DE Diamond Engineering
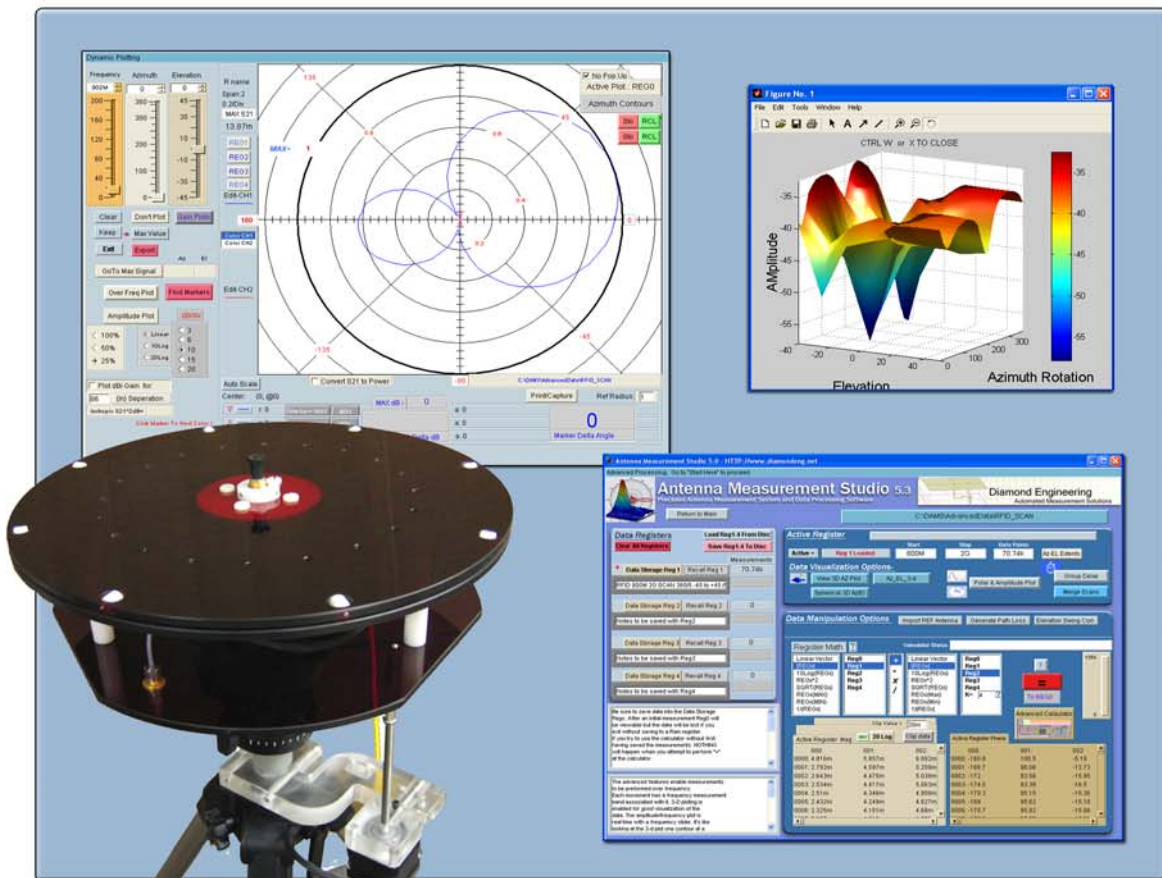## Automated Measurement Systems

Desktop Antenna Measurement System
x000 and x100 series

Users Manual & Setup Guide

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System Overview

Introduction

**Congratulations on your purchase of a Diamond Engineering
Desktop Antenna Measurement System! Also Known As DAMS**

Diamond Engineering's Desktop Antenna Measurement System has been designed to aid in the testing and development of small to medium sized Antennas. Using 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 Feature enables you to not only plot 3D graphs of the measurements, but save and recall those measurements for future use or comparison. Using the Group Delay function will enable you to calculate the exact distance of the Test Antenna, Identify Multipath rays, and eliminate the need to use another measuring device. Our software also allows you to export your data to a 3rd party application or spreadsheet.

This manual will fully assist you step by step with Assembling, configuring, and using the Desktop Antenna System. To achieve the full functionality of the rotator system we expect you to have some prior knowledge about the concepts and theories about Microwaves and Antenna Design and Development before using this software and rotator unit.

We cannot emphasize enough about the importance of fully reading and understanding this manual before using this piece of equipment to avoid any risk of damaging the unit and possibly voiding your warranty.

Best Regards, The Diamond Engineering Team

Key Features

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

- **USB Port 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.

- **Quality Components-** The antenna measurement platform is built only with the best of components for long lasting reliability.

- **Compatibility-** Our Software supports a wide range of network analyzers and instruments that use the GPIB / 488.1/2 and SCPI methods of communication.

- **Phase/Angle Measurement-**Software can measure All four Vector S-Parameters over a specified frequency range at each measurement point using a VNA

- **2-axis movement-** 360 Degrees Horizontal at 1/8 degree per measurement to +/- 45 degrees vertical movement angle at 1 degree per step.

- **DC to 8, 18, 40 Ghz. Measurement Range-(depends on model)** A wide frequency range allows for a more diversified range of antennas that can be tested with the system.

- **Rotary SMA Joint-** Using a high performance rotary joint the system can make accurate measurements without jeopardizing signal integrity.

- **Data Processing Feature-**Designed for post measurement processing you can perform a range of functions such as:

  - **Complete 3D Visualization for All Frequencies and Angles**
  - **3D Azimuth/Elevation plots for true 3D data representation.**
  - **Ability to save and Recall Data Sets from RAM or local Disk**
  - **Group Delay (distance calculation)**
  - **Spherical 3D plots**
  - **Gain Plots**
  - **Ability to work with 4 different data sets at once**
  - **Ability to map over 50,000 Different measurement Points onto one 3D chart**
  - **Reference Antenna Import Feature**
  - **Path Loss Calculator**
  - **Dipole Link Calculator**
  - **Calculator for modifying measurement results and comparing antennas**
  - **Export your data to a Spreadsheet or 3rd part application such as MatLAB**
  - **Dipole Link Simulator allows creation of simulated dipole antennas**

Minimum System Requirements

- AMD/Pentium Class Computer with 1.5 GHz. Processor or Higher (2 GHz or Higher Recommended)
- 512 MB Ram
- 500 Megabytes Hard Disk Space
- 1 Available USB Port
- 1024x768 Display Resolution (Minimum)
- Windows 95/98/ME/NT/2000/XP Operating Systems are supported
  *Windows XP home is not compatible with the Parallel Port Model
- Keyboard and Mouse
- Compatible Network Analyzer or Power Meter/Spectrum Analyzer and Signal Generator.

  As of the date of this manual the following Instruments are are currently supported by the Standard DAMs Software.

  VECTOR NETWORK ANALYZERS
          -HP/Agilent 8510x Series
          -HP/Agilent 8714 Series
          -HP/Agilent 8720 Series
          -HP/Agilent 8753 Series
          -HP/Agilent 507x Series
          -HP/Agilent 836x Series PNA's
          -Wiltron/Anritsu 46xx Series Analyzers (Scorpion)
          -Wiltron/Anritsu 37xx Series Analyzers (Lightning)
          -Rhode & Schwarz ZVx Series

  SIGNAL GENERATORS
          -HP 83650 Series
          -HP 8350 Series

  POWER METERS
          -Elva DPM-10
          -HP436A
          -HP437B
          -ML2438A (antritsu)

  SPECTRUM ANALYERS
          -HP8565 Series

- Printer (optional) for printing Measured Antenna Plots

To Find System Information:

- Right Click on "my computer" on your windows desktop and select Properties
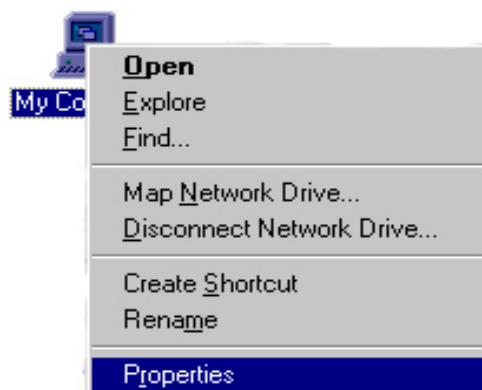
The USB Platform Control unit is a highly accurate Microprocessor based stepper controller. Movement signals are sent from the measurement PC to the controller unit where precision stepping sequences are generated. We also offer a development kit enabling you to write your own software to control the platform.

Platform Controller rear view

USB type B "Mini"
5 Pin

Platform Controller top view

The Parallel Port Platform Control unit (discontinued) controls the positioning of the Horizontal and Vertical movements based on signals received from the Computer's Parallel Port. We also offer a Platform development kit which will allow you to adapt the DAMS Platform to your own software using a special DLL library.

Control Unit Front View

Control Box power LED

Activity Lights-
Blink when active

Platform Power Switch - OFF---ON

Reserved for future use

ACTIVITY

VERTICAL   HORIZONTAL   POWER

PARALLEL PORT

12VDC 2.5A MAX
CENTER POSITIVE

Must be connected to computer LPT1 Port.

DC Power In

Control Unit Side View

MOTOR CONNECTION

HORIZ.   VERT.

Horizontal Motor Connection

Vertical Motor Connection
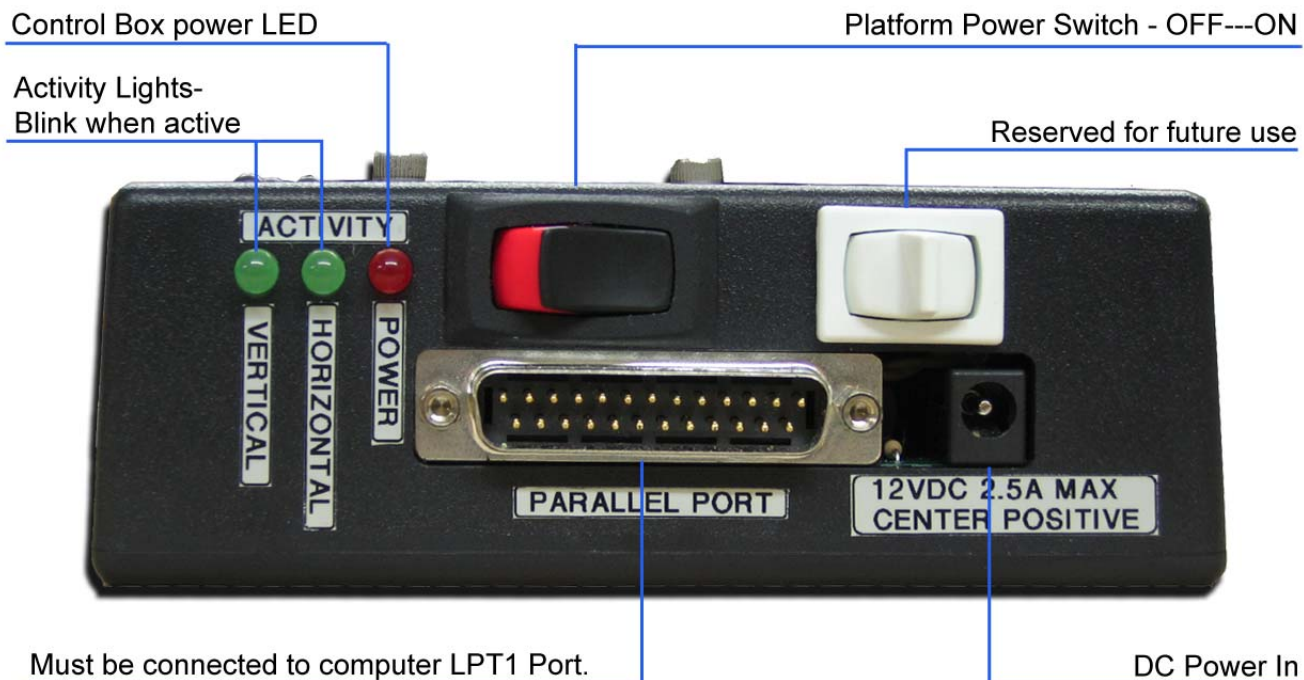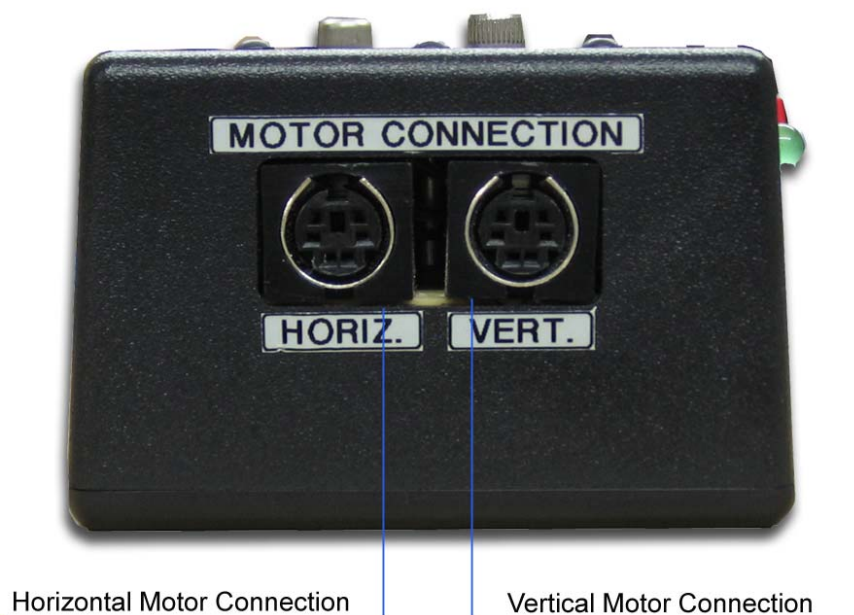
Chapter 1
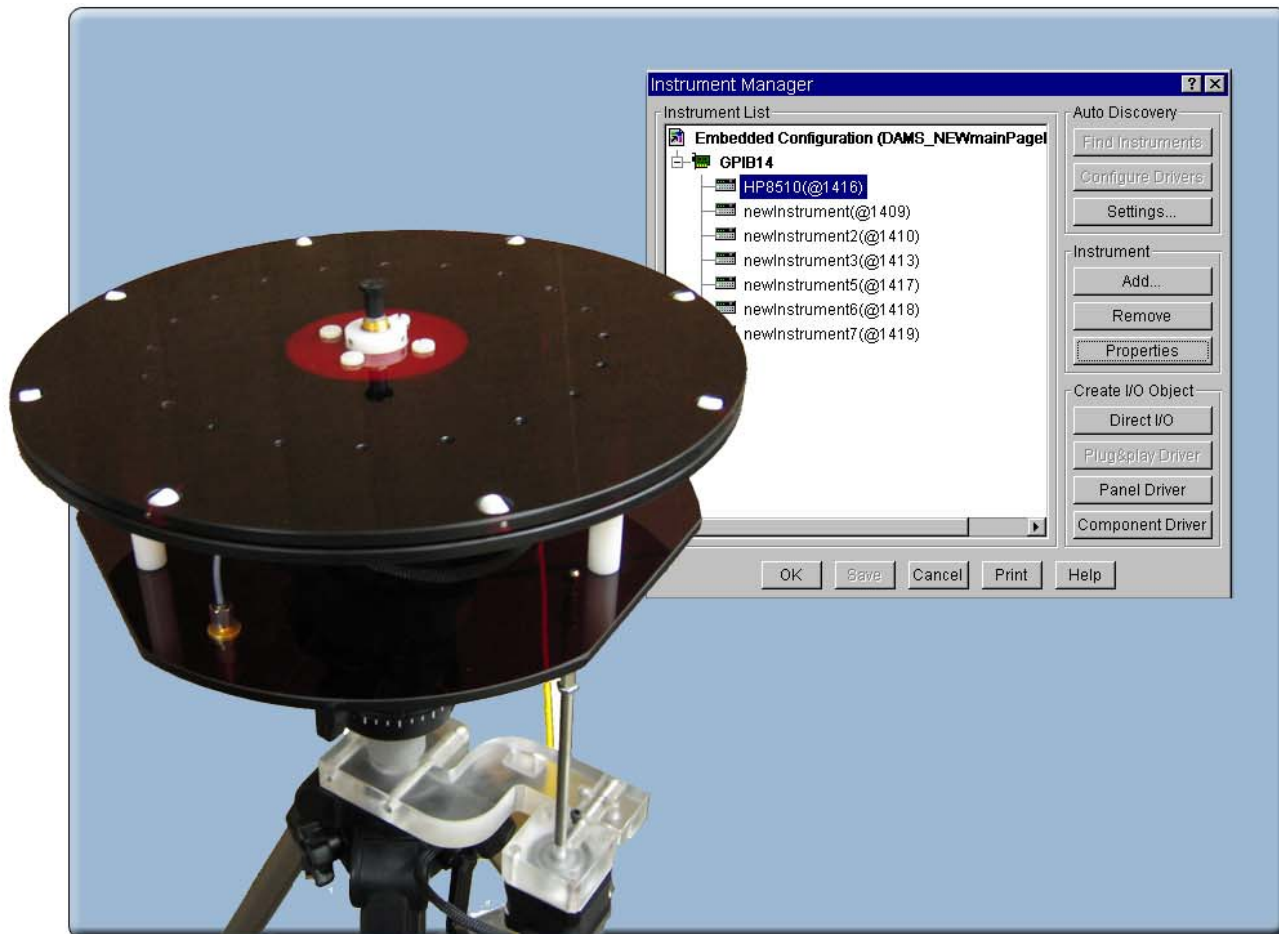
Installation and Configuration

Package Contents

Upon receiving your shipment of the Rotator Unit Please inspect the package to ensure all pieces are there and not damaged

Main components

1. Positioner Platform
2. Tripod
3. Vertical assembly
4. Vertical spacer
5. Vertical jack screw
6. 90 Deg. pivot **
7. USB Platform Controller
8. Hex wrench tools. (SAE and Metric)
9. 110/220v Power Supply with AC line cord

-Copy of your Order (Not Shown)

10. USB cable
11. Laser alignment tool **
12. 2 10'- Ultra Low loss cables SMA-M - SMA-M *
13. Platform control cables
14. Digital Inclinometer **
15. DAMS Manual / Software CD (not shown)
16. Small accessory packet (not shown)

* - DAMS 5000 supplied with Low Loss cables
**-- Optional or Inlcluded with DAMS 6000/7000 systems.

