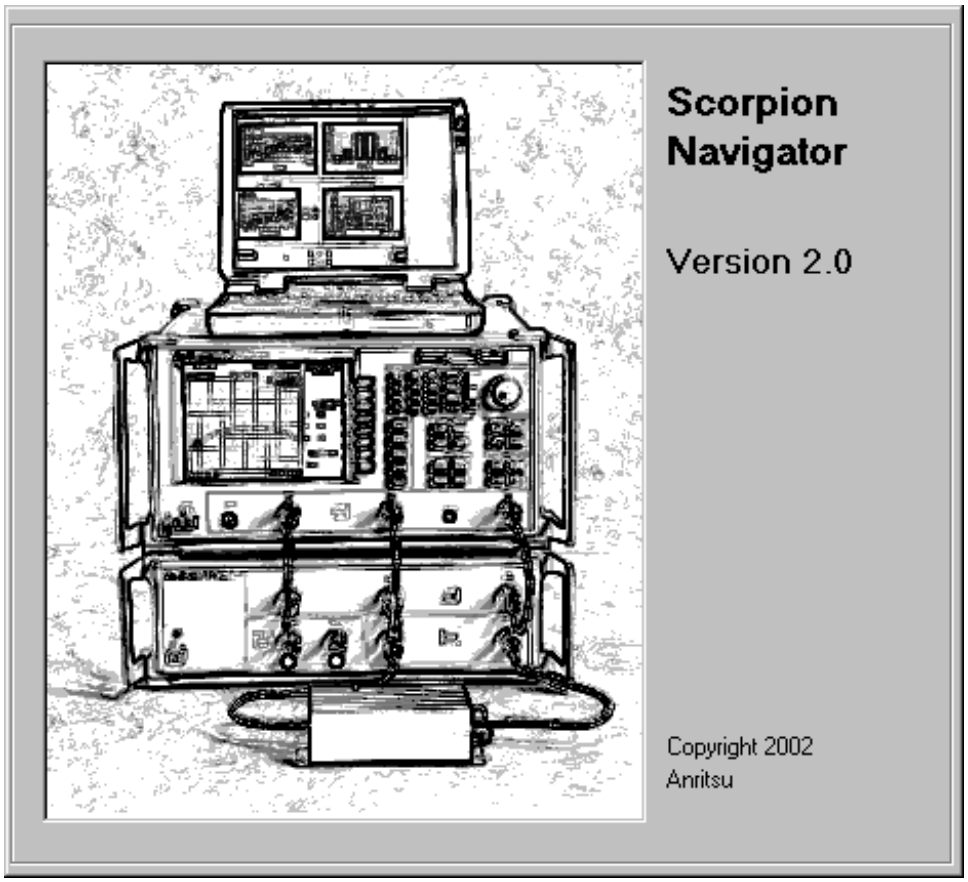
Anritsu 2300-353

Scorpion Navigator Version 2.0

Software User's Guide



Anritsu

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Chapter 5 Measurements

Chapter 1
General Information

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Chapter 1
General Information

1-1 Scope of Manual

This manual provides general information, installation, and operating information for the Anritsu Scorpion Navigator® software program. Manual organization is shown in the table of contents. The following topics are discussed:

- Software Description and Hardware Requirements
- Software Installation Procedures
- General Software Operations
- Calibration Operations
- Measurement Operations and Results Interpretation

Refer to the documentation supplied with the instrument you are using the Scorpion Navigator software with for more details and explanations of the instrument, system equipment, and operating procedures.

1-2 Introduction

Anritsu Scorpion Navigator is a software program designed for use with the following Anritsu Scorpion based instruments and test systems:

- Scorpion Vector Network Measurement System MS462XX (VNMS)
- Power Amplifier Test System (PATS)
  - Base Station (100-Watt) Configuration ME7840A
  - Handset (5-Watt) Configuration ME7840/4
- Tower Mounted Amplifier Test System ME7842B (TMATS)

Scorpion Navigator software interfaces with these measurement and test systems to help automate and perform common RF and microwave calibrations, measurements, and tests. The software runs on an IBM PC compatible computer equipped with the Windows 95 or later operating system.

1-3 Scorpion Navigator Features

Scorpion Navigator version 2.0 software supports the following measurements and features:

- ACPR Measurements
  - CW and swept power ACPR
  - GPIB control of Agilent ESG for CDMA and WCDMA
  - GPIB control of Anritsu MG3681A for WCDMA
  - GPIB control of R&S FSIQ spectrum analyzer for verification

- Simplified Calibration
  - Added calibration wizard
  - Eliminated use of calibration specification files
- Additional Measurements
  - Multifrequency gain compression in 1-tone power sweep
  - Multifrequency gain compression in 2-tone power sweep
  - Swept offset measurements in 2-tone power sweep
  - Power swept measurements displayed as a function of power out
- Data Output and Management
  - Cal File Manager saves and recalls sets of calibration files that correspond to a particular device or test set variation
  - Output graphical data to printer or a bitmap file
  - Create comma delimited text files of measurement data that can be processed in Microsoft Excel
  - Automatically generate Visual Basic source code for measurement automation and Automatic Test Equipment (ATE) implementation

1-4 Related Manuals

The related instrument manual set consists of the following manuals:

Manual Description	Anritsu Part Number
MS462XX Operating Manual	10410-00203
MS462XX Programming Manual	10410-00204
MS462XX Maintenance Manual	10410-00205 (Optional)
ME7840A PATS, Base Station Configuration Operation Manual	10410-00225
MS4782A/MS4782D PATS, Base Station Configuration Maintenance Manual	10410-00238 (Optional)
ME7840/4 PATS, Handset Configuration Operation Manual	10410-00247
MN4783A PATS, Handset Configuration Maintenance Manual	10410-00248 (Optional)
ME7842B TMATS Operation Manual	10410-00244
MN4790A TMATS Maintenance Manual	10410-00245 (Optional)

The operating and programming manuals are supplied with the equipment; the maintenance manuals are optional items that may be purchased.

1-5 Related Literature

There are a number of marketing brochures and related application notes available for the various test systems and the MS462XX VNMS. Refer to Table 1-1 for a listing and part numbers. Most of these items are available from our Internet site, *http://www.anritsu.com*.

Table 1-1. *Related Literature and Software for Scorpion Navigator*

Literature	Part Number	Literature	Part Number
Brochures and Data Sheets		Scorpion Frequency Translated Group Delay	11410-00236
Scorpion Data Sheet/Brochure	11410-00212	Scorpion Global Power Sweep	11410-00243
AutoCal Brochure	11410-00189	Scorpion Multiple Source Control	11410-00244
PATS Data Sheet/Brochure	11410-00263	Reflectometer Measurements-Revisited	11410-00214
TMATS Data sheet/Brochure	11410-00292	Time Domain for VNAs	11410-00206
Application Notes		AutoCal	11410-00258
Adjacent Channel Power Ratio (ACPR)	11410-00264	***Software***	
Scorpion Noise Figure	11410-00210	Scorpion Command Encyclopedia	2300-364
Scorpion Noise Figure Accuracy	11410-00227	Scorpion Navigator	2300-353
Scorpion Intermodulation Distortion	11410-00213	Exact Uncertainty	2300-361
Scorpion Harmonics	11410-00222	***Demonstration Kits***	
Hot S_{22} and Hot K-factor Measurements	11410-00295	Scorpion Demo Kit	SC6287

1-6 Conventions

Throughout this manual, the terms *measurement system* and *test system* will be used interchangeably to refer to the instrument set specified in Section 1-2. The *MS462XX* may be referenced as *Scorpion* or *MS462XX*.

1-7 Online Manuals

Updates to this manual, if any, may be downloaded from the Anritsu Internet site at: *http://www.anritsu.com*.

1-8 User Supplied Items

The following items are required for the operation of Scorpion Navigator to interface with a measurement or test system and must be supplied by the user.

Item	Critical Specification
Personal Computer (PC)	Pentium II or better, 200 MHz or faster, with the Windows® 95/98/NT/2000 or XP operating system and a National Instruments GPIB card/drivers installed.
GPIB Cable	IEEE 488, long enough to connect the PC controller to the test system.

Chapter 2
Installation

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Chapter 2
Installation

2-1 Introduction

This chapter describes a typical installation of Scorpion Navigator on a personal computer.

2-2 Required Equipment

Scorpion Navigator PC and system requirements are as follows:

- 200 MHz Pentium II or better PC running the Windows 95 or later operating system with 500 MB of hard drive storage space and 256 MB of RAM
- CD ROM drive
- General Purpose Interface Bus controller card (NI-488.2 software version 1.7 or higher and NI VISA version 2.5 or higher recommended)
- Anritsu Scorpion based measurement or test system:
  - Scorpion MS462XX VNMS with Firmware Version 1.15 or later
  - ME7840A PATS, Base Station Configuration
  - ME7840/4 PATS, Handset Configuration
  - ME7842B TMATS

2-3 Software Installation

The Anritsu Scorpion Navigator software is delivered on a CD ROM.

CD ROM Contents

The CD ROM includes a Readme.txt file in the root directory and several folders. The readme file contains the latest instructions for installing the software and a listing of the features in the version being installed. The CD ROM contents are as follows:

- Scorpion Navigator Version 2.0 Installation Files
  - MS462XX Installation Files
  - ME7840A Installation Files
  - ME7840/4 Installation Files
  - ME7842B Installation Files
- Measurement and Programming Examples
- Presentations
- Additional Support Files

Installation

Insert the CD ROM into the CD ROM drive and run the *Setup.exe* file to install Scorpion Navigator and the measurement and test system software (Figure 2-1). During installation, the system may indicate that some files being installed already exist. In general it is best to accept copying newer versions of the files and reject copying older versions. If in doubt, cancel the installation, backup the files in question, and try again. The Readme.txt file lists the files and versions copied to the target system during installation of the software.

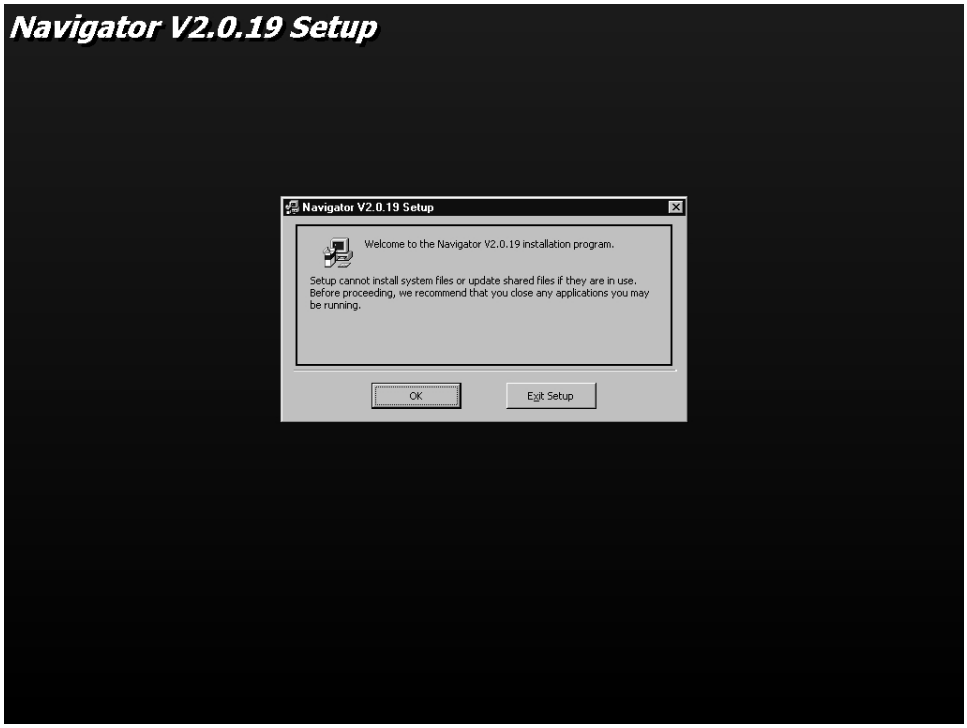

Figure 2-1. *Software Installation Window*

Uninstalling the Software

To uninstall the measurement and test system software or Scorpion Navigator, go to Window's Control Panel and click on "Add/Remove Programs." Select the programs you would like to remove and follow the on-screen instructions.

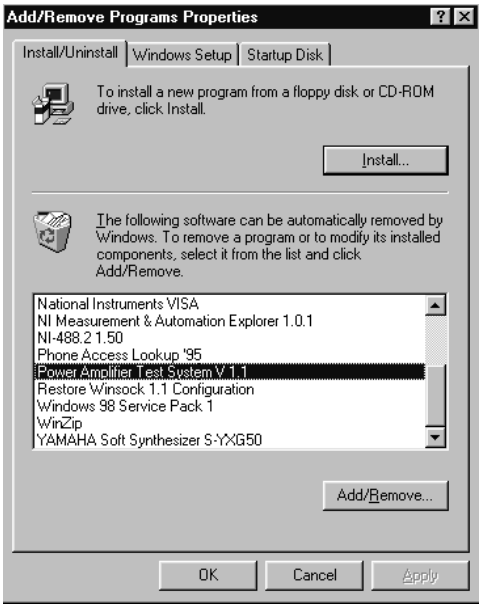

Figure 2-2. *Software Uninstall Window*

2-4 Service Centers

Table 2-1. *Anritsu Service Centers*

UNITED STATES

ANRITSU COMPANY
490 Jarvis Drive
Morgan Hill, CA 95037-2809
Telephone: (408) 776-8300
1-800-ANRITSU
FAX: 408-776-1744

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Telephone: (973) 227-8999
1-800-ANRITSU
FAX: 973-575-0092

ANRITSU COMPANY
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Richardson, TX 75081
Telephone: 1-800-ANRITSU
FAX: 972-671-1877

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ANRITSU PTY. LTD.
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FAX: 03-9558-8255

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CEP22250-040, Rio de Janeiro, RJ, Brasil
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FAX: 016-44-61-065

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FAX: 0211-9685555

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FAX : 011-2-644250023

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FAX: (03) 64-78-334

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832-41, Yeoksam Dong
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FAX: 282-2533

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12 Surrey Square Office Park
330 Surrey Avenue
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FAX: 011-27-11-787-0446

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Chapter 3
General Operation

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Chapter 3
General Operation

3-1 Introduction

The basic operation of Scorpion Navigator software is described in this and the following two chapters: Calibration Operations and Measurement Operations. “Calibration Operations” describes the software measurement calibration function and “Measurement Operations” describes the software measurement function. This chapter describes the setup and general operation of the software for use with Scorpion based measurement and test systems.

3-2 Preparing the System

Refer to the measurement and test system documentation for equipment setup and preparation for use with Scorpion Navigator (see Section 1-4 for a list of related manuals).

3-3 Using Scorpion Navigator

Scorpion Navigator software requires a computer with GPIB capability running Windows 95 or higher (NT/2000). The software is started by selecting Start | Programs | Navigator V2.0 | Navigator V2.0 (Figure 3-1).

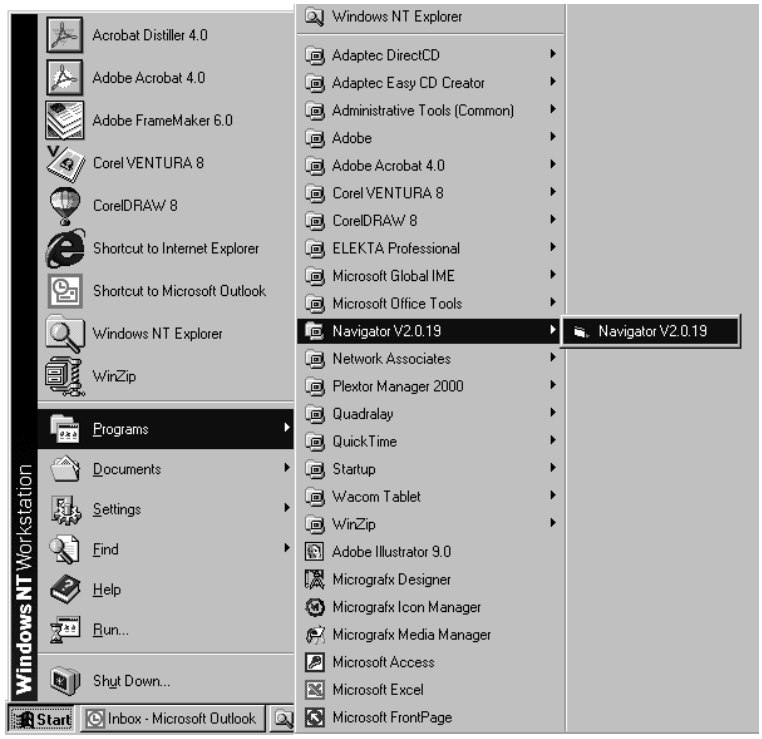
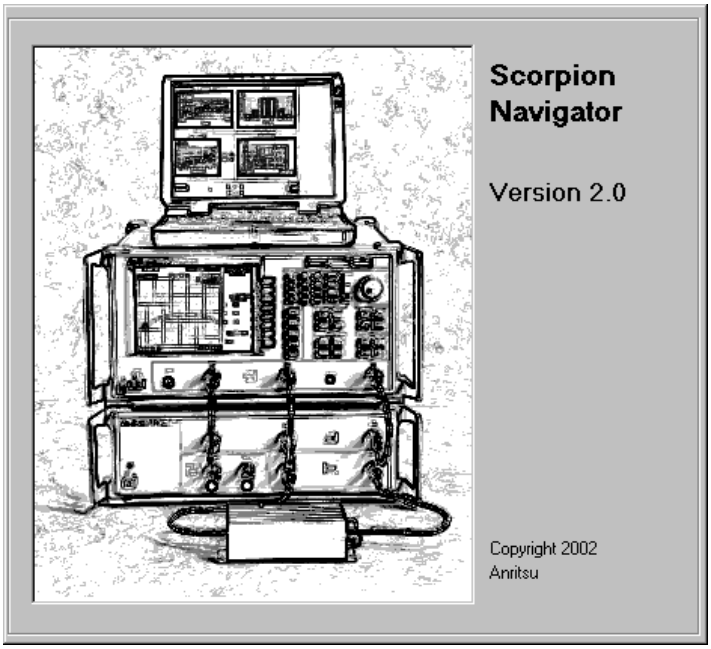
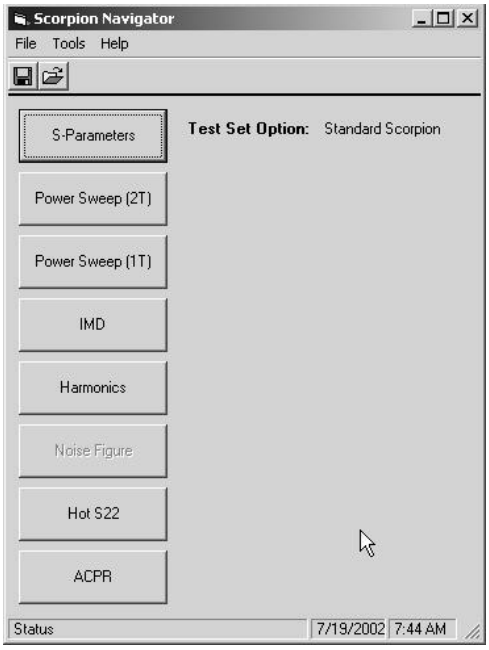


Figure 3-1. *Starting the Scorpion Navigator Software*

Scorpion Navigator starts by briefly displaying a splash screen (below) that indicates the software version, then the main dialog box.



Scorpion Navigator's main dialog box (below) provides access to all software options.



Software Organization

The Scorpion Navigator software has two main and three collateral functions. The two main functions are:

- Calibrations (described in Chapter 4)
- Measurements (described in Chapters 5)

The three collateral functions are:

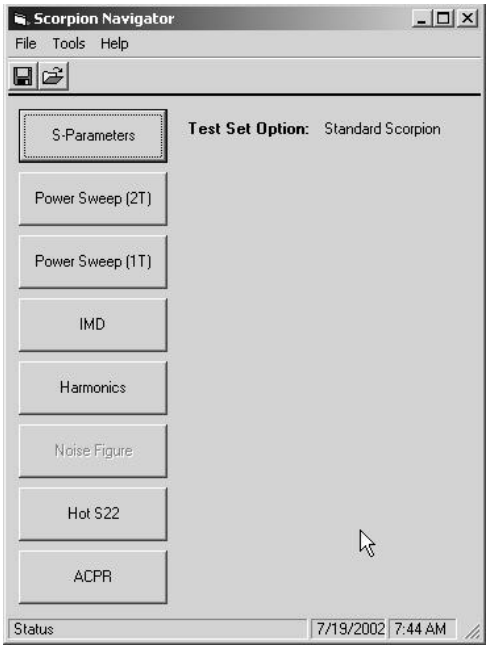
- File
- Tools
- Help

These collateral functions are accessed from the program's top menu and are described in the following section.

3-4 Collateral Functions

Scorpion Navigator's collateral functions are found on the top drop-down menus (below). The collateral functions are used to:

- Set up the file management system
- Configure the basic software settings
- Check the communications between the test system and the PC



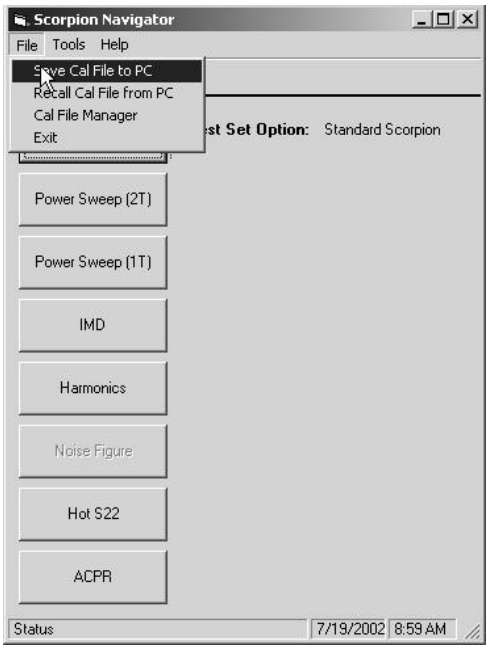
The remaining buttons enter calibration and measurement modes and are discussed in Chapters 4 and 5.

File

The file menu provides for:

- Saving files from the PC to the Scorpion
- Recalling files from the Scorpion to the PC
- Managing calibration file systems
- Exiting the Scorpion Navigator software

Click on File to display a drop-down list (below) that provides the four options described on the following pages.



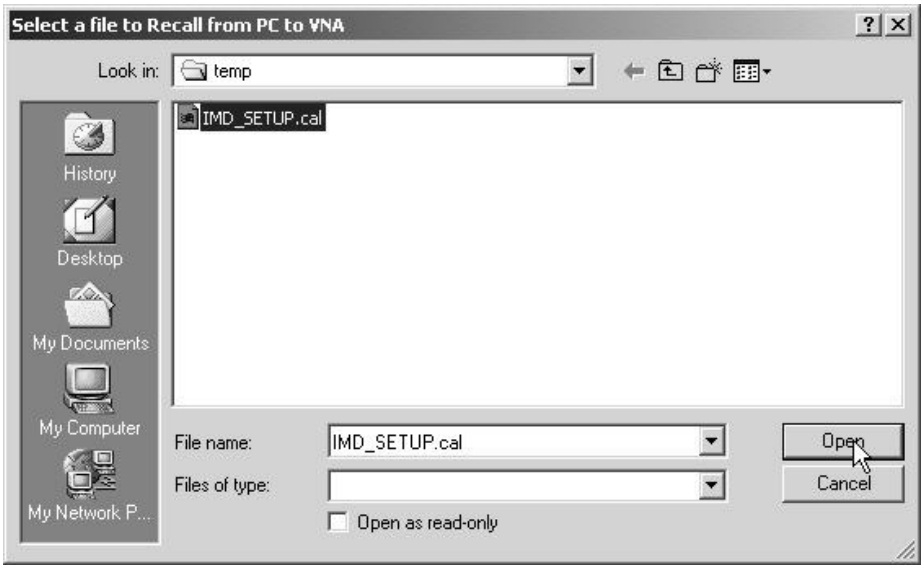
Scorpion Navigator's Save and Recall functions have the exact same behaviors as the Save/Recall button on the Scorpion. However, instead of saving to, or recalling from, the Scorpion's hard disk, the Scorpion Navigator software allows you to save to, and recall from, the PC's hard disk.

Save Cal Files to PC

The Save Cal Files to PC menu selection displays a dialog box (similar to that shown for Recall Cal Files from PC, below) showing the calibration files stored in the default folder (Temp). This function is useful for saving the front panel setup and calibration data to a file on the PC. You have the option of overwriting an existing file by selecting an existing file from the file listing or creating a new file by typing in a file name. You must type in a ".cal" extension or the program will report an error. The calibration procedure automatically saves calibration files to the PC. The file names of these calibration files are specified in the calibration specification file (*.txt file).

