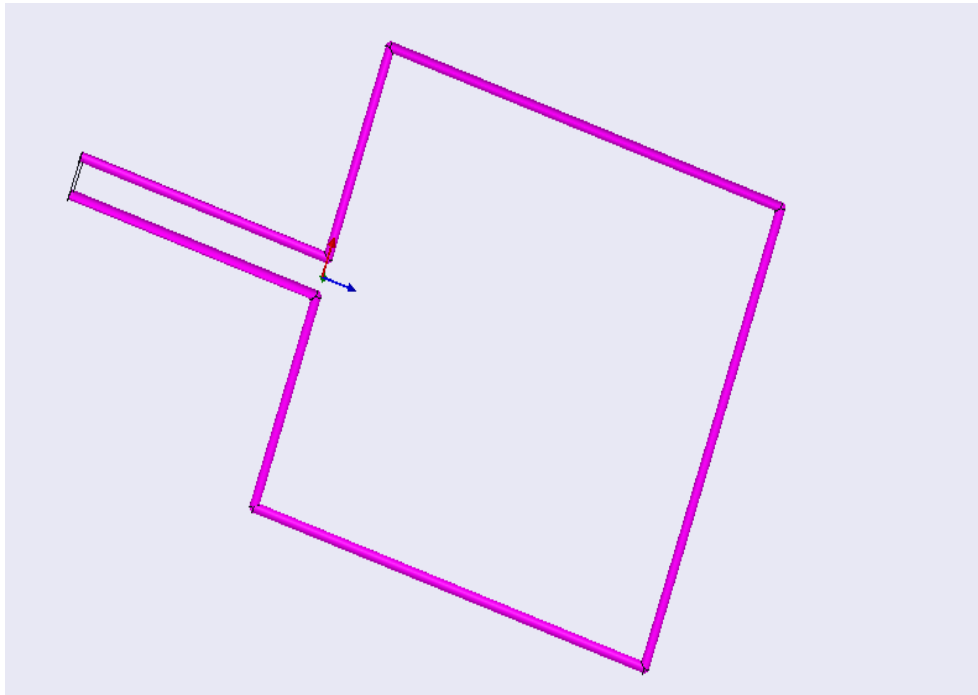


Experiment No.7

Loop Antenna

This example is intended to show you how to create, simulate, and analyze a 10 Meter loop Antenna using the Ansoft HFSS Design Environment.



Ansoft HFSS Design Environment:

The following features of the Ansoft HFSS Design Environment are used to create this passive device model:

3D Solid Modeling:

Primitives: **Cylinders, Sphere**

Boolean: **Union, Subtract, Connect**

Boundaries/Excitations:

Excitations: **Wave Ports**

Boundaries: **Radiation**

Results:

Plotting: **Radiation Pattern**

Design Review:

Port Size/Type:

Since the port is external to the model we could use a Wave Port. The size of the port is determined by the physical dimensions of the sheet created by gap inside the feed of loop antenna.

Free Space:

Since we are evaluating a radiating structure, we need to create a free space environment for the device to operate in. This can be achieved by using the Radiation Boundary condition. We will use a Radiation Boundary since the surface will be rectangular box. The Radiation Boundary needs to be placed at least 1/4 from radiating devices.

Getting Started:

Launching Ansoft HFSS:

To access Ansoft HFSS, click the Microsoft **Start** button, select **Programs**, and select the **Ansoft, HFSS 10** program group. Click **HFSS 10**.

Setting Tool Options:

To set the tool options:

Note: In order to follow the steps outlined in this example, verify that the following tool options are set:

1. Select the menu item **Tools > Options > HFSS Options**
2. HFSS Options Window:
 1. Click the **General** tab Use Wizards for data entry when creating new boundaries: **Checked**
 - Duplicate boundaries with geometry: **Checked**
 2. Click the OK button
 3. Select the menu item **Tools > Options > 3D Modeler Options**.
 4. 3D Modeler Options Window:

1. Click the **Operation** tab

Automatically cover closed polylines: _ **Checked**

2. Click the **Drawing** tab

Edit property of new primitives: _ **Checked**

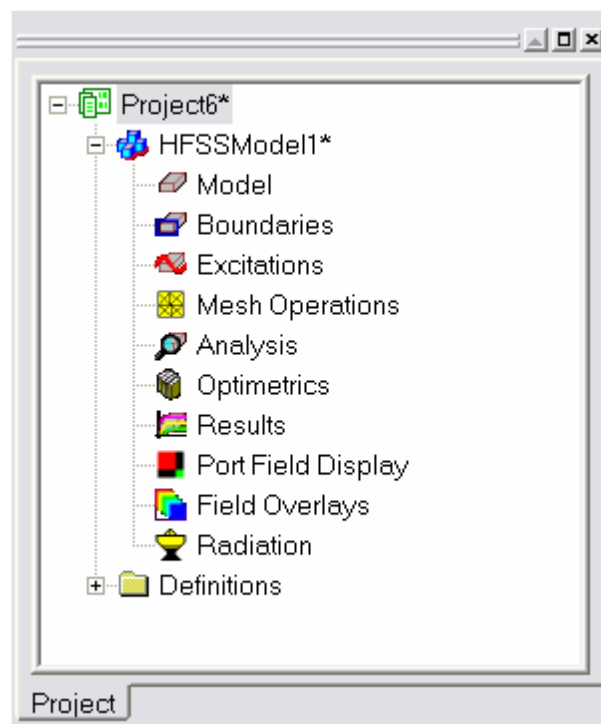
3. Click the **OK** button

Opening a New Project:

