Microwave Engineering Lab

Experiment: 5

Design of Wilkinson Power Divider with 3 dB power division

Southern University of Science and Technology, Shenzhen, P.R. China

***Task*-1:**

Design of Wilkinson Power Divider with 3 dB power division

Objective

• Design of circuit model of the Wilkinson power divider with 3 dB power division using ADS.

• Full-wave simulation of Wilkinson power divider using HFSS.

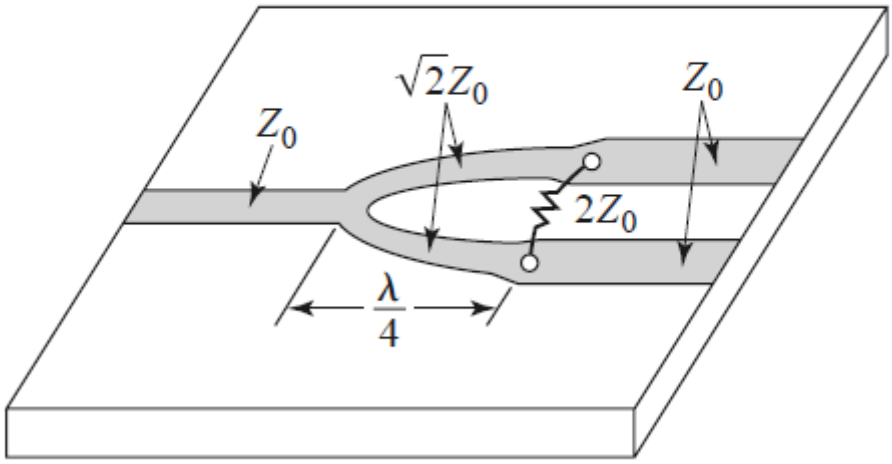


Fig. 1 Wilkinson power divider with 3 dB power division. Here $Z_0 = 50\ \Omega$.

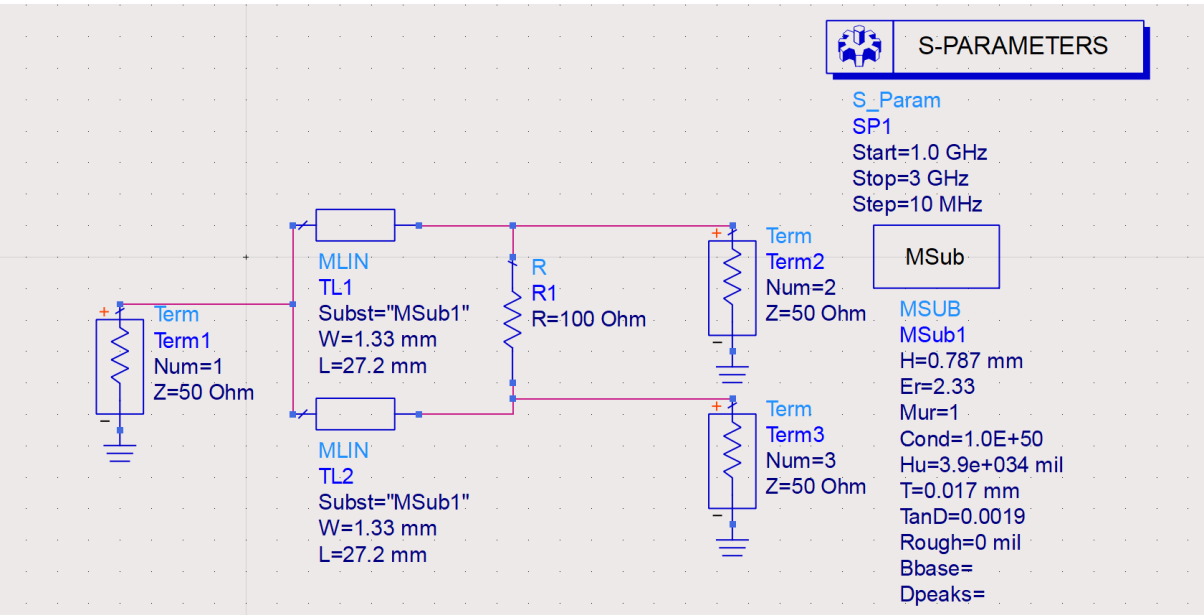
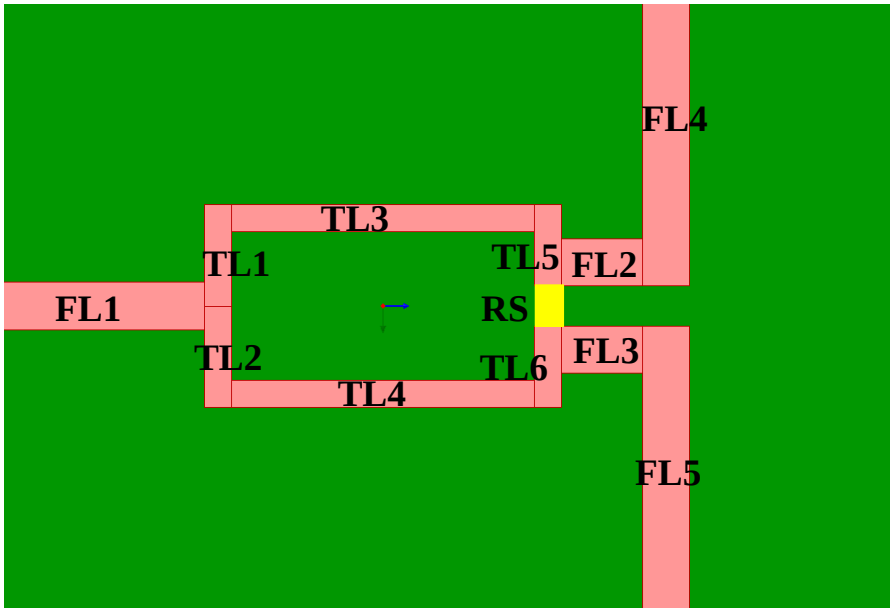


Fig. 2 Design of Wilkinson power divider in ADS.



