

Simple Antenna Measurements Using DAMs5.0 Advanced Software



Gain And Arbitrary Beamwidth Measurement For Identical Test Antennas

This note demonstrates the measurement procedure using two identical AUTs (Antennas Under Test) in a lab environment (no anechoic chamber).

Statement Of The Measurement

Determine the Antenna Gain And Beamwidth for a microstrip 802.11 printed antenna subject to the following conditions:

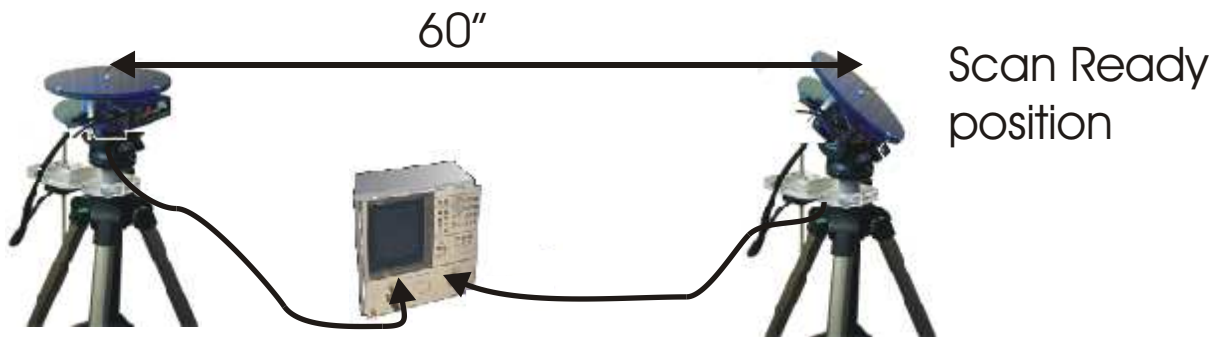
Freq : 2.4GHz to 2.5GHz 101 points
Azimuth: 0 to 360deg 5 deg resolution
Elevation: -30 to +30deg 5 deg resolution
Gain: Max Gain dBi & dBd
Beamwidth: 3dB down from peak

Compare to ideal Isotropic link

Generate an ideal $\frac{1}{2}$ wave dipole measurement data container and compare to the measurements above.

Compare results to a commercial 802.11 set of dipoles

Direct Measurement Using Two Identical Antennas



Establish your VNA calibration including the platform and cables.
Set the total Az movement. Tilt the platform to a starting elevation and set the slider to the end EI.

Antenna Measurement Studio 4.5
Precision Antenna Measurement System and Data Processing Software

Diamond Engineering
Automated Measurement Solutions

Start Here ?

QUIT!

Measurement Setup

Select Instrument: HP8510
Select Receiver: HP4194

Settings

Cal System

Measurement Setting Applied

Degrees Per Measurement: 5
Number of Measurements: 7

1. Select Total Rotation: 360
2. Select Deg. Per Meas.: 5

Direction: CW

Measurement Setup - Elevation

Vertical Step Size: 5
Limit Check: Yes

Jog Value: 15

Platform Settings and Control

Jog Left: 5
Jog Right: 5

Vertical Calibration

Measurement Controls

Measure Front Sweep
Measure Rear Sweep

Scan V/H ?
Repeat All Data ?

Post Measurement Options

Move to Max. Signal
Export data

Proceed to Data Processing ?

Initiate the Scan

After the Scan is Complete go to the Advanced section

Center Frequency Amplitude Plot

Rotation Tracker

Smith Chart

Rx Span: 2.0
0.5/Div

Center: (0, @0)
Ref Radius: 1

Save your data

Review your scan using Spherical with Isotropic and Dipole overlay

The screenshot shows the Antenna Measurement Studio 4.5 interface. The top bar includes the title 'Antenna Measurement Studio 4.5' and the company name 'Diamond Engineering'. The main window is divided into several panels:

