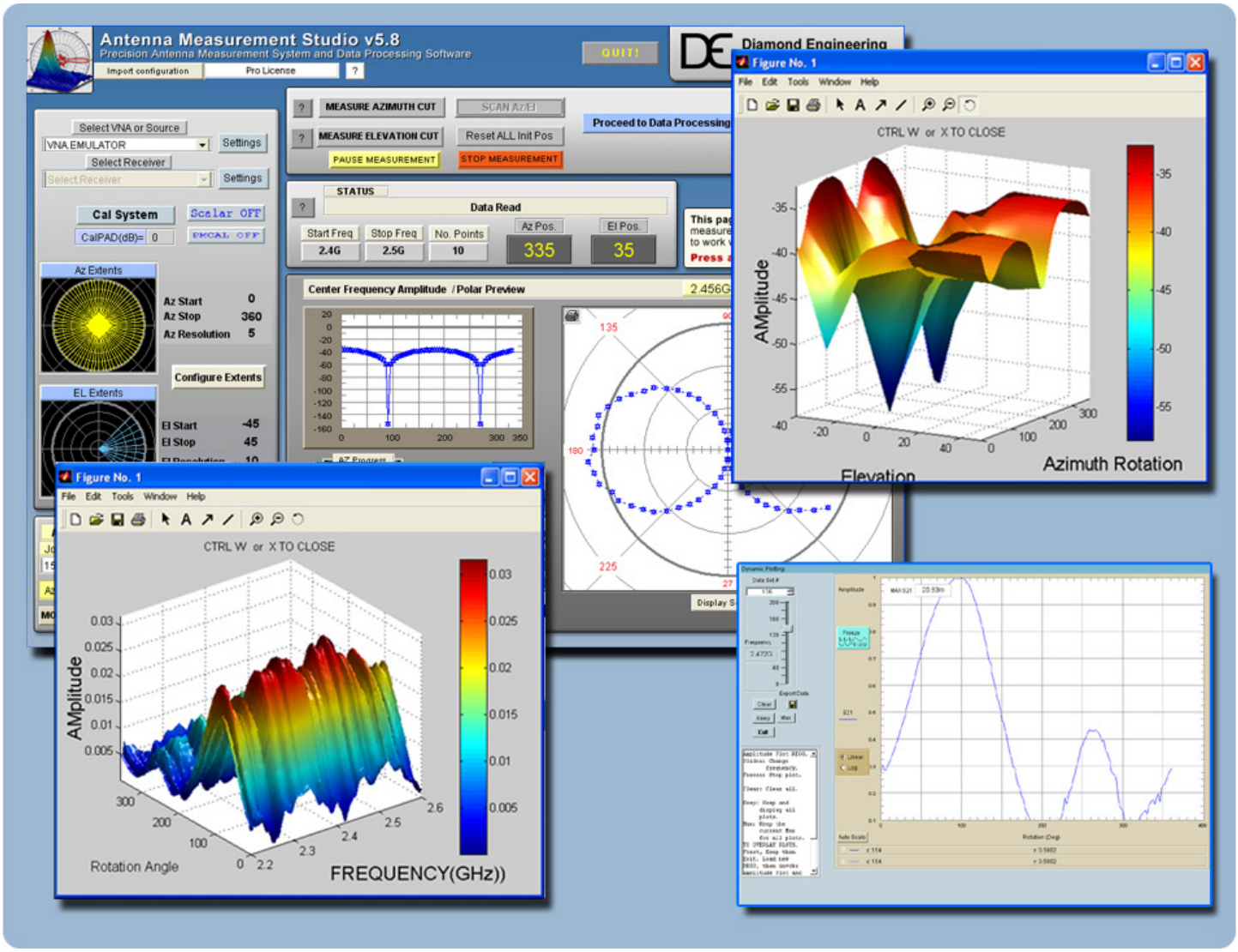
Diamond Engineering

Automated Measurement Systems

Antenna Measurement Studio

Automated Measurement Software



Users Manual & Setup Guide

Diamond Engineering

Automated Measurement Systems

Congratulations on your purchase!

Diamond Engineering's Desktop Antenna Measurement System has been designed to aid in the testing and development of small to medium sized antennas. Using our state of the art software, this system enables you to make many different types of measurements with complete user-definable configuration settings. The "Advanced Processing" features enable you to not only plot 3D graphs of the measurements, but also to save and recall those measurements for future use or comparison. Using the "Group Delay" function, you can calculate the exact distance to the test Antenna, identify multi-path rays, and eliminate the need for other measuring devices. Our software also allows you to export your data to a 3rd party application or spreadsheet.

This manual will fully assist you with the assembling and configuring as well as teach you how to utilize the many features of your Desktop Antenna Measurement System. To achieve the full functionality of the rotator system, it's expected the user has some working knowledge about the concepts and theories involved in microwaves and antenna design development.

We cannot emphasize the importance of fully reading and understanding this manual enough before actually using the equipment, as to avoid damaging the unit and/or possibly voiding your warranty.

Best regards,

The Diamond Engineering Team

Table of Contents

Key Features

Light Weight
Platform is made of high quality, light weight Acrylic material for easy portability.

Easy USB Connectivity
Unit easily connects to the computer using a standard USB cable.

User Friendly Software
Our software has been designed to be understood easily to ensure the shortest time to successful antenna measurement.

High Quality Components
The antenna measurement platform is built mostly with non-metallic, custom machined parts.

Widely Compatible
Our software supports a wide range of network analyzers and instruments that use the GPIB / 488.1/2 and SCPI methods of communication. TCP/IP and USB is supported on some instruments.

Phase/Angle Measurement
DAMS can measure any vector S-parameter over a specified frequency range, at each measurement point, using a VNA.

Dual-Axis Movement
360 degrees of horizontal motion at 1/8th degree per measurement and +/- 45 degrees vertical movement angle at 1 degree per step.

DC to 8, 18, 40 GHz. Measurement Ranges
Our wide frequency range allows for a diversified gamut of compatible antennas. (model dependent)

Rotary SMA Joint
Our high-performance rotary joint enables accurate measurements without jeopardizing signal integrity.

Advanced Data Processing Features
Designed for post measurement processing you can perform a range of functions such as:

- 3D visualization for all frequencies and angles
- Azimuth and elevation plots for true 3D data modeling
- Save / recall data sets from RAM or local disk
- Group delay (distance calculation)
- Excel-based reports with data
- Efficiency, radiation resistance, and AUT loss
- 4-trace 2D-plots
- Spherical 3D-plots
- Gain plots
- Simultaneously manipulate 4 different data sets
- Map over 50,000 measurement points into a single 3D-chart
- Reference antenna import feature
- 3-point gain substitution, and path loss correction methods
- Path loss calculator
- Calculator for modifying measurement results and comparing antennas
- Exports data to spreadsheet or 3rd part application (such as MatLAB)
- Dipole Link Simulator allows creation of simulated dipole antennas

System Requirements

- AMD / Intel (Core i5 or better is recommended)
- 4 GB RAM (minimum)
- 3 GB hard disk space
- 1 available USB port
- 1024 x 768 display resolution (minimum)
- Keyboard and mouse
- Compatible Network Analyzer or Power Meter/Spectrum Analyzer and Signal Generator
- PCI, USB or PC Card based name brand GPIB adapter (OR Ethernet if supported)
- Printer (if printing measured antenna plots)

Supported Instruments

If you do not see your instrument on our list, please contact us. It does not necessarily mean it is not supported.

VECTOR NETWORK ANALYZERS
ADVANTEST R376x Series
Agilent 507x Series
Agilent 836x Series PNA's
Agilent 836x Series PNA's
Agilent (HP) 8510x Series
Agilent (HP) 8714 Series
Agilent (HP) 8720 Series
Agilent (HP) 8753 Series
Agilent (HP) 8757 Series
Agilent FieldFox Series
Agilent N5320A Series PNA's
Anritsu 46xx Series Analyzers (VectorStar)
Anritsu 46xx Series Analyzers (ShockLine)
Anritsu 46xx Series Analyzers (Scorpion)
Anritsu 37xx Series Analyzers (Lightning)
Anritsu MS20xx VNA Master Series
Copper Mountain S2 / S4 VNAs
Planar TR1300 Series
Planar S5048 Series
Rohde & Schwarz ZVx Series
Rohde & Schwarz ZND Series
Rohde & Schwarz ZNB Series
Tektronix TTR500 Series

SIGNAL GENERATORS
HP 83650 Series
HP 8350 Series
Agilent N9310A Series
SMP Series
Anritsu MG36xx Series
Anritsu MG69xx Series
Rohde & Schwarz SML Series
Rohde & Schwarz SMP Series
Rohde & Schwarz SMU Series

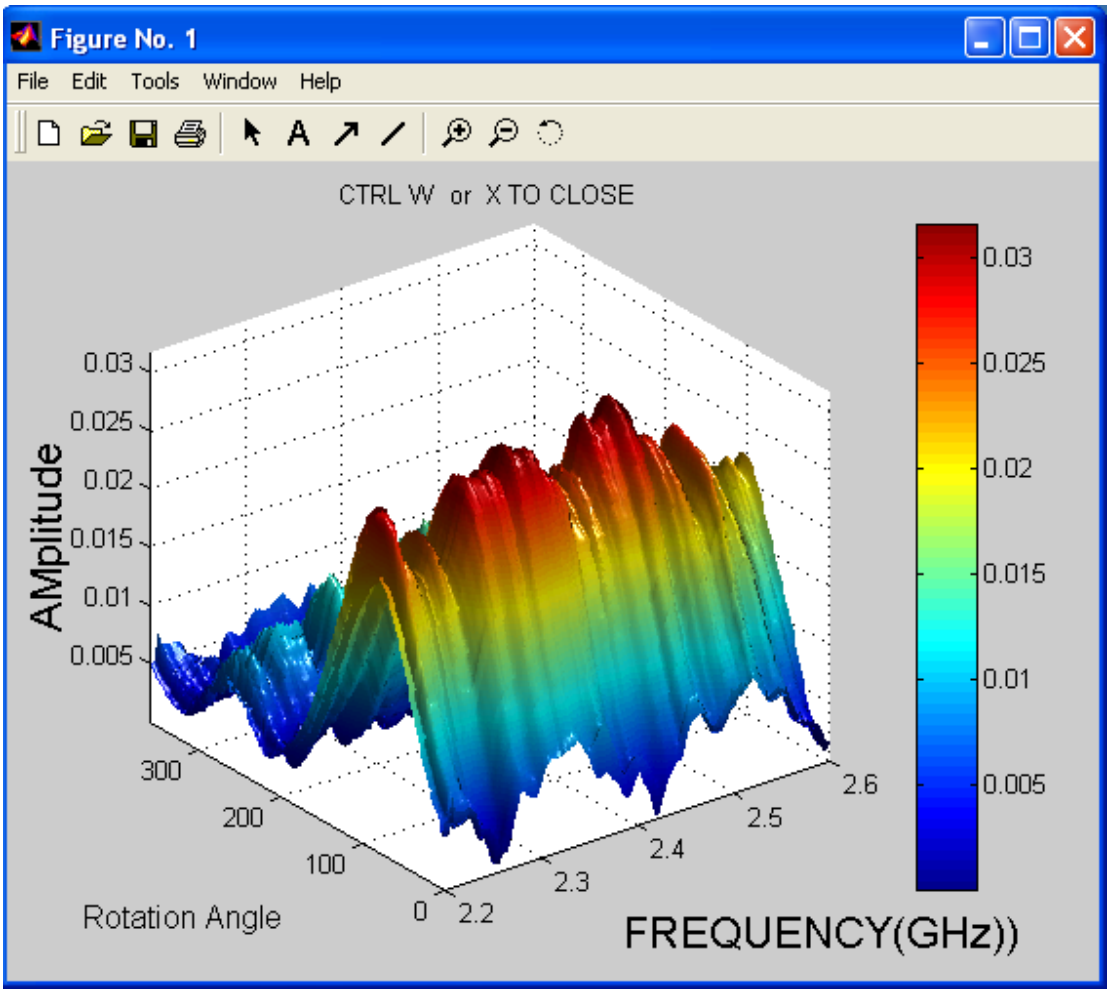
POWER METERS
Elva DPM-10
HP436A
HP437B
Anritsu ML2438A

SPECTRUM ANALYZERS
HP8565 Series
Rohde & Schwarz FSL Series
Anritsu MS27xx Series
Anritsu MT82xx Series

OTHER / MISC
Agilent N51xx Series
Anritsu MT8860C
Anritsu S820E
Quanset QM2010 Synth

NOTE: For the most updated list of supported instruments, please visit:
https://www.DiamondEng.net/supported-instruments/

Antenna Measurement Studio Installation



Antenna Measurement Studio

Supports a wide range of power meters, voltmeters, spectrum analyzers and VNA/PNA's with many data processing features such as quad trace polar plots, dual trace amplitude plots and more

Instrument Configuration

Instrument Communication

Antenna Measurement Studio communicates with instruments using GPIB, TCP/IP, or USB. This is accomplished using the Agilent I/O Libraries / Connection Expert and the Agilent VEE Runtime I/O Configuration, which should be located in your start menu.

NOTE: An entry in the runtime configuration is ALWAYS required even if there is nothing configured using the Agilent Connection Expert

If using GPIB we recommend one of the adapters listed below:

- National Instruments GPIB products (ALL)
- Agilent GPIB products (ALL)
- Measurement Computing PCI or PCMCIA GPIB adapters.

NOTE: Using an adapter that is not listed could result in strange behavior and installation or configuration issues.

Supported Instrument Types

Please see our list of "Supported Instruments" which are compatible with DAMS Antenna Measurement Studio. We have designed the software to work with many types of instruments including, but not limited to:

- Vector Network Analyzers
- Spectrum Analyzers
- Voltmeters
- Signal Generators
- Power Meters

NOTE: For the most updated list of supported instruments, please visit: http://www.DiamondEng.net/dams-software-studio/supported-instruments

Agilent Connection Expert & VEE Runtime Configuration

Configuring your Instruments

***** For Copper Mountain / Planar VNA's, see next section *****

After Antenna Measurement Studio is installed, the following Start Menu folders should exist:

- Agilent I/O Libraries
- Agilent VEE Pro (X.X) Runtime

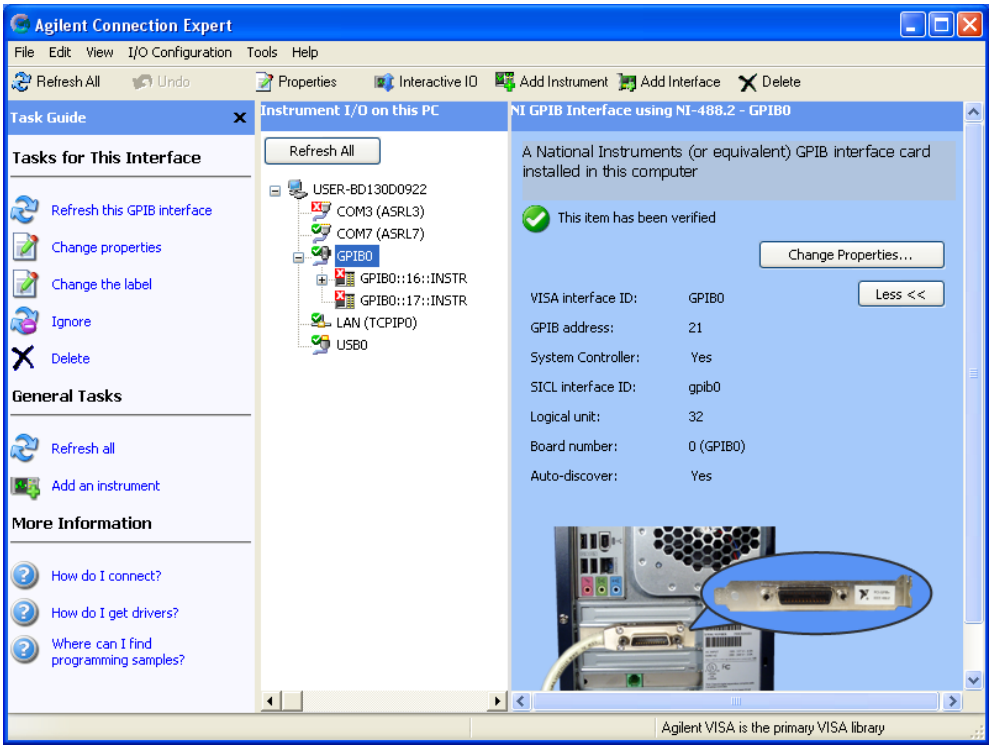
NOTE: If any folders are missing, refer to the software installation for your model.

Step 1: Find instruments using Agilent Connection Expert

1. Connect and turn on instruments.
2. Click Start → Programs → Agilent I/O Libraries → Connection Expert.
3. The Connection Expert will find and display any interfaces and instruments.
4. This step is complete, Exit the Connection expert and proceed to the next section (VEE Runtime I/O Configuration)

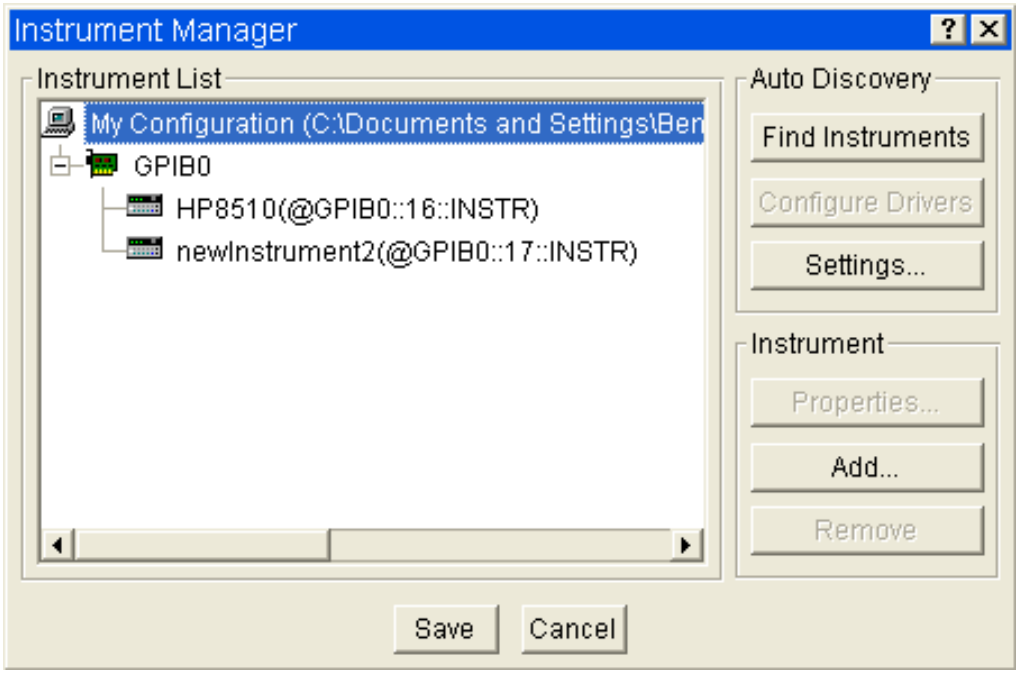
NOTE: Some GPIB instruments do not support the *IDN command. For example, HP8510 show up with a red X and say "Communication Failure", but is not a problem.

ADDING TCP/IP INSTRUMENTS: If your TCP/IP instrument was NOT automatically found, you must attempt to manually configure it. To do this, right click on TCP/IP in the list and select "ADD". Then, choose TCP/IP and attempt to manually enter the IP address or hostname of the instrument.



Step 2. VEE Runtime I/O Name Configuration

IMPORTANT: You ***must*** complete the following steps for our software to communicate with your instruments. Antenna Measurement Studio will display an error if you do not enter the correct instrument name exactly as shown in the list on the following page.



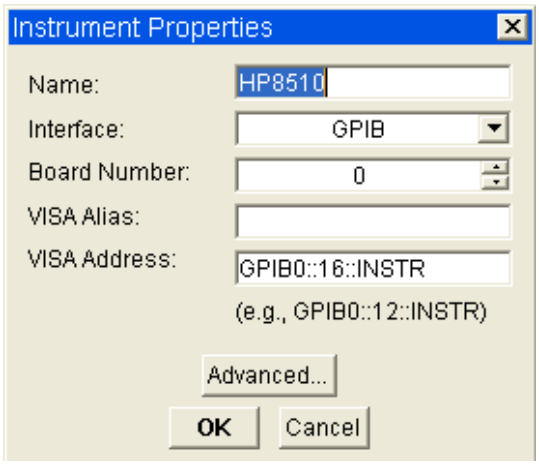
1. Click Start → Programs → Agilent VEE pro 8.0 Runtime → I/O Config

2. Click "Find Instruments". *(See image above)*

3. Instrument should appear in the list labeled as "newInstrument". *(See image above)*

4. **C**licking "Properties" opens a new window *(see image to right)*. Change "Name" to match the one from our list on the next page which matches your analyzer.

5. After you've entered the appropriate name exactly as it is shown in the list, click "Advanced" and set the "Instrument Time-Out" to 15 seconds. Press "OK" and "SAVE", closing out of both boxes.



Step 2. VEE Runtime I/O Name Configuration (continued)

NOTE: Don't see your instrument? Contact us, we may have compatible/custom drivers.

Network Analyzers	"Name" Setting
HP 8510 series analyzers	HP8510
HP 8714 series analyzers	HP8714
HP 8720 series analyzers	HP8720
HP 8753 series analyzers	HP8753
HP 8757 Scalar	HP8757
Advantest R376x Series	ADVR376X
Agilent / HP 8530	HP8350
Agilent 5230A series analyzers	N5230A
Agilent 5071 series analyzers	AT5071
Agilent 836x PNA analyzers	AT8363
Agilent PNA Universal Driver	AGILENTPNA
Agilent Fieldfox N992x	N99XX
Anritsu Scorpion Analyzers	MS462X
Anritsu MS20xx VNA	MS20XX
Anritsu MT8860C VNA	MT8860C
Anritsu S820E	S820
Anritsu Lightning Analyzers	ML37XX
Anritsu Vector Star Analyzers	VSTAR
(Vector Star includes MS46121 and the Shockline Series)	
Copper Mountain S2VNA	*exempt*
Rohde & Schwarz RS series	RSZVR
Rohde & Schwarz ZVH series	RSZVH
Rohde & Schwarz ZND series	RSZND
Rohde & Schwarz Planar 304 and 804 series	*exempt*
Rohde & Schwarz Planar S5048 series, TR1300 series	*exempt*

Signal Generators	
Agilent 33xxx Series Signal Generator	AT33XXX
Agilent 51XX Series Signal Generator	N51XX
Agilent 9310A Series Signal Generator	N9310
Anritsu MG69xx Series Signal Generator	MG69XX
Anritsu MG36xx Series Signal Generator	MG36XX
HP Universal Sig-Gen Driver	HPGENERATOR
HP 83650B Signal Generator	HP836
HP 8350 Sweep Generator	HP8350
HP 8648 Sweep Generator	HP8648
Quonset QM2010 Synthesizer	QM2010
Rohde & Schwarz SMP Series	RSSMP
Rohde & Schwarz SML Series	RSSML
Rohde & Schwarz SMU Series	RSSMU

Spectrum Analyzers	
Advantest 32XX Series	ADV32XX
Agilent E440x Series	E440X
Anritsu MS20xx Series	MS20XX
Anritsu MS26xx Series	MS26XX

(list continues...)

Anritsu MT82xx and MS27xx Series	MS27XX
HP 8565 Series	HP8565
Nex 1 NS132 Spectrum Analyzer	NS132
Rohde & Schwarz FSL Series	RSFSL
Tektronix 271x Spectrum Analyzer	TEK271X

Power Meters

Agilent EPM Series	AGEPM
Agilent / HP 34401A Multimeter	HP34401
Anritsu ML2438A	ML2438
Anritsu ML4803A	ML4803
Boonton 4530	BN4530
Boonton 52018	*exempt*
ELVA-1 DPM 10	DPM10
HP 436A Power Meter	HP436
HP 437B Power Meter	HP437
Keithley K2182	K2182
Telemakus TED8000-40 USB Power Detector	TED8000

Copper Mountain / Planar VNA's - Installation

Step 1: Set DAMS to run as administrator

1. Go to C:\Program Files (x86)\Agilent\Vee Pro Runtime folder
2. Right Click on VEERUN.EXE and select properties
3. Click the compatibility tab and enable "RUN AS ADMINISTRATOR"
4. Click OK to save settings

Step 2: Install and Start VNA Software

1. Install the copper Mountain S2 VNA software, IMPORTANT- at the end of the installation be sure to select the option to install COM libraries!!!
2. Connect the VNA to the PC, the drivers should load
3. Right click on the VNA Software icon, select properties, click compatibility tab and place a check mark in "RUN AS ADMINISTRATOR" then click OK
4. Start the VNA Software, it should load and connect to the VNA

Step 3: Making a Measurement using DAMS Software

1. Configure the VNA for desired start / stop frequency / number of points
2. Start the DAMS Software.
3. From the "Select Instrument" pull-down, select your PLANAR model.
4. Press settings to configure S21 or S12 Measurement.
5. Calibrate system either using VNA or DAMS Software, see chapter on calibration for details and examples.
6. Press one of the "Measure" buttons, the software should start collecting data and the positioner should move.

USB Polarization Switch Installation (DPA-Autopol)

Configuration Instructions for option DPA_Autopol automatic polarization switching using a USB RF switch.

Step 1: Install USB switch driver and libraries

1. Install MiniCircuits switch software from the mini-circuits support website.

Step 2: Configure DAMS software

1. Start DAMS antenna measurement studio
2. Click the "Pol Settings" button and select MiniCircuits Switch from the pull-down- If an error occurs you may not have the libraries installed, please be sure that you are using the latest DLL files, repeat the steps in step 1 with current minicircuits software.
3. Look on the back of your switch module and note the serial number of the unit. Enter the serial number into the window and press "update and connect" if working properly the switch should say "Connected"

Step 3: Verification Test

1. From either the settings panel under Pol Setting, or from the main page of the software, pressing either H or V should cause the switch to change.
2. The change cam be seen by the LED indicator located on the front of the switch changing color, you will also hear a very slight audible click.

   Further information on the Automatic polarization switching and options can be found under the software overview section of this manual

Configuring Other DAMS Positioners (D6050, DCP252, ETC.)

Other DAMS Positioner Settings

Detailed positioner setup instructions can be found in the associated manual for the particular DAMS positioner. For your convenience, we have listed a number of DAMS Positioner configurations with the Appropriate DAMS Software Settings.

D6050 Series using MC3B / LC4x Series 3 Axis Series Controllers

Azimuth/Horizontal/Roll

Motor Resolution : .1125
Gear Ratio:
Belt Drive: 36
Worm Drive: 72
D6050 Checkbox: Selected
Full Spherical Mount Checkbox: Selected
Start Speed: 1000
Stop Speed: 8000
Slope: 8
Mini Stepping: ON
Holding Current: ON

Elevation/Vertical/Turntable

Motor Resolution : .1125
Gear Ratio: 90
D6050 Checkbox: Selected
Full Spherical Mount Checkbox: Selected
Start Speed: 1000
Stop Speed: 8000
Slope: 8
Mini Stepping: ON
Holding Current: ON

D6050 Series using SSXYQE 2 Axis Series Controllers

Azimuth/Horizontal/Roll

Motor Resolution : 1.8
Gear Ratio: 144
D6050 Checkbox: Selected
Full Spherical Mount Checkbox: Selected
Start Speed: 250
Stop Speed: 500
Slope: 8
Mini Stepping: ON
Holding Current: ON

Elevation/Vertical/Turntable

Motor Resolution : 1.8
Gear Ratio: 190
D6050 Checkbox: Selected
Full Spherical Mount Checkbox: Selected
Start Speed: 250
Stop Speed: 500
Slope: 8
Mini Stepping: ON
Holding Current: ON

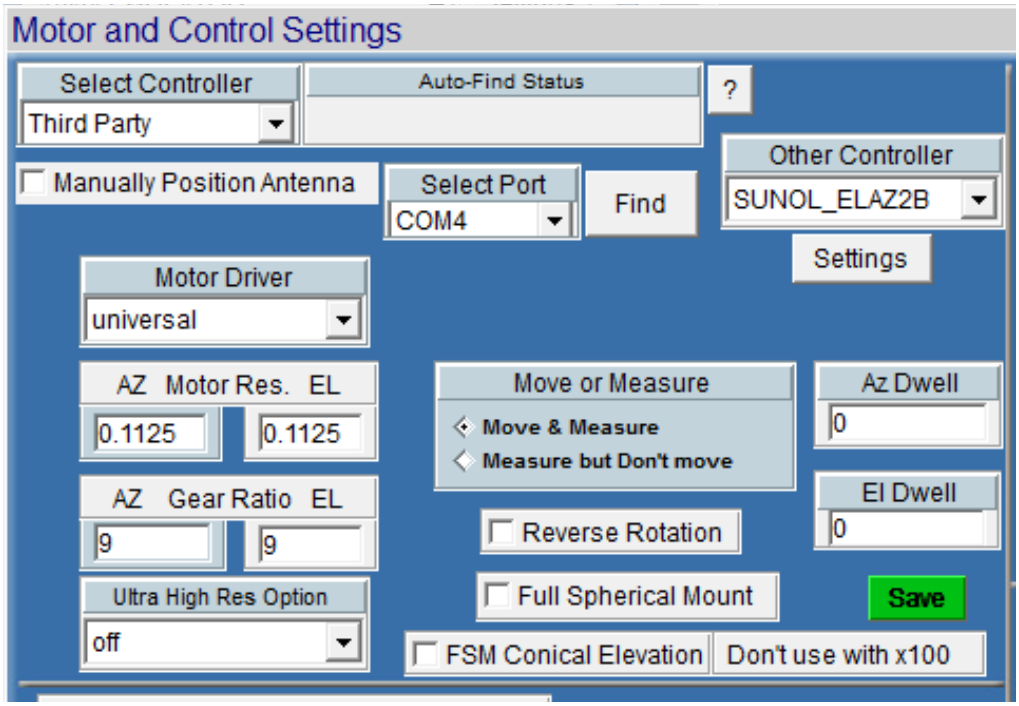
Configuring a 3rd party positioner (Sunol, Frankonia, M2, Etc)

Sunol ELAZ2B

The Sunol ELAZ2B is a 2-axis positioner with a resolution of 28,800 steps per revolution for both Azimuth and Elevation, it is configured by performing the following steps:

1. Start the DAMS Software and press "Positioner Settings"
2. Under "Select Controller" select 3rd Party
3. Click the Third Party pull-down and select Sunol ELAZ2B
4. Manually enter the COM port of the positioner (this can be found in device manager under PORTS COM&LPT
5. For "Motor Resolution" enter .1125" and a gear ratio of 9 for both Azimuth and Elevation Axis
6. Press "SAVE" then select "restart with default extents"

Use the image below for reference:



Sunol ELAZ-75 / SC110V GPIB Controller

The Sunol SC100V controller has up to 3 channels which all are have independent GPIB addresses. The DAMS software can use up to 2 of these channels (AZ / EL)

GPIB Configuration

1. Verify each axis of the controller is configured for a specific GPIB address and properly configured for the positioner, is attached to that axis and the gpib adapter is connected to the controller. Note which one is AZ and which one is EL.

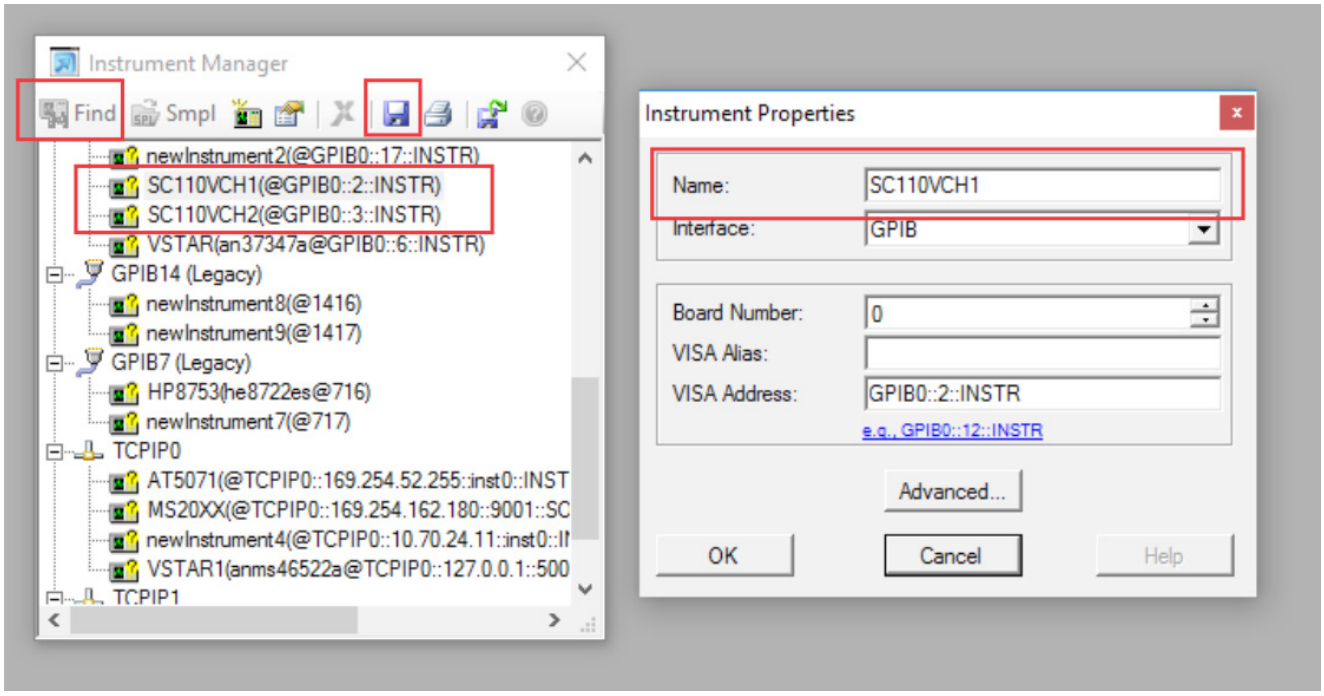
2. On the computer, open the Agilent/Keysight Connection Expert, the connection expert should show all of the controllers as active. Once verifying, close the connection expert.

3. Open Start → Programs → Agilent VEE Pro Runtime → I/O Configuration.

4. Press "FIND" it should ask to send an IDN request to each axis.

5. Once the controllers are found they will have a name like "newinstrumentX" you must change the names to SC110VCH1 and SC100VCH2.