To open a new project:

1. In an Ansoft HFSS window, click the _ On the Standard toolbar, or select the menu item **File > New**.

2. From the **Project** menu, select **Insert HFSS Design**.



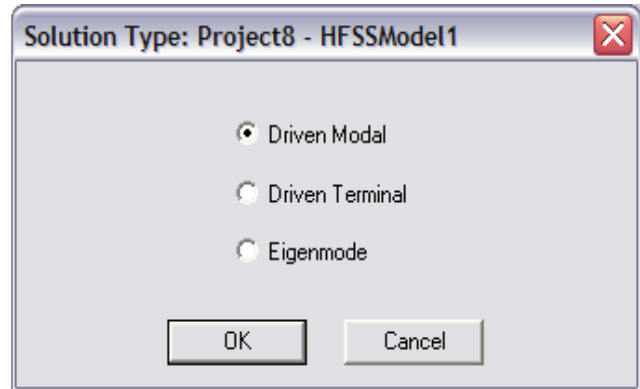
Set Solution Type:

To set the solution type:

1. Select the menu item **HFSS > Solution Type**

2. Solution Type Window:

1. Choose **Driven Modal**
2. Click the **OK** button

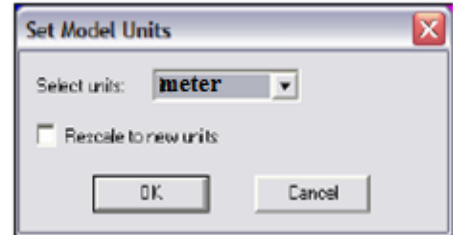


Creating the 3D Model:

Set Model Units:

To set the units:

1. Select the menu item **3D Modeler > Units**
2. Set Model Units:
 1. Select Units: **meter**
 2. Click the **OK** button



Set Default Material:

To set the default material:

Using the 3D Modeler Materials toolbar, choose **copper**



Create Circular Waveguide:

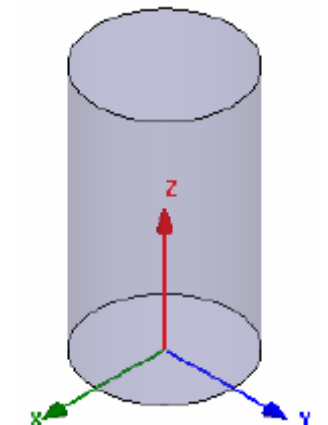
Create upper rib of antenna

1. Select the menu item **Draw > Cylinder**
2. Using the coordinate entry fields, enter the cylinder position
X: 0.0, Y: 0.0, Z: 0.02 Press the **Enter** key
3. Using the coordinate entry fields, enter the radius:
dX: 0.01, dY: 0.0, dZ: 0.0 Press the **Enter** key
4. Using the coordinate entry fields, enter the height:
dX: 0.0, dY: 0.0, dZ: 1.326 Press the **Enter** key

To set the name:

1. Select the Attribute tab from the Properties window.
2. For the Value of Name type: **L_1**
3. Click the **OK** button

To fit the view:



1. Select the menu item **View > Fit All > Active View**.

Or press the **CTRL+D** key

Create Circular rib of antenna:

Create lower rib of antenna

1. Select the menu item **Draw > Cylinder**

2. Using the coordinate entry fields, enter the cylinder position

X: **0.0**, Y: **0.0**, Z: **-0.02** Press the **Enter** key

3. Using the coordinate entry fields, enter the radius:

dX: **0.01**, dY: **0.0**, dZ: **0.0** Press the **Enter** key

4. Using the coordinate entry fields, enter the height:

dX: **0.0**, dY: **0.0**, dZ: **-1.326** Press the **Enter** key

To set the name:

1. Select the Attribute tab from the Properties window.

2. For the Value of Name type: **L_2**

3. Click the **OK** button

To fit the view:

1. Select the menu item **View > Fit All > Active View**.

Or press the **CTRL+D** key

Create Circular rib of antenna:

Create rib of antenna corresponding to previous the upper and lower ribs

1. Select the menu item **Draw > Cylinder**

2. Using the coordinate entry fields, enter the cylinder position

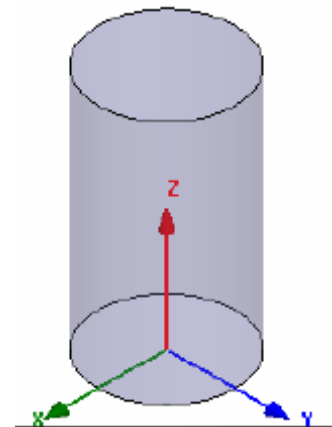
X: **0.0**, Y: **2.692**, Z: **-1.346** Press the **Enter** key