- Data Registers:** A table with columns for 'Data Storage Reg', 'Recall Reg', and 'Measurements'. It shows four registers, each with a 'Recall' button and a 'Measurements' value (e.g., 48.4k, 51).
- Active Register:** Shows 'Active = Reg1', 'Loaded', 'Start = 2.4G', 'Stop = 2.5G', and 'Data Points = 48.4k'.
- Data Visualization Options:** Includes buttons for 'View 3D Az Plot', 'Az_EL_3-d', 'Spherical 3D Az/EI', 'Amplitude/Freq Plot', 'Polar Plot', 'Group Delay', and 'Merge Scans'.
- Data Manipulation Options:** Includes 'Dipole & Isotropic Link' and 'Elevation Swing Corr.'.
- Register Math:** A calculator interface with 'Register Math' and 'Calculator Status' sections, showing mathematical operations on registers (e.g., Linear Vector, 10Log(REGx), REGx*2).
- 3-d Spherical Az-EL Plotting:** A large panel with 'Generate Plot' and 'Iso-Sphere' sections. It includes a 'Frequency' slider set to 2.455G, 'Data Plotting Options' (Map to Sphere, Wireframe, Az-El View Point), and 'Add Isotropic (dBi)' and '1/2 T Dipole' sub-panels with various parameters like (+dBd), R(in), GridRES(deg), and Wireframe.

Annotations with arrows point to specific features:

- An arrow points to the 'Save Reg1-4 To Disc' button in the Data Registers panel.
- An arrow points to the 'Spherical 3D Az/EI' button in the Data Visualization Options panel.
- An arrow points to the 'Generate Plot' button in the 3-d Spherical Az-EL Plotting panel.
- An arrow points to the 'Frequency' slider in the 3-d Spherical Az-EL Plotting panel.
- An arrow points to the 'Add Isotropic (dBi)' sub-panel in the 3-d Spherical Az-EL Plotting panel.
- An arrow points to the '1/2 T Dipole' sub-panel in the 3-d Spherical Az-EL Plotting panel.

Additional text annotations:

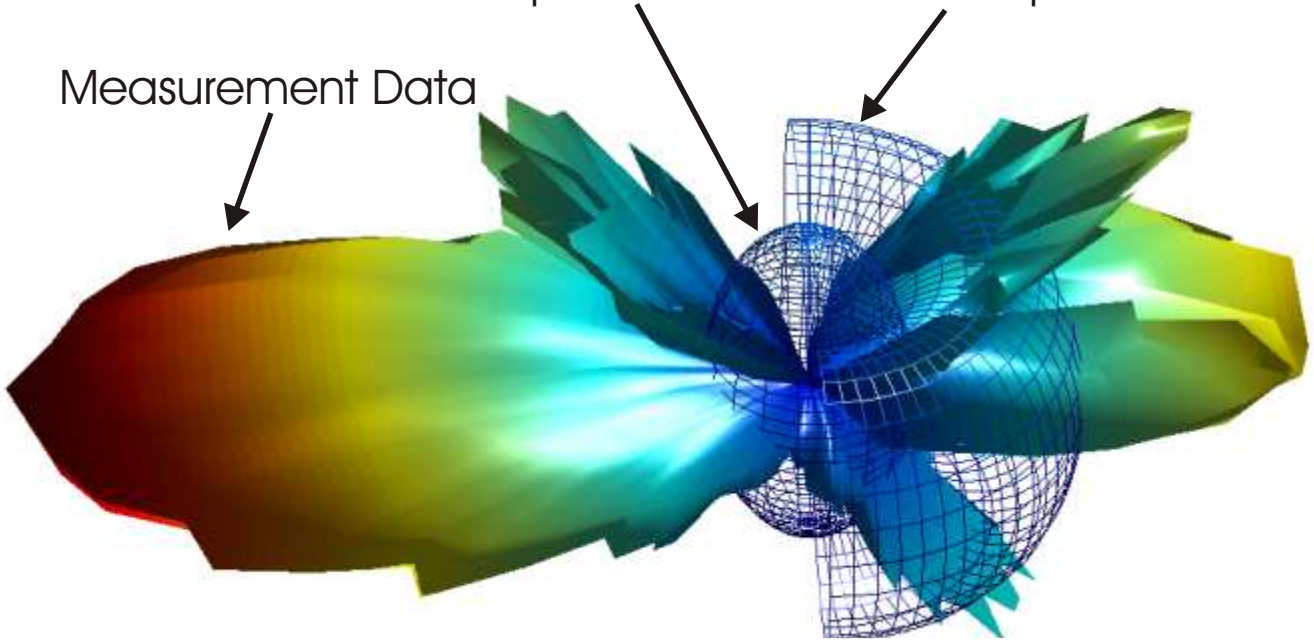
- 'Enter the Tx Rx separation' points to the 'R(in)' field in the Dipole sub-panel.
- 'Select the frequency and invoke a plot' points to the 'Frequency' slider and the 'Generate Plot' button.