Design of Wilkinson power divider

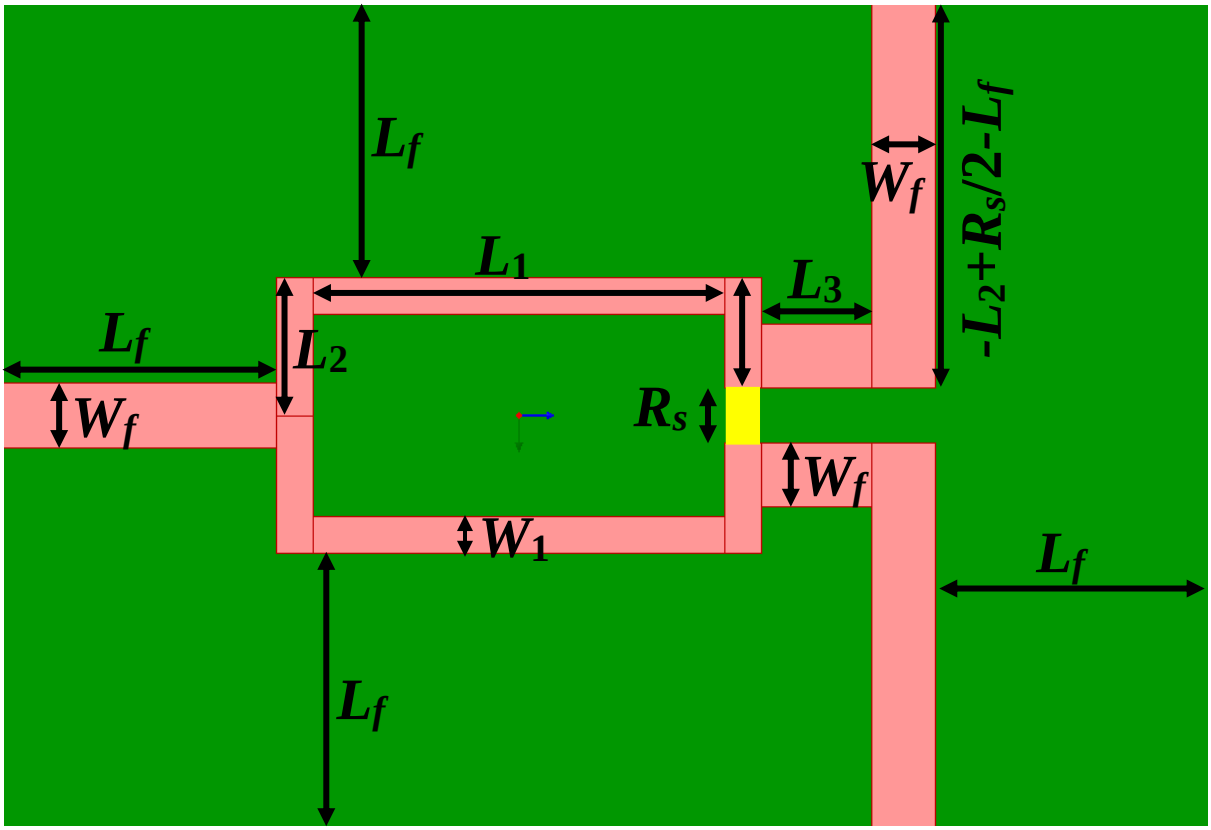


Fig. Wilkinson power divider with dimensions.

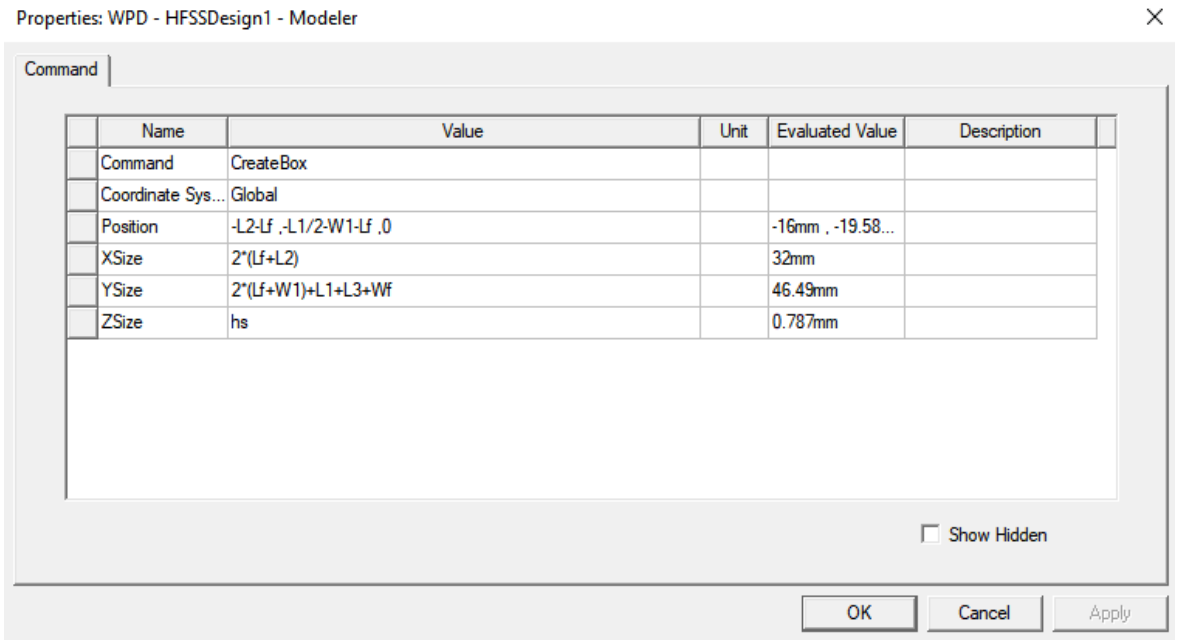
hs	0.787	mm	0.787mm	Design
hc	0.017	mm	0.017mm	Design
Lf	10	mm	10mm	Design
Wf	2.33	mm	2.33mm	Design
L1	16.5	mm	16.5mm	Design
W1	1.33	mm	1.33mm	Design
L2	6	mm	6mm	Design
L3	5	mm	5mm	Design
Rs	2	mm	2mm	Design

