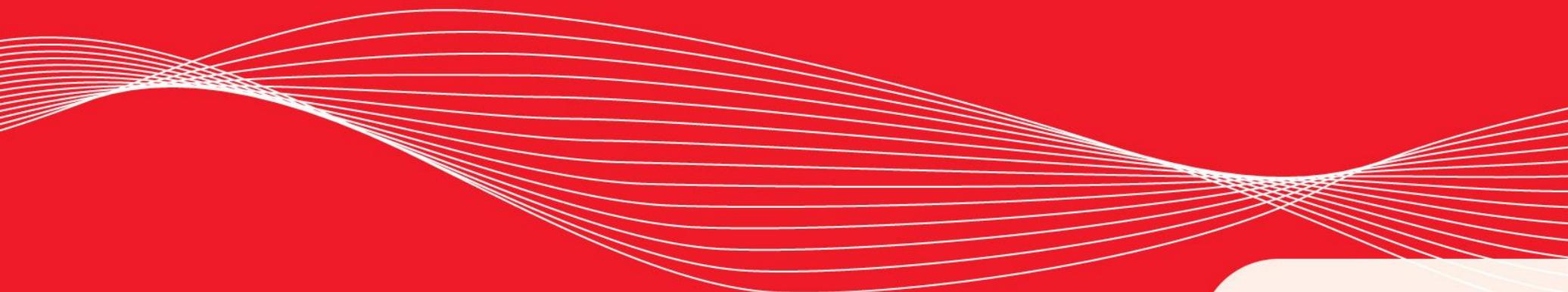


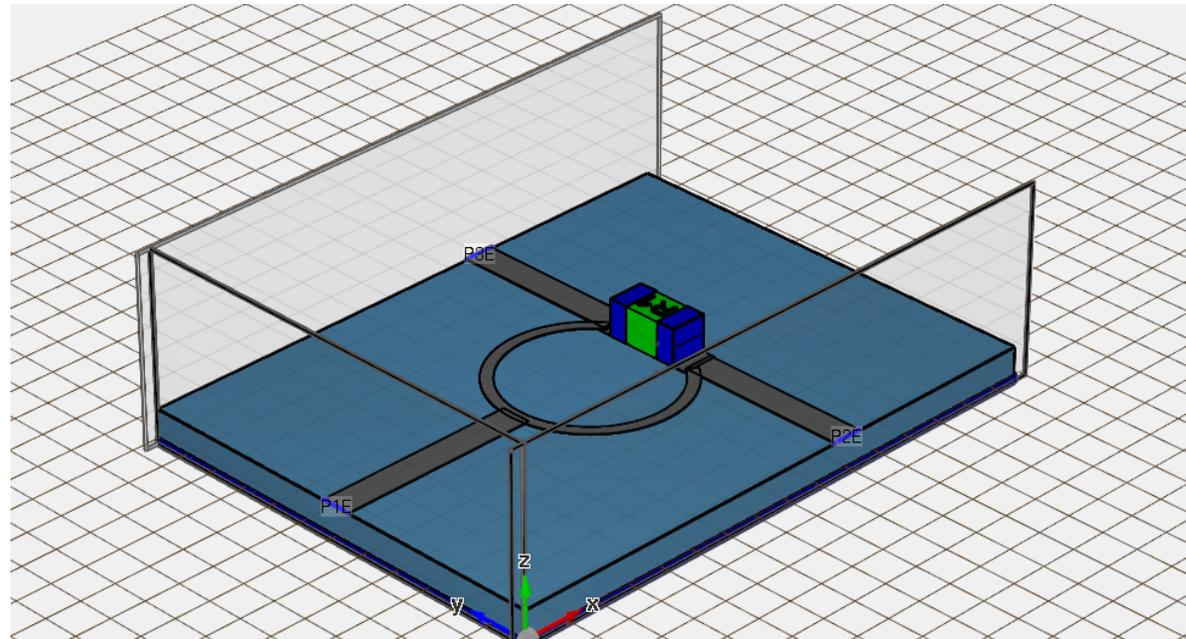
# EMPIRE XPU Tutorial

## 3D Design – Wilkinson Divider



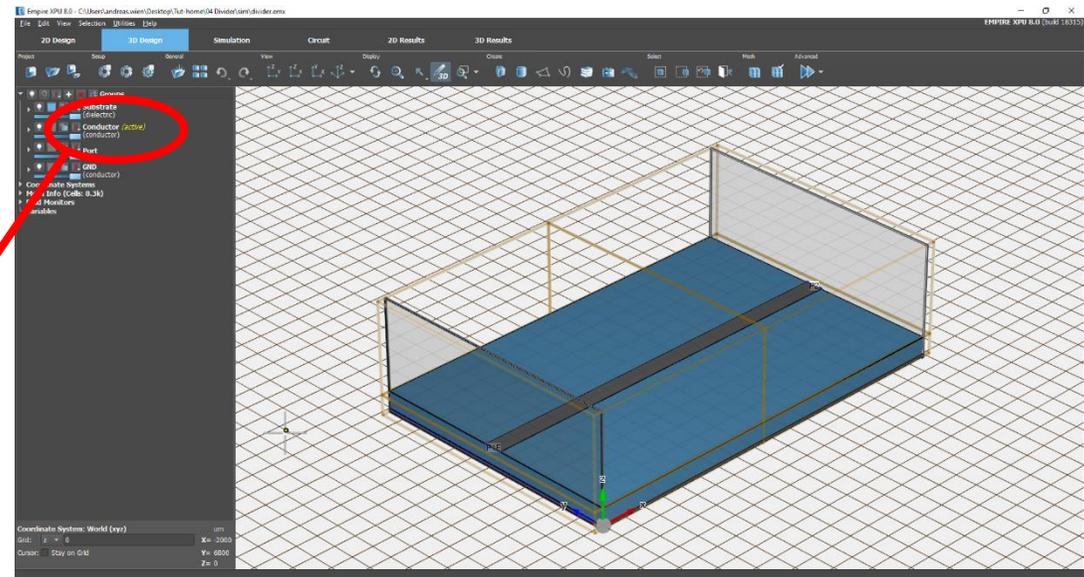
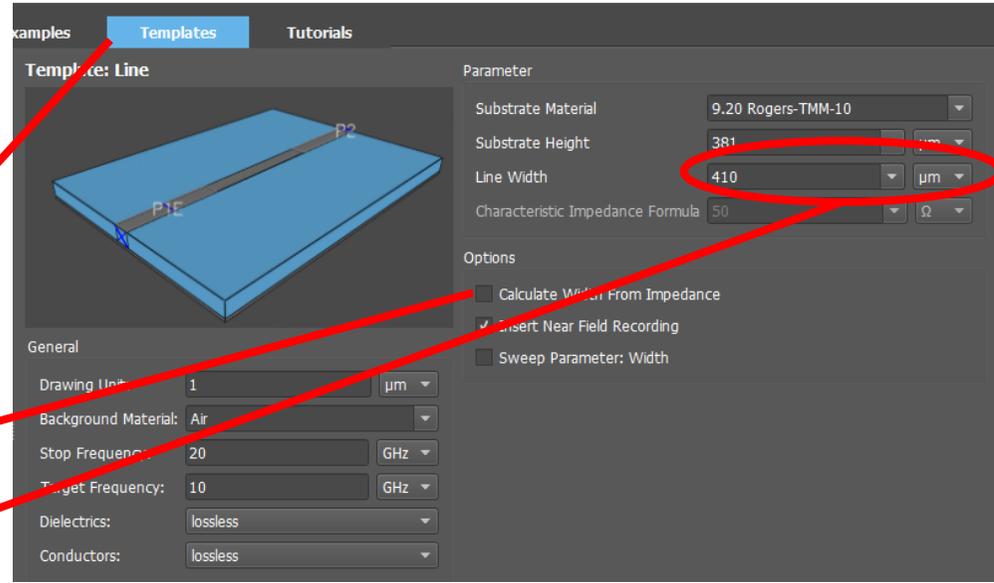
# Overview: Topics

- Use template
- 3D structure definition
- Shift and Mirror
- MSL Port
- SMD Resistor
- S-Parameters
- Even, odd mode



# Step 1: Start

- Start Empire XPU
- Select Templates
- Uncheck „Calculate...“
- Set initial Line Width 410  $\mu\text{m}$
- Click OK
- File  $\rightarrow$  Save as
- Create new directory “divider” and save file



