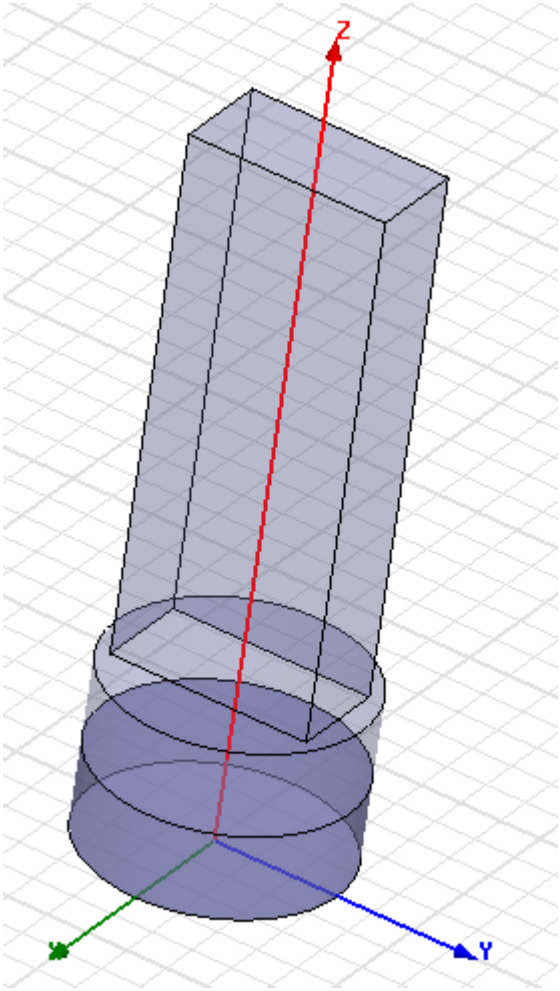
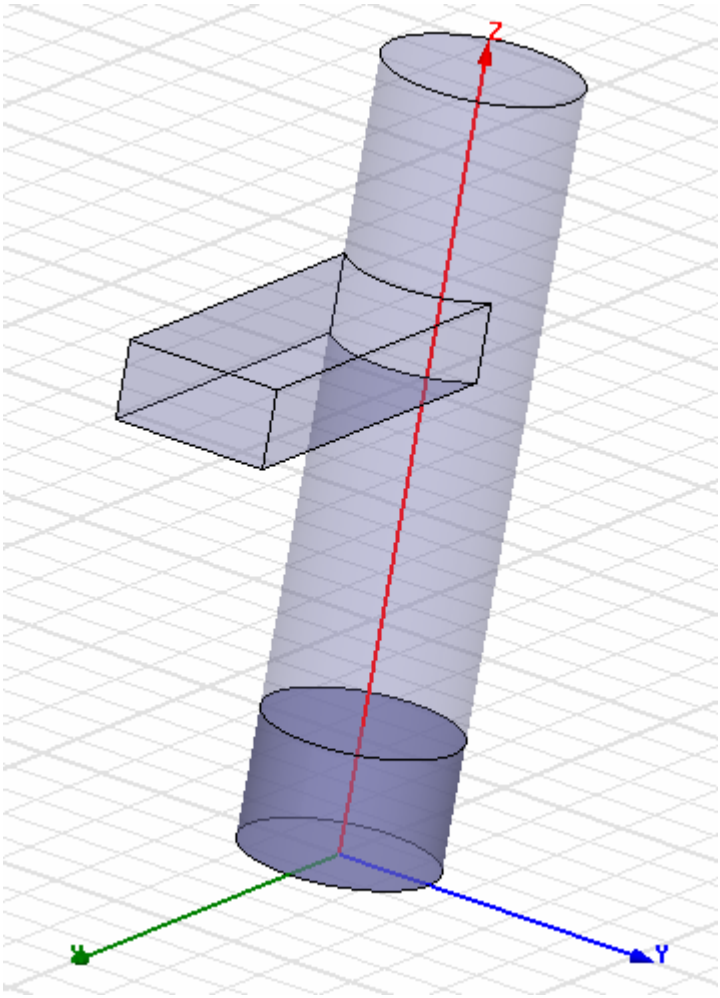
Ansoft's High Frequency Structure Simulator (HFSS)

Beginner's Tutorial

Part (A), Part (B)

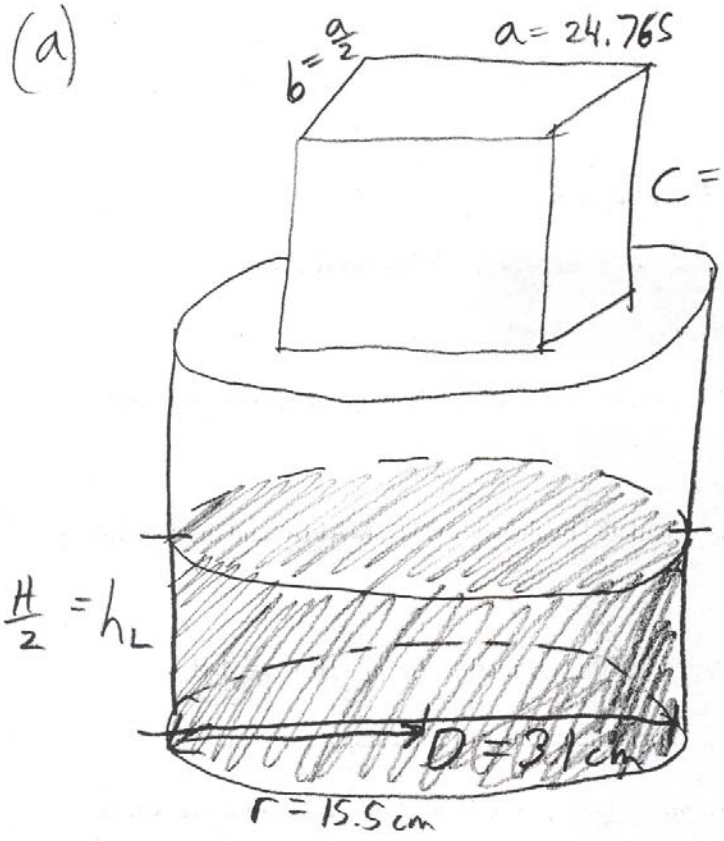

Z
Y


Z
Y

HFSS Beginner's Tutorial

Part (A) of the HFSS Beginner's Tutorial will guide you step by step to the completion of your first HFSS model. In Part (B) you will create a second model that is very similar to the first. The repetition of these steps will help you learn HFSS more quickly. The tutorial becomes less detailed as you proceed. After completion of the HFSS Beginner's Tutorial you will be able to make simple HFSS models. The more you use the software, the easier it will become to build different models.

(a)



HFSS Beginner's Tutorial
Part (A)

Definitions for Project Variables

$\varepsilon_r = 4 - j \cdot 1$

$\frac{1}{4} = 0.25$ is the dielectric loss tangent.

4 is the relative permittivity.

$a = 24.765$

$b = \frac{a}{2}$

$C = 65\ cm$

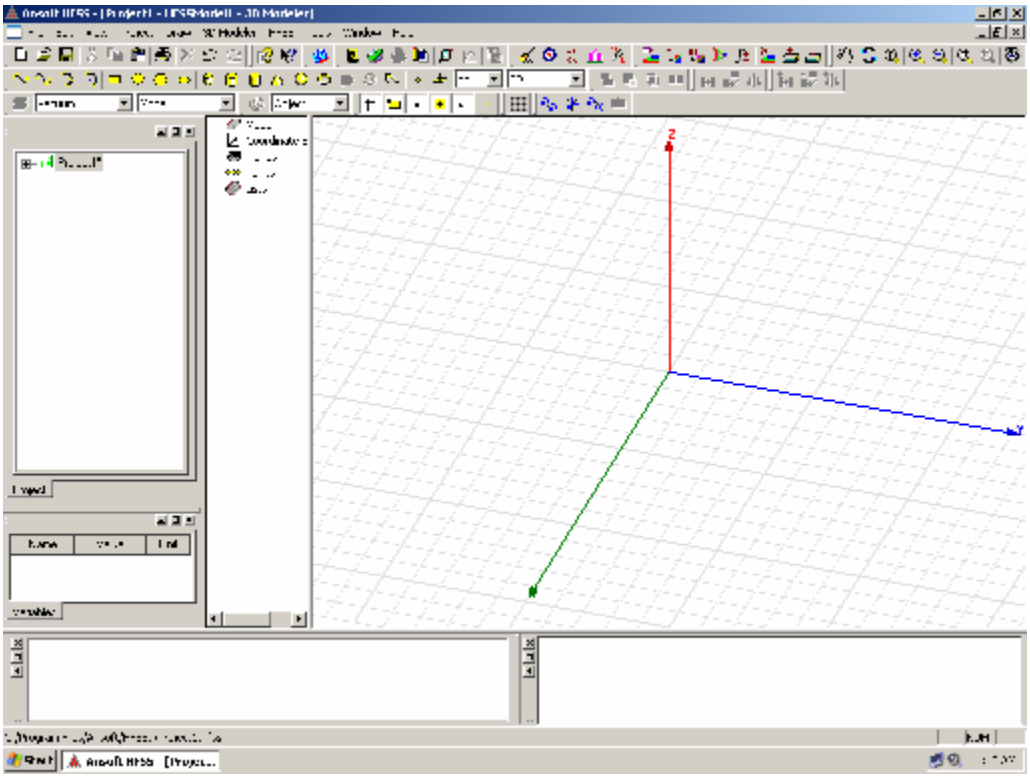
$r = 15.5\ cm$

$H = 20.7\ cm$

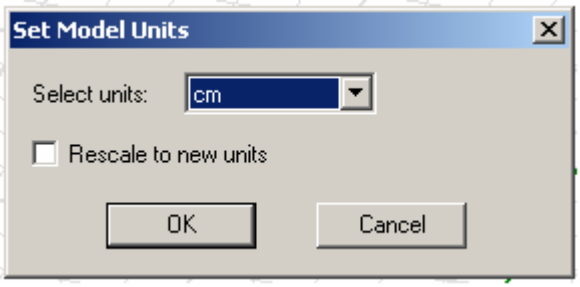
$hL = \frac{H}{2}$

$\varepsilon_r = 4 - j$

1) After opening HFSS, L-click on the **Insert HFSS Design** button () at the top of the screen. Your window should look like the picture below:

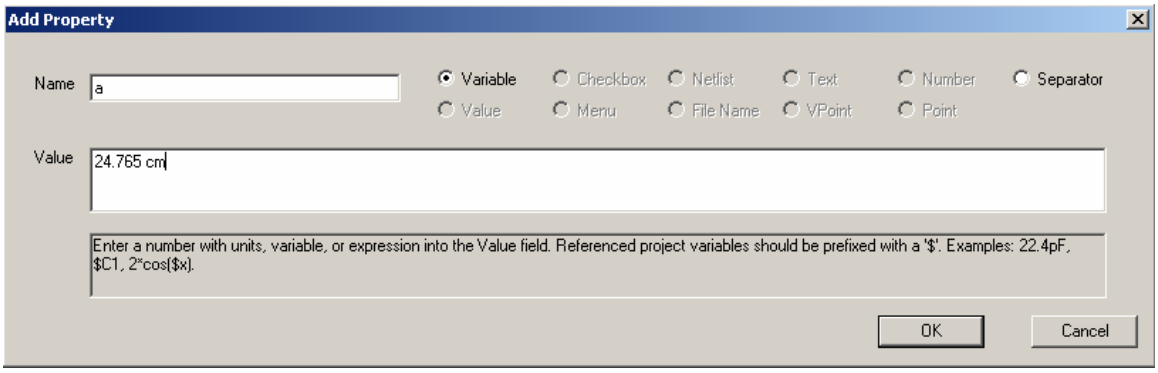


2) On the menu bar choose **3D Modeler** . . . **Units** . . . and select "cm".



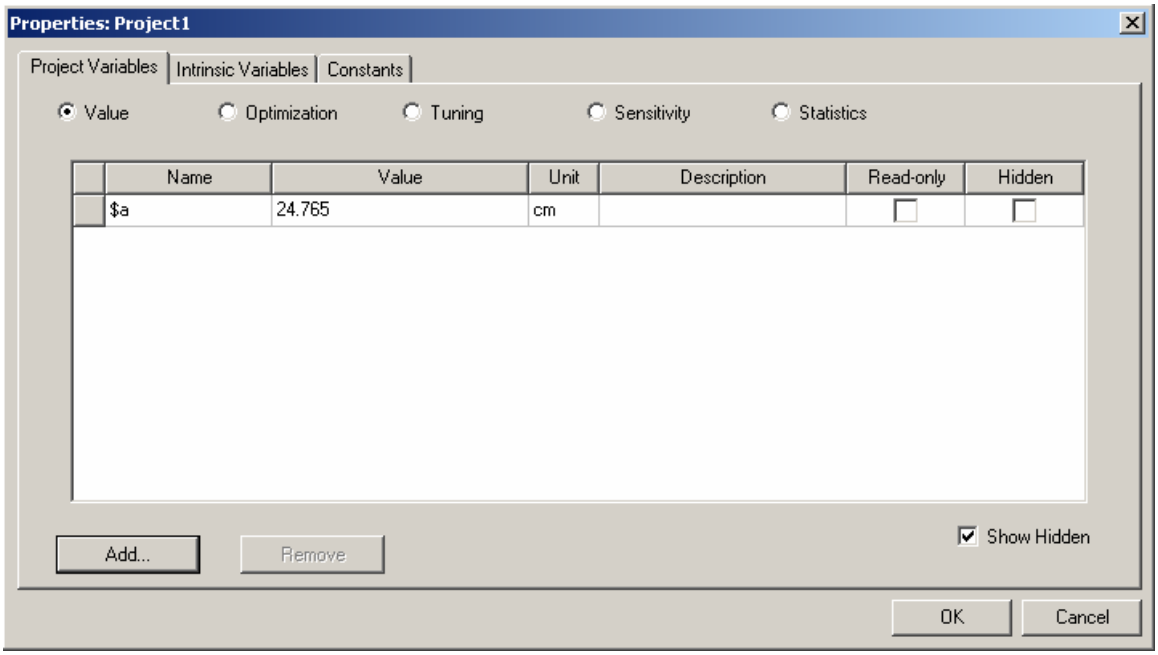
Click **OK**.

3) On the menu bar choose **Project** . . . **Project Variables** . . . **Add** . . and enter the first variable as seen in the window on the next page.

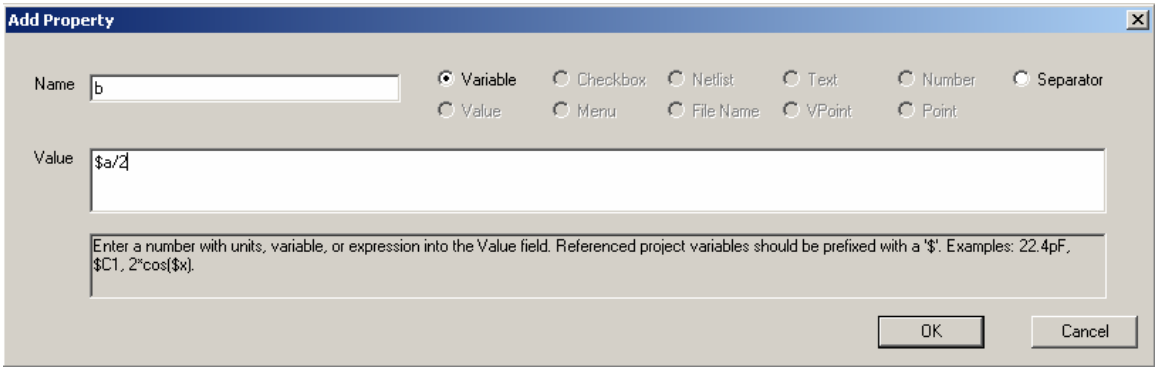


Click **OK**.

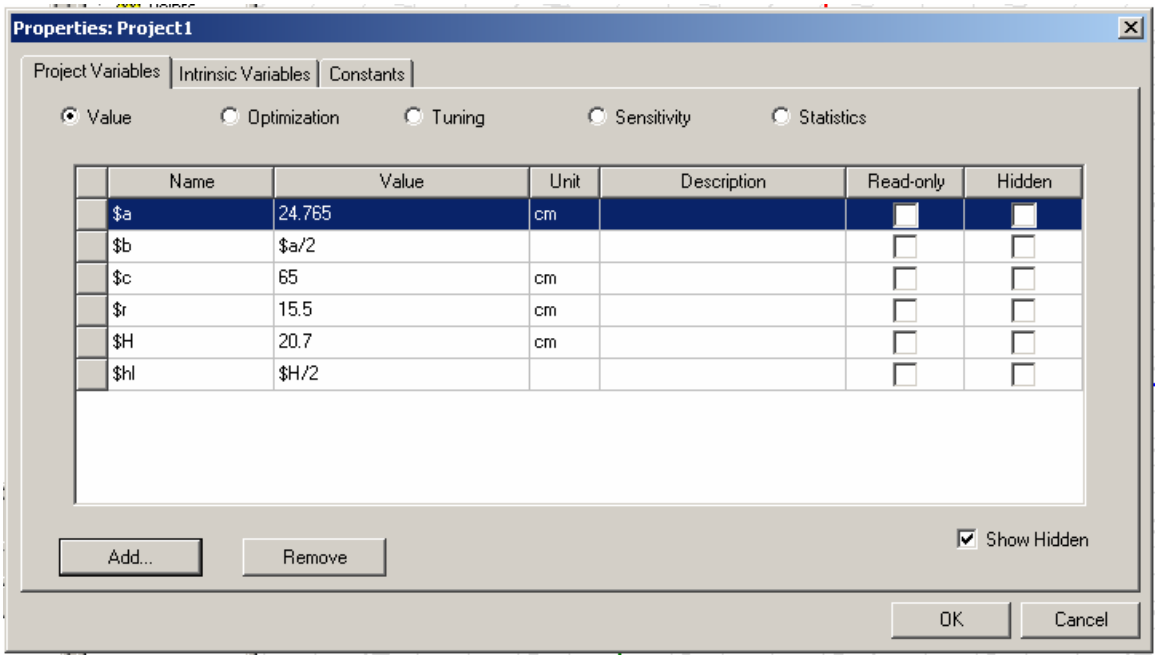
4) You should now see one variable in the Project Variables table.



5) Click Add again and enter the second variable.