3. Using the coordinate entry fields, enter the radius:

dX: **0.01**, dY: **0.0**, dZ: **0.0** Press the **Enter** key

4. Using the coordinate entry fields, enter the height:

dX: **0.0**, dY: **0.0**, dZ: **2.692** Press the **Enter** key

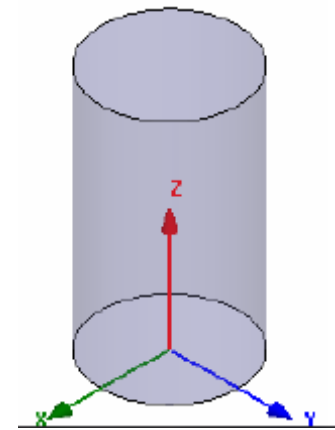


To set the name:

1. Select the Attribute tab from the Properties window.
2. For the Value of Name type: **L_3**
3. Click the **OK** button

To fit the view:

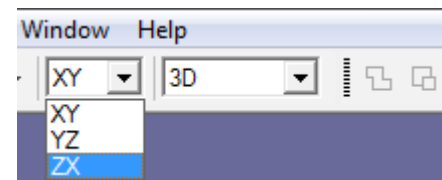
1. Select the menu item **View > Fit All > Active View**.
- Or press the **CTRL+D** key



Set Grid Plane:

To set the grid plane:

1. Select the menu item **3D Modeler > Grid Plane >zx**



Create Horizontal Circular rib of antenna:

Create horizontal rib of antenna

1. Select the menu item **Draw > Cylinder**
2. Using the coordinate entry fields, enter the cylinder position

X: **0.0**, Y: **0.0**, Z: **1.346** Press the **Enter** key

3. Using the coordinate entry fields, enter the radius:

dX: **0.01**, dY: **0.0**, dZ: **0.0** Press the **Enter** key

4. Using the coordinate entry fields, enter the height:

dX: **0.0**, dY:**2.692**, dZ:**0.0** Press the **Enter** key

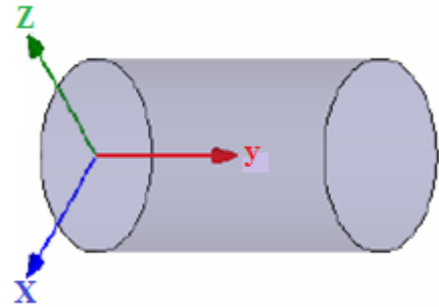
To set the name:

1. Select the Attribute tab from the Properties window.
2. For the Value of Name type: **L_4**
3. Click the **OK** button

To fit the view:

1. Select the menu item **View > Fit All > Active View**.

Or press the **CTRL+D** key



Create Spherical join:

Create Spherical join between ribs of antenna

1. Select the menu item **Draw > Sphere**

2. Using the coordinate entry fields, enter the sphere position

X: **0.0**, Y: **0.0**, Z: **1.346** Press the **Enter** key

3. Using the coordinate entry fields, enter the radius:

dX: **0.01**, dY: **0.0**, dZ: **0.0** Press the **Enter** key

4. Using the coordinate entry fields, enter the height:

dX: **0.0**, dY: **0.0**, dZ: **0.0** Press the **Enter** key

To set the name:

1. Select the Attribute tab from the Properties window.

2. For the Value of Name type: **Sphere1**

3. Click the **OK** button

To fit the view:

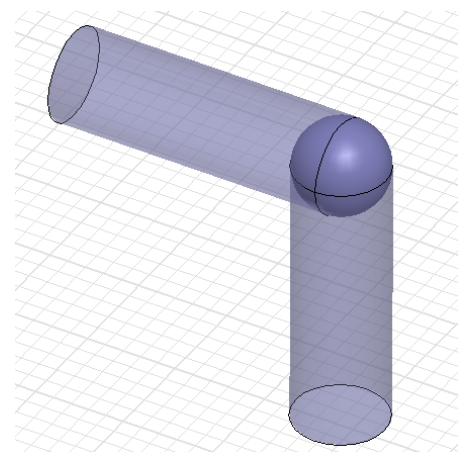
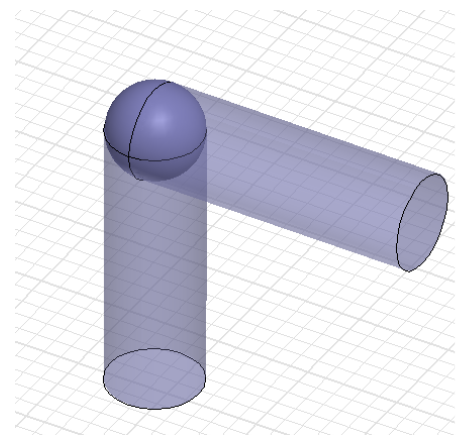
1. Select the menu item **View > Fit All > Active View**.