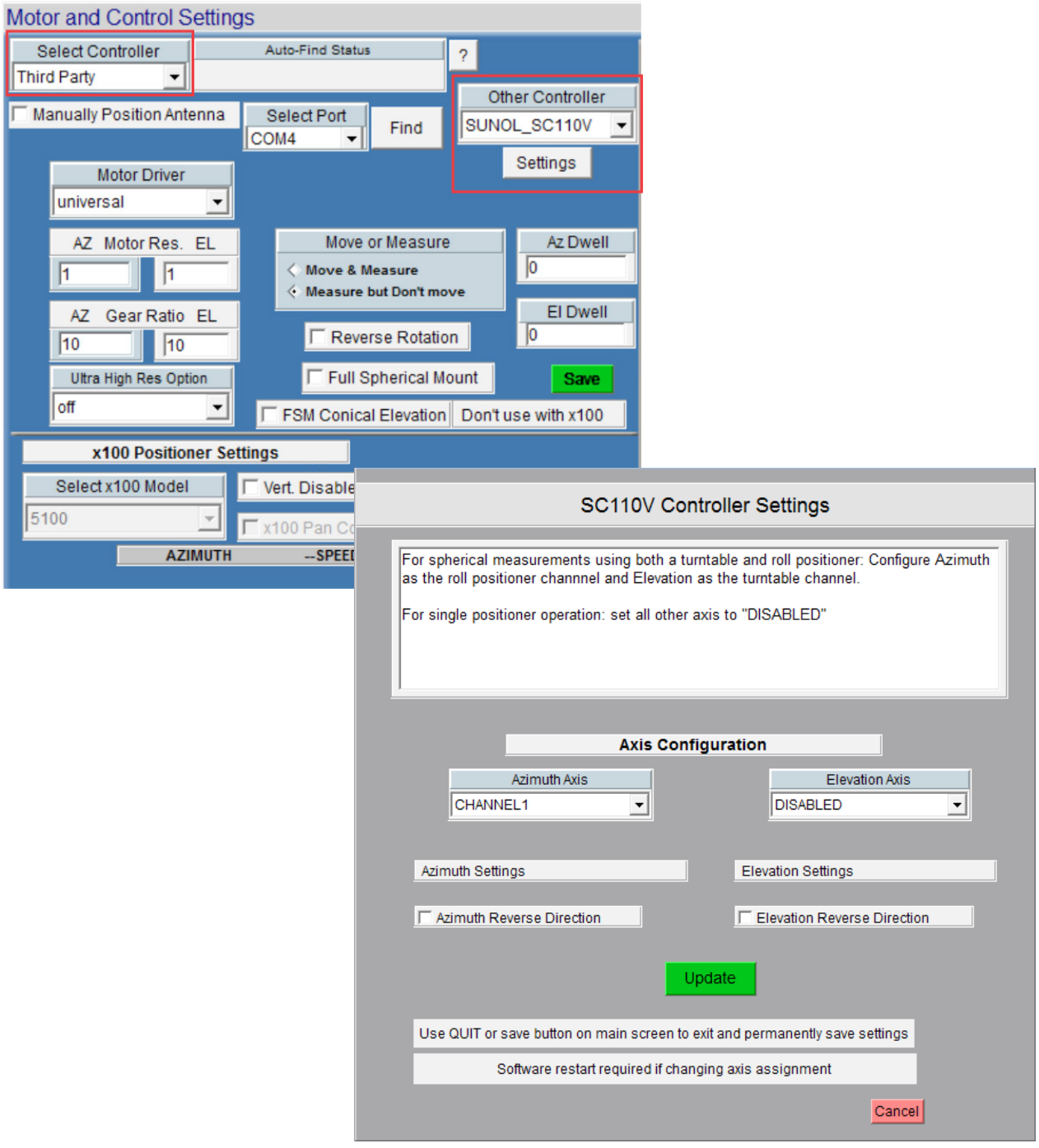
6. Press the SAVE button then close the I/O Configuration.



Sunol SC110V GPIB Controller (continued)

DAMS Configuration

1. Start the DAMS Software and open "Positioner Settings"
2. From Select controller choose "Third Party"
3. From the "Other positioner" setting choose "SUNOL SC110V"
4. Press the settings button and assign the proper channels to axis or set as disabled.
5. Press "Update" then SAVE and restart the DAMS Software.



INNCO C03000 Controller

(with CP1500 Arch Scanner and CTE500 Compact turntable)

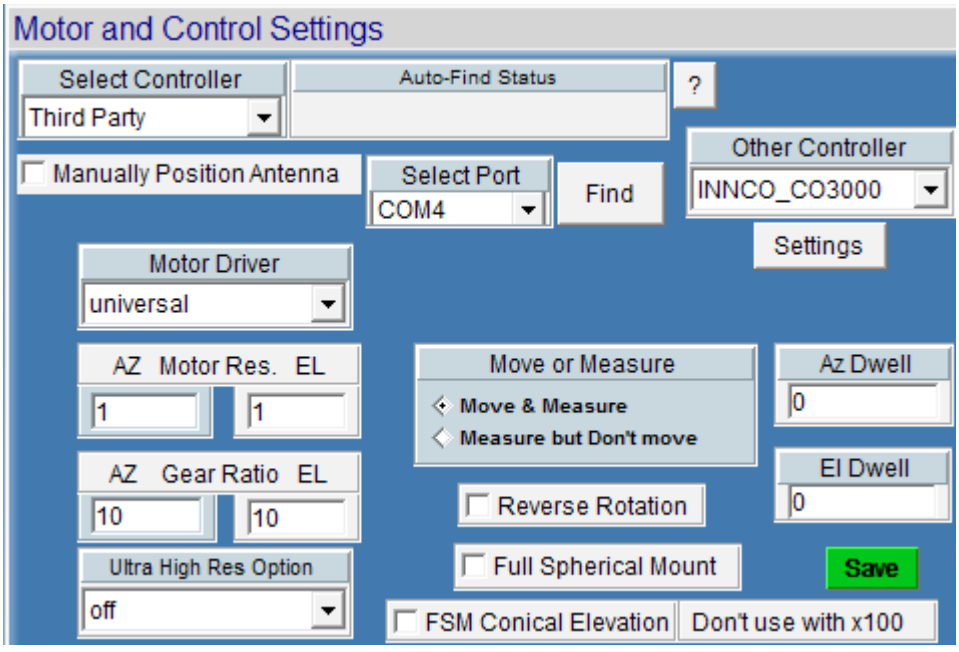
The INNCO CO3000 controller is a multi-axis controller. Currently the DAMS supports this controller using a CTE5000 compact turntable for azimuth and CP15000 dual-carriage positioner for elevation. We recommend this positioner be operated using GPIB. Before configuring the positioner within the DAMS, it must first be added to Agilent VEE Pro Runtime I/O configuration.

Adding GPIB Device to I/O Configuration

1. Click Start → Programs → Agilent VEE Pro Runtime I/O Configuration → I/O Config
2. Press "FIND", it should find the controller
3. Right click on the controller and select properties, change the name from "new instrument" to INNCOC3000
4. Press the "Save" button and then select the blue disk icon to save the configuration.

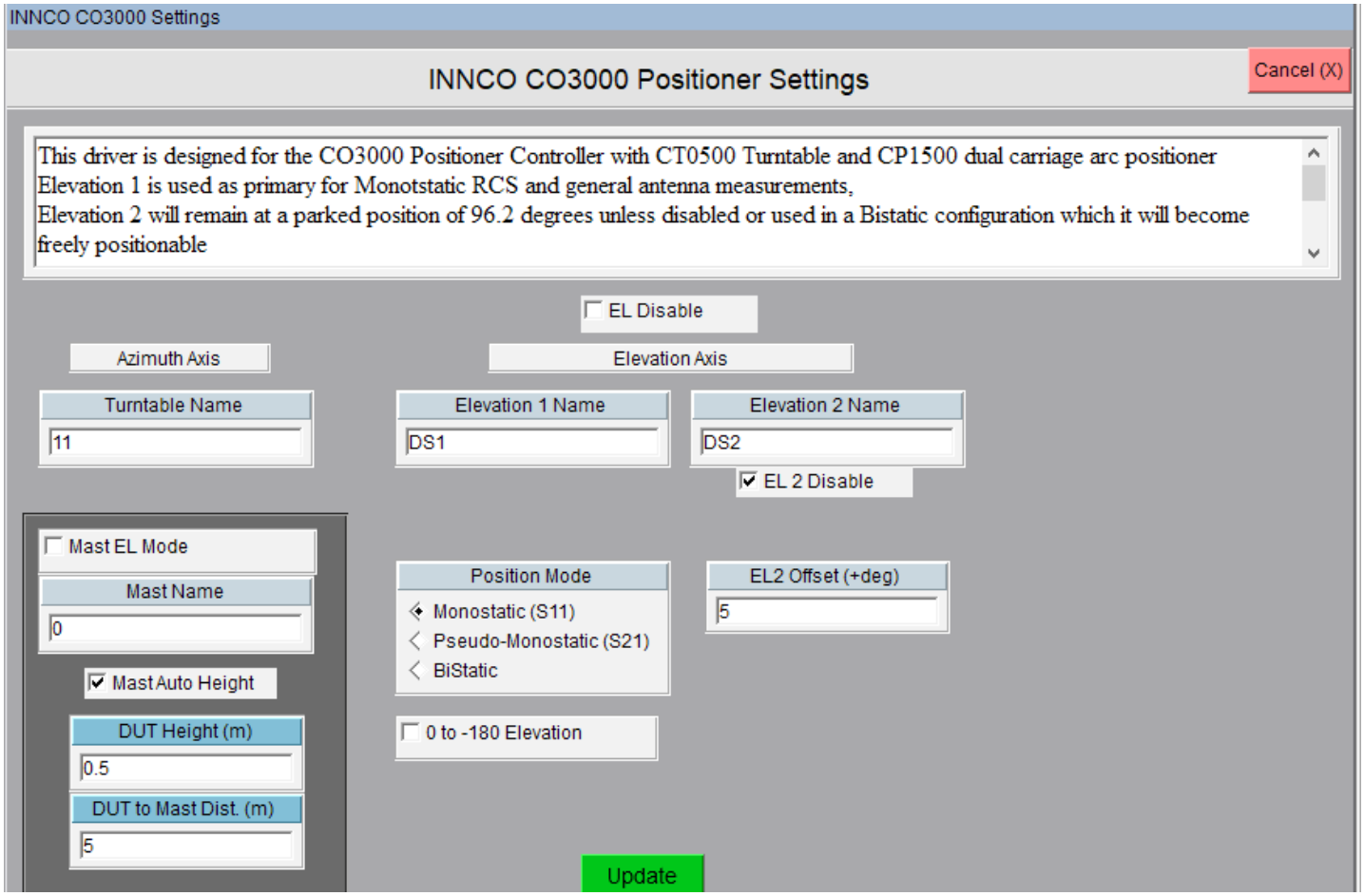
Configuring DAMS software to use the INNCO Controller

1. Start the DAMS software and press "Positioner Settings"
2. Under "Select Controller", select 3rd Party (see pic below for reference)
3. Click the Third Party pull-down and select INNCO C03000
4. For "Motor Resolution" enter 1" and a gear ratio of 10 for both azimuth and elevation axes.
5. Press the SETTING button located under where you selected the controller and see the settings on the following page.



INNCO C03000 Controller - Axis Configuration

Standard configuration is 3 axes; one turntable and two arc positioners. Please see the default configuration below. A special mode is available to make use of an INNCO mast to automatically adjust height, angle and polarization. Detailed explanations of the various positioning modes for this positioner can be provided upon request.



Special Installation Notes

Power Saving Options

Be sure to disable screen sleepers, power saving features and other applications, which may cause a .DLL or GPIB to crash.

Other Running Applications

The DAMS Software requires a large amount of CPU and system resources. We advise not having any other applications running while the DAMS Software is in operation.

Reporting Bugs

During especially complex and/or untested scenarios, a software failure may occur. If you encounter such a scenario, please do not hesitate to let us know. We will happily address your problem and may offer you a hot fix to quickly resolve your issue. Reporting bugs greatly helps us improve all aspects of our systems. Please report any errors or questions about the software operation to Support@DiamondEng.net.

Tripod Compatibility Information

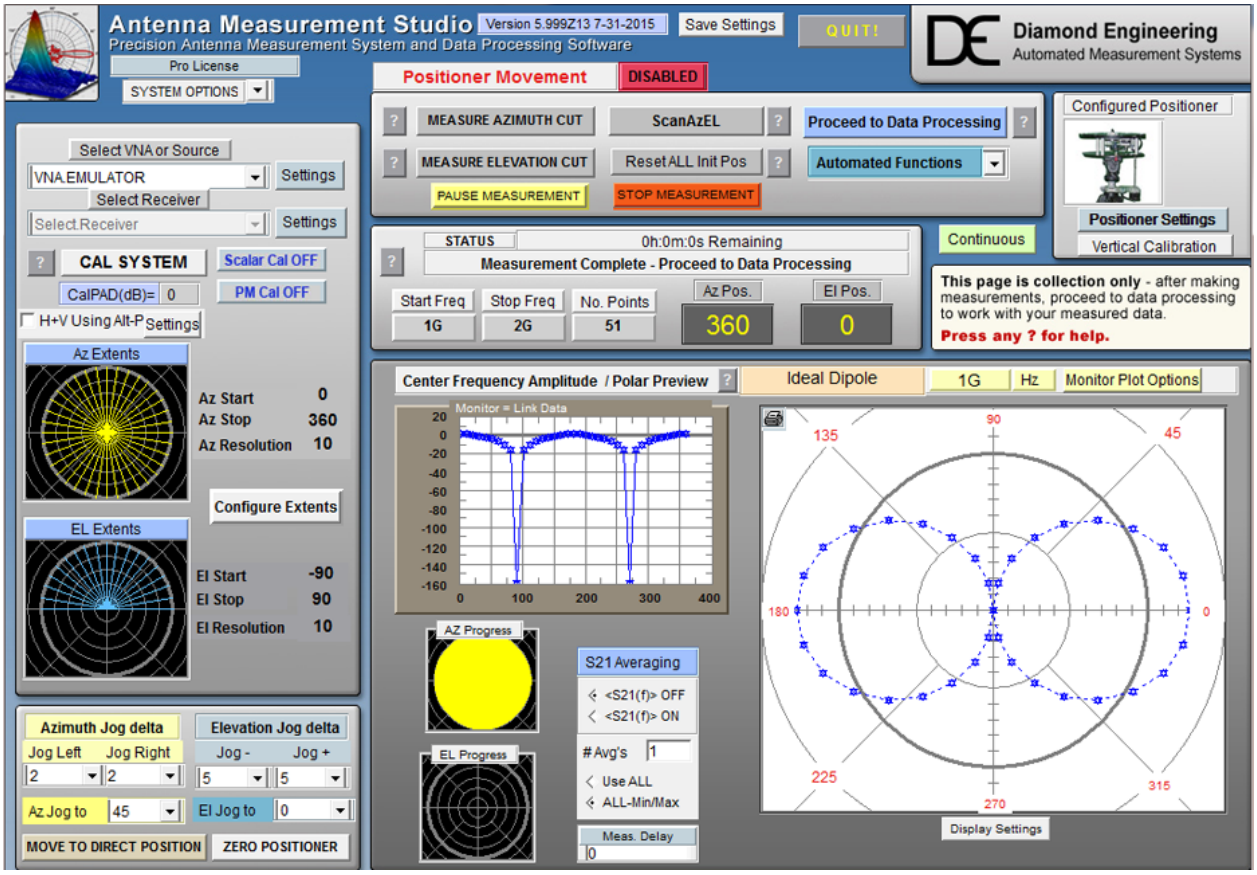
The DAMS system has been designed so that it will operate with nearly any tripod. x000 Series, which uses a linear actuator, require a slightly more specific tripod with a pivoting head and a neck diameter of about one inch. When purchasing a new tripod, ensure all parts from the current system fit onto the new tripod free of angle or clearance problems. Once you are ready to configure the software please follow the instructions below for calibrating the vertical axis. If you're unsure if a prospective tripod would be compatible, feel free to contact us and we would be happy to assist.

Matlab Plotting with Windows 7/8 - 64 Bit

When using the DAMS software under 64-bit versions of Windows 7, you must follow the instructions below or the software will show a "could not start matlab engine" error code.

1. Open C:\Program Files\Agilent\Vee Pro Runtime\ *(might be Program files(x86))*
2. Right click on veerun.exe and select "Properties"
3. Click the compatibility tab and select "Run as Administrator"
4. Click OK and restart our software.
5. Plot a 3D file, it should plot OK.
6. If 3D plotting works ok, go back and de-select "Run as administrator"

Antenna Measurement Studio Software Overview



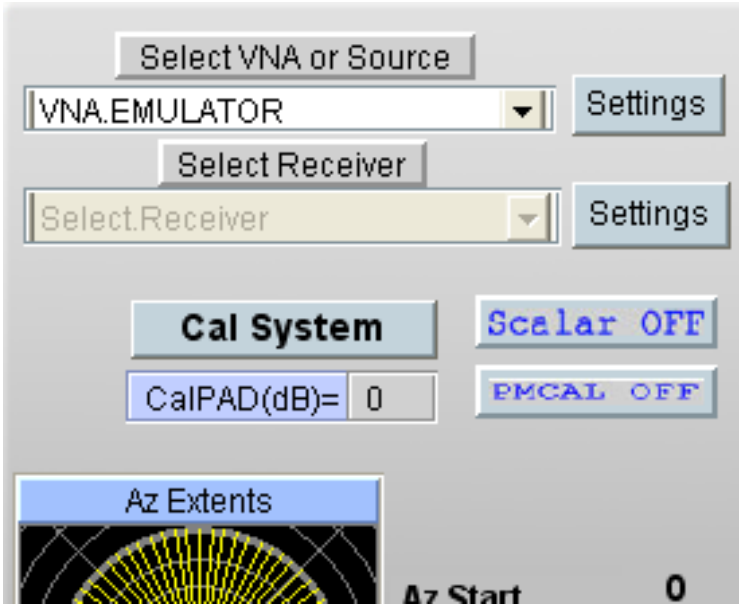
DAMS Software Basics

Instrument Selection & Settings

Configuration Versatility

NOTE: For most network analyzers the settings are all made on the analyze front panel.

You can choose from multiple combinations of instruments such as a signal generator and a power meter, or a signal generator and a spectrum analyzer.

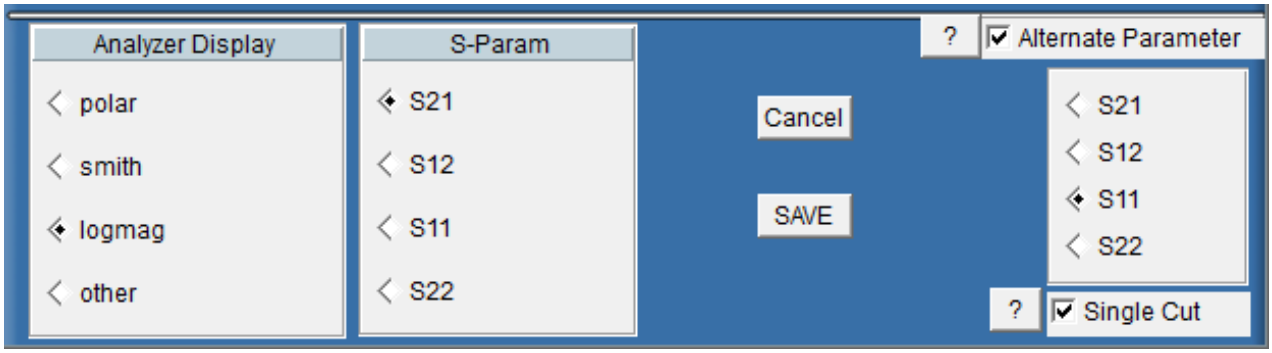


VNA Settings (available for certain VNA models)

NOTE: Start frequency, stop frequency and number of points are always set on the analyzer

S-Parameter This is the primary parameter that will be measured, usually S21 or S22 is selected

Alternate Parameter This option will collect an alternate S-Parameter such as S22 (Reflection) Single Cut - This will only collect alternate parameter data on the First azimuth cut



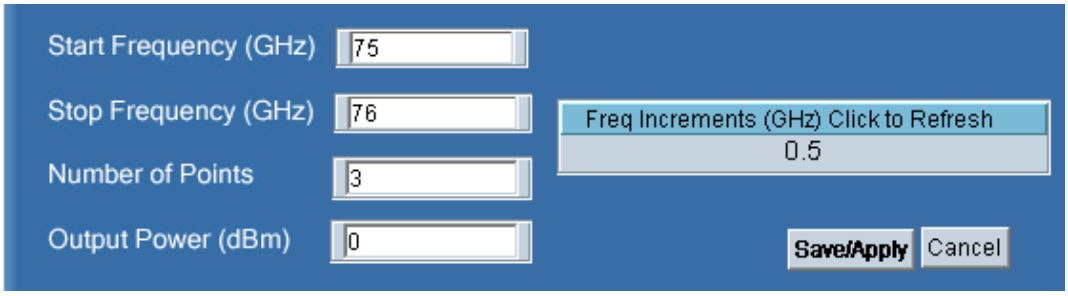
Source Instrument Settings (Generator, or Receive Only)

NOTE: These settings also apply for the ***RECEIVE ONLY*** instrument.

Start / Stop Frequency: Enter the frequency in GHz (decimals are acceptable).
Example: 450Mhz = 0.45

Number of points: Similar to a VNA configuration you may choose the number of frequency points for the sweep, click the "Freq Increments" window to display the calculated Frequency Step.

Output Power: Sets the output power of the Signal Generator. Format is dBm.

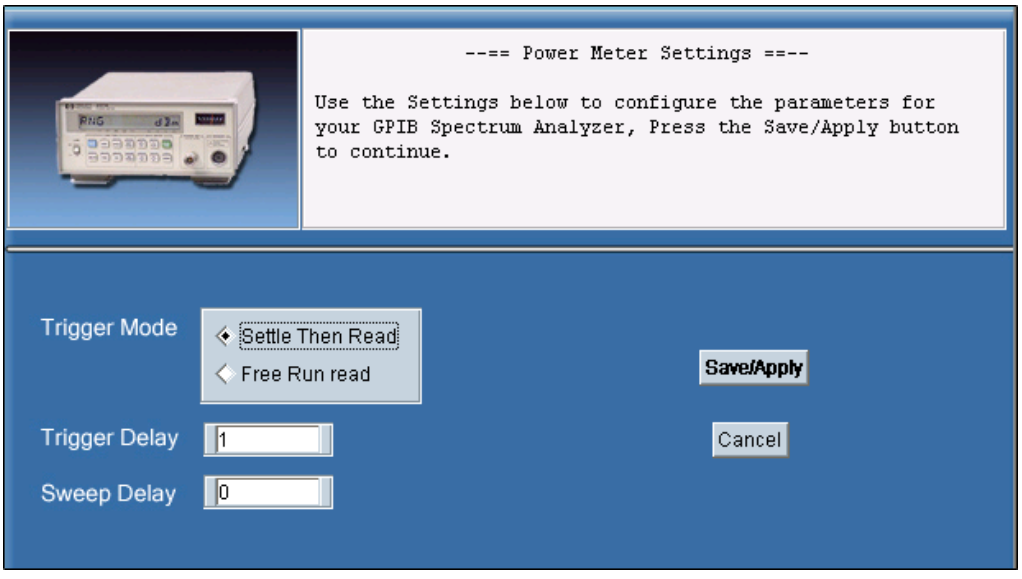


Receive Instrument Settings

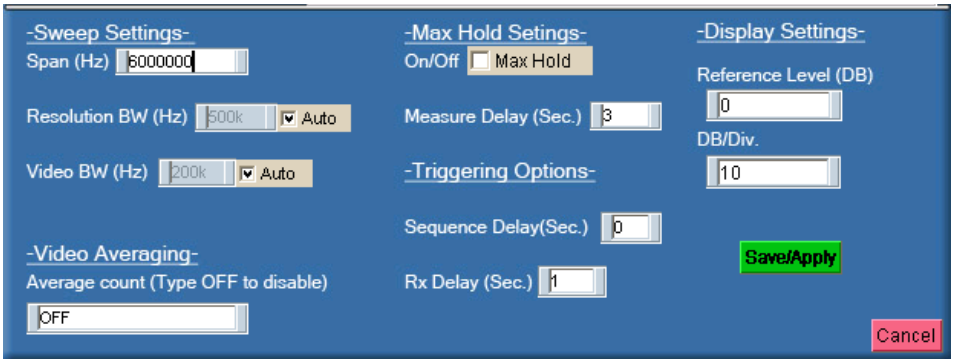
Trigger Mode Changes how the power meter reads the sensor. This setting is only applied to certain meters.

Trigger Delay Sets the delay / settling time between when the signal generator is called and the power meter is queried for a reading. Format is in seconds.
(Example: 1/10 second = 0.10)

Sweep Delay This sets the number of seconds the signal generator will wait before initiating the sweep. This allows larger antennas a chance to completely stop moving.



Receive Instrument (Spectrum Analyzer Settings)



Sweep Settings

Span	Span of spectrum analyzer sweep. Format is in Hz.
Res Bandwidth	Sets bandwidth window on spectrum analyzer (the smaller the window, the faster the sweep). Format is in GHz.
Video Bandwidth	Sets video bandwidth window on spectrum analyzer.

Video Averaging

Average Count	Sets number of times spectrum analyzer will average the Video BW before the data is read.

Max Hold Settings

Max Hold On/Off	Turns the Max Hold option on or off.
Measure Delay	Sets how long the spectrum analyzer sweeps and updates the max hold before sending data to the software. This function is useful for non-CW signals.

Display Settings

Reference Level	Sets the reference level of the spectrum analyzer display. (Settings in DB)
dB/Div	Sets the "dB per division" scale on spectrum analyzer display.

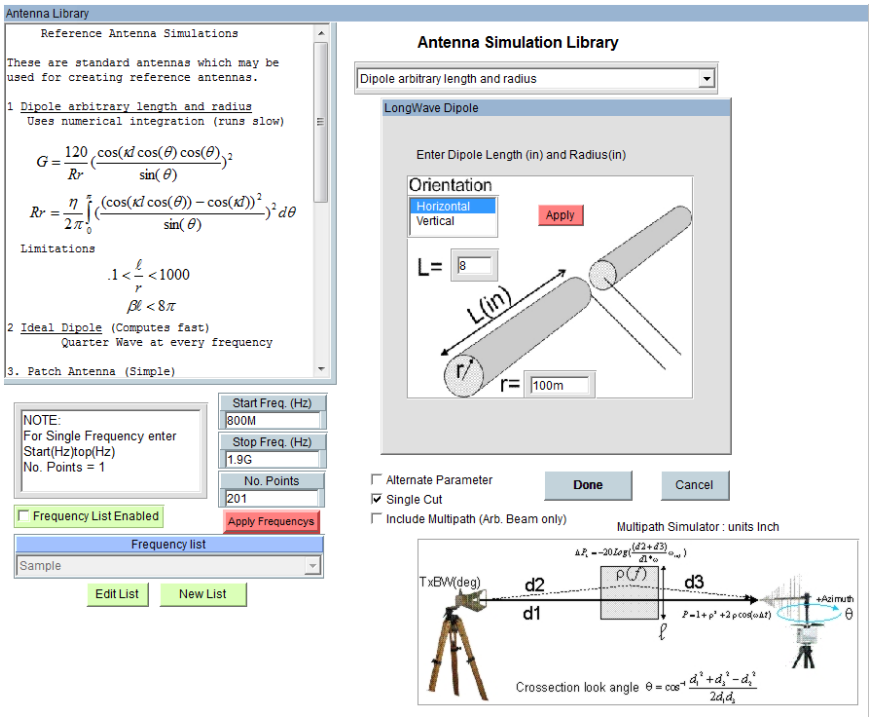
Triggering Options

Sequence Delay	Sets the delay time between when the platform starts and the measurement sequence is started
RX Delay	Sets the delay time between the time the signal generator is called and the spectrum analyzer is triggered to sweep.

VNA Emulator / Antenna Library

Antenna Simulation Library

This feature is accessed by selecting "VNA Emulator" from the instrument pull-down. Select the type of antenna you would like to generate and enter the desired start, stop frequencies and number of frequency points. Patterns will be generated by using the "measure" buttons on the front panel of the software, it is advisable to disable motor movement to reduce time.



Ideal 1/4 wave Dipole - Generates an ideal dipole pattern for every frequency

Dipole Arbitrary Length / Radius - Generates frequency accurate dipole patterns based on the entered dimensions.

Patch Antenna - Enter the size of the patch and air-gap to generate pattern. Pattern can also be peaked to any desired AZ/EL position

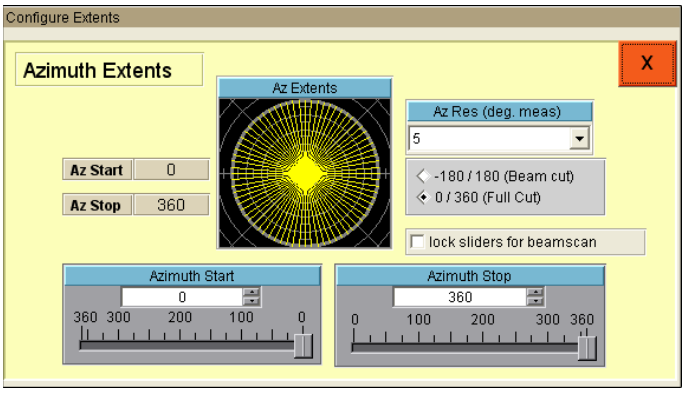
Axial Helix - Generates pattern based off entered helix properties

Arbitrary Beam- Generates an ideal beam at a desired angle, Gain is dependent on beamwidth

Ideal Parabolic Dish - Enter dish diameter and desired peak AZ/EL position for frequency accurate pattern.

Movement Settings & Position Extents

Azimuth extents setup



Degrees Per Measurement — Displays current degrees per measurement based off of the current extent settings for this axis.

Show Hig Res Values — Calcualtes high resolution step values (having this enabled will Cause high refresh times to display resolutions)

Azimuth Start Value — Selects starting position of measurement.

Azimuth Stop Value — Selects stop position of measurement.

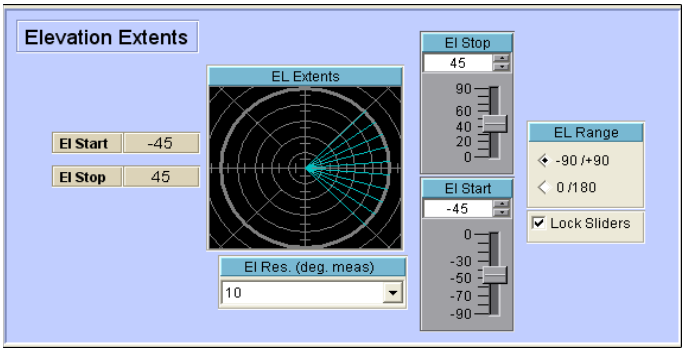
Degrees Per Measurement — Contains all possible degrees per measurement setting combinations for selected total rotation and selected positioner.

Beam Cut / Full Cut — Enables measuring from a negative angle to a positive angle, versus 0-360 for the full cut option.

Run as Z Axis — When selected, instead of moving the rotary stage, it will step the z axis , when running in this mode , degrees is equivalent to mm

Lock Sliders — Locks the two sliders in beam scan mode offering mirrored extents from 0 degrees.

Elevation Setup



Degrees Per Measurement Displays current degrees per measurement based off of the current extent settings for this axis.

Show High Res Values Calculates high resolution step values (having this enabled will Cause high refresh times to display resolutions)

Azimuth Start Value Selects starting position of measurement.

Azimuth Stop Value Selects stop position of measurement.

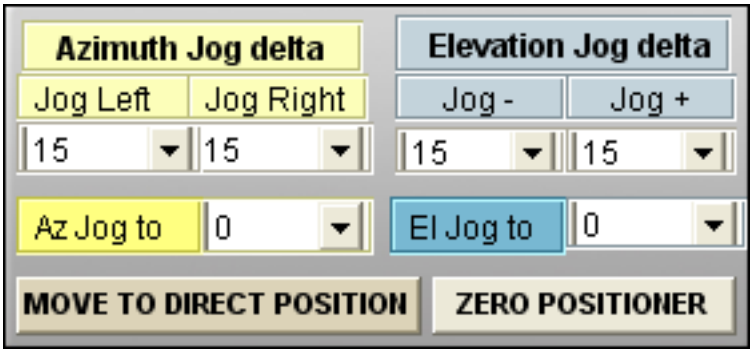
Degrees Per Measurement Contains all possible degrees per measurement setting combinations for selected total rotation and selected positioner.

Beam Cut / Full Cut Enables measuring from a negative angle to a positive angle, versus 0-360 for the full cut option.

Run as Z-Axis When selected, instead of moving the rotary stage, it will step the Z-axis , when running in this mode , degrees is equivalent to mm

Lock Sliders Locks the two sliders in beam scan mode offering mirrored extents from 0 degrees.

Jog Settings and Control



Jog Delta Moves the selected axis relative to current position, move is completed immediately after selection

Jog To Moves selected axis to absolute position, move is completed immediately after selection

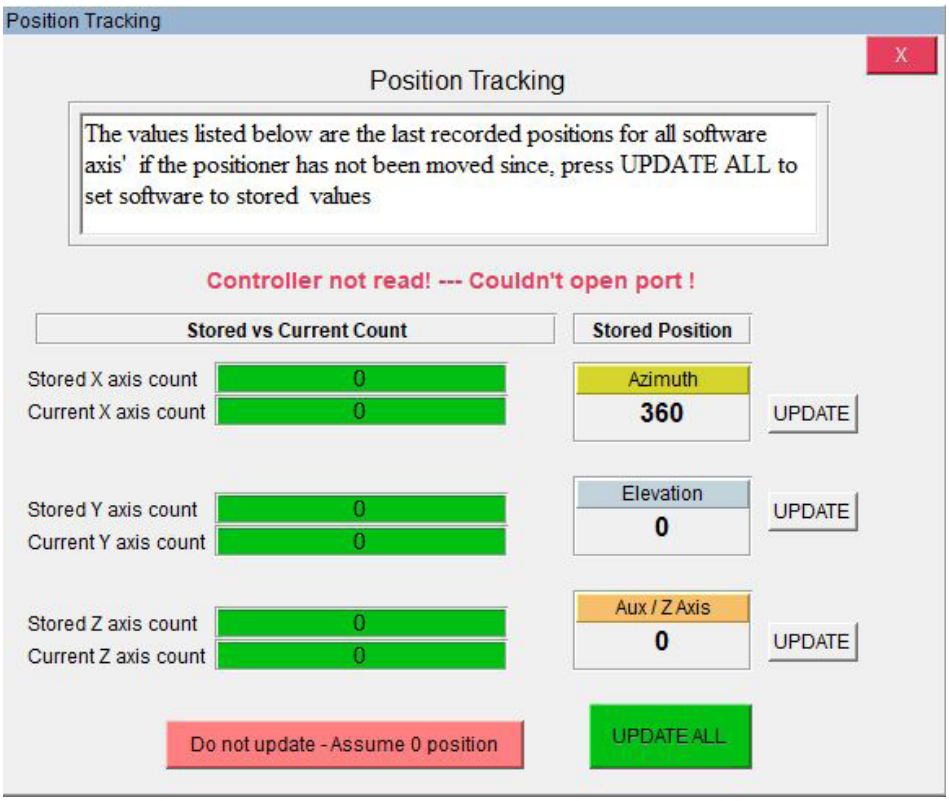
Move to Direct Position Moves to the specified AZ/EL Position

Zero Positioner Sets current position as 0,0

Position Tracking

A position tracking function is provided to reduce the chances of having to re-zero the positioner upon software restart or positioner power loss. This feature is used for any of our positioners without absolute feedback (such as a resolver or encoder) and can be enabled under positioner settings. This function works by writing to a file each time the positioner is moved - both the position and an internal count from the positioner is written. When the software is restarted, it will compare the stored count to the current controller count to validate the stored position.

This screen shown at software startup, GREEN windows indicate matching count values. Displayed position is accurate unless it has been physically forced off of stored position. RED windows indicate that there is a count discrepancy. If the positioner has been power cycled but NOT moved it is *generally* safe to update to stored position.