Tripod and Elevation Unit Assembly

The rotator unit has been shipped to you 85% assembled in a matter that requires Minimal effort to assemble.

BEFORE YOU BEGIN: Unpack ALL items and ensure there is no damage or missing parts.

-Vertical Assembly

1. Unfold the Tripod and extend the top of the tripod 1/2 way and secure the height adjustment- (Fig. 1)

2. IMPORTANT! Take the grey vertical spacer and snap it onto the very top of the tripod neck(fig. 2) Without this piece your unit will not make accurate Vertical measurements.

3. Atttach the vertical assembly onto the top of the tripod using the included hex wrench so the top edge of the vertical assembly is touching the bottom edge of the vertical spacer. (Fig 3)

Fig 1- Extend the Tripod   Fig 2- Attach vertical Spacer

Fig 3- Attach vertical Assembly-
Ensure the Vertical Actuator Rod
will have adequate clearance and
will not hit the tripod leg.

Connecting the platform and vertical actuator.

1. Ensure that the Azimuth of the tripod is unlocked.

2. Place the Tripod head in a horizontal position and tighten the locking screw (Loosen screw after assembly)
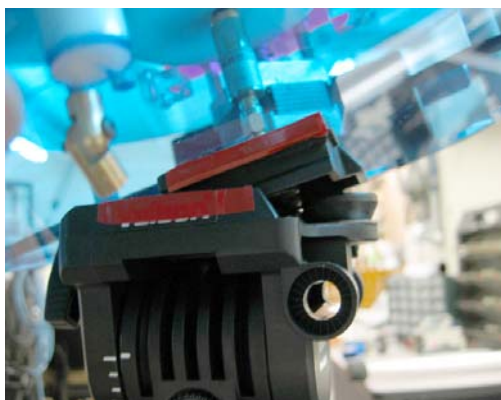
3. Align the colored piece of tape on the platform with the tape on the tripod head and insert the platform into the head at a 30 degree angle, the head will automatically lock the platform into position.

4. Loosen the Tilt Lock (Pic 2) enough to allow the platform to tilt and connect the vertical actuator rod to the platform , tighten the locknut while holding the HEX shaft using a wrench to ensure the rod does not disconnect.

Attaching the optional thrust plate-   Applies to Acrylic and Aluminum models.

Attach the Thrust Plate using the 4 included 10-32x1/4" Screws. Be sure not to overtighten screws and if using your own screws be sure they do not hit the metal bearing below.
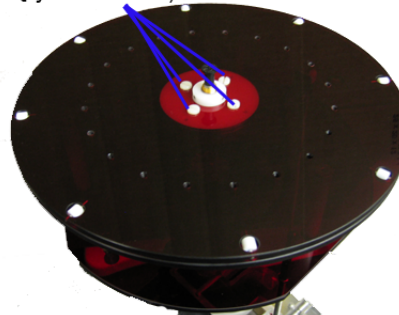
Attaching the cables

You should have received 5 separate cables and a power supply with your DAMS System.

1. 2- 10 Ft. Custom Calibrated SMA cable.(1-20' Cable Optional)
2. 1- USB cable.
3. 2- 6m Platform control cables

> **Step 1.** Connect the USB cable to the Platform Controller. DO NOT CONNECT TO PC YET.
>
> **Step 2.** Connect the power supply wire to the platform controller.
>
> **Step 3.** Connect one end of the Calibrated SMA cable to the bottom of the platform.
>
> **Step 4.** Attach other end of SMA cable to your VNA. **USE CARE** cable damage can compromise antenna results.
>
> **Step 5**. Connect the straight end of the yellow cable with the black band on the connector to the "Horizontal" port on the Platform Controller and the non-banded cable to the "vertical" port.
>
> **Step 6.** Connect the other ends of the yellow cables to the platform. The banded rightangle connector connects to the turntable. And the non-banded connector connects to the vertical actuator.
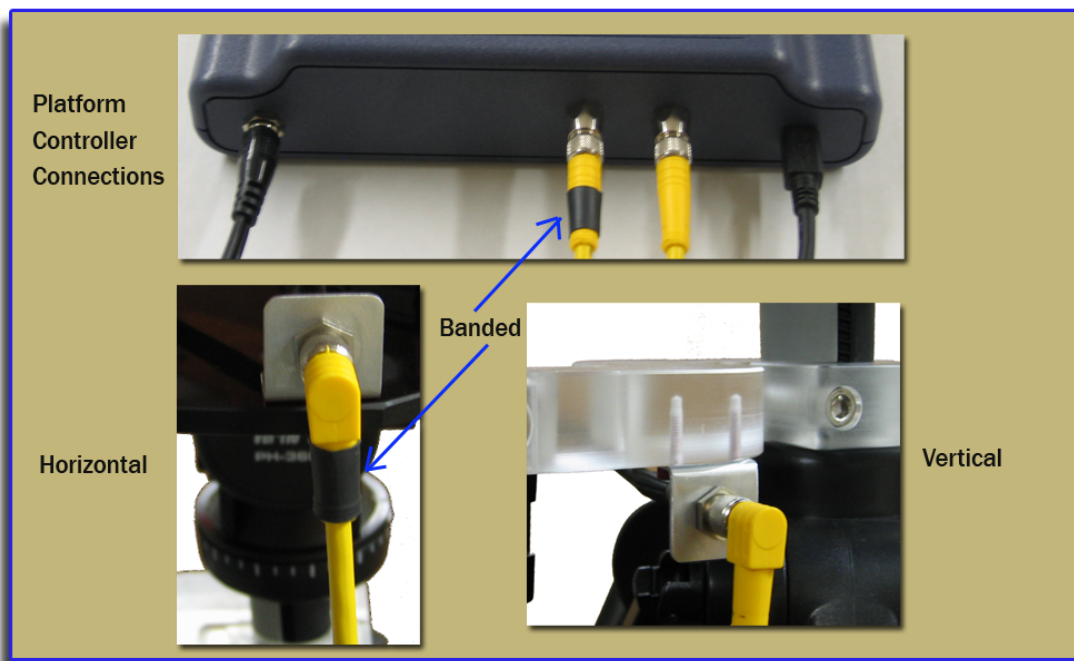
Installing the Software

1. Place Software CD in CD-ROM drive, The CD Menu should Start Automatically, If the menu does not start automatically run setup.exe from your CD-ROM in "My Computer" or from Windows Explorer

2. Click next/OK through **all** Following Screens**.**

3. Before the software is finished installing , the Agilent Runtime setup will start, Continue through this setup as you would a normal software installation.

4. After installation is complete the Software can be found on your desktop and in the start menu under "DAMS**"**

Note To NT/200/XP Pro. Users! If you using a Parallel Port Controller— You must install the UserPort driver discussed on the next page.

Connecting the Controller and Installing the drivers. (Blue USB models Only)

1. Connect the DAMS Platform Controller to the Computer using the included USB Cable. A window should appear indicating that a new device has been found. **Do not select the option to automatically search for the latest driver!**.

2. Click the Box labelled Search Manually then click "Next"

3. Select CD-ROM

4, Click Next, You will then be prompted that the driver has not passed the WHQL certification. Select the "Continue Anyway" button.

5. Click Finish.

6. A new window will pop up indicating another device has been found, repeat steps 2-5 above.

8.Turn on Controller, start the DAMS Software and click the "Motor Settings" button in the bottom left corner of the software, Make sure the USB/Serial option is selected and press the "Find" button, It should say "Controller found on Com x". The USB controller configuration is now complete. If it does not find the controller follow the instructions below.

Troubleshooting-
1. Check all connection between controller and PC
2. On your computer click Start -> Control Panel -> System -> Hardware Tab -> Device Manager.
3. Expand the section labeled Ports Com&LPT, you should see the DAMS Platform controller listed. and an associated com port. If no controller is listed you may need to re-install the driver. Please contact us for assistance.

Connecting the controller and installing the Parallel Port drivers (Pre-2005 Parallel interface units ONLY)

Installing the Userport.Sys Driver (Required for Windows NT, 2000, And XP Professional users)

NOTE: If you recieved a Pre-Configured Laptop From us, the Steps below have already been performed -you will any need to follow the steps below if you are Re-Installing the Operating System.

Overview

This guide will Assist you with the Required Changes that must me made to windows XP Professional before the software and platform will function correctly

Note about Windows XP: The Antenna Measurement Software Has only been tested and is only supported on the Professional version of Microsoft Windows XP .

(LPT) Parallel Port Driver Installation Instructions:

Step 1:
The software installation has placed a Folder named "UserPort" located in the "C:\DAMS" Folder.
The userport.sys file allows the Windows XP operating system to communicate with the parallel port and control the platform. Follow the instructions bellow to install the Userport.sys Driver.

1. Go to the "C:\dams\userport\" folder and copy the "Userport.sys" file to the windows system32\Drivers Folder. It is usually located in "C:\windows\system32\drivers"

2. Run the Userport.Exe program as shown at right and Select the I/O range you wish to use and Press Start. (If you do not know which ports to leave open just press start and the defaults will be used)
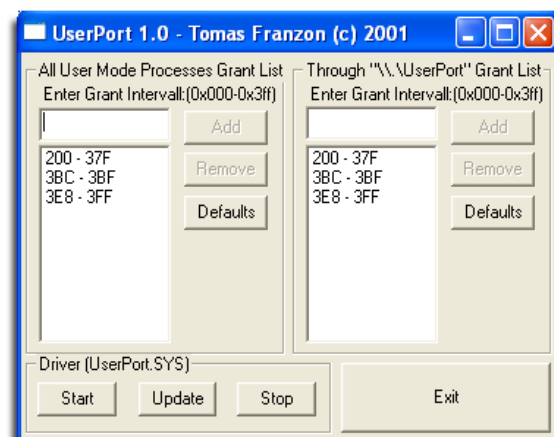
-- For additional Information Please read the Userport.PDF located in the Userport Folder ---

Step 2:
Setting the Compatibility mode for VEE Runtime 6.0 (XP PRO ONLY!)
 In order for the software to work absolutely correctly we recommend setting the Windows XP compatibility mode to Windows 98/Me Mode for less chances of errors caused by the windows XP Kernel.

1. Open "My Computer" located in the Start Menu

2. Open your "C:" Drive

3. Double click on the "Program Files" Folder

4. Double Click "Agilent" then double click the "Vee Pro Runtime" Folder.
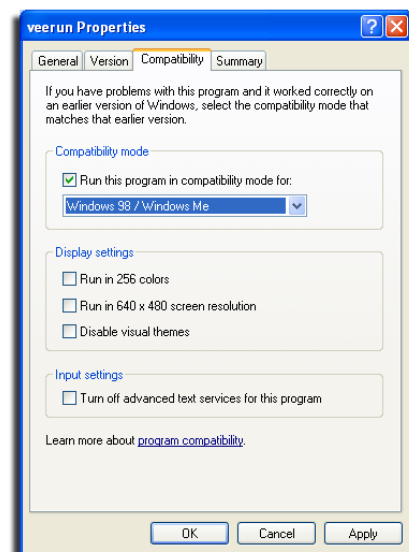
VEE Runtime I/O Configuration

You must complete these steps for the Software to communicate with your network analyzer!.

1. Click Start -> Programs->Agilent VEE pro 7.0 Runtime-> I/O Config.

2. Turn on you Network Analyzer and Click the "Find Instruments" button.

3. You should see your network analyzer appear in the list

The instrument number consists of the GPIB controller ID number and the Instrument number **Example:**
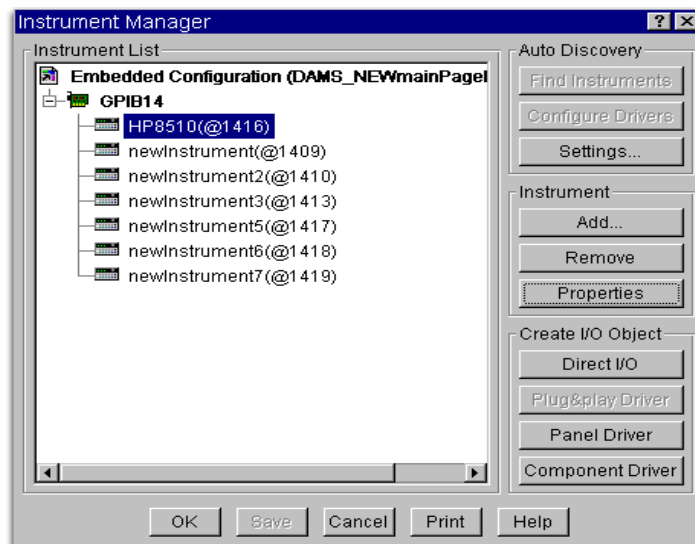ID (newinstrument@**xxyy**)
xx=Nat inst GPIB controller   **yy**=Analyzer ID #
4 digit format

4. Select your analyzer from the list and click on the "Properties button" You should see the window to the right, Change the name that is shown to one from the list below that matches your analyzer.

Network Analyzer	"Name" setting
HP 8510 series analyzers	HP8510
HP 8714 series analyzers	HP8714
HP 8720 series analyzers	HP8720
HP 8753 series analyzers	HP8753
AT 5071 series analyzers	AT5071
AT 836x PNA analyzers	AT8363
Anritsu Scorpion Analyzers	MS462X
Anritsu Lightning Analyzers	ML37XX
Rhode & Schwarz RS series	RSZVR

Signal Generator	"Name" setting
HP 83650B Signal Gen.	HP836
HP 8350 Sweep Generator	HP8350

Spectrum Analyzer	"Name" setting
HP 8565 Series	HP8565
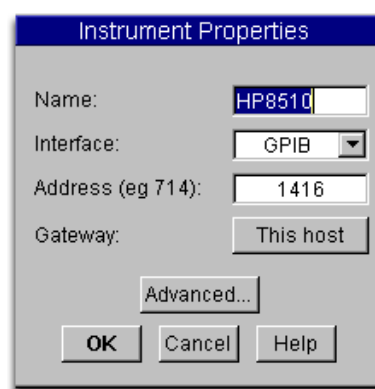
Power Meter	"Name" setting
HP 436A Power Meter	HP436
HP 437B Power Meter	HP437
Anritsu ML2438A	ML2438
Anritsu ML4803A	ML4803
ELVA-1 DPM 10	DPM10

5. Press the "Advanced" button to bring up the Advanced Properties Dialog Box.
Set the **Instrument Time-out** to 15 seconds. Press OK , then OK, then "SAVE". You have now successfully completed the Analyzer Configuration Process.
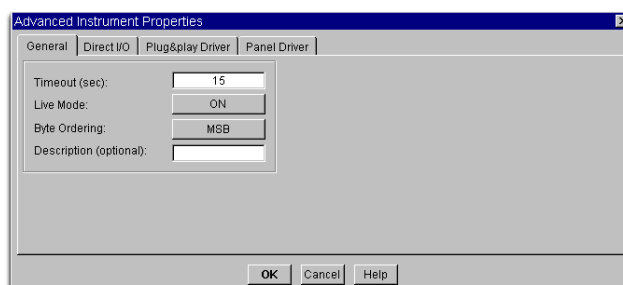
The DAMS system has been designed so that it will operate with most any tripod, when purchasing a new tripod you must ensure that all of the parts from the current system will fit onto the new tripod without angle or clearance problems. Once you are ready to configure the software please read the "DAMS Application note / Tips and Tricks" for a complete description and how to calibrate the vertical movement with a Tripod other than the one that was included with your Antenna Measurement System. If you need Assistance you are welcome to call or e-mail us and we will be glad to help.