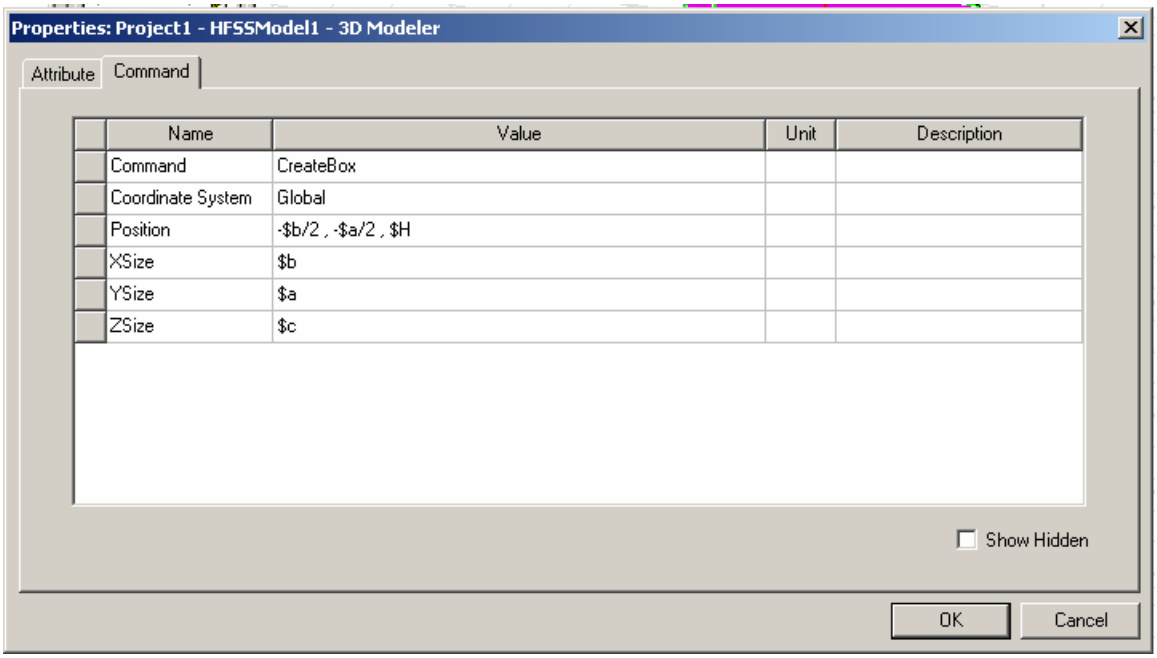
6) Enter the rest of the variables on your own.



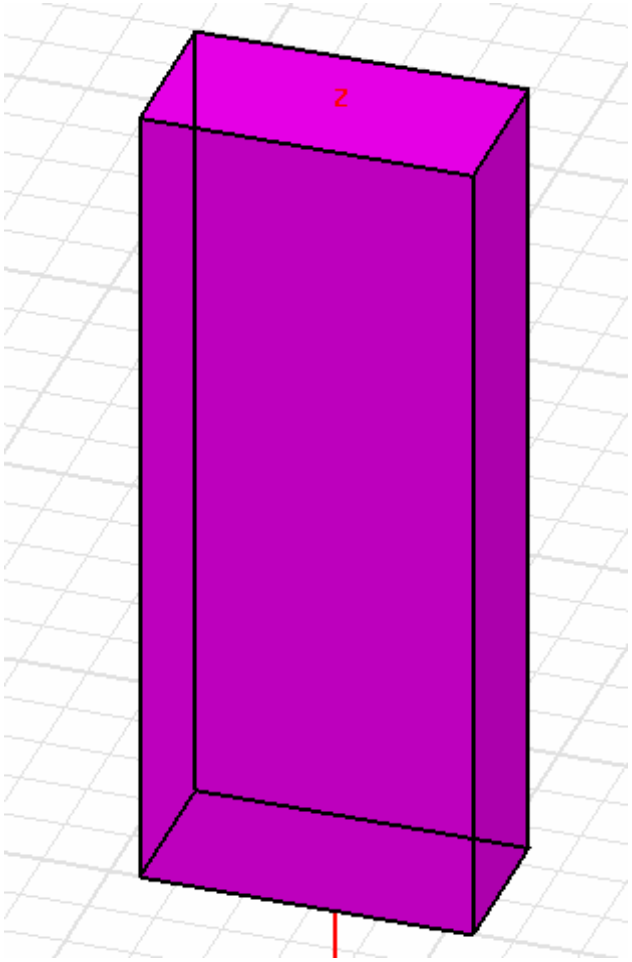
Click **OK**.

7) L-click on the Draw Box button (). Now L-click on the graph at 3 different points to make a box of any size.

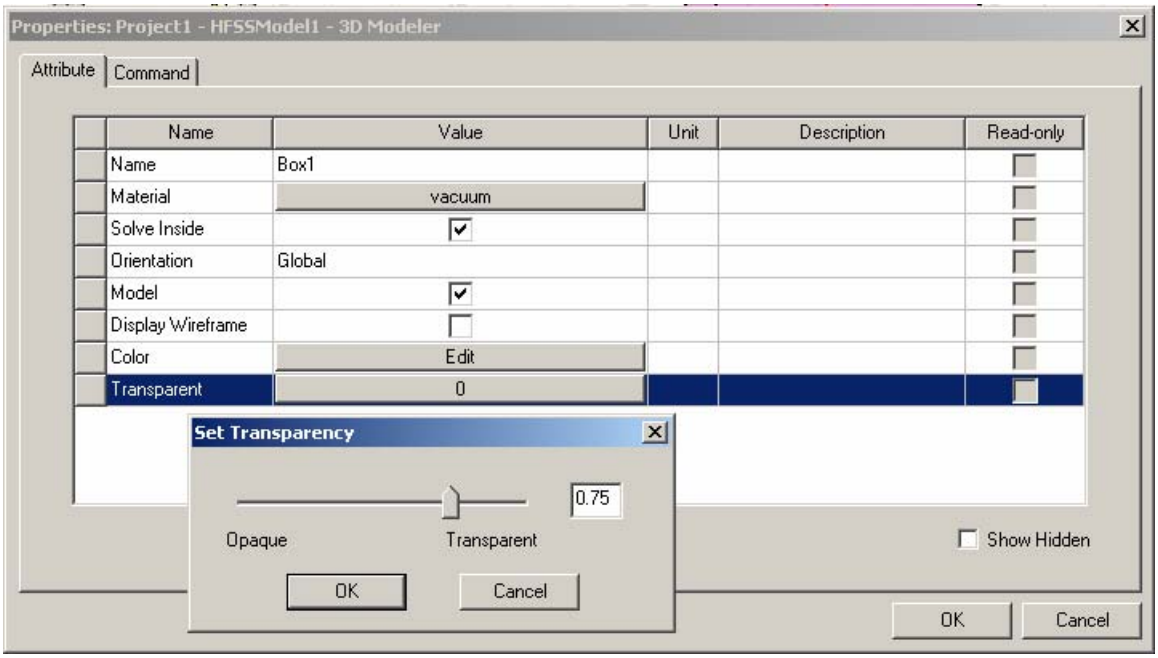
8) If this is done correctly, a dialogue window will open. Enter the following dimensions for the box:



Click **OK**.
Type **Ctrl-D**. You should see a box like the one on the next page.

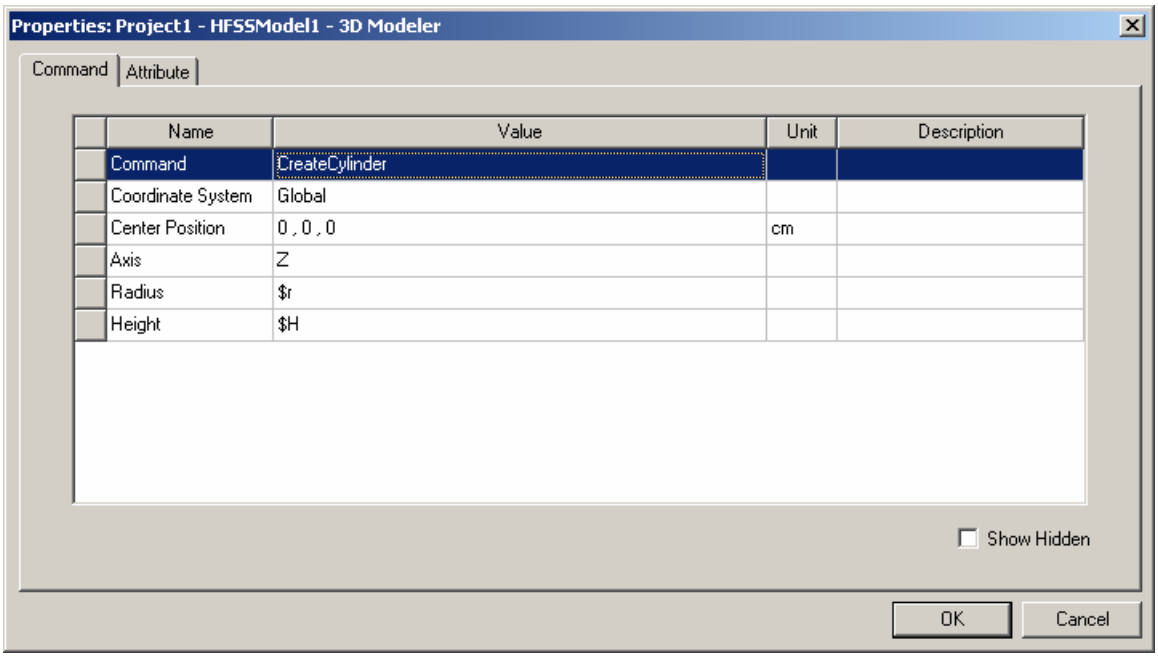


8) L-click on your box. It should be highlighted in purple like the picture above. This lets the user know that an object has been selected. R-click on the box and choose **Edit . . . Properties** . . . under the **Attribute** tab, click on the button with a "0" to change the **Transparency** of your box. Set the Transparency to 0.75.



Click **OK** twice.

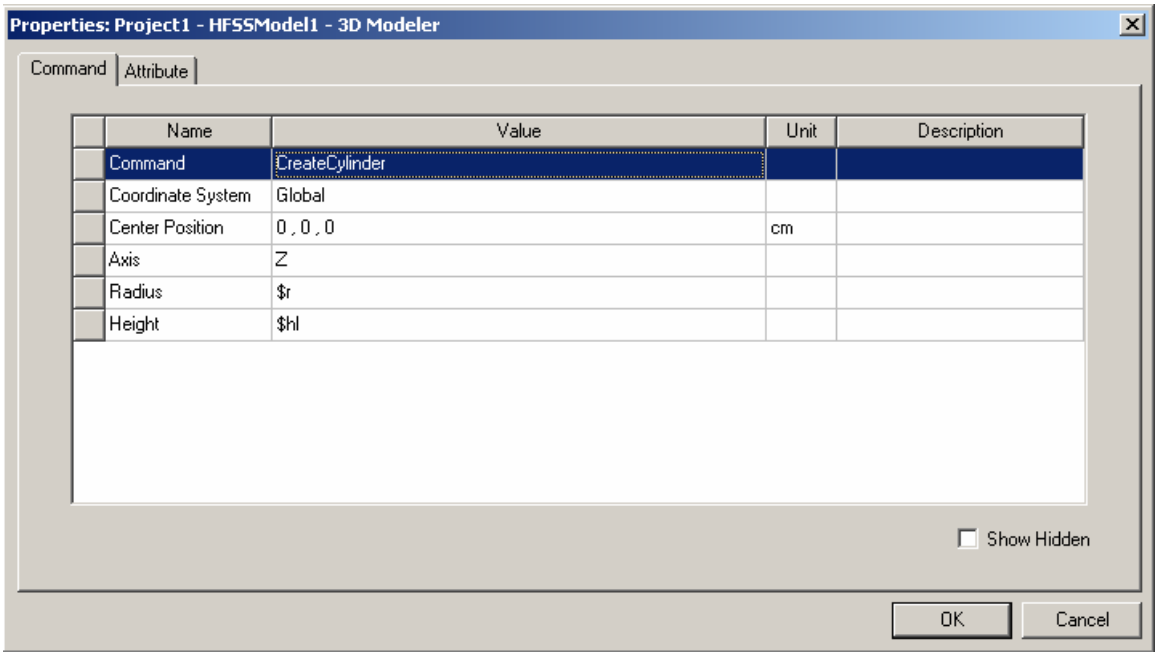
9) L-click on the Draw Cylinder button ( ). L-click on the graph at 3 different points to make a cylinder of any size. Enter the dimensions seen below.



Click **OK**.
Type **Ctrl-D**.

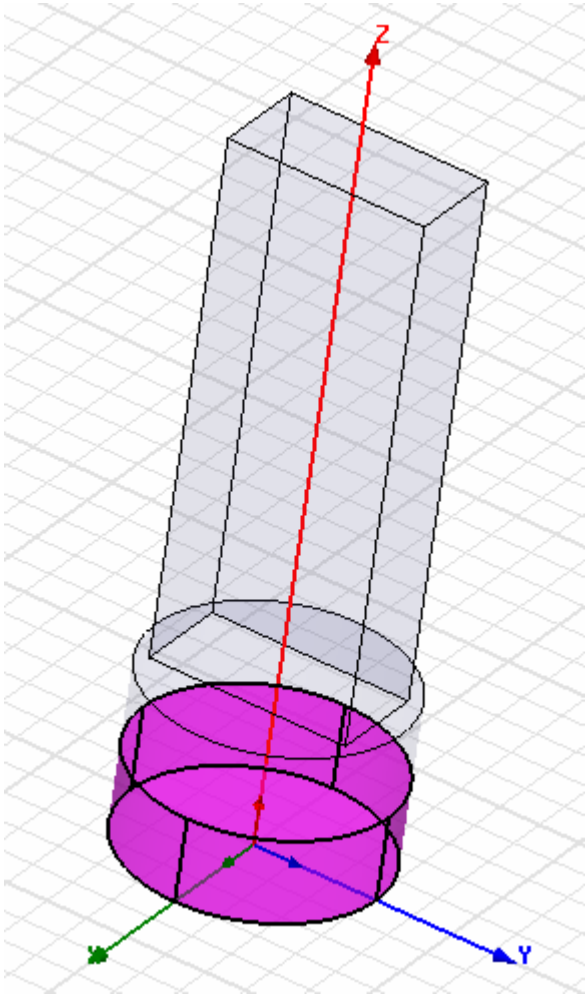
10) L-click on the new cylinder to select it. R-click on the cylinder and select **Edit . . . Properties . . .** under the **Attribute** tab, change the **transparency** to 0.75, just like with the box.

11) When you are finished changing the cylinder's transparency, L-click on the **Draw Cylinder** button ( ). L-click on the graph at 3 different points to make a second cylinder. Enter these dimensions:



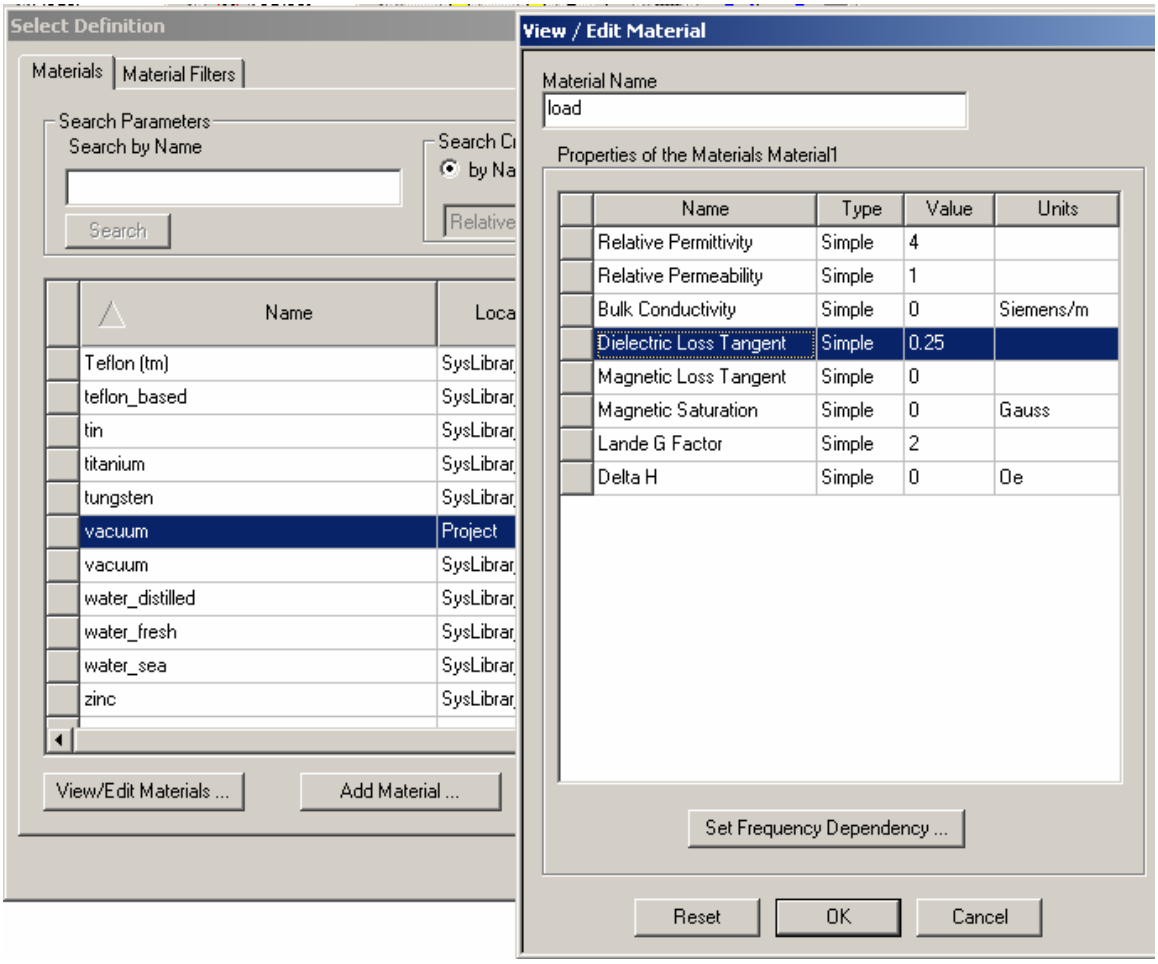
Click **OK**.
Type **Ctrl-D**.

12) Select the second smaller cylinder with a L-click. Now, R-click on the cylinder and select **Edit . . . Properties . . .** under the **Attribute** tab, change the transparency to 0.50. Now you should see that the small cylinder is inside the large cylinder.



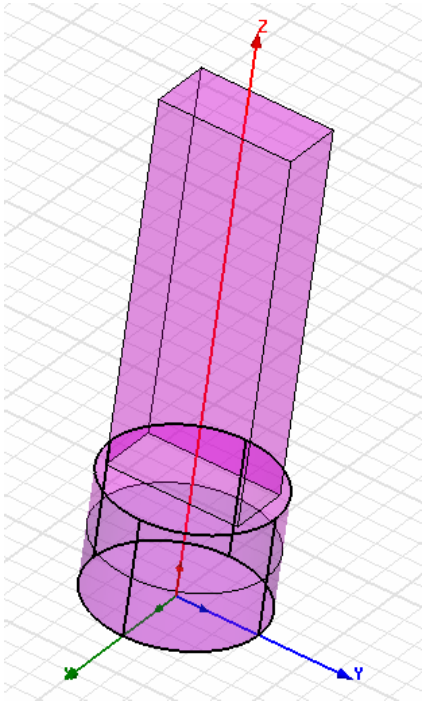
13) Now we will change the name of the smaller cylinder. Select the second, smaller cylinder again. R-click on the cylinder and select **Edit . . . Properties . . .** under the Attribute tab, change the name from "cylinder2" to "Sample". Click **OK**.