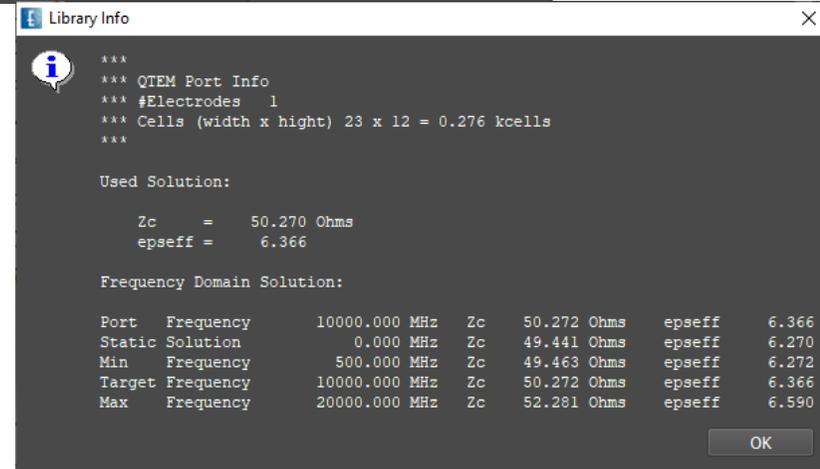
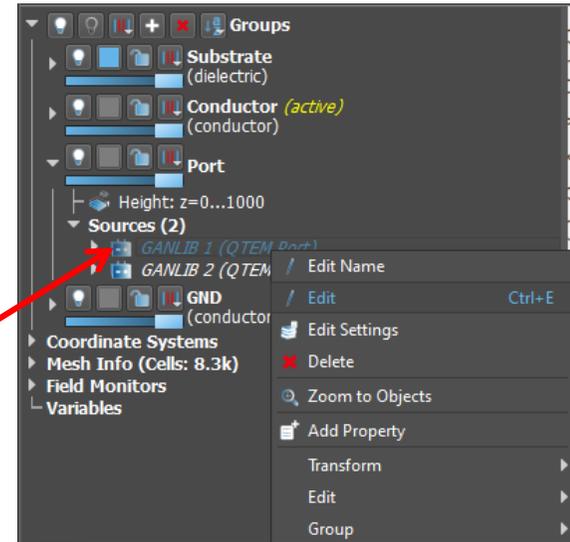
## Comments:

- The default template creates a microstrip line including ports on a TMM 10 substrate
- Note the current group is “Conductor”: new objects get the property of this group unless the group is changed

# Step 2

## → Check Impedance

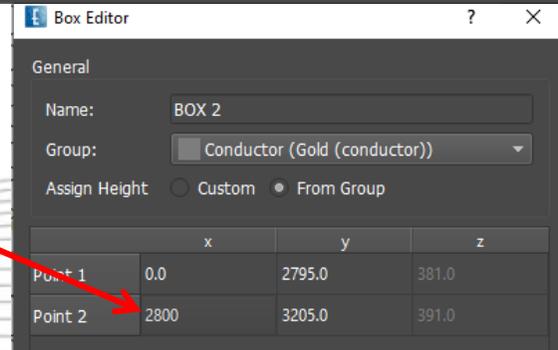
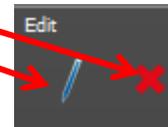
- Open Group Port - Sources
- Right click on GANLIB 1 - Edit
- Click „Edit Settings“
- Click „Info“



### Comments:

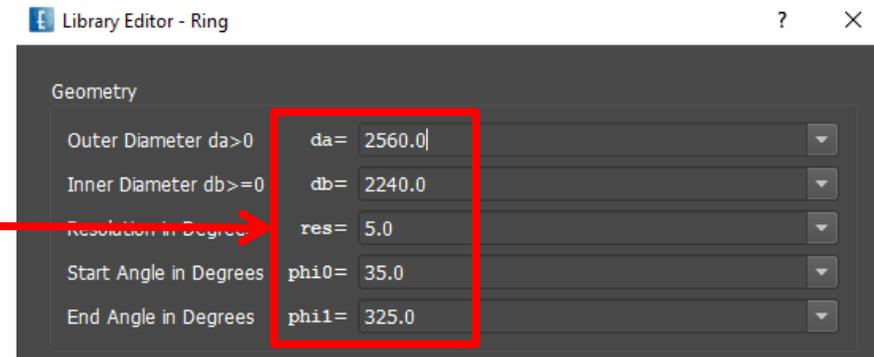
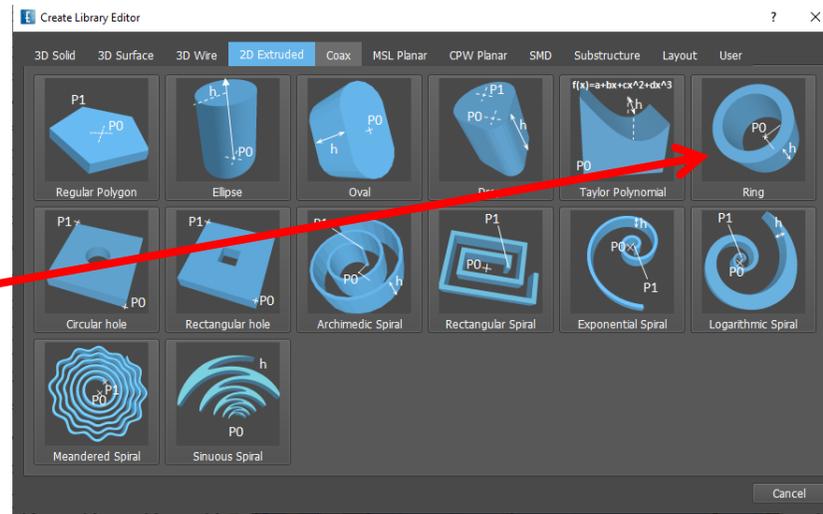
Width=410 yields approx. 50 Ohm with epseff=6.37  
 -> 2.97mm is a quarter wavelength at the target frequency of 10 GHz