Recall Cal Files from PC

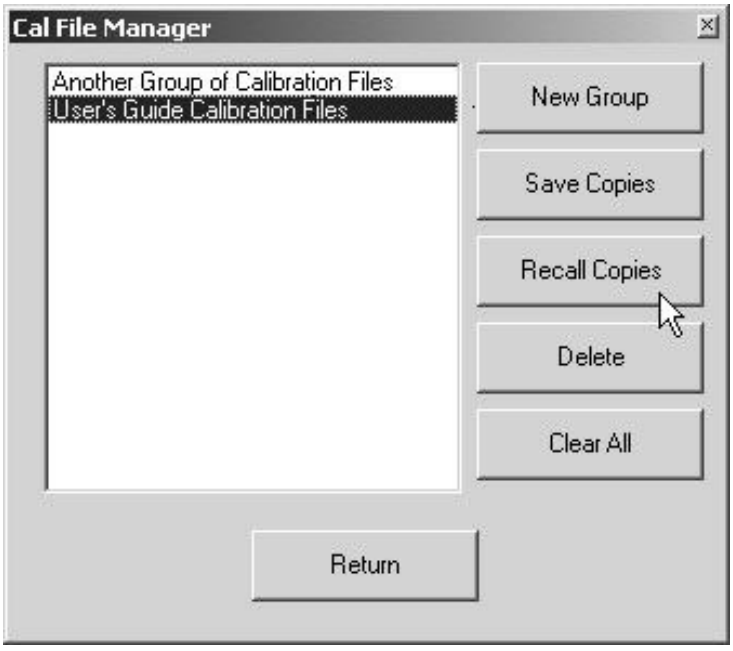
The Recall Cal Files from PC menu selection displays a dialog box similar to that shown below with a listing of calibration file names. This function transfers a calibration file from the PC to the Scorpion over the GPIB bus (and names the file *a.cal* on the Scorpion's hard disk) and then recalls the front panel setup and calibration data from the *a.cal* file to the Scorpion.



Cal File Manager
The Cal File Manager menu selection displays the Cal File Manager dialog box (below). This function lets you save and recall sets of calibration files under a logical name (highlighted below). For example, a manufacturer may have two different devices that require two different calibrations. With this utility the manufacturer can acquire a complete calibration for part "1234" and then save the complete calibration to "MANF X PART 1234."

A complete calibration is actually a set of 8 "*.cal" files that are copied to a directory under C:\temp on the user's PC. Then, the user can acquire a complete calibration for part "5678" and then save the complete calibration to "MANF Y PART 5678."

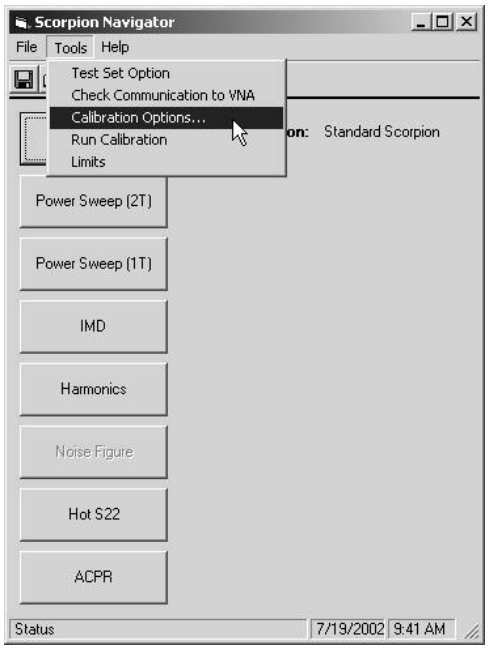
The "active" calibration is the most recently acquired calibration. The user can replace the "active" calibration by "recalling" a calibration set that was previously "saved."



Exit
Exits the Scorpion Navigator software.

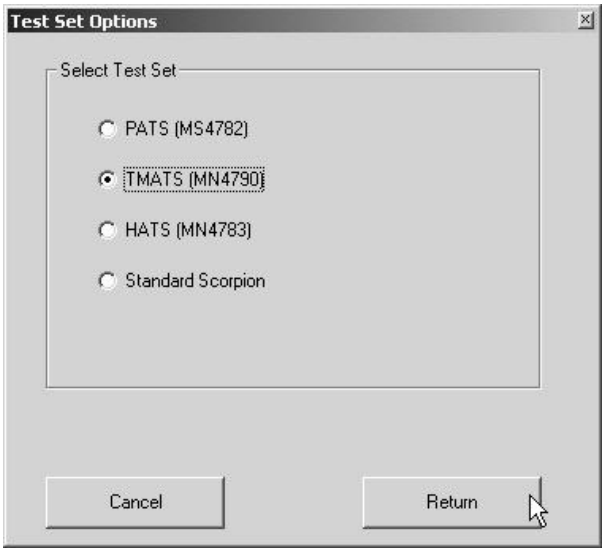
Tools

The Tools menu (below) displays a drop-down list that provides the three collateral options described below. The Calibration Options and Run Calibration menu selections are described in Chapter 4.



Test Set Option

The Test Set Options menu selection opens the Test Set Options dialog box (below). The Test Set Options dialog box allows you to select your test set.



Check Communications to VNA

The Check Communications to VNA menu selection runs a test to check that the VNA communicates with the PC. Run this option first to ensure that the test system's setup is correct and functioning properly. If so, dialog boxes appear like those shown below.

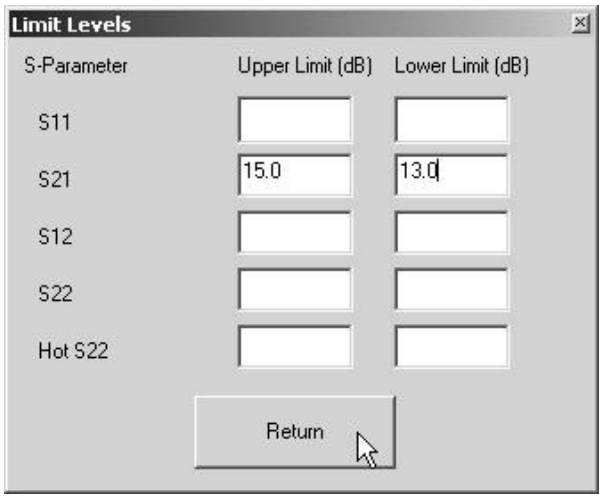
If the VNA fails communication, you will see the following dialog box.

The most likely causes of failed connections are:

- Defective GPIB cable or connector
- GPIB address not set to six
- GPIB controller malfunction

Limits

The Limits menu selection displays the Limit Levels dialog box. The Limit Levels dialog box provides fields for setting the measurement limits of the S-parameter calibrations measurements. Refer to the MS462XX OM for more information on setting limits.



Help

The Help function is not available in the current software.

Chapter 4
Calibrations

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Chapter 4
Calibrations

4-1 Introduction

Measurements always include a degree of uncertainty due to imperfections in the measurement system. The measured value is always a combination of the actual value plus the systematic measurement errors. Calibration, as it applies to network analysis, characterizes the systematic measurement errors and subtracts them from the measured value to obtain the actual value.

Each of Scorpion Navigator's measurements require a calibration to account for measurement uncertainties. This chapter describes the measurement calibration operations of the Scorpion Navigator software.

4-2 Operation, General

Refer to Chapter 3 for general operation and a description of Scorpion Navigator's functions.

4-3 Test Equipment

Power level and S-parameter calibrations require the following equipment:

- Power Meter
- Power Sensor
- N-Type Calibration Component Kit

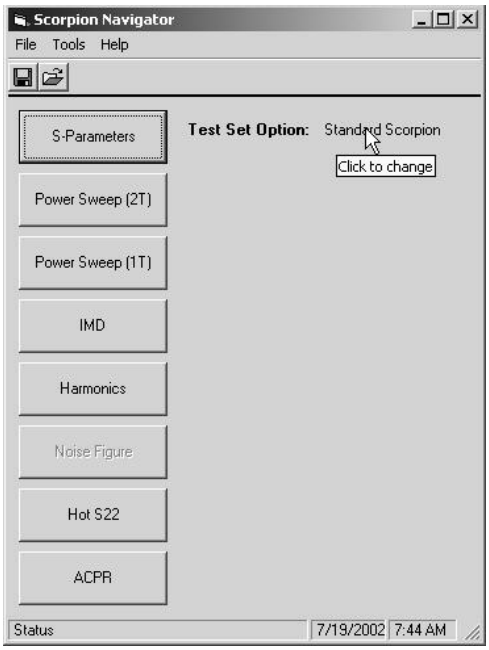
Additionally, for ACPR measurements on W-CDMA devices, the MG3681 Digital Modulation Signal Generator is supported.

4-4 Calibration Setup

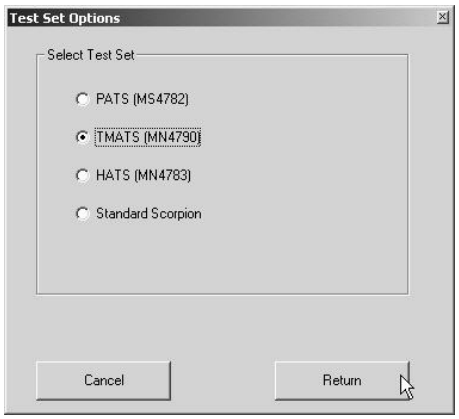
The Scorpion Navigator calibration setup procedures are described in the following Steps 1 through 8. For the purposes of this discussion, the TMATS MN4790A test set is used to illustrate the menus. Depending on your selection, the following menu options may be slightly different.

Step 1. Click Start | Programs | Navigator V2.0 | Navigator V2.0 (Figure 3-1, page 3-3) to start the software.

Step 2. Select the measurement or test system by clicking the displayed test set option (below) or by clicking Tools | Test Set Options.

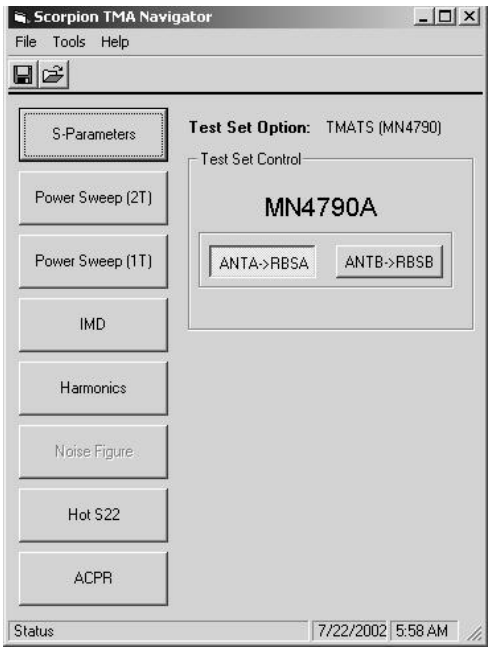


The Test Set Options dialog box is displayed (below).



Step 3. Select your test set and click Return.

Selecting the test set adds a "Test Set Control" interface (if applicable) to the main Scorpion Navigator dialog box (below).



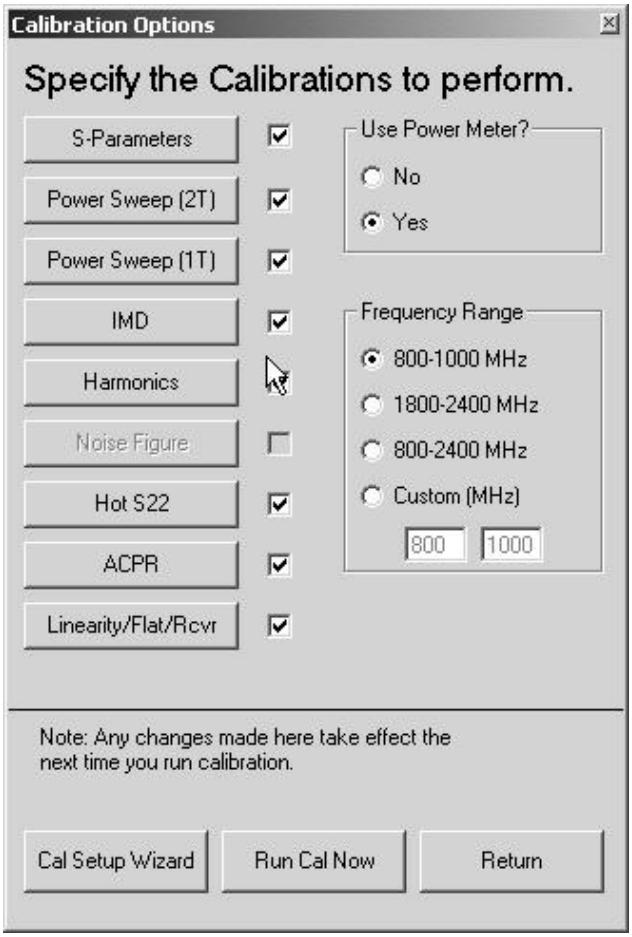
The test set is controlled by a GPIB or serial interface. Selecting the proper test set ensures that the appropriate commands are sent to the test set. The switches in the test set are set to the correct path as soon as the button is clicked.

Before making any measurements, the system must be calibrated.

Step 4. Select Tools | Calibration Options to set up and configure the calibrations.

The Calibration Options dialog box is displayed (below).

Each software module has its own calibration settings. If a module is dimmed, then Scorpion Navigator did not detect that this option is installed on the connected Scorpion. If the module is checked, then a calibration will be performed for that measurement. The software module's calibration settings are accessed by clicking on these buttons.

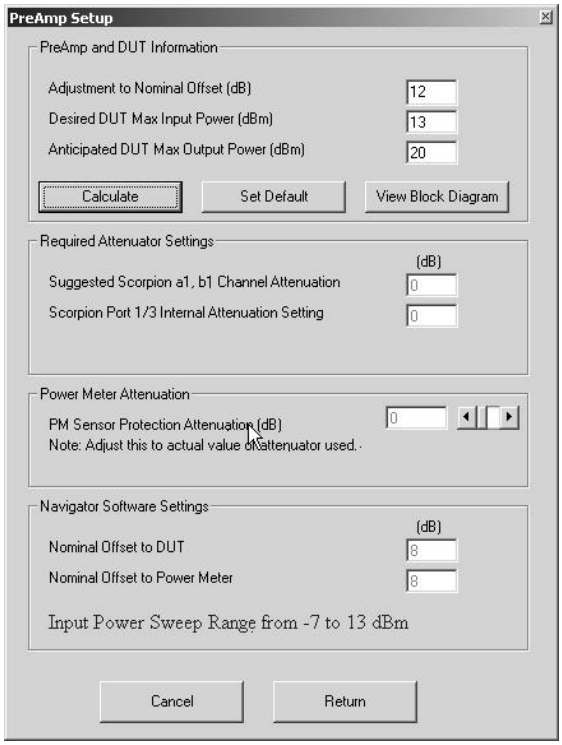


The **Use Power Meter?** option specifies whether to perform Linearity and Flat Power calibrations with a power meter connected to the dedicated GPIB port on the Scorpion.

Frequency Range applies to all calibrations; however, some modules (like S-parameters and Noise Figure) may override this global setting.

The **Cal Setup Wizard** lets you specify the exact hardware configuration on your measurement system.

Step 5. Click on Cal Setup Wizard to configure your hardware. The PreAmp Setup dialog box is displayed (below).



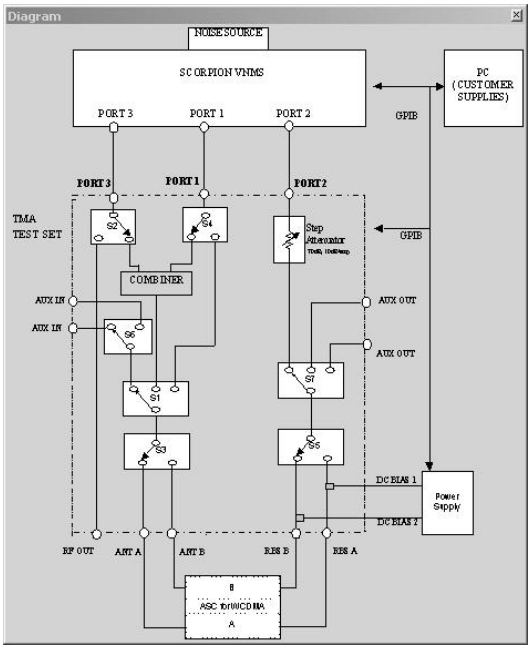
This dialog box helps you set up the test set for calibration.

Button Control Description

Set Default: The default settings assume that you are using a standard test set and a DUT that needs the maximum calibrated input power and produces a maximum output power.

Calculate: When you move to a new field, the parameters are "calculated." You can enter a number and then click the Calculate button to make sure the parameters are being calculated.

View Block Diagram: Clicking on this button displays a block diagram (TMATS shown below).



This diagram provides a graphic indication of the input and output locations and the internal signal path.

Cancel: Aborts the Setup Wizard and returns to the Calibration Options dialog box.

Return: Saves the setup and returns to the Calibration Options form.

PreAmp and DUT Information

Many power amplifier measurements require higher power input to the DUT than the Scorpion sources are able to generate. You may insert preamps (or driver amps) into the measurement setup to boost the RF power from the Scorpion sources to a level desirable for measurement.

To properly set up the calibration, Scorpion Navigator needs to know the gain of the preamplifier in the frequency range being measured. If the gain varies with frequency, then the maximum gain value should be used.

Adjustment to Nominal Offset (dB): By default, enter a nominal offset into this field to account for the standard condition of including a combiner in the test setup. If a preamp is inserted before the DUT, enter the gain as a positive adjustment. For example, a preamp with 12 dB gain should be entered as 12.

If extra attenuation is added in front of the DUT, enter this value as a negative number. A 10 dB pad permanently inserted into the path before the DUT would be entered as –10.

If the combiner loss is actually 7 dB, enter –3 in this field. Check that the "Nominal Offset to DUT" is calculated as expected before continuing.

Desired DUT Max Input Power (dBm): Used to set the desired maximum input power. Many amplifier measurements involve sweeping the input power to the DUT. Scorpion Navigator needs to know the maximum desired RF power at the input to the DUT. By default, enter 0 dBm into this field. The software will attempt to calibrate the instrument so that swept power measurements will achieve the desired maximum input power. Assume that the Scorpion sources can sweep in the -15 dBm to +5 dBm range. If a combiner is added with 4 dB of loss, then this range becomes -19 dBm to +1 dBm (default case). If a preamp with 12 dB of gain is added after the combiner (or two matching 12 dB preamps before the combiner), then the sweep range is -7 to +13 dBm.

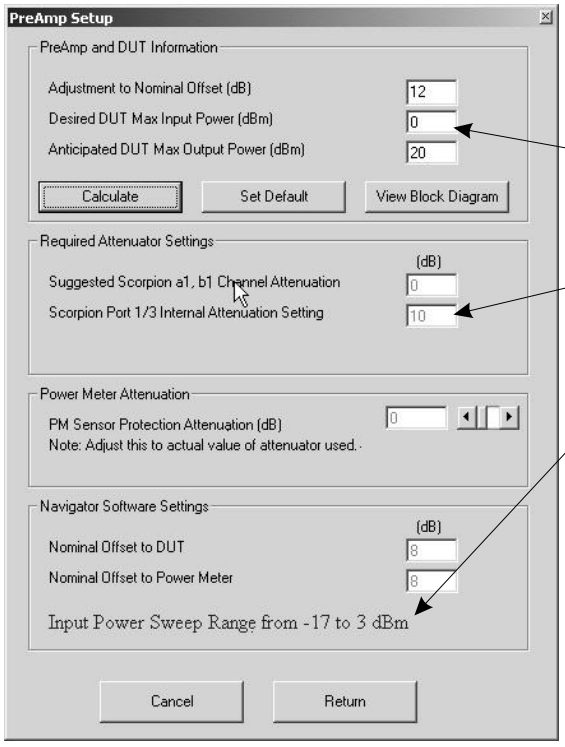
Anticipated DUT Max Output Power (dBm): Used to set the maximum output power. Assuming that the maximum input power is applied to the DUT, what is the expected maximum DUT output power? Scorpion Navigator needs to know this to help set the test set attenuator during calibration and measurement. With a Standard Scorpion or TMATS setup, you will need to limit the DUT maximum output power to be less than 25 dBm.

Required Attenuator Settings
These fields display the current channel and port attenuation settings. Configure the Scorpion Port 1/3 for the Internal Attenuation settings shown.

Power Meter Attenuation
When preamps are used in the system, the calibration strategy is to add a known attenuator before the power meter while acquiring the linearity calibration and the flat power calibration. Scorpion Navigator first suggests an attenuator value to use, but this value should be adjusted to exactly match the value of the attenuator.

Navigator Software Settings
The Cal Wizard adjusts the nominal offsets automatically based on the software's knowledge of the loss through the test set.

Example:
Adjusting Nominal Offset and Desired DUT Max Input Power

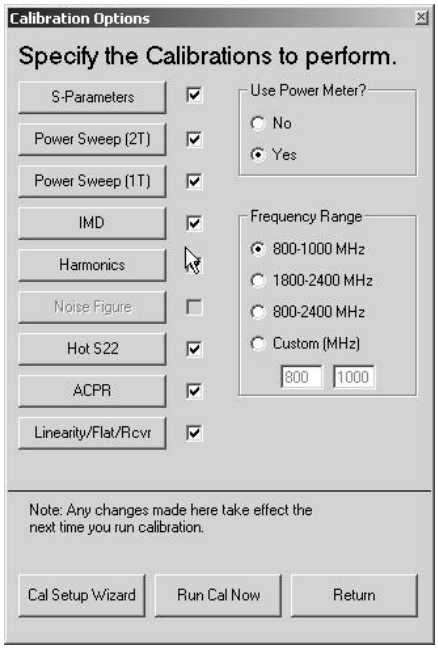


The Desired DUT Max Input Power is changed to 0 dBm.

The Scorpion Port 1/3 Internal Attenuation changes to 10 dB.

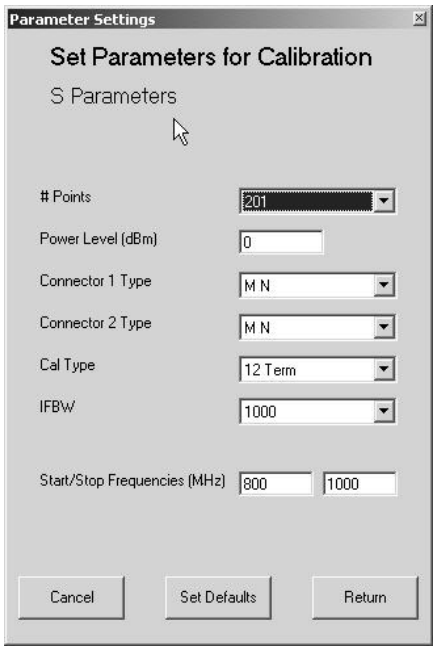
This allows a sweep range more closely aligned to the entered value.

Step 6. Set up the calibration options by clicking Tools | Calibration Options... The Calibrations Options dialog box is displayed (below).



Step 7. Click on each of the available calibration module buttons to open the Parameter Settings dialog box and set the parameters for that particular calibration as follows:

S-Parameter Calibration Options



 # Points: The number of points on which the calibration is performed can be set from 3 to 1601 points. During a measurement, the number of points may be decreased, but may not be increased to more than the value set during this calibration.

Power Level (dBm): The lower limit is -85 plus the Nominal Offset. The upper limit is 10 plus the Nominal Offset. It is suggested that this value agree with the flat power calibration level and that this not be changed significantly (such that the attenuation changes) during measurements.

Connector Type: M=Male, F=Female, SMA, N, K, 3.5 mm or Special

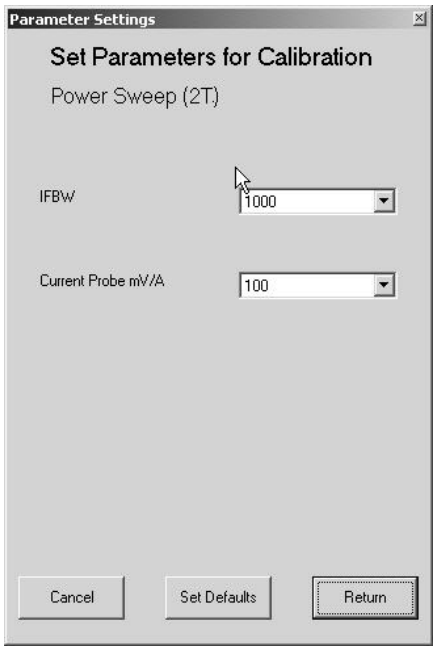
Cal Type: Manual Calibrations—12 Term (allows S11, S21, S12, S22), 1 Path 2 Port Fwd (S11 and S21 only), Fwd Transmission (S21 only), Rev Reflection (S22 only), LRL AutoCal—Full 2 Port Cal (S11, S21, S12, S22)

IFBW: 100 to 30,000 (lower IFBW settings are difficult to synchronize with GPIB control). This may be changed during a measurement.

Start / Stop Frequencies: These settings will over-ride the global settings.

Power Sweep (2T) Calibration Options

Two-Tone Power Sweep is an IMD mode measurement where the input power to the DUT is swept over a maximum 25 dB range. The calibration relies on an accurate Linearity calibration and an accurate Receiver calibration.

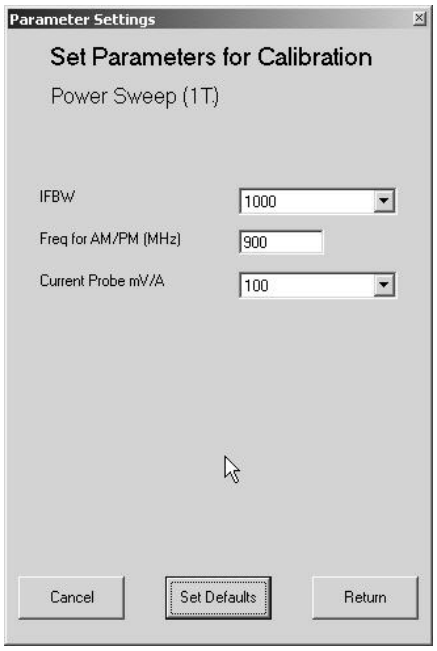


IFBW: 100 to 30,000 (lower IFBW settings are difficult to synchronize with GPIB control).