14) Now we will change the material inside the smaller cylinder. Select the second, smaller cylinder one more time. R-click on the cylinder and select **Edit . . . Properties . . .** under the **Attribute** tab, click the "**vacuum**" button. Choose **Add Material** . . . in the new window. Enter "load" as the new material name, and change the "**relative permittivity**" and the "**dielectric loss tangent**" to 4 and 0.25, respectively. See picture on the next page.



Click **OK** 3 times.

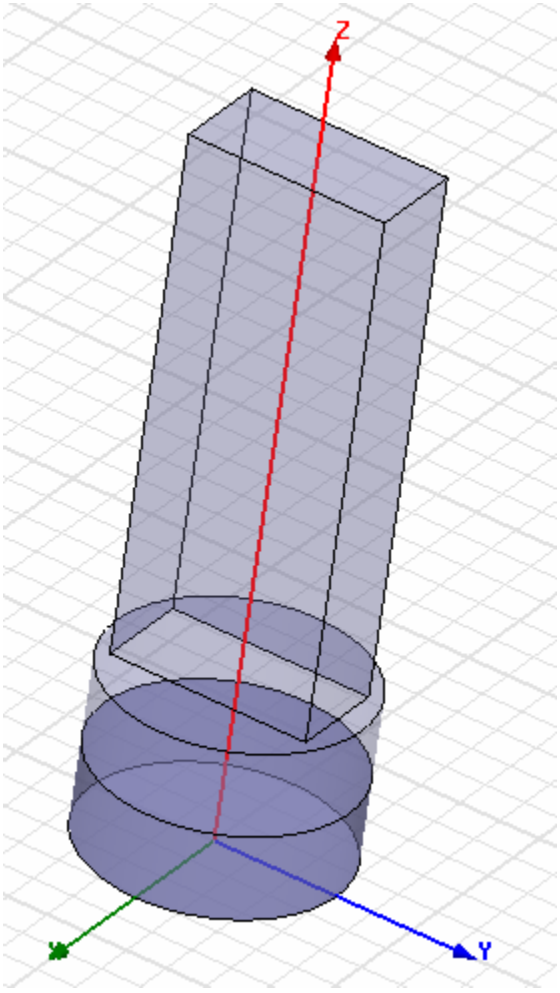
15) Now we will join the large cylinder and the box into one object. Select the large cylinder. Now hold Ctrl and L-click on the box to select both the large cylinder and the box simultaneously. Your model should look like the one below.



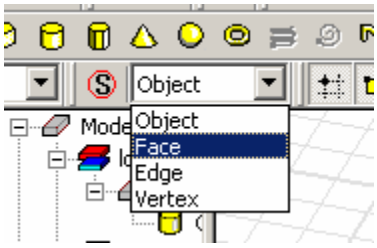
16) R-click on the box and choose **Edit . . . Boolean . . . Unite**. Now the large cylinder and box are one object instead of two.

17) Let us change the name of the united object. Select the united object. R-click on it and select **Edit . . . Properties . . .** under the **Attribute** tab change the name from "cylinder1" to "Chassis".

18) Now click on the graph so that nothing is selected and your model looks like the one below.

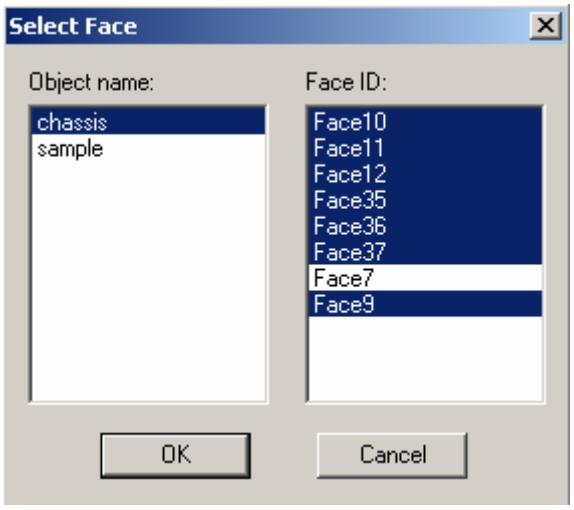


19) Now we will assign boundaries to the faces of our model. Choose "**Face**" instead of "**Object**" on the **Selection Mode** pull down tab as seen below.



20) L-click on the Select by Name button ().

21) In the new window choose Chassis and use Ctrl-L-click to choose all faces shown below. As you select the faces, they will be highlighted in purple on the graph.

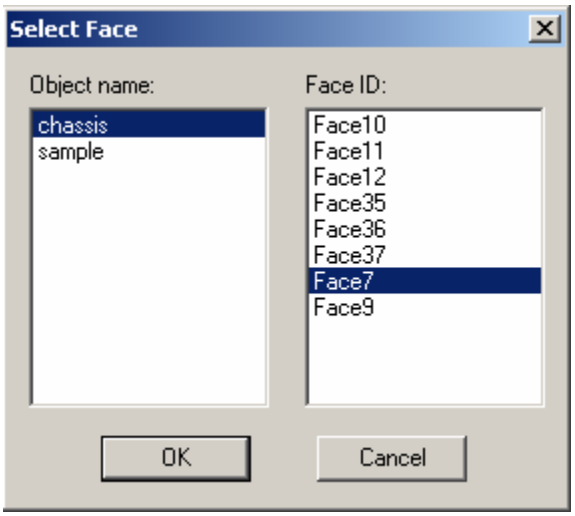


Click **OK**.

22) R-click on the highlighted Chassis and choose **Assign Boundary . . . Perfect E.** Click **OK**.

23) Click on the graph so that nothing is selected. L-click on the Select by Name button ( ).

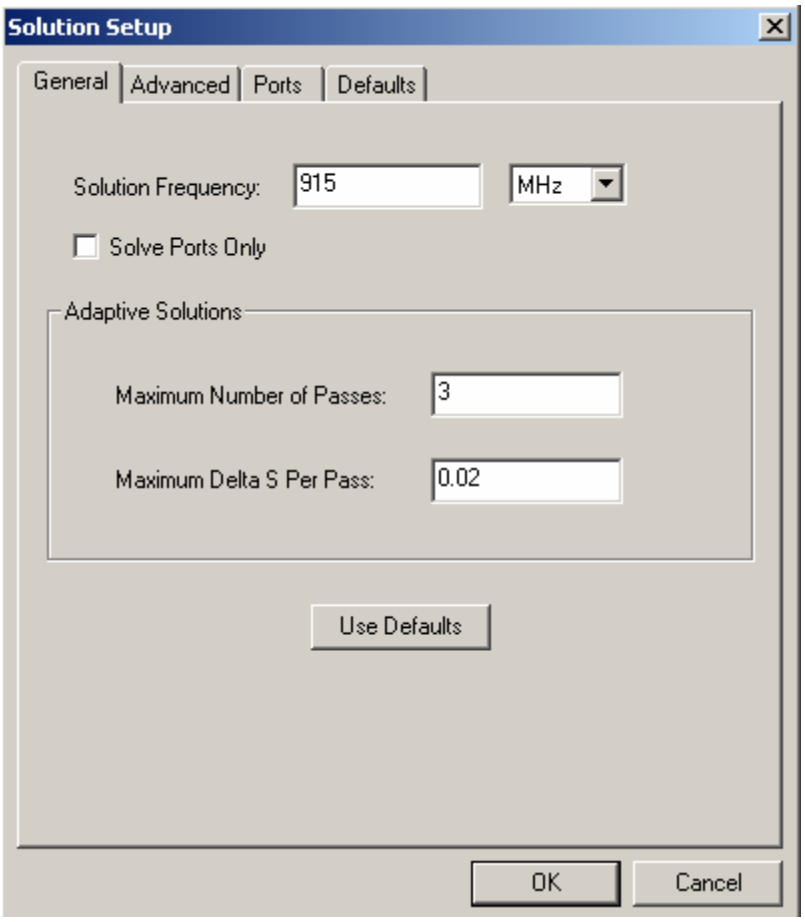
24) In the new window choose Chassis and the face shown below.



Click **OK**.

25) R-click on the highlighted face of the Chassis and choose **Assign Excitation** . . . **Wave Port**. Click Next → Next → Finish to create the wave port.

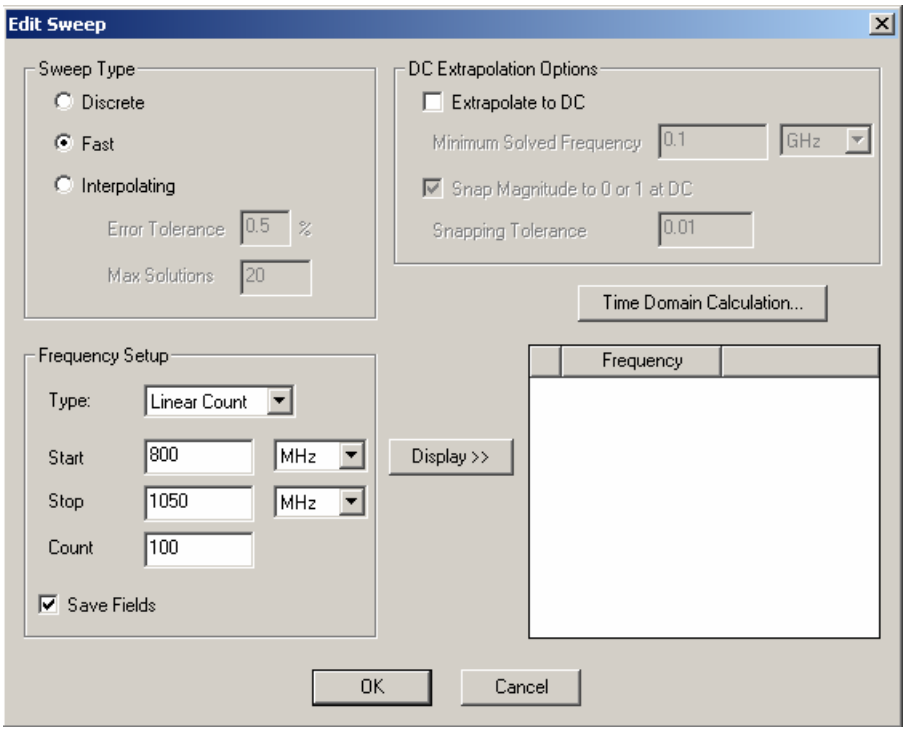
26) Click on the **Add Solution Set Up** button ( ). Change the **Solution Frequency** to 915 MHz.



Click **OK**.

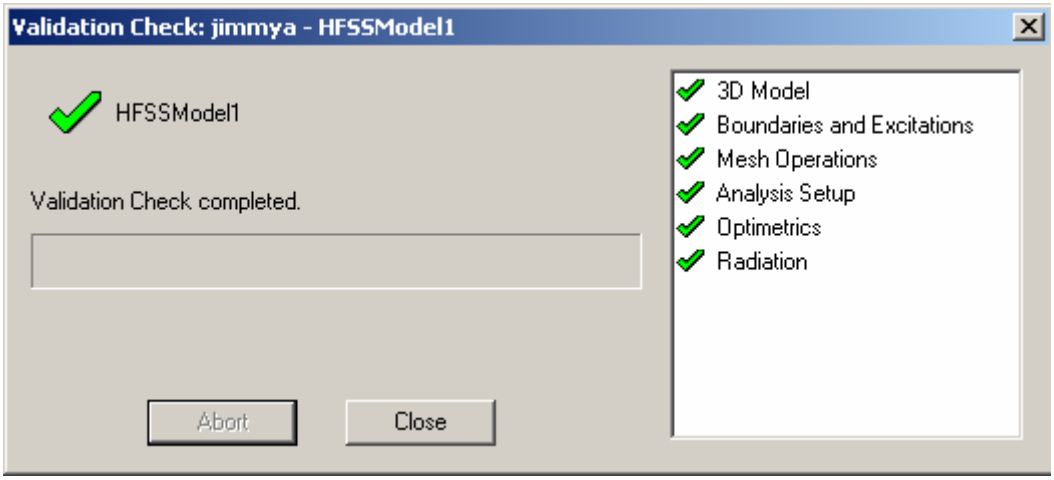
27) Choose the **Add Sweep** button ( ). Click **OK** in the new window.

28) Now fill out the **Edit Sweep** Window as shown:



Click **OK**.

29) Click the Validate button (). If no mistakes were made, a window will appear, just as the one below. You must correct your model now, if you have made a mistake.

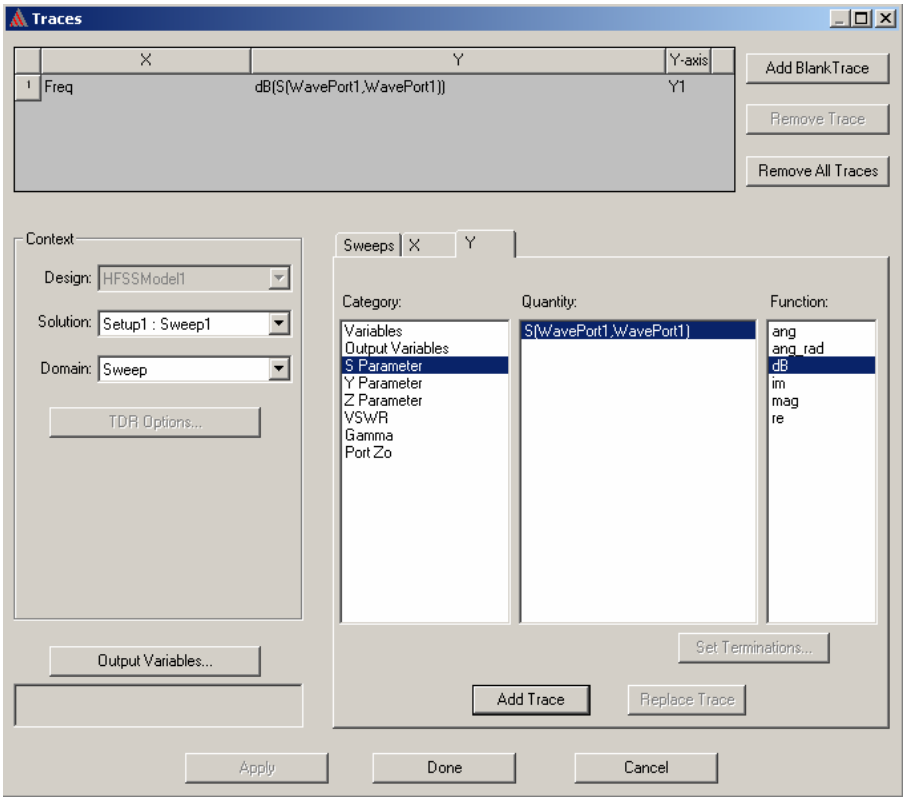


Click **Close**.

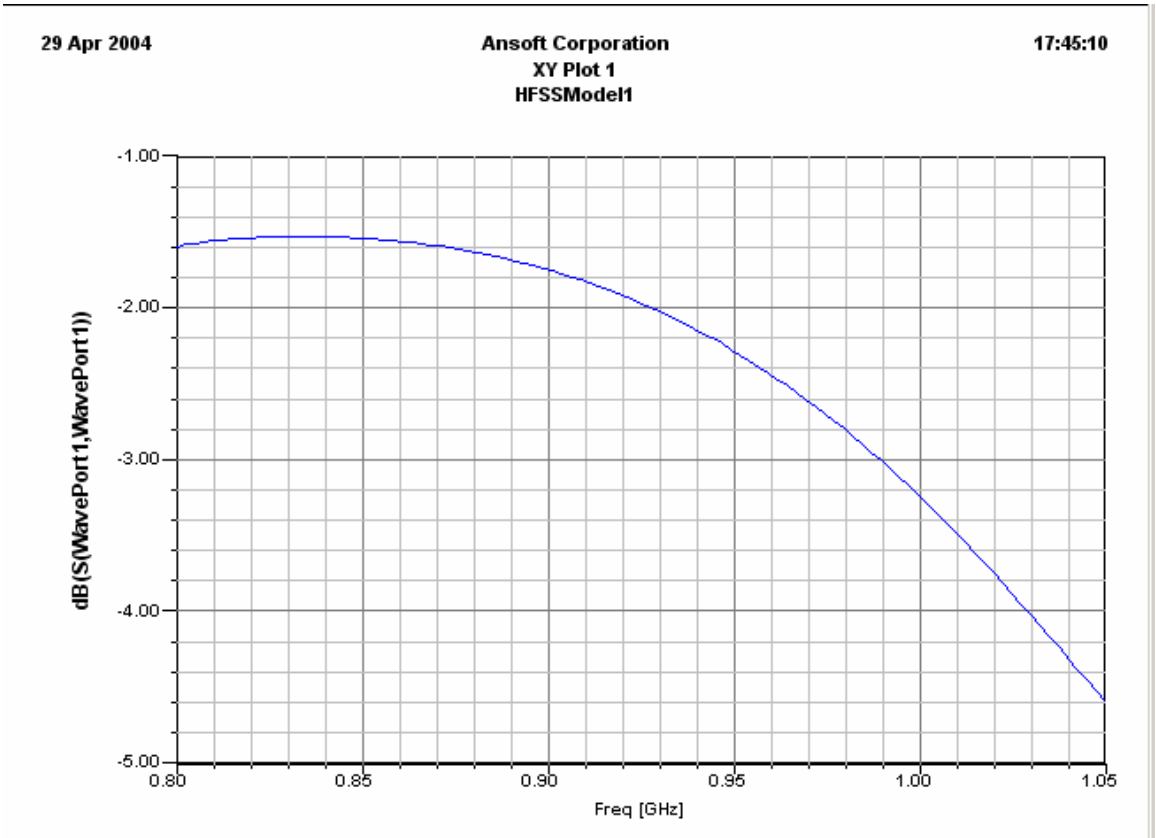
30) If you have not saved the HFSS model, you should now. Goto the menu bar and choose **File . . . Save.**

31) Click on the Analyze button (). This analysis will take about 2 minutes. Save your model again after analysis.

32) Goto the menu bar and select **HFSS . . . Results . . . Create Report**. Click OK in the new window. Another window will open and you should click Add Trace so that the window looks like the one below.

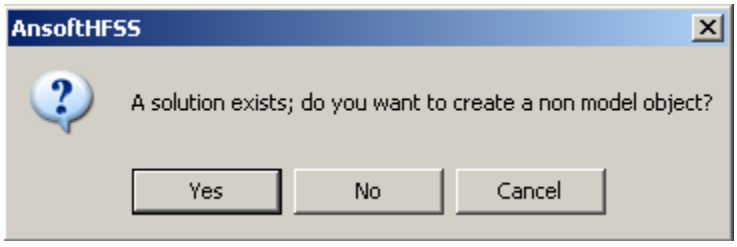


Click Done and the following graph will appear.