- Close Windows with OK
- Click on GANLIB 2 - Delete
- Click on strip line, Open Object
- Adjust Point 2, x=2800, OK



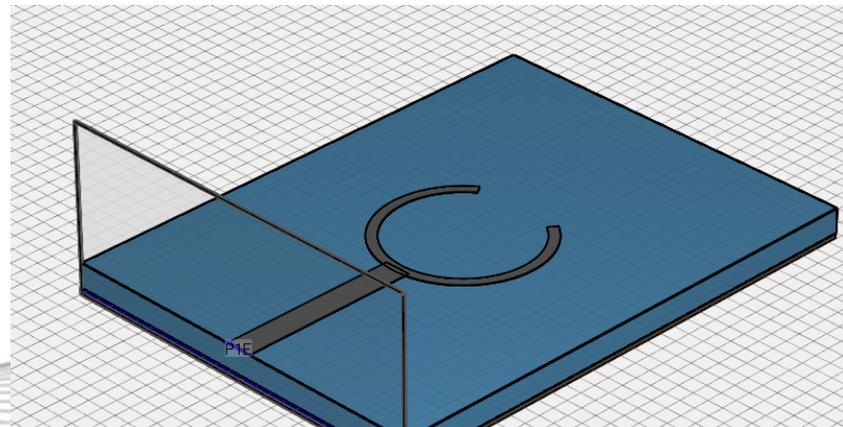
# Step 3: Ring

- Click „Create Library Object“ 
- Select Tab „2D Extruded“
- Select „Ring“
- Left click at  $x=4000$ ,  $y=3000$
- Set inner radius to e.g. 1000 (will be set later)
- Long left click to use group height thickness
- Click „Edit Settings“
- Adjust values:  $da$ ,  $db$ ,  $\phi_0$ ,  $\phi_1$
- Close with OK



*Comments:*

*Ring values are chosen so that impedance is ~70 Ohm and length is half wavelength*