Current Probe Setting: 10, 100 or 1000 mv/Amps.

Power Sweep (1T) Calibration Options

One-Tone Power Sweep is a Transmission/Reflection (T/R) mode measurement where the input power to the DUT is swept over a maximum 25 dB range. The calibration relies on an accurate Linearity calibration and an accurate Receiver calibration.



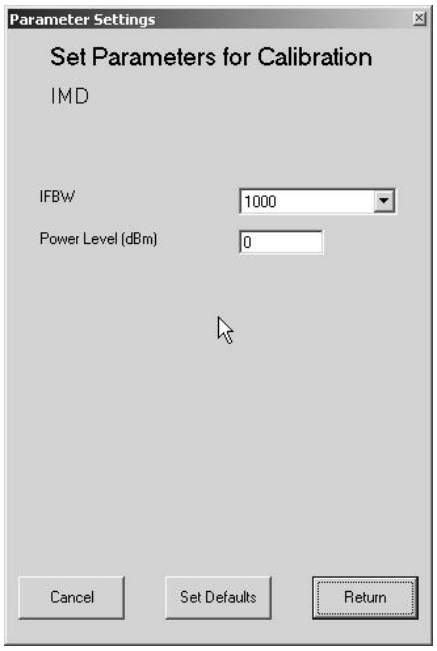
IFBW: 100 to 30,000 (lower IFBW settings are difficult to synchronize with GPIB control).

Freq for AM/PM (MHz): This frequency should be within the Global Frequency Range. Calibrations for AM/PM measurements are only performed at 1 Frequency as specified here.

Current Probe Setting: 10, 100 or 1000 mv/Amps.

IMD Calibration Options

IMD Calibration allows CW IMD measurements, Swept Frequency IMD products, and TOI. The calibration relies on an accurate Flat Power calibration and an accurate Receiver calibration.

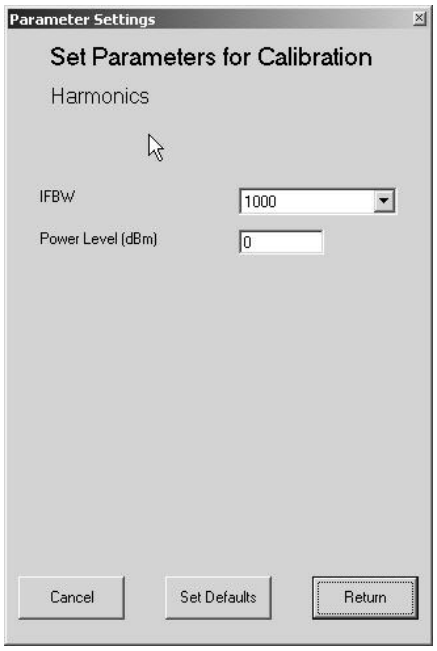


IFBW: 100 to 30,000 (lower IFBW settings are difficult to synchronize with GPIB control). This is simply an initial IFBW setting and may be changed at measurement time.

Power Level (dBm): This level is set prior to doing an IMD calibration. This calibration allows for Input Referred measurements. Note that any Input Referred measurement must be performed at this power level.

Harmonics Calibration Options

Harmonics Calibration relies on an accurate Flat Power calibration (if you are interested in absolute power levels) and performs a quick Receiver calibration over the entire frequency range of the Scorpion. For limited bandwidth test sets (such as PATS), measurements outside the bandwidth of the test set may be degraded.

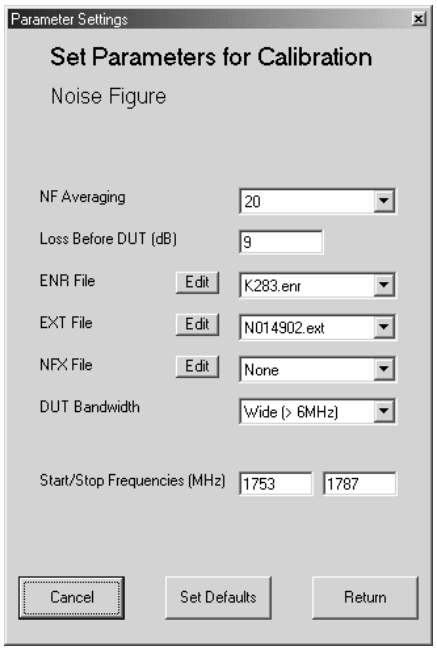


IFBW: 100 to 30,000 (lower IFBW settings are difficult to synchronize with GPIB control). This is an initial IFBW setting and may be changed at measurement time.

Power Level (dBm): This level is shared with IMD calibration setup (if you change the level here, it will change in IMD also). This is an initial setting and may be changed at measurement time.

Noise Figure Calibration Options

Noise Figure measurements allow you to compare the decrease (or degradation) in signal-to-noise ratio through the DUT. (Option 4X is required on the Scorpion MS462XX VNMS in order to enable the noise figure calibration options.)



NF Averaging: Sets the number of points to average over the specified measurement range.

Loss Before DUT(dB): If a network (attenuator) is placed between Port 1 and the input of the DUT, the contribution to ENR reduction can be entered here. This method should only be used for networks which have a flat frequency response (loss is constant over frequency).

ENR File: Excess Noise Ratio (ENR) tables are unique for each particular noise diode and must be selected to match the diode in use for the noise figure measurement.

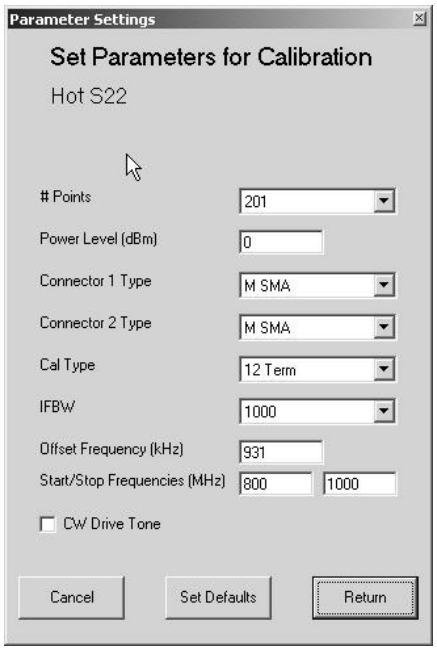
EXT File: When the network ahead of the DUT does not have a flat frequency response, the 2-Port S-parameters of the network can be measured and the Scorpion can compute the correction file for the path from the rear panel of the instrument all the way to the DUT input connector.

NFX File: The NFX file characterizes the network between the Port 1 connector and the DUT input connector. The file is a user generated .S2P file of the four S-parameters for the user inserted network.

DUT Bandwidth: Specifies the bandwidth of the DUT.

Start / Stop Frequencies (MHz): Specifies the Start and Stop frequencies for the test.

Hot S22 Calibration Options



 # Points: The number of points over which calibration is performed can be set from 3 to 1601 points. During a measurement, the number of points may be decreased, but may not be increased to more than the value set during this calibration.

Power Level (dBm): The lower limit is -85 plus the Nominal Offset. The upper limit is 10 plus the Nominal Offset. It is suggested that this value agree with the flat power calibration level and that this not be changed significantly (such that the attenuation changes) during measurements.

Connector Type: M=Male, F=Female, SMA, N, K, 3.5 mm or Special

Cal Type: Manual Calibrations—12-Term (allows S11, S21, S12, S22), 1 Path 2-Port Forward (S11 and S21 only), Forward Transmission (S21 only), Reverse Reflection (S22 only), LRL AutoCal—Full 2-Port Cal (S11, S21, S12, S22)

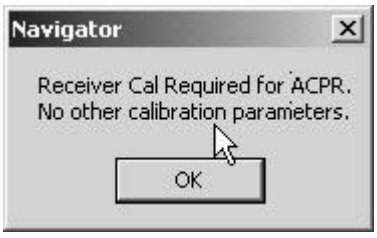
IFBW: 100 to 30,000 (lower IFBW settings are difficult to synchronize with GPIB control). This may be changed during a measurement.

Start/Stop Frequencies: These settings will over-ride the global settings.

CW Drive Tone: Activates the CW Drive Tone field.

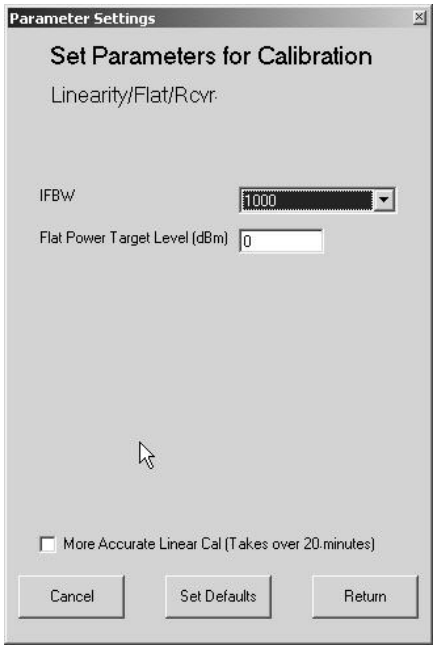
ACPR Calibration Options

ACPR calibration does not have any user settable parameters. The calibration procedure relies on an accurate receiver calibration and sets up the Scorpion in the correct mode to acquire the raw data necessary to calculate the ACPR.



Linearity/Flat/Receiver Calibration Options

These calibrations form the basis of many other calibrations and are performed over the global frequency range.



The order of these calibrations is important:

a. Linearity Calibration: This calibration adjusts the Scorpion Sources to apply accurate input power levels to the DUT at all power levels across the frequency range.

b. Flat Power Calibration.

c. Receiver Calibration.

IFBW: 100 to 30,000 (lower IFBW settings are difficult to synchronize with GPIB control). This is the IFBW used in performing the Receiver calibration.

Flat Power Target Level (dBm): This is the input power required at the DUT for IMD, Harmonics, and S-parameters.

Step 8. After the calibration parameters are set, click the Run Cal Now button on the Calibration Options dialog box or select Tools | Run Calibration on the main Scorpion Navigator dialog box. This starts the calibration. After the calibration is started, screens will display depending on the check boxes selected in the Calibration Options dialog box. All checked items will be calibrated. Scorpion Navigator determines the order of the calibrations as follows:

a. Linearity
b. Flat
c. Receiver
d. Hot S22
e. S-Parameter
f. Power Sweep
g. IMD
h. Harmonics
i. ACPR

The calibration screens are straight forward. In general, follow the on-screen instructions before clicking the Next button. Pressing the PC's Enter key should also execute Next. Clicking the Return button should return Scorpion Navigator to the main Scorpion Navigator dialog box and abort the calibration procedure. However, the Scorpion will retain the calibrations that were completed.

4-5 Calibration Operation

Scorpion Navigator calibration procedures for TMATS are described in the following Steps 1 through 32. Other test system configurations, such as PATS, use a similar calibration sequence. In general, follow the on-screen instructions when calibrating your test system.

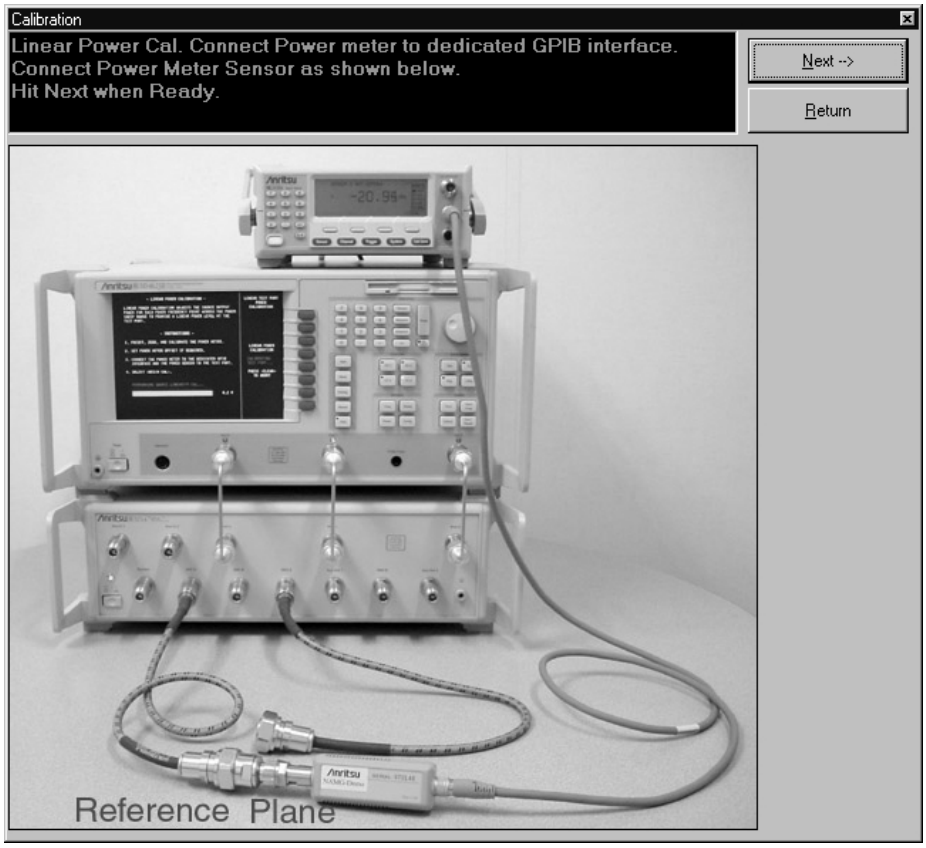
The Linearity Power Calibration is typically the first calibration to be performed. The use of cables and adapters does not effect the final measurement result if they are in place for the calibration process. The vector error corrections established during the calibration process eliminates cable and adapter effects as long as the ports used are stable and exhibit good repeatability, which is the case if good quality components are used.

Many calibration kits include adapters that are designed to have equal phase length. These parts are called Phase Equal Adapters (PEAs). Anritsu designs in-series adapters (for example, SMA connector M-M, M-F, and F-F) to be phase insertable when technically possible.

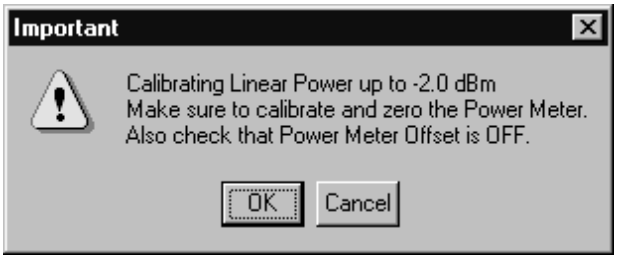
The linear power calibration takes up to five minutes to complete. It calibrates the output power at the reference plane for both of Scorpions's internal sources (power out of Port 1, then Port 3) according to the target power across the frequency range set in the calibration specification file.

Linearity Power Calibration

Step 1. Connect the power sensor to the point where power enters the DUT, as shown in the calibration screen below. This becomes the power reference plane. Click the Next button to begin the calibration.



Step 2. Before the calibration begins, you will be prompted to zero and calibrate the power meter. Refer to the procedures outlined in your power meter's documentation to ensure that the power meter is properly calibrated and that any offset feature is turned off.

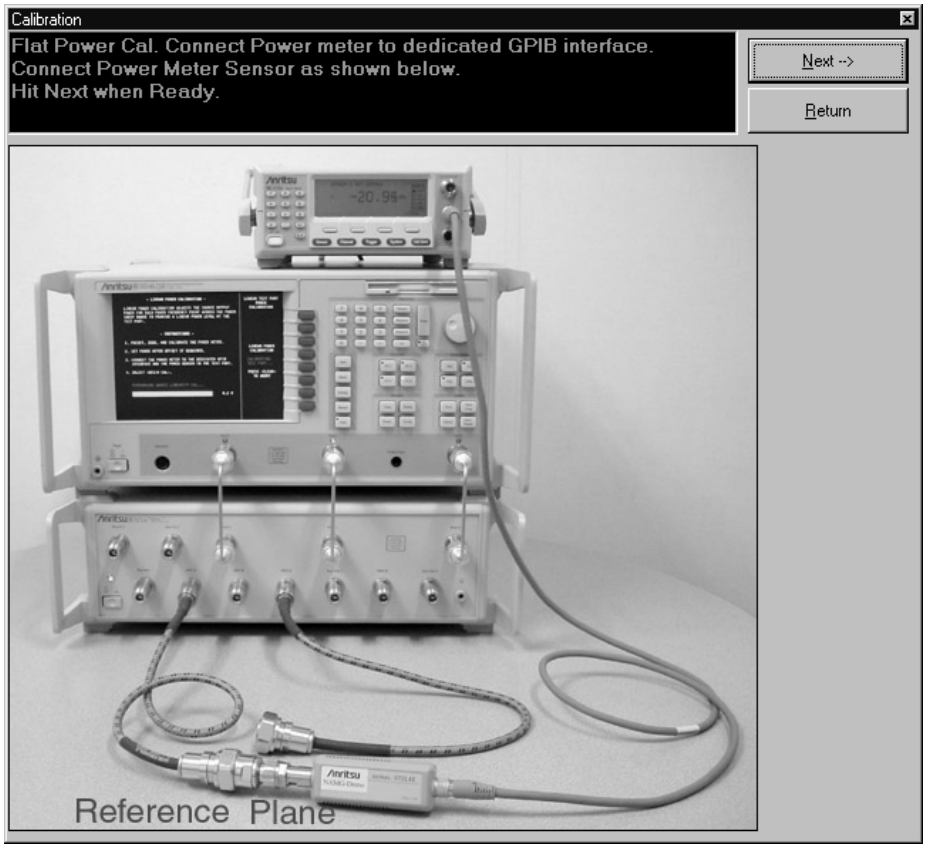


Step 3. Reconnect the power sensor to the power reference plane and click OK.

When the test completes, the Next button will become available.

Flat Power Calibration

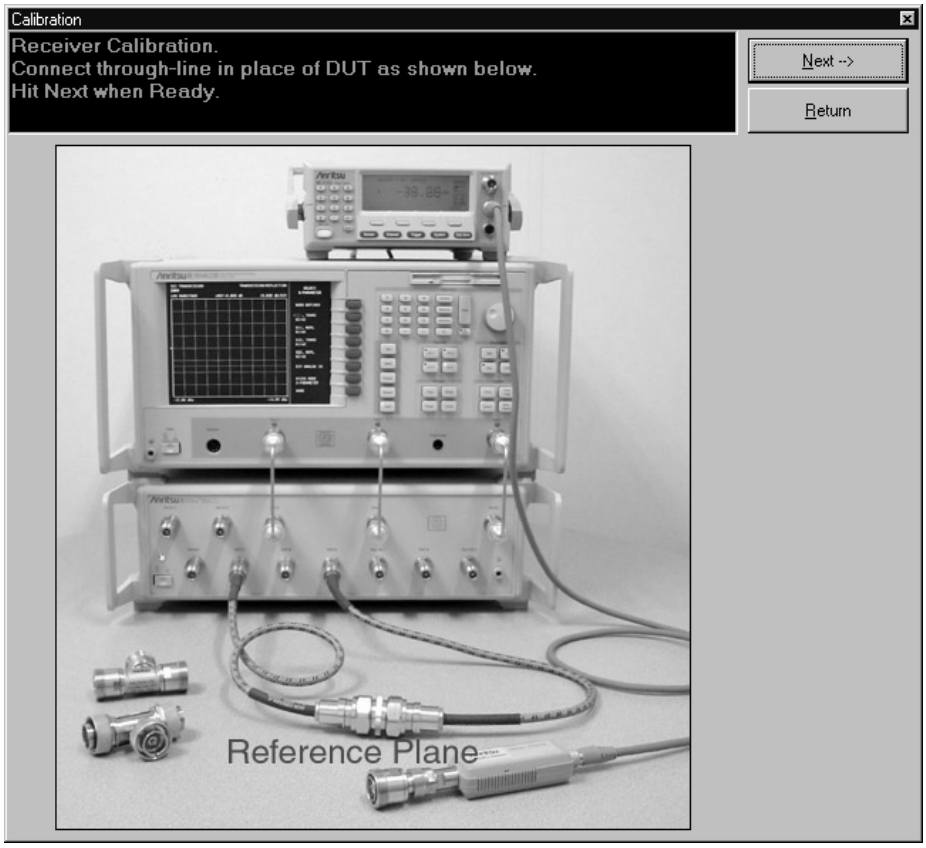
Step 4. Connect the power sensor as shown and press Next to initiate the Flat Power Calibration (below).



The Flat Power calibration takes less than one minute to complete. It calibrates the output power at the reference plane for both of the Scorpion's internal sources (power out of Port 1, then Port 3) according to the target power across the frequency range set in the calibration specification file. When the test completes, the Next button will become available.

Receiver Calibration

Step 5. Before pressing Next to initiate the Receiver Calibration, disconnect the power sensor and connect a through line between Test Port 1 and Test Port 2 on the test set as shown below.



Step 6. Press Next to perform the Receiver Calibration.

Hot S22 Calibration

If the Hot S22 box is checked, it is the next calibration to be displayed. Hot S22 is a return loss measurement of an amplifier's output port (Port 2) while stimulus is applied to its input port (Port 1). Software prompts provide you with instructions and Scorpion Navigator will set up the Scorpion to make calibrated measurements on your DUT. At the completion of the calibration, the measurement information is saved to a "*.cal" file.

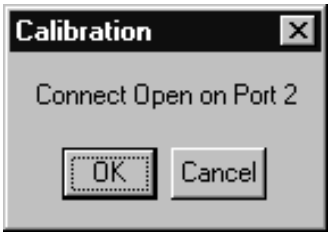
Step 7. Click Next to begin the Hot S22 calibration.

The 3753R Calibration Kit contains a disk with the calibration kit data. The data has to be installed to the Scorpion from the instrument's front panel.

Step 8. Place the floppy disk from the kit into the Scorpion's disk drive. Press the Cal hard-key on the Scorpion's front panel, then press the COMPONENTS UTILITIES | INSTALL KIT INFO FROM FLOPPY DISK soft-keys.

Step 9. Click OK on the calibration dialog box (below) after the calibration data has been loaded to the Scorpion.

Step 10. Connect the Open to Test Port 2 on the test set and click OK.



Step 11. Connect the Short to Test Port 2 on the test set and click OK.

Step 12. Connect the Load to Test Port 2 on the test set.

Step 13. Click OK to complete the Hot S22 calibration.

S-Parameters Calibration

If the S-parameters box is checked, it is the next calibration to be displayed. The following prompts set up the Scorpion to a state where it is ready to make calibrated measurements on your DUT.

Step 14. Click Next to begin the S-parameters calibration.

The 3753R Calibration Kit contains a disk with the calibration kit data. The data has to be installed to the Scorpion from the MS4623B front panel.

Step 15. Place the floppy disk from the kit into the MS4623B disk drive. Press the Cal hard-key on the Scorpion's front panel, then press the COMPONENTS UTILITIES | INSTALL KIT INFO FROM FLOPPY DISK soft-keys.

Step 16. Click OK on the calibration dialog box (below) after the calibration data has been loaded to the Scorpion.

Step 17. Connect the broadband Load to Test Port 1 on the test set and click OK.

Step 18. Connect the Open to Test Port 1 on the test set and click OK.

Step 19. Connect the Short to Test Port 1 on the test set and click OK.

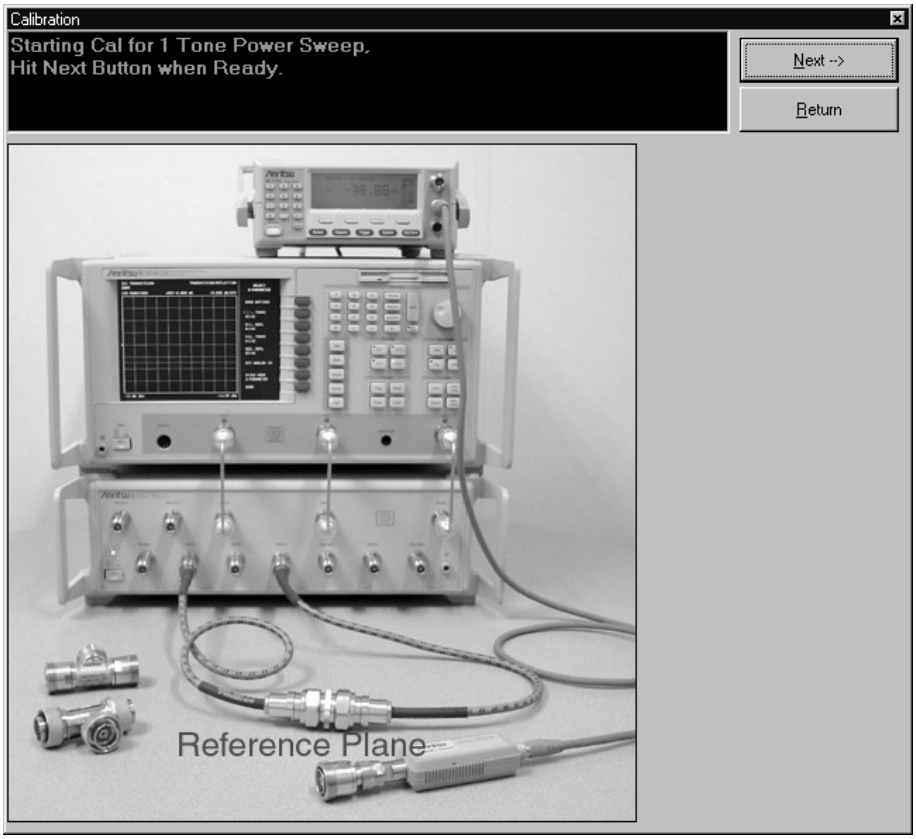
Step 20. Connect the throughline between Test Port 1 and Test Port 2 on the test set.

