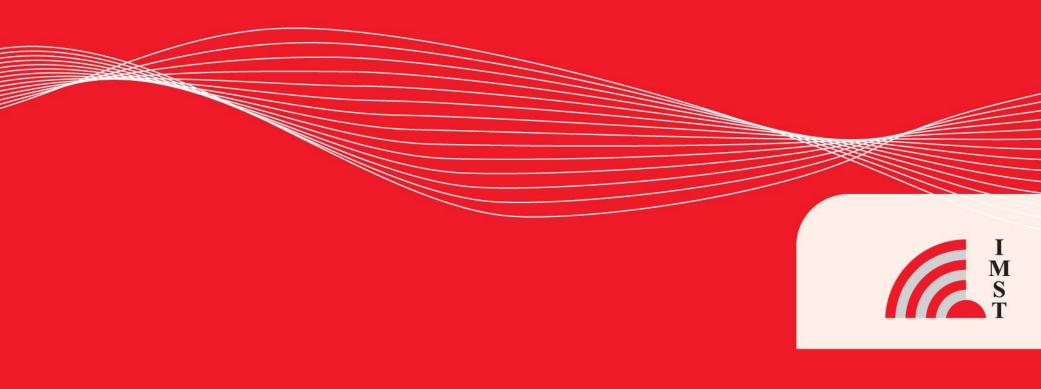
EMPIRE XPU Tutorial

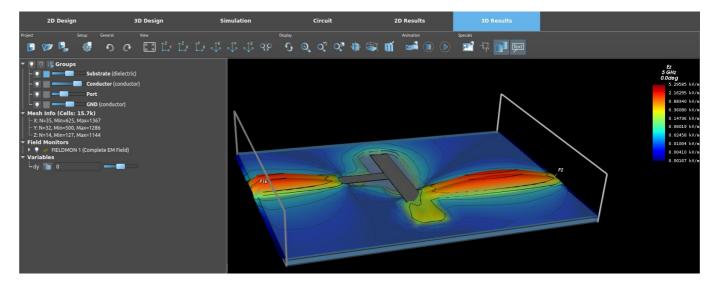
Low Pass Filter



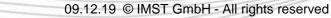


Overview: Topics

- Start using a template
- Basic features
- Mouse control
- Simulation flow
- QTEM ports
- Modify objects
- Animation



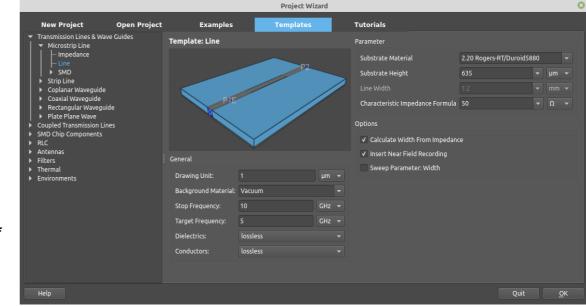
Comments: A three-button mouse with wheel is recommended for EMPIRE.





Step 1: Start

Start EMPIRE XPU from Desktop
Enter "10 GHz" in End Frequency and
"5 GHz" in Target Frequency
Choose "Rogers-RT/Duroid 5880" as Substrate Material
Choose "635 µm" as Substrate Height*
Press "Open Selection"



Select File → Save As
Enter, e.g. "C:\tutorial1\msl"

Comments:

3

• Here, we want to adapt a template for the filter definition thus we can take advantage of the predefined groups and settings.

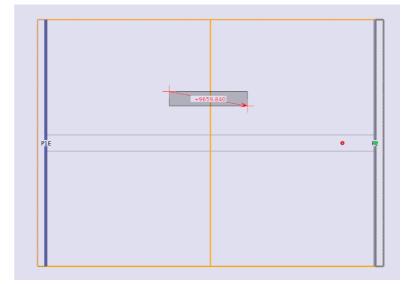
• * Please note the current unit is micron





Step 2: Draft Mode, basic features

- Switch to "2D Design" Tab
- Move cursor in the drawing area
- Press and drag left mouse button to enter an arrow
- Press left mouse button on an object edge for selection
- Scroll wheel forward/backward or press Page up/down to zoom in/out
- Press up/down/left/right arrow on keyboard or scrollbars to pan
- Press Escape key to erase arrows and deselect objects



Comments: The 2D Design mode displays the structure in a wire frame model and is well suited for editing planar geometry.



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Step 3: 3D Design Mode, Basic features



- Press the "3D Design" Tab at the top
- Press and drag middle mouse button to pan
- Turn wheel forward / backward to zoom
- Press and drag right mouse button to rotate
- Open group list on the left and move the slider near "Substrate" to adjust transparency
- Press the "2D Design" Tab at the top

Comments: The 3D Results mode usage is similar. It displays the structure in a rendered model and is used for verifying the geometry as well as displaying field distributions, animations or radiation patterns.



