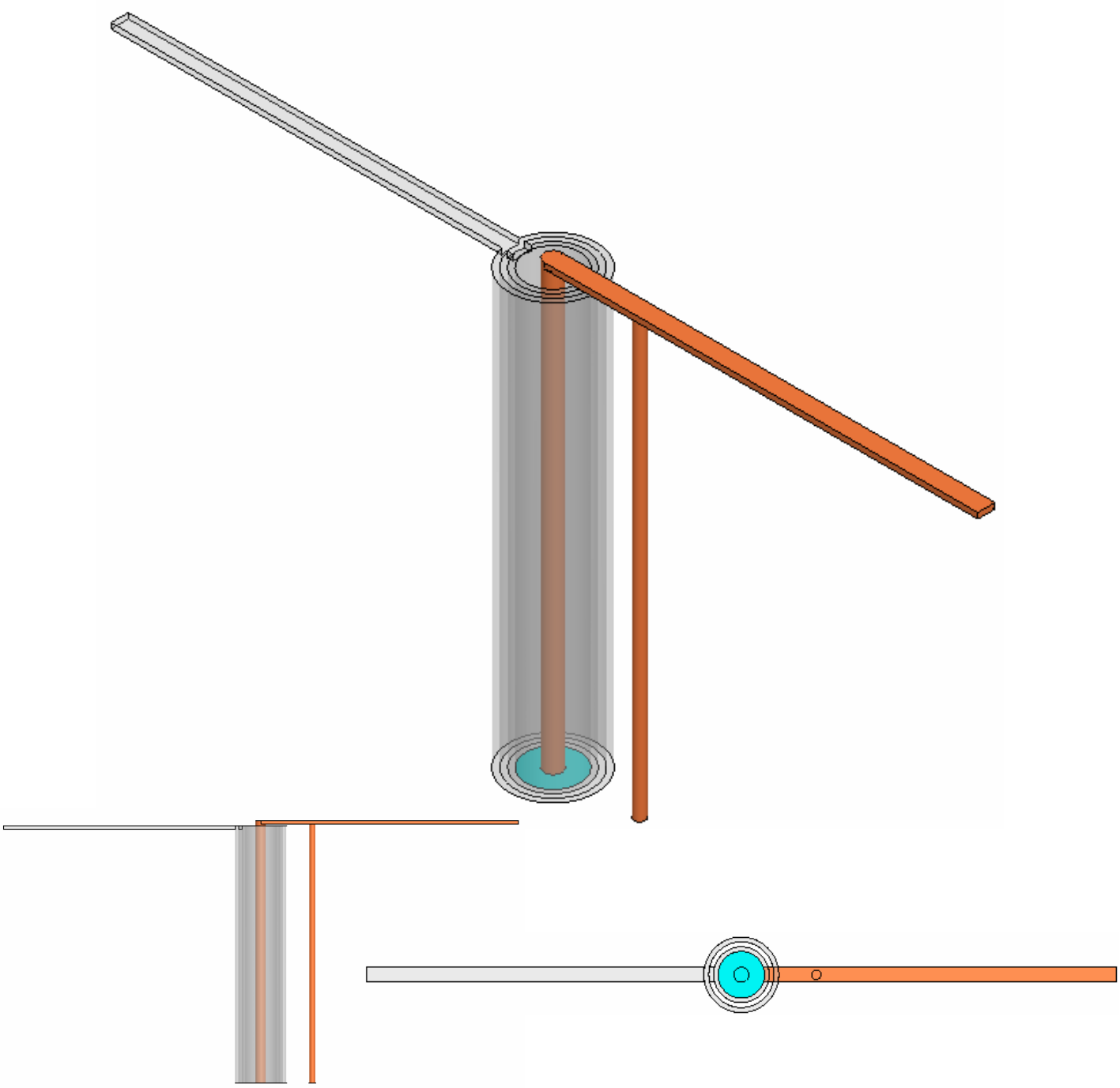
The Ultra-High Frequency (UHF) Probe

- This example is intended to show you how to create, simulate, and analyze a UHF probe, 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, Boxes**
    - Boolean Operations: **Unite, Subtract**
  - Boundaries/Excitations
    - Ports: **Wave Ports**
  - Analysis
    - Sweep: **Fast Frequency**
  - Results
    - **Cartesian plotting**
  - Field Overlays:
    - **3D Far Field Plots**

Getting Started

Launching Ansoft HFSS

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

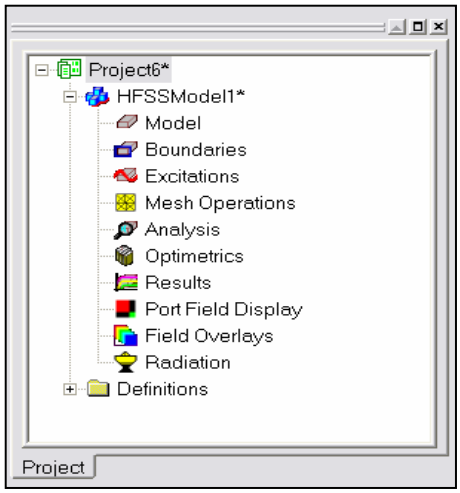
Setting Tool Options

- **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:

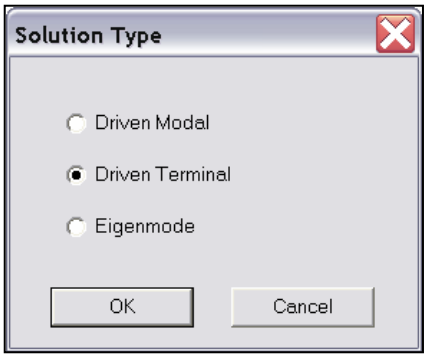
1. In an Ansoft HFSS window, click the 🗋 On the Standard toolbar, or select the menu item ***File > New***.
2. From the ***Project*** menu, select ***Insert HFSS Design***.



