


Workshop 1-3: Frequency Sweep

2015.1 Release

A visualization of fluid flow, showing blue and white streamlines swirling around a central point, representing fluid dynamics simulation results.


Fluid Dynamics

A 3D model of a dark purple gear with a glowing white and purple center, representing structural mechanics simulation results.

Structural Mechanics

A series of concentric green and white circles, representing electromagnetic field simulation results.

Electromagnetics

A 3D arrangement of teal and black rectangular blocks, representing systems and multiphysics simulation results.

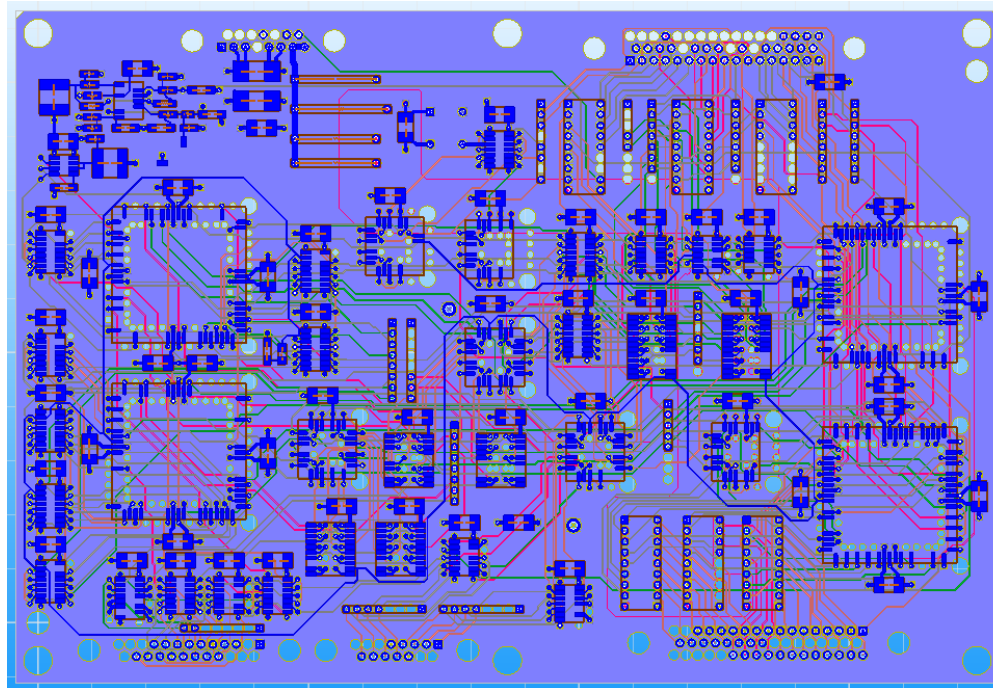
Systems and Multiphysics

Introduction to ANSYS SIwave

SIwave Frequency Sweep Analysis

- **Frequency Sweep Response**

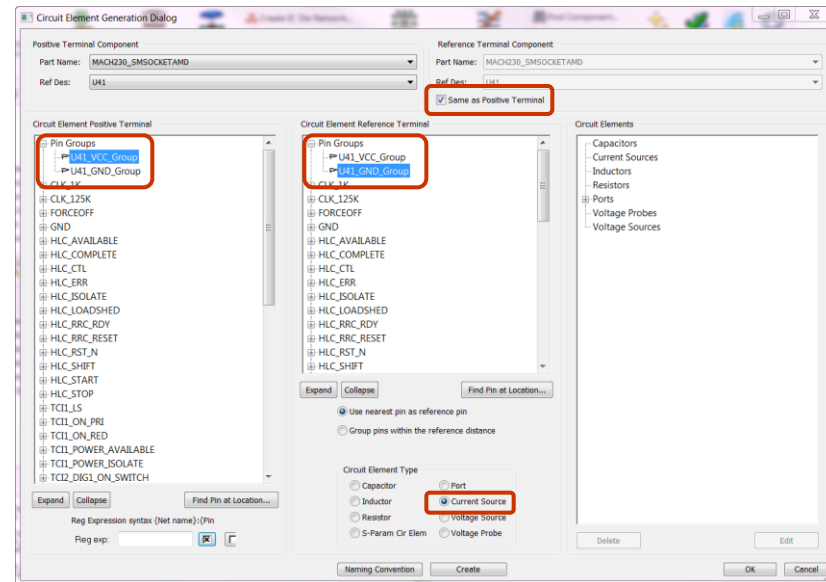
- The first part of this exercise investigated the effects of resonant modes on a printed circuit board. The resonant mode analysis in Workshop 1.1 yielded the frequency and voltage distribution of the eigenmodes on the PCB.
- The second part of this exercise, Workshop 1.2, correlated the peaks in a power plane impedance plot to the resonant mode frequencies of the board.
- The following exercise demonstrates how the current drawn by a device leads to voltage ripple in the power distribution system. We will use the board design that was created during the previous parts of this exercise: `siwave_board.siw`