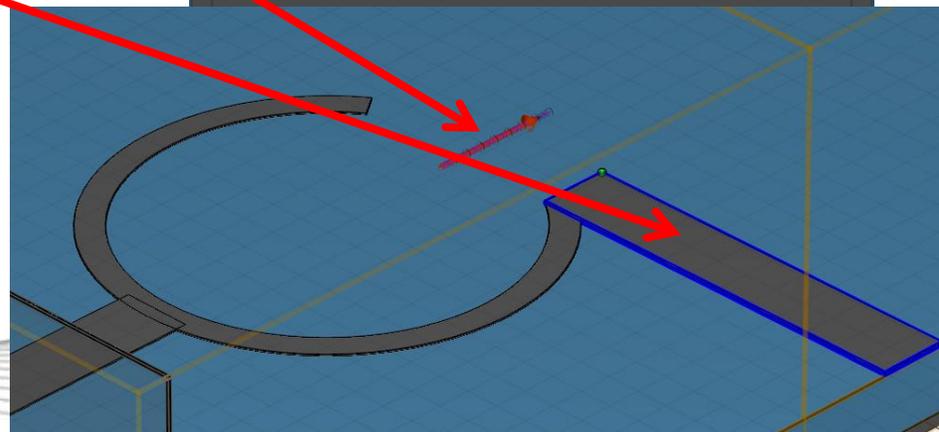
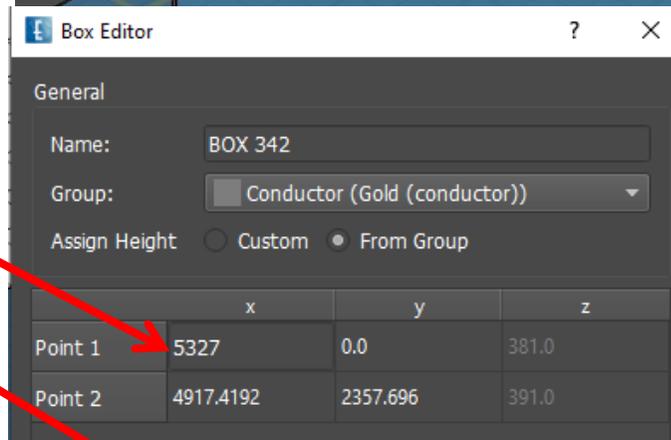
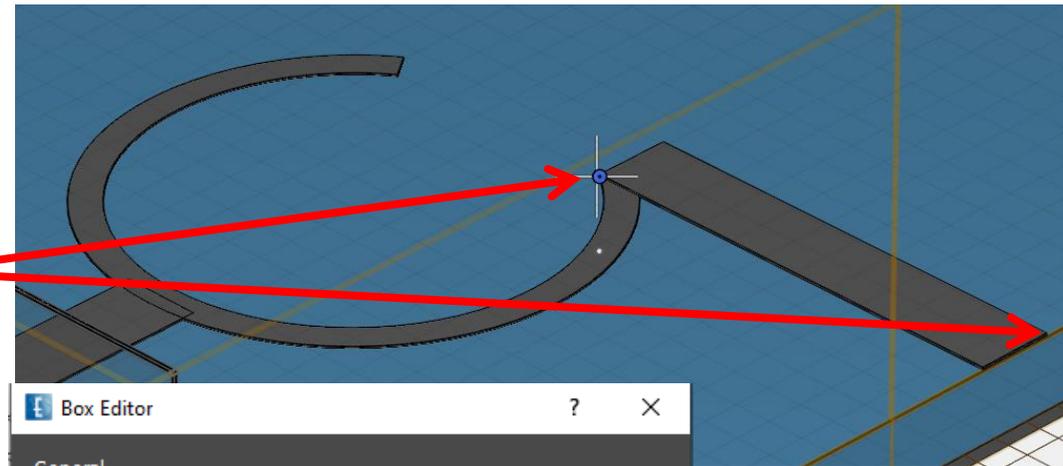
# Step 4: feed lines

- Zoom in to center
- Click „Create Box“
- Click on edge (x~5200)
- Click on corner
- Long click to use group height
- Adjust value

(to get width of 410  $\mu\text{m}$ )

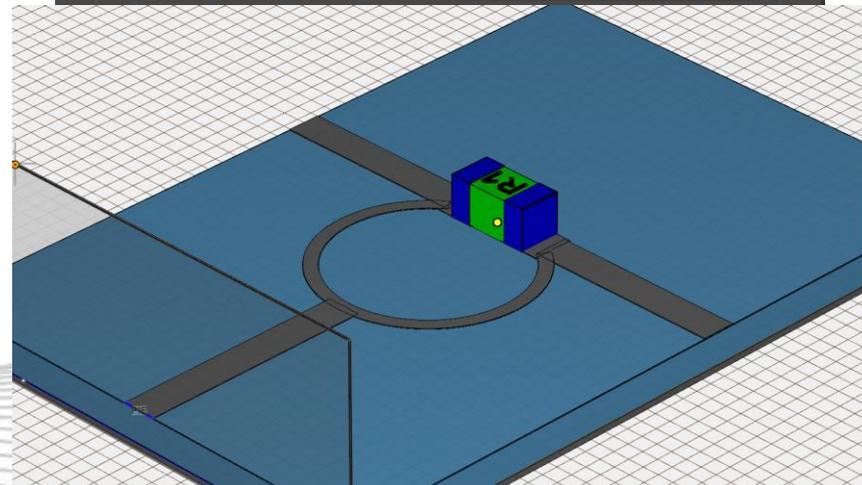
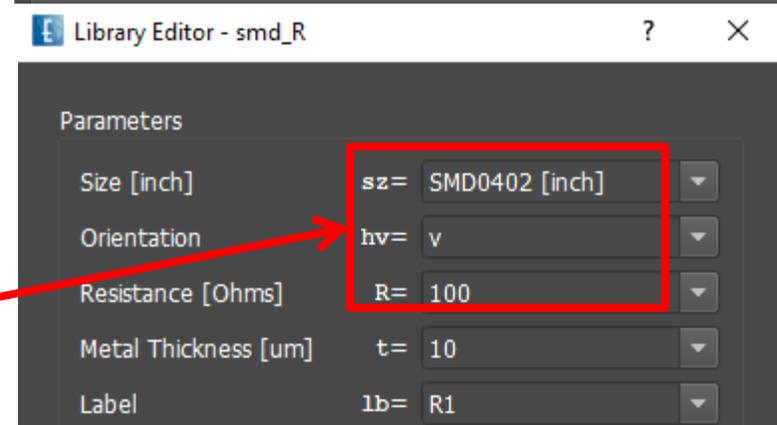
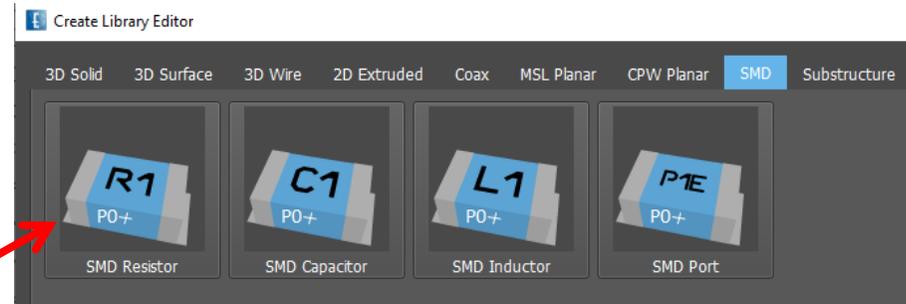
- Enter 1D Arrow at y=3000\*
- Select line
- Click „Copy & Mirror“ 

