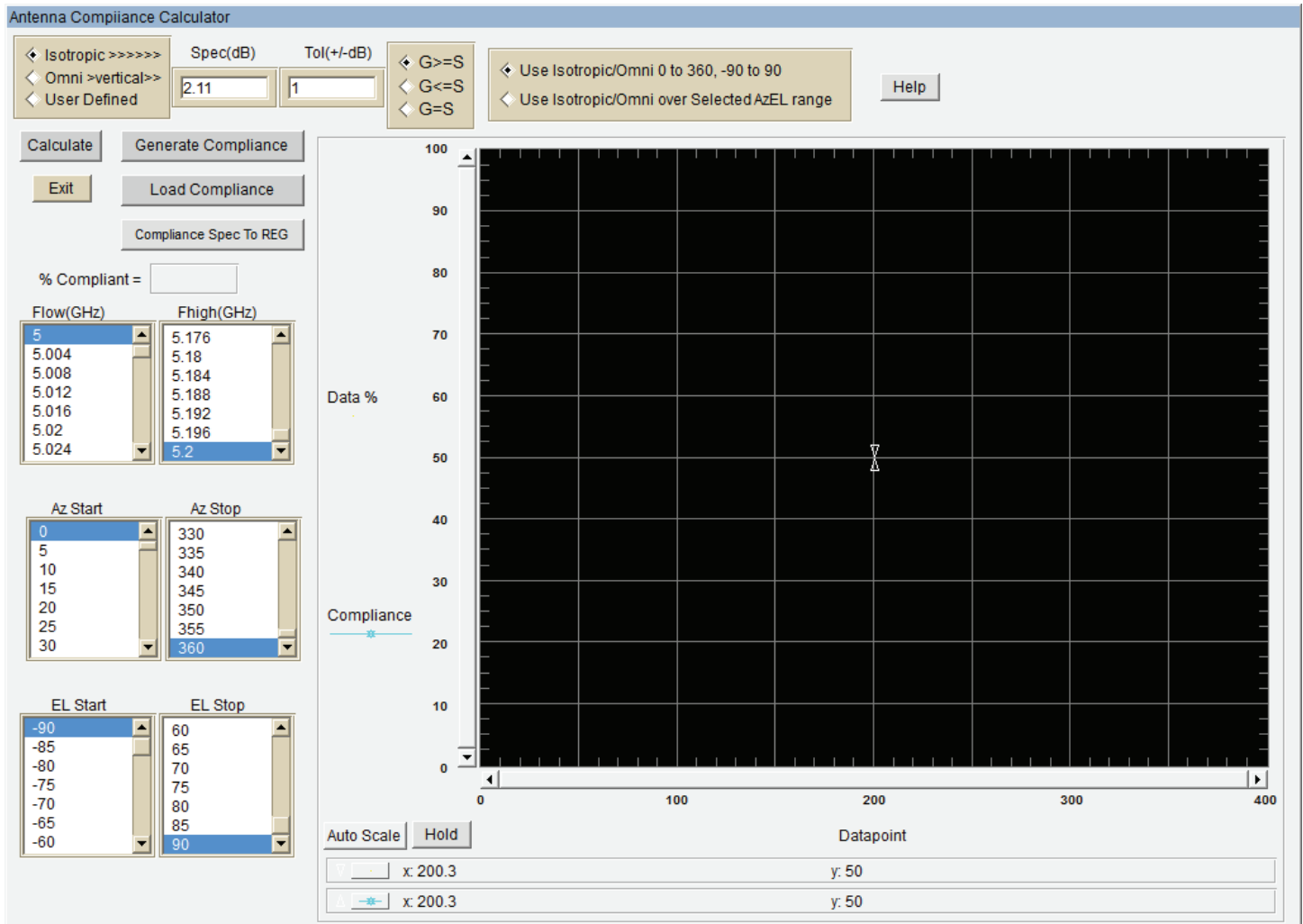


# Antenna Compliance Testing

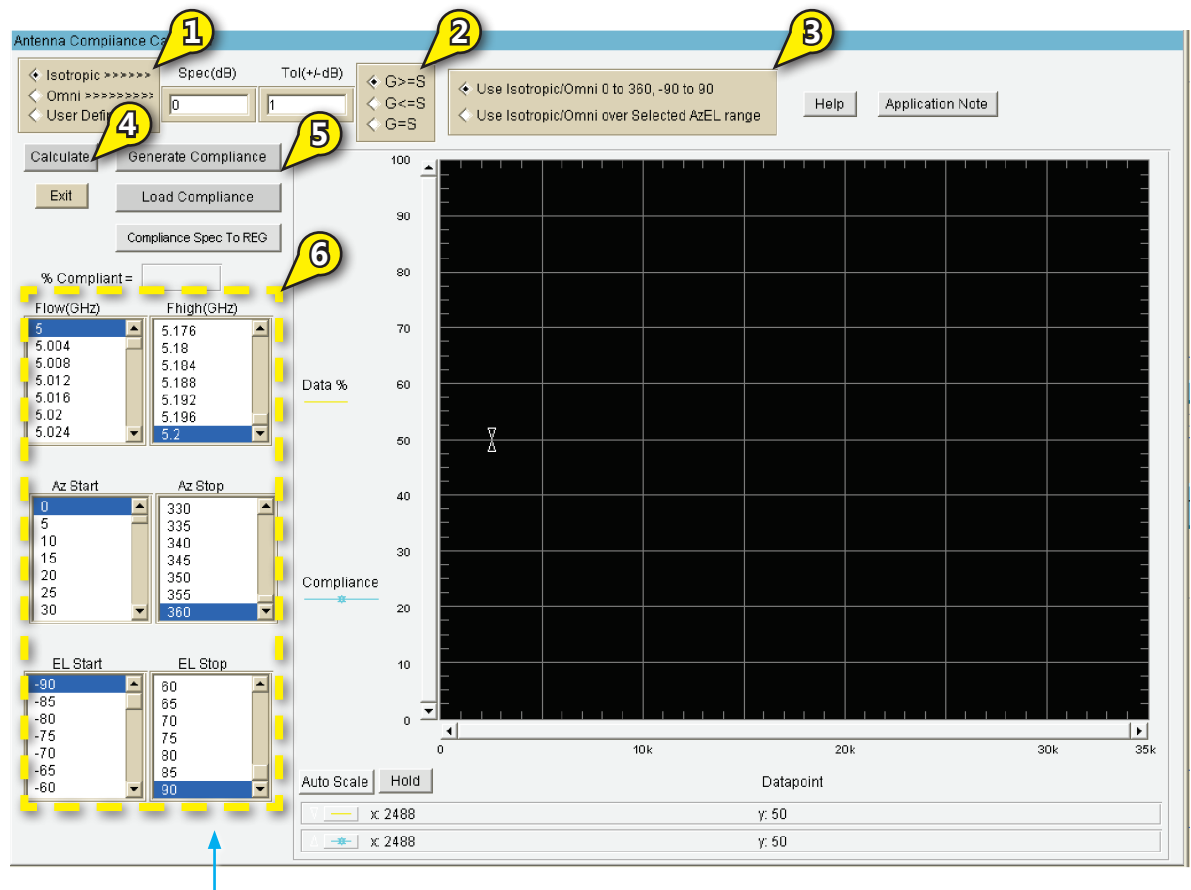
## Application Note



This application note will explain how to use the Compliance Testing module, which enables antenna measurements (gain, typically) to be evaluated against a specification over AzEL and frequency. Two standard patterns are given: Isotropic and Omni. A user defined specification can also be implemented using Excel. In Excel, the data sets AzEL extents and frequency array are presented so the user can utilize Excel tools (for either piecewise limits or equations) to generate the desired specification. This enables pattern specifications or equations to define the required performance over AzEL and frequency. The Spherical and 3D AzEL module can then be used to plot the specification in wireframe over the data for visual confirmation.