Set Solution Type

To set the solution type:

1. Select the menu item ***HFSS > Solution Type***
2. Solution Type Window:
   1. Choose **Driven Terminal**
   2. Click the **OK** button



Creating the 3D Model

Set Model Units

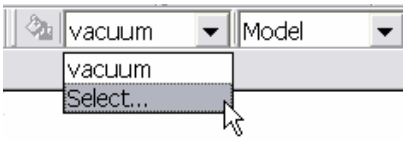
To set the units:

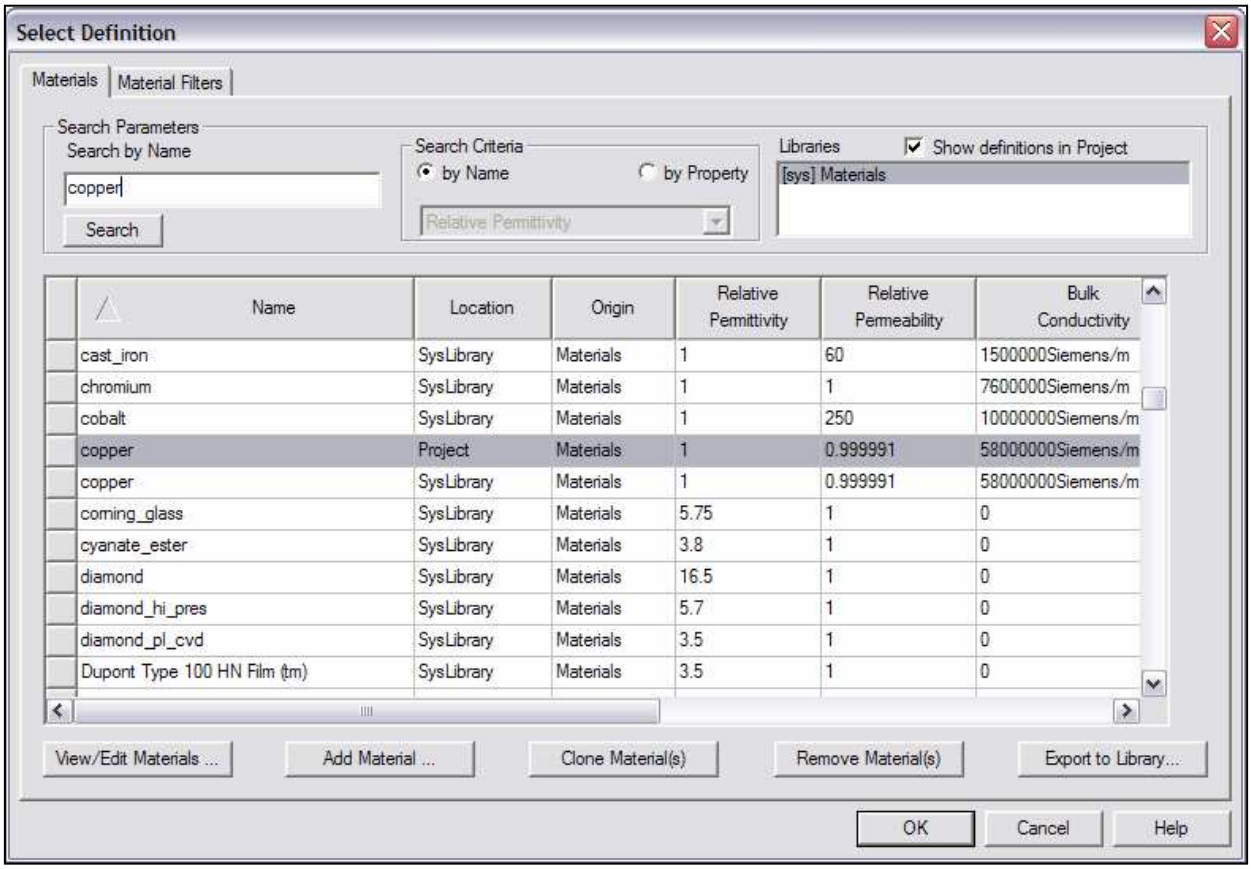
1. Select the menu item *3D Modeler > Units*
2. Set Model Units:
    1. Select Units: **in (inches)**
    2. Click the **OK** button

Set Default Material

To set the default material:

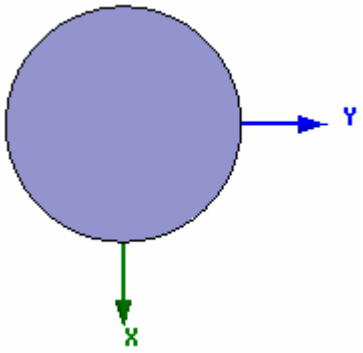
1. Using the 3D Modeler Materials toolbar, choose **Select**
2. Select Definition Window:
    1. Type **copper** in the **Search by Name** field
    2. Click the **OK** button