Example – Frequency Sweep

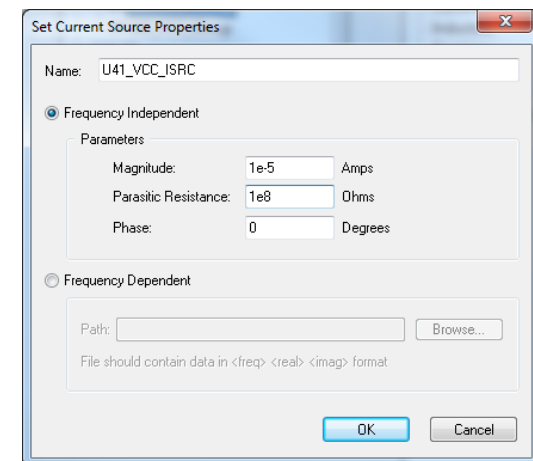
• Create Current Sources

- Select the **Tools** tab and click **Generate Circuit Elements on Components**
 - Positive Terminal Component
 - Part Name: **MACH230_SMSOCKETAMD**
 - Ref Des: **U41**
 - Reference Terminal Component (or ☒ **Same as Positive Terminal**)
 - Part Name: **MACH230_SMSOCKETAMD**
 - Ref Des: **U41**
 - In the Circuit Element Positive Terminal pane expand the **Groups** item.
 - Choose the pin group **U41_VCC_Group**
 - In the Circuit Element Reference Terminal pane expand the **Groups** item.
 - Choose the pin group **U41_GND_Group**
 - Under Circuit Element Type select **Current Source**
 - Click the **Create** button.
 - A dialog window appears asking for the name of the port.
 - Name: **U41_VCC_ISRC**
 - Magnitude: **1e-5 Amps**
 - Parasitic Resistance: **1e8 Ohms**
 - Click the **OK** button to accept the information and create the current source
 - Click the **OK** button to exit the Circuit Element Generation dialog



Pin

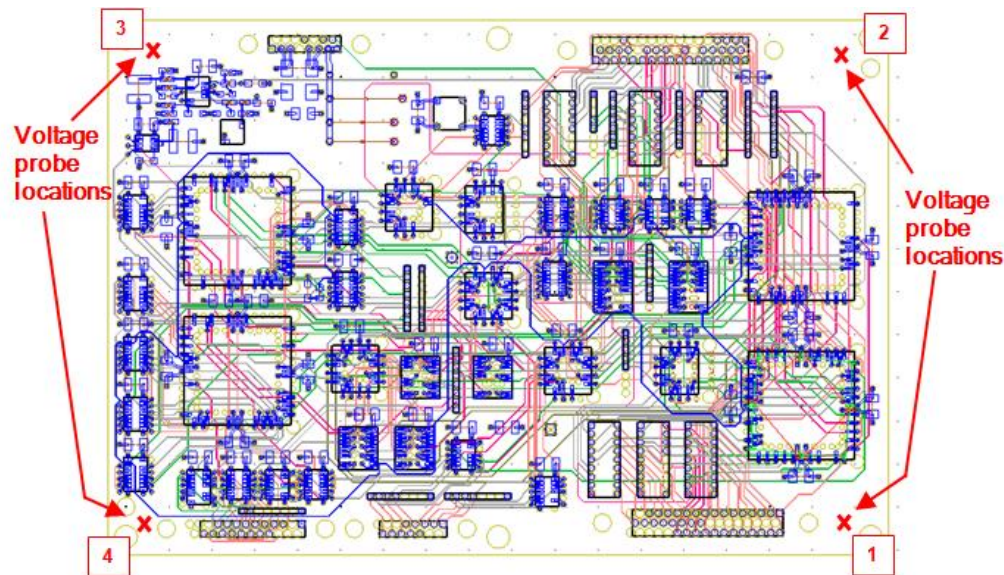
Pin



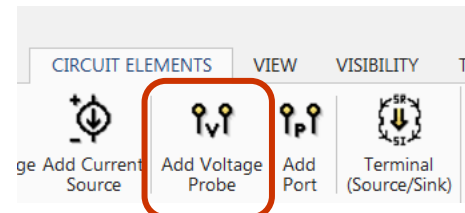
Example – Frequency Sweep

- **Create Voltage Probes**

- The problem of induced ripple voltage in the power distribution will be investigated by measuring the voltage between the VCC and GND nets at various locations on the printed circuit board. The ripple voltage is measured using voltage probes.



- Select the **Circuit** Elements tab and click on **Voltage Probe**



Example – Frequency Sweep

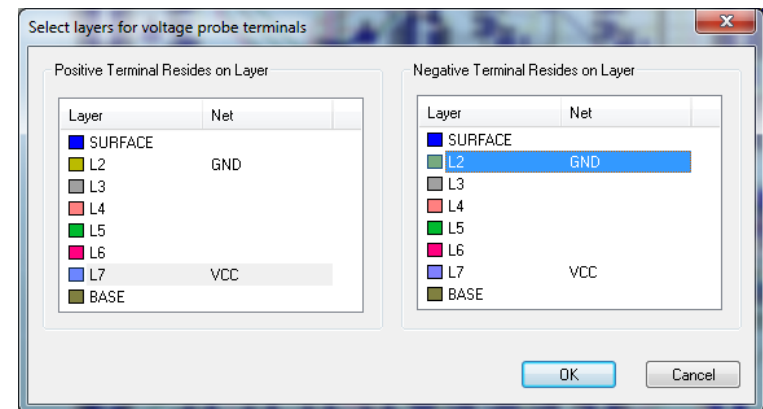
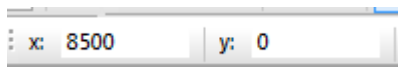
• Create Voltage Probes

- Place one voltage probe in each corner of the board. The left mouse button must be clicked twice to place a probe. The first click is for the positive terminal; the second click is for the reference terminal. Both terminals may be located at the same position, since the probe will measure the voltage between two planes on different layers.