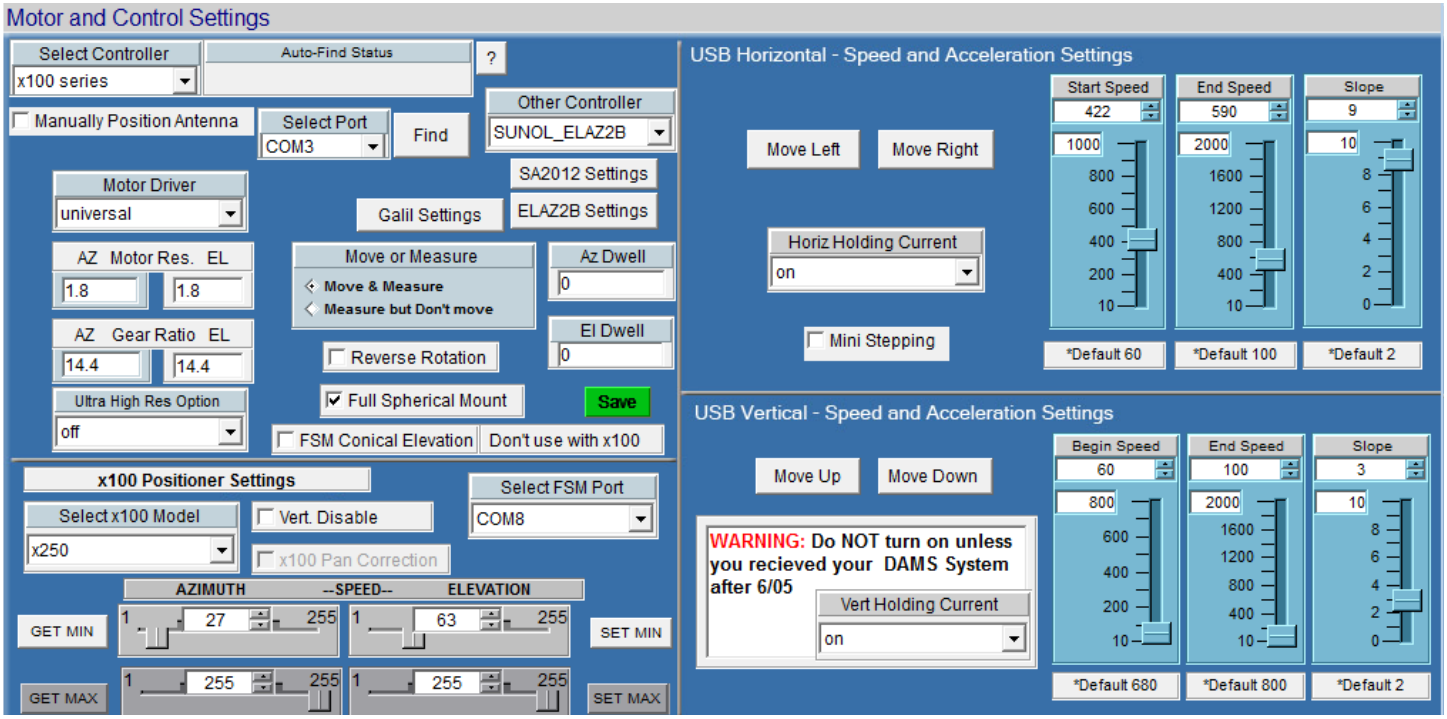


Stored Count	Last controller count stored to a file
Current Count	Current count read from controller
Stored Position	The last store position for that axis
Update ALL	Sets current position as stored position for all axes
Update	Updates individual axis position to stored value
Do not update	Ignores saved positions and starts software with 0 values for all axes

Positioner Settings

Platform Settings and Calibration

These settings allow you to tailor the software for your specific configuration needs. You can specify the speed, controller type gear ratio, controller driver, acceleration, deceleration and hold settings on the newer Platform Controllers. When choosing "Low Gear" option, the default motor speed will automatically change to the default value.



Settings For All Models

Select Controller - Choose between USB and and x100 series controller models. See "Controller Setup & USB Driver Installation" for help identifying your controller.

Move/Measure on/off - Allows you to turn the motors off while running the software as if the motors were connected to the system.

Full Spherical Mount - Check this box if you are using FSM Series mounts.

Settings Applicable to x000 Series

Motor Resolution - Specifies resolution of stepper motor installed on platform. This number is .1125 for microstepping controllers and 1.8 for legacy controllers

Gear Ratio - The entire gear ratio between the motor and the rotating platform hub. For DAMS x000 Belt series positioners this value is usually 14.4 unless instructed otherwise

FSM Conical Elevation

When using the FSM mount you have the option to measure a -180 to 180 degree elevation cut instead of the standard -90 to +90 cut do NOT use with Scan Az/El

Motor Hold Option
We recommend using the motor hold option on the HORIZONTAL axis to ensure the platform does not move on it's own between movement sequences. Vertical hold should only be enabled when using a heavy load which causes the lead screw to move on it's own.

Move Buttons
After changing the acceleration setting, these buttons allow for testing.

Start Speed
Sets the number of steps per second the motor will start/stop moving at.

End Speed
Maximum number of steps per second motor will move.

Slope
Sets the acceleration/deceleration ramp by setting time between motor start speed and maximum end speed. 0 will disable acceleration while 1 will offer the slowest acceleration and deceleration.

Settings Applicable to x100 and x250 Series

x100 Model
Choose your model if using a x100 or x250 series heavy duty positioner.

x100 Pan Correction
Special 6100 pan correction. Use only if instructed to do so.

x100 FSM Port
If using a x100 series +FSM positioner, select port for controller.

x100 Speed Settings
Applies to x100 models only, use the GET button to read the current speed setting and the SET buttons to send the settings to the positioner.

Motor Resolution
For x100 and x250 series, this value should be 1 (if using FSM mount this number should be 1.8 for the azimuth axis.

Gear Ratio
For 6100,7100, and X250 systems this number is 10 for 5100 models this number is 25, if using FSM Mount the value should be 14.4

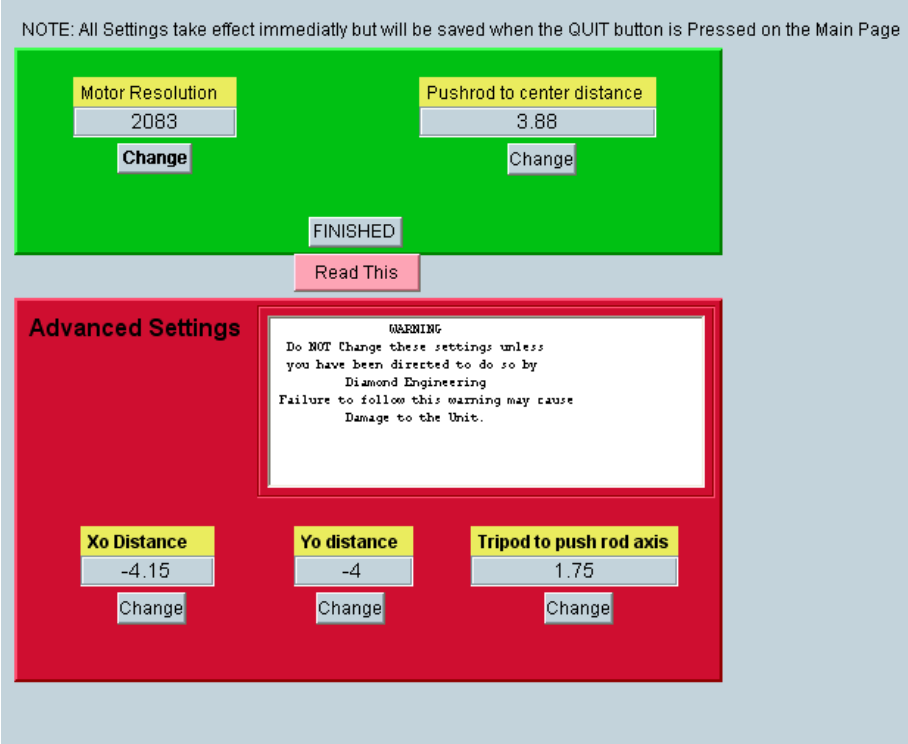
Vert Disable
This option will disable the vertical movement on the positioner for all move and reset commands.

Vertical Calibration Settings

x000 Series Vertical/Tilt Settings

NOTE: Applies to x000 series actuator based vertical/elevation movement only.

These settings will configure the tilt/elevation axis calibration. The design of the vertical axis requires a number of calibration contents that are sometimes specific to a particular unit. Your unit will have a sticker that has all of the parameters either on the control box or the platform itself. If your sticker only has 2 numbers ex. 2083/3.99, these are the values in the GREEN section of the calibration menu and you do NOT need to change any of the numbers in the RED section. Simply enter your numbers in the windows and press save then use the "QUIT" button in the software and restart the software to activate the changes.



Polarization Configuration

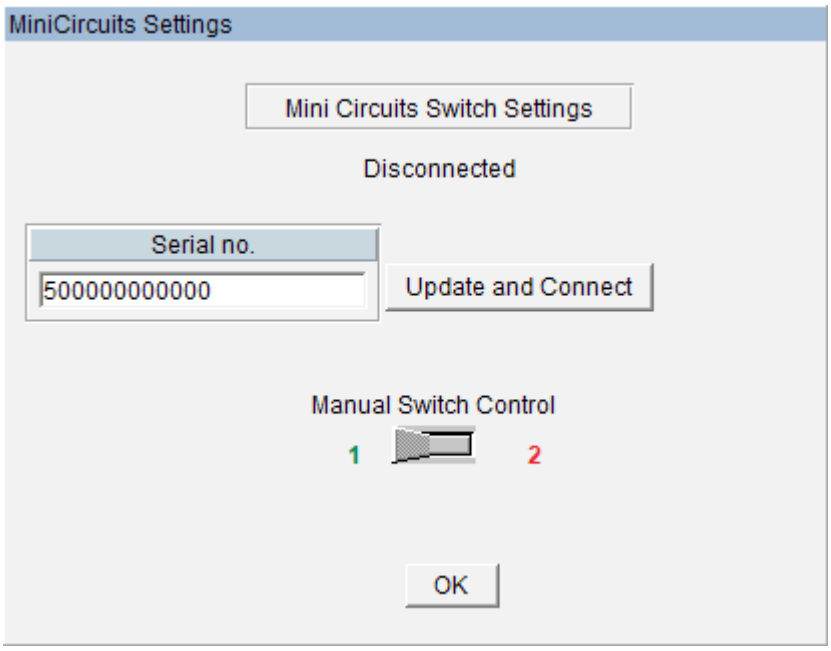
Selecting and configuring a polarization device

For instructions on using the polarization feature see "Polarization Switching" under "making measurements"

The DAMS software is capable of switching measurement polarization using Manual, Electronic, or rotary switching methods. Polarization Settings can be accessed from the settings button located under the polarization heading on the front page of the software.

Configuring a Mini-Circuits USB Switch

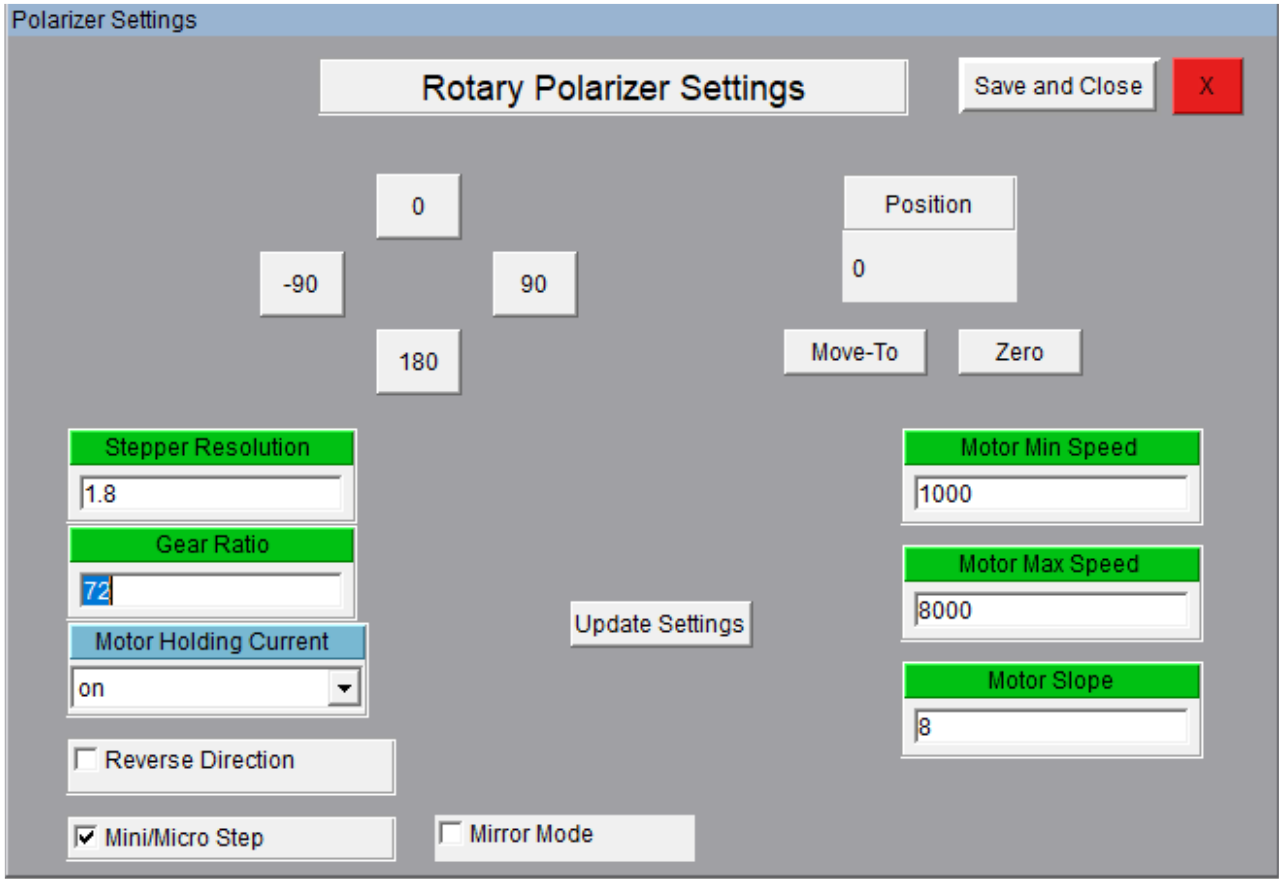
1. Install the Mini-Circuits software onto the PC before configuring the DAMS software to use the switch.
2. Inside of the polarization settings, choose the Mini-Circuits selection from the pull-down menu and press settings to open the dialog box below.



3. Enter the serial number of your switch (found on the back or bottom of the unit) and press "Update and Connect". The status should now say connected and you should be able to manually change the switch position. Press OK to save your settings.

Configuring a rotary polarization stage

As of the writing of this manual, systems equipped with a 3-axes controller can use the Z-axis channel to control a rotary positioner stage. Technically, any stepper motor controlled stage can be used if the gear ratio and motor resolution is known.

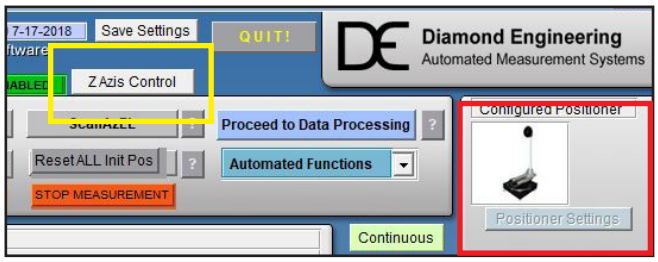


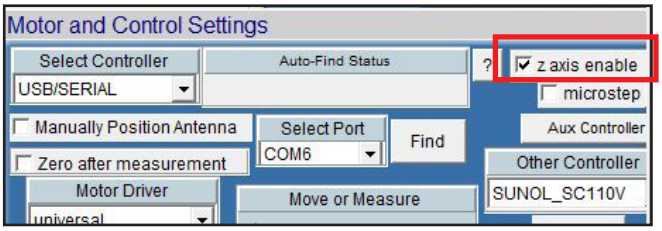
Enter the above values just as you would in positioner settings screen. For more information, please view the "Positioner Settings" section.

Using the Z-Axis

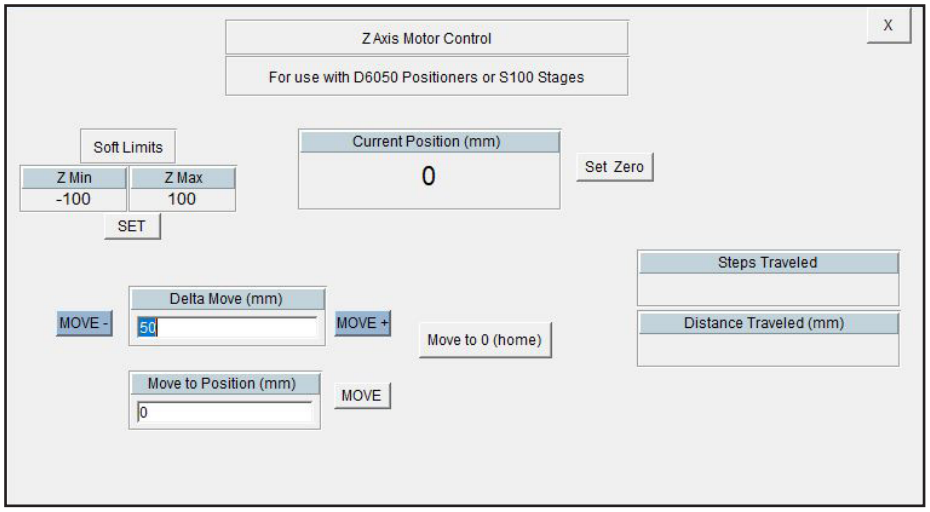
(Applies to D6050 and all other models with Z-Axis option)

Before you use the Z-axis option, you ensure it has been enabled. This will show as an option for "Z Axis Control" located above the measure buttons. To enable this option, open positioner settings and select Z-Axis checkbox on the upper section of the page (see red box highlights below).



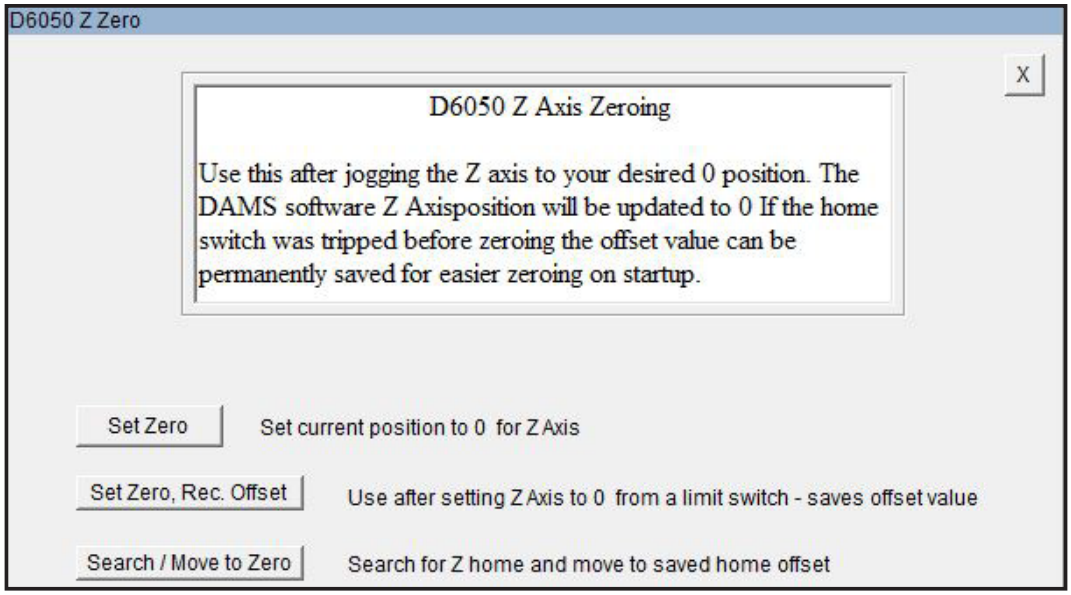


To access the Z-axis motor control screen, select the Z Axis Control button on the main screen (see yellow box highlight above). This will open the following control options.



Z Axis Motor Control

Move to 0 (Home)	Moves the axis to the last position set as 0
Delta Move +	Moves entered distance from current away from turntable center
Delta Move -	Move entered distance from current position towards turntable center
Soft Limits	Values are in mm. To find your soft limits, zero the positioner along the Z-axis, then measure from each side of the ball nut to the limit switch. Click "SET" and input these values.
Current Position	Displays the current position
Set Zero	Offers options for zeroing the axis (see next page)
Steps Traveled	Shows the real number of steps the axis was commanded to move
Distance Traveled	Shows the distance the z-axis moved during last move



Z Axis Motor Control

Set Zero Sets software position to zero

Set Zero, record offset Sets current position to 0, records step offset value (if available to use to re-zero the positioner

Search, Move to zero Moves the axis unitil the home limit is struck, from here the positioner can be moved back to a stored zero position.

Z-Axis Homing and Limit Switches

Applies to mmW models and other models with Z-Axis that feature home and or limit switches

The limit switches serve two purposes, to prevent over-travel of the axis and to provide a known reference position for purposes of zeroing. Once the known position has been reached the internal controller count can be the monitored. The axis does not contain an encoder, so if the power to the controller is reset, the software is restarted, or the axis is manually moved, the software cannot track it's position. In these cases it's necessary to either use a stored offset or create a new offset. The default stored offset is roughly at the center of the ball screw.

Manual Jogging and Soft Limits

1. Press "Zero Positioner"
2. Select "Search / move to zero"

The positioner will move up to 370 degrees clockwise to find the limit switch. When the switch has been found, use the "Stored position" option to have the software move the turntable to the physical 0 location.

Creating a new zero offset

An offset can ONLY be stored once either the Home or Max limit switch has been struck once during the software session.

1. Open Z Axis Control and press "Set Zero"
2. If the home limit switch has not been struck press "search for home". The positioner will move to home.
3. Select "move to standard offset" this will move the Z axis to the general center or zero position of the axis.
4. Using the Move +/- buttons or the "Move to" button, find the position you want to set as zero.
5. Open the "set zero" option and press Set Zero/Record offset, this will record the proper motor step count from the home switch location.
6. The software Z position is now set to zero and all movements will be relative.

Using a stored offset

1. Open Z Axis Control and press "Set Zero"
2. Select "Search / Move to zero"
3. The positioner will move to the home switch and stop. When prompted, select "move to stored offset" which will move the Z axis to the position last stored using the Z axis zeroing function. The software position is reset to zero and all movements are relative.

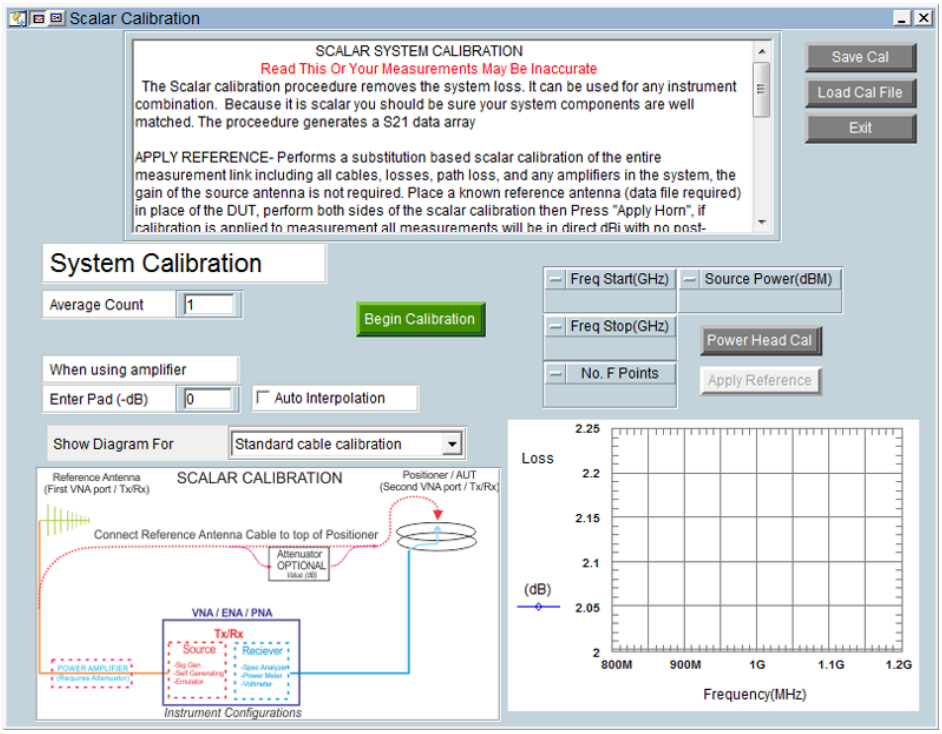
Measurement Calibration Settings

Scalar Calibration - For cabling and / or substitution

This feature enables you to make a scalar cable or substitution calibration of your system by normalizing any system gains or losses to 0dB. If a calibrated reference antenna with data is connected in place of DUT, the entire link (including path loss) can be normalized to the calibrated antenna values.

An in depth explanation and example is located in "System Calibration".

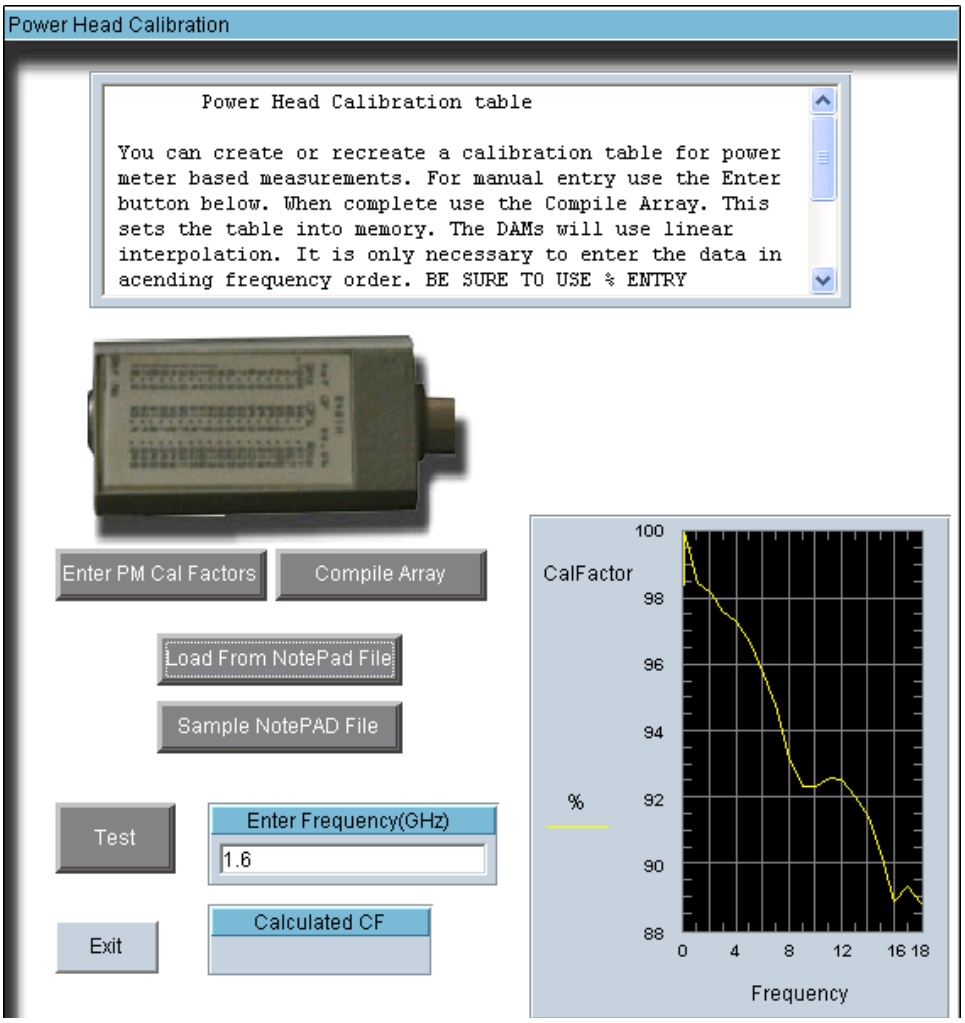
NOTE: If using a power meter with non-programmed sensor, you MUST load or enter a power sensor calibration table before performing a scalar calibration.



Load Cal	Load a calibration file from your computer
Save Cal	Save a calibration file on your computer
Begin Calibration	Triggers a single cable / link measurement from analyzer / equipment
Apply Reference	Substitution-style calibration with calibrated reference in place of DUT performed after measuring link
Averaging	In cases of large amounts of background noise you may want to average the calibration measurements
Interpolation	If measurement settings are within the frequency range of the calibration but the number of points vary the software will linear interpolate the calibration.
Pad (-dB)	If using a post amp with attenuator, enter the attenuator value in this window.
Power Head Cal	This button invokes the power sensor calibration menu.

Power Sensor Calibration

The Power Head / Sensor calibration menu is located in the Scalar Calibration section.



Enter PM Cal Factors — Allows entry of calibration table directly to check compatibly.

Compile Array — Compile the manually entered Cal-Factors and display on chart.

Load Cal — Load a calibration file from your computer.

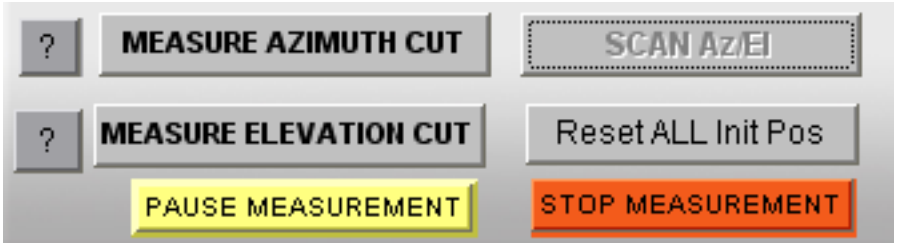
Load from Notepad File — Load a file containing a Cal-Factor lookup table.

Sample Notepad File — Shows how a Cal-Factor Notepad file needs to look

Test — Enter a frequency within the value of the Cal-Factor table, you will see the corresponding exact Cal-Factor in the "Calculated CF" window.

Measurement Controls

Control Overview



Measure Azimuth Cut Software will begin making measurements by moving the azimuth axis, and retrieving the data from the instrument. Button remains grayed out while measurement is in progress.

Measure Elevation Cut Software will begin making measurements by moving the platform horizontally, and retrieving the data from the network analyzer. Button will remain grayed out while measurement is in progress.

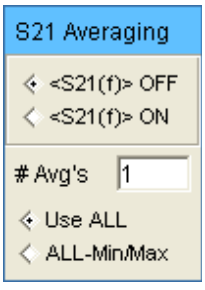
Scan AzEl Software will begin what is called an "Az/El Scan" by making a complete Azimuth cut and then move to the next elevation position to make another complete horizontal sweep. This process will continue until the platform reaches the ending elevation position.

Reset All-Init Pos This button must be pressed before making another measurement if you have already made one. Button will clear all plots on the front page and reset everything to 0.

Pause Measurement Will pause and interrupt the measurement process after the positioner has moved, before the signal is measured.

Stop Measurement Stops the measurement at the next point in the measurement cycle. After the measurement has stopped, you may reset the positioner/plots and start over or change settings.

S21 Averaging Turning this feature on will perform averaging on a specified number of VNA Sweeps for each physical measurement position. The All-Min/Max option discards max and min sweeps and average the rest.



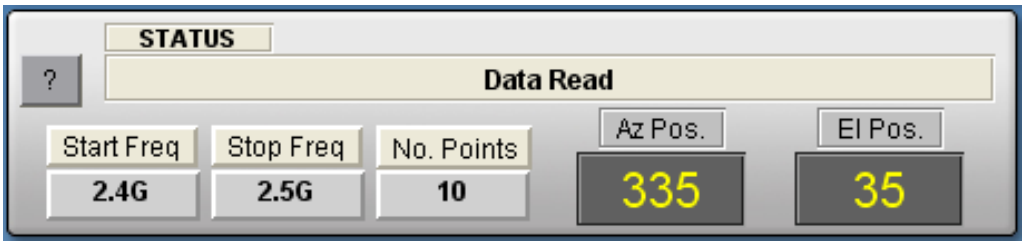
Proceed to Data Processing

After making measurements, this button allows you to view or manipulate any aspect of the measurement, as well as allowing you to view data in different formats such as Polar, Mag or 3D.

Measurement Status & Displays

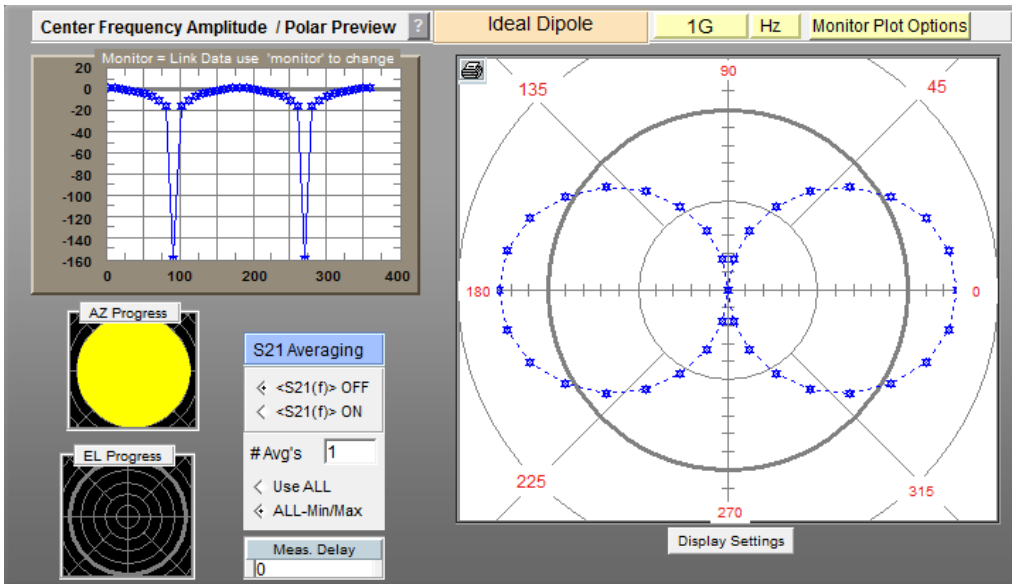
Measurement Status Window

The measurement status window displays all of the current measurement parameters and will update automatically during the measurement process.



Graphical Status Display

The graphical status windows allows you to view the real-time center frequency data as it's captured. All status graphs display the center measurement frequency - especially useful for observing the measurement for proper pattern and levels.