Calibrating/Setting the Vertical Movement to 0 Degrees -- See Also *Vertical Calibration Settings*

In order for the software to move the platform correctly on the vertical axis you must have the platform at 0 degrees when starting the DAMS Software - or the platform must match the vertical position shown in the software before moving vertically.

If the Platform Angle and Software Angle do not match, Use the Jog +/- buttons to move the platform to the level position, you can change the Change jog distance by using the pulldown.

NOTE- Before clearing a measurement you will need to reset the platform to 0 degrees using the vertical slider and the "manual move" button

Platform Positioning Test.

1. Turn on the Platform Controller

2. Make sure the platform is level , if it is not level see the information at the top of this page.

3. Start the rotator software, Click Start -> Programs -> DAMS ->DAMS x.xx

4. Click the orange "Manual Move" button located in the upper left hand section of the software. The platform should now horizontally move the number of times specified in the "Total Number of Measurements" window completing a 360 degree sweep.

5. Set the Vertical Differential slider to a value of -5 degrees and press the green "Manual Move" button, the platform should now move to -5 degrees. Slide the slider back to 0 and press the "Manual Move" button. The platform should now return to it's starting position.

****If the Rotator Unit successfully performed the above functions, the rotator platform is fully functional and is ready for Use.****

6. If The Rotator Unit does not Perform one or more of the above tests please refer to the Troubleshooting Section located on Page 43

Special Installation Notes

SCREEN SLEEPERS and Power Saving options.
Be sure to disable screen sleepers, Power Saving Features and other
Applications, which may cause GPIB or dll to crash.

Other Running Applications-
The DAMs Software requires a large amount of CPU and System Resources. We advise you not to have any other
applications running while the DAMs Software is operating

Reporting Bugs-
During some certain complicated/untested scenarios a failure may occur, If this happens, Please let us know. We will be
able to address the problem and offer a hot fix faster if the error is reported. Please send all errors and questions about
software operation to support@diamondeng.net

Chapter 2
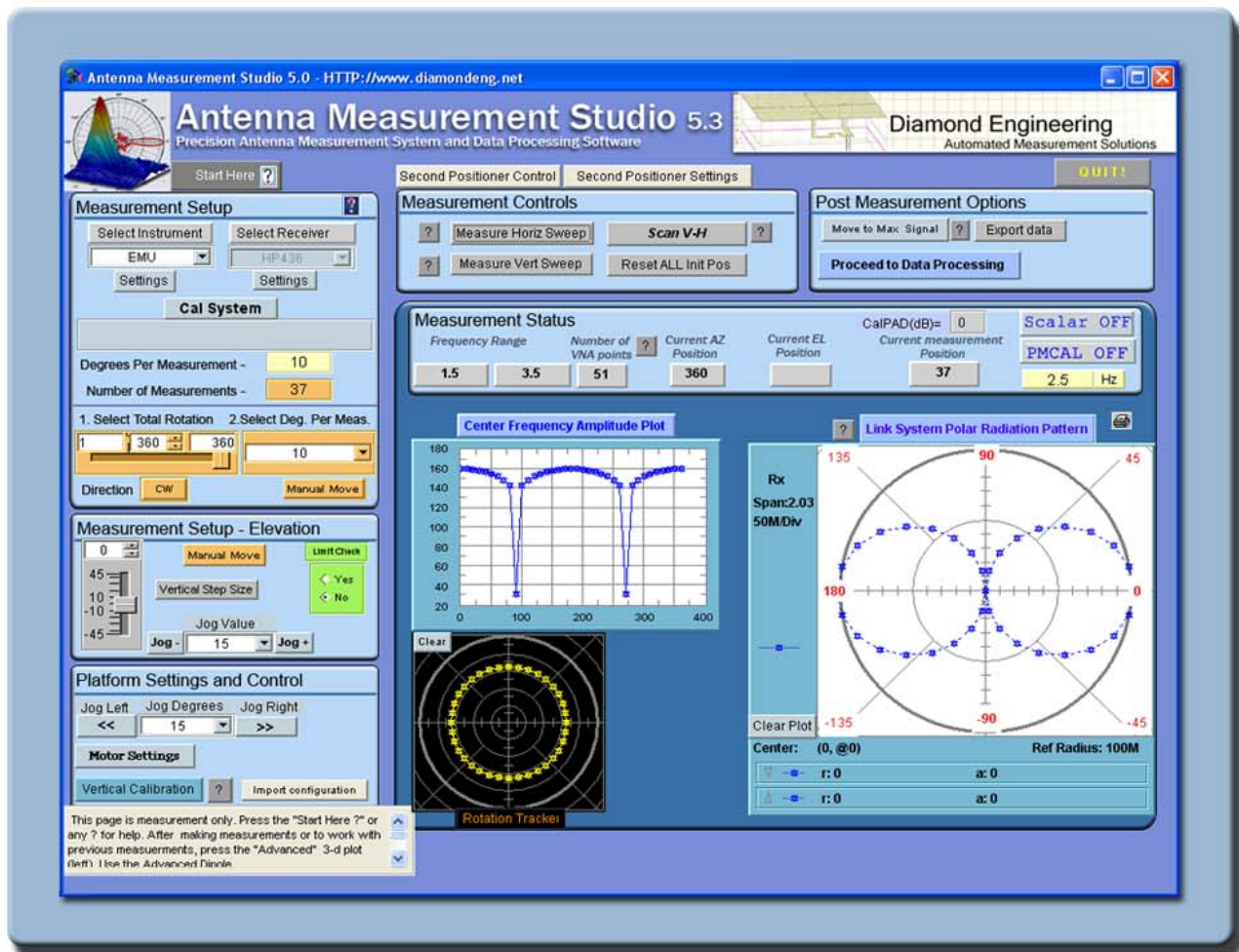
Software Overview

Measurement Settings

Instrument Selection and Settings

You can now choose from multiple combinations of instruments such as a Signal Generator and Power Meter or Signal Generator and Spectrum Analyzer.

Available Modes of Operation

1. VNA ONLY
2. Signal Generator and Power Meter
3. Signal Generator and Spectrum Analyzer
4. Signal Generator and Multimeter
5. Special Receive Only Mode.
6. Emulation Mode. (Simulated Dipole Measurement)
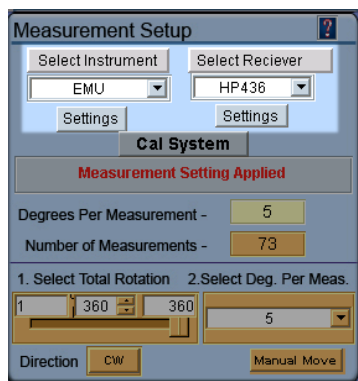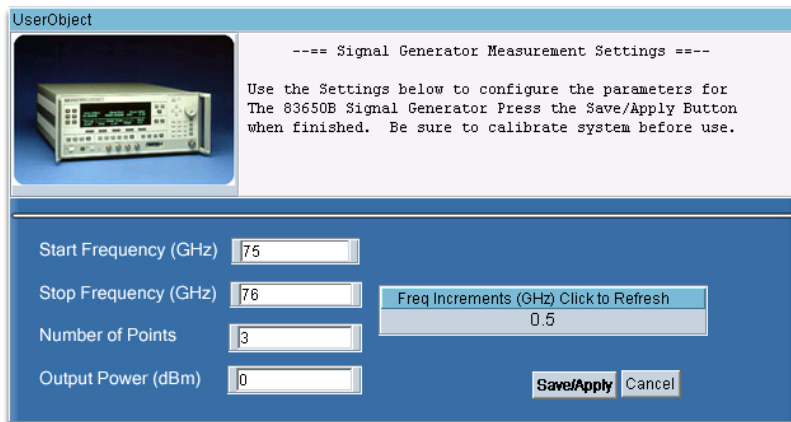(NOTE: Any instrument that you want to select must be configured in the VEE I/O Configuration program prior to selection)

Source Instrument Settings

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

Start / Stop Frequency- Enter the frequency in GHz Decimals are OK , example: 450Mhz = .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 -Power Meter Settings
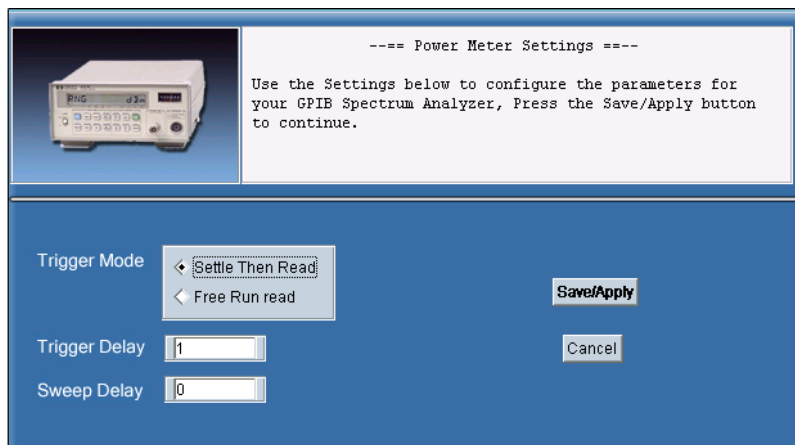
Trigger Mode- Changes the way the power meter reads the sensor, this setting is only applied to certain meters.

Trigger Delay- This 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 = .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.

Measurement Settings

Receive Instrument -Spectrum Analyzer Settings

Sweep Settings
Span-Sets the Frequency Span of the spectrum analyzer sweep. Input format is in Hz.

Res Bandwidth- Sets the bandwidth window on the spectrum analyzer , the smaller the window the faster the sweep. Format is in GHz.

Video Bandwidth- Sets the video bandwidth window on the spectrum analyzer

Video Averaging
Average Count- Sets the number of times the 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 will sweep and update the max hold before sending data to the software. This function is useful for signals that are not CW

Display Settings
Reference Level- Sets the reference level of the spectrum analyzer display. (Settings in DB)

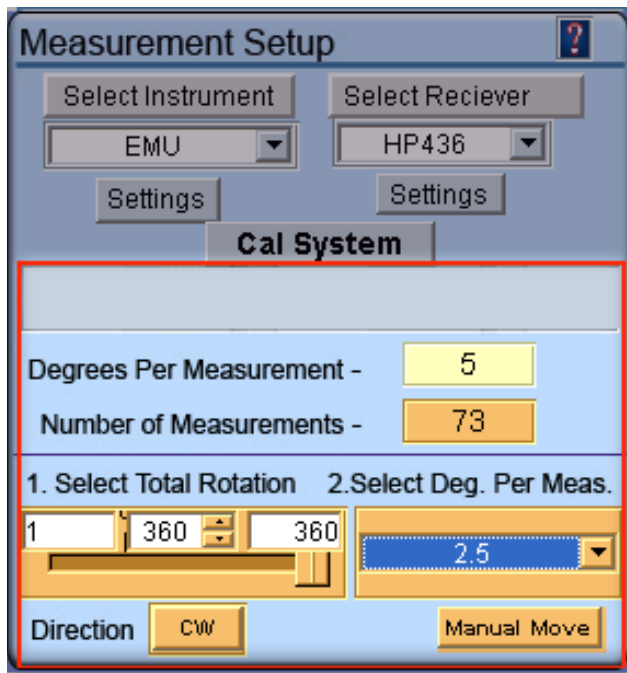**dB/Div-** Sets the dB per Division scale on the spectrum analyzer display.

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.

Measurement Settings

Azimuth setup

Degrees Per Measurement- Displays the CURRENT degrees-per measurement based off of total degrees slider and the degrees per measurement settings (note: This window may indicate a different value than the pulldown, remember this is the current setting)

Number of measurements readout- Displays the CURRENT total number of measurements that will be made based on the settings below.

Total Rotation Slider- This slider sets the total number of degrees the Platform will sweep the antenna (360 default)

Degrees Per Measurement Pulldown- This drop down list contains all of the possible degrees per measurement combinations for the selected total rotation.

Direction- Click this button to change the rotation direction of the platform

Manual Move- When this button is pressed the platform will simulate the movement sequence without actually measuring data.

Elevation setup
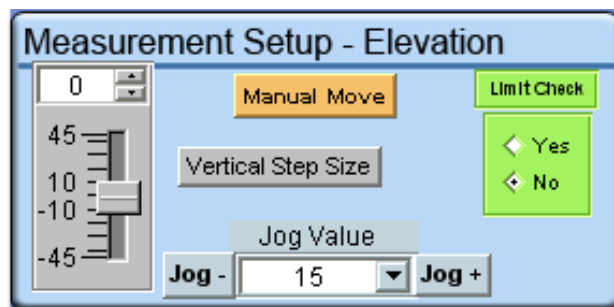
Vertical Slider- Use this slider to set the vertical angle that you would like the platform to move to.

Vertical Step size- This sets the vertical measurement and movement resolution.

Limit Check- monitor the movement of the platform to advise you if your selected vertical movement will cause the platform to exceed the vertical limits.

Manual Move- When this button is pressed the platform will simulate the movement sequence without actually measuring data.

Jog +/- Use this to set the platform to 0 degrees, the numbers do NOT represent degrees but direct vertical motor

Platform Settings and Calibration
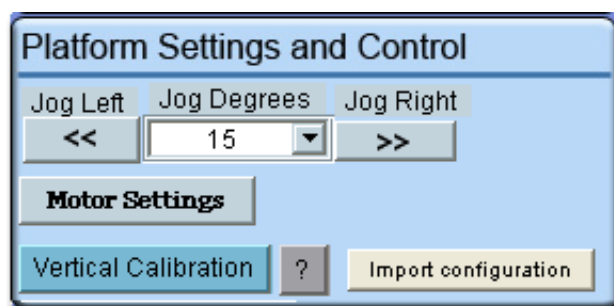
Jog Left/Right- Use these to manually rotate the turntable

Motor Settings- Contains configuration settings relating to motor type, gear ratio and motor driver. Please see section 1-2 for more details.

Vertical Calibration- This button opens the vertical calibration window described in section 1-2 of the manual -

Import Configuration- After upgrading your software, press this button to import your previous settings.

Motor and Controller Settings

These settings will configure the software for your specific configuration. Here you can specify the speed, controller type gear ratio, controller driver, and acceleration, deceleration and hold settings on the newer Platform Controllers. When choosing the "Low Gear" option the default motor speed will automatically be changed to the default value**.**

Select Port- Choose between USB and Parallel port controller models. See chapter 1 to identify your controller.

Motor Driver- If possible we recommend using the Legacy driver , this driver usually offers better performance but is not always compatible with certain computers. See chapter 1 for installation instructions for the "legacy driver". There is no installation necessary to use the "universal driver"

Motor Resolution- This specifies the resolution of the stepper motor installed on the platform, this number is always 1.8 unless you have the .9 degree LIN engineering motors.

Gear Ratio- This number is the entire ratio between the motor and the rotating platform hub. This number is usually 7.2 for original 2 gear system, 14.4 for new 2 belt system and 28.8 for 3 gear high res. system

Ultra High Res Option- If your platform has a total of 3 gears on the bottom you have this option. When this option is turned on or off the speed settings will be changed to the default value for that resolution option.

Move/Measure on/off- This option allows you to turn the motors off but run the software as if you had the motors connected to the system.

Start Speed- This will set the number of steps per second the motor will start and stop moving at.

End Speed- This is the maximum number of steps per second the motor will move during movement.

Slope- This sets the acceleration/deceleration ramp by setting the time between the motor start speed and the Maximum end speed. A setting of 0 will disable acceleration. A number of 1 will offer the slowest acceleration and deceleration.

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. The vertical hold should only be enabled when using a heavy load that causes the lead screw to move on it's own.

Move left/right/up/down- After you have made a change to the acceleration setting you may test them using the move buttons.

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Vertical Calibration Settings

These settings will configure the vertical axis calibration. The design of the vertcal 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.