- x: **8500mils**
- y: **0mils**
- Press the **Enter** key until the Select layers dialog appears
- From the Select layers for voltage probe terminal
 - Positive Terminal Resides on Layer: **L7 (VCC)**
 - Negative Terminal Resides on Layer: **L2 (GND)**
 - Click the **OK** button
- Edit Probe Name dialog
 - Click the **OK** button
- Repeat steps 1-5 for VPROBE2-4

Probe name	x-position	y-position	units
VPROBE1	8500	0	mils
VPROBE2	8500	5000	mils
VPROBE3	400	5400	mils
VPROBE4	160	-140	mils

- To exit probe placement select menu item:
Click on the **Voltage Probe** icon



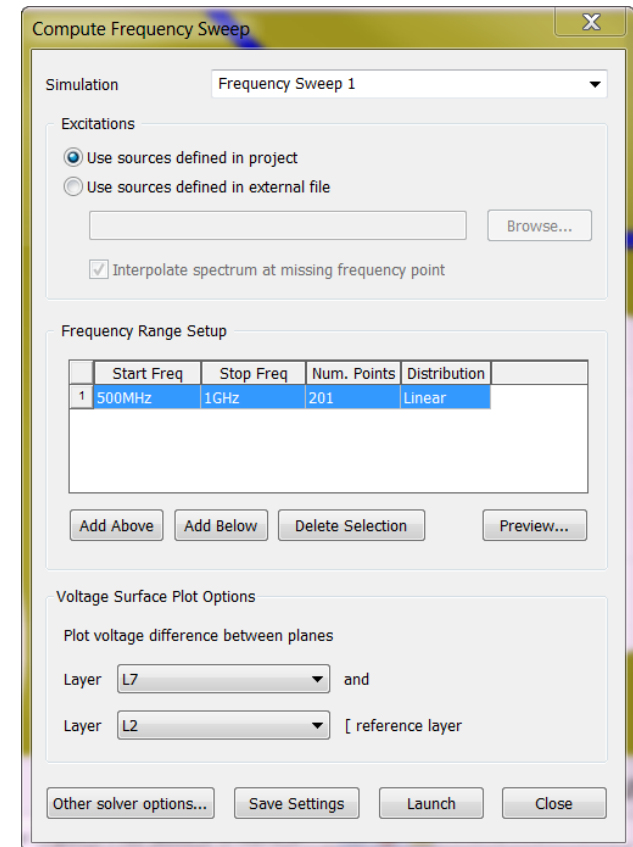
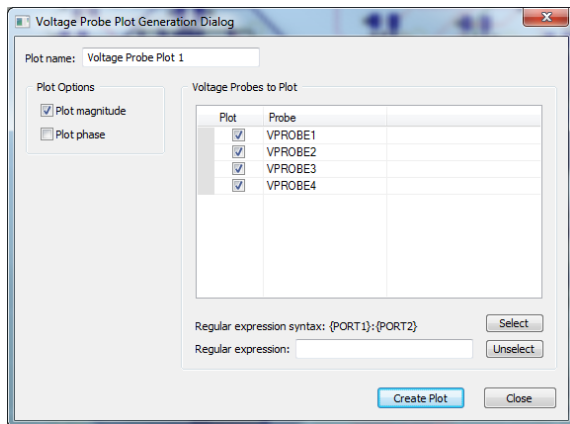
Example – Frequency Sweep

• Run Frequency Sweep Analysis

- Click the **Simulation Tab** select **Compute Frequency Sweep**
 - Start Freq: **500 MHz**
 - Stop Freq: **1 GHz**
 - Num. Points: **201**
 - Distribution: **Linear**
 - Voltage Surface Plot Options:
 - Layer: **L7** and **L2**
 - Click the **Launch** button

