Operation Manual

# ShockLine™
# MS46122A/B Series
# Compact Vector Network Analyzer

**MS46122A/B-010, 1 MHz to 8 GHz, 2-Port**
**MS46122A/B-020, 1 MHz to 20 GHz, 2-Port**
**MS46122A/B-040, 1 MHz to 43.5 GHz, 2-Port**
**MS46122B-043, 1 MHz to 43.5 GHz, 2-Port**


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# Chapter Descriptions

### Chapter 1 — Overview
This chapter provides an overview of the ShockLine™ MS46122A/B 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 — Front and Rear Panels
The chapter provides an overview of the MS46122A/B Series VNA hardware user interface including front panel buttons and front panel connectors. Included are photographs of the front and rear panels. Each port and connector is described with its connector type, its function, input/output limits, and a cross-reference to a detailed connector pin-out diagram.

### Chapter 3 — Installation
This chapter provides information for the initial inspection and preparation for use of the ShockLine MS46122A/B 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 MS46122A/B 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 MS46122A/B 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 MS46122A/B. Tips include:

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# Chapter 1 — Overview

## 1-1 Introduction

This chapter provides an overview of the ShockLine™ MS46122A/B 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 MS46122A/B Series VNA Description

The ShockLine MS46122A/B Series VNA is an instrument system that contains a built-in source, test set, and analyzer. The MS46122A/B is a 2-port Compact USB VNA that is controlled from an external pc running ShockLine software. Designed for simple engineering, manufacturing, and educational applications, the MS46122A/B 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 MS46122A/B Series VNA provides a maximum frequency range from 1 MHz to 43.5 GHz. The MS46122A/B 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.** MS46122B Front Panel

### ShockLine MS46122A/B Series VNA Models

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

**Table 1-1.** ShockLine MS46122A/B Series VNA Models

| VNA Model Number | Name | Specifications | Test Port Connectors |
|---|---|---|---|
| MS46122A/B-010 | Compact Vector Network Analyzer | 1 MHz – 8 GHz | N(f) Connector Test Ports (2) |
| MS46122A/B-020 | Compact Vector Network Analyzer | 1 MHz – 20 GHz | K(m) Connector Test Ports (2) |
| MS46122A/B-040 | Compact Vector Network Analyzer | 1 MHz – 43.5 GHz | K(m) Connector Test Ports (2) |
| MS46122B-043 | Compact Vector Network Analyzer | 1 MHz – 43.5 GHz | Extended-K™(m) Connector Test Ports (2) |

| Option | Descriptions |
|---|---|
| MS46122A/B-002 | Time Domain with Time Gating |

# 1-3 ShockLine MS46122A/B VNA Instrument Control

Other than test connectors, I/O connectors, and the standby power switch, there are no user controls on the front panel. The ShockLine MS46122A/B Series VNA is controlled and operated by an external PC controller loaded with ShockLine Software.

| | |
|---|---|
| **Note** | The PC Controller is an External Computer which is not provided. Windows 7, Windows 8 or Windows10 is required to run the ShockLine software that controls the MS46122A/B series VNA. The ShockLine Software is provided on the Anritsu website at: http://www.anritsu.com |

### The MS46122A/B Series VNA is controlled via:

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

### 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 Mini-B Connector | 3-2000-1498 |
| Rack Ear Hardware | 3-80790 |

# 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.

### Verification Kits

Verification kits can be used with the provided software and data to verify the calibration and resulting performance of the ShockLine MS46122A/B Series VNA. The applicable calibrations are Short-Open-Load-Thru (SOLT) using the Mechanical Cal kits.

## 1-6 User Documentation

The following ShockLine MS46122A/B 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

- MS46122A Series VNA Technical Data Sheet – 11410-00822
- MS46122B Series VNA Technical Data Sheet – 11410-00995
- MS46122A/B Series VNA Operation Manual – 10410-00340
- MS46122A/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
- MS46122A/B Series VNA Maintenance Manual – 10410-00341
- MS46122A/B Series VNA User Documentation – 2300-559-R

