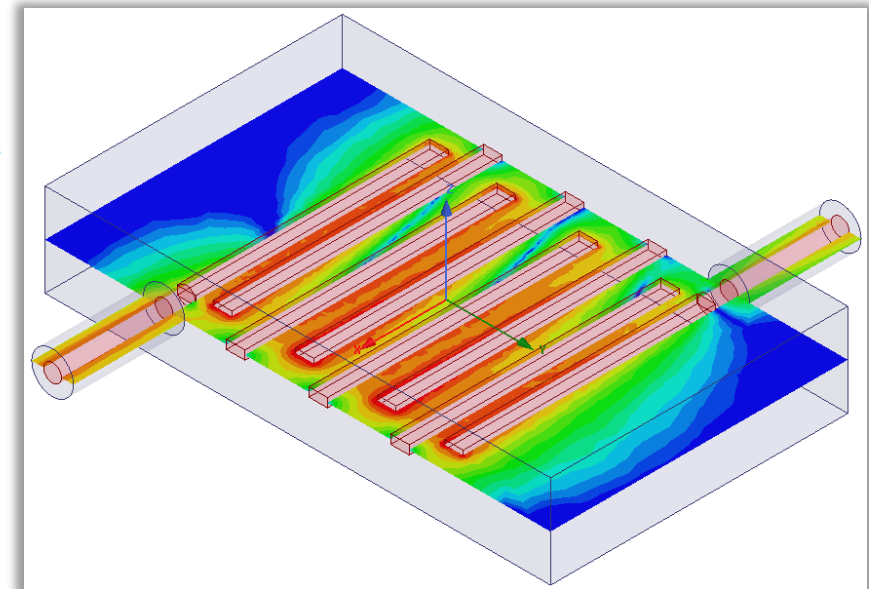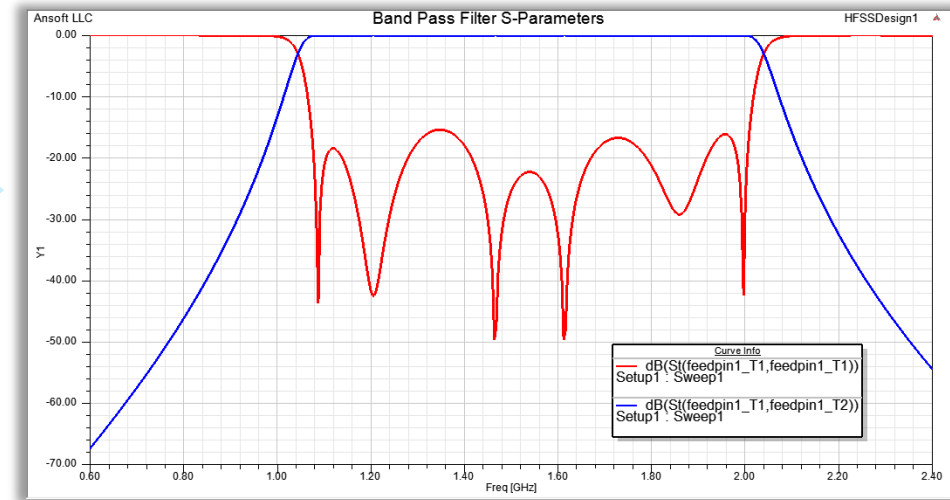# Lecture 4: Simulation Post Processing

HFSS Getting Started
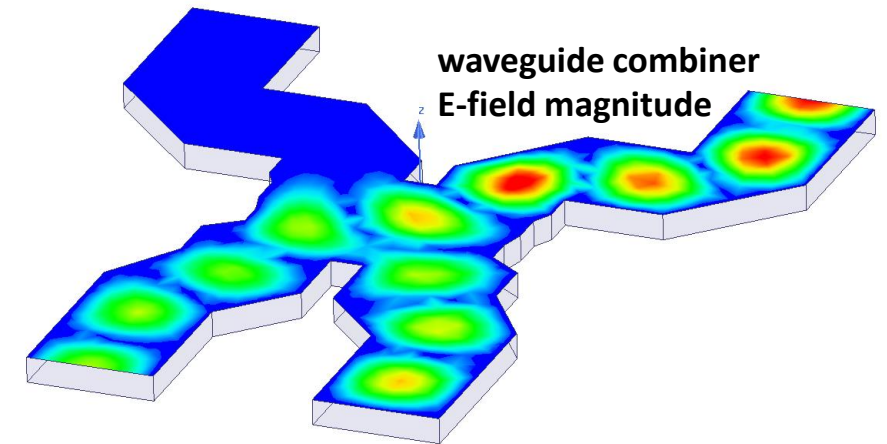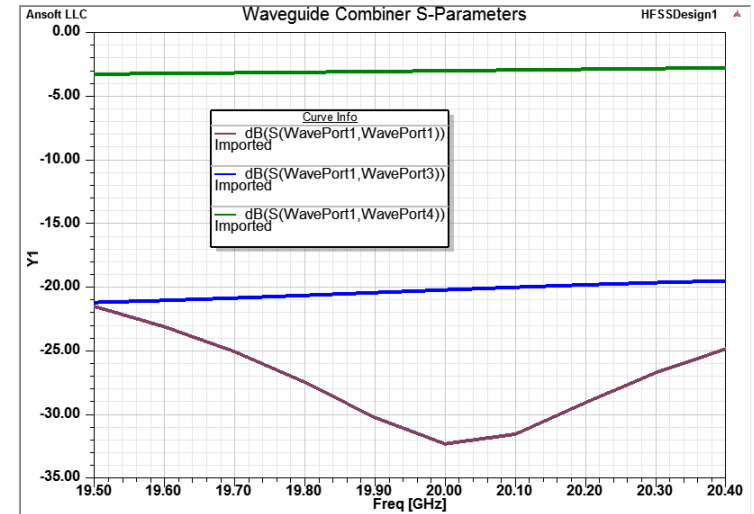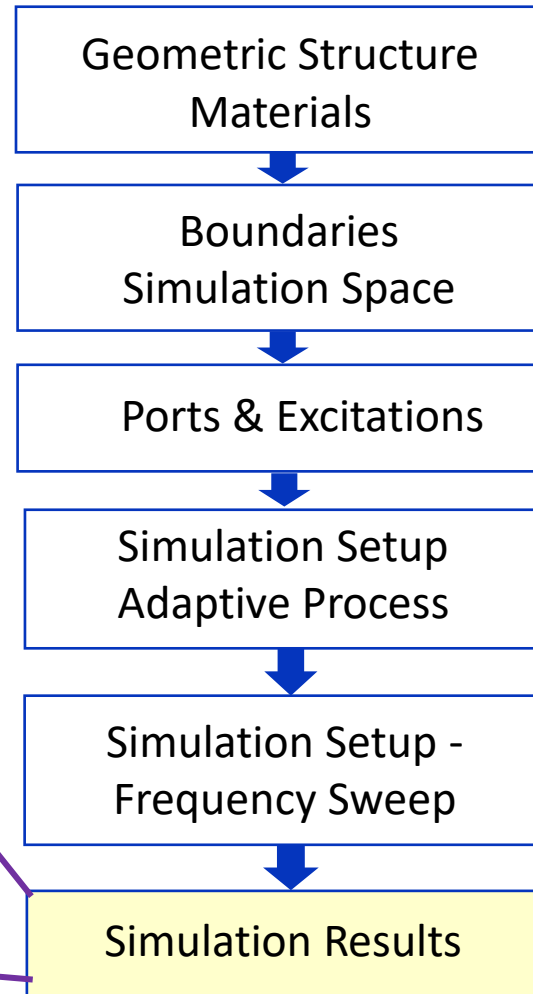
Release 2020 R2

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Outline - Post Processing - HFSS S-Parameters and Fields

- Plotting S-Parameters with Rectangular Plots
  - Setting up and modifying S-Parameter plots
  - Modifying visual appearance of plots
  - Copying rectangular plot Data and Definitions

- Overview of Available Post Processing
  - Quantities
  - Formats
  - Report Editor

- Plotting Fields and Overlays
  - What simulation is needed for a field
  - Setting up Field Plots
  - Field Plot Overlays on Geometries