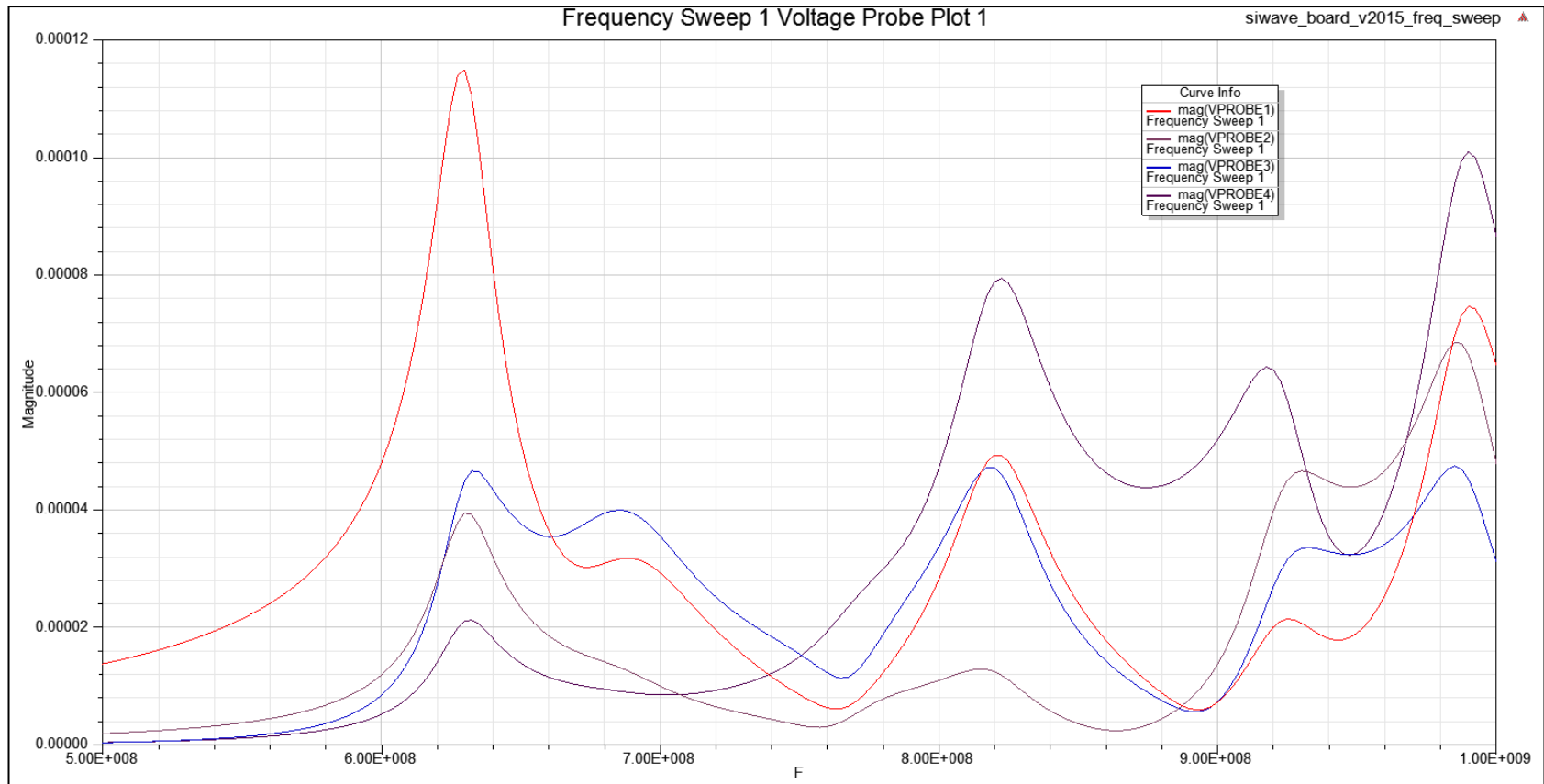
• Plot Probe Voltages

- Click on the Results Tab **Results > Frequency Sweep > Frequency Sweep 1 > Plot Probe Voltages**
 - Click the **Create Plot** button



Example – Frequency Sweep

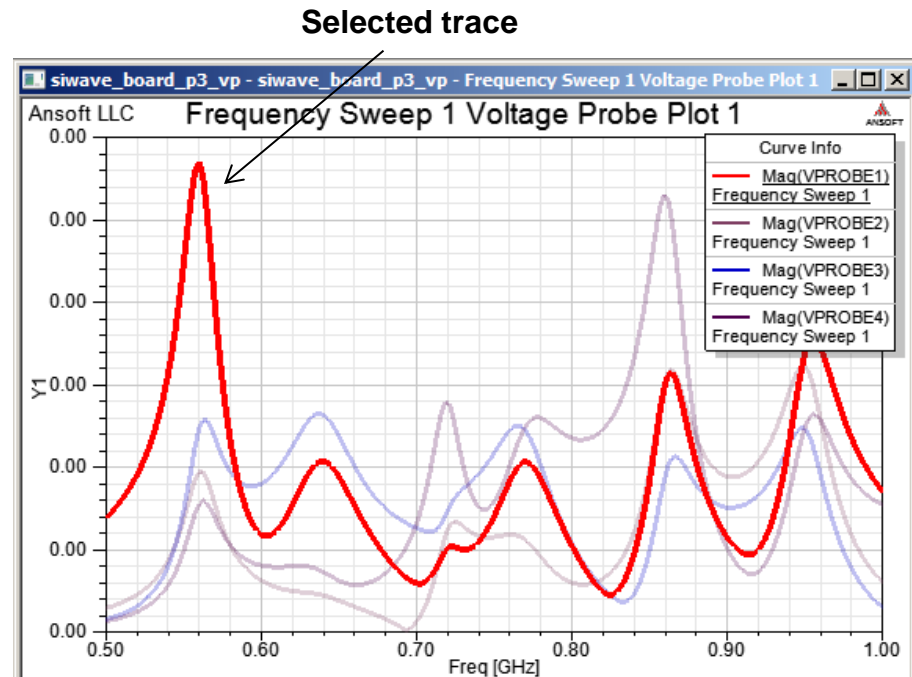
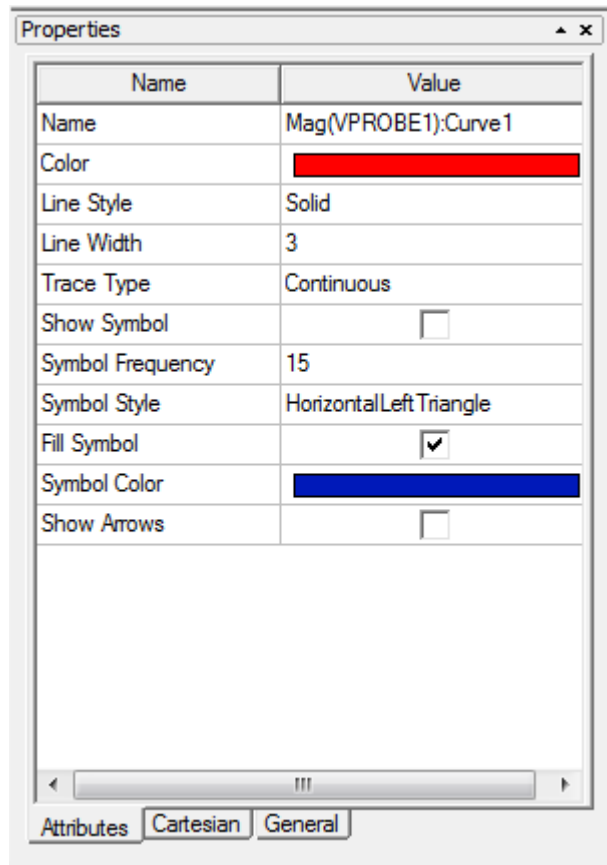
- Plot Probe Voltages
 - Siwave creates voltage probe plots in the Electronics Desktop