### Documentation Conventions

The following conventions are used throughout the entire MS46122A/B 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.
- MS46122A/B Series VNA refers to any of the VNAs in the MS46122A/B family.
- The specific model number, such as MS46122A/B-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 MS46122A/B 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.
```

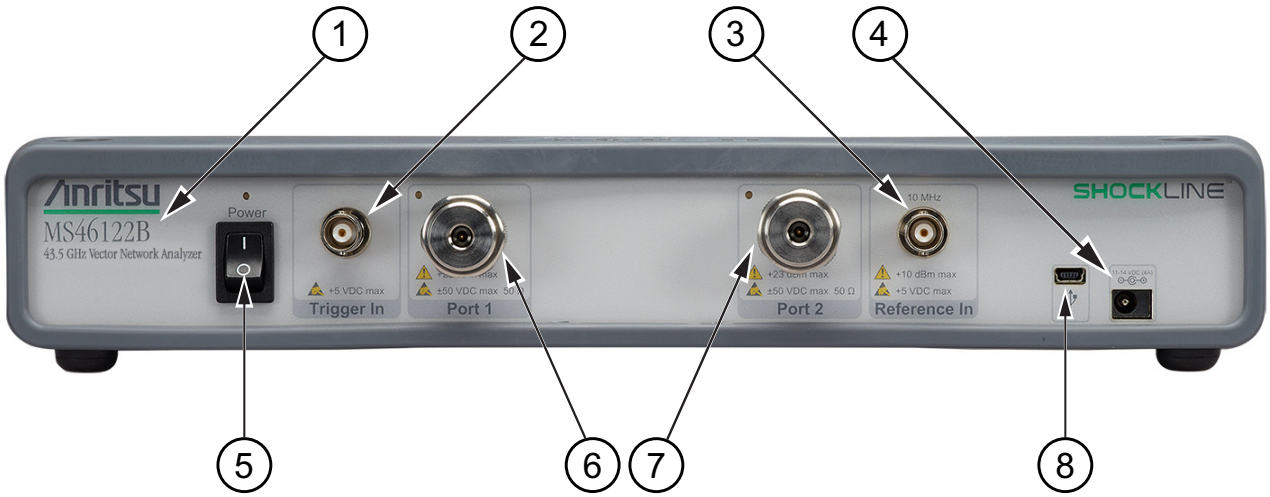
# Chapter 2 — Front and Rear Panels

## 2-1 Chapter Overview

The chapter provides an overview of the MS46122A/B Series VNA hardware user interface including front panel buttons and front panel connectors. Included are photographs of the front and rear panels. Each port and connector is described with its connector type, its function, input/output limits, and a cross-reference to a detailed connector pin-out diagram.

## 2-2 Front Panel Components

The MS46122A/B Series VNA front panel and port connectors are identified below in Figure 2-1.

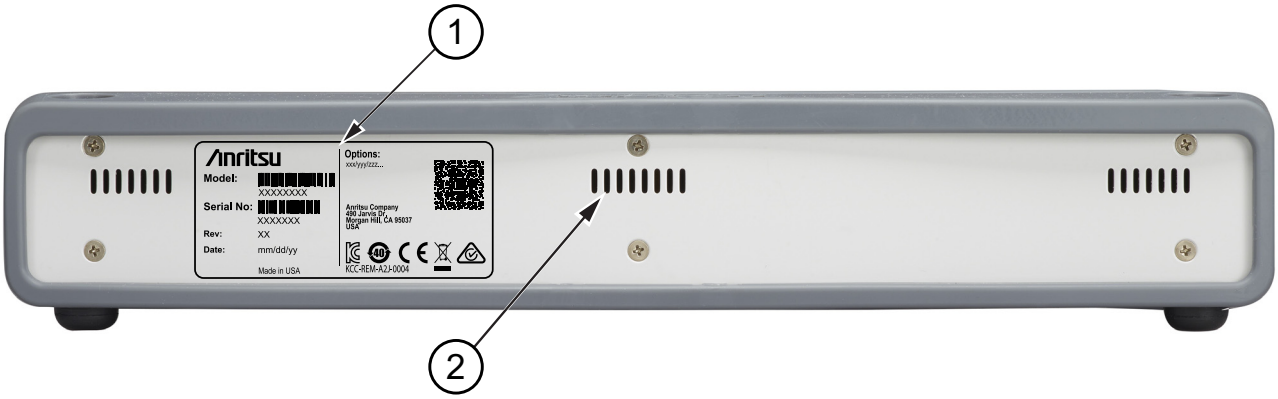



| | |
|---|---|
| 1. ID Plate – Instrument model number identification | 5. Operate / Standby Power Switch |
| 2. Trigger In | 6. Test Port 1 – K(m) or N(f) |
| 3. 10 MHz External Reference Input | 7. Test Port 2 – K(m) or N(f) |
| 4. DC Power Supply Connector | 8. USB Port |

**Figure 2-1.** MS46122A/B VNA Front Panel

# 2-3 Rear Panel Components

The MS46122A/B Series VNA rear panel is shown below Figure 2-2, “MS46122A/B Rear Panel”.




| 1. Serial Number and Model Number Label | 2. Air Flow Vent (one of three) |
|---|---|