NOTE: All Settings take effect immediatly but will be saved when the QUIT button is Pressed on the Main Page

Motor Resolution: 2083
Change

Pushrod to center distance: 3.88
Change

FINISHED

Read This

Advanced Settings

WARNING
Do NOT Change these settings unless you have been directed to do so by Diamond Engineering
Failure to follow this warning may cause Damage to the Unit.
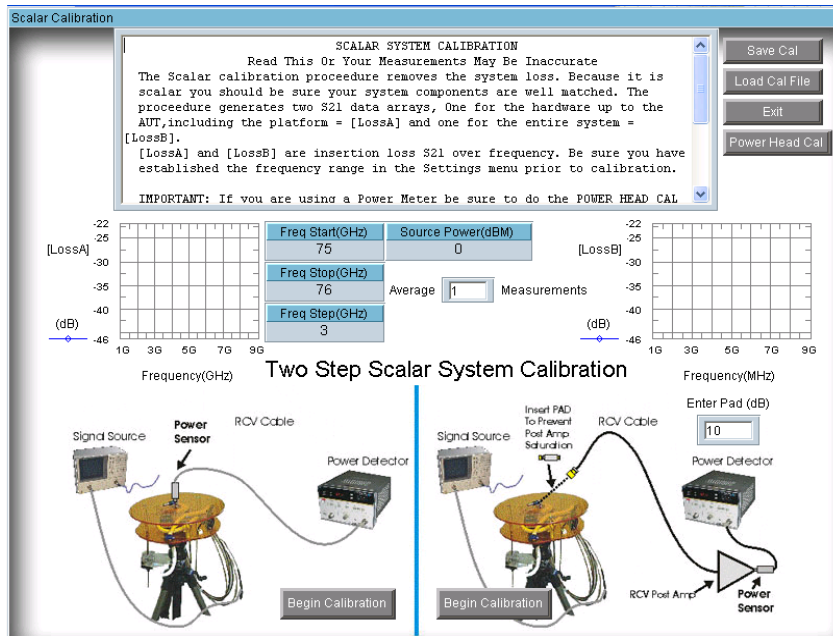
Xo Distance: -4.15
Change

Yo distance: -4
Change

Tripod to push rod axis: 1.75
Change

Calibration Settings

Scalar Calibration

This feature enables you to make a scalar calibration using your Signal Generator and Receive source. An in depth explanation and example is located in chapter 3 - Calibrating your system.

Averaging- in cases of large amounts of background noise you may want to average the calibration measurements.

Save Cal- Save your calibration to a file on your computer.

Load Cal - Load a calibration file from your computer.

Pad (dB)- if using a post amp with attenuator , you need to enter the attenuator value in this window.

Power Head Cal- This button invokes the power sensor cal menu.
(NOTE: If using a power meter with Non-Programmed sensor You MUST load or enter a Power Sensor cal table before performing a scalar calibration)

Power Sensor Calibration

The Power Head / Sensor calibration menu is located in the Scalar Calibration section.
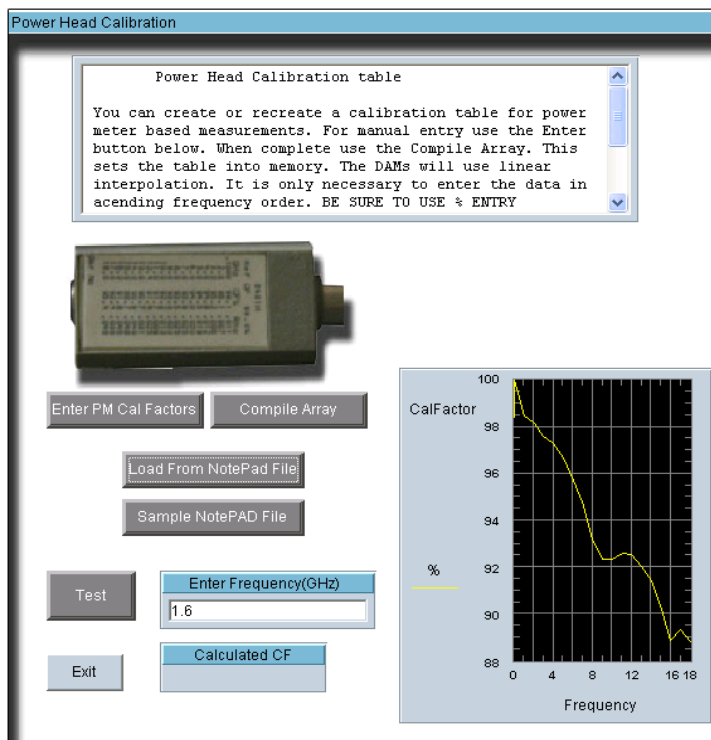
Enter PM cal factors- you can enter the calibration table directly to check compatibly

Compile Array- Compile the manually entered Cal factors and display them on the chart below

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- This file shows you how your Cal-Factor notepad file needs to look

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

Measurement Controls

Measure Horiz. Sweep- When this button is pressed, the software will begin making measurements by moving the platform horizontally , then retrieving the data from the network analyzer. The button will remain "grayed out" while the antenna measurement is in progress

Measure Vert. Sweep- When this button is pressed, the software will begin making measurements by moving the platform horizontally , then retrieving the data from the network analyzer. The button will remain "grayed out" while the antenna measurement is in progress

Scan VH- When this button is pressed, the software will begin what is called a scan sweep, the software will make a complete horizontal measurement then move to the next vertical position and make another complete horizontal sweep. This process will continue until the platform reaches the ending vertical position.

Reset Accumulator- When this button is pressed, the software will begin making measurements by moving the platform horizontally , then retrieving the data from the network analyzer. The button will remain "greyed out" while the antenna measurement is in progress

Post Measurement Options

Move to Max Signal - **When this button is pressed, the software will analyze the measurements you have just made to find the position where the antenna had the maximum gain , the software will then move the antenna to the maximum signal position.**

Proceed to Data Processing- **Once you have completed making your measurements and you click this button you** will be taken to a section of the software that will allow you to view/manipulate any part of the measurement. The Data Processing section also allows you to view the data in many different formats including , Polar, Mag, and 3D
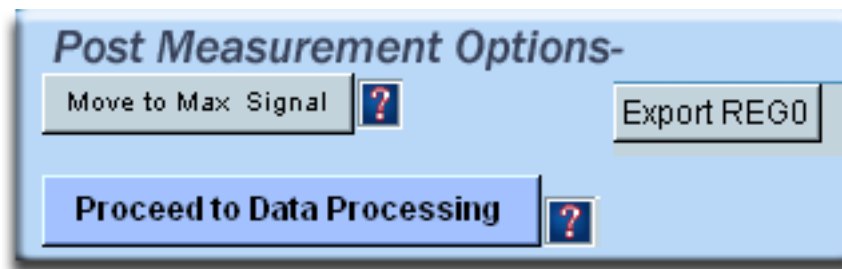
Export Reg 0 - **When you have completed a measurement you can instantly export the data set to an outside file for the ability to import the data into a spreadsheet or use in a 3rd party plotting or processing program.**

Measurement Status and 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 Displays

The Graphical status windows allow you to view the Real-Time data as it is captured from the Network Analyzer. All Status
Graphs display the center measurement frequency.
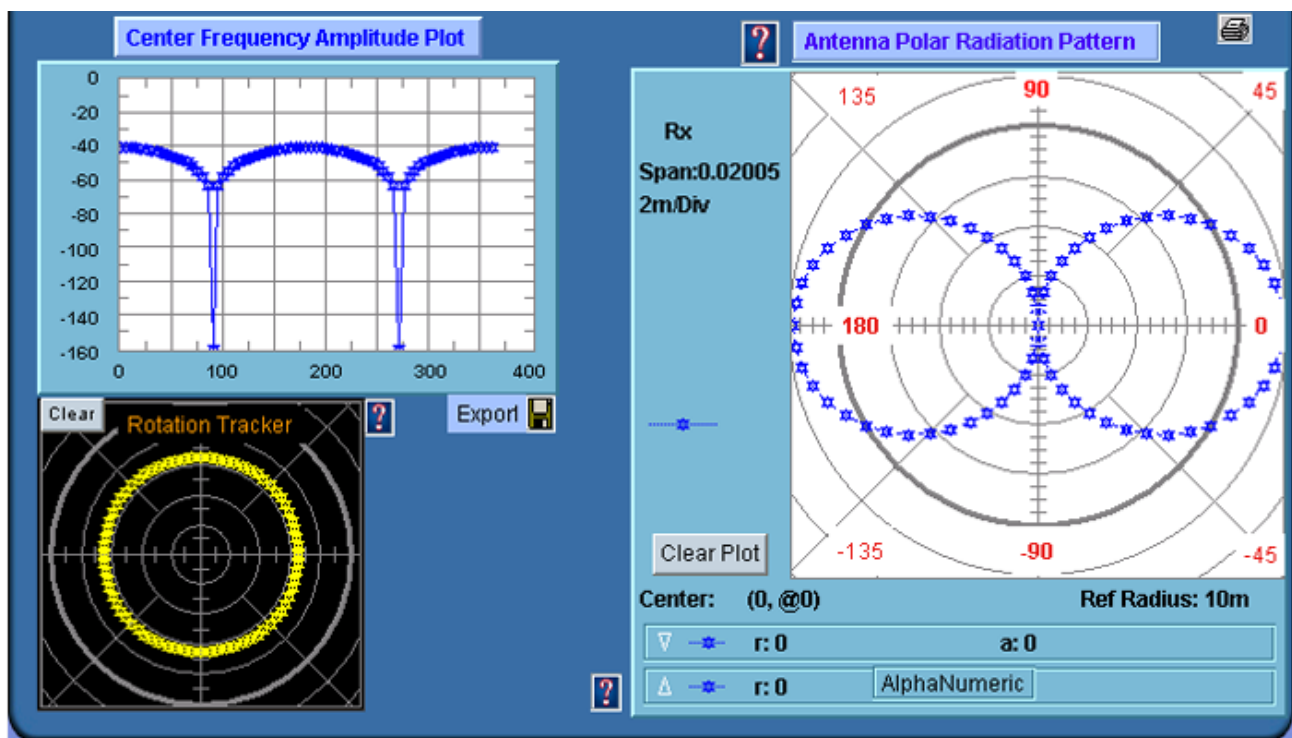
Center Frequency Amplitude Plot- This plot displays the Amplitude in dB of the measured Antenna.

Antenna Polar Radiation Pattern- This plot displays the Real-Time pattern of the measured Antenna

High Res Plot - Display a high resolution MatLAB Polar plot of your measured Antenna at the Center Frequency.

Rotation Tracker- This plot shows the current position of the platform, the Horizontal Axis is shown with circular data
points, and the Vertical movement is shown with data points on the center plane of the plot.

Clear Plot- Each plot has it's own "Clear-Plot" button , this will clear all current data from the plot

Data Processing Introduction

　　　The Data Processing Feature is your gateway to unlocking the data contained within your antenna measurements. After making your initial measurement of the Antenna you can press the "Data Processing" button located in the "Post Measurement Options" window of the main software page and you will be taken to the screen shown below.
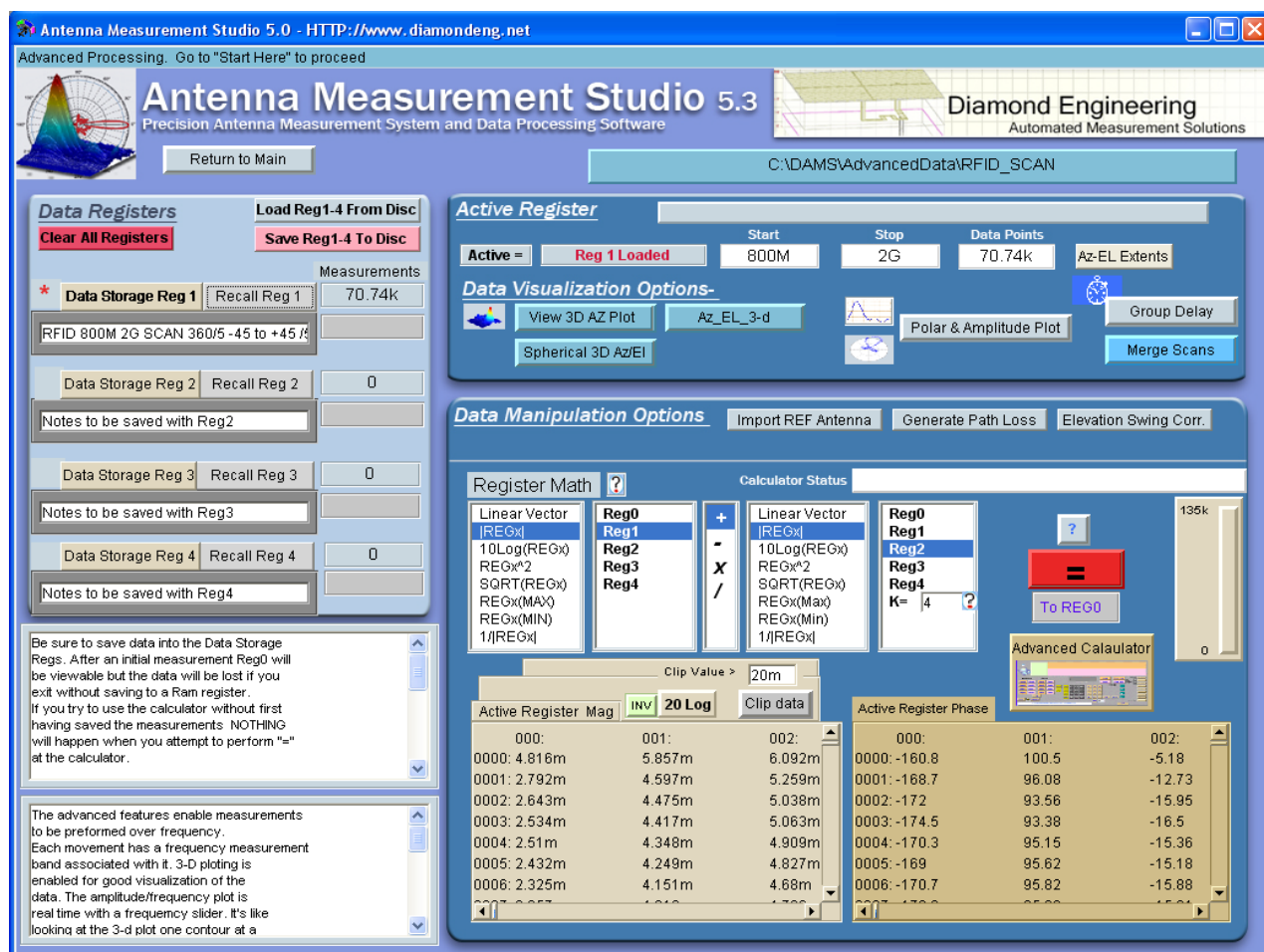
This section of the manual will describe all of the functions located in the Data Processing feature.

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 particular data sets. This is very useful for working with multiple measurements from other antennas. There are 5 registers total, 4 storage registers and 1 Active register.

Active Register

Once you have completed a measurement and open 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.

Data Registers

The Data Storage Registers offer space to put up to 4 different measurement sets that you can recall at any point in time, you can also save the entire set of 4 registers to disc for use at a later time.
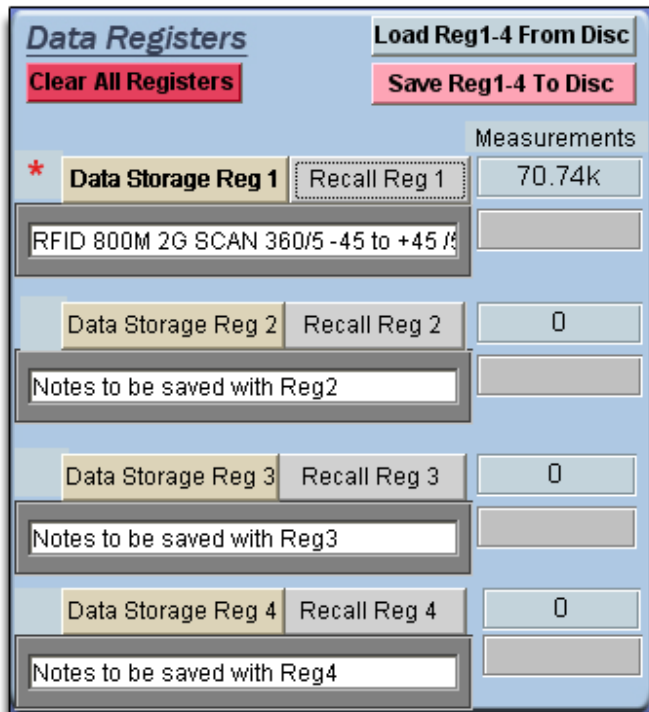
Data Storage Button- When this button is pressed , all of the data in the Active Register is stored to whichever storage button that you chose.

Recall Button- When this button is pushed , all of the data in the chosen storage register will be written 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.