Example – Frequency Sweep

Trace Properties

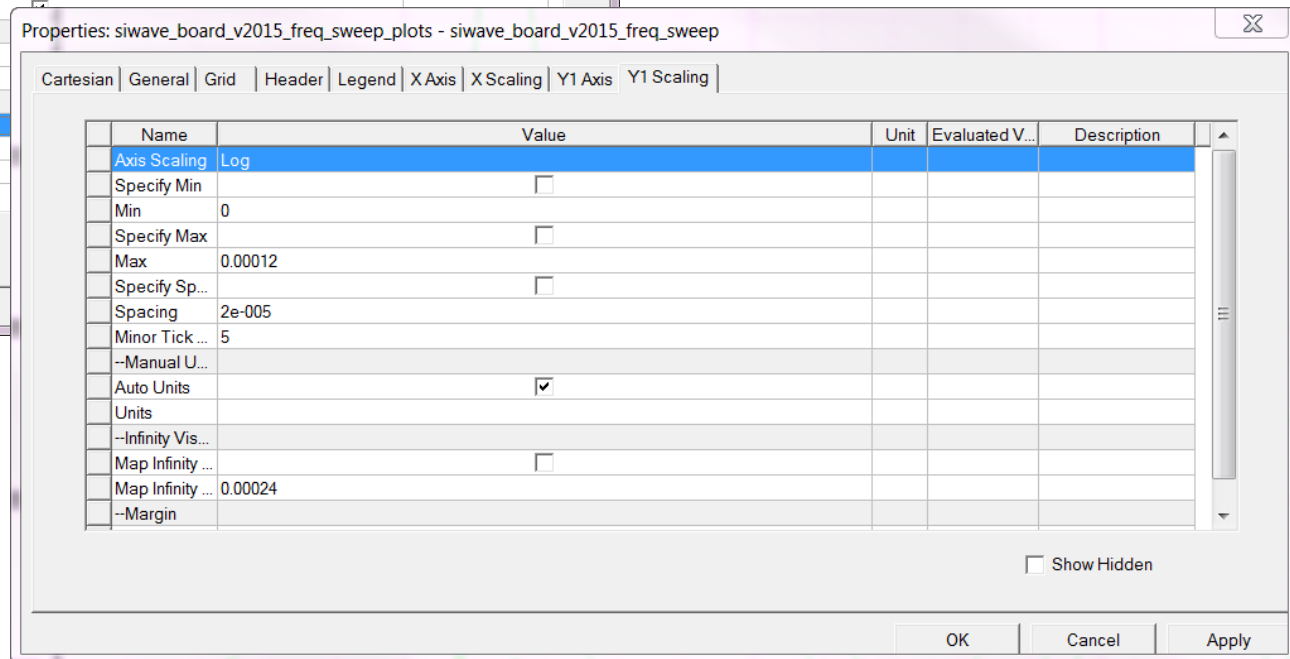
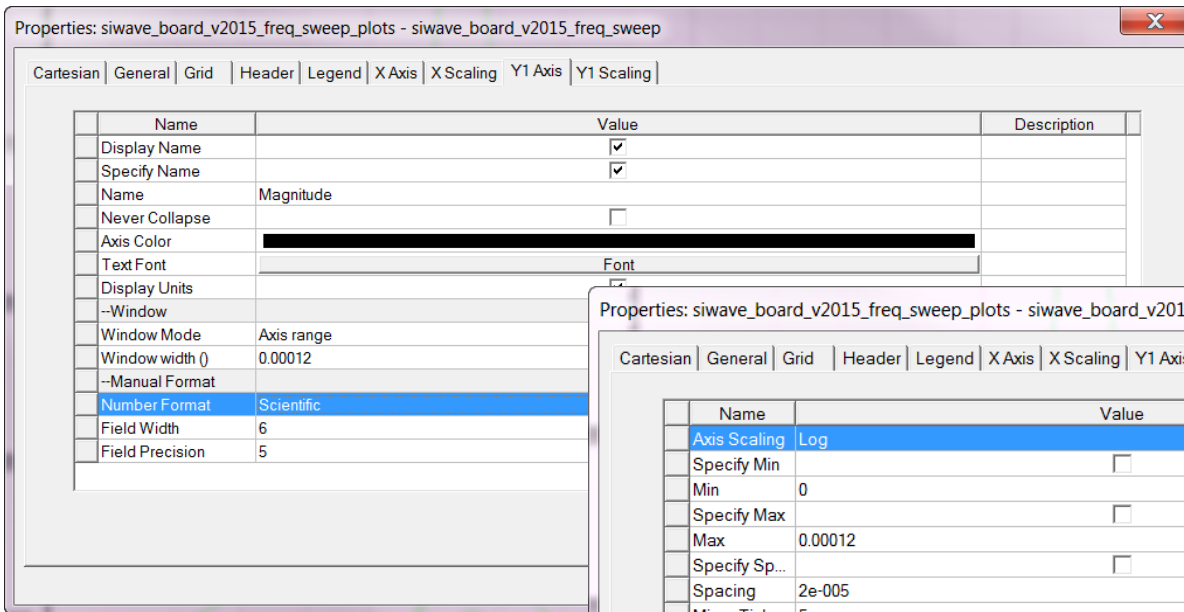
- As with most other ANSYS products, the context sensitive properties window can be used to modify the properties of currently selected objects. For example, individual traces can be selected and properties such as Line Width, Line Style, Symbol visibility, etc. can be modified in the properties window.



