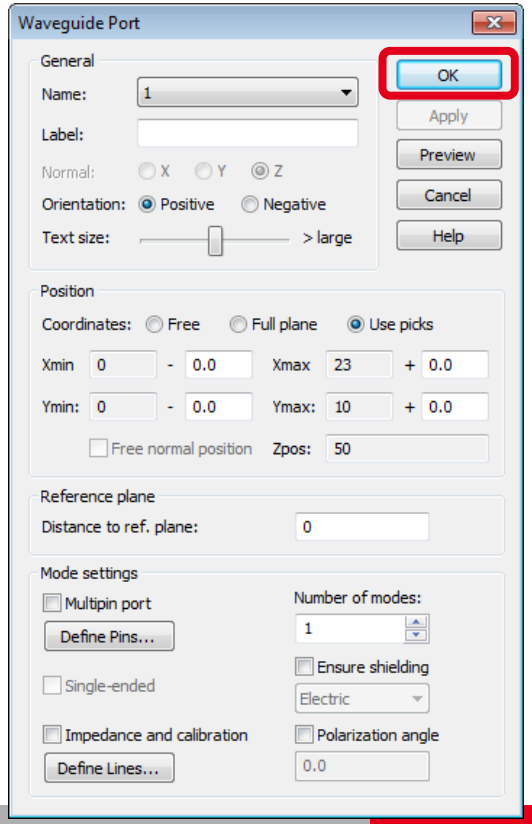
Create Geometry



Define Excitation

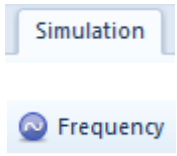


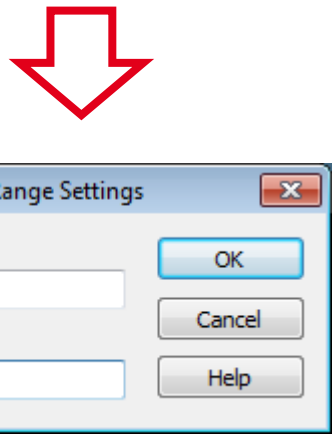




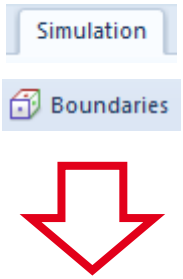
Define the port on the other side using the same workflow.

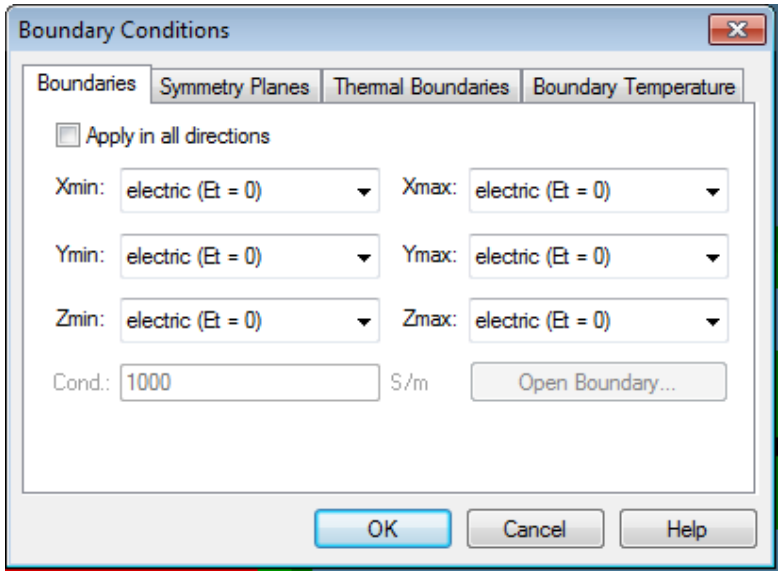
Frequency Range / Boundaries





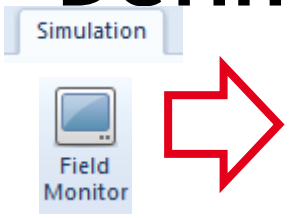
Fmin should be above the cutoff frequency of the mode of interest.

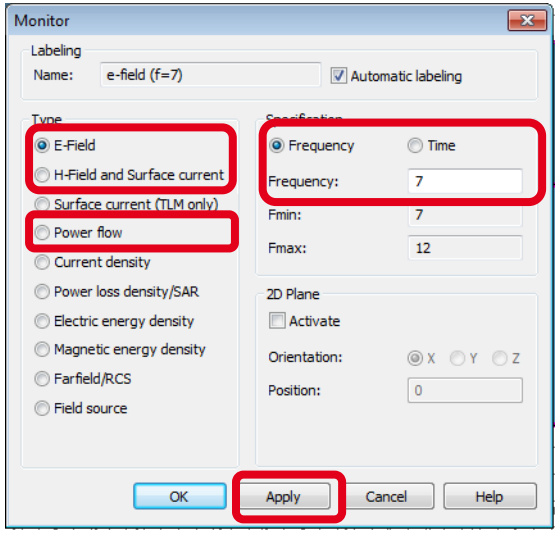




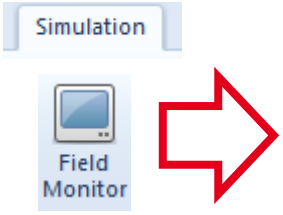
This has been correctly set by the project template.

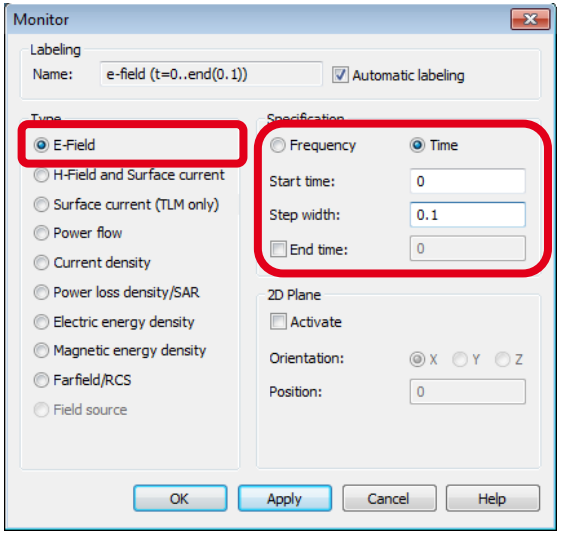
Define Monitors





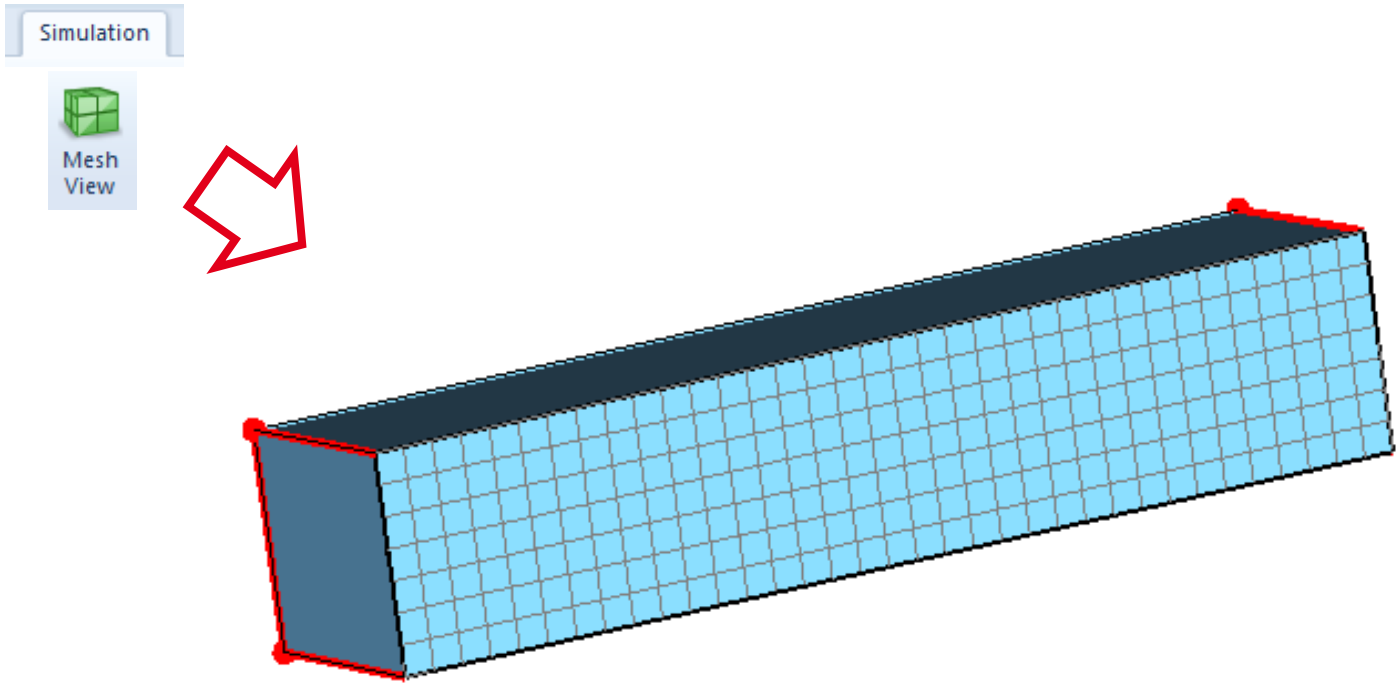
Define E-field, H-field and Power Flow monitors at 7 GHz and 12 GHz.





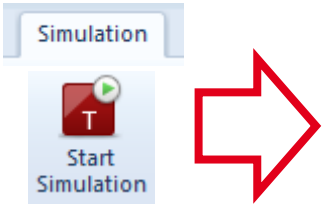
Define a time domain monitor for the E-field.

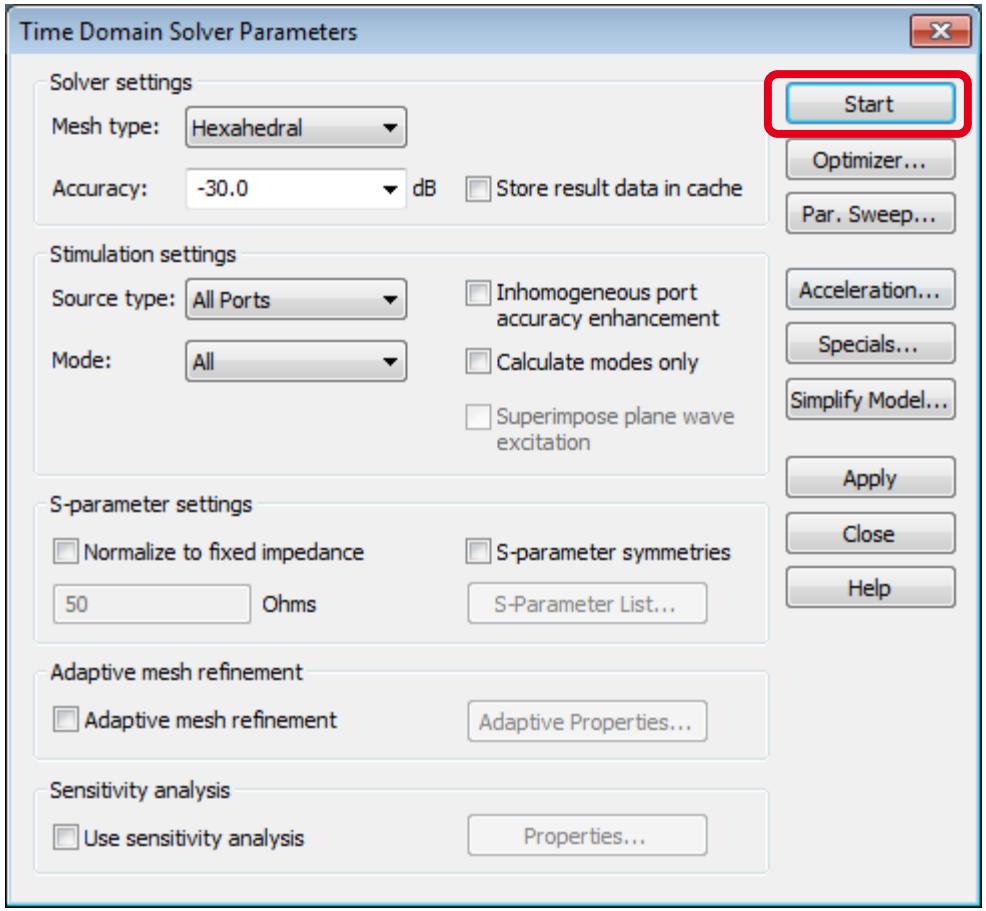
Check the Mesh



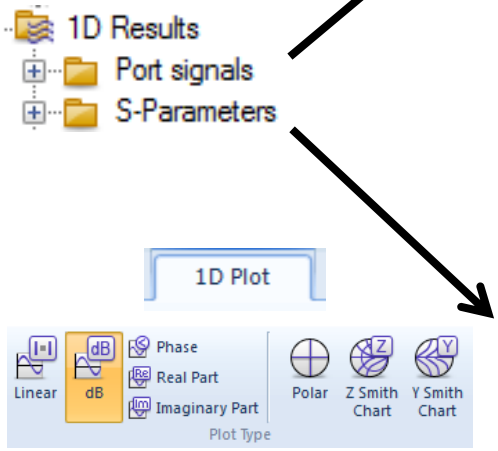
For this simple model there are no critical things which would need further adjustments.