The HFSS Simulation *Results* and *Field Overlays* in the Workflow


Geometric Structure
Materials

↓

Boundaries
Simulation Space

↓

Ports & Excitations

↓

Simulation Setup
Adaptive Process

↓

Simulation Setup -
Frequency Sweep

↓

Simulation Results

**waveguide combiner
E-field magnitude**

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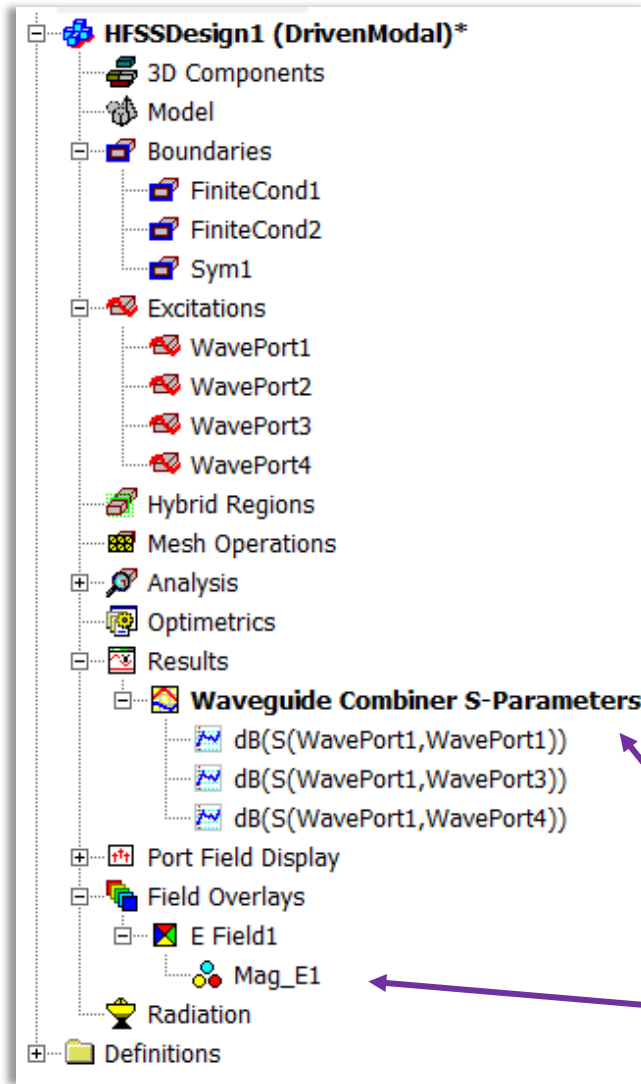
How to Access S-Parameter Plot Setup
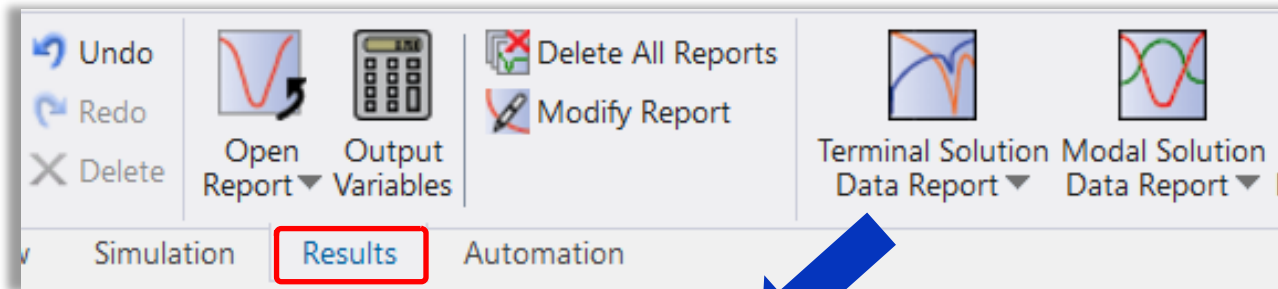
How to Access S-parameter *Reports*

– In the **Project Manager**, right-click on **Results** and choose **Create ____ Solution Data Report**.
– Choose **Rectangular Plot** or **Smith Chart**.

The blank ____ gets filled in with a **Solution Type**, such as **Modal, Terminal**, or **Eigenmode**.
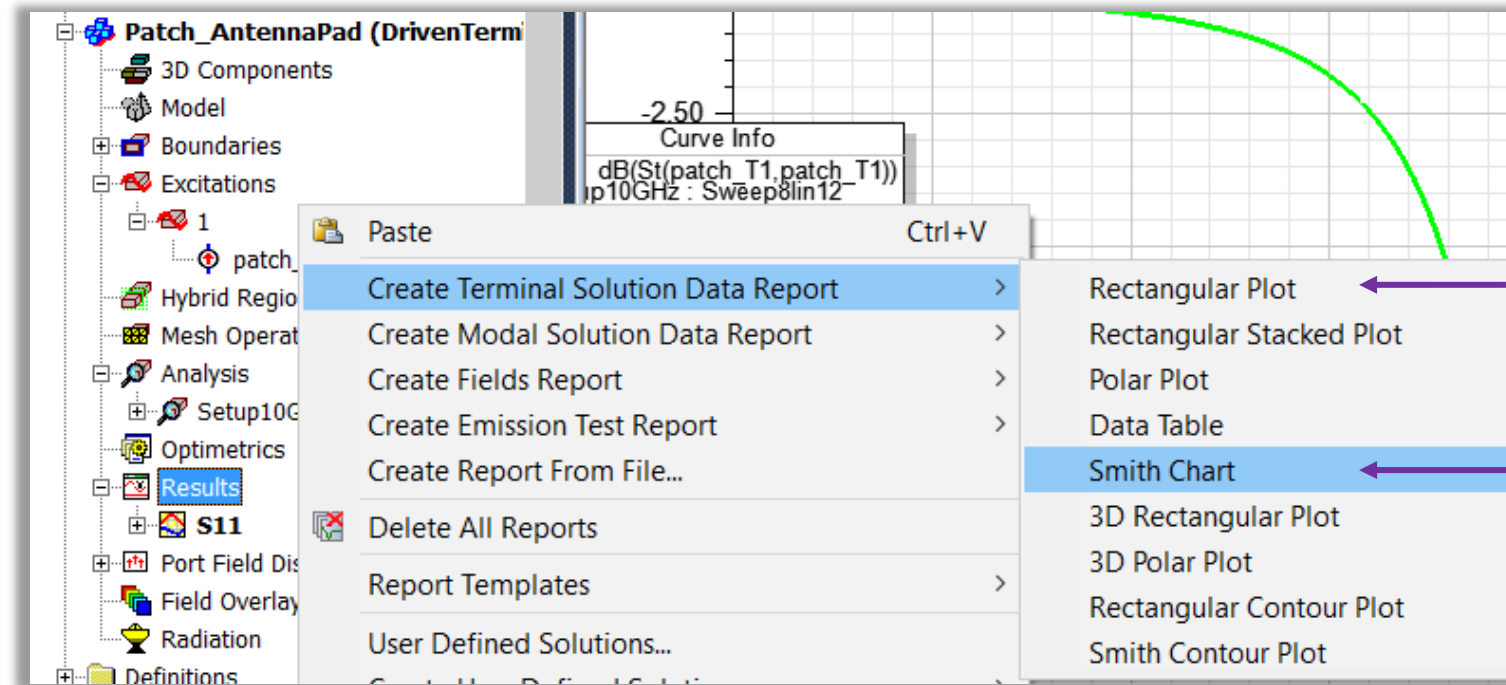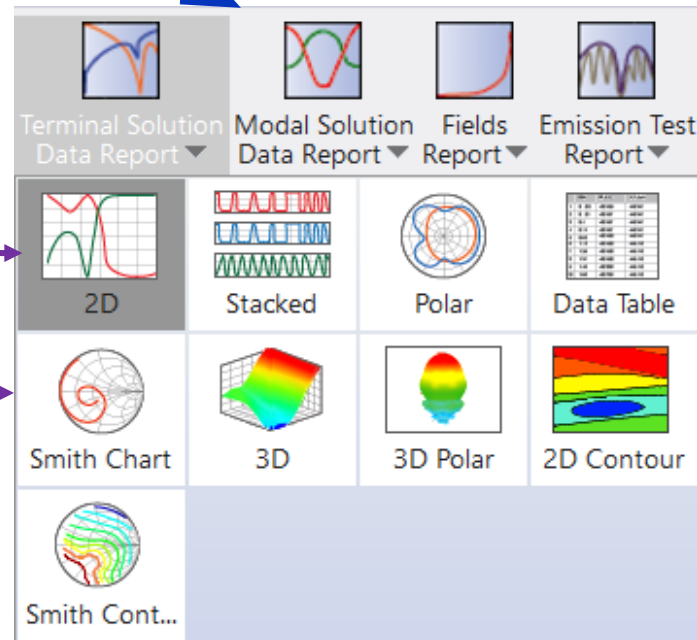

Choose one of these.