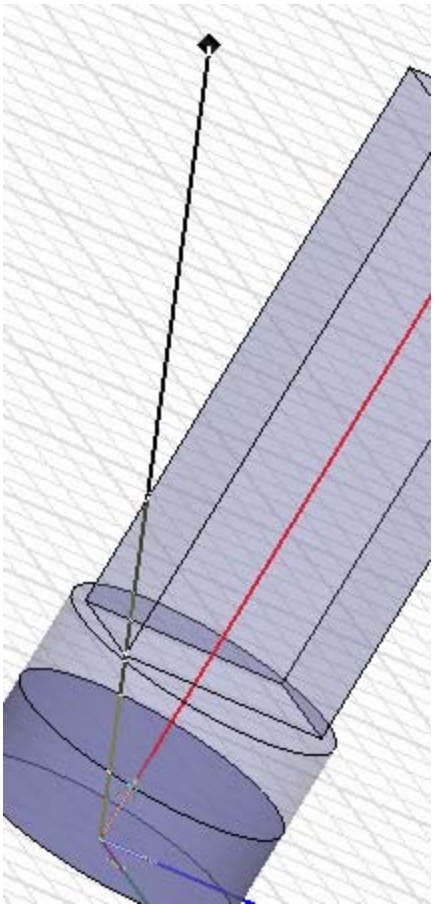
33) Now we will try to see how the electric field is distributed inside the Chassis. Click on the Draw Line button ( ).

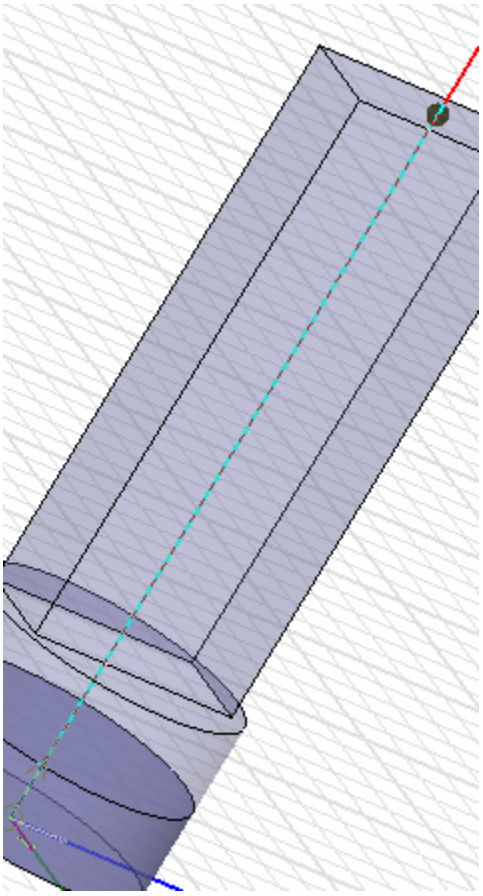
34) When the window below opens, click yes.



When you create a non-model object, HFSS is able to use the previous solution, because no materials are assigned to non-model objects.

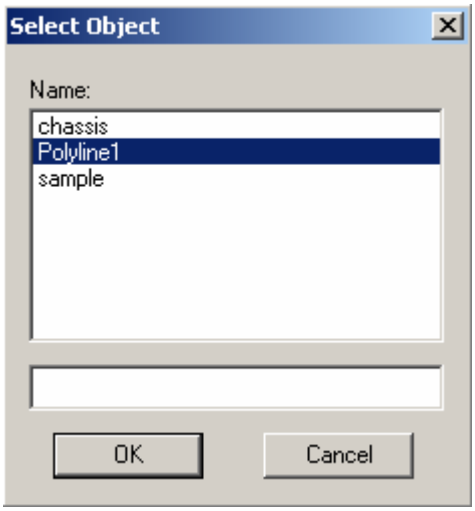
35) We will define a line from the origin of the graph to the top of the Chassis congruous with the Z-axis. L-click on the origin of the graph.





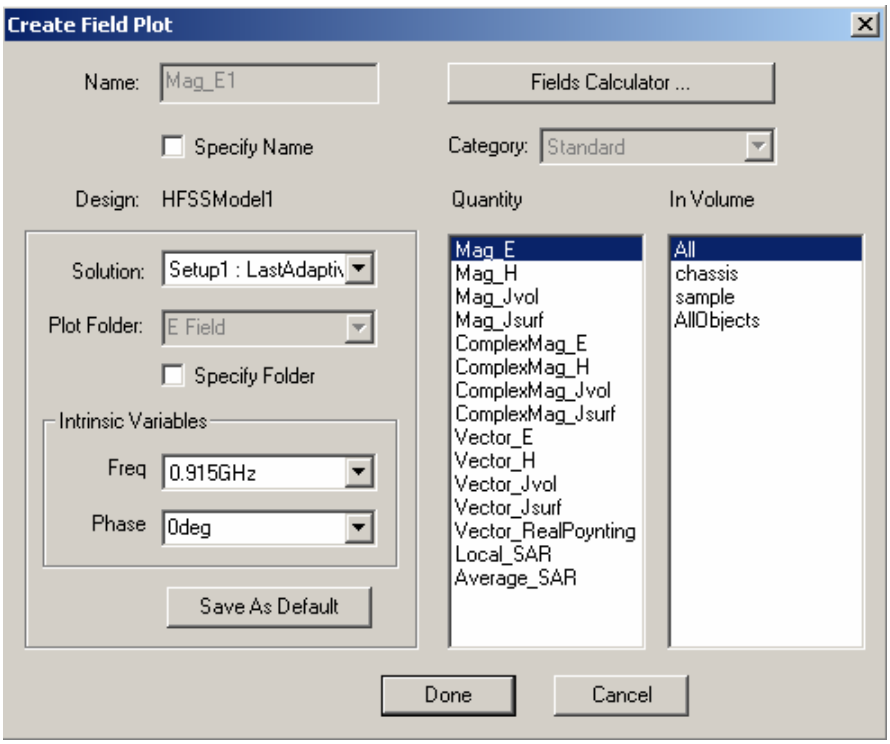
36) Your line will look like the picture at the top left of this page right now. Move the cursor so that your line is congruent with the Z-axis. Your line will turn a light blue color like the picture at the top right of this page. Move the cursor so that the line ends at the top of the Chassis. When your line is positioned correctly it will look exactly like the picture at the top right of this page. Notice the circular dot at the endpoint of the line. This indicates that you are centered with the top face of the top of the Chassis. To complete the line double L-click. An **attributes** window opens. Click **OK**.

37) Click on the Select by Name button ( ). Choose Polyline 1.



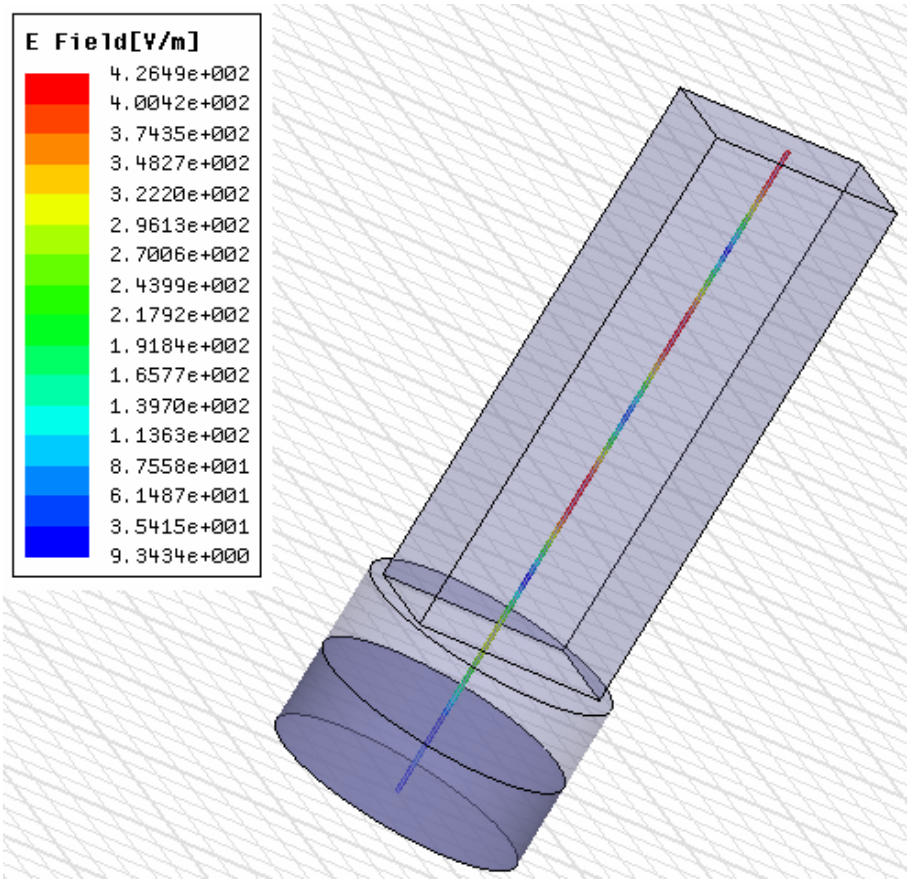
Click **OK**.

38) R-click on the graph and choose Plot Fields . . . **Mag_E**.

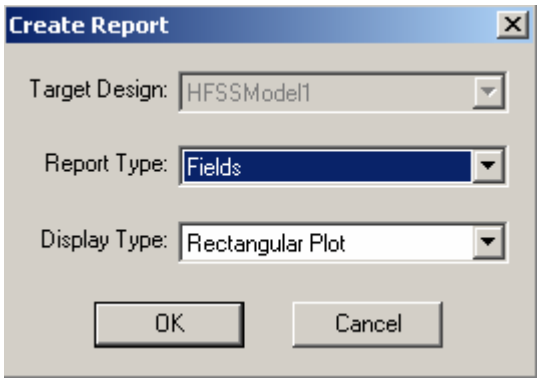


Click **Done**.

39) Go to the menu bar and select **View . . . Coordinate System . . . Hide**. Now we can see our line clearly.

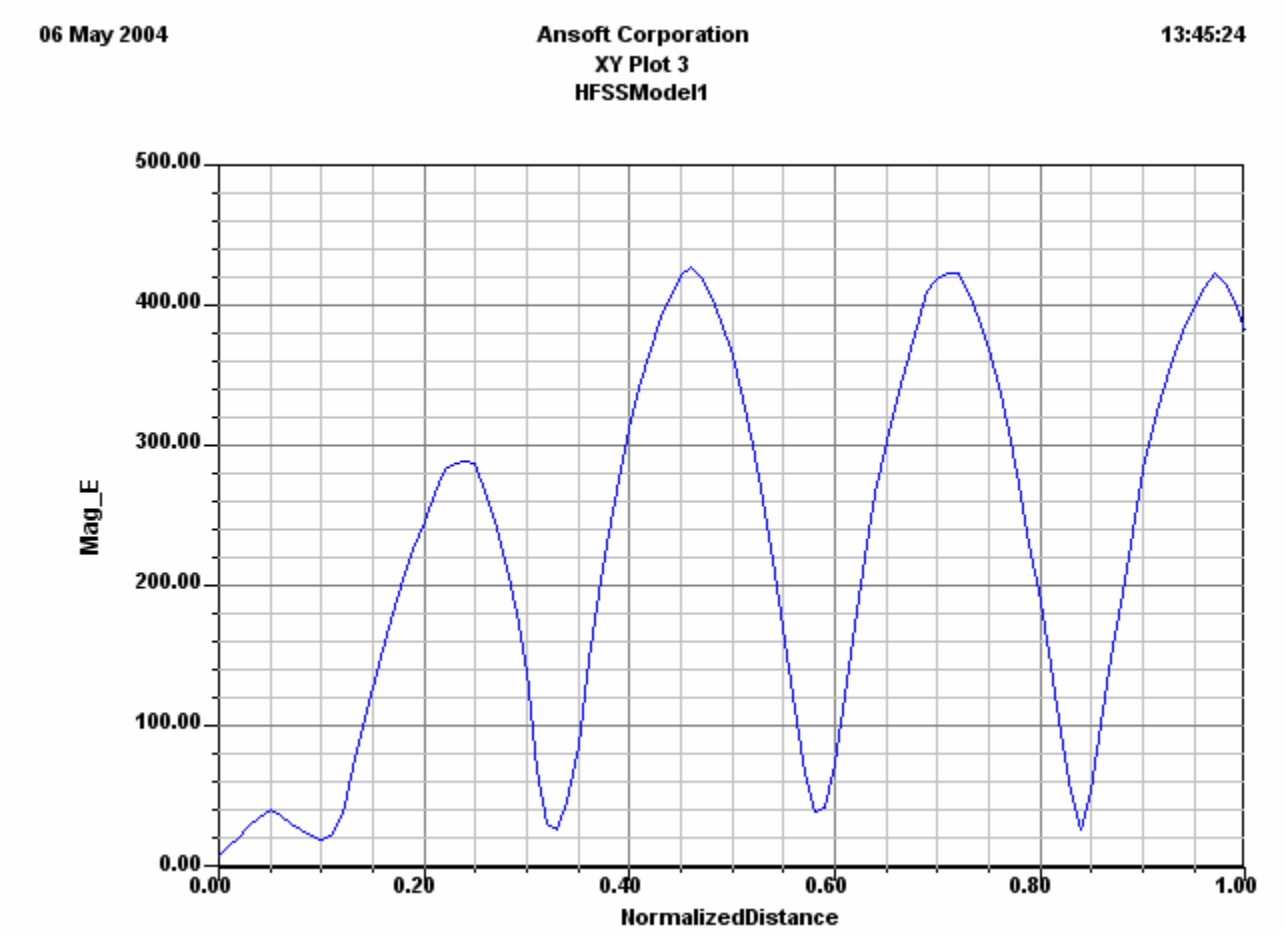


40) We will create a graph for the line. (**Electric Field vs. Normalized Distance from the bottom of the Chassis to the top.**) Go to the menu bar and select **HFSS . . . Results . . . Create Report**. In the new window change Report Type to "Fields".



Click **OK**.

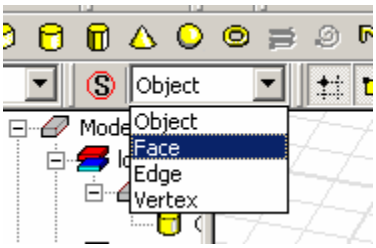
41) In the new window click **Add Trace**. Click **Done**.



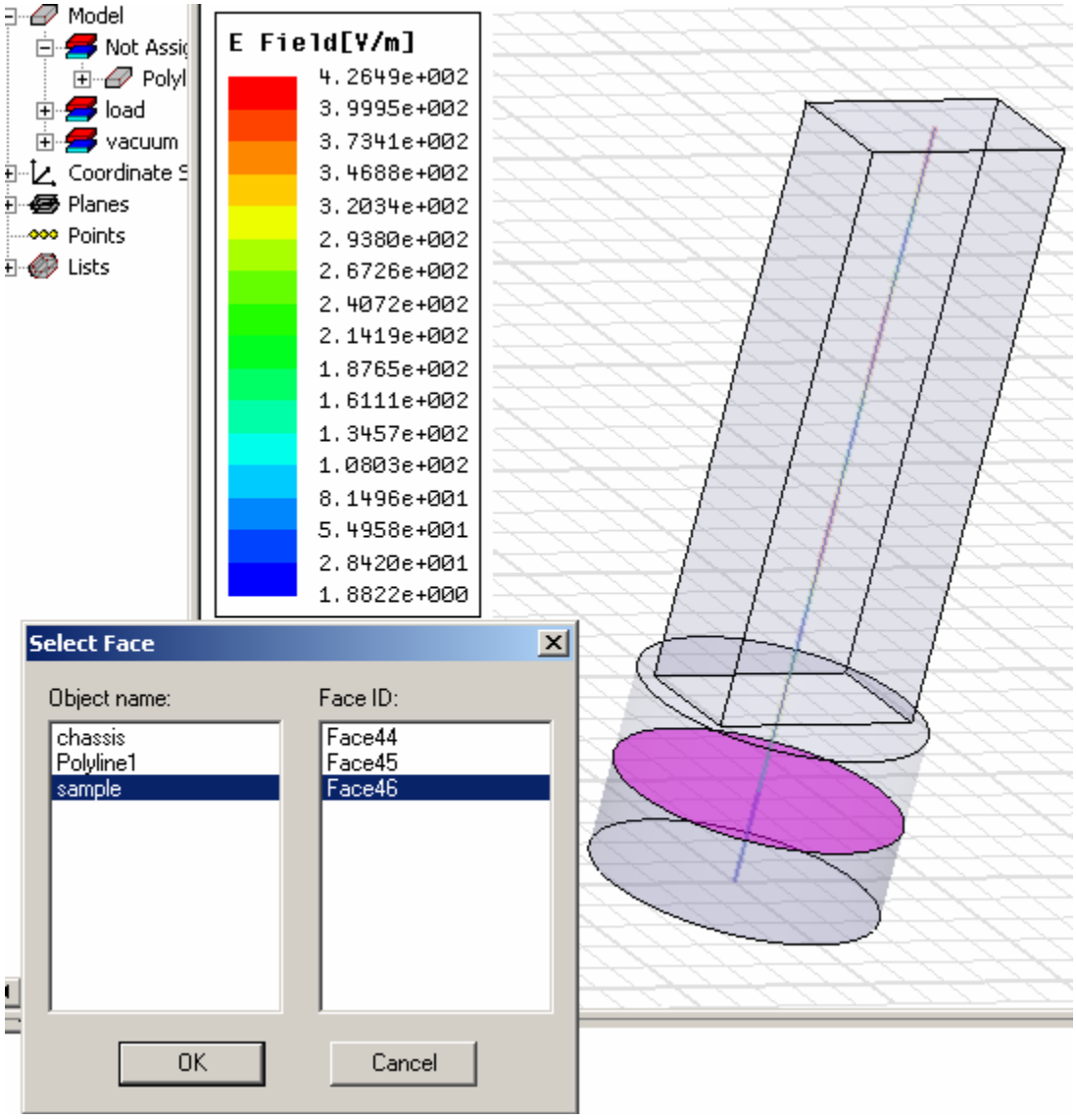
Notice that the wave propagates periodically at the top of the Chassis until it reaches the Sample, where the energy is dissipated.

42) To return to our model, go to the menu bar and select Window . . . 1 (the name of your file will be here).

43) Change the Selection Mode to **Face**.

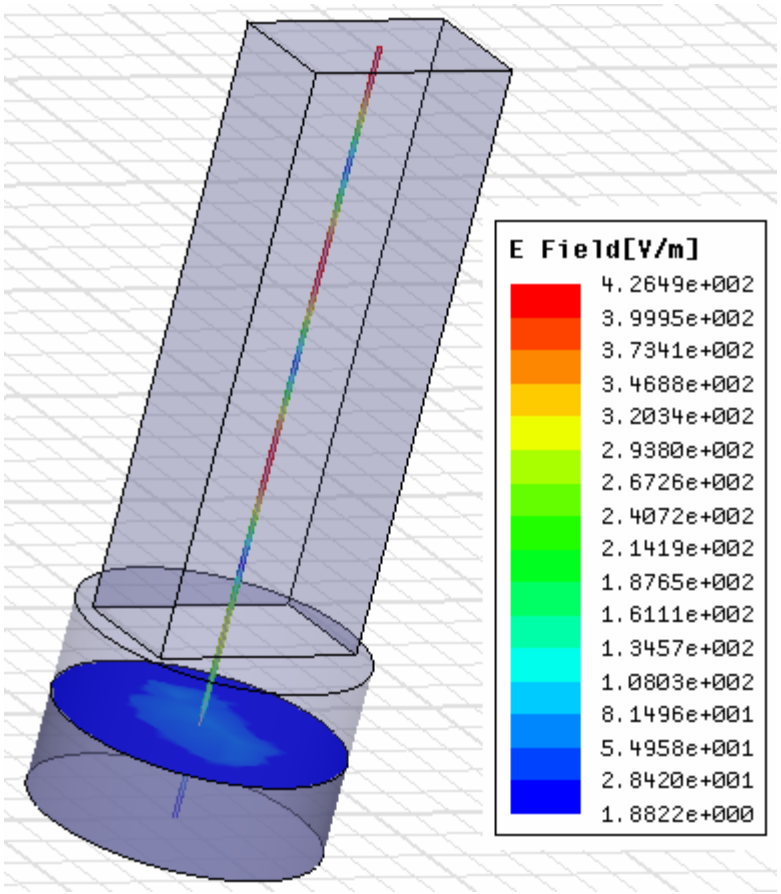


44) Click on the Select by Name button ( ). Choose sample and Face 46.