Properties window

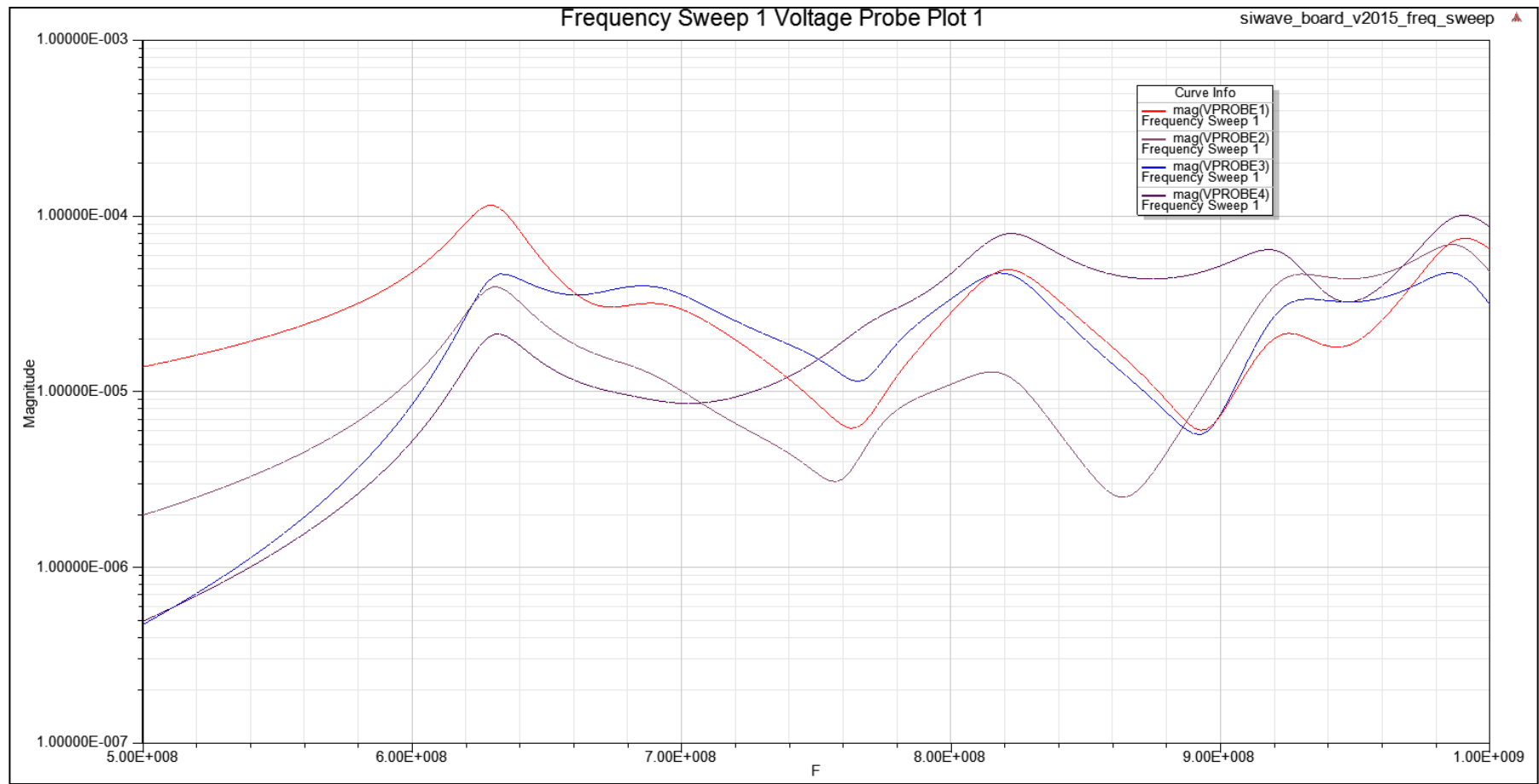
Example – Frequency Sweep

- Axis Properties
 - Open the axis properties by double-clicking on it. The Properties window will appear.
 - In the **Axis Properties** window active the **Y1 Axis** tab and change the **Number Format** to **Scientific**.
 - In the **Axis Properties** window activate the **Y1 Scaling** tab and change the **Axis Scaling** to **Log**