More Ways to Access S-Parameter Plot Setup

...from the Ribbon

- In the **Ribbon**, highlight Results.
- Click on ____ **Solution Data Report**.
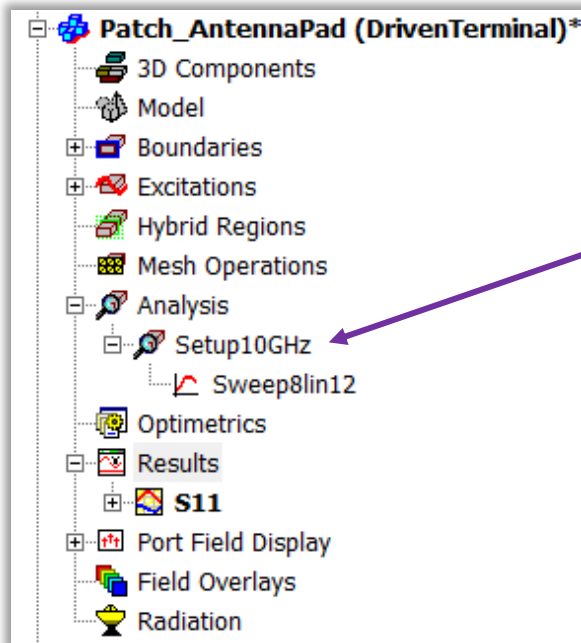- Choose **2D** or **Smith Chart**.

The blank ____ gets filled in with a **Solution Type**, such as **Modal**, **Terminal**, or **Eigenmode**.

Both the **2D** and the **Smith Chart** are more general than just S-parameters. For example, impedance can be graphed in either.

Setting up S-parameter plots is also available from:
HFSS > Results > Create ____ Solution Data Report.

S-Parameter Rectangular Report Dialog Box

This was accessed via:
Terminal Solution Data Report > Rectangular Plot.

Domain: Sweep refers to frequency sweep. The other choice is time.
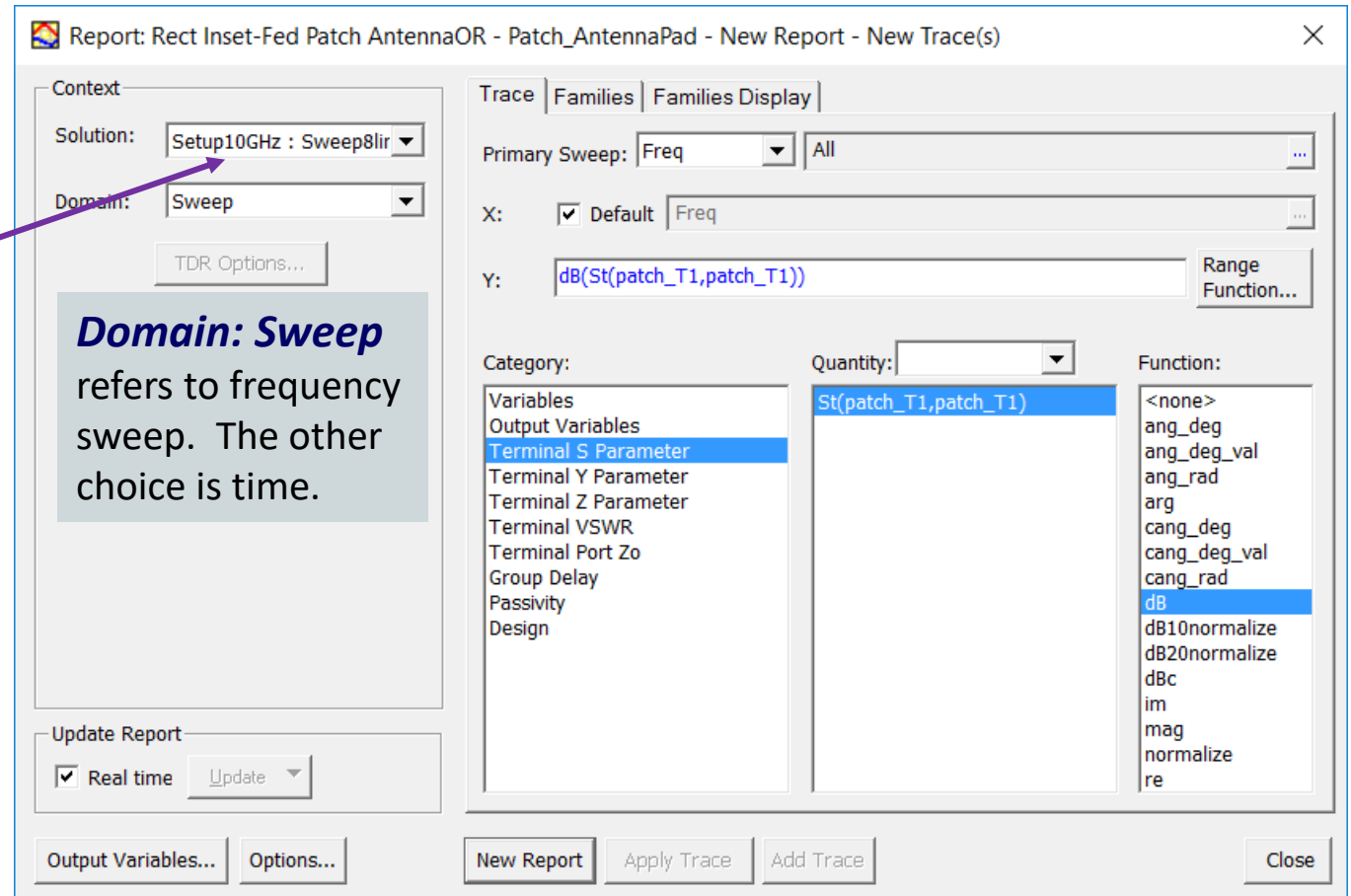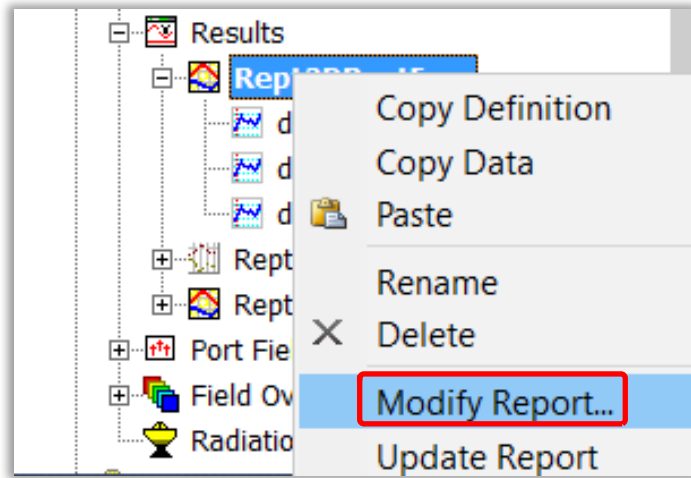
For information on the *Families* tab, see *HFSS.pdf*, section on *Using Families Tab for Reports*.