# Overview

- 1 Compliance Reference
- 2 Compliance Conditional
- 3 Compliance Az-EL extents
- 4 Calculate
- 5 Generate or load Excel compliance file (user specified option)
- 6 Lists are set to Azimuth, Elevation, and Frequency extents.



**TIP:** You can change the Az, El, F extents by clicking on the desired value in the List window.

## Problem 1

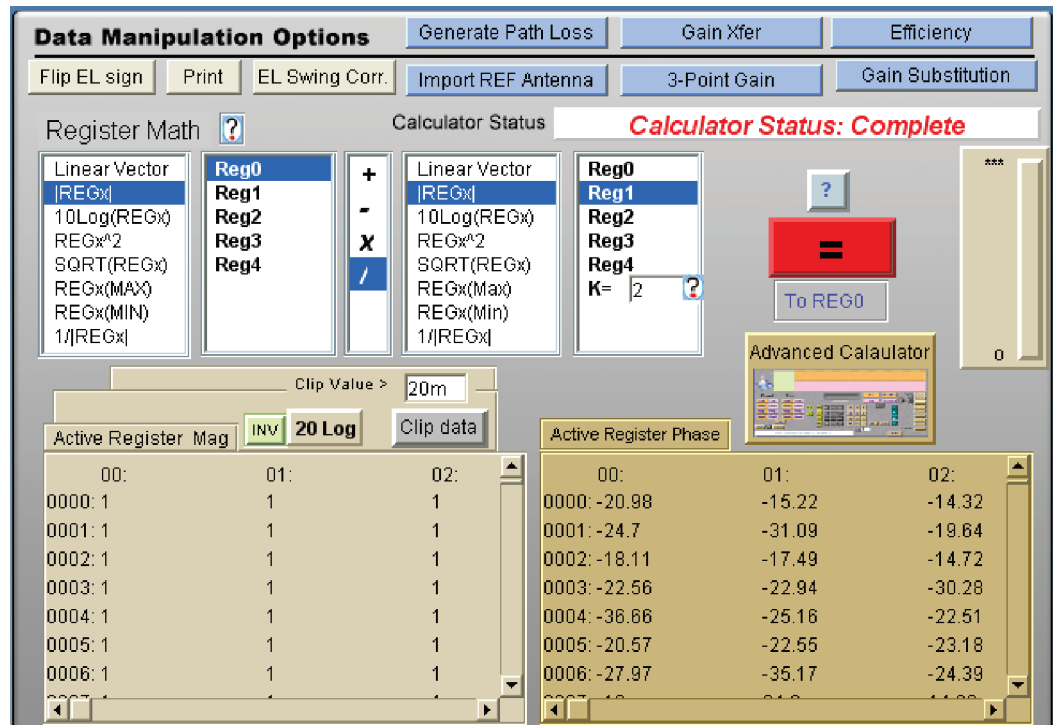
Create an ideal Isotropic antenna and determine the compliance over the following:

- Gain  $\geq$  0dBi Full extents and Az: 0 to 180 deg
- Gain  $\leq$  -3dBi Full extents
- Gain = 3dB TOL=value necessary for %100 compliance, Full extents
- % Gain omni compliant to 2.14dBi, Full extents

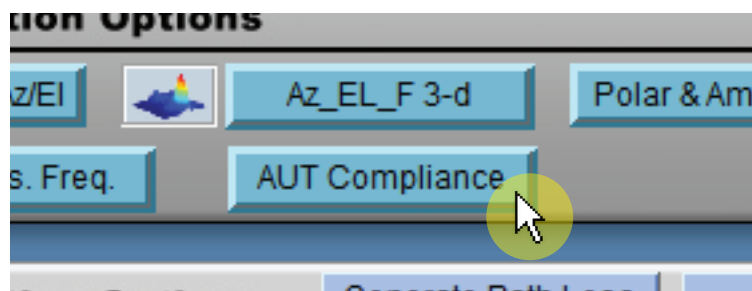
## Problem 1 Solution

**NOTE:** It is assumed you are familiar with DAMS Antenna Studio. This simplified example will demonstrate use of compliance.