Step 21. Click OK to complete the S-parameter calibration.

Power Sweep Calibration

If the Power Sweep (1T) or Power Sweep (2T) box is checked, it is the next calibration to be displayed.

Step 22. Click Next to begin the Power Sweep calibration.



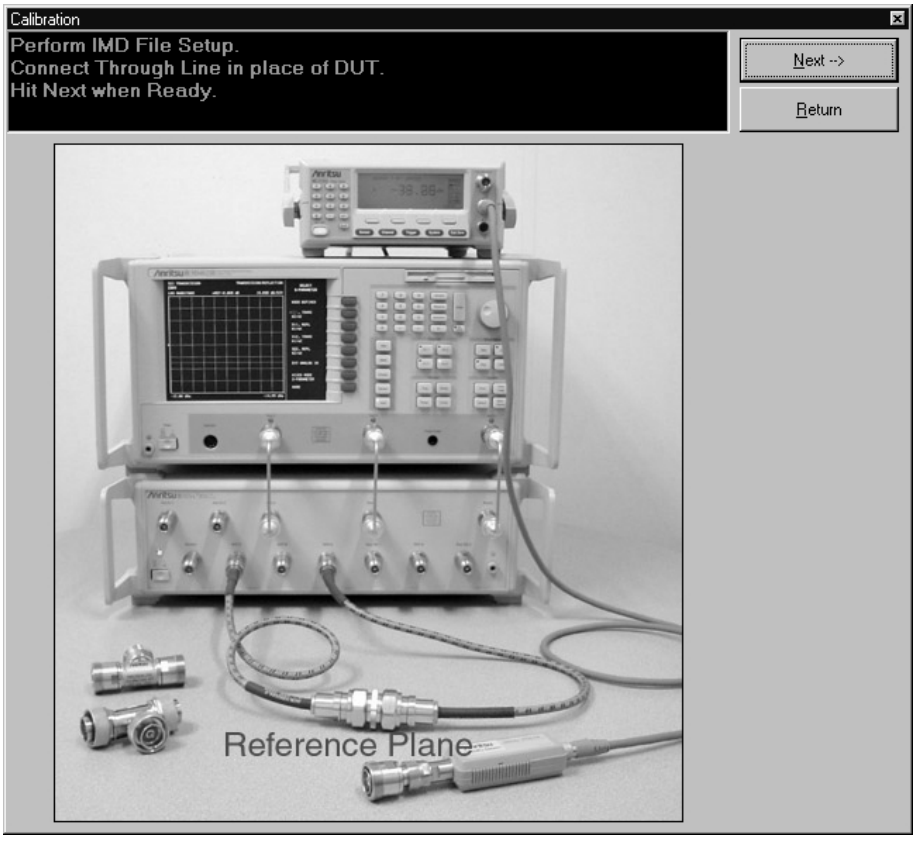
Step 23. Connect a throughline between Test Port 1 and Test Port 2 on the test set.

Step 24. Click OK to continue the calibration.

IMD Calibration

If the IMD box is checked, it is the next calibration to be displayed.

Step 25. Connect a throughline between Test Port 1 and Test Port 2 on the test set.

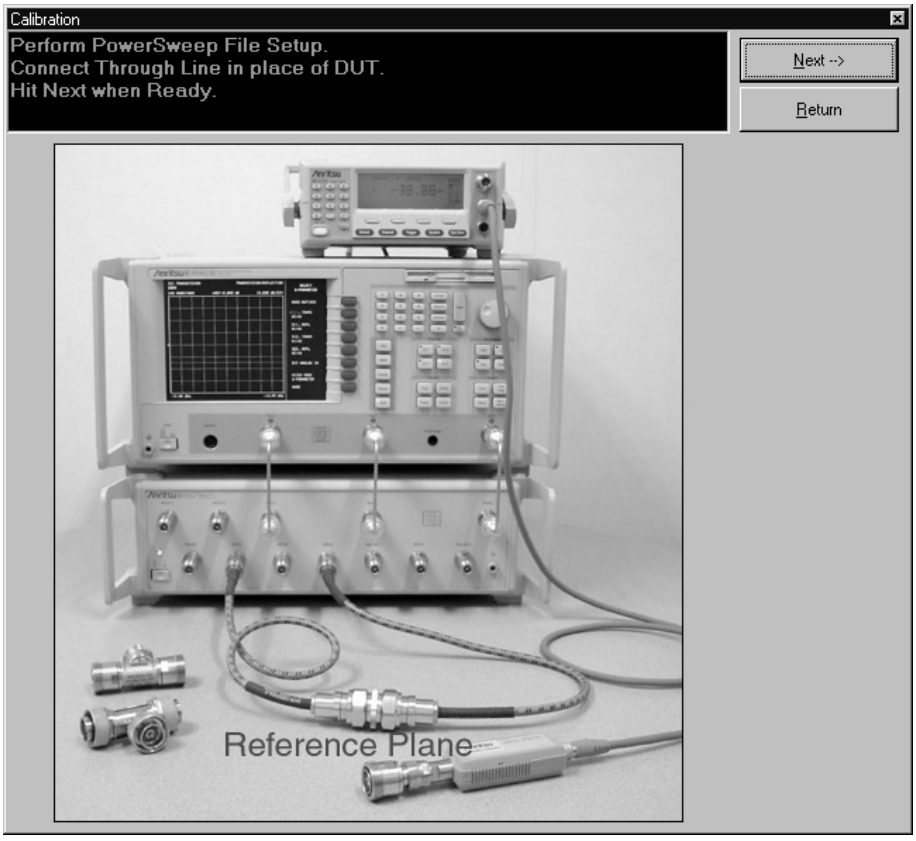


Step 26. Click Next to perform the IMD calibration.

Power Sweep Calibration

If the Power Sweep calibration box is checked, it is the next calibration to be displayed.

Step 27. Connect the throughline between Test Ports 1 and Test Port 2 on the test set.

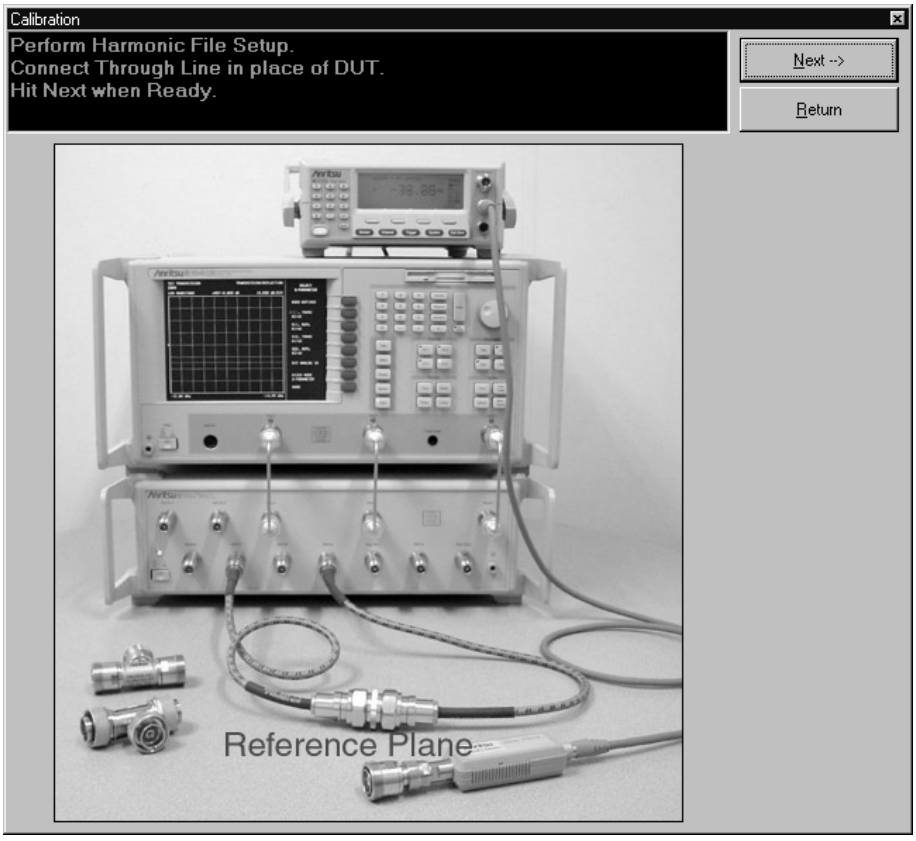


Step 28. Click Next to perform the Power Sweep calibration.

Harmonics Calibration

If the Harmonics calibration box is checked, it is the next calibration to be displayed.

Step 29. Connect the throughline between Test Port 1 and Test Port 2 on the test set.

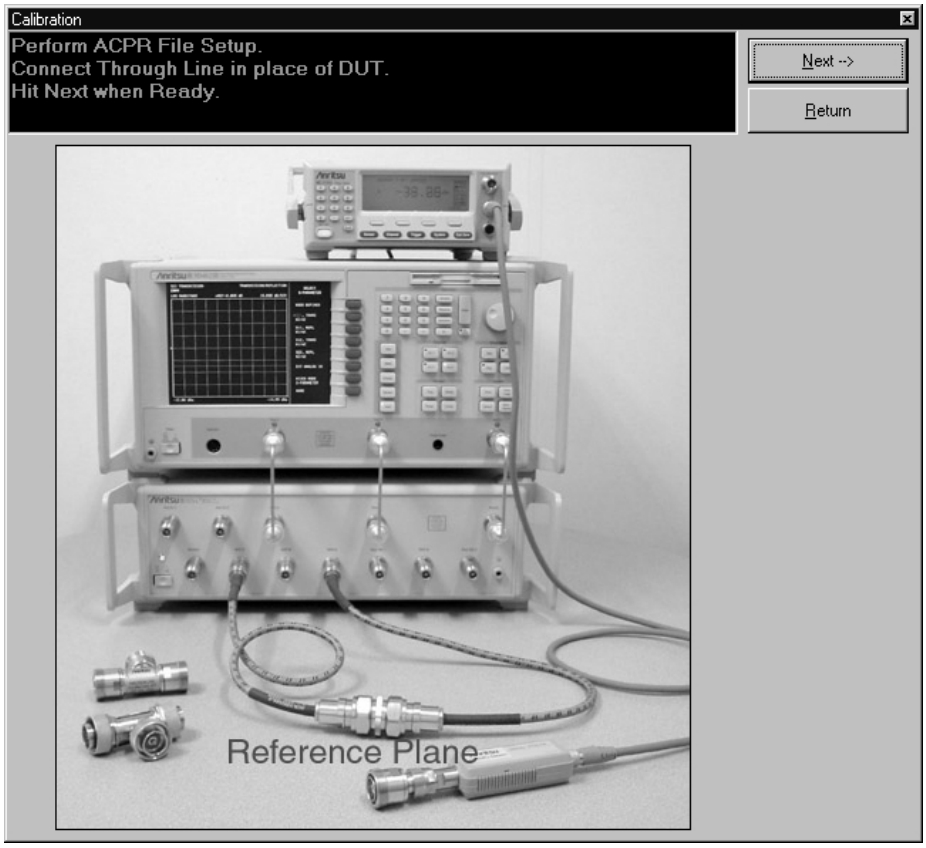


Step 30. Click Next to perform the Harmonics calibration.

ACPR Calibration

If the ACPR calibration box is checked, it is the next calibration to be displayed.

Step 31. Connect the throughline between Test Port 1 and Test Port 2 on the test set.



Step 32. Press Next to perform the calibration.

At the completion of the calibration procedure, the software returns to the Main Scorpion Navigator dialog box and you are ready to perform calibrated measurements. At this point, even if you exit the Scorpion Navigator software and turn off the Scorpion, the set of calibrations just acquired remains current and available the next time Scorpion Navigator is started with the Scorpion turned on and connected to the PC controller.

Chapter 5
Measurements

Table of Contents

Chapter 5
Measurements

5-1 Introduction

This chapter describes the eight measurements available with Scorpion Navigator software:

- S-Parameters
- K-Factor
- Power Sweep
- IMD
- Harmonics
- Noise Figure
- Hot S22
- ACPR

5-2 General Operation

Refer to Chapter 3 for general operation and a description of Scorpion Navigator functions.

5-3 Measurement Calibration

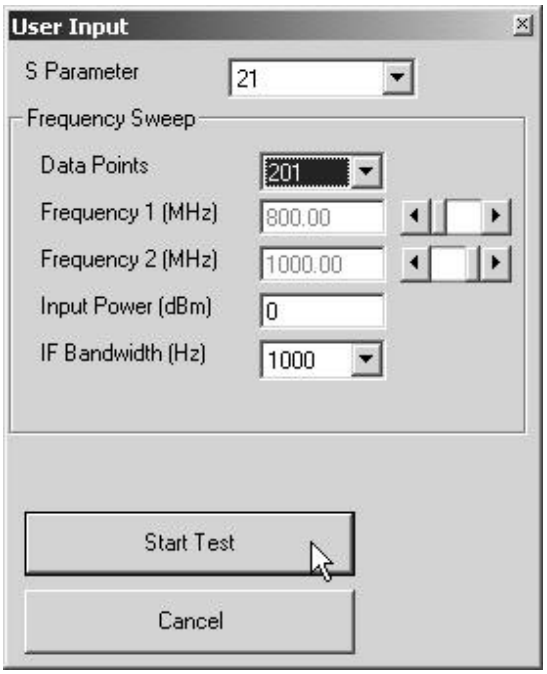
Measurements always include a degree of uncertainty due to imperfections in the measurement system. The measured value is always a combination of the actual value plus the systematic measurement errors. Calibration, as it applies to network analysis, characterizes the systematic measurement errors and subtracts them from the measured value to obtain the actual value. Each of the test system measurements require a calibration to account for measurement uncertainties. Refer to Chapter 4 for measurement calibration procedures.

5-4 S-Parameter Measurements

The S-parameter measurement describes the scattering parameters (S-parameters). This measurement module is comprised of six tests: S11, S12, S21, S22, overlay of all S-parameters (ALL), and K-factor (this test is described in paragraph 5-5). In each case, the measurement screens are similar. This procedure presents a test screen for the "S21" measurement and describes certain differences at the end of the procedure.

Procedure: Prepare the test system as described in the instruments documentation.

Enter the appropriate test values in the displayed User Input screen. The inputs required for this test are described below:



- **S-Parameter:** Set the drop down options to S21 for this procedure. Other selections include S11, S12, S22, ALL (overlay of all S-parameters), and K-factor (Section 5-5).
- **Data Points:** The drop down options set the number of data points in the frequency sweep.
- **Frequency 1 (MHz):** Use this field to set the lower frequency or start frequency.
- **Frequency 2 (MHz):** Use this field to set the upper frequency or stop frequency.
- **Input Power (dBm):** Use this field to set the input power level, in dBm.
- **IF Bandwidth (Hz):** Use this field to set the intermediate frequency bandwidth for the test, in Hertz.

- **Select Start Test:** Observe that the S-parameter test screen (Figure 5-1) appears.

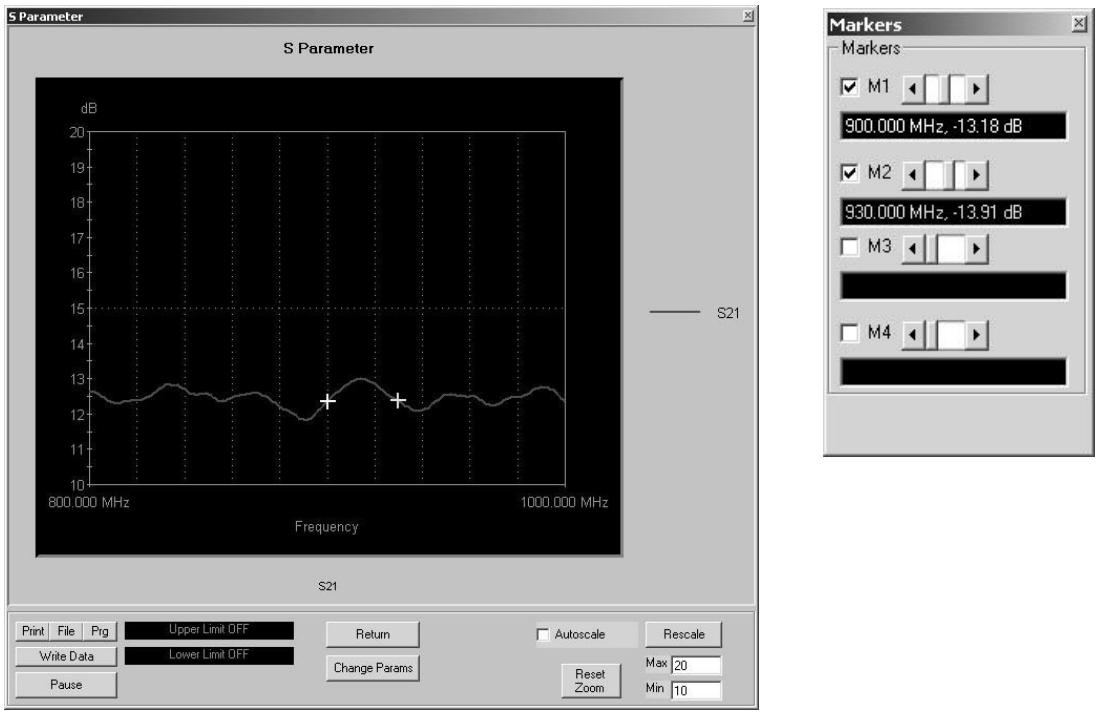
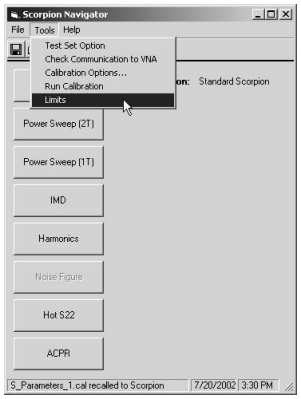


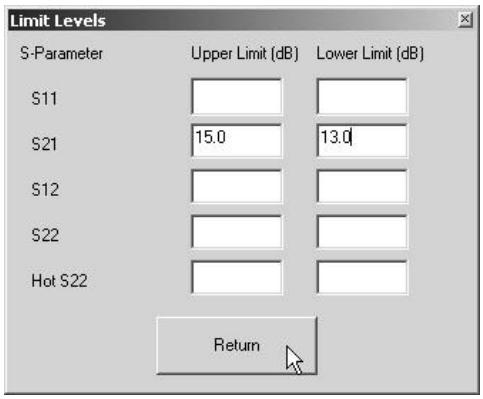
Figure 5-1. *S-Parameters Test Screen for S21*

Button panel and test screen display options:

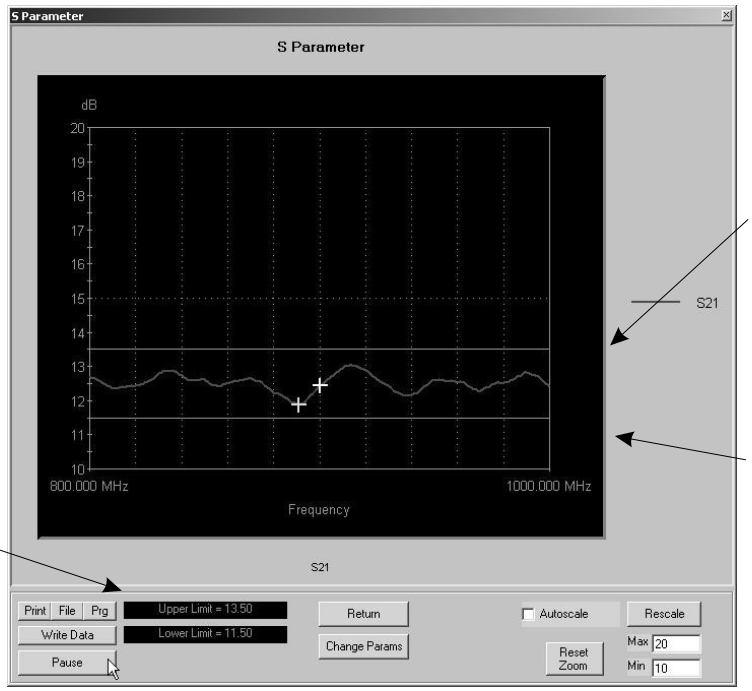
- **Print:** Click this button to send the screen graphic to a printer. A printer dialog box will allow you to assign the printer and set its parameters.
- **File:** Click this button to send the screen graphic to a bitmap file. A File dialog will allow you to set the filename and location.
- **Prg:** Click this button to generate a stand-alone program file that will set up the measurement being displayed.



- **Write Data:** Click this button to write two data files to the C:\Program Files\<test system>\Datafiles folder; the file name will have a time stamp. One data file has a ".csv" file extension and the other has a ".s2p" file extension. *For example:* "S17-16-19-29.csv (and s2p)" was created on the 17th day of the month at 4:19:29 PM. CSV and S2P files are comma delimited text files and can be opened in a Microsoft Excel spreadsheet.
- **Pause:** Click this button to stop the measurement sweeps and turn off all RF power from the Scorpion Sources.
- **Upper Limit/Lower Limit:** Use these fields to set the display of limit lines. Set their values by clicking the Tools | Limits menus from the main Scorpion Navigator dialog box (left). This opens the Limit Levels dialog box (below).



Limit lines are displayed on the S-parameter test screen as shown below.

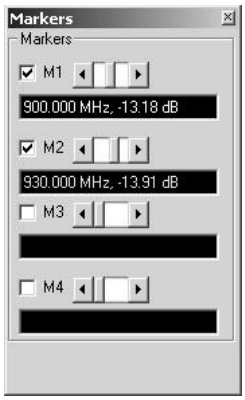


The limit line values are displayed here and will change color to green or red depending on the pass/fail condition.

The upper limit line displays green if all the data points are less than the upper limit and displays red if any data point is greater than the upper limit.

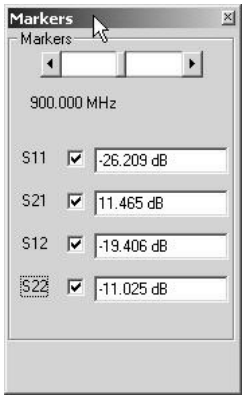
The lower limit line displays green if all the data points are greater than the lower limit and displays red if any data point is less than the lower limit.

- **Return:** Click this button to return to the main Scorpion Navigator dialog box.
- **Change Params:** Click this button to return to the User Input screen.
- **Autoscale Check box:** If Autoscale is checked, Scorpion Navigator automatically scales the display to include all the data. To manually scale the display, uncheck the Autoscale box, enter a Max and Min value, and then click the Rescale button.
- **Reset Zoom:** You can drag the cursor on the graph to zoom in on the selected area. To undo the zoom and return to full scale, click the Reset Zoom button.
- **Max/Min:** Use these fields to set the maximum and minimum display values. Click Rescale after changing the values.
- **Rescale:** Click the Rescale button to automatically adjust the Y-axis.



Markers Screen Options for S11, S21, S12, and S22 (upper left):

- **M1:** Checking M1 turns marker 1 on or off (checked or unchecked). If the marker is on, the slider sets the marker's frequency. The field below displays the marker's numerical frequency and amplitude values.
- **M2:** Same as above for marker 2.
- **M3:** Same as above for marker 3.
- **M4:** Same as above for marker 4.



Markers Screen Options for ALL (lower left):

- **Marker Slider:** The marker slider moves the marker between data points.
- **Frequency Display:** This field displays the marker's frequency.
- **S11:** Checking this box displays the S11 input return loss trace.
- **S21:** Checking this box displays the S21 gain trace.
- **S12:** Checking this box displays the S12 output isolation trace.
- **S22:** Checking this box displays the S22 output return loss trace.

5-5 S-Parameter Measurements: K-Factor

This measurement describes K-factor, a parameter that is sometimes used to indicate the stability of an amplifier. K-factor is calculated from the real and imaginary data of all four S-parameters and is defined by the formula:

$$K = \frac{1 - |S_{11}|^2 - |S_{22}|^2 + |\Delta|^2}{2|S_{11}S_{21}|}$$

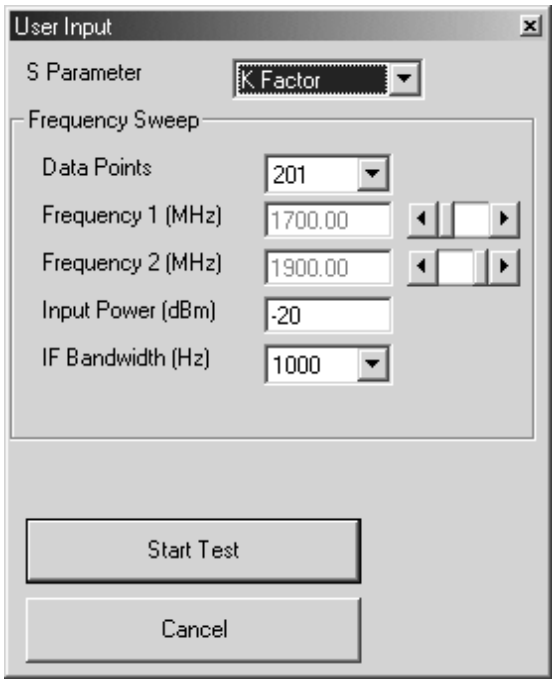
Where $\Delta = S_{11}S_{22} - S_{12}S_{21}$

The necessary and sufficient condition for unconditional stability is that K>1 and $|\Delta| < 1$.