Visualization Options

The data visualization options enables you to view the Antenna Data in a wide variety of formats.
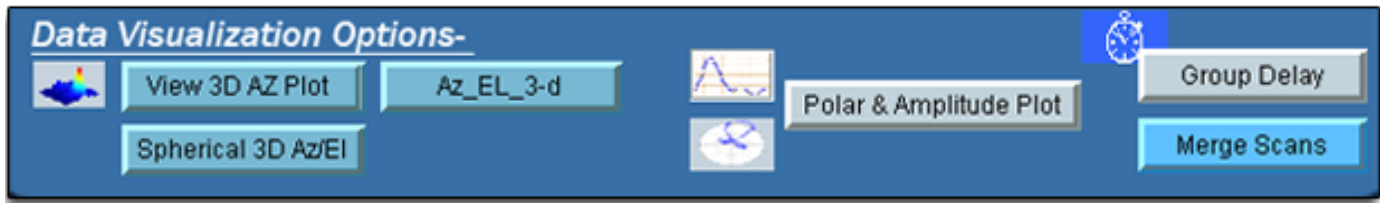
Azimuth vs. Frequency vs. Amplitude 3D Plot
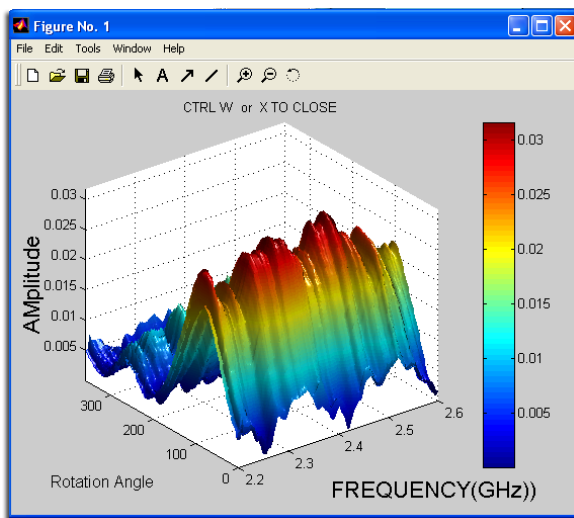
About: This plot is the most versatile of the 3D plots and will give you a good idea of the frequency response Vs. Rotation of the Antenna you have measured . If you have made AZ/El measurements you can use the AZ/El 3D plot for a more detailed view.

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

Azimuth vs. Elevation vs. Amplitude 3D Plot

About: After you make a AZ/El measurement you can view the Azimuth vs. Elevation for any measured frequency using the AZ/El 3D Plot use the Azimuth Vs Frequency 3D plot to view frequency response to aid in the selection of the single frequency.

Features
        View AZ/El Data for any Frequency point
        Full Plot Rotation
        Zoom In/Out feature
        Line and Notation Tools
        Exportable to common graphic formats
        Printable
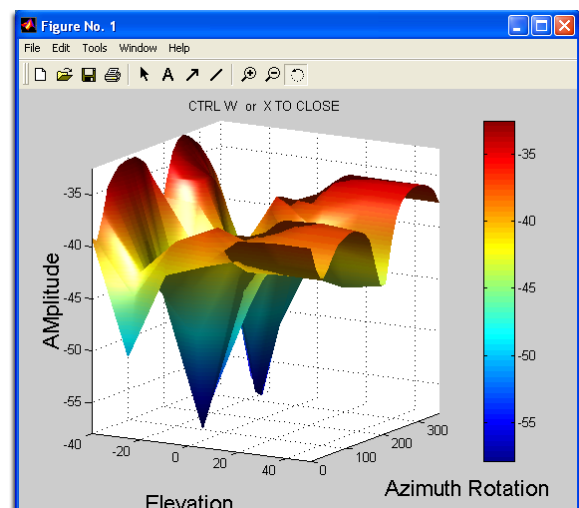
About: When a H/V scan measurement is made you can plot the data in true 3D up to the extents of your measurement. This data can be viewed in true 3D, mapped onto a sphere, and even compared to an ideal Iso-sphere or dipole right on the same plot. REMEMBER- Sphereical plotting will only work with AZ/EL measurement data loaded into the Active Register.
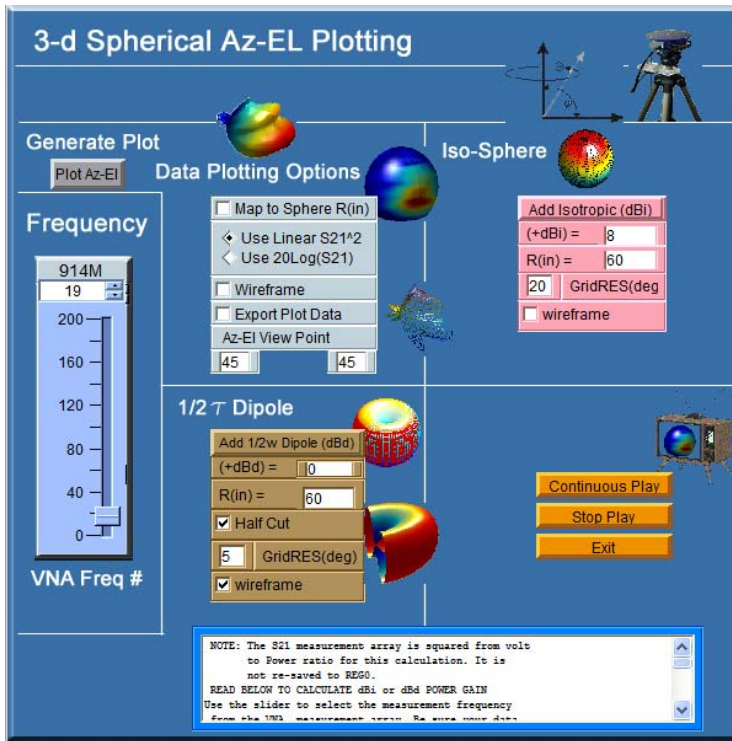
General Spherical Plotting Features

Data Plotting Options- These items change how the measured data is displayed in the plot window

Iso-Sphere- Generates a true Iso-Sphere on the same plot as the measured data

Dipole Generator- Generates a spherical dipole plot on the same plot as the measured data.

Frequency- Choose the frequency that you want to plot.

Generate Plot- After configuring your display options, press this to generate your plot.

Spherical Plot Examples

Standard Spherical
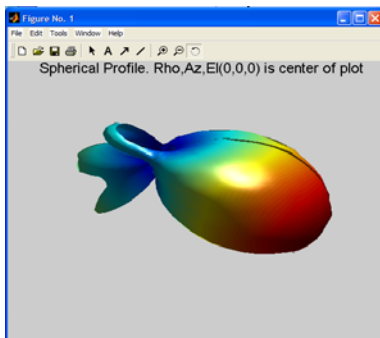
Spherical over Iso-Sphere
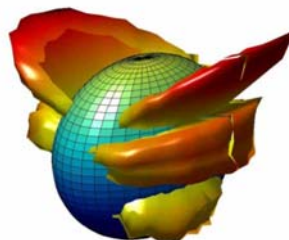
Parabolic Dish
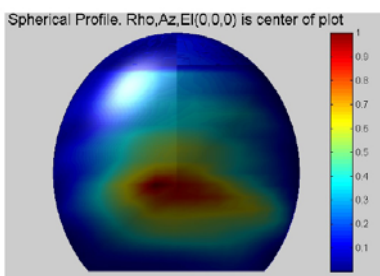
Map to Sphere over Freq.

Map to Sphere

Map to Sphere with Grid

Check the Wireframe option to view the response against the measurement profile.

NOTE: The Latitude grid = Az resolution

The Longitude grid = El resolution

The green area represents the 3dB beamwidth
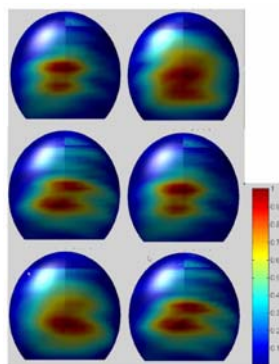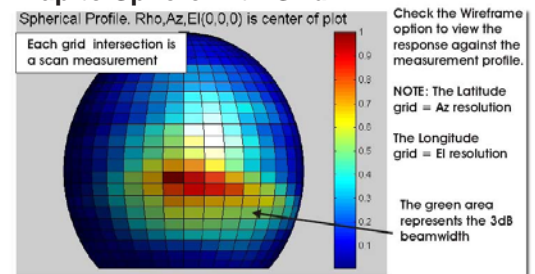
Dynamic Amplitude Plot - Invoked from Polar Plot window
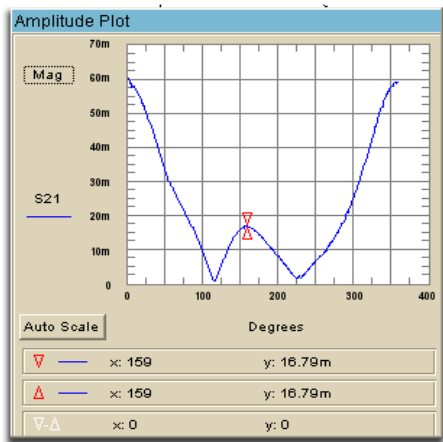
About: This plot is a sub-function of the polar plot. This function allows you to view the amplitude while adjusting the sliders in the polar plot window.

Dynamic Polar Plot

About: This plot offers a Linear or Log Polar 2D look into the Rotation Gain Pattern of the measured Antenna for a specified frequency point.

Features

Linear or Log Format	Dual Trace Plotting
Multiple Scale Options	Dual Markers
Automatically updates	Marker Delta and Gain
Keep Max Function	Vertical or Horizontal
Data Export	Printable
Auto Scale Function	Find Max Signal
Zoom In/Out	Zoom In/Out
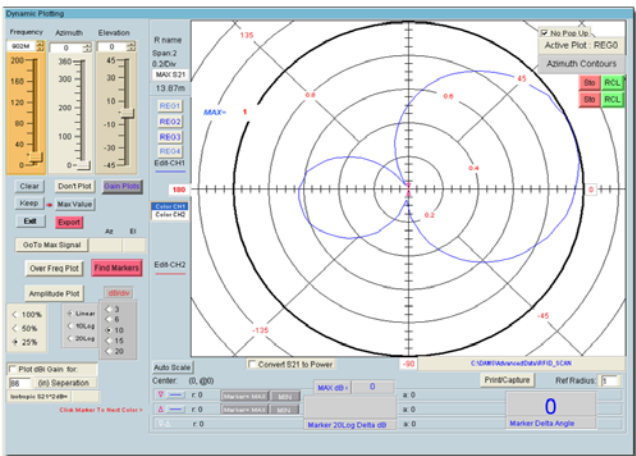
Group Delay Function
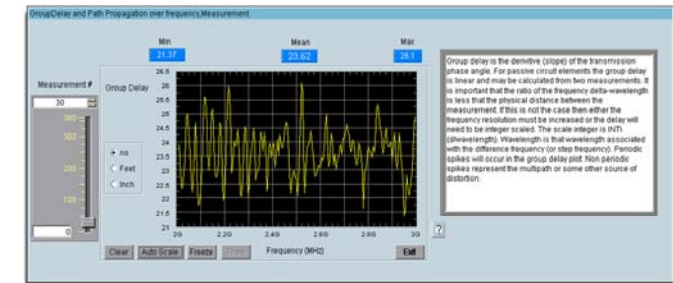
About: This features allows the analysis of the Group Delay and Path Propagation Data. You can also make an accurate measurement of the antenna distances using this feature.

Features

Distance Scale Functions
Data Export
Auto Scale Function
Printable Plots

Measurement Calculator
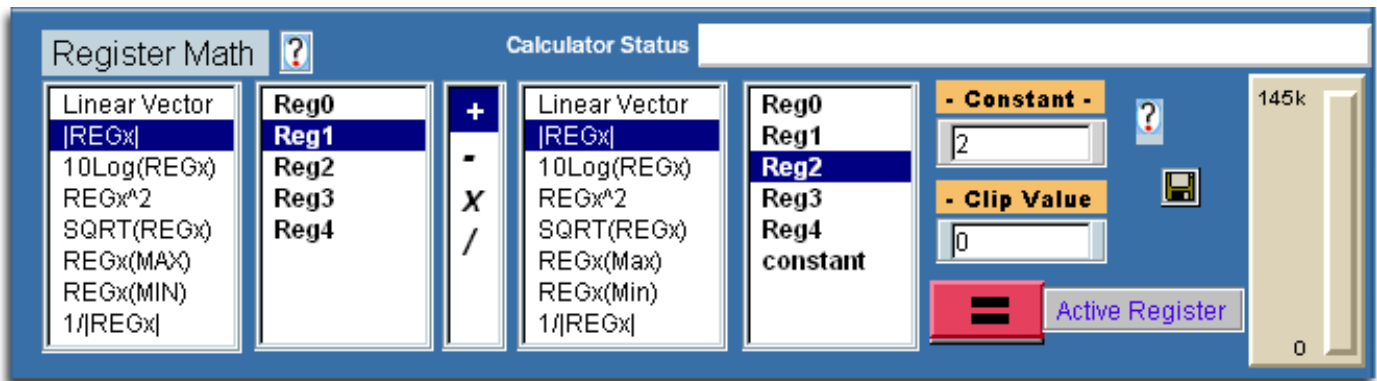
     Use this option to perform arithmetic operations on the measurement registers. For example if you make measurements on one antenna and wish to compare the results to another antenna at each point of rotation and each frequency. Or if you have a calibrated reference antenna an wish to normalize additional 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.

Dipole Link Simulator

     The Dipole Link Simulator is used to create ideal dipole measurements based on a set of physical and environmental factors. These calculated measurements can be imported directly to the measurement calculator for comparison with Measured Data.
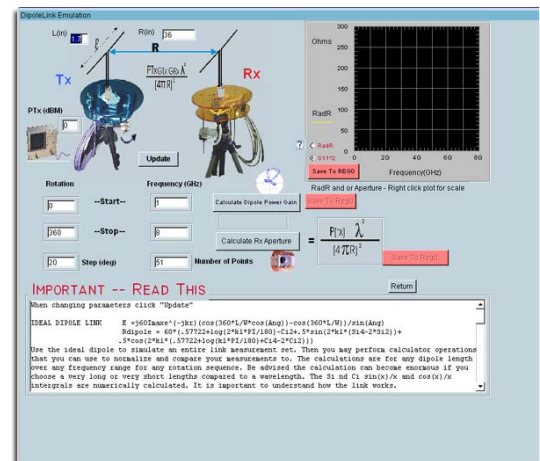
Vertical Swing Correction
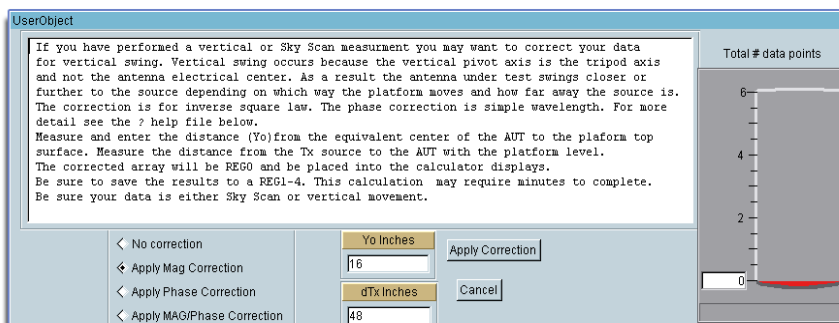
     The Vertical Swing Correction tool is used to compensate for the tilt of the platform when making Vertical / Elevation Measurements.