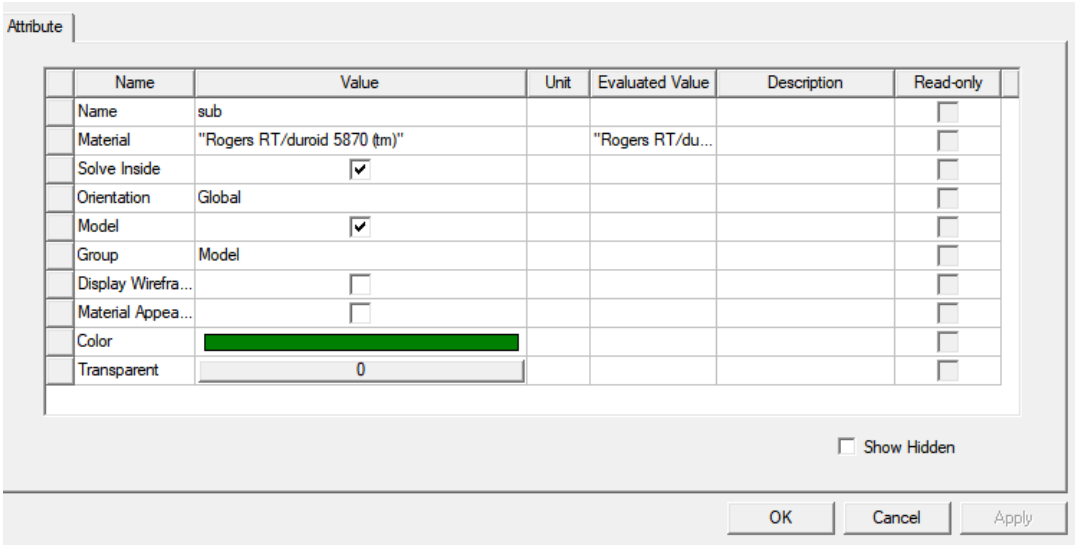
Design procedure of Wilkinson power divider:

1. **Substrate:**

   Create a box with the below properties.

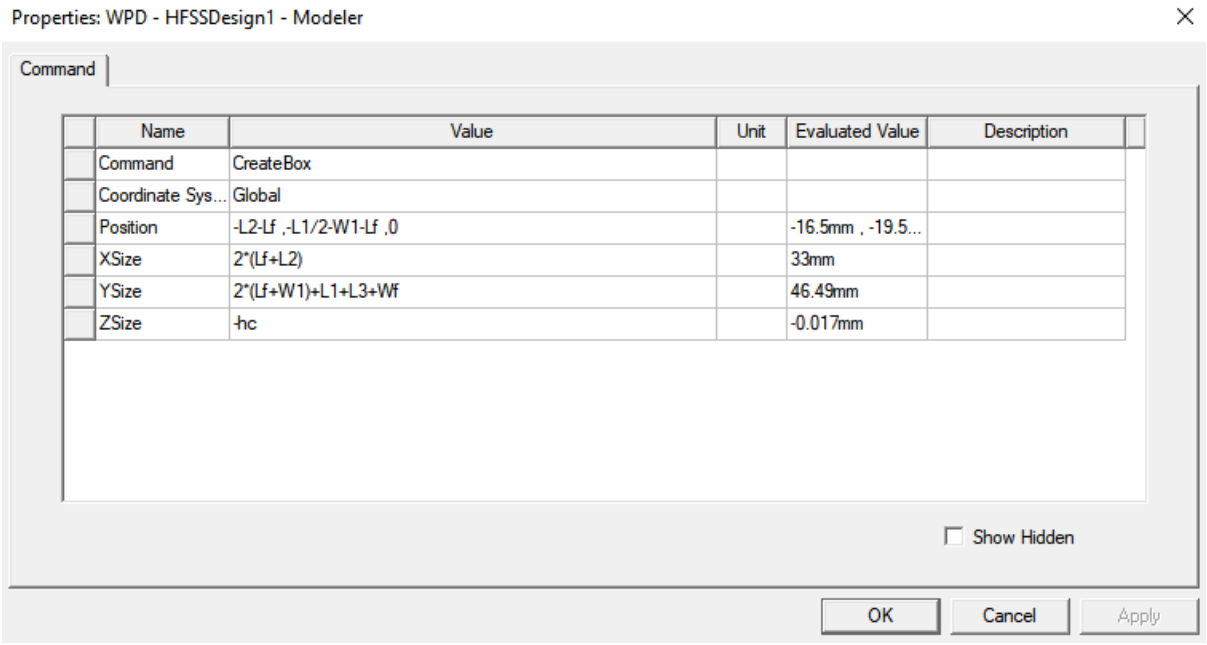
   Assign material: Right Click>Assign Material>Rogers/Select RT Duroid 5870





2. Ground:

Create a box with the below properties.



Properties: WPD - HFSSDesign1 - Modeler

Attribute

	Name	Value	Unit	Evaluated Value	Description	Read-only
	Name	GND				
	Material	"copper"		"copper"		
	Solve Inside					
	Orientation	Global				
	Model	✔				
	Group	Model				
	Display Wirefra...					
	Material Appea...					
	Color					
	Transparent	0				

Show Hidden

OK Cancel Apply

3. AirBox:

Create a box with the below properties.

