Operation Manual

ShockLine™
MS46131A Series
Modular Vector Network Analyzer

MS46131A-010, 1 MHz to 8 GHz, 1-Port
MS46131A-020, 1 MHz to 20 GHz, 1-Port
MS46131A-043, 1 MHz to 43.5 GHz, 1-Port

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Chapter Descriptions

Chapter 1 — Overview
This chapter provides an overview of the ShockLine™ MS46131A Series Vector Network Analyzer (VNA) and a description of its major functions and available documentation. A summary of available precision component kits including mechanical calibration kits and verification kits is included.

Chapter 2 — Standard Device Connections
The chapter provides an overview of the MS46131A Series VNA hardware user interface, including buttons and connectors. Included are photographs of the MS46131A panels.

Chapter 3 — Installation
This chapter provides information for the initial inspection and preparation for use of the ShockLine MS46131A Series VNA and includes information on instrument installation, loading ShockLine Software, required operating environment, power requirements, and initial inspection. After power up, the various power modes are described with general warm-up and calibration time intervals. The preventive maintenance section includes information on cleaning along with preparation for storage or shipment.

Chapter 4 — User Interface Display
The chapter describes the general display options of the ShockLine MS46131A Series VNA and provides a general description of the Menu bar, the Icon toolbar, and the right-side function menus. General descriptions and procedures are provided for trace graph setup, marker setup, and limit line setup.

Appendix A — Vector Network Analyzer Primer
This chapter describes the basic functions of a Vector Network Analyzer (VNA) and how it measures magnitude and phase characteristics of networks, amplifiers, attenuators, and antennas. Scattering parameters (S-parameters) are defined.

Appendix B — Maintenance and Security

Appendix C — Abbreviation Glossary
This glossary defines the abbreviations and terms that appear on the connectors and buttons of the MS46131A Series VNA. In some cases, due to space limitations, multiple abbreviations are used for the same term or the same abbreviation is used with different punctuation.

Appendix D — Troubleshooting
This section provides troubleshooting tips when operating the MS46131A.

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Chapter 4 — User Interface Display

Chapter 1 — Overview

1-1 Introduction

This chapter provides an overview of the ShockLine™ MS46131A Series Vector Network Analyzer (VNA) and a description of its major functions and available documentation. A summary of available precision component kits including mechanical calibration kits and verification kits is included.

1-2 ShockLine MS46131A Series VNA Description

The ShockLine MS46131A Series VNA is an instrument system that contains a built-in source, test set, and analyzer. The MS46131A is a 1-port portable and modular USB VNA that is controlled from an external PC running ShockLine software. Designed for simple engineering, manufacturing, and educational applications, the MS46131A series VNA supports manual test programming through the same Graphical User Interface (GUI) available on all the ShockLine family VNAs. Test results can be displayed real time on an external PC. Screen captures can easily be printed or saved in common graphic file formats.

The ShockLine MS46131A Series VNA provides a maximum frequency range from 1 MHz to 43.5 GHz. The MS46131A Series VNA has up to 16,001 total test points available with up to 16 channels with 16 trace display graphs per channel. Each trace can have up to 12 standard markers and one reference marker.

Figure 1-1. MS46131A 1-Port VNA

ShockLine MS46131A Series VNA Models

The three basic frequency models are available as shown in Table 1-1.

Table 1-1. ShockLine MS46131A Series VNA Models

VNA Model Number	Name	Specifications	Test Port Connectors
MS46131A-010	Compact Vector Network Analyzer	1 MHz – 8 GHz	N(f) Connector Test Port
MS46131A-020	Compact Vector Network Analyzer	1 MHz – 20 GHz	K(m) Connector Test Port
MS46131A-043	Compact Vector Network Analyzer	1 MHz – 43.5 GHz	Extended-K™(m) Connector Test Port

Option	Descriptions
MS46131A-002	Time Domain with Time Gating

1-3 ShockLine MS46131A VNA Instrument Control

Other than test connectors and I/O connectors, there are no user controls on the ShockLine MS46131A Series VNA. The MS46131A VNA is controlled and operated by an external PC controller loaded with ShockLine Software.

Note	The PC Controller is an External Computer that is not provided. Windows 7, Windows 8, or Windows 10 is required to run the ShockLine software that controls the MS46131A series VNA. The ShockLine software is provided on the Anritsu website at: http://www.anritsu.com

The MS46131A Series VNA is controlled via:

- An external computer, monitor or touchscreen, keyboard, and mouse
- ShockLine Software
- USB A to a Micro-B Cable

Graphical User Interface

The graphical user interface (GUI) provides a combination of a menu command bar, icon task bar, and right-side navigation menu for most system functions. All of the on-screen navigation elements can be accessed on the user supplied computer.

1-4 Accessories

Accessory	Part Number
External PC Controller with Windows 7, Windows 8, or Windows 10	Not Included
Computer AC to DC 12V 5A Power Supply	40-187-R
USB cable with a USB A to Micro-B Connector	2000-1816-R

1-5 Calibration and Verification Kits

Precision Component and Calibration Kits

Precision-component calibration and verification kits are available. Calibration kits contain components used to identify and separate error sources inherent in microwave test setups. Verification kits consist of components with characteristics traceable to the National Institute of Standards and Technology (NIST) and are used as the most dependable means of checking system accuracy. Each of these kits contains a USB memory device that provides coefficient, characterization, or measurement data for each component. Refer to the instrument data sheet for detailed specifications on automatic calibrators, mechanical calibration kits, and verification kits.

Precision-component calibration kits are available on the Anritsu Website located at: the Precision Calibration Kit page.

Mechanical Calibration Kits

The mechanical calibration kits provide 50 ohm calibrations for N or K devices. The mechanical calibration kits for ShockLine VNAs is available on the Anritsu Website located at the Mechanical Calibration Kit page.

1-6 User Documentation

The following ShockLine MS46131A Series Vector Network Analyzers documentation and updates are available on the Anritsu web site at: http://www.anritsu.com

Product Information, Compliance, and Safety

- ShockLine Product Information, Compliance, and Safety (PICS) – 10100-00067

ShockLine Vector Network Analyzers

- MS46131A Series VNA Technical Data Sheet – 11410-01146
- MS46131A Series VNA Operation Manual – 10410-00780
- MS46122A/B-MS46131A-MS46322A/B Series VNA Measurement Guide – 10410-00336
- MS46121A/B-MS46122A/B-MS46131A-MS46322A/B Series VNA ShockLine User Interface Reference Manual – 10410-00337
- ShockLine Programming Manual – 10410-00746
- MS46131A Series VNA Maintenance Manual – 10410-00781

Documentation Conventions

The following conventions are used throughout the entire MS46131A Series VNA documentation set:

Instrument Identification

Throughout this manual, the following term definitions are used:

- ShockLine VNA refers to any ShockLine VNA module or system.
- VNA refers to any ShockLine VNA module.
- MS46131A Series VNA refers to any of the VNAs in the MS46131A family.
- The specific model number, such as MS46131A-010 (refers to the 8.0 GHz model) when required to identify a specific VNA model.

Instrument Connectors

Panel connectors are denoted with a bold Sans Serif font such as **10 MHZ IN**.

User Interface, Menus, and Soft Buttons

The ShockLine MS46131A Series VNA user interface consists of menus, button lists, sub-menus, toolbars, and dialog boxes. All of these elements are denoted with a special font. Generally, the top level menu items are denoted with a Sans Serif font and capitals, and the subordinate items are denoted with a regular Sans Serif font, such as **Frequency** menu button.

User Interface Navigation

Elements in navigation shortcuts or paths are separated with the pipe symbol ("|"). Menu and dialog box names are distinctive Sans Serif font in CAPITALS. Button names are in Title Case. For example, the path to the Manual Cal menu is:

- MAIN | Calibration | CALIBRATION | Calibrate | CALIBRATE | Manual Cal | MANUAL CAL

User Input

User input such as entering values or other information is denoted in a mono-spaced font such as:

```
This font denotes a string of user input.
```

Chapter 2 — Standard Device Connections

2-1 Chapter Overview

The chapter provides an overview of the MS46131A Series VNA hardware user interface, including buttons and connectors. Included are photographs of the MS46131A panels.

2-2 Standard Device Connections

The MS46131A Series VNA panels are identified in Figure 2-1. The MS46131A Series VNA connectors are identified in sections Section 2-3, Section 2-4, and Section 2-5.

Figure 2-1. MS46131A VNA Front Panel

2-3 Top Panel

The MS46131A Series VNA top panel is shown in Figure 2-2.

Figure 2-2. MS46131A Test Port Panel

2-4 Bottom Panel

The MS46131A Series VNA bottom panel is shown in Figure 2-3.

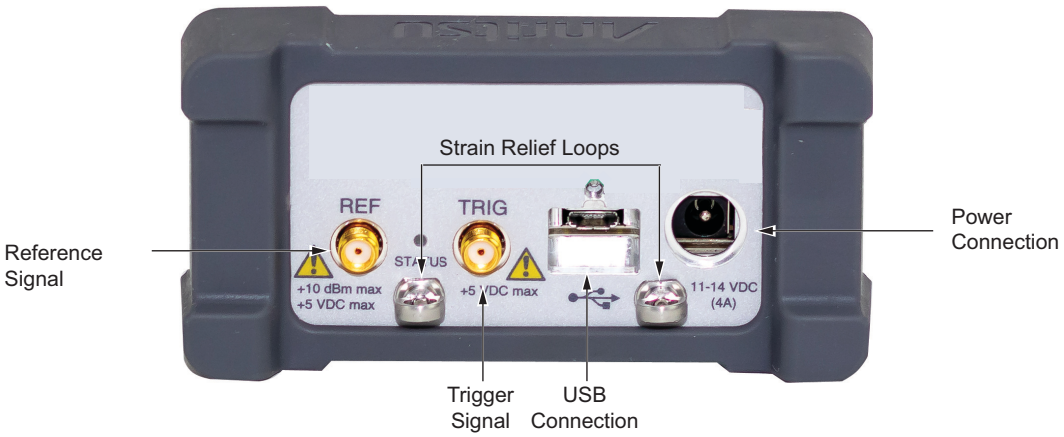


Figure 2-3. MS46131A Bottom Panel

2-5 Back Panel

The label that is attached to the MS46131A back panel displays the:

- Model number
- Revision (R) number
- Options installed
- Serial number

Chapter 3 — Installation

3-1 Introduction

This chapter provides information for the initial inspection and preparation for use of the ShockLine MS46131A Series VNA and includes information on instrument installation, loading ShockLine Software, required operating environment, power requirements, and initial inspection. After power up, the various power modes are described with general warm-up and calibration time intervals. The preventive maintenance section includes information on cleaning along with preparation for storage or shipment.

3-2 Unpacking the Product

Initial Inspection

Inspect the shipping container for damage. If the container or cushioning material is damaged, retain until the contents of the shipment have been checked against the packing list and the instrument has been checked for mechanical and electrical operation. If the ShockLine MS46131A Series VNA is physically damaged, notify your local sales representative or Anritsu Customer Service. If either the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as Anritsu. Keep the shipping materials for the carrier's inspection.

Preparation for Use

The ShockLine MS46131A Series VNA requires software installation. To interface with the instrument through direct manual control, a PC running Windows 7 or higher with keyboard, mouse, monitor or touchscreen, ShockLine software, and interfacing USB cable are required.

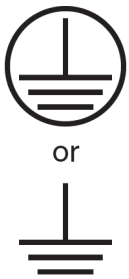
3-3 Operating Environment and Power Requirements

Before installing the ShockLine MS46131A Series VNA in its operating environment, ensure airflow passages around the instrument are clear. The ShockLine MS46131A Series VNA can be operated within the following environmental limits:

Table 3-1. Operational Environmental and Power Requirements

Parameter	Specification
Environmental Requirements (per MIL-PRF-28800F; class 2)	
Operating Temperature Range:	-10 to +55 degrees Celsius
Relative Humidity:	5 % to 95 % at +30 degrees Celsius, non-condensing
Power Requirements	
Voltages:	90 to 264 VAC maximum (single phase)
Frequency:	47 to 63 Hz (power factor controlled)
Power:	153 VA maximum
Installation Category:	The ShockLine MS46131A Series VNA is intended for Installation Category (Over-voltage Category) II

Warning



When supplying power to this equipment, connect the accessory power supply to a 3-pin grounded power outlet connected in turn to local AC Mains. If a grounded 3-pin outlet is not available, use a conversion adapter and ground the green wire, or connect the equipment frame to a suitable ground. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock.

Note	For maximum ESD protection, proper grounding is required. Connect the accessory power supply to a 3-pin grounded power outlet or use the ground receptacle on the top panel of the unit to ground the chassis.

3-4 Power-On/Power-Off Procedures

The power-on procedure involves connecting the instrument power supply to AC Mains, and then using the instrument software to toggle the instrument into operate mode. The power-off procedure involves unplugging the power supply from the unit to turn the instrument off.

Note	Unplugging the instrument or unplugging the USB cable when the unit is in operate mode will cause the ShockLine software interface to close. A pop-up dialog window will appear on the controller PC asking the user whether or not they would like to save their settings, allowing the user to save their work. After the save is done the ShockLine software will close.

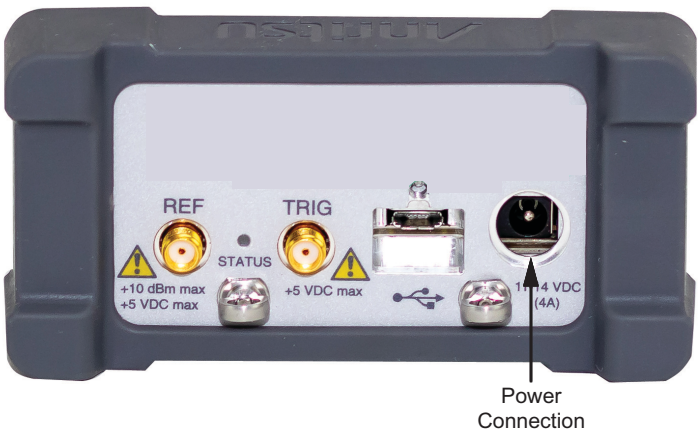


Figure 3-1. Power Connection to AC Mains Power

Procedure – Power-On

To turn the instrument on:

1. Connect a power cord to the power supply. Connect the DC connector from the power supply to the power input connection on the bottom panel of the MS46131A. See Figure 3-1.
2. Connect the AC power cord to local AC mains power.

Procedure – Operate Mode

To set the instrument to operate mode:

1. Connect the MS46131A to the user provided PC via the USB cable included with the unit.
2. Start the ShockLine software by double clicking the ShockLine icon on the desktop.
3. If multiple MS46131A VNAs are connected, select the appropriate port for each MS46131A VNA. See Figure 3-2.

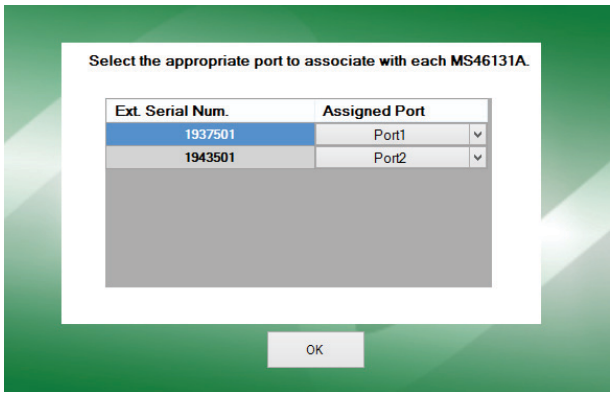


Figure 3-2. MS46131 Port Configuration Dialog Box

4. When fully in operate mode, the computer controlling the ShockLine MS46131A Series VNA displays the main trace display with the application menus on the right side. See Figure 4-1, "User Interface - FREQUENCY Menu (simulated data)" for a typical full screen display.

Note	When placing the ShockLine MS46131A Series VNA in operation, allow at least 30 minutes of warm-up time in the operate mode before using the VNA to assure stable operation and the highest possible accuracy.

Figure 3-3. ShockLine Series VNA Startup Splash Screen

Procedure – Power-Off

Turn off the instrument by unplugging the external power supply. Shutting down the ShockLine software on the external PC does not power down the MS46131A hardware. After turning off the instrument, you must wait at least 5 seconds before plugging the instrument in again. This delay is required to assure a reliable cold start.

3-5 External Control of ShockLine VNA

Connecting the External Computer

After unpacking, the ShockLine MS46131A Series VNA is ready for use. In order to enable the ShockLine VNA application to control the MS46131A, you must connect a USB A to Mini-B cable between the VNA and to an external computer loaded with the ShockLine software.

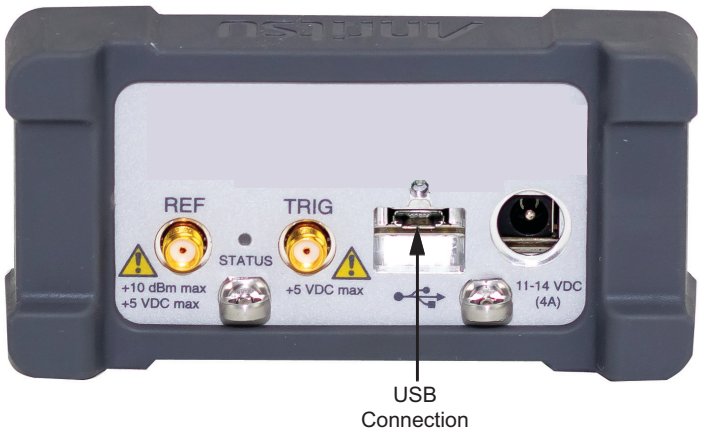


Figure 3-4. ShockLine MS46131A Series VNA USB Connection

3-6 Installing ShockLine Software

Preparation for Software Installation

All instrument functions are performed using:

- An external PC controller running ShockLine software with Windows 7 or higher
- USB 2.0 connection between the external PC controller and the MS46131A VNA
- Graphical User Interface (GUI) control or remote SCPI or IVI-C programming and interfacing

The MS46131A can be controlled:

1. Remotely, via USB controlled SCPI or IVI-C.
2. Directly through the GUI.

Software Installation Procedure

1. Locate and connect the USB cable from the MS46131A VNA to the PC controller USB port.
2. Download and install the MS46131A ShockLine latest software onto the PC from the Anritsu Website: https://www.anritsu.com/search/en-US/default?q=mechanical+calibration+kit&sort=date:D:L:d1#q=MS46131A%20software
3. If the download is successful. a ShockLine icon will appear on your PC screen.
4. Run the ShockLine software installer as Administrator and follow the instructions displayed on the monitor to complete the installation of the software into the PC.

5. To use SCPI with TCP/IP protocol, SOCKETS should be used. The user will have to download a development tool to setup the socket and there are many open source development tools for this purpose. Sockets will run SCPI with or without NI VISA.
6. For IVI use, download the IVI-C driver from the ShockLine website: https://www.anritsu.com/search/en-US/default?q=mechanical+calibration+kit&sort=date:D:L:d1#q=MS46131A%20IVI
7. Double click the ShockLine desktop icon to launch the ShockLine software to use the MS46131A with the graphical user interface.

3-7 Running the ShockLine Software Application

If you have not done so, refer to Section "Preparation for Software Installation" on page 3-4 to prepare the ShockLine software installation before continuing to this section.

Launching the ShockLine Software

The following simple step-by-step procedure will setup the ShockLine VNA for use with ShockLine software.

1. Launching the ShockLine software without plugging in the USB cable from the VNA to the controller first will result in the software asking the user if they want to run in simulation mode. See Figure 3-5. If you want to run in Simulation mode, go to Section 3-8 "Simulation Mode" on page 3-6.

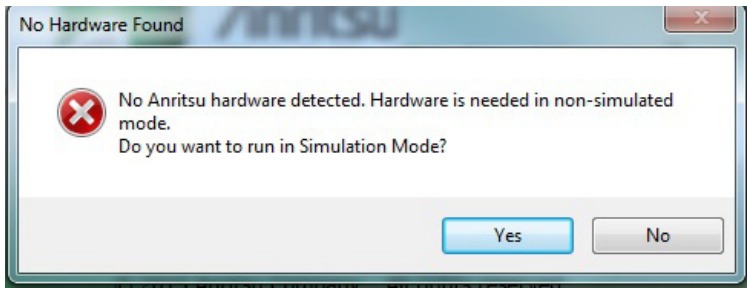


Figure 3-5. No Hardware Prompt

2. Open the ShockLine software. You should see a GUI interface screen as Figure 4-1 on page 4-1.

Note	ShockLine software may be run in non-admin mode.

Note: ShockLine software may be run in non-admin mode.

3. If no GUI interface is displayed, then un-plug and re-plug the VNA USB to the controller and then reopen the ShockLine software.
4. To validate the software connection, check if the VNA is sweeping.
   - A sweep is indicated by a cursor moving along the bottom of the display(s).
5. If the VNA USB connection to the controller is removed, a warning message will appear stating that the Anritsu hardware can not be detected and ask the user if the setup should be saved before closing the application.

3-8 Simulation Mode

When the ShockLine VNA software is being initiated, the program will provide the user a choice to select Simulation Mode when there is no hardware detected. The program will prompt “No hardware is detected” when the Micro USB is not connected from the ShockLine MS46131A to a PC or when the user is using the software on a standalone PC for simulation only.

Simulation Mode provides the same ShockLine VNA GUI as when hardware is detected. Simulation Mode provides the user testing scenarios with the benefits of real testing, except there are no real measurements resulting from a hardware test setup.

Benefits of Simulation Mode include:

- Import .SnP files to manipulate waveforms to be differential or time domain.
- Rework programming scenarios to check commands or setups
- Gain familiarity with the ShockLine GUI menus.

The following simple step-by-step procedure will setup the ShockLine VNA software in Simulation Mode.

Launch the ShockLine program from the icon on your PC, or download the program from the Anritsu ShockLine VNA Software library located at:
https://www.anritsu.com/en-US/test-measurement/support/downloads/software/dwl011051

1. Download the ShockLine VNA software.
    - Once the ShockLine software is loaded onto your PC, the initial startup screen will appear as shown in Figure 3-6.

Figure 3-6. ShockLine GUI Initialization Screen

2. From the NO HARDWARE FOUND dialog box, Figure 3-7, select YES to run in Simulation Mode.
   - No hardware will be detected if running the software on an independent computer for simulation or the USB micro cable is not connected or has been disconnected from the controller.

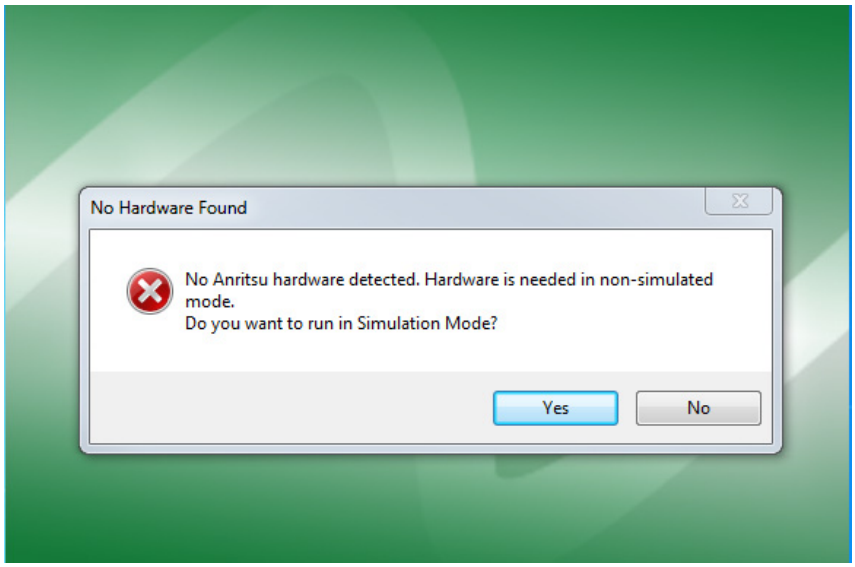


Figure 3-7. ShockLine GUI Initialization Screen

3. Once Simulation Mode is selected, the default menu screen appears, see Figure 3-8.
4. Select the menu/option configuration that you wish to simulate.

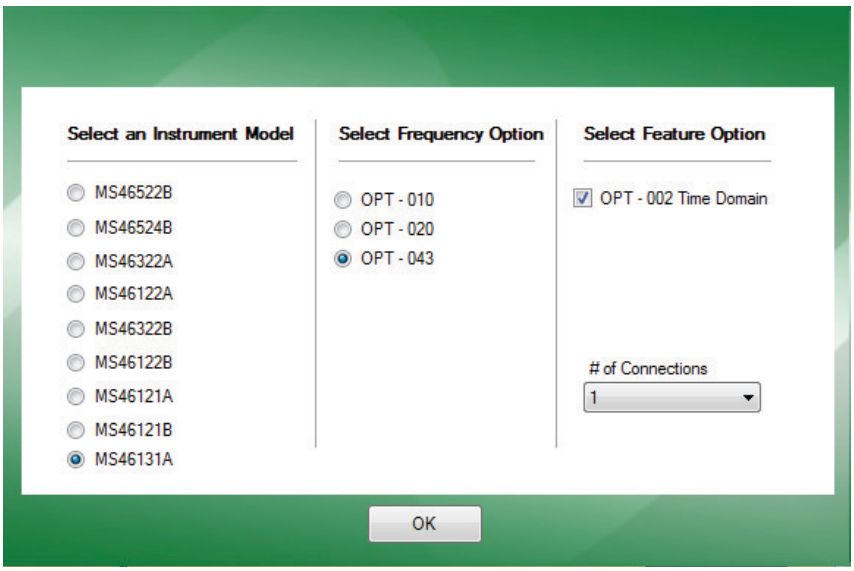


Figure 3-8. Simulator Select Instrument

5. Once the ShockLine VNA model/configuration has been selected, press OK. The menus within the simulated program will provide the appropriate menu screens for the selected model/option configurations selected.

To learn more about the User Interface, see Chapter 4, "User Interface Display".

Chapter 4 — User Interface Display

4-1 Chapter Overview

The chapter describes the general display options of the ShockLine MS46131A Series VNA and provides a general description of the Menu bar, the Icon toolbar, and the right-side function menus. General descriptions and procedures are provided for trace graph setup, marker setup, and limit line setup.

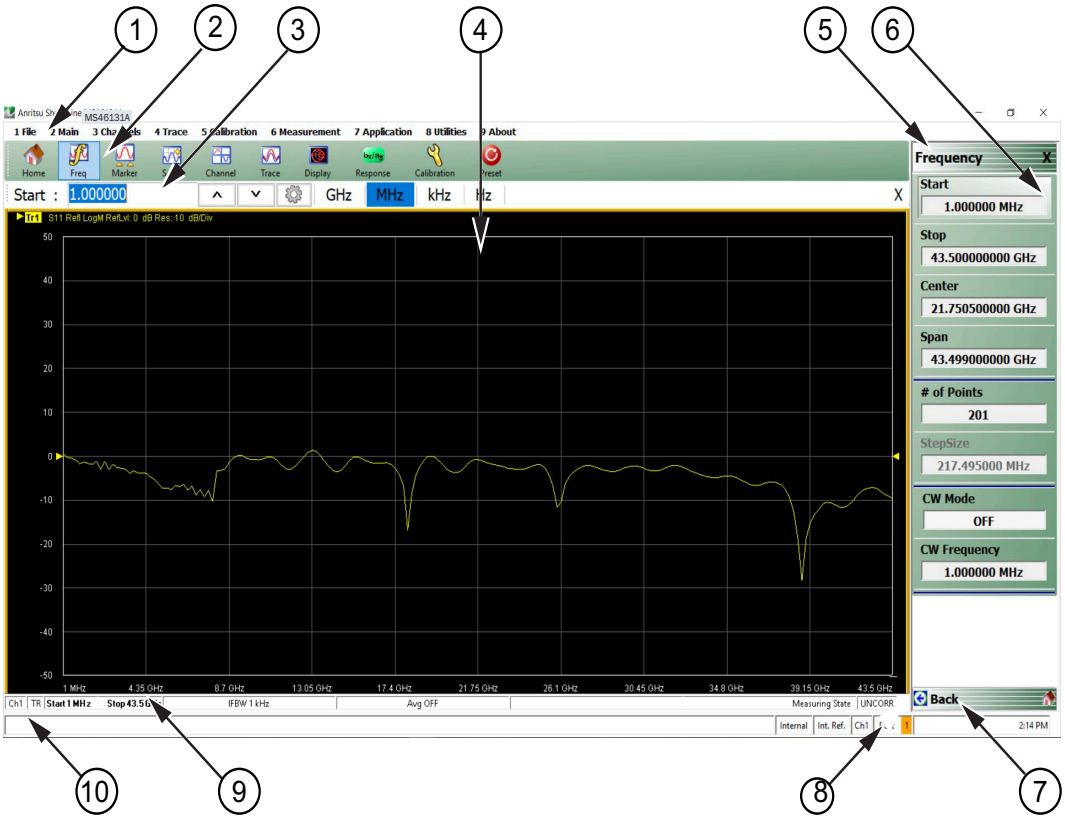
4-2 User Interface Main Screen

The main screen is shown below in Figure 4-1. The key areas of the main screen are the Menu Bar, Icon Toolbar, and MAIN MENU right-side function menus. These are identified in Figure 4-2 on page 4-2

Figure 4-1. User Interface - FREQUENCY Menu (simulated data)

User Interface Control and Display Areas

The instrument main display can be manipulated by clicking with an attached USB mouse, though the keyboard can also be used for some items.. Figure 4-2 shows the general display areas for a single channel displaying four graphical traces.