Chapter 3
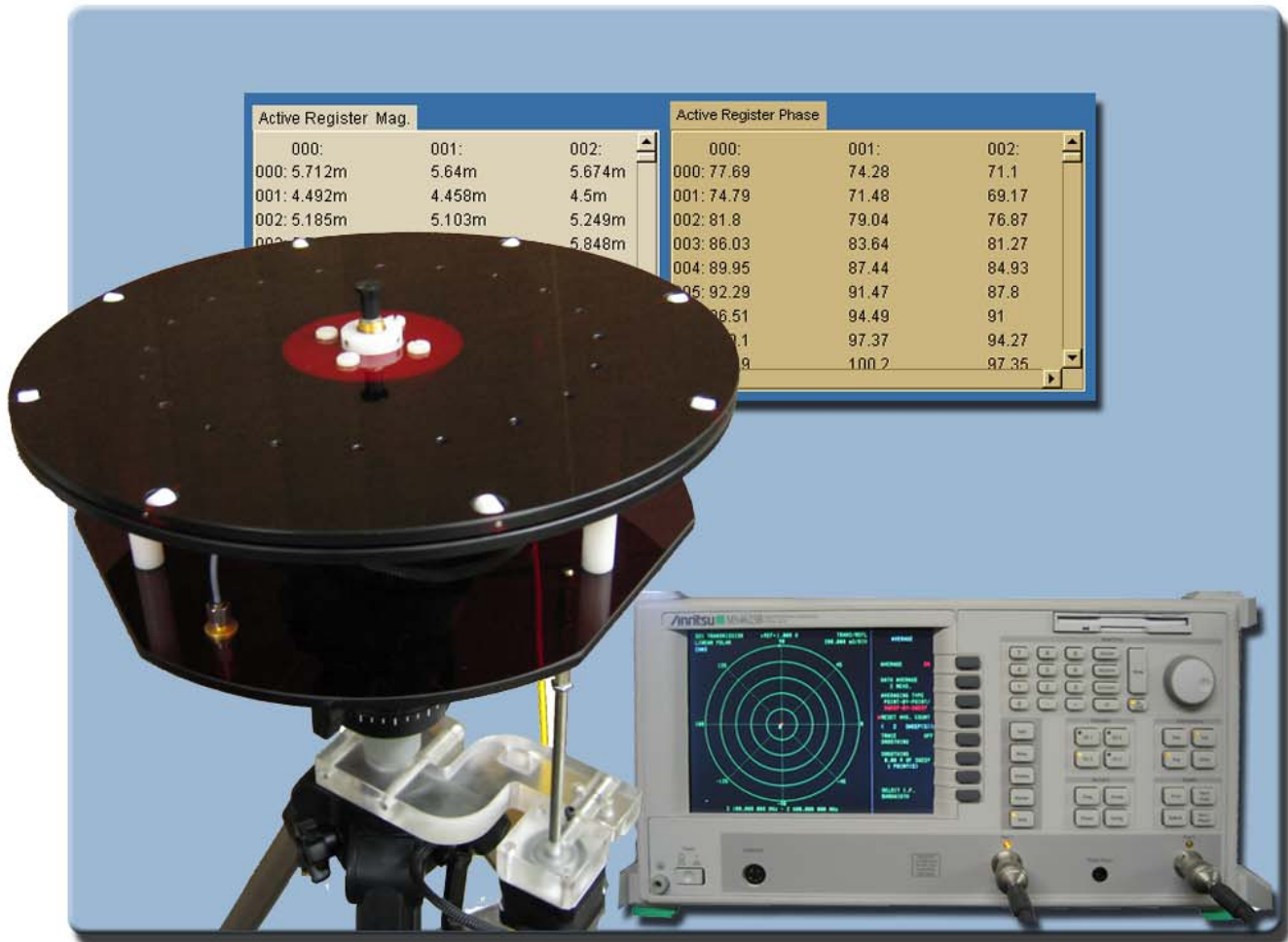
Making Measurements

Performing a Scalar Calibration when using Source / Receive Configuration

1. Ensure platform Power supply is securely attached and plugged in and connected to your VNA using the supplied SMA cable.

3. Turn platform controller power ON.

4. Select the Source Instrument you plan to use (ex. HP83650) , After selection click the "Settings" button located below the icon to configure parameters for your measurement (start , stop , number of points , etc.)

5. Click the "Cal System button

6. Connect the power meter to the top of the DAMs System.

7. Follow the on screen directions.

Performing a Scalar Calibration when using a VNA configuration

1. Ensure positioner is connected to the controller and also connected to your VNA using the supplied RF cable.

3. Turn platform controller power ON.

4. Configure your VNA for desired Start/Stop/No Points.

5. Click the "Cal System" button

6. Connect the end of the cable going to your Reference Antenna. To the top of the DAMS platform.
   (NOTE: If using an amplifier be sure to attenuate the signal to avoid exceeding the maximum input power on your VNA.)

7. Set the pad value to 0 unless you are using an amplifier

8. Press the first "Begin Calibration" button, you will see the loss data display in the small window to the upper left.

9. Press the second "Begin Calibration" button. The loss data will be displayed in the upper right window.

10. You may now save the calibration or just click "exit" where you will be prompted to apply the calibration data to your measurements.

Making a basic Horizontal/Azimuth Measurement

1. Be sure Platform Power supply is securely attached and plugged in

2. Attach antenna to rotator platform with SMA connector

3. Turn Platform Power ON.

4. On your analyzer select S21, POLAR Plot and the proper Calibration set Example: 4 to 6 GHz @ 201 Points.
*if your analyzer has not been calibrated, you need to follow the calibration procedure listed in chapter 1

5. Select the total Number of degrees you want the platform to move using the **"Total Degrees Slider",** the total amount will be shown in the slider window.

6. Select the **"Degrees Per Measurement"** setting of your choice using the associated Slider. The **"Total number of measurements"** window will be updated once a selection has been made.

7. Select your Direction using the **CW/CCW** selection

8. Press the **"Measure Horiz Sweep"** Button to start the measurement Process

9. During the measurement process you will see the Rotator Platform moving and center frequency data starting to appear on your screen. The **"Measure Horiz Sweep"** button will remain greyed out for the duration of the measurements. Once the button has returned to its normal state you may enter the "Advanced Processing" section or perform other Post Measurement options.

Making a basic Vertical/Elevation Measurement

1. Be sure Platform controller is turned on and connected.

2. Attach antenna to rotator platform with SMA connector

3. Start the DAMS Software.

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

5. Be sure the platform angle matches the position displayed on the screen, if it is not correct refer to the vertical calibration information located on page --

6. Set the vertical position slider to the desired start position and press the **Manual Move** button, this will move the platform to the beginning Elevation position.

7. Select the desired stop position on the vertical slider.

8. Press the **"Measure Vert Sweep"** Button to start the measurement Process

9. During the measurement process you will see the Rotator Platform moving and center frequency data starting to appear on your screen. The **"Measure Vert Sweep"** button will remain greyed out for the duration of the measurements. Once the button has returned to its normal state you may enter the **"Advanced Processing"** section or perform other Post Measurement options.

Performing an AZ/EL Scan Measurement

1. Be sure 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 with 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. The Total Degrees Slider must be set to 360 degrees or the software will not sort measurements correctly.

6. Select the degrees per measurement using the **degrees per measurement pulldown,** the total number of measurements will be shown above the pulldowns.
   *remember the total number of measurements you select is multiplied by the number of elevation measurement points, this will cause large files and may cause problems for some computers depending on resolution)

7. Select your Direction using the **"CW/CCW"** selection

8. Move the platform to the Elevation start position using the vertical slider and the **"Manual Move"** button.
   (If the vertical position of the platform does not match the software readout - level the platform first, Pg. --)

9. Set the Vertical movement slider to the desired elevation stop position.

10. Press the **"Scan AZ/EL"** button to begin making measurements.

11. During the measurement process you will see the Rotator Platform make a complete horizontal sweep then move to the next desired elevation point and will repeat the horizontal sweep. You should also see some data starting to appear on your screen, The Scan AZ/EL button will remain greyed out during the measurement process. Once the button returns to it's normal state your measuring process is complete and you may continue on to Data Processing.
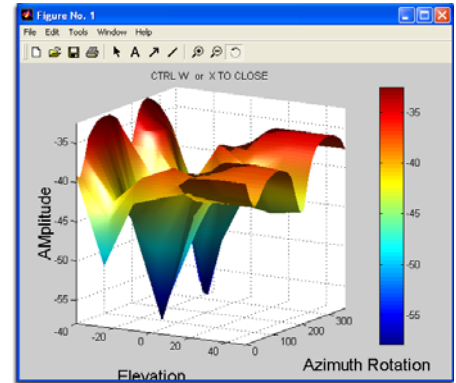
Chapter 4
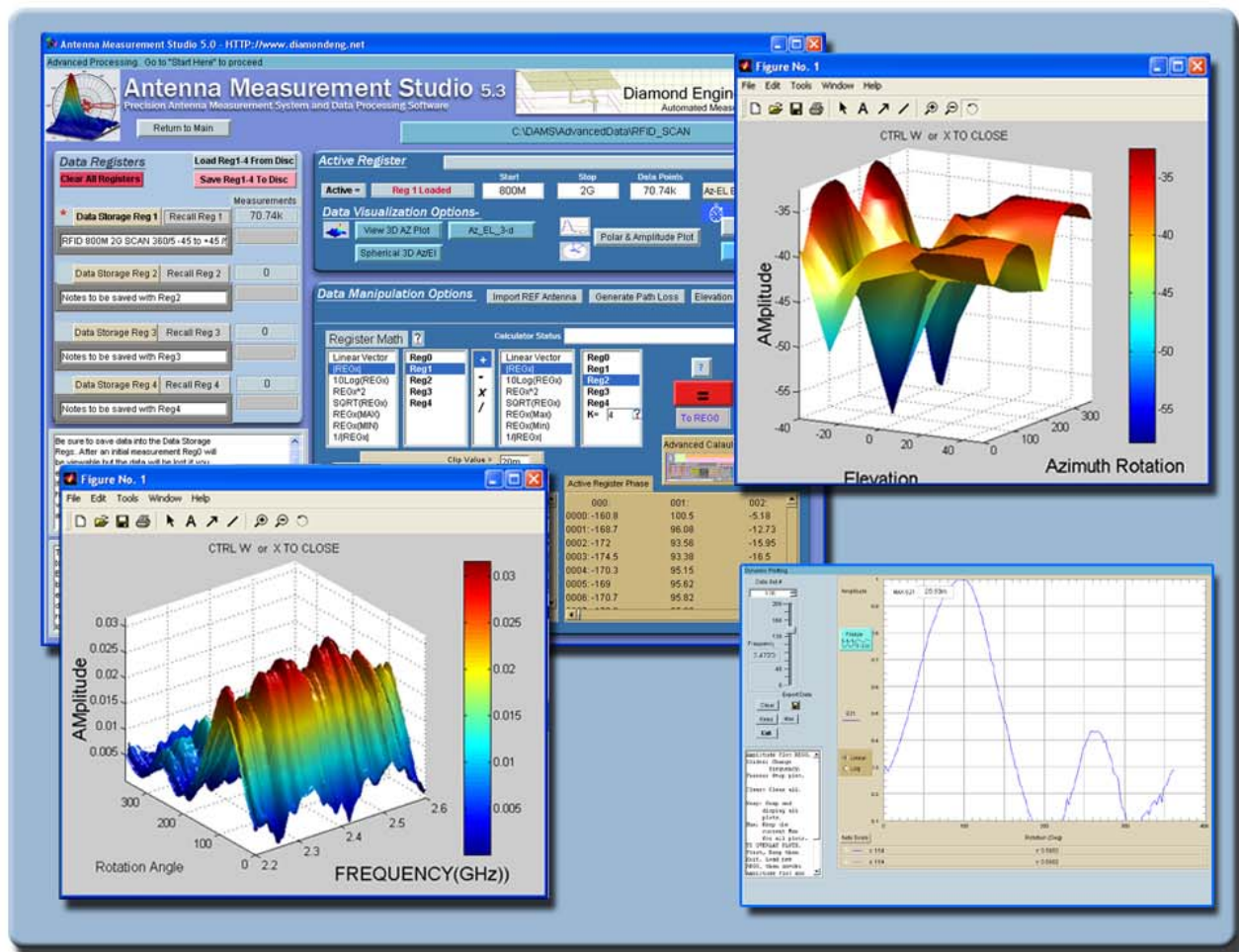
Using the Data Processing Feature

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 located on page.

Data Processing Screenshot
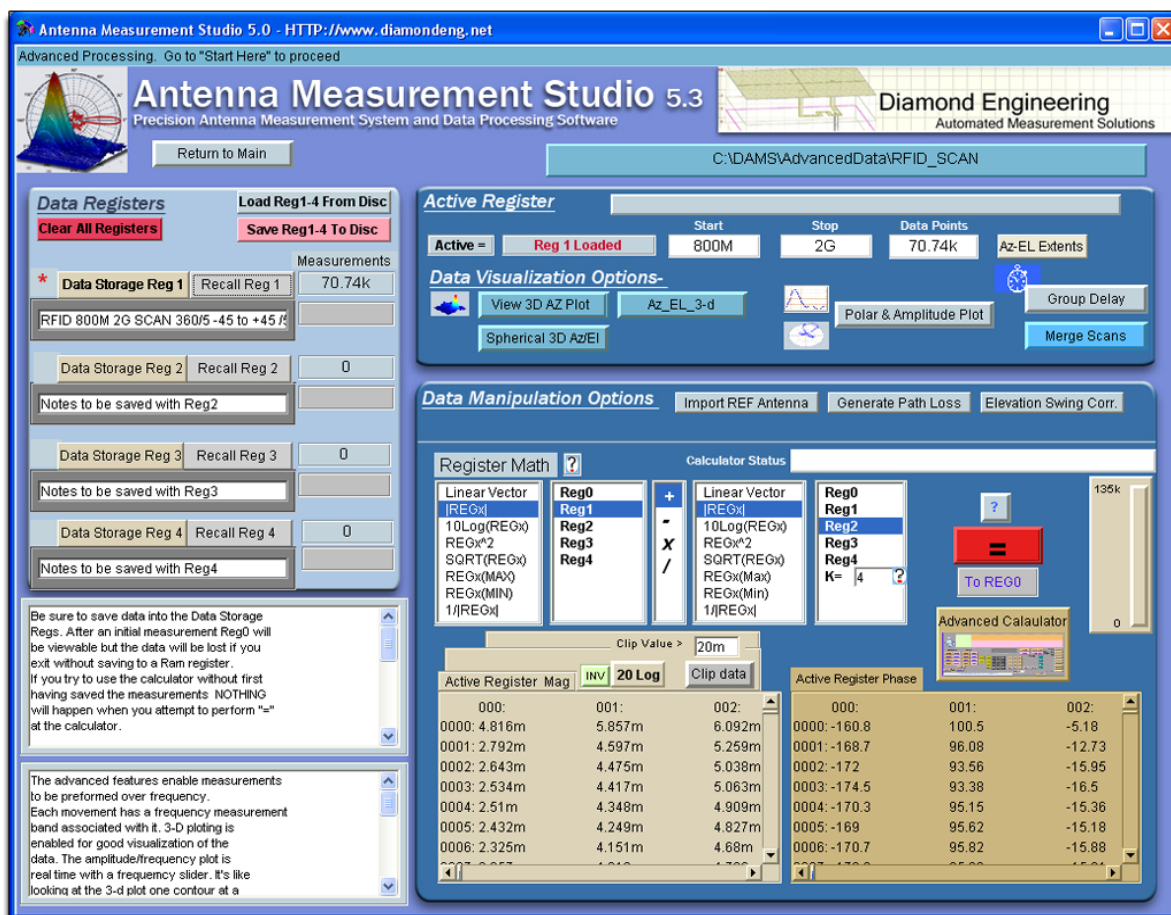
Saving and Loading Measurement Data Sets.

        All measurement data is stored in "data storage registers" each Data Set consists of a group of 4 Data Registers. These 4 Registers are used only for storing and recalling data within the Data Processing feature, the Data Sets can be recalled or saved to disc at any point in time. There is one register called the "Active Register" this will contain your current measurement or any loaded measurement, Any plots, graphs, and export features will be based off of this register, but this register is considered "temporary" and will not be saved to disc, any Active Register data that you want to save must be placed into one of the 4 Data Registers.

        Once you enter the Data Processing section after making an Antenna Measurement, all of the measurement data will be placed in the "Active Register" . To save this data you would click the button labeled "Data Storage Reg 1" this will place all of the active register data into Data Storage Register 1 and cause a red * to be places next to that data register. To save this data set to the hard drive you would press the "Save Reg 1-4 to disc" button.

Active Register

		Start	Stop	Data Points
Active =	Reg 1 Loaded	2.2G	2.6G	9231

Data Registers

Clear All Registers   Load Reg1-4 From Disc
                             Save Reg1-4 To Disc

		Measurements
* Data Storage Reg 1	Recall Reg 1	70.74k
RFID 800M 2G SCAN 360/5 -45 to +45 /5		
Data Storage Reg 2	Recall Reg 2	0
Notes to be saved with Reg2		
Data Storage Reg 3	Recall Reg 3	0
Notes to be saved with Reg3		
Data Storage Reg 4	Recall Reg 4	0
Notes to be saved with Reg4		

Data Storage Button 1-4- When this button is pressed , all of the data in the Active Register is stored to whichever storage button that you chose.

Recall Button- When this button is pushed , all of the data in that storage register will be loaded 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.

Quick Tip : After entering Data Processing Immediately press the "Data Storage Reg 1" button to keep the original measurement data available

Viewing and working with measurements in 3D

Press any of the 3D Buttons to View the "Active Register" Data in 3D Using the MatLAB Viewing Interface.

Viewing 3D Azimuth Measurements

1. Be Sure there is data in the "Active Register, if there is no data you must recall data from one of the storage registers or make a Measurement.