A status bar at the bottom contains a note: 'NOTE: The S21 measurement array is squared from volt to Power ratio for this calculation. It is not re-saved to REG0. READ BELOW TO CALCULATE dBi or dBd POWER GAIN'.

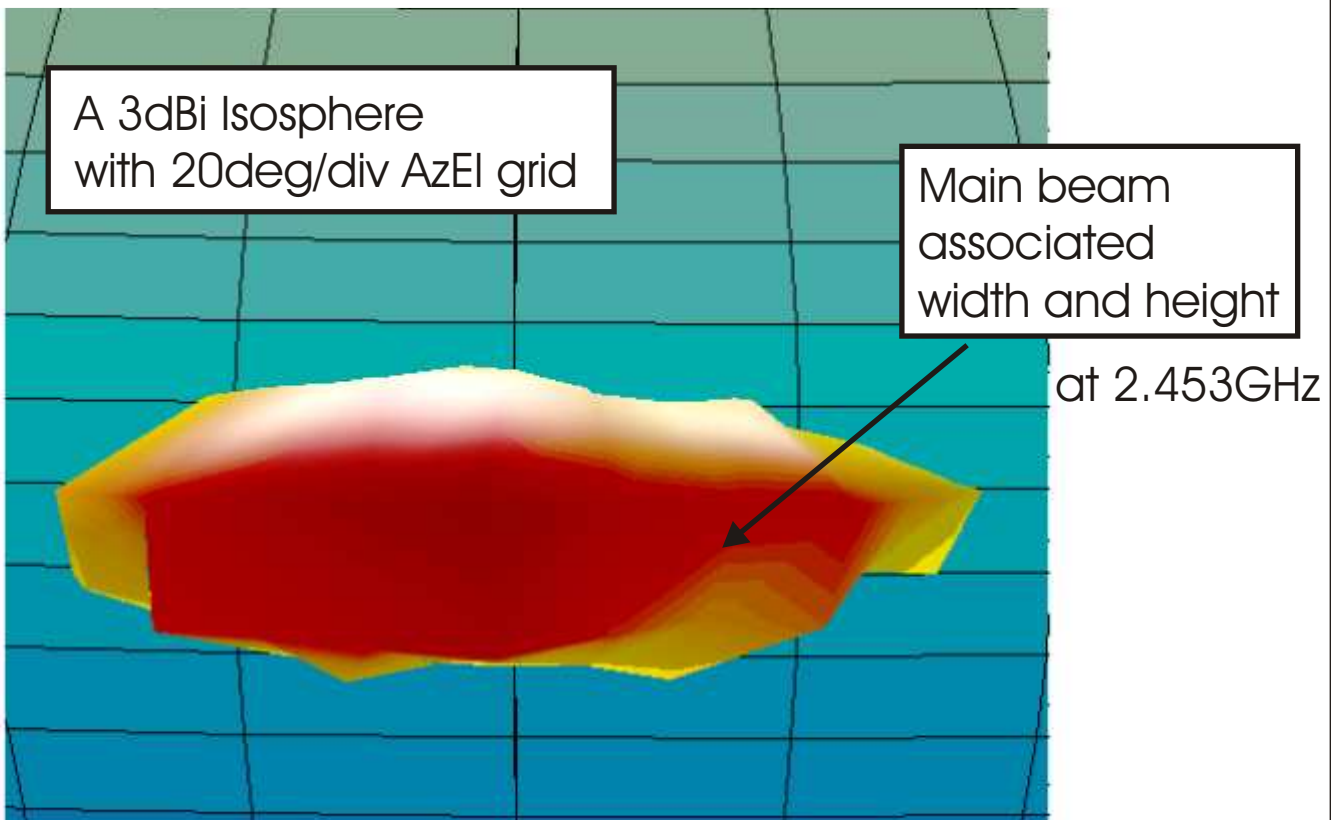
Spherical Profile. Rho,Az,El(0,0,0) is center of plot