**Figure 2-2.** MS46122A/B Rear Panel

The label that is attached to the rear panel displays the:

- Anritsu Company logo
- Serial number
- Model number
- Revision (Rev) number
- Date of manufacture
- Options installed
- Compliance markings
- Identification barcode

# Chapter 3 — Installation

## 3-1 Introduction

This chapter provides information for the initial inspection and preparation for use of the ShockLine MS46122A/B 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 MS46122A/B 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 MS46122A/B 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.

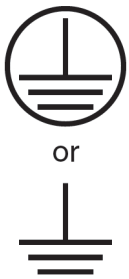
## 3-3 Operating Environment and Power Requirements

Before installing the ShockLine MS46122A/B Series VNA in its operating environment, ensure airflow passages around the instrument are clear. Proper ventilation is of particular importance whenever the unit is being rack mounted. The ShockLine MS46122A/B 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 3)** | |
| Operating Temperature Range: | 0 to +50 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: | 550 VA maximum |
| Installation Category: | The ShockLine MS46122A/B Series VNA is intended for Installation Category (Over-voltage Category) II |

**Warning**



or

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.

## 3-4 Power-On/Power-Off Procedures

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

| | |
|---|---|
| **Note** | Unplugging the instrument, turning the standby power switch to off, or unplugging the usb cable when the unit is in operate mode will cause the ShockLine software interface to close. A popup 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. |


| | |
|---|---|
| 1. Standby Power Switch | 2. Power Supply Input Connection |

**Figure 3-1.** Front Panel Power Connection to AC Mains Power

### Procedure – Power-On to Standby Mode

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 front of the MS46122A/B. See Figure 3-1
2. Connect the AC power cord to local AC mains power.
3. Turn on the standby power switch. The MS46122A/B is now in standby mode.

## Procedure – Standby Mode to Operate Mode

To set the instrument to operate mode:

- Connect the MS46122A/B to the user provided PC via the USB cable included with the unit.
- Start the ShockLine software by double clicking the ShockLine icon on the desktop.
- When fully in operate mode, the computer controlling the ShockLine MS46122A/B Series VNA displays the main trace display with the application menus on the right side. See Figure 4-1, "User Interface - Four Traces - FREQUENCY Menu (simulated data)" for a typical full screen display.

| | |
|---|---|
| **Note** | When placing the ShockLine MS46122A/B 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 3-2.** ShockLine Series VNA Startup Splash Screen

## Procedure – Power-Off

Turn off the instrument by toggling the front panel standby power switch and unplugging the external power supply. Shutting down the ShockLine software on the external pc does not power down the MS46122A/B hardware. After turning off the instrument, you must