1. Load a measurement set which has been processed to Linear gain.
2. Create an Isotropic Antenna by recalling your data into REG0. Divide REG0 by itself creating isotropic gain = 1. Reg0 is now isotropic as shown below:



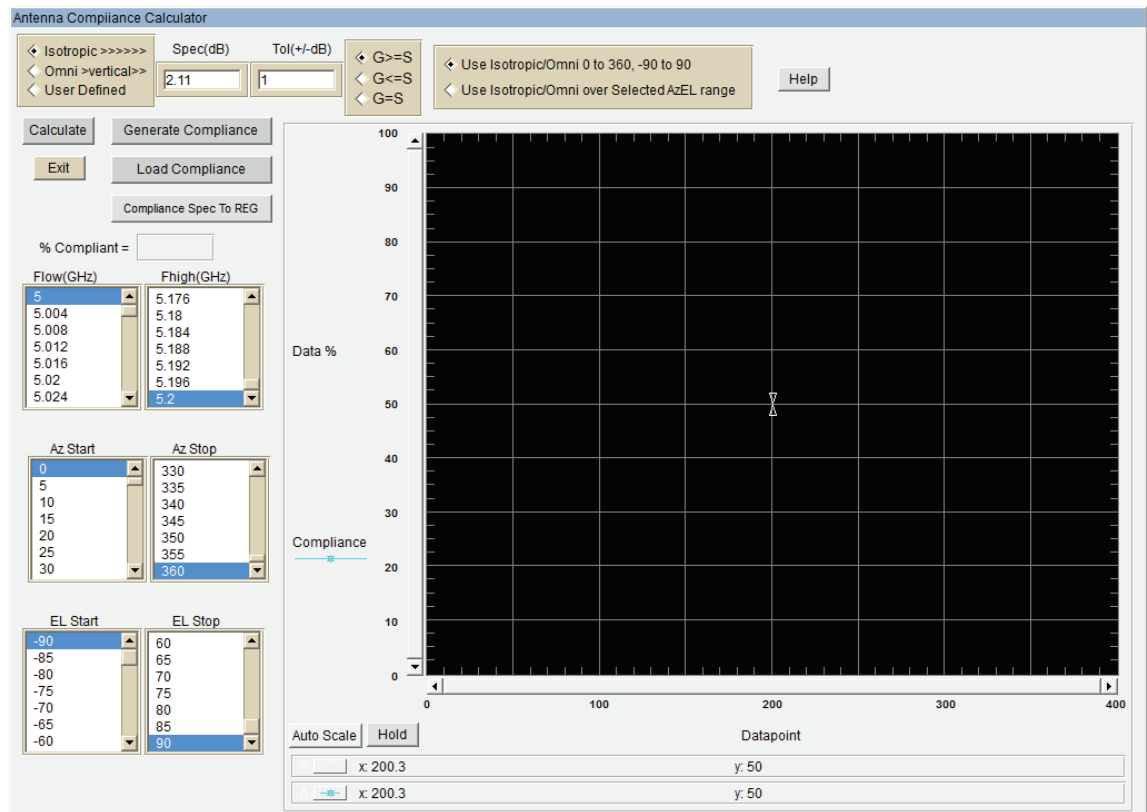
3. Invoke the Compliance Module by selecting the AUT Compliance button as shown below:



*Continues next page...*

## Problem 1 Solution (Continued)

The Compliance Module window opens as shown below:



4. Calculate half-Az extents compliance by setting the AzStop list to 180 degrees and clicking calculate.
5. Now calculate Isotropic Compliance  $\leq -3$ dB by entering  $-3$  into the Spec(dB) field and calculate compliance at 200%.
6. For 100% compliance on full extents, we must calculate compliance = 3dB and TOL= [value]. Enter 3dB into the Spec(dB) field and select  $G \geq$  as the conditional. It should graphically show no compliance at 3dBi Gain. Click calculate.
7. Try TOL = 3.1dB (+/-) and re-evaluate. It should show 100% compliance to 3dBi
8. Gain with 3.1dB tolerance. Click calculate.
9. Finally, we calculate the omni compliance to 2.14dBi on full extents by selecting Omni (default is 2.14dBi) and calculate at 93.08%