Isotropic Link And 1/2 Wave Dipole Link

Measurement Data



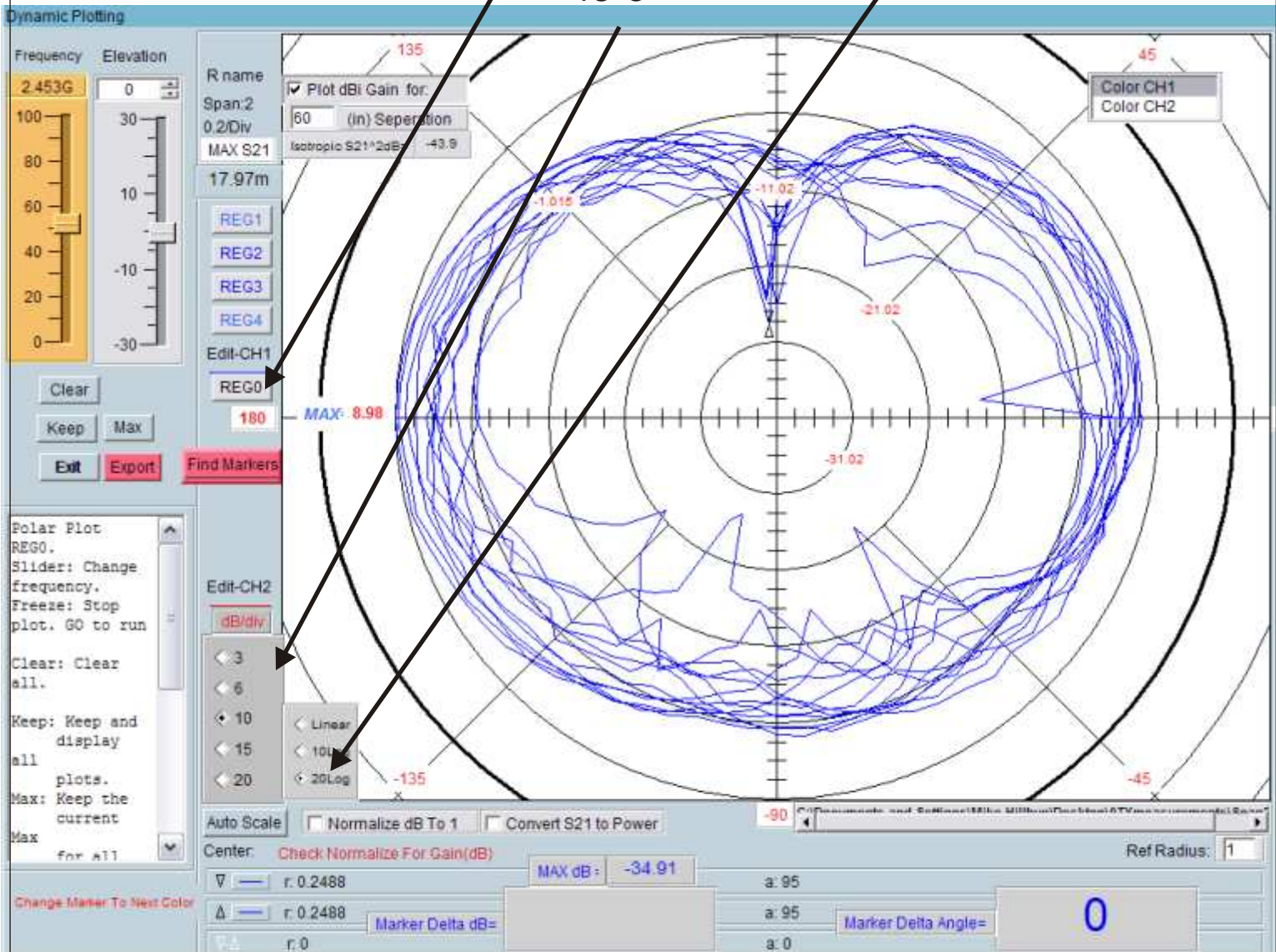
Replot using a solid IsoSphere with desired wire grid deg.
Rotate to main beam to see associated beamwidth