Adding Traces to an S-Parameter Report (Plot)

<u>To modify an existing **Report**</u>:
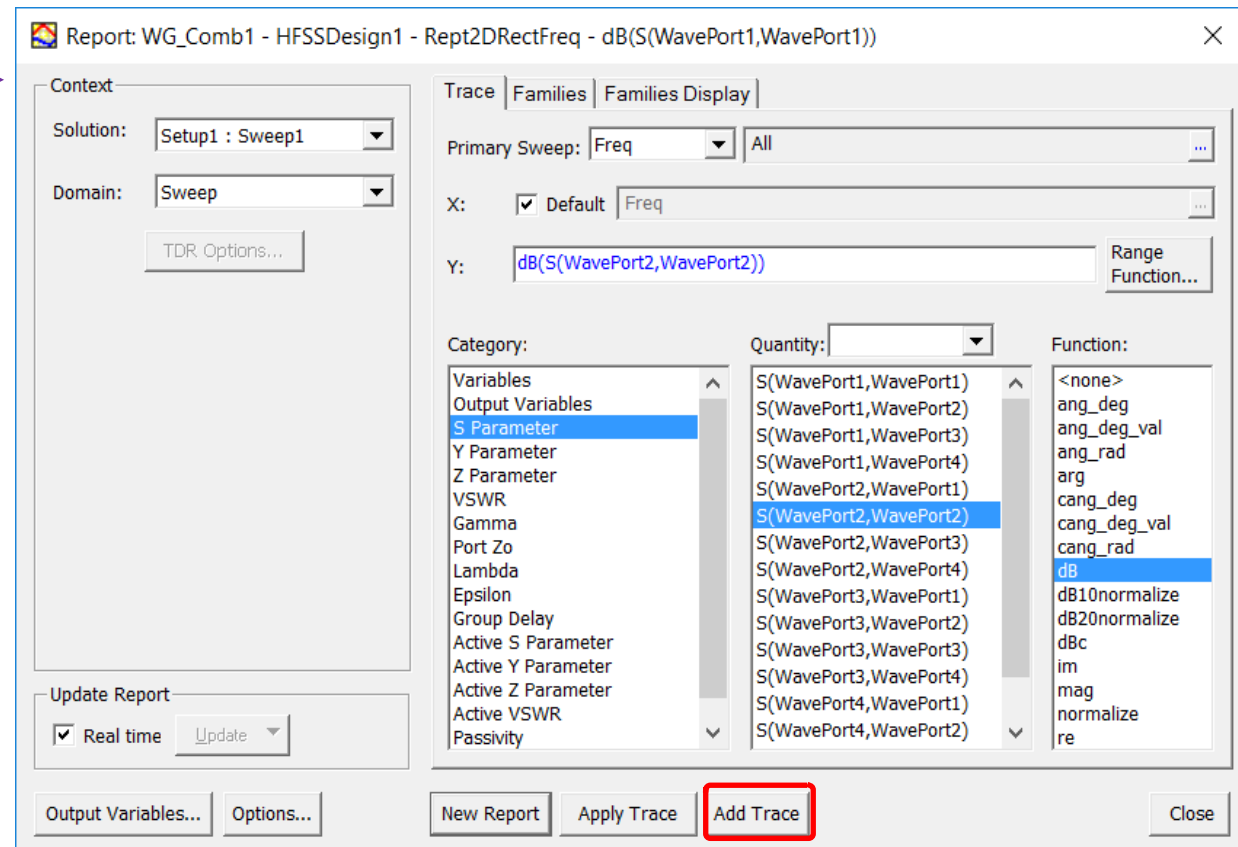
1. In the **Project Manager**, select the report
2. Right-click and select **Modify Report** …which brings up the dialog box.

<u>To add a trace:</u>

1. Select the desired trace (e.g. in blue)
2. Click on **Add Trace** (bottom middle)
3. Click on **Close**

For more information in Help see **HFSS.pdf**, chapter on **Modifying Reports.**

S-Parameter Plotting Summary

– S-Parameter plots can be 2D rectangular reports.

– S-Parameter plots can be Smith charts.

– S-Parameter plots need to reference the HFSS Solution type (e.g. **Modal**, **Terminal**, **Eigenmode**).

  ▪ The waveguide combiner example only has modal solution data reports available.
  ▪ A patch antenna with terminal solution type, has modal solution data Reports available, but not modal S-parameters. We plot S-parameters with terminal solution data.

– S-Parameter plots refer to a particular **Solution**, including both **Analysis** and **Sweep**.
  (A given **Analysis Setup** can have more than one sweep.)

– Multiple port devices can have Active S-Parameters

  ▪ Generally S-Parameters are calculated one port at a time.
  ▪ Active S-Parameters can have more than one port active at a time.

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Modifying S-Parameter Report Visual Properties

Pay attention the *Properties* window under the *Project Manager*.

What you **select** determines which **properties** you'll see.

In this picture, a trace is selected, so we see the trace properties, including color and thickness in the Properties menu.
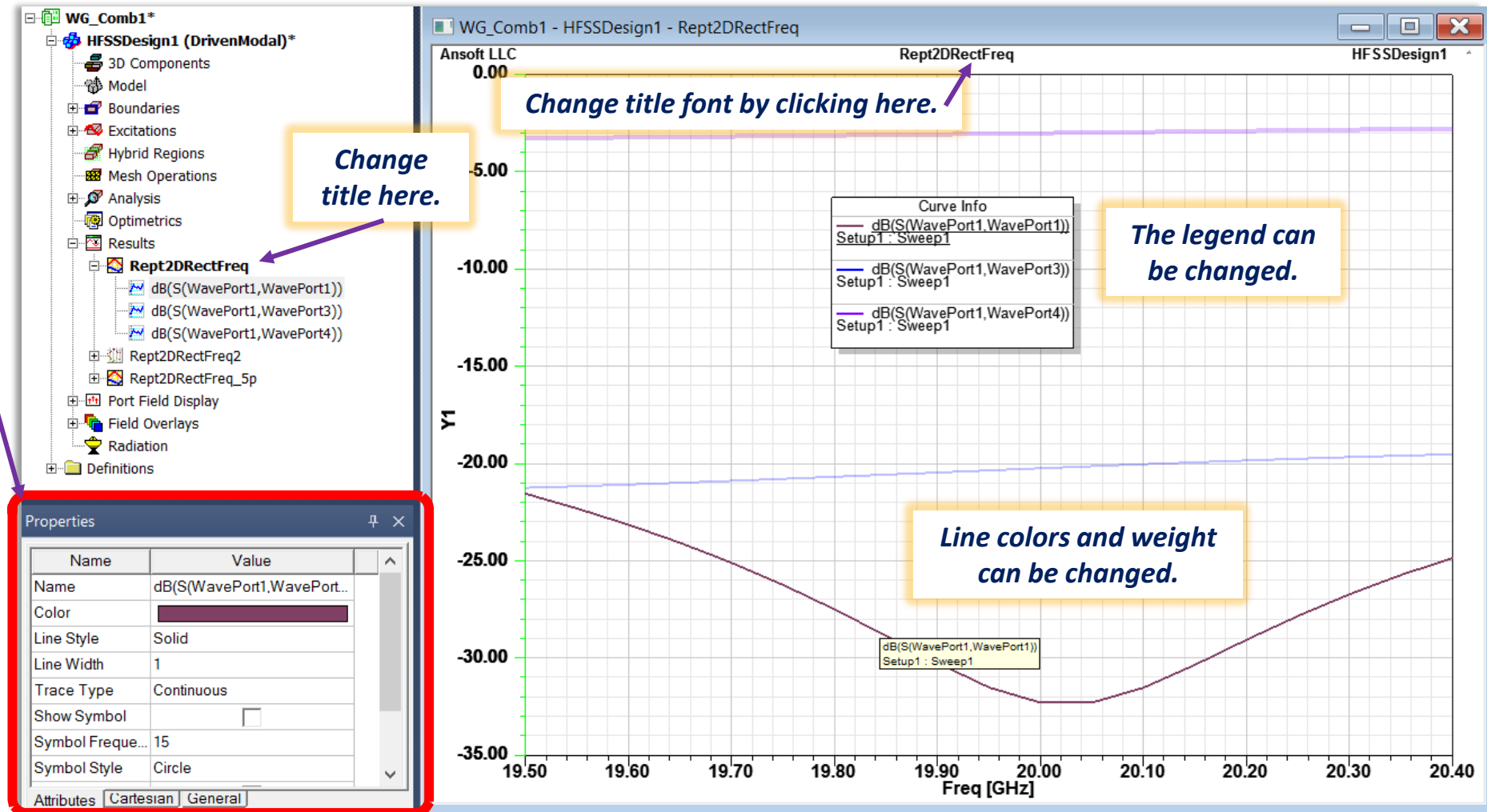
For more information see *HFSS.pdf*, Chapter 22 *Modifying the Background Properties of a Report*.

Changing Rectangular Report Name and Deleting Traces

Signal and Report names can be changed in the *Properties* window under the *Project Manager*.