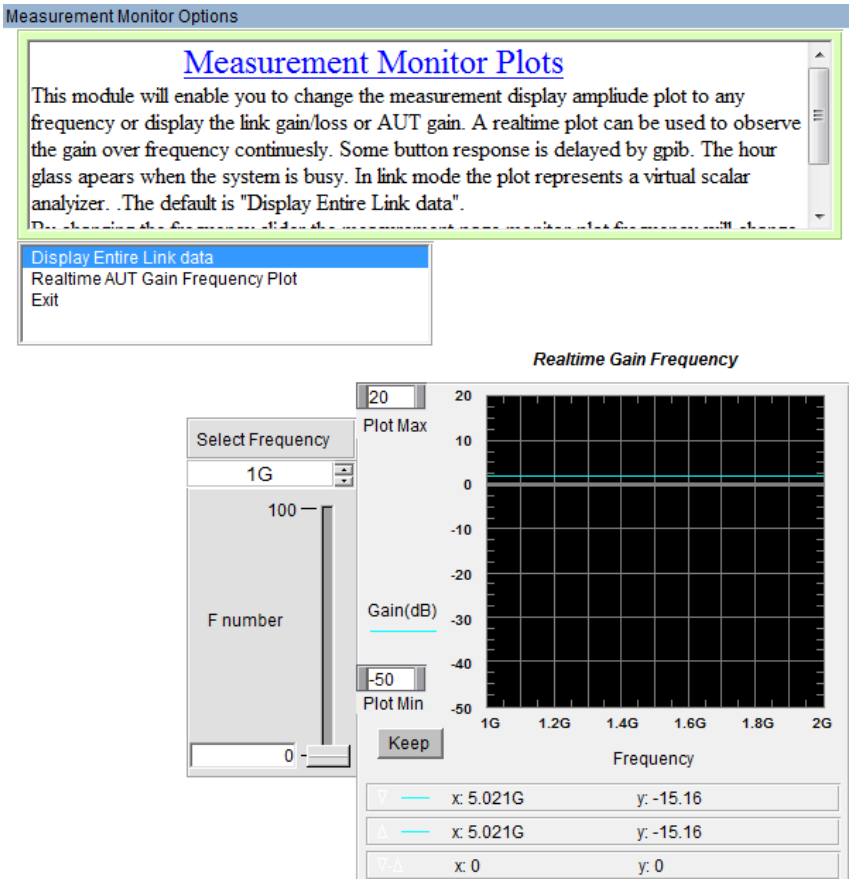


CW Monitor Plot	Amplitude in dB of the measured data
Antenna Polar Radiation Pattern	Real-time linear polar pattern of measured antenna at selected frequency
AZ Progress	Shows progress of selected azimuth extents
EL Progress	Shows progress of selected elevation extents
S21 Averaging (f)	Turns frequency averaging on/off
# Averages	Sets number of sweep averages
All - min/max	Averages without min/max values
Meas Delay	Delay in seconds before measuring

Monitor Plot Options

The monitor plot option can be used to select the frequency of the data displayed on the main measurement page. This will normally default to the first frequency or center frequency of the measurement.

In addition, the monitor plot options can be used to view real-time link or gain data.



Select Frequency Selects the frequency which will be displayed on the measurement page plots

Display Link Data Continuously queries the over-frequency link data from the VNA and displays it on the plot

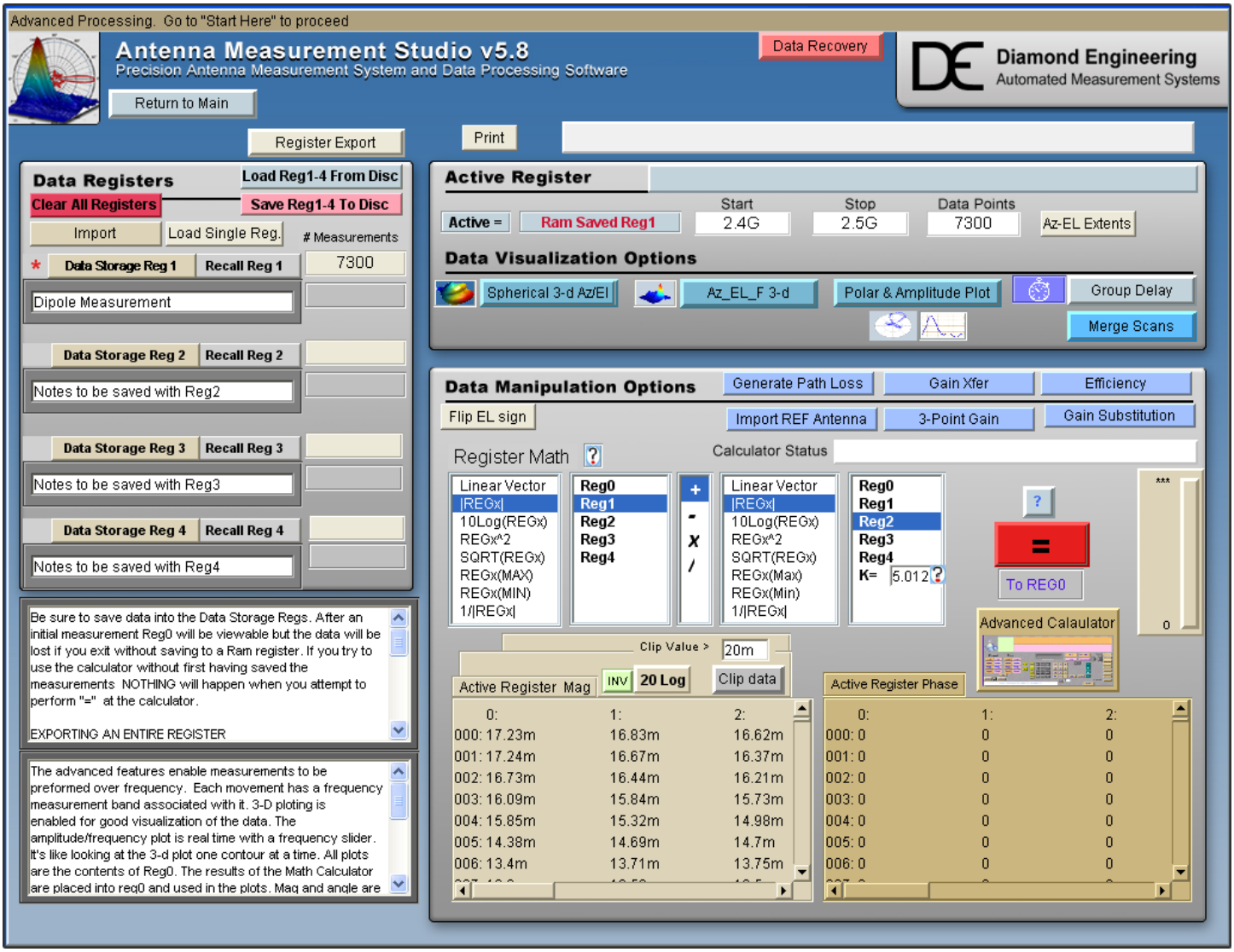
Realtime Gain Frequency Provides the option to load path and reference data to show the actual gain over frequency of your AUT in real time

Exit Applies the selected and exits

Data Processing Introduction

Introduction

Our data processing features are your gateway to unlocking all the data contained within your antenna measurements. After making your initial measurement of the antenna, press the "Data Processing" button (located in the "Post Measurement Options" window of the main software) and you will be taken to the screen shown below.



About Data Registers

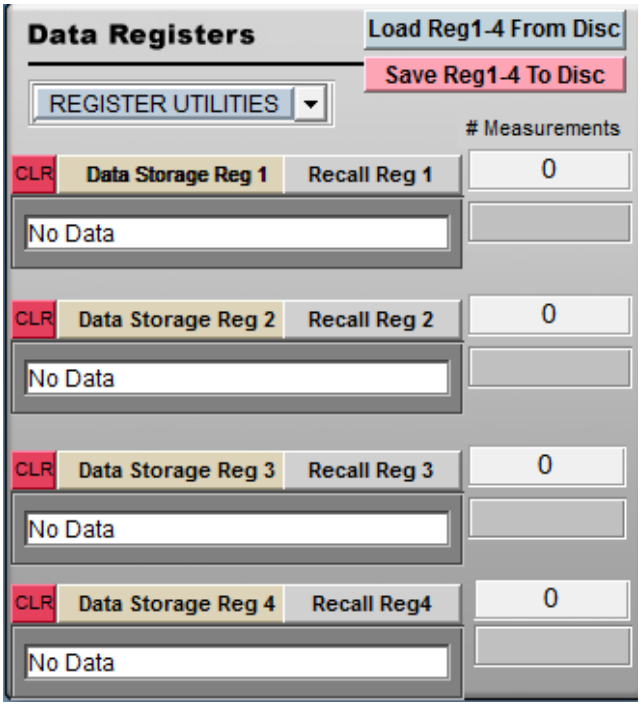
When working with data in the Data Processing feature all of the data is stored in registers. These registers allow you to have "holding space" for data sets. This is a very useful way to work with multiple measurements from other antennas or variations of the current antenna. There are five (5) registers total: four (4) storage registers and one (1) active register.

Active Register

After completing a measurement and opening the Data Processing feature, the entire data set from your measurement will automatically be placed into the "Active" Data Register. The Active Register is applied to all functions including 3D plots and Data Export functions, (with the exception of the Measurement Calculator, which can pull data from any of the 5 registers). We suggest storing your data to a Register and then saving it to disk so a permanent copy of the raw data is saved.

Storage Registers 1-4

The Data Storage Registers offer space to put up to four different measurement sets that you can recall at any point in time, or permanently save the set registers to disc.



Data Storage Button — All data in Active Register is stored to the storage button you chose

Recall Button — All data in chosen storage register will be written to active register for viewing or modification

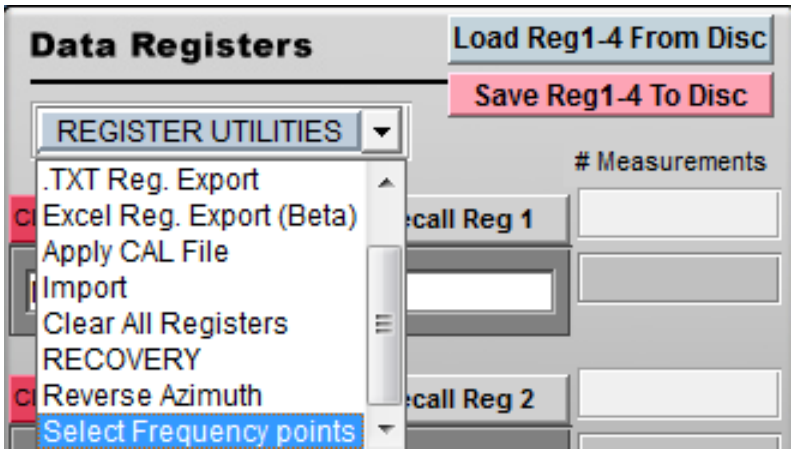
Load Reg 1-4 From Disc — Load a set of 4 registers from the disc

Save Reg 1-4 To Disc — Save a set of 4 registers to the disc

Clear All Registers — Clear all data from registers 1-4

Register Utilities

The register utility pull-down contains a number of tools for working with registry data. These tools will help you perform data functions including export, import, and merge.



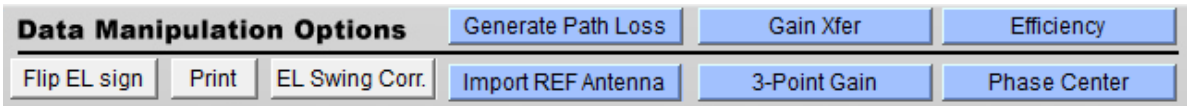
Load Single Register	Loads a single register from a different saved data set into any of the current registers 1-4
Frequency Merge	Used for merging the upper and lower frequency bands from two identical sets. Requires duplicate start/stop frequencies, number of points, and AZ/EL points
Apply CAL file	If a measurement was made without having the scalar calibration applied it can be applied post-measurement
.TXT Export	Exports the entire/selected contents of any register 1-4, this data can be imported directly to excel and other programs
Excel Reg. Export	Exports any register directly to excel in either data only or as a simple report
Import	Imports external data directly to a register, external data must be in a specific format
Clear All Registers	Clears registers 1-4 with option for active register (Reg0)
Recovery	Load the last completed raw measurement
Reverse Azimuth	Reverses the azimuth cut for every elevation angle
Select Frequency Points	Generates a new data set with a selected group of frequencies or reducing the entire frequency set to a specific number of points

Register Utilities *(continued)*

Data Editor	This will enable data truncation and number of frequency points reduction. Simple enter the Min/Max extents and the results will load into REG0
MSI/Planet Export	This module will export a file compatible with MSI / Planet site planing software, requires a single AZ/EL cut with 1 degree resolution
Stitching Tool	Cuts that start at 0 and end at 360 degrees may have different amplitude values due to noise, this feature will stitch the en-points into the same amplitude to eliminate the gap found in 3D or 2D polar plots.
Boresight Normalization	This module will normalize the bore sight gain levels to those imported from a previously generated calibration file. Results are stored back to the Active register (REG0)
Total Power Addition	Performs a total power addition of Register 1 and 2, the results will be stored to REG 3
Large File Gain Transfer	Performs gain transfer on measurement sets greater than 500K data points.
Process Circular	Will take gain data in REG1 and REG 2 and process as circular, RHCP and LHCP data will be stored to REG3 and REG 4 Respectively
N2F Export	Exports H-POL and V-POL data for us in Howland Co's N2F nearfield to far field data processing software.
N2F Peak Gain Generator	Exports H-POL and V-POL data for us in Howland Co's N2F nearfield to far field data processing software. (***NOTE: This feature still in development.)***

Data Manipulation Options

After you have made a measurement, use these options to correct for things like reference gain, path loss, or to plot efficiency.



Generate Path Loss — Calculates the path loss over the measured frequency range and specified distance

Import Ref. Antenna — Applies gain correction for a calibrated reference antenna and values are loaded from text file

Gain Xfer — Calculates AUT gain by removing path loss and reference gain (See "Gain Transfer Function" for more information)

Efficiency — Generates the efficiency over frequency for the measured AUT

3 Point Gain — Activates the 3-point method for calculating gain

Phase Center — Calculates phase center when used with appropriate data.

Flip EL Sign — Reverses the elevation indexes, effectively reversing the elevation plots

Data Visualization

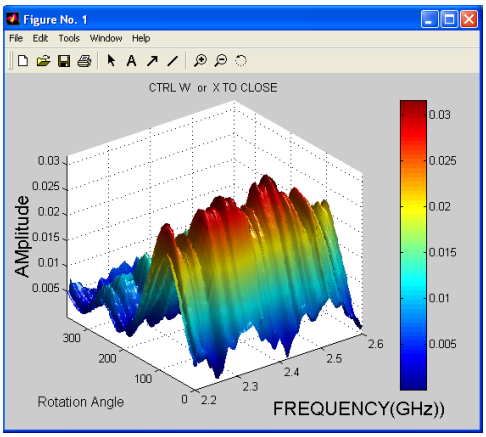
Visualization Options

The data visualization options enables you to view the Antenna Data in a wide variety of formats.

Azimuth vs. Frequency vs. Amplitude 3D-Plot

This plot is the most versatile of the 3D-plots and gives a good idea of the frequency response versus rotation of the antenna you have measured. If you have made AZ/EL measurements you can use the AZ/EL 3D-plot for a more detailed view.

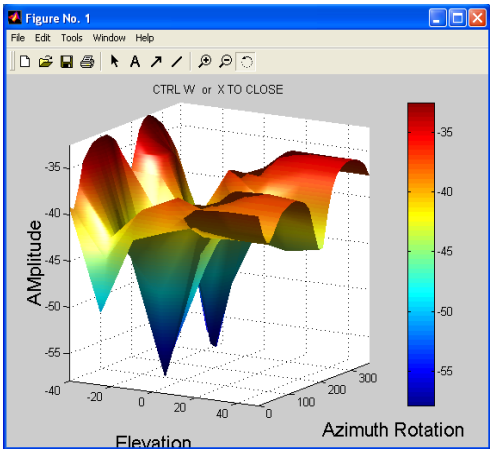
Features:
View entire data set at once
Full Plot Rotation
Zoom In/Out feature
Line and Notation Tools
Exportable to common graphic formats
Printable



Az/El vs. Amplitude 3D-Plot

After you make a AZ/EL measurement, you can view the azimuth versus the elevation for any measured frequency by using the AZ/EL 3D-Plot. Use the azimuth versus frequency 3D-plot to view frequency response to aid in the selection of the single frequency.

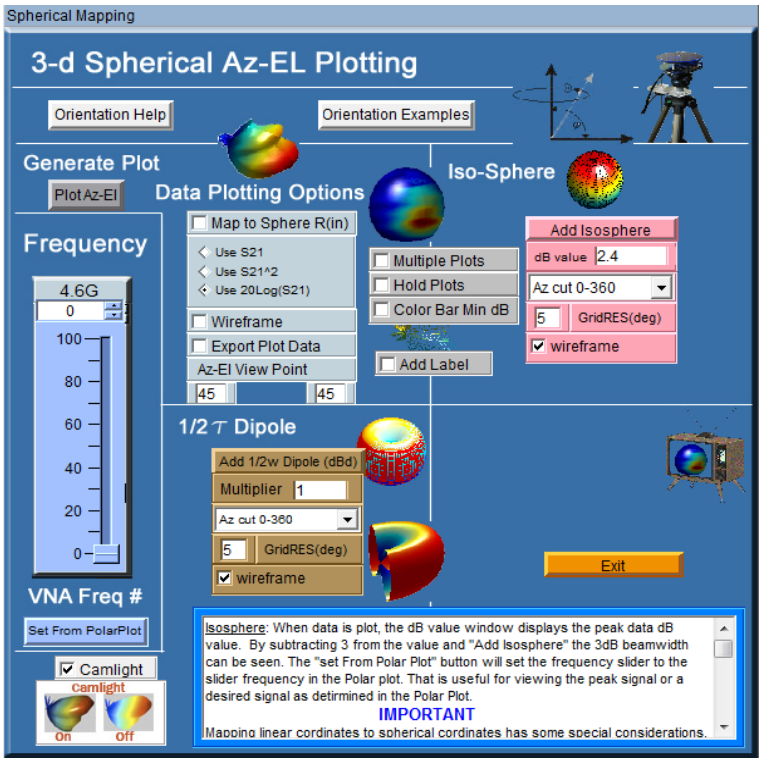
Features:
View AZ/EE data for any frequency point
Full plot rotation
Zoom in/out features
Line and notation tools
Exportable to common graphic formats
Printable



Spherical 3D Plots

When an Az/El scan measurement is made, you can plot the data in true 3D (up to the extents of your measurement.). This data can be viewed in true 3D, mapped onto a sphere, and even compared to an ideal isosphere or dipole right on the same plot.

IMPORTANT: Spherical plots will only work if AZ/EL measurement data is loaded in Active Register.



Frequency - Select which frequency to plot

Generate Plot - Click after configuration is set

Data Plotting Options - Modify how measured data is displayed in plot window (select 20log for dBi)

Iso-Sphere - Generates true iso-sphere on same plot as measured data. Enter the desired IsoSphere size in dBi. **NOTE**: Max value is updated AFTER plotting the selected frequency

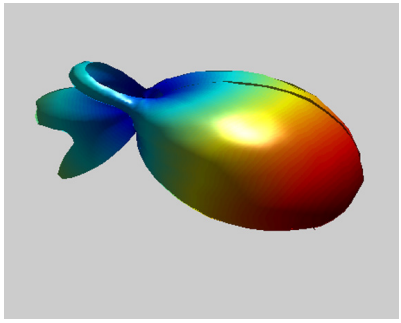
Dipole Generator - Generates spherical dipole plot on same plot as measured data. Change the size of the dipole using the Multiplier 1 = Ideal dipole gain.

Viewpoint - Sets default viewpoint for 3D plots

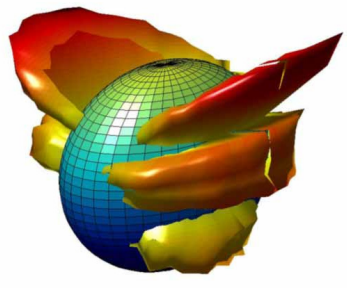
Multiple Plots - Enables plotting of multiple frequencies

Spherical Plot Examples

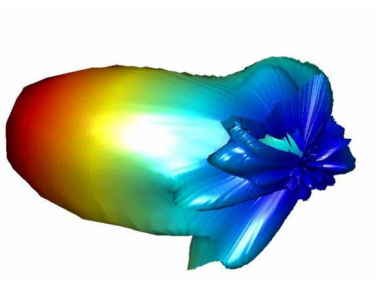
Standard Spherical



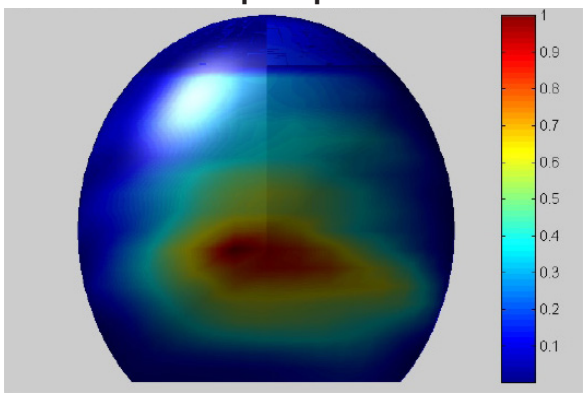
Spherical over Iso-Sphere



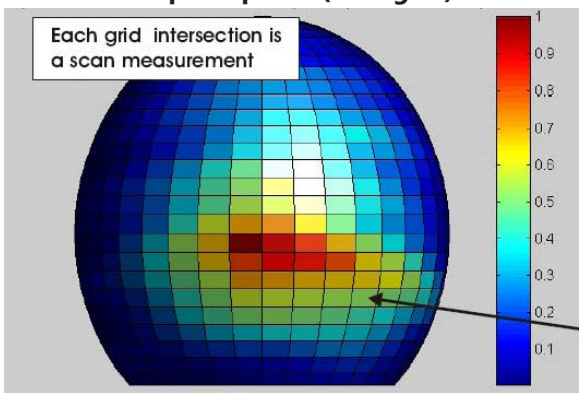
Parabolic Dish



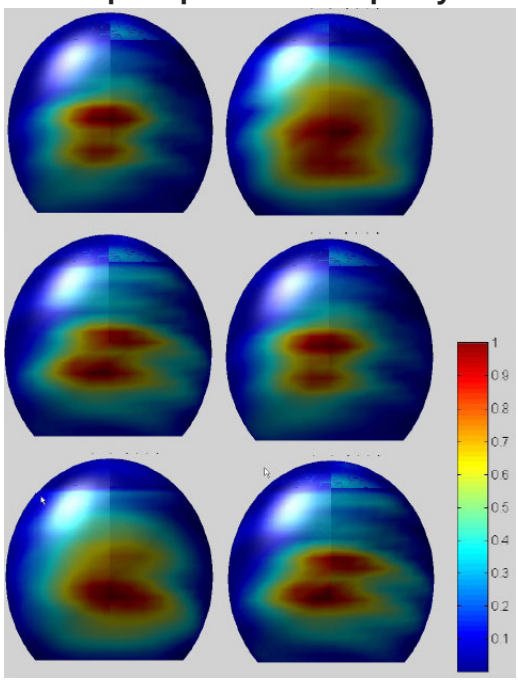
Map to Sphere



Map to Sphere (with grid)



Map to Sphere over Frequency

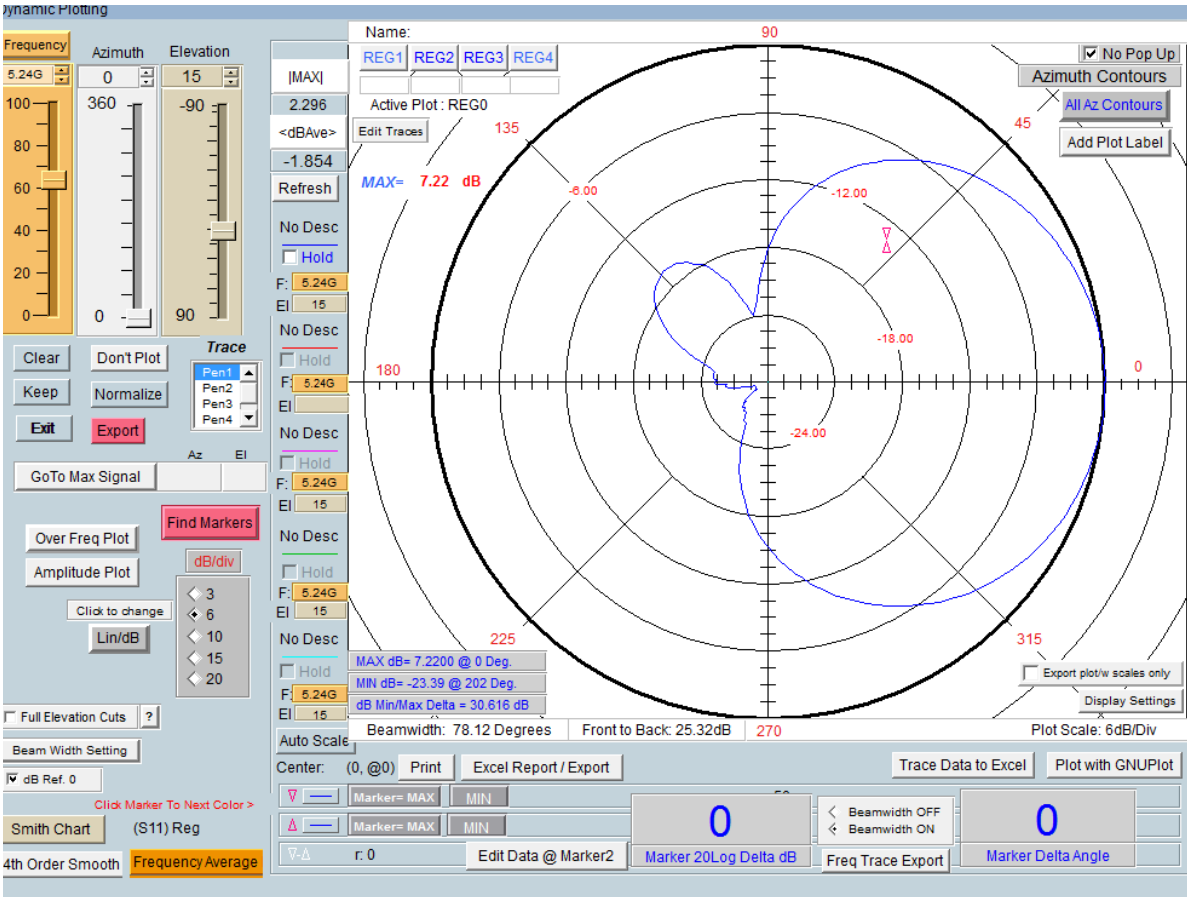


Dynamic Polar Plot

Dynamic Polar Plot offers a linear or log polar 2D look into the rotation gain pattern of a measured antenna for a specified frequency, and Az, or El point.

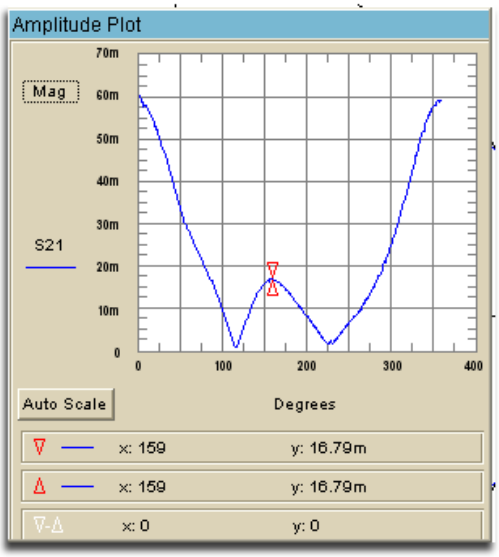
Features:

- Linear or Log Format
- Multiple Scale Options
- Automatically updates
- Keep Max Function
- Data Export
- Auto Scale Function
- 4 Trace Plotting
- Dual Markers
- Marker Delta Readout
- Azimuth or Elevation Plots
- Printable
- Find Max Signal
- GnuPlot Plots



Amplitude Plot

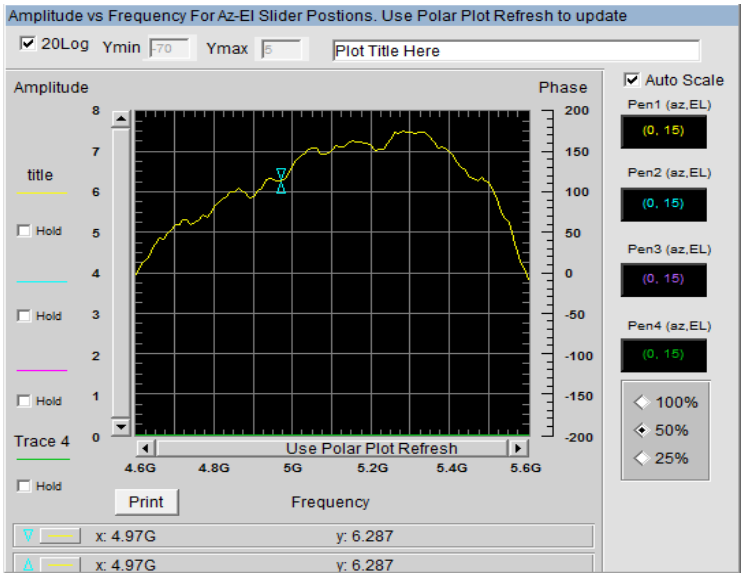
The Dynamic Amplitude Plot is accessible through the Polar Plot window.



This plot is a sub-function of the polar plot. This function allows you to view the amplitude while adjusting the sliders in the polar plot window. The plot is closed by pressing the "Amplitude Plot" button again.

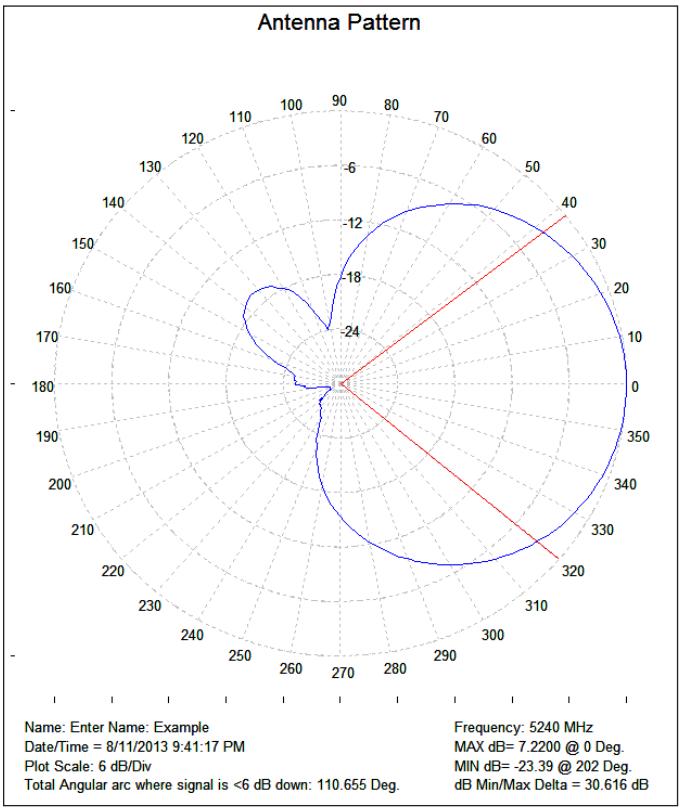
Over Frequency Plot

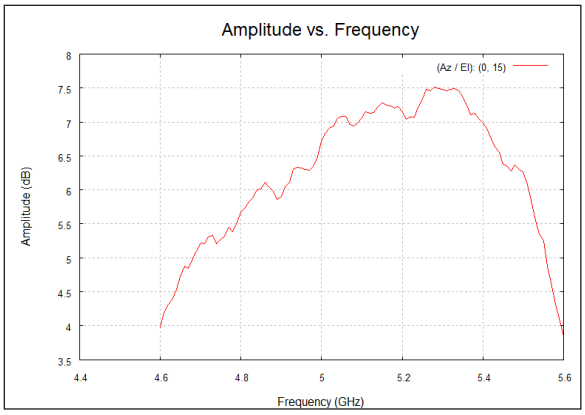
This plot is also accessed through the Polar Plot window. It displays the over frequency data for the selected Az/El position set via the polar plot sliders. The plot is closed by pressing the "Over Freq Plot" button again
For multiple trace plots see the section titled "Multiple Trace Plots"

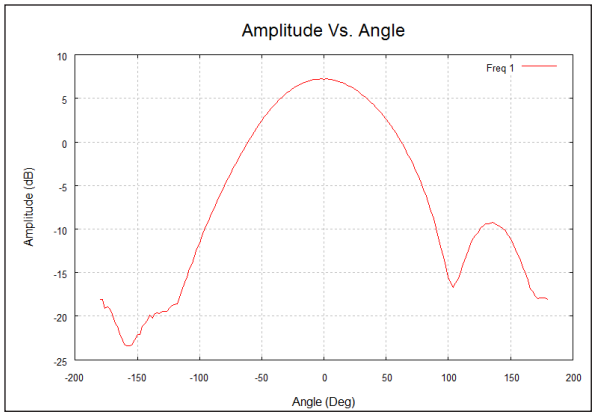


GnuPlot Plots

This plotting feature produces publish quality plots based on certain plots within the DAMS Software, Presently the GnuPlot feature is available for the following plots, the Plot is generated by pressing the “Plot with GnuPlot” button located within the plot.

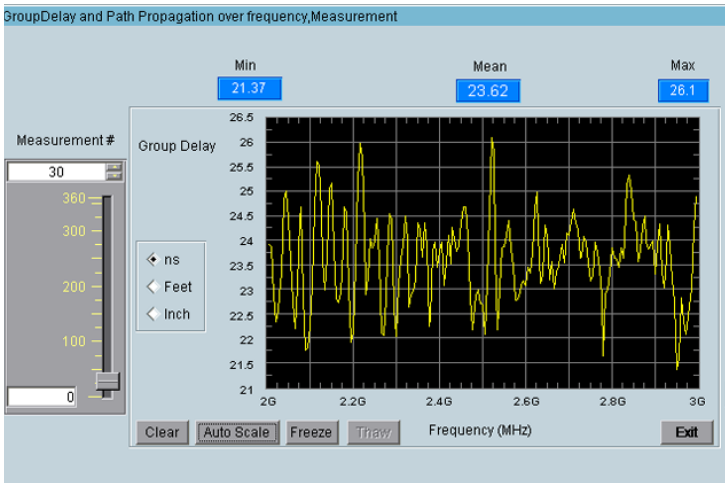






Group Delay Function

Allows the analysis of the Group Delay and Path Propagation data. You can also make an accurate measurement of the antenna distances using this feature.