Initially all Scan contours appear. The "Plot dBi Gain" is used to scale the plot to dBi. The frequency slider can slide through the Scan realtime.

Exit the Spherical overview and invoke the Polar Plot from the Advanced Menu. Recall REG0 so all Scan contours for the Slider Frequency appear.

Set the Scale to 20LOG and dB/div to 6



When the Elevation slider is moved only the single contour associated with that frequency and elevation will be plotted.

In the above plot the red labels are the dBi gains. The MAX gain (8.9dBi) is indicated at 180 deg (in this case) at 2.453GHz

To determine the 3dB beamwidth position one marker to the peak and the second marker to the nearest -3dB point. The marker difference windows show the associated magnitude and angle difference. In this case the $\frac{1}{2}$ beamwidth is 30 deg. The markers can be used to measure front to back and lobe ratios.

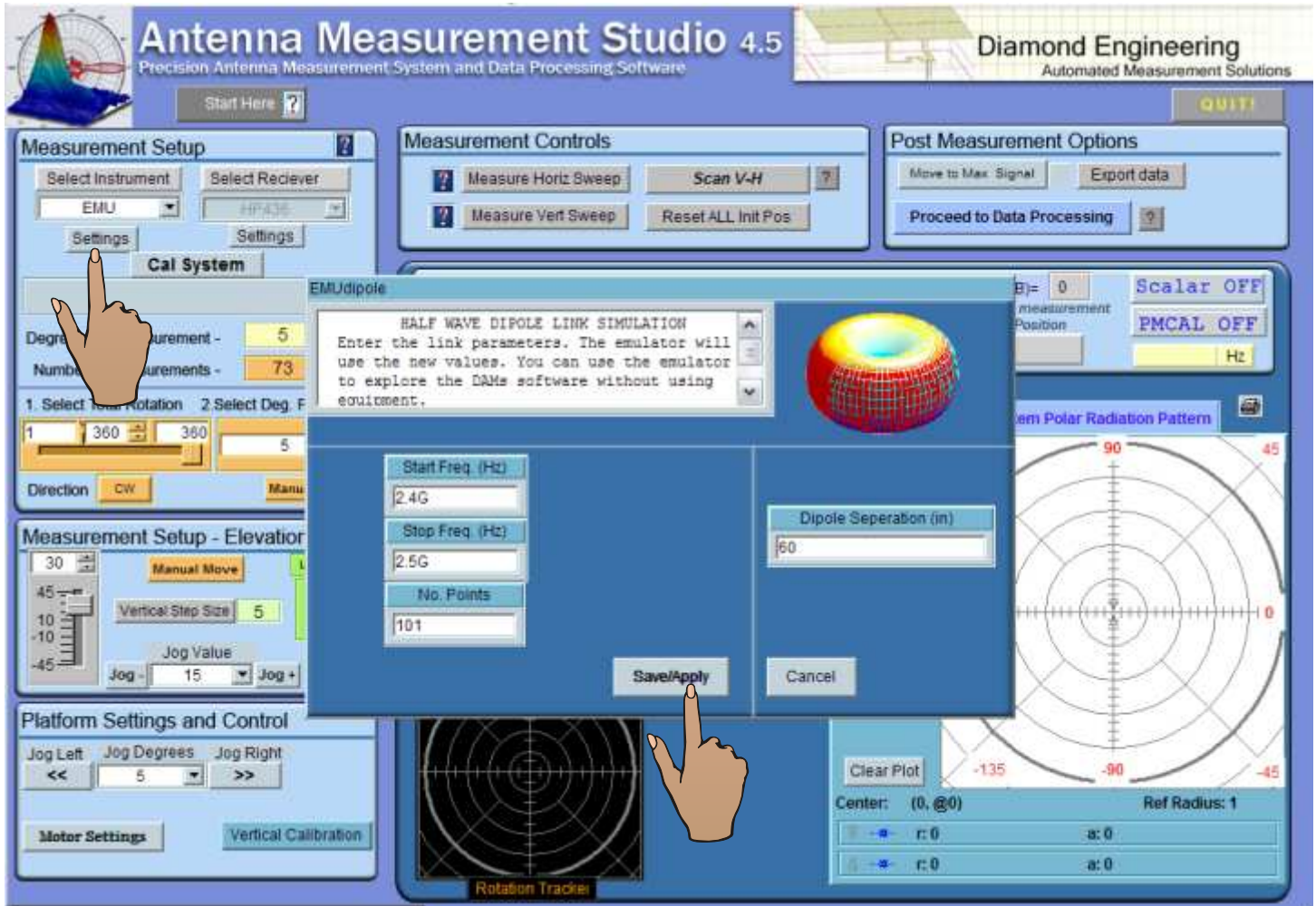
Log scale set to 3dB/div



Since "Plot dBi gain" is checked the red labels are dBi values
Compare this beamwidth to the previous Spherical Beamwidth

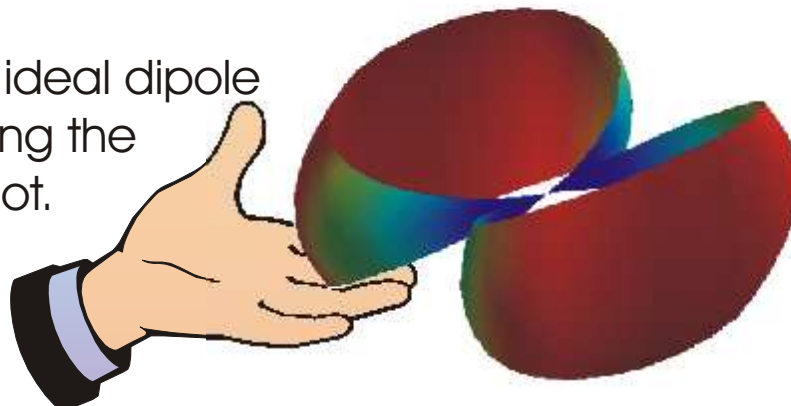


Generate the ideal $\frac{1}{2}$ wave dipole by using the EMU (emulate) in the "select Instrument" menu of the measurement page. Use the "Settings menu to establish the identical measurement sequence as your measurement data.