**Problem Solved!**

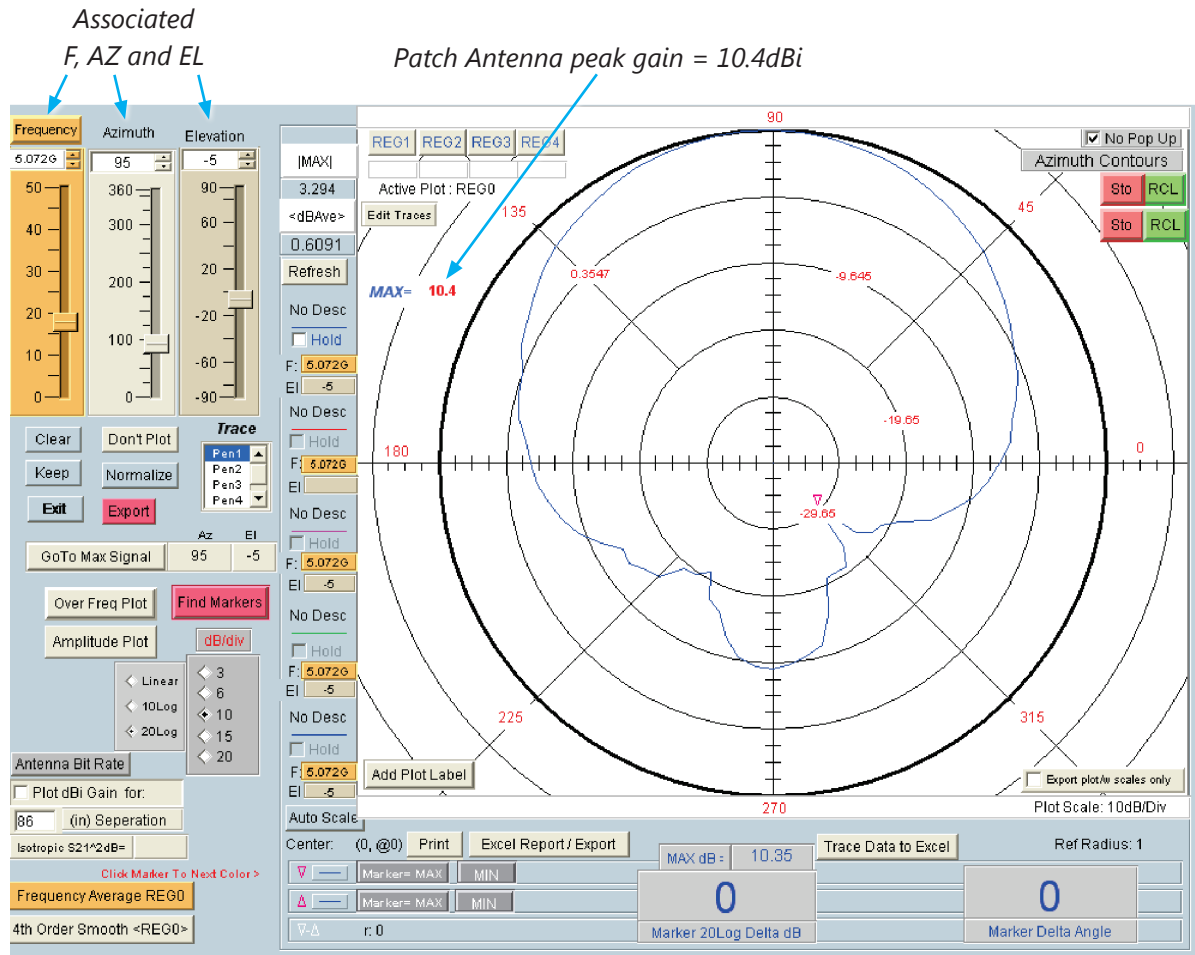
## Problem 2

Assume a patch has been measured over Az: 0 to 360 step 10 EL: -90 to 90 step 10

- Evaluate compliance to Omni
- Create a compliance file for main lobe testing
- Evaluate compliance an plot against data in 3-d AzEL and Spherical

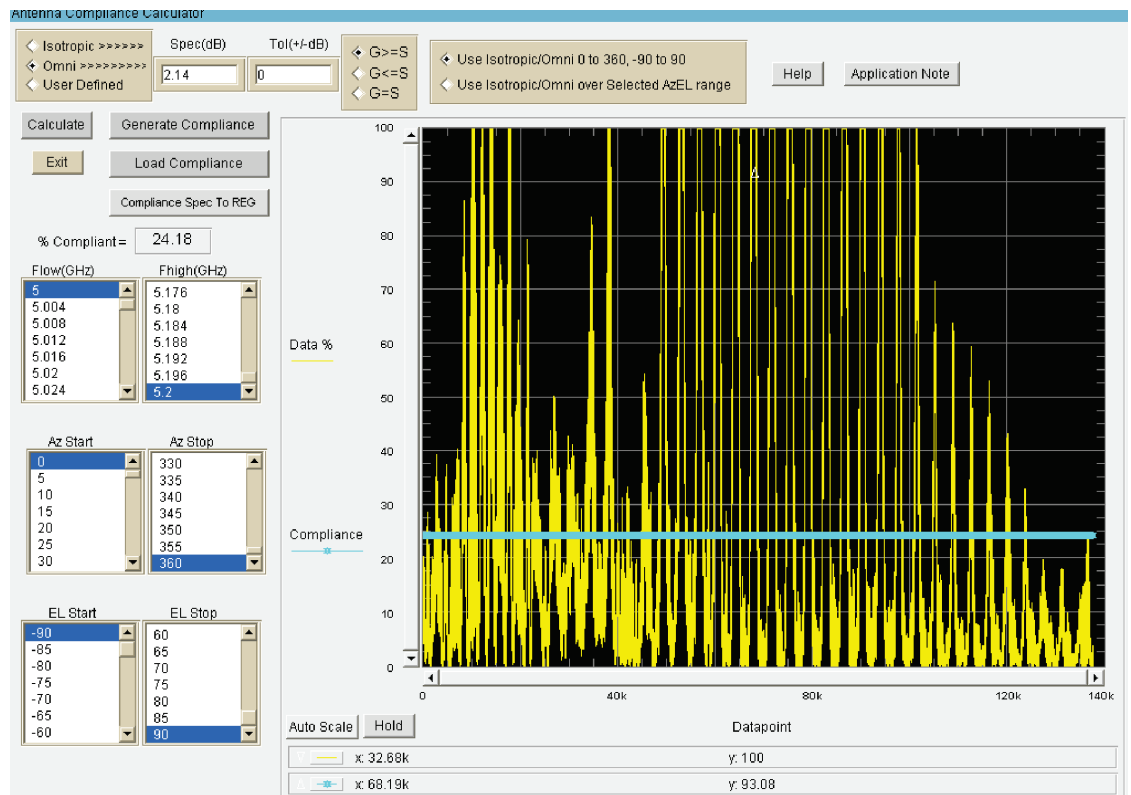
## Problem 2 Solution

1. Open the file `c:\DAMS\AdvancedData\PatchAntennaScan.dat`
2. Recall **REG4** and enter the Polar plot. (**REG4** contains the precalculated Gain Data.)



Continues next page...

3. With the scale set to 20Log invoked, go to MAX SIGNAL
4. Compare to Omni over all AZ, EL, F as shown below. Compliance is at 24.18%.



5. Create a compliance file for main lobe testing. If you would prefer to skip this step, click "**Load Compliance File**" and open C:\DAMs\AdvancedData\PatchAntennaScanCompliance.xls
6. Click the "**Generate Compliance**" button as shown above to open the screen shown below:

7. Select the desired Azimuth, Elevation and Frequency ranges (Main Lobe definition)
8. Select Log format for easy spec creation in Excel. Data will be used in Linear form.
9. Select peak frequency to fill Excel cells
10. Click "**Generate Compliance Sheet**". Excel will then open with this template as shown on the following page.