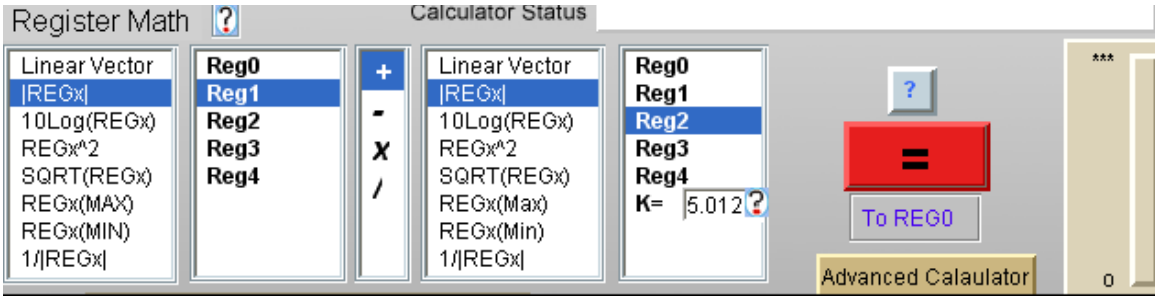
Features:

Distance Scale Functions
Data Export
Auto Scale Function
Printable Plots

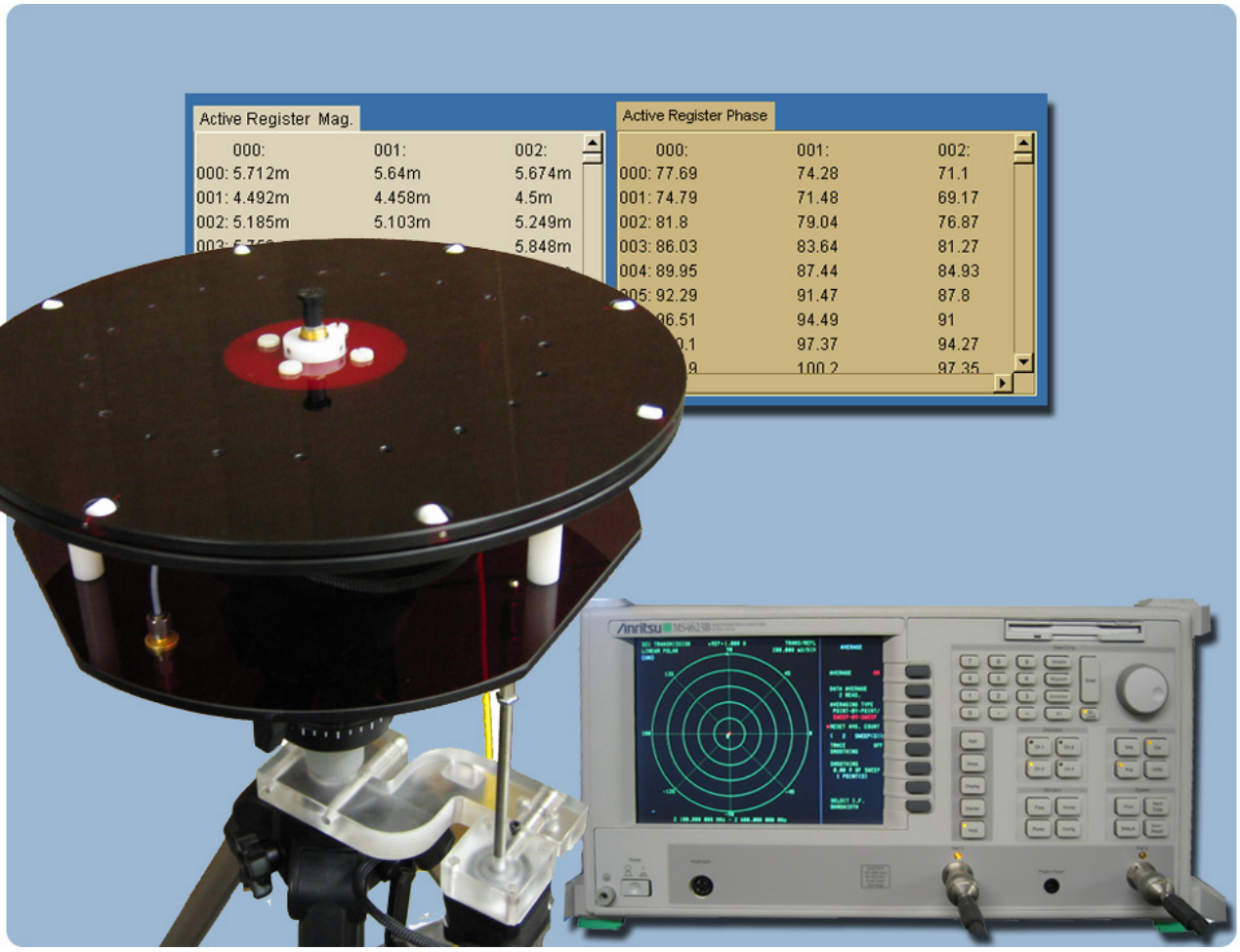
Measurement Calculator

Overview

Use this option to perform arithmetic operations on the measurement registers. For example if you make measurements on one antenna and wish to compare the results to another antenna at each point of rotation and each frequency. Or if you have a calibrated reference antenna an wish to normalize additional measurements to the max or min value of the reference antenna. Remember all measurement data is linear so you may want to "LOG" the data before doing math. If you select MAX or MIN then all measurement elements will be replaced with MAX or MIN. This creates a normalization reference if you do your math correctly.



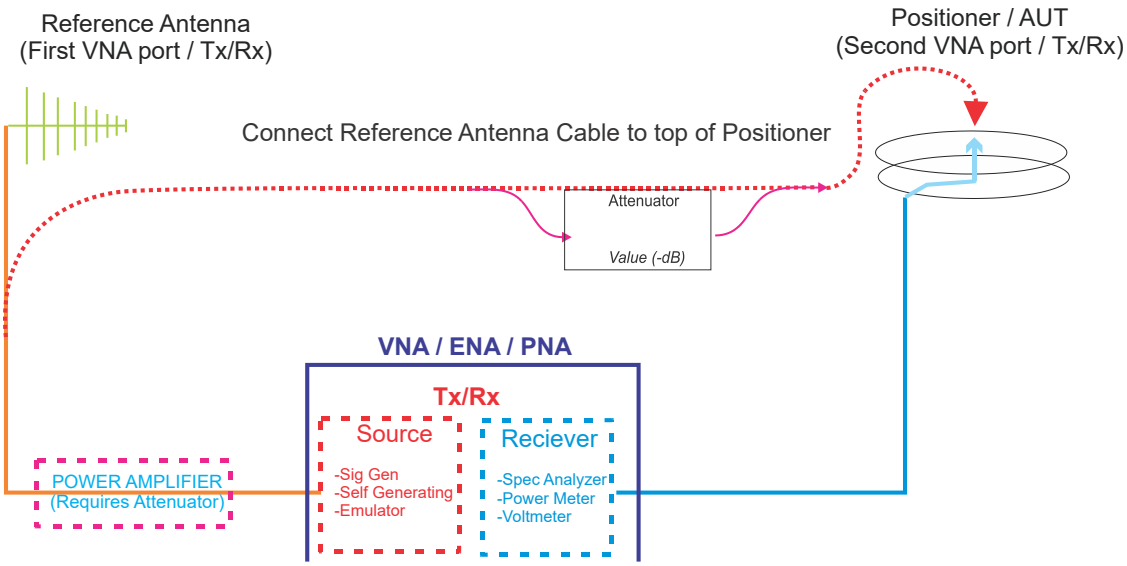
Making Measurements



Basic and Advanced Measurements

Scalar System Calibration

NOTE: If you have already calibrated any system losses (cables, etc) using VNA calibration you do not need to perform a scalar cable calibration, a full 2 port calibration of the VNA is recommended when making phase dependent measurements



Scalar Calibration with Generator and Receiver Configuration

1. Select your Source Instrument and click the "Settings" button, which is located below the icon to configure parameters for your measurement (start, stop, number of points, etc.).
2. Select receiver from pull-down and configure any applicable settings.
3. Connect system as shown in the selected diagram.
4. Press the Begin Calibration button, a trace will be displayed when complete
5. If performing substitution calibration press the "apply reference" button and import the calibrated reference data
6. Save calibration and exit to apply to measurement.

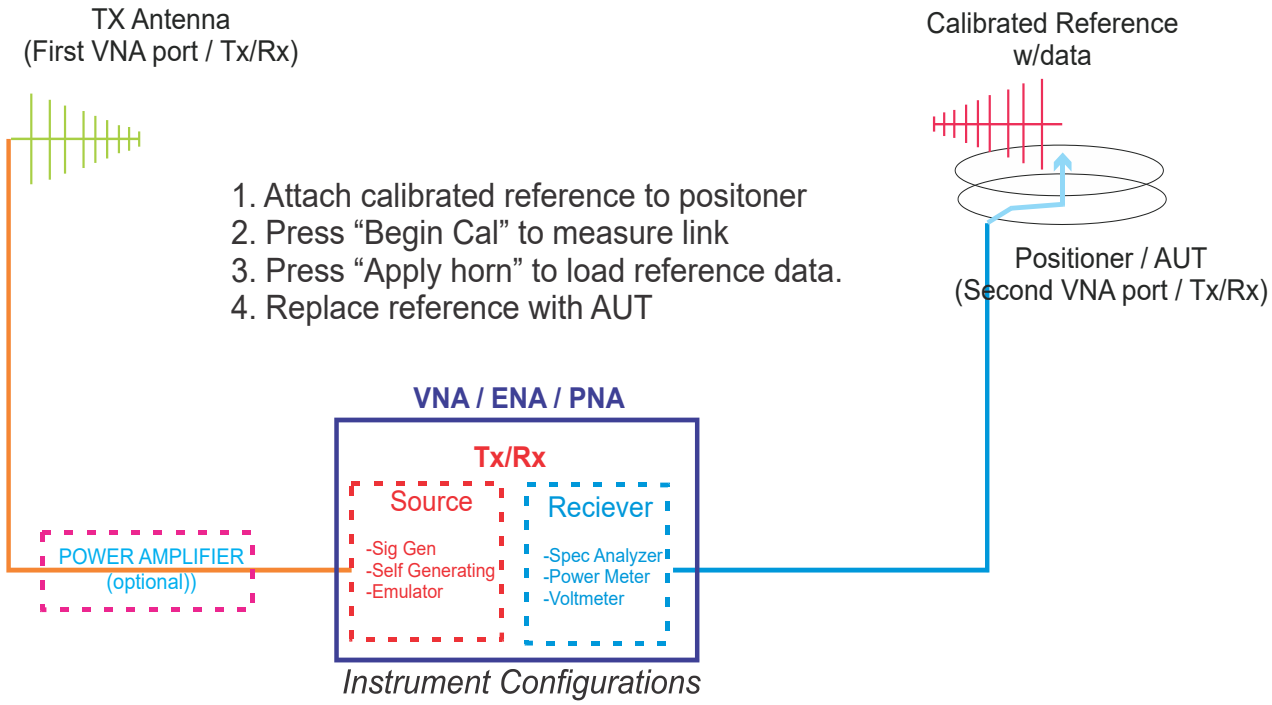
Performing Scalar Calibration with VNA configuration

1. Configure your VNA for desired start/stop frequency and number of points.
2. Connect system as shown in the diagram.
3. Press the Begin Calibration button and a trace will be displayed when complete.
4. If performing substitution calibration press the "apply reference" button and import the calibrated reference data.
5. Save calibration. When exiting you will be prompted to apply the calibration to the measurement.

NOTE: If using an amplifier, be sure to attenuate its signal to avoid exceeding maximum input power on your VNA.

Scalar System Calibration - Substitution

NOTE: When a Substitution calibration is made there is NO post processing necessary. All of your data will be collected in dBi.



Instrument Configurations

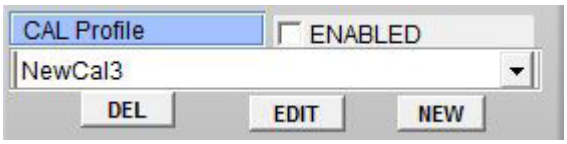
Performing Substitution Calibration with calibrated reference antenna

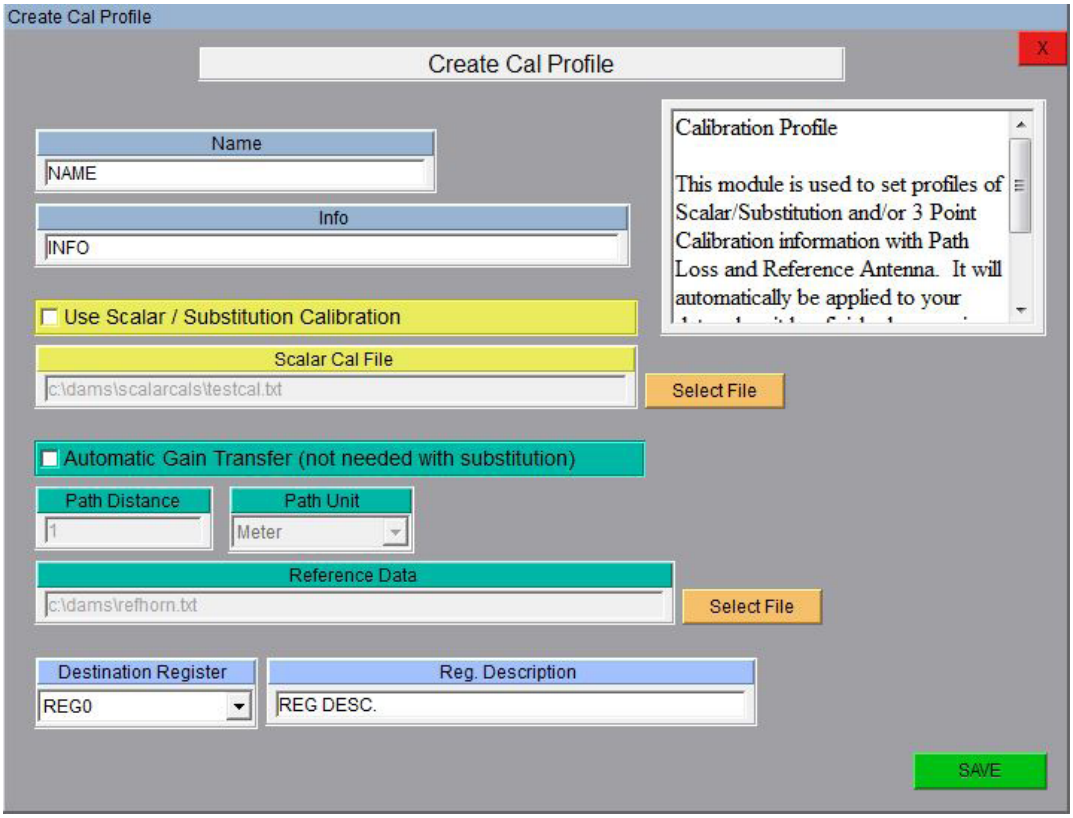
1. Place a calibrated antenna with known values in place of the DUT.
2. Perform both sides of the Scalar Calibration routine as described above.
3. Press the Apply Horn button to apply the reference antenna data to measured data.
4. Save and apply your calibration data.
5. Replace the Calibrated antenna with your DUT.
6. Make your measurement, all measured data will now be in dBi.

Calibration Profiles

Introduction

Calibration profiles store specific details such as scalar/substitution calibration files, reference antenna data, and path loss information, this data will be automatically applied to measurements eliminating the need for any post processing. Multiple files can be created for different measurement setups.





Scalar / Substitution Calibration
Apply data has been saved using the "scalar calibration" module within the software. A cable calibration is generally used in conjunction with Automatic gain transfer whereas a substitution calibration is not used with gain transfer, the resultant data is stored in the specified destination register

Automatic Gain Transfer
Path and reference antenna data is automatically applied to the measurement when it is complete, no further processing is necessary, measurement results will be in dBi.

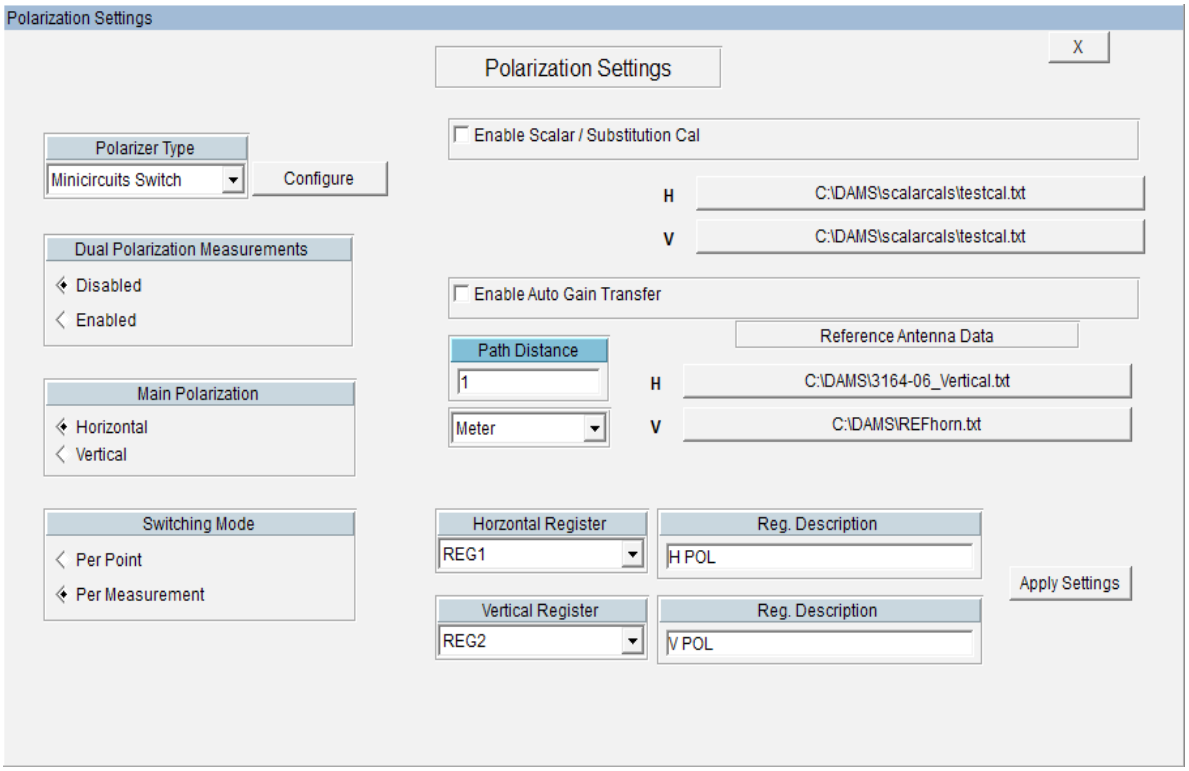
Destination Register
Specify the destination register and description for resultant data.

Auto / Manual Polarization Switching

NOTE: Software must be configured for a supported type of polarizer or "manual" which will prompt to manually change polarization

Overview

This feature allows fully automated collection of both H + V Polarization of the DUT including automatic gain calculation. Polarization switching can be performed at every physical point or at every complete measurement. Scalar / Substitution, and/or gain transfer calibration can automatically be applied during collection



Polarizer Type Selects the type of polarizer that will be used, selecting manual will cause a software prompt to manually change polarization, the settings button changes polarizer specific settings

Enable / Disable When enabled, the software will perform dual polarization measurements for Azimuth, Elevation, or 3D scans as configured on this page

Switching Mode Per-Point will switch the polarization at every physical point the positioner stops, for electronic switching this option will reduce error by only requiring the AUT to move only once to each position. Per measurement will complete one full measurement at each polarization. It is recommended to perform a per measurement sweep for any rotary positioner to reduce measurement time and wear on the polarization stage.

Scalar / Substitution Cal This option will reference to any calibration file made using the DAMS scalar / system calibration function located on the front page, the calibration can be just cable calibration or a normalized substitution calibration.

Auto Gain Transfer This option will apply the selected reference antenna file and path distance correction to the measured data, a separate gain file can be used for each polarization if using a dual polarization reference or multiple antennas. The cable loss must still be corrected. This can be used in conjunction with a scalar calibration file to correct for cable loss.

Destination Register When a dual polarization measurement has been completed, the data needs to be stored into one of the 4 data registers. These options will set both the target register and description.

Azimuth & Elevation Measurements

NOTE: Software assumes positioner is level when started or after being reset. If it is NOT, use "Vertical Jog" to move platform to true level and "set to zero" before making measurements.

Basic Azimuth or Elevation Measurement

1. Ensure power cables are connected, software is running and positioner movement is confirmed.
2. Attach AUT to rotator platform or FSM (If equipped) with SMA connector.
3. Ensure controller power is ON.
4. Select S21 on your analyzer, AND linear polar OR smith chart. If you have a saved calibration file, be sure to load it before making measurements. *Example: 4 to 6 GHz @ 201 Points.*

NOTE: If your analyzer has not been calibrated, follow the appropriate calibration procedure.

5. Click "Configure Extents" to configure the start/stop position and resolution of this measurement.
7. Click "Measure Azimuth Cut" or "Measure Elevation Cut" to start measurement process.
8. During measurement process, the rotator platform will begin moving and center frequency data should begin appearing on screen. "Measure Azimuth Cut" will remain greyed out during measurements. Once measurement completes, button will reappear. Then you may enter the "Data Processing" section or perform other post-measurement options.

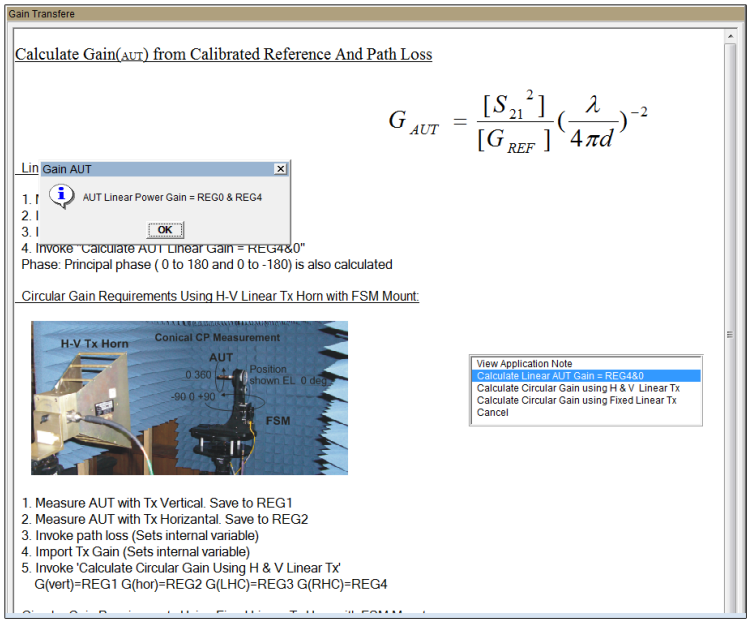
Gain Transfer Function

Prerequisite: Measurement with VNA or DAMS Scalar Calibration Enabled

Overview

The gain transfer function will use previously generated path loss and reference data to calculate the dBi gain of the measured antenna across all angles and frequencies. Corrected data will be stored into Reg4 and the Active Register (Reg0).

After calculating, save Reg 1-4 to the hard drive this file will contain original and calculated data including path and REF data.



Gain Transfer Module

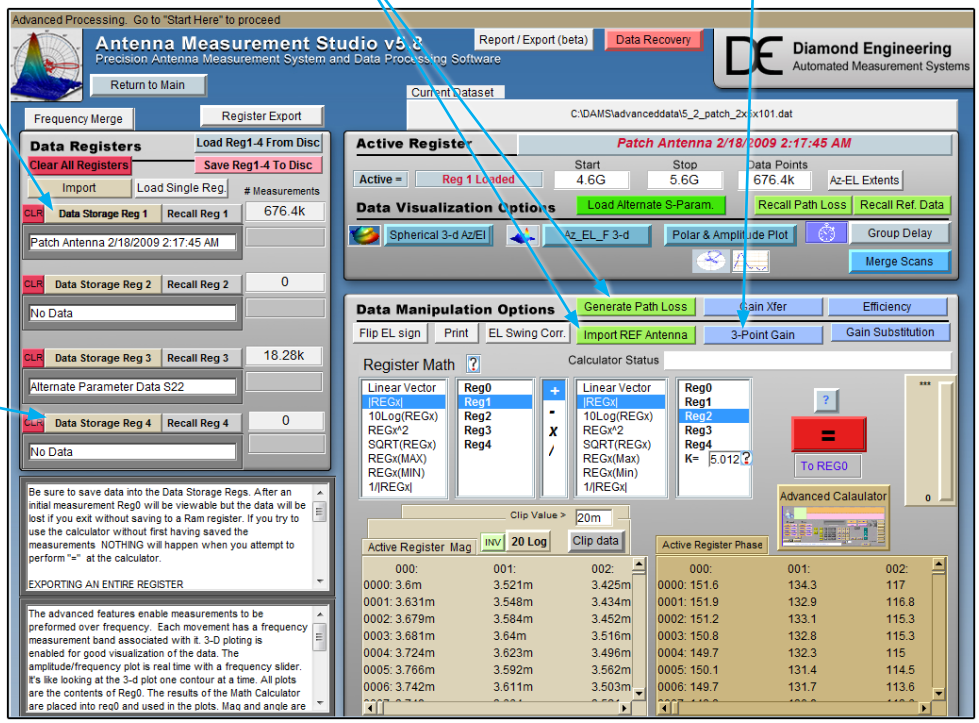
To Perform Gain Transfer

1. Measurement data must be present in Reg 1

2. Path loss and REF buttons must be green indicating data is present, click to set path or reference data

3. Run Gain Transfer function

Resultant AUT Gain Data (Also in Reg0)



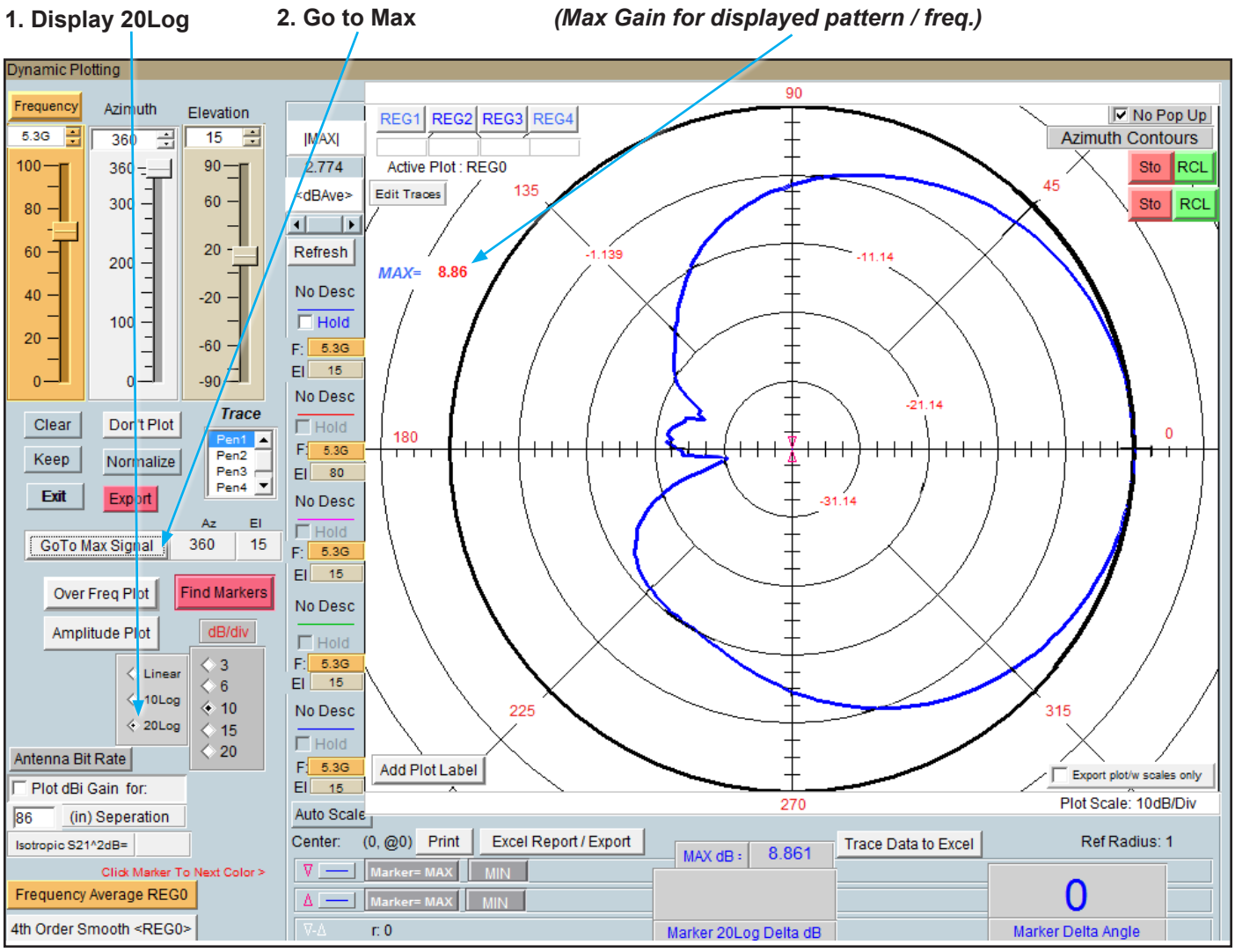
Data processing page after Gain Transfer has been completed

Antenna Gain Pattern

Once the gain transfer has been completed the antenna pattern can be plotted in a number of ways. The quickest way to analyze the max gain positions and frequencies is with the polar plot. Up to four antenna traces can be plotted at one time. The radiation pattern for any frequency or axis can be displayed simply by moving the sliders to the desired setting.

Locating maximum gain frequency / angle:

1. Select 20Log to view the gain in dB.
2. Press “Go to Max signal” and plot will be changed to plot with the maximum gain.
3. Max gain value for specified frequency/cut will be displayed left of polar plot.



Antenna azimuth pattern showing a peak gain of 8.86 dBi at 15 degrees elevation

Performing Azimuth/Elevation Scan Measurement

Basic AZ/EL Scan Measurement

1. Ensure rotator power is securely attached and plugged in.

2. Attach Antenna to rotator platform using a SMA connector.

NOTE: For directional antennas, we recommend starting the max gain point of the antenna 180 degrees from the source antenna.

3. Turn platform power ON.

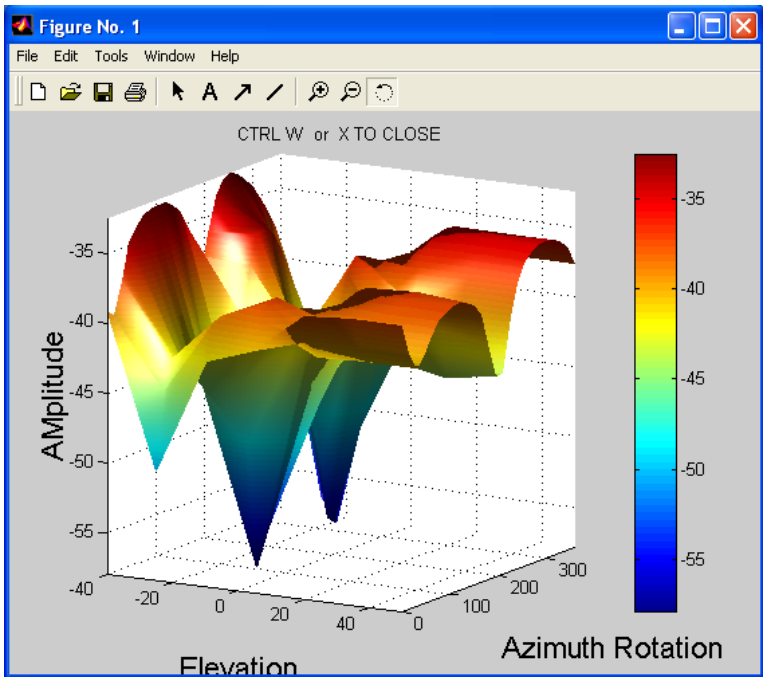
4. On your analyzer select S21, POLAR Plot and the proper instrument state.
   Example: 4 to 6 GHz @ 201 Points.

5. Click "***Configure Extents***" to select the Start/Stop positions, resolution, etc.

6. Press the "***Scan AZ/EL***" button to begin measurement process.

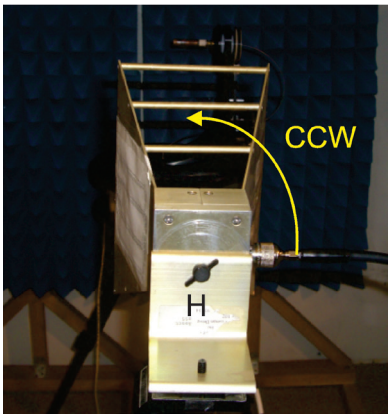
7. During the process, the rotator platform will make a complete azimuth cut, then move to the next desired elevation point, and then it will repeat the azimuth cut. You should also see some data starting to appear on your screen at this time. The "***Scan AZ/EL***" button will remain greyed out during the measurement process. Only after the button returns to it's normal state is your measuring process is complete and when you may continue on to Data Processing.

Example Result



Measuring a Left Hand Circular Double Helix

Circular Measurement Procedure



1. Measure AUT with Horn in vertical position and save that data to ***REG1***.

2. Rotate Reference Horn 90 degrees counter clock-wise (from behind reference). Repeat measurement and save data to ***REG2***.

3. Now invoke the "***Path Loss Calculator***" and specify the appropriate figures. Once completed, ensure the "***Generate Path Loss***" button is green as shown below. The green signifies that the data has been saved internally.

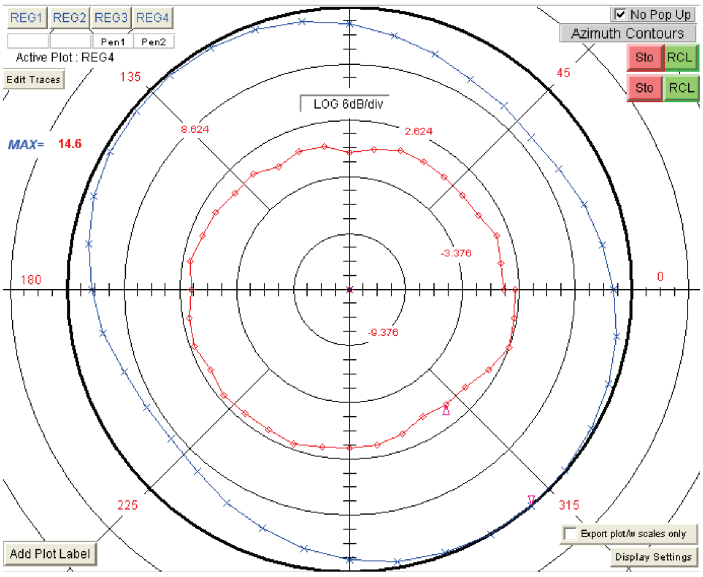
4. Once completed, invoke the "***Import REF Antenna***" button to load the appropriate calibration data. Again, verify this button has also now turned green as shown below:

5. Invoke Gain Xfer and specify Circular Gain

6. Use KEEP, Normalize and don't plot to compare LHC RHC. Scale to 20Log and set contour and position markers to measure LHC and RHC difference.

NOTE: Incorrect rotation of the reference horn will switch LHC and RHC. The DAMs is set up for CCW rotation. Vertical orientation is arbitrary. The difference between the H and V measurement must be 90 degrees.

Example Result



Performing 3-Antenna Calibration

Summary

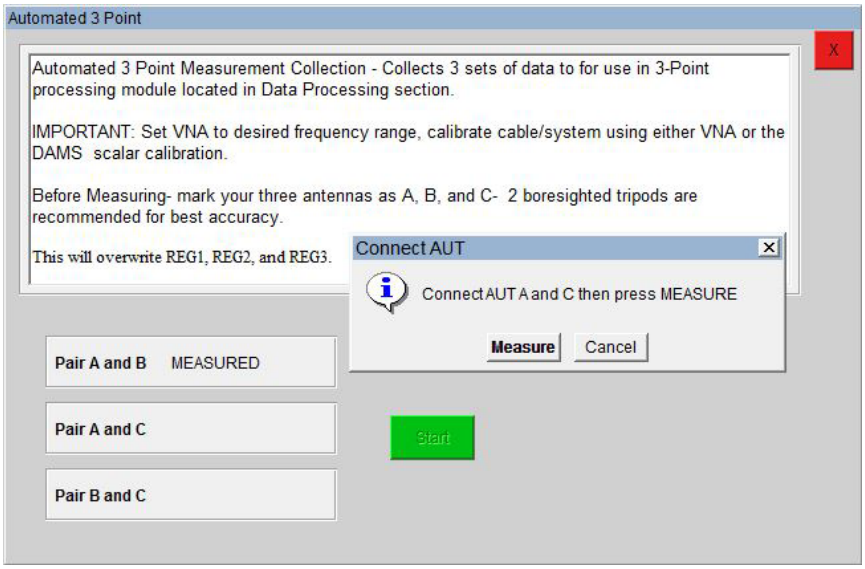
Three unknown antennas can be measured against each other to obtain the realized dBi gain for each antenna, this data can then be viewed, saved, or exported into files. If you wish to use this data for a measurement, you must export the data and make a reference antenna file with the data in dBi.

Prerequisites

1. Calibrate all cabling using either a VNA calibration or DAMS Scalar Calibration

Procedure

1. Label your antennas A, B, and C. for easy identification.
2. Click "Automated Functions" on the front page and select "3 Point Collection" this will launch the Automated 3 Point module.
3. Press the start button and follow the on-screen instructions



4. When all 3 steps have been completed, proceed to the data processing section and launch the 3 point gain module.

Continues next page...