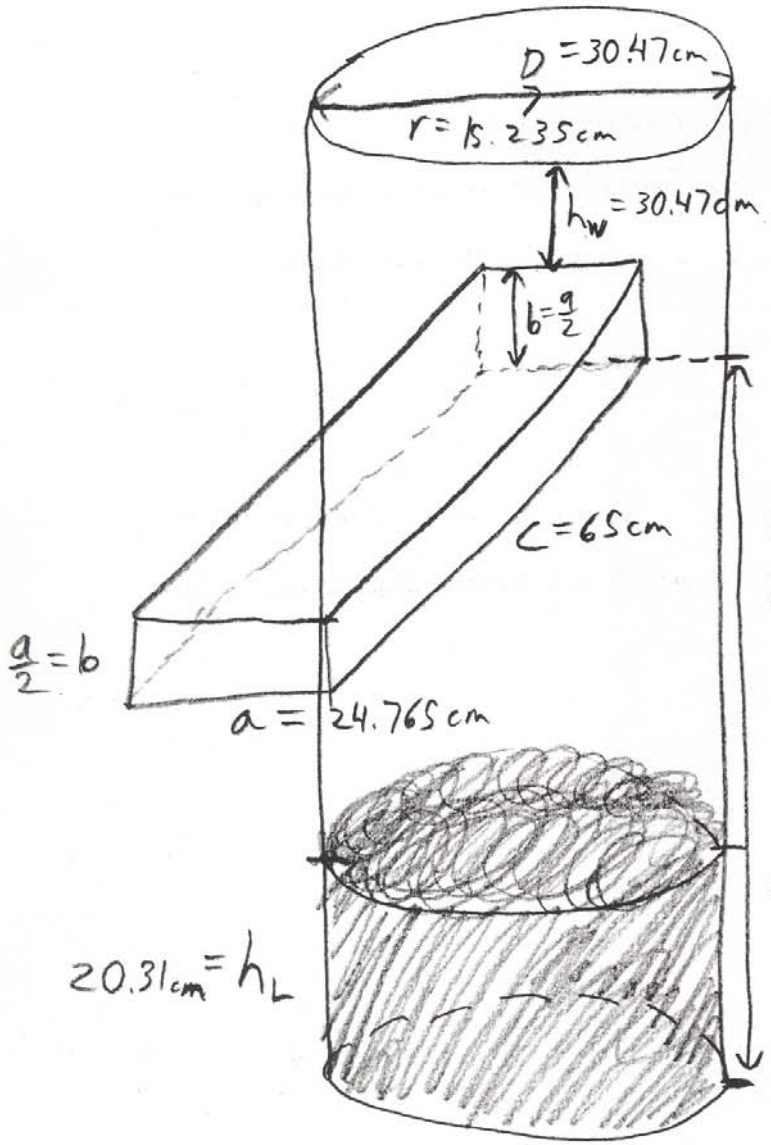
Click **OK**.

45) R-click on the graph and select Plot Fields . . . **Mag_E**. In the new window click **Done**.



This concludes Part (A) of the HFSS Beginner's Tutorial. Save your file and exit the program.

(b) HFSS Beginner's Tutorial Part(B)



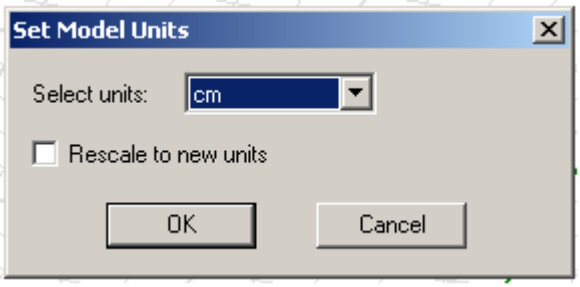
Definitions for Project Variables

a = 24.765cm
b = $\frac{a}{2}$
c = 65cm
r = 15.235cm
H = 121.87cm
$h_g = H - b - 30.47cm$
h_L = 20.31cm

a relative permittivity of 3.6
a dielectric loss tangent of $\frac{0.19}{3.6}$

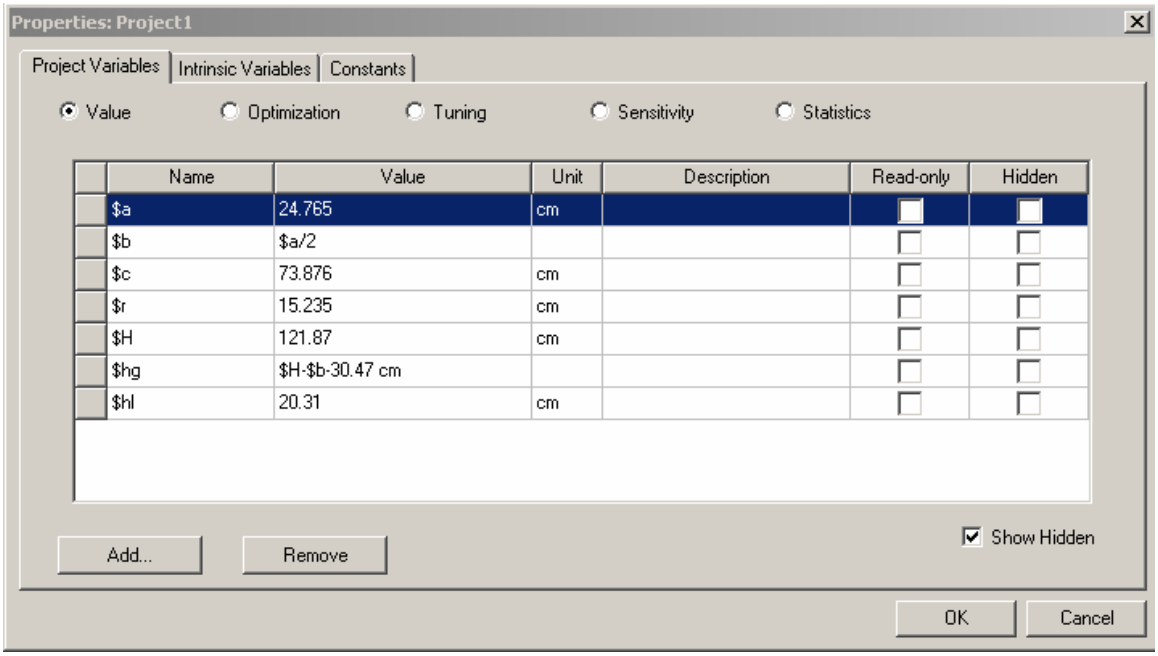
1) Open HFSS. L-click on the **Insert HFSS Design** button ( ) at the top of the screen.

2) On the menu bar choose **3D Modeler** . . . **Units** . . . and select "cm".

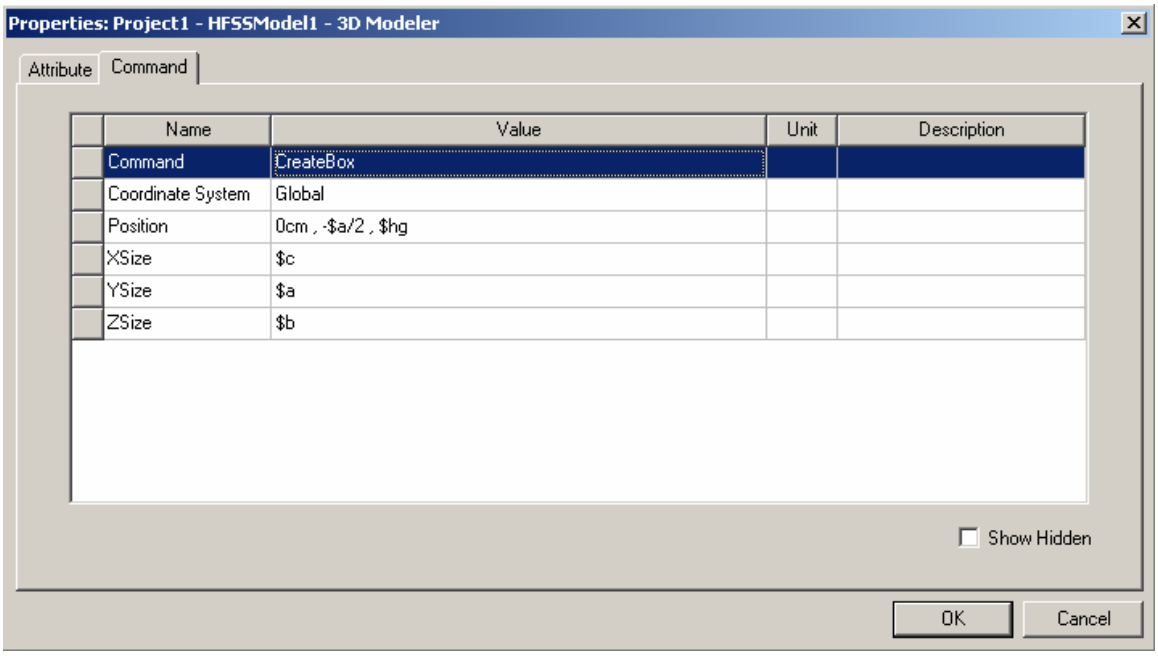


Click **OK**.

3) On the menu bar choose **Project . . . Project Variables . . . Add** . . . and follow the directions to add all variables that are in the table below.

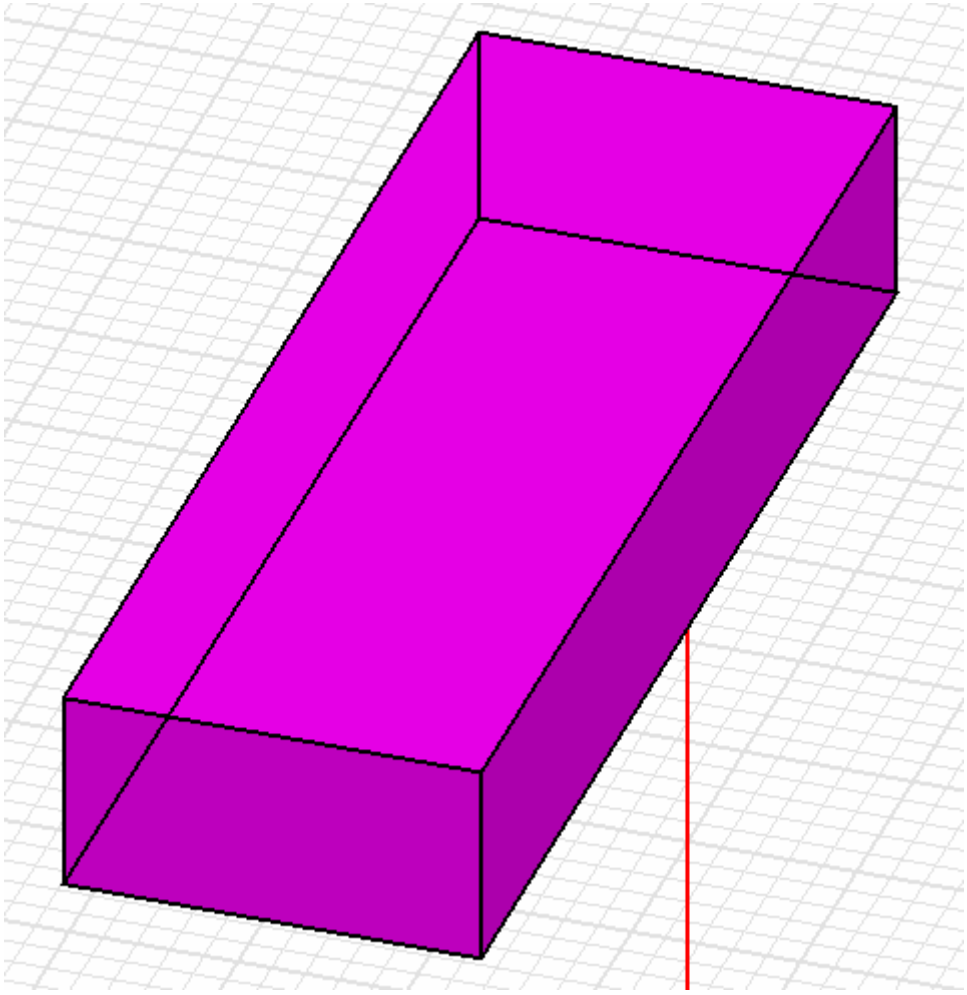


4) L-click on the Draw Box button ( ). Now L-click on the graph at 3 different points to make a box. Enter the following dimensions.

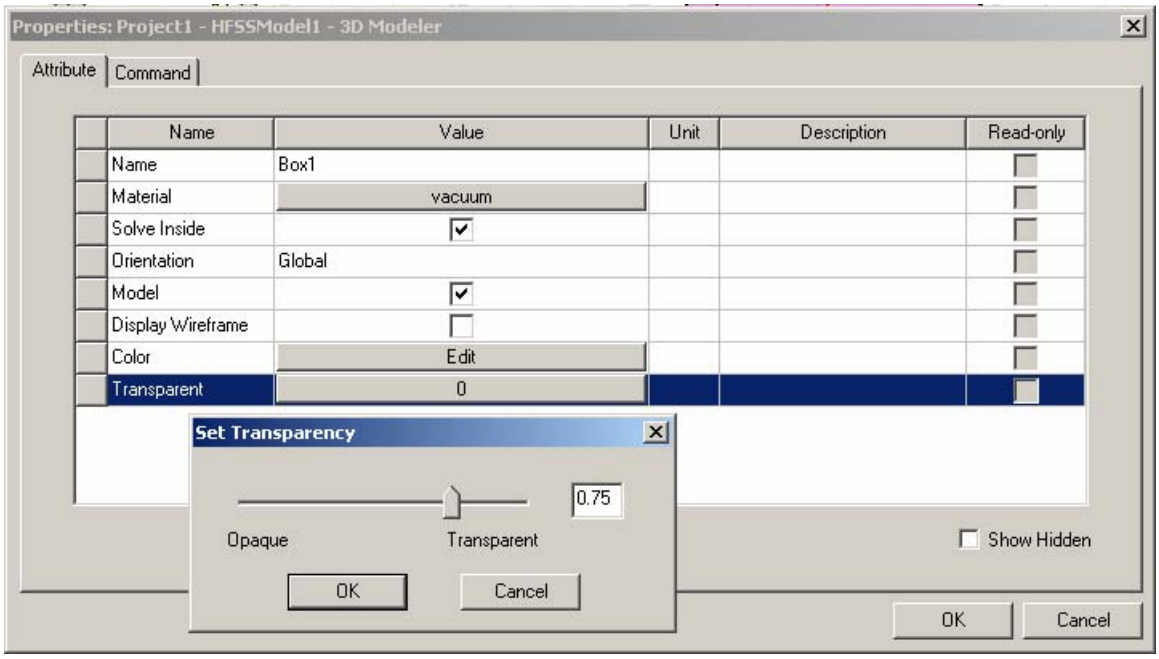


Click **OK**.

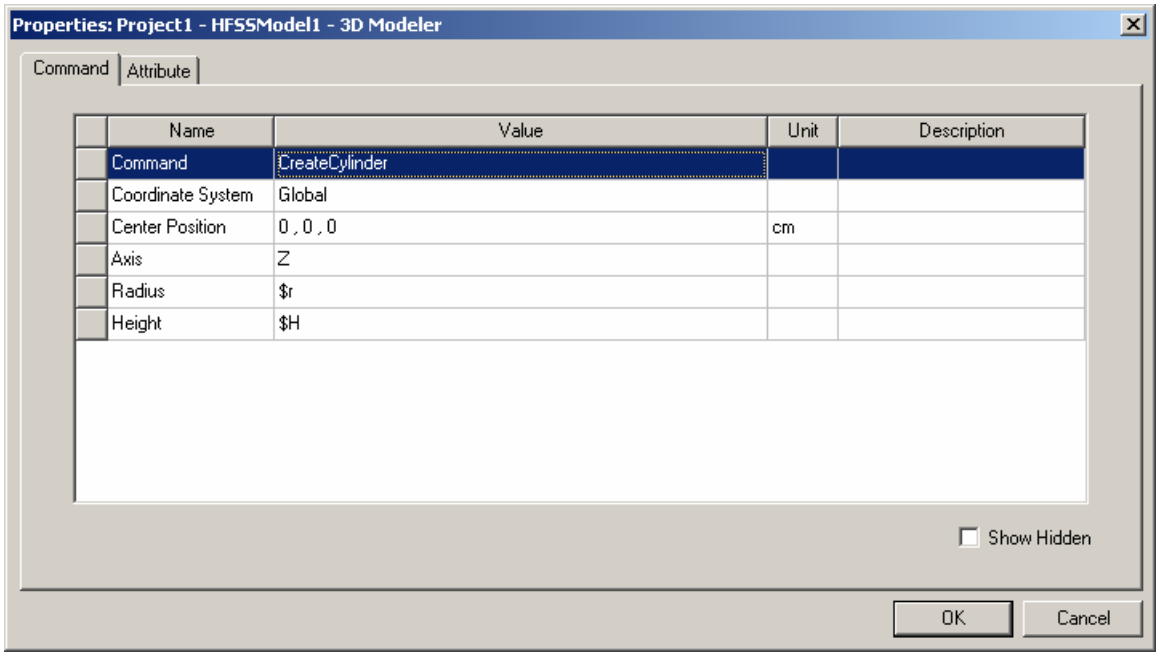
Type **Ctrl-D** to see your new box.



5) Select the box and change the **Transparency** to 0.75 as illustrated below.