1. Menu Bar – Displays nine (9) drop down menus: FILE, MAIN, CHANNEL, TRACE, CALIBRATION, MEASUREMENT, APPLICATION, UTILITIES, and ABOUT.
2. Icon Toolbar – User-configured with up to 20 user-selected quick access icons.
3. Field Toolbar – Appears only when field button is clicked for input. Display field for value, with one or more units (such as dB, dBm, or Hz), an Enter button, and an X close button.
4. Display Area – Displays from one to 16 trace display graphs. Each trace display can optionally have from one to 12 markers, a reference marker, and an upper and lower limit line.
5. Menu Title – Displays the name of the displayed right-side menu. Menu titles are unique to each menu.
6. Menu Buttons – The menu buttons allow the user to set parameters, make configuration selections, read result values, start processes, toggle between two or more values, display sub-menus, and display dialog boxes.
7. Menu Navigation Buttons – The navigation buttons always appear at the bottom of the right-side menu and allow browser-like forward and backward navigation through the user's history. Back returns to previous selected higher-level menu, Next returns to a previously selected lower-level menu, and Home returns to the MAIN MENU.
8. System Status Bar – Displays status messages, and configuration status that affects the entire instrument.
9. Trace Status Bar – Provides status for active trace near the bottom of the screen.
10. Tableau Data Display/Input Area – The tableau area only appears when the appropriate menu button is selected. When selected, the display shrinks upwards and the tabular data area expands.

Figure 4-2. User Interface Display Areas

For all ShockLine MS46131A Series VNA models, the user can have up to 16 graphical traces. The figure below shows an instrument setup with four displayed windows, each with three traces. The displayed trace display layout shown below is user-defined as a 2 × 2 configuration trace display.

Figure 4-3. User Interface - 3 Traces (simulated data)

1. Three Traces	3. TRACE Menu
2. Arrow Pointing to Active Trace	4. Number of Traces Selected for Viewing

Function Access

The ShockLine MS46131A Series VNA software user interface provides access to menus and functions using an external computer.

A keyboard and mouse or touchscreen can be used to control the instrument through five major user interface areas on the main display:

- The top Menu bar with its drop-down menus and menu commands.
- The Icon toolbar with up to 10 single-click functions, available as a default configuration or as a user-definable configuration of icon functions.
- The right side MAIN MENU provides access to function menus, sub-menus, dialog boxes, and configuration options.
- For some parameters, selecting a button displays a Field toolbar that appears just below the icon toolbar allowing input of parameter values and units.
- For some parameters, selecting a button displays a Configuration or Setup tableau below the main display area for input of complex parameter sets such as segmented frequency or power sweeps.

To Select a Channel

1. Select a channel in a multi-channel display by doing one of the following:
    - Click anywhere inside the desired channel box.
    - From the keyboard, enter **ALT + 3**, then **3** to view the previous channel or **ALT + 3**, then **4** to view the next channel.
    - On the top menu bar, select Menu Bar | Channels | Channel Prev or Menu Bar | Channels | Channel Next.
    - On the right side menu, select MAIN | Channel | CHANNEL | Chan Next or Chan Previous.

2. The selected channel border changes from gray to white. (Figure 4-3, "User Interface - 3 Traces (simulated data)" on page 4-3 shows Channel 2 (Ch2) selected.)

Note	The **Ch->Max**, **Ch->Next**, and **Ch-Prev** icons are available for the icon toolbar. These icons provide one click access to channel maximum, channel next, and channel previous functions. They can be added to the icon toolbar for a custom configuration and saved as part of a preset configuration.

To Maximize a Channel Display

1. Use one of the methods above to select the desired channel.
2. Do one of the following to maximize the selected channel:
   - From the keyboard, enter **CTRL + 1** or **ALT + 3**, then **2**.
   - On the main display, double-click the channel border box.
   - On the top menu bar, select Menu Bar | Channels | Channel Max.
   - On the right side menu, select MAIN | Channel | CHANNEL | Chan. Max.
3. The selected channel now fills the display area.
   - Maximize a channel display to review the channel status information at the bottom of its screen.

To Make the Display Area Larger

1. The top Icon toolbar and the right side menus can be removed to make the display area larger.
2. Remove the Icon toolbar by doing one of the following:
   - From the keyboard, select **ALT + 8**, then **2.**
   - On the top menu bar, select Menu Bar | Utilities | Toolbar Off.
3. The Icon toolbar disappears. Repeat **Step #2** to make the icon toolbar reappear.
4. Remove the right side menus by doing one of the following:
   - From the keyboard, enter **ALT + 8**, then **7**.
   - On the top menu bar, select Menu Bar | Utilities | Clear.
5. The right side menu disappears. Repeat **Step #4** to make the menu reappear.

To Select Traces

1. Use one of the methods above to maximize the channel display.
2. Select a trace in a multi-trace display by doing one of the following:
   - With a mouse, single click the trace title.
     - If you double-click either the trace title or anywhere within the trace, the trace is both selected and maximized.
   - From the keyboard, enter **ALT + 4**, then **7** to view the previous trace or **ALT + 4,** then **8** to view the next trace.
   - On the top menu bar, select Menu Bar | Trace | Trace Prev or Menu Bar | Trace | Trace Next.
   - On the right side menu, select MAIN | Trace | TRACE | Trace Previous or Trace Next.
   - The selected trace number is highlighted and a left arrow appears.

Trace 1 Selected	Trace 1 Not Selected

Figure 4-4. Trace Selection Indicator

Note	The **Tr->Max**, **Tr->Next**, and **Tr->Previous** icons are available for the Icon toolbar. These icons provide one click access to trace maximum, trace next, and trace previous functions. They can be added to the icon toolbar for a custom configuration and saved as part of a preset configuration.

To Maximize a Trace Display

1. Use one of the methods above to select the desired trace.

2. For a maximum display, make sure the trace's channel is maximized.

3. Do one of the following to maximize the selected trace:

- From the keyboard, select **ALT + 4,** then **6**.
- On the main display, double-click anywhere in the trace title.
- On the top menu bar, select Menu Bar | Trace | Trace Max.
- On the right side menu, select MAIN | Trace | TRACE | Trace Max.

4. The selected trace now fills the display area.

- Maximize a trace display to review the trace status information at the bottom of trace screen.

5. Repeat the actions above to return the trace to its normal size.

4-3 Using the Menu Bar Interface

Menu Bar Overview

The Menu bar at the top of the screen provides drop-down menus for access to major ShockLine VNA functions and dialogs. The figure below shows all of the available Menu bar functions and command menus.

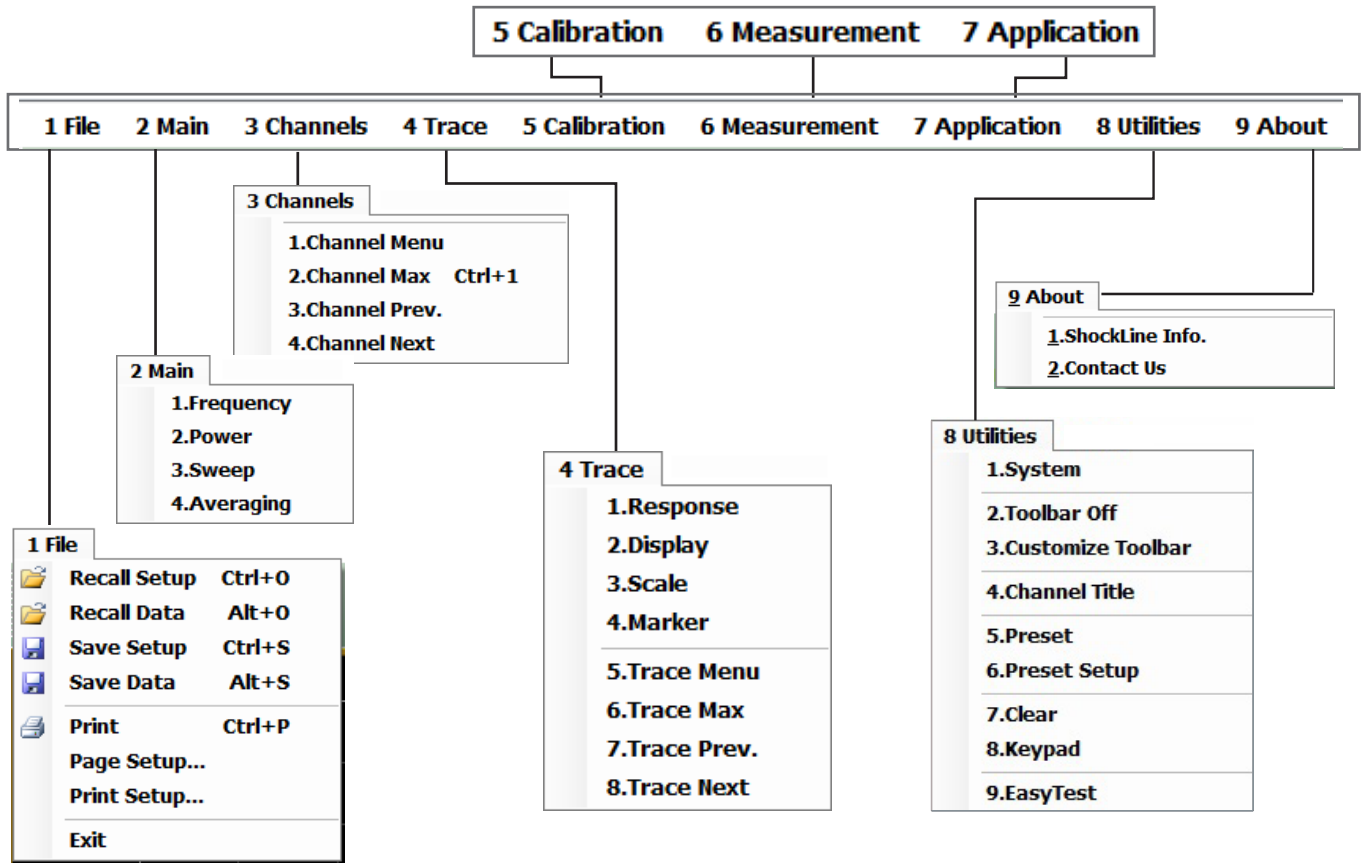


Figure 4-5. Menu Bar Major Functions, Drop-Down Menus, and Commands

Menu Bar General Operation

The Menu bar drop-down menus and commands can be accessed by clicking on the Menu bar and required command.

The keyboard can be used to enter the menu and/or command short cut, most of which use the **ALT (ALTERNATE)** key. To access a menu from the keyboard, press and hold the **ALT (ALTERNATE)** key and the number in front of the menu name.

- For example, **ALT + 1** opens the FILE menu.
- For example, **ALT + 8** opens the UTILITY menu.

To access most commands listed on the drop-down menus, follow the **ALT +** sequence with the menu command number.

- For example, to access the Preset command on the UTILITIES menu, enter **ALT + 8,** then **5**.
- For example, to access the right side SYSTEM menu, enter **ALT + 8,** then **1**.

Some Menu bar commands can also be accessed by using the keyboard **Control (CTRL)** key. Press and hold the **CTRL** key and then the letter key.

- For example, to recall a previously saved setup, enter **CTRL + O** (letter O).
- For example, to print the current display screen, enter **CTRL + P**.

Menu Bar Drop-down Menus and Commands

The Menu bar appears at the top of the instrument display and provides direct access to system menus and some button functions.

The table below summarizes all Menu bar drop down commands. The **MS46121A/B, MS46122A/B, MS46131A, MS46322A/B User Interface Reference Manual** describes the resultant menus or commands in greater detail.

Table 4-1. Menu Bar Drop-Down Menu Descriptions (1 of 10)

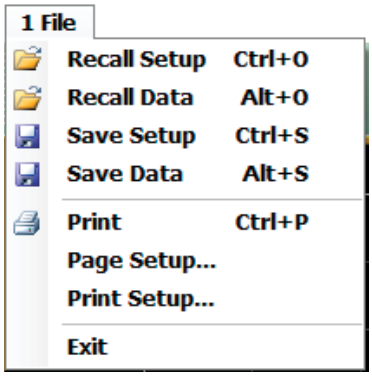
Menu and Command Name	Menu and Command Descriptions
FILE Drop-Down Menu	 • Keyboard: ALT + 1 • Menu Bar | File • MAIN | File | FILE
Recall Setup Command	Select displays the RECALL SETUP dialog box and allows the recall of previously saved setup and/or calibration files: – Active Channel Setup and Calibration (.chx) File – Active Channel Setup (.stx) File – All Channel Setup (.sta) File • Keyboard: CTRL + O (letter O) • Menu Bar | File | Recall Setup • MAIN | File | FILE | Recall Setup | RECALL SETUP Dialog Box
Recall Data Command	Select displays the RECALL DATA dialog box and allows the recall of a previously saved active channel and/or active trace data file of these types: – Active Channel S1P (.s1p), S2P (.s2p), S3P (.s3p), S4P (.s4p) Files – Formatted Data into Active Trace (.tdf) File – Unformatted Data into Active Trace (.tdu) File – Formatted Data into Active Trace Memory (.tdf) File – Unformatted Data into Active Trace Memory (.tdu) File • Keyboard: ALT + O (letter O) • Menu Bar | File | Recall Data • MAIN | File | FILE | Recall Data | RECALL DATA Dialog Box
Save Setup Command	Select displays the Save Setup dialog box and allows the user to save the currently applied system presets configuration file. • Keyboard: CTRL + S • Menu Bar | File | Save Setup • MAIN | File | FILE | Save Setup | SAVE SETUP Dialog Box

Table 4-1. Menu Bar Drop-Down Menu Descriptions (2 of 10)

Menu and Command Name	Menu and Command Descriptions
Save Data Command	Select displays the SAVE DATA (Active Channel.txt) dialog box. Use this dialog to save the current channel data file. • Keyboard: ALT + S • Menu Bar | File | Save Data • MAIN | File | FILE | Save Data | SAVE DATA Dialog Box
Print Command	Select displays the Windows PRINT dialog box to print the current main display. • Keyboard: CTRL + P • Menu Bar | File | Print • MAIN | File | Print | PRINT Dialog Box
Exit Command	Select displays a confirmation dialog box. Click OK to exit the ShockLine application and return to the Windows desktop. Click Cancel to remain in the ShockLine application. • Menu Bar | File | Exit

Table 4-1. Menu Bar Drop-Down Menu Descriptions (3 of 10)

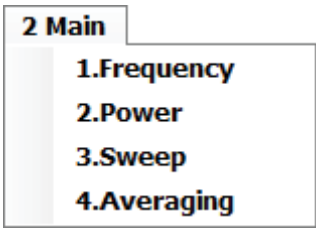
Menu and Command Name	Menu and Command Descriptions
MAIN Drop-Down Menu	 • Keyboard: ALT + 2 • Menu Bar | Main
Frequency Command	Select displays the right-side FREQUENCY menu. • Front Panel Key: **Frequency** • Keyboard: ALT + 2, then 1 • Menu Bar | Channels | Frequency • MAIN | Frequency | FREQUENCY
Power Command	Select displays the right-side POWER menu. • Front Panel Key: **Power** • Keyboard: ALT + 2, then 2 • Menu Bar | Channels | Power • MAIN | Power | POWER
Sweep Command	Select displays the right-side SWEEP SETUP menu. • Front Panel Key: **Sweep** • Keyboard: ALT + 2, then 3 • Menu Bar | Channels | Sweep • MAIN | Sweep Setup | SWEEP SETUP
Averaging Command	Select displays the right-side AVERAGING menu. • Front Panel Key: **Avg** (Average) • Keyboard: ALT + 2, then 4 • Menu Bar | Channels | Averaging • MAIN | Averaging | AVERAGING

Table 4-1. Menu Bar Drop-Down Menu Descriptions (4 of 10)

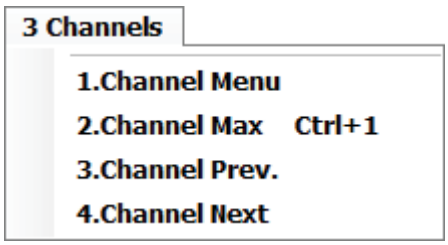
Menu and Command Name	Menu and Command Descriptions
CHANNELS Drop-Down Menu	 • Keyboard: ALT + 3 • Menu Bar | Channels • MAIN | Channel | CHANNEL
Channel Menu Command	Select displays the right-side CHANNEL menu. • Keyboard: ALT + 3, then 1 • Menu Bar | Channels | Channel Menu • MAIN | Channel | CHANNEL
Channel Max Command	Select maximizes the display of the active channel. Select again returns to the previous multi-channel display. • Keyboard: ALT + 3, then 2 • Keyboard: CTRL + 1 • Menu Bar | Channels | Channel Max • MAIN | Channel | CHANNEL | Chan. Max
Channel Previous Command	Selects the next lower channel number. If channel 1 was previously selected, selects the highest numbered channel. • Keyboard: ALT + 3, then 3 • Menu Bar | Channels | Channel Prev. • MAIN | Channel | CHANNEL | Chan. Previous
Channel Next Command	Selects the next higher channel number. If the highest numbered channel was previously selected, selects channel 1. • Keyboard: ALT + 3, then 4 • Menu Bar | Channels | Channel Next • MAIN | Channel | CHANNEL | Chan. Next

Table 4-1. Menu Bar Drop-Down Menu Descriptions (5 of 10)

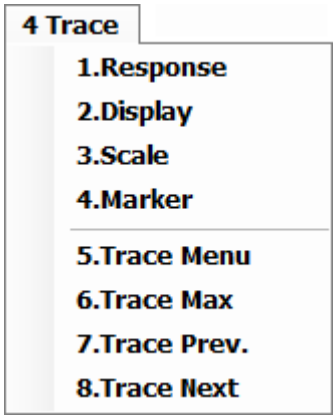
Menu and Command Name	Menu and Command Descriptions
TRACE Drop-Down Menu	 • Keyboard: ALT + 4 • Menu Bar | Trace • MAIN | Trace | TRACE
Response Command	Select displays the right-side RESPONSE menu. • Keyboard: ALT + 4, then 1 • Menu Bar | Trace | Response • MAIN | Response | RESPONSE
Display Command	Select displays the right-side DISPLAY menu. • Keyboard: ALT + 4, then 2 • Menu Bar | Trace | Display • MAIN | Display | DISPLAY
Scale Command	Select displays the right-side SCALE menu. The name of the SCALE menu (and the buttons on it) depend on the display type selected such as: – Scale (Log Mag) – Scale (Lin Mag) – Scale (Phase) – Scale (Real) – Scale (Imag) – Scale (SWR) • Keyboard: ALT + 4, then 3 • Menu Bar | Trace | Scale • MAIN | Scale | SCALE
Marker Command	Select displays the right-side MARKERS [1] menu. • Keyboard: ALT + 4, then 4 • Menu Bar | Trace | Marker • MAIN | Marker | MARKER [1]
Trace Menu Command	Select displays the right-side TRACE menu. • Keyboard: ALT + 4, then 5 • Menu Bar | Trace | Trace Menu • MAIN | Trace | TRACE

Table 4-1. Menu Bar Drop-Down Menu Descriptions (6 of 10)

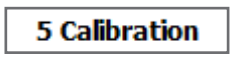
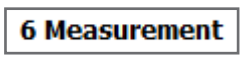
Menu and Command Name	Menu and Command Descriptions
Trace Max Command	Select maximizes the active trace to full screen display. Selecting again, returns the trace to the standard multi-trace display. • Keyboard: ALT + 4, then 6 • Menu Bar | Trace | Trace Max • MAIN | Trace | TRACE | Trace Max
Trace Previous Command	Selects the next lower trace number on the active channel. If Trace 1 is currently selected, the highest numbered trace is selected. If the current trace is not maximized, the previous trace will not be maximized. If the current trace is maximized, the previous trace will be maximized. • Keyboard: ALT + 4, then 7 • Menu Bar | Trace | Trace Prev. • MAIN | Trace | TRACE | Trace Previous
Trace Next Command	Selects the next higher trace number on the active channel. If the highest numbered trace is currently displayed, the Trace 1 is displayed. If the current trace is not maximized, the next trace will not be maximized. If the current trace is maximized, the next trace will be maximized. • Keyboard: ALT + 4, then 8 • Menu Bar | Trace | Trace Next • MAIN | Trace | TRACE | Trace Previous
CALIBRATION Drop-Down Menu	 The CALIBRATION drop-down menu has one command that selects the right-side CALIBRATION menu • Keyboard: ALT + 5 • Menu Bar | Calibration • MAIN | Calibration | CALIBRATION
MEASUREMENT Drop-Down Menu	 Select displays the right-side MEASUREMENT menu. • Keyboard: ALT + 6 • Menu Bar | Measurement • MAIN | Measurement | MEASUREMENT
APPLICATION Drop-Down Menu	 The APPLICATION menu/command selects the right-side APPLICATION menu. • Keyboard: ALT + 7 • Menu Bar | Application • MAIN | Application | APPLICATION

Table 4-1. Menu Bar Drop-Down Menu Descriptions (7 of 10)

Menu and Command Name	Menu and Command Descriptions
UTILITIES Drop-Down Menu	 • Keyboard: Alt + 8 • Menu Bar | Utilities
System Command	Select displays the right-side SYSTEM menu. • Keyboard: Alt + 8, then 1 • Menu Bar | Utilities | System • MAIN | System | SYSTEM
Toolbar Off Command	Toggles the ICON TOOLBAR, immediately below the Menu Bar, on and off. • Keyboard: Alt + 8, then 2 • Menu Bar | Utilities | Toolbar Off
Customize Toolbar Command	Select displays the CUSTOMIZE TOOLBAR dialog box and allows the user to select which icons are to be displayed in the toolbar. Up to 10 icons can be displayed at one time and there are a total of 24 available icons. The Icon Toolbar configuration is saved when a Preset Save is completed. • Keyboard: Alt + 8, then 3 • Menu Bar | Utilities | Customize Toolbar
Channel Title Command	Select displays the DISPLAY SETUP menu and allows a user-defined title to be applied to and displayed above the active channel. Each channel can have a different or the same title. • Keyboard: Alt + 8, then 4 • Menu Bar | Utilities | Channel Title • MAIN | Display | DISPLAY | Display Area Setup | DISPLAY SETUP | Edit Chan. Title | EDIT CHANNEL TITLE Dialog Box

Table 4-1. Menu Bar Drop-Down Menu Descriptions (8 of 10)

Menu and Command Name	Menu and Command Descriptions
Preset Command	• Returns the instrument to its prior saved state which can be either the factory-default preset, or a user-defined setup. The PRESET SETUP menu selection defines which is used. • Keyboard: Alt + 8, then 5 • Menu Bar | Utilities | Preset • No right-side menu available to preset the instrument: – Use the Menu Bar Function above.
Preset Setup Command	Select displays the PRESET SETUP menu and allows user-defined preset parameters to be applied during a preset command. • Keyboard: Alt + 8, then 6 • Menu Bar | Utilities | Preset Setup
Clear Command	Select toggles the displayed right-side menu off and on. When toggled back on, the previously selected menu is displayed. For example, if the CALIBRATE function menu was displayed when the display was cleared, the CALIBRATE function menu is again displayed when Clear is selected a second time. • Keyboard: Alt + 8, then 7 • Menu Bar | Utilities | Clear Command
KeyPad Off Command	Select toggles the display of the keypad dialog window off and on. The keypad allows for easier entry of input parameters. • Keyboard: Alt + 8, then 8 • Menu Bar | Utilities | KeyPad Off Command

Table 4-1. Menu Bar Drop-Down Menu Descriptions (9 of 10)

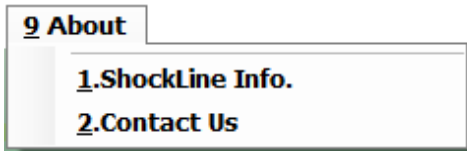
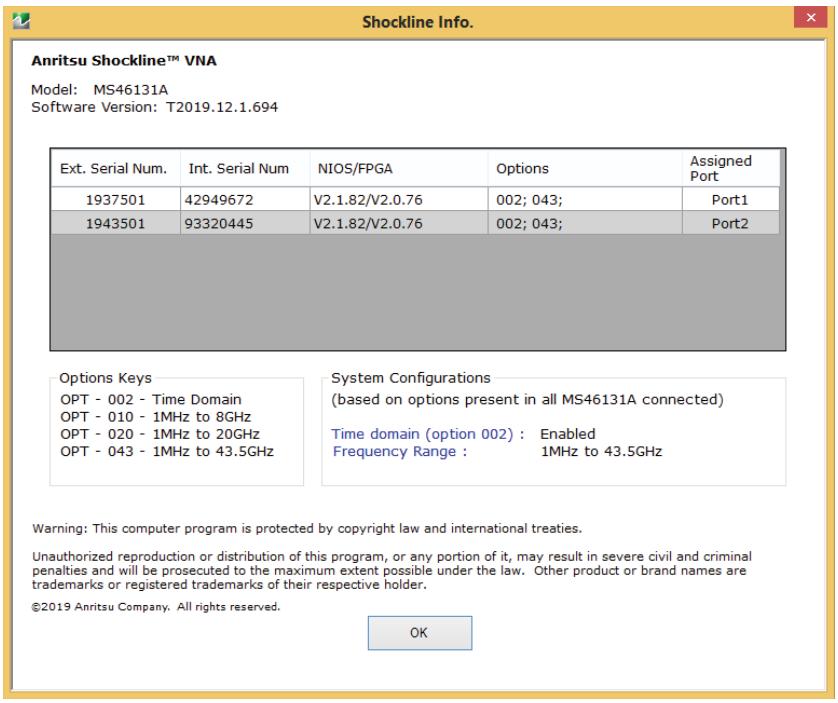
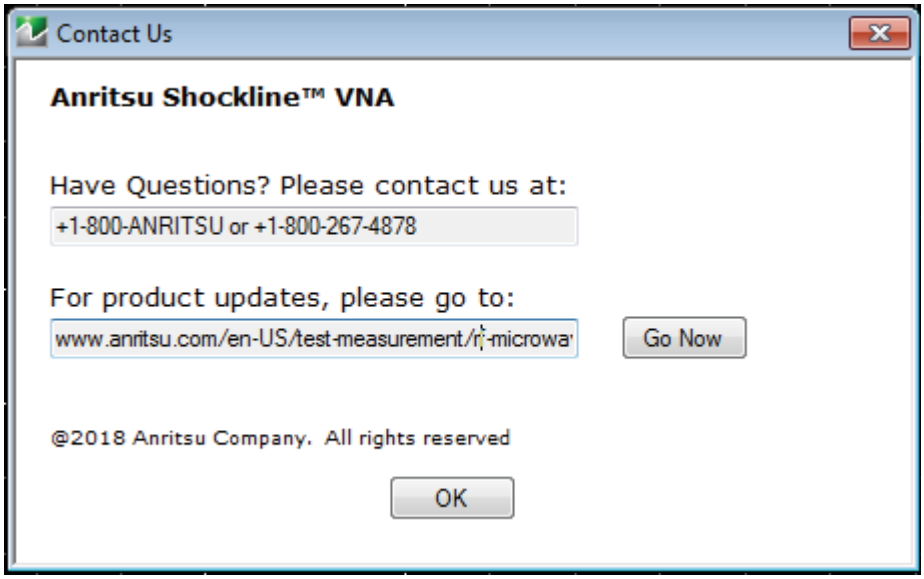
Menu and Command Name	Menu and Command Descriptions
About Drop-Down Menu	 • Keyboard: ALT + 9 • Menu Bar | About
ShockLine Info	Select displays the SHOCKLINE INFO dialog box with typical information as shown below.  The dialog box provides instrument configuration information. Click OK to close the dialog box. The following information is provided: – Copyright Statement – Software Version – Firmware Version – Model Number – Serial Number(s) – Options Installed – Assigned Port Numbers **Keypad** • Keyboard: ALT + 9, then 1 • Menu Bar | About | ShockLine Info

Table 4-1. Menu Bar Drop-Down Menu Descriptions (10 of 10)

Menu and Command Name	Menu and Command Descriptions
Contact Us Command	Select displays the CONTACT US dialog box with typical information as shown below. 

4-4 Icon Toolbar

Overview

The Icon Toolbar is located immediately below the Menu Bar and allows single-click access to many menus and functions. The icon toolbar is user-configurable and up to 10 icons can be displayed in any configuration.

Using the Icon Toolbar Interface

The default Icon Toolbar is shown below:

The definitions and functions of the default icons are (from left to right):

- **Home Icon –** Select displays the right side MAIN MENU. Does not reset or lose previously set values.
- **Sweep Icon –** Select displays the right-side Sweep menu.
- **Freq Icon** – Select displays the right-side FREQUENCY menu.
- **Power Icon** – Select displays the right-side POWER menu.
- **Marker Icon** – Select displays the right-side MARKERS [1] menu.
- **Scale Icon** – Select displays the right-side SCALE menu.
- **Channel Icon –** Select displays the right-side CHANNEL menu.
- **Trace Icon** – Select displays the right-side TRACE menu.
- **Display Icon** – Select displays the right-side DISPLAY menu.
- **Response Icon** – Select displays the right-side RESPONSE menu.
- **Calibration Icon** – Select displays the right-side CALIBRATION menu.
- **Preset Icon** – Select returns the system to its prior preset status at the time of the last preset save.

All available icons are described in the in Table 4-2.

Figure 4-6. Icon Toolbar with Factory Default Function Icons

Available Icon Functions

The available icon functions that can be added to a user-defined icon toolbar are listed in table below. Once configured, a preset save allows the toolbar configuration to be recalled at any time.

The procedures for changing the icon toolbar are described following the icon table and uses the "CUSTOMIZE TOOLBAR Dialog Box" on page 4-23 below. When a user-defined toolbar is configured, the first selected icon goes to the left-most position on the toolbar. The tenth selected icon goes to the right-most position on the toolbar.

Table 4-2. Icon Descriptions - Listed Alphabetically (1 of 5)

Icon Name	Icon	Description
Icon Description Definitions		**Default Icons** – These are one of the 10 default icons and are provided after a return to the factory standard configuration. **Keyboard** – If available, the keyboard shortcut to access this menu or function. **Menu Bar** – If available, navigation path to access this menu or function. **Navigation** – To navigate to this menu or function from the MAIN menu. **Description** – If available, where this menu, dialog box, or function is described in greater detail in this document.
Calibration Icon	 Calibration	Default Icon. Select displays the right-side CALIBRATION menu. • Keyboard: ALT + 5 • Menu Bar | Calibration • MAIN | Calibration | CALIBRATION
Continue Icon	 Continue	After a system pause or hold with the Hold icon, the Continue icon resumes operation with all prior settings in effect. • MAIN | Sweep Setup | SWEEP SETUP | Hold Functions | HOLD FUNCTIONS | Continue
Channel Icon	 Channel	Default Icon. Select displays the right-side CHANNEL menu. • Front Panel Key: **Channel** • MAIN | Channel | Channel Menu
Ch->Max Icon	 Ch->Max	When multiple channels are used, select activates and displays the channel with the maximum trace value. • MAIN | Channel | CHANNEL | Channel Max
Ch->Next Icon	 Ch->Next	When multiple channels are used, select activates and displays the next higher channel number. If the highest channel number is currently active, channel 1 (one) is activated and displayed. • MAIN | Channel | CHANNEL | Channel Next
Ch->Prev Icon	 Ch->Prev	When multiple channels are used, select activates and displays the next lower channel number. If channel 1 (one) is currently active, the highest numbered channel is activated and displayed. • MAIN | Channel | CHANNEL | Channel Prev.