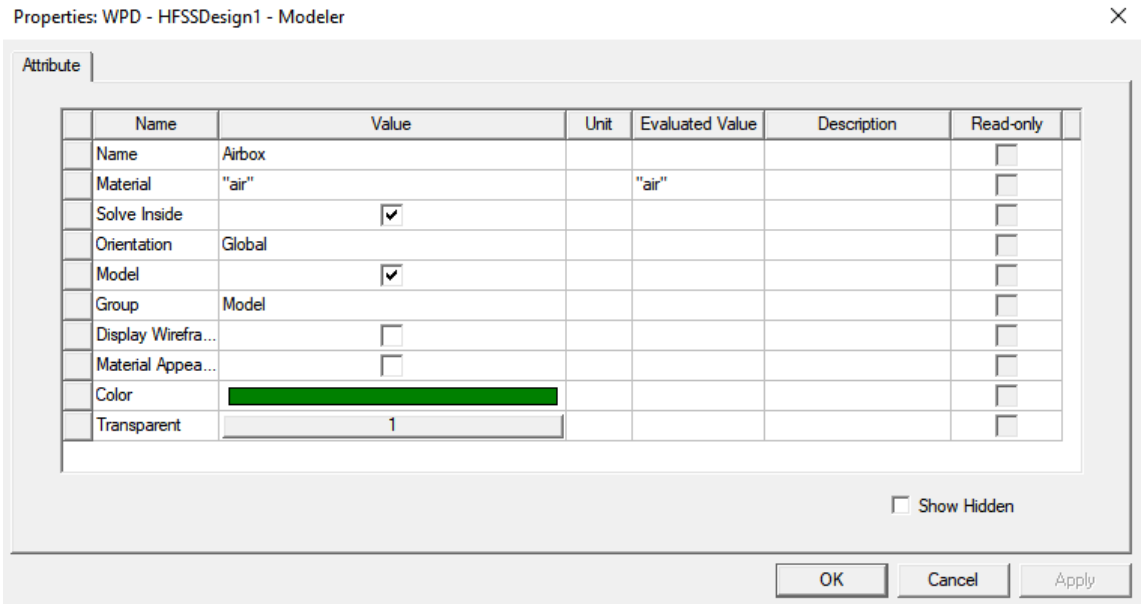
Properties: WPD - HFSSDesign1 - Modeler

Command

	Name	Value	Unit	Evaluated Value	Description
	Command	CreateBox			
	Coordinate Sys...	Global			
	Position	-L2-Lf ,-L1/2-W1-Lf ,-10mm		-16.5mm , -19.5...	
	XSize	2*(Lf+L2)		33mm	
	YSize	2*(Lf+W1)+L1+L3+Wf+10mm		56.49mm	
	ZSize	20	mm	20mm	

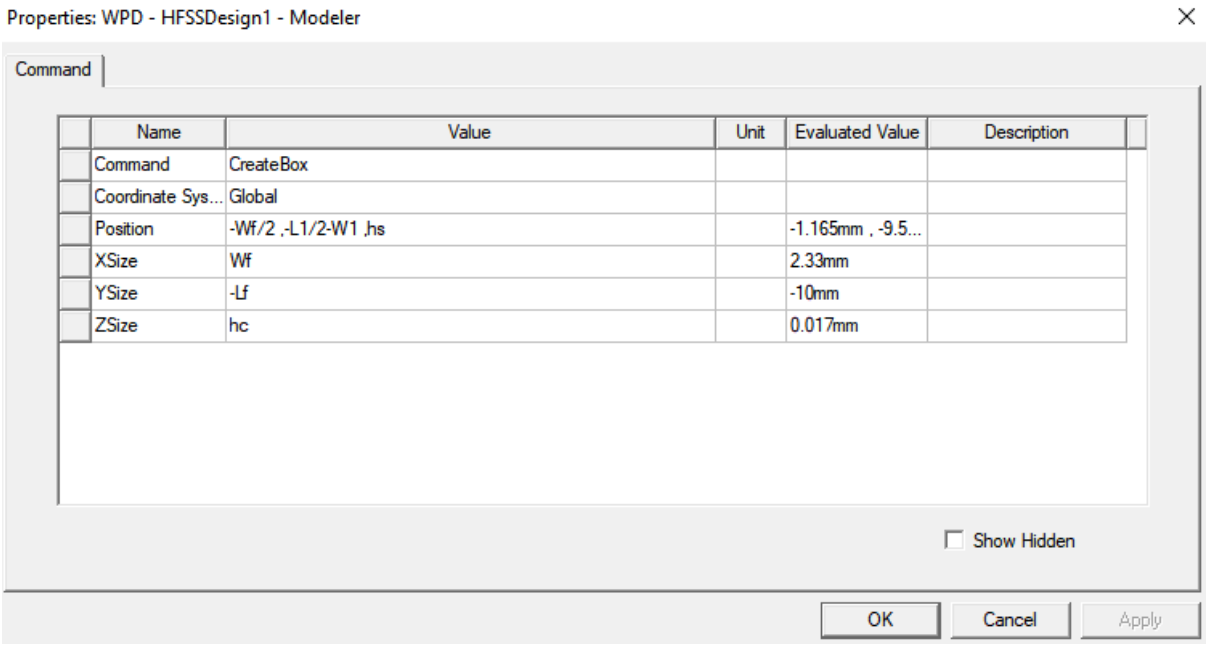
Show Hidden

OK Cancel Apply



4. **FL1:**

Create a box with the below properties.



Properties: WPD - HFSSDesign1 - Modeler

Attribute

	Name	Value	Unit	Evaluated Value	Description	Read-only
	Name	FL1				
	Material	""		""		
	Solve Inside					
	Orientation	Global				
	Model	☑				
	Group	Model				
	Display Wirefra...					
	Material Appea...					
	Color					
	Transparent	0				

Show Hidden

OK Cancel Apply

5. FL2:

Create a box with the below properties.

Properties: WPD - HFSSDesign1 - Modeler

Command

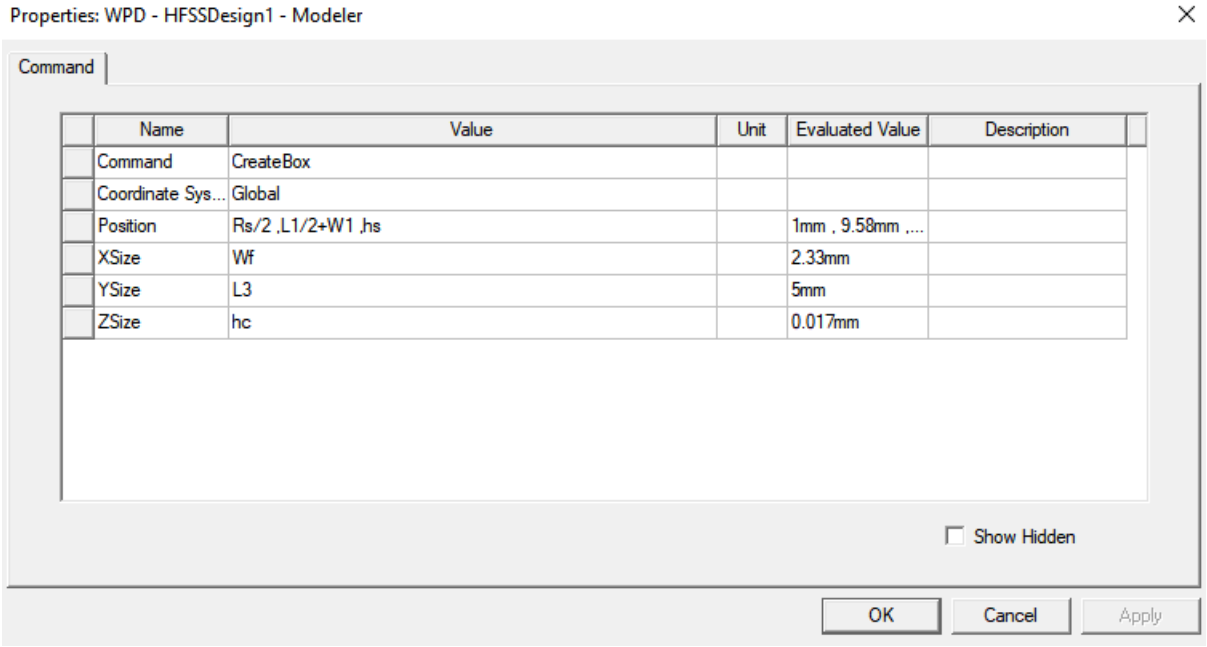
	Name	Value	Unit	Evaluated Value	Description
	Command	CreateBox			
	Coordinate Sys...	Global			
	Position	-Rs/2 ,L1/2+W1 ,hs		-1mm , 9.58mm ...	
	XSize	-Wf		-2.33mm	
	YSize	L3		5mm	
	ZSize	hc		0.017mm	