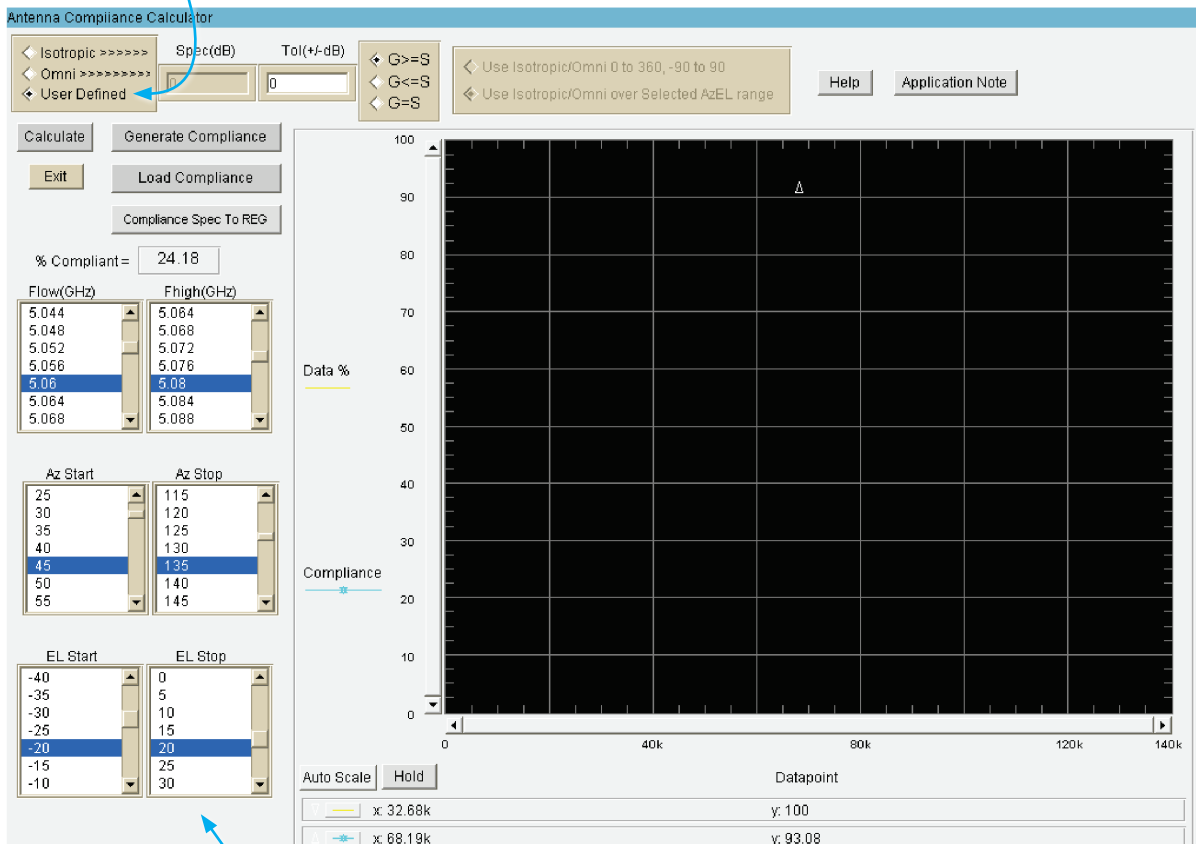
The DAMs compliance template will contain the extents and gain data previously established. Save the template with a new name in your project directory so you don't over write the DAMs template.

Antenna Compliance Template				AZ/EL Gain Table																	
Details	Start	Stop	Step																		
Frequency MHz	5060	5080	4																		
Azimuth Deg	45	135	5																		
Elevation Deg	-20	20	5																		
Data Format:	Log																				
Freq. (MHz)	Dependence	Az Pos >	EL Pos >	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	13	
5060	0	45	20	5.013272	3.808245	4.417255	4.901098	5.304143	5.648634	5.884788	5.928765	6.098334	5.954435	5.887167	5.522079	5.459663	5.059271	4.735797	3.951987	3.268	
5064	0	20	-15	2.335878	3.790973	4.570535	5.368464	6.142241	6.852230	7.048924	7.41741	7.570441	7.536623	7.617075	7.497877	7.31969	7.033008	6.40559	5.841088	4.980524	4.2
5072	0	-10	5	4.426362	5.500551	6.414529	6.992618	7.834762	8.376796	8.994312	9.364213	9.527541	9.633211	9.428282	9.06908	8.38337	7.963826	7.022643	6.243127	5.33	
5076	0	-5	0	4.940563	5.868619	6.749595	7.549073	8.301819	8.912564	9.310356	9.61144	10.05996	10.22425	10.35469	10.1134	9.784355	9.442695	9.026887	8.365942	7.754193	6.98
5080	0	0	5	3.049813	5.11864	5.95218	6.666821	7.504044	8.032826	8.551722	9.010924	9.352235	9.523011	9.474196	9.300481	9.008144	8.711027	8.068852	7.302703	6.746529	5.91
		10	0	3.959485	4.942651	5.79942	6.50368	7.227687	7.947063	8.3185	8.640417	8.915443	8.741732	8.59206	8.183494	7.717765	7.15766	6.29694	5.809188	4.89	
		15	5	3.741718	4.928634	5.880786	6.521255	7.176469	7.612601	8.147301	8.552389	8.785835	8.89108	8.808356	8.732462	8.349331	8.077321	7.427926	6.858948	6.042601	5.36
		20	0	4.6186	5.888058	6.618249	7.432119	7.785441	8.467573	8.70263	9.036842	9.060488	9.075279	9.03604	8.989776	8.748234	8.547144	8.330736	7.604612	7.082903	6.37
		20	0	4.076101	5.01869	5.8903	6.563004	7.103214	7.58006	8.043887	8.21352	8.363553	8.537424	8.64135	8.571015	8.41482	8.122096	7.779885	7.050405	6.559466	5.90

A compliance template may contain equations or constants or can be the measured data for use with = +/- TOL. Templates may be used with other data files so long as the Extents are present in the data. Once the compliance file is saved it will need to be loaded by invoking Load Compliance File. Upon loading, the data AzEL,F lists will default to the compliance extents. You can modify a compliance sheet "on the fly" followed by re-saving and reloading.