Table 4-2. Icon Descriptions - Listed Alphabetically (2 of 5)

Icon Name	Icon	Description
Icon Description Definitions		**Default Icons** – These are one of the 10 default icons and are provided after a return to the factory standard configuration. **Keyboard** – If available, the keyboard shortcut to access this menu or function. **Menu Bar** – If available, navigation path to access this menu or function. **Navigation** – To navigate to this menu or function from the MAIN menu. **Description** – If available, where this menu, dialog box, or function is described in greater detail in this document.
Custom Icon 1		Select performs the action defined for Custom Icon 1 using the right-side context menu. After definition, custom-action icons are displayed in the Icon Bar. The steps to define a Custom-action Icon are described in the *MS46121AB, MS46122AB, MS46131A, MS46322AB User Interface and Reference Manual* (10410-00337).
Custom Icon 2		Select performs the action defined for Custom Icon 2 using the right-side context menu. After definition, custom-action icons are displayed in the Icon Bar. The steps to define a Custom-action Icon are described in the *MS46121AB, MS46122AB, MS46131A, MS46322AB User Interface and Reference Manual* (10410-00337).
Custom Icon 3		Select performs the action defined for Custom Icon 3 using the right-side context menu. After definition, custom-action icons are displayed in the Icon Bar. The steps to define a Custom-action Icon are described in the *MS46121AB, MS46122AB, MS46131A, MS46322AB User Interface and Reference Manual* (10410-00337).
Custom Icon 4		Select performs the action defined for Custom Icon 4 using the right-side context menu. After definition, custom-action icons are displayed in the Icon Bar. The steps to define a Custom-action Icon are described in the *MS46121AB, MS46122AB, MS46131A, MS46322AB User Interface and Reference Manual* (10410-00337).
Custom Icon 5		Select performs the action defined for Custom Icon 5 using the right-side context menu. After definition, custom-action icons are displayed in the Icon Bar. The steps to define a Custom-action Icon are described in the *MS46121AB, MS46122AB, MS46131A, MS46322AB User Interface and Reference Manual* (10410-00337).
Display Icon		Default Icon. Select displays the right-side DISPLAY menu. • Keyboard: Alt + 4, then 2 • Menu Bar | Trace | Display • MAIN | Trace | TRACE
Easy Test Icon		Select displays the Easy Test dialog box used to load Easy Test scripts. A separate easyTest Tools PC application is used to generate the easyTest work instruction (ETT) files that are loaded by this icon. To get the easyTest tools PC application, download the installer from the Anritsu website. • Keyboard ALT + 8 then 9 • Menu Bar | Utilities | EasyTest

Table 4-2. Icon Descriptions - Listed Alphabetically (3 of 5)

Icon Name	Icon	Description
Icon Description Definitions		**Default Icons** – These are one of the 10 default icons and are provided after a return to the factory standard configuration. **Keyboard** – If available, the keyboard shortcut to access this menu or function. **Menu Bar** – If available, navigation path to access this menu or function. **Navigation** – To navigate to this menu or function from the MAIN menu. **Description** – If available, where this menu, dialog box, or function is described in greater detail in this document.
File Icon	 File	Select displays the right-side FILE menu. • Keyboard: ALT + 1 • MAIN | File | FILE
Freq Icon	 Freq	Default Icon. Select displays the right-side FREQUENCY menu. • MAIN | Frequency | FREQUENCY
Hold Icon	 Hold	Select pauses the system operation, retaining all system presets and current configuration settings. • MAIN | Sweep Setup | SWEEP SETUP | Hold Functions | HOLD FUNCTIONS | Hold
Home Icon	 Home	Select displays the right-side main menu. Does not reset or lose previous set values. • MAIN
Marker->Max Icon	 Marker->Max	Displays marker with maximum value. • MAIN | Marker | MARKER [1] | Marker Search | MARKER SEARCH | Max
Marker->Min Icon	 Marker->Min	Select displays the marker with minimum value. • MAIN | Marker | MARKER [1] | Marker Search | MARKER SEARCH | Min
Marker->Off Icon	 Marker->Off	Select turns all marker displays off. • MAIN | Marker | MARKER [1] | Marker Setup | MARKER SETUP | All Markers Off
Marker->Peak Icon	 Marker->Peak	Select displays marker with the highest peak value. • MAIN | Marker | MARKER [1] | Marker Search | MARKER SEARCH | Peak | PEAK | Search Peak

Table 4-2. Icon Descriptions - Listed Alphabetically (4 of 5)

Icon Name	Icon	Description
Icon Description Definitions		**Default Icons** – These are one of the 10 default icons and are provided after a return to the factory standard configuration. **Keyboard** – If available, the keyboard shortcut to access this menu or function. **Menu Bar** – If available, navigation path to access this menu or function. **Navigation** – To navigate to this menu or function from the MAIN menu. **Description** – If available, where this menu, dialog box, or function is described in greater detail in this document.
Marker->Pk Lft Icon	 Marker->Pk Lft	Select displays the next peak value marker to the left of current selected marker. • MAIN | Marker | MARKER [1] | Marker Search | MARKER SEARCH | Peak | PEAK | Search Left
Marker->Pk Rt Icon	 Marker->Pk Rt	Select moves the current active marker to the next trace peak value to the right of its current position. • MAIN | Marker | MARKER [1] | Marker Search | MARKER SEARCH | Peak | PEAK | Search Right
Marker Icon	 Marker	Default Icon. Select displays the right-side MARKERS [1] menu. • Keyboard: Alt + 4, then 4 • Menu Bar | Trace | Marker • MAIN | Marker | MARKER [1]
Measurement Icon	 Measurement	Select displays the right-side MEASUREMENT menu. • Keyboard: ALT + 6 • Menu Bar | Measurement | MEASUREMENT • MAIN | Measurement
Power Icon	 Power	Default Icon. Select displays the right-side POWER menu. • MAIN | Power | POWER
Preset Icon	 Preset	Default Icon. Select returns the system to its prior preset status which is the status at the time of the last preset save. • Keyboard: Alt + 8, then 5 • Menu Bar | Utilities | Preset
Print Icon	 Print	Select displays the PRINT dialog box, usually to print a copy of the main display. Once the dialog box appears, click OK to print; click Cancel to abort. • Keyboard: ALT + 1, then P • Menu Bar | File | Print • MAIN | File | FILE | Print | PRINT Dialog Box
Response Icon	 Response	Default Icon. Select displays the right-side RESPONSE menu. • Keyboard: Alt + 4, then 1 • Menu Bar | Trace | Response • MAIN | Response | RESPONSE

Table 4-2. Icon Descriptions - Listed Alphabetically (5 of 5)

Icon Name	Icon	Description
Icon Description Definitions		**Default Icons** – These are one of the 10 default icons and are provided after a return to the factory standard configuration. **Keyboard** – If available, the keyboard shortcut to access this menu or function. **Menu Bar** – If available, navigation path to access this menu or function. **Navigation** – To navigate to this menu or function from the MAIN menu. **Description** – If available, where this menu, dialog box, or function is described in greater detail in this document.
Scale Icon	 Scale	Default Icon. Select displays the right-side SCALE menu. • Keyboard: Alt + 4, then 3 • Menu Bar | Trace | Scale • Main | Scale | SCALE
Sweep Icon	 Sweep	Select displays the right-side SWEEP SETUP menu. • MAIN | Sweep Setup | SWEEP SETUP
System Icon	 System	Select displays the right-side SYSTEM menu. • Keyboard: Alt + 8, then 1 • Menu Bar | Utilities | System • MAIN | System | SYSTEM
Time Domain Icon	 Time Domain	Select displays the right-side Time Domain menu. • MAIN | Time Domain
Trace Icon	 Trace	Default Icon. Select displays the right-side TRACE menu. • Keyboard: Alt + 4, then 5 • Menu Bar | Trace | Trace Menu • MAIN | Trace | TRACE
Tr->Max Icon	 Tr->Max	Select maximizes the display with the currently active trace. • Keyboard: Alt + 4, then 6 • Menu Bar | Trace | Trace Max • MAIN | Trace | TRACE | Trace Max
Tr->Next Icon	 Tr->Next	Select displays the next higher trace number. When the highest number is reached, next click displays lowest trace number. • Keyboard: Alt + 4, then 8 • Menu BAR | Trace | Trace Next • MAIN | Trace | TRACE | Trace Next
Tr->Previous Icon	 Tr->Previous	Select displays the next lower trace number. When the lowest number is reached, next click displays the highest numbered trace. • Keyboard: Alt + 4, then 7 • Menu Bar | Trace | Trace Prev. • MAIN | Trace | TRACE | Trace Previous

CUSTOMIZE TOOLBAR Dialog Box

Use the CUSTOMIZE TOOLBAR dialog box to setup the Icon toolbar with the icons you need for quick access to commands and functions. Once configured, and after a Preset Configuration save, the Icon toolbar settings can be recalled with the other preset configuration parameters.

Previous

- "UTILITIES Drop-Down Menu" on page 4-13

Keyboard

- **ALT + 8, then 3**

Navigation

- Menu Bar | Utilities | Customize Toolbar | CUSTOMIZE TOOLBAR Dialog Box

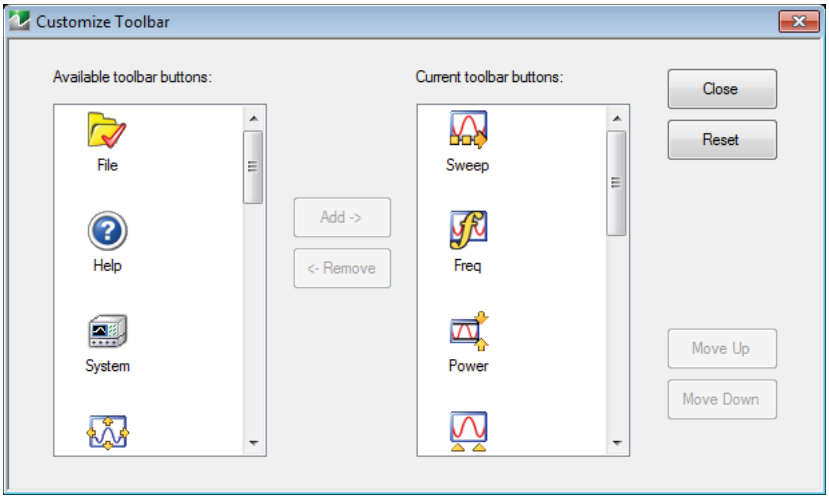


Figure 4-7. CUSTOMIZE TOOLBAR Dialog Box

Procedure

With the CUSTOMIZE TOOLBAR dialog box open, the left-side Available Toolbar Buttons area shows icons that are not in use on the current toolbar, while the right-side Current Toolbar Buttons area shows the current in-use icons.

Removing Icons

1. To change the icons in the current icon toolbar, in the right side Current Toolbar Buttons area, select an icon to remove. When selected, the Add-> and <-Remove buttons become available.
2. Remove unwanted icons as required by selecting the icon and then clicking the <-Remove button.
3. Removed icons appear at the bottom of the Available Toolbar Buttons list.

Adding Icons

1. Scroll through the Available Toolbar Buttons list and select an icon to add, then click the Add-> button. The selected icon appears in the right side Current Toolbar Buttons area.
2. Repeat the selection process until all required icons listed in the right side Current Toolbar Buttons area or you have reached the maximum of 20 icons.
3. In the Current Toolbar Buttons display, the icon displayed at the top of the list will appear on the extreme list of the toolbar. The last icon displayed at the bottom of the list will appear on the extreme right of the toolbar.

Moving Icons

To change the left to right sequence of the current icons, select an icon, and click the Move Up/Move Down buttons until the icons are correctly positioned left to right.

Saving the Configuration

When the icons are in the correct sequence. Click the Close button to apply the icons to the icon toolbar. It is recommended that a Preset Save be performed to save the icon toolbar configuration. If the icon toolbar needs adjustment, re-open the Customize Toolbar dialog box and repeat the steps above.

Reset to Factory Default

To return the icon toolbar to its factory default state, click the Reset button.

4-5 MAIN Menu and Application Menus

This section summarizes the MAIN MENU, which is the home menu for all right-side menu interface menus, dialog boxes, and functions.

Note that if the height of the MAIN MENU exceeds that of your monitor display, a scroll bar will appear to provide vertical navigation.

MAIN Menu

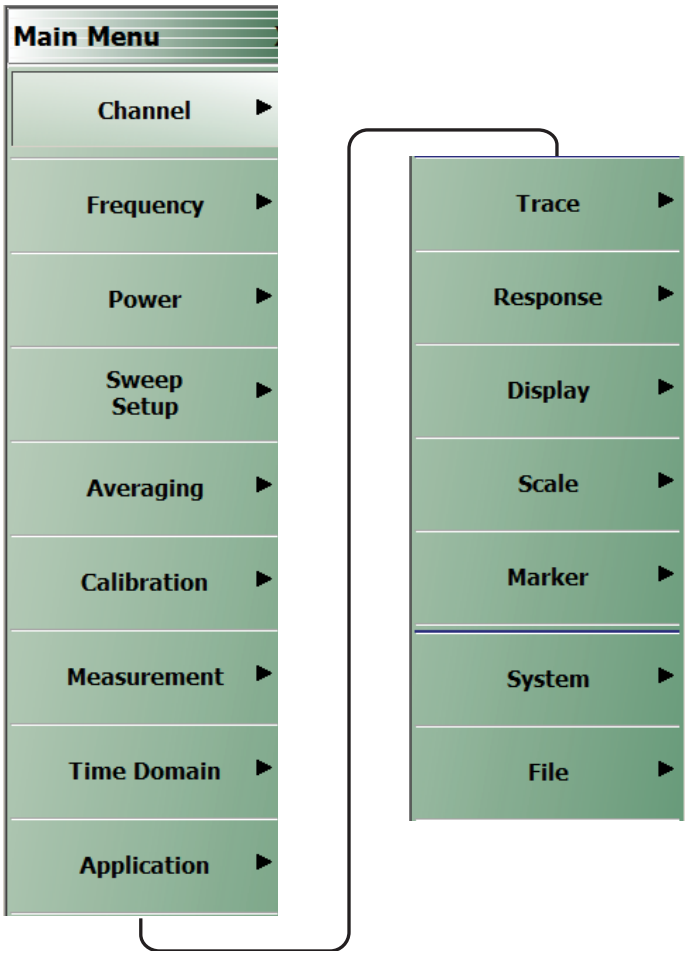


Figure 4-8. MAIN Menu

Channel

Select displays the CHANNEL menu. See the **User Interface Reference Manual** for descriptions of the CHANNEL menu.

Frequency

Select displays the FREQUENCY menu. The name, appearance, and available buttons on the FREQUENCY menu varies depending on the sweep type set and if CW frequency is selected.

Power

Select displays the POWER menu.

Sweep Setup

Select displays the SWEEP SETUP menu.

Averaging

Select displays the AVERAGING menu.

Calibration

Select displays the CALIBRATION menu.

Measurement

Select displays the MEASUREMENT menu.

Time Domain

Select displays the TIME DOMAIN menu

Application

Select displays the APPLICATION menu.

Trace

Select displays the TRACE menu.

Response

Select displays the RESPONSE menu.

Display

Select displays the DISPLAY menu.

Scale

Select displays the SCALE menu which allows the user to change the scaling and other attributes of a trace display.

SCALE menu variants are dependent on selections made from TRACE FORMAT menu options.

Marker

Select displays the MARKER [1] menu.

System

Select displays the SYSTEM menu.

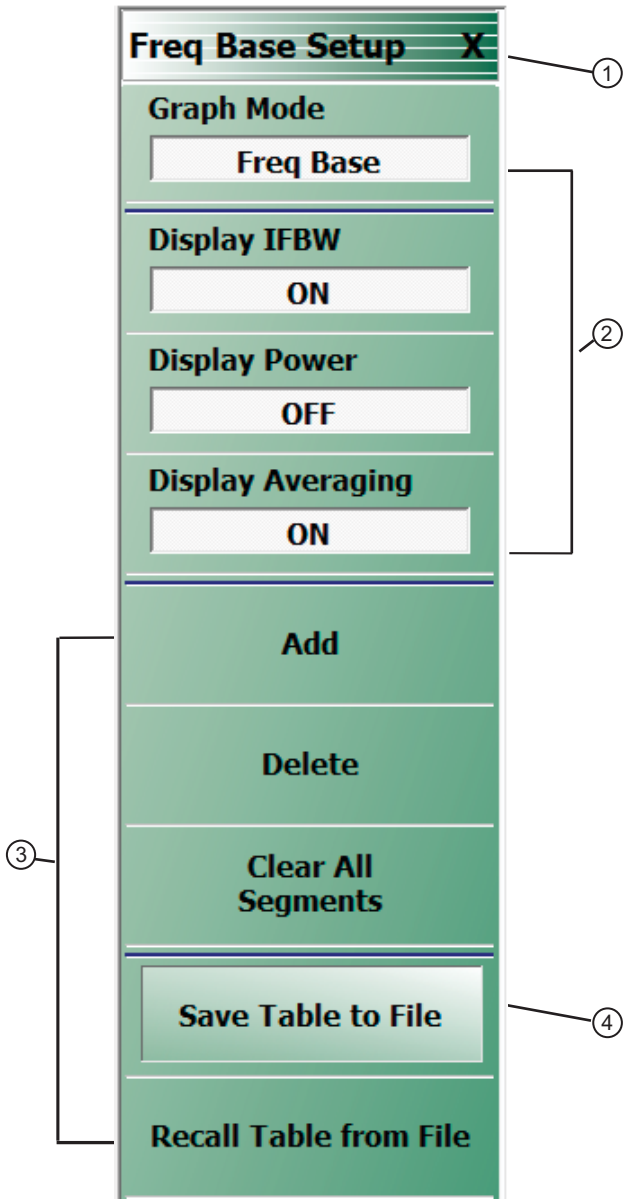
File

Select displays the FILE menu.

4-6 Using the Main Menu Interface

Types of Menus, Menu Buttons, and Menu Toolbars

The MAIN MENU (or MAIN) is the right-side navigation function for the instrument. The MAIN MENU has multiple types of menus, menu buttons, and menu toolbars that allow the user to configure and control the operation of the VNA. Each menu consists of the elements shown in the figure below.



1. Menu Title – Each menu title is unique.	3. Menu Buttons – Displays a menu or dialog box.
2. Field Buttons – The button shows the currently selected value. Selecting the button displays a field toolbar.	4. Active Selection

Figure 4-9. Menu and Button Components

Menu Title

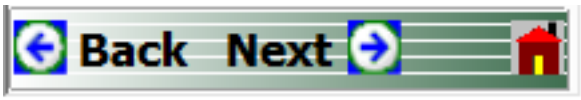
At the top of the menu, a unique menu title, which is not repeated on any other menu. For space reasons, menu names are often abbreviated. For definitions, see Appendix C, "Abbreviation Glossary".

Menu Buttons

One or more menu buttons that either call a sub-menu, allow for a field value to be specified, toggle a function off or on, or allow a selection to be made from a group of choices. If the menu is longer than one screen, a scroll box and scroll arrows appear on the right side of the menu.

Menu Navigation Buttons

The menu navigation area buttons appear at the bottom of each menu.



Back Button

The Back button returns the menu display to last selected higher-level menu.

Next Button

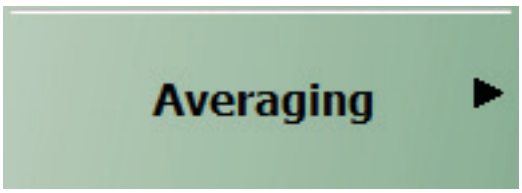
The Next button returns the menu display to the next deeper sub-menu that has already been selected. The availability of the Back and Next buttons (above) depends on the user's navigation path. The Home button (below) always appears.

Home Button

The Home button returns the menu display to the MAIN menu.

Menu Buttons

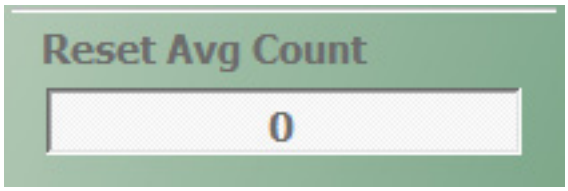
Menu buttons call lower-level menus.



For example, the Averaging button on the MAIN menu calls the AVERAGING menu.

Read-Only Buttons

Read-only buttons display system values based on other settings and parameters.



For example, the Reset Avg Count button is in a read-only state because the Averaging button is set to OFF.

Function Buttons

Function buttons are used to start a process or to select an option. The buttons are highlighted to indicate selection. Selected options display a radio button icon.

Toggle Buttons

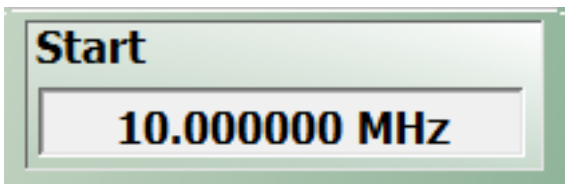
Toggle buttons toggle through two or more values with each click of the button and display their current setting in the button field. For example, in the MAIN MENU | Response | RESPONSE | User Defined | USER DEFINED menu, the Driver Port button displays the default Port 1 setting.

Clicking the Driver Port button toggles to the Port 2 setting.

Clicking the Driver Port button a second time toggles back to the Port 1 setting.

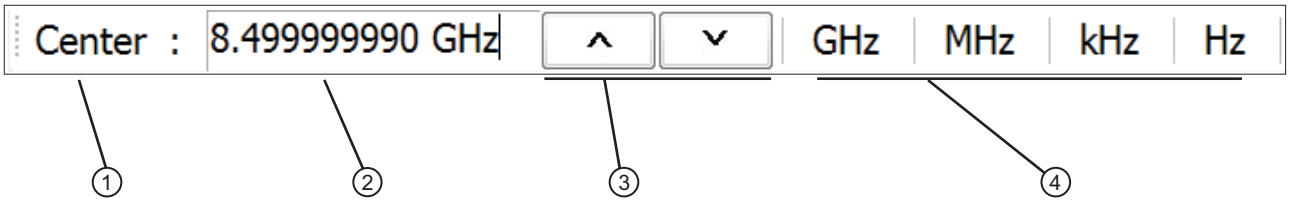
Field Selection Buttons

Field selection buttons display a user-defined parameter or value. Clicking a field selection button such as the Start button on the FREQUENCY menu displays a field toolbar (described below) that allows the user to specify parameter values and units.



Field Toolbars

Field toolbars appear under the Icon Toolbar after the associated field button has been selected. The field toolbar displays its name, a value field, up/down arrows to increment the value, and one or more unit select buttons.



1. Toolbar Name – The toolbar name usually is based on the name of the button that called the toolbar.
2. Value Field – Entry area for parameter value. Entry can be from the front panel Number Keys, or from an attached USB keyboard, or by clicking the Up/Down arrows (below).
3. Up/Down Arrows – Increments the value field up or down to quickly enter values. The same effect from the front panel Up/Down Arrow Keys, or from the keyboard Up/Down arrow keys.
4. Available Units Selection – If available (shown in the upper toolbar), allows the selection of units from two or more values. If not available (shown in the lower toolbar), the units are fixed and not selectable.

Figure 4-10. Field Toolbar Selections

For example, clicking the Start button on the FREQUENCY menu displays the Start (Frequency) field toolbar, with multiple frequency options.

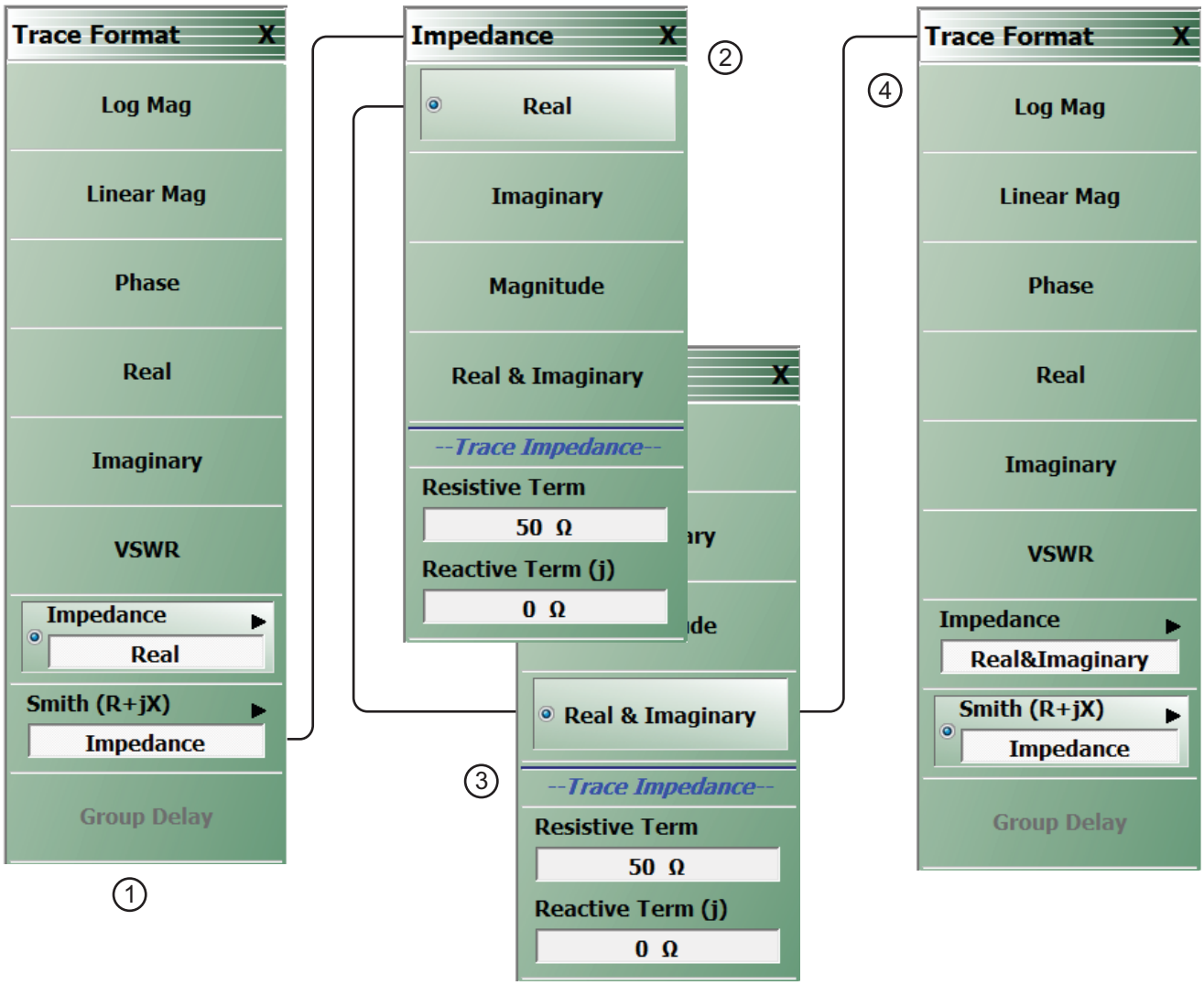
Some field toolbars display a single unit with no options. For example, in the MAIN MENU | Scale | SCALE menu, clicking the Reference Value button displays the Reference Value toolbar with a single dB unit value option.

The system limits for each toolbar are defined in the System Limits section in the Programming Manual Supplement. The appendix lists the default, minimum allowable, and maximum allowable values and whether the toolbar changes apply on a per-trace, per-channel, or per-system basis.

Auto-Return Button Groups

Auto-return groups are button selection groups (described above) that automatically return to the higher-level menu after a selection is made.

For example, on the TRACE FORMAT menu shown below (1), clicking on the Impedance button displays the IMPEDANCE menu with its current selection of Real (2). When another selection such as Real & Imaginary is made (3), the system auto-returns to the TRACE FORMAT menu with the Impedance button now set to Real & Imaginary (4).



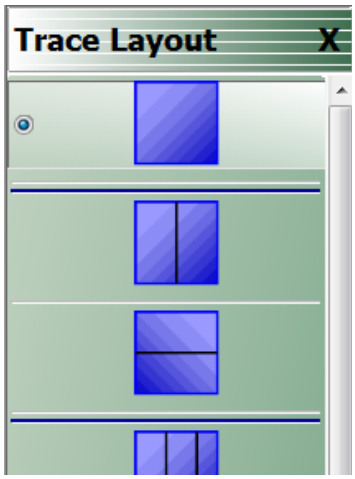
1. Original TRACE FORMAT Menu with Impedance setting as “Real”
   - The bottom Impedance field button is set to “Real
   - Clicking the Impedance button displays the IMPEDANCE menu.
2. Original IMPEDANCE Menu with “Real”
   - The IMPEDANCE menu appears with impedance set as “Real.”
3. IMPEDANCE Menu with “Real & Imaginary”
   - The user selects “Real & Imaginary” and the system auto-returns to the TRACE FORMAT menu.
4. Modified TRACE FORMAT Menu with Impedance setting as “Real & Imaginary”
   - The TRACE FORMAT menu automatically re-appears with impedance set as “Real & Imaginary.”

Figure 4-11. Auto-Return Button Group Example on the IMPEDANCE Menu

Button Selection Icon

The button select icon identifies a selected option.

In the example below, the TRACE LAYOUT menu shows that the Single Screen option has been selected.



After selection, depending on the menu, the user either clicks the Back button navigation icon to return to the prior menu, or once selected, the system auto-returns to the prior menu.