Creating Annular Rings

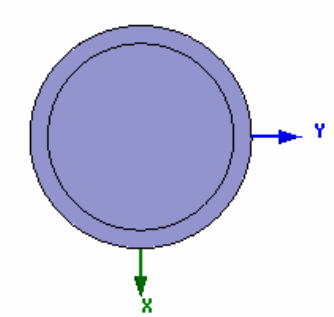
- Creating a ring is accomplished by creating a cylinder that represents the outer radius and a cylinder that represents the inner radius. By performing a Boolean subtraction, the resulting geometry is a ring.
- For this model, two sets of rings are necessary. Instead of manually creating both rings, we will create one ring, copy it, and edit the dimensions of the copy.
- **Create Ring 1**
  1. Select the menu item ***Draw > Cylinder***
  2. Using the coordinate entry fields, enter the cylinder position
     - X: **0.0**, Y: **0.0**, Z: **0.0**, Press the **Enter** key
  3. Using the coordinate entry fields, enter the radius:
     - dX: **0.31**, 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: **5.0,** Press the **Enter** key
- **To set the name:**
  1. Select the **Attribute** tab from the **Properties** window.
  2. For the **Value** of **Name** type: **ring_inner**
  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



Creating Annular Rings (Continued)

Create Ring 1 (Continued)

1. Select the menu item *Draw > Cylinder*
2. Using the coordinate entry fields, enter the cylinder position
   - X: **0.0**, Y: **0.0**, Z: **0.0**, Press the **Enter** key
3. Using the coordinate entry fields, enter the radius:
   - dX: **0.37**, 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: **5.0**, Press the **Enter** key



To set the name:

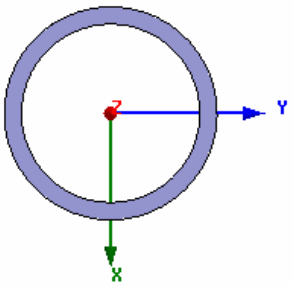
1. Select the **Attribute** tab from the **Properties** window.
2. For the **Value** of **Name** type: **ring_1**
3. Click the **OK** button

To select objects to be subtracted:

1. Select the menu item *Edit > Select > By Name*
2. Select Object Dialog,
   1. Select the objects named: **ring_1, ring_inner**
   2. Click the **OK** button

To subtract:

1. Select the menu item *3D Modeler > Boolean > Subtract*
2. Subtract Window
   - Blank Parts: **ring_1**
   - Tool Parts: **ring_inner**
   - Clone tool objects before subtract: ☐ **Unchecked**
   - Click the **OK** button



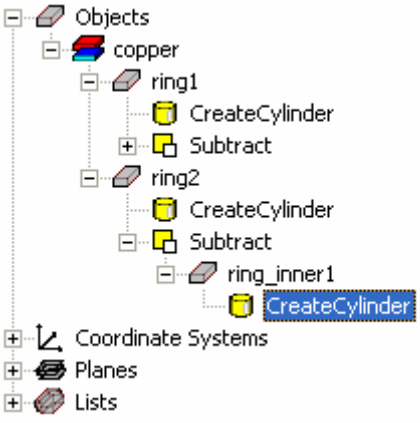
Creating Annular Rings (Continued)

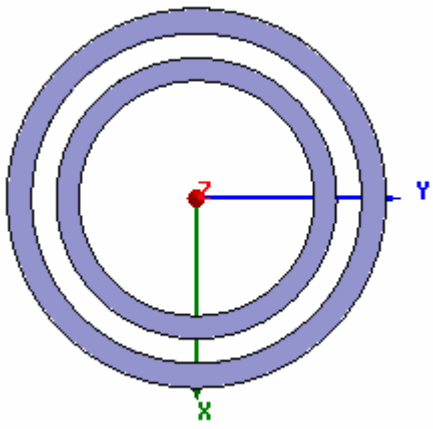
Create Ring 2

1. Select the menu item ***Edit > Select > By Name***
2. Select Object Dialog,
    1. Select the objects named: **ring_1**
    2. Click the **OK** button
3. Select the menu item ***Edit > Copy***
4. Select the menu item ***Edit > Paste***

Change the dimensions of Ring 2

1. To change the dimensions of ring_2, expand the model tree as shown below. It should be noted that order of the editing is important. If you make the inner radius > then the outer radius, a invalid object will result and it will be removed from the model.
2. Using the mouse, double click the left mouse button on the **CreateCylinder** command for **ring_2**
3. Properties dialog
    1. Change the radius to: **0.5 in**
    2. Click the **OK** button
4. Using the mouse, double click the left mouse button on the **CreateCylinder** command for **ring_inner1**
5. Properties dialog
    1. Change the radius to: **0.435 in**
    2. Click the **OK** button





Create Arm_1

To create Arm_1

1. Select the menu item *Draw > Box*
2. Using the coordinate entry fields, enter the box position
   - X: **-0.1**, Y: **-0.31**, Z: **5.0**, Press the **Enter** key
3. Using the coordinate entry fields, enter the opposite corner of the base rectangle:
   - dX: **0.2**, dY: **-4.69**, dZ: **-0.065**, Press the **Enter** key

To set the name:

1. Select the **Attribute** tab from the **Properties** window.
2. For the **Value** of **Name** type: **Arm_1**
3. Click the **OK** button