2. Press the "View 3D AZ Plot" button.

3. Depending on the size of your measurement and the speed of your computer it may take up to 2 minutes for your 3D plot to appear on the screen.
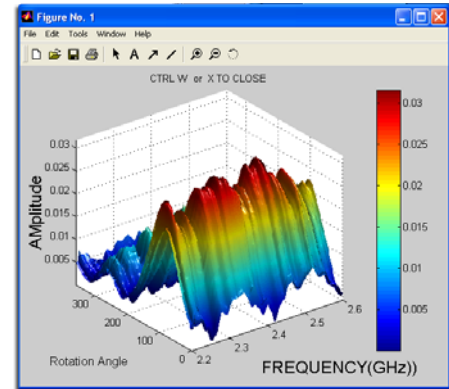
Viewing 3D AZ/El Measurements

1. Be Sure there is data in the "Active Register, if there is no data you must recall data from one of the storage registers or make a Measurement.

2. You can only view 1 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 a frequency to view.

3. Depending on the size of your measurement and the speed of your computer it may take up to 2 minutes for your 3D plot to appear on the screen.

QUICK TIP: Use the Amplitude plot to get a reference of the frequency response of the antenna.
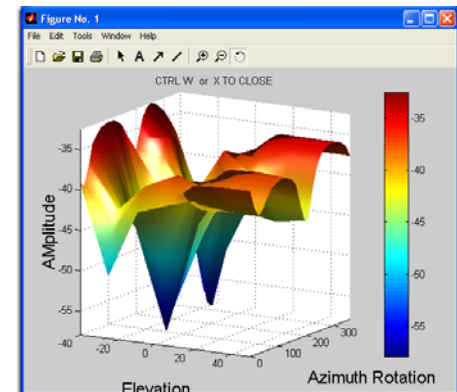
Working With 3D Data

Below are a few common functions that you can do with the 3D plots.

To Rotate a Plot- Click Tools -> Rotate 3D

To Print a Plot- Click File->Print

To Label a Plot- Click Tools -> Add -> Text

To save a Plot- Click File -> Save (Saved File compatible with MatLAB viewer only)

To Export as BMP Image File- Click File -> Export
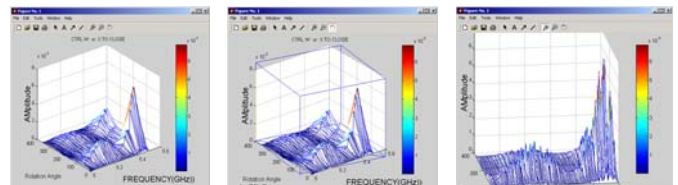
Dynamic Polar and Amplitude Plots

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. Simply select the frequency and elevation (if applicable) and the data will be instantly displayed on the plot. Press the "Amplitude Plot" to view the amplitude plot , press the button again to close the plot.

Instructions:

1. From the Main Data Processing Page click on "Polar/Amplitude Plot" and you will be taken to the screen shown below

2. REG0 will be loaded automatically, use the REGx buttons to select different data sets.

3. Use the sliders to browse through the dataset.

4. The Lin/Log , DB/DIV, Separation values can be set to desired settings. NOTE: if you have already calculated the path loss and applied it to the antenna you want to keep this feature UNCHECKED

5. Markers located in the center of the plot can be dragged to different areas of the trace, the resultant amplitude and angle differences will be displayed in the large numerical windows at the bottom.

6. To Export the current trace data to a file click the "Export" button.

7. To save the entire plot with the number labels you must use the 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 and printed.

8. Click the "Gain Plots" button for detailed instructions. More advanced procedures such as working with dual trace plots are discussed in the Advanced Techniques application note.

QUICK TIP: Right-Click the plot to see a list of visualization options such as zoom, and scaling functions.

Polar Plot/Amplitude plot Screenshot
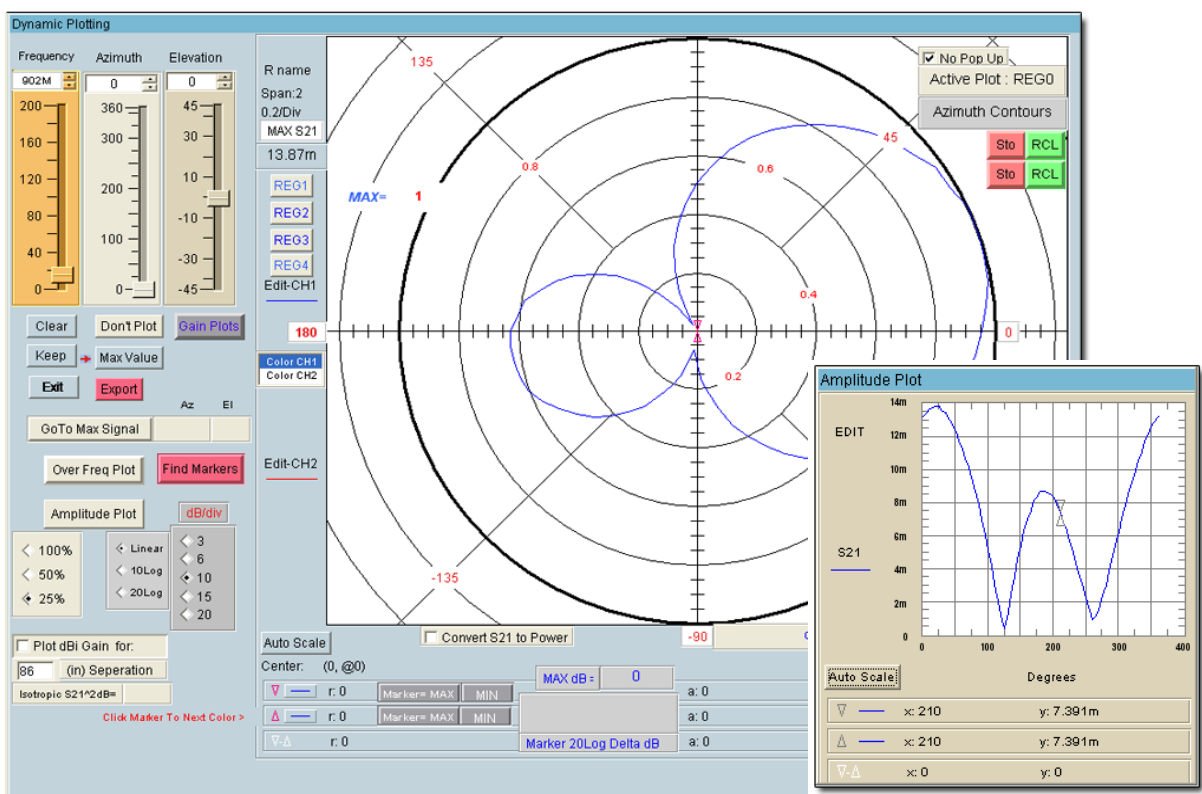
Importing reference antenna data and calculating path loss.

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

Importing reference antenna data

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 the "Import Reference" button
4. Click the "Load from notepad file" and select your reference data file.
5. Wait until you see "Data loaded into REG0" appear and press "continue"
6. You now have your measured data in REG1 and your reference data in REG0 (active register)
7. From this point you can do a number of functions but we will focus on just applying the reference data to your measurement and placing it into REG2 using the calculator.
8. Set the following items in the calculator from left to right: REGx, REG1, / , REGx, REG0. then Press "=" , the calculator has processed the information and placed it in the active register (reg0), store the data into REG2 and now you have your original data in REG1 and your data with the reference data in REG2.

Example reference data for a 1-18 GHz horn. **FORMAT: frequency(in ghz) (tab) gain value**

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 and applying path loss data.

      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 into REG0" appear and press "continue"

    6. You now have your measured data in REG1 and your path loss data in REG0 (active register)

    7. From this point you can do a number of functions but we will focus on just applying the path loss data to your measurement and placing it into REG2 using the calculator. NOTE: if you already have calculated the reference antenna data , you have the option at this point to divide REG2 by REG0 instead of performing the steps listed below.

    8. Set the following items in the calculator from left to right: REGx, REG1, / , REGx, REG0. then Press "=" , the calculator has processed the information and placed it in the active register (reg0), store the data into REG2 and now you have your original data in REG1 and your data with the path loss data in REG2.

Using the Measurement Calculator / Register Math Function.

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
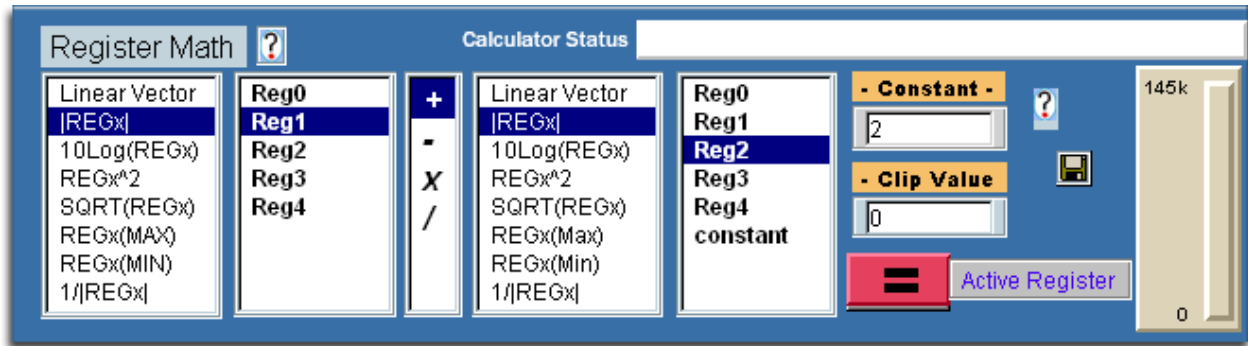
Understanding the Register Math Functions

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.

The 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.

Notice: 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	+,-
l**inMag**	+,-,*,/
LogMag	+,-,*,/

TERM 2 MULTIPLIER All functions above plus Constant

IMPORTANT: Not all combinations of Math are possible. Be sure you have the same size data array

Measurement Export Process

The DAMS software offers you 2 sperate ways to export your data. We refer to them as the "Front Page 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.

NOTES:

1. When using the front page export we recommended using 51 points or less and keeping the degrees per measurement set to 5 degrees.

2. To export using the single frequency export function simply open the Polar/Amplitude plot and select the frequency and vertical angle (if applicable) of your choice and press the export button, select the name and location you want to save to and press the OK button to save the data, you will be shown the resultant export file as well.

Sample single frequency export (available in the Polar/Amplitude Module)

```
!   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
```

Front page export information.

Adata is your measurement data array in complex format from the basic page 1 software

The first column is a scalar array and can set the count for example "frequencies" or angle. You can do this in one of two ways. Enter a known one dimensional array variable such as "NumM". The program variable "NumM" is a 1-D array otherwise only a single row will be written. The number of elements in the NumM array will set column 1 variable "Scalar" (number of data ROWS). Column1 "Scalar" array is automatically set
from the variable you enter into the window unless you press one of the other two Set Scalar buttons.

Make your own Scalar array. Enter the Start, Stop, NumPts such as
Frequencies in the windows below the Scalar switch. Remember if switch is in the up position Scalar will still be used for the number of rows but not written to the output file.

Notice there is also a SET SCALAR button below column 2. You may choose to set the number of rows using the size of column 2.
This will set Scalar and if Scalar is present in column 1 window and switch 1 isin the down position then the output file will include the row count or whatever.

Any one of the switches in the up position will skip that parameter in the output file. Note that for basic Antenna rotation measurements the frequency is constant while the path loss and angle is the program measurement complex variable "Adata". I you wanted to create a text
based output file for a spreadsheet which contains the results of a rotation and measurement set then set all switches to the up position except for switch 2 (or 3 or 4 or 5). Then enter Adata into window 2 below switch 2. Press the Set Scalar button in column 2. Then export the data. The resulting text file will contain two columns. Column 1 = Magnitude and column 2 will contain the position. Open the file with Note Pad and use copy & paste to transfer into spreadsheet. If you wanted column 1 to contain the row count then use Set Scalar in column 1. Enter the number of measurements (n)from page 1 software (in the slider window) and a start stop(n) number. Then export.
Notice that there are "From Variable" "From Disc" check boxes below each Complex switch. When From Variable is checked the data is retrieved from the variable in the box below the switch at the time of export.

Use the ideal dipole to simulate an entire link measurement set. Then you may perform calculator operations that you can use to normalize and compare your measurements to.
The calculations are for any dipole length over any frequency range for any rotation sequence. Be advised the calculation can become enormous if you
choose a very long or very short lengths compared to a wavelength. The Si and Ci sin(x)/x and cos(x)/x intergrals are numerically calculated.

It is important to understand how the link works. The dipole current is sinusoidal. The current is assumed the same over all frequencies.

The radiated power at all frequencies is the same. If Imax is to be constant over the frequency band then the total radiated power changes with RadR. Maintaining Imax with frequency requires an imaginary tuner between the dipole and the VNA... Once you have calculated the Tx dipole gain you must complete the link by defining the receive aperture. If you save the dipole gain to a REG and perform a plot function you may see that the dipole gain peaks at frequencies other than the 1/4 wave frequency. This is because you must multiply the dipole gain by the apertures at distance.

Think of the aperture as the hole through which the dipole radiated power is received. The effective hole area is inversely proportional to frequency or 1/f^2 in power.
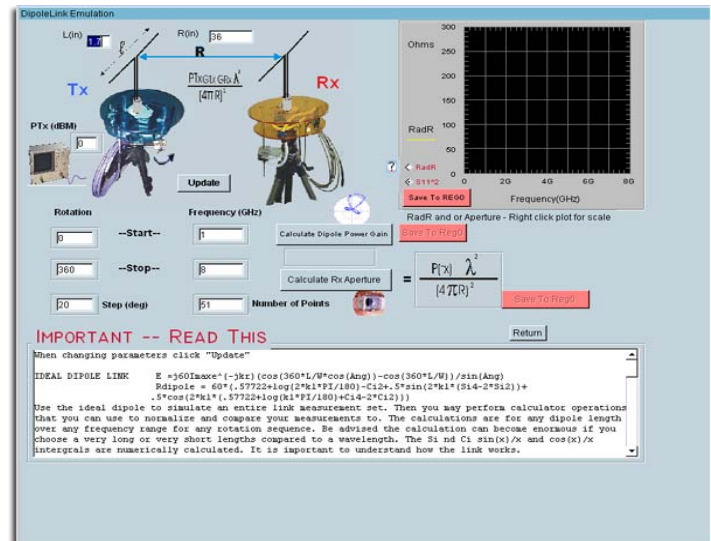
After each calculation return to the advanced menu and store the results into Re1 and Reg2. Note that these results are linear power.

If you are planning to compare your link measurements to this ideal dipole link
then you need to set the frequency and rotation start, stop, &step to the same values.
Set the PTx(dBM)to your VNA power + DAMs loss. Make sure the number of VNA measurement points are the same. This matches the data matrix dimensions and extents with your actual measurements.

The dipole will simulate an entire measurement set, performing rotation and measurements at each point. It is assumed the dipole has been matched (S11=0) at each measurement.

You should try a few calculations to get a feel for the CPU time involved before actually making measurements. Once the calculations are complete the calculate button reappears. You may exit the process at any time if you get tired of waiting. The plot of radiation resistance appears first. After which the pattern calculations progress much faster. This results in one gain(f,Angle).

Note the results are linear not dB. From this point you will want to store these results in a REG.

Then you must decide how to define the Rx antenna and use the calculator to calculate the classical link equation.

Calculate the Rx Aperture. Use this to calculate and fill
the frequency array with the area aperture equation for use with the receive antenna.

Using the Dipole and Isotropic Link Calculator   **Contd.**

Once you have saved your dipole array into REG1 (or 2,3,4) calculate the Aperture array and save the results into REG2. Now use the calculator to multiply REG1 x REG2. The result is the entire link gain normalized to
the Rx antenna gain.

Save the results into a REG3. Now choose a receive antenna. You could go back into the dipole section and calculate another dipole for Rx.
Save these results into REG4. Multiply REG4 X REG3. This gives the entire path gain over Tx rotation and frequency.

********—THE Rx Aperture— If the Rx antenna is isotropic (GRx=1) then the "Calculate Rx Aperture" is the receive power for two isotropic radiators (one Tx and one Rx) at distance R. It is as the figure above except that each dipole is replaced with an ideal infinitesimal isotropic antenna where the Tx radiator is fed with the PTx power (converted to linear)

********—ABOUT PHASE— The phase angle for the dipole is in absolute degrees. This makes it easy to
calculate group delay

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 that the physical distance between the measurement. If this is not the case then 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 that 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 applied only toThe display. Use the EXPORT button on the display to save the display values to disc. Note that if you made measurements and saved them to the disc or into a Reg that they will NOT be corrected for system delay but WILL be corrected for system loss. You Should note 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" (left). The plots will automatically update allowing you see both the corrected and uncorrected profiles.