\* Drag left button starting at x=4500, y=3000, release at x=5000, y=3000



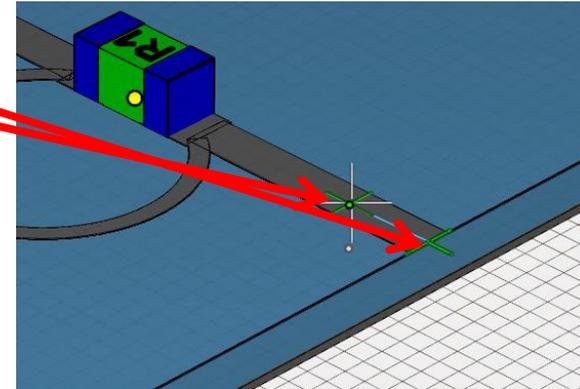
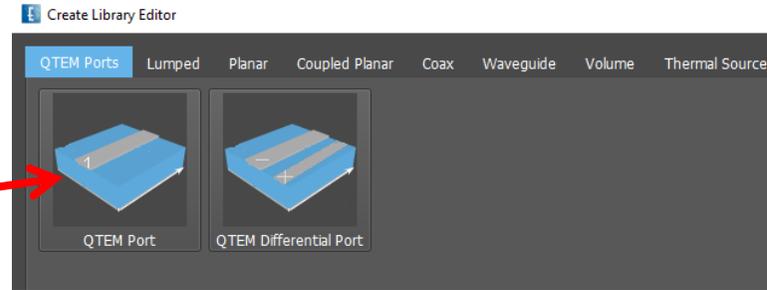
# Step 5: SMD Resistor

- Click „Create Library Object“
- Select SMD tab
- Select „SMD Resistor“
- Left click at x=5100, y=3000
- Click „Edit Settings“
- Adjust values:
  - Size:** SMD0402 [inch]
  - Orientation:** set „v“ for vertical orientation
  - Resistance:** define 100 Ohm load
- Close with OK



# Step 6: Port Setup

1. Click „Create Port“ 
  2. Click „QTEM Port“ 
  3. 1st click at center line start
  4. 2nd click in wave direction
  5. OK
- Repeat 1-5 for opposite port
  - Click „Port Setup Wizard“ 
  - Select Excitation Tab
  - Uncheck Excitation for port 3, OK



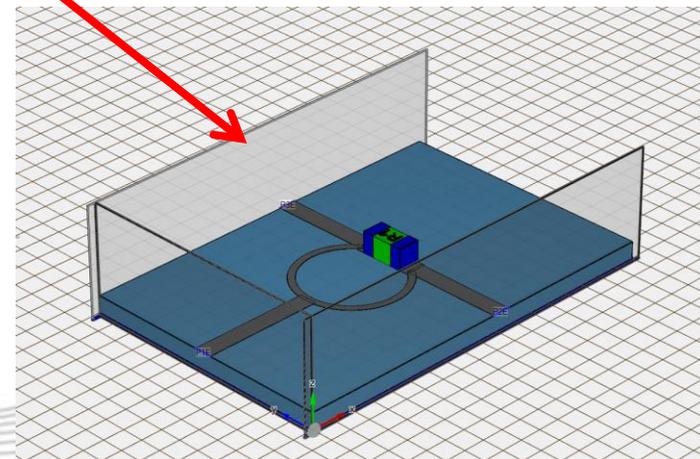
Port Editor

Table Style: Detail View

Number	Excitation	Group	Amplitude	Load Impedance	Current Probe
1	<input checked="" type="checkbox"/>	Port	1		1
2	<input checked="" type="checkbox"/>	Conductor (Gold (conductor))	1		1
3	<input type="checkbox"/>	Conductor (Gold (conductor))	1		1