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Step 3: Display Mode, Basic features

Groups Open group list on the left and move the • Substrate slider near "Substrate" to adjust (dielectric) transparency Conductor (active) (conductor) Press the "2D Design" Tab at the top • Port GND (conductor) Coordinate Systems Mesh Info (Cells: 10.7k) **Field Monitors** 2D Design **3D Design** Variables Project Setup General



Step 4: Simulation Flow



- Start Simulation Start a complete simulation? Options Note: This may overwrite already existing results! ✓ Save Project Use the simulation tab for more detailed simulation setups ✓ Discretize Click on "Simulation Control" in the Design Toolbar at the top Auto Mesh Help
- Press Simulation and OK •

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Wait until the simulation is finished and click on the "2D Results tab" .



Comments: With Start Simulation, the structure will be meshed and prepared for simulation (creation of a file .acad). Then the simulation engine starts and generates a processor-optimized code for execution. During execution the time domain energy is displayed until steady state is reached. After this the post processing is started (DFT) and S-Parameters are available in 2D Results tab when finished.

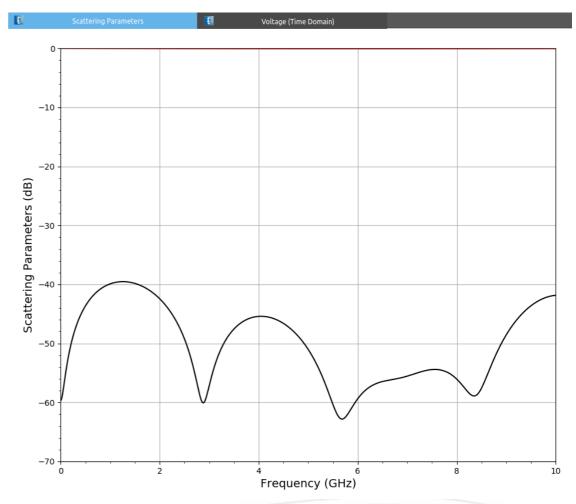


Step 4: Simulation Flow



- Select "Scattering Parameters" for the "Plot Type"
- Select "Log. Magnitude (dB)" for "Plot Format"

Plot Type & Format							
Plot Type:	Scattering	g Parame	ters		•		
Plot Format: Log. Magnitude (dB)					•		
Results	Results Marker		Masks				
Curve	Туре	Sub	Port	Excite			
s1_'	1 dB(s)	1	1	1			
s2'	1 dB(s)	1	2	1			



Comments: The simulation of this simple line shows the pulse at the start (black) and at the end (red) of the line with a certain delay.

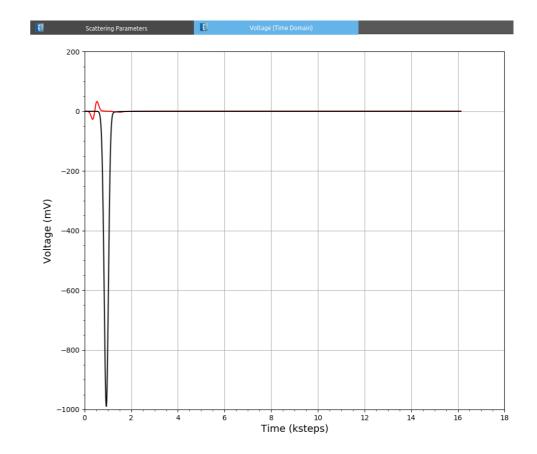


Step 4: Simulation Flow



- Select "Scattering Parameters" for the "Plot Type"
- Select "Log. Magnitude (dB)" for "Plot Format"
- Right click on "utf1.ref" type "ut" and "ut2" type "ut" and select "Show only & Autocolor"

Plot Type &	Format				E	
Plot Type:	Voltag	Voltage (Time Domain)				
Plot Format	: Time (steps), Value				200
Results	Marker	Masks				
Curve	Тур	oe Sub	Port	Ext	1	
ut	1.ref ut	1	1	ref		
						0
ut	:2 ut	Show o	nly & Auto	ocolor	Alt	0 +S
		Show o	nly	4	Shif	ft+S
		Show				
		Hide				
		Delete			Del	
		Show a	ແ			
		Hide al				
		Hide Si	ngle Value	e Columns		
		Hide Co	olumn			•
		Edit Sty	/le			
		Autoco	lor		Alt	+A
		Set Col	ог			►
		Set Line	ewidth			►
		Set Line	estyle			Þ
		Y Edit Fil	ter		Ctrl	l+F
		Auto-R	esize Colu	mns		
		Tree Vi	ew			



Comments: The transmission (red) and the reflection (black) is shown after the simulation and the post processing has finished.