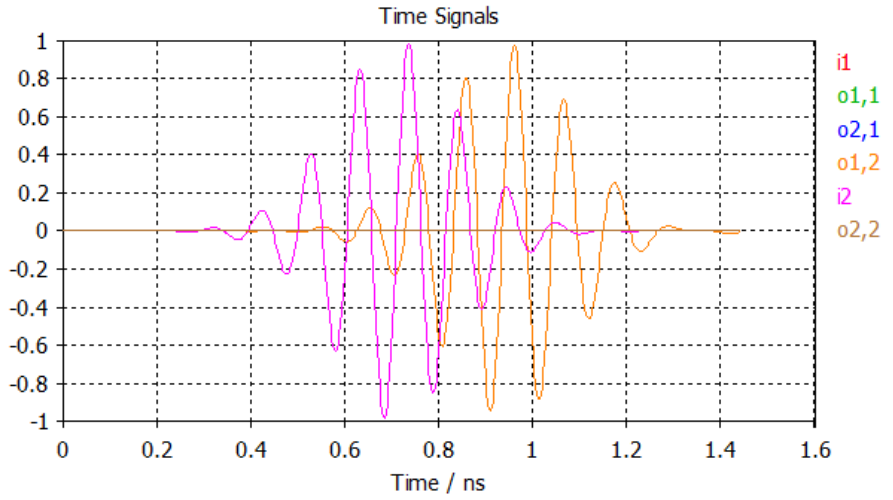
Start the Transient Simulation

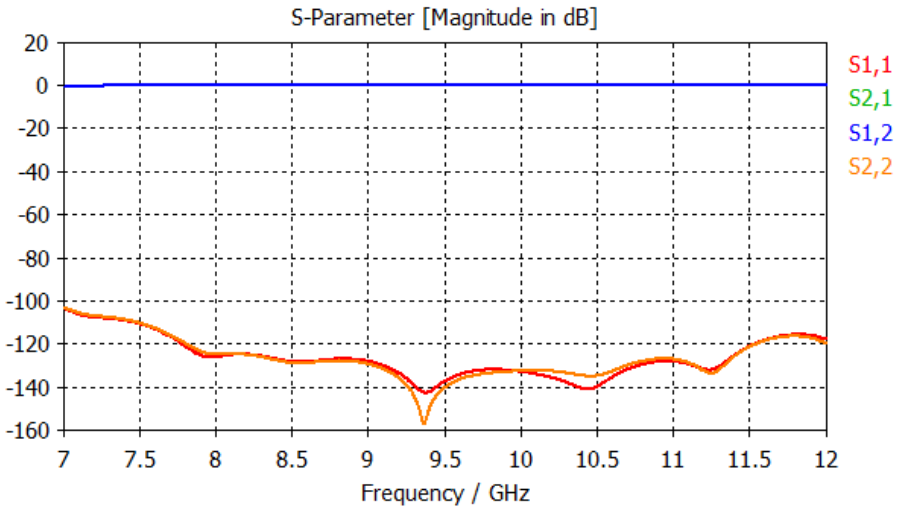




Results 1D

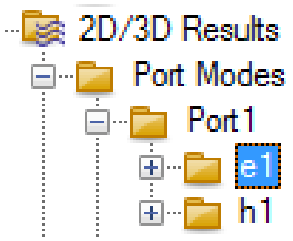




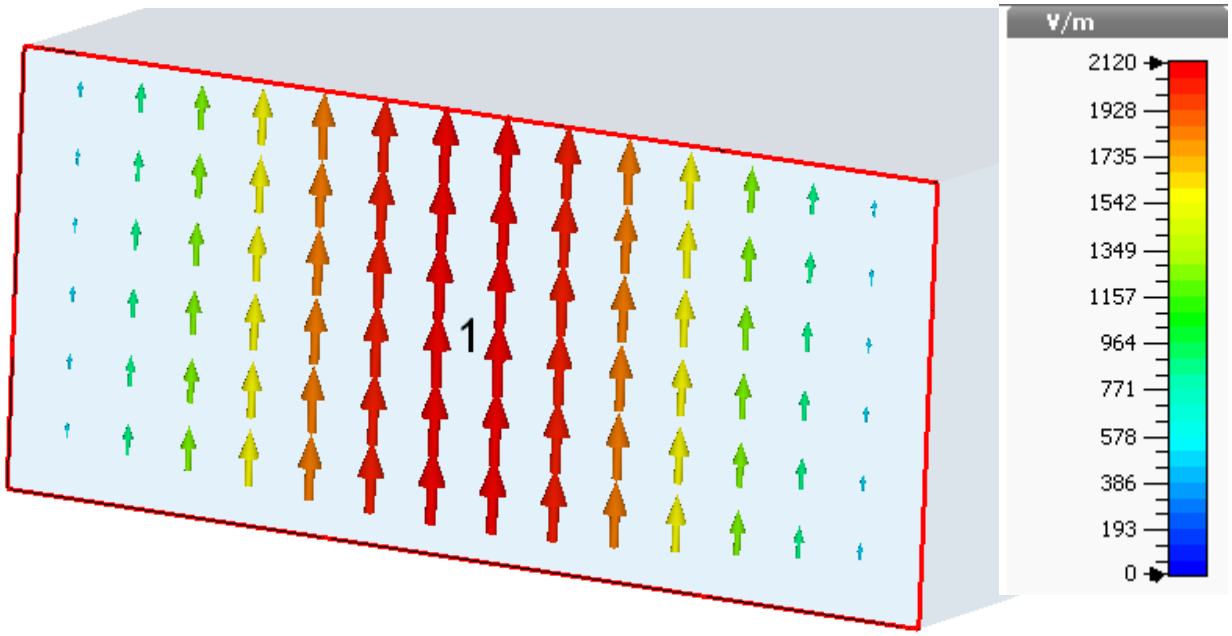


- You can switch to a different plot mode using the toolbar.

Results 3D - Port Modes

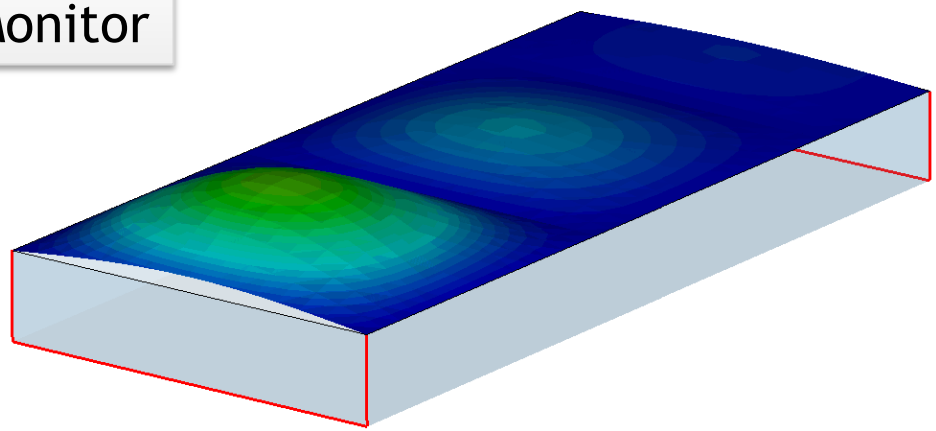


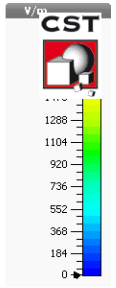
Port1_e1 (peak)	
Frequency:	9.5
Phase:	0
Wave Imp. [Ohms]:	517
Beta [1/m]:	145.1
Fcutoff:	6.507
Accuracy:	1.084e-14
Mode type:	TE
Maximum:	2120
Plane at z	50



Results 3D

Time Domain Monitor

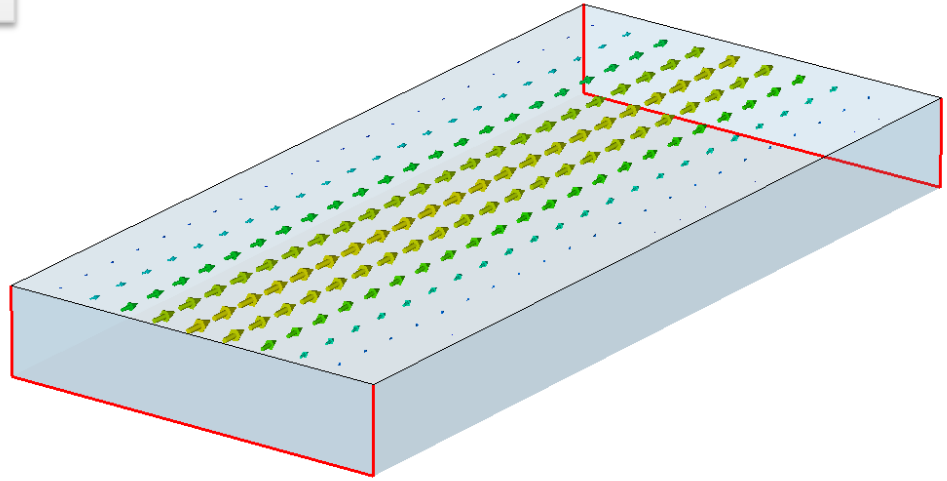


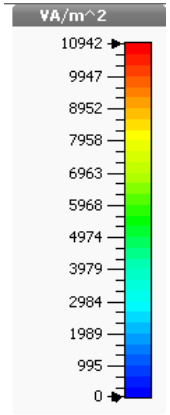


e-field (t=0..end(0.1)) [1]

Cutplane normal:	0, 1, 0
Cutplane position:	5
Component:	Abs
2D Maximum:	1160
Sample(15):	7
Time:	0.6

Power Flow Monitor



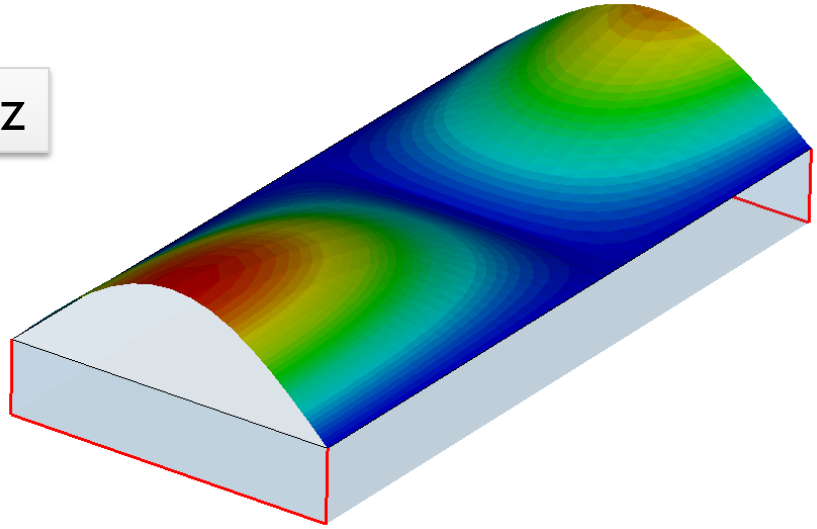


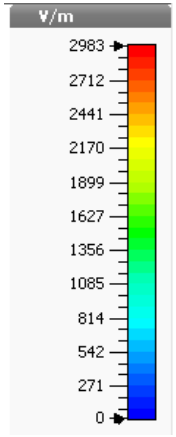
power (f=7) [1] (peak)