Navigation

- MAIN | Trace | TRACE LAYOUT | Trace Layout

Completion Checkmark Button

In the CALIBRATION menus, some buttons list the required tasks for each calibration type. The completion checkmark icon indicates that a calibration task has been completed.

For example, in a Full 2 Port Reflection Calibration, one of the required steps is a Port 1 Short test.

The button above left shows the test has not been started. The user makes the necessary physical connections between the VNA and the required connector/adapter, and then clicks the button to begin the test. The button dims while the test is performed. After the test is successfully completed, the completion icon appears on the left side of the button as shown above right.

4-7 Using Dialog Boxes

Most dialog boxes are standard Microsoft dialog boxes and appear in the center of the display area.

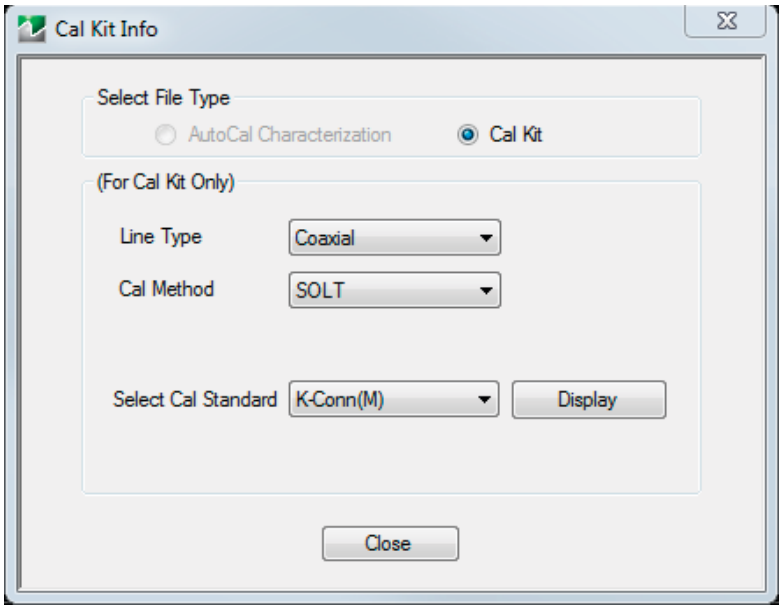


Figure 4-12. CAL KIT INFO Dialog Box Example

Standard Dialog Box Buttons

Most dialog boxes also have some combination of standard buttons for OK, Cancel, and Save. Other buttons and types of buttons may be present. Within dialog boxes are dialog box areas that are usually named for the options that can be selected or the information that is displayed. Most dialog box areas are delimited by a line, box, or shadowbox that contains the information or settings for a series of common attributes. If the area is named in the dialog box, that name is used in any related procedures. If the area is not named, the area is named for the first data or input field. Some dialog boxes have links that call sub-dialog boxes.

4-8 Instrument Status Display Area

At the bottom of the instrument display is the status bar where instrument states and conditions are reported.

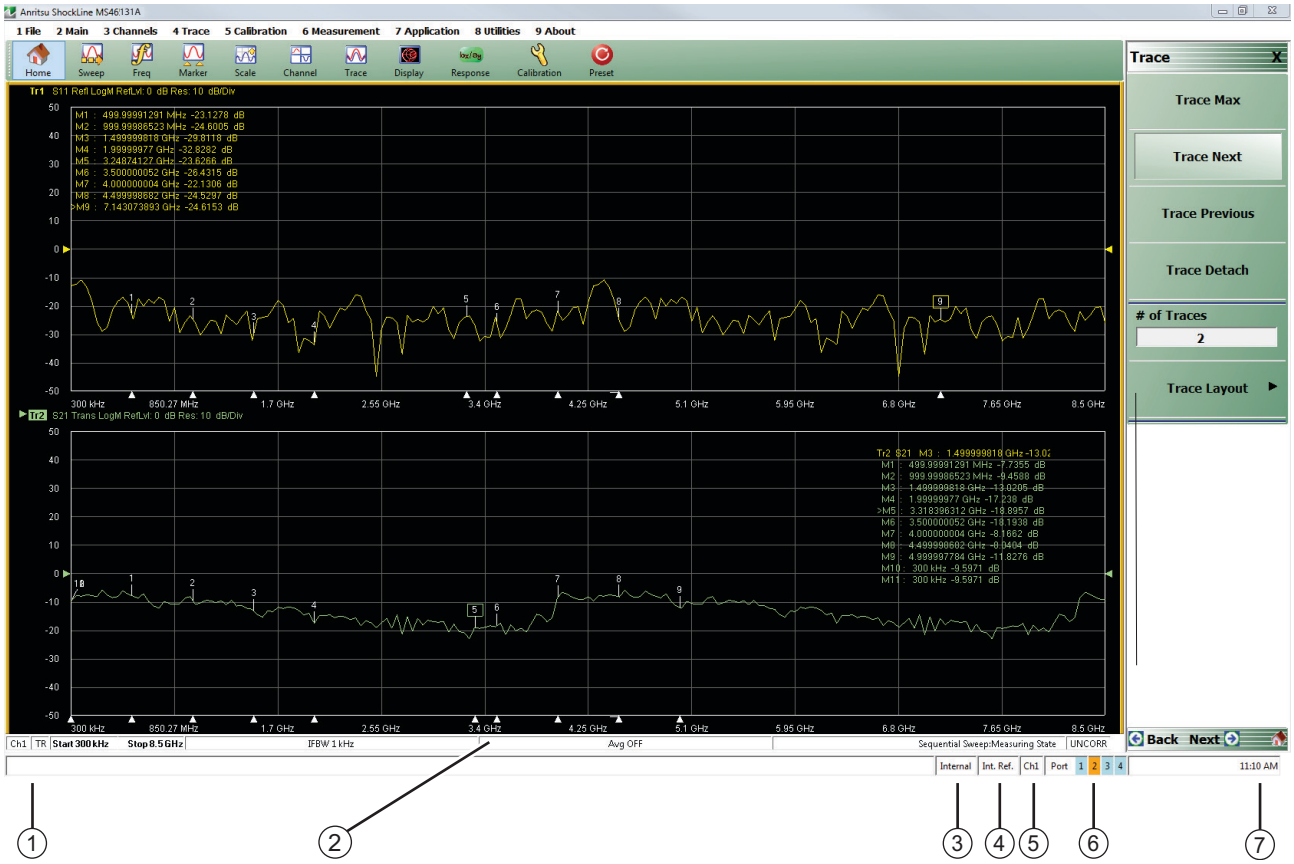


Figure 4-13. Instrument Status Area

Instrument Status Data

Table 4-3. Instrument Status Display Abbreviations

Status Display	Description
1. Warning Messages	Displays warning messages.
2. Channel Status Display Area	See “Channel Status Display Area”.
3. Internal / External / Manual	Displays status of system triggering.
4. Int. Ref. / Ext. Ref.	Indicates usage of internal or external reference[a,b,c].
5. Ch 1-16	Displays the active channel.
6. Port 1 / Port 2 / Port 3 / Port 4	Highlights the port being driven; 2-Port VNAs cycle between Port 1 and 2.
7. Time	Displays system time.

a.Case 1: Two units without sync; no external reference connected to either unit

Both the units will be masters. If the user changes the reference from internal to external on UI, it will change back to internal.

b.Case 2: Two units without sync; external reference connected to both units

Both the units will be masters. External reference will be locked for both units; if the user changes the reference from internal to external on UI, it will stay as external. It will not go back to internal reference.

c.Case 3: Two units without sync; external reference connected to only one unit

Both the units will be masters. The unit that has external reference connected will have external reference locked; if the user changes the reference from internal to external on UI, it will stay as external. It will not go back to internal reference. The unit without an external reference will stay as internal reference.

4-9 Channel Status Display Area

At the bottom of the display above the instrument status bar, is the Channel Status bar where the following information is reported. The displayed parameters are context and setting dependent. Not all parameters are displayed all the time. In a multi-channel display, the display may be truncated. To maximize the channel display, select any of the following:

- Keyboard: **CTRL + 1**
- Keyboard: **ALT + 3, then 2**
- MAIN | Channel | CHANNEL | Chan. Max

Figure 4-14. Channel Status Bar

Table 4-4. Channel Status Bar Abbreviations

	Status Display	Description
1	Ch#	Displays the channel number. For example, Ch2 means that the display is for Channel 2.
2	TR	Displays the measurement mode as transmission/reflection.
3	[Start]	In general, the left-side parameters define the starting position of distance, frequency, time, or power.
	Start # Units	From the FREQUENCY menu, if CW Mode is set to off, displays the current Start Frequency value with units of kHz, MHz, or GHz.
4	CW Frequency # Units	From the FREQUENCY menu, if CW Mode is set to on, displays the current CW Frequency value with units of kHz, MHz, or GHz.
5	[End]	In general, the right-side parameters define the ending position of distance, frequency, time, or power.
	Stop # Units	From the FREQUENCY menu, if CW Mode is set to off, displays the current Stop Frequency value with units of kHz, MHz, or GHz.
6	IFBW # Units	From the AVERAGING menu, reports the IF Bandwidth Frequency setting with units of Hz, kHz, or MHz.
7	Avg OFF	From the AVERAGING menu, reports that Averaging is off, or if values are present, Averaging is on.
	Avg #	If Averaging is on, and the Averaging Type is Per-Point, reports the Averaging factor.
	# / #	If Averaging is on, and the Averaging Type is Per-Sweep, the left-side number reports the number of average sweeps; the right-side number displays the Averaging Factor.
8	Measuring State Calibrating State	Indicates whether the instrument is measuring or being calibrated.
9	UNCORR	UNCORR indicates that a calibration is not being applied.
	CORR	CORR (with a green background) indicates that the calibration for the active channel is being applied (corrected).
	EDE	EDE (with green background) Indicates Embedding or De-embedding is being applied.
	E/O	E/O, O/E, or O/O (with a green background) indicates an optical measurement state.

4-10 Working with Channels

Each VNA channel is like a separate VNA, with its own frequency list, calibrations, power setup and other parameters. Each channel can display up to 16 individual trace graph displays. The number of VNA channels is user-definable up to a maximum of 16 channels.

Channel Menu

Navigation to the CHANNEL Menu:

MAIN MENU | Channel | CHANNEL |

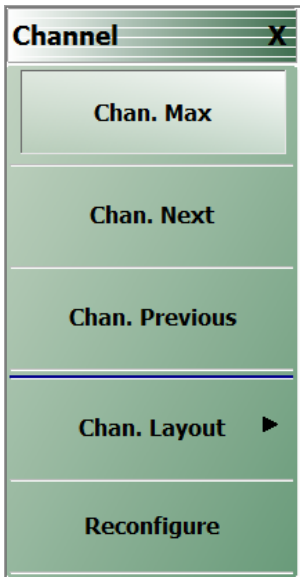


Figure 4-15. Channel Menu

To Select a Channel

1. Select a channel in a multi-channel display by doing one of the following:
   - Click anywhere inside the desired channel box.
   - From the keyboard, enter **ALT + 3**, then **3** to view the previous channel or **ALT + 3**, then **4** to view the next channel.
   - On the top menu bar, select Menu Bar | Channels | Channel Prev or Menu Bar | Channels | Channel Next.
   - On the right side menu, select MAIN | Channel | CHANNEL | Chan Next or Chan Previous.
2. The selected channel border changes from gray to white. (Figure 4-3, “User Interface - 3 Traces (simulated data)” on page 4-3 shows Channel 2 (Ch2) selected).

To Maximize a Channel Display

1. Use one of the methods above to select the desired channel.
2. Do one of the following to maximize the selected channel:
   - From the keyboard, enter **CTRL + 1** or **ALT + 3**, then **2**.
   - On the main display, double-click the channel border box.
   - On the top menu bar, select Menu Bar | Channels | Channel Max.
   - On the right side menu, select MAIN | Channel | CHANNEL | Chan. Max.
3. The selected channel now fills the display area.
   - Maximize a channel display to review the channel status information at the bottom of its screen.

To Make the Display Area Larger

1. The top icon toolbar and the right side menus can be removed to make the display area larger.
2. Remove the icon toolbar by doing one of the following:
   - From the keyboard, select **ALT + 8**, then **2.**
   - On the top menu bar, select Menu Bar | Utilities | Toolbar Off.
3. The icon toolbar disappears. Repeat **Step #2** to make the icon toolbar reappear.
4. Remove the right side menus by doing one of the following:
   - From the keyboard, enter **ALT + 8**, then **7**.
   - On the top menu bar, select Menu Bar | Utilities | Clear.
5. The right side menu disappears. Repeat **Step #4** to make the menu reappear.

4-11 Working with Traces

For each channel defined above, from 1 (one) to 16 trace graphs (called “traces”) can be defined where each trace is a data display within a specific channel. Each trace is defined by a response parameter (such as S11), a graph type display (such as a rectilinear graph, a polar display or Smith chart), a scale, and possibly post-processing elements such as time domain and smoothing.

Trace Menu

Navigation to the TRACE Menu:

MAIN MENU | Trace | TRACE |

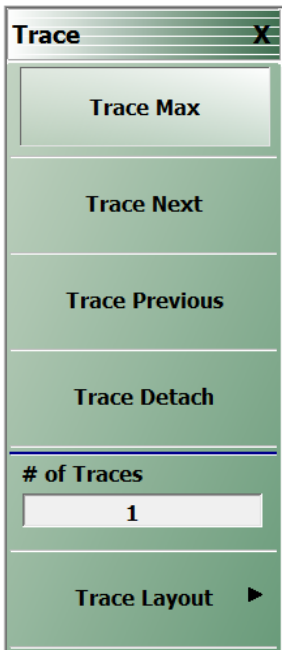


Figure 4-16. Trace Menu

To Select Traces

1. Use one of the methods above to maximize the channel display.
2. Select a trace in a multi-trace display by doing one of the following:
   - With a mouse, single click the trace title.
     - If you double-click either the trace title, the trace is both selected and maximized.
   - From the keyboard, enter **ALT + 4**, then **7** to view the previous trace or **ALT + 4,** then **8** to view the next trace.
   - On the top menu bar, select Menu Bar | Trace | Trace Prev or Menu Bar | Trace | Trace Next.
   - On the right side menu, select MAIN | Trace | TRACE | Trace Previous or Trace Next.
   - The selected trace number is highlighted and a left arrow appears.

Trace 1 Selected	Trace 1 Not Selected

Figure 4-17. Trace Selection Indicator

Note	The **Tr->Max**, **Tr->Next**, and **Tr->Previous** icons are available for the icon toolbar. These icons provide one click access to trace maximum, trace next, and trace previous functions. They can be added to the icon toolbar for a custom configuration and saved as part of a preset configuration.

To Maximize a Trace Display

1. Use one of the methods above to select the desired trace.
2. For a maximum display, make sure the trace's channel is maximized.
3. Do one of the following to maximize the selected trace:
   - From the keyboard, select **ALT + 4,** then **6**.
   - On the main display, double-click anywhere in the trace display.
   - On the top menu bar, select Menu Bar | Trace | Trace Max.
   - On the right side menu, select MAIN | Trace | TRACE | Trace Max.
4. The selected trace now fills the display area.
   - Maximize a trace display to review the trace status information at the bottom of trace screen.

Repeat the actions above to return the trace to its normal size.

Types of Trace Displays

There are four general graph types available and within each general type are multiple sub-types:

- Rectilinear single graph
- Rectilinear dual graph
- Smith chart
- Polar plot graph

Trace Data Types

The data types generated by the VNA (real, imaginary, magnitude, phase) are used in the display graph to show the possible ways in which S-Parameter data can be represented. For example, complex data, that is data in which both phase and magnitude are graphed, may be displayed in any of the following ways:

- **Complex Impedance**

  Displayed on a Smith chart graph as impedance or as admittance.
- **Real and Imaginary**

  If simultaneous displays are required, displayed on a real and imaginary rectilinear (a Cartesian plot) graph. If only one type is required, a single rectilinear real graph or single rectilinear imaginary graph.
- **Phase and Magnitude**

  Displayed on a single rectilinear graph, as paired rectilinear graphs, or as a polar graph.
- **Group Delay**

  Defined as the frequency span over which the phase change is computed at a given frequency point. The quantity group delay is displayed using a modified rectilinear-magnitude format. In this format, the vertical scale is in linear units of time (either ps, ns, us, or ms). With one exception, the reference value and reference line functions operate the same as they do with a normal magnitude display.

Trace Display Graphs

A separate graph can be assigned to each active channel and display area. The following available display graph types are listed in Table 4-5 below.

Table 4-5. Available Trace Display Types (1 of 3)

Menu Name	Definition and Display Options	Y-Axis Dependent Variable	X-Axis Independent Variable	Measurement Applications
Rectilinear Single Graphs				
Log Mag	Log magnitude rectilinear format graph Magnitude		Y = dB	Return loss measurement Insertion loss measurement Gain measurement
Linear Mag	Linear magnitude rectilinear format graph	Magnitude	Linear units	Reflection coefficient measurement
Phase	Phase rectilinear format graph	Phase displayed in range from -180 to + 180 degrees	Degrees	Linear phase deviation measurements
Imaginary	Imaginary rectilinear format graph	Imaginary part of measured complex parameter	Linear units	
Real	Real rectilinear format graph	Real part of measured complex parameter	Linear units	
SWR	Standing Wave Ratio rectilinear format graph	$SWR = \frac{1+\rho}{1-\rho}$ where ρ = Reflection Coefficient	Linear units	Standing wave measurements Antenna analysis
Impedance	Impedance rectilinear format graph Four options are: • Real • Imaginary • Magnitude • Real & Imaginary • Inductance • Capacitance			
Rectilinear Paired Graphs				
Log Magnitude and Phase	Paired graphs with Log Magnitude on top and Phase on bottom	As above	As above	Same as having one trace with a Log Magnitude display and a second trace with a Phase rectilinear display.

Table 4-5. Available Trace Display Types (2 of 3)

Menu Name	Definition and Display Options	Y-Axis Dependent Variable	X-Axis Independent Variable	Measurement Applications
Linear Magnitude and Phase	Paired graphs with Linear Magnitude on top and Phase on bottom	As above	As above	Same as having one trace with a Linear Magnitude display and a second trace with a Phase rectilinear display.
Real and Imaginary	Paired graphs with Real on top and Imaginary on bottom	As above	As above	Same as having one trace with a Real rectilinear display and a second trace with an Imaginary rectilinear display.
Polar Graphs				
Linear Polar	Linear polar plot graph The polar graph format traces are used to display one magnitude value and phase on the same chart. Plot options: • Lin/Phase • Real/Imag.		Chart mode options: • Magnitude/Phase • Magnitude/Swap Position	
Log Polar	Plot options: • Log/Phase • Real/Imag.		Chart mode options: • Magnitude/Phase • Magnitude/Swap Position	
Smith Chart Graphs				
Smith (R + jX)	Smith Chart graphs with impedance (circuit resistance and reactance) Four read out style options are available: • Lin/Phase • Log/Phase • Real/Imag. • Impedance		The impedance is the measure of a circuit's opposition to alternating current which consists of the circuit resistance and the circuit reactance, together they determine the magnitude and phase of the impedance.	• Reflection measurements

Table 4-5. Available Trace Display Types (3 of 3)

Menu Name	Definition and Display Options	Y-Axis Dependent Variable	X-Axis Independent Variable	Measurement Applications
Group Delay / Power Graphs				
Group Delay	Displays the time lag through a DUT measured in ps, ns, us, or ms.	Time measured in ps, ns, us, or ms.	Frequency	Bandpass filter design Transmission studies
Max Efficiency Display Type				
When using Max Efficiency response type, a new set up Display types are available. They can be displayed as both Rectilinear Single graph or Rectilinear Paired graph				
Menu Name	**Definition and Display Options**	**Y-Axis Dependent Variable**	**X-Axis Independent Variable**	**Measurement Applications**
Rectilinear Single Graphs				
kQ	Displays the kQ product of the coupling coefficient k and the Quality factor Q	Dependent Variable	Independent Variable	Frequency Measurement Applications Wireless power transfer
n Max	Displays the maximum efficiency Y-Axis Dependent Variable	Dependent Variable	Independent Variable	Frequency Measurement Applications Wireless power transfer
Rectilinear Paired Graphs				
kQ	Displays the kQ product of the coupling coefficient k and the Quality factor Q	Dependent Variable	Independent Variable	Frequency Measurement Applications Wireless power transfer
n Max	Displays the maximum efficiency Y-Axis Dependent Variable	Dependent Variable	Independent Variable	Frequency Measurement Applications Wireless power transfer

Each graph type is described in greater detail below with sample graphs, and explanation of supporting trace displays.

Trace Labels

Each trace (i.e. each graph display) is labeled with information such as its trace number, the graph type, scaling, reference delay, and S-parameter associated with that trace. Depending on the trace settings and the graph type, other information may be displayed. The Trace number field can be edited for a custom trace name.

The general format of trace label consists of the following parameters and their associated abbreviations appearing from left to right in the trace label. Some parameters may not appear depending on the instrument settings.

- Trace Number
- Measurement Type
- Time Domain
- Graph Type
- Reference Level
- Resolution Units
- Trace Memory Statistics

Trace Label Abbreviations

The trace label abbreviations are described in the tables below:

- Table 4-6, "Trace Labels - Trace Number, Measurement Type"
- Table 4-7, "Trace Labels - Abbreviation, Type and Name, Reference Level Units, Resolution Units"

Table 4-6. Trace Labels - Trace Number, Measurement Type

Abbreviation	Definition	Description
Trace Number Abbreviation		
Tr#	Trace number	Trace 1 through Trace 16.
Measurement Type Abbreviations		
S11 Refl	S11 Port 1 forward reflection	S-parameters are selected on the RESPONSE menu.
S12 Trans	S12 Port 1 reverse transmission	
S21 Trans	S21 Port 2 forward transmission	
S22 Refl	S22 Port 2 reverse reflection	
NN / DD | Port #	NN is user-defined numerator value. DD is user-defined denominator value. Port number	User-defined numerator, denominator, and driver port are selected on the RESPONSE | User-defined | USER-DEFINED menu. Numerator and denominator options are A1, B1, A2, B2, or 1. Port number selection options are Port 1 or Port 2.
[EQN]	Equation Editor	If using Equation Editor, [EQN] notation will show.

Table 4-7. Trace Labels - Abbreviation, Type and Name, Reference Level Units, Resolution Units

Graph Abbreviation	Graph Name and Type	Reference Level (RefLvl)	Resolution Units (Res)
Rectilinear Single Graph			
LogM	Log Mag (Log Magnitude) rectilinear	dB	dB / Div
LinM	Linear Mag (Linear Magnitude) rectilinear	U	U / Div
Phase	Phase rectilinear with units in degrees (º)	º	º / Div
Real	Real rectilinear	U	U / Div
Imag	Imaginary rectilinear	U	U / Div
SWR	SWR rectilinear	U	U / Div
Imped Real	Impedance Real rectilinear with units in Ohms (Ω)	Ω	Ω / Div
Imped Imag	Impedance Imaginary rectilinear	Ω	Ω / Div
Imped Mag	Impedance Magnitude rectilinear	Ω	Ω / Div
Imped R + I	Impedance Real and Imaginary rectilinear. A rectilinear paired graph.	Ω	Ω / Div
Rectilinear Paired Graphs			
LogM + P	Log Magnitude and Phase rectilinear paired graphs.	dB	º Res: dB/Div, º/Div
LinM + P	Linear Magnitude and Phase rectilinear paired graphs	dB	º Res: dB/Div, º/Div
R + I	Real and Imaginary rectilinear paired graphs	U	Res: U/Div, U/Div
Smith Charts with Impedance			
Smith Imped	The display can be one of four possible Smith Chart with impedance displays: • Smith (R+jX) Linear/Phase Smith Chart • Smith (R+jX) Log/Phase Smith Chart • Smith (R+jX) Real/Imaginary Smith Chart • Smith (R+jX) Impedance Smith Chart	—	U / Div
Polar Graphs			
Lin Pol	Linear Polar, Linear/Phase polar	U	U/Div
Lin Pol, RI	Linear Polar, Read/Imaginary polar	U	U/Div
Log Pol	Log Polar, Log/Phase polar	dB	dB/Div
Log Pol, RI	Log Polar, Real/Imaginary polar	dB	dB/Div
Group Delay and Power Rectilinear Graphs			
Grp Dly	Group Delay rectilinear with units of seconds	s	Res: s/Div

Rectilinear Single Graph

A rectilinear graph is a display of a Cartesian coordinate system or plan consisting of an X-axis and a Y-axis. The X-axis displays the independent variable (such as frequency or time) and the Y-axis displays the dependent value.

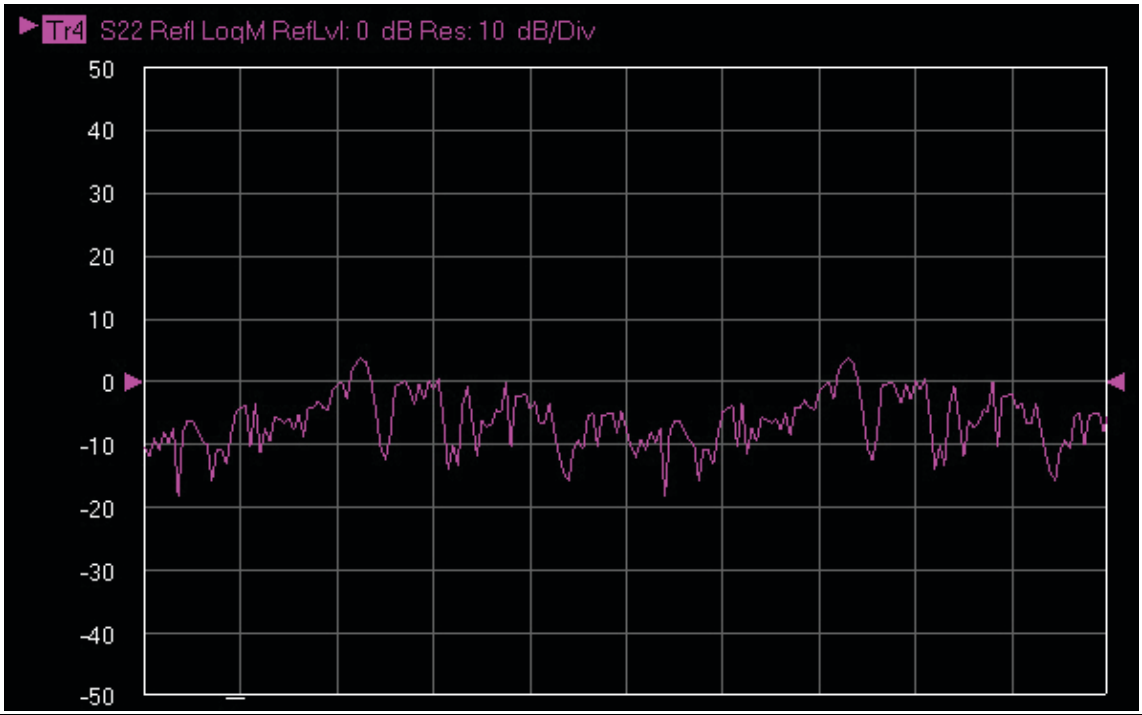


Figure 4-18. Trace Graph - Rectilinear Single - Log Magnitude (Log Mag) Trace Display Graph

Rectilinear Paired Graphs

As above, but paired with a phase rectilinear graph below. Useful to provide immediate comparison with a function value and its phase.

Figure 4-19. Trace Graph - Rectilinear Paired - Trace Log Magnitude and Phase Trace Display

Smith Charts

The power reflected from a DUT has both magnitude and phase because the impedance of the device has both a resistive and a reactive term of the form *r+jx.* We refer to the *r* as the real or resistive term, while we call *x* the imaginary or reactive term. The *j,* which we sometimes denote as *i,* is an imaginary number. It is the square root of –1. If *x* is positive, the impedance is inductive, if *x* is negative the impedance is capacitive. The size and polarity of the reactive component *x* is important in impedance matching. The best match to a complex impedance is the complex conjugate which means an impedance with the same value of *r* and *x,* but with *x* of opposite polarity. This term is best analyzed using a Smith Chart, which is a plot of *r* and *x.*

To display all the information on a single S-parameter requires one or two traces, depending upon the format we want. A very common requirement is to view forward reflection on a Smith Chart (one trace) while observing forward transmission.

Smith Chart with Impedance (Circuit Resistance and Reactance)

The Smith Chart with impedance (Smith R + jX) has four display options:

- Lin/Phase
- Log/Phase
- Real/Imag.
- Impedance

The impedance is the measure of a circuit's opposition to alternating current which consists of the circuit resistance and the circuit reactance, together they determine the magnitude and phase of the impedance.

