Microwave Engineering Practices

Lab Instructor: Dr. WU Guang

Lab Timing: Thursday (10:00 – 12:00)

Experiment: 4

Part-1: Characterization of Rectangular Waveguide

Part-2: Characterization of Circular Waveguide

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***Task*-1:**

Characterization of Rectangular Waveguide

Objective

• Using HFSS, simulate an air-filled WR-90 waveguide shown in Fig. 1.
• To obtain the Field patterns, propagation constant for the first 4 modes (TE_{10}, TE_{20}, TE_{01}, TE_{11} modes).

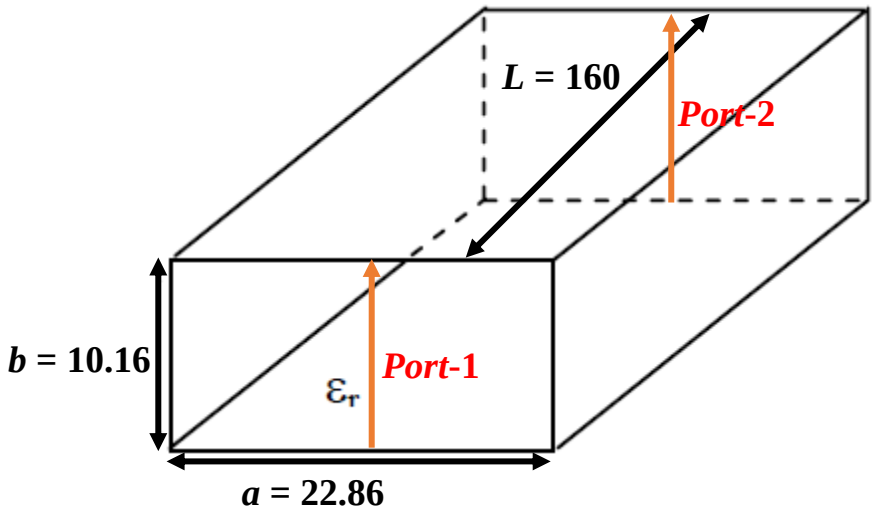

Fig. 1. Rectangular waveguide. Units are in mm.

Analysis

1. Sweep from 1-20 GHz
2. Analysis must include first three modes (TE_{10}, TE_{20}, TE_{01} and TE_{11})
3. Generate a graph for β vs. frequency for each mode using HFSS

Report

1. Format should include title, objective, analysis/discussion, results, and conclusion
2. Include all relevant graphs and outputs from HFSS
3. Compare results for β with those obtained using corresponding theoretical expressions.

Procedure:

1. Draw the rectangular waveguide based on the dimensions given in Fig. 1 and assign material as vacuum.
2. Select the faces other than ports and assign boundary as finite conductivity.
3. Assign ports: **Click HFSS>Excitations>Assign>Wave Port**. Choose number of modes as **4**. Define integral lines for each mode.
4. Point to analysis Setup and add solution setup.
   Solution Frequency: 20 GHz
   Max number of passes: 10
   Max Delta S per passes: 0.002
   Frequency Sweep: 1 GHz – 20 GHz
   Sweep type: Discrete
5. Validate your model and analyze.

6. Results: Plot propagation constant vs frequency to check for the first 4 modes. You can see other parameters by right click on the setup and select matrix data.
7. Analyze E and H field patterns for the first four modes. Observe the different modes (TE_{10}, TE_{20}, TE_{01} and TE_{11}) at the ports.

Task-2:

Characterization of Circular Waveguide

Objective

• Using HFSS, simulate an air-filled circular waveguide shown in Fig. 2.
• To obtain the Field patterns, propagation constant for the first 6 modes (HE_{11}, HEM_{11}, TE_{01}, TM_{01}, HE_{21}, and HEM_{21} modes).

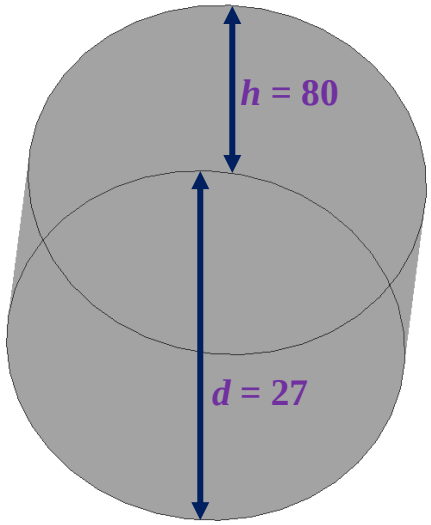

Fig. 2. Circular waveguide. Units are in mm.

Analysis

1. Sweep from 10-40 GHz
2. Analysis must include first three modes (HE_{11}, HEM_{11}, TE_{01}, TM_{01}, HE_{21}, and HEM_{21} modes)
3. Generate a graph for β vs. frequency for each mode using HFSS

Report

1. Format should include title, objective, analysis/discussion, results, and conclusion
2. Include all relevant graphs and outputs from HFSS
3. Compare results for β with those obtained using corresponding theoretical expressions.

Procedure:

1. Draw the rectangular waveguide based on the dimensions given in Fig. 1 and assign material as vacuum.

2. Select the faces other than ports and assign boundary as finite conductivity.
3. Assign ports: **Click HFSS>Excitations>Assign>Wave Port**. Choose number of modes as **6**. Define integral lines for each mode.
4. Point to analysis Setup and add solution setup.
   Solution Frequency: 30 GHz
   Max number of passes: 10
   Max Delta S per passes: 0.008
   Frequency Sweep: 10 GHz – 40 GHz
   Sweep type: Discrete
5. Validate your model and analyze.
6. Results: Plot propagation constant vs frequency to check for the first 6 modes. You can see other parameters by right click on the setup and select matrix data.
7. Analyze E and H field patterns for the first four modes. Observe the different modes (HE_{11}, HEM_{11}, TE_{01}, TM_{01}, HE_{21}, and HEM_{21} modes) at the ports.