Cutplane normal:	0, 1, 0
Cutplane position:	5
2D Maximum:	1.094e+04
Frequency:	7

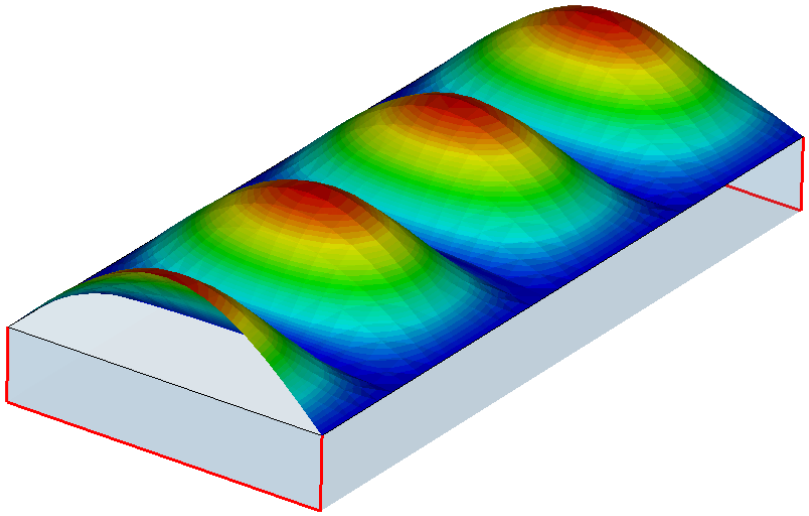
Results 3D

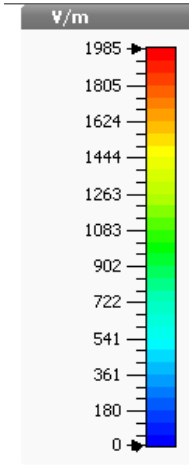
E-field at 7 GHz





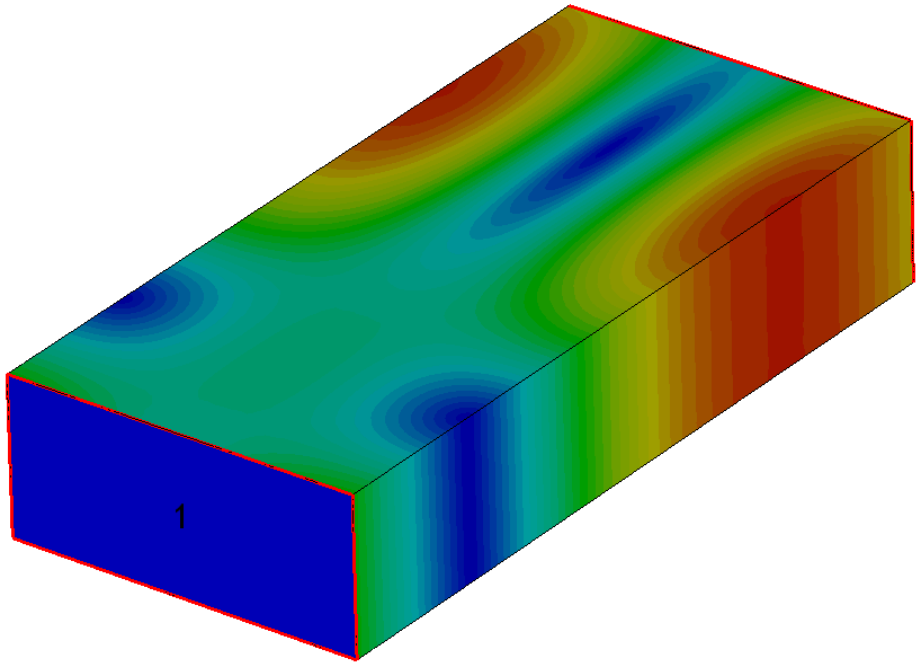
E-field at 12 GHz





Results 3D

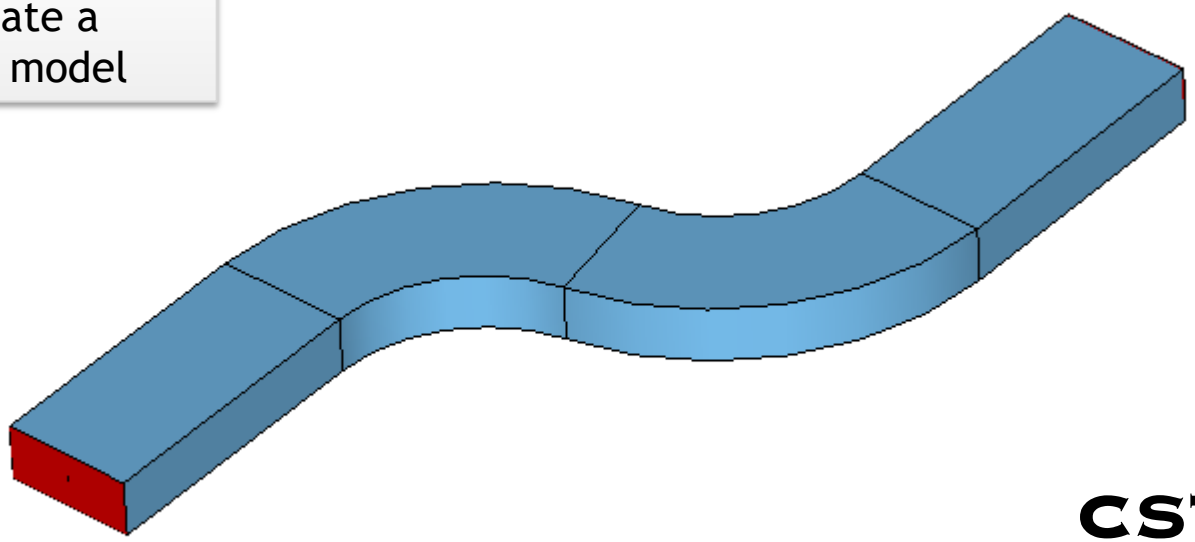
Surface Currents at 7 GHz



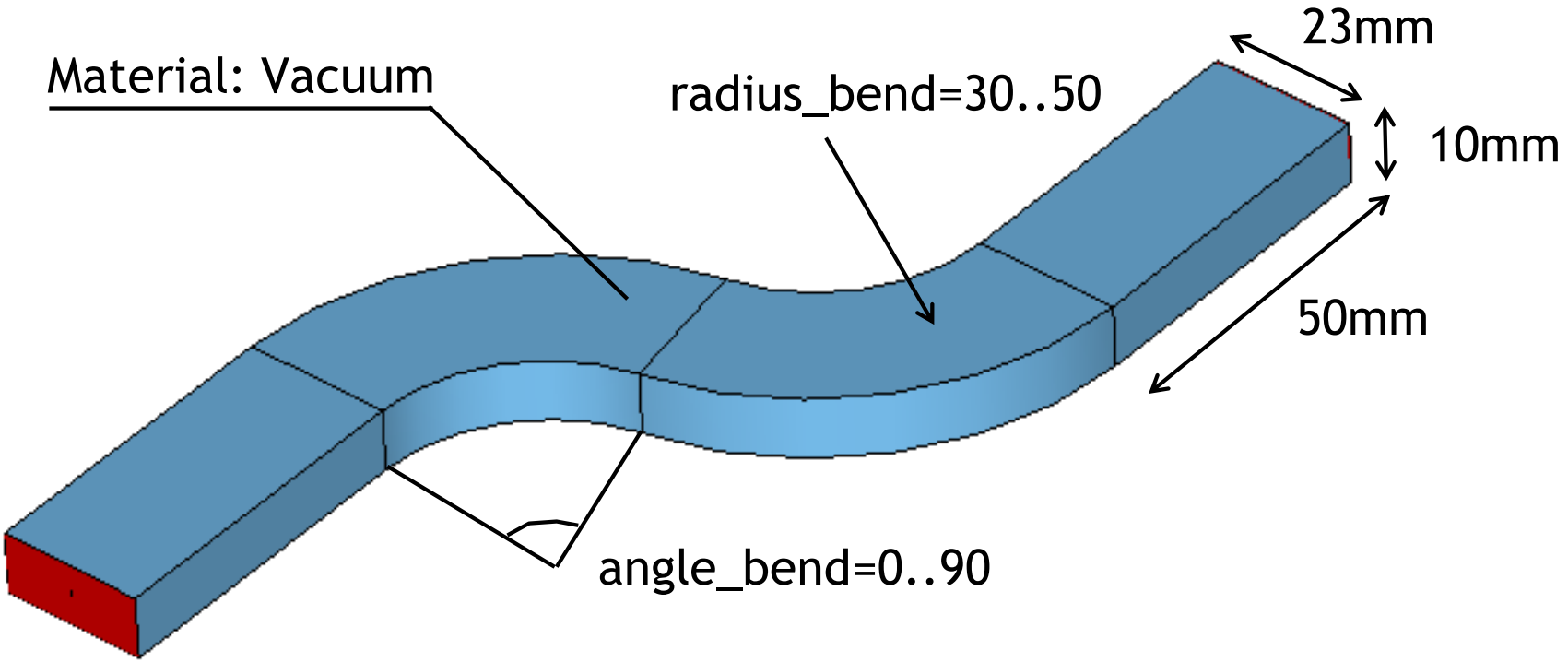
Workflow Example

S-Bended Rectangular Waveguide

Purpose: Create a parameterized model



Model


Material: Vacuum
radius_bend=30..50
23mm
10mm
50mm
angle_bend=0..90

CST MWS - Standard Workflow

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  - parameters + geometry + materials
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- Specify boundary and symmetry conditions.
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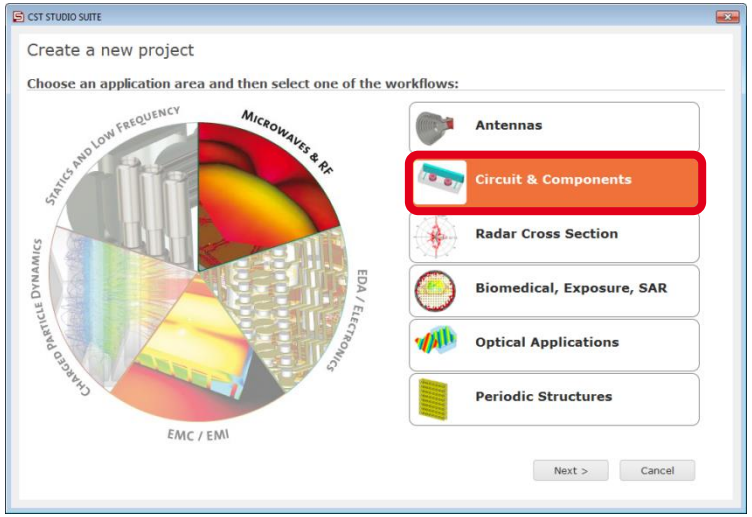
- Check the mesh.
- Run the simulation.

New Project Wizard

Create Project



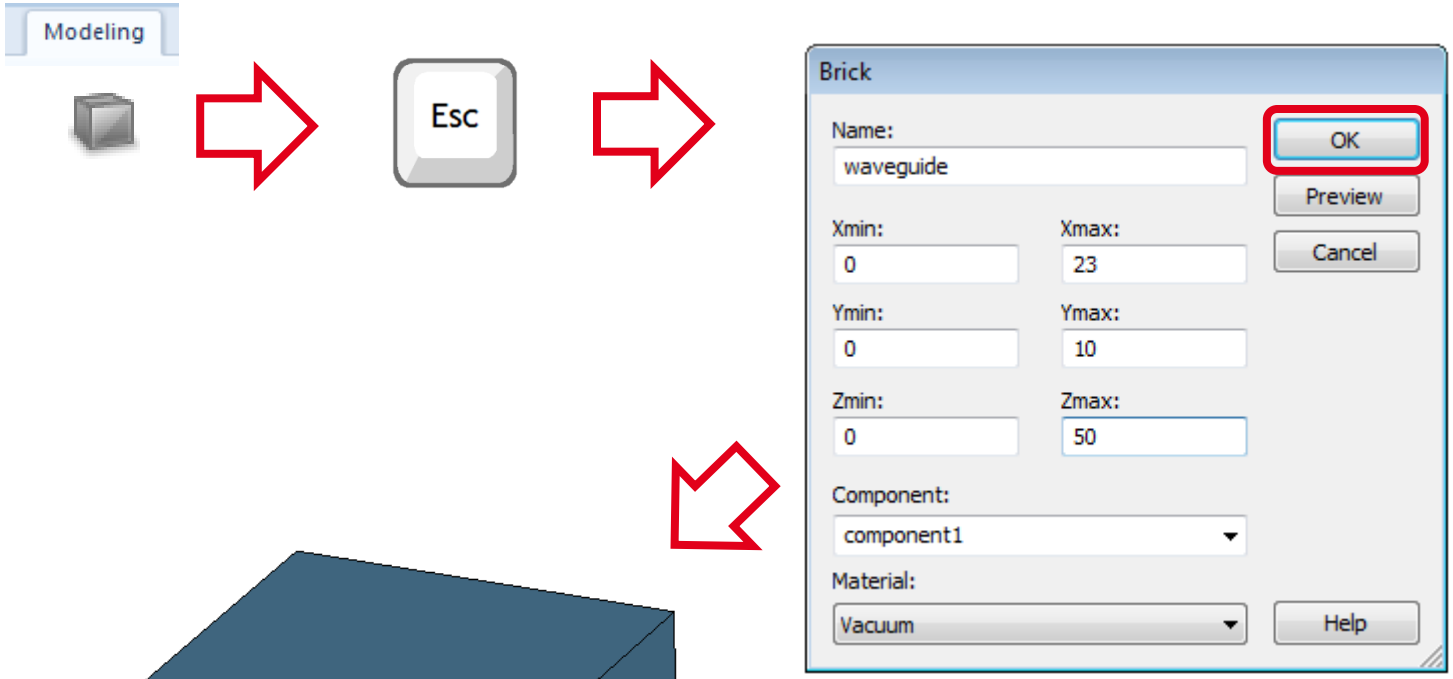
Waveguide Couplers & Dividers

Time Domain

Leave the default settings for units, background materials, etc.

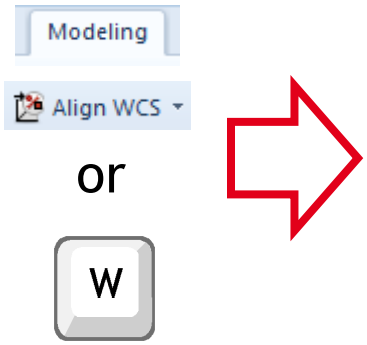
The new project wizard customizes the default settings for particular types of applications.

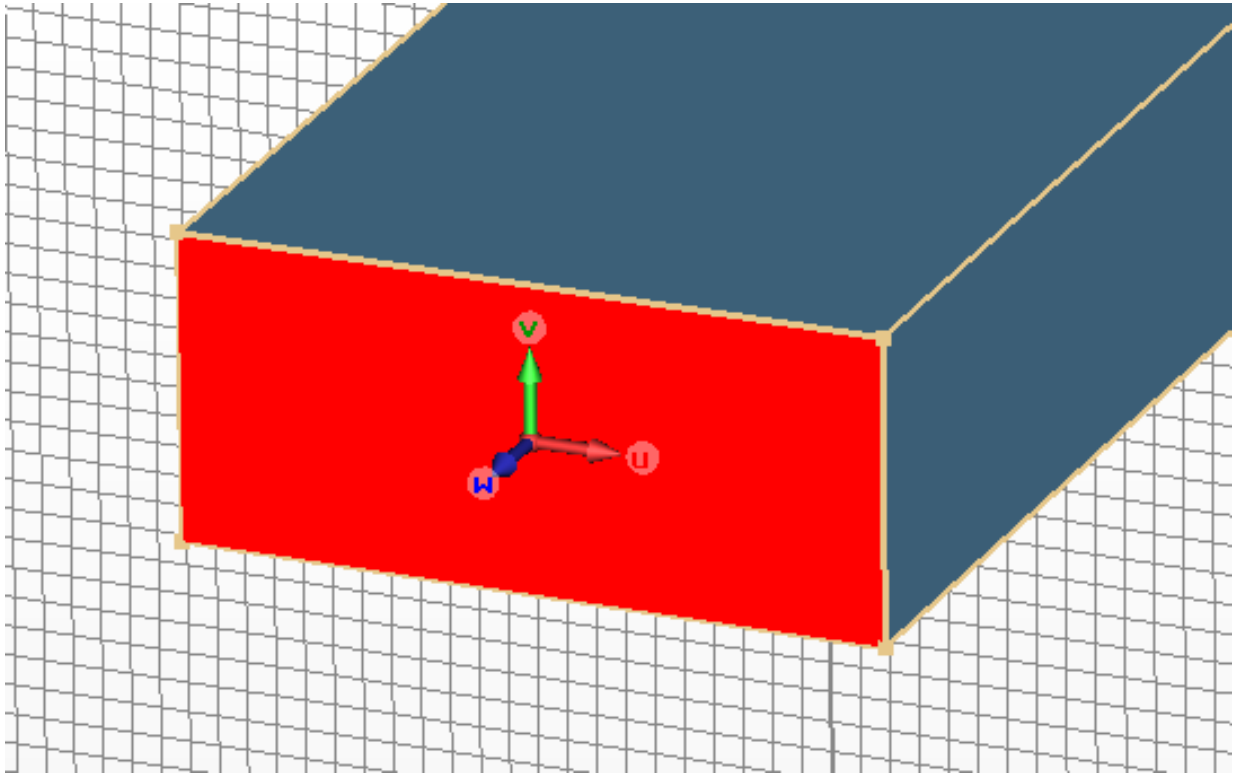
Create Geometry (I)



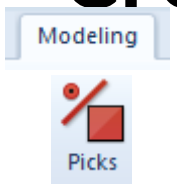
Create Geometry (II)

- Align working coordinate system with the small face of the brick.

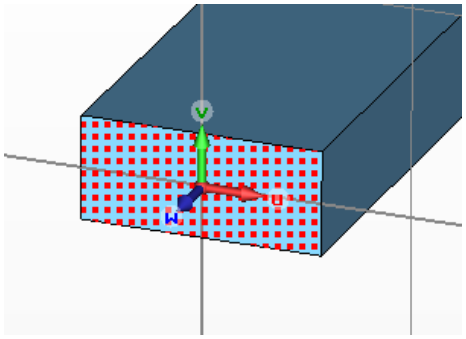




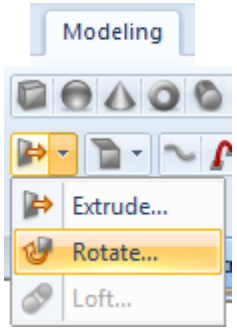
Create Geometry (III)

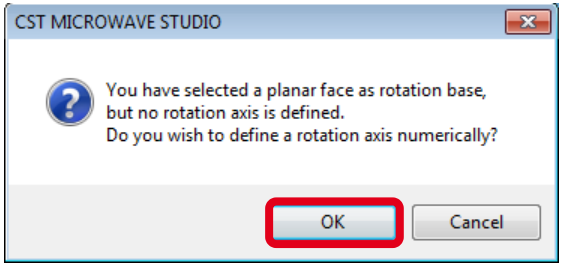


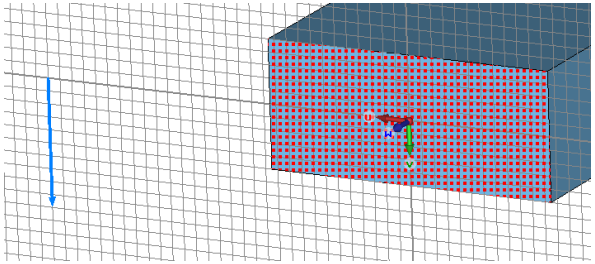
or



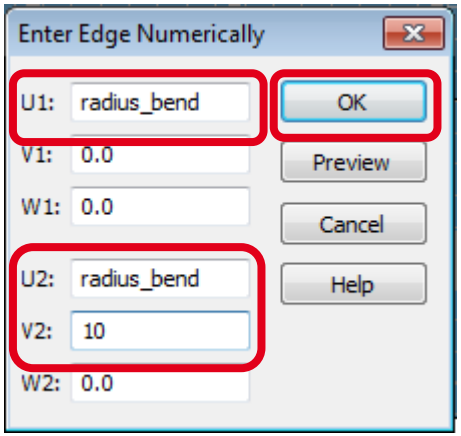
Pick Face





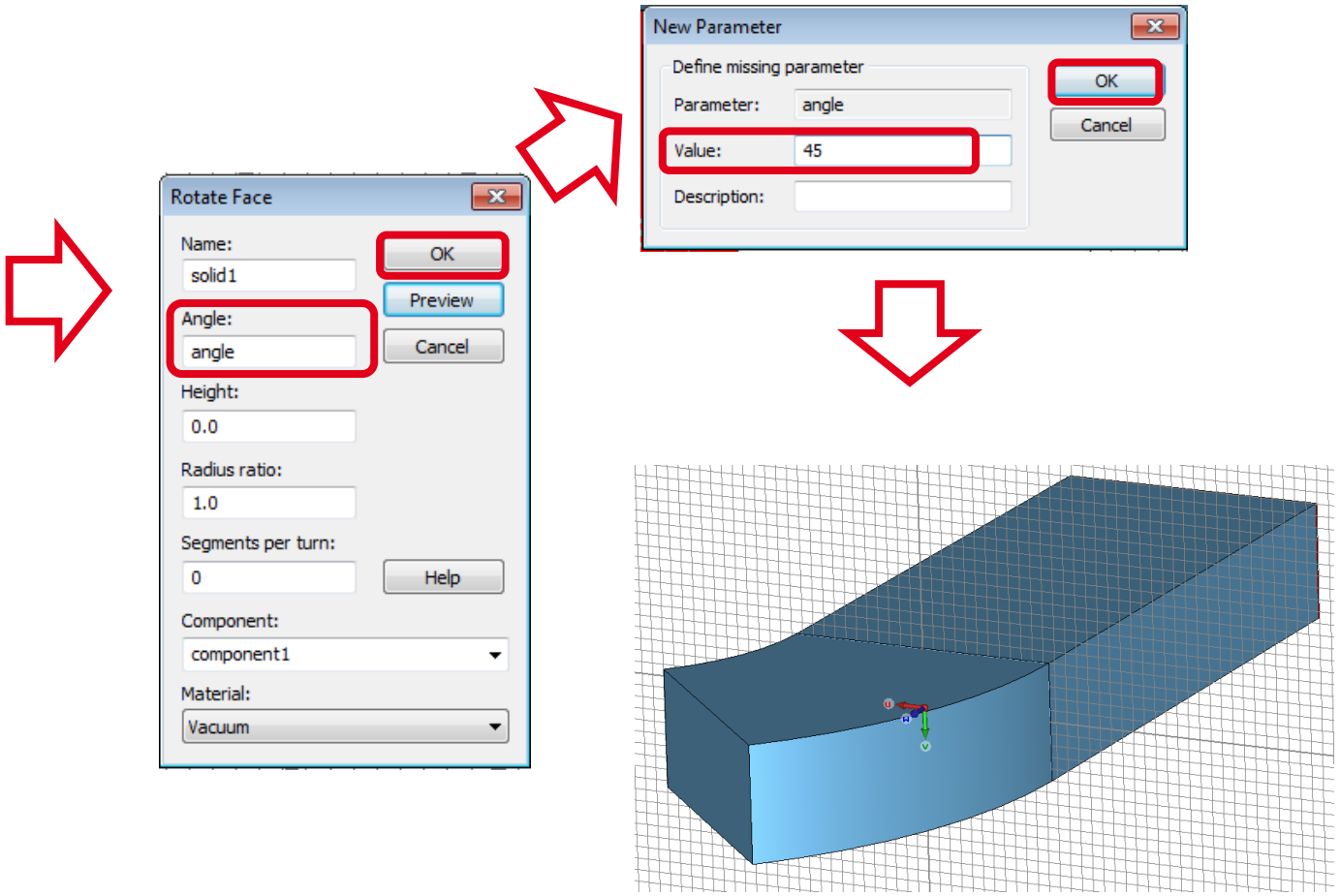


Set radius_bend to 30.