Show Hidden

OK Cancel Apply

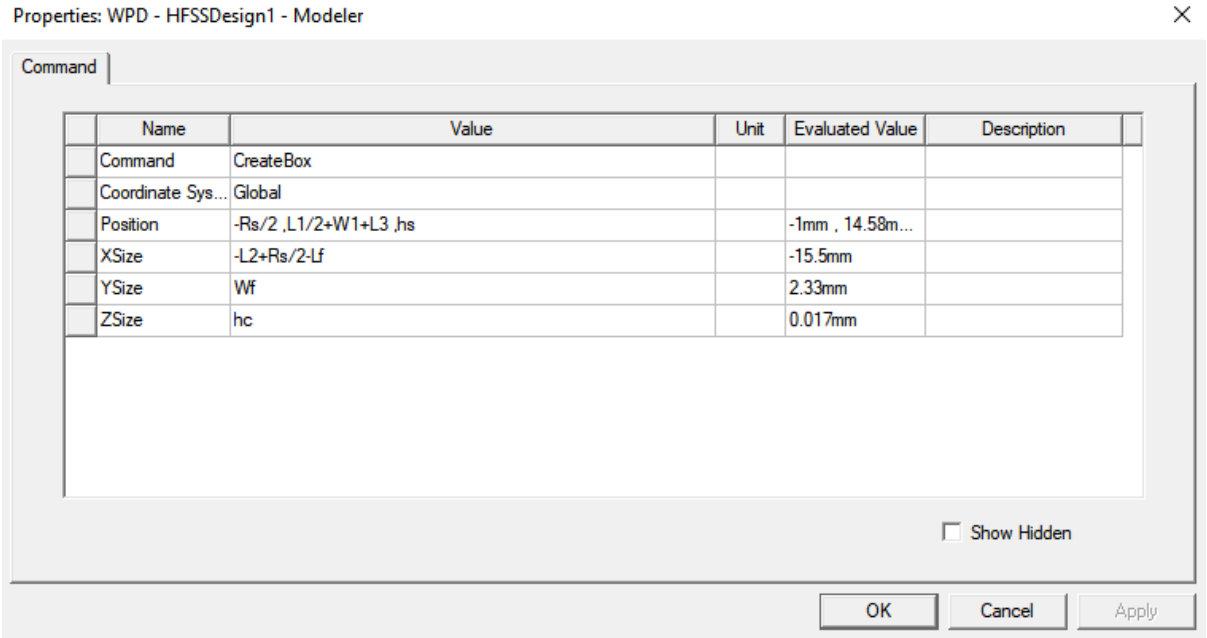
6. **FL3:**

Create a box with the below properties.



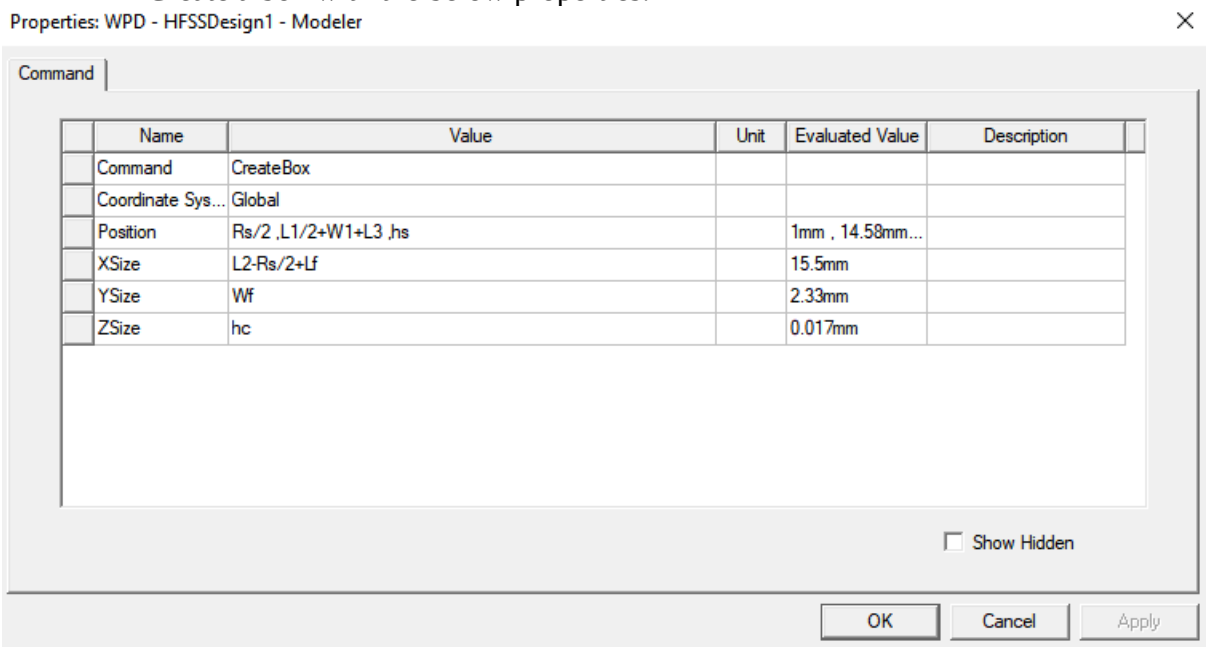
7. **FL4:**

Create a box with the below properties.