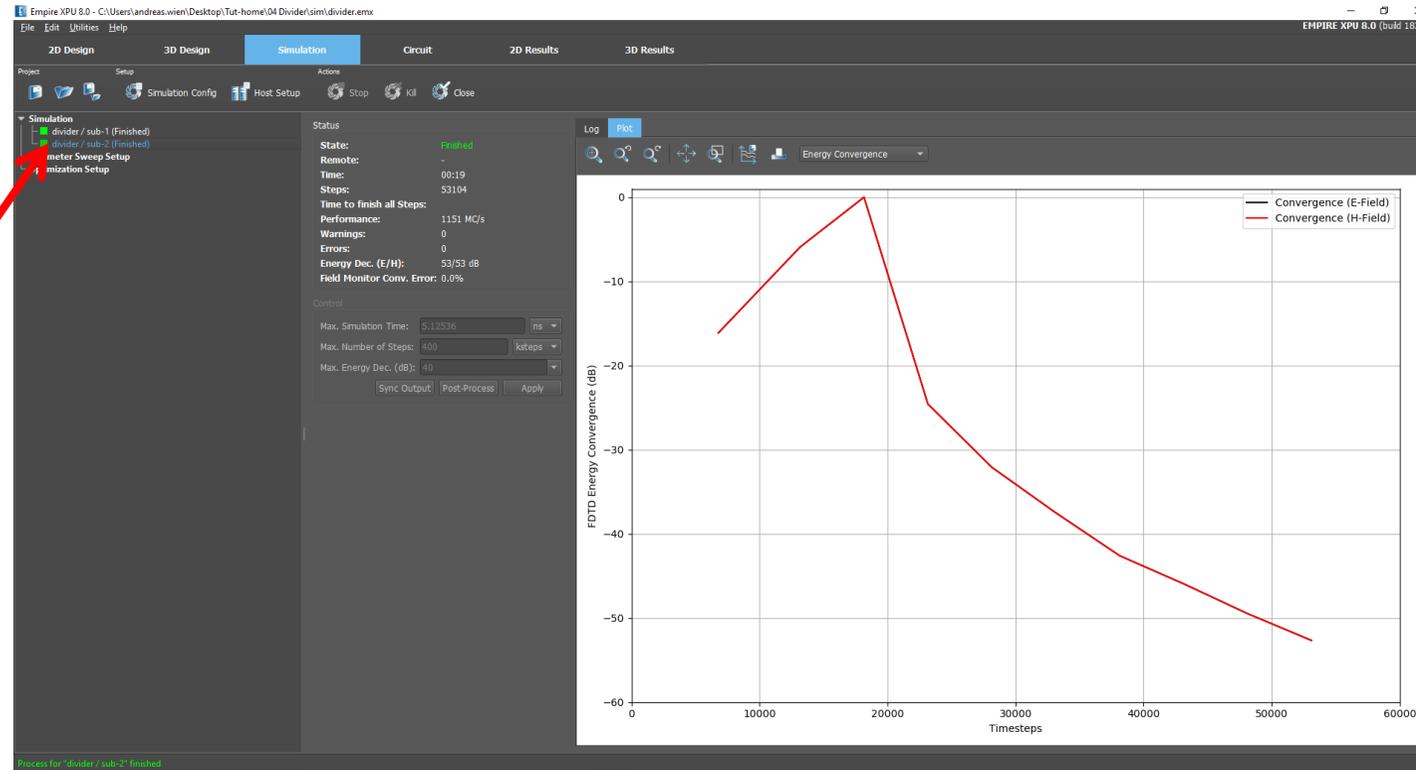
**Comments:**

- With this setting 2 subsequent simulations will be carried out
- 1: Even mode
- 2: Odd mode



# Step 7: Simulation

- Click „ Start Simulation“
- OK
- Wait for Finished state of simulations in sub-1 and sub-2