Or press the **CTRL+D** key

Create Spherical join:

Create Spherical join between ribs of antenna

1. Select the menu item **Draw > Sphere**



2. Using the coordinate entry fields, enter the sphere position

X: **0.0**, Y: **2.692**, Z: **1.346** Press the **Enter** key

3. Using the coordinate entry fields, enter the radius:

dX: **0.01**, dY: **0.0**, dZ: **0.0** Press the **Enter** key

4. Using the coordinate entry fields, enter the height:

To set the name:

1. Select the Attribute tab from the Properties window.

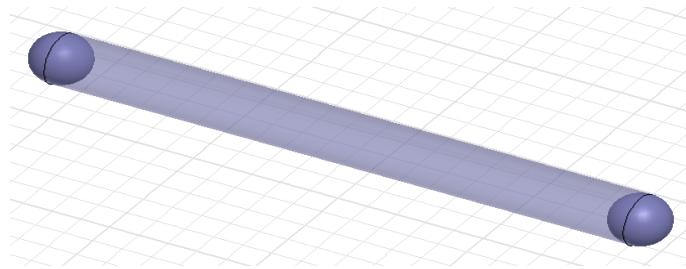
2. For the Value of Name type: **Sphere2**

3. Click the **OK** button

To fit the view:

Select the menu item **View > Fit All > Active View.**

Or press the **CTRL+D** key



Create Circular rib of antenna with two joints:

To create circular rib of antenna with two joints:

Create a Cylinder

Position 0,0,-1.346

Dx= 0.01

Y=2.692

Create spher

Position :0,2.692, -1.346

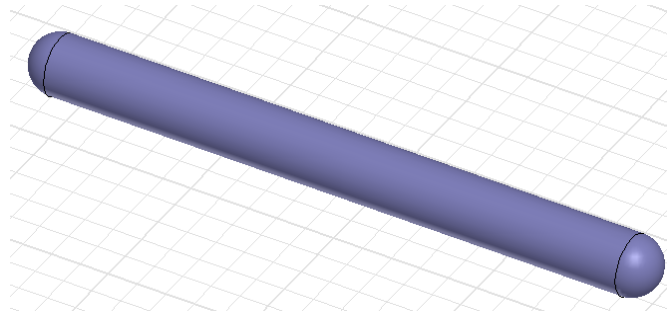
Radius dx= 0.01

Create spher

Position: 0,0, -1.346

Radius: dx= 0.01

cylinder



Create Horizontal Circular rib of antenna with two joints:

Create horizontal rib of antenna corresponding to horizontal previous rib:

1. Select the Attribute tab from the **3D modeler design tree**.
2. Select **L_4**, and select the menu item **Toolbars > Mirror Duplicate**.
 1. Using the coordinate entry fields, enter the sphere position
X: 0.0, Y: 0.0, Z: 0.0 Press the **Enter** key
 2. Using the coordinate entry fields, enter the radius:
dX: 0.0, dY: 0.0, dZ: 1.0 Press the **Enter** key

To set the name:

1. Select the Attribute tab from the Properties window.
2. For the Value of Name type: **L_5**
3. Click the **OK** button

To fit the view:

Select the menu item **View > Fit All > Active View**.

Or press the

CTRL+D

Create

antenna:

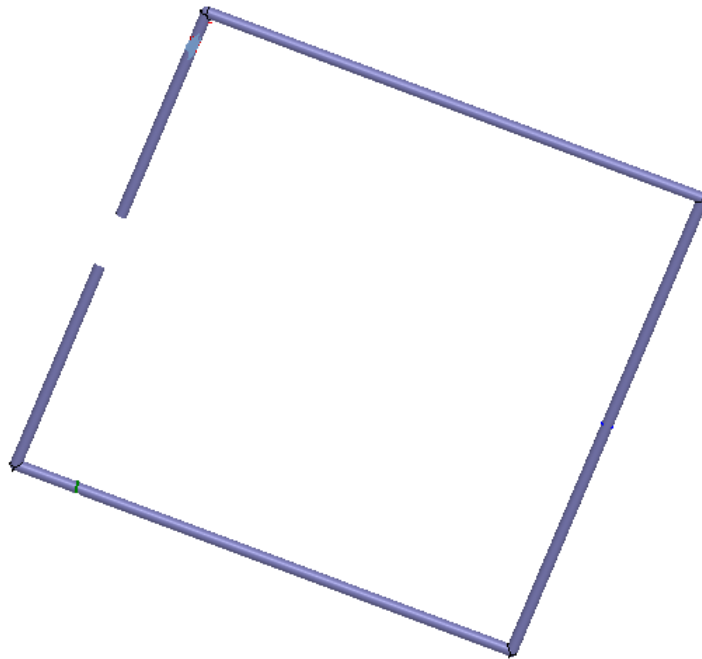
To create

antenna

previous

created

1. Select



key

Loop

loop

from

~ ribs

above:

the

Attribute tab from the **3D modeler design tree**.

2. Select all ribs starting from **L_1, L_2, L_3, L_4** and **L_5**.

3. Select the menu item **Modeler > Boolean>Unite**.

To set the name:

1. Select the Attribute tab from the Properties window.

2. For the Value of Name type: **Loop_Antenna**

3. Click the **OK** button

To fit the view:

Select the menu item **View > Fit All > Active View**.