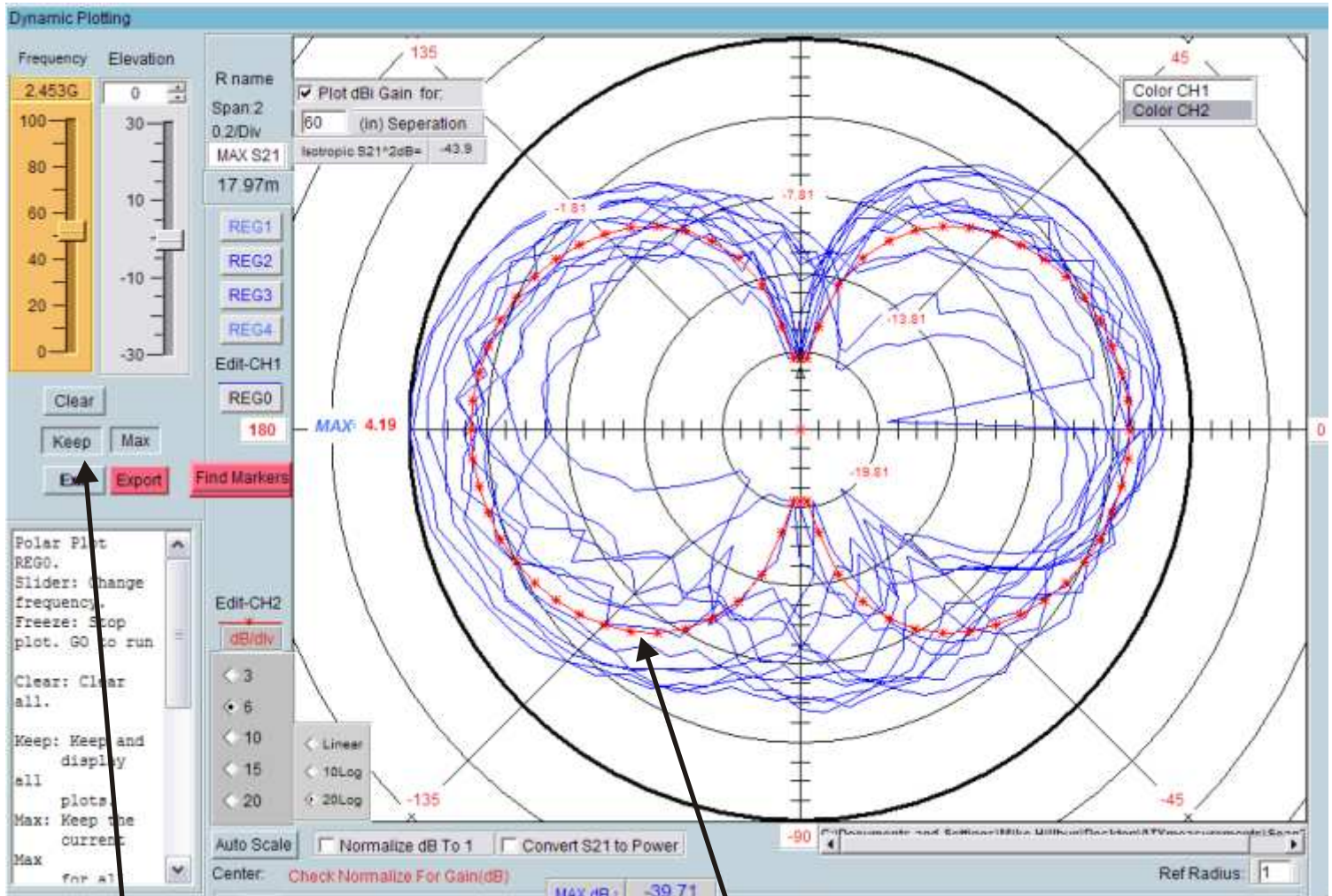
Spherical Profile. Rho,Az,EI(0,0,0) is center of plot

Inspect the ideal dipole data set using the Spherical plot.



Reload your original measurements into the Reg0 from the disc. Reg0 data (ideal dipole) will remain. In the polar plot recall your measurements in Reg1 and invoke "Keep Max". The recall the ideal dipole data in Reg0 and change the line type for better visibility.