K-factor is available as the sixth choice in the S-parameters menu (first five choices are: S11, S22, S21, S12 and ALL). The same conditions and setup as S-parameter measurements including a full 12-term calibration applies to this measurement. The result is *dynamic*, meaning that the above formula is applied at each point for each sweep as the S-parameters are reported to the PC over the GPIB.

Procedure: Prepare the test system as described in the instruments documentation.

Enter the appropriate test values in the displayed User Input screen. The inputs required for this test are described below:



- **S-Parameter:** Select K-factor in the S-parameter drop down options for this measurement.
- **Data Points:** The drop down options set the number of data points in the frequency sweep.
- **Frequency 1 (MHz):** Use this field to set the lower frequency or start frequency.
- **Frequency 2 (MHz):** Use this field to set the upper frequency or stop frequency.
- **Input Power (dBm):** Use this field to set the input power level, in dBm.
- **IF Bandwidth (Hz):** Use this field to set the intermediate frequency bandwidth for the test, in Hertz.

- **Select Start Test:** Observe that the test screen (Figure 5-2) appears.

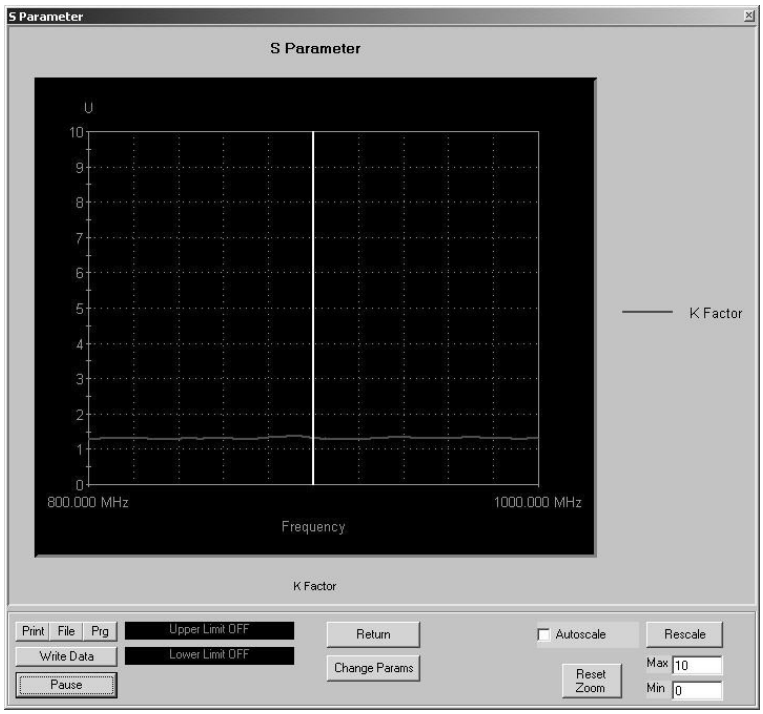
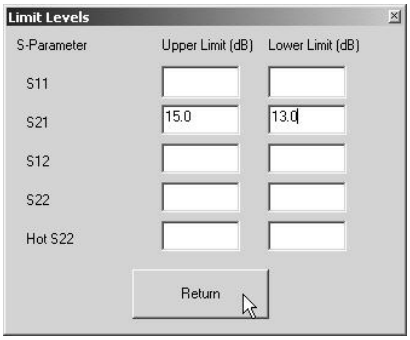
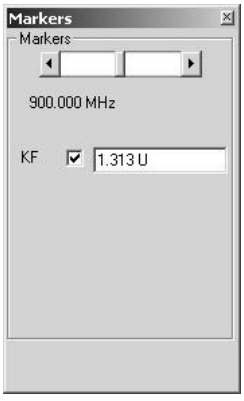


Figure 5-2. *S-Parameters Test Screen for K-Factor*

Button panel and test screen display options:

- **Print:** Click this button to send the screen graphic to a printer. A printer dialog box will allow you to assign the printer and set its parameters.
- **File:** Click this button to send the screen graphic to a bitmap file. A File dialog will allow you to set the filename and location.
- **Prg:** Click this button to generate a stand-alone program file that will set up the measurement being displayed.





- **Write Data:** Click this button to write two data files to the C:\Program Files\<test system>\Datafiles folder; the file name will have a time stamp. One data file has a ".csv" file extension and the other has a ".s2p" file extension. *For example:* "S17-16-19-29.csv (and s2p)" was created on the 17th day of the month at 4:19:29 PM. CSV and S2P files are comma delimited text files and can be opened in a Microsoft Excel spreadsheet.
- **Pause:** Click this button to stop the measurement sweeps and turn off all RF power from the Scorpion sources.
- **Upper Limit/Lower Limit:** Use these fields to set the display of limit lines. Set their values by clicking the Tools | Limits menus from the main Scorpion Navigator dialog box (Chapter 3). This opens the Limit Levels dialog box (left).
- **Return:** Click this button to return to the main Scorpion Navigator dialog box.
- **Change Params:** Click this button to return to the User Input screen.
- **Autoscale Check box:** If Autoscale is checked, Scorpion Navigator automatically scales the display to include all the data. To manually scale the display, uncheck the Autoscale box, enter a Max and Min value, and then click the Rescale button.
- **Reset Zoom:** You can drag the cursor on the graph to zoom in on the selected area. To undo the zoom and return to full scale, click the Reset Zoom button.
- **Max/Min:** Use these fields to set the maximum and minimum display values. Click Rescale after changing the values.
- **Rescale:** Click the Rescale button to adjust the Y-axis.

Markers Screen Options for K-factor (left):

- **Marker Slider:** The marker slider moves the marker between data points.
- **Frequency Display:** This field displays the marker frequency.
- **KF:** Check this field to display the K-factor value. The "U" stands for units.

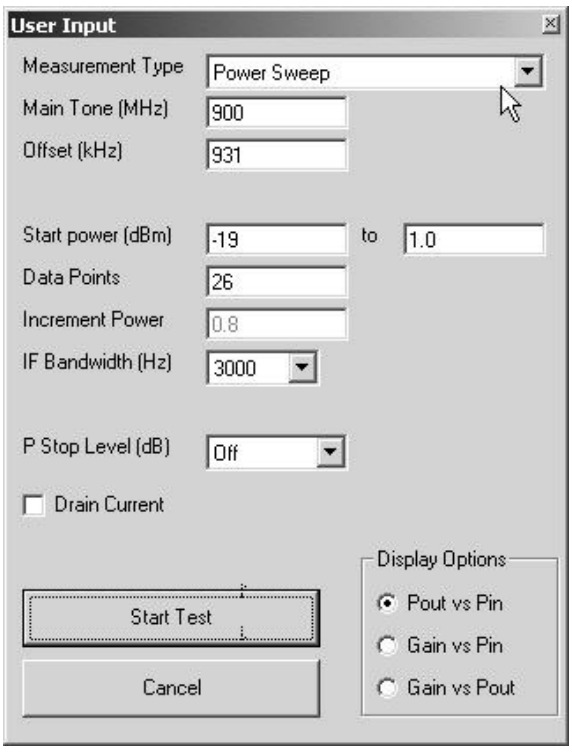
5-6 Power Sweep Measurements: 2-Tone

This measurement module has four variations of possible Measurement Types: Power Sweep (single frequency), Multi Frequency Power Sweep, Gain, and IMD.

Single Frequency Power Sweep

Procedure: Prepare the test system as described in the instruments documentation.

Enter the appropriate test values in the displayed User Input screen (left). The input fields are described below:



- **Measurement Type:** The drop down menu options include Power Sweep (single frequency), Multi Freq Power Sweep (uses 3 frequencies), Gain, and IMD. Set the measurement type to "Power Sweep" for this test.
- **Main Tone (MHz):** Use this field to set the CW frequency of Source 1.
- **Offset (kHz):** Use this field to set the separation (in kHz) of Source 2 (Source 2 will be set to the Main Tone + Offset frequency).
- **Start Power (dBm):** Use this field to set the power level sweep start power (input RF power to DUT). Enter the stop power in the "to" field. Both sources are simultaneously set to the power level setting.
- **Data Points:** Use this field to set the number of data points in the sweep.
- **Increment Power (dBm):** Use this field to set the increment power value for each data point (calculated and displayed only).
- **IF Bandwidth (Hz):** Use this field to set the effective IF Bandwidth to use for this measurement. Scorpion Navigator sometimes uses a combination of averaging and IFBW settings to achieve an effective IF Bandwidth.

- **P Stop Level (dB):** Use this field to set the P Stop value based on the level of gain compression. Drop down options include compression levels of 1 dB through 10 dB in 1 dB increments, and OFF. If OFF is selected, then the P Stop equals the value entered in the "to" field above. If the selected compression occurs, P Stop for all subsequent power sweeps is reset to one increment before the P_{in} value where this compression level is reached.
- **Drain Current Check box:** When checked, the drain current is measured and the Power Added Efficiency (PAE) is calculated and displayed. Selecting this option when no current probe is present will slow down the measurements considerably. If checked, then you must specify the DC power in order to get an accurate PAE measurement.
- **Display Options:** Specifies what is presented on the X and Y axes during the measurement. The first parameter is displayed on the Y-axis and the second on the X-axis. For example, in "Gain vs. P_{out}" Scorpion Navigator will display Gain on the Y-axis and P_{out} on the X-axis. The display options for the various measurement types are shown below:
  - Power Sweep
    - P_{out} vs. P_{in}
    - Gain vs. P_{in}
    - Gain vs. P_{out}
  - Overlay Power Sweep
    - P_{out} vs. P_{in}
    - Gain vs. P_{in}
    - Gain vs. P_{out}
  - Multifrequency Power Sweep
    - Gain
    - P_{out}
  - IMD Offset Sweep
    - Gain
    - P_{out}

- **Select Start Test:** Observe that the test screen (Figure 5-3) appears.

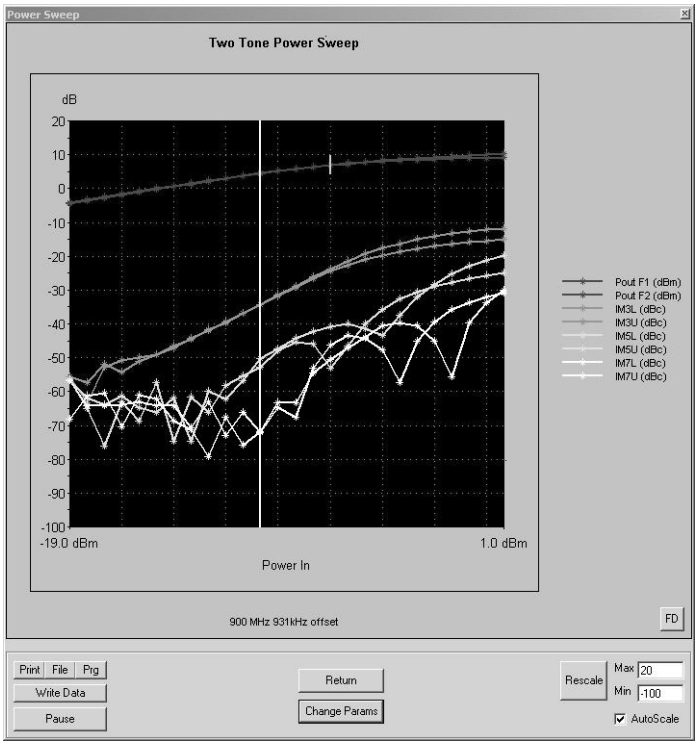
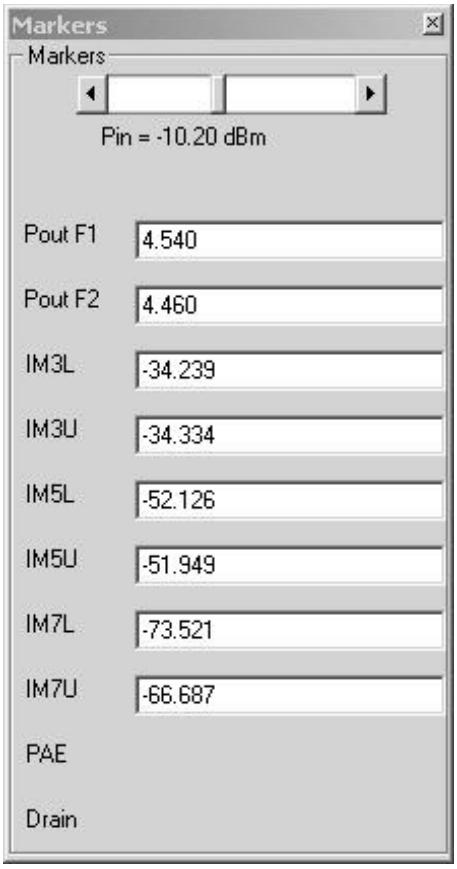


Figure 5-3. *Single Frequency Power Sweep Test*

Button panel and test screen display options:

- **Print:** Click this button to send the screen graphic to a printer. A printer dialog box will allow you to assign the printer and set it's parameters.
- **File:** Click this button to send the screen graphic to a bitmap file. A File dialog will allow you to set the filename and location.
- **Prg:** Click this button to generate a stand-alone program file that will set up the measurement being displayed.

- **Write Data:** Click this button to write two data files to the C:\Program Files\<test system>\Datafiles folder; the file name will have a time stamp. One data file has a ".csv" file extension and the other has a ".s2p" file extension. *For example:* "S17-16-19-29.csv (and s2p)" was created on the 17th day of the month at 4:19:29 PM. CSV and S2P files are comma delimited text files and can be opened in a Microsoft Excel spreadsheet.
- **Pause:** Click this button to stop the measurement sweeps and turn off all RF power from the Scorpion sources.
- **Return:** Click this button to return to the main Scorpion Navigator dialog box.
- **Change Params:** Click this button to return to the User Input screen.
- **Autoscale Check box:** If Autoscale is checked, Scorpion Navigator automatically scales the display to include all the data. To manually scale the display, uncheck the Autoscale box, enter a Max and Min value, then click the Rescale button.
- **Max/Min:** Use these fields to set the maximum and minimum display values. Click Rescale after changing the values.
- **Rescale:** Click the Rescale button to automatically adjust the Y-axis.



Markers Screen Options (left):

- **Markers Slider:** The marker slider moves the marker between data points.
- **Power In Reading:** This field indicates the input power value.
- **P_{out} F1:** This field indicates the power output at frequency 1.
- **P_{out} F2:** This field indicates the power output at frequency 2.
- **IM3L:** This field indicates the intermodulation product 3 lower sideband.
- **IM3U:** This field indicates the intermodulation product 3 upper sideband.
- **IM5L:** This field indicates the intermodulation product 5 lower sideband.
- **IM5U:** This field indicates the intermodulation product 5 upper sideband.
- **IM7L:** This field indicates the intermodulation product 7 lower sideband.
- **IM7U:** This field indicates the intermodulation product 7 upper sideband.
- **PAE:** This field indicates the power-added efficiency percentage.
- **Drain:** This field indicates the drain current value.

NOTE

PAE and **Drain** may be on or off according to the check box in the User Input dialog box.

- **2D Chart Control Properties:** With the mouse over the graph area, use a right click to bring up a form for setting custom lines and symbols on the graph display (Figure 5-4).

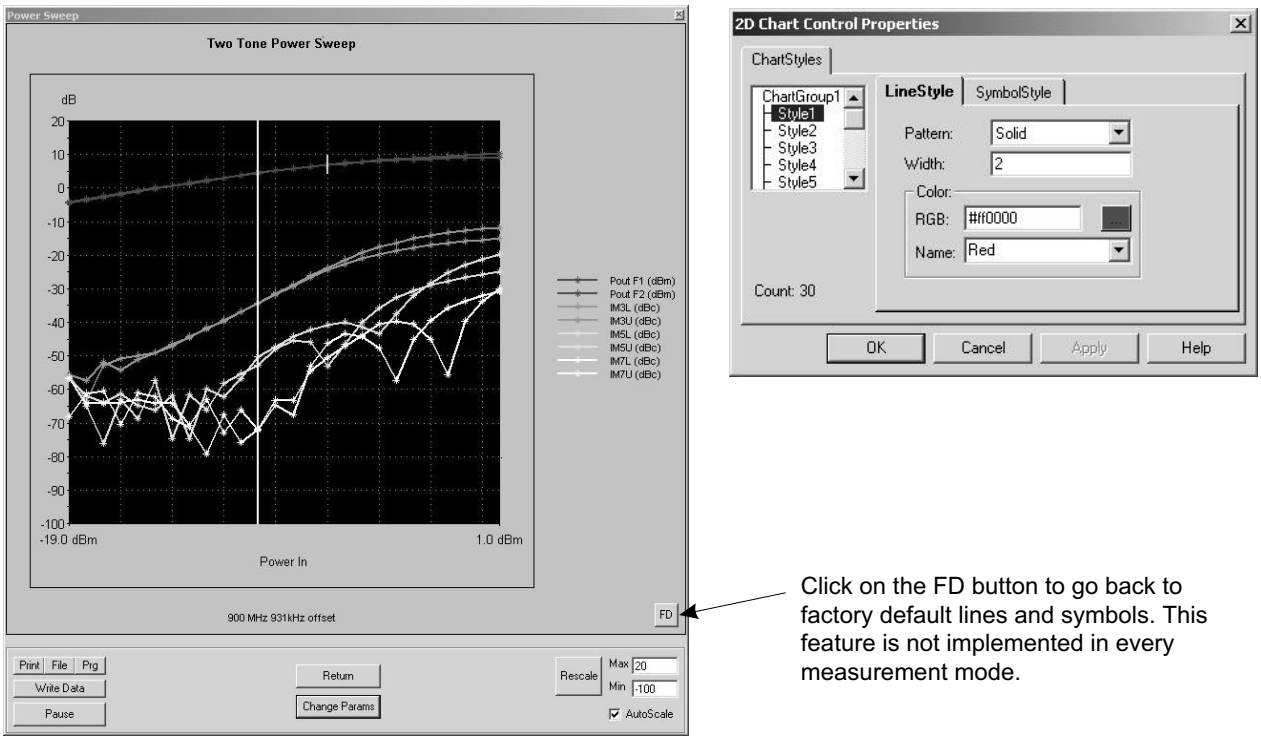
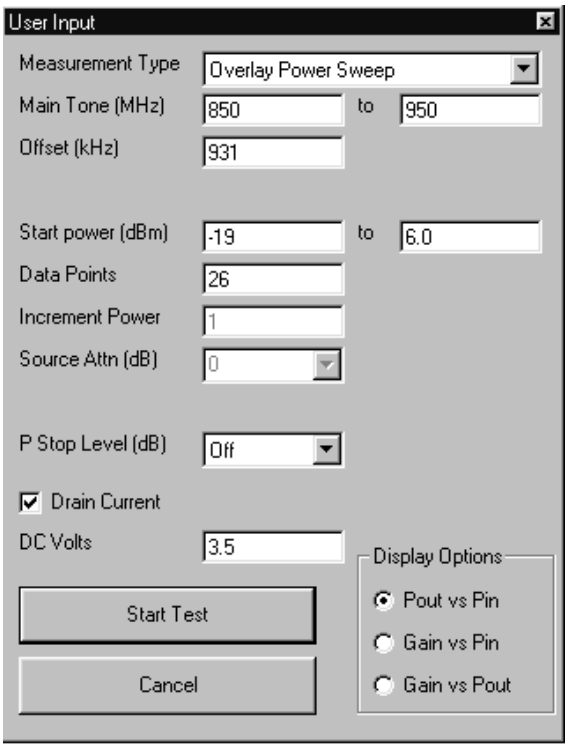


Figure 5-4. *2D Chart Control Properties*

Overlay Power Sweep

Procedure: Prepare the test system as described in the instruments documentation.

Enter the appropriate test values in the displayed User Input screen (left). The input fields are described below:



- **Measurement Type:** Set the drop down options to "Overlay Power Sweep" for this test.
- **Main Tone (MHz):** This field sets the CW frequency of Source 1. You may set a lower tone and upper tone. The software will sweep three frequencies (the two input plus one between) and the RF input power to produce the display data.
- **Offset (kHz):** This field sets the offset frequency of Source 2 (Source 2 will be set to Main Tone + Offset).
- **Start Power (dBm):** Use this field to set the power level sweep start power (input RF power to DUT). Enter the stop power in the "to" field. Both sources are simultaneously set to the power level setting.
- **Data Points:** Use this field to set the number of data points in the power sweep.
- **Increment Power (dBm):** Use this field to set the increment power value for each data point (calculated and displayed only).
- **Source Attn (dB):** Use this field to set the source attenuation between 0 and –70 (calculated and displayed only).
- **Drain Current Check box:** When checked, the drain current is measured and power added efficiency is calculated and displayed.
- **P Stop Level (dB):** Use this field to set the P Stop value based on the level of gain compression. Drop down options include compression levels of 1 dB through 10 dB in 1 dB increments, and OFF. If OFF is selected, then the P Stop equals the value entered in the "to" window above. If the selected compression occurs, P Stop for all subsequent power sweeps is reset to one increment before the P_{in} value where this compression level is reached.

- **Select Start Test:** Observe that the test screen (Figure 5-5) appears.

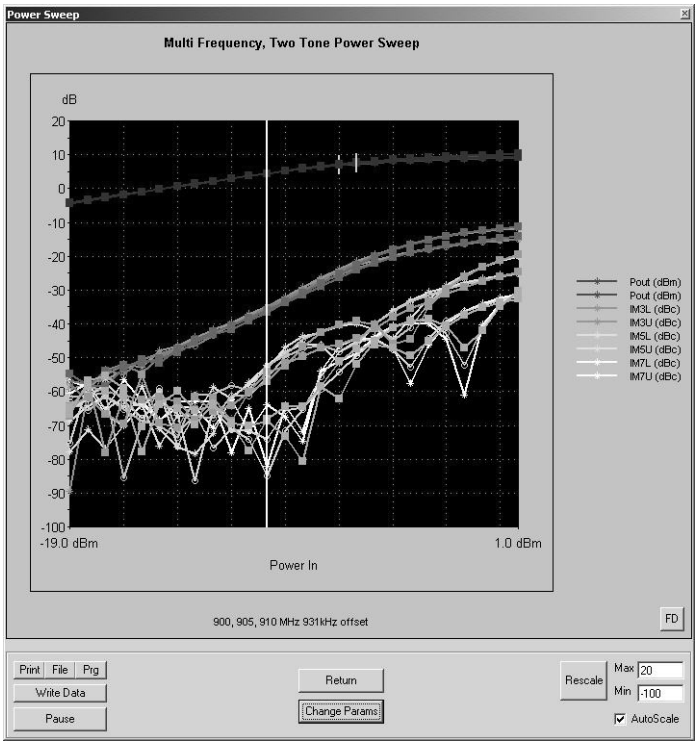
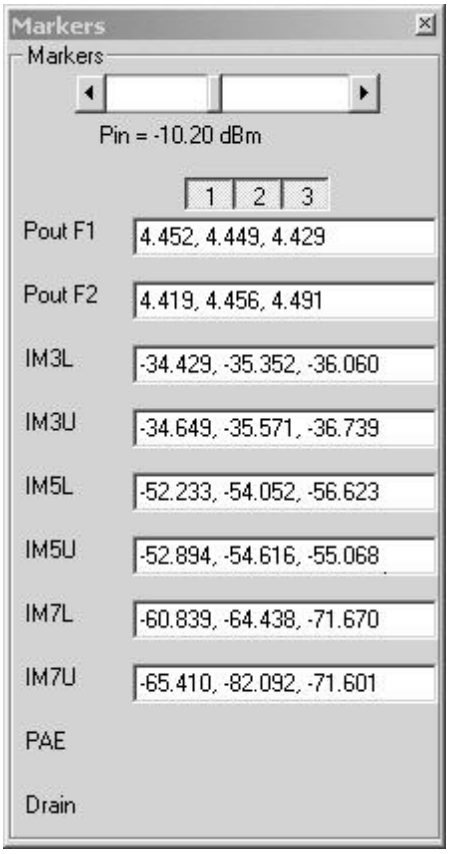


Figure 5-5. *Overlay Power Sweep Test*

Button panel and test screen display options:

- **Print:** Click this button to send the screen graphic to a printer. A printer dialog box will allow you to assign the printer and set it's parameters.
- **File:** Click this button to send the screen graphic to a bitmap file. A File dialog will allow you to set the filename and location.
- **Prg:** Click this button to generate a stand-alone program file that will set up the measurement being displayed.

- **Write Data:** Click this button to write two data files to the C:\Program Files\<test system>\Datafiles folder; the file name will have a time stamp. One data file has a ".csv" file extension and the other has a ".s2p" file extension. *For example:* "S17-16-19-29.csv (and s2p)" was created on the 17th day of the month at 4:19:29 PM. CSV and S2P files are comma delimited text files and can be opened in a Microsoft Excel spreadsheet.
- **Pause:** Click this button to stop the measurement sweeps and turn off all RF power from the Scorpion sources.
- **Return:** Click this button to return to the main Scorpion Navigator dialog box.
- **Change Params:** Click this button to return to the User Input screen.
- **Autoscale Check box:** If Autoscale is checked, Scorpion Navigator automatically scales the display to include all the data. To manually scale the display, uncheck the Autoscale box, enter a Max and Min value, then click the Rescale button.
- **Max/Min:** Use these fields to set the maximum and minimum display values. Click Rescale after changing the values.
- **Rescale:** Click the Rescale button to adjust the Y-axis.