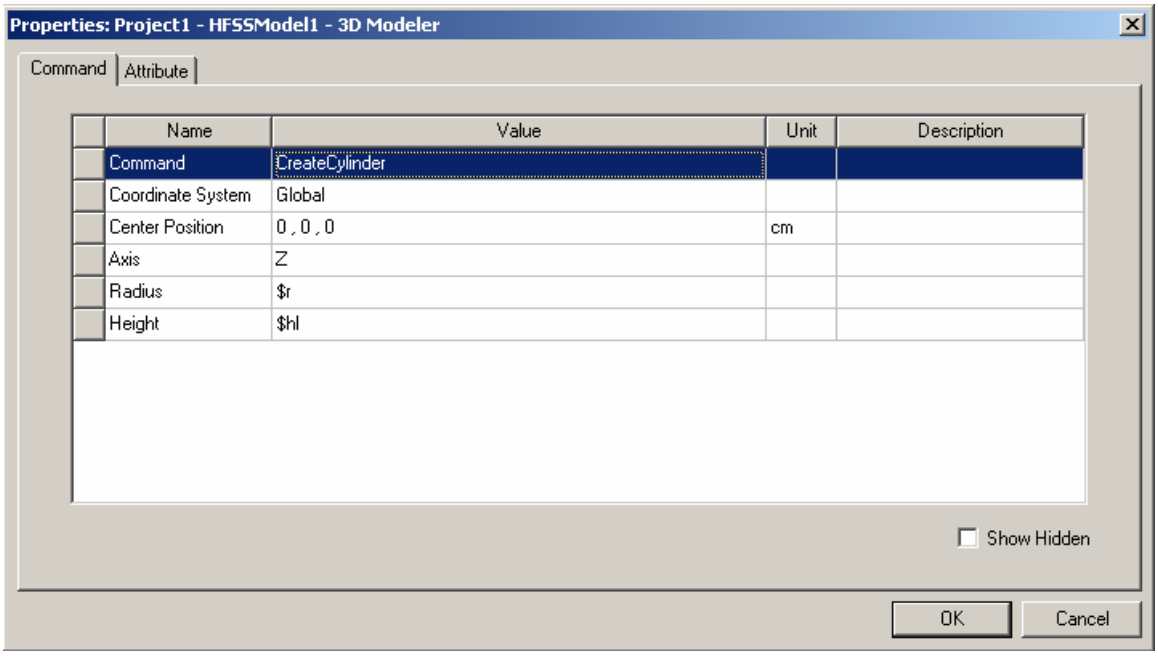
6) L-click on the Draw Cylinder button (). L-click on the graph at 3 different points to make a cylinder. Enter these dimensions:



Click **OK**.
Type **Ctrl-D**.

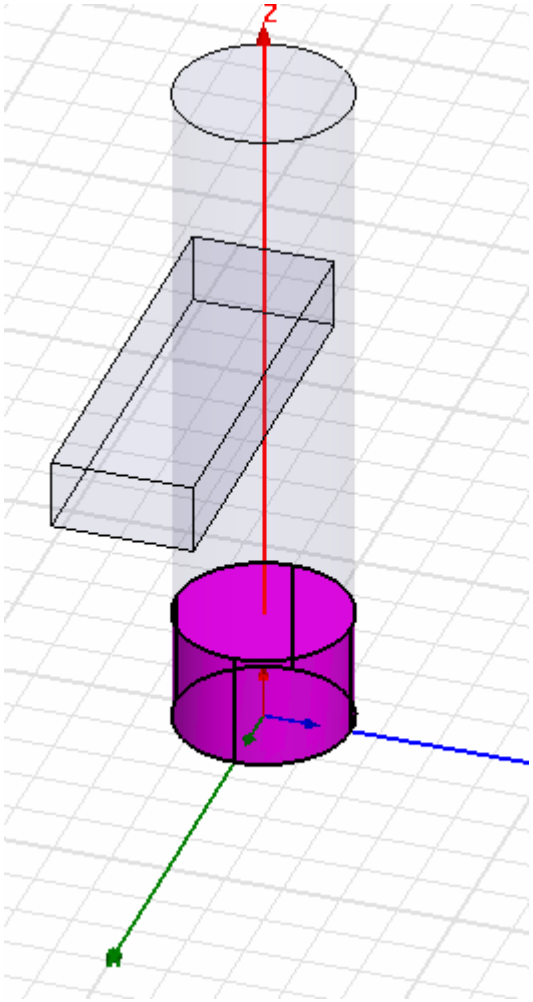
7) Change the new cylinder's transparency to 0.75, just like with the box.

8) Draw another cylinder with the following dimensions:

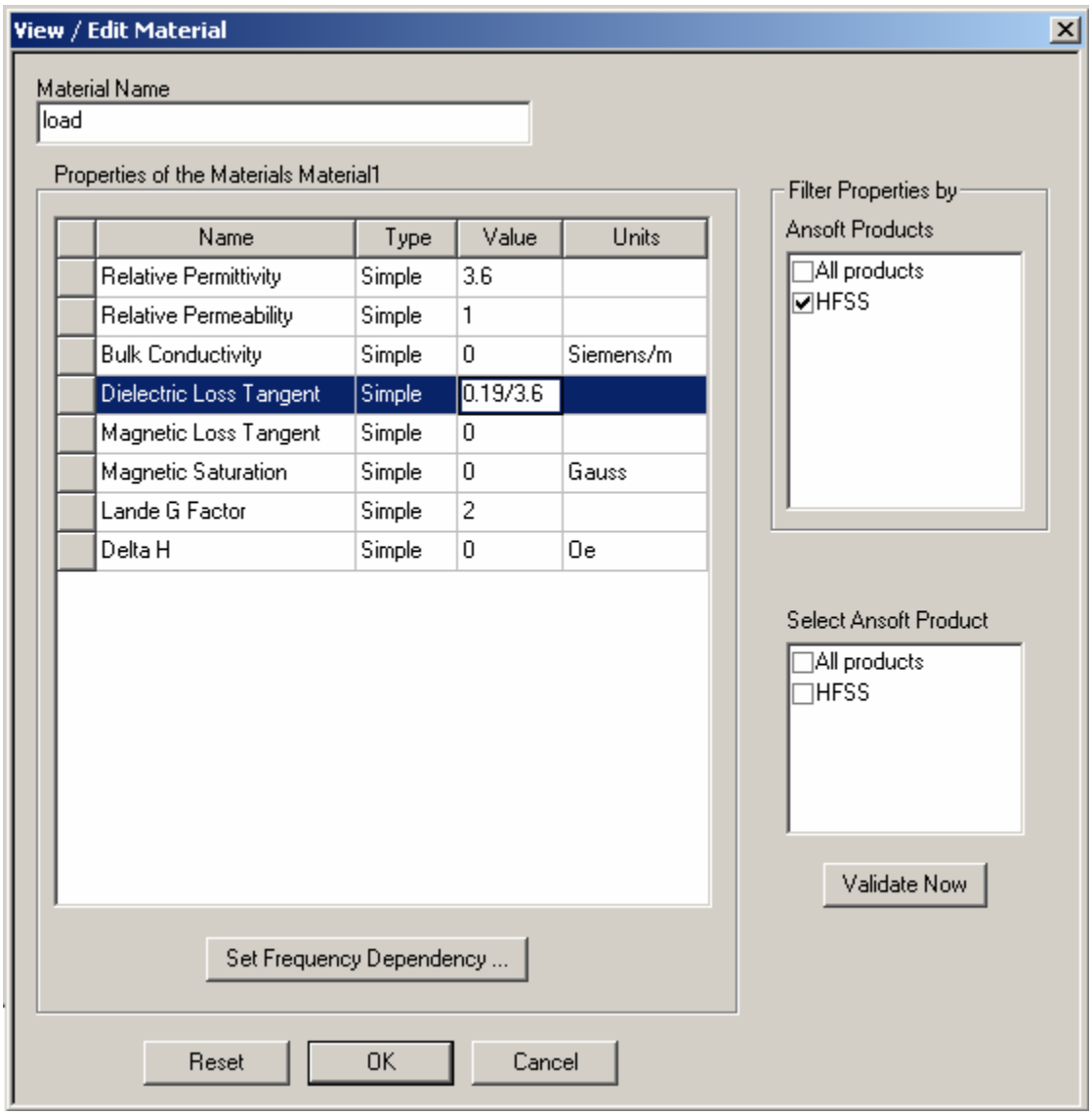


Click **OK**.

Type **Ctrl-D**. Your graph should look like the one below.

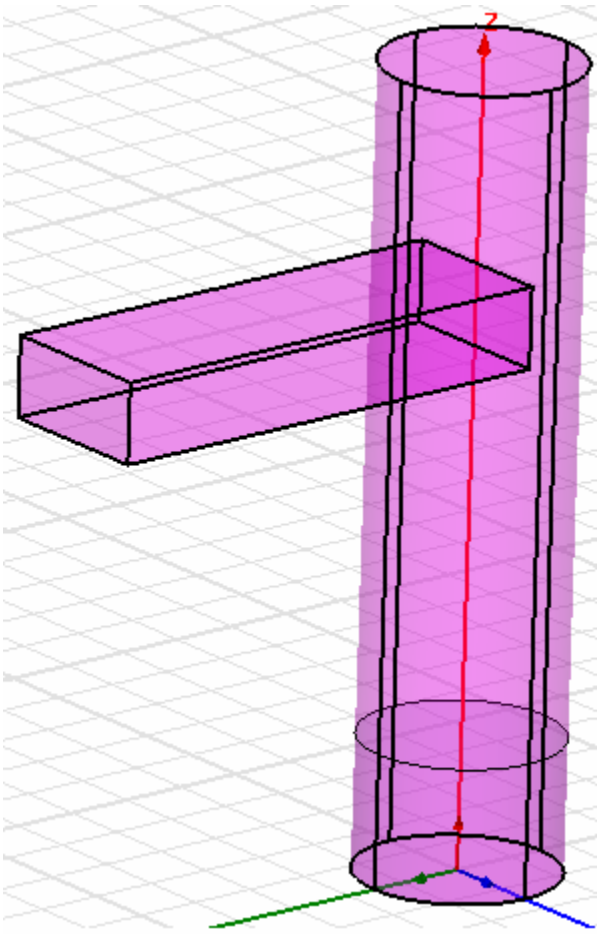


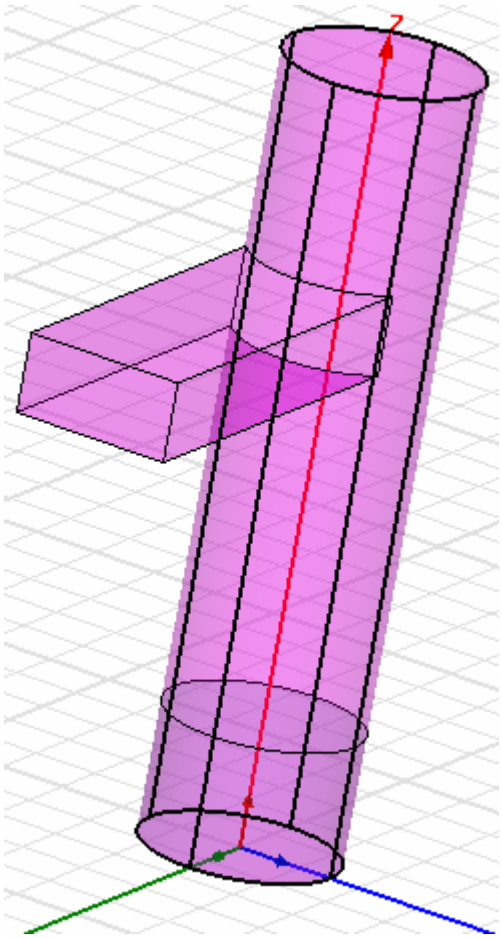
9) Select the second smaller cylinder. R-click on it and select **Edit . . . Properties** . . . . This time we will change the transparency, name, and material all at once. Change the transparency to 0.50, the name from "cylinder2" to "Sample", and the material according to the window below.



Click **OK** 3 times.

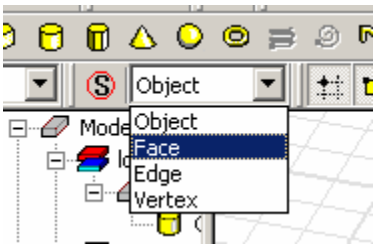
10) Now we will join the large cylinder and the box into one object. Select both the large cylinder and the box simultaneously. R-click on the box and choose **Edit . . . Boolean . . . Unite**. Your model will change from left to right as follows:





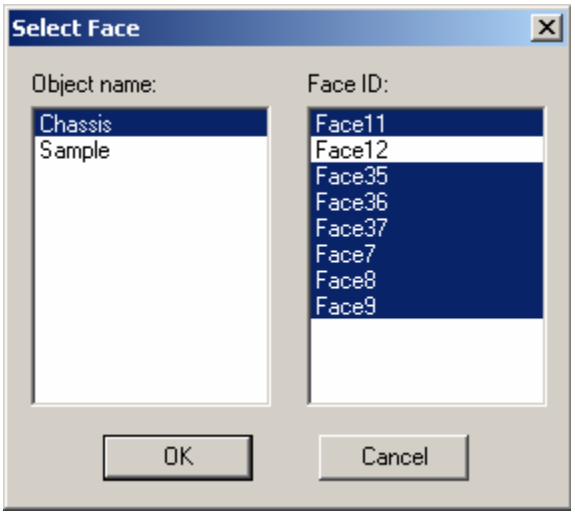
11) Change the name of the united object from “cylinder1” to “Chassis”.

12) Now we will assign boundaries to the faces of our model. Click on the graph so that nothing is selected. Choose “Face” instead of “Object” on the Selection Mode pull down tab as seen below.



13) L-click on the Select by Name button ( ).

14) In the new window choose Chassis and use Ctrl-L-click to choose all faces highlighted in the picture on the next page.

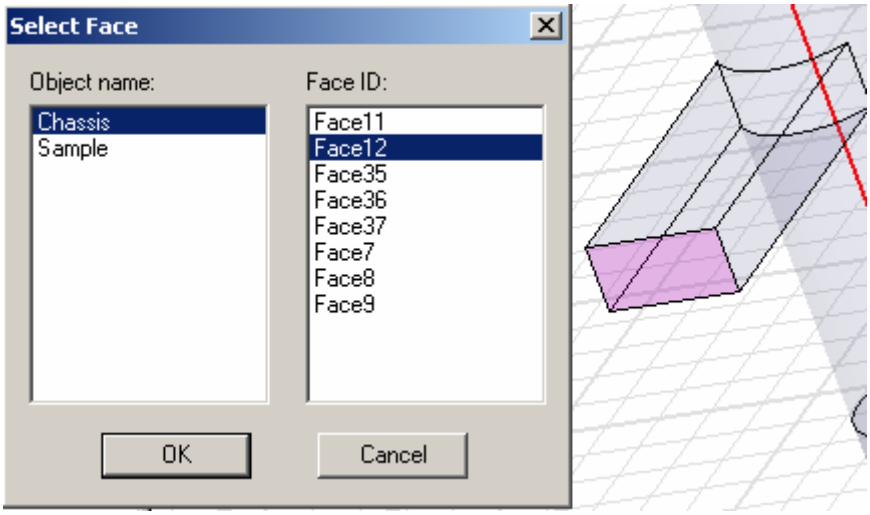


Click **OK**.

15) R-click on the highlighted Chassis and choose **Assign Boundary . . . Perfect E**. Click **OK**.

16) L-click on the **Select by Name** button ( ).

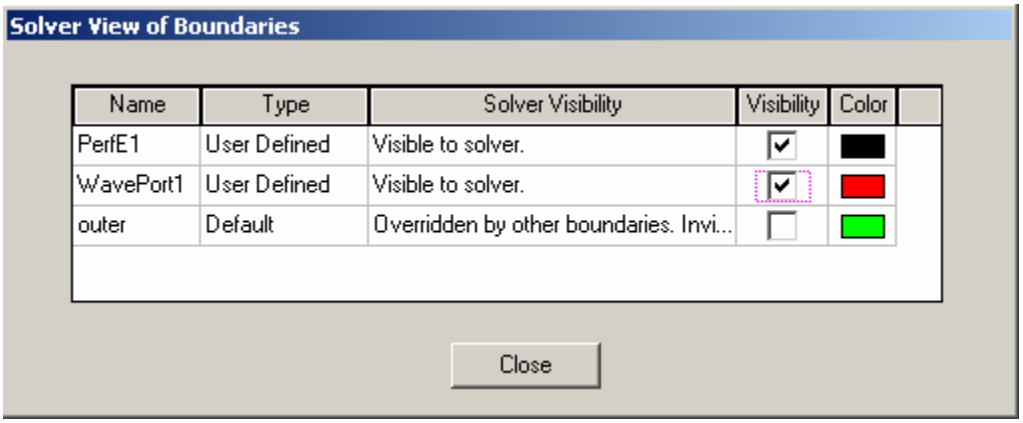
17) In the new window choose Chassis and Face 12.



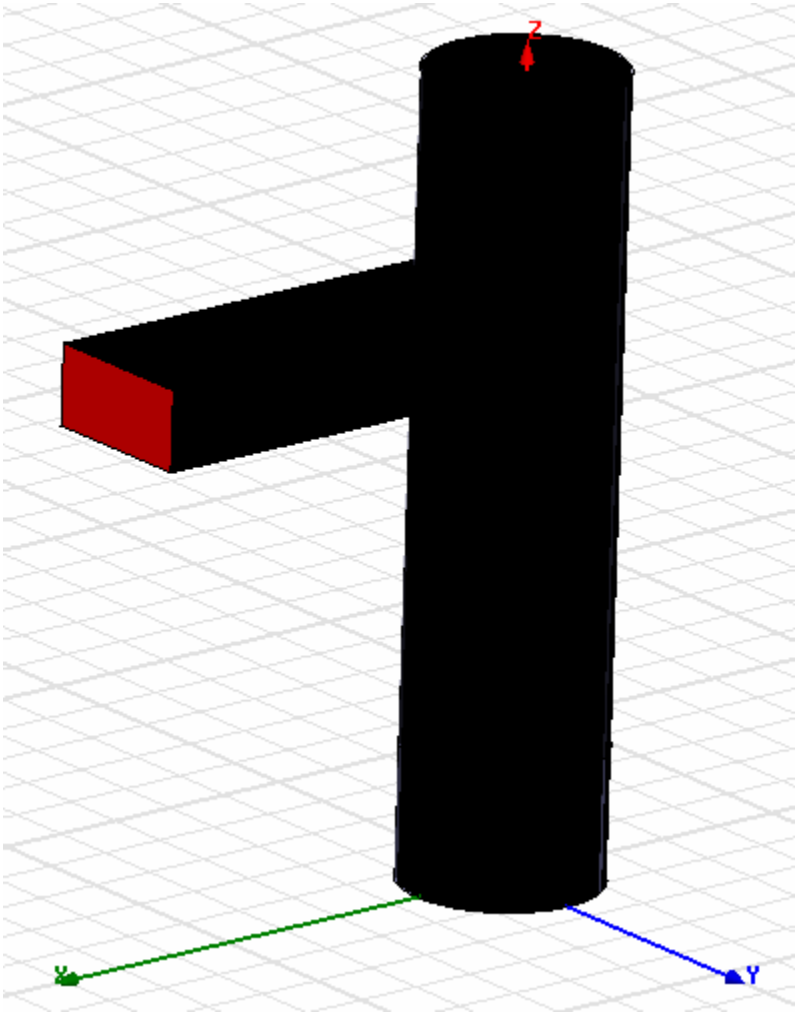
Click **OK**.

18) R-click on the highlighted face of the Chassis and choose **Assign Excitation . . . Wave Port**. Click Next → Next → Finish to create the wave port.

19) To visualize the different face assignments, go to the menu bar and choose **HFSS . . . Boundary Display (Solver View)**. Check the following two visibility boxes in the new window.