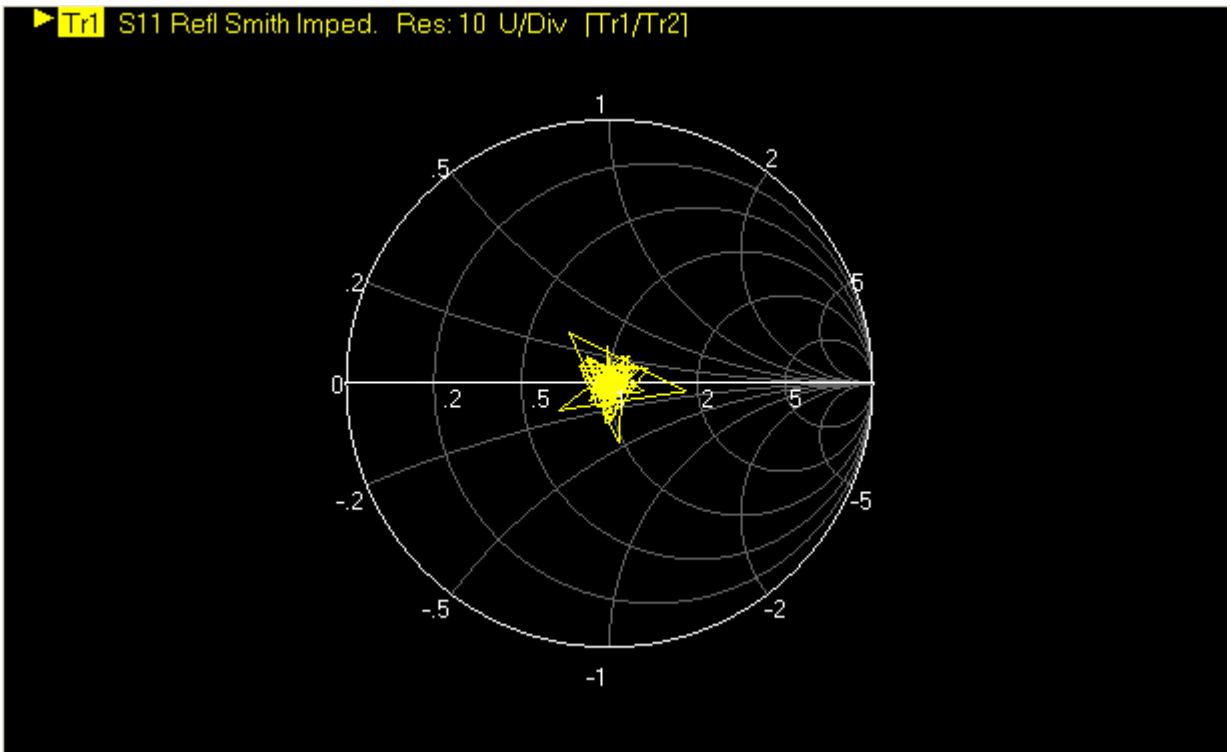


Figure 4-20. Smith Chart with Impedance (R+jX)

Polar Graphs

A polar graph represents a two-dimensional coordinate system where each point is determined by an angle and a distance. The polar coordinate system is especially useful in situations where the relationship between two points is most easily expressed in terms of angles and distance such as in phase relationships in antenna and feedline design. The magnitude parameter can use either a linear or log scale. As the coordinate system is two-dimensional, each point is determined by two polar coordinates: the radial coordinate (distance from the center) and the angular coordinate (degrees counterclockwise from the right edge). Polar displays are used for transmission measurements, especially for cascaded devices in series. The transmission result is the addition of the phase and log magnitude (dB) information in the polar display of each device.

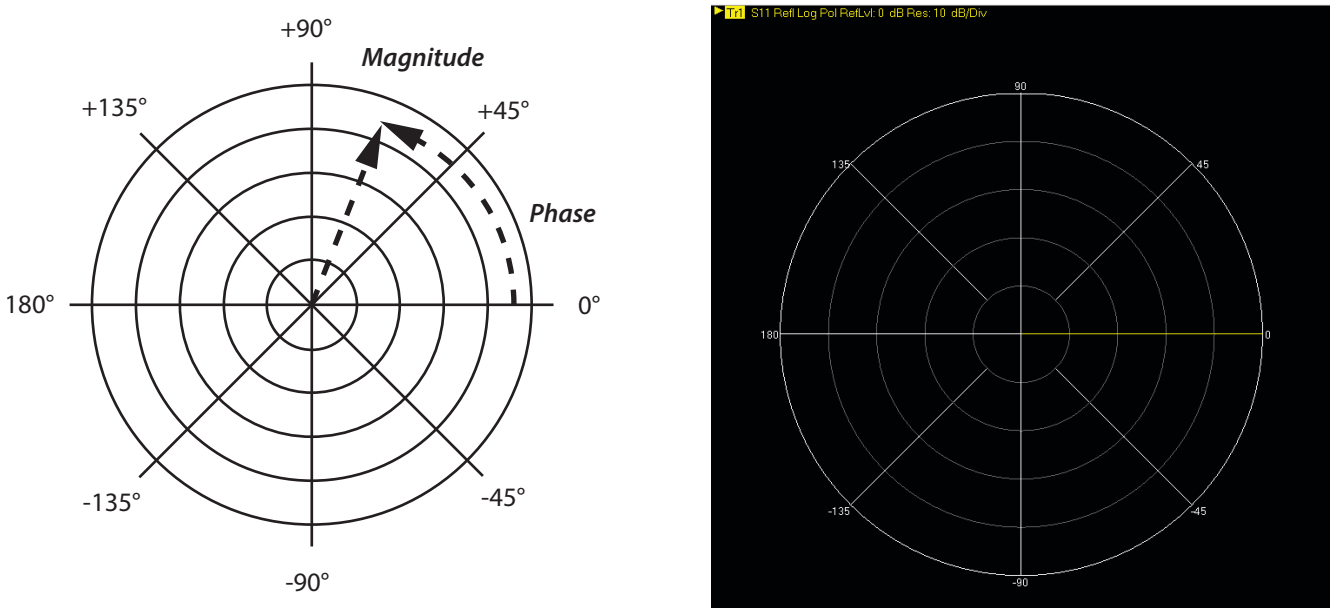


Figure 4-21. Log Polar Diagram and Trace Graph Example

Group Delay Graphs

The quantity group delay is displayed using a modified rectilinear-magnitude format. In this format the vertical scale is in linear units of time (ps, ns, us, ms). With one exception, the reference value and reference line functions operate the same as they do with a normal magnitude display. The exception is that they appear in units of time instead of magnitude.

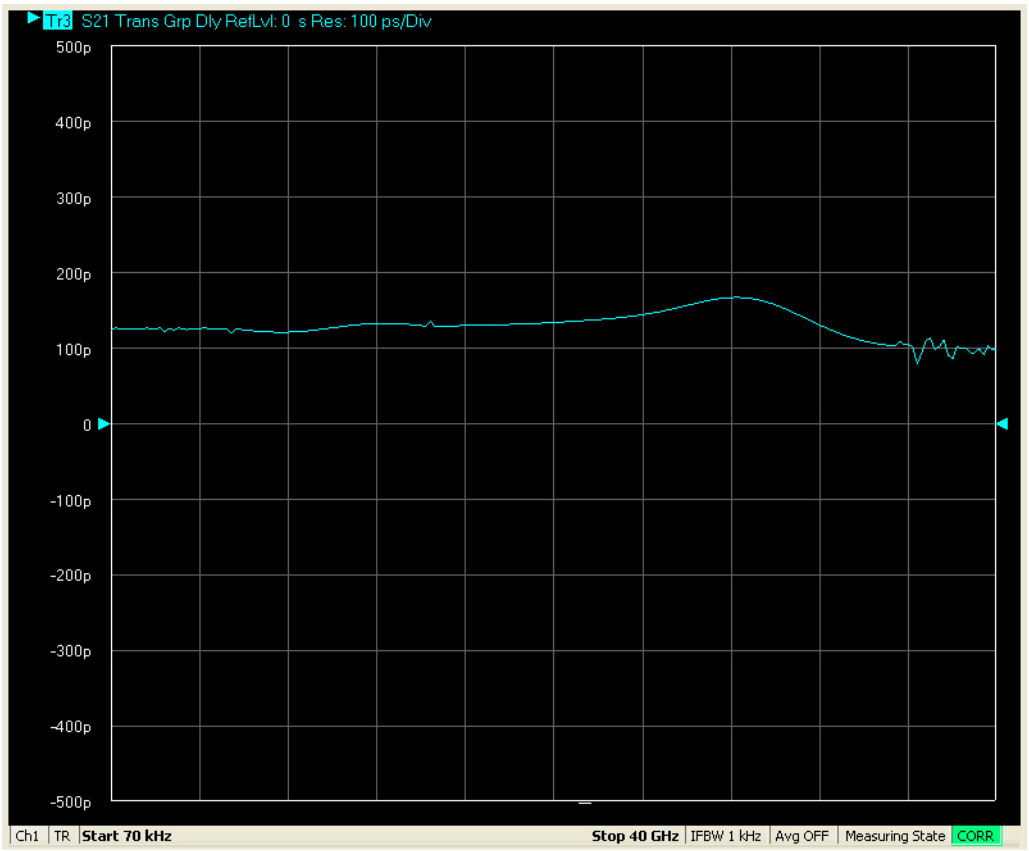
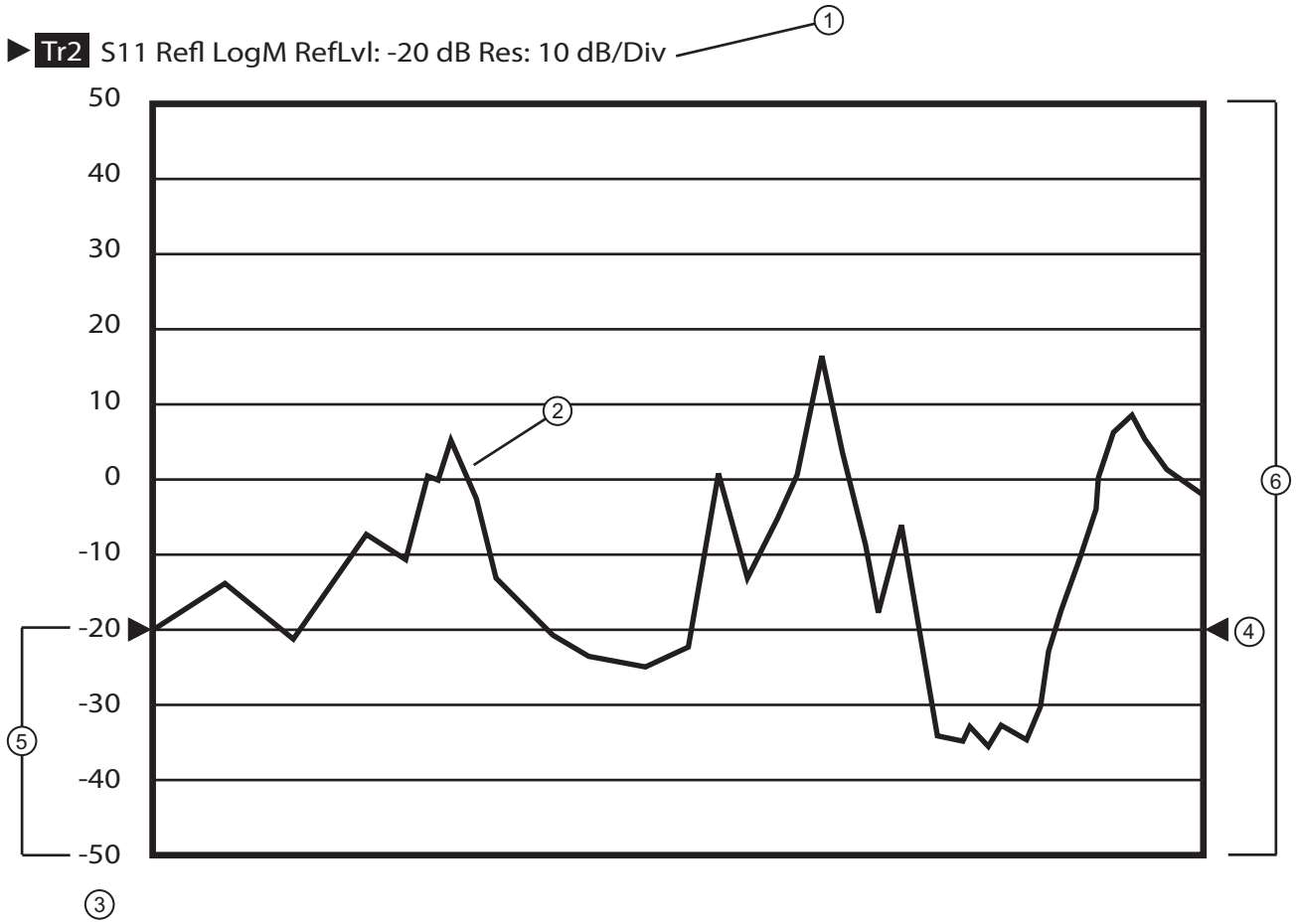


Figure 4-22. Group Delay Trace Graph Example

4-12 Working with Reference Lines and Reference Position

You can manipulate the display elements in a rectilinear trace graph from either the trace itself or from the right-side menus.



1. Trace Label – The trace label appears above the trace graph. The example above shows Trace 2 measuring S11, displayed on a Log Magnitude graph, with a Reference Level of -20 dB, and a graph resolution of 10 dB per vertical division.
2. Response Graph – A typical S11 response graph.
3. Resolution in Units per Division – The example shows 10 dB per division.
4. Reference Line Pointers – Reference lines are only available in rectilinear trace graphs and are indicated by the paired arrows on the trace graph display and show the position of the reference value on the Y-axis scale. The example Reference Value is set to -20 dB. Click-hold-and-drag the line pointers to change the reference line value.
5. Reference Position – The example Reference Position is set to 3. Click-hold-and-drag the reference position scale to change the position of the graph on the Y-axis up or down. The value of the Reference Line Points does not change.
6. Number of Vertical Divisions – The example number of vertical divisions is set to 10.

Figure 4-23. Trace Display Controls and Settings

4-13 Working with Markers

The ShockLine VNA GUI display provides up to thirteen markers per trace of which twelve are direct markers and one a reference marker. Each marker data array can be repositioned by a drag/drop anywhere within the signal response trace display. Each marker can be individually controlled on/off and positioned as required on the signal response display.

If the reference marker is off, each marker provides measurement data based on its display position. If the reference marker is on, each marker provides differential measurement data based on its position relative the reference. Figure 4-24, is an overview of the marker menu..

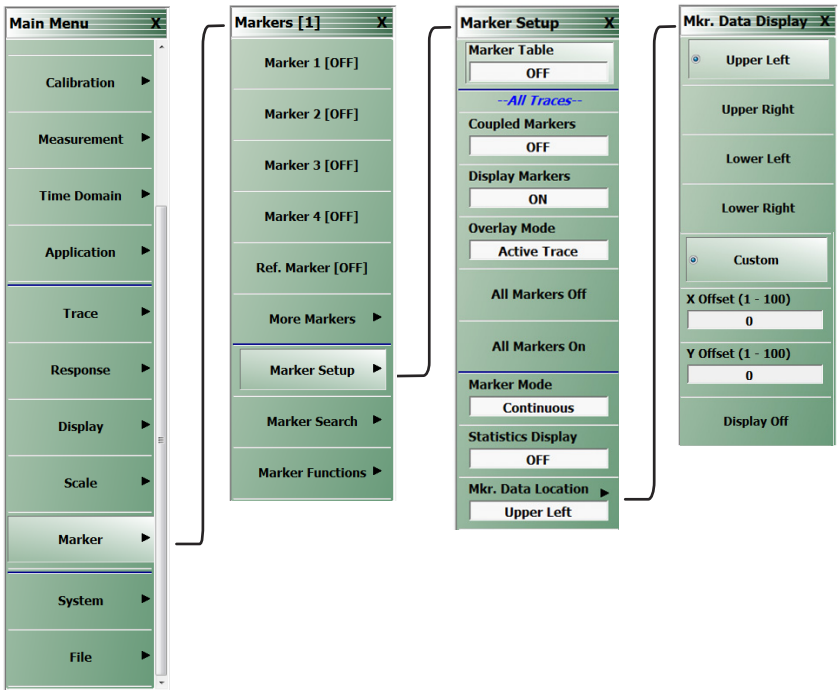
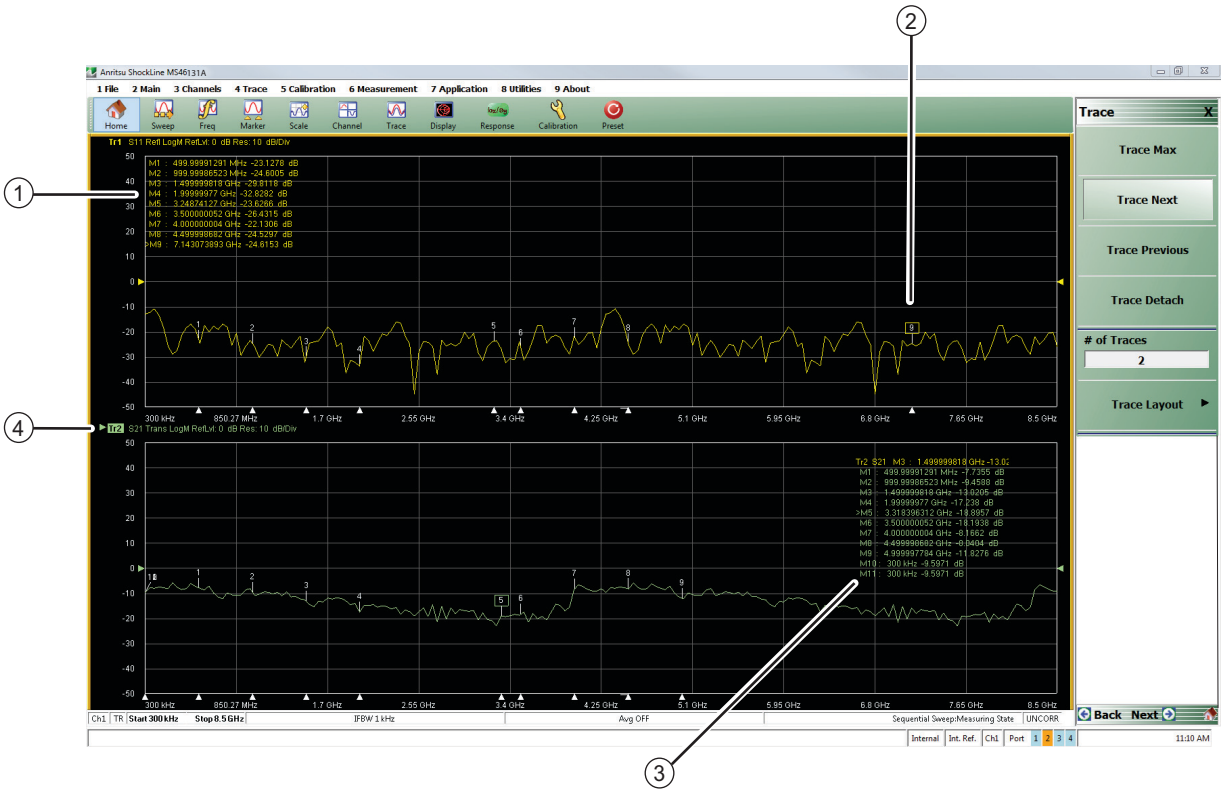


Figure 4-24. Marker Menus

Markers

- Can be set between Discrete and Continuous Modes
- Can be set to Statistics Display.
- Can be set to Coupled mode on or off.
- Can be set to be repositioned within the display.
- Can be set to search Bandwidth Loss field and Notch Loss field.
- Can set Tableau Display to view all active markers.
- Can set Marker Labels.
- Can search Target Markers.
- Can search range units depending on the Sweep Types selected.

The example below Figure 4-25, depicts a two trace display. On the top trace display, the individual marker [9] is selected, and repositioned. In the bottom trace, the marker data display is repositioned. The marker(s) can be repositioned while using any parameter setup menu. Note that the marker data display placement area on the main display window may be limited if the detachable trace view windows in use are smaller in size than then the main display window.



1. Trace 1 marker data display with nine active markers 2. Trace 1 marker with a single selected marker [9] repositioned by click-drag-drop	3. Trace 2 marker data display with 11 active markers repositioned by click-drag-drop 4. Highlighted active trace.

Figure 4-25. Marker Data Display Drag-Drop

4-14 Working with Limit Lines

Limit lines are a powerful tool to help compare a set of measured DUT data against specifications or expectations. Figure 4-26 shows basic menu navigation to reposition markers through the Marker Display Menu. .

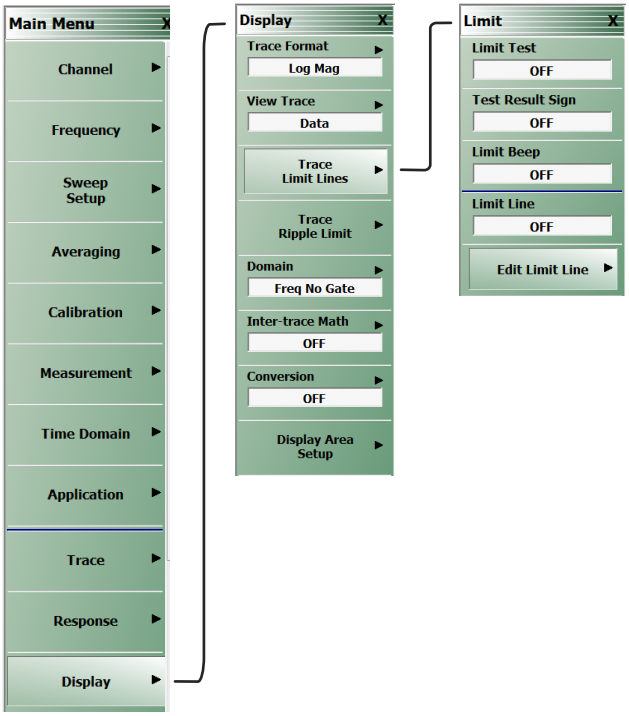


Figure 4-26. Display Trace Limit Lines Menu

Limit lines

- Can be configured as settable maximum and/or minimum indicators for the value of displayed data on a per-trace basis.
- Can be rescaled automatically and maintains their correct value if the trace display is rescaled.
- Are settable in the basic units of each trace.
- Are limited to a total of 50 segments (upper and lower combined) per-trace.
- Are available only for ShockLine rectilinear and polar displays.
- Are not available for ShockLine Smith charts.
- For dual displays, such as the Log Mag And Phase display, the segment limit is 50 segments for the top display and 50 segments for the bottom display.

4-15 Working with Ripple Limit Lines

Limit lines are a powerful tool to help evaluate the ripple of a DUT against specifications or expectations. Figure 4-27 shows basic menu navigation to reposition markers through the Marker Display Menu.

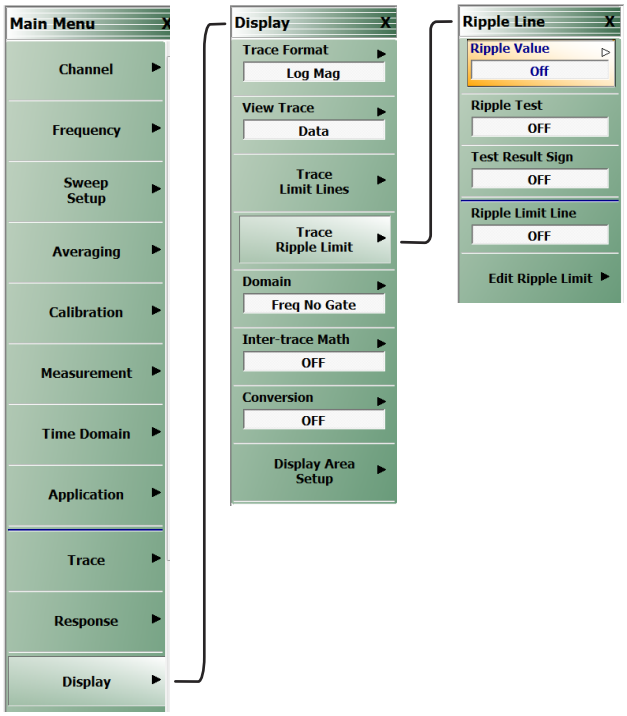


Figure 4-27. Display Trace Ripple Lines Menu

Ripple Limit lines

- Are settable tolerance indicators for the specified ripple value based on Absolute Value or Margin of displayed data on a per-trace basis.
- Are settable in the basic units of each trace.
- Are limited to a total of 50 segments (upper and lower combined) per-trace.
- Are available only for ShockLine rectilinear and polar displays.
- Are not available for ShockLine Smith charts.
- Can be used simultaneously with trace limit lines.
- Can be rescaled automatically and maintain their correct value if the trace display is rescaled.
- When used with trace limit lines and the Test Result sign functions, a logical OR is used as the result.

For dual displays, such as the Log Mag And Phase display, the segment limit is 50 segments for the top display and 50 segments for the bottom display.

Appendix A — Vector Network Analyzer Primer

A-1 Appendix Overview

This chapter describes the basic functions of a Vector Network Analyzer (VNA) and how it measures magnitude and phase characteristics of networks, amplifiers, attenuators, and antennas. Scattering parameters (S-parameters) are defined.

This section provides front panel operating and measurement application information and data. It includes discussions on the following topics:

- System description
- General discussion about network analyzers
- Basic measurements and how to make them
- Error correction
- General discussion on test sets

A-2 General Description

The ShockLine MS46131A Series Vector Network Analyzer (VNA) System measures the magnitude and phase characteristics of networks, amplifiers, attenuators, and antennas. It compares the incident signal that leaves the analyzer with either the signal that is transmitted through the test device or the signal that is reflected from its input. Figure A-1 and Figure A-2 illustrate the types of measurements that the MS46131A Series VNA can make.

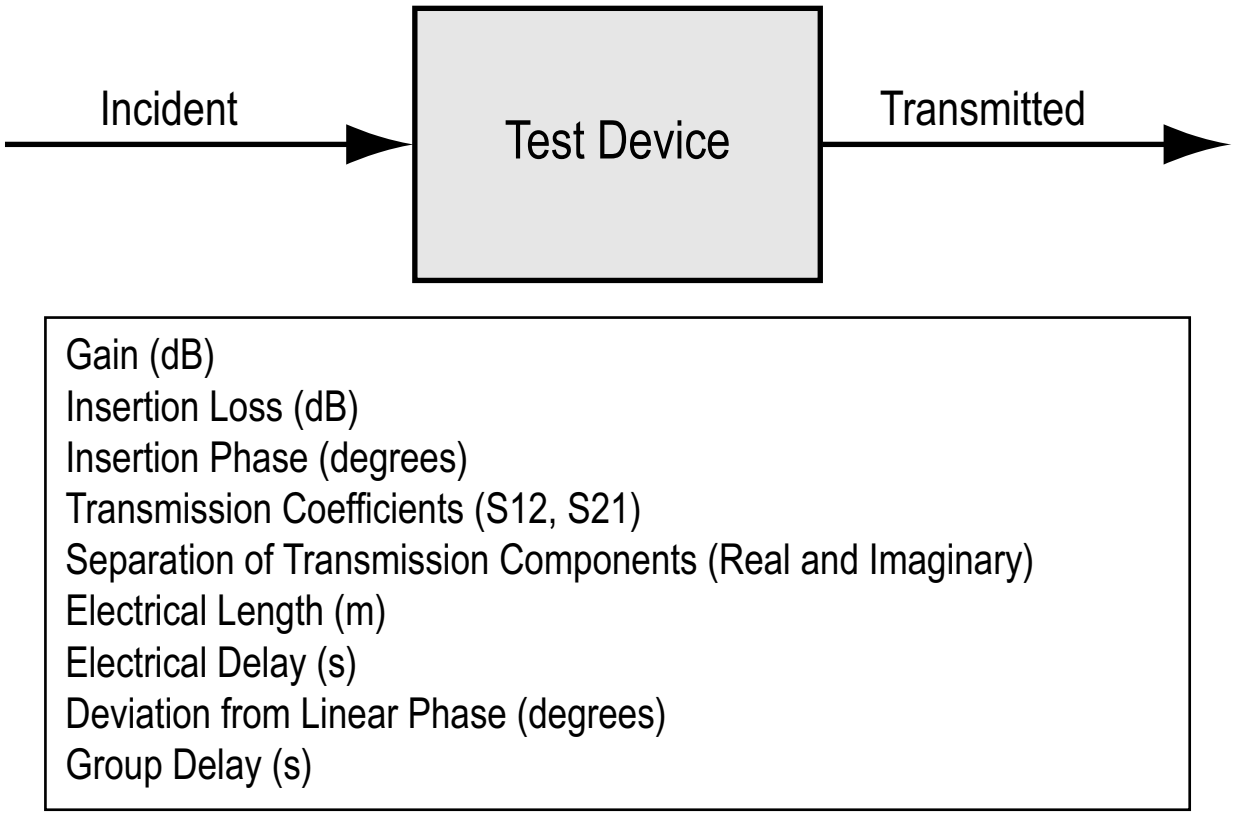


Figure A-1. Transmission Measurements

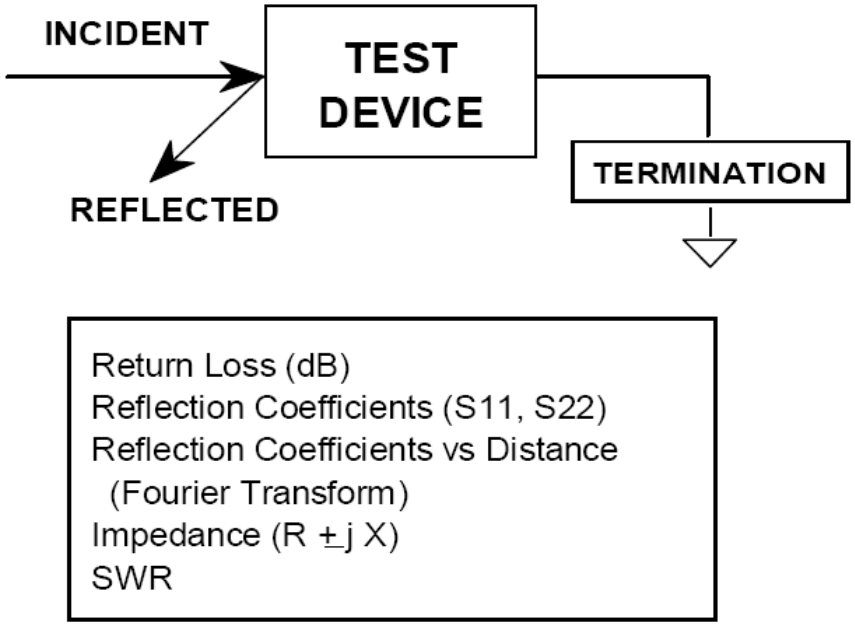


Figure A-2. Reflection Measurements

A-3 Instrument Description

The ShockLine MS46131A Series VNA is a self-contained, fully integrated measurement system that includes an optional time domain capability. The system hardware consists of the following:

- Analyzer
- Precision components required for calibration and performance verification

The ShockLine MS46131A Series VNA internal system modules perform the following functions:

Source Module

This module provides the stimulus to the device under test (DUT). The frequency range of the source and test set modules establish the frequency range of the system.