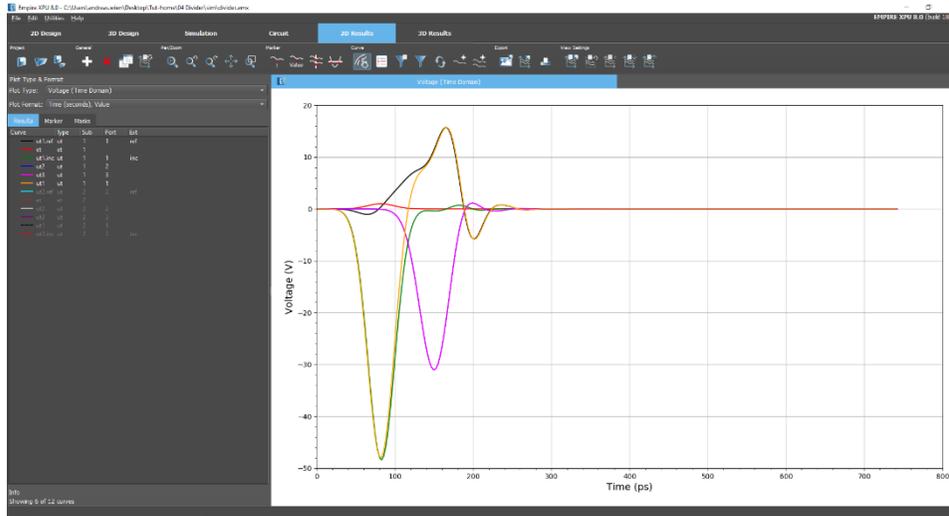


## Comments:

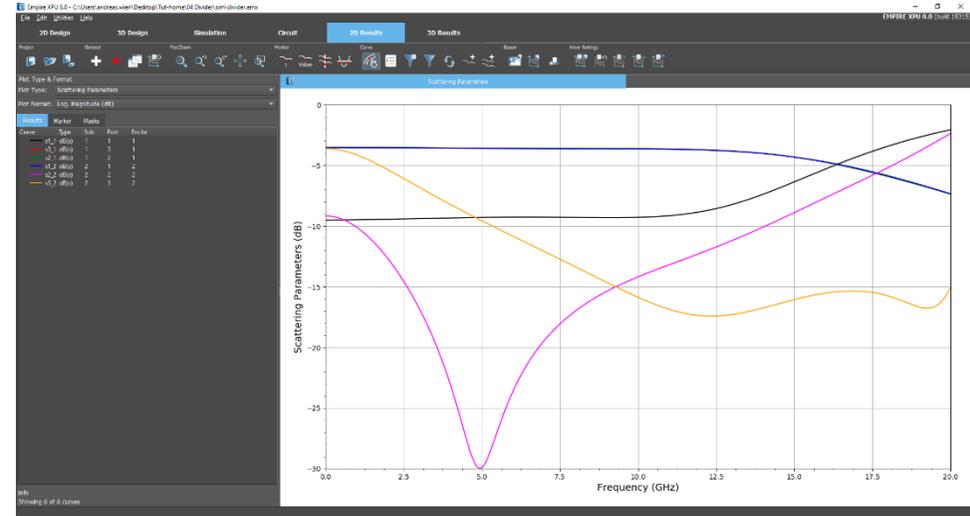
- The following will be executed
  - Automatic meshing and saving the input file
  - For each excited port (folders sub-1 and sub-2):
    - Preprocessing (creating simulation files and folders)
    - Statistics and Memory estimation (Simulation Tab, log window)
    - Compilation (creating the source code)
    - Running the simulation and displaying the voltage time series
    - Postprocessing (DFT, Far field, ...)

# Step 8: Results

- Select 2D Results – Plot Type Voltage



- 2D Results – Plot Type S-Parameters



## Comments:

- Result tabs have predefined Type which may be changed to other results, e.g. time domain current
- Format depends on selected type, e.g. dB or lin
- Right click to open a context menu in Legend or Plot area to adjust file selection or plot range
- By default, first 5 curves in the list will be plotted. Right click at grey legend entry, select “show” to display hidden curve

# Step 9: Near field

- Select „3D Results“ tab
- Open „Field Monitors“ on the left
- Use sliders to adjust animation planes
  
- Right click on FIELDMON 1 - Edit
- Source Type: Manual
- File: sub-2\emvolume\_1.dbx
- OK

### Comments:

Here, the z-component of the electric field is selected. Results in folder sub-1 refer to the excitation of port P1 (even mode), sub-2 refer to excitation of port P2 (odd mode)