Example – Frequency Sweep

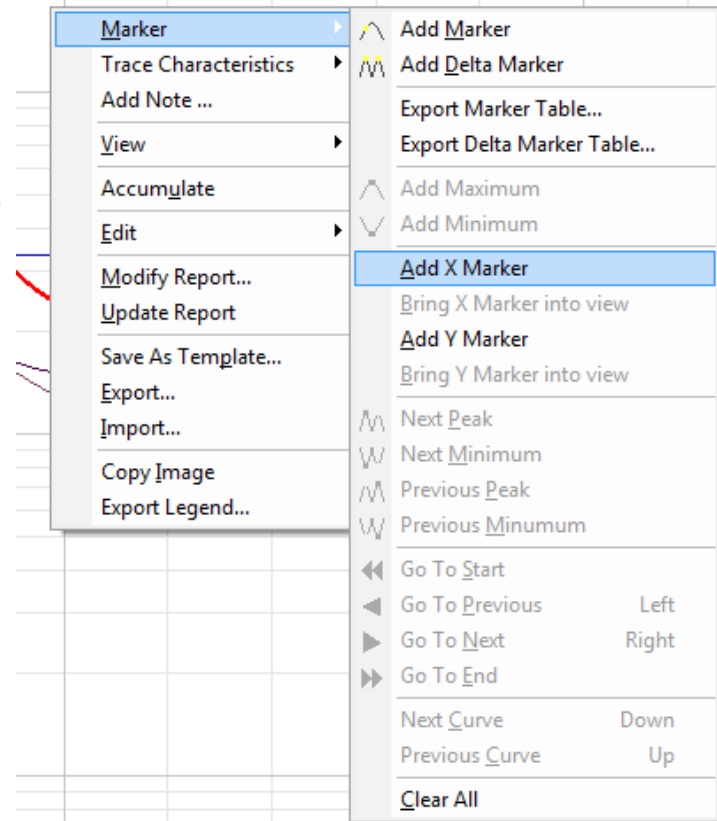
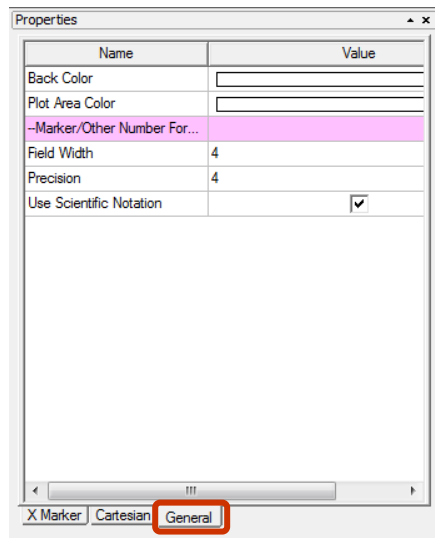
- Probe Voltage Plot



Example – Frequency Sweep

• Analyze the Results

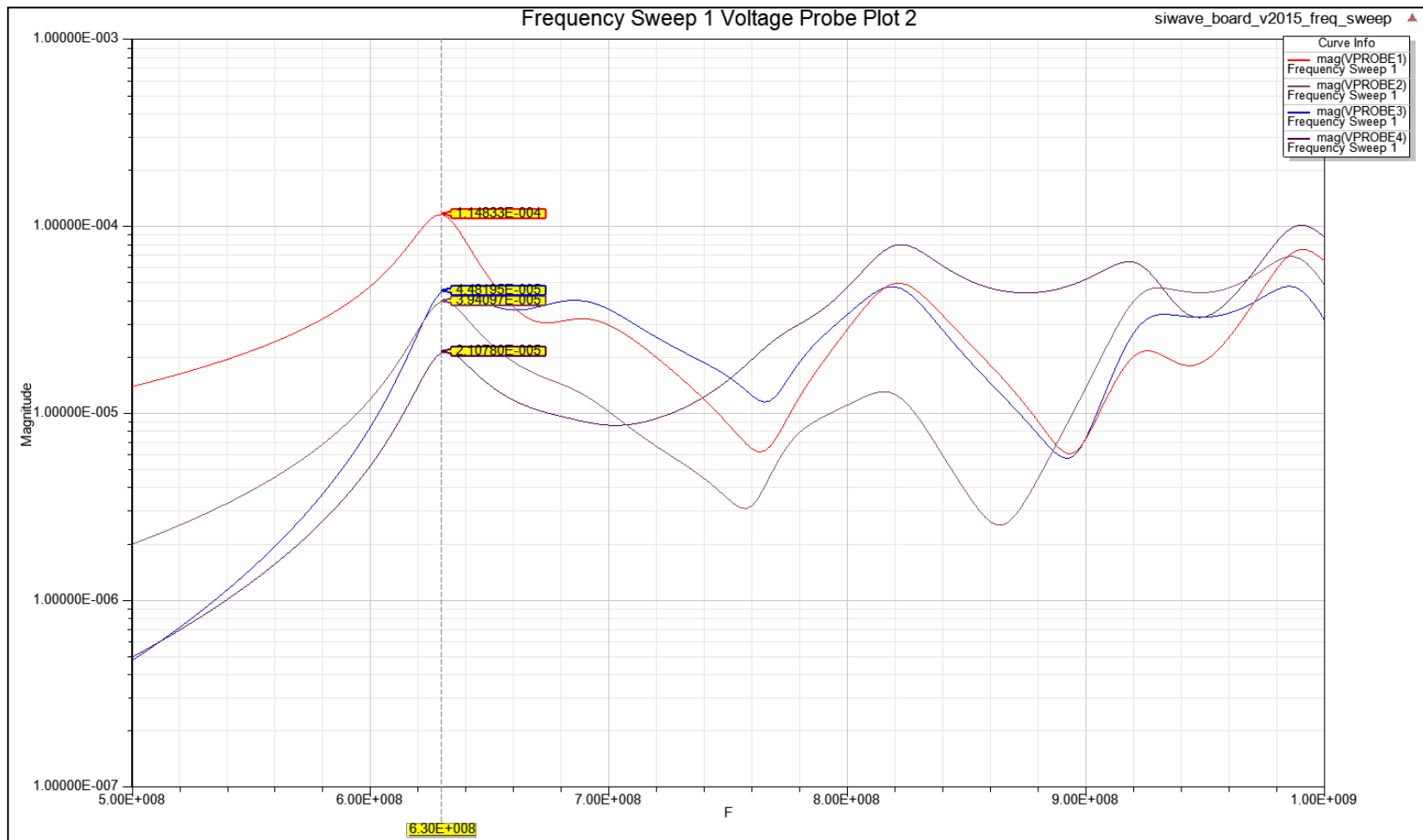
- On the voltage profile plot:
Right Mouse Click > Marker > Add X Marker
- Move the mouse to the top of the first peak and **Mouse Left Button** click to add the X marker.
- Grab the dotted line by click on it and drag it to the first peak in the voltage profile.
- With the X marker line selected navigate to the the **Properties** box and select the **General** tab and ☒ **Use Scientific Notation**