3-Point Gain Module

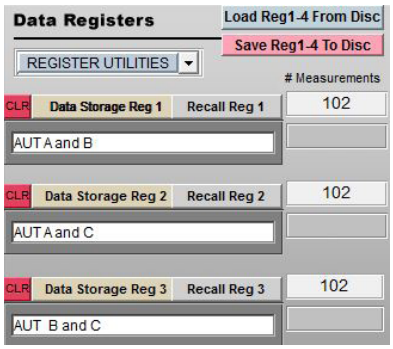
Launching the 3-Point Gain module

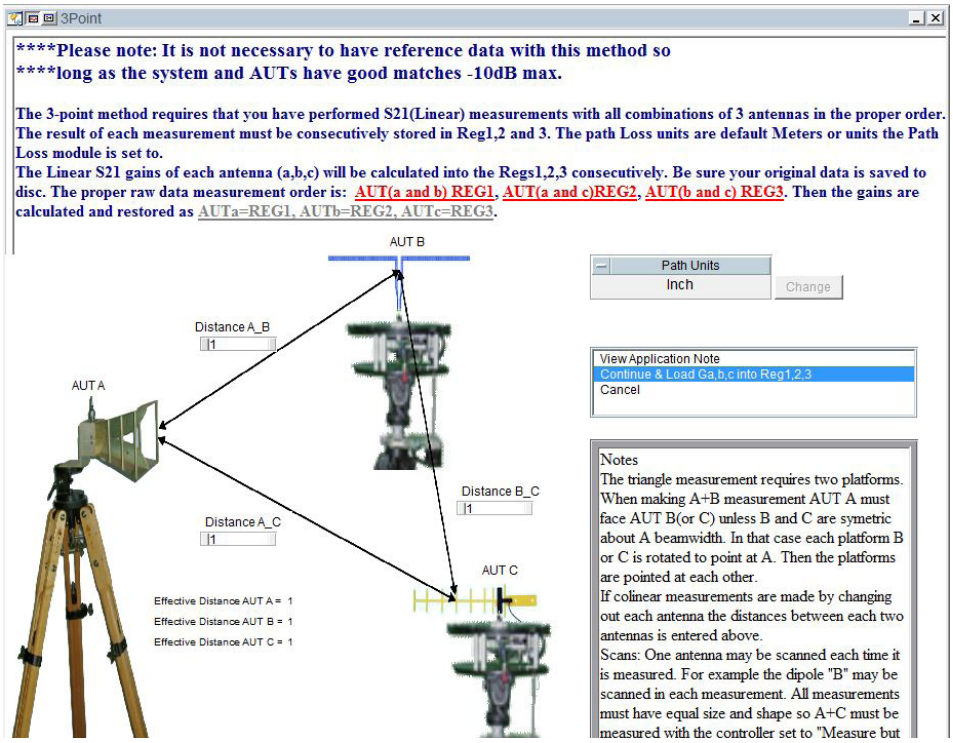
The 3 point gain module is located in the data processing section. It will take the 3 measurements you've already made in the previous steps and convert them all to gain measurements for each individual AUT (A, B, and C)

Prerequisites

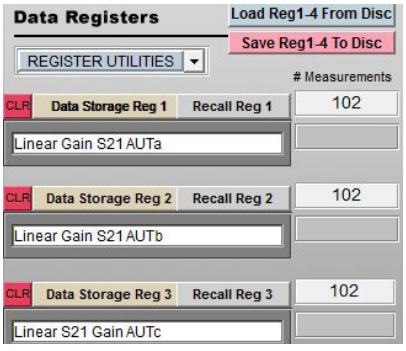
You must first use either the automated 3-point collection or manually measure 3 required pairs and store them to the appropriate registers.

REGS BEFORE





REGS AFTER



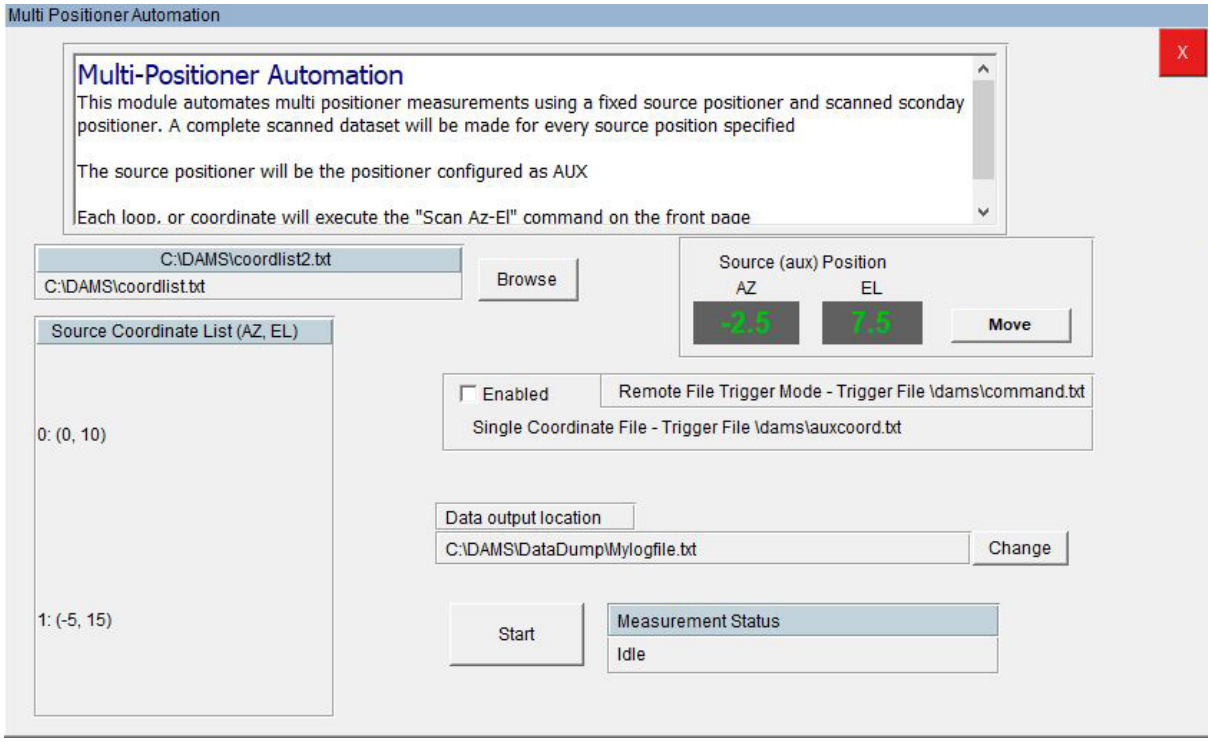
Viewing Data

Recall your desired register and open the Polar Plot → Over Frequency Plot to view the calibrated data for each antenna, use .TXT or Excel Export options to export the data.

Multi-Positioner Automation

Multi-Positioner Automation Module

This module, located under Automated Functions on he main page will set an auxiliary positioner to a specific position from a list or dynamically updated file and perform a full scan using the primary positioner controlled by the main DAMS software page. Since this module has the capability to collect massive amounts of data, the data will be stored directly to disk, each measured position will be stored as a separate file containing the magnitude and phase data for the entire frequency range. ***(See next page for file format examples)***



Source Coordinate List Specify a list of source position coordinates, an entire Az/El scan using the primary positioner will be made for each pair of coordinates

Remote File Trigger In this mode, the software will monitor the C:\dams\command.txt file , when the value in this file changes to a 1 , the software move the Source positioner to the coordinate located in C:\dams\auxcoord.txt and will perform an AZ/EL scan. In this mode the Coordinate list file is NOT used!!

Data Output Location Select a working directory where the log file will be located, the directory where the log file is located is also where all data files will be saved. As noted earlier a file for each AZ/EL position will be made containing all frequency information for that position.

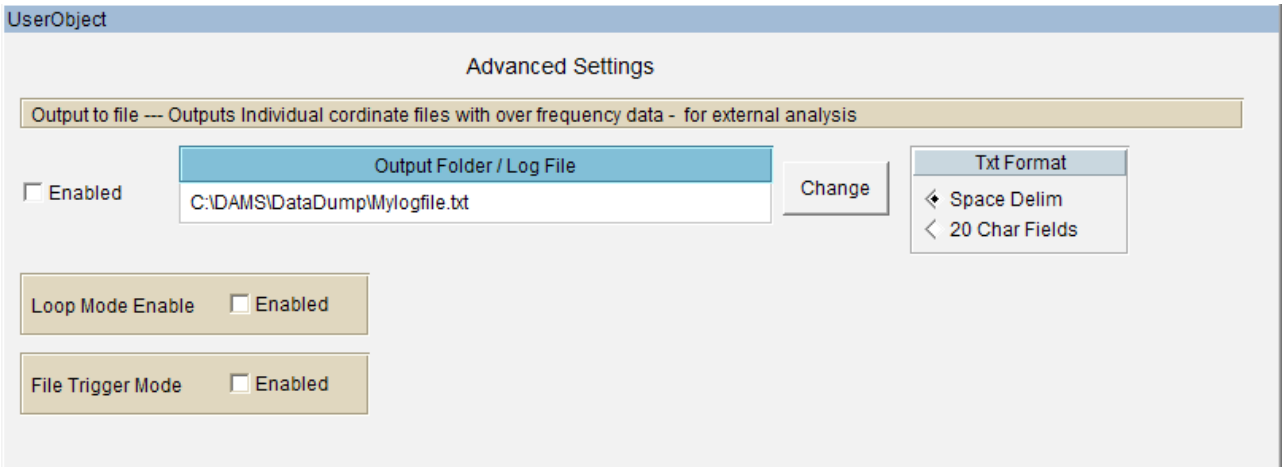
Status Displays the current operation being performed.

File Trigger Mode

File Triggering , Loop Mode, and Write to Disk

The DAMS Software can trigger a measurement and output the data to a file for external analysis the software can be triggered by writing a 1 to a certain file, upon a completed measurement the software will change the 1 back to a 0. From the main page,

Select System Options → Advanced Settings to display the menu below



Output to file For large measurements over 1,000,000 data points see following page for the example data format and file naming conventions.

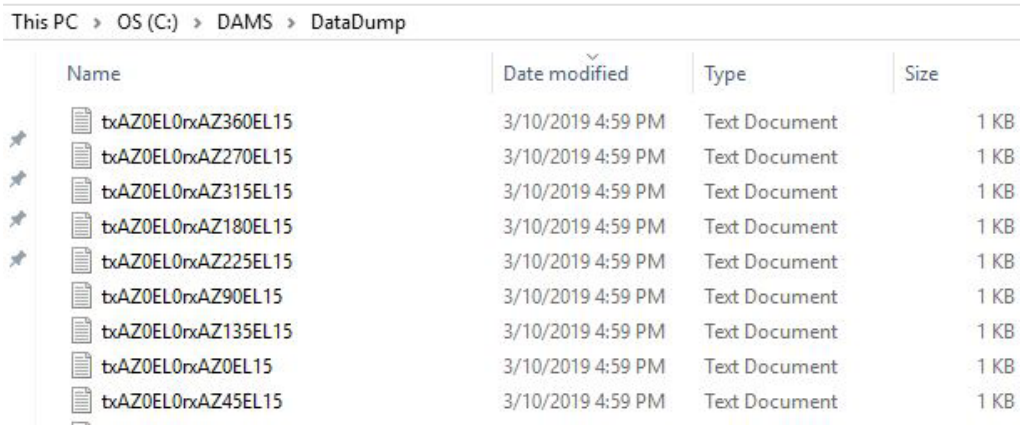
Loop Mode This sets the DAMS to loop mode, this mode is useful for demo displays or simply running the same pattern repeatedly.

File Trigger Mode Requires loop mode. When this mode is enabled, after you press any of the "begin measurement" buttons, the DAMS software will monitor the file C:\command.txt. When the 1 changes to a 0 the DAMS Software will execute a measurement and write a 0 back tot he file when finished.

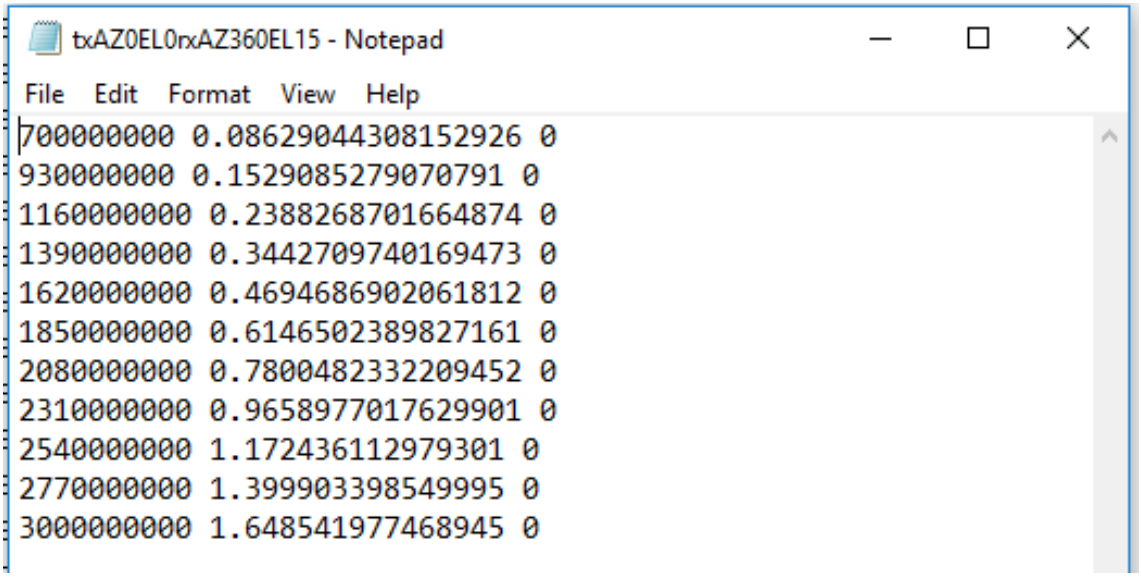
Automation Module - Exported File Format

Individual Coordinate Files

The automation module is designed to save the data directly to the disk instead of being plottable within the DAMS Software. This is because the DAMS software has a ~500K point limit and these measurements can easily exceed that value.



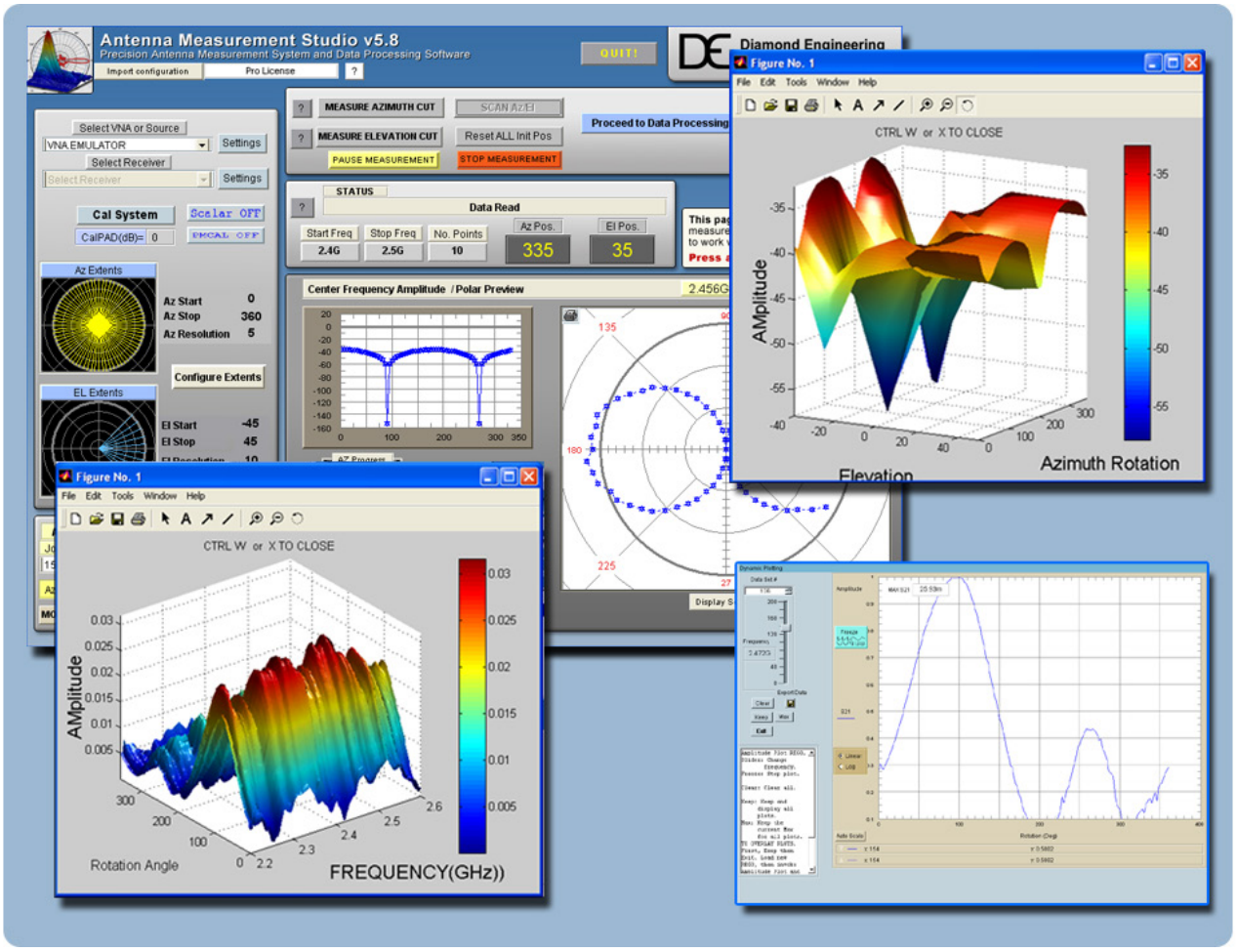
C:\DAMS\coordlist.txt - Each row is a pair of tab delimited coordinates - the format is AZ EL



Exported File Contents:
Format space/tab delimited:

(Frequency(Hz)) (Linear Magnitude) (Phase)

Utilizing the Data Processing Features



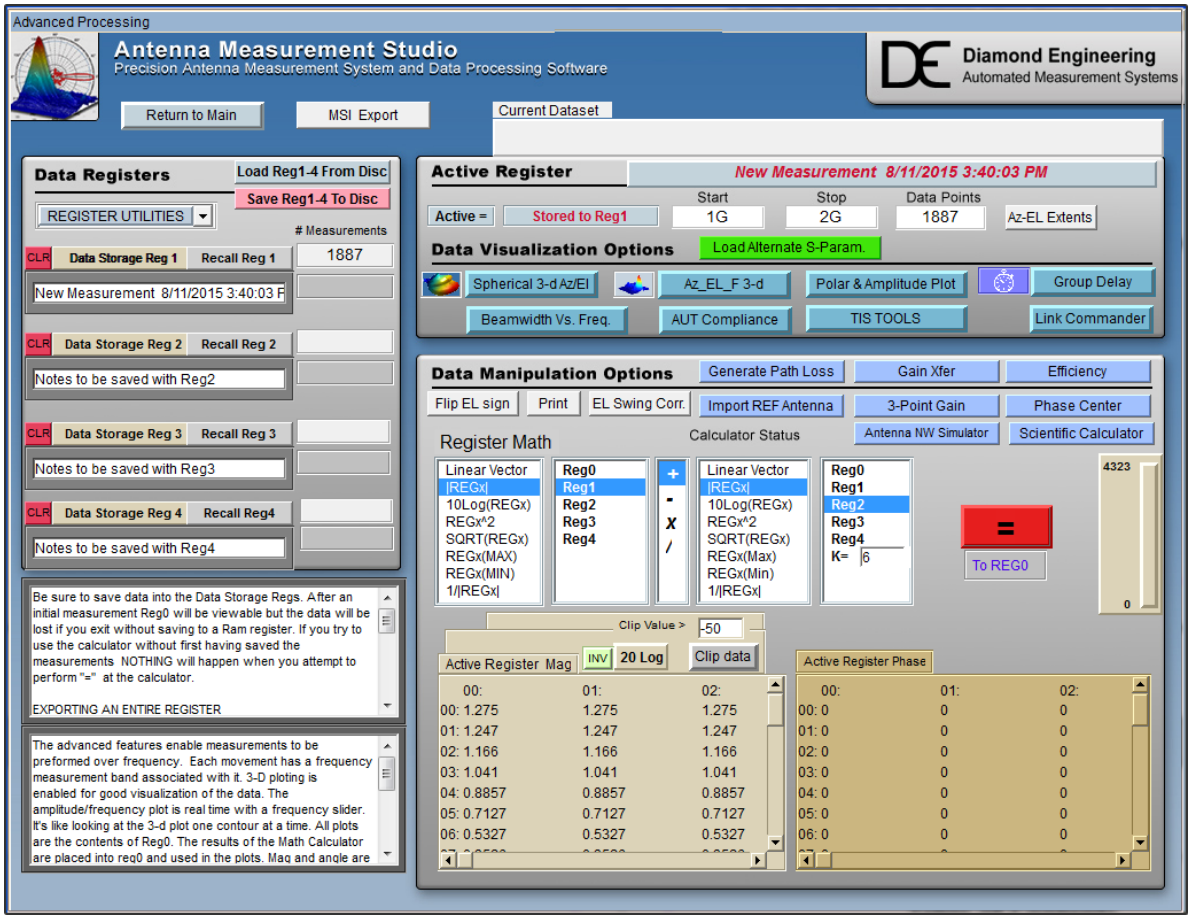
Post-Measurement Data Manipulation

Post-Measurement Data Manipulation

Introduction

Use the Data Processing section to work with the data you collected after you make any Antenna Measurements. This feature allows complete control over the data including the ability to completely manipulate the data using a large set of math operators as well as compare the current antenna to another Antenna or a calibrated reference antenna. A complete set of plotting options allow you visualize your data in a multitude of formats. This section of the manual will assist you with getting the most out of your Antenna Measurement System. If you are not familiar with any of the terms mentioned in this chapter, please refer to the Software Overview.

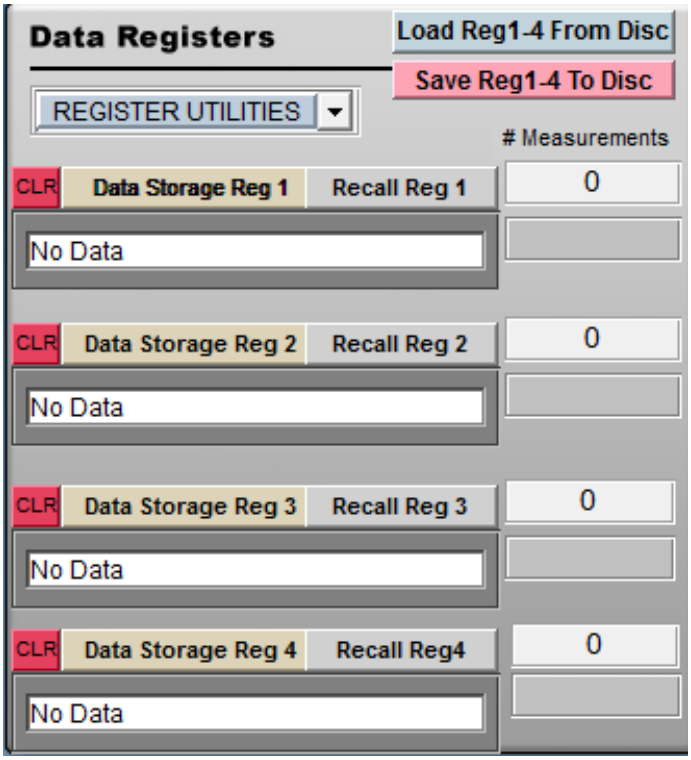
Screenshot



Saving & Loading Measurement Data Sets

All measurement data is stored in "data storage registers" and each data set consists of a group of four (4) data registers. These registers are used for storing and recalling data within the Data Processing feature and can be recalled or saved to disc at any time. The register labeled "Active Register" will contain your current measurement or any loaded measurement. All plots, graphs, and export features will be based off of this register, but is considered "temporary" and will not be saved to disc. Any active register data to be saved must be placed into one of the four data registers.

Once you enter the Data Processing section after making an antenna measurement, all of the measurement data is placed in the "Active Register". To save this data, click "Data Storage Reg 1". The data will be placed into Data Storage Register 1 (and causes a red * to be placed next to that data register). To save this data set to the hard drive, press "Save Reg 1-4 to disc".



QUICK TIP:

After entering Data Processing, click "Data Storage Reg 1" immediately to keep original measurement data available.

Data Storage Buttons All data in Active Register is stored to the storage area that you chose.

Recall Button All in that storage register will load into to the active register for viewing or modification.

Load Reg 1-4 From Disc This button will load a set of 4 registers from the disc.

Save Reg 1-4 To Disc This button will save a set of 4 registers to the disc.

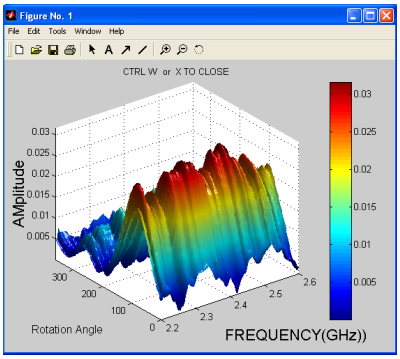
Clear All Registers This button will clear all data from registers 1-4.

Viewing & Working with 3D Measurements

Introduction

Press any of the 3D buttons to view the "Active Register" data in 3D using MatLAB Viewing Interface.

Viewing 3D Azimuth Measurements

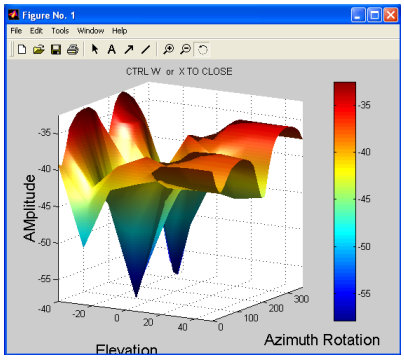


1. Ensure data is present in "Active Register". If there is no data, recall data from one of the storage registers or make a measurement.

2. Click "View 3D AZ Plot".

3. Depending on the size of your measurement and the speed of your computer, it may take up to two minutes for your 3D plot to render on screen.

Viewing 3D AZ/EL Measurements



1. Ensure data is present in "Active Register". If there is no data, recall data from one of the storage registers or make a measurement.

2. You can only view one frequency at a time using the AZ/EL 3D Plots. When you press the "View 3D AZ/El" measurements you will be prompted to choose which frequency to view.

3. Depending on the size of your measurement and the speed of your computer it may take up to two minutes for your 3D plot to render on screen.

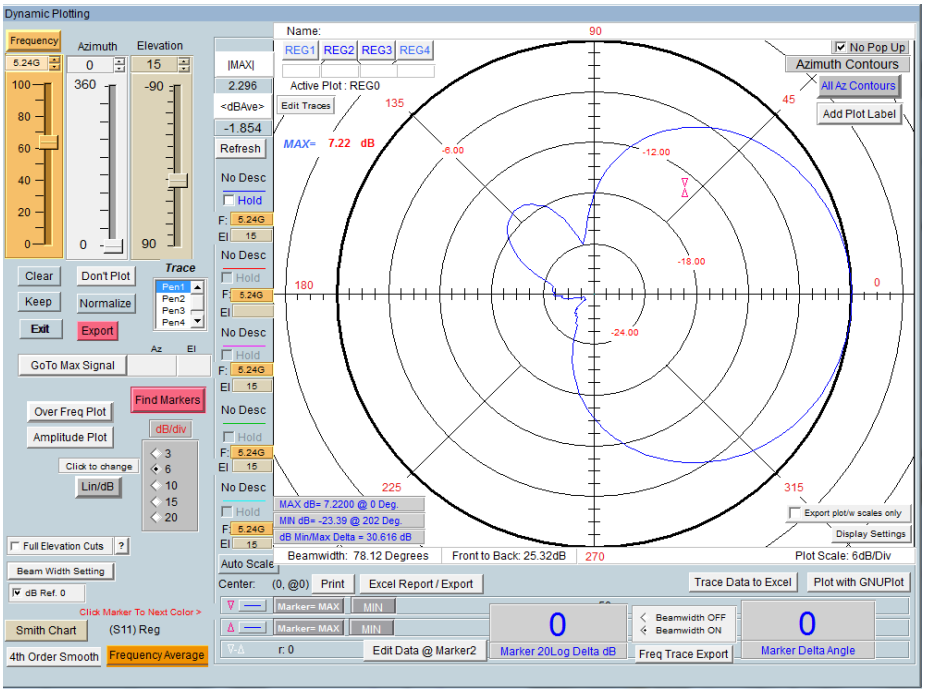
QUICK TIP: Amplitude Plot can get a reference of the frequency response for antenna.

Working With 3D Data

Rotate plot:	Tools → Rotate 3D
Print plot:	File → Print
Label plot:	Tools → Add → Text
Save plot:	File → Save (saved file compatible with MatLAB viewer only)
Export plot as image:	File → Export (exports BMP image)

Dynamic Polar / Amplitude Plots

The Polar and Amplitude plots allow you to view the Horizontal or Vertical sweep data over specific frequencies and/or elevations. The Polar and Amplitude plots have been combined to use the same control panel. Select the frequency and elevation (if applicable), and the data will be instantly displayed on the plot. Click "Amplitude Plot" to view the amplitude plot (click again to close).



Instructions for Dynamic Polar and Amplitude Plots

1. In main Data Processing window, click on "Polar/Amplitude Plot", revealing the screenshot above.
2. REG0 will be loaded automatically. Use the REGx buttons to select different data sets.
3. Use the sliders to browse through the data set.
4. Set Lin/Log and DB/DIV separation values as desired.

NOTE: If you have already calculated the path loss and applied it to the antenna, keep this feature UNCHECKED.

5. Markers located in center of the plot can be dragged to different areas of the trace, the resultant amplitude and angle differences are displayed in the large numerical windows at the bottom.
6. To export the current trace data, click "Export".
7. To save entire plot with number labels, you must use Windows' screen capture function by pressing the "Print Screen" button on your keyboard. Then paste the image into an image editing program where it can be further labeled or printed.
8. Click "Gain Plots" detailed instructions.

NOTE: Advanced procedures such as working with dual trace plots are discussed in the Advanced Techniques application note.

Importing Reference Antenna Data

Introduction

After you have made your antenna measurements and have entered the Data Processing area, you may then import your Reference Antenna data and Path Loss data for the measurement. This data can be directly applied to your measurement or you can be saved in it's own register for later use.

You can enter all of the gain values for a specific reference antenna into an appropriately formatted text document. The software will read and interpolate these values across the entire measurement frequency range of your measurement and place the values into the Active register, the calculator can now be used to apply the reference data to your register containing the original measurement data. See the REFhorn.txt file located in C:\DAMS.

Instructions

1. Make your antenna measurement and proceed to the Data Processing section.
2. Store your measured data into REG1
3. Click "Import Reference"
4. Click "Load from notepad file" and select your reference data file.
5. Wait until you see "Data loaded" and press "Continue".
6. The "Import Reference" button is now green indicating that reference data is present.
7. Reference data can be recalled into the active register for additional operations but is not required for basic gain transfer calculations.
8. If the path loss data has already been calculated you can now proceed with the Gain Transfer

 **NOTE:** See following page for example reference data.

Example Reference Antenna File

Example Reference Data

Example is for a 1-18 GHz horn.
Standard .TXT File
FORMAT: frequency(in ghz) (tab) gain value in dBi

```
1       6.7
1.5     8.7
2       7.3
2.5     8.1
3       8.9
3.5     8.7
4       9.6
4.5     9.6
5       8.7
5.5     9.4
6       9.4
6.5     9.7
7       9.6
7.5     9.8
8       10.4
8.5     10.6
9       11.3
9.5     11.1
10      11.6
10.5    11.3
11      10.9
11.5    10.6
12      11.6
12.5    11.2
13      11.7
13.5    10.8
14      11.2
14.5    11.1
15      12.2
15.5    12.9
16      12.5
16.5    10.7
17      9.8
17.5    9.4
18      9.3
```

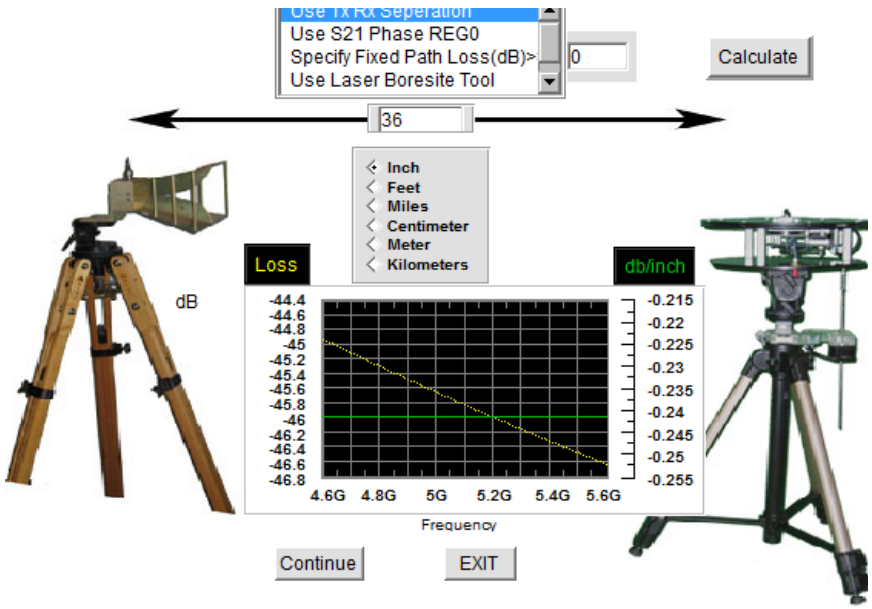
Calculating & Applying Path Loss Data

Introduction

You can calculate the loss for the given distance between two antennas using the path loss calculator. This process is nearly the same as importing reference data. The instructions below will show you how to simply apply the path loss data to your measurement and save that data into a new register.

Instructions

1. Make your antenna measurement and proceed to the Data Processing section.
2. Store your measured data into REG1
3. Click the "Calculate path loss" button
4. Enter your desired distance into the window and select your designator, the press calculate
5. Wait until you see "Data loaded" appear and press "continue"
6. The "Generate Path Loss" button is now green indicating that path loss data is present.
7. Path loss data can be recalled into the active register for additional operations but is not required for basic gain transfer calculations.
8. If the reference antenna data has already been imported you can now proceed with the Gain Transfer or Gain Substitution module.



Efficiency Measurements

Introduction

This module calculates the efficiency of a spherically measured antenna, the TRP can also be calculated if the transmit power is known.