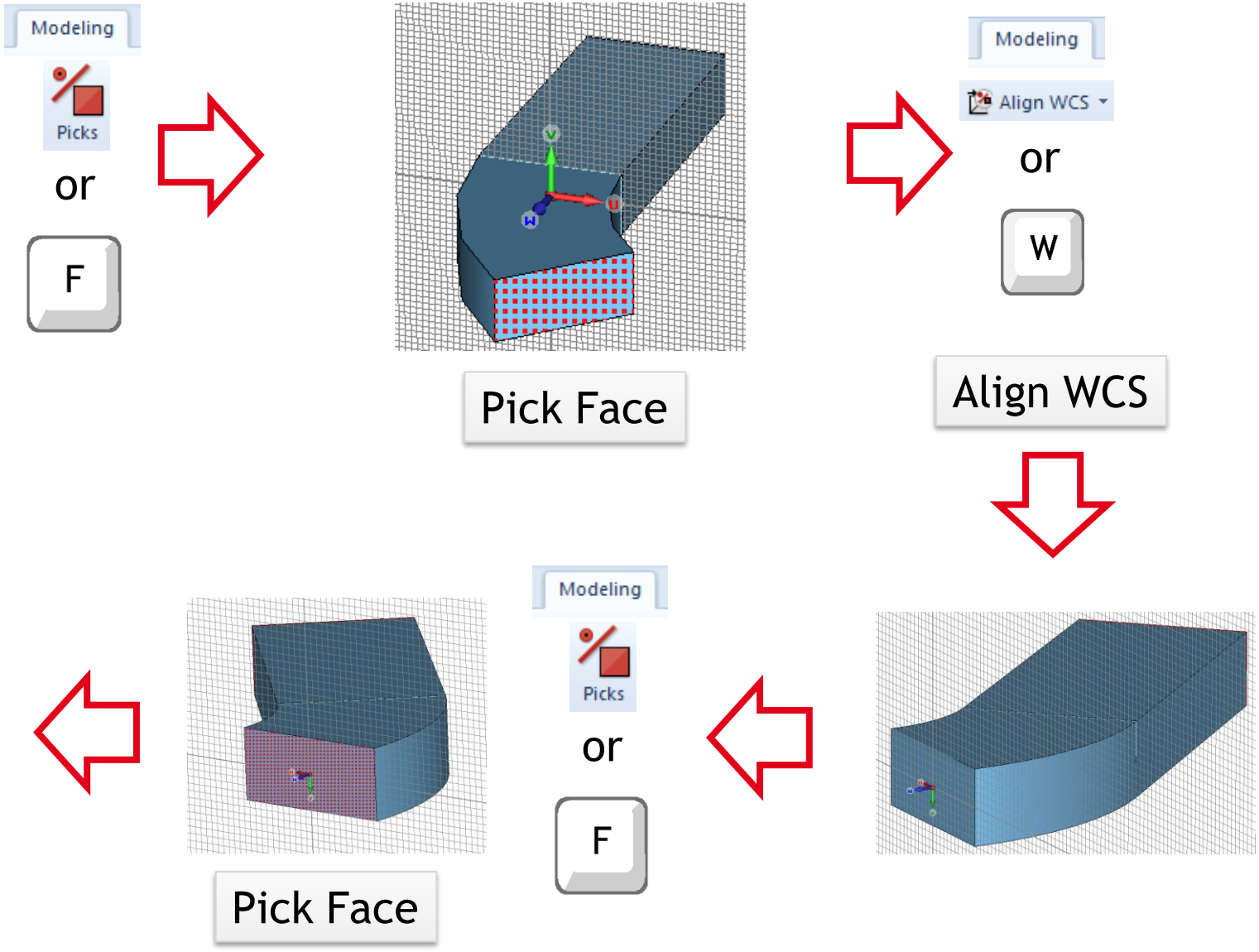


Create Geometry (IV)

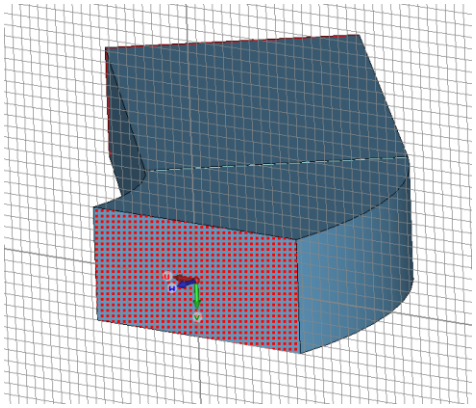
...

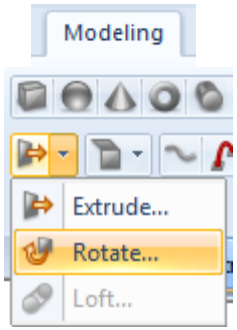


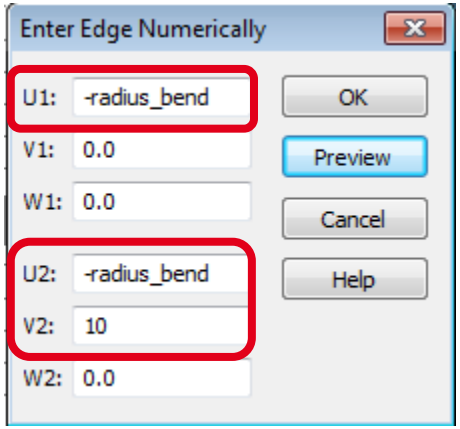
Create Geometry (V)

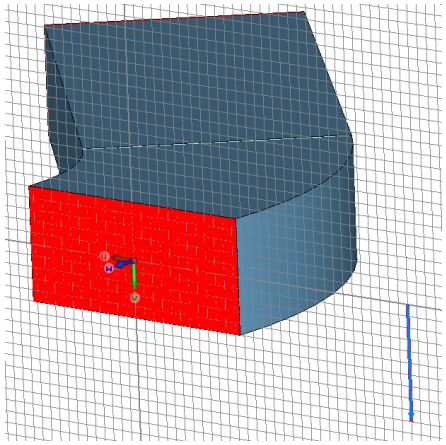


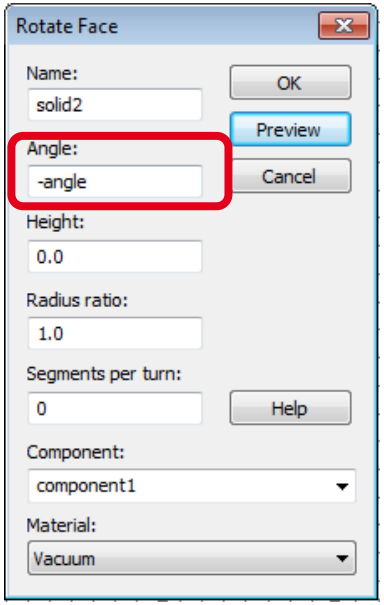
Create Geometry (VI)







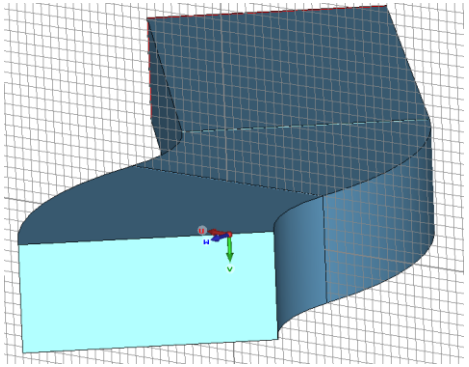


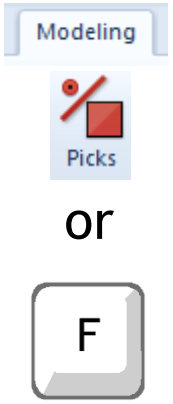


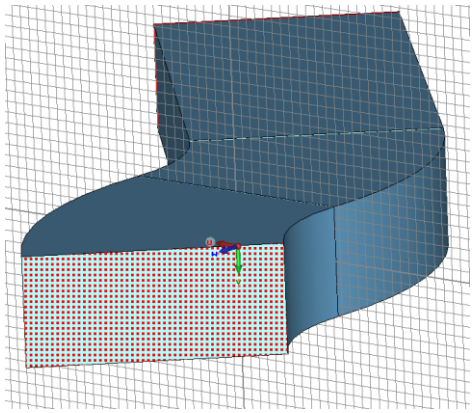
...

Create Geometry (VII)

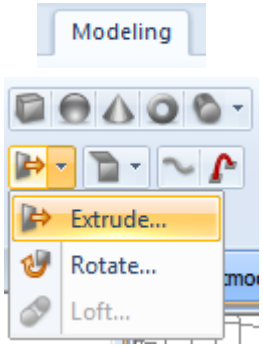
...

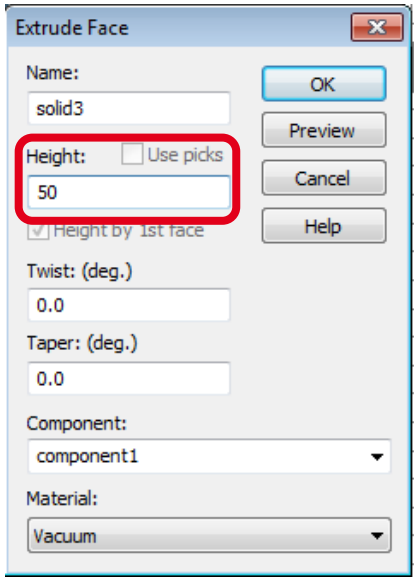


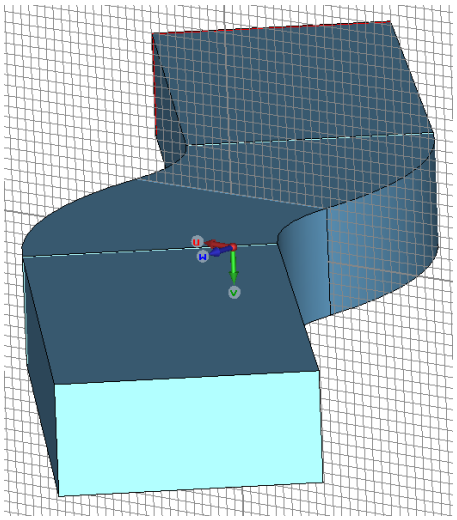




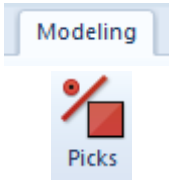
Pick Face



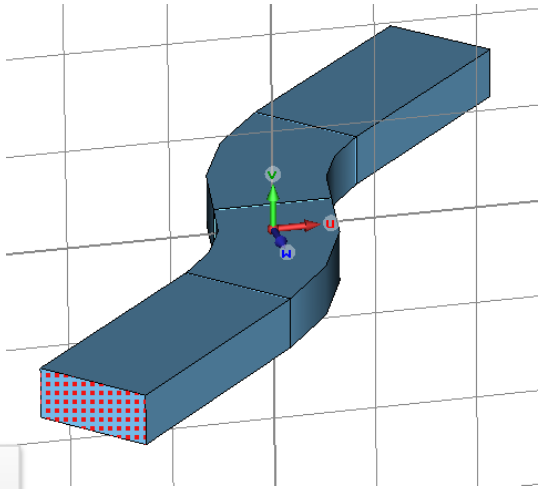




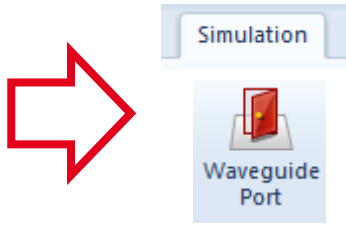
Define Ports

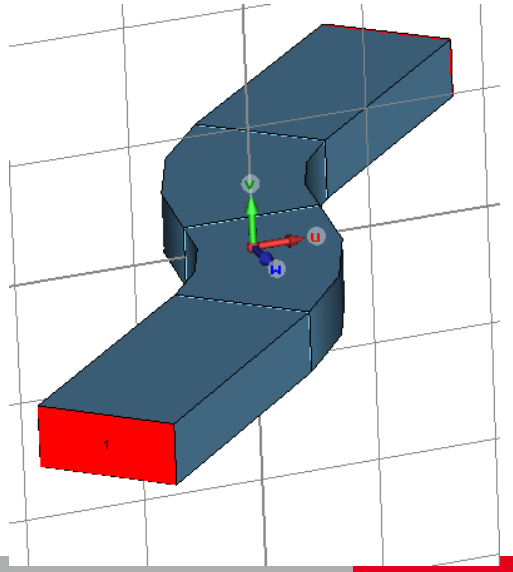


or



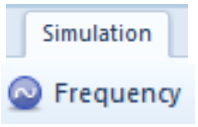
Pick Face

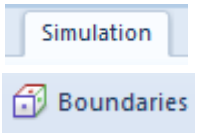


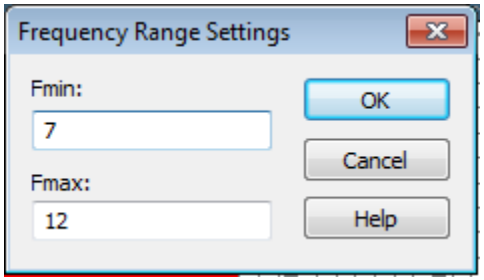


Same procedure for port at the other end.