Right- clicking here accesses Rename and Delete.
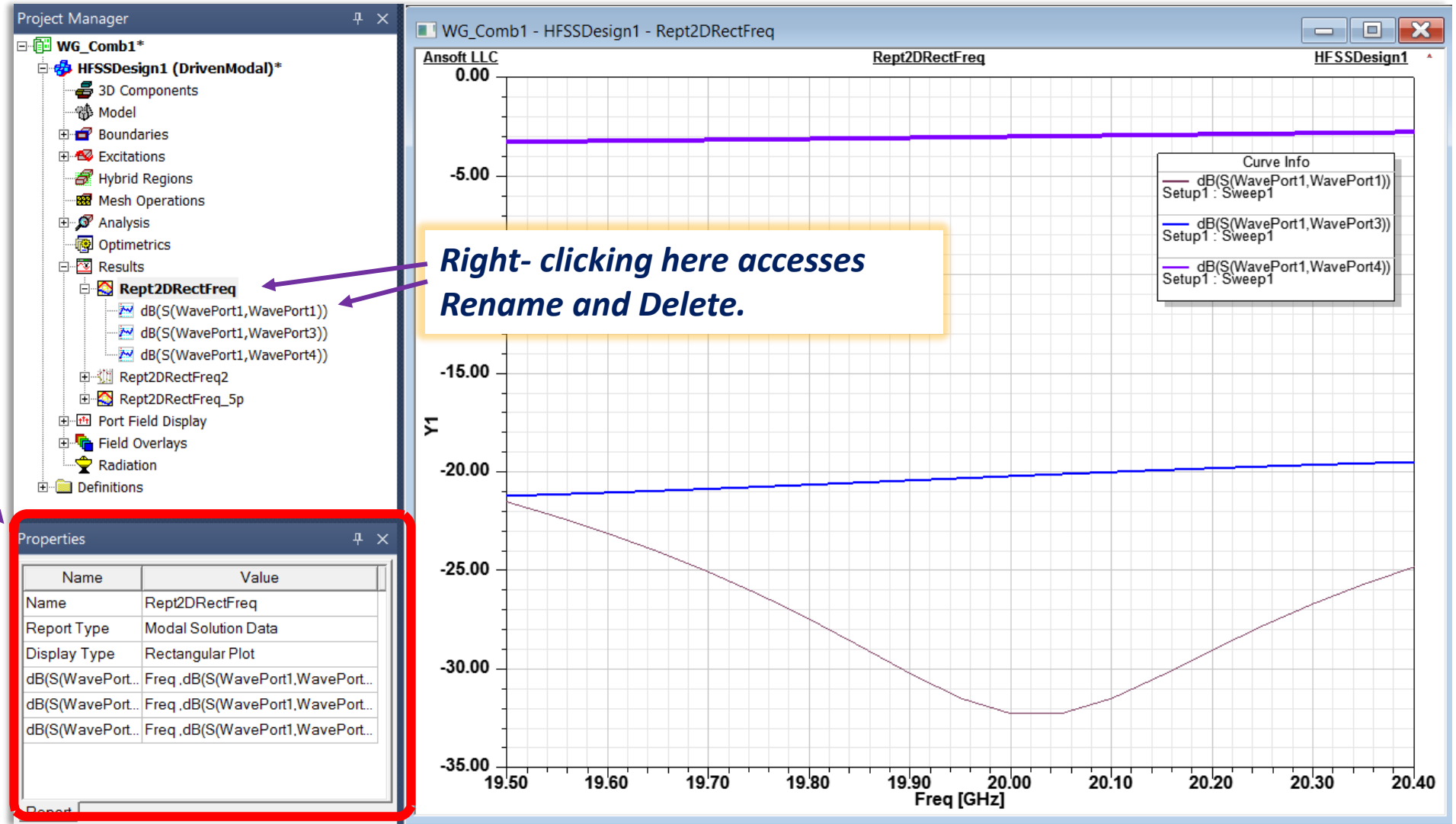
Post Processing Quantities

- Post-Processing allows users to investigate how a device behaves.
- There are 4 general types of post-processing in HFSS:
- Field Data
  - Field quantities are derived from the fields solved throughout the solution domain
    - MagE, ComplexMagE, VectorE
    - MagH, ComplexMagH, VectorH
    - MagJsurf, ComplexMagJsurf, VectorJsurf
    - Vector_RealPoynting
- Network Data
  - S, Y and Z Parameters
  - Propagation Constant (Υ), Port Characteristic Impedance (Z_o), Effective Epsilon (ε), Effective Lambda (λ)
- Radiation Data
  - Far-Field
  - Near-Field
- Solution Data
  - Convergence
  - Mesh Statistics

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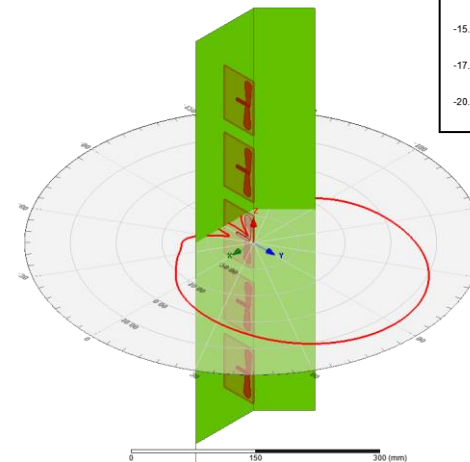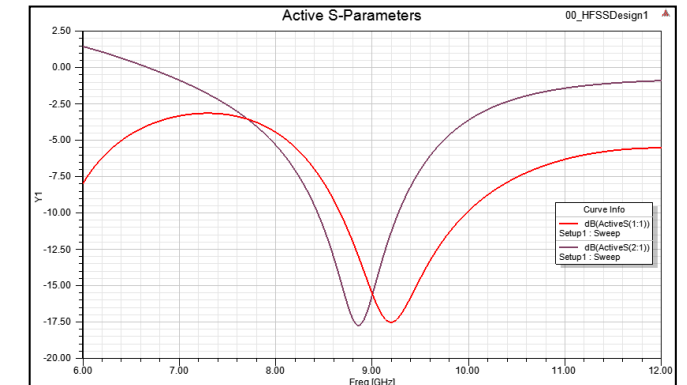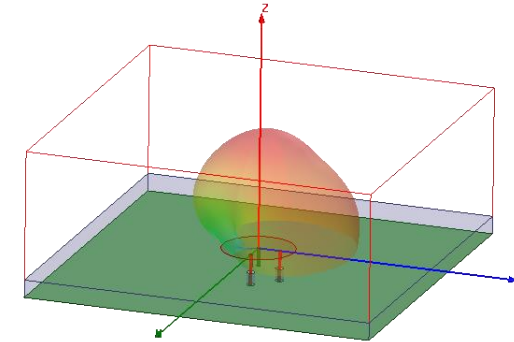
Post-Processing Formats

Data is presented in 4 different formats

- Reports
  - *Results* branch in *Project Manager* window
    - Rectangular Plots
    - Polar Plots
    - Data Tables
    - Smith Charts

- Solution Data   includes matrices
- Select the menu item

- Field Overlays
  - *Field Overlays* branch *Project Manager* window
    - Volumetric 3D Field Contours
    - Volumetric 2D Field Contours
    - Radiation Pattern Overlay