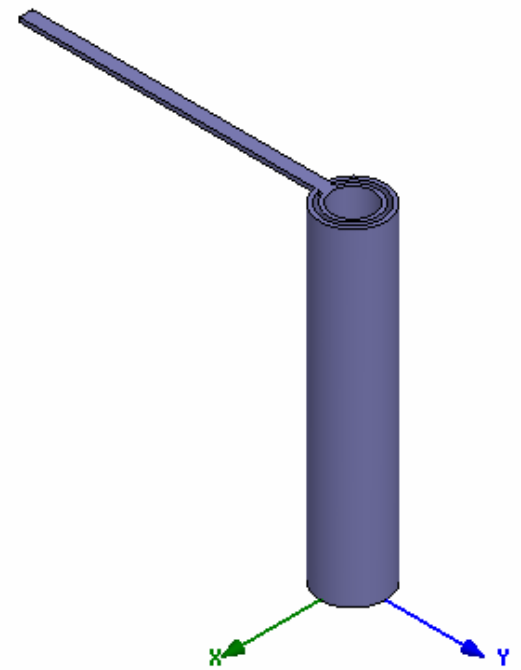
To fit the view:

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

Group Conductors

To group the conductors:

1. Select the menu item *Edit > Select All Visible*. Or press the **CTRL+A** key
2. Select the menu item, *3D Modeler > Boolean > Unite*



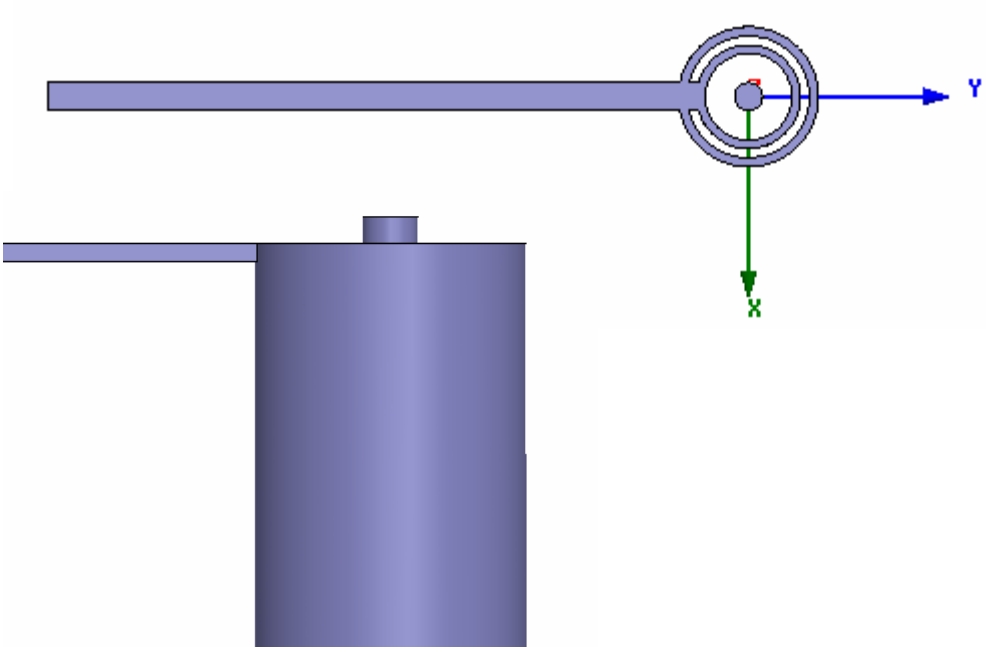
Create the Center pin

To create the center pin

1. Select the menu item *Draw > Cylinder*
2. Using the coordinate entry fields, enter the cylinder position
   - X: **0.0**, Y: **0.0**, Z: **0.0**, Press the **Enter** key
3. Using the coordinate entry fields, enter the radius:
   - dX: **0.1**, 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: **5.1**, Press the **Enter** key

To set the name:

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



Create Arm_2

To create Arm_2

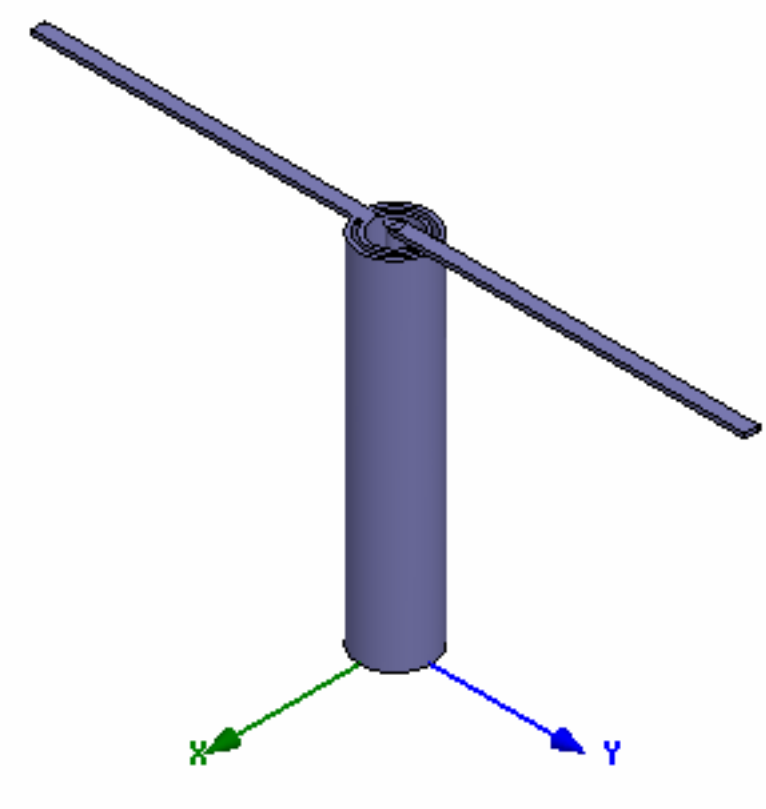
1. Select the menu item *Draw > Box*
2. Using the coordinate entry fields, enter the box position
   - X: **-0.1**, Y: **0.0**, Z: **5.1**, Press the **Enter** key
3. Using the coordinate entry fields, enter the opposite corner of the base rectangle:
   - dX: **0.2**, dY: **5.0**, dZ: **-0.065**, Press the **Enter** key