Or press the **CTRL+D** key

Create Horizontal Circular rib of The Feed:

To create horizontal rib of the feed

1. Select the menu item **Draw > Cylinder**
2. Using the coordinate entry fields, enter the cylinder position
X: 0.0, Y: 0.0, Z: 0.02 Press the **Enter** key
3. Using the coordinate entry fields, enter the radius:
dX: 0.01, dY: 0.0, dZ: 0.0 Press the **Enter** key
4. Using the coordinate entry fields, enter the height:
dX: 0.0, dY:-1.743, dZ:0.0 Press the **Enter** key

To set the name:

1. Select the Attribute tab from the Properties window.
2. For the Value of Name type: **Feed_1**

To fit the view:

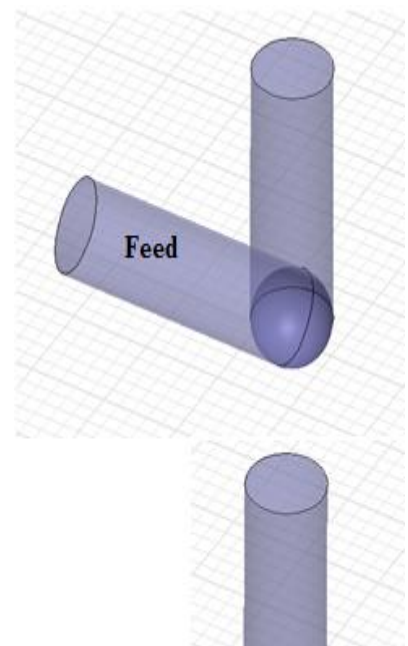
Select the menu item **View > Fit All > Active View.**

Or press the **CTRL+D** key

Create Spherical joint:

Create Spherical joint between ribs of feed

1. Select the menu item **Draw > Sphere**
2. Using the coordinate entry fields, enter the sphere position
X: 0.0, Y: 0.0, Z: 0.02 Press the **Enter** key
3. Using the coordinate entry fields, enter the radius:
dX: 0.01, dY: 0.0, dZ: 0.0 Press the **Enter** key
4. Using the coordinate entry fields, enter the height:



dX: **0.0**, dY:**0.0**, dZ:**0.0** Press the **Enter** key

To set the name:

1. Select the Attribute tab from the Properties window.
2. For the Value of Name type: **Sphere3**
3. Click the **OK** button

To fit the view:

Select the menu item **View > Fit All > Active View.**

Or press the **CTRL+D** key

Create Horizontal Circular rib of The Feed:

To create horizontal rib corresponding to previous feed

1. Select the menu item **Draw > Cylinder**
2. Using the coordinate entry fields, enter the cylinder position

X: **0.0**, Y: **0.0**, Z: **-0.02** Press the **Enter** key

3. Using the coordinate entry fields, enter the radius:

dX: **0.01**, dY: **0.0**, dZ: **0.0** Press the **Enter** key

4. Using the coordinate entry fields, enter the height:

dX: **0.0**, dY:**-1.743**, dZ:**0.0** Press the **Enter** key

To set the name:

1. Select the Attribute tab from the Properties window.
2. For the Value of Name type: **Feed_2**
3. Click the **OK** button

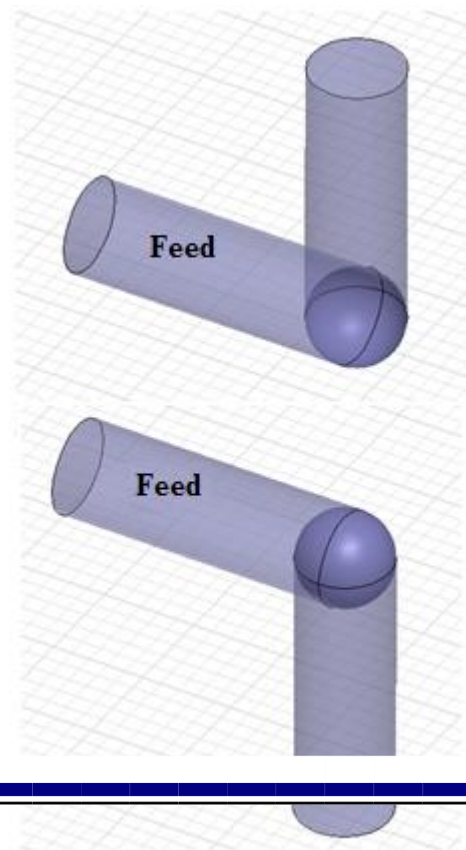
To fit the view:

Select the menu item **View > Fit All > Active View.**

Or press the **CTRL+D** key

Create Spherical join:

Create Spherical join between ribs of feed



1. Select the menu item **Draw >Sphere**
2. Using the coordinate entry fields, enter the sphere position
X: 0.0, Y: 0.0, Z: -0.02 Press the **Enter** key
3. Using the coordinate entry fields, enter the radius:
dX: 0.01, dY: 0.0, dZ: 0.0 Press the **Enter** key
4. Using the coordinate entry fields, enter the height:
dX: 0.0, dY:0.0, dZ:0.0 Press the **Enter** key

To set the name:

1. Select the Attribute tab from the Properties window.
2. For the Value of Name type: **Sphere4**
3. Click the **OK** button

To fit the view:

Select the menu item **View > Fit All > Active View.**

Or press the **CTRL+D** key

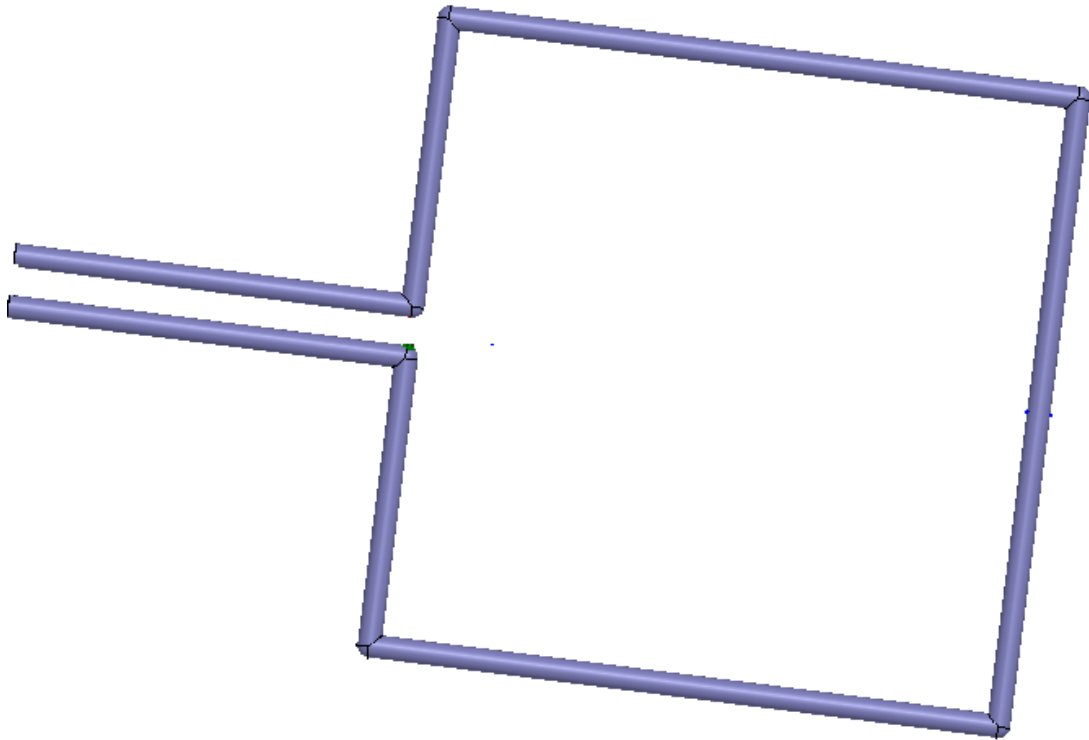
Create Loop antenna with transmission feed:

To create loop antenna from all previous:

1. Select the Attribute tab from the **3D modeler design tree.**
2. Select all ribs starting from **Loop_Antenna, Feed1, Feed2, sphere3 and sphere4.**
3. Select the menu item **Modeler > Boolean>Unite.**

Select the menu item **View > Fit All > Active View.**

Or press the **CTRL+D** key

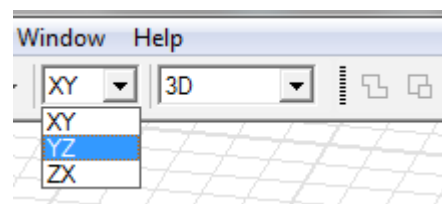


Set Grid Plane:

To set the grid plane:

Select the menu item **3D Modeler >**

Grid Plane >YZ



Create the Lumped Port

To create a rectangular that represents the port:

1. Select the menu item **Draw > Rectangle**

2. Using the coordinate entry fields, enter the center position

X: **0.0**, Y: **-1.743**, Z: **-0.01** Press the **Enter** key

3. Using the coordinate entry fields, enter the radius of the circle:

dX: **0.0**, dY: **0.02**,

dZ: **0.02** Press

the **Enter** key



To set the name:

1. Select the **Attribute** tab from the **Properties** window.
2. For the **Value** of **Name** type: **p1**
3. Click the **OK** button

To select the object **p1**:

1. Select the menu item **Edit > Select > By Name**
2. Select Object Dialog,
 1. Select the objects named: **p1**
 2. Click the **OK** button

Create Lumped Port Excitation:

