Experiment 1 : E-Plane Structure Using HFSS

Aim

To design and model an E-plane structure using ANSYS HFSS by creating and modifying 3D geometry.

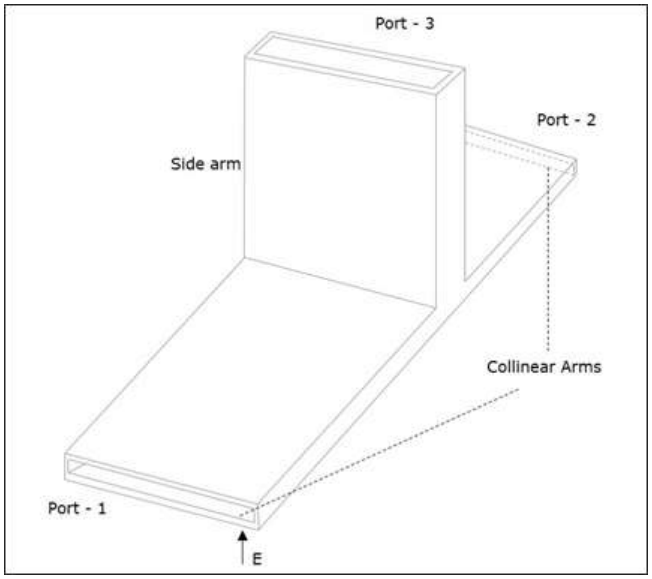
Software Required

ANSYS Electronics Desktop (HFSS)

Theory

An E-Plane Tee junction is formed by attaching a simple waveguide to the broader dimension of a rectangular waveguide, which already has two ports. The arms of rectangular waveguides make two ports called collinear ports i.e., Port1 and Port2, while the new one, Port3 is called as Side arm or E-arm. This E-plane Tee is also called as Series Tee.

As the axis of the side arm is parallel to the electric field, this junction is called E-Plane Tee junction. This is also called as Voltage or Series junction. The ports 1 and 2 are 180° out of phase with each other. The cross sectional view of the E plane Tee is given in figure below:



Procedure

1. **Creation of the Base Box**
   a. Open **HFSS** and start a new 3D model.
   b. Go to **Draw** → **Box** to create a rectangular box.
   c. Enter the following dimensions:
      - **X-dimension**: 22.86 mm
      - **Y-dimension**: 10.16 mm
      - **Z-dimension**: 60 mm
   d. Specify the position of the box as:
      - **X = -11.43 mm**
      - **Y = -5.08 mm**
      - **Z = 0 mm**
   e. Click **OK** to create the box.
   f. Press **Ctrl + D** to zoom out and view the model properly.

2. **Duplicating the Geometry Around the X-Axis**
   a. Right-click the created box.
   b. Select **Edit** → **Duplicate** → **Around Axis**
   c. In the Duplicate Around Axis window:
      - Select **Axis = X-axis**
      - Enter **Rotation Angle = +90°**
   d. Click OK to generate the first rotated copy.
   e. Again right-click on the original box.
   f. Select **Edit** → **Duplicate** → **Around Axis**
   g. In the dialog box:
      - Select **Axis = X-axis**
      - Enter **Rotation Angle = -90°**
   h. Click **OK** to generate the second rotated copy.

3. **Uniting the Model**
   a. Select **all three boxes** created.
   b. Right-click on the selection.
   c. Choose **Edit** → **Boolean** → **Unite** to merge all the shapes into a single solid model.

4. **Assigning Wave Ports**
    a. Select **one face** at the end of the plane (the open end).
    b. Right-click on the selected face and choose: **Excitations** → **Wave Port** → **Next**
    c. In the dialog box, change **Name** if required → click **New Line**.
    d. Move the cursor on the face; when the cursor becomes a **triangle**, click and drag to draw the **integration line** from the center of the inner line to the top inner line.
    e. Click **Next** → **Finish** to complete the wave port assignment.
    f. Select the **other end face** and repeat the same procedure to assign the second wave port.

5. **Assigning Perfect E Boundary**
    a. Select **all the faces of the plane except the two end faces** where the wave ports were assigned.
    b. Right-click and choose: **Assign Boundary** → **Perfect E**
    c. Click **OK**.

6. **Adding Solution Setup**
    a. Go to **Analysis** → **Add Solution Setup**.
    b. Enter the **Solution Frequency = 10 GHz**.
    c. Set **Maximum Number of Passes = 6**.
    d. Click **OK**.

7. **Adding Frequency Sweep**
    a. Go to **Analysis** → **Setup**.
    b. Click on **Setup 1** → choose **Add Frequency Sweep**.
    c. Enter the sweep limits:
        - **Start Frequency = 5 GHz**
        - **Stop Frequency = 15 GHz**
    d. Click **OK**.
    e. Right-click on **Analysis** and select **Analyze All**.
    f. Save the project. The simulation will now run.

8. **Plotting Electric Field Vectors**
    a. Select the plane and right-click.
    b. Choose **Plot Fields** → **E** → **Vector E**.
    c. A dialog box appears → click **Done**.
    d. Electric field vectors will be displayed.
    e. Animate the field distribution if required.

9. **Plotting Magnetic Field (One Side of Plane)**
    a. Select one side of the plane and right-click.
    b. Choose **Plot Fields** → **H** → **Mag H**.
    c. Click **Animate** to observe the magnetic field variation.

10. **Plotting Magnetic Field on Remaining Faces**
    a. Select all the other faces and right-click.
    b. Choose **Plot Fields** → **H** → **Mag H**.
    c. When the dialog box appears, click **Done**.
    d. Animate if required.

Result

The E-plane structure was successfully created, simulated, and field distributions were observed in HFSS