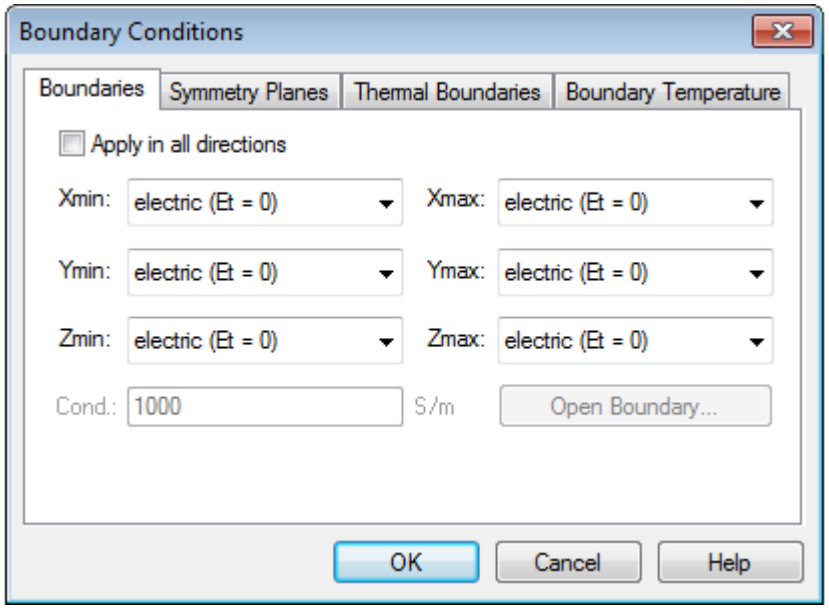
Frequency Range / Boundaries





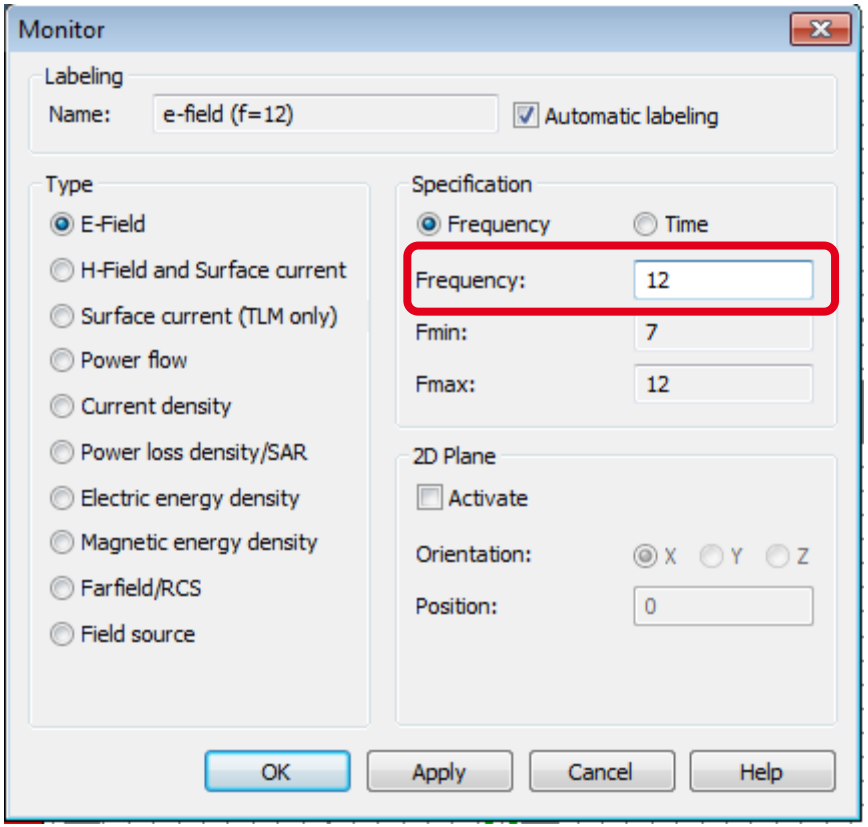


Fmin should be above the cutoff frequency of the mode of interest.



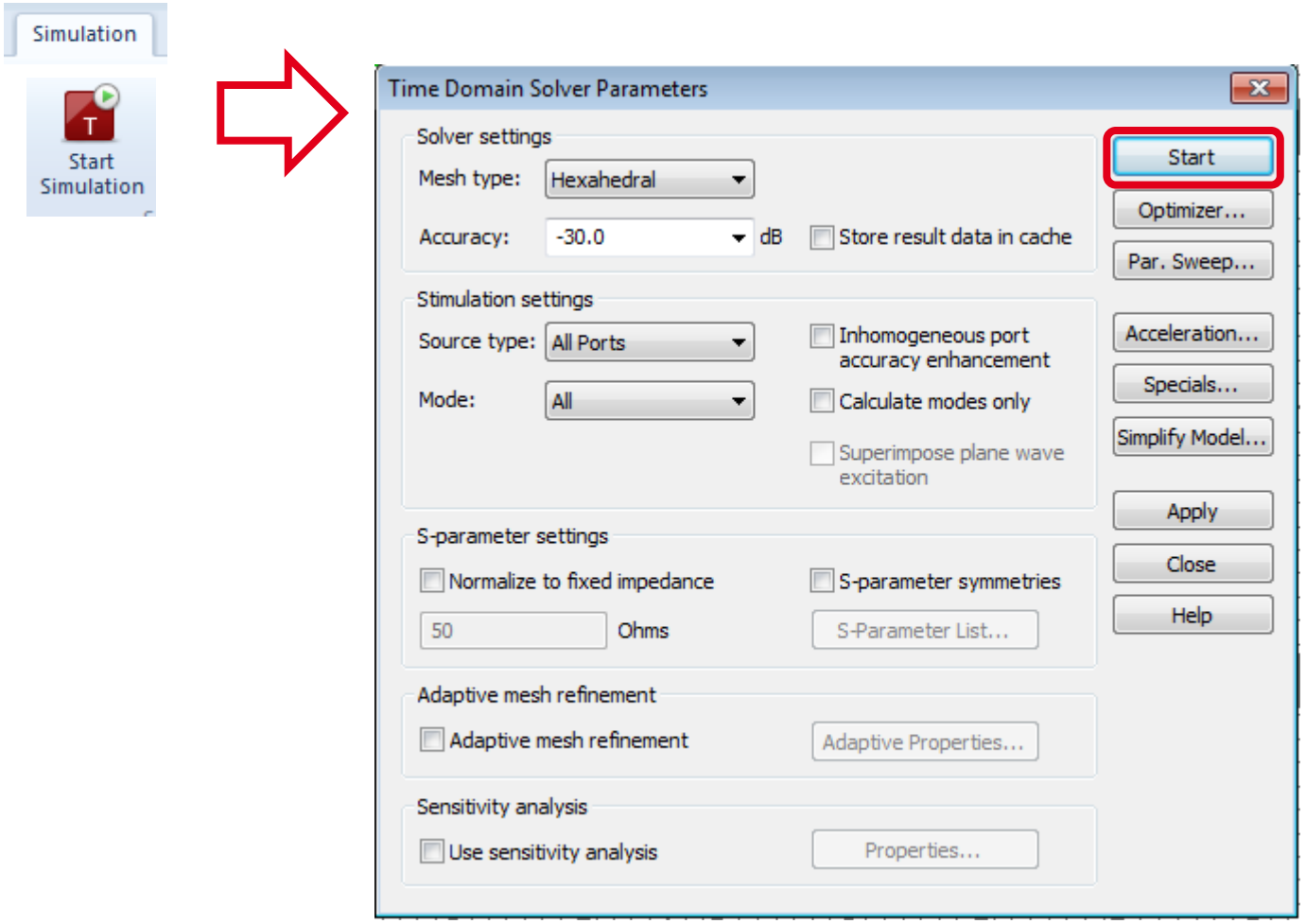
This has been correctly set by the project template.

Define Monitor



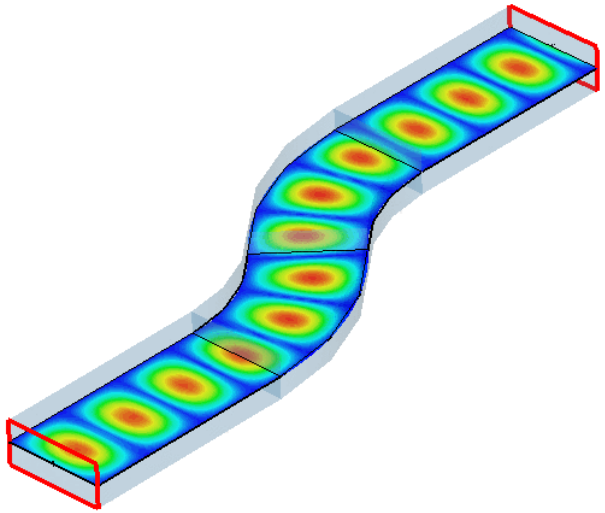
Define E-field monitor at 12 GHz.

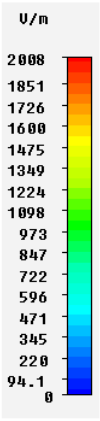
Start Simulation



E-Field at 12 GHz

Clamp to range: (Min: 0/ Max: 2008)

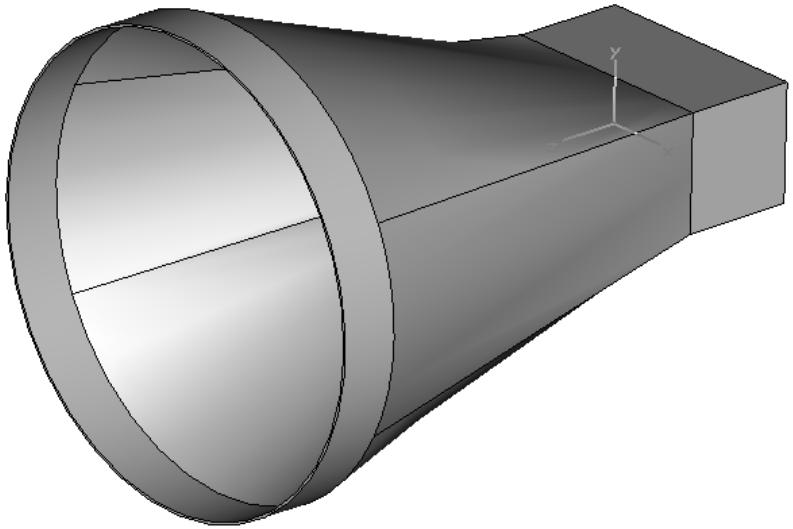




Type	E-Field (peak)
Monitor	e-field (f=12) [1]
Component	Abs
Plane at y	5
Maximum-2d	2022.16 V/m at 16.8135 / 5 / 75.9862
Frequency	12
Phase	0 degrees

Workflow Example
Horn Antenna

Create a horn antenna model and analyze its far field properties.

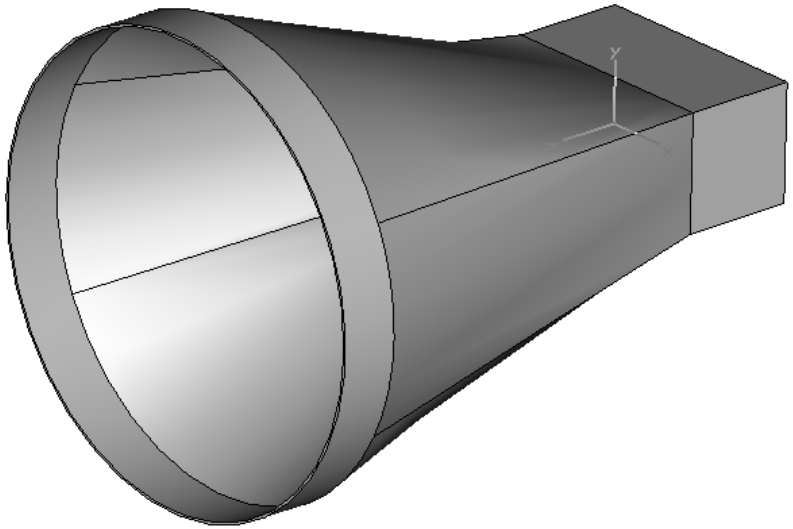


CST MWS - Standard Workflow

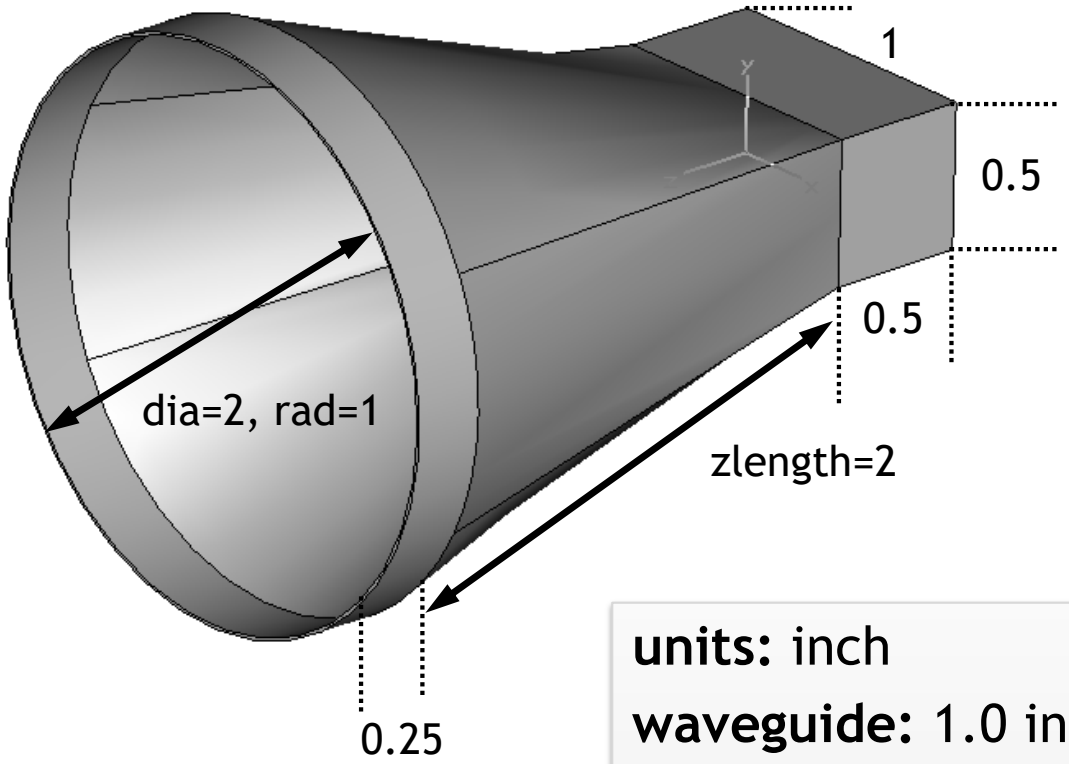
- Choose a project template.
- Set the frequency range.
- Create your model.
  - parameters + geometry + materials
- Define ports.
- Specify boundary and symmetry conditions.
- Define monitors.
- Check the mesh.
- Run the simulation.

Workflow Example
Horn Antenna

Create a horn antenna model and analyze its far field properties.



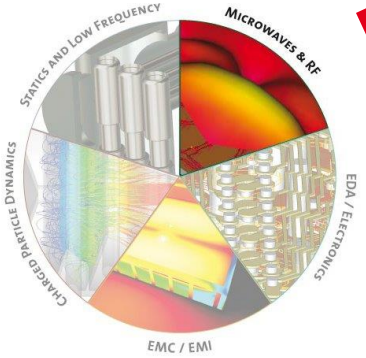
Cylindrical Horn Antenna 8 - 12 GHz

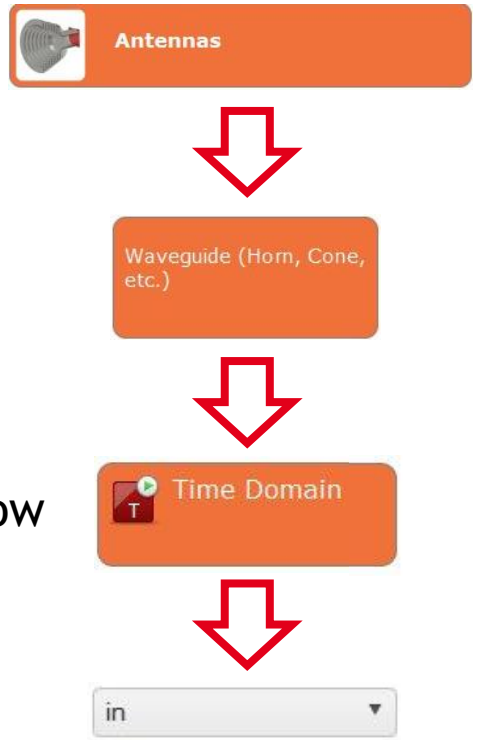


units: inch
waveguide: 1.0 in x 0.5 in x 0.5 in
aperture radius: 1.0 in, **length:** 0.25 in
shell thickness: 0.01 in (outside)
monitors: E-field, H-field & far field at 10 GHz

New Project Template

- At the beginning, choose "Create Project" to create a new project.
- This starts the configuration wizard in order to help you to choose the appropriate module, main project settings and result recorders for the particular application.