Group Delay Screenshot
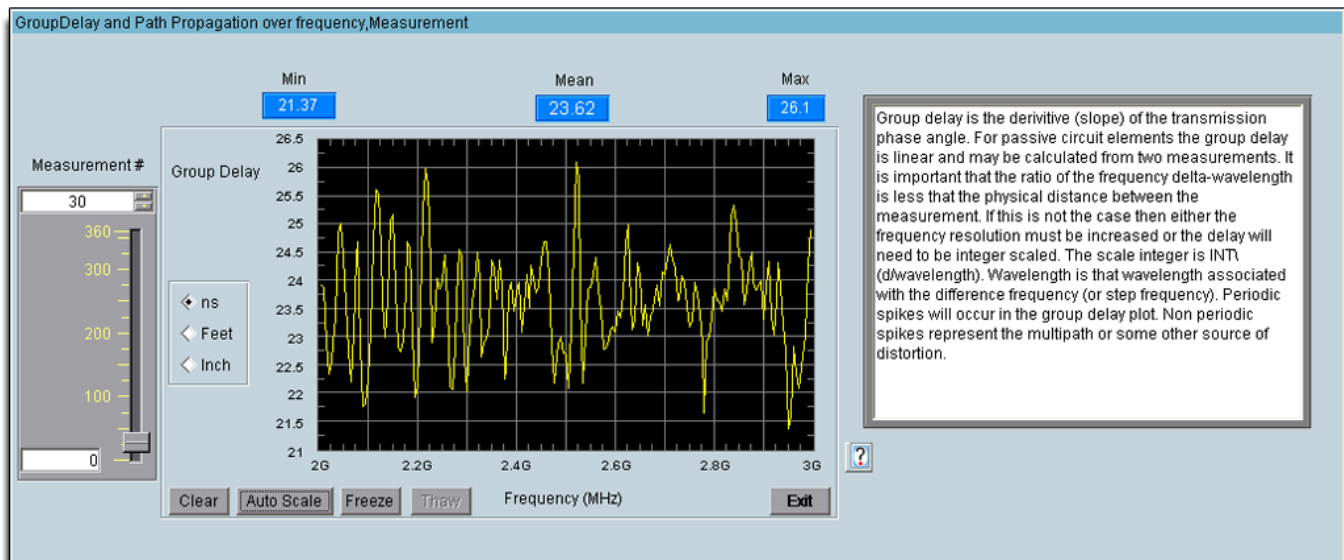
Chapter 5

Troubleshooting and Service Info.

Troubleshooting

Problem- Green light on controller is not on
Possible Causes- Power Supply is not connected correctly, Power Switch is not in the ON position
Solution- Check all of the Items listed above and if everything is OK and light still does not come on please contact us immediately for service.

Problem- Green light is on but positioner does not move
Possible Causes- USB cable not connected, driver is not installed or Improper port selection in DAMS software
Solution-Check all connections, reboot computer, Click "motor settings" in DAMS software and click "Find"

Problem- Only one axis is moving
Possible causes- Loose cable connection, controller error
Solution- With the controller off, disconnect and reconnect yellow cables.

Problem- ERROR: Driver for (instrument name) not found , use instrument manager to add it.
Possible Causes- Your instrument is not configured properly in the Agilent VEE Runtime I/O configuration
Solution- Read instrument configuration instructions.

Problem- Analyzer does not initialize on Program start/Program Crashes with ID error
Possible Causes- Analyzer ID is set incorrectly, Missing Instrument Driver, GPIB Card/Bus is not working correctly
Solution- Using Vee-Runtime I/O manager verify the ID number is set correctly. And run the GPIB Pre-Test to verify Connectivity.

**If you are experiencing any of the above problems or an unlisted problem and cannot determine the cause, please contact us as soon as possible so we can resolve any issues.

Warranty Information

The Antenna Measurement System is guaranteed for 2 years on parts and labor from the time it was received by you. If there is a problem 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 bad part we will ship you a replacement part or unit with a self addressed box to send the defective unit back with

Replacement Parts

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

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The DAMS 6000-100 Antenna Measurement System Features a 100lb. capacity positioner with extra heavy duty tripod for measuring frequencies up to 18 GHz. This system uses the same software as the other 5000, 6000, and 7000 models. This guide has been provided to assist with the understanding, setup, and operation of the 6000-100 system. All other instuction such as using the software and making measurements is covered under the regular users manual provided to you with this system.

Package Contents

Upon receiving your shipment of the DAMS 6000-100 Verify that you received all of the items below and check for any damages that may have ocurred during the shipment process. Please contact us immediatly if any items are missing or damaged.

List of Parts

1. 100lb Positioner
2. 2- 10' Ultra Low Loss Cables
3. Positioner Power/Data Cable
4. Tripod Adapter Plate
5. USB Interface box
6. USB Cable
7. 24V Power Supply
8. Hex wrench tools. (SAE)
9. Loctite, SMA Saver, Additional Hardware

10. Digital Level
11. Laser alignment tool **
12. Heavy duty tripod
13. Thrust Plate
15. DAMS Manual / Software CD (not shown)

Tripod / Positioner Assembly

WARNING: USE EXTREME CAUTION TO AVIOD DAMAGING ANY OF THE SMA CONNECTORS DURING ASSEMBLY

BEFORE YOU BEGIN: Unpack ALL items and ensure there is no damaged or missing parts.

Assembly Steps-

1. Lay the positioner on its side and attach the Tripod Adapter Plate to the bottom of the Positioner using the 4 included Hex Cap Screws and included hex wrenches, use the blue marks for proper orientation (Fig. 1)

2. Unfold the Tripod and Loosen the height lock, Crank the hight up to 2 inches- (Fig. 2)

3. Place the positioner on the tripod by holding it upright and sliding the shaft on the adapter plate into the hole in the top of the tripod neck, Rotate the assembly until you can fit the Included red-handled hex wrench into the set screw located inside of the hole, tighten the set screw until tight. The positioner should now be securly mounted to the tripod. (Fig. 3)

4. The positioner should now be securely attached to the tripod and ready to attach cables.
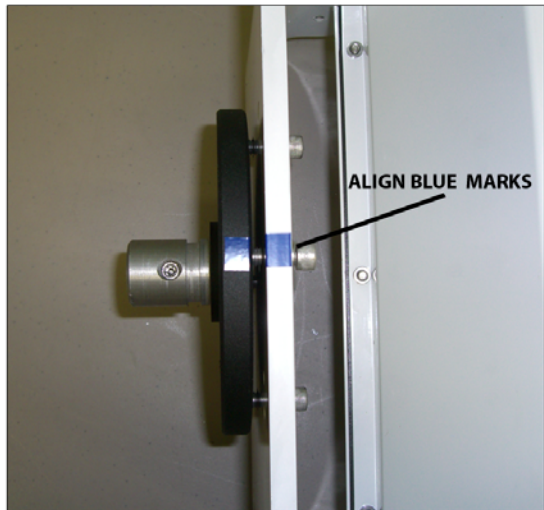
Fig 1

Fig. 2

Fig. 3

Cable Connections

1. Attach the control/power harness to the side of the positioner (Fig. 1)

2. Connect the USB cable and the white cable from the control/power harness to the USB Interface box, DO NOT connect to computer at this time (Fig. 2)

3. Connect the Power supply to the control/power harness (Fig. 3)

4. Connect one end of the precision cable to the side of the positioner, tighten well but do not over-torque (Fig. 4)

5. Connect the other side of the precision cable to port 1 or 2 of your Test Equipment. (not shown)
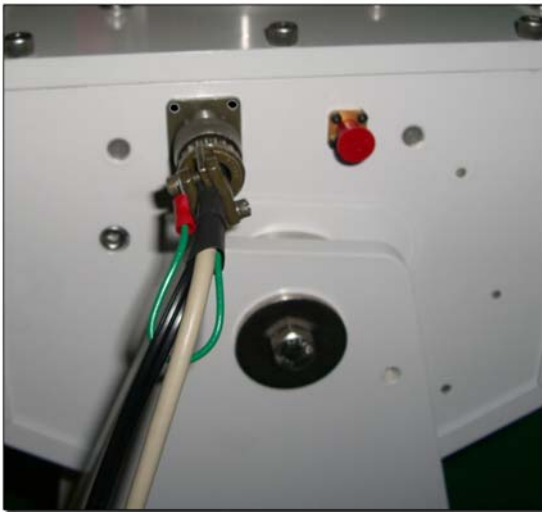
Fig. 1

Fig. 2

Fig. 3

Fig. 4

Installing the USB Driver

NOTE: If you were shipped a Pre-Configured Laptop or PC , you do NOT need to perform any of these steps, you will only need to follow these instructions if you are re-installing the system.

NOTE: The DAMS software should be installed on the PC prior to performing the steps below.

1. Connect the DAMS Platform Controller to the Computer using the included USB Cable. A window should appear indicating that a new device has been found. **Do not select the option to automatically search for the latest driver!**.

2. Click the Box labelled Search Manually then click "Next"

3. Select CD-ROM

4, Click Next, You will then be prompted that the driver has not passed the WHQL certification. Select the "Continue Anyway" button.

5. Click Finish.

6. A new window will pop up indicating another device has been found, repeat steps 2-5 above.

7. Open up the control panel on the computer (start->settings->control panel), double click on the system icon. (if using the category view you must click "performance and maintenance" before you can open system) click the hardware tab then click on "Device Manager"

8. Click the "+" sign next to "Ports COM&LPT" , the controller will listed as "USB Serial Port" **Make note of the port number on a piece of paper.**

Configuring the DAMS software for the 6000-100 positioner

1. Start the DAMS software

2. Click the "Positioner Settings" button

3. Select the 6000-100 from the "Interface" pulldown

4. Select the proper COM port from the "port" pulldown

5. Press the "SAVE" button then press the "QUIT" button to quit the program and save settings.

Verifying Positioner connectivity and operation

The steps below will assit you with checking the 6000-100 positioner operation with the DAMS software. All of the previous steps for installing and configuring the software and connecting the cables should be completed before performing the steps below.

Step 1. Ensure all cables are connected to the positioner and the Power Supply is plugged into a live AC outlet.

Step 2. Start the DAMS Antenna Measurement Software

Step 3. Vertical Movment Test
Set the Elevation slider to 90 Degrees and press the "MANUAL MOVE" button, the positioner should tilt over at in 5 degree increments until it reaches 90 degrees. Now change the slider to -90 degrees and press the "MANUAL MOVE" button, the positioner should now move to -90 degrees in 5 degree increments. If the positioner moved accordingly the elevation/tilt portion of the system is functioning.
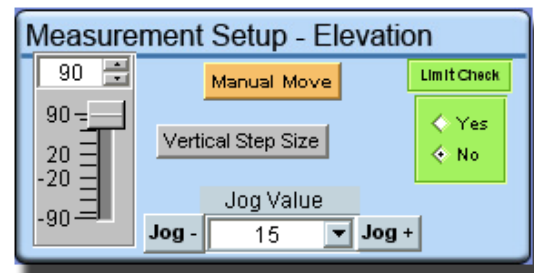
Step 4. Horizontal Movement Test
The Horizontal sliders should be pre-set to a value of 360 degrees total roation with 10 degrees per measurement with 37 total measurements. Press the "MANUAL MOVE" button under the settings to make the positioner simlate making the 37 measurements, the positioner should make a total pan of 360 degrees and stop. If the positioner moved accordingly the Horizontal/Pan portion of the system is working properly.
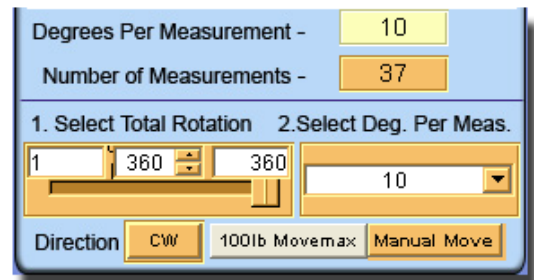
Step 5. Resetting to 0, 0 Degrees
After you have completed the horizontal and vertical test you need to press the "Reset ALL init. pos" button this will clear out all position settings and move the positioner to 0 Deg. Az. and 0 Deg El.

The testing and verification of the Model 6000-1000 positioner has now been completed please see the next section on using and making measurements with the 6000-100 positioner.

Using the 6000-100 Positioner

NOTE: Refer to the Main Users' Manual for detailed instructions on making antenna measurements, this section is degined to advise you of specific items related to the 6000-100 postioner ONLY.

Using the 6000-100 positioner follows the same procedure as the original 5000,6000, or 7000 positioners except for a few key items.

- The units positioner is tracked using internal absolute encoders, at zero degrees the posiioner will always be in the same position

- The jog features in the software currently are disabled for the 6000-100 positioner.

Before making any measurements , ensure the postioner is at 0 Deg. Az. and 0 Deg. El , this can be accomplished using the "RESET ALL INT. POS" button in the software. you can now attach your antenna to the positioner ensuring it is oriented properly to the fixed reference antenna, Use the pictures below to understand the orientation of the positioner for a given position setting. When making a scan measurement (horizontal and vertical) the postioner will move from 0-360 degrees for the first cut, then the positioner will tilt and scan back from 360 degrees to 0 degrees. it will continue with this pattern of movements until the measurement is complete.

Positioning Examples

See the images below for an example of how the positioner will move when instructed to move

Elevation/Tilt Examples

-90 degrees elevation   **0 degrees elevation**   **+90 degrees elevation**

Azimuth/Pan Examples

+90 degrees elevation
0/360 degrees azimuth

+90 degrees elevation
90 degrees azimuth

+90 degrees elevation
180 degrees azimuth

Positioner Specs

Movement

       Resolution: .1 degrees (both axis)
       Horizontal/Az: 0-360 degrees
       Vertical/El: -90 to +90 degrees
       Horizontal/Az torque: 50 Ft lbs.
       Vertical/El Torque: 150 Ft lbs.
       Drivetrain: Precision worm drive with roller bearings
       Weight Handling Capacity: 100 Lbs

Electrical

       Volts: 24 VDC
       Amps: 2.3
       Interface: RS232 and USB converter

RF Connectivity

       Frequency: DC-18 GHz
       Rotary DUT connector: SMA Female
       Stationary Connector: SMA Female
       Rotary Joint: S.I.C based coaxial rotary joint

Physical Specs

       Material: Powdercoated Aluminum
       Weight : 44 Lbs (20 kg)
       Height: 12.51" (31.8 cm)
       Width: 12.61" (32 cm)
       Depth: 8.87" (22.5 cm)

Tripod Specs

Material: Aluminum and ABS
Weight:23 Lbs. (10.4 kg)
Height Min: 33.5" (85 cm)
Height Max:70" (178 cm)
Maximum Spread: 73" (185 cm)
Collapsed Dimensions (transport Mode) : 40.5" x 12.5" (102 x 31.3cm)
Leg Sections: 2
Column Travel: 18" (45 cm)
Foot Plate Diameter: 4" (10 cm) Self Leveling 5/8" hole for spiking

Positioner Troubleshooting

The DAMS 6000-100 Positioner is a very robust and stable positioner. In the event that you belive you may have a problem with your positoiner. Please check the items below. If you do not see your problem listed below or you are not able to get your problem resolved, please contact us and we will be happy to assist you with your problems.

Problem: Software message is displayed that the positoner has reached its limit.
Possible Cause: The Horizontal/Vertical tracking in the software is out of sync.
Solution: Restart the software and press the "Reset All Init. Pos." button to reset everything.

Problem: When Instructed to move the positioner does nothing
Possible Causes: Power is not connected, Wrong Port Selection, Software Glitch
Solution: Check all cables, Reboot PC , disconnect and reconnect positioner power.

If you think there may be a problem with the positioner itself, you may check the Control/Power port on the side of the positioner using an ANALOG multimeter set to "ohms" and look for the following values- Refer to the connector diagram below for proper pins. --NOTE POLARITY OF TEST LEADS-- All values within 10%
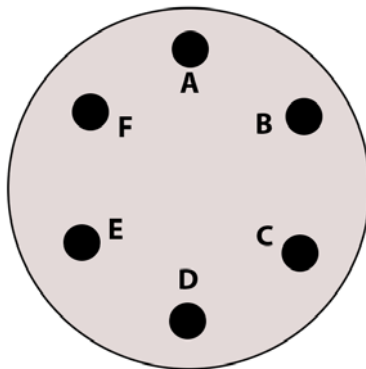
A- to F+: 8.1k
A- to E+: 13.3k
B- to Connector +: 21k (15 sec. settling time)
C to Connector : Short

Control/Power Connector Pinout.

The diagram below lists the connection points for Serial Control as well as DC power.

6000-100 Control/Power Connector

A: Serial Ground
B: 24 VDC +
C: Power Supply Ground -
D: Housing Ground
E: Serial TX
F: Serial RX

Warranty Information

The Antenna Measurement System is guaranteed for 2 years on parts and labor from the time it was received by you. If there is a problem 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 bad part we will ship you a replacement part or unit with a self addressed box to send the defective unit back with

Replacement Parts

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

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