Step 5: Parameter definition

- Return to the 2D Design Tab
- Open Field Monitor, switch off
- Right click on Variables
- Create new variable
- Enter Name = dy
- Value = 0
- Min = -200
- Max = 200
- Step = 50

•	Ok
---	----

	Create Variable				
	Name:	dy			
	Comment:				
	Туре:	Stepped	•		
	Value:	0			
•	Start:	-200			
	Stop:	200			
	Step Value:	50			
	Help	<u>C</u> ancel <u>O</u> K			

Groups
 Groups
 Substrate (dielectric)
 Conductor (active) (conductor)

GND (conductor)

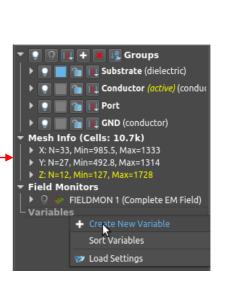
FIELDMON 1 (Complete EM Field)

🕕 Port

Mesh Info (Cells: 10.7k)

Field Monitors

Variables

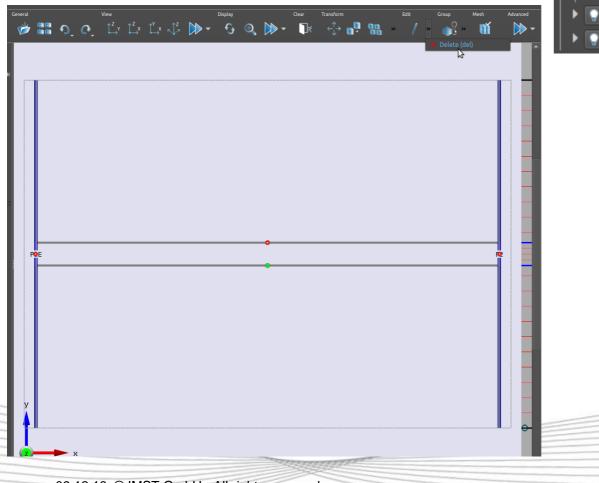


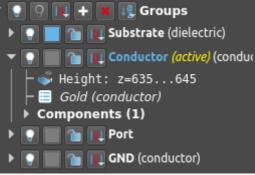




Step 6: Line definition

- Open group list, verify Conductor is current group (blue text)
- Select the center line
- Delete









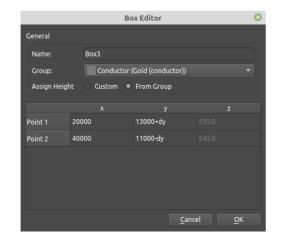
Step 6: Line definition

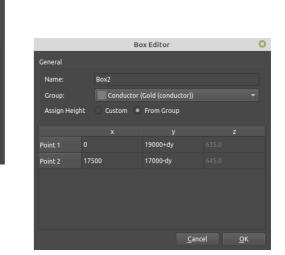
• Create 3 Boxes (x,y), keep z:

P1=(17500,25000) P2=(20000,5000)

P1=(0,19000+dy) P2=(17500,17000-dy)

P1=(20000,13000+dy) P2=(40000,11000-dy)





Box Editor

Conductor (Gold (conductor))