To set the name:

1. Select the **Attribute** tab from the **Properties** window.
2. For the **Value** of **Name** type: **Arm_2**
3. Click the **OK** button

To fit the view:

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



Create the Grounding Pin

To create the grounding pin

1. Select the menu item *Draw > Cylinder*
2. Using the coordinate entry fields, enter the cylinder position
   - X: **0.0**, Y: **1.0**, Z: **0.0,** Press the **Enter** key
3. Using the coordinate entry fields, enter the radius:
   - dX: **0.0625**, 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: **5.1**, Press the **Enter** key

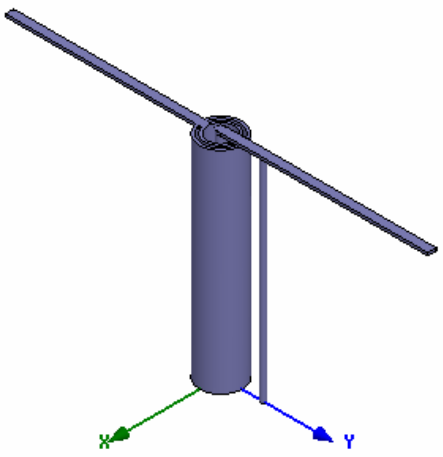
To set the name:

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

Group Conductors

To group the conductors:

1. Select the menu item *Edit > Select > By Name*
2. Select Object Dialog,
   1. Select the objects named: **Arm_2, center_pin, pin**
      - **Note:** Use the Ctrl + Left mouse button to select multiple objects
   2. Click the **OK** button
3. Select the menu item, *3D Modeler > Boolean > Unite*



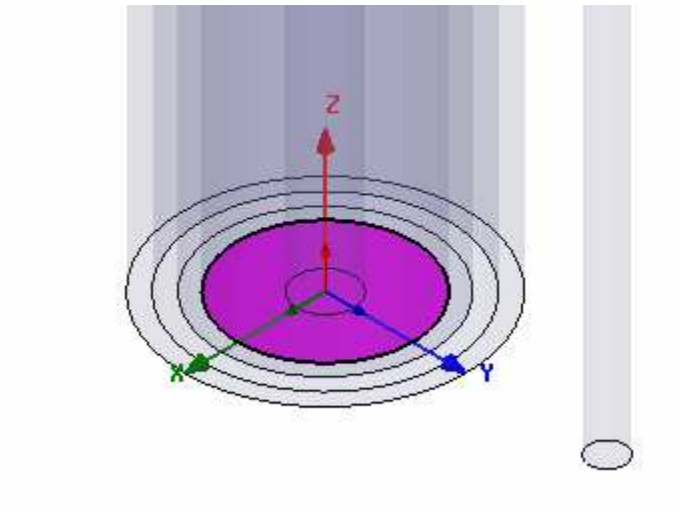
Create the Wave port

To create a circle that represents the port:

1. Select the menu item *Draw > Circle*
2. Using the coordinate entry fields, enter the center position
   - X: **0.0**, Y: **0.0**, Z: **0.0**, Press the **Enter** key
3. Using the coordinate entry fields, enter the radius of the circle:
   - dX: **0.31**, 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: **p1**
3. Click the **OK** button

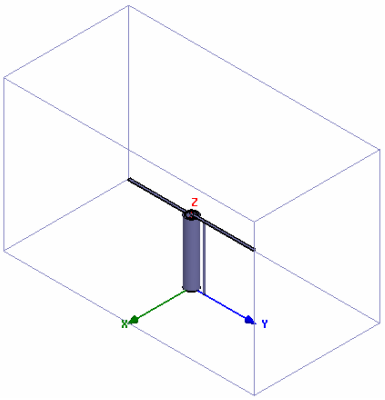


Set Default Material

- **To set the default material:**
  - Using the 3D Modeler Materials toolbar, choose **vacuum**

Create Air

- **To create Air**
  1. Select the menu item *Draw > Box*
  2. Using the coordinate entry fields, enter the box position
     - X: **-5.0**, Y: **-10.0**, Z: **0.0,** Press the **Enter** key
  3. Using the coordinate entry fields, enter the opposite corner of the base rectangle:
     - dX: **10.0**, dY: **20.0**, dZ: **12.0**, 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:**
  1. 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

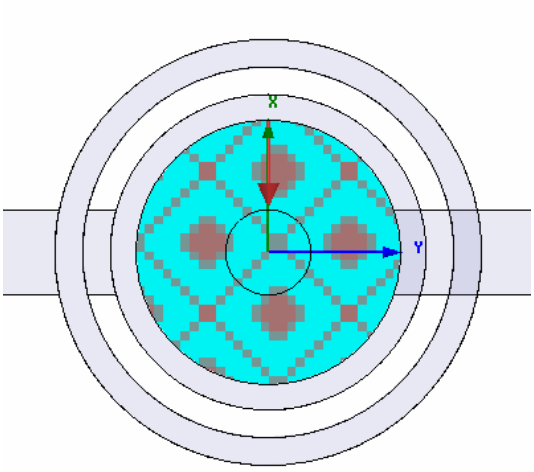
Create Wave Port Excitation 1 (Continued)