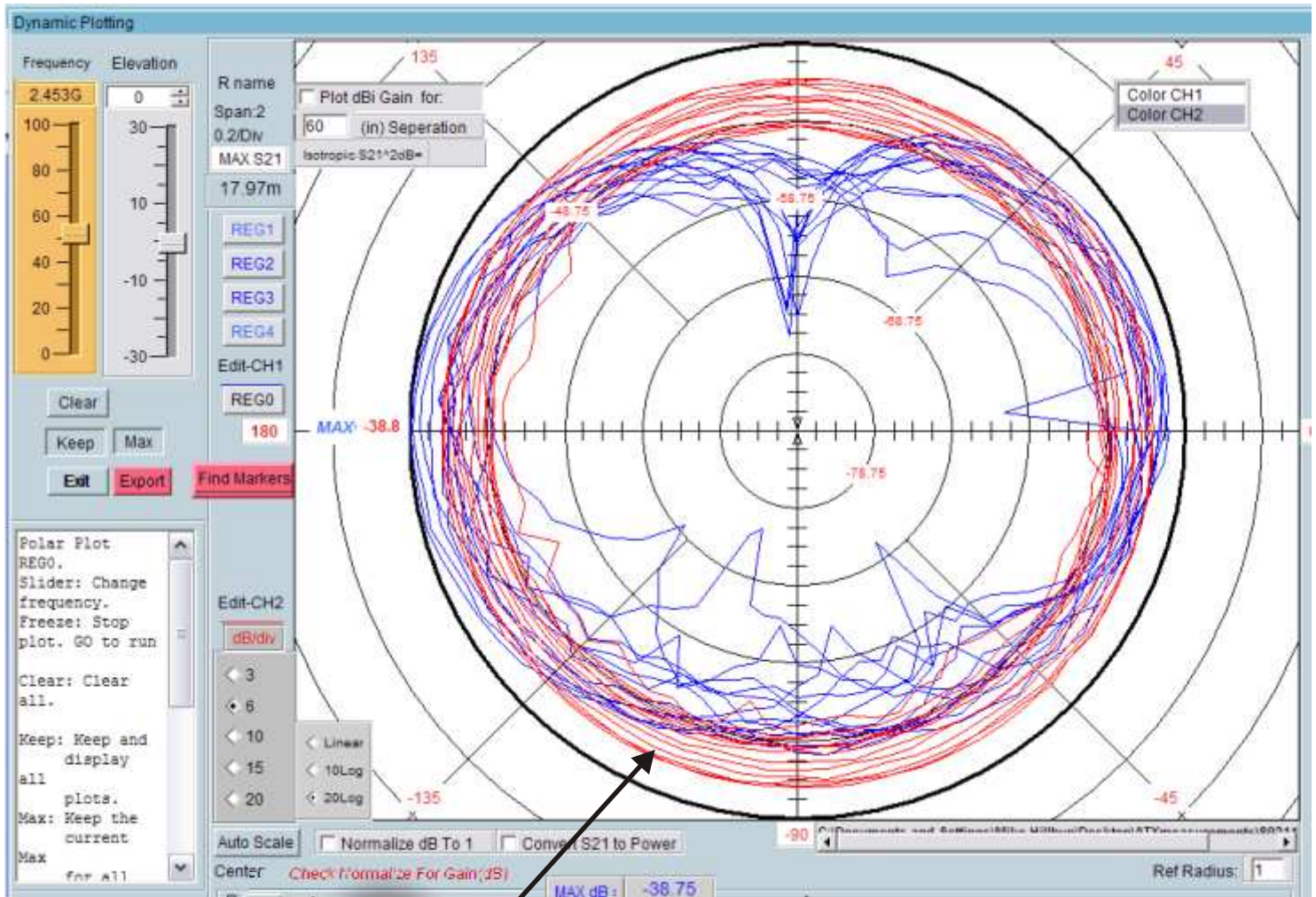
Scale set to 6dBi/Div



"Keep Max" will lock the plot diameter to existing data set.

The next data set will plot against the previous data set. The markers can jump from one contour to another for measurement.

To compare two antenna measurement sets load both sets into the registers. Recall the reference set (Reg1 our previous data) and invoke "Keep Max". Then load the second set (commercial dipole) from Reg2 so both overlay. You can then use the markers for measurement.



Scale : 6dB/div

This comparison could also have been done by using the array calculator to perform REG1/REG2. The resulting single data set would represent the gain relative to the commercial dipole.

Commercial 802.11 dipole (red) plotted against the 802.11 microstrip antenna