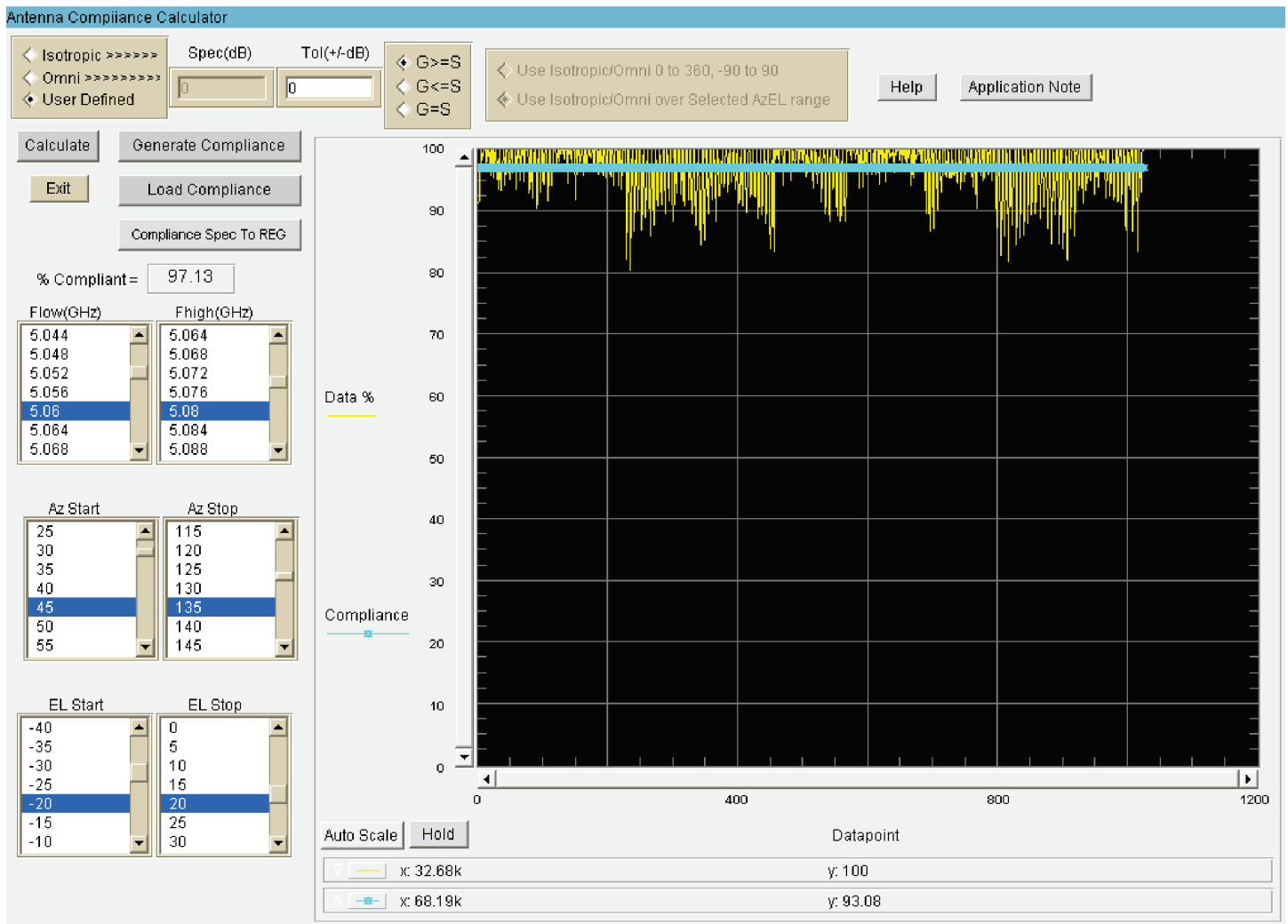
Compliance module after loading the compliance file:

Ensure User Defined is checked



List Defaults are set to compliance extents

With the compliance sheet loaded with peak data only the frequency variation of the data will lower compliance. Check  $G \geq S$  and run the compliance. Result is 97.13% as shown below:



Next, we modify the compliance file as demonstrated here:

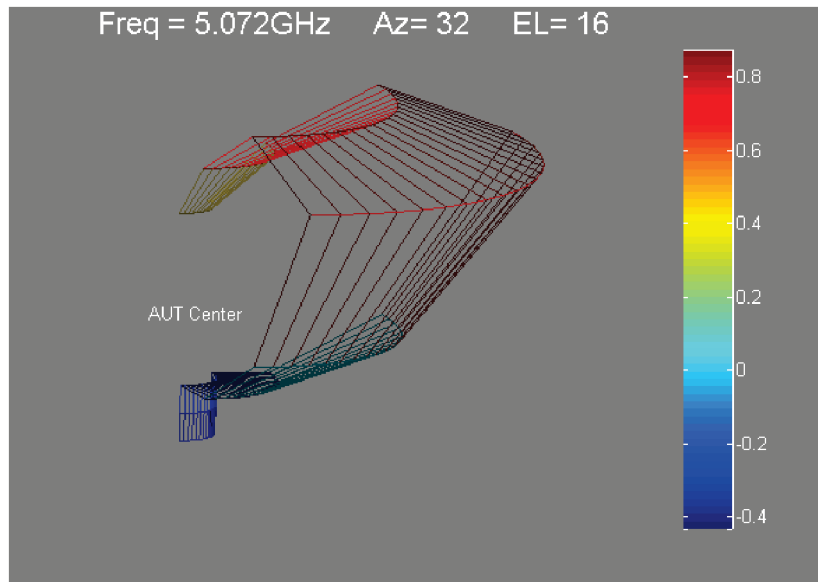
**Original compliance template with peak gain data:**