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

To assign wave port excitation

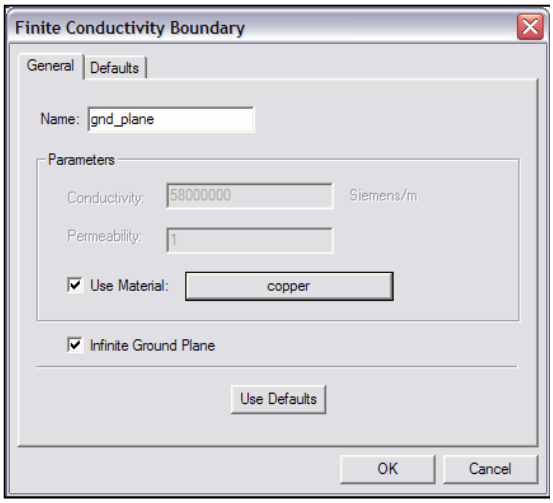
1. Select the menu item *HFSS > Excitations > Assign > Wave Port*
2. Wave Port : General
    1. Name: **p1**,
    2. Click the **Next** button
3. Wave Port : Terminals
    1. Number of Terminals: **1**,
    2. For **T1**, click the **Undefined** column and select **New Line**
    3. Using the coordinate entry fields, enter the vector position
        - **X: 0.31, Y: 0.0, Z: 0.0,** Press the **Enter** key
    4. Using the coordinate entry fields, enter the vertex
        - **dX: -0.21, dY: 0.0, dZ: 0.0,** Press the **Enter** key
    5. Click the **Next** button
4. Wave Port : Differential Pairs
    1. Click the **Next** button
5. Wave Port : Post Processing
    1. Reference Impedance: **50**
6. Click the **Finish** button



Create Infinite Ground Plane

To create an Infinite ground

1. Select the menu item ***Edit > Select > Faces***
2. Graphically select the face of the Air object at Z=0
3. Select the menu item ***HFSS > Boundaries > Assign> Finite Conductivity***
4. Finite Conductivity Boundary window
    1. Name: **gnd_plane**
    2. Use Material: ☑ **Checked**
    3. Click the **vacuum** button
    4. Select Definition Window:
        1. Type **copper** in the **Search by Name** field
        2. Click the **OK** button
    5. Infinite Ground Plane: ☑ **Checked**
    6. Click the **OK** button



Create a Radiation Setup

To define the radiation setup

1. Select the menu item ***HFSS > Radiation > Insert Far Field Setup > Infinite Sphere***
2. Far Field Radiation Sphere Setup dialog
    1. **Infinite Sphere** Tab
        1. Name: **ff_2d**
        2. Phi: (Start: **0**, Stop: **90**, Step Size: **90**)
        3. Theta: (Start: **-180**, Stop: **180**, Step Size: **2**)
    2. Click the **OK** button

Analysis Setup

Creating an 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: **0.55 GHz**
        - Maximum Number of Passes: **10**
        - Maximum Delta S per Pass: **0.02**
     2. Click the **OK** button

Adding a Frequency Sweep

- **To add a frequency sweep:**
  1. Select the menu item *HFSS > Analysis Setup > Add Sweep*
     1. Select Solution Setup: **Setup1**
     2. Click the **OK** button
  2. Edit Sweep Window:
     1. Sweep Type: **Fast**
     2. Frequency Setup Type: **Linear Count**
        - Start: **0.35GHz**
        - Stop: **0.75GHz**
        - Count: **401**
        - Save Fields: ☑ **Checked**
     3. Click the **OK** button

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_uhf_probe**
3. Click the **Save** button

Analyze

Model Validation

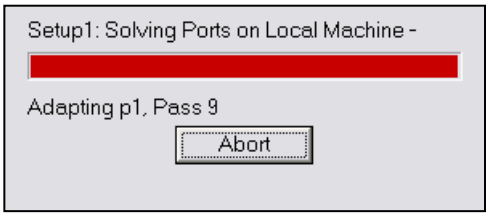
To validate the model:

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:

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



Solution Data

To view the Solution Data:

1. Select the menu item *HFSS > Results > Solution Data*

To view the Profile:

1. Click the **Profile** Tab.

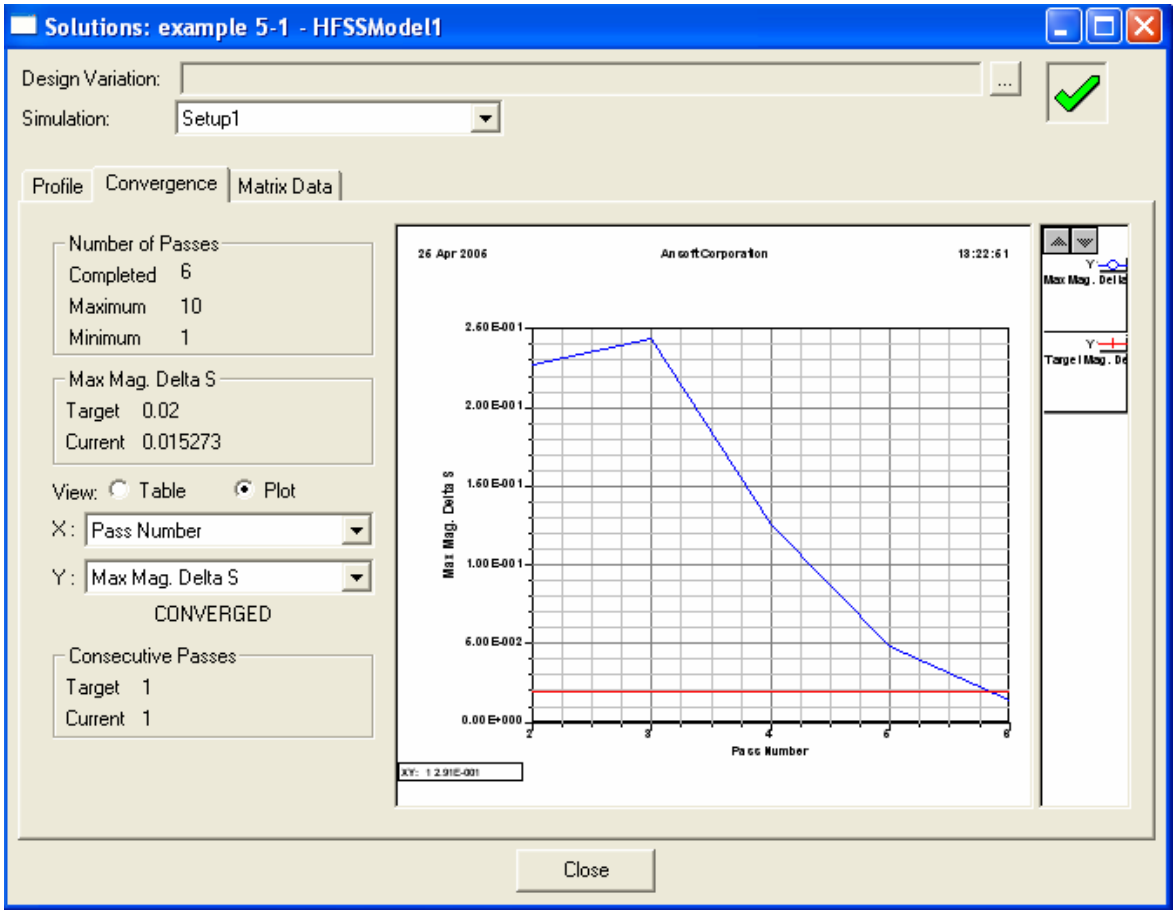
To view the Convergence:

1. Click the **Convergence** Tab
   - **Note:** The default view is for convergence is **Table**. Select the **Plot** radio button to view a graphical representations of the convergence data.

To view the Matrix Data:

1. Click the **Matrix Data** Tab
   - **Note:** To view a real-time update of the Matrix Data, set the Simulation to **Setup1, Last Adaptive**