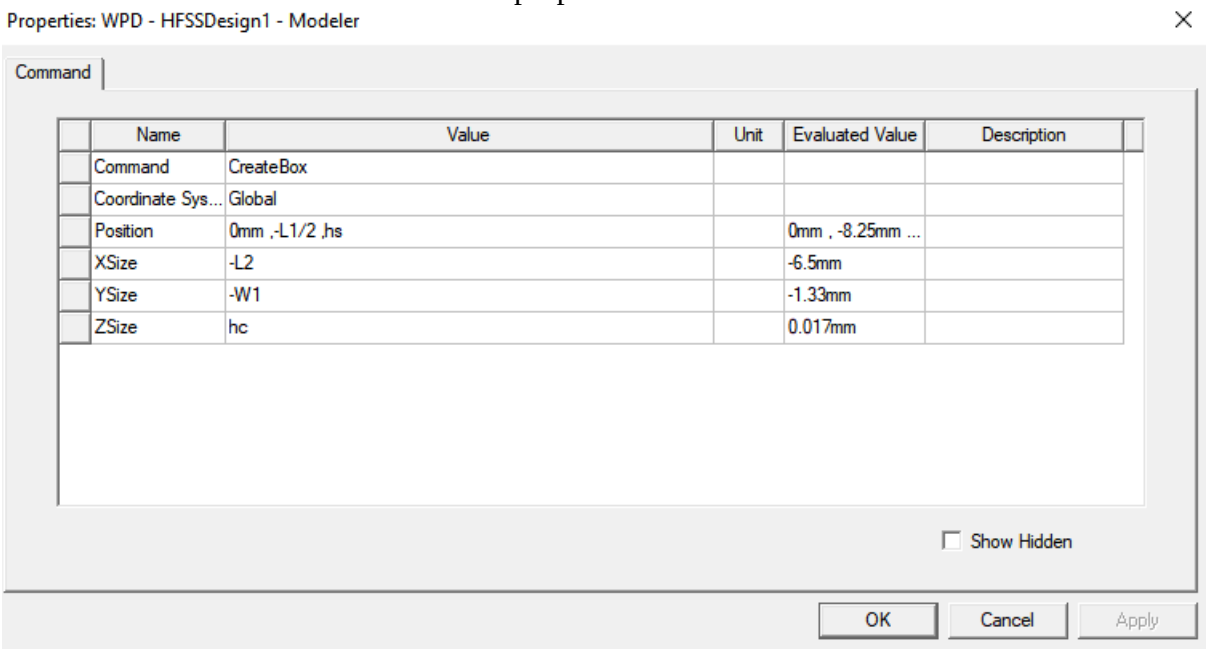
8. **FL5:**

Create a box with the below properties.



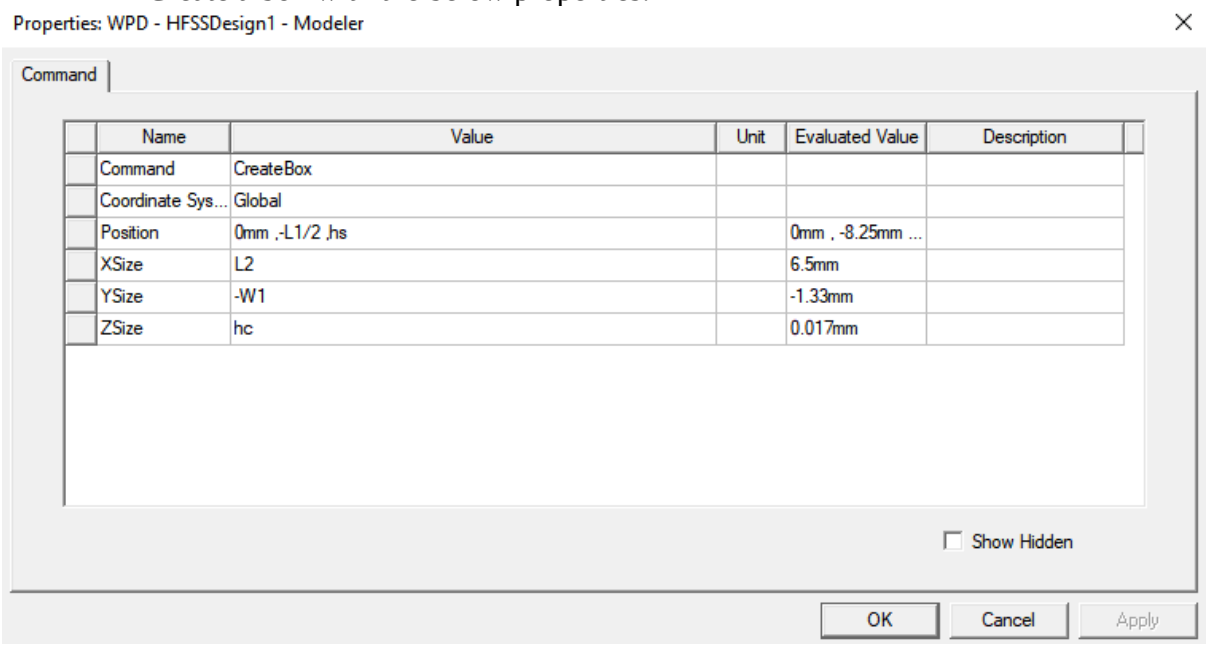
9. TL1:

Create a box with the below properties.