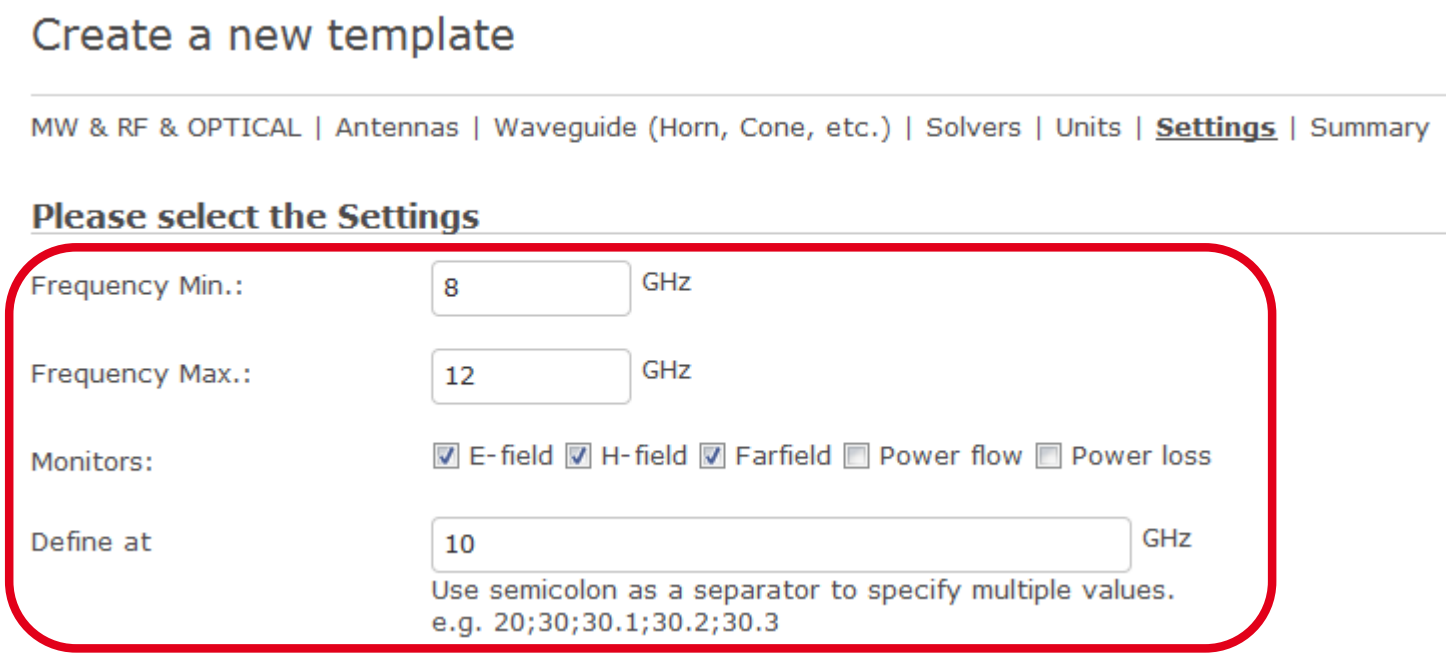




- We choose
  - Microwave & RF
  - Antennas
  - Waveguide (Horn, Cone, etc.)
  - The recommended solvers for the selected workflow are T, I and F. We choose the Time Domain solver.
  - Change the dimensions to inch.

New Project Template

Apply Frequency settings and set 3D field monitors.



New Project Template - Summary

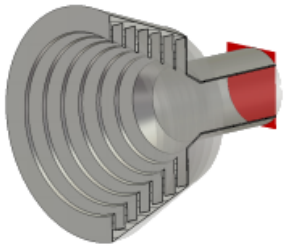
Finally, verify your settings for the template and save it.

Create a new template

MW & RF & OPTICAL | Antennas | Waveguide (Horn, Cone, etc.) | Solvers | Units | Settings | **Summary**

Please review your choice and click 'Finish' to create the template:

Template Name: Antenna - Waveguide

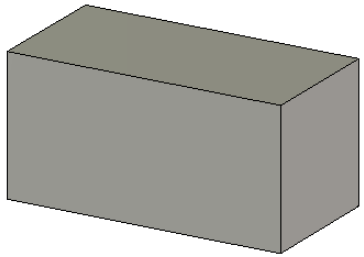


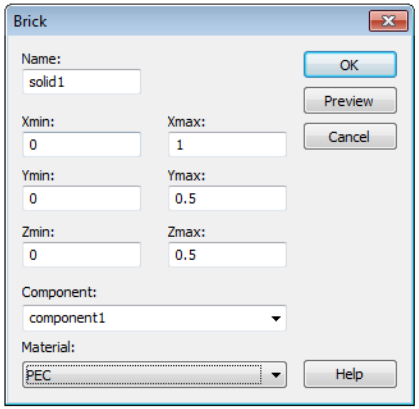
Solver	Units	Settings
Time Domain	- Dimensions: in - Frequency: GHz - Time: ns - Temperature: Kelvin	- Frequency Min.: 8 GHz - Frequency Max.: 12 GHz - Monitors: E-field, H-field, Farfield - Define At: 10

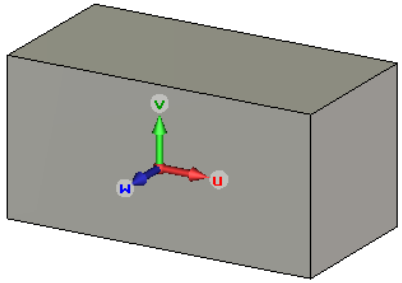
Antennas which consist of waveguide elements or which transform energy from guided form (waveguide, coaxial line) to radiating by a gradual transition, e.g. horn or conical elements.

< Back | Finish | Cancel

Horn Antenna - Constructions (I)



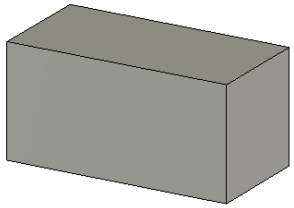


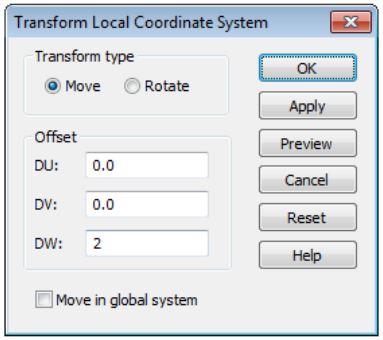


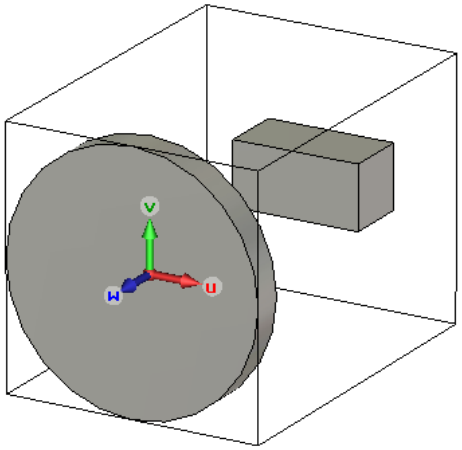
Define a brick (1.0 x 0.5 x 0.5 in) made of PEC.

Pick face.

Align the WCS with the face.





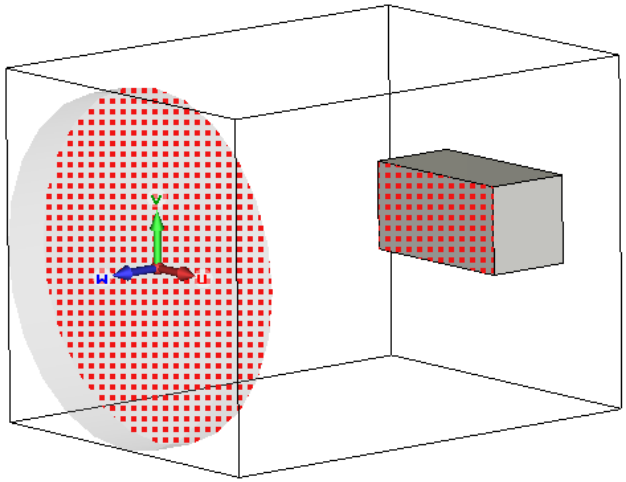


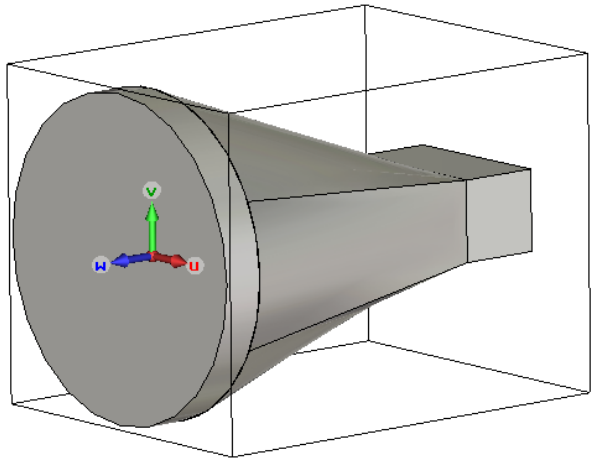
Define a cylinder (outer radius: 1.0 in, height: 0.25 in) made of PEC.

Move the WCS by 2.0 in.

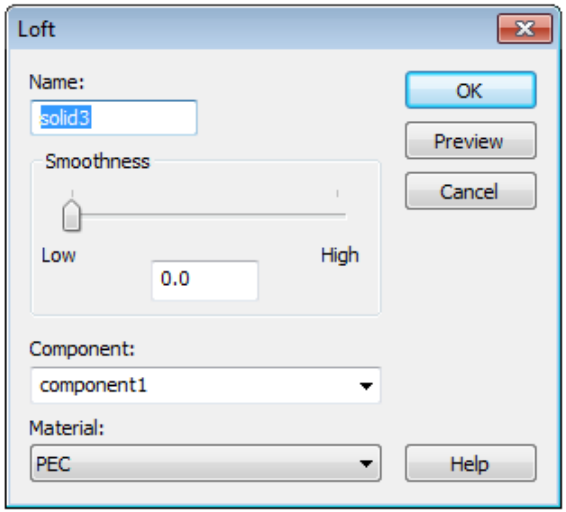
Horn Antenna - Constructions (II)

- Pick two opposite faces.

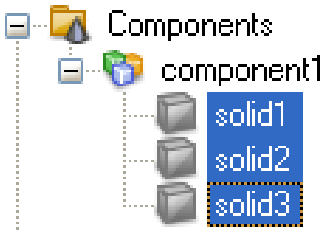




- Perform a loft.

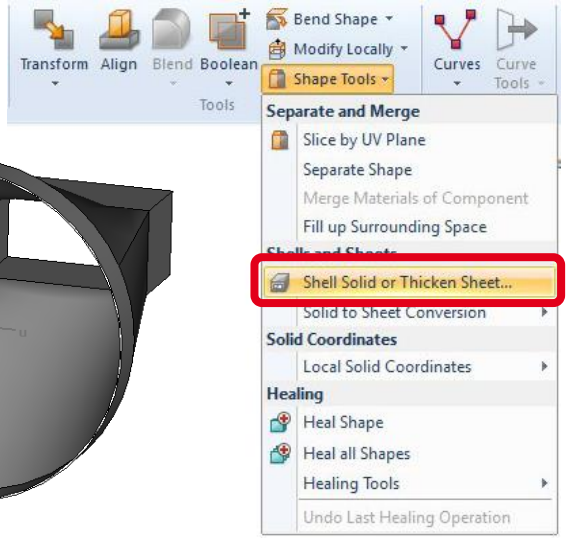


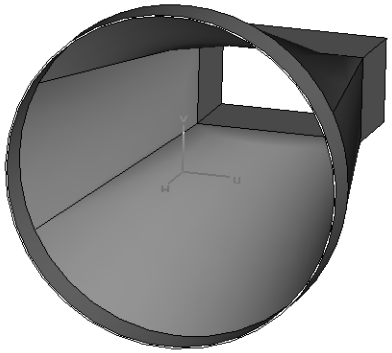
Horn Antenna - Construction (III)



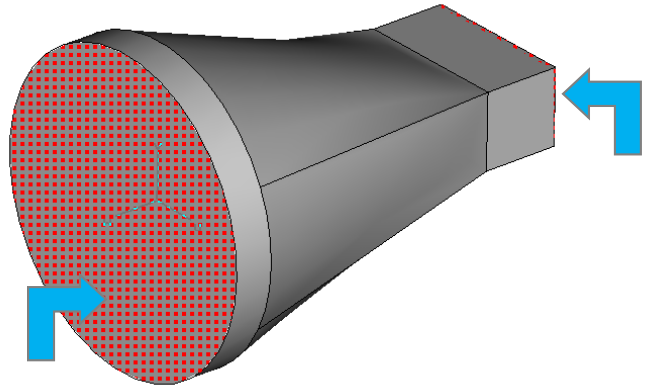
Perform a Boolean add.

Select multiple objects (ctrl or shift + left mouse button).





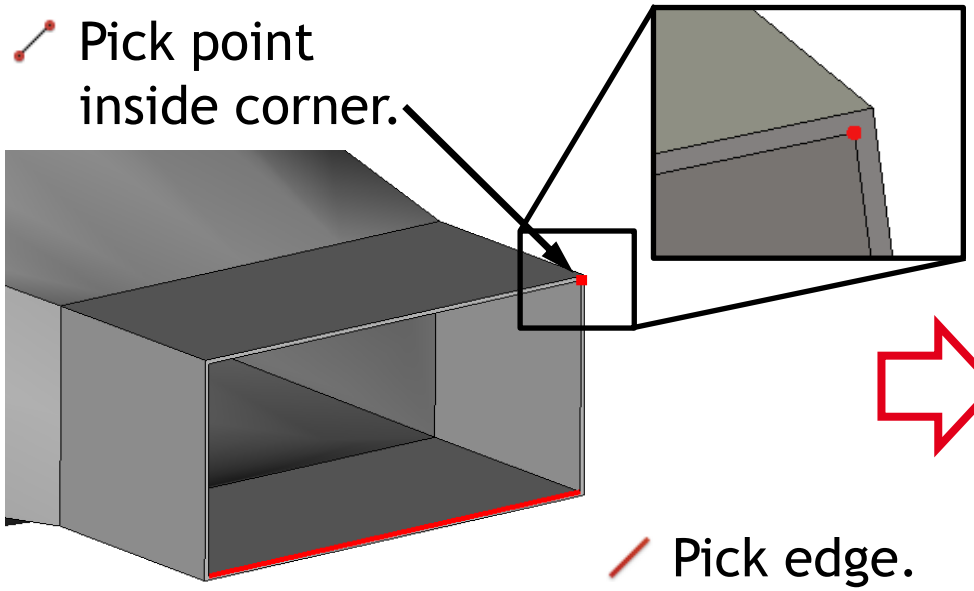
Shell solid: 0.01 in (outside).