Antenna Compliance Template				AZ/EL Gain Table																		
Details	Start	Stop	Step																			
Frequency MHz	5060	5080	4																			
Azimuth Deg.	45	135	5																			
Elevation Deg.	-20	20	5																			
Data Format:	Log																					
Freq. (MHz)	Dependence	EL Pos	Az Pos >	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	
5060	0	20	45	3.013272	3.806245	4.417255	4.901098	5.304143	5.648634	5.984788	5.926765	6.098334	5.954435	5.887167	5.522079	5.459663	5.059271	4.735797	3.951987	3.280095	2.457636	
5064	0	-15		3.790873	4.570536	5.388464	6.142241	6.65228	7.048924	7.41741	7.570441	7.536623	7.617075	7.497877	7.31889	7.033808	6.40559	5.641068	4.890524	4.26015	3.189288	
5072	0	-10		5.500651	6.414529	6.990618	7.834762	8.378796	8.994312	9.364213	9.627541	9.633211	9.599731	9.428262	9.06908	8.38337	7.963826	7.022543	6.243127	5.331834	4.294901	
5076	0	-5		5.888819	6.749588	7.549073	8.301819	8.912564	9.310366	9.81144	10.05896	10.22425	10.35469	10.1134	9.784356	9.442685	9.026887	8.365942	7.754193	6.993343	6.217256	
5080	0	0		4.15782	5.11864	5.95218	6.886821	7.504044	8.032626	8.561722	9.010924	9.352235	9.523011	9.474196	9.300481	9.006144	8.711027	8.069852	7.302703	6.746529	5.914639	4.881345
	5			3.049313	3.959485	4.942651	5.79942	6.50398	7.227687	7.947063	8.3185	8.640417	8.915443	8.741732	8.59208	8.183494	7.717765	7.15766	6.29594	5.308198	4.691731	4.136298
	10			3.741718	4.928634	5.880786	6.521255	7.176489	7.612601	8.147301	8.562369	8.785936	8.890108	8.806366	8.732462	8.349331	8.077321	7.427926	6.859948	6.042601	5.367556	4.403388
	15			4.6186	5.898059	6.616249	7.432119	7.785441	8.467573	8.70263	9.036842	9.080488	9.036279	9.03604	8.989776	8.746234	8.547144	8.330736	7.604612	7.082903	6.377816	5.542397
	20			4.076101	5.01869	5.6903	6.563004	7.103214	7.58005	8.043887	8.21352	8.363553	8.537424	8.64135	8.571015	8.41482	8.122096	7.779985	7.050405	6.569466	5.904668	4.771226

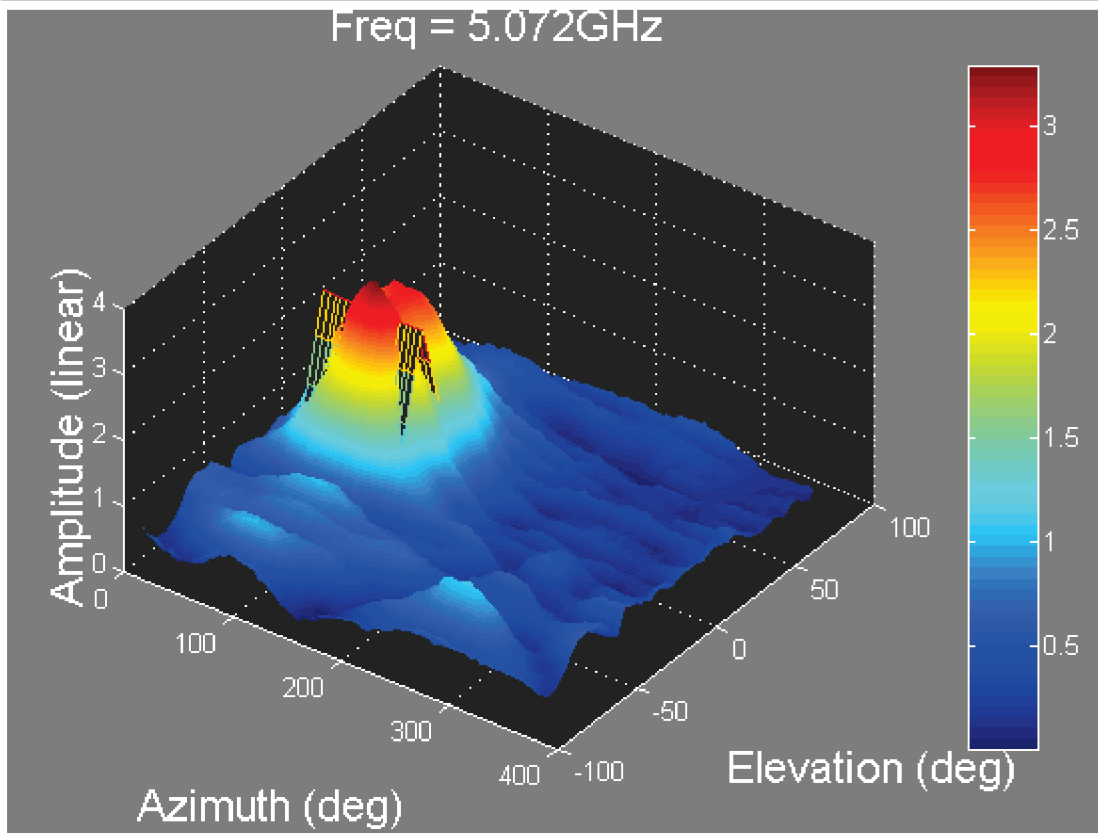
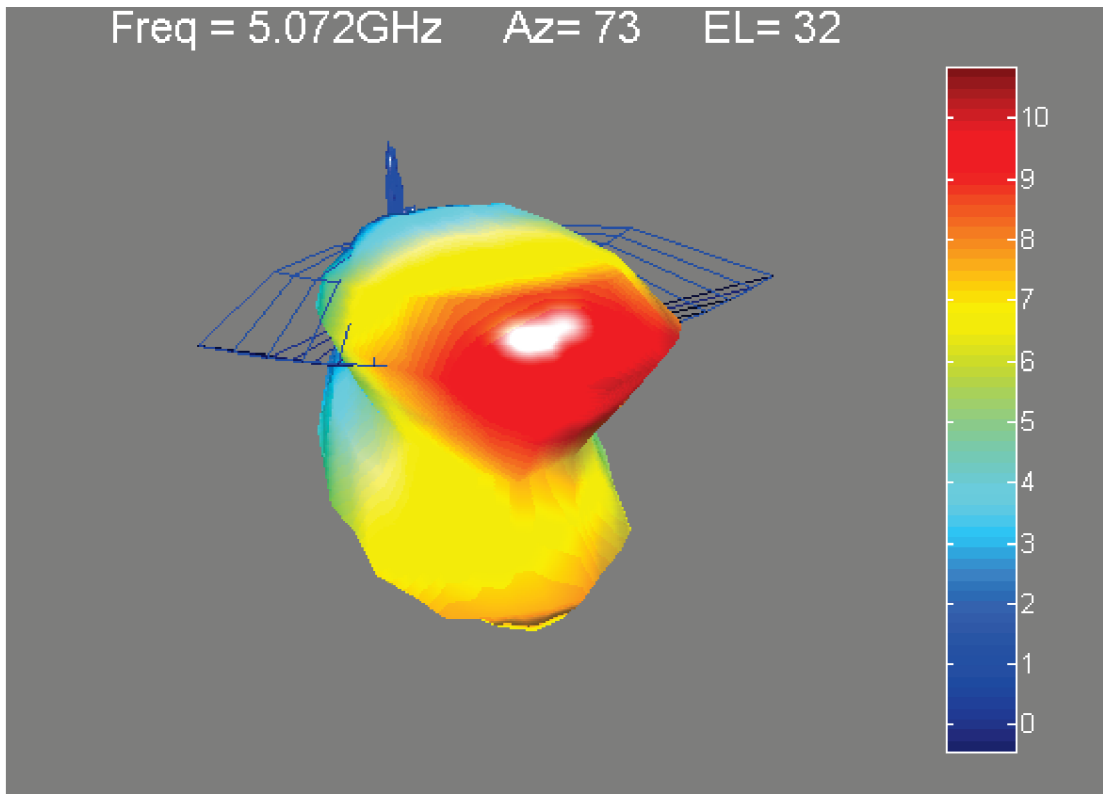
**Modified template with specification rows and columns**