- Antenna Parameters
  - Right-click on the *Infinite Sphere* setup in *Radiation* branch and select
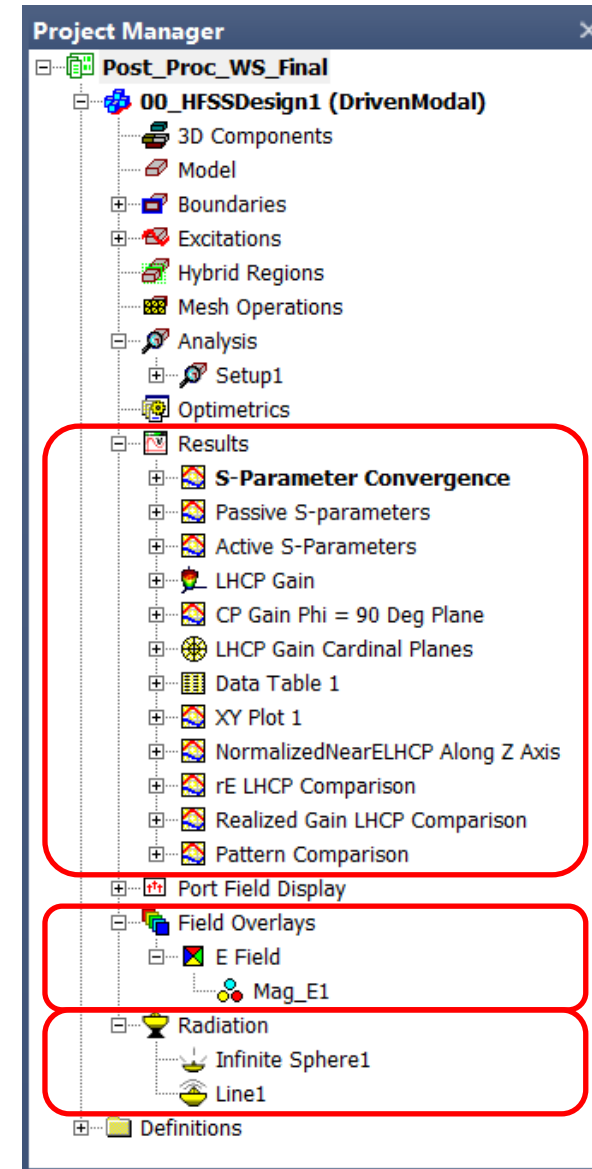
The Report Editor

- The *Context* Section
  - Controls which Solution the data is plotted from. Many simulations have only one.
  - Controls if data is in the Frequency Domain (Sweep) or Time Domain.
- The *Trace* Tab
  - Selects the Quantity to be plotted
 - Selects the independent sweep variable
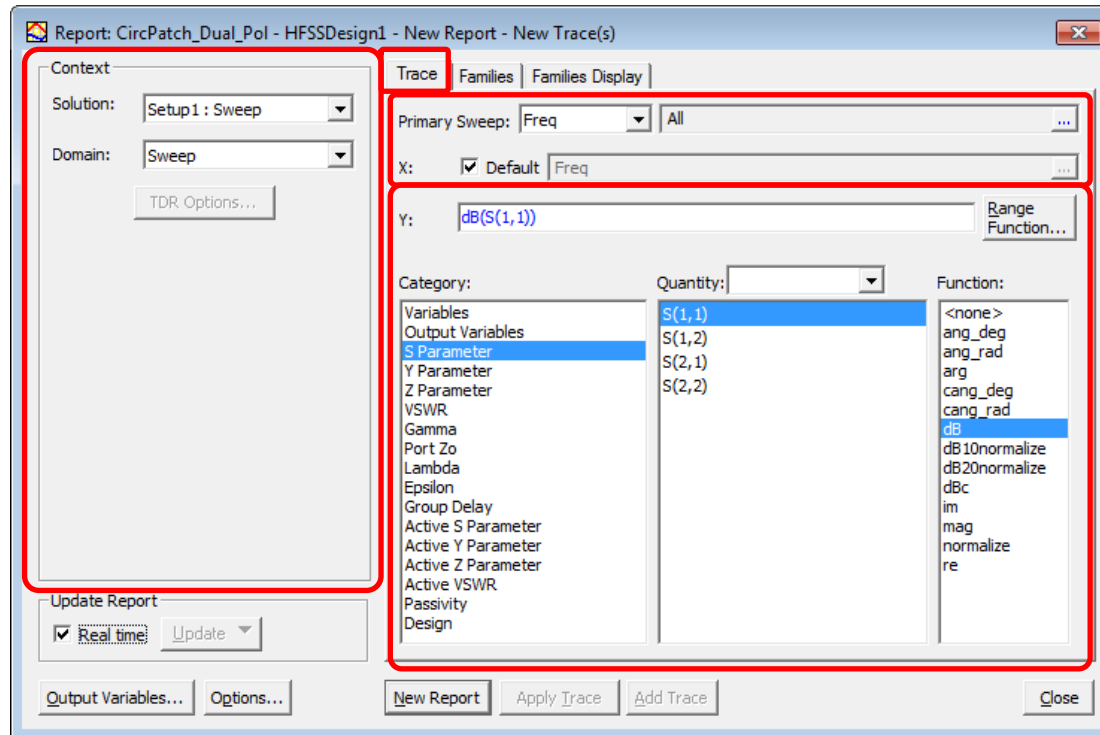
Selecting the *Sweep Variable*
(a.k.a the variable associated with the horizontal X-axis)

**Selecting the *Quantity* associated with the vertical Y-axis**

S-Parameter Solution versus *Adaptive Pass*

This *Report* plots S-parameters versus adaptive pass on the horizontal axis:
Choosing *AdaptivePass* for *Solution* made *Pass* available for plots.
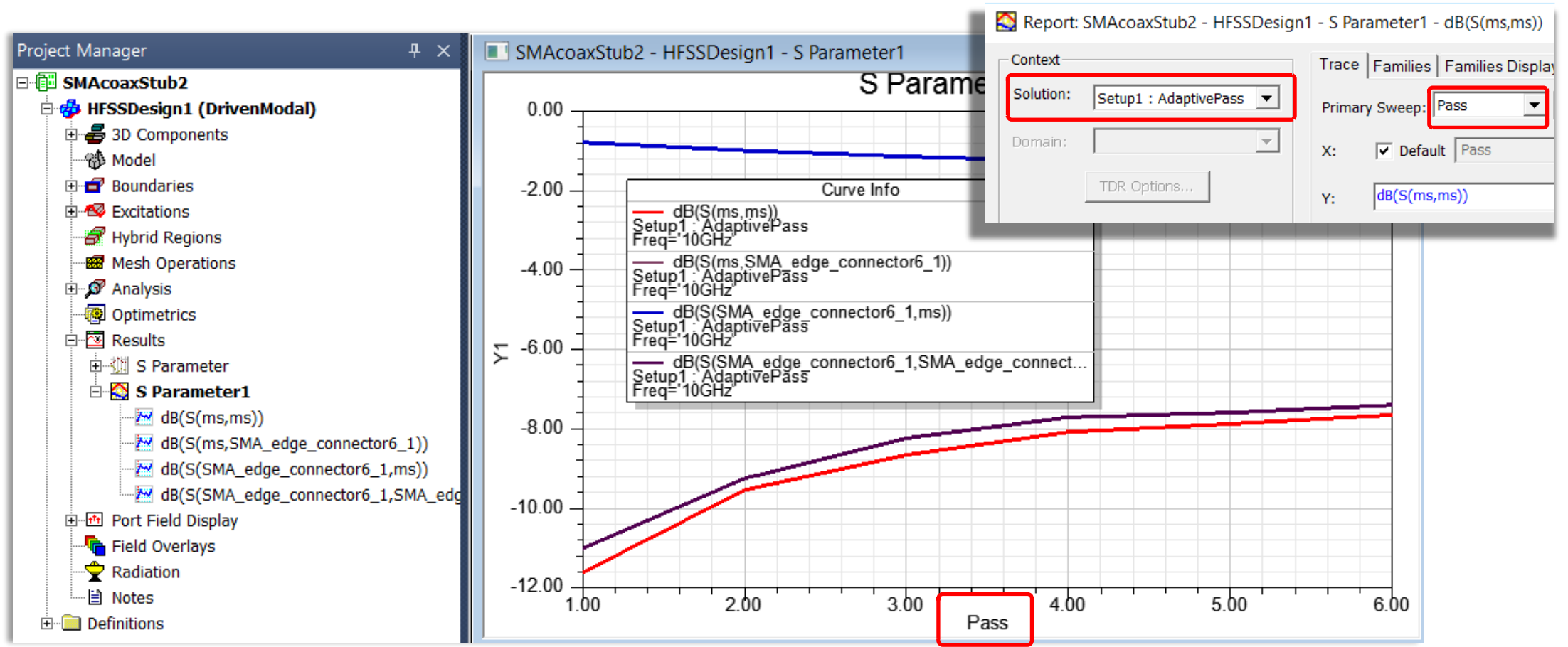
The Report Editor (Cont'd)