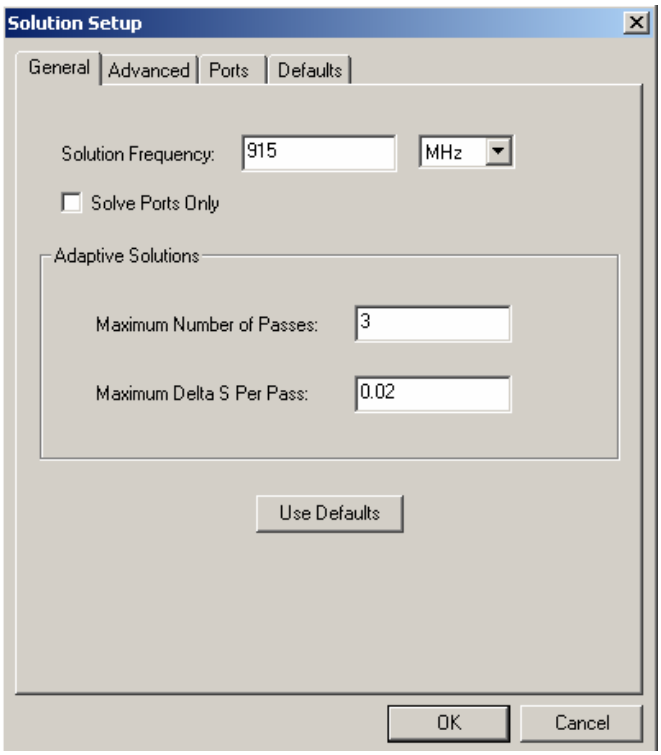


Now your graph should look like the one below.



Click Close and the colors will disappear.

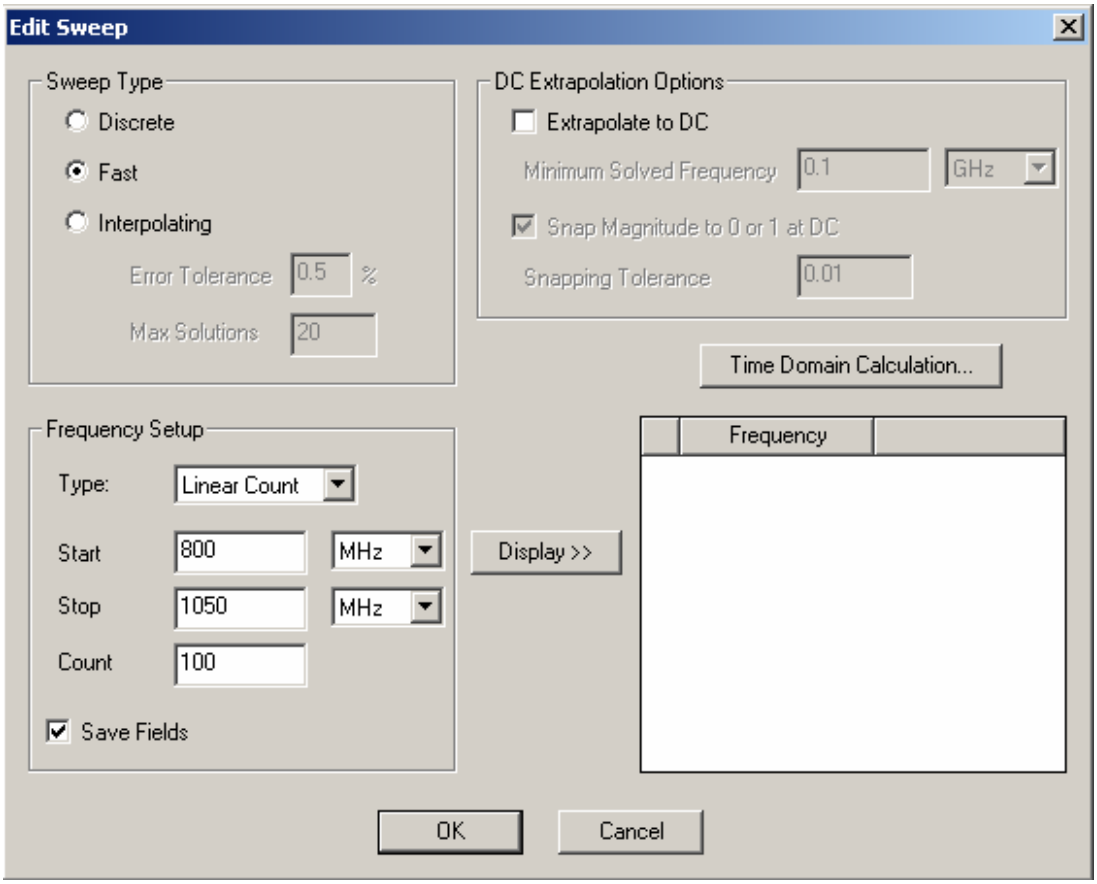
20) Click on the Add Solution Set Up button ( ). Change the Solution Frequency to 915 MHz.



Click **OK**.

21) Choose the Add Sweep button ( ). Click OK in the new window.

22) Now fill out the Edit Sweep Window:

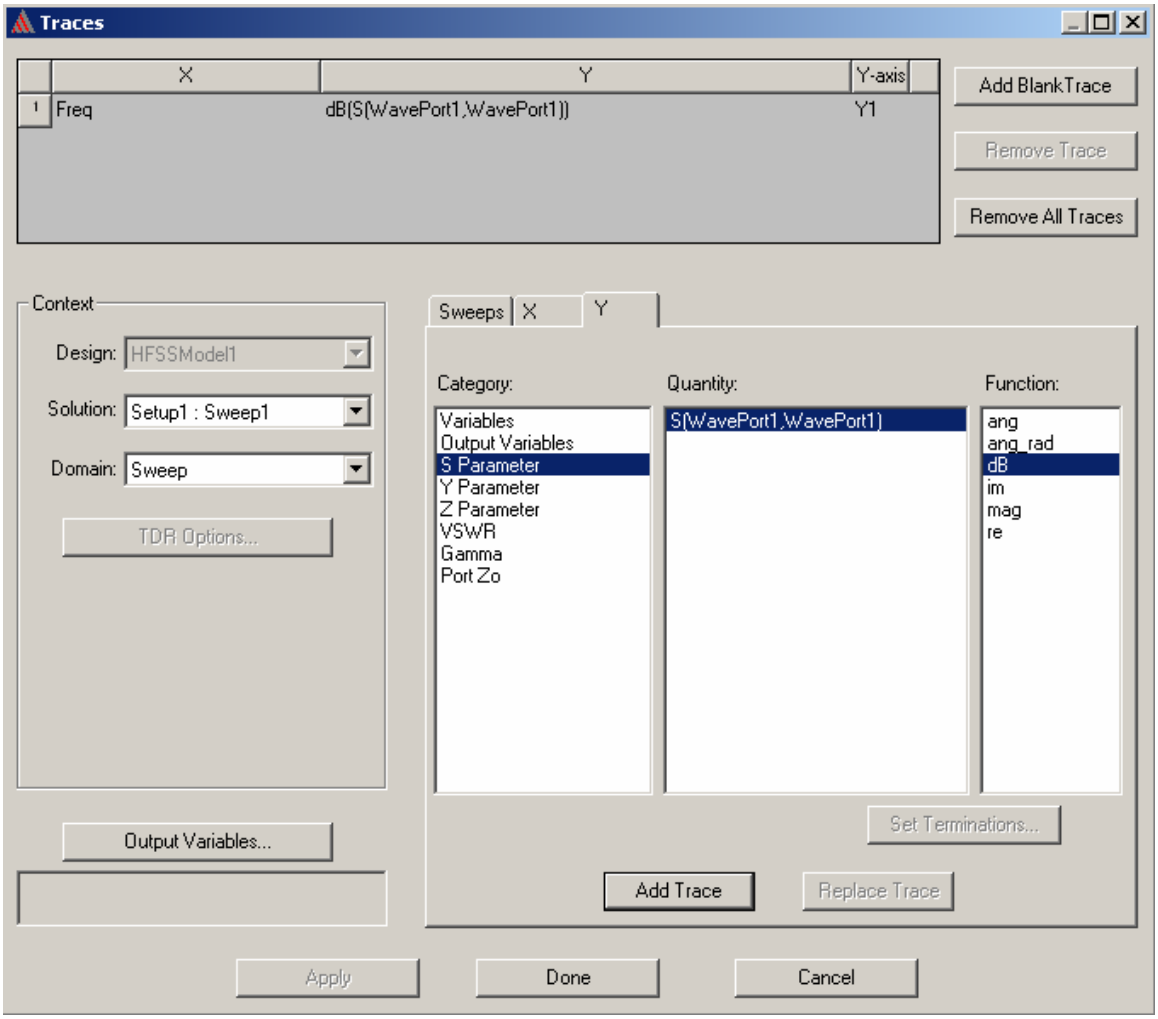


Click **OK**.

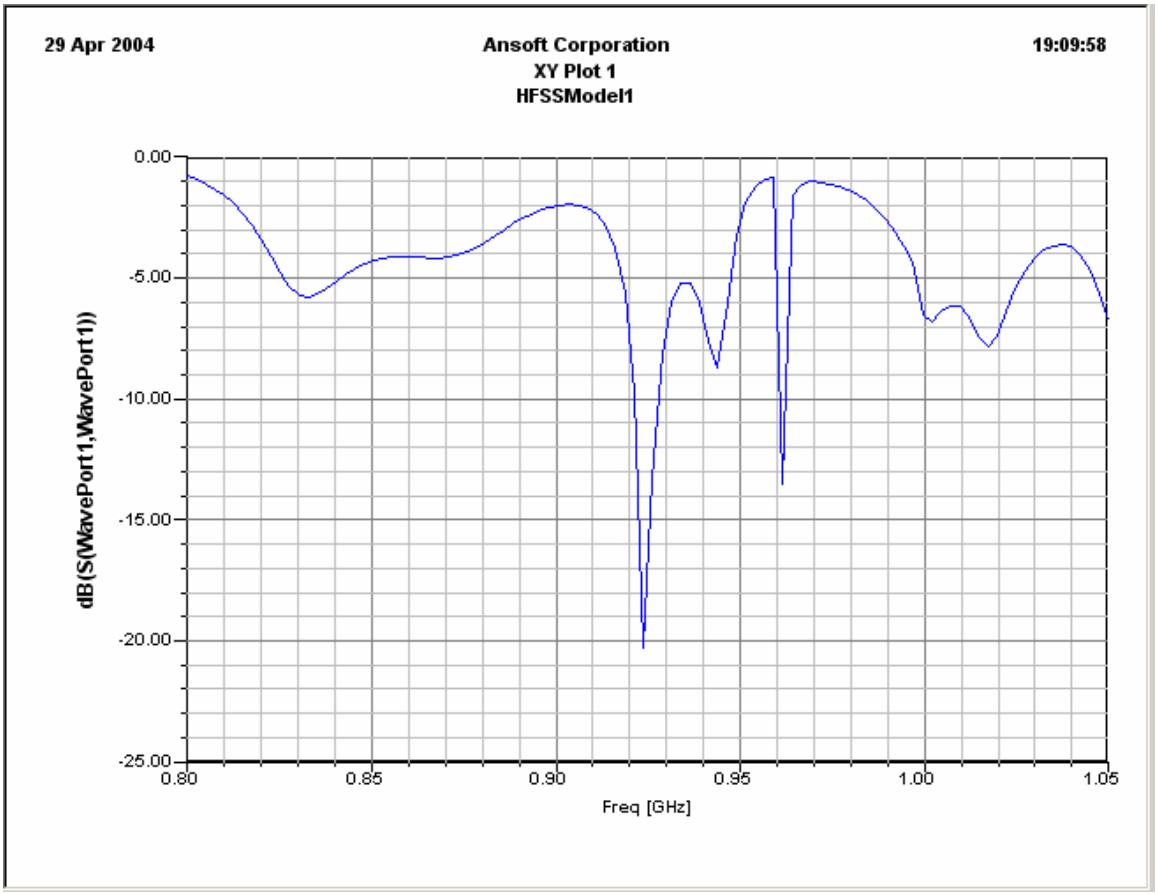
23) Click the **Validate** button ( ), to check your work.

24) Save your model. Click on the **Analyze** button ( ). Allow the computer to work for 5 minutes and then save your model again.

25) Goto the menu bar and select **HFSS . . . Results . . . Create Report**. Click OK in the new window. Another window will open and you should choose **Add Trace** so that the window looks like the one below.

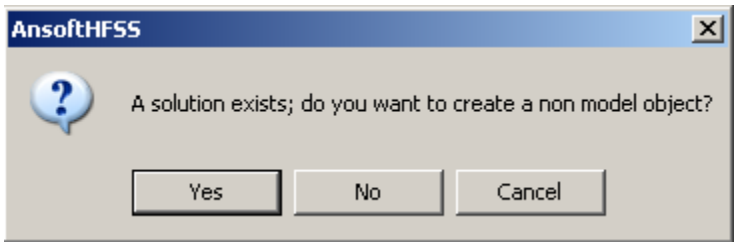


Click Done and the following graph will appear.

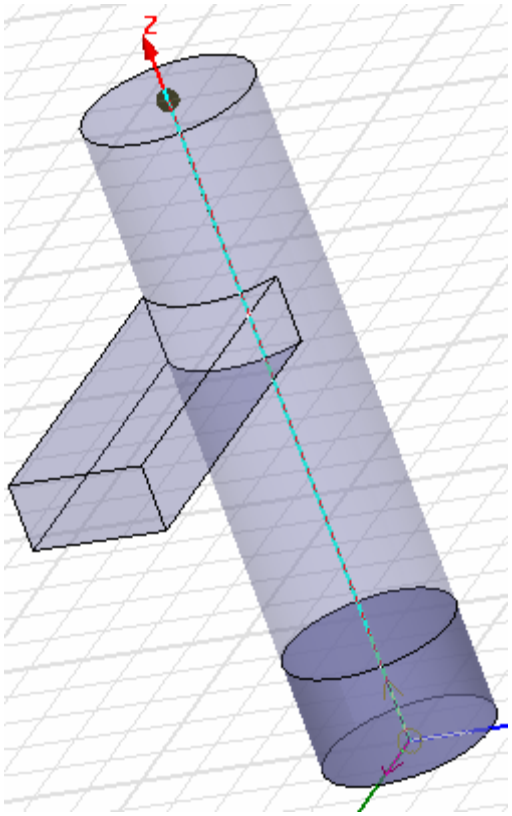


46) Now we will try to see how the electric field is distributed inside the Chassis. Click on the **Draw Line button (**  **).**

47) When the window below opens, click yes.

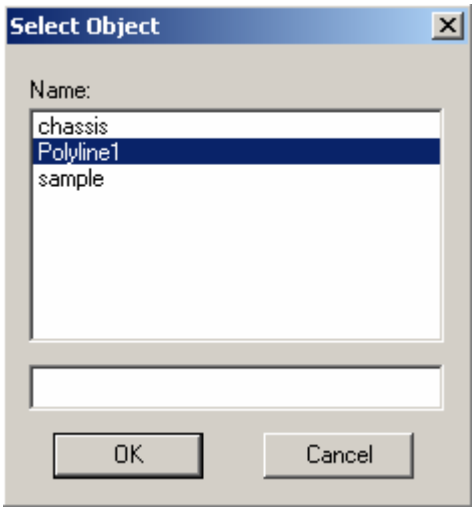


48) We will define a line from the origin of the graph to the top of the Chassis congruous with the Z-axis. L-click on the origin of the graph.



49) Define your line as shown above. Remember to double L-click to create the endpoint for the line.

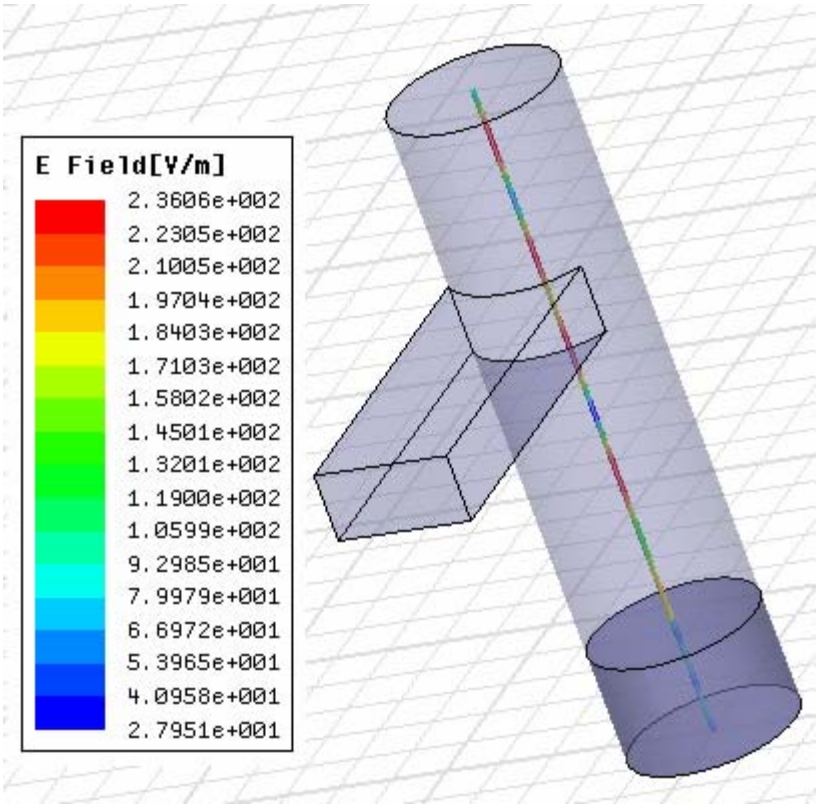
50) Click on the Select by Name button ( ). Choose **Polyline** 1.



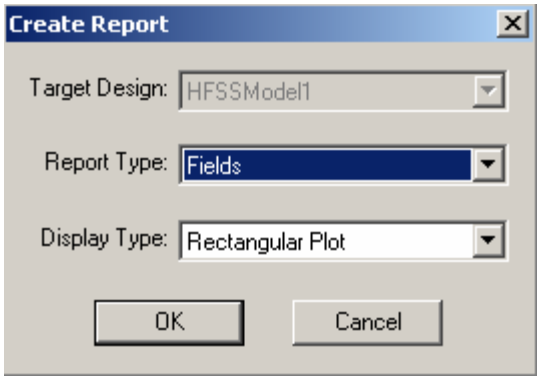
Click **OK**.

51) R-click on the graph and choose **Plot Fields . . . Mag_E**. In the new window click **Done**.

52) Go to the menu bar and select **View . . . Coordinate System . . . Hide**. Now we can see our line clearly.