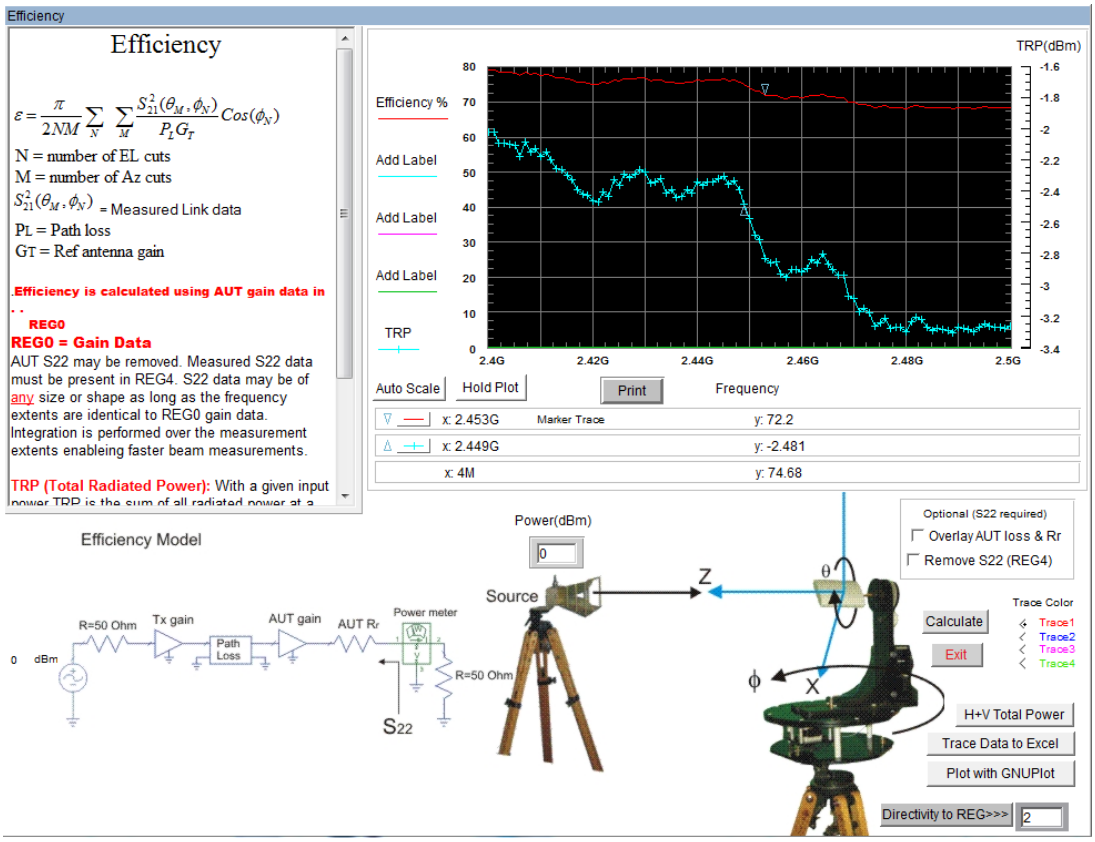
For optimal efficiency measurements it is required to make a full spherical measurement with the reference antenna in both the horizontal and vertical polarizations (H+V Total Power).

Prerequisites

1. Calculated gain data must be recalled into the active register prior to running the efficiency module.

2. If Total Power data is desired, the calculated gain for both polarizations must be located in Reg1 and Reg2 and the "Total Power" button can be used to combine both measurements. The result will be stored to Reg3.

3. S22 (reflection data) must be stored in Reg4 if you wish to de-embed the data.



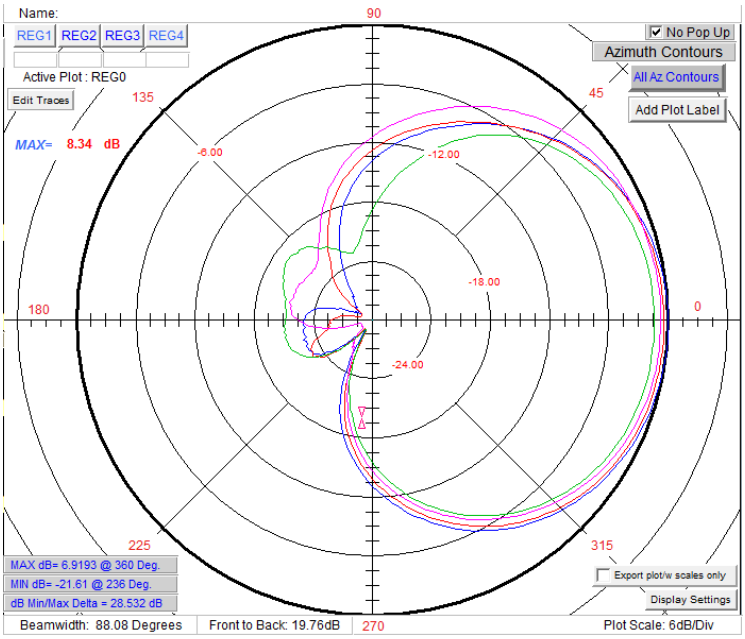
Multi-Trace Plots

Introduction

The DAMS Polar plot module includes an over frequency plot which is capable of multiple trace plots. Once a multi-trace plot has been generated it may be exported to excel or plotted with GnuPlot.

Multi-Trace Polar Plots

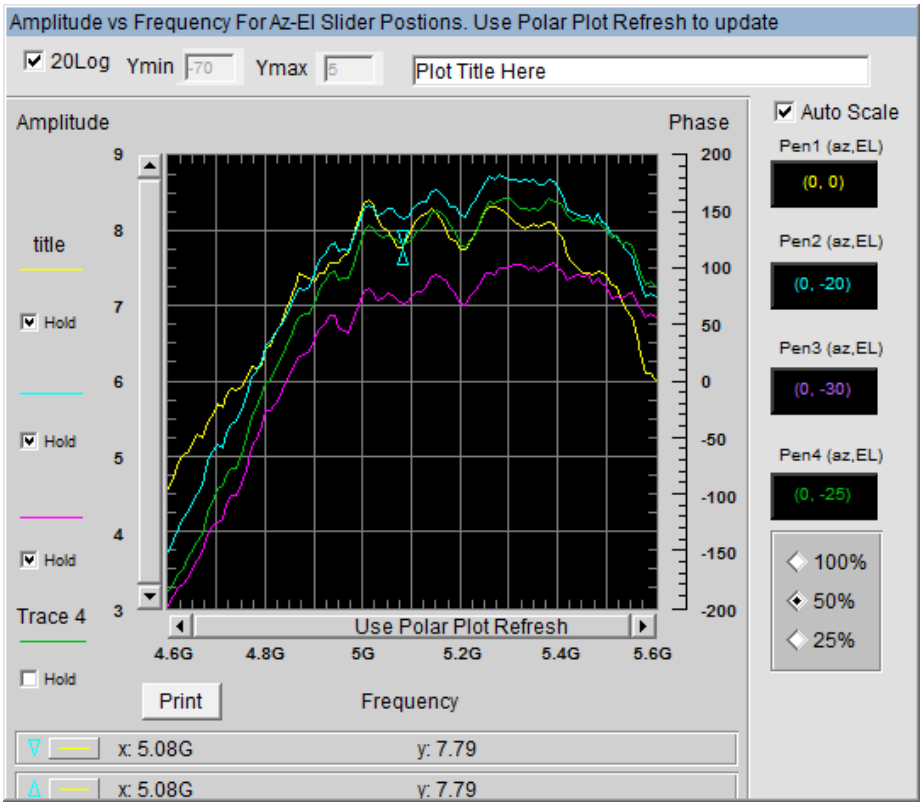
1. Have your desired measurements in the proper registers. *Note: multiple registers are not required as you can also select different frequencies of the same antenna to compare.*
2. Open the Polar / Amplitude Plot, default should be in dB.
3. Set desired plot scale dB/Div.
4. Find the freq/register you wish to compare with the highest gain (this should be the first one as we will normalize to this max value).
5. Make sure Pen1 is selected.
6. Press the normalize button, which normalizes the plot to this maximum gain level.
7. Press the first hold checkbox to the left of the polar plot.
8. Change to Pen2.
9. Select the next frequency/register for comparison.
10. Press the second hold button.
11. Change to Pen3.
12. Select your next register for comparison.
13. If desired, again select hold, then select pen 4 and load your last set.
14. Press Excel Export / Report, if your data looks good, Press “SEND TO EXCEL” or use “Plot with GnuPlot” and select the Multi-Trace check box.
15. If you wish to do another comparison, press the Normalize button again to undo normalization of the data. Also uncheck all the hold boxes and change back to pen1 before continuing.



Multi-Trace Over Frequency Plots

NOTE: It is important to follow these instructions in the exact order specified to ensure your exported plots and data match.

1. Ensure your desired measurements are in proper registers. *Note: multiple registers are not required as you can also select different frequencies of the same antenna to compare.*
2. Open the Polar / Amplitude Plot, default should be in dB.
3. Press the "Over Frequency" Button, be sure 50% size is selected
4. Move the plot over the polar plot itself to have access to the sliders and pen settings.
5. Using the polar plot sliders, find the first AZ/EL position for which you want to display
6. Ensure Pen1 is selected in the main polar plot window.
7. Press the first hold checkbox in the over frequency plot.
8. Change to Pen2.
9. Select the next Az/El (or another register for comparison).
10. Press the second hold button.
11. Change to Pen3.
12. Select your next register/point for comparison.
13. If desired, hold, select pen4 and load your last set.
14. Press Excel Export / Report, if your data looks good. Press "SEND TO EXCEL" or use "Plot with GnuPlot", where you will have the option to enter trace descriptions.
15. If you wish to do another comparison, press the Normalize button again to undo normalization of the data. Also uncheck all the hold boxes and change back to pen1 before continuing.

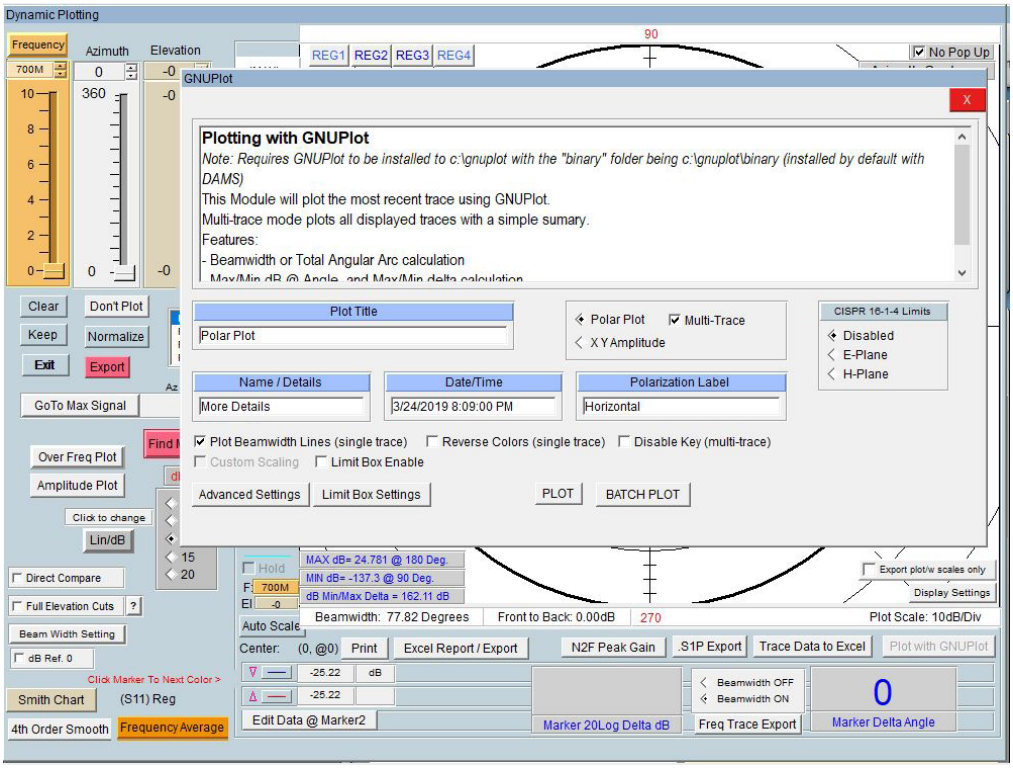


GnuPlot Polar and Amplitude Plots

Introduction

Certain measurement plots and data can be plotted using gnuplot which was installed with your software. Gnuplot produces multi-plot, publish quality plots. Below is information on which sections of antenna measurement studio support Gnuplot

2D Polar GnuPlot



Beamwidth Lines (single trace only) - Plots 3dB beamwidth lines on the single trace gnuplot.

Multi-Trace - Check this box when you have multiple traces selected in the polar plot.

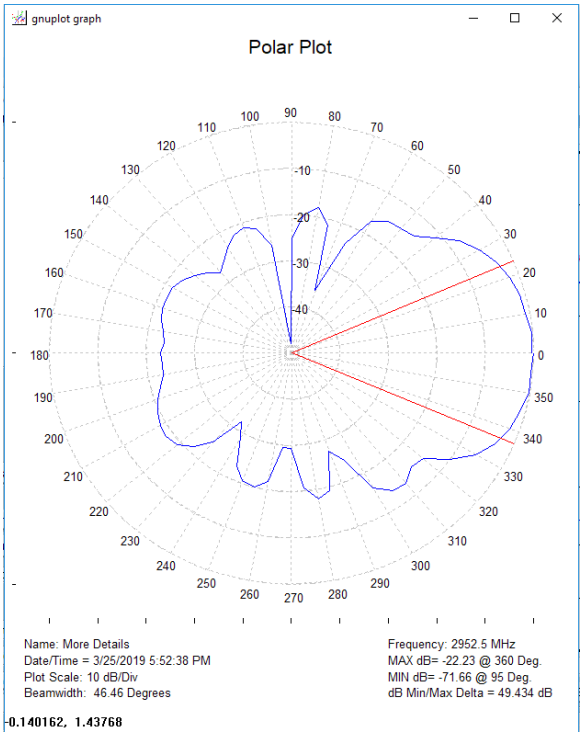
XY Amplitude - Cartesian XY plot of amplitude over rotation.

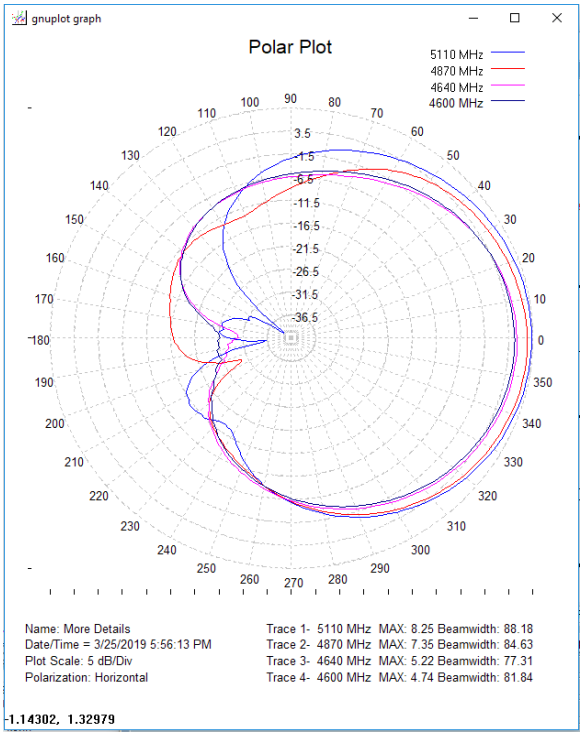
CISPR 16-1-4 - Generates CISPR Compliant plots (requires data to be collected as specified in CISPR standard)

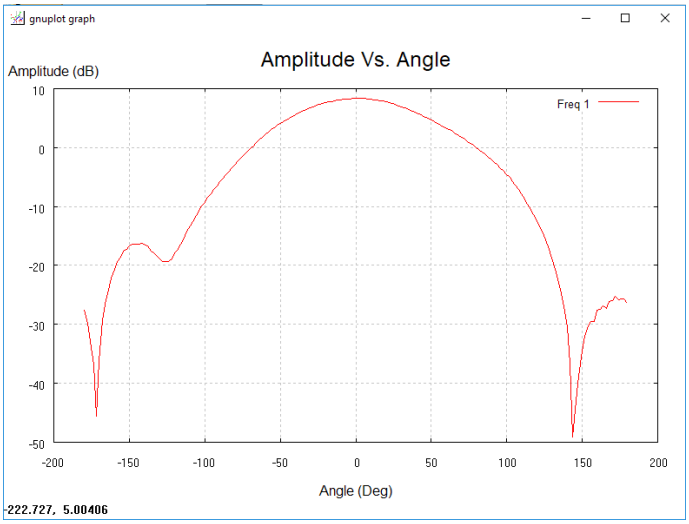
Polar / XY plot examples

Certain measurement plots and data can be plotted using gnuplot which was installed with your software. Gnuplot produces multi-plot, publish quality plots. Below is information on which sections of antenna measurement studio support Gnuplot.

NOTE: Gnuplot will auto-sense whether a polar or over frequency plot is being displayed and display the appropriate menu!!

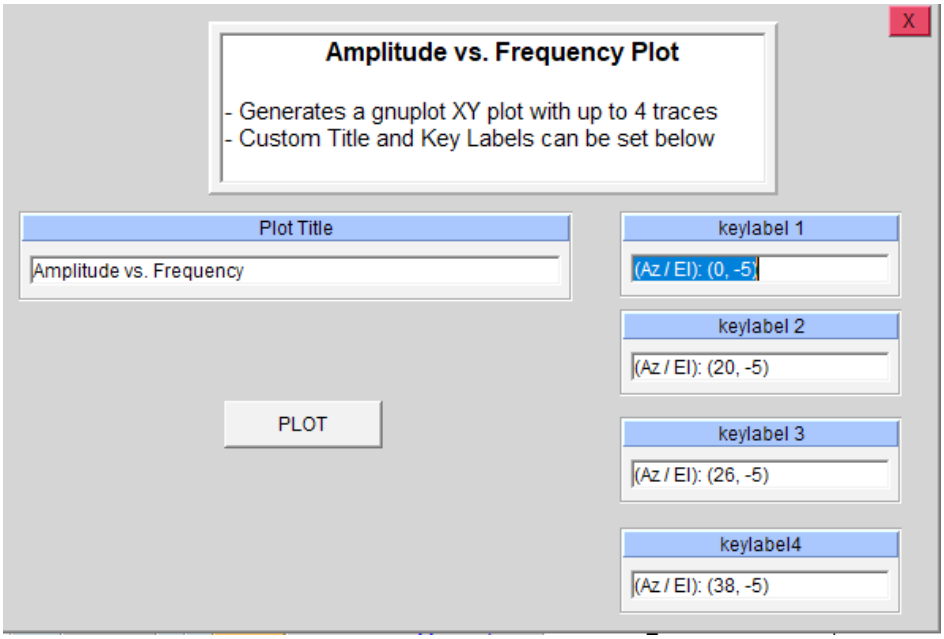


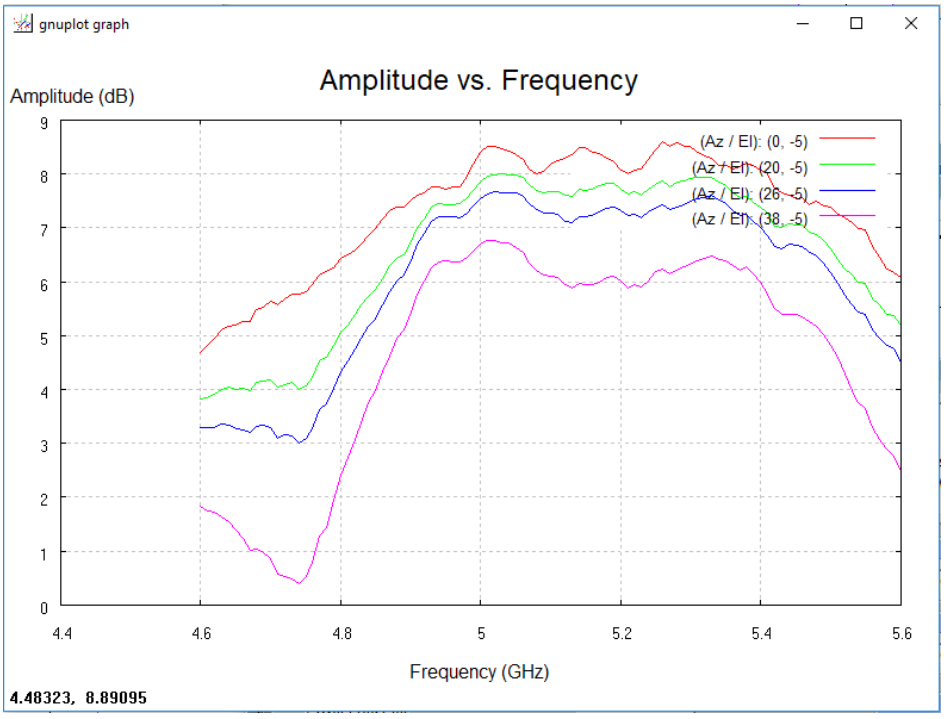




Over Frequency Plots (Launched from polar plot)

Over frequency plots follow all of the same procedures as the polar plot regarding single or multiple traces. The Over Frequency plot has the ability to change the trace descriptions, the default value is the AZ/EL position of the over frequency trace



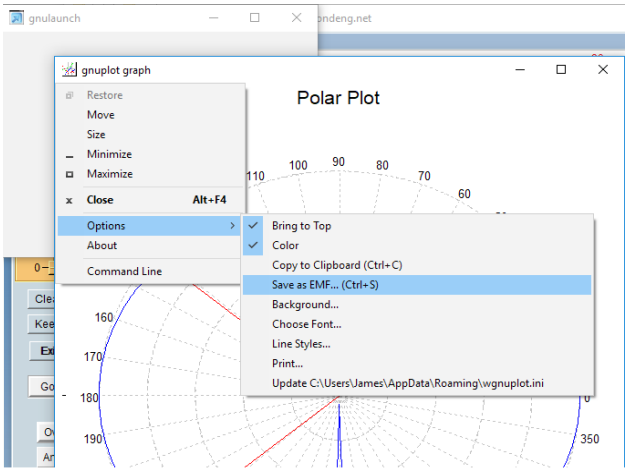


Saving Plots

Currently the default format for direct save from the GnuPlot window is .EMF format , this is a vector format that can be opened by a number of graphics editing applications.

To save a plot

1. Right click the upper left icon of the plot
2. Select Options → Save as .EMF
3. Select the save location and press save.

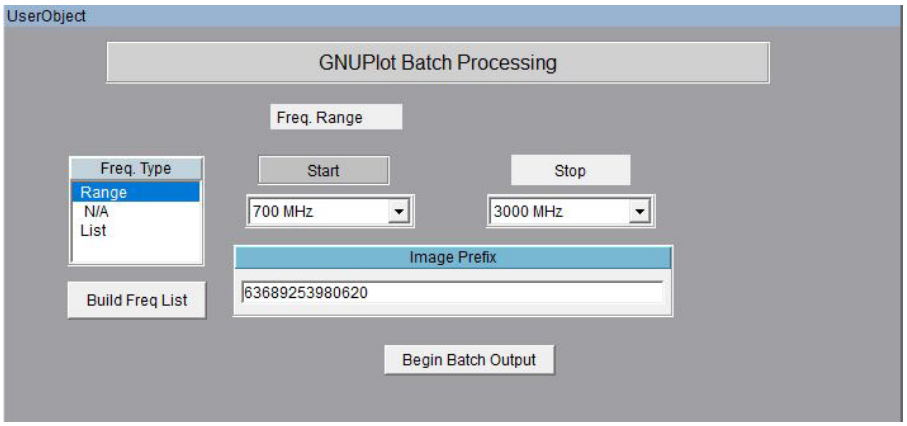


Batch Plotting

Batch plotting will export a polar plot of every frequency in the data set. Currently the only directory that files will be saved to is C:\DAMS therefore it is important to move the files into a new folder to prevent the clutter of the C:\DAMS folder

Range Types

Range	All frequencies between the start and stop frequencies
CW	Selects a single frequency
List	Select a list of point with any spacing

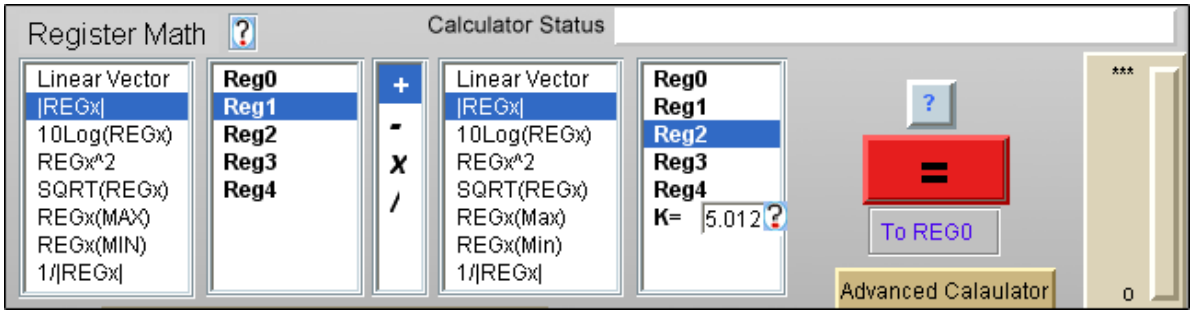


Measurement Calculator / Register Math Function

Introduction

Use this option to perform arithmetic operations on the measurement registers. For example if you make measurements on one antenna and wish to compare the results to another antenna at each point of rotation and each frequency. Or if you have a calibrated reference antenna an wish to normalize additional measurements to the max or min value of the reference antenna. Remember all measurement data is linear so you may want to "LOG" the data before doing math. If you select MAX or MIN then all measurement elements will be replaced with MAX or MIN. This creates a normalization reference if you do your math correctly.

Register Math / Calculator Screenshot



Understanding the Register Math Functions

Measurement data is initially stored in the Active register when you leave the main software page and enter the advanced processing section. When you proceed to the Data Processing Feature you have a choice of 4 additional registers in which to store Reg0.

NOTE: Measurement format is: **dataReg0-4[Mag,Phase,(Hpos,Vpos),0/1,freq]**

Each time you press the Reg calculator = sign the results are save to the Active Register. You can then save those results to any one of the 4 original Regs. Be sure to have saved the original to disc as it will be over written.

Math Functions

Linear When highlighted the Reg# to the right is to be used as S21 in vector format arithmetic is performed using vector components

LinearMag When highlighted the Magnitude of Reg # to the right is to be Logged (dB) and used as a scalar array in all arithmetic operations. The angle information is remains in the original Reg# but is lost in the calculator.

LOGmag When highlighted the Reg# to the right is to be used as 10LOG(S21^2) in scalar format The frequency S21 angle information remains in the original Reg # but is lost in the calculator.

^2 When highlighted the Reg# to the right is to be used in complex format and squared

SQRT When highlighted the Reg# to the right is to be used complex format ^(1/2)

Max When highlighted the Reg# to the right Maximum Linear value is to be used in all matrix arithmetic. This provides a good way to normalize measurements. The frequency S21 angle information remains in the original Reg# but is lost in the calculator.

Min When highlighted the Reg# to the right Minimum Linear value is to be used in all matrix arithmetic. This provides a good way to normalize measurements. The frequency S21 angle information remains in the original Reg# but is lost in the calculator.

Constant Use the constant option to +-/* a constant to the first register set (left) This is useful when you wish to add level shifts such as 3dB for HV polarization measurements not accounted for anywhere else.

Clip Function

Use this to create a threshold level. A ZERO value clip causes software to ignore clipping and resume normal calculator mode.
For example lets say the you wish to not include data points smaller than some low level value such as <-50dBM.

Enter the value -50 into the constant window Understanding the Register Math Functions and highlight "Clip". This will operate on only the data from the first set (left of the +-*/). Any magnitude values LESS that the clip value will be set EQUAL to the clip value.

NOTE: The plotting functions will be affected by the clip value. Use this to scale and expand the plots. Notice also that the calculator can be used to change the plot scales from linear to log or to add offset to measurements.

TERM 1 MULTIPLIER	**Works with**
LINEAR	+,-
linMag	+,-,*,/
LogMag	+,-,*,/

TERM 2 MULTIPLIER
All functions above plus Constant

IMPORTANT: Not all combinations of math are possible. Ensure you have same size data array.

Exporting Data for Howland N2F Software

N2F Software Compatibility

DAMS Antenna measurement studio can be used to collect an export spherical near field data to be processed using 3RD party N2F transform software.

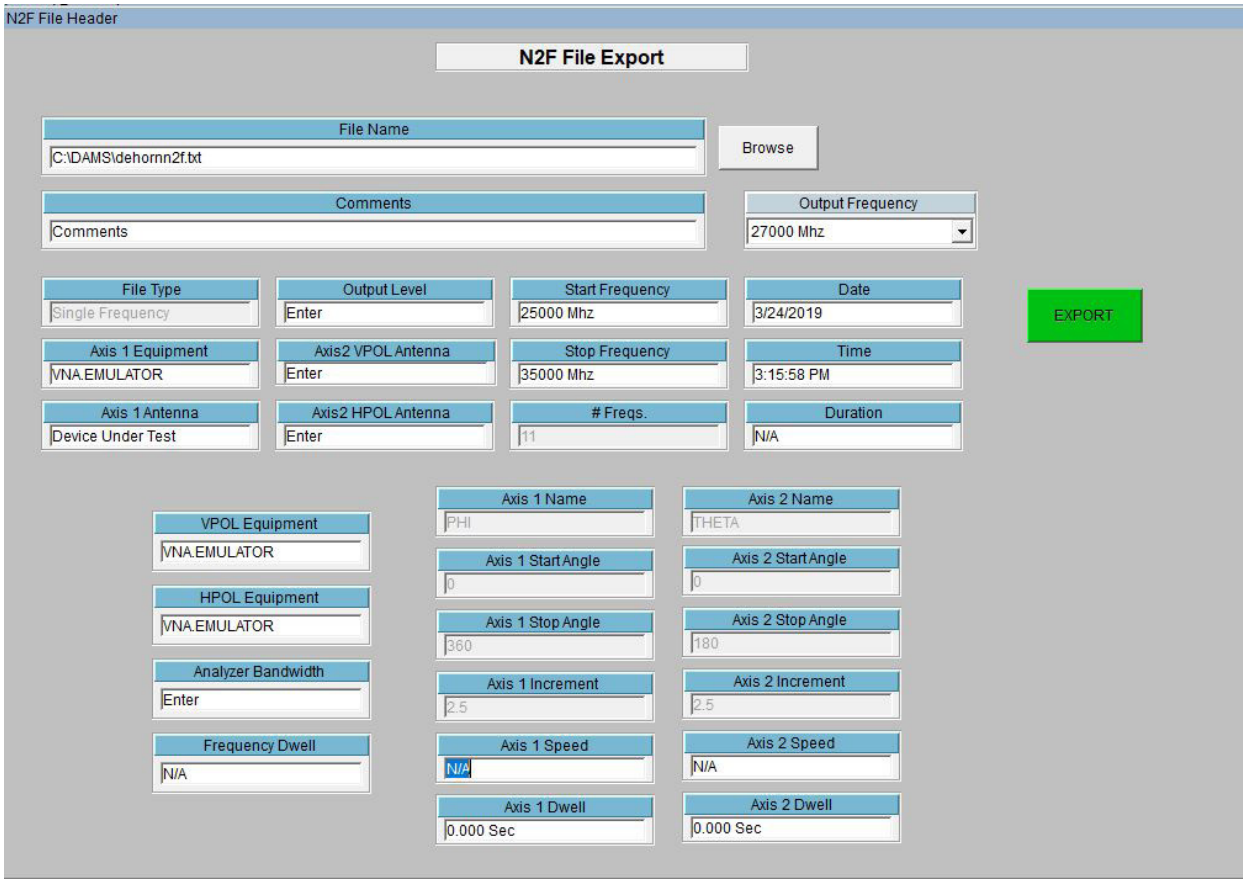
Exporting Calibration or AUT scan data for Nearfield Processing

Make a spherical scan at your desired frequency range and axis resolution, you will need a scan at horizontal position and a scan at vertical calibration. Non Symmetrical axis resolution will generate an error in the Howland software but will still process data. Store one polarization to REG1 and the Other polarization to REG2 Located under "Register Utilities" in the DAMS software you will find N2F data export, when this is selected you will be presented with the screen below:

N2F Data Export Screen

1. Browse and select the export file location, .txt format is required
2. Select your frequency to export

NOTE: Greyed out areas are mandatory / auto-filled other fields are not required but can be viewed within the N2F software and are useful for making notes about the measurement.