Markers Screen Options (left):

- **Markers Slider:** The markers slider moves the marker between data points.
- **P_{out} F1:** This field indicates the power output at frequency 1.
- **P_{out} F2:** This field indicates the power output at frequency 2.
- **IM3L:** This field indicates the intermodulation product 3 lower sideband.
- **IM3U:** This field indicates the intermodulation product 3 upper sideband.
- **IM5L:** This field indicates the intermodulation product 5 lower sideband.
- **IM5U:** This field indicates the intermodulation product 5 upper sideband.
- **IM7L:** This field indicates the intermodulation product 7 lower sideband.
- **IM7U:** This field indicates the intermodulation product 7 upper sideband.
- **PAE:** This field indicates the power-added efficiency percentage.
- **Drain:** This field indicates the drain current value.

NOTE

PAE and **Drain** may be on or off according to the check box in the User Input dialog box.

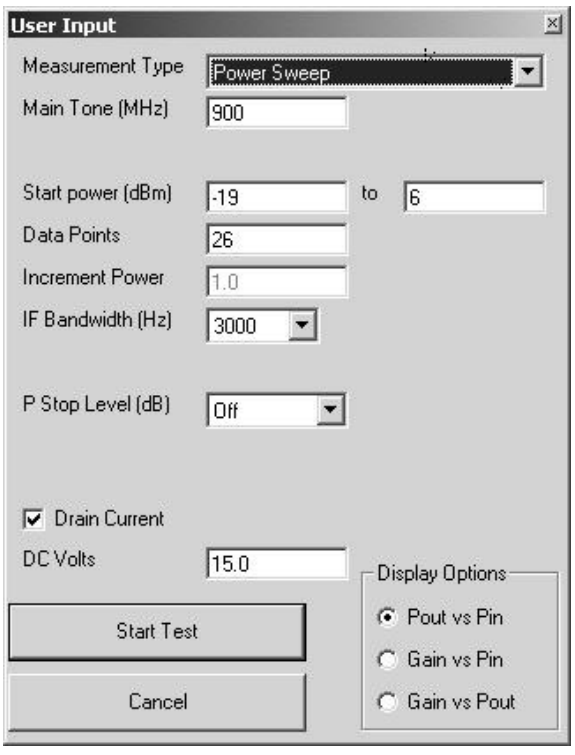
5-7 Power Sweep Measurements: 1-Tone

This measurement module has three variations of possible measurement types: Power Sweep (single frequency), Multi Frequency Power Sweep, Gain and IMD.

Single Frequency Power Sweep

Procedure: Prepare the test system as described in the instruments documentation.

Enter the appropriate test values in the displayed User Input screen. The input fields are described below:



- **Measurement Type:** The drop down menu options include Power Sweep (single frequency), Multi Freq Power Sweep (uses three frequencies), Gain, and IMD. Set the measurement type to "Power Sweep" for this test.
- **Main Tone (MHz):** Use this field to set the CW frequency of Source 1.
- **Offset (kHz):** Use this field to set the separation (in kHz) of Source 2 (Source 2 will be set to the Main Tone + Offset frequency).
- **Start Power (dBm):** Use this field to set the power level sweep start power (input RF power to DUT). Enter the stop power in the "to" field. Both sources are simultaneously set to the power level setting.
- **Data Points:** Use this field to set the number of data points in the power sweep.
- **Increment Power (dBm):** Use this field to set the increment power value for each data point (calculated and displayed only).
- **IF Bandwidth (Hz):** Use this field to set the effective IF Bandwidth for this measurement. Scorpion Navigator sometimes uses a combination of averaging and IFBW settings to achieve an effective IF Bandwidth.

- **P Stop Level (dB):** Use this field to set the P Stop value based on the level of gain compression. Drop down options include compression levels of 1 dB through 10 dB in 1 dB increments, and OFF. If OFF is selected, then the P Stop equals the value entered in the "to" field above. If the selected compression occurs, P Stop for all subsequent power sweeps is reset to one increment before the P_{in} value where this compression level is reached.
- **Drain Current Check box:** When checked, the drain current is measured and the Power Added Efficiency (PAE) is calculated and displayed. Selecting this option when no current probe is present will slow down the measurements considerably. If checked, then you must specify the DC power in order to get an accurate PAE measurement.
- **Display Options:** Specifies what is presented on the X and Y axes during the measurement. The first parameter is displayed on the Y-axis and the second on the X-axis. For example, in "Gain vs. P_{out}" Scorpion Navigator will display Gain on the Y-axis and Pout on the X-axis. The display options for the various measurement types are shown below:
  - ❑ Power Sweep
    - P_{out} vs. P_{in}
    - Gain vs. P_{in}
    - Gain vs. P_{out}
  - ❑ Overlay Power Sweep
    - P_{out} vs. P_{in}
    - Gain vs. P_{in}
    - Gain vs. P_{out}
  - ❑ Multifrequency Power Sweep
    - Gain
    - P_{out}
  - ❑ IMD Offset Sweep
    - Gain
    - P_{out}

- **Select Start Test:** Observe that the test screen (Figure 5-6) appears.

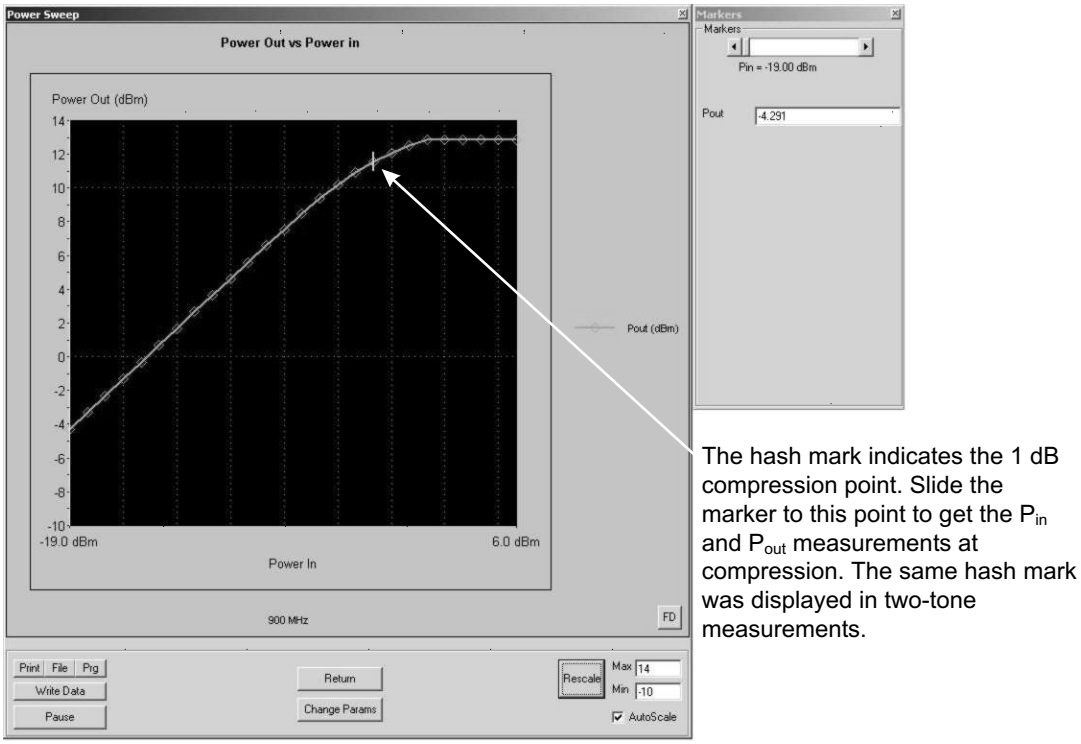


Figure 5-6. *Single Frequency Power Sweep Test*

Button panel and test screen display options:

- **Print:** Click this button to send the screen graphic to a printer. A printer dialog box will allow you to assign the printer and set it's parameters.
- **File:** Click this button to send the screen graphic to a bitmap file. A File dialog will allow you to set the filename and location.
- **Prg:** Click this button to generate a stand-alone program file that will set up the measurement being displayed.

- **Write Data:** Click this button to write two data files to the C:\Program Files\<test system>\Datafiles folder; the file name will have a time stamp. One data file has a ".csv" file extension and the other has a ".s2p" file extension. *For example:* "S17-16-19-29.csv (and s2p)" was created on the 17th day of the month at 4:19:29 PM. CSV and S2P files are comma delimited text files and can be opened in a Microsoft Excel spreadsheet.
- **Pause:** Click this button to stop the measurement sweeps and turn off all RF power from the Scorpion sources.
- **Return:** Click this button to return to the main Scorpion Navigator dialog box.
- **Change Params:** Click this button to return to the User Input screen.
- **Autoscale Check box:** If Autoscale is checked, Scorpion Navigator automatically scales the display to include all the data. To manually scale the display, uncheck the Autoscale box, enter a Max and Min value, then click the Rescale button.
- **Max/Min:** Use these fields to set the maximum and minimum display values. Click Rescale after changing the values.
- **Rescale:** Click the Rescale button to adjust the Y-axis.

Markers Screen Options:

- **Markers Slider:** The markers slider moves the markers between data points.
- **P_{in}:** This field displays the power input at the marker.
- **P_{out}:** This field displays the power output at the marker.

Gain vs. Power In

- **Select Start Test:** Observe that the test screen (Figure 5-7) appears.

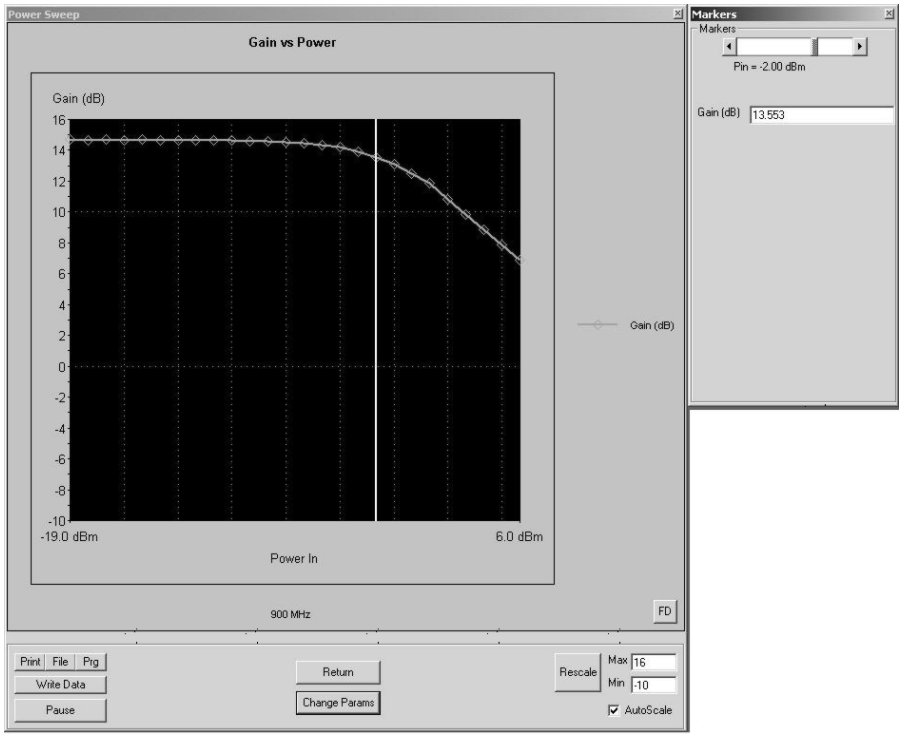


Figure 5-7. *Single Frequency Power Sweep Test, Gain vs. Power In*

Button panel and test screen display options:

- **Print:** Click this button to send the screen graphic to a printer. A printer dialog box will allow you to assign the printer and set it's parameters.
- **File:** Click this button to send the screen graphic to a bitmap file. A File dialog will allow you to set the filename and location.
- **Prg:** Click this button to generate a stand-alone program file that will set up the measurement being displayed.

- **Write Data:** Click this button to write two data files to the C:\Program Files\<test system>\Datafiles folder; the file name will have a time stamp. One data file has a ".csv" file extension and the other has a ".s2p" file extension. *For example:* "S17-16-19-29.csv (and s2p)" was created on the 17th day of the month at 4:19:29 PM. CSV and S2P files are comma delimited text files and can be opened in a Microsoft Excel spreadsheet.
- **Pause:** Click this button to stop the measurement sweeps and turn off all RF power from the Scorpion sources.
- **Return:** Click this button to return to the main Scorpion Navigator dialog box.
- **Change Params:** Click this button to return to the User Input screen.
- **Autoscale Check box:** If Autoscale is checked, Scorpion Navigator automatically scales the display to include all the data. To manually scale the display, uncheck the Autoscale box, enter a Max and Min value, then click the Rescale button.
- **Max/Min:** Use these fields to set the maximum and minimum display values. Click Rescale after changing the values.
- **Rescale:** Click the Rescale button to adjust the Y-axis.

Markers Screen Options:

- **Markers Slider:** The marker slider moves the marker between data points.
- **P_{in}:** This field displays the power input at the marker.
- **Gain:** Gain (in dB) is measured at the CW frequency for each power level in the power sweep and displayed in this field (Could also be called Gain compression measurement).

Gain and Normalized Phase vs. Power In

- **Select Start Test:** Observe that the test screen (Figure 5-8) appears.

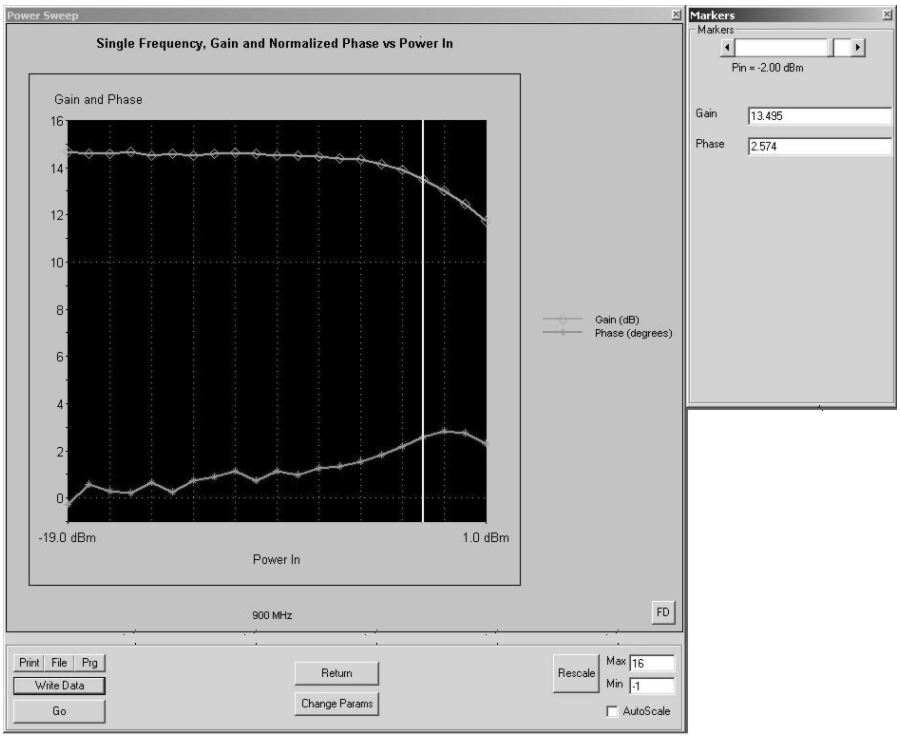


Figure 5-8. *Single Frequency Power Sweep Test, Gain and Normalized Phase vs. Power In*

Button panel and test screen display options:

- **Print:** Click this button to send the screen graphic to the printer. A printer dialog box will allow you to assign the printer and set it's parameters.
- **File:** Click this button to send the screen graphic to a bitmap file. A File dialog will allow you to set the filename and location.
- **Prg:** Click this button to generate a stand-alone program file that will set up the measurement being displayed.

- **Write Data:** Click this button to write two data files to the C:\Program Files\<test system>\Datafiles folder; the file name will have a time stamp. One data file has a ".csv" file extension and the other has a ".s2p" file extension. *For example:* "S17-16-19-29.csv (and s2p)" was created on the 17th day of the month at 4:19:29 PM. CSV and S2P files are comma delimited text files and can be opened in a Microsoft Excel spreadsheet.
- **Pause:** Click this button to stop the measurement sweeps and turns off all RF power from the Scorpion sources.
- **Return:** Click this button to return to the main Scorpion Navigator dialog box.
- **Change Params:** Click this button to return to the User Input screen.
- **Autoscale Check box:** If Autoscale is checked, Scorpion Navigator automatically scales the display to include all the data. To manually scale the display, uncheck the Autoscale box, enter a Max and Min value, then click the Rescale button.
- **Max/Min:** Use this field to set the maximum and minimum display values. Click Rescale after changing the values.
- **Rescale:** Click the Rescale button to adjust the Y-axis.

Markers Screen Options:

- **Markers Slider:** The marker slider moves the marker between data points.
- **P_{in}:** This field displays the power input at the marker.
- **Gain:** Gain (in dB) is measured at the CW frequency for each power level in the power sweep and displayed in this field (Could also be called Gain Compression measurement).
- **Phase:** Phase is an AM/ΦM measurement/display. The phase at the initial power level of the power sweep is used as a normalized level (zero). As the power is swept, the phase displayed in this field is the difference from the normalized value.

Multi-Frequency 1 dB Compression Points

- **Select Start Test:** Observe that the test screen (Figure 5-9) appears.

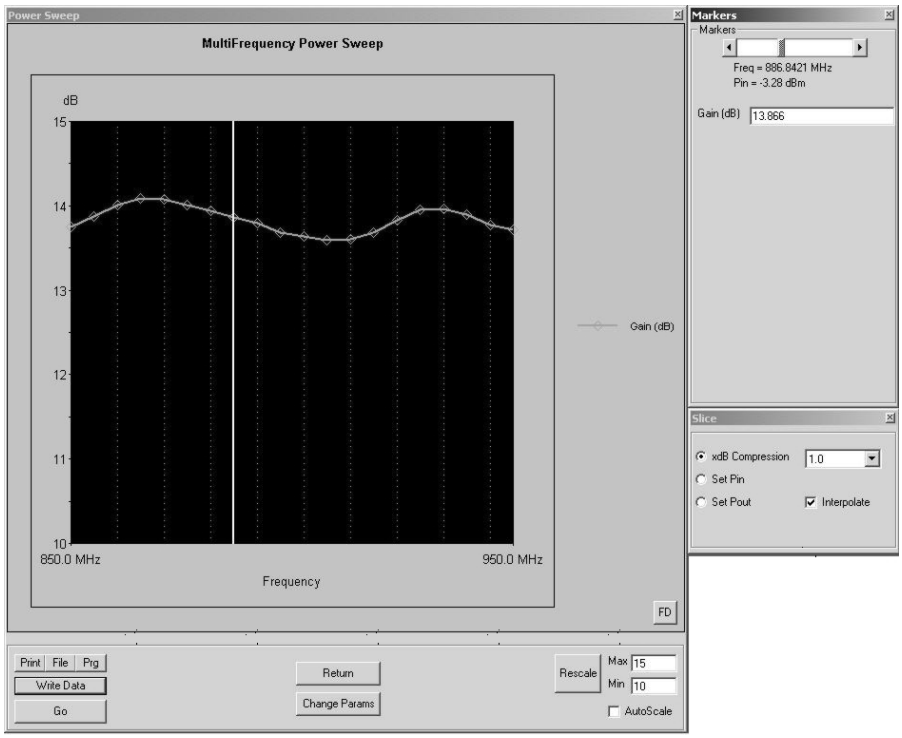


Figure 5-9. *Single Frequency Power Sweep Test, Multi-frequency 1 dB Compression Points*

Button panel and test screen display options:

- **Print:** Click this button to send the screen graphic to a printer. A printer dialog box will allow you to assign the printer and set it's parameters.
- **File:** Click this button to send the screen graphic to a bitmap file. A File dialog will allow you to set the filename and location.
- **Prg:** Click this button to generate a stand-alone program file that will set up the measurement being displayed.
- **Write Data:** Click this button to write two data files to the C:\Program Files\<test system>\Datafiles folder; the file will have a time stamp. One data file has a ".csv" file extension and the other has a ".s2p" file extension.

For example: "S17-16-19-29.csv (and s2p)" was created on the 17th day of the month at 4:19:29 PM. CSV and S2P files are comma delimited text files and can be opened in a Microsoft Excel spreadsheet.

- **Pause:** Click this button to stop the measurement sweeps and turn off all RF power from the Scorpion sources.
- **Return:** Click this button to return to the main Scorpion Navigator dialog box.
- **Change Params:** Click this button to return to the User Input screen.
- **Autoscale Check box:** If Autoscale is checked, Scorpion Navigator automatically scales the display to include all the data. To manually scale the display, uncheck the Autoscale box, enter a Max and Min value, then click the Rescale button.
- **Max/Min:** Use these fields to set the maximum and minimum display values. Click Rescale after changing the values.
- **Rescale:** Click the Rescale button to adjust the Y-axis.

Markers Screen Options:

- **Marker Slider:** The marker slider moves the marker between data points.
- **Freq:** This field displays the marker frequency.
- **P_{in}:** This field displays the power input at the marker.
- **Gain:** Gain (in dB) is measured at the CW frequency for each power level in the power sweep and displayed in this field (Could also be called Gain compression measurement).

Slice Screen Options:

- **xdB Compression:** Specifies to plot the Gain (in dB) or P_{out} (output power in dBm) at the xdB compression point (x = 0.5 to 3 dB) for each frequency.
- **Set P_{in}:** Specifies to plot the Gain or P_{out} at a fixed Input Power level for each frequency.
- **Set P_{out}:** Specifies to plot the Gain or Pout at a fixed Output Power level for each frequency.
- **Interpolate:** Sets linear interpolation to smooth the displayed data.

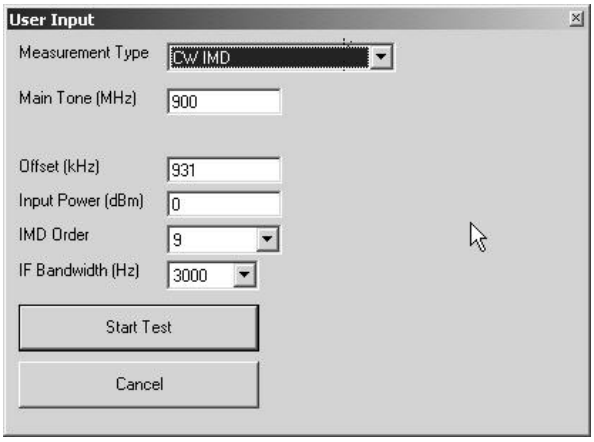
5-8 IMD

The IMD measurement measures inter-modulation distortion. This measurement module is comprised of three tests: CW IMD, Swept Products, and Swept TOI.

CW IMD

Procedure: Prepare the test system as described in the instruments documentation.

Enter the appropriate test values in the displayed User Input screen. The input fields are described below:



- **Measurement Type:** The drop down options include CW IMD measurements, Swept Products, and Swept TOI. Set this field to “CW IMD” for this test.
- **Main Tone (MHz):** Use this field to set the CW frequency (in MHz) of Source 1.
- **Offset (kHz):** Use this field to set the offset frequency (in kHz) of Source 2 (Source 2 will be set to Main Tone + Offset).
- **Input Power (dBm):** Use this field to set the power at the input of the DUT from each tone (Note that the total power into the device is approximately 3 dB higher than the specified input power since the power of the two tones is added together).
- **IMD Order:** Use this field to specify IMD 3, 5, 7 or 9. In CW IMD, selecting 9 will display all IMD products.
- **IF Bandwidth:** Use this field to set the IF Bandwidth for this measurement.

- **Select Start Test:** Observe that the test screen (Figure 5-10) appears.

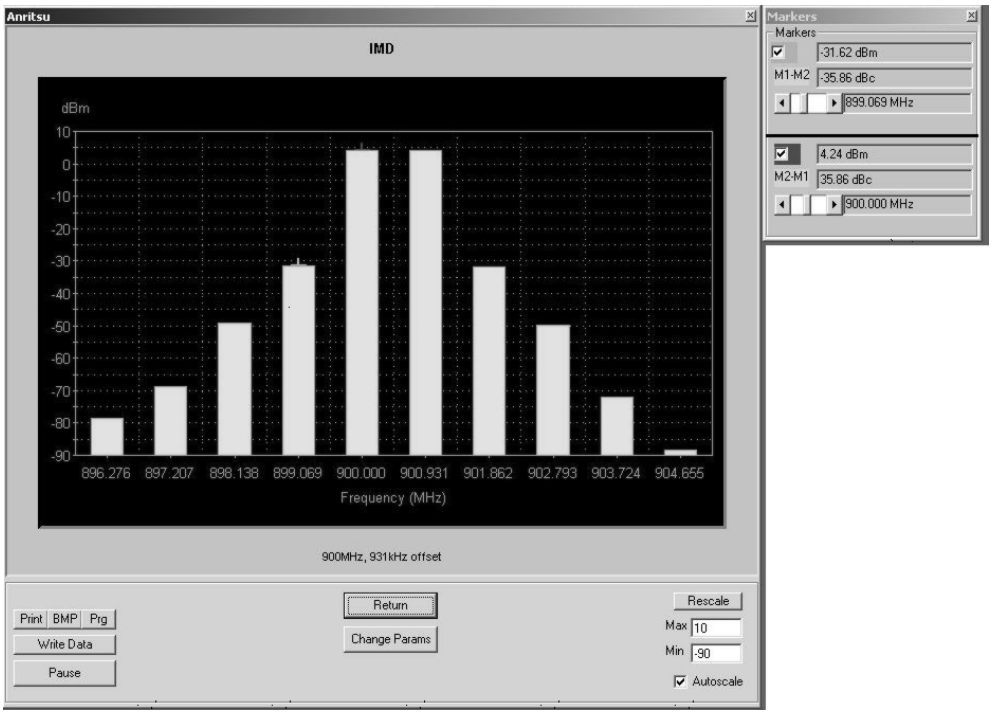


Figure 5-10. *CW Intermodulation Distortion Test Screen*

Button panel and test screen display options:

- **Print:** Click this button to send the screen graphic to a printer. A printer dialog box will allow you to assign the printer and set it's parameters.
- **File:** Click this button to send the screen graphic to a bitmap file. A File dialog will allow you to set the filename and location.
- **Prg:** Click this button to generate a stand-alone program file that will set up the measurement being displayed.

