

7-Port Divider

In this application, we simulate 7 -port divider. The divider will be simulated from 1.4 GHz to 1.6 GHz. The results of interest are s_{11} , s_{21} , s_{31} ... s_{71} parameters. This device is realized in microstrip technology while its layout is shown in Figure 1.

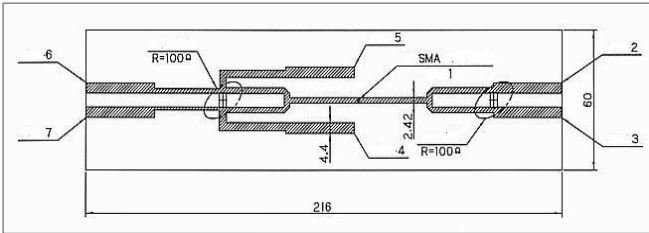


Figure 1. Layout of the divider.

The feeding port is marked as 1 (Tx) while the remaining 6 ports are marked using numbers 2-7. The divider is fed by probe with SMA connector at Tx port (Figure 2).

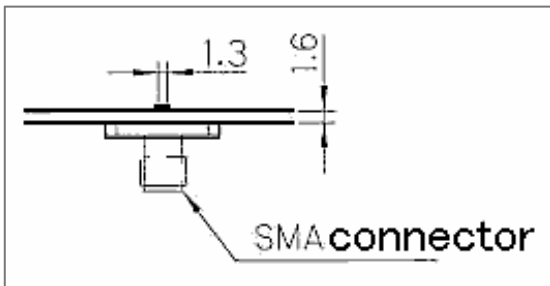


Figure 2. SMA connector at the first port.

Modeling

In WIPL-D, there are several procedures for modeling the divider:

- by using WIPL-D Pro built-in modeler to make parametrized geometry (defining symbols, nodes, creating plates...)
- by using AW Modeler or WIPL-D Pro CAD for importing .dxf file
- by using WIPL-D Pro CAD for importing .x_t, .stp, .sat, .iges...
- by using WIPL-D Pro CAD built-in modeler to make parametrized geometry (defining symbols, using solid modelling, Boolean operations and automated mesh).

The first procedure will be presented in this paper. It is very simple, but it takes a bit more time than the other procedures. Nevertheless, with this procedure we can obtain optimal mesh with minimum simulation time. The process is done more efficiently if the Copy/Layer manipulation is used to obtain layers starting from the top layer.

All dimensions are provided as symbols. Table of symbols is presented in Figure 3.

Symbols		
		Symbol
1	1.3	Din=1.3; inner diameter of coaxial line
2	8	Nseg=8; number of segments for BOR objects
3	1.6	Hsub=1.6; substrate thickness
4	2.6	Er=2.6
5	0.0022	tgD=0.0022
6	4.4	w1=4.4
7	2.42	w2=2.42
8	60	W=60
9	6	Gap=6
10	31	l1=31
11	29.5	l2=29.5
12	8.02	l3=8.02
13	29.94	l4=29.94
14	31	l5=31
15	62	l6=62
16	27.88	l7=27.88
17	31	l8=31
18	1.9	wn=1.9
19	3	wx=3
20	2.42	wy=2.42
21	26.38	ln=26.38
22	100	R=100; resistance [ohm]
23	3	Hbor=3; length of coaxial line

Figure 3. Table of symbols.

The WIPL-D model is shown in Figure 4.

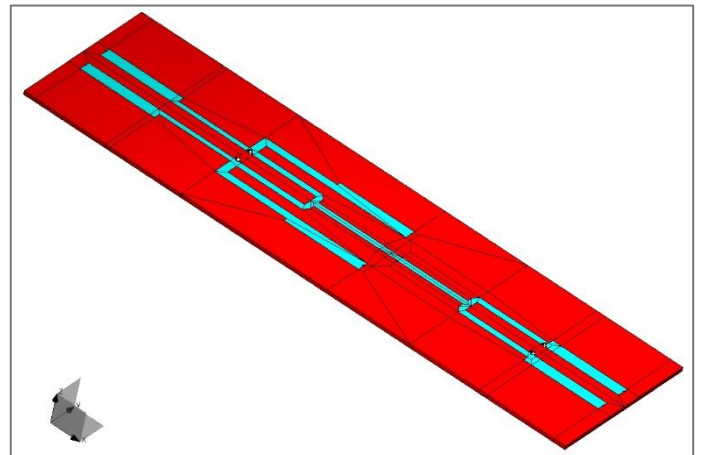


Figure 4. WIPL-D Pro model of the divider.

Layout of the Wipl-D model and clarifications of certain symbols are shown in Figure 5.