- The *Families* Tab
  - When solutions exist for multiple variations, the *Families* tab allows users to variations.
  - If multiple variations are selected each one shows up as an additional curve
  - The button in the *Edit* column allows finer control over which variations are included
  - Variables can be set to their nominal values to simplify the list
    - Nominal values are the current values these variables are set in the design
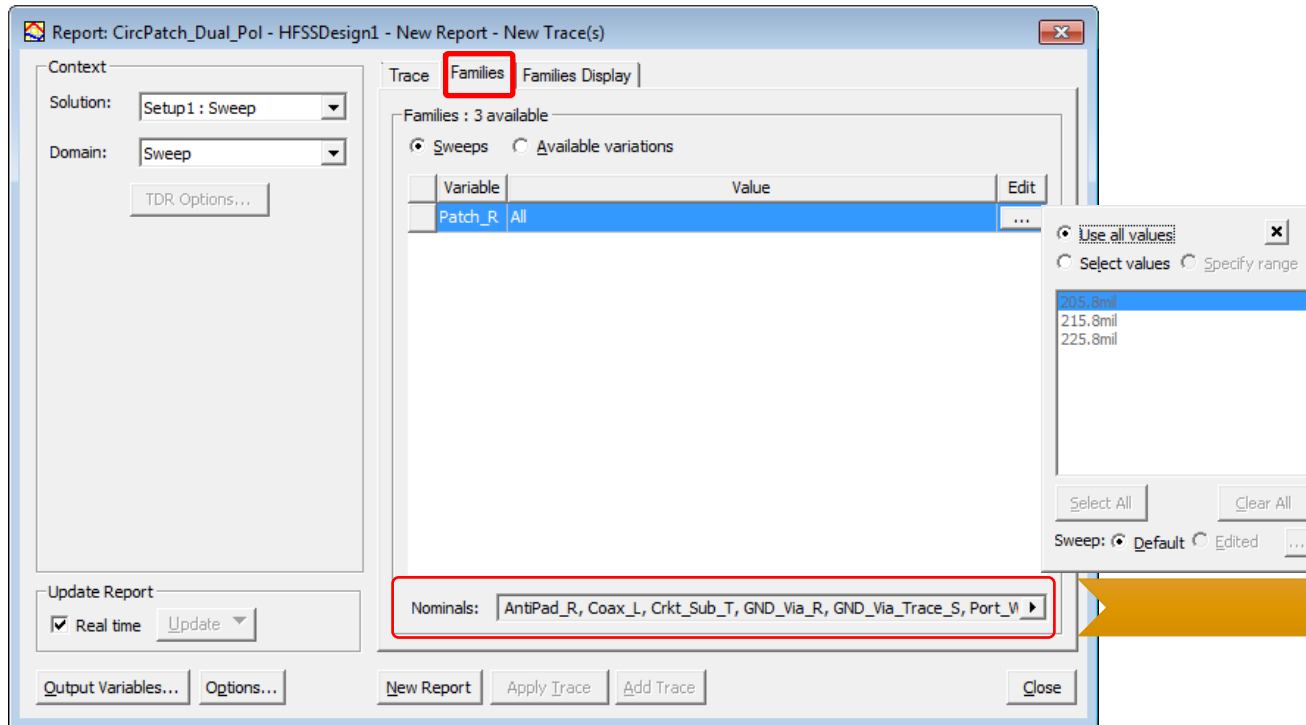


Selecting the Nominal Variables

Field Overlays on Surfaces - E-Fields, H-Fields, and Currents

Plotting Field Results

HFSS can produce a plot of any standard electromagnetic quantity, such as the electric field, magnetic field, Poynting vector, or current density. Generally, fields are displayed on 2D objects, faces of 3D objects, or on coordinate system planes. Plots can be scalar quantity plots or vector quantity plots.

HFSS Post-Processing 6-8

From the file:
An Introduction to HFSS.pdf
Chapter 6 ***HFSS Post Processing.***
...in the Help/HFSS subdirectory GSG (Getting Started Guides)
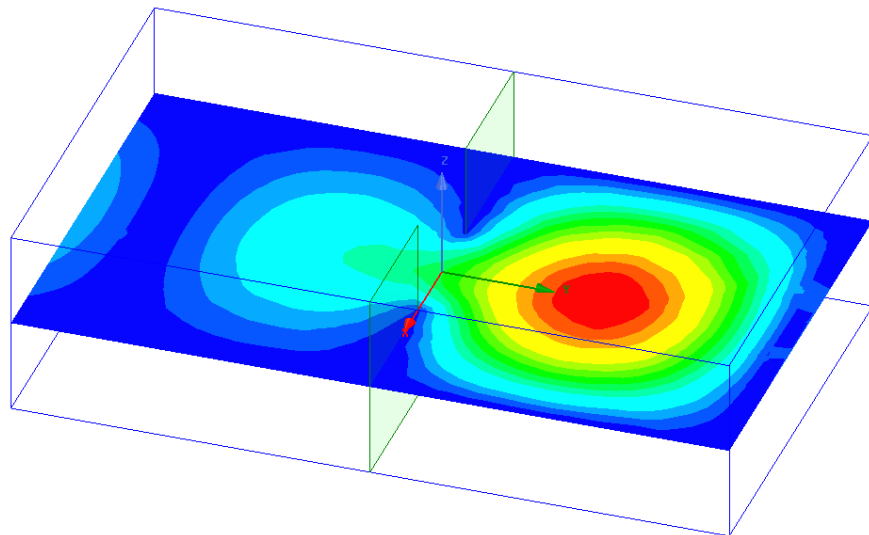
HFSS can plot many types of fields, including antenna radiation far-field patterns, electric field, magnetic field, and current densities. Here we'll focus on **E-fields and currents on surfaces.**

Shown on the left is an E-field in a waveguide.

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Field Overlays Start with Selecting a Geometric Object

To Plot Fields

To plot a basic field quantity:

1. Select a point, line, surface, cutplane, or object to create the plot on or within.
2. Click [*solver*]>Fields>Plot Fields., or right-click on Field Overlay icon in the Project tree and select **Plot Fields**, or right click in the modeler window, and select **Plot Fields** from the context menu.
3. On the **Plot Fields** menu, click the field quantity you want to plot.