- **Write Data:** Click this button to write two data files to the C:\Program Files\<test system>\Datafiles folder; the file name will have a time stamp. One data file has a ".csv" file extension and the other has a ".s2p" file extension. *For example:* "S17-16-19-29.csv (and s2p)" was created on the 17th day of the month at 4:19:29 PM. CSV and S2P files are comma delimited text files and can be opened in a Microsoft Excel spreadsheet.
- **Pause:** Click this button to stop the measurement sweeps and turn off all RF power from the Scorpion sources.
- **Return:** Click this button to return to the main Scorpion Navigator dialog box.
- **Change Params:** Click this button to return to the User Input screen.
- **Autoscale Check box:** If Autoscale is checked, Scorpion Navigator automatically scales the display to include all the data. To manually scale the display, uncheck the Autoscale box, enter a Max and Min value, then Click the Rescale button.
- **Max/Min:** Use these fields to set the maximum and minimum display values. Click Rescale after changing the values.
- **Rescale:** Click the Rescale button to adjust the Y-axis**.**

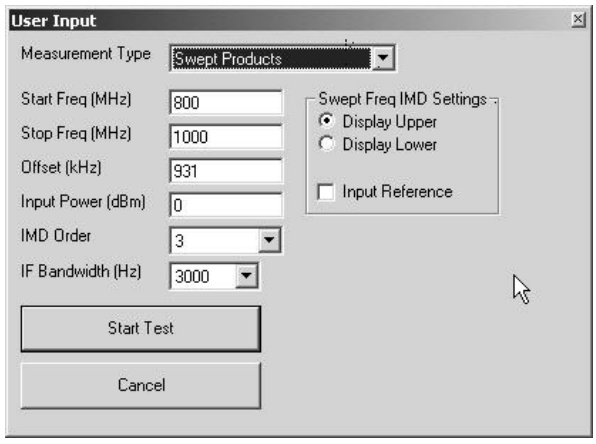
Markers Screen Options:

- **M1-M2 Check box:** Turns M1-M2 feature on or off.
- **M1-M2 Readout:** This field displays the value of M1 minus M2.
- **M1 Slider:** Moves M1 between the displayed harmonics. A blue + symbol appears on the top of the selected harmonic.
- **M2-M1Checkbox:** Turns M2-M1 feature on or off.
- **M2-M1 Readout:** This field displays the value of M2 minus M1.
- **M2-M1 Slider:** Moves M2 between the displayed harmonics. A blue + symbol appears on the top of the selected harmonic.

Swept Products and Swept TOI

Procedure: Prepare the test system as described in the instruments documentation.

Enter the appropriate test values in the displayed User Input screen. The input fields are described below:



- **Measurement Type:** The drop down options include CW IMD measurements, Swept Products, and Swept TOI. Select “Swept Products” for this test.
- **Main Tone (MHz):** Use this field to set the CW frequency (in MHz) of Source 1.
- **Offset (kHz):** Use this field to set the offset frequency (in kHz) of Source 2 (Source 2 will be set to Main Tone + Offset).
- **Input Power (dBm):** Use this field to set the power at the input of the DUT from each tone (Note that the total power into the device is approximately 3 dB higher than the specified input power since the power of the two tones is added together).
- **IMD Order:** Use this field to specify IMD 3, 5, 7 or 9. In CW IMD, selecting 9 will display all IMD product.
- **IF Bandwidth:** Use this field to set the IF Bandwidth for this measurement.
- **Display Upper:** Select to display the Upper IMD product or TOI measurement.
- **Display Lower:** Select to display the Lower IMD product or TOI measurement.
- **Input Reference:** This selection relies on the IMD calibration.

- **Select Start Test:** Observe that the test screen (Figure 5-11) appears.

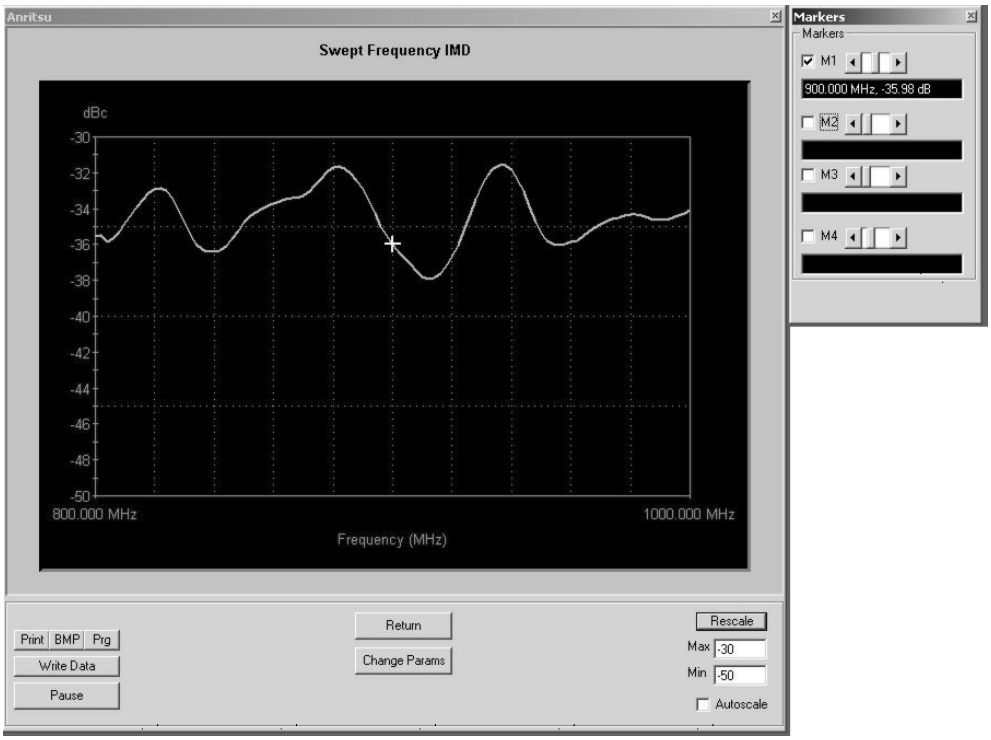


Figure 5-11. *Swept Frequency IMD*

Button panel and test screen display options:

- **Print:** Click this button to send the screen graphic to a printer. A printer dialog box will allow you to assign the printer and set its parameters.
- **File:** Click this button to send the screen graphic to a bitmap file. A File dialog will allow you to set the filename and location.
- **Prg:** Click this button to generate a stand-alone program file that will set up the measurement being displayed.

- **Write Data:** Click this button to write two data files to the C:\Program Files\<test system>\Datafiles folder; the file name will have a time stamp. One data file has a ".csv" file extension and the other has a ".s2p" file extension. *For example:* "S17-16-19-29.csv (and s2p)" was created on the 17th day of the month at 4:19:29 PM. CSV and S2P files are comma delimited text files and can be opened in a Microsoft Excel spreadsheet.
- **Pause:** Click this button to stop the measurement sweeps and turn off all RF power from the Scorpion sources.
- **Return:** Click this button to return to the main Scorpion Navigator dialog box.
- **Change Params:** Click this button to return to the User Input screen.
- **Autoscale Check box:** If Autoscale is checked, Scorpion Navigator automatically scales the display to include all the data. To manually scale the display, uncheck the Autoscale box, enter a Max and Min value, then click the Rescale button.
- **Max/Min:** Use these fields to set the maximum and minimum display values. Click Rescale after changing the values.
- **Rescale:** Click the Rescale button to adjust the Y-axis.

Markers Screen Options:

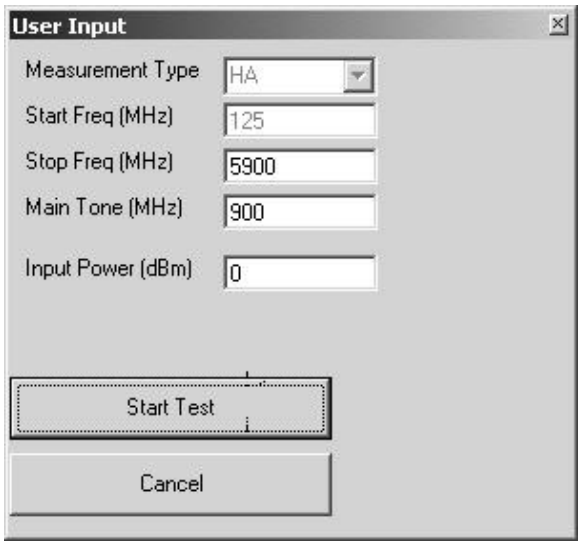
- **M1:** Checking M1 turns marker 1 on or off (checked or unchecked). If the marker is on, the slider sets the marker's frequency. The window below displays the marker's numerical frequency and amplitude values.
- **M2:** Same as above for marker 2.
- **M3:** Same as above for marker 3.
- **M4:** Same as above for marker 4.

5-9 Harmonics

The harmonics measurement displays the harmonics of the device under test.

Procedure: Prepare the test system as described in the instruments documentation.

Enter the appropriate test values in the displayed User Input screen. The input fields are described below:



- **Measurement Type:** This field is already set to "HA" for Harmonics—input disabled.
- **Start Frequency (MHz):** Use this field to set the lower frequency to be displayed. Typically set to a value less than or equal to the main tone.
- **Stop Frequency (MHz):** Use this field to set the upper frequency to be displayed. Typically set to a value less than the system's maximum frequency (for example, the MS4623B is set to a maximum of 5000 MHz).
- **Main Tone (MHz):** Use this field to set the CW frequency of Source 1.
- **Input Power:** Use this field to set the RF input power to the DUT.

- **Select Start Test:** Observe that the test screen (Figure 5-12) appears.

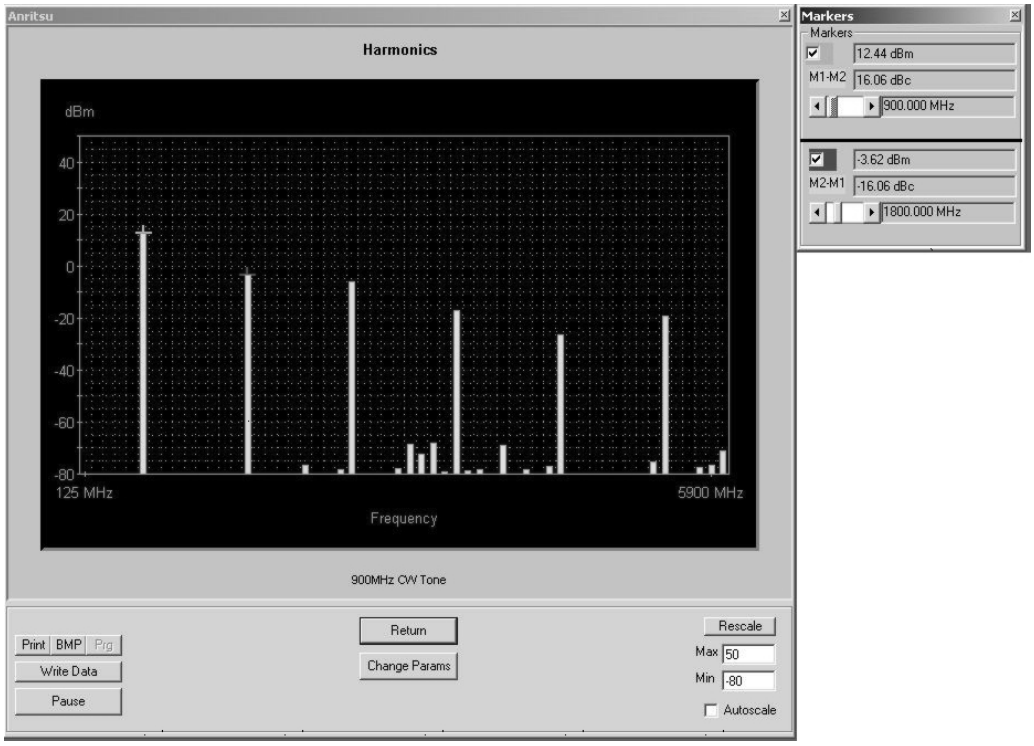


Figure 5-12. *Harmonics Test Screen*

Button panel and test screen display options:

- **Print:** Click this button to send the screen graphic to a printer. A printer dialog box will allow you to assign the printer and set it's parameters.
- **File:** Click this button to send the screen graphic to a bitmap file. A File dialog will allow you to set the filename and location.
- **Prg:** This button is disabled for this test.
- **Write Data:** Click this button to write two data files to the C:\Program Files\<test system>\Datafiles folder; the file name will have a time stamp. One data file has a ".csv" file extension and the other has a ".s2p" file extension. *For example:* "S17-16-19-29.csv (and s2p)" was created on the 17th day of the month at 4:19:29 PM. CSV and S2P files are comma delimited text files and can be opened in a Microsoft Excel spreadsheet.

- **Pause:** Click this button to stop the measurement sweeps and turn off all RF power from the Scorpion sources.
- **Return:** Click this button to return to the main Scorpion Navigator dialog box.
- **Change Params:** Click this button to return to the User Input screen.
- **Autoscale Check box:** If Autoscale is checked, Scorpion Navigator automatically scales the display to include all the data. To manually scale the display, uncheck the Autoscale box, enter a Max and Min value, then click the Rescale button.
- **Max/Min:** Use these fields to set the maximum and minimum display values. Click Rescale after changing the values.
- **Rescale:** Click the Rescale button to adjust the Y-axis**.**

Markers Screen Options:

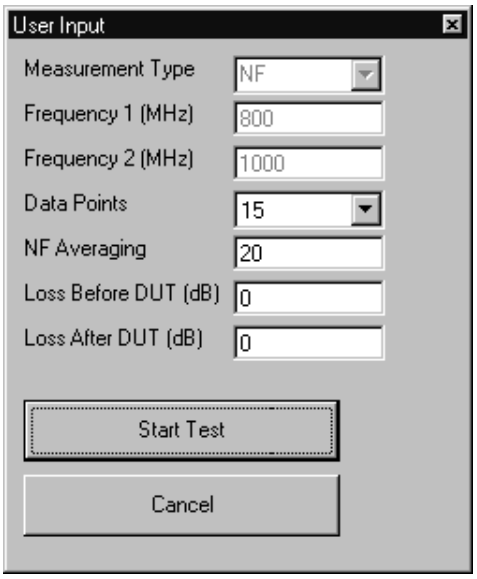
- **M1-M2 Check box:** Turns the M1-M2 feature on or off.
- **M1-M2 Readout:** Displays the value of M1 minus M2.
- **M1 Slider:** Moves M1 between the displayed harmonics. A blue + symbol appears on the top of the selected harmonic.
- **M2-M1Checkbox:** Turns the M2-M1 feature on or off.
- **M2-M1 Readout:** Displays the value of M2 minus M1.
- **M2-M1 Slider:** Moves M2 between the displayed harmonics. A red + symbol appears on the top of the selected harmonic.

5-10 Noise Figure

The Noise Figure measurement displays the noise in the device under test. (Option 4X is required on the Scorpion MS462XX VNMS in order to enable Noise Figure measurements.)

Procedure: Prepare the test system as described in the instruments documentation.

Enter the appropriate test values in the displayed User Input screen. The input fields are described below:



- **Measurement Type:** This field is already set to "NF" for Noise Figure – input disabled.
- **Frequency 1 (MHz):** Use this field to set the lower frequency to be displayed. Typically set to a value less than or equal to the main tone.
- **Frequency 2 (MHz):** Use this field to set the upper frequency to be displayed. Typically set to a value less than the system's maximum frequency (for example, for MS4623B is set to a maximum of 5000 MHz).
- **Data Points:** Use this field to set the number of data points to measure.
- **NF Averaging:** Use this field to set the number of averages for the measurement.
- **Loss Before DUT (dB):** Use this field to set the loss (attenuator) before the test device.
- **Loss After DUT (dB):** Use this field to set the loss (attenuator) after the test device.

- **Select Start Test:** Observe that the test screen (Figure 5-13) appears.

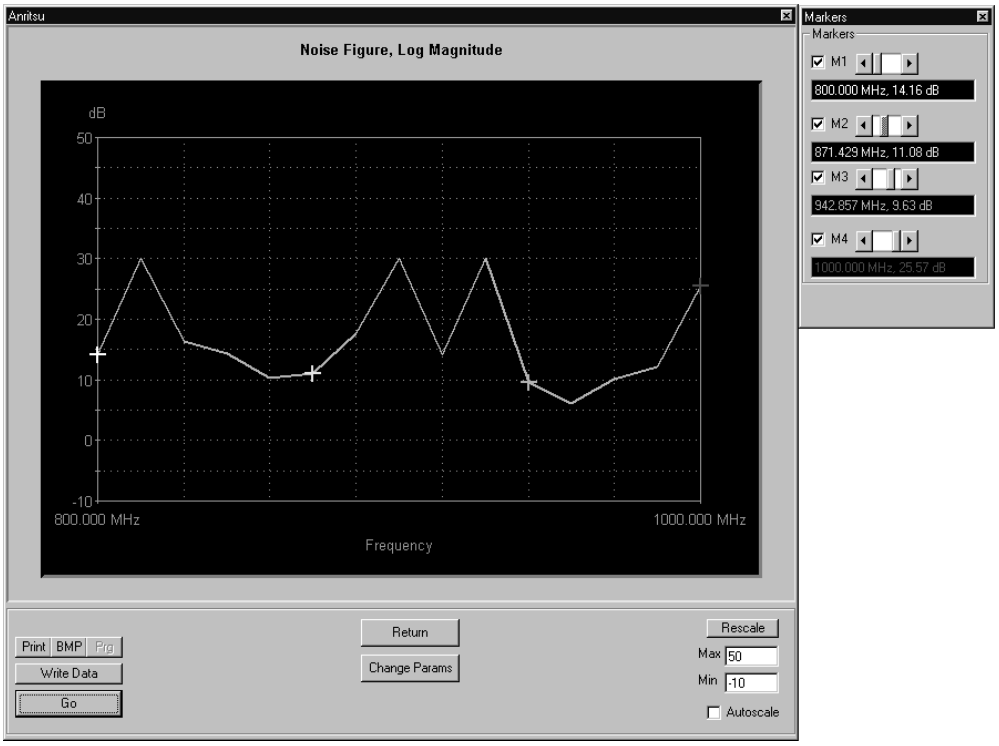


Figure 5-13. *Noise Figure Test Screen*

Button panel and test screen display options:

- **Print:** Click this button to send the screen graphic to a printer. A printer dialog box will allow you to assign the printer and set it's parameters.
- **File:** Click this button to send the screen graphic to a bitmap file. A File dialog will allow you to set the filename and location.
- **Prg:** This button is disabled for this test.
- **Write Data:** Click this button to write two data files to the C:\Program Files\<test system>\Datafiles folder; the file name will have a time stamp. One data file has a ".csv" file extension and the other has a ".s2p" file extension. *For example:* "S17-16-19-29.csv (and s2p)" was created on the 17th day of the month at 4:19:29 PM. CSV and S2P files are comma delimited text files and can be opened in a Microsoft Excel spreadsheet.

- **Pause:** Click this button to stop the measurement sweeps and turn off all RF power from the Scorpion sources.
- **Return:** Click this button to return to the main Scorpion Navigator dialog box.
- **Change Params:** Click this button to return to the User Input screen.
- **Autoscale Check box:** If Autoscale is checked, Scorpion Navigator automatically scales the display to include all the data. To manually scale the display, uncheck the Autoscale box, enter a Max and Min value, then click the Rescale button.
- **Max/Min:** Use these fields to set the maximum and minimum display values. Click Rescale after changing the values.
- **Rescale:** Click the Rescale button to adjust the Y-axis**.**

Markers Screen Options:

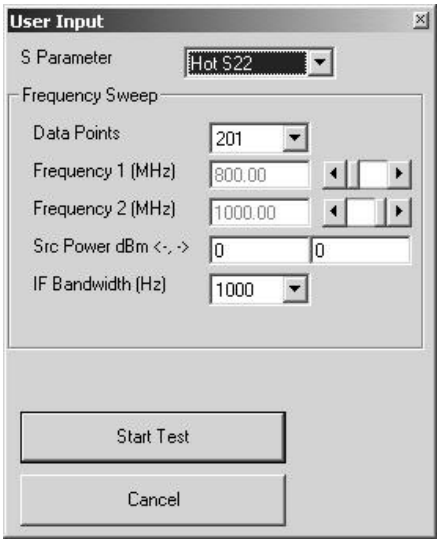
- **M1-M2 Check box:** Turns the M1-M2 feature on or off.
- **M1-M2 Readout:** Displays the value of M1 minus M2.
- **M1 Slider:** Moves M1 between the displayed harmonics. A blue + symbol appears on the top of the selected harmonic.
- **M2-M1Checkbox:** Turns M2-M1 feature on or off.
- **M2-M1 Readout:** Displays the value of M2 minus M1.
- **M2-M1 Slider:** Moves M2 between the displayed harmonics. A red + symbol appears on the top of the selected harmonic.

5-11 HOT S22

The output match of a power amplifier under excited conditions yields critical information that has a strong bearing on efficiency, output power, stability, and often the economic viability of the design. One way of dealing with this information—primarily in power devices operating well away from compression or in somewhat matched amplifiers—is a quasi-linear measurement of S22 while the amplifier is operating under normal drive. Such a measurement is termed hot S22 and it can provide some information on the degree of mismatch in the system, potential operational stability, and the effects of the amplifier's performance on subsequent stages or an antenna.

The Hot S22 measurement uses one source (Source 2) to provide stimulus to the DUT input port while the other source (Source 1) provides a pilot tone injected to the output of the DUT for measuring S22 at the DUT output port.

Procedure: Prepare the test system as described in the instruments documentation.



Enter the appropriate test values in the displayed User Input screen. The input fields are described below:

- **S-Parameter:** This field is already set to "Hot S22" for this test – input disabled.
- **Data Points:** Use the drop down options to set the number of data points in the frequency sweep.
- **Frequency 1 (MHz):** Use this field to set the lower frequency to be displayed. Typically set to a value less than or equal to the main tone. Can also be reset by using the slider control.
- **Frequency 2 (MHz):** Use this field to set the upper frequency to be displayed. Typically set to a value less than the system's maximum frequency (for example, for MS4623B set to a max of 5000 MHz). Can be reset by using the slider control.
- **Src Power dBm <-,->:** Use this field to set the source power level, in dBm.
- **IF Bandwidth (Hz):** Use this field to set the intermediate frequency value, in Hertz.

- **Select Start Test:** Observe that the test screen (Figure 5-14) appears.

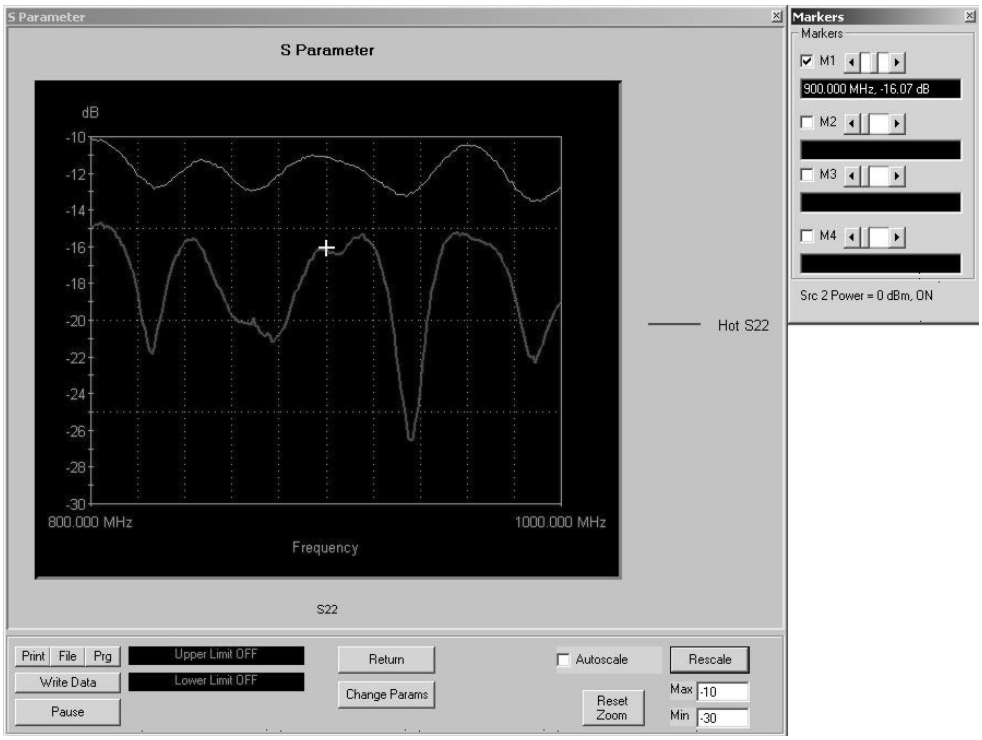
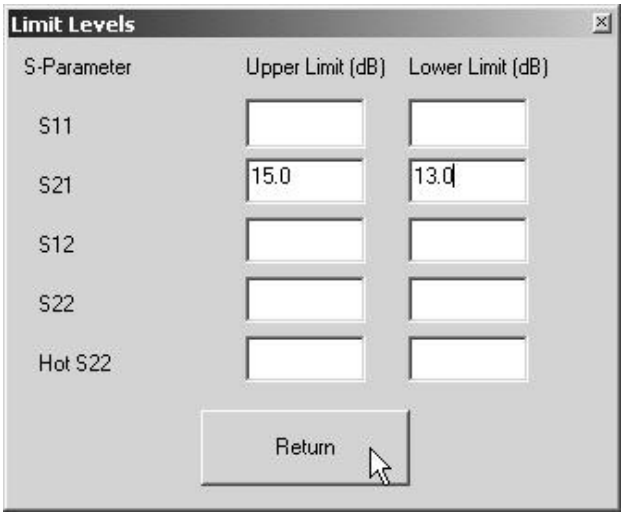


Figure 5-14. *Hot S22 Test Screen*

Button panel and test screen display options:

- **Print:** Click this button to send the screen graphic to a printer. A printer dialog box will allow you to assign the printer and set it's parameters.
- **File:** Click this button to send the screen graphic to a bitmap file. A File dialog will allow you to set the filename and location.
- **Prg:** Click this button to generate a stand-alone program file that will set up the measurement being displayed.
- **Write Data:** Click this button to write two data files to the C:\Program Files\<test system>\Datafiles folder; the file name will have a time stamp. One data file has a ".csv" file extension and the other has a ".s2p" file extension. *For example:* "S17-16-19-29.csv (and s2p)" was created on the 17th day of the month at 4:19:29 PM. CSV and S2P files are comma de-



limited text files and can be opened in a Microsoft Excel spreadsheet.