2. Click the **Close** button

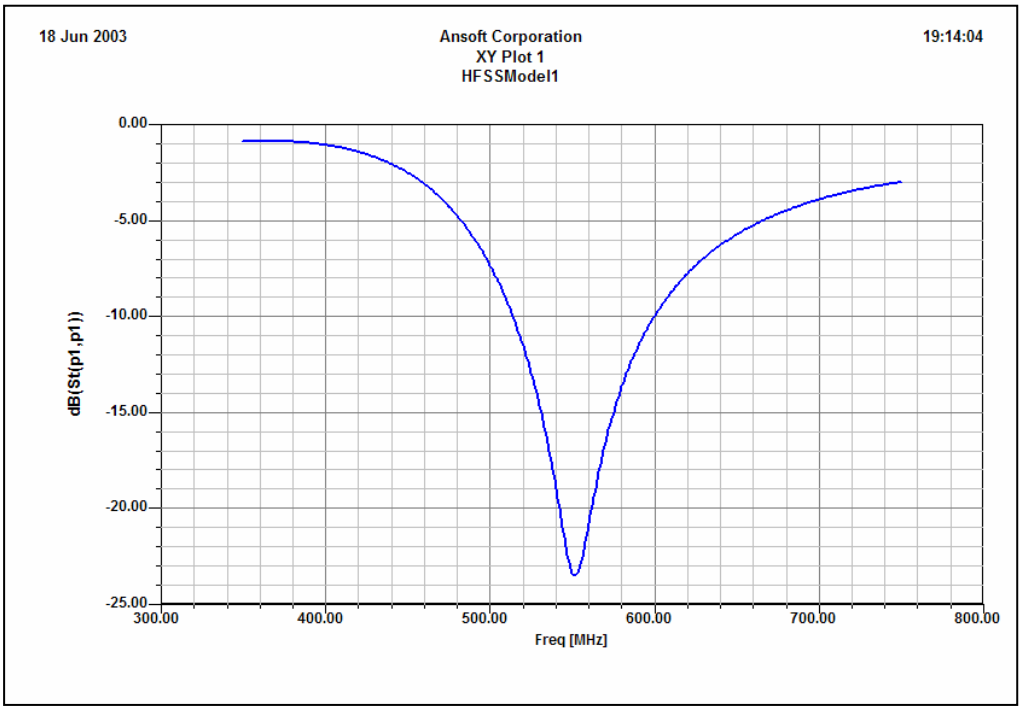


Create Reports

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

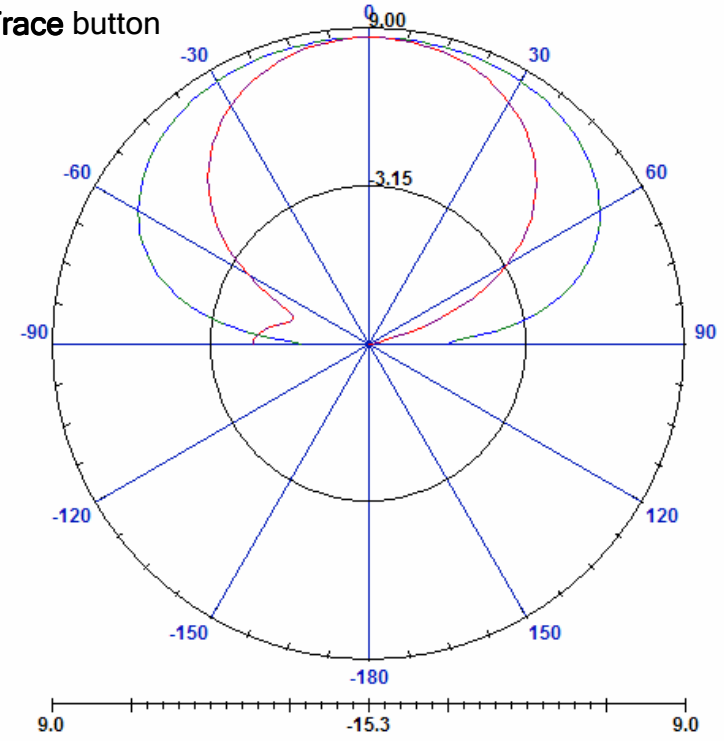


Far Field Overlays

Create Far Field Overlay

To create a 2D polar far field plot :

1. Select the menu item *HFSS > Results > Create Report*
2. Create Report Window:
   1. Report Type: **Far Fields**
   2. Display Type: **Radiation Pattern**
   3. Click the **OK** button
3. Traces Window:
   1. Solution: **Setup1: LastAdaptive**
   2. Geometry: **ff_2d**
   3. In the **Sweeps** tab, select **Phi** under the **Name** column, and on the drop list, select **Theta**. This changes the primary sweep to Theta.
   4. In the **Mag** tab
      1. Category: **Gain**
      2. Quantity: **GainTotal**
      3. Function: **dB**
      4. Click the **Add Trace** button
   5. Click the **Done** button



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。

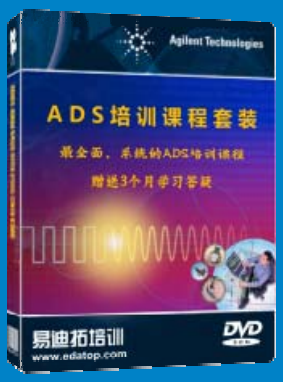
易迪拓培训课程列表：http://www.edatop.com/peixun/rfe/129.html

射频工程师养成培训课程套装

该套装精选了射频专业基础培训课程、射频仿真设计培训课程和射频电路测量培训课程三个类别共 30 门视频培训课程和 3 本图书教材；旨在引领学员全面学习一个射频工程师需要熟悉、理解和掌握的专业知识和研发设计能力。通过套装的学习，能够让学员完全达到和胜任一个合格的射频工程师的要求…

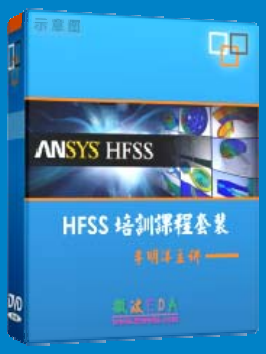
课程网址：http://www.edatop.com/peixun/rfe/110.html

ADS 学习培训课程套装



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…

课程网址：http://www.edatop.com/peixun/hfss/11.html

CST 学习培训课程套装

该培训套装由易迪拓培训联合微波 EDA 网共同推出，是最全面、系统、专业的 CST 微波工作室培训课程套装，所有课程都由经验丰富的专家授课，视频教学，可以帮助您从零开始，全面系统地学习 CST 微波工作的各项功能及其在微波射频、天线设计等领域的设计应用。且购买该套装，还可超值赠送 3 个月免费学习答疑…

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

HFSS 天线设计培训课程套装

套装包含 6 门视频课程和 1 本图书，课程从基础讲起，内容由浅入深，理论介绍和实际操作讲解相结合，全面系统的讲解了 HFSS 天线设计的全过程。是国内最全面、最专业的 HFSS 天线设计课程，可以帮助您快速学习掌握如何使用 HFSS 设计天线，让天线设计不再难…

课程网址：http://www.edatop.com/peixun/hfss/122.html

13.56MHz NFC/RFID 线圈天线设计培训课程套装

套装包含 4 门视频培训课程，培训将 13.56MHz 线圈天线设计原理和仿真设计实践相结合，全面系统地讲解了 13.56MHz 线圈天线的工作原理、设计方法、设计考量以及使用 HFSS 和 CST 仿真分析线圈天线的具体操作，同时还介绍了 13.56MHz 线圈天线匹配电路的设计和调试。通过该套课程的学习，可以帮助您快速学习掌握 13.56MHz 线圈天线及其匹配电路的原理、设计和调试…

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

我们的课程优势：

※ 成立于 2004 年，10 多年丰富的行业经验，

※ 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

联系我们：

※ 易迪拓培训官网：http://www.edatop.com

※ 微波 EDA 网：http://www.mweda.com

※ 官方淘宝店：http://shop36920890.taobao.com