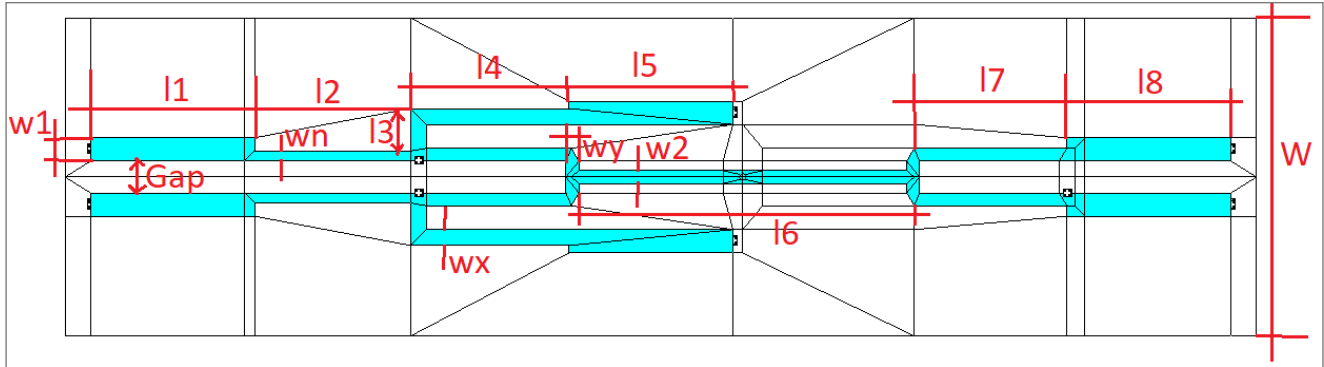


Figure 5. Layout of WIPL-D model.

Feeder at the port 1 is modeled as coaxial line by using objects (BoR and Circle). Feeder attached to the first port is shown in the Figure 6.

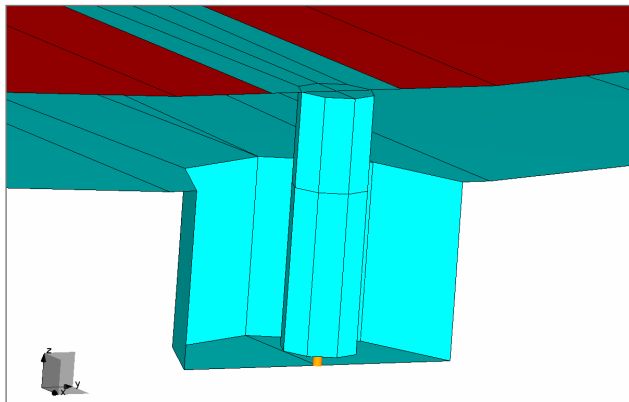


Figure 6. Coaxial feeder (the first or Tx port).

Feeders at the other ports (ports 2-7) are identical, made as WIPL-D standard microstrip port. Model of this feeder is shown in Figure 7.

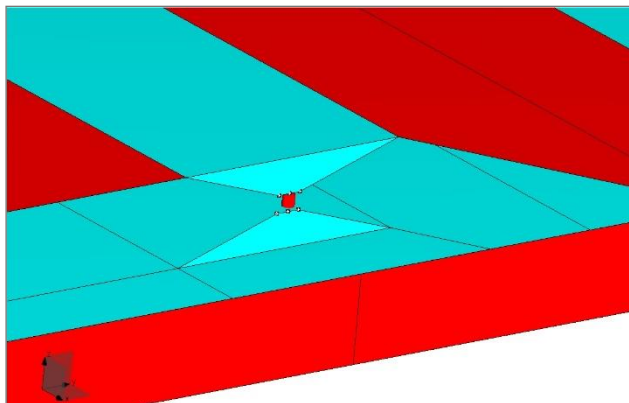


Figure 7. Feeder at ports 2-7.

Simulation settings and results

Frequency range mentioned above (1.4 GHz to 1.6 GHz) was divided into 11 frequency points. Operation mode ANTENNA

(One generator at time) is chosen. Such a low number of frequency points is possible owing to built-in interpolation.

The filter model is symmetrical. Only half of the model can be simulated, with the feature asymmetry used. In this case, the simulation is run twice (with symmetry plane replaced with PEC/PMC) and the results are combined. However, even a 7-port divider is considered as electrically small structure in WIPL-D. The number of unknowns and simulation time are minimum, so applying symmetry does not shorten. But the required number of unknowns is halved.

The simulation was carried out on regular desktop Intel® Core™ i7 CPU 7700@ 3.60 GHz.

Table 1. Simulation time and number of unknowns.

Model	Number of unknowns	Simulation time per frequency
Full	1357	8 sec
With asymmetry	2792	7 sec

s11 (in dB) is shown in Figure 8. Because of symmetry of the structure, parameters s21-s31, s41-s51 and s61-s71 are identical.

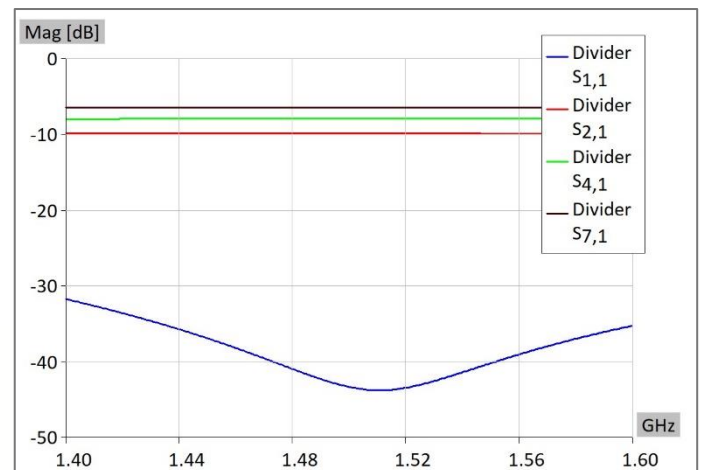


Figure 8. Magnitude of S11 parameters.