Example .N2F File

Howland Wireless Test Lab Ver: V5.02
Date: 3/19/2019
Time: 9:03:27 AM
File Name: C:\DAMS\n2fCHbalCal.txt
File Type: Single Frequency

Antenna Pattern Test
Network Analyzer Measurement
Measurement Mode: Relative
Calibration Standard Antenna: None
_____

Device Under Test (DUT): Dut Antenna
DUT Test Position: Free Space

Test Type: Discrete Test
Test Duration: N/A
Test Comments: Comments

Axis2 VPOL Antenna: Enter
Axis2 HPOL Antenna: Enter
Axis1 Antenna: Device Under Test

Axis1 Equipment: HP8722
Test Frequency: 32000 Mhz
Output Level: Enter
Frequency Count: 11
Start Frequency: 25000 Mhz
Stop Frequency: 35000 Mhz

VPOL Equipment: HP8722
HPOL Equipment: HP8722
Network Analyzer Bandwidth: Enter
Frequency Dwell: N/A

Axis1 Name: PHI
Axis1 Start Angle: 0.000
Axis1 Stop Angle: 360.000
Axis1 Increment: 2.500
Axis1 Speed: N/A
Axis1 Dwell: 0.000 Sec

Axis2 Name: THETA
Axis2 Start Angle: 0.000
Axis2 Stop Angle: 165.000
Axis2 Increment: 2.500
Axis2 Speed: N/A
Axis2 Dwell: 0.000 Sec

******* Insertion Loss Measurement Results ********
Network Analyzer Response Correction: OFF

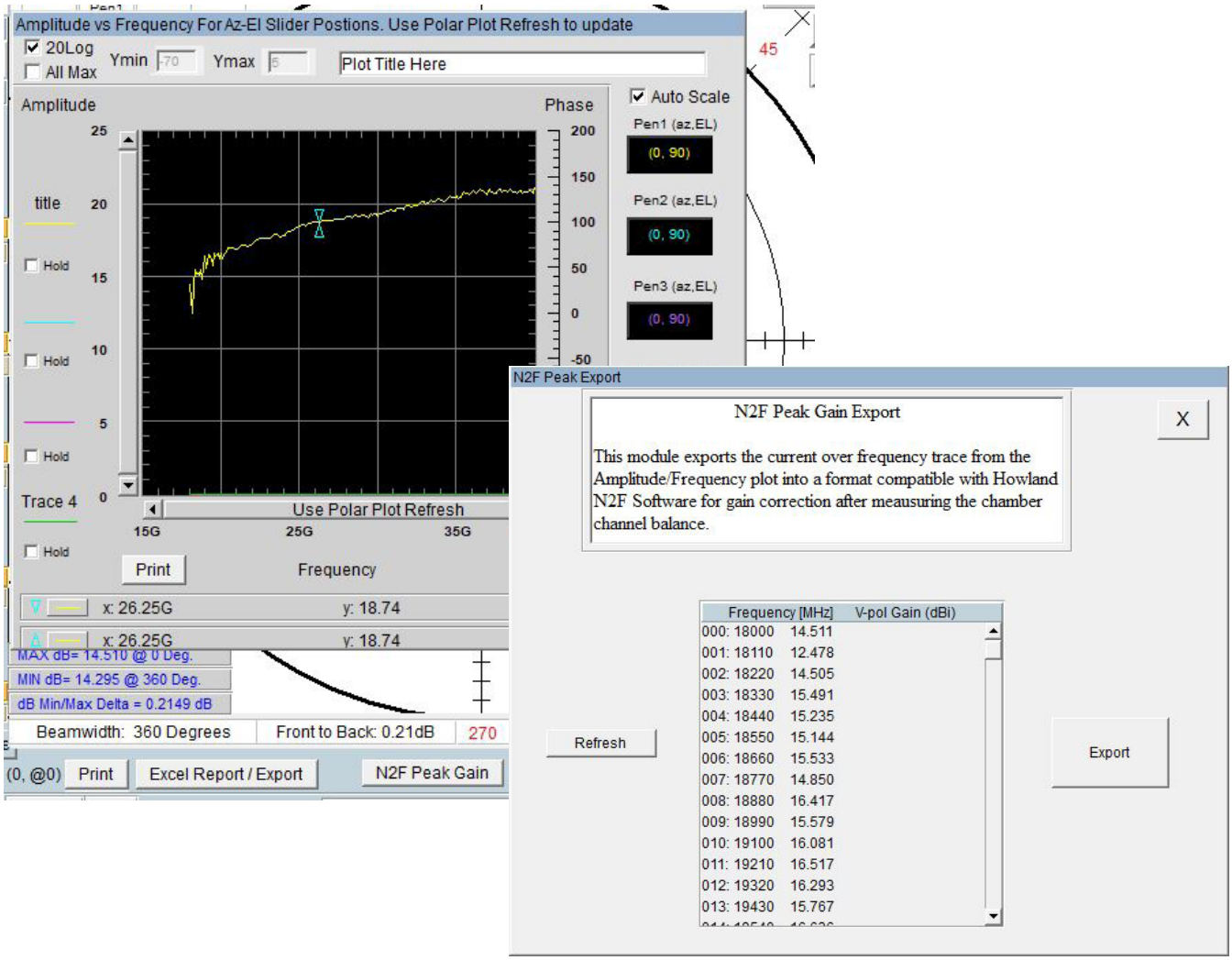
		H-Pol	H-Pol	V-Pol	V-Pol
THETA	PHI	Mag	Phase	Mag	Phase
(deg)	(deg)	(dB)	(deg)	(dB)	(deg)
0.00	0.00	-23.160	-15.97	-49.198	-10.83
0.00	2.50	-23.142	-18.10	-42.728	-3.89
0.00	5.00	-23.119	-18.19	-39.318	-5.44
0.00	7.50	-23.273	-18.65	-37.028	-1.30
0.00	10.00	-23.340	-18.38	-34.946	-4.35
0.00	12.50	-23.385	-18.40	-33.639	-4.79
0.00	15.00	-23.530	-19.24	-32.099	-4.50

Exporting Peak Gain data for Nearfield calibration / correction

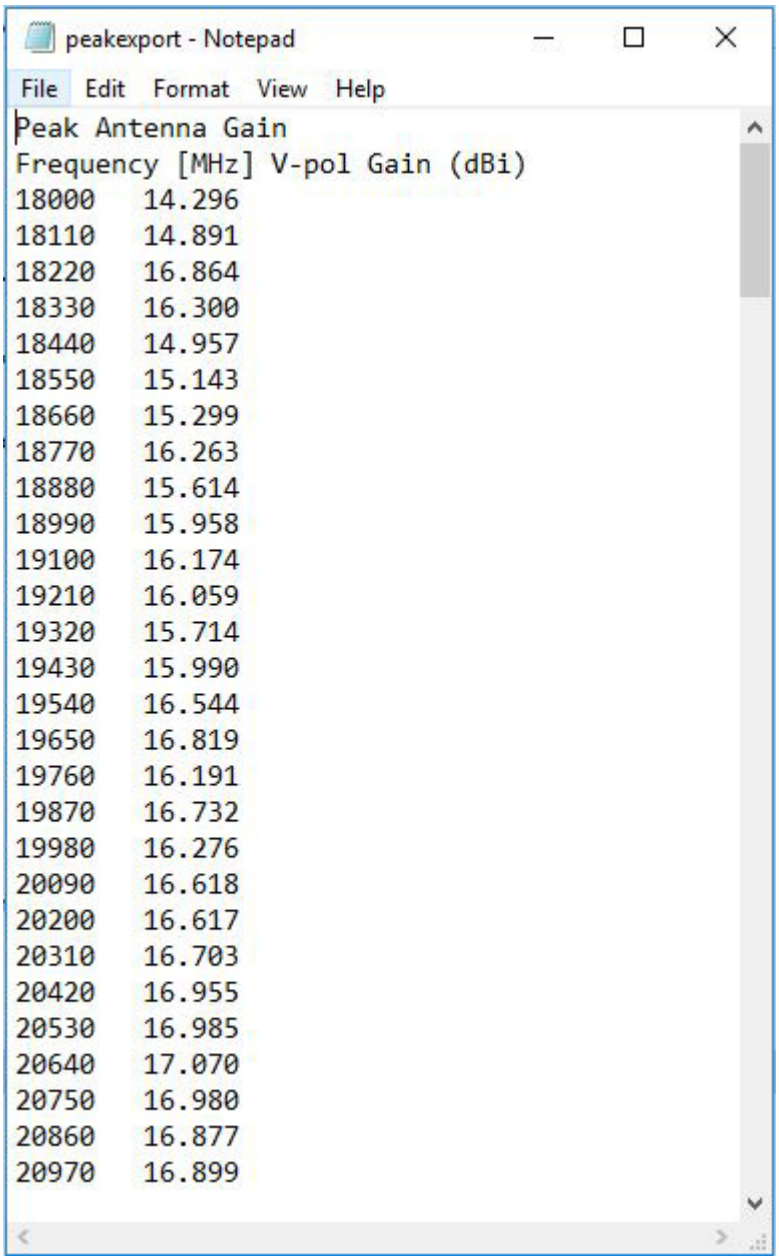
Similar to the reference import format for the DAMS software, the N2F software requires a specific format for peak gain data, this data is used for the substitution style calibration of the N2F software this file is used in conjunction with the antenna that you used for the channel balance measurement / calibration.

N2F Peak Gain Export

1. Load or recall the desired data set into the DAMS Software, this data will contain over-frequency data for your calibrated antenna.
2. Load the polar plot and select "Over Frequency Plot'.
3. Navigate to the desired AZ/EL position which contains the Peak or calibrated gain data. While the over frequency plot is displayed, press the N2F export button in the main polar plot.



Example .N2F Peak Gain File



Exporting Data

Export Methods

The DAMS software offers you 2 ways to export your data. We refer to them as the "REGISTER EXPORT" which will export your entire measurement set over the entire horizontal/vertical axis and over frequency and the "SINGLE FREQUENCY" export which can be found in the "Polar and Amplitude" plot function in the Data Processing section.

Single Frequency Export Instructions

Available in the Polar/Amplitude Module.

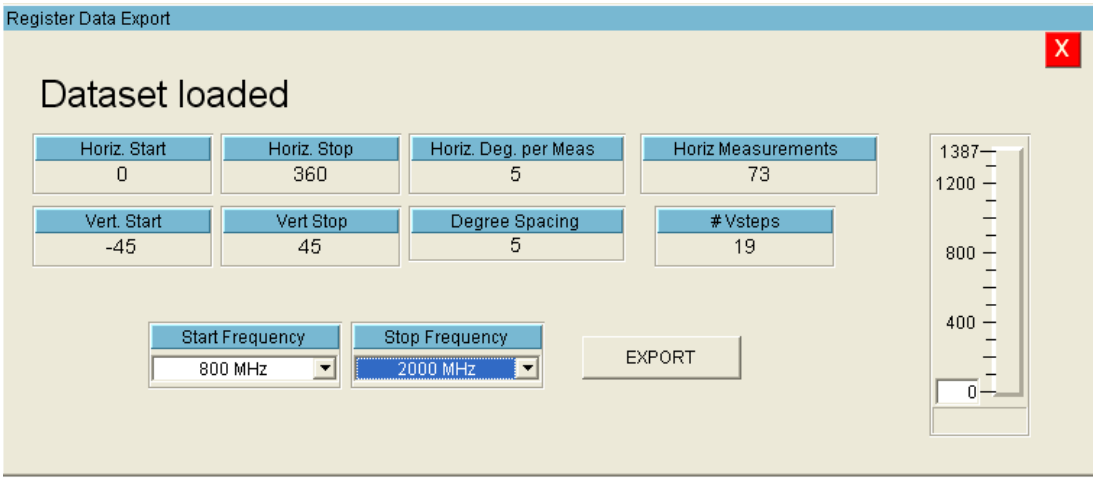
After loading the Polar Plot, select desired frequency and click "Export Data". You will be prompted to select a file name.

EXPORTED DATA EXAMPLE

```
!  Saturday July,16  2005
!  Freq = 896MHz          Elevation = 0
!  Azimuth          S21mag        S21ang
   0                0.0169        86.8
   5                0.0146        81.6
   10               0.0151        82.9
   15               0.0141        81.4
   20               0.0135        81.9
   25               0.0129        82.4
   30               0.0123        82.8
   35               0.0114        84
```

Register Export Screenshot

This feature is located in the Advanced Processing window under "Register Utilities".



Register Export Instructions

1. Under the "Register Options" pull-down located in the data processing section, click "Register Export" button and select one of your 4 data registers that you would like to export.

2. Verify the parameters are correct and select your desired frequency range to export.

3. Press the Export button and choose the file to export to.

NOTE: Some programs have a limit on the number of columns that they can input. If importing fails, try reducing the number of frequencies that are exported.

Example Exported File

Azimuth Elevation Freq.1 Mag Freq.1 Phase Freq.2 Mag Freq.2 Phase

C:\DAMS\AdvancedExport\testexport.txt

Azimuth	Elevation	854000000		860000000	
0	-45	0.0073389955	56.00155	0.0075925113	-46.104067
5	-45	0.0066556963	38.083739	0.0067356808	-64.358889
10	-45	0.0063229896	39.090269	0.0061538937	-62.531082
15	-45	0.0056502828	37.393564	0.0055037691	-62.34994
20	-45	0.0058736247	39.32346	0.0057624272	-61.984988
25	-45	0.0056197749	39.32101	0.0055511257	-61.766101
30	-45	0.0053924567	39.168881	0.0049243659	-60.207258
35	-45	0.0051994658	39.407125	0.0051107474	-62.184654
40	-45	0.0050164525	38.297067	0.0048906071	-64.315777
45	-45	0.0047651581	36.329346	0.0046334455	-66.482573
50	-45	0.0044033717	35.654601	0.0043345237	-66.733488
55	-45	0.0040289231	33.845266	0.004053478	-69.718299
60	-45	0.003853513	30.926909	0.0037650155	-73.047278
65	-45	0.0036035837	26.292688	0.003521638	-77.165236

Importing Register Export Data into Excel

The data generated by the Register Export feature is directly importable into EXCEL by following the steps below.

1. Open Excel. Select File → Open. In the file type pull-down menu, select "Text Documents (*.txt)" to easily locate your file and click "Open".

2. In the box labeled "Original data type", select "Fixed Width" and click "Finish". Additional options can be set but are not required to complete import.

3. Your data should open segregated into individual cells within a new Excel Workbook.

testexport.txt

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Azimuth	Elevation	8.54E+08		8.6E+08		8.66E+08		8.72E+08		8.78E+08		8.84E+08		8.9E+08
2	0	-45	0.007339	56.00155	0.007593	-46.1041	0.006929	-143.358	0.006749	129.4986	0.007748	40.41213	0.009109	-53.9315	0.010393
3	5	-45	0.006656	38.08374	0.006736	-64.3589	0.005624	-163.868	0.004947	115.6173	0.006215	32.70906	0.007523	-62.2365	0.008727
4	10	-45	0.006323	39.09027	0.006154	-62.5311	0.00525	-158.609	0.004892	122.3427	0.006338	37.30346	0.007641	-58.8741	0.008913
5	15	-45	0.00565	37.39356	0.005504	-62.3499	0.004597	-155.447	0.004538	127.7777	0.006189	40.85088	0.007455	-56.3237	0.008658
6	20	-45	0.005874	39.32346	0.005762	-61.985	0.004813	-158.468	0.004525	125.5857	0.005961	39.78112	0.007245	-55.6459	0.008543
7	25	-45	0.00562	39.32101	0.005551	-61.7661	0.004621	-158.996	0.004231	126.2276	0.005782	41.99935	0.006984	-54.266	0.008297
8	30	-45	0.005392	39.16888	0.004924	-60.2073	0.004465	-159.616	0.003943	125.6671	0.005306	43.07865	0.006688	-53.0356	0.007945
9	35	-45	0.005199	39.40713	0.005111	-62.1847	0.004198	-159.593	0.003628	126.3697	0.005105	44.35955	0.00636	-51.4501	0.007661
10	40	-45	0.005016	38.29707	0.004891	-64.3158	0.003845	-161.7	0.00336	126.1821	0.004705	45.89377	0.005981	-49.6135	0.007213
11	45	-45	0.004765	36.32935	0.004633	-66.4826	0.003674	-164.155	0.002966	125.6513	0.004387	47.48266	0.005615	-48.6861	0.006793
12	50	-45	0.004403	35.6546	0.004335	-66.7335	0.003356	-167.158	0.002556	125.0053	0.003944	49.95079	0.005146	-46.7391	0.006339
13	55	-45	0.004029	33.84527	0.004053	-69.7183	0.003128	-170.157	0.00219	122.7735	0.003503	51.89093	0.00476	-45.0396	0.005946
14	60	-45	0.003854	30.92691	0.003765	-73.0473	0.00288	-176.062	0.001741	119.9528	0.003145	52.8598	0.004247	-43.0754	0.005423
15	65	-45	0.003604	26.29269	0.003522	-77.1652	0.002594	178.8517	0.00136	116.2999	0.002681	55.51167	0.003826	-41.0469	0.004885
16	70	-45	0.003392	22.30606	0.003298	-83.8062	0.002459	169.1898	0.001057	103.8079	0.00229	58.20725	0.003434	-38.97	0.00443

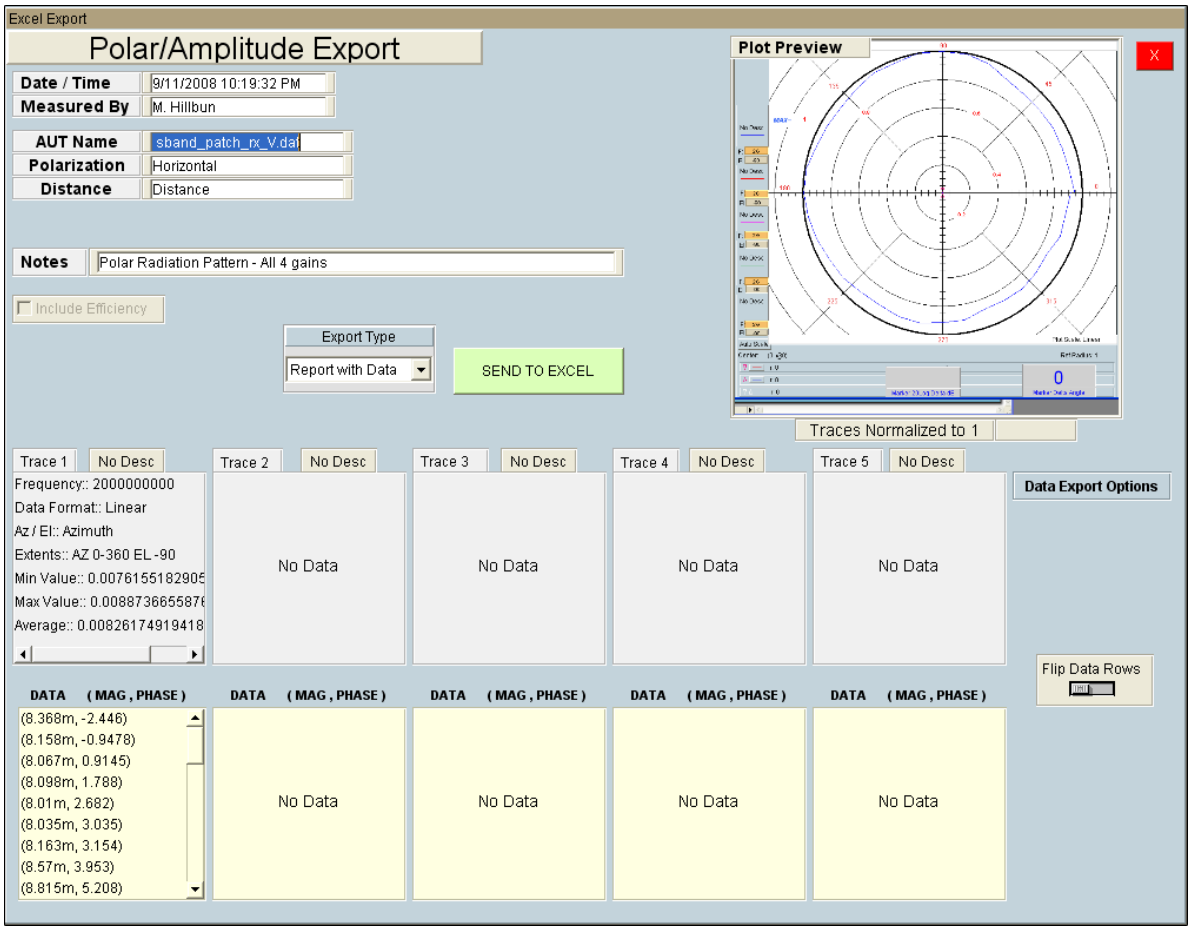
testexport

Excel Report - Polar Plot and Over Frequency

Introduction

The Report function is located in the Polar Plot feature. 2 Methods are offered for making a printable measurement report including a polar plot and antenna information. After you have plotted your antenna at the desired frequency and applied any other settings (DB, Markers, scale, etc) press the Printable Report button.

Excel Export Screenshot



Features & Options

Report and Data — Generates a two-page Excel spreadsheet containing plot with trace details on page one and actual trace data on page two.

Report Only — Only exports the image with trace details such as min., max. or avg.

Data Only Exports a multi-column sheet of all displayed trace data

Flip Rows Should you want to reverse the data plotting direction, this will reverse the direction of the measurements made. (*Example: 0-360 becomes 360-0)*

Include Efficiency Box If the Efficiency function has been used this option becomes selectable. You may choose to export the efficiency trace numbers along with the standard trace data.

Export Types Examples

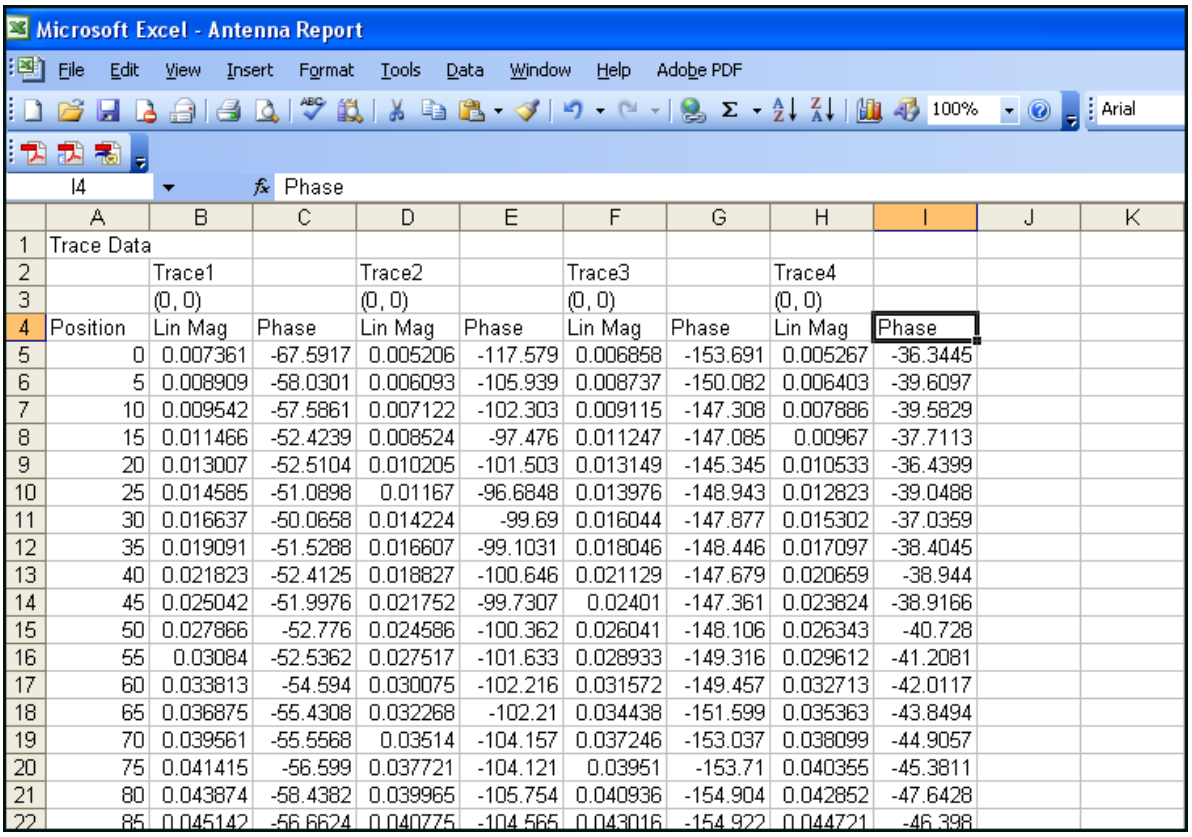
Sheet 1 - Plot Image with Trace Details

	A	B	C	D	E	F
1						
2	AUT Name:	sband_patch_rx_V.dat		Measured By:	M. Hillbun	
3	Polarization:	Horizontal		Date / Time:	9/16/2008 12:04:20 AM	
4	Distance:	Distance		Notes:	Polar Radiation Pattern - 4 Trace	
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40	Trace	No Desc	No Desc	No Desc	No Desc	
41	Frequency	5072 Mhz	5112 Mhz	5152 Mhz	5064 Mhz	
42	Format	20Log	20Log	20Log	20Log	
43	Az / El	Azimuth	Azimuth	Azimuth	Azimuth	
44	Position	AZ 0-360 EL -5	AZ 0-360 EL -5	AZ 0-360 EL -5	AZ 0-360 EL -5	
45	Gain Min.	-71.746902	-73.179115	-57.007311	-58.735098	
46	Gain Max.	-26.612587	-27.669432	-27.245524	-26.909033	
47	Avg. Gain	-36.358196	-38.014940	-36.945162	-36.512714	

(Continues next page...)

Export Types Examples (Continued)

Sheet 2 - Trace Details



Microsoft Excel - Antenna Report

File Edit View Insert Format Tools Data Window Help Adobe PDF

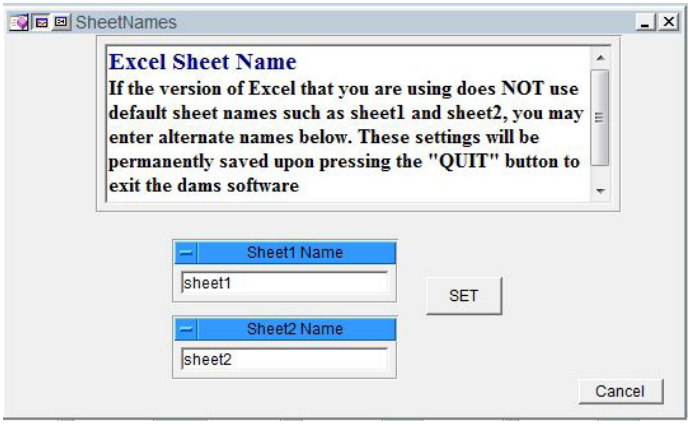
I4 fx Phase

	A	B	C	D	E	F	G	H	I	J	K
1	Trace Data										
2		Trace1		Trace2		Trace3		Trace4			
3		(0, 0)		(0, 0)		(0, 0)		(0, 0)			
4	Position	Lin Mag	Phase	Lin Mag	Phase	Lin Mag	Phase	Lin Mag	Phase		
5	0	0.007361	-67.5917	0.005206	-117.579	0.006858	-153.691	0.005267	-36.3445		
6	5	0.008909	-58.0301	0.006093	-105.939	0.008737	-150.082	0.006403	-39.6097		
7	10	0.009542	-57.5861	0.007122	-102.303	0.009115	-147.308	0.007886	-39.5829		
8	15	0.011466	-52.4239	0.008524	-97.476	0.011247	-147.085	0.00967	-37.7113		
9	20	0.013007	-52.5104	0.010205	-101.503	0.013149	-145.345	0.010533	-36.4399		
10	25	0.014585	-51.0898	0.01167	-96.6848	0.013976	-148.943	0.012823	-39.0488		
11	30	0.016637	-50.0658	0.014224	-99.69	0.016044	-147.877	0.015302	-37.0359		
12	35	0.019091	-51.5288	0.016607	-99.1031	0.018046	-148.446	0.017097	-38.4045		
13	40	0.021823	-52.4125	0.018827	-100.646	0.021129	-147.679	0.020659	-38.944		
14	45	0.025042	-51.9976	0.021752	-99.7307	0.02401	-147.361	0.023824	-38.9166		
15	50	0.027866	-52.776	0.024586	-100.362	0.026041	-148.106	0.026343	-40.728		
16	55	0.03084	-52.5362	0.027517	-101.633	0.028933	-149.316	0.029612	-41.2081		
17	60	0.033813	-54.594	0.030075	-102.216	0.031572	-149.457	0.032713	-42.0117		
18	65	0.036875	-55.4308	0.032268	-102.21	0.034438	-151.599	0.035363	-43.8494		
19	70	0.039561	-55.5568	0.03514	-104.157	0.037246	-153.037	0.038099	-44.9057		
20	75	0.041415	-56.599	0.037721	-104.121	0.03951	-153.71	0.040355	-45.3811		
21	80	0.043874	-58.4382	0.039965	-105.754	0.040936	-154.904	0.042852	-47.6428		
22	85	0.045142	-56.6624	0.040775	-104.565	0.043016	-154.922	0.044721	-46.398		

Excel Sheet Settings - For Excel 2013 and International Customers

Excel 2013 Customers: In Excel, click file then options, change the default number of sheets to 3

International customers: You may experience issues with exporting data to excel due to default sheet names in a foreign language. We have added a feature to enter the sheet name as shown below. This is located within any of the Excel Export menus. Once it has been changed, it will save with the DAMS software settings.



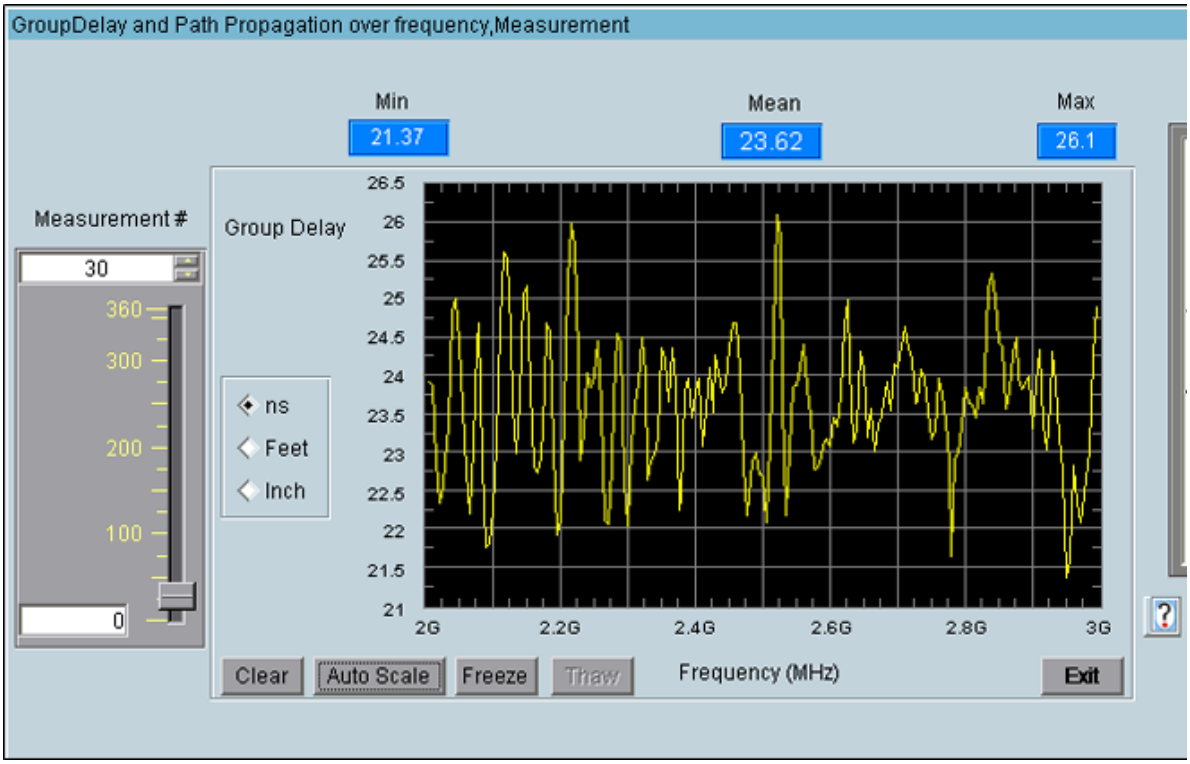
Group Delay Function

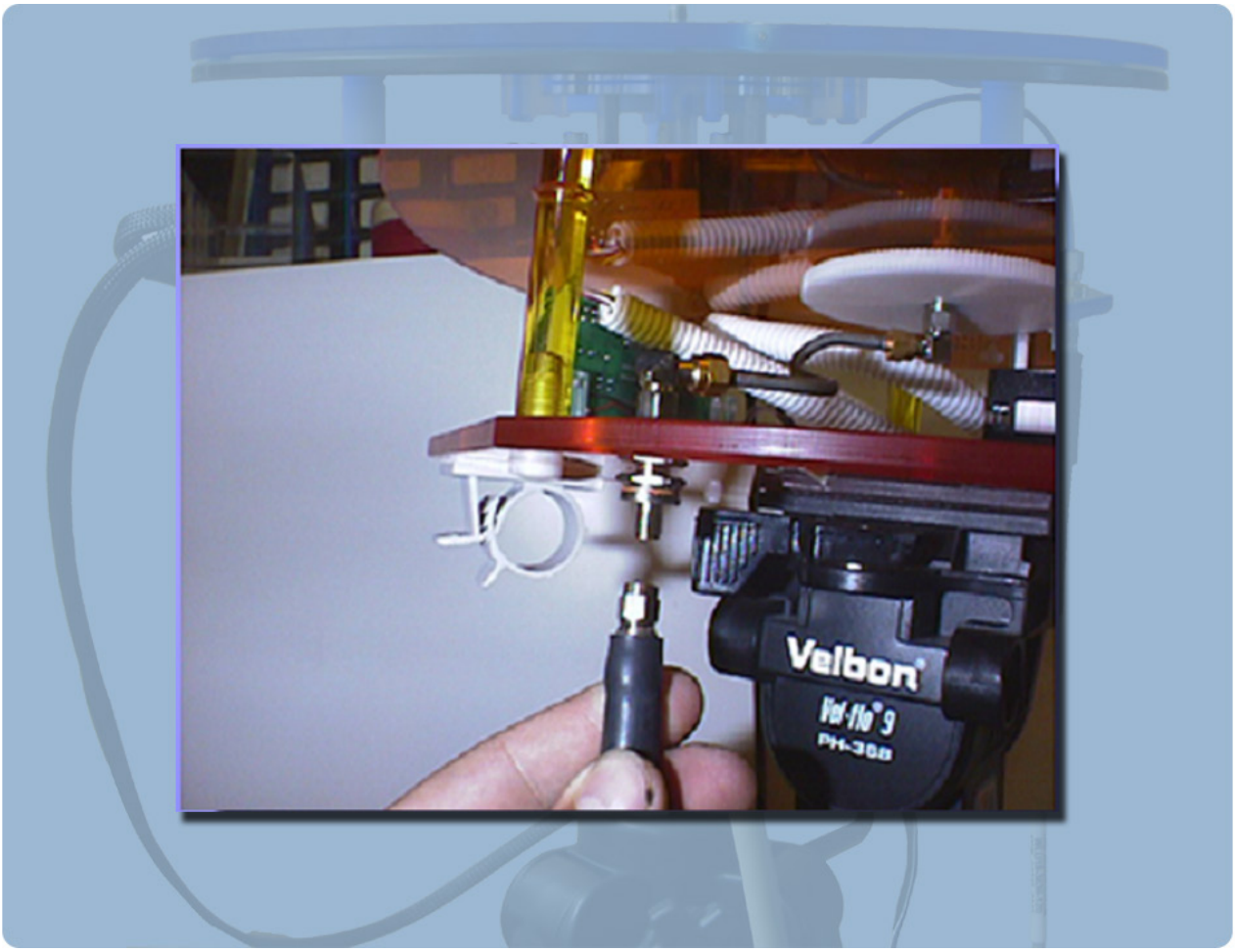
Group delay is the derivative (slope) of the transmission phase angle. For passive circuit elements, the group delay is linear and may be calculated from two measurements. It is important that the ratio of the frequency delta-wavelength is less than the physical distance between the measurement. If this is not the case, either the frequency resolution must be increased or the delay will need to be integer-scaled. The scale integer is INT(d/wavelength). Wavelength is the specific wavelength associated with the difference frequency (or step frequency). Periodic spikes will occur in the group delay plot. Non-periodic spikes represent the Multipath or some other source of distortion.

Be advised this software does not perform vector corrections for free space measurements. The corrected group delay is only applied to the display. Use the "EXPORT" button on the display to save the display values to disc.

IMPORTANT: If you have made measurements and saved them to the disc (or into a Data Register), they will NOT be corrected for system delay but WILL be corrected for system loss. We advise noting this in your file document item to avoid incorrect displays, or re-save. To correct the group delay (locally) check the radial "Correct for system delay" (on the left). The plots will automatically update allowing you see both the corrected and uncorrected profiles.

Group Delay Screenshot





General Problem Solving & Maintenance Info

General System Troubleshooting

Problem	Possible Causes	Solutions
Power supply light on but controller is not on	Power supply not connected correctly, Power Switch is not turned ON?	Check the above items and if all is correct, please *contact us* for service.
Controller light is on but positioner does not move	USB cable not connected? Driver not installed? Improper port selection in DAMS software?	Check all connections and reboot. Open "positioner settings" and click "Find". If controller not found, go to: Control Panel → System → Device Manager → COM Ports. Verify the DAMS Platform Controller is listed. If not, follow the "USB Driver Installation & Configuration" for x000 Series or "x100 USB Driver Installation & Configuration" for x100 Series.
Only one axis is moving	Loose cable connection? Controller error?	With the controller off, disconnect and then reconnect yellow cables.
Wrong axis moving	Reversed cable connections? Improper positioner settings?	Verify all positioner settings within the software and/or reverse yellow cables.
ERROR: Driver for [instrument] not found	Instrument not configured properly in Agilent VEE Runtime I/O configuration?	Read instrument configuration instructions. Contact us if problem persists.
Out of memory	Measuring with too many frequency points for physical resolution settings?	Reduce the number of points, or limit the AZ / EL extents.
Matlab Error	Is Agilent VEE Pro Runtime set to run as administrator?	Open C:\program files (x86)\Agilent\Vee Pro Runtime, right click veerun.exe and select properties, click the compatibility tab and select "RUN AS ADMINISTRATOR"
Excel Export Crashes	Is Excel installed on PC? Are there are least 3 sheets? Do sheet names shown in DAMS software match excel?	In Excel, click file, options and change default number of sheets. In DAMS software open excel export and click sheet names, verify the names match the default sheet names in excel.

If you are experiencing any of the above problems or an unlisted problem and cannot determine the cause, please do not hesitate to *contact us*. We are happy to assist in resolving any issues.

Warranty, Replacement Parts & Contact Information

Warranty Information

Diamond Engineering's Antenna Measurement Systems are guaranteed from one to three years on parts and labor from the time it was received by you. If there is an issue with the product please send us a picture or write a very detailed description of the problem. If we determine that you have a faulty unit or a bad part, we will ship you a replacement part or unit along with a pre-paid self-addressed box to send the defective unit back.

Replacement Parts

If you ever need a replacement part for your unit, please call us or e-mail us for pricing information. Most repairs are covered under warranty except for damages resulting from obvious abuse or misuse of the product.

Contact Information

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Automated Measurement Systems