Test Set Module

The test set module routes the stimulus signal to the DUT and samples the reflected and transmitted signals. The type of connector used is important, as is the “Auto Reversing” feature. Auto Reversing means that it applies the stimulus signal in both the forward and reverse direction. The direction is reversed automatically. This saves you from having to reverse the test device physically to measure all four scattering parameters (S-parameters). Frequency conversion occurs in the test set module.

Analyzer Module

The analyzer module receives, and interprets the 3rd IF signal for phase and magnitude data. It then displays the results of this analysis on the ShockLine Software display. This display can show all four S-parameters simultaneously.

A-4 Network Analyzers

We will begin this discussion with a subject familiar to most Anritsu customers: scalar network analysis. After showing comparisons, we will proceed to the fundamentals of network analyzer terminology and techniques. This discussion serves as an introduction to topics presented in greater detail later in this section. This discussion will touch on new concepts that include the following:

- Reference Delay
- S-parameters: what they are and how they are displayed
- Complex Impedance and Smith Charts

Scalar Analyzer Comparison

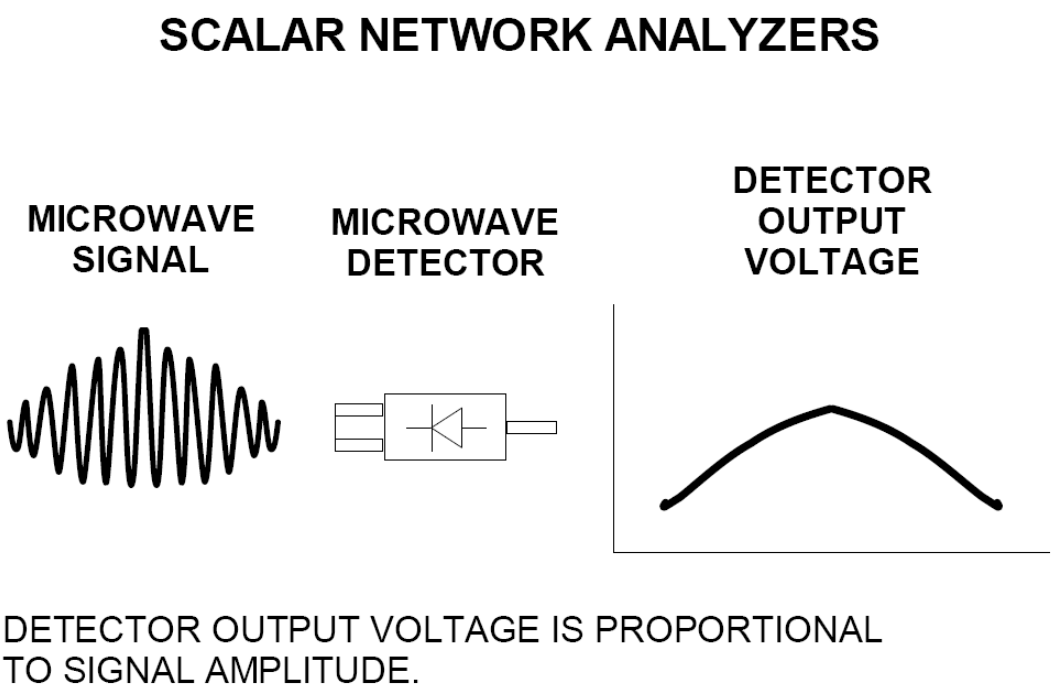


Figure A-3. Scalar Analyzer Detection

Network Analyzers do everything that scalar analyzers do except display absolute power, although absolute power can be displayed on a network analyzer through the use of a receiver calibration. In addition, they add the ability to measure the phase characteristics of microwave devices and allow greater dynamic range.

If all a Network Analyzer added was the capability for measuring phase characteristics, its usefulness would be limited. While phase measurements are important in themselves, it is the availability of this phase information that unlocks many new features for complex measurements. These features include Smith Charts, Time Domain, and Group Delay. Phase information also allows greater accuracy through *vector error correction* of the measured signal.

First, let us look at scalar network analyzers (SNAs). SNAs measure microwave signals by converting them to a DC voltage using a diode detector (Figure A-3). This DC voltage is proportional to the magnitude of the incoming signal. The detection process, however, ignores any information regarding the phase of the microwave signal.

In a vector network analyzer, access is needed to both the magnitude and phase of a microwave signal. There are several different ways to perform the measurement. The method Anritsu employs (called Harmonic Sampling or Harmonic Mixing) is to down-convert the signal to a lower intermediate frequency (IF). This signal can then be measured directly by a tuned receiver. The tuned receiver approach gives the system greater dynamic range. The system is also much less sensitive to interfering signals, including harmonics.

Vector Network Analyzer Basics

The vector network analyzer is a tuned receiver (Figure A-4). The microwave signal is down converted into the pass band of the IF. To measure the phase of this signal, we must have a reference to compare it with. If the phase of a signal is 90 degrees, it is 90 degrees different from the reference signal (Figure A-5). The network analyzer would read this as –90 degrees, since the test signal is delayed by 90 degrees with respect to the reference signal.

This phase reference can be obtained by splitting off some of the microwave signal before the measurement (Figure A-7).

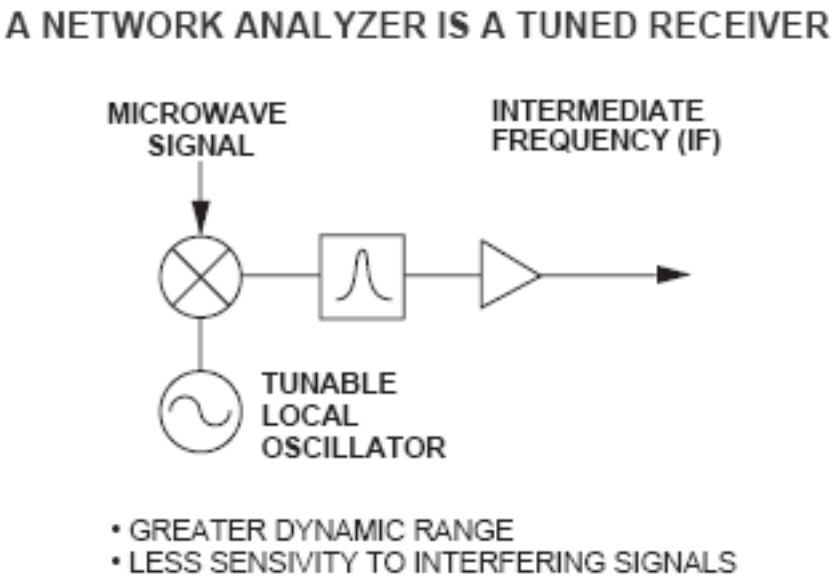


Figure A-4. Network Analyzer as a Tuned Receiver

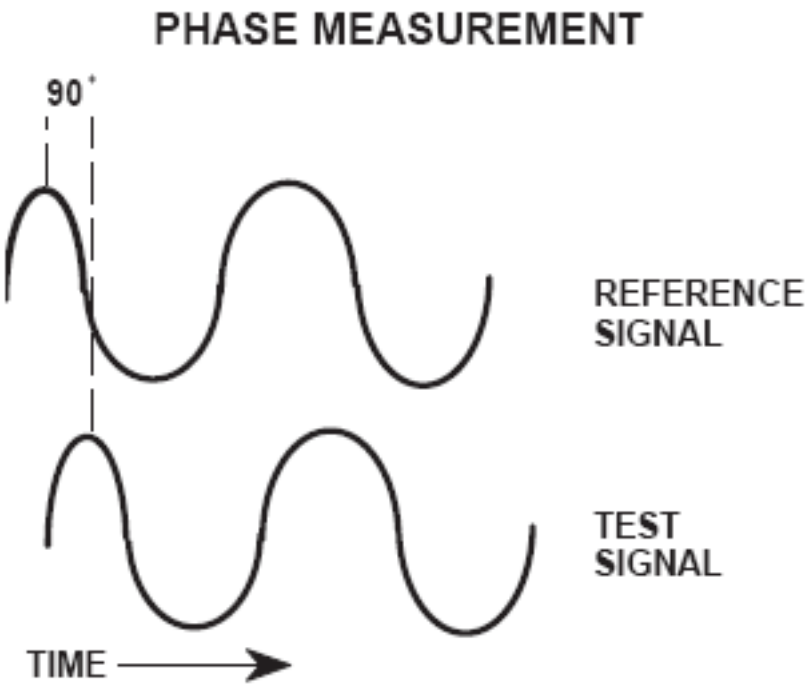


Figure A-5. Signals with a 90 Degree Phase Difference

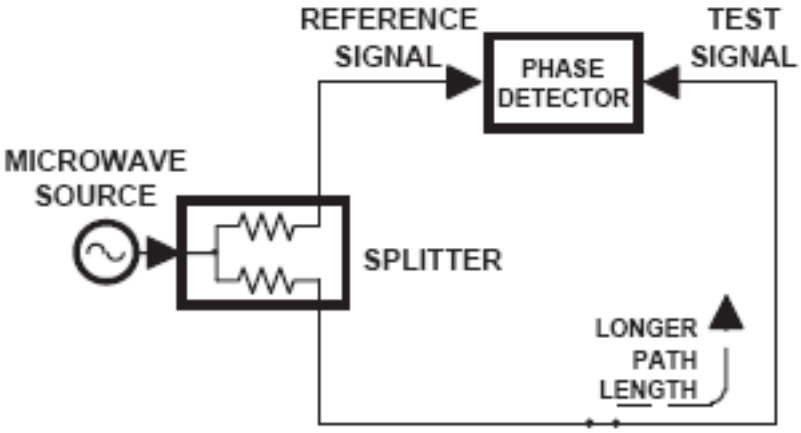


Figure A-6. Split Signal where a Length of Line Replaces the DUT

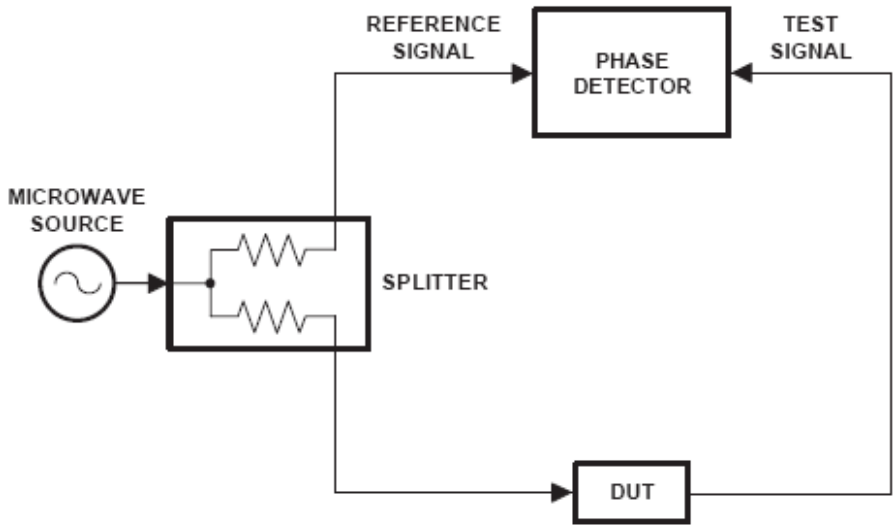


Figure A-7. Splitting the Microwave Signal

The phase of the microwave signal after it has passed through the device under test (DUT) is then compared with the reference signal. A network analyzer test set automatically samples the reference signal, so no external hardware is needed.

Let us consider for a moment that you remove the DUT and substitute a length of transmission line (Figure A-6). Note that the path length of the test signal is longer than that of the reference signal. Now let us see how this affects our measurement.

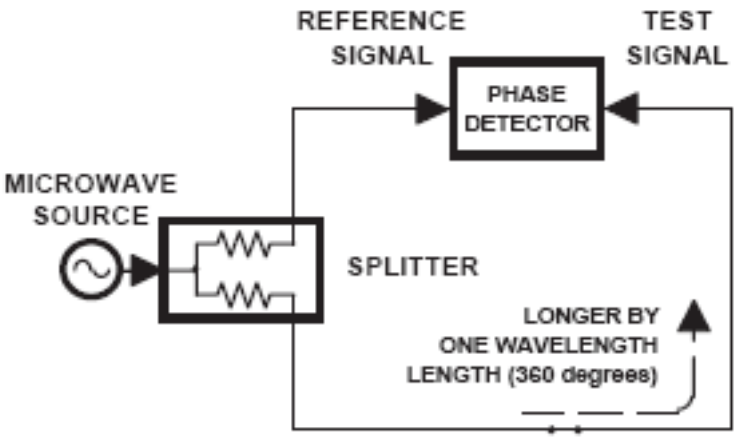


Figure A-8. Split Signal where Path Length is Different by Exactly One Wavelength

Assume that we are making a measurement at 1 GHz and that the difference in path-length between the two signals is exactly 1 wavelength. This means that test signal is lagging the reference signal by 360 degrees (Figure A-8).We cannot really tell the difference between one sine wave maxima and the next (they are all identical), so the network analyzer would measure a phase difference of 0 degrees.

Now consider that we make this same measurement at 1.1 GHz. The frequency is higher by 10 percent so therefore the wavelength is shorter by 10 percent. The test signal path length is now 0.1 wavelength longer than that of the reference signal (Figure A-9). This test signal is:

```
1.1 X 360 = 396 degrees
```

This is 36 degrees different from the phase measurement at 1 GHz. The network analyzer will display this phase difference as –36 degrees. The test signal at 1.1 GHz is delayed by 36 degrees more than the test signal at 1 GHz.

You can see that if the measurement frequency is 1.2 GHz, we will get a reading of –72 degrees, –108 degrees for 1.3 GHz, etc. (Figure A-10). There is an electrical delay between the reference and test signals. For this delay we will use the common industry term of reference delay.

You also may hear it called phase delay. In older network analyzers you had to equalize the length of the reference arm with that of the test arm to make an appropriate measurement of phase vs. frequency.

To measure phase on a DUT, we want to remove this phase-change-vs.-frequency due to changes in the electrical length. This will allow us to view the actual phase characteristics. These characteristics may be much smaller than the phase change due to electrical length difference.

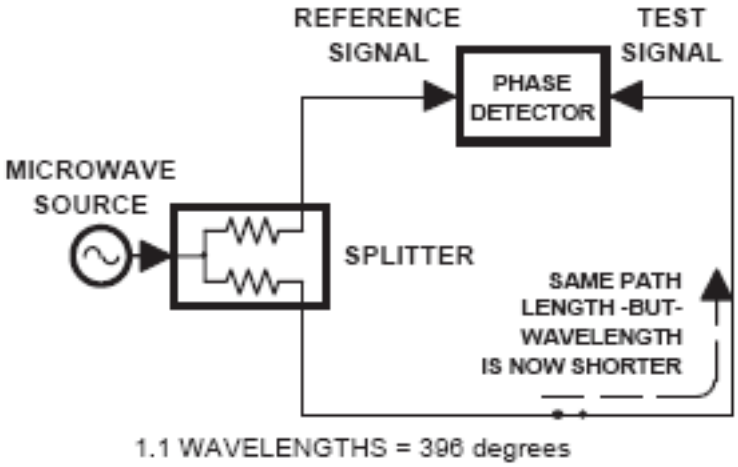


Figure A-9. Split Signal where Path Length is Longer than One Wavelength

Figure A-10. Electrical Delay

There are two ways of accomplishing this. The most obvious way is to insert a length of line into the reference signal path to make both paths of equal length (Figure A-11).With perfect transmission lines and a perfect splitter, we would then measure a constant phase as we change the frequency. The problem using this approach is that we must change the line length with each measurement setup.

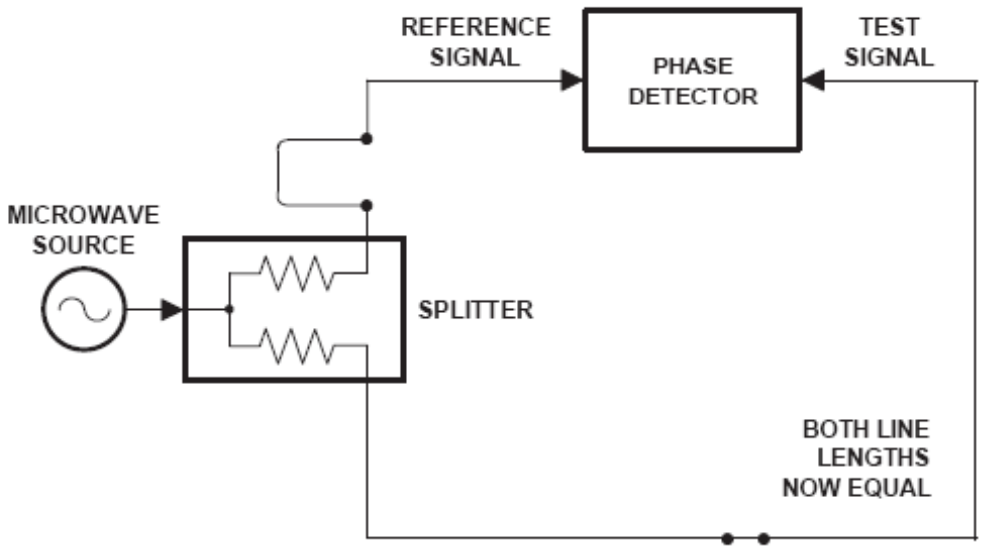


Figure A-11. Split Signal where Paths are of Equal Length

Another approach is to handle the path length difference in software. Figure A-12 displays the phase-vs.-frequency of a device. This device has different effects on the output phase at different frequencies. Because of these differences, we do not have a perfectly linear phase response. We can easily detect this phase deviation by compensating for the linear phase. The size of the phase difference increases linearly with frequency so we can modify the phase display to eliminate this delay.

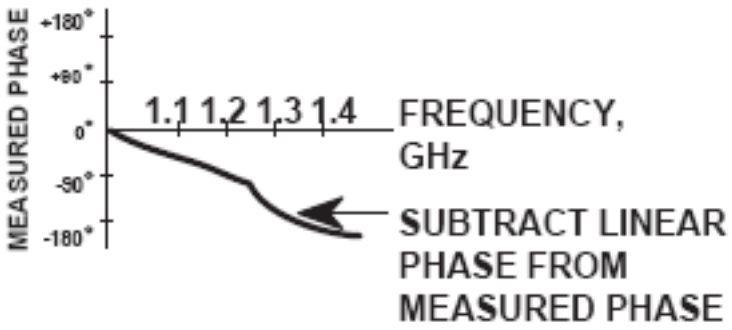


Figure A-12. Phase Difference Increases Linearly with Frequency

The ShockLine MS46131A Series VNA offers automatic reference delay compensation. Figure A-13 shows the resultant measurement when we compensate path length. In a system application you can usually correct for length differences; however, the residual phase characteristics are critical.

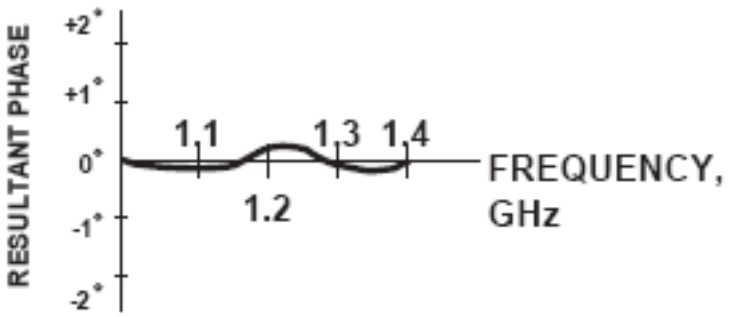


Figure A-13. Resultant Phase with Path Length

Now let us consider measuring the DUT. Consider a two port device; that is, a device with a connector on each end. What measurements would be of interest?

First, we could measure the reflection characteristics at either end with the other end terminated into 50-ohms. If we designate one end as the normal place for the input that gives a reference, we can then define the reflection characteristics from the reference end as forward reflection, and those from the other end as reverse reflection (Figure A-14).

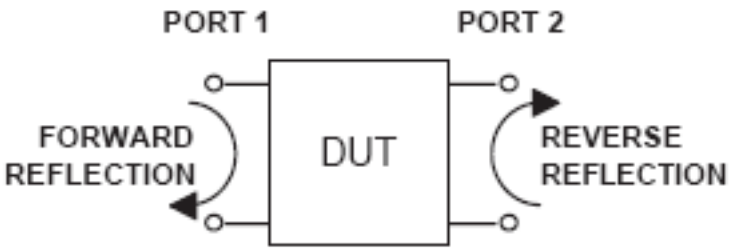


Figure A-14. Forward and Reverse Measurements

Second, we can measure the forward and reverse transmission characteristics. However, instead of saying "forward," "reverse," "reflection," and "transmission" all the time, we use a shorthand. That is all that S-parameters are, a shorthand! The "S" stands for scattering. The second number is the device port that the signal is being injected into, while the first is the device port that the signal is leaving. S11, therefore, is the signal being injected into port 1 relative to the signal leaving port 1. The four scattering parameters (Figure A-15) are:

- S11: Forward Reflection
- S21: Forward Transmission
- S22: Reverse Reflection
- S12: Reverse Transmission

S-parameters can be displayed in many ways. An S-parameter consists of a magnitude and a phase. We can display the magnitude in dB, just like a scalar network analyzer. We often call this term log magnitude. We can display phase as "linear phase" (Figure A-16). As discussed earlier, we cannot tell the difference between one cycle and the next. Therefore, after going through 360 degrees, we are back to where we began. We can display the measurement from –180 to +180 degrees. The –180 to +180 degree approach is more common. It keeps the display discontinuity removed from the important 0 degree area used as the phase reference.

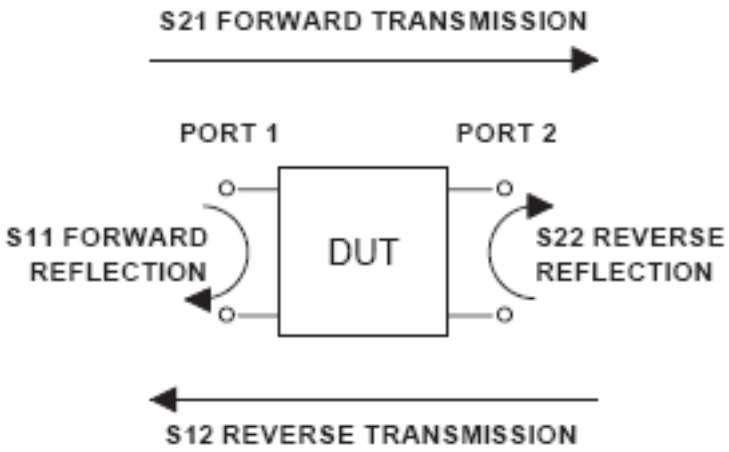


Figure A-15. S-Parameters

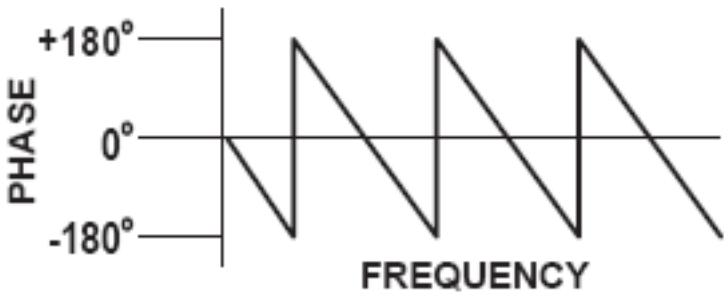


Figure A-16. Linear Phase with Frequency Waveform

There are several ways in which all the information can be displayed on one trace.

A-5 Polar Display

One method is a polar display (Figure A-17). The radial parameter (distance from the center) is magnitude. The rotation around the circle is phase. We sometimes use polar displays to view transmission measurements, especially on cascaded devices (devices in series). The transmission result is the addition of the phase and log magnitude (dB) information of each device's polar display.

Resistive and Reactive Terms

As we have discussed, the signal reflected from a DUT has both magnitude and phase. This is because the impedance of the device has both a resistive and a reactive term of the form $r+jx$. We refer to the r as the real or resistive term, while we call x the imaginary or reactive term. The j, which we sometimes denote as i, is an imaginary number.

It is the square root of –1. If x is positive, the impedance is inductive; if x is negative, the impedance is capacitive.

The size and polarity of the reactive component x is important in impedance matching. The best match to a complex impedance is the complex conjugate. This complex-sounding term simply means an impedance with the same value of r and x, but with x of opposite polarity.

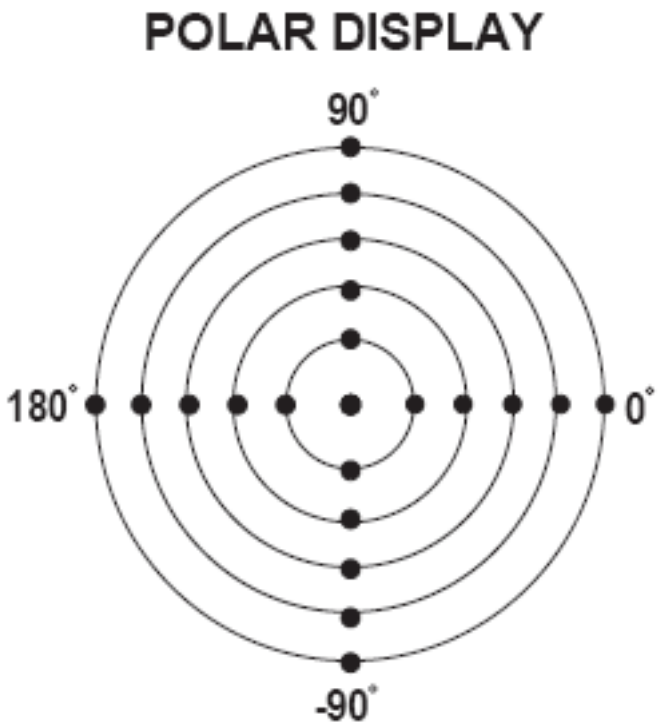


Figure A-17. Polar Display

A-6 Smith Chart

The complex conjugate is best analyzed using a Smith Chart (Figure A-18), which is a plot of *r* and *x*. To display all the information on a single S-parameter requires one or two traces, depending upon the format we want. A very common requirement is to view forward reflection on a Smith Chart (one trace) while observing forward transmission in Log Magnitude and Phase (two traces). Let us see how to accomplish this in the ShockLine MS46131A Series VNA.

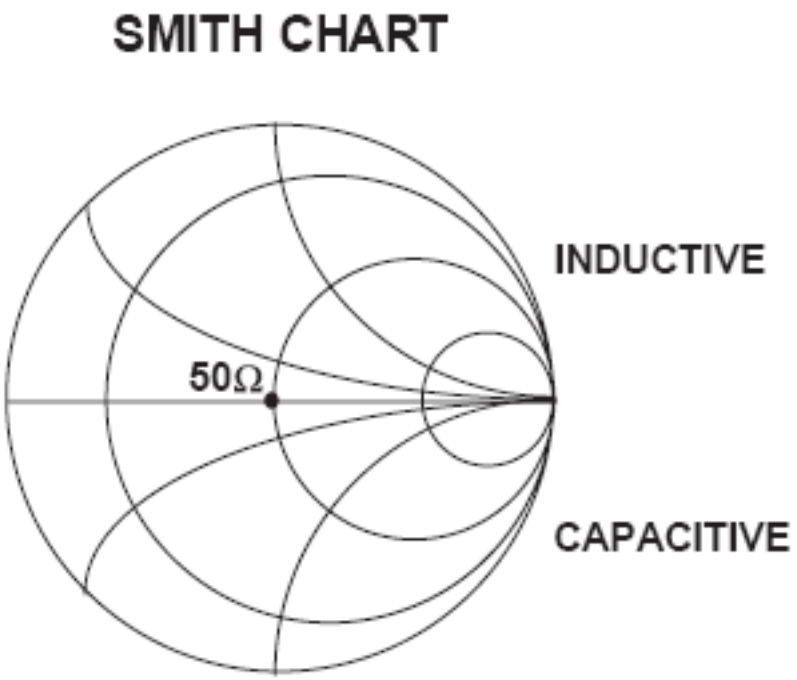


Figure A-18. Smith Chart

An important parameter we can measure when phase information is available is group delay. In linear devices, the phase change through the DUT is linear-with-frequency. Thus, doubling the frequency also doubles the phase change. An important measurement, especially for communications system users, is the rate of change-of-phase-vs.-frequency (group delay). If the rate of phase-change-vs.-frequency is not constant, the DUT is nonlinear. This nonlinearity can create distortion in communications systems.

Measurement Error Correction

Since we can measure microwave signals in both magnitude and phase, it is possible to correct for six major error terms:

- Source Test Port Match
- Load Test Port Match
- Directivity
- Isolation
- Transmission Frequency Response
- Reflection Frequency Response

We can correct for each of these six error terms in both the forward and reverse directions, hence the name 12-term error correction. Since 12-term error correction requires both forward and reverse measurement information, the test set must be *reversing*. "Reversing" means that it must be able to apply the measurement signal in either the forward or reverse direction.

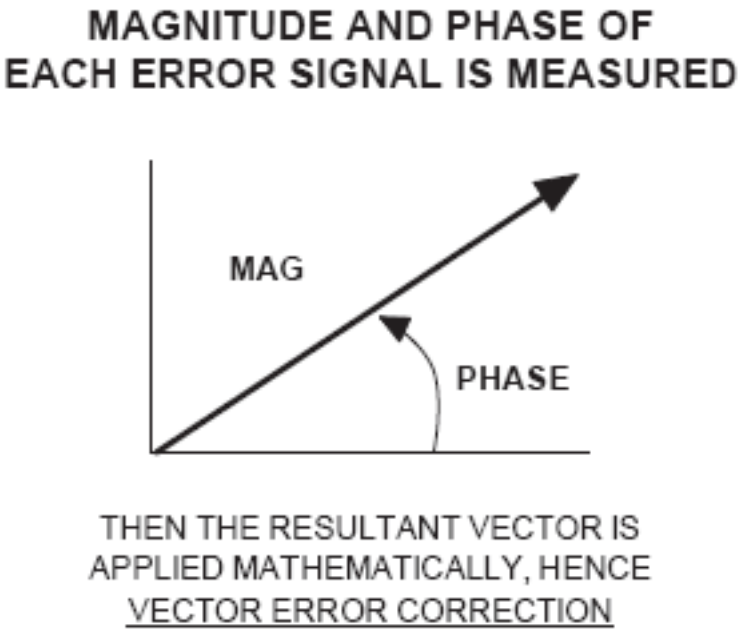


Figure A-19. Magnitude and Phase

To accomplish this error correction, we measure the magnitude and phase of each error signal (Figure A-19). Magnitude and phase information appear as a vector that is mathematically applied to the measurement signal. This process is termed *vector error correction*.