To assign lumped port excitation

1. Select the menu item **HFSS > Excitations >**

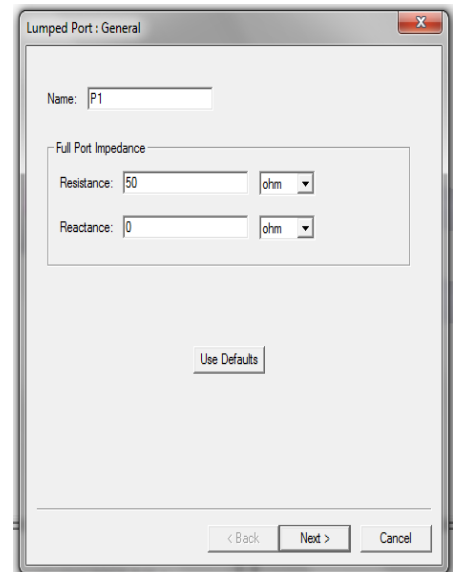
Assign >Lumped Port

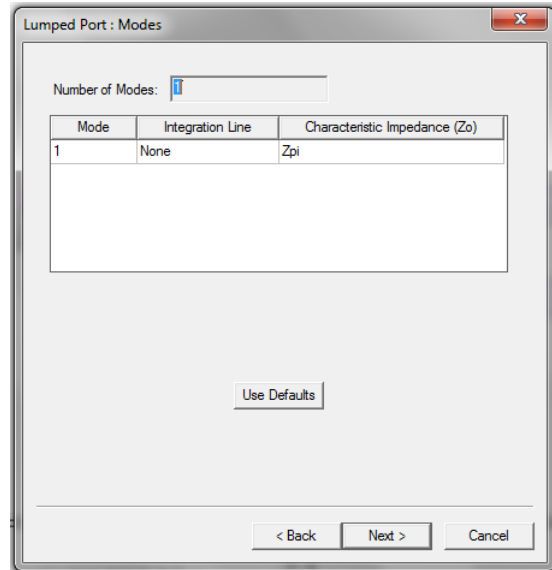
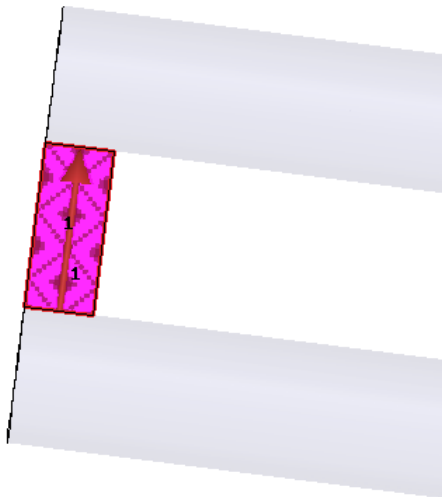
2. Wave Port: General

1. Name: **p1**
2. Click the **Next** button

3. Lumped Port: Modes

1. Number of Modes: **1**
2. For **Mode 1**, click the **None** column and select **New Line**
3. Using the coordinate entry fields, enter the vector position
X:0.0, Y: -1.733, Z: 0.0 Press the **Enter** key
4. Using the coordinate entry fields, enter the vertex
dX: 0.0, dY:-1.733, dZ: 0.01 Press the **Enter** key
5. Click the **Next** button
6. Click the **Finish** button



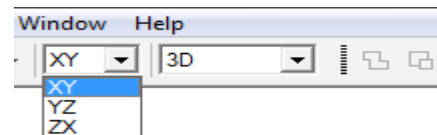


Set Grid Plane:

To set the grid plane:

Select the menu item **3D Modeler > Grid Plane > XY**

Set Default Material



To set the default material:

Using the 3D Modeler Materials toolbar, choose **vacuum**

Create Air:

Create Air

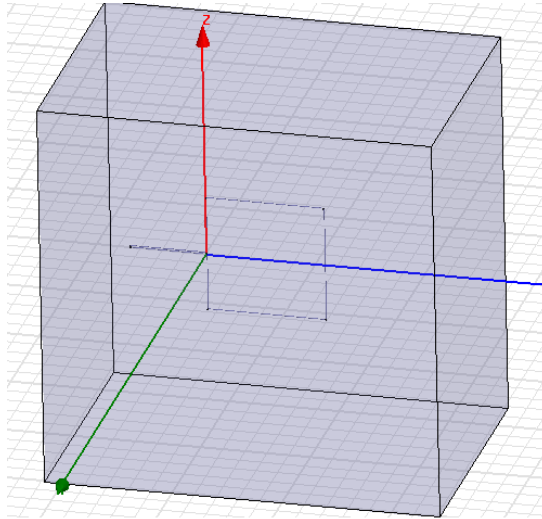
1. Select the menu item **Draw >Box**
2. Using the coordinate entry fields, enter the cylinder position
X:-3.0, Y: -3.0, Z:-4.5 Press the **Enter** key
3. Using the coordinate entry fields, enter the radius:
dX:6.0, dY: 9.0, dZ: 9.0 Press the **Enter** key

To set the name:

1. Select the **Attribute** tab from the **Properties** window.
2. For the **Value** of Name type: **Air**
3. Click the **OK** button

To fit the view:

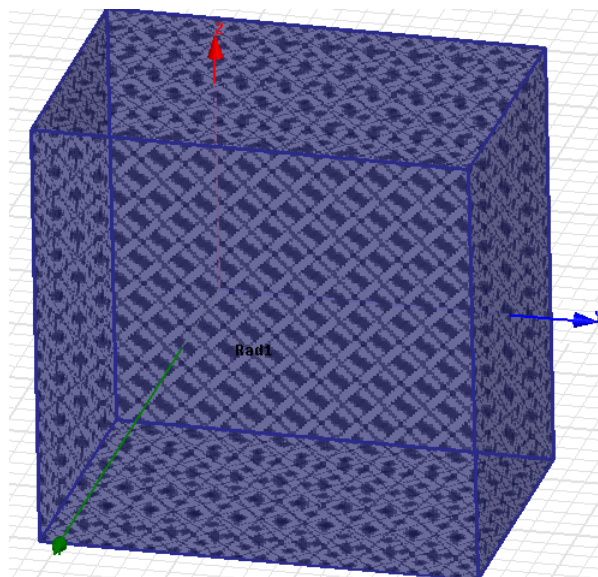
Select the menu item **View > Fit All > Active View.**