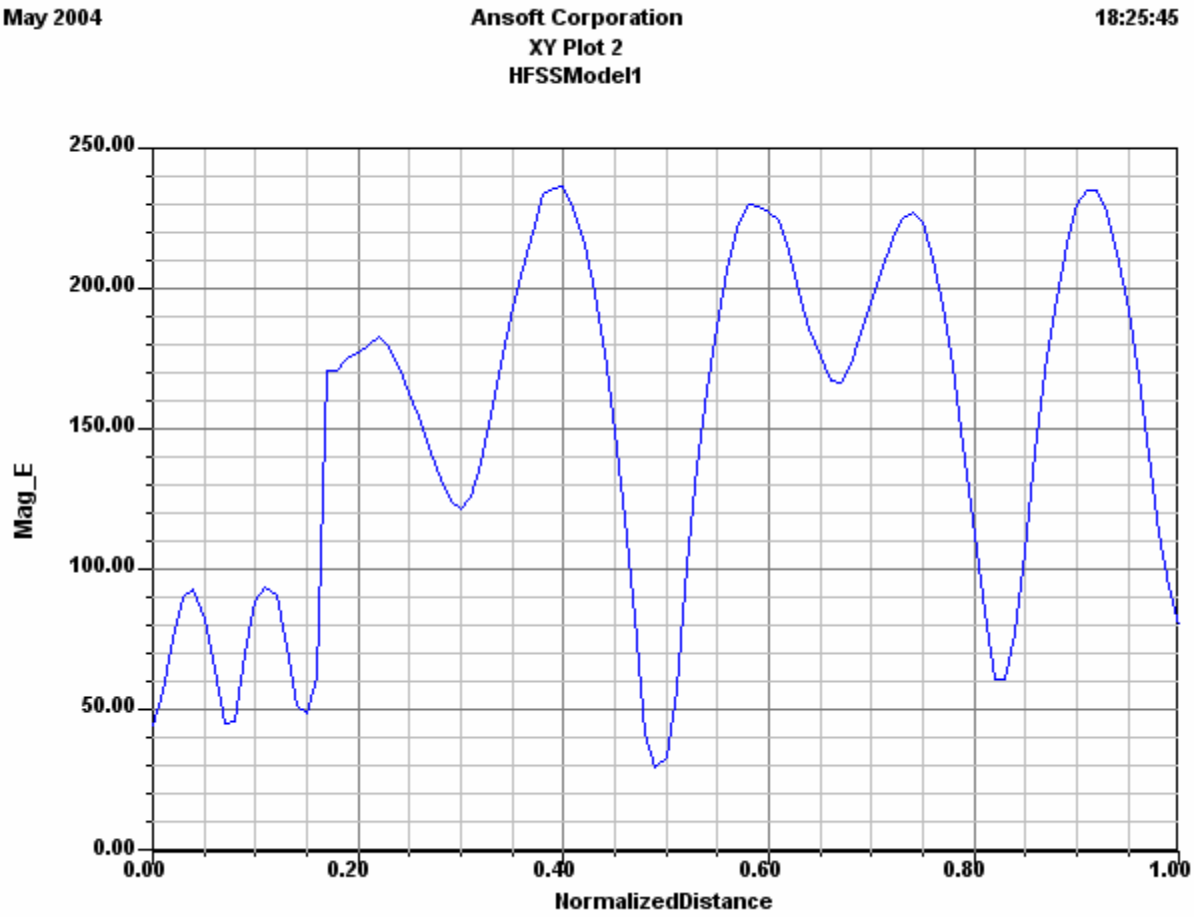


53) We will create a graph for the line. (**Electric Field vs. Normalized Distance from the bottom of the Chassis to the top.**) Go to the menu bar and select HFSS . . . **Results . . . Create Report**. In the new window change Report Type to "Fields".



Click **OK**.

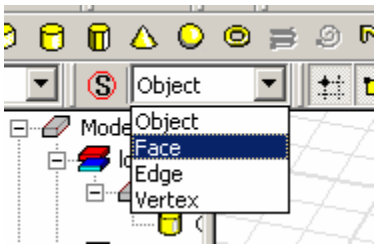
54) In the new window click **Add Trace**. Click **Done**.



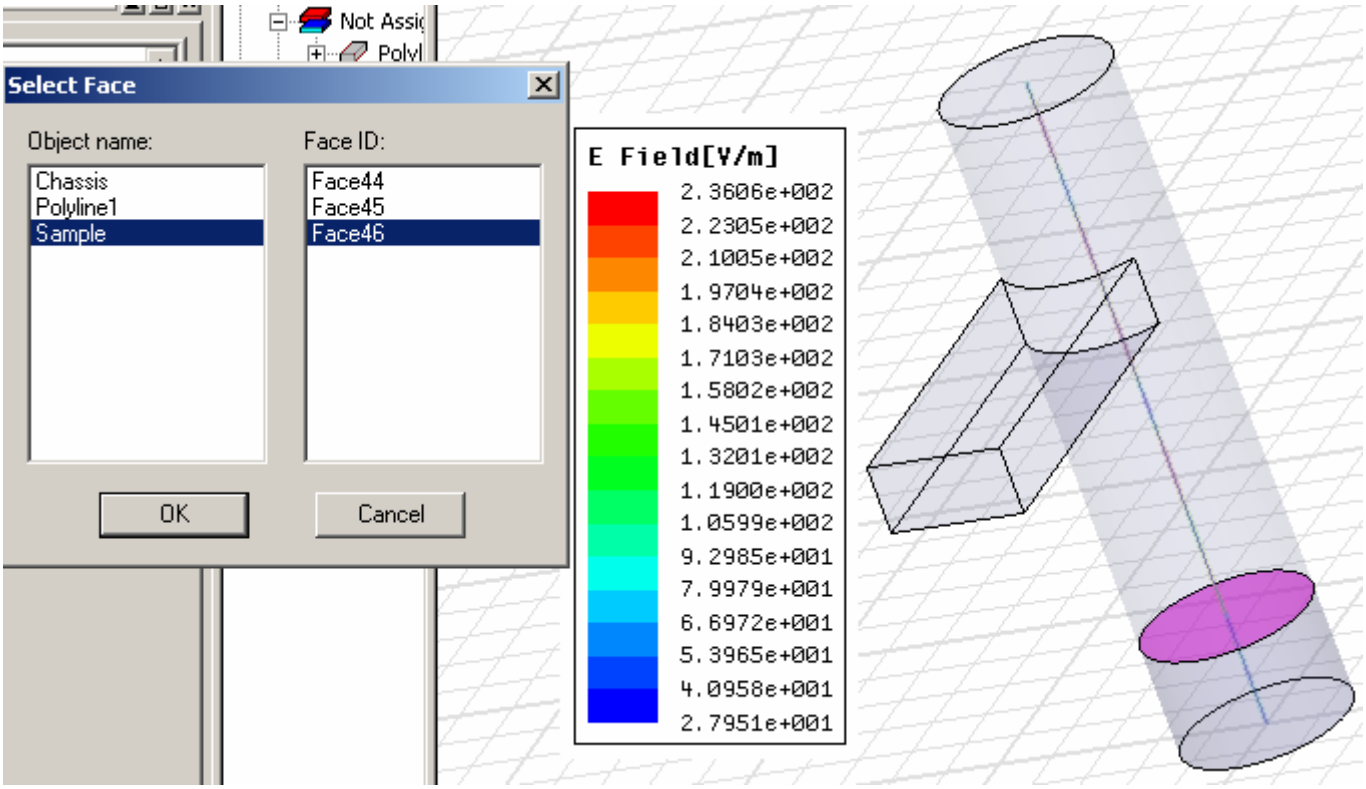
Compare this graph with the one from Part (A). The waveguide in this model merges into the resonating chamber from the side.

55) To return to our model, go to the menu bar and select Window . . . 1 (the name of your file will be here).

56) Change the **Selection Mode** to **Face**.

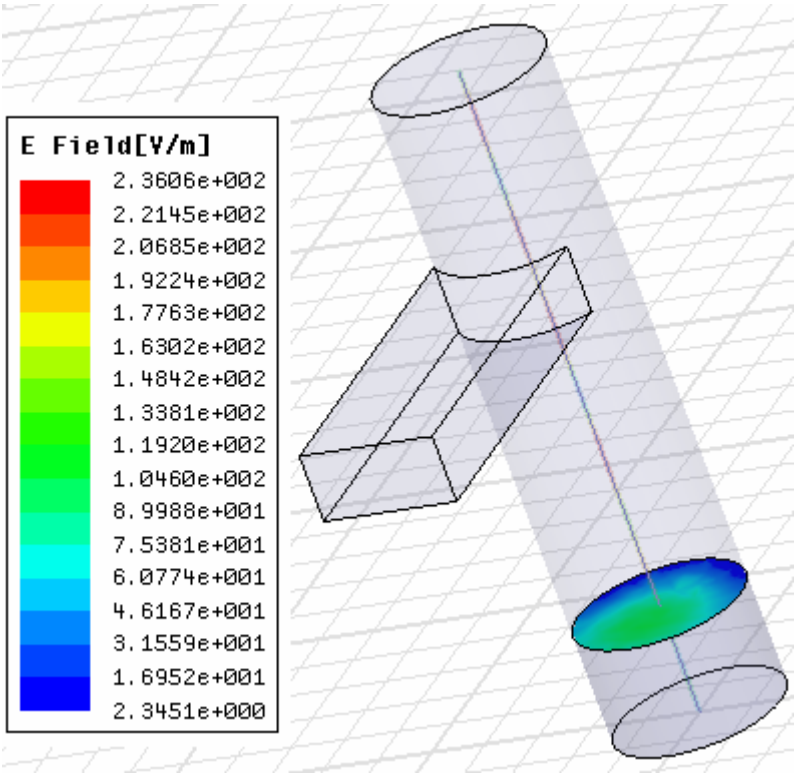


57) Click on the **Select by Name** button (). Choose sample and Face 46.



Click OK.

58) R-click on the graph and select **Plot Fields . . . Mag_E**. In the new window click Done.

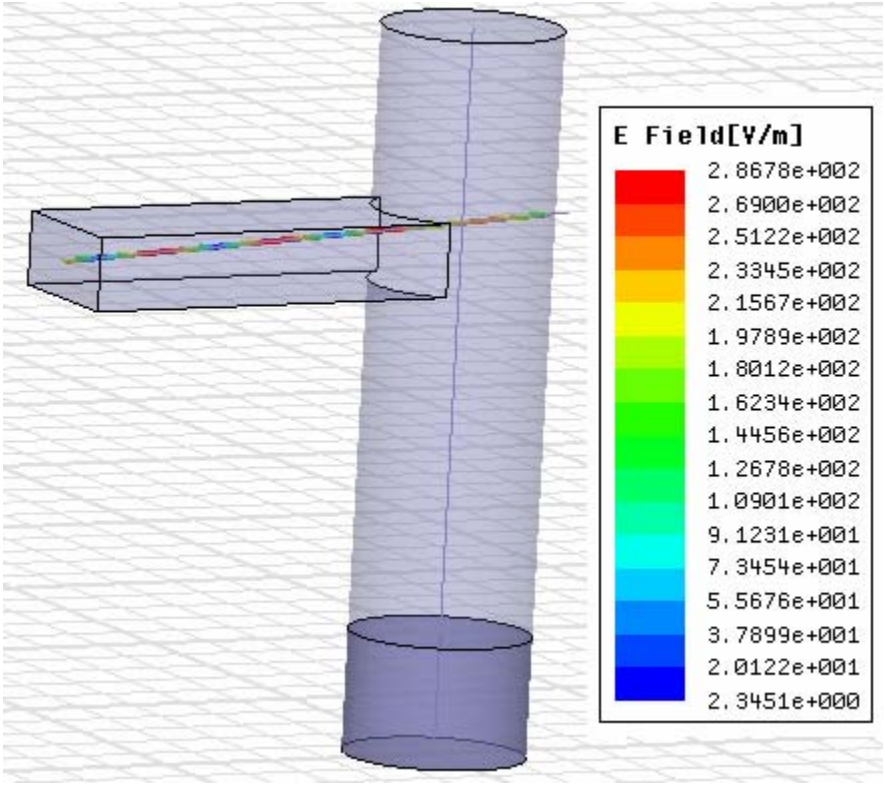


59) We will create one more line. Click on the Draw Line button ( ).

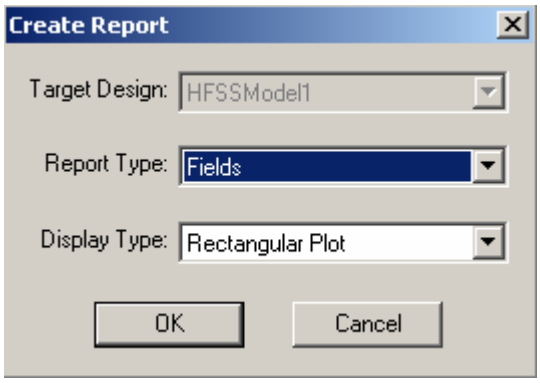
60) Define a line through the center of the wave-guide starting at the center of the front face of the wave-guide and ending at the back of the Chassis. See picture below.

61) Click on the Select by Name button ( ). Choose Polyline 2.

62) R-click on the graph and choose **Plot Fields . . . Mag_E**. In the new window click Done.

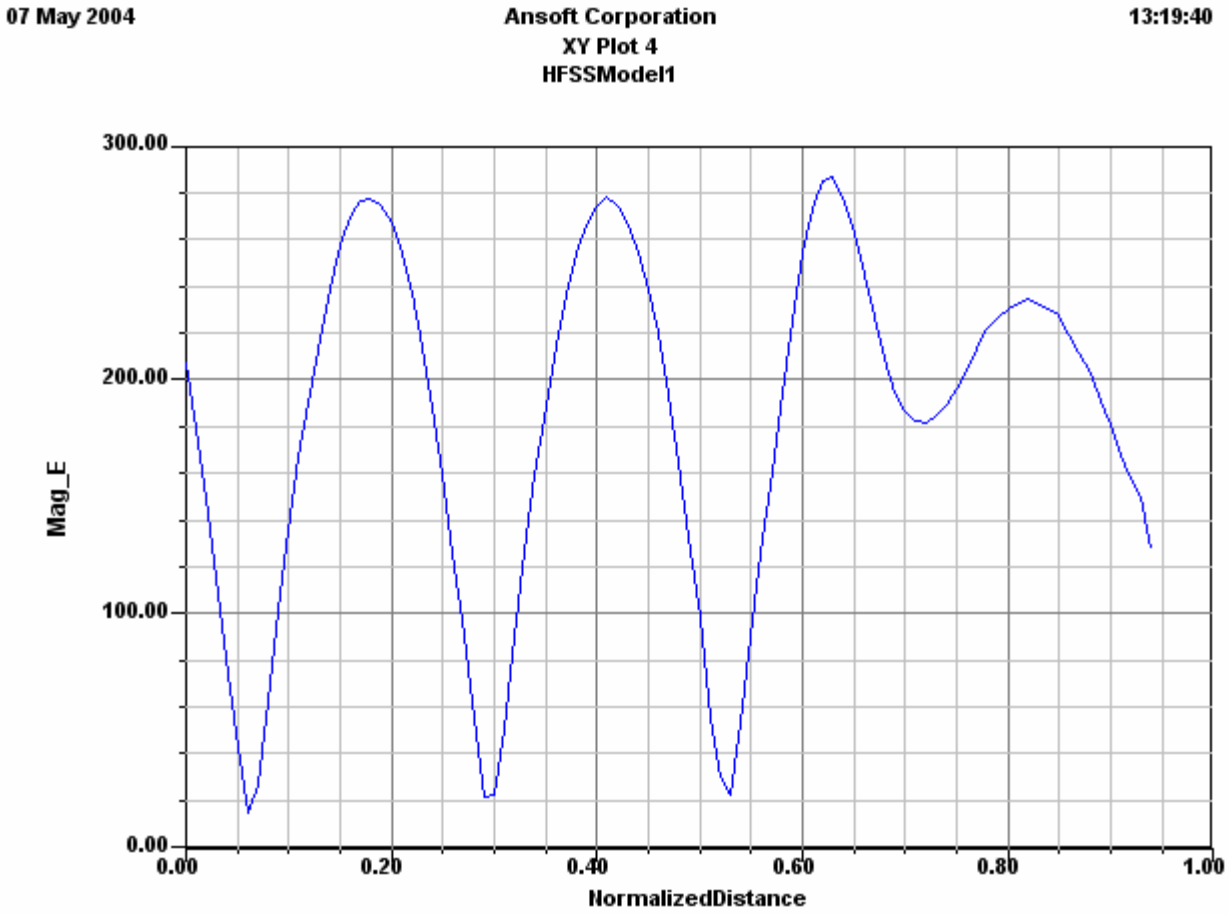


63) We will create a graph for the line. (**Electric Field vs. Normalized Distance**) Go to the menu bar and select **HFSS . . . Results . . . Create Report**. In the new window change Report Type to "Fields".



Click OK.

64) In the new window make sure you choose Polyline 2, and then click Add Trace. Click Done.



This concludes the HFSS Beginner's Tutorial. Save your file and exit the program. Good Luck with your modeling!

射 频 和 天 线 设 计 培 训 课 程 推 荐

易迪拓培训(www.edatop.com)由数名来自于研发第一线的资深工程师发起成立，致力并专注于微波、射频、天线设计研发人才的培养；我们于 2006 年整合合并微波 EDA 网(www.mweda.com)，现已发展成为国内最大的微波射频和天线设计人才培养基地，成功推出多套微波射频以及天线设计经典培训课程和 ADS、HFSS 等专业软件使用培训课程，广受客户好评；并先后与人民邮电出版社、电子工业出版社合作出版了多本专业图书，帮助数万名工程师提升了专业技术能力。客户遍布中兴通讯、研通高频、埃威航电、国人通信等多家国内知名公司，以及台湾工业技术研究院、永业科技、全一电子等多家台湾地区企业。

易迪拓培训课程列表：http://www.edatop.com/peixun/rfe/129.html

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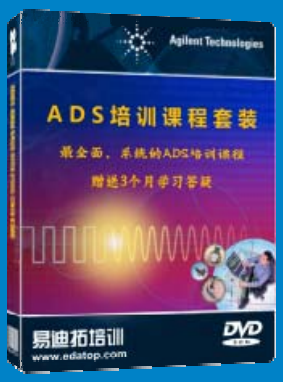
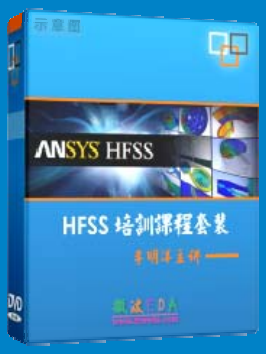


该套装是迄今国内最全面、最权威的 ADS 培训教程，共包含 10 门 ADS 学习培训课程。课程是由具有多年 ADS 使用经验的微波射频与通信系统设计领域资深专家讲解，并多结合设计实例，由浅入深、详细而又全面地讲解了 ADS 在微波射频电路设计、通信系统设计和电磁仿真设计方面的内容。能让您在最短的时间内学会使用 ADS，迅速提升个人技术能力，把 ADS 真正应用到实际研发工作中去，成为 ADS 设计专家...

课程网址： http://www.edatop.com/peixun/ads/13.html



HFSS 学习培训课程套装

该套课程套装包含了本站全部 HFSS 培训课程，是迄今国内最全面、最专业的 HFSS 培训教程套装，可以帮助您从零开始，全面深入学习 HFSS 的各项功能和在多个方面的工程应用。购买套装，更可超值赠送 3 个月免费学习答疑，随时解答您学习过程中遇到的棘手问题，让您的 HFSS 学习更加轻松顺畅…

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课程网址：http://www.edatop.com/peixun/cst/24.html

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详情浏览：http://www.edatop.com/peixun/antenna/116.html

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※ 一直致力并专注于微波射频和天线设计工程师的培养，更了解该行业对人才的要求

※ 经验丰富的一线资深工程师讲授，结合实际工程案例，直观、实用、易学

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