Appendix B — Maintenance and Security

B-1 Security and Memory Overview

The ShockLine MS46131A Series VNA does not require memory purging after it has been removed from a secure location, since there is no data memory in the unit.

B-2 Preparation for Storage or Shipment

Use the following information for preparing the ShockLine MS46131A Series VNA for storage or shipment.

Preparation for Storage

Preparing the VNA for storage consists of cleaning the unit, packing it inside of the storage container with moisture-absorbing desiccant crystals, and storing the unit in a temperature-controlled environment that is maintained between –40 °C and +75 °C.

Preparation for Shipment

To provide maximum protection against damage in transit, the VNA should be repackaged in the original shipping container. If this container is not available and the unit is being returned to Anritsu for repair, advise Anritsu Customer Service to inquire about obtaining a suitable container. In the event these options are not possible, instructions for packaging and shipment are given below:

Dimensions

The instrument body dimensions are:

- **Height:** 61 mm
- **Width:** 328 mm
- **Depth:** 198 mm

1. Remove any user-supplied connectors or adapters. If installed, remove the rack mounting ears and related hardware.
2. Obtain a corrugated cardboard carton with at least 125 kg test strength. This carton should have inside dimensions of no less than 15 cm (6.0”) larger than the instrument unit dimensions to allow for cushioning.
3. Surround the unit with polyethylene sheeting to protect the finish. A sealed bag is recommended as a best practice.
4. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the unit. Provide at least 8 cm (3.0”) of dunnage on all sides; best practices recommend completely filling the space between the carton and instrument with dunnage.
5. Seal the carton by using either shipping tape or an industrial stapler.
6. If the instrument is being returned to Anritsu for service, mark the address of the appropriate Anritsu service center and your return address on the carton in one or more prominent locations.

Appendix C — Abbreviation Glossary

C-1 Appendix Overview

This glossary defines the abbreviations and terms that appear on the connectors and buttons of the MS46131A Series VNA. In some cases, due to space limitations, multiple abbreviations are used for the same term or the same abbreviation is used with different punctuation.

C-2 Glossary

Abbreviation or Term	Meaning / Definition (1 of 14)
%	Percentage
#	Number
(1:2):3	One differential pair and one singleton. Trace and dialog labeling for Mixed-mode with one differential pair and one singleton. In this example, The DUT port differential is measured from 1 to 2 and 3 is the singleton.
(1:2):3:4	One differential pair and two singletons. Trace and dialog labeling for Mixed-mode with one differential pair and two singletons. In this example, the DUT port differential is measured from 1 to 2 while 3 and 4 are the singletons.
(4:1):(2:3)	Two differential pairs. Trace and dialog labeling for Mixed-mode with two differential pairs. In this example, the first port pair is measured from 4 to 1 and the second port pair is measured from 2 to 3.
(4:2):1	One differential pair and one singletons. Trace and dialog labeling for Mixed-mode with one differential pair and one singleton. The DUT port differential is measured from 4 to 2 and 1 is the singleton.
(4:2):1:3	One differential pair and two singletons. Trace and dialog labeling for Mixed-mode with one differential pair and two singletons. In this example, the DUT port differential is measured from 4 to 2 while 1 and 3 are the singletons.
(1:2):(3:4)	Two differential pairs. Trace and dialog labeling for Mixed-mode with two differential pairs. In this example, the first port pair is measured from 1 to 2 and the second port pair is measured from 3 to 4.
1P2PF	Abbreviation for one-path two-port calibration forward direction. Used in the SCPI command:SENSe{1-16}:CORRection:COLLect[:METHod]:1P2PF to simulate the calibration.
1P2PR	Abbreviation for one path two port calibration reverse direction. Used in the SCPI command:SENSe{1-16}:CORRection:COLLect[:METHod]:1P2PR to simulate the calibration.
A1 a1	Reference 1 or Reference a
A2 a2	Reference 2 or Reference b
Actv.	Active
Addr.	Address
ALC	Automatic Level Control

Abbreviation or Term	Meaning / Definition (2 of 14)
ALRM A-LRM™	Calibration menu. Advanced-Line-Reflect-Match calibration algorithm and method. A-LRM is a trademark of Anritsu Company.
Auto-Return Auto-return	User interface. After a button selection, the instrument automatically returns to previous menu where the user selection is usually displayed on a field button. Auto-return buttons are usually a member of a button selection group (“a radio button” group) described below.
Avg.	Average
B1 b1	S-Parameter. Test 1 or Test a
B2 b2	S-Parameter. Test 2 or Test b
Bal.	Balance
BB	Broadband
BeginningSwp	Beginning sweep
Button Selection Group	Popular name is “radio button” group. A group of two or more soft buttons where selection of one button de-selects all other button members of the group. Often combined with auto-return function (described above) where the interface automatically returns to previous menu after the button selection is made.
Button Buttons	Individual elements of the right-side user interface menus. Button come in a variety of types such as toggle buttons, or menu buttons. See also “Soft buttons.”
C(P) C(S) C(S)-L(P) C(P)-L(S)	Abbreviation for LC circuit primitives. Capacitance (Parallel), Capacitance (S), Capacitance (Series)-Inductor (Parallel), and Capacitance (Parallel)-Inductor (Series).
CAL (.CAL) File	File type extension.
Cal. Eff. Pwr	Calculated effective power
Cal Cal.	Calibrate Calibration
Cals Cals.	Calibrations
CCKTFour	A four-node capacitance C circuit. Port assignments are defined in separate commands. Available if the instrument is in 4-Port VNA mode.
Charac.	Characterize Characterization
cm	Distance units abbreviation. Centimeter.
Cnt	Count
Coax	Coaxial cable
Coef.	Coefficient
Comm.	Communication
Compress	Compression
Config.	Configure Configuration

Abbreviation or Term	Meaning / Definition (3 of 14)
CPLS	Parallel capacitance with series inductance. Available if the instrument is in 2-Port VNA mode.
CSLP	Series capacitance with parallel inductance. For capacitance only, set L to zero. Available if the instrument is in 2-Port VNA mode.
CW	Continuous Wave
D1S0	D One S Zero. In 4-Port VNAs, one differential pair and no singletons. Used in the MXP SETUP dialog box and the:CALCulate{1-16}:MXP SCPI commands. • MAIN | System | SYSTEM | Setup | SETUP | Misc. Setup | MISC. SETUP | MnP Files Setup | MXP SETUP Dialog Box
D1S1	D One S One. In 4-Port VNAs, one differential pair and one singleton. Used in the MXP SETUP dialog box and the :CALCulate{1-16}:MXP SCPI commands. • MAIN | System | SYSTEM | Setup | SETUP | Misc. Setup | MISC. SETUP | MnP Files Setup | MXP SETUP Dialog Box
D1S2	D One S Two. In 4-Port VNAs, one differential pair and two singletons. Used in the MXP SETUP dialog box and the :CALCulate{1-16}:MXP SCPI commands. • MAIN | System | SYSTEM | Setup | SETUP | Misc. Setup | MISC. SETUP | MnP Files Setup | MXP SETUP Dialog Box
D2S0	D Two S Zero. In 4-Port VNAs, two differential pairs and no singletons. Used in the MXP SETUP dialog box and the :CALCulate{1-16}:MXP SCPI commands. • MAIN | System | SYSTEM | Setup | SETUP | Misc. Setup | MISC. SETUP | MnP Files Setup | MXP SETUP Dialog Box
DAC	Digital to Analog Converter
Data/Mem	Data value divided by the memory value.
Data+Mem	Data value plus the memory value.
DataMem	Data value times the memory value.
Data-Mem	Data value minus the memory value.
DataMemMath	Data and memory mathematical equations.
dB	Decibels
dB/Div	SCALE menu toolbar function. Decibels per trace display division.
DDS	Direct Digital Synthesis
De-embed De-Embed Deembed	De-embedding. Process where calibration parameters for a test fixture are removed from the calibrated instrument and connection cables.
Deg Degs	Degree Degrees
Degs/Div	SCALE menu toolbar function. Degrees per trace display division. For circular Polar or Smith Chart displays only.
Diff.	Differential
Div.	Division
DTF	Distance to fault
DUT	Device under test

Abbreviation or Term	Meaning / Definition (4 of 14)
E/DE EDE Embed Embedding	Embedding/De-Embedding. Process where known calibration parameters for a test fixture are added to the instrument calibration consisting of just the instrument and connection cables.
EMC	Electromagnetic Compatibility
Eqn	Equation
Ext.	External
Ext. Src. Addr.	External source address
Extrap	Extrapolation
Fctry	Factory
Field Toolbar	When some buttons are selected, the field toolbar that appears near the top of the screen display just below the icon toolbar. The toolbar provides user control to select the value of the required input such as a frequency, attenuation level, or device address. Some toolbar fields allow the selection of units; for example, frequency field toolbars allow selection of Hz, kHz, MHz, or GHz units. Some field toolbars appear at the bottom of the display area when editing table information such as for Segmented Sweep operations.
Flash drive	See USB Memory Device.
Freq-Base	Frequency-Based
Freq Freq.	Frequency
FreqIniTable.ini	File type.
FreqTable.mft	File type.
Full 2-port Full Two port	Calibration method. Also called “12 Term Calibration.”
FULL1	Abbreviation for full one port calibration. Used in the SCPI command :SENSe{1-16}:CORRection:COLLect[:METHod]:FULL1 to simulate the calibration.
FULL2	Abbreviation for full two port calibration. Used in the SCPI command :SENSe{1-16}:CORRection:COLLect[:METHod]:FULL2 to simulate the calibration.
FULLB	Abbreviation for full one port reflection calibration both ports. Used in the SCPI command :SENSe{1-16}:CORRection:COLLect[:METHod]:FULLB to simulate the calibration.
GHz	Gigahertz. 10E9 Hertz.
GPIB	IEEE-488.2 General Purpose Interface Bus. GPIB Command.
GUI	Graphical User Interface
HDD	Hard Disk Drive
Het.	Heterodyne
ID	Identification number
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IEEE-488.2	IEEE Specification 488.2 for General Purpose Interface Bus (GPIB)

Abbreviation or Term	Meaning / Definition (5 of 14)
IF	Intermediate Frequency
IFBW	Intermediate Frequency Bandwidth
Imag.	Imaginary
IMD	Intermodulation distortion
Imped.	Impedance
Imped. Transf.	Impedance transformation
Indep.	Independent
Inter.	Interface Interference
IntraTrace	Mathematical operations within the same trace display. As opposed to inter-trace operations.
IP	Internet Protocol
j	Imaginary number
jX	Reactance term in Ohms
K Connector	Connector type. Compatible with SMA, WSM and 3.5 mm connectors, it has a rated frequency range from DC to 40 GHz. K Connector is a trademark of Anritsu Company.
kHz	Kilohertz. 10E3 Hertz.
km	Distance units abbreviation. Kilometer.
L(P) L(S) L(P)-C(S) L(S)-C(P)	Abbreviation for LC circuit primitives. Inductor (Parallel), Inductor (Series), Inductor (Series)-Capacitance (Parallel), and Inductor (Parallel) and Capacitance (Series).
Lang.	Language
LCD	Liquid Crystal Display
LCKTFour	A four-node inductance L circuit. Port assignments are defined in separate commands. Available if the instrument is in 4-Port VNA mode.
Lft	Left
Lin	Linear
LO	Local Oscillator
Log	Logarithmic
LogMag	Logarithmic Magnitude
LRL/LRM	Calibration method. Line-reflect-line calibration algorithm. Line-reflect-match calibration algorithm.
LSCP	Series inductance with parallel capacitance. For inductance only, set C to zero. Available if the instrument is in 2-Port VNA mode.
LSCS	Parallel inductance with series capacitance. Available if the instrument is in 2-Port VNA mode.
LVD	Low Voltage Directive
m	Distance unit abbreviation. Meter.
Mag Mag.	Magnitude
max Num	Maximum Number

Abbreviation or Term	Meaning / Definition (6 of 14)
Max max	Maximum
MB/s	Megabytes per second
Mb Mbit	Megabit. 1 megabit equals 10E6 bits or 1,000,000 bits.
MB Mbyte	Megabyte. In SI decimal units, 1 megabyte equals 1000E3 bytes or 1,000,000 bytes. In IEC binary units, a “mebibyte or MiB” equals 1024E3 bytes or 1,048,576 bytes, but is also commonly called a “megabyte.”
Mem Mem.	Memory
Memory stick	See USB Memory Device.
menu	Available menus in the top level menu-bar command interface.
Menu command	Individual commands listed on a drop-down menu from the top menu bar. For example, on the File menu, the first command is Recall.
MFT (.mft) Files	File type extension.
MG	Anritsu Measurement Guide
MHz	Megahertz. 10E6 Hertz. 1,000,000 Hertz
Micr.	Microporous Teflon dielectric type
Min Min.	Minimum
Misc.	Miscellaneous
Mkr # [OFF]	Marker number with the Reference Marker function toggled off and the marker also toggled off; for example, Mkr 1 [OFF] for Marker 1.
Mkr # [ON]	Marker number with the Reference Marker function toggled off and the marker toggled on; for example, Mkr 1 [ON] for Marker 1.
Mkr#-Ref [OFF]	Marker number with the Reference Marker function toggled on and the marker toggled off; for example, Mkr1-Ref [OFF] for Marker 1.
Mkr#-Ref [ON]	Marker number with the Reference Marker function toggled on and the marker also toggled on; for example, Mkr1-Ref [ON] for Marker 1.
Mkr Mkrs	Marker, Markers
mm	Units abbreviation. Millimeter.
MM	Anritsu Maintenance Manual
mmWave mm-Wave	Millimeter wavelength
Model#	Model Number
ms	Time units abbreviation. Millisecond.
MS46131A Series VNA	The function or feature refers to any VNA model in the series: MS46131A.

Abbreviation or Term	Meaning / Definition (7 of 14)
Navigation paths	Navigation to a menu or dialog box of interest is entered using navigation notation where the pipe (" | ") symbol is used to separate elements. The starting menu is usually the MAIN Menu. The general format is with menu and dialog boxes in ALL CAPS and buttons in Title Case; both use this distinctive Sans Serif Font in the general format: MAIN | Button | MENU | ... | Button | DESTINATION MENU/DIALOG BOX For example, the navigation path to the REFERENCE PLANE menu is: MAIN | Measurement | MEASUREMENT | Reference Plane | REFERENCE PLANE
NIST	National Institute of Standards and Technology.
ns	Time units abbreviation. Nanosecond.
Ntwk Ntwk.	Network
Ohms/Div	SCALE menu toolbar function. Ohms (Ω) per trace display division.
OM	Anritsu Operations Manual
Op.	Operand Operation Operations
Out.	Output
P2P	Pulse-to-Pulse
Param.	Parameter Parameters
PDF	Proprietary Portable Document Format from Adobe Corporation.
PG	Pulse Generator
PIP	Point-in-Pulse
PM	Anritsu Programming Manual
Prev Prev.	Previous
PRF	Pulse Repetition Frequency
PRI	Pulse Repetition Interval
Profile	Pulse Profile
ps	Time units abbreviation. Picosecond.
Pwr Pwr.	Power
R	Resistance
R(P), R(S)	Parallel Resistance, Series Resistance
R-Circuit	Resistive element of an L-C circuit
RCKTFour	A four-node resistive R circuit. Port assignments are defined in separate commands. Available if the instrument is in 4-Port VNA mode.
Rcvr Rcvr.	Receiver

Abbreviation or Term	Meaning / Definition (8 of 14)
Rect.	Reactance Rectangle Rectangular
Ref.Mkr	Reference Marker
Ref Ref.	Reference
RESP1	Abbreviation for one-port response calibration. Used in the SCPI command :SENSe{1-16}:CORRection:COLLect[:METHod]:RESP1 to simulate the calibration.
RESPB	Abbreviation for one-port response calibration both ports. Used in the SCPI command :SENSe{1-16}:CORRection:COLLect[:METHod]:RESPB to simulate the calibration.
RF	Radio Frequency
RP	Resistive parallel network. Available if the instrument is in 2-Port VNA mode.
RS	Resistive series network. Available if the instrument is in 2-Port VNA mode.
Rt	Right
s	Time units abbreviation. Second.
S11	S-Parameter. Used in text for S-parameter measurement of input reflection coefficient. In text written as “S11”. Mathematical version uses subscripts as S_{11}. Available in 2-Port and 4-Port VNAs.
S12	S-Parameter. Used in text for S-parameter measurement of reverse transmission coefficient. Mathematical version uses subscripts as S_{12}. Available in 2-Port and 4-Port VNAs.
S13	S-Parameter. Used in test for S-parameter measurement. Mathematical version used subscripts as S_{13}. Available only in 4-Port VNAs.
S14	S-Parameter. Used in test for S-parameter measurement. Mathematical version used subscripts as S_{14}. Available only in 4-Port VNAs.
S21	S-Parameter. Used in text for S-parameter measurement of forward transmission coefficient. Mathematical version uses subscripts as S_{21}. Available in 2-Port and 4-Port VNAs.
S22	S-Parameter. Used in text for S- parameter measurement of output reflection coefficient. Mathematical version uses subscripts as S_{22}. Available in 2-Port and 4-Port VNAs.
S23	S-Parameter. Used in test for S-parameter measurement. Mathematical version used subscripts as S_{23}. Available only in 4-Port VNAs.
S24	S-Parameter. Used in test for S-parameter measurement. Mathematical version used subscripts as S_{23}. Available only in 4-Port VNAs.

Abbreviation or Term	Meaning / Definition (9 of 14)
s2p	File extension. Abbreviation for S-parameter 2-Port configuration file. The general type of file extension is referred to an ".snp" file where the "n" refers to the number of ports, such as ".s1p" for an S-parameter 1-Port configuration file.
S2Pfile	Allows an S2P calibration file to be used. Available if the instrument is in 2-Port VNA mode.
S31	S-Parameter. Used in test for S-parameter measurement. Mathematical version used subscripts as S_{31}. Available only in 4-Port VNAs.
S32	S-Parameter. Used in test for S-parameter measurement. Mathematical version used subscripts as S_{32}. Available only in 4-Port VNAs.
S33	S-Parameter. Used in test for S-parameter measurement. Mathematical version used subscripts as S_{33}. Available only in 4-Port VNAs.
S34	S-Parameter. Used in test for S-parameter measurement. Mathematical version used subscripts as S_{34}. Available only in 4-Port VNAs.
S41	S-Parameter. Used in test for S-parameter measurement. Mathematical version used subscripts as S_{41}. Available only in 4-Port VNAs.
S42	S-Parameter. Used in test for S-parameter measurement. Mathematical version used subscripts as S_{42}. Available only in 4-Port VNAs.
S43	S-Parameter. Used in test for S-parameter measurement. Mathematical version used subscripts as S_{43}. Available only in 4-Port VNAs.
S44	S-Parameter. Used in test for S-parameter measurement. Mathematical version used subscripts as S_{44}. Available only in 4-Port VNAs.
S4Pfile	Allows an S4P calibration file to be used. Available if the instrument is in 4-Port VNA mode.
SC1C1	Two differential pairs. Trace labeling for Mixed-mode with two differential pairs. S-parameter for common-mode reception at Pair 1 and common-mode drive at Pair 1.
SC1C2	Two differential pairs. Trace labeling for Mixed-mode with two differential pairs. S-parameter for common-mode reception at Pair 1 and common-mode drive at Pair 2.
SC1D1	Two differential pairs. Trace labeling for Mixed-mode with two differential pairs. S-parameter for common-mode reception at Pair 1 and differential drive at Pair 1.
SC1D2	Two differential pairs. Trace labeling for Mixed-mode with two differential pairs. S-parameter for common-mode reception at Pair 1 and differential drive at Pair 2.
SC2C1	Two differential pairs. Trace labeling for Mixed-mode with two differential pairs. S-parameter for common-mode reception at Pair 2 and common-mode drive at Pair 1.

Abbreviation or Term	Meaning / Definition (10 of 14)
SC2C2	Two differential pairs. Trace labeling for Mixed-mode with two differential pairs. S-parameter for common-mode reception at Pair 2 and common-mode drive at Pair 2.
SC2D1	Two differential pairs. Trace labeling for Mixed-mode with two differential pairs. S-parameter for common-mode reception at Pair 2 and differential drive at Pair 1.
SC2D2	Two differential pairs. Trace labeling for Mixed-mode with two differential pairs. S-parameter for common-mode reception at Pair 2 and differential drive at Pair 2.
SCC	One differential pair and one singleton. Trace labeling for Mixed-mode with common-mode reception at Pair 1 and common-mode drive at Pair 1. S-Parameter for common-mode reception at Pair 1 and common-mode drive at Pair 1. One differential pair and two singletons. Trace labeling for Mixed-mode for Pair 1 common-mode reception and Pair 1 drive. S-Parameter for common-mode reception at Pair 1 and common-mode drive at Pair 1. Trace labeling for Mixed-mode with common-mode reception at Pair 1 and common-mode drive at Pair 2. S-Parameter for common-mode reception at Pair 1 and common-mode drive at Pair 1.
SCD	One differential pair and one singleton. Trace labeling for Mixed-mode for Pair 1 reception and Pair 1 drive. S-Parameter for common-mode reception at Pair 1 and differential drive at Pair 1. One differential pair and two singletons. Trace labeling for Mixed-mode with common-mode reception at Pair 1 and differential drive at Pair 2. S-Parameter for common-mode reception at Pair 1 and differential drive at Pair 1.
SCX	One differential pair and one singleton. Trace labeling for Mixed-mode with Pair 1 common-mode reception and singleton drive. S-Parameter for common-mode reception at Pair 1 and singleton drive. One differential pair and two singletons. Trace labeling for Mixed-mode with common-mode reception at Pair 1 and drive at first singleton. S-Parameter for common-mode reception at Pair 1 and first singleton drive.
SCY	One differential pair and two singletons. Trace labeling for Mixed-mode with common-mode at Pair 1 and drive at second singleton. S-Parameter for common-mode reception at Pair 1 and second singleton drive.
SD1C1	Two differential pairs. Trace labeling for Mixed-mode with two differential pairs. S-parameter for differential reception at Pair 1 and common-mode drive at Pair 2.
SD1C2	Two differential pairs. Trace labeling for Mixed-mode with two differential pairs. S-parameter for differential reception at Pair 1 and common-mode drive at Pair 2.
SD1D1	Two differential pairs. Trace labeling for Mixed-mode with two differential pairs. S-parameter for differential reception at Pair 1 and differential drive at Pair 2.

Abbreviation or Term	Meaning / Definition (11 of 14)
SD1D2	Two differential pairs. Trace labeling for Mixed-mode with two differential pairs. S-parameter for differential reception at Pair 1 and differential drive at Pair 2.
SD2C1	Two differential pairs. Trace labeling for Mixed-mode with two differential pairs. S-parameter for differential reception at Pair 2 and common-mode drive at Pair 1.
SD2C2	Two differential pairs. Trace labeling for Mixed-mode with two differential pairs. S-parameter for differential reception at Pair 2 and common-mode drive at Pair 2.
SD2D1	Two differential pairs. Trace labeling for Mixed-mode with two differential pairs. S-parameter for differential reception at Pair 2 and differential drive at Pair 1.
SD2D2	Two differential pairs. Trace labeling for Mixed-mode with two differential pairs. S-parameter for differential reception at Pair 2 and differential drive at Pair 2.
SDC	One differential pair and one singleton. Trace labeling for Mixed-mode for Pair 1 reception and Pair 1 drive. S-Parameter for differential reception at Pair 1 and common-mode drive at the port pair. One differential pair and two singletons. Trace labeling for Mixed-mode with differential reception at Pair 1 and common-mode drive at Pair 1. S-Parameter for differential reception and common-mode drive at Pair 1.
SDD	One differential pair and one singleton. Trace labeling for Mixed-mode for Pair 1 reception and Pair 1 drive. S-Parameter for differential reception and differential drive. One differential pair and two singletons. Trace labeling for Mixed-mode with differential reception at Pair 1 and differential drive at Pair 1. S-Parameter for differential reception and differential drive at Pair 1.
SDX	One differential pair and one singleton. Trace labeling for Mixed-mode for Pair 1 reception and singleton drive. S-Parameter for differential reception at Pair 1 and singleton drive. One differential pair and two singletons. Trace labeling for Mixed-mode with differential reception at Pair 1 and drive at first singleton. S-Parameter for differential reception at Pair 1 and first singleton drive.
SDY	One differential pair and two singletons. Trace labeling for Mixed-mode with differential reception at Pair 1 and drive at second singleton. S-Parameter for differential reception at Pair 1 and second singleton drive.
Seg.	Segment Segmented
SerNum	Serial Number
Set.	Settings
SI	International System of Units
Single Offset	Calibration method

Abbreviation or Term	Meaning / Definition (12 of 14)
Soft buttons	Buttons that appear in the right side menu interface on the MS46131A Series VNA screen. In text, the name of the menu is formatted with a distinctive font in capitals, such as the FREQUENCY menu. Soft buttons on each menu, such as the Select Port toggle button are formatted in the same font with initial capitals.
SOLT/SOLR	Calibration methods. Short-open-load-thru or short-open-load-reciprocal calibration algorithm.
Sparam	S-Parameters or scattering parameters
S-Parameters s-parameters	Scattering parameters.
Src Src.	Source
SRPRP SRR SXR SRX SXX	General button format for mixed mode settings. In 4-port VNA mixed mode settings, this is the name format of the selectable button names. For buttons with five letters, “S” indicates a mixed mode S-Parameter, “R” is the selected response type of either “D” for differential or “C” for common mode, and “P” is the Port number between 1 and 4. For buttons with three letters, “S” indicates a mixed-mode S-Parameter, “R” is the selected response type of either “D” for differential or “C” for common mode, and “X” is the singleton drive.
SSD	Solid State Drive
SSLT/SSLR	Calibration methods. Short-short-load-thru or short-short-load-reciprocal calibration algorithm
SSST/SSSR	Calibration methods. Short-short-short-thru or short-short-short-reciprocal calibration algorithm. Also called “Triple Offset Short”.
Swp	Sweep
SWR	Standing Wave Ratio
SXC	One differential pair and one singleton. Trace labeling for Mixed-mode with first singleton reception and common-mode drive at Pair 1. S-Parameter for first singleton reception and common-mode drive at Pair 1. One differential pair and two singletons. Trace labeling for Mixed-mode with singleton reception and differential drive. S-Parameter for singleton reception and common-mode drive at Pair 1.
SXD	One differential pair and one singleton. Trace labeling for Mixed-mode with singleton reception and Pair 1 drive. S-Parameter for singleton reception and differential drive at Pair 1. One differential pair and two singletons. Trace labeling for Mixed-mode with first singleton reception and differential drive at Pair 1. S-Parameter for first singleton reception and differential drive at Pair 1.
SXX	One differential pair and one singleton. Trace labeling for Mixed-mode with singleton reception and singleton drive. S-Parameter for singleton reception and singleton drive. One differential pair and two singletons. Trace labeling for Mixed-mode with first singleton reception and first singleton drive. S-Parameter for first singleton reception and first singleton drive.

Abbreviation or Term	Meaning / Definition (13 of 14)
SXY	One differential pair and two singletons. Trace labeling for Mixed-mode with first singleton reception and first singleton drive. S-Parameter for first singleton reception and second singleton drive.
SYC	One differential pair and two singletons. Trace labeling for Mixed-mode with second singleton reception and common-mode drive at Pair 1. S-Parameter for second singleton reception and common-mode drive at Pair 1.
SYD	One differential pair and two singletons. Trace labeling for Mixed-mode with second singleton reception and differential drive at Pair 1. S-Parameter for second singleton reception and differential drive at Pair 1.
SYX	One differential pair and two singletons. Trace labeling for Mixed-mode with second singleton reception and first singleton drive. S-Parameter for second singleton reception and first singleton drive.
SYY	One differential pair and two singletons. Trace labeling for Mixed-mode with second singleton reception and second singleton drive. S-Parameter for second singleton reception and second singleton drive.
TCP	Transmission Control Protocol. Part of the Ethernet network communication protocol.
TDS	Anritsu Technical Data Sheet. Document location of the most recent instrument performance specifications.
TFRB	Abbreviation for transmission frequency response calibration both directions. Used in the SCPI command :SENSe{1-16}:CORRection:COLLect[:METHod]:TFRB to simulate the calibration.
TFRF	Abbreviation for transmission frequency response calibration forward direction. Used in the SCPI command :SENSe{1-16}:CORRection:COLLect[:METHod]:TFRF to simulate the calibration.
TFRR	Abbreviation for transmission frequency response calibration reverse direction. Used in the SCPI command :SENSe{1-16}:CORRection:COLLect[:METHod]:TFRR to simulate the calibration.
TLine	A defined transmission line with specifications for Impedance (Ohms), Length (meters), Loss (dB/mm), @ Frequency (GHz), and Dielectric Value. Note that programmatically, length is entered in meters. From the user interface, length is usually entered in millimeters. Available if the instrument is in 2-Port VNA mode.
T-Line	Transmission line
TLINEFour	Allows two separate through (“thru”) lines to be used. In separate commands, each link is defined by Length (meters), @ Frequency (GHz), Z0-Odd (Ohms), Loss-Odd (dB/mm), Dielectric Odd (unitless number), Z0Even (Ohms), Loss-Even (dB/mm), and Dielectric Even (unitless number). Note that programmatically, length is entered in meters. From the user interface, length is usually entered in millimeters. Available if the instrument is in 4-Port VNA mode.
TMS	True Mode Stimulus
Toggle Button	A software button that toggles between two or more states such as ON and OFF or Port 1 and Port 2.