Point, Line, Surface, Cutplane, or Object

From the file:*HFSS.pdf*
Chapter 22 *HFSS Post-Processing and Generating Reports. .*...in the HFSS installation directories /Help.
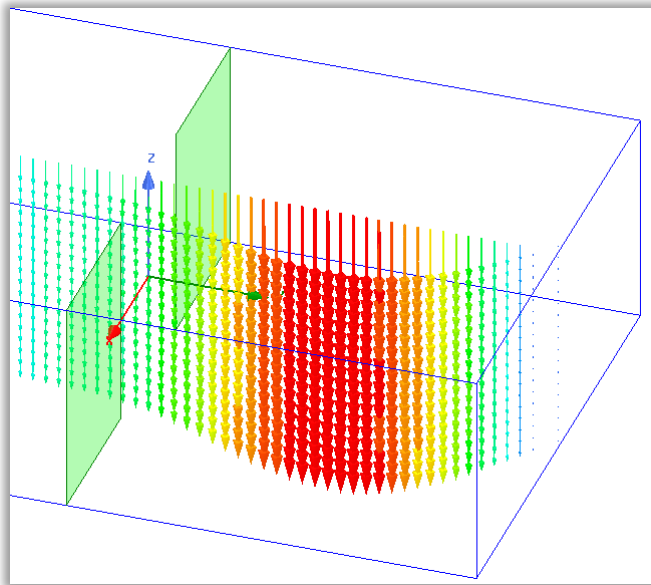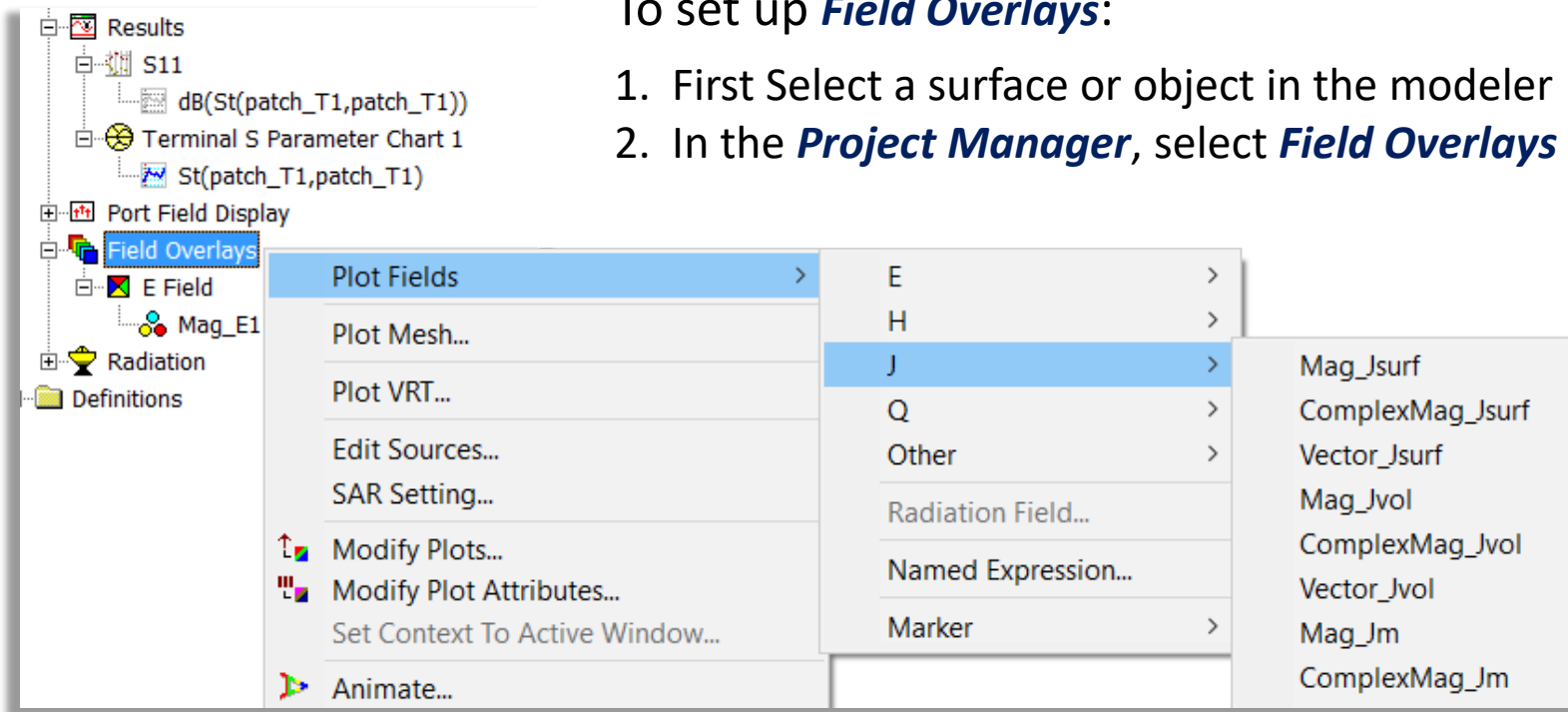

Waveguide vector E-field on the YZ coordinate axis plane running down the middle.
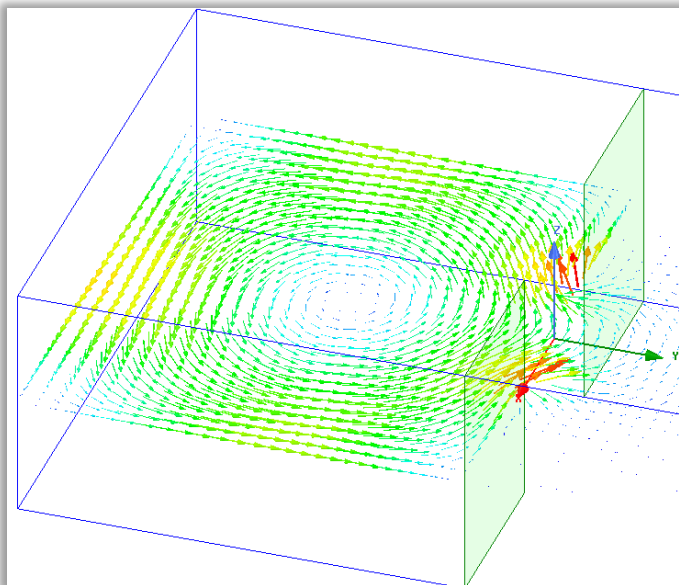
Waveguide vector H-field on the YX coordinate axis plane running down the middle

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Field Overlays on Surfaces - E-Fields and Currents

To set up *Field Overlays*:

1. First Select a surface or object in the modeler
2. In the *Project Manager*, select *Field Overlays*

Field overlay plots can also be accessed from the pull-down menus at the top of the GUI: *HFSS > Fields > Plot Fields*

3. Right-click and select *Plot Fields*…
4. Choose field type
5. This brings up the *Create Field Plot* dialog box.

Create Field Plot Dialog Box
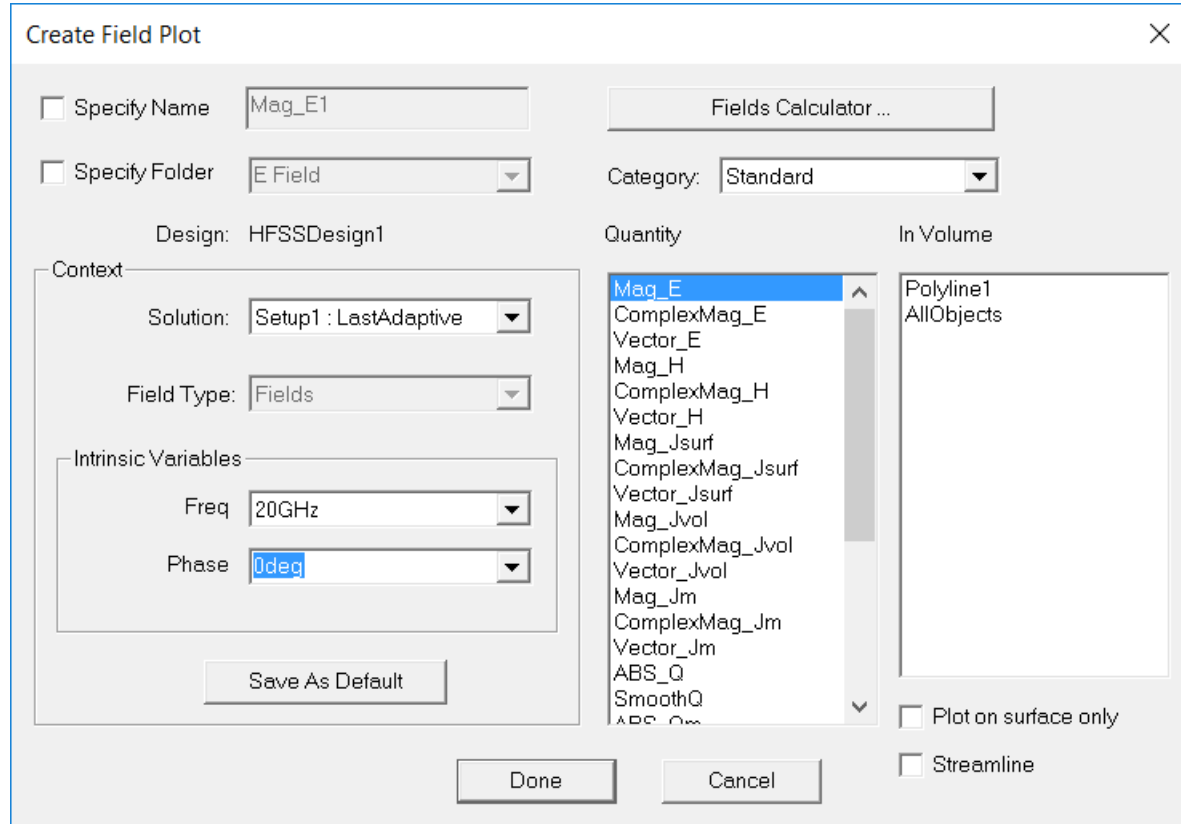
Create Field Plots dialog box:

1. Often one can use the settings without making changes.

2. There needs to be simulated data for the chosen frequency. In some cases, a second discrete sweep simulation can provide simulated data points with fields saved.

3. An object selected for the field plot may not explicitly show on the right, under ***In Volume***.

4. This is also the same dialog box as ***Modify Plot Field*** that one gets by right-click on the field in the ***Project Manager***, under ***Fields Overlays***, and selecting ***Modify Plot***.

End of Presentation