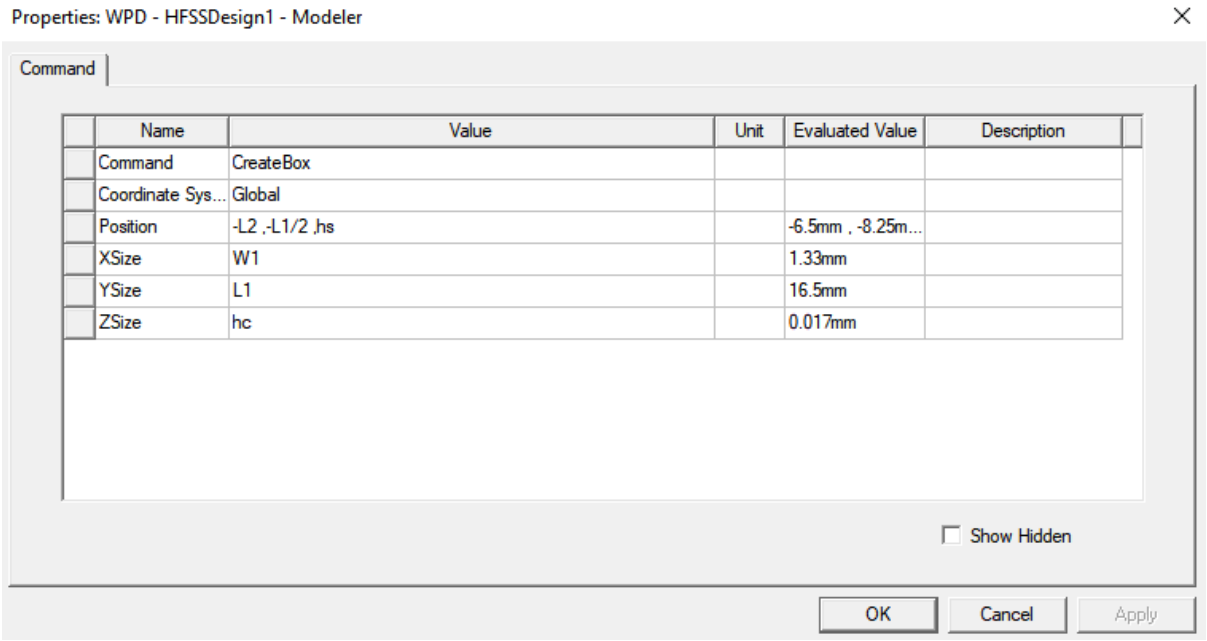
10. TL2:

Create a box with the below properties.



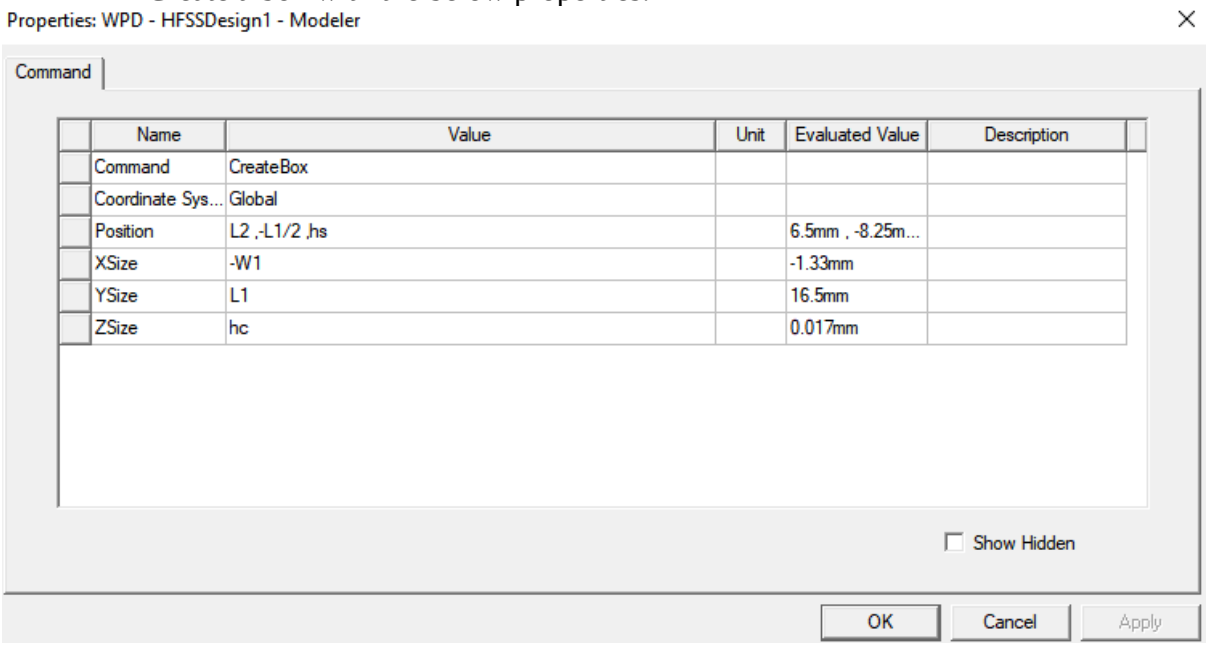
11. TL3:

Create a box with the below properties.



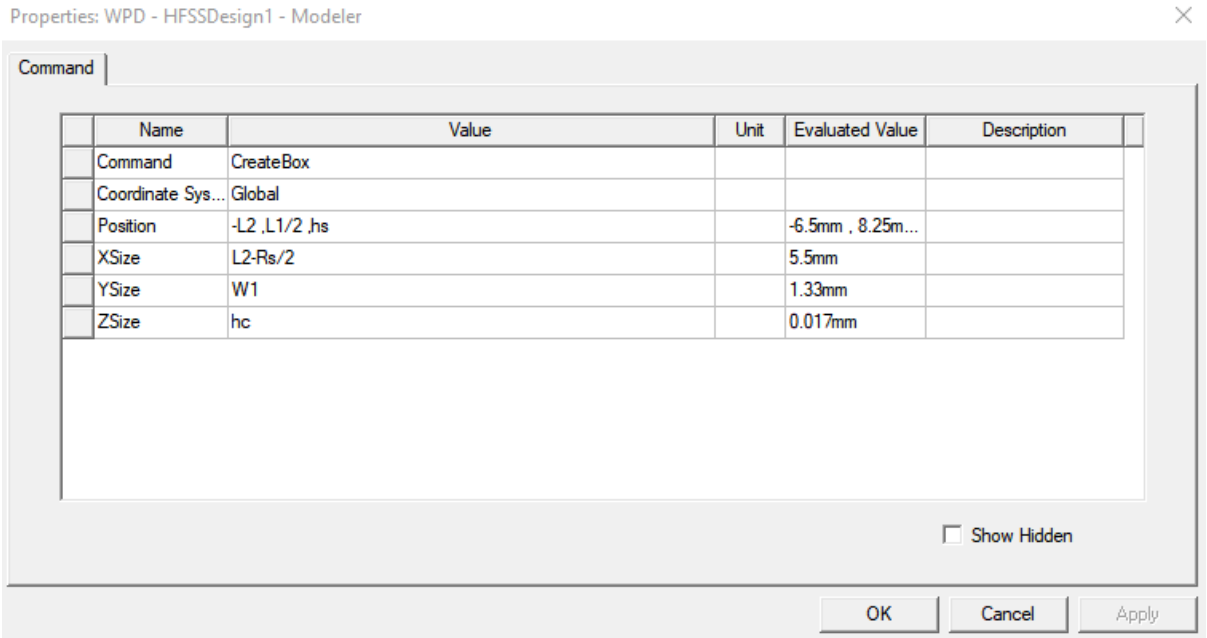
12. TL4:

Create a box with the below properties.