Abbreviation or Term	Meaning / Definition (14 of 14)
TR	Instrument mode. Transmission/reflection mode.
Transf Transf.	Transfer Transformation
Triple Offset Short	Calibration method. Short-short-short-thru. Commonly abbreviated as "SSST."
TRL	Thru Reflect Line Calibration method. See LRL.
TRM	Thru Reflect Match Calibration method. See ALRM.
Tr Tr.	Trace
TS	Troubleshooting
TS Mode	Troubleshooting Mode
TTL	Transistor-Transistor Logic
U	Units
um	Distance units abbreviation. Micrometer.
Units/Div	SCALE menu toolbar function. Measurement units per trace display division.
us	Time units abbreviation. Microsecond.
USB	Universal Serial Bus
USB Memory Device	Also called a "USB flash drive", "USB stick", "thumb drive", or "memory stick." In the context of Anritsu documentation, a USB memory device is used to transfer calibration, certification, and/or operating system updates to the MS46x20A instrument. When the instrument interface or hardware uses another term such as "Calibration Memory Device," its first use is always followed by the "USB Memory Device" in parenthesis. For example: "...use the Calibration Memory Device (USB Memory Device) to load the characterization parameters for the calibration kit..."
USB stick	See USB Memory Device.
UTF	Universal Test Fixture
V	Volts Voltage
V AC	Volts Alternating Current.
V Connector™	Anritsu Company trademarked connector name. Connector type. A 1.85 mm coaxial connector with a rated frequency range from DC to 65 GHz. V Connector is a trademark of Anritsu Company.
V DC	Volts Direct Current
VCO	Voltage Control Oscillator
VISA	Virtual Instrument System Architecture
VNA	Vector Network Analyzer
VSWR	Voltage Standing Wave Ratio

Appendix D — Troubleshooting

D-1 Introduction

This section provides troubleshooting tips when operating the MS46131A.

Tips include:

- Section D-2 “No Hardware Detected”
- Section D-3 “Anritsu Hardware is Unavailable”
- Section D-4 “Driver Initialization Error”
- Section D-5 “Application Launch Failure”
- Section D-6 “EEPROM Does Not Match (Firmware Update)”
- Section D-7 “Updating EEPROM Unsuccessful (Firmware Update Failed)”
- Section D-8 “Updating Firmware Manually”
- Section D-9 “Traces Flat, No Sweeping”
- Section D-10 “Text Size Too Large”

D-2 No Hardware Detected

If the ShockLine installation download results in a No Hardware Detected message:

1. Check the PC Device Manager. If installed successfully, the device should be present under Universal Serial Bus controllers as “Anritsu Programmed USB”. See Figure D-1.

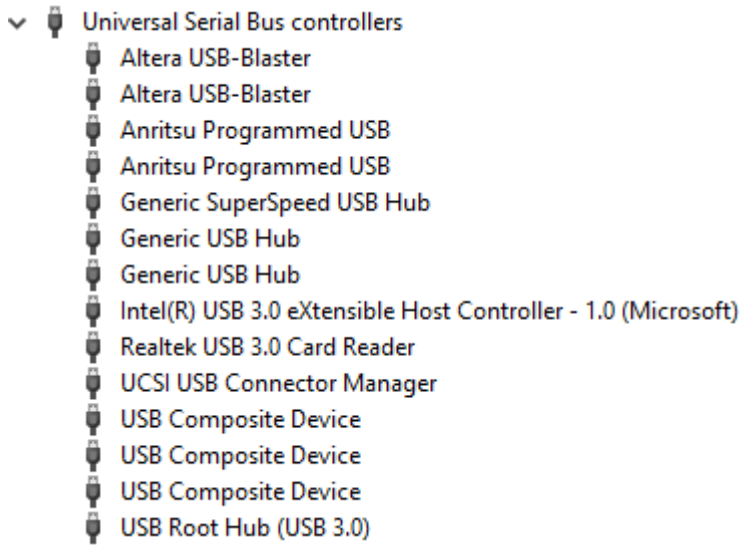


Figure D-1. USB Controller or Other Devices

2. Double-click on Anritsu Programmed USB. In the ANRITSU PROGRAMMED USB PROPERTIES dialog box, change the Property field to Hardware Ids, as shown in Figure D-2. Under Value, MS46131A units will display with a PID of FF20.

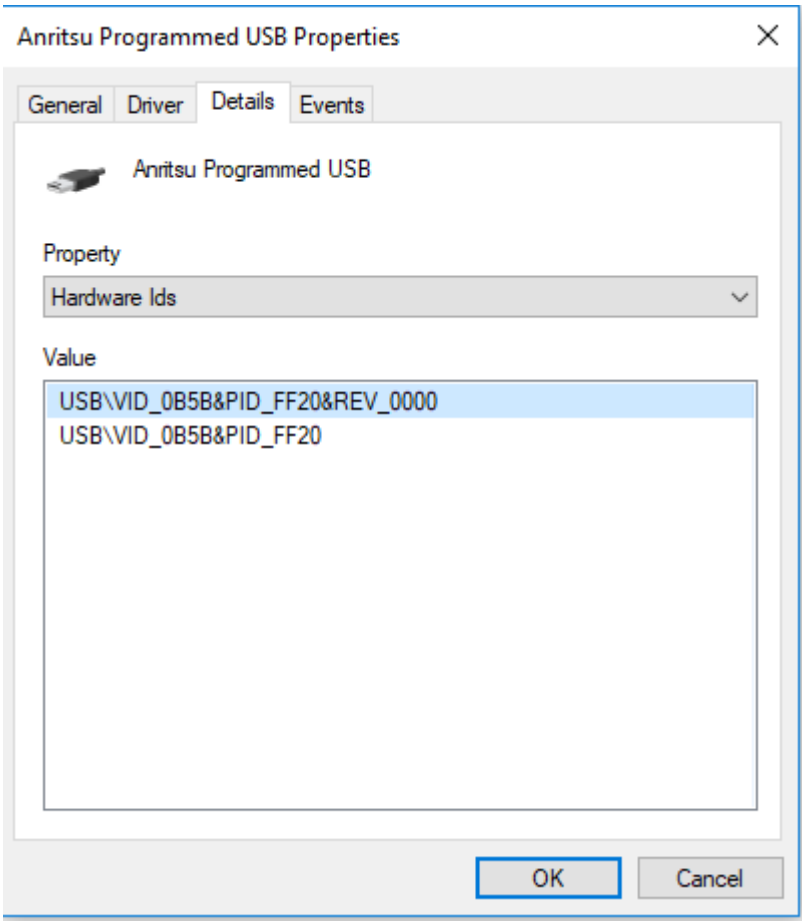


Figure D-2. ANRITSU PROGRAMMED USB PROPERTIES Dialog Box

3. If it is displayed as “Anritsu Programmed USB” with an exclamation mark on it, perform an uninstall and delete the drivers until it is removed under USB controllers. See Figure D-3.

Figure D-3. Confirm Device Uninstall

You might have to do this several times. However, if “No Hardware Detected” still appears in the PC Device Manager, please contact Anritsu Customer Service at:

https://www.anritsu.com/en-US/test-measurement/contact-us

Once it is installed successfully, it will appear in the Device Manager or Other Devices folder as in Figure D-1.

Then you can install the latest ShockLine software (if it’s not installed) and it will automatically install the drivers or install the drivers from “C:\Program Files (x86)\Anritsu Company\ShockLine\Application”.

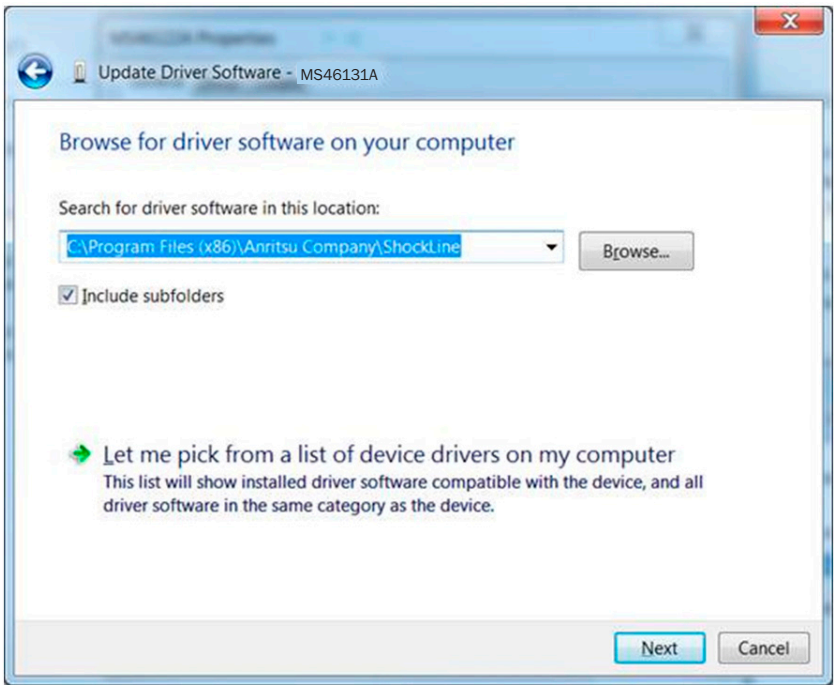


Figure D-4. Update Driver Software

D-3 Anritsu Hardware is Unavailable

ShockLine software and IVI Clients cannot run simultaneously on the same PC. If ShockLine software is running and an IVI client is being started, then the ShockLine GUI will be automatically stopped. But if an IVI client is running, the ShockLine GUI will not be able to start and the following error message will be displayed as shown in Figure D-5. If this occurs, wait until the IVI client finishes and retry after to run ShockLine GUI.

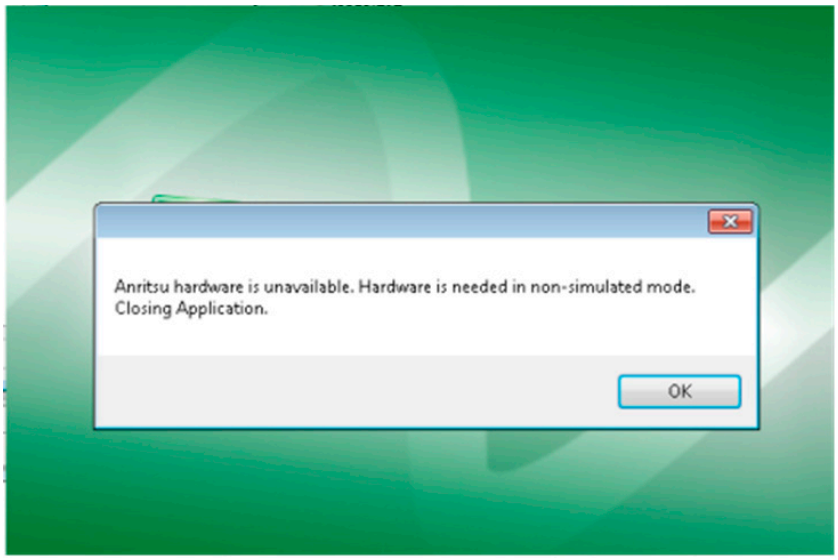


Figure D-5. Anritsu Hardware Is Unavailable

Or if the IVI client was not properly closed, then the IVI Server has to be manually restarted because the hardware was not released.

Restart IVI Server

The ShockLine Tray Daemon provides the Start IVI Server and Stop IVI Server user interface.

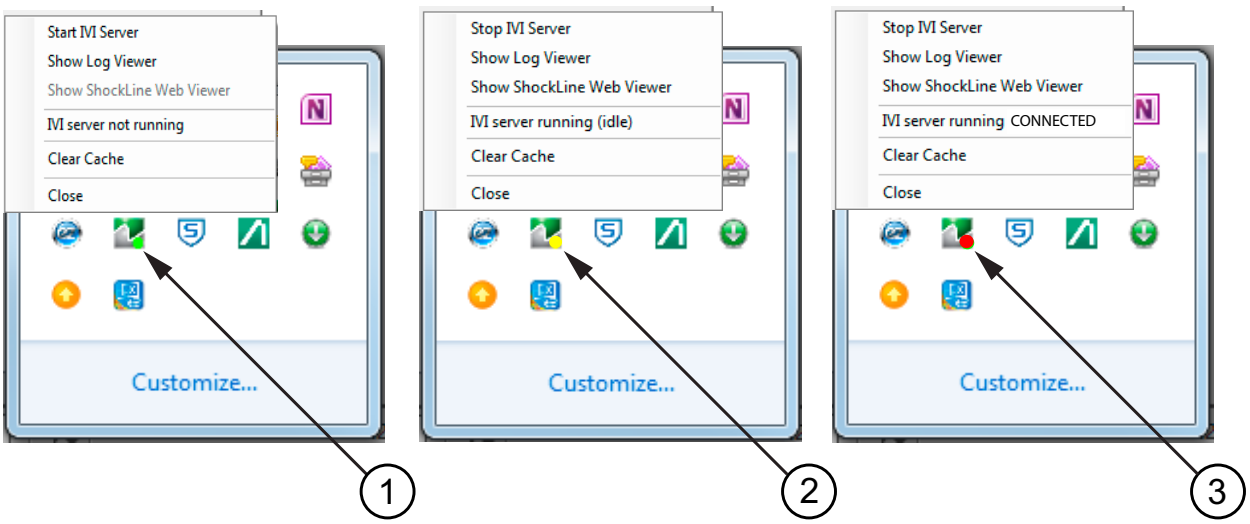


Figure D-6. ShockLine Tray Daemon

1. Green Indicator
2. Yellow Indicator
3. Red Indicator

Figure D-6. ShockLine Tray Daemon

Indicator Color Definitions

Green

When ShockLine Tray Daemon is green – the IVI Server is not running and that no IVI connections are available. Only ShockLine GUI can be used.

Yellow

When ShockLine Tray Daemon is yellow – the IVI Server is running. The IVI Clients or ShockLine GUI can be run.

Red

Note the tray menu provides two status states when Red.

- If the state is "CONNECTED" – currently an IVI Client is connected and the hardware is busy; therefore, ShockLine GUI could not be used.
- If the state is "WAITING" – waiting for an IVI Client, but the hardware is not busy; therefore, ShockLine GUI nor an IVI Client can be run.

D-4 Driver Initialization Error

If an error occurs when trying to initialize an IVI Client as in Figure D-7, then the IVI Server has to be restarted as described in "Anritsu Hardware is Unavailable" on page D-5.

Figure D-7. Driver Initialization Error

D-5 Application Launch Failure

In order to fix Application Launch Failure, perform the following.

1. Download the MVC++ 2015 package (if it's a 322/52X instrument you will need x86)
   - https://www.microsoft.com/en-us/download/confirmation.aspx?id=52685
2. Install the package
   - If it returns an error saying that the same package is already installed, you might have to uninstall the current version of MVC++ 2015 first.
3. Download the Shockline software.
   - https://www.anritsu.com/en-us/test-measurement/support/downloads/software/dwl18844

D-6 EEPROM Does Not Match (Firmware Update)

Note	Firmware updates only work properly if only one Anritsu ShockLine instrument is connected.

ShockLine software will poll the firmware version (EEPROM) on the MS46131A, and if the software has an updated firmware version it will ask the user if they would like to update the firmware on the VNA, as shown in Figure D-8. Users are recommended to always update firmware to the latest revision. Users must be in administrator mode in order to program the firmware.

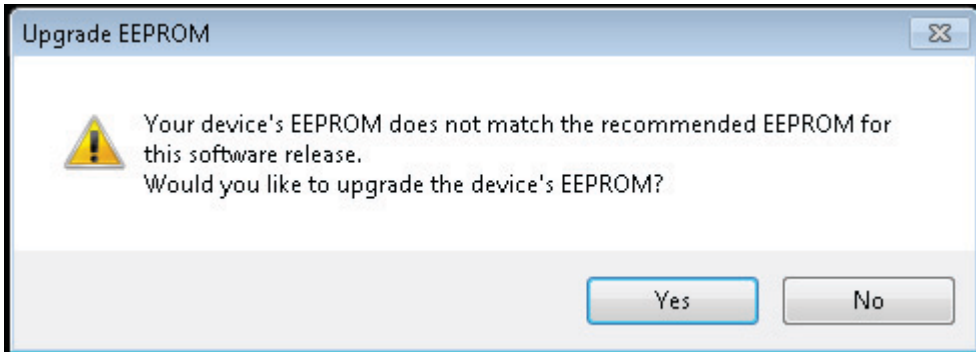


Figure D-8. EEPROM Does Not Match Warning Message

While the firmware update is proceeding, the message shown in Figure D-9 will be displayed. Do not cycle the power or close the application while the firmware update is in process.

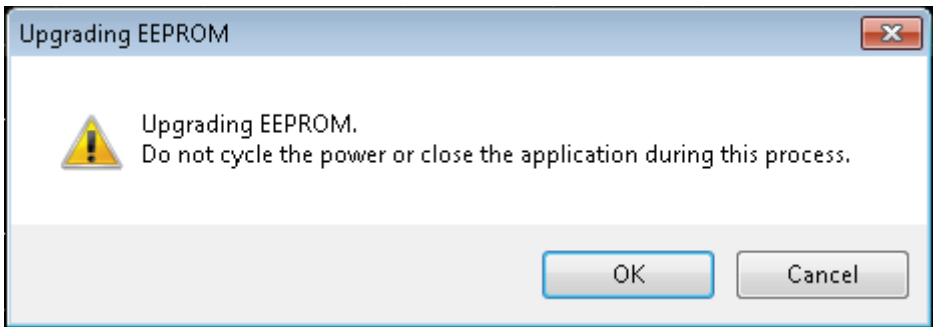


Figure D-9. Upgrading EEPROM (Firmware) Message

If the firmware update fails (see Figure D-10), but the display is active, proceed to the trouble-shooting tip: "Updating EEPROM Unsuccessful (Firmware Update Failed)".

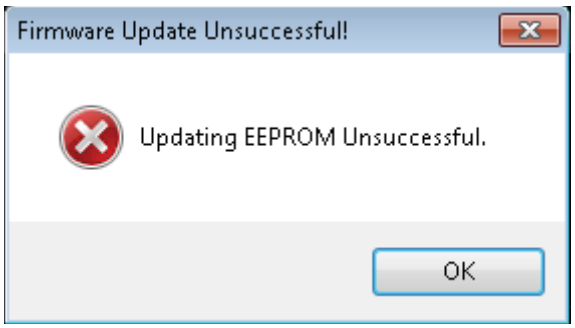


Figure D-10. Firmware Update Unsuccessful Message

If, after the firmware update has completed, the trace display is completely flat and remains so after a reset, or if the firmware update fails (see Figure D-10) and the trace display is completely flat, proceed to the trouble-shooting tip: "Traces Flat, No Sweeping".

D-7 Updating EEPROM Unsuccessful (Firmware Update Failed)

If the firmware update fails (see Figure D-10), but the trace display is active, either:

- Exit ShockLine, disconnect all USB devices but keyboard/mouse and Anritsu ShockLine instrument, then try again.

Note	Firmware updates only work properly if only one Anritsu ShockLine instrument is connected.

- Make sure the user is running ShockLine as Administrator.

or

- Try to update the firmware manually (see the trouble-shooting tip "Updating Firmware Manually").

Caution	Updating the firmware manually could result in an inoperable instrument, requiring assistance from Anritsu Customer Service.

D-8 Updating Firmware Manually

If the firmware update fails repeatedly, perform the following steps:

1. Launch ShockLine as Administrator.
2. Click No if prompted to update firmware on startup.
3. Navigate to UTILITIES > System.
4. Click Update FPGA (if ShockLine is not run as Administrator, this button will be disabled).
5. Navigate to C:\Program Files (x86)\Anritsu Company\ShockLine\Application\Firmware in the Updating Firmware dialog.
6. Select the folder that matches the attached instrument.

Caution	Attempting to load firmware for a non-matching instrument can render the instrument inoperable, and require a call to Anritsu Customer Service to get it working again.

7. Load the .fpga file from the selected folder.
8. Follow the prompts (may require closing the ShockLine application and/or rebooting).

Caution	If done incorrectly, manually updating the firmware can result in an inoperable instrument that will require help from Anritsu to get working again. Contact Anritsu Customer Service at: https://www.anritsu.com/en-US/test-measurement/contact-us

D-9 Traces Flat, No Sweeping

If, after a firmware update has completed, the port indicator is static and the trace display is completely flat and remains so after a preset, or if the firmware update fails (see Figure D-10) and the trace display is completely flat, perform the following steps:

1. Uninstall ShockLine software.
2. Uninstall IVI Shared Components software, if present.
3. Reboot the computer.
4. Re-install ShockLine software.

The MS46131A will successfully connect to ShockLine software and sweep without issue.

D-10 Text Size Too Large

Note	What is displayed on different versions of Windows may vary.

1. Exit the ShockLine application.
2. Navigate to where the ShockLine executable is located:
   a. Right click on the ShockLine application icon on the desktop.
   b. Select Open file location (`C:\Program Files (x86)\Anritsu Company\ShockLine \Application`).
3. Right-click on `AC_GUI_Main.exe` and select Properties.
4. Navigate to the Compatibility tab. Depending on your Windows version, this tab may vary.
   a. For Windows 7, the Compatibility tab looks like this. Uncheck Disable display scaling on high DPI settings:

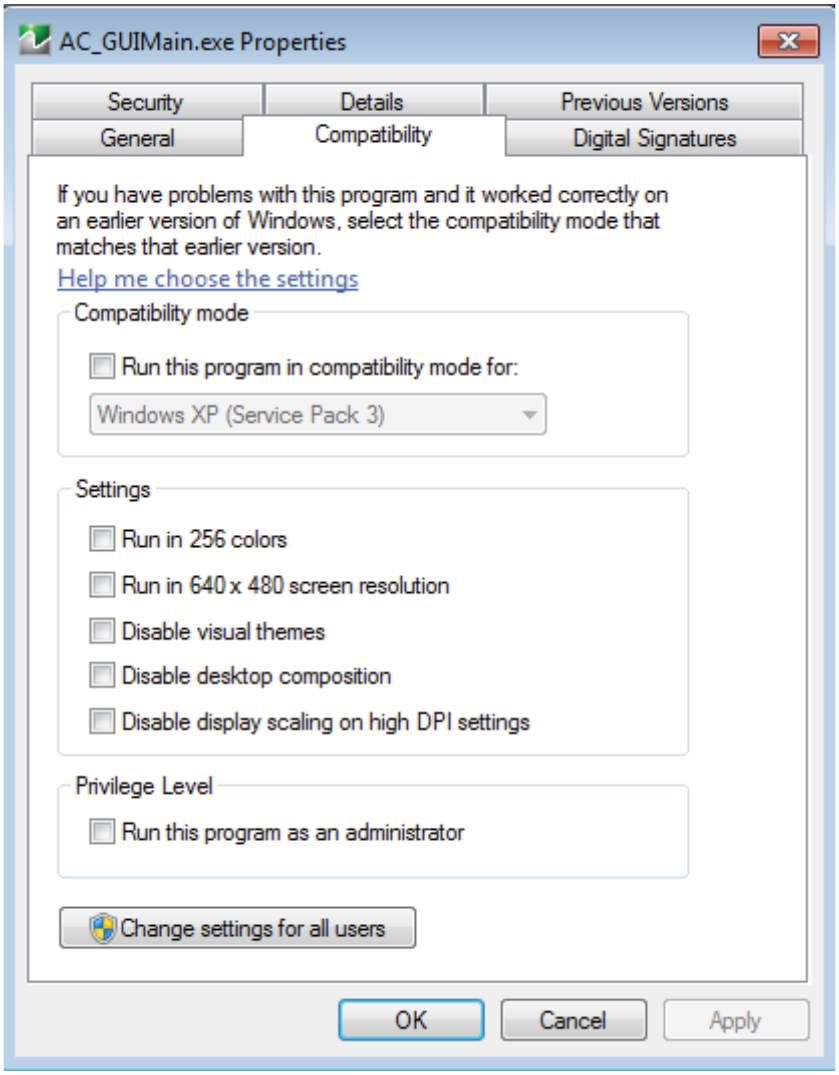


Figure D-11. Compatibility Tab: Windows 7 and Windows 10 version 1607 and prior

b. For Windows 10, the Compatibility tab looks like this:

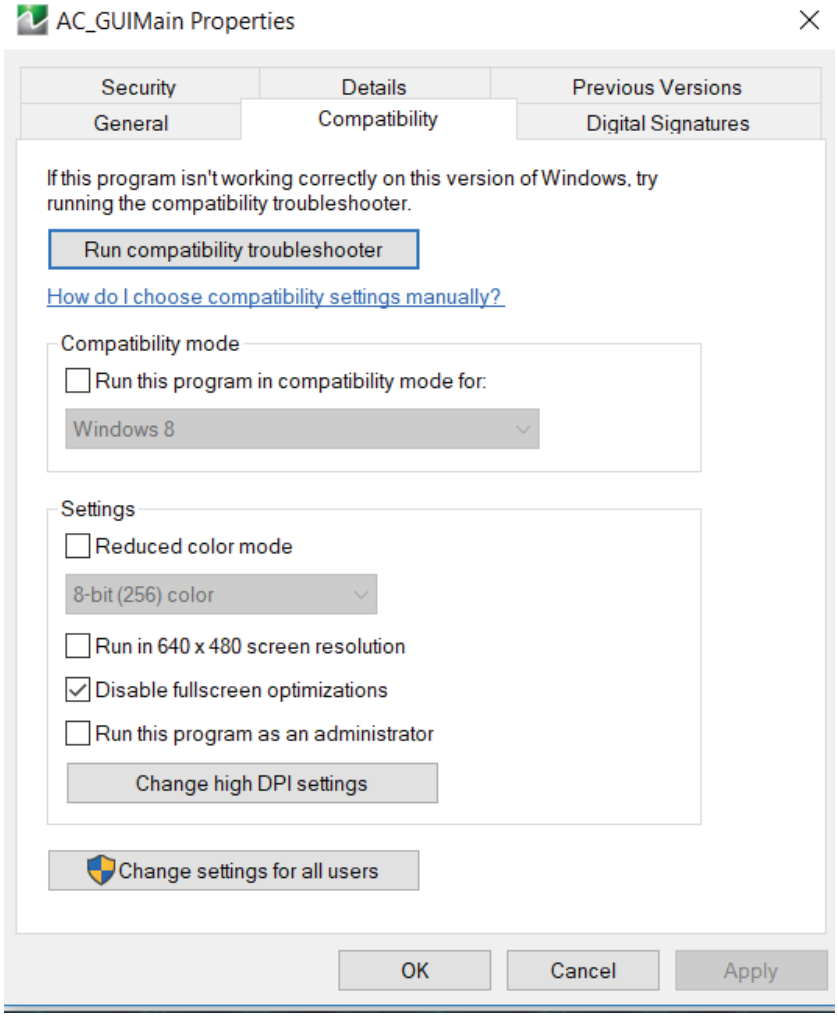


Figure D-12. Compatibility Tab: Windows 10 version 1703 and later

i. Click Change high DPI settings, which will display the following dialog:

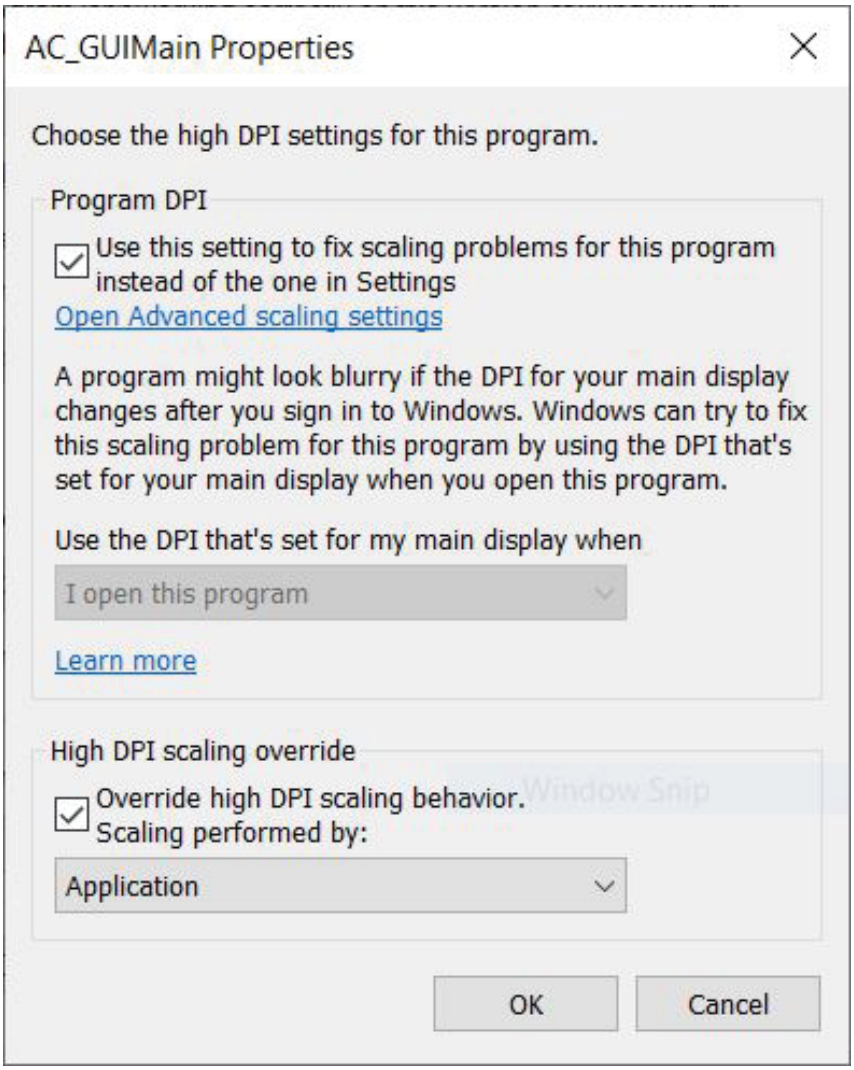


Figure D-13. Change High DPI Settings Dialog

ii. Select Use this setting to fix scaling problems for this program instead of the one in Settings.

iii. For Use the DPI that's set for my main display when, select I open this program.

iv. Select Override high DPI scaling behavior. Scaling performed by Application.

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A

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