25000

Custom

 From Group

General Name

Group

Point 1

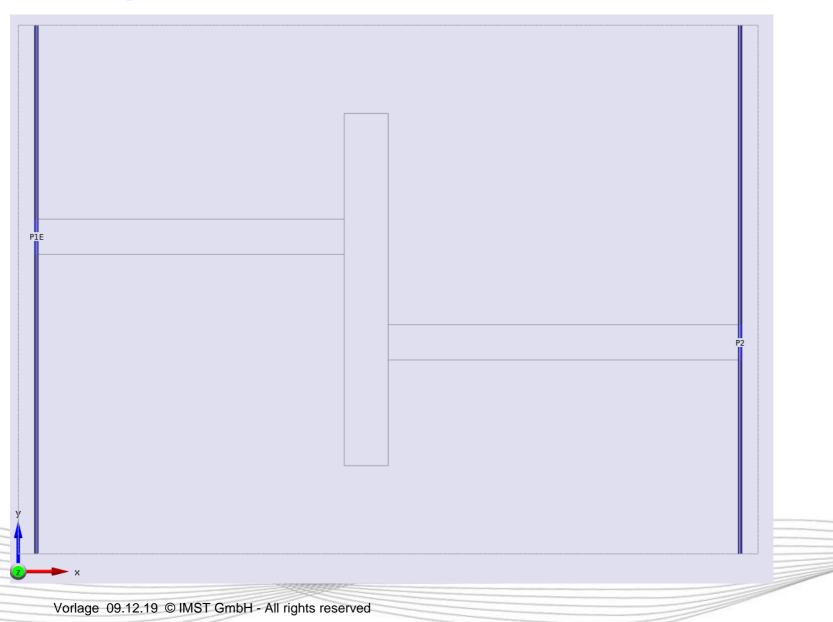
Point 2

Box1



I M S

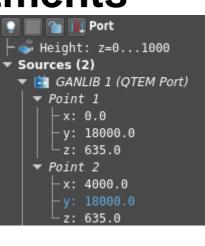
Step 6: Line definition

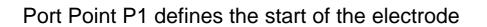




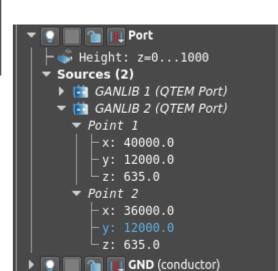
Step 7: Port Adjustments

- Open Sources Group Conductor
- Open P1E
- Set y=18000 for P1 and P2
- Open Port P2
- Set y=12000 for P1 and P2
- Close



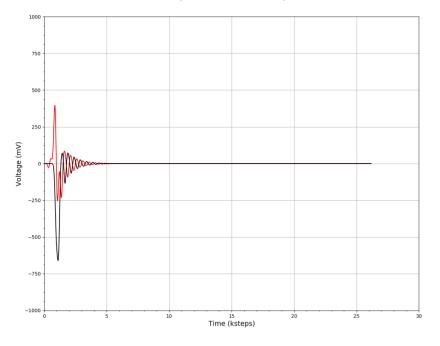


Port Point P2 defines the direction of the wave



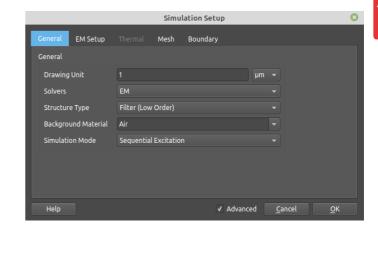
Step 8: Start Simulation

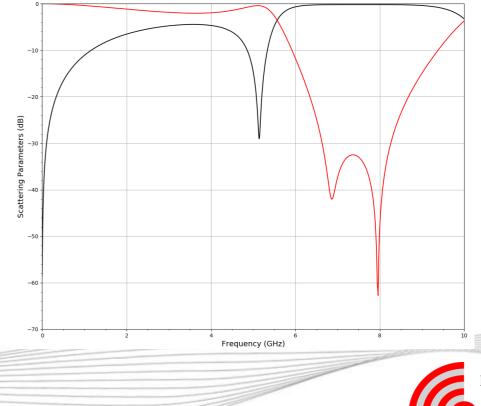
- Press the "Simulation Setup" button
 In General
 Structure Type
- In General → Structure Type select "Filter (Low Order)"



- Close Window
- Click on "Simulation Control" in the Design Toolbar at the top → Simulation

Comments: The Structrure Type parameter defines the maximum number of time steps and energy decay level.







Step 9: Animation

Field Monitors

- FIELDMON 1 (Complete EM Field)
 Plane: xy, Height: 635.0
 Plane: yz, Height: 20000.0
- Switch back to the 2D Design mode
- Switch on the FIELDMON 1 (Light bulb) in the Field Monitor list.
- Right click on FIELDMON 1 and select "Edit"
- In "Plot Options" set "5000" for "Field Plot Amplitude",OK

Near Field Monitor Settings					8
Storage Options Plot Option	ns				
Data Source			Display		
Source Type Curve Sub Use Optimization Frequency (Hz)	Automatic Automatic 1 off 5 CHz		Animation Loop Type Field Plot Amplitude Color-Map	phase_20_deg 5000 -	
Field Options			Legend Entries	10 Surface	
Field Field Components Plane Interpolation	Electric Field z Cell		Plot Style Contour Lines Exclusive Number of Lines	Surrace	
Normalization (Frequency Domain Only)			Color	black 👻 Color	
Type Port Weight			Contour Surfaces Contour Count Max. Value		
Scaling					
Type Max. Value Range (dB)	Logarithmic Auto TO		Arrow Display Exclusive Arrow Size		
In Plane Averaging			Arrow Oversize Factor		
Type of Averaging Area Area Length/Radius in units Avg. Sample Count	0ff 100 1000		✓ Scale Arrows by Value Mag Arrow Type Color	gnitude Cone auto v Color	
Help			✓ Advanced Apply		<u>о</u> к





Step 10: Animation

- Right click on "Plane: yz" and select "Remove Plane"
- Double click on remaining field plane to set to xy, Height: 635
- Switch to the 3D Results tab