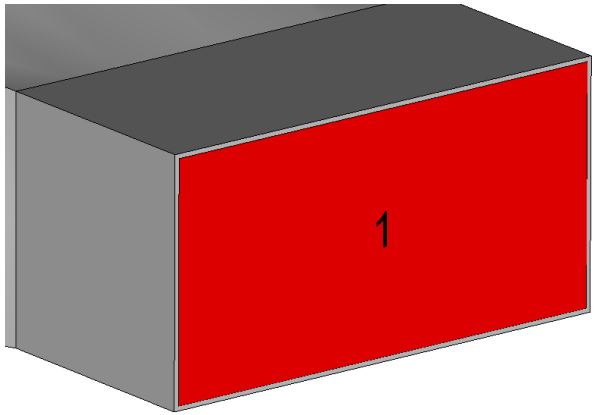
Pick two faces.

Port Definition

Pick point inside corner.

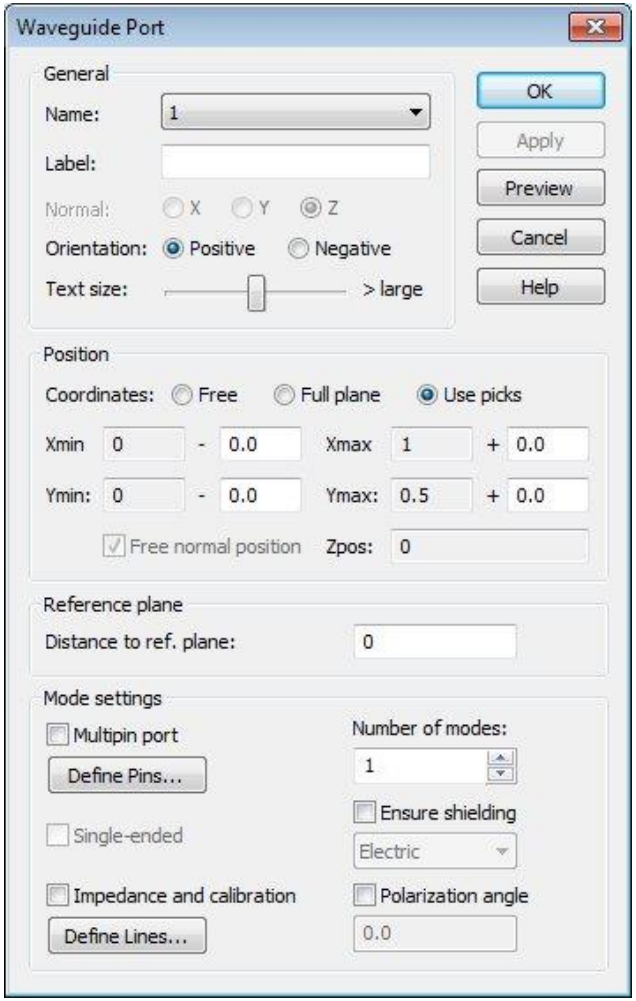


Pick edge.

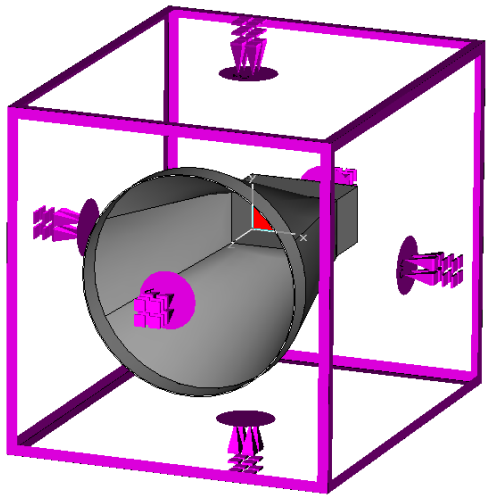


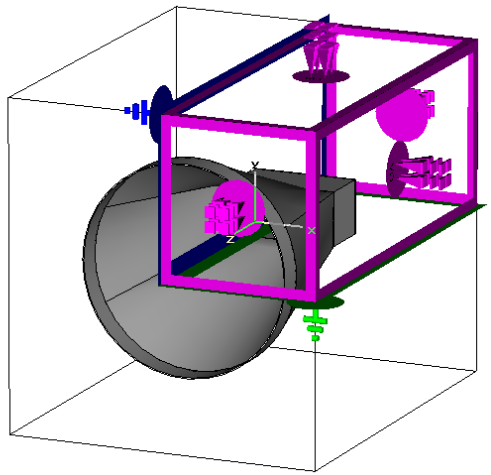
Define the port on the internal profile.

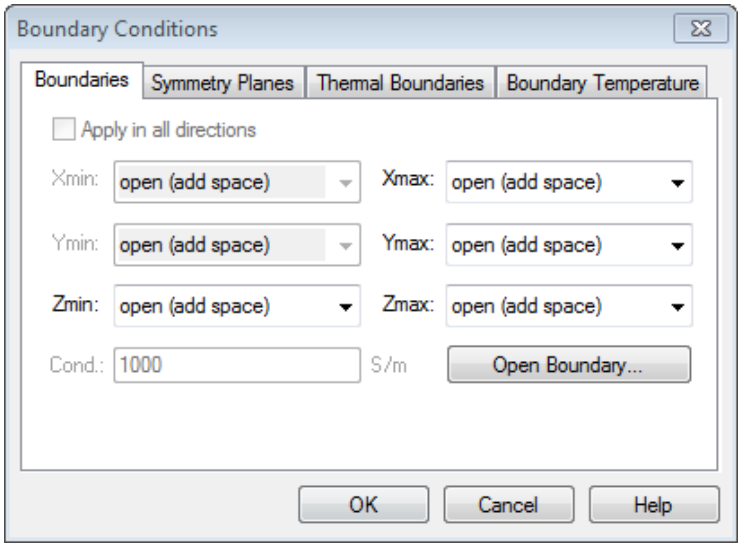
Define a waveguide port.

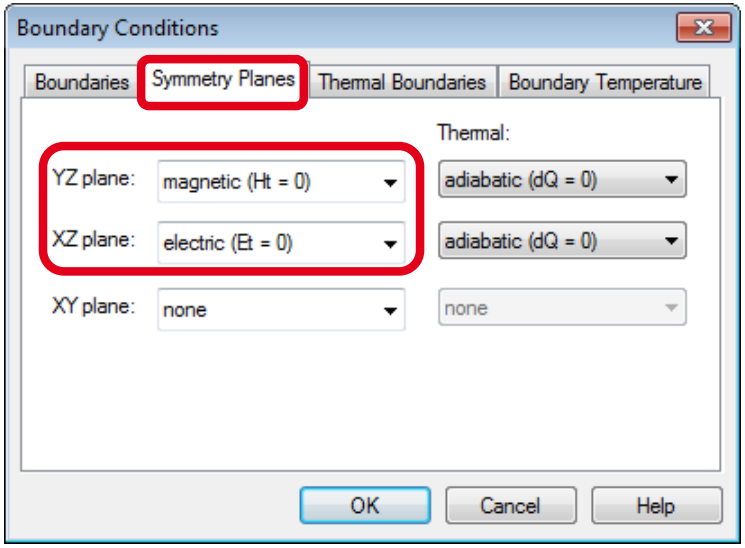


Boundary Conditions and Symmetry Planes

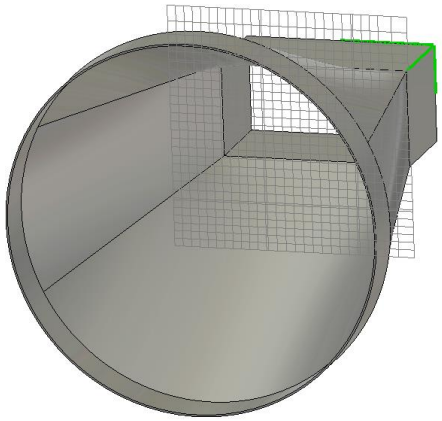


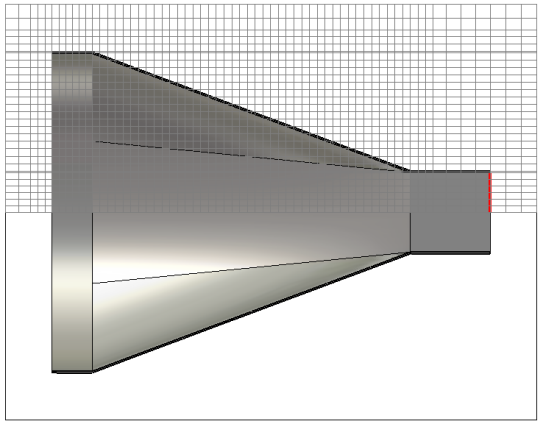


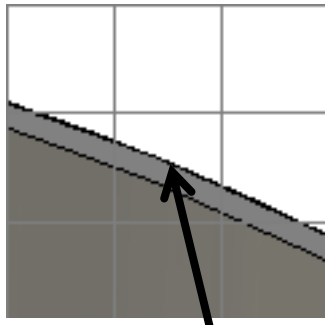




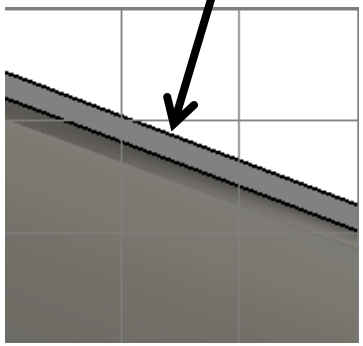
Mesh View



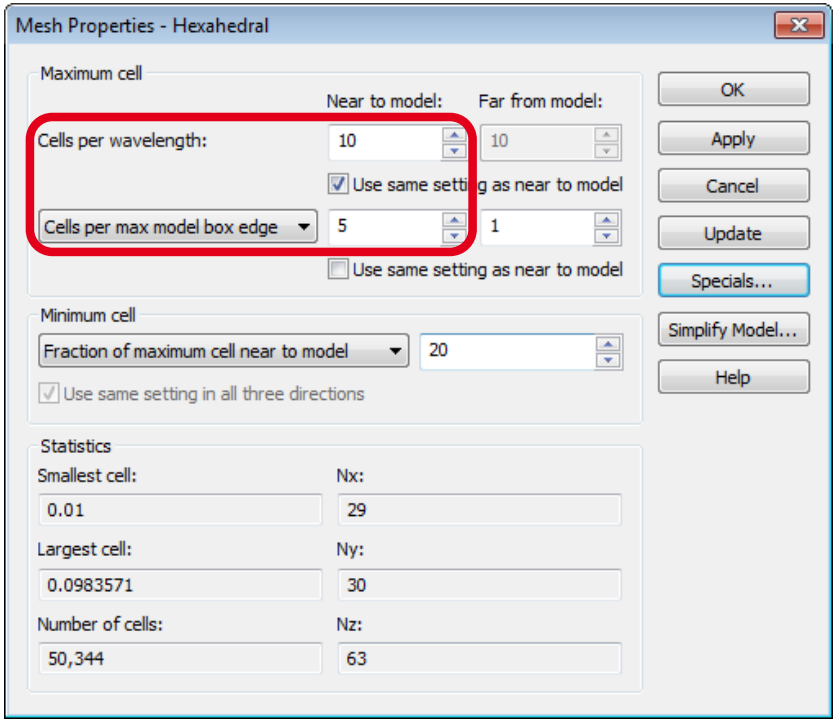




TST at work!



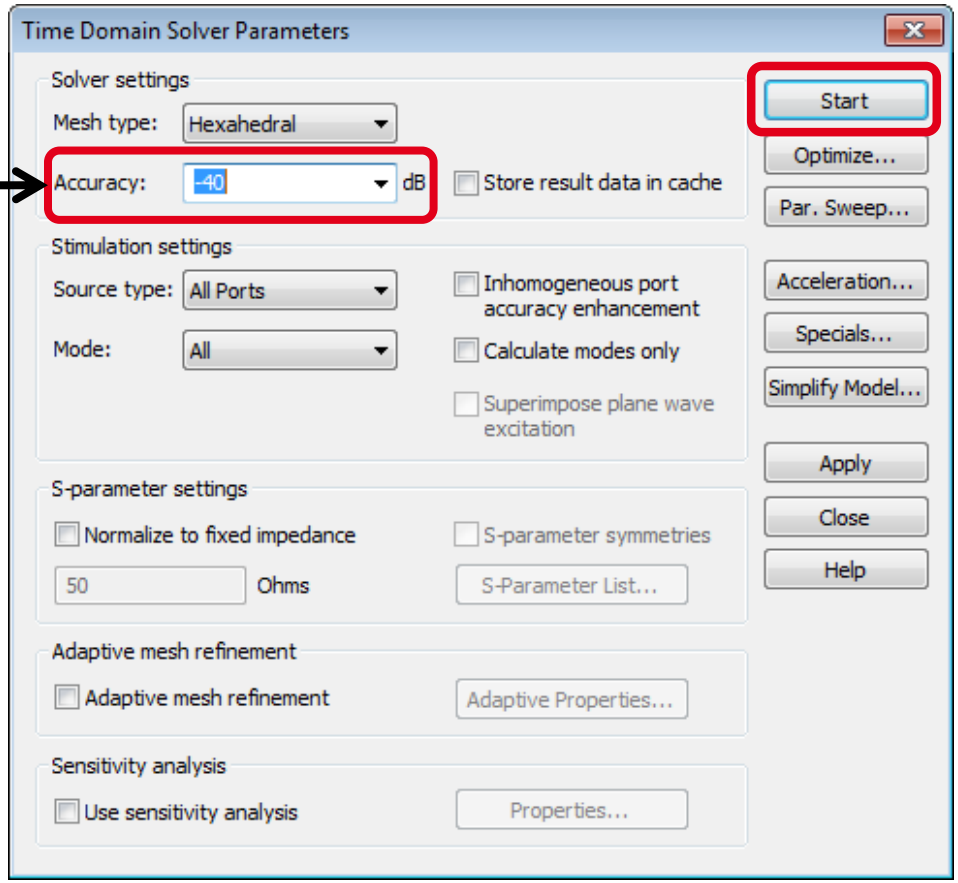
Mesh properties



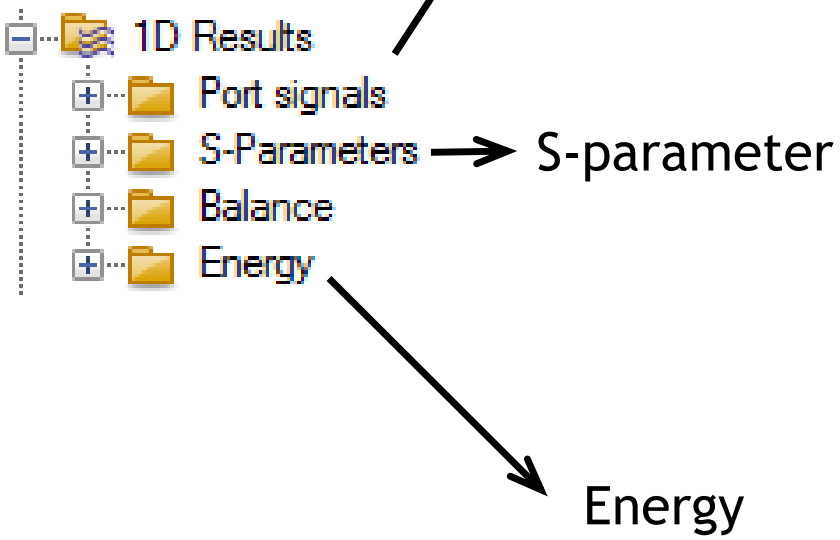
Transient Solver: Start Simulation

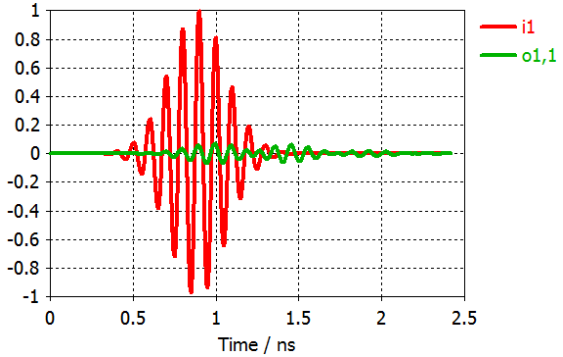
Save the file as ‘Horn.cst’.