Example – Frequency Sweep

- Plot Probe Voltages

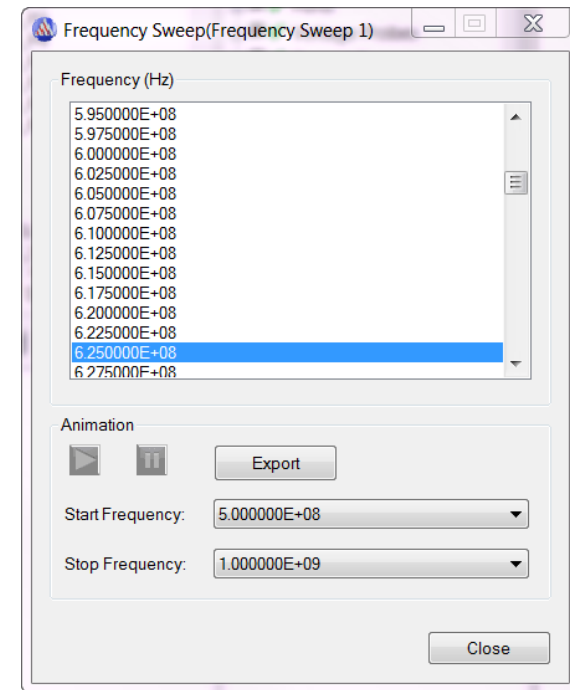
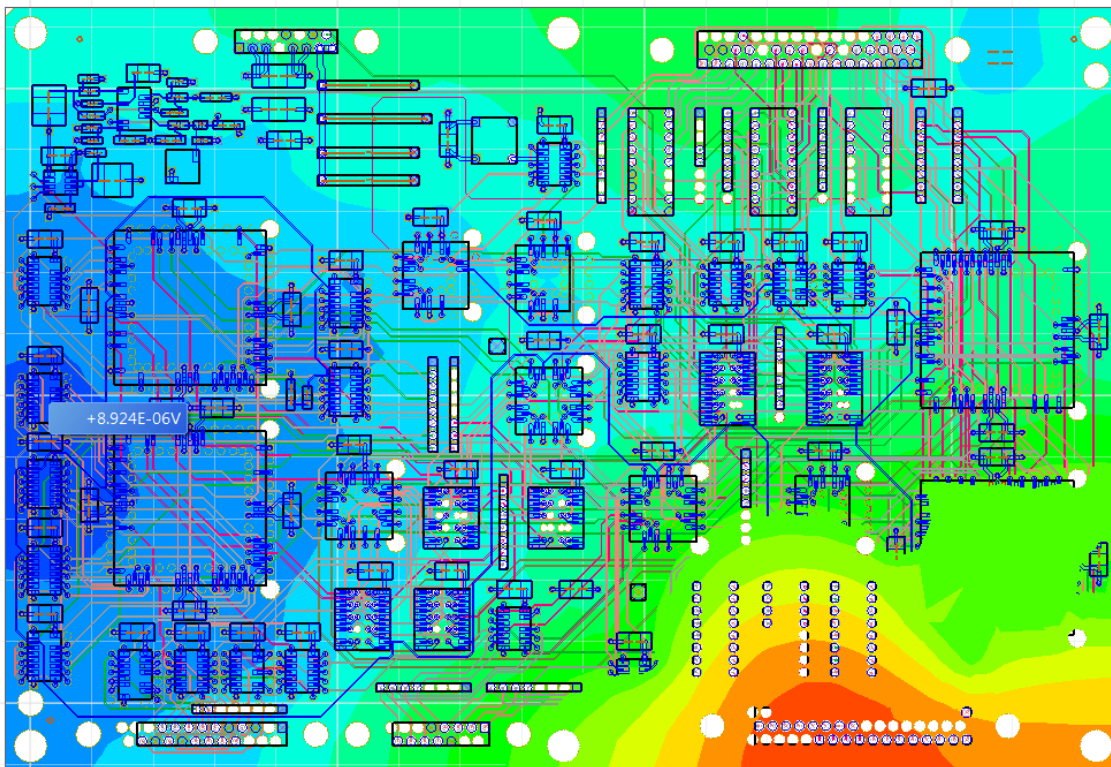
- Compare the voltage ripple shown in this plot with the impedance plots in the previous Workshop (1.2). As expected the frequencies at which peaks occur in the impedance profile correlate well with the frequencies at which the ripple voltage is largest.



Example – Frequency Sweep

- **View 2D Voltage Plots**

- Switch back to the SIwave GUI
- Click the **Close** button on the Voltage Probe Plot dialog if it is still displayed
- Select the menu item **Results > Frequency Sweep > Frequency Sweep 1 > Plot Surface Voltages**
- A plot showing the voltage difference between layers L7 and L2 will now be overlaid on the PCB layout display. The Frequency Sweep window can be used to select the frequency for which data is displayed



Example – Frequency Sweep

- **View 2D Voltage**

- Note that it is possible to quickly scan through the frequencies using the up and down arrow keys while the **Frequency Sweep** window is active.
- Compare the voltage distribution on the PCB at 627 MHz with the probe voltages on page 9. Note in particular the voltage at VPROBE1 compared to the other probes.

- **Save Slwave project file**

- Select the **File > Save** menu item