- **Pause:** Click this button to stop the measurement sweeps and turn off all RF power from the Scorpion sources.
- **Upper Limit/Lower Limit:** Use these fields to set the display of limit lines. Set their values by clicking the Tools | Limits menus from the main Scorpion Navigator dialog box (Chapter 3). This opens the Limit Levels dialog box (left).
- **Return:** Click this button to return to the main Scorpion Navigator dialog box.
- **Change Params:** Click this button to return to the User Input screen.
- **Autoscale Check box:** If Autoscale is checked, Scorpion Navigator automatically scales the display to include all the data. To manually scale the display, uncheck the Autoscale box, enter a Max and Min value, then click the Rescale button.
- **Reset Zoom:** You can drag the cursor on the graph to zoom in on the selected area. To undo the zoom and return to full scale, click the Reset Zoom button.
- **Max/Min:** Use these fields to set the maximum and minimum display values. Click Rescale after changing the values.
- **Rescale:** Click the Rescale button to adjust the Y-axis.

Markers Screen Options:

- **M1:** Checking M1 turns marker 1 on or off (checked or unchecked). If the marker is on, the slider sets the marker's frequency. The window below displays the marker's numerical frequency and amplitude values.
- **M2:** Same as above for marker 2.
- **M3:** Same as above for marker 3.
- **M4:** Same as above for marker 4.
- **Status:** The status of Source 2 is displayed at the bottom of the markers screen. The source may be toggled on and off and the power level may be changed.

The Hot S22 measurement provides the following additional features:

- Ability to vary the DUT input excitation power level (Source 2 of Scorpion, at Port 1) while observing the Hot S22 response. After clicking on the graph, pressing U on the PC keyboard increases the input excitation power level by 0.5 dB. Pressing D decreases it by 0.5 dB. The actual input excitation power (in dBm) is displayed on the PC screen.
- Ability to turn the amplifier input excitation source (Source 2 of Scorpion, at Port 1) ON and OFF while observing the Hot S22. After clicking on the graph, pressing Shift S turns Source 2 OFF. Pressing S turns it ON. This basically provides a comparison of S22 parameters.
- Ability to capture the Hot S22 plot at a given excitation level (history plot on the PC screen) for comparison with other levels. After clicking on the graph, pressing C captures the plot (creates history plot). Pressing Shift C removes the plot.
- Ability to show Hot S22 Smith Chart on the Scorpion Screen while Log Magnitude is displayed on the PC screen. The Scorpion display can be selected by the Scorpion front panel controls during the measurement (below).

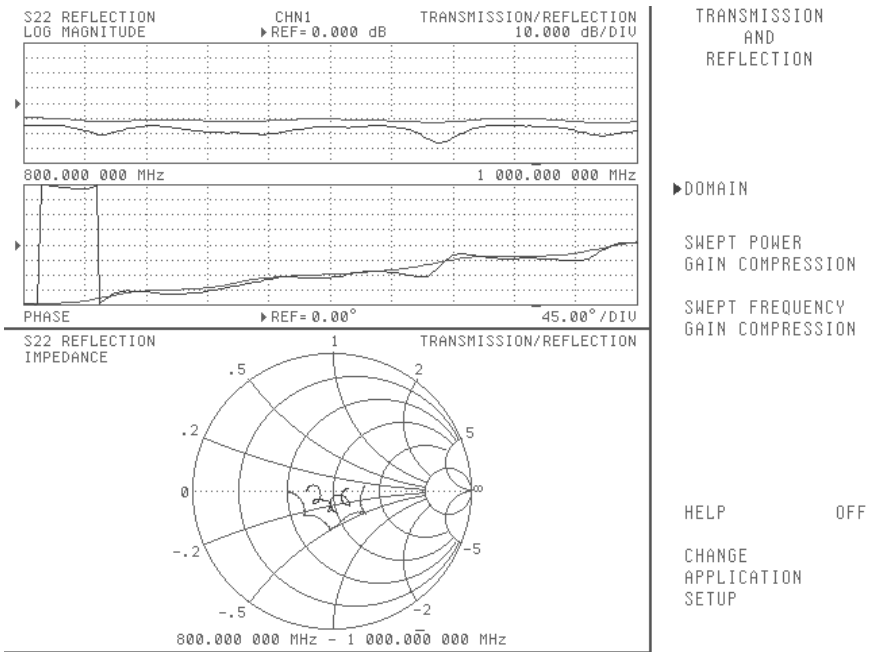


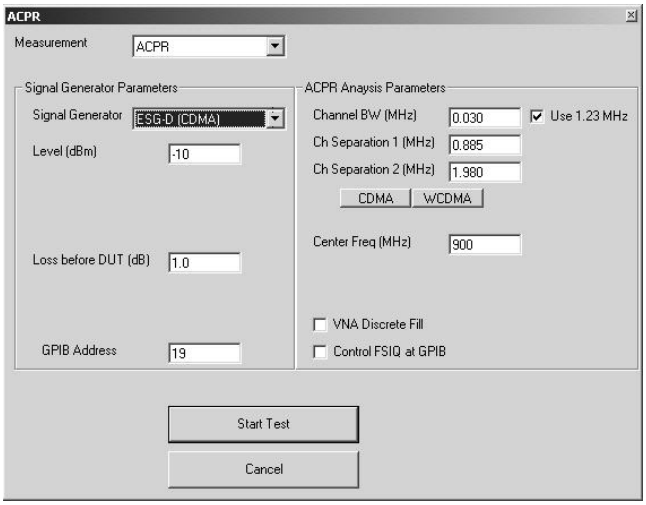
Figure 5-15. *Hot S22 Coordinated Display on Scorpion to Show Magnitude/Phase and Smith Chart*

5-12 ACPR

This section describes the screens that guide the user through the adjacent channel power ratio (ACPR) measurement. ACPR is fully described in the Anritsu Application Note 11410-00264. This note is available from your local representative or from our Internet site, *http://www.anritsu.com*.

CW Measurements

Procedure: Prepare the test system as described in the instruments documentation.



Enter the appropriate test values in the displayed User Input screen. The input fields are described below:

- **Signal Generator Parameters:** These fields provide controls for the Anritsu MG3681 Signal Generator (for WCDMA) and Agilent ESG (for CDMA and WCDMA). In addition, Scorpion Navigator supports manual setup of the modulated signal:
  - **Signal Generator:** Choose the signal generator model number from the drop-down list.
  - **Level (dBm):** Use this field to set the signal generator's power level.
  - **Loss before DUT (dB):** This field lets you account for the loss between the signal generator output and the DUT input. The signal generator's power level will be adjusted by this value. Enter the loss as a positive number.
  - **GPIB Address:** Use this field to set the GPIB address for the signal generator.

- **ACPR Analysis Parameters:** These fields provide controls for signal analysis. Scorpion Navigator will support the R&S FSIQ series of analyzers (for comparison purposes only). The Scorpion handles the brunt of ACPR analysis:
  - **Channel BW (MHz):** Use this field to set the center channel's frequency width of the ACPR measurement.
  - **Ch Separation 1 (MHz):** Use this field to set the separation between the center channel and the Adjacent Channel. For CDMA this is typically 885 MHz and for WCDMA this is typically 5 MHz.
  - **Ch Separation 2 (MHz):** Use this field to set the separation between the center channel and the Alternate Channel. For CDMA this is typically 1.990 MHz and for WCDMA this is typically 10 MHz.
  - **Use 1.23 MHz Check box:** Specifies, for a CDMA measurement, to use 1.23 MHz as the center channel bandwidth and 30 kHz as the alternate and adjacent channel bandwidths.
  - **CDMA and WCDMA:** Click these buttons to automatically enter typical parameters for CDMA or WCDMA measurements.
  - **Center Freq (MHz):** Use this field to set the center frequency for the measurement. This value will also be sent to the signal generator if it is not set for manual control.
  - **VNA Discrete Fill:** Check this box to use the Scorpion's discrete fill function to increase the number of data points in the measurement bands and decrease the number of points outside of the measurement bands. This increases the measurement accuracy.
  - **Control FSIQ at GPIB:** Check this box to specify that an FSIQ is connected via GPIB and will be set to perform the ACPR measurements through a split-out channel.

- **Select Start Test:** Observe that the test screen (Figure 5-16) appears.

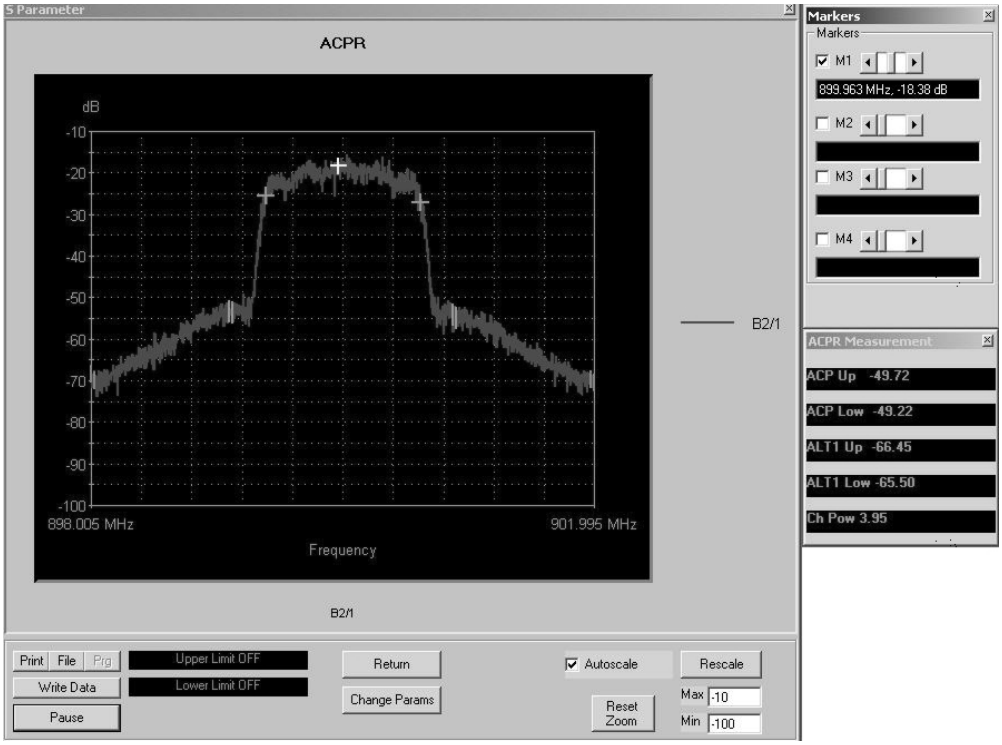
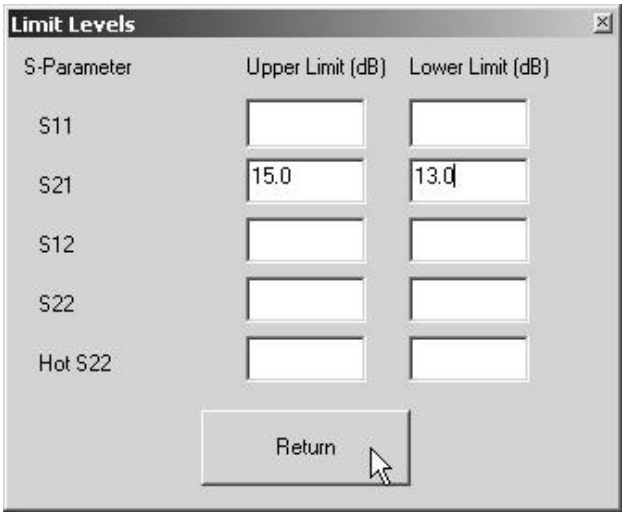


Figure 5-16. *ACPR Test Screen*

Button panel and test screen display options:

- **Print:** Click this button to send the screen graphic to a printer. A printer dialog box will allow you to assign the printer and set its parameters.
- **File:** Click this button to send the screen graphic to a bitmap file. A File dialog will allow you to set the filename and location.
- **Prg:** This button is disabled for this test.
- **Write Data:** Click this button to write two data files to the C:\Program Files\<test system>\Datafiles folder; the file name will have a time stamp. One data file has a ".csv" file extension and the other has a ".s2p" file extension. *For example:* "S17-16-19-29.csv (and s2p)" was created on the 17th day of the month at 4:19:29 PM. CSV and S2P files are comma delimited text files and can be opened in a Microsoft Excel spreadsheet.



- **Pause:** Click this button to stop the measurement sweeps and turn off all RF power from the Scorpion sources.
- **Upper Limit/Lower Limit:** Use these fields to set the display of limit lines. Set their values by clicking the Tools | Limits menus from the main Scorpion Navigator dialog box (Chapter 3). This opens the Limit Levels dialog box (left).
- **Return:** Click this button to return to the main Scorpion Navigator dialog box.
- **Change Params:** Click this button to return to the User Input screen.
- **Autoscale Check box:** If Autoscale is checked, Scorpion Navigator automatically scales the display to include all the data. To manually scale the display, uncheck the Autoscale box, enter a Max and Min value, then click the Rescale button.
- **Reset Zoom:** You can drag the cursor on the graph to zoom in on the selected area. To undo the zoom and return to full scale, click the Reset Zoom button.
- **Max/Min:** Use these fields to set the maximum and minimum display values. Click Rescale after changing the values.
- **Rescale:** Click the Rescale button to adjust the Y-axis.

Markers Screen Options:

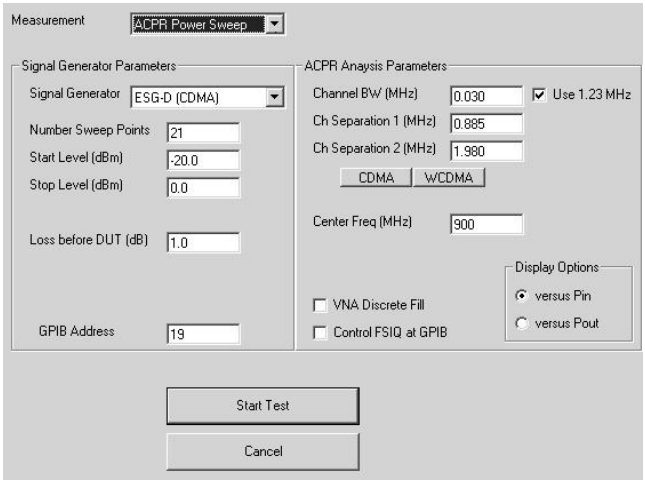
- **M1:** Checking M1 turns marker 1 on or off (checked or unchecked). If the marker is on, the slider sets the marker's frequency. The window below displays the marker's numerical frequency and amplitude values
- **M2:** Same as above for marker 2.
- **M3:** Same as above for marker 3.
- **M4:** Same as above for marker 4.

ACPR Measurement Screen:

- **ACP Up:** Displays the measured upper value.
- **ACP Low:** Displays the measured lower value.
- **ALT1 Up:** Displays the upper alternate value.
- **ALT1 Low:** Displays the lower alternate value.
- **Ch Pow:** Displays the channel power.

Power Sweep Measurements

Procedure: Prepare the test system as described in the instruments documentation.



Enter the appropriate test values in the displayed User Input screen. The input fields are described below:

- **Signal Generator Parameters:** These fields provide controls for the Anritsu MG3681 Signal Generator (for WCDMA) and Agilent ESG (for CDMA and WCDMA). In addition, Scorpion Navigator supports manual setup of the modulated signal:
  - **Signal Generator:** Choose the signal generator's model number from the drop-down list.
  - **Number Sweep Points:** Use this field to set the number of different power levels to use in the measurement.
  - **Start Level (dBm):** Use this field to set the signal generator's initial power level.
  - **Stop Level (dBm):** Use this field to set the signal generator's final power level.
  - **Loss before DUT (dB):** This field lets you account for the loss between the signal generator output and the DUT input. The signal generator's power level will be adjusted by this value. Enter the loss as a positive number.
  - **GPIB Address:** Use this field to set the GPIB address for the signal generator.

- **ACPR Analysis Parameters:** These fields provide controls for signal analysis. Scorpion Navigator will support the R&S FSIQ series of analyzers (for comparison purposes only). The Scorpion handles the brunt of ACPR analysis:
  - **Channel BW (MHz):** Use this field to set the center channel's frequency width of the ACPR measurement.
  - **Ch Separation 1 (MHz):** Use this field to set the separation between the center channel and the Adjacent Channel. For CDMA this is typically 885 MHz and for WCDMA this is typically 5 MHz.
  - **Ch Separation 2 (MHz):** Use this field to set the separation between the center channel and the Alternate Channel. For CDMA this is typically 1.990 MHz and for WCDMA this is typically 10 MHz.
  - **Use 1.23 MHz Check box:** Specifies, for a CDMA measurement, to use 1.23 MHz as the center channel bandwidth and 30 kHz as the alternate and adjacent channel bandwidths.
  - **CDMA and WCDMA:** Click these buttons to automatically enter typical parameters for CDMA or WCDMA measurements.
  - **Center Freq (MHz):** Use this field to set the center frequency for the measurement. This value will also be sent to the signal generator if it is not set for manual control.
  - **VNA Discrete Fill:** Check this box to use the Scorpion's discrete fill function to increase the number of data points in the measurement bands and decrease the number of points outside of the measurement bands. This increases the measurement accuracy.
  - **Control FSIQ at GPIB:** Check this box to specify that an FSIQ is connected via GPIB and will be set to perform the ACPR measurements through a split-out channel.
- **Display Options:** Selects the parameter to display on the X-axis. For this measurement, P_{in} is being varied (or swept) and P_{out} is measured; however, P_{out} may still be used as the X-axis parameter.

- **Select Start Test:** Observe that the test screen (Figure 5-17) appears.

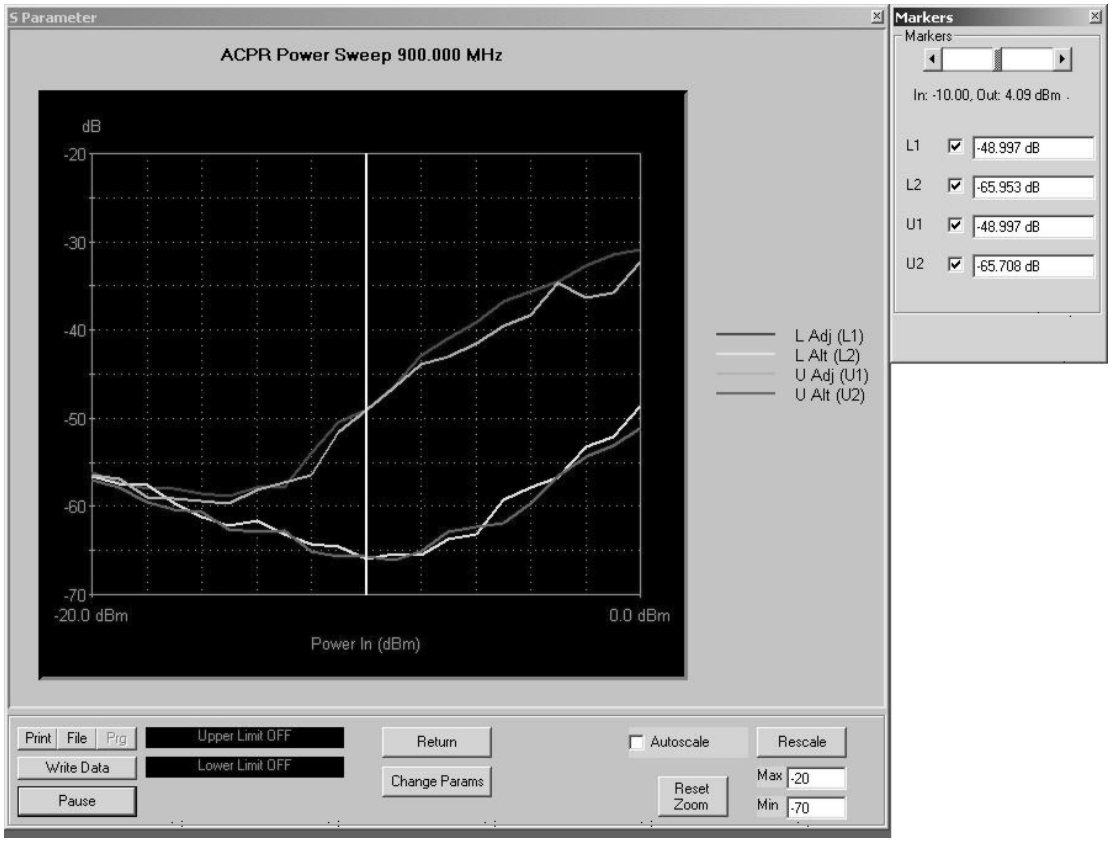
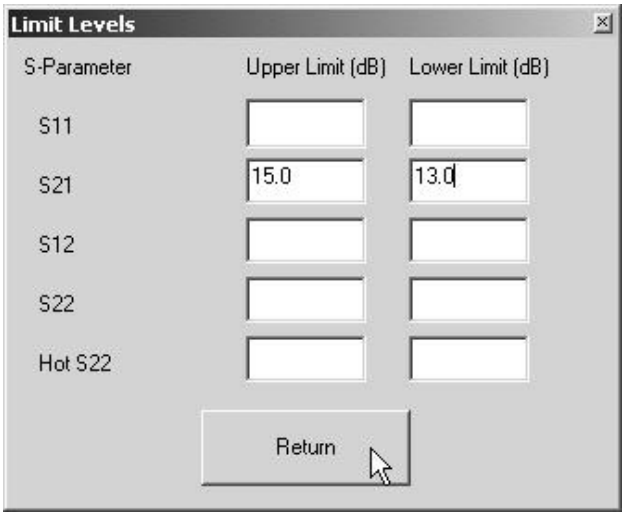


Figure 5-17. *ACPR Test Screen*

Button panel and test screen display options:

- **Print:** Click this button to send the screen graphic to a printer. A printer dialog box will allow you to assign the printer and set its parameters.
- **File:** Click this button to send the screen graphic to a bitmap file. A File dialog will allow you to set the filename and location.
- **Prg:** This button is disabled for this test.
- **Write Data:** Click this button to write two data files to the C:\Program Files\<test system>\Datafiles folder; the file name will have a time stamp. One data file has a ".csv" file extension and the other has a ".s2p" file extension.



For example: "S17-16-19-29.csv (and s2p)" was created on the 17th day of the month at 4:19:29 PM. CSV and S2P files are comma delimited text files and can be opened in a Microsoft Excel spreadsheet.

- **Pause:** Click this button to stop the measurement sweeps and turn off all RF power from the Scorpion sources.
- **Upper Limit/Lower Limit:** Use these fields to set the display of limit lines. Set their values by clicking the Tools | Limits menus from the main Scorpion Navigator dialog box (Chapter 3). This opens the Limit Levels dialog box (left).
- **Return:** Click this button to return to the main Scorpion Navigator dialog box.
- **Change Params:** Click this button to return to the User Input screen.
- **Autoscale Check box:** If Autoscale is checked, Scorpion Navigator automatically scales the display to include all the data. To manually scale the display, uncheck the Autoscale box, enter a Max and Min value, then click the Rescale button.
- **Reset Zoom:** You can drag the cursor on the graph to zoom in on the selected area. To undo the zoom and return to full scale, click the Reset Zoom button.
- **Max/Min:** Use this field to set the maximum and minimum display values. Click Rescale after changing the values.
- **Rescale:** Click the Rescale button to adjust the Y-axis.

Markers Screen Options:

- **Markers Slider:** The markers slider moves the markers between data points.
- **L1:** Check to display the lower adjacent channel power.
- **L2:** Check to display the lower alternate channel power.
- **U1:** Check to display the upper adjacent channel power.
- **U2:** Check to display the upper alternate channel power.

Subject Index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