Antenna Compliance Template				AZ/EL Gain Table																	
Details	Start	Stop	Step																		
Frequency MHz	5060	5080	4																		
Azimuth Deg.	45	135	5																		
Elevation Deg.	-20	20	5																		
Data Format:	Log																				
Freq. (MHz)	Dependence	EL Pos	Az Pos >	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135
5060	0	20	45	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5064	0	-15	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5072	0	-10	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
5076	0	-5	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
5080	0	0	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	5		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	10		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	15		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	20		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

The original data was modified by rows and columns to specific gain values. Beam equations of individual cell values could also have been used. Invoke "**Compliance Spec To Reg**" so it can be viewed in the spherical module:

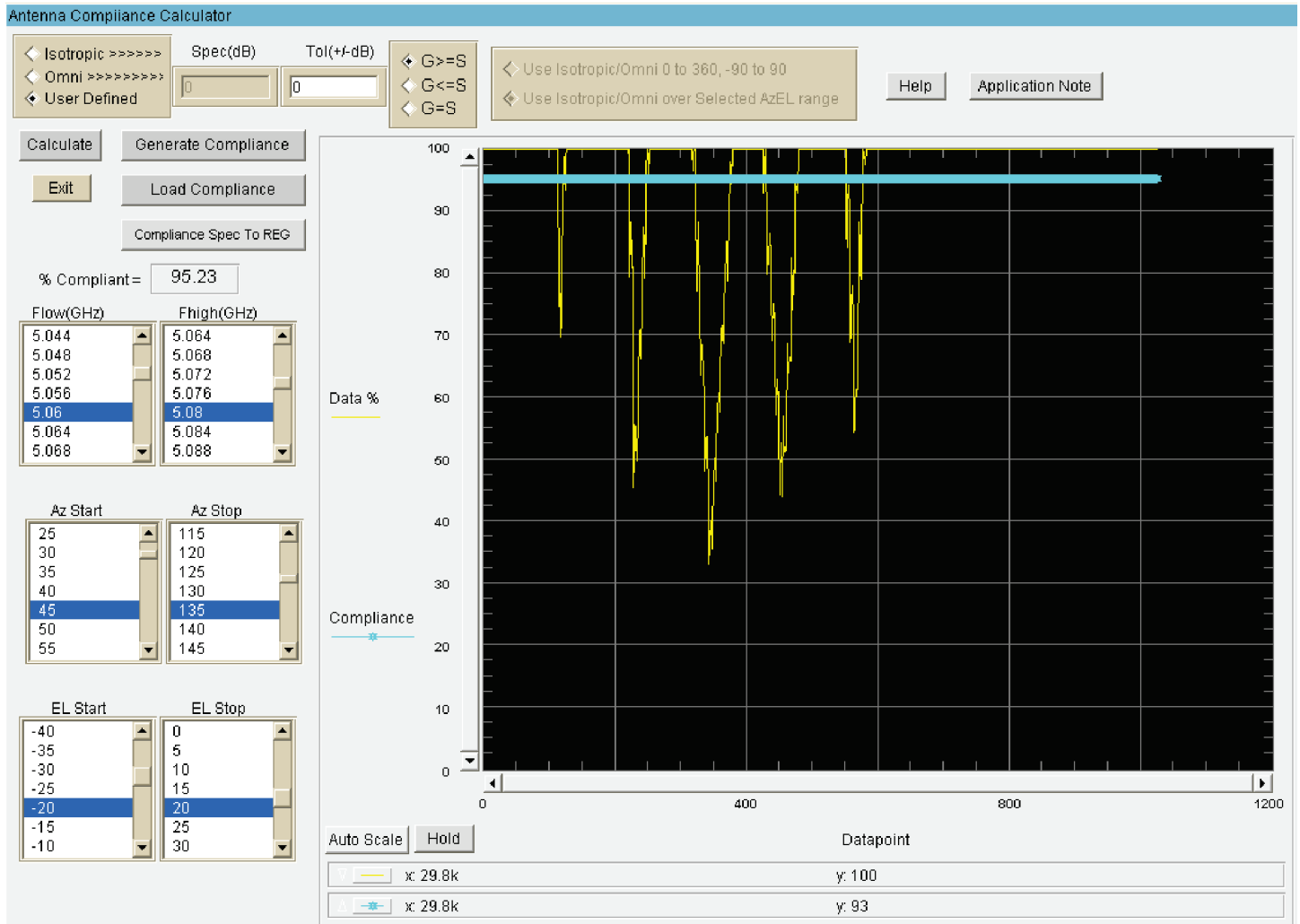


**Spherical and AzEL View of Compliance and data(Linear)**



Finally, we calculate the compliance to the new template as shown below:

% Compliant = 95.23



 **Problem Solved!**