13. TL5:

Create a box with the below properties.



14. TL6:

Create a box with the below properties.

Properties: WPD - HFSSDesign1 - Modeler

Command

	Name	Value	Unit	Evaluated Value	Description
	Command	CreateBox			
	Coordinate Sys...	Global			
	Position	L2 ,L1/2 ,hs		6.5mm , 8.25m...	
	XSize	-L2+Rs/2		-5.5mm	
	YSize	W1		1.33mm	
	ZSize	hc		0.017mm	

Show Hidden

OK Cancel Apply

15. RS:

Create a Rectangle in XY-plane with the below properties.

Properties: WPD - HFSSDesign1 - Modeler

Command

	Name	Value	Unit	Evaluated Value	Description
	Command	CreateRectangle			
	Coordinate Sys...	Global			
	Position	-Rs/2 ,L1/2 ,hs		-1mm , 8.25mm ...	
	Axis	Z			
	XSize	Rs		2mm	
	YSize	W1		1.33mm	

Show Hidden

OK Cancel Apply

16. Port1:

Create a Rectangle in ZX-plane with the below properties.

Properties: WPD - HFSSDesign1 - Modeler

Command

	Name	Value	Unit	Evaluated Value	Description
	Command	CreateRectangle			
	Coordinate Sys...	Global			
	Position	-2.5*Wf ,-L1/2-W1-Lf ,0mm		-5.825mm , -19....	
	Axis	Y			
	XSize	5*Wf		11.65mm	
	ZSize	4.2*hs		3.3054mm	

Show Hidden

OK Cancel Apply

17. Port2:

Create a Rectangle in YZ-plane with the below properties.

Properties: WPD - HFSSDesign1 - Modeler

Command

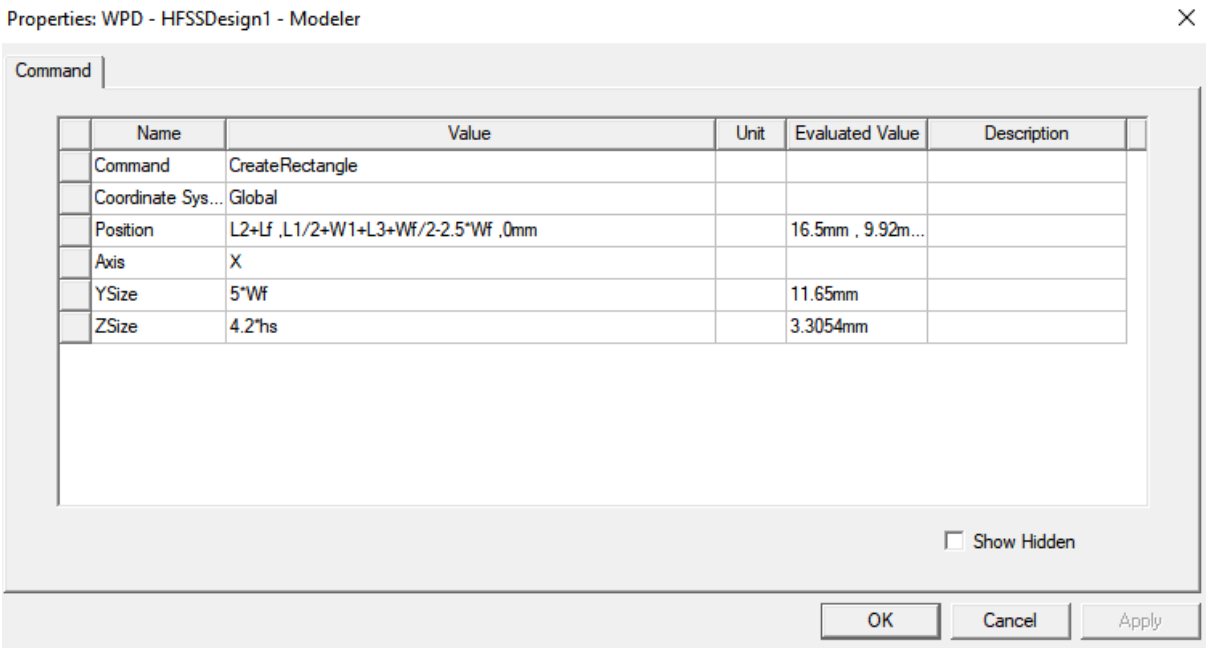
	Name	Value	Unit	Evaluated Value	Description
	Command	CreateRectangle			
	Coordinate Sys...	Global			
	Position	-L2-Lf ,L1/2+W1+L3+Wf/2-2.5*Wf ,0mm		-16.5mm , 9.92...	
	Axis	X			
	YSize	5*Wf		11.65mm	
	ZSize	4.2*hs		3.3054mm	

Show Hidden

OK Cancel Apply

18. Port3:

Create a Rectangle in YZ-plane with the below properties.



Analysis

1. Assign boundary to airbox: Right Click on Airbox>Go to Assign Boundary> select Radiation.
2. Assign boundary to RS: Right Click on RS>Go to Assign Boundary> select Lumped RLC>select resistance (100 Ω)>Define Integration Line.
3. Assign ports: **Click HFSS>Excitations>Assign>Wave Port**.
4. Define integral lines for each port.
5. Point to analysis Setup and add solution setup.
   Solution Frequency: 2 GHz
   Max number of passes: 20
   Max Delta S per passes: 0.002
   Frequency Sweep: 1 GHz – 3 GHz
   Sweep type: Fast
6. Validate your model and analyze.
7. Generate a graph for S_{11}, S_{21}, and S_{31} vs. frequency. Also plot the phase response between two output ports.

Report

1. Format should include title, objective, analysis/discussion, results, and conclusion
2. Include all relevant graphs and outputs from ADS and HFSS with detailed design procedure for HFSS
3. Compare the results for obtained from ADS and HFSS.