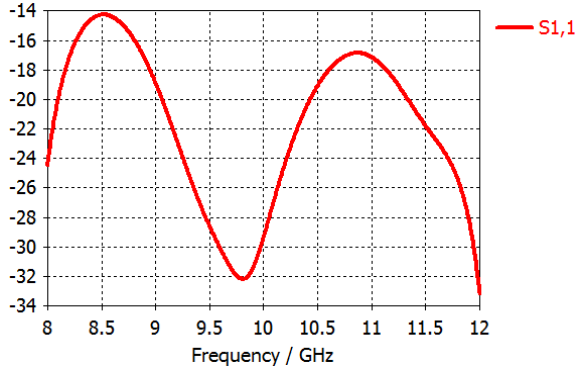
The accuracy defines the steady-state monitor.
The simulation is finished when the electromagnetic energy in the computational domain falls below this level.

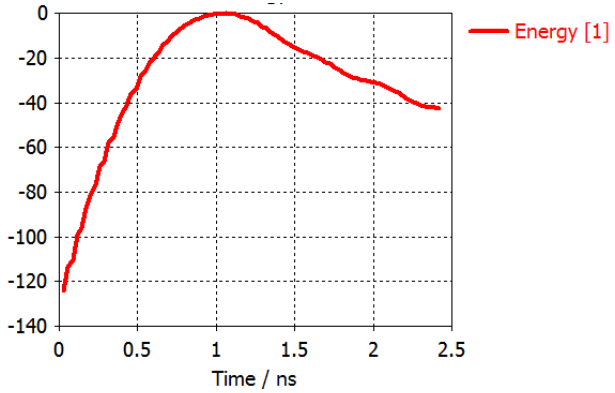


Analyze 1D Results

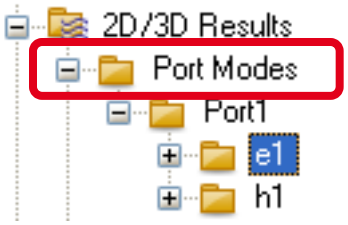


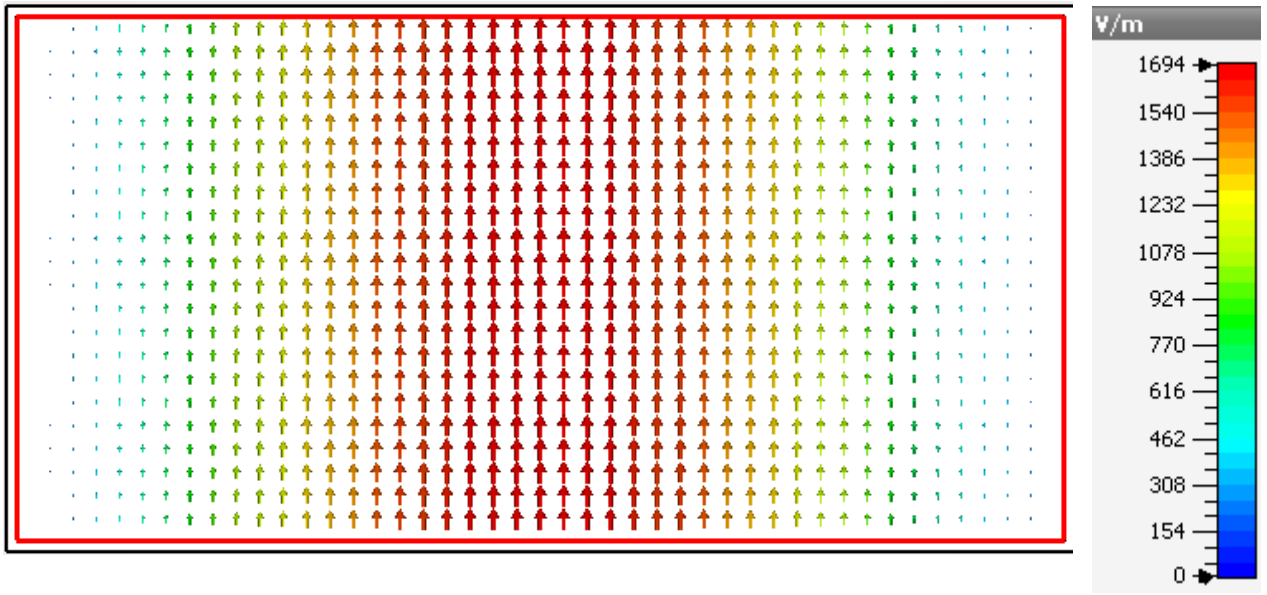






Analyze 2D/3D Results



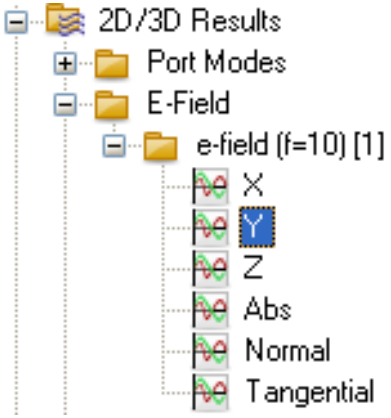


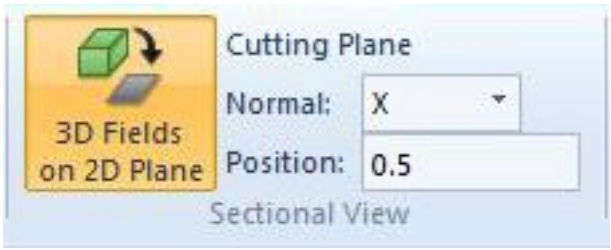
Port1_e1 (peak)	
Frequency:	10
Phase:	0
Wave Imp. [Ohms]:	466.4
Beta [1/m]:	169.3
Fcutoff:	5.896
Accuracy:	4.384e-14
Mode type:	TE
Maximum:	1694
Plane at z	0

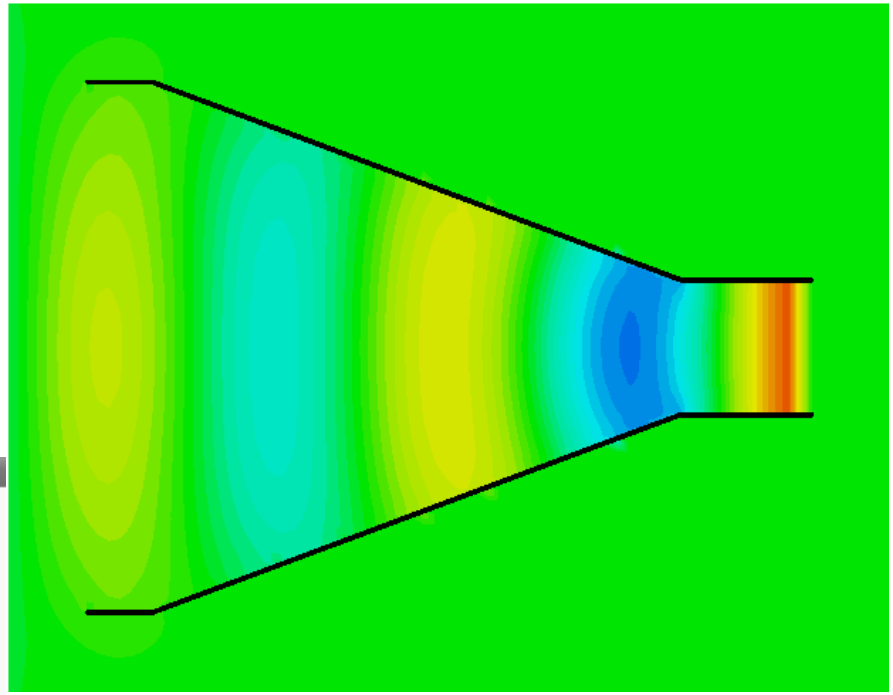
Port information:

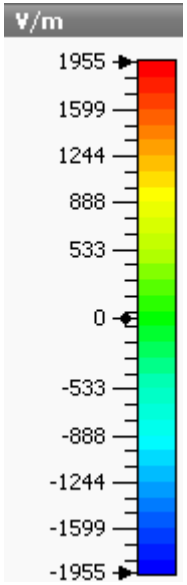
- cut-off frequency
- line impedance
- propagation constant

Electric Field at 10 GHz







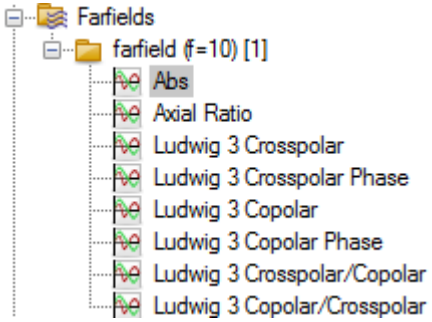


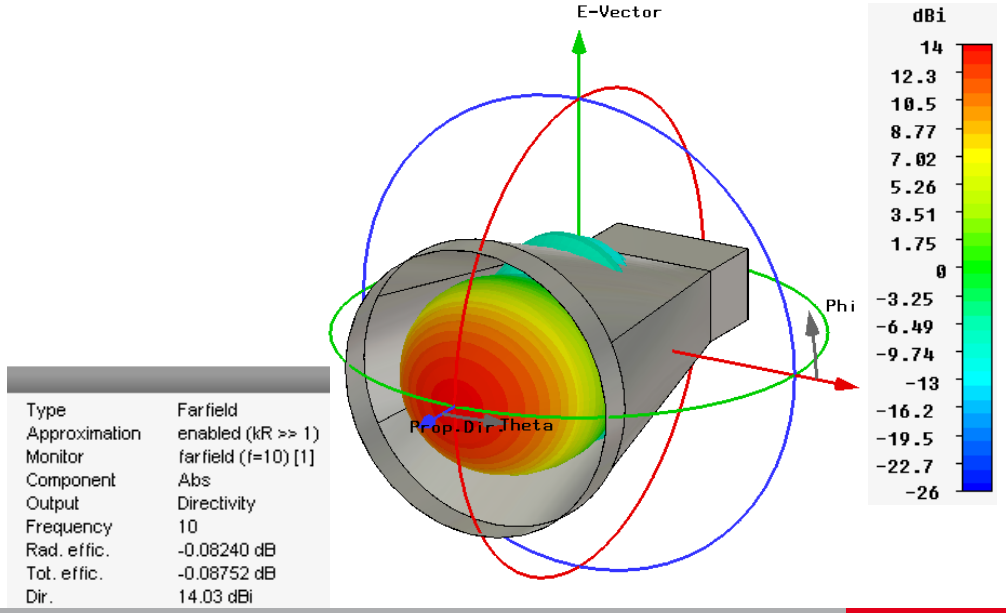
e-field (f=10) [1] (peak)	
Cutplane name:	Cross Section A
Cutplane normal:	1, 0, 0
Cutplane position:	0.5
Component:	Y
2D Maximum [V/m]:	1955
Frequency:	10
Phase:	0

Farfield at 10 GHz

Different Plot type can be chosen from the Farfield Plot ribbon.

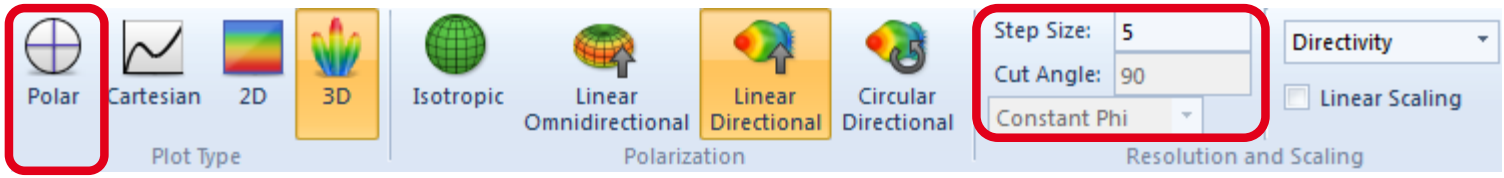
The Linear Directional polarization is plotted in 3D using the Ludwig 3 coordinate system. The orientation of the E field vector and the propagation directions are indicated in the plot.



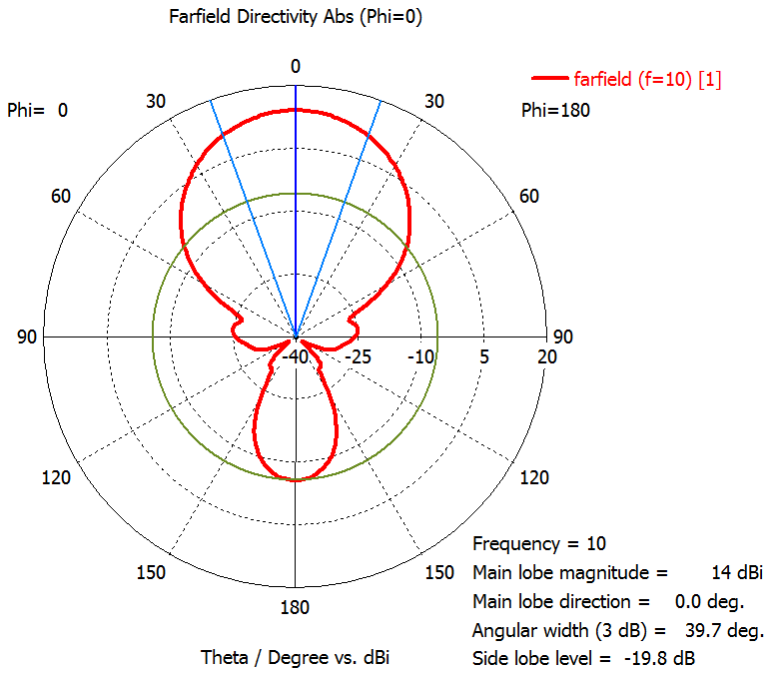


Polar Plot for Farfield at 10 GHz

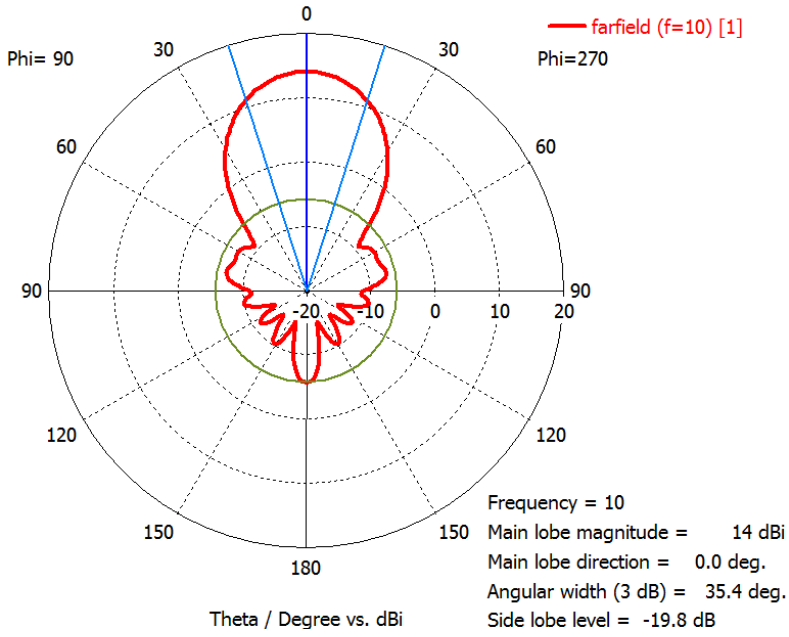
The Polar plot is obtained for E and H plane by selecting different Cut Angles.



Phi=0



Phi=90



Comparing Polar plots

The polar plots can be compared for different cut planes by copying them as 1D results using Farfield Plot properties.