Create Radiation Boundary:

To create a radiation boundary:

1. Select the menu item **Edit > Select > By Name**
2. Select Object Dialog,
 1. Select the objects named: **Air**
 2. Click the **OK** button
3. Select the menu item **HFSS > Boundaries > Assign > Radiation**
4. Radiation Boundary window
 1. Name: **Rad1**
 2. Click the **OK** button



Analysis Setup:

To create an analysis setup:

1. Select the menu item **HFSS > Analysis Setup > Add Solution Setup**
2. Solution Setup Window:
 1. Click the General tab:
Solution Frequency: **28MHz**
Maximum Number of Passes: **10**
Maximum Delta S per Pass: **0.02**
 2. Click the **OK** button

Adding frequency sweep Analysis Setup:

To create an analysis frequency sweep setup:

1. Select the menu item **HFSS > Analysis Setup > Add frequency sweep**
2. Solution Edit Sweep Window:
 - 1- Sweep name: **Sweep1**
Sweep type: **Fast**
 - 2- Frequency setup:
Type: **linear setup**
Start: **0.1 MHz**
Stop: **40 MHz**
Step size: **0.01 MHz**
 - 3- Save fields **checked**

Save Project:

To save the project:

1. In an Ansoft HFSS window, select the menu item **File > Save As.**
2. From the **Save As** window, type the Filename: **hfss_LoopA**
3. Click the **Save** button

Model Validation

To validate the model:

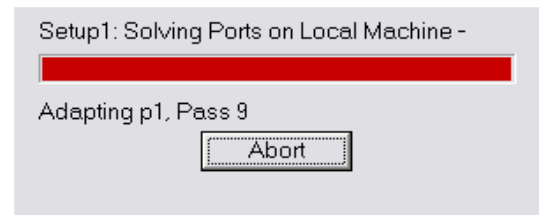
1. Select the menu item **HFSS > Validation Check**
2. Click the Close button

Note: To view any errors or warning messages, use the Message Manager.

Analyze:

To start the solution process:

Select the menu item **HFSS > Analyze All**

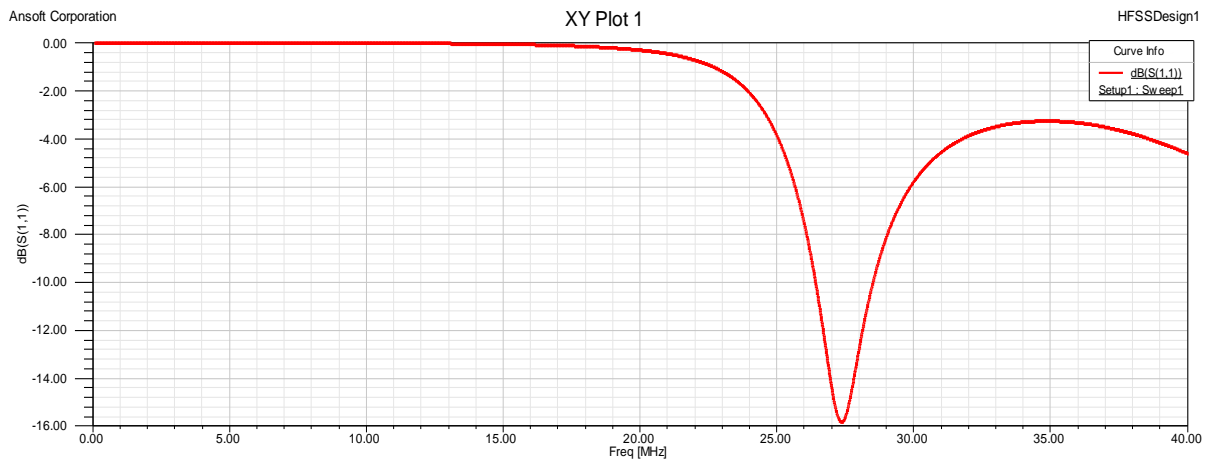


Create Reports:

Create Terminal S-Parameter Plot - Magnitude

To create a report:

1. Select the menu item **HFSS > Results > Create Report**
2. Create Report Window:
 1. Report Type: **Terminal S Parameters**
 2. Display Type: **Rectangular**
 3. Click the **OK** button
3. Traces Window:
 1. Solution: **Setup1: Sweep1**
 2. Domain: **Sweep**
 3. Click the Y tab
 1. Category: **Terminal S Parameter**
 2. Quantity: **St (p1,p1),**
 3. Function: **dB**
 4. Click the **Add Trace** button
4. Click the **Done** button
5. Select the menu **Report 2D > Mark All Traces**
Click the Min button.



Discussion:

- 1- What are the difference between small square loop antenna and small circular?
- 2- Why loop antenna used in angle finding application?