wait at least 15 seconds before turning the instrument back on again. This delay is required to assure a reliable cold start. Switching off the standby power switch or unplugging the external power supply from the VNA will cause the ShockLine software on the external pc controlling the unit to shutdown.

# 3-5 External Control of ShockLine VNA

## Connecting the External Computer

After unpacking, the ShockLine MS46122A/B Series VNA is ready for use. In order to enable the ShockLine VNA application to control the MS46122A/B, you must connect a USB A to Mini-B cable between the VNA and to an external computer loaded with the ShockLine software.


1. Mini USB Port

**Figure 3-3.** ShockLine MS46122A/B 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 MS46122 VNA
- Graphical User Interface (GUI) control or remote SCPI or IVI-C programming and interfacing

The MS46122A/B 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 MS46122A/B VNA to the PC controller USB port.
2. Download and install the MS46122A/B 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=MS46122B%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.

| | |
|---|---|
| **Note** | By default the ShockLine application is designed to run in Admin mode. To change the default, right-click on the ShockLine application icon and then select Properties. In Properties select the Shortcut tab and the Advance button. In the Advanced Properties dialog, uncheck the Run as administrator box and then OK. Now users with standard access to the PC will be able to log into the PC and access the ShockLine application. |

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/default?q=mechanical+calibration+kit&sort=date:D:L:d1#q=MS46122B%20IVI
7. Double click the ShockLine desktop icon to launch the ShockLine software to use the MS46122A/B 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 3-4. If you want to run in Simulation mode, go to Section 3-8 "Simulation Mode" on page 3-6.

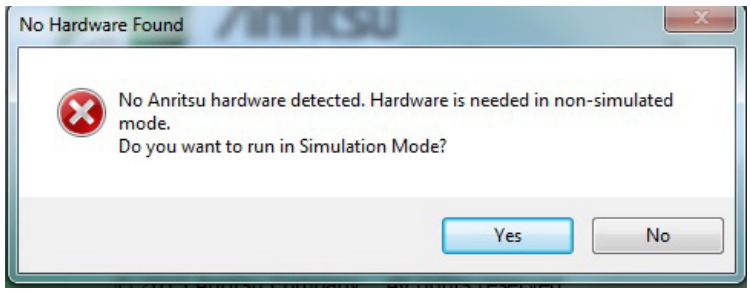



**Figure 3-4.** No Hardware Prompt

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

| | |
|---|---|
| **Note** | By default the ShockLine application is designed to run in Admin mode. To change the default, one can right-click on the ShockLine application icon and then select Properties. In Properties select the Shortcut tab and the Advance button. In the Advanced Properties dialog, uncheck the Run as administrator box and then OK. Now users with standard access to the PC will be able to log into the PC and access the ShockLine application. |

If no GUI interface is displayed, then un-plug and re-plug the VNA USB to the controller and then reopen the ShockLine software.

3. 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).
4. 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 MS46122A/B 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 Drive/Firmware/Software download library located at:
https://www.anritsu.com/en-US/test-measurement/support/downloads?model=MS46122B

1. Download the ShockLine VNA software from the Download Library:
    - Once the ShockLine software is loaded onto your PC, the initial startup screen will appear as shown in Figure 3-5.


**Figure 3-5.** ShockLine GUI Initialization Screen

2. From the NO HARDWARE FOUND dialog box, Figure 3-6, 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.

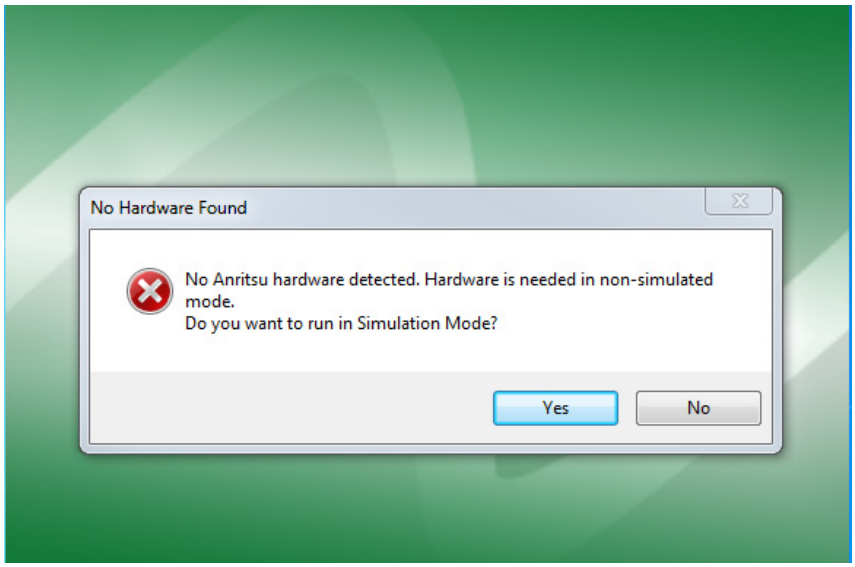



**Figure 3-6.** ShockLine GUI Initialization Screen

3. Once Simulation Mode is selected, the default menu screen appears, see Figure 3-7.
4. Select the menu/option configuration that you wish to simulate.

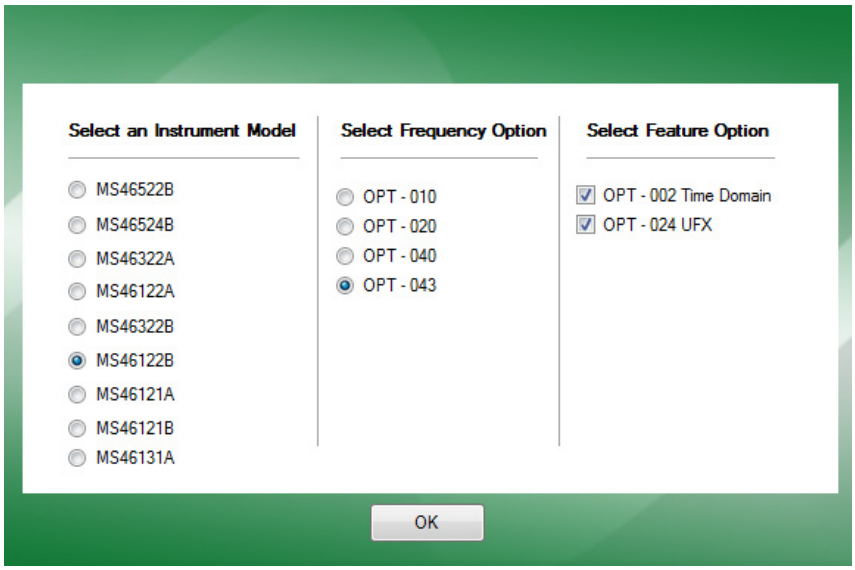



**Figure 3-7.** Simulator Select Instrument

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 MS46122A/B 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

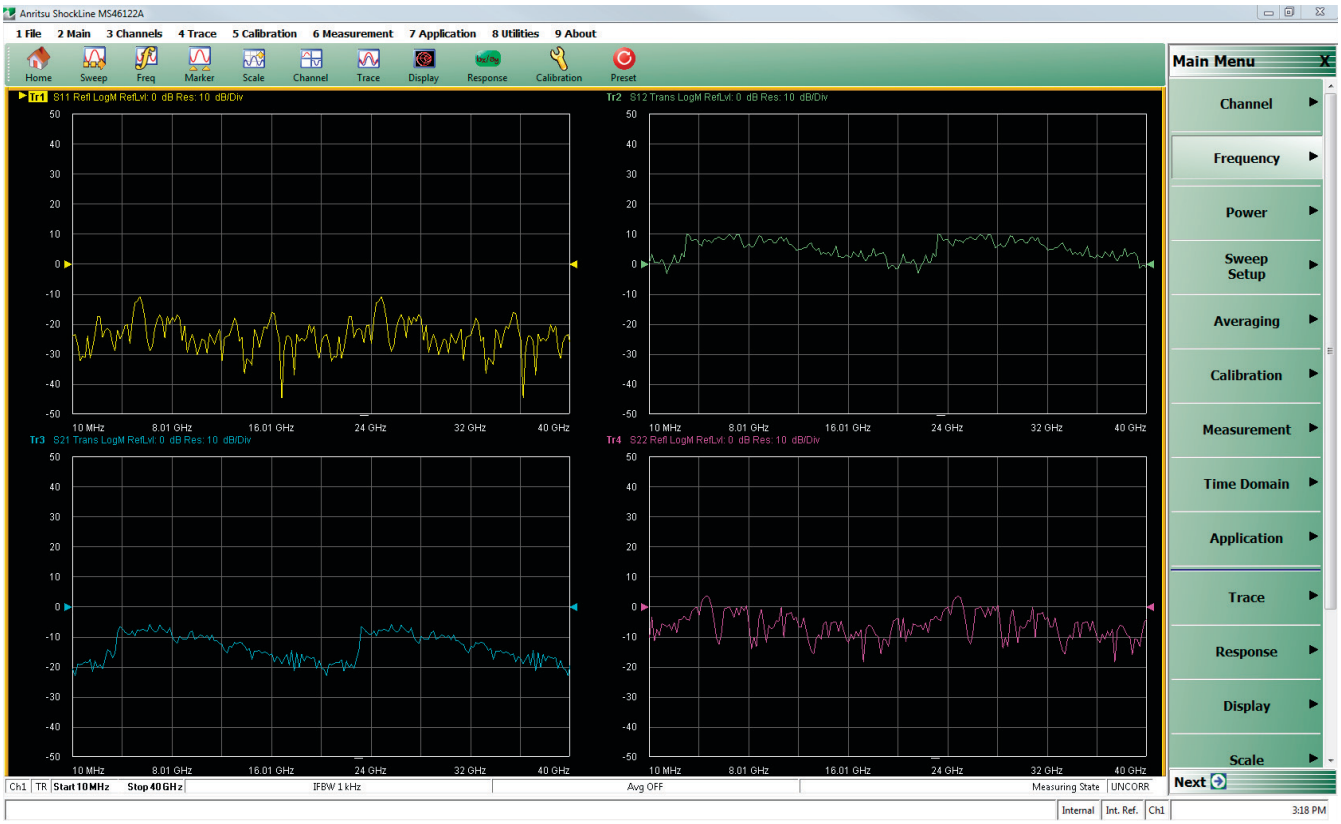
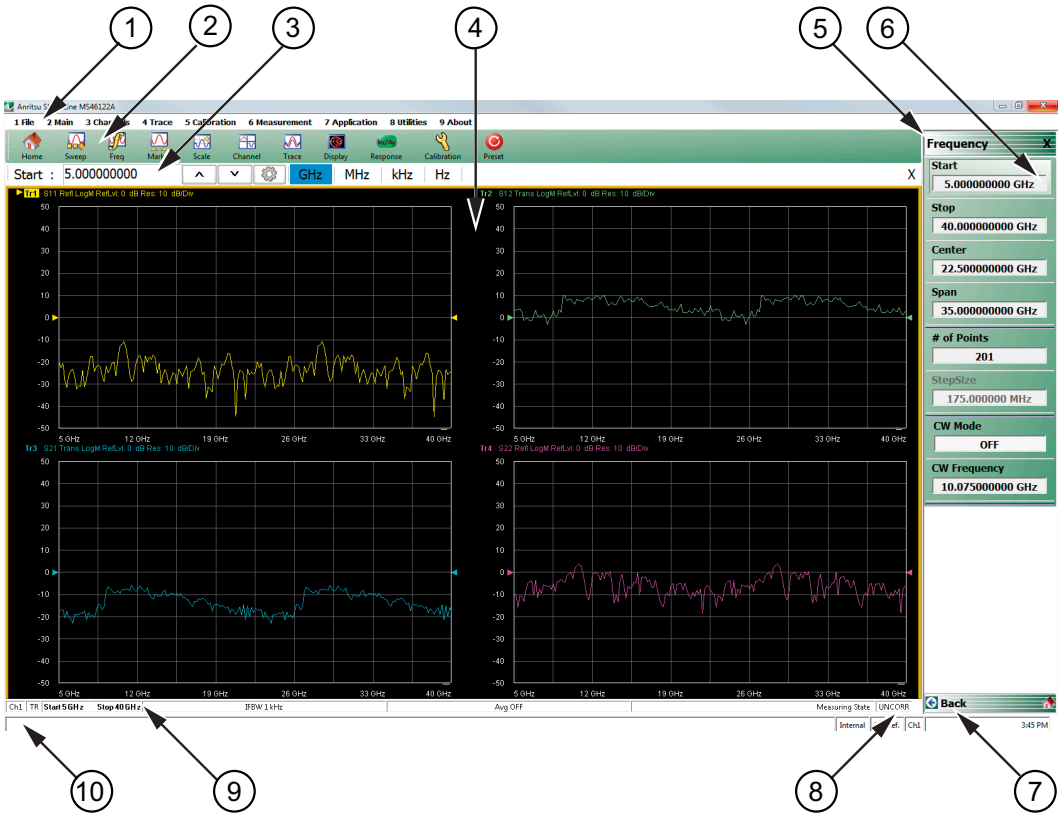



**Figure 4-1.** User Interface - Four Traces - FREQUENCY Menu (simulated data)

## 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 MS46122A/B 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 - 12 Traces (simulated data)

| | |
|---|---|
| 1. Three Traces per screen (4 Screens / 12 Traces) | 3. TRACE Menu |
| 2. Arrow Pointing to Active Trace | 4. Number of Traces Selected for Viewing |

## Function Access

The ShockLine MS46122A/B 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 20 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 - 12 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.

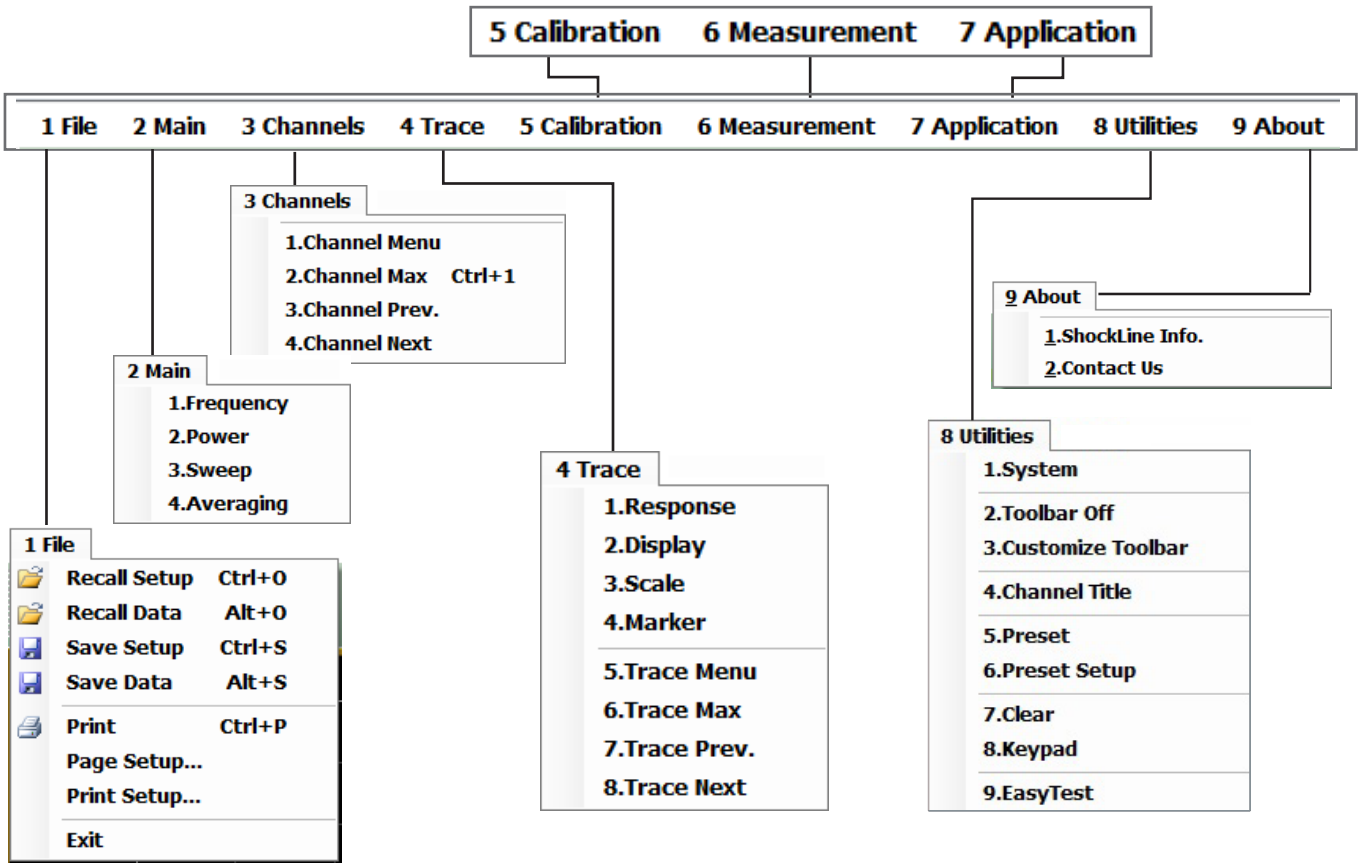



**Figure 4-5.** Menu Bar Major Functions, Drop-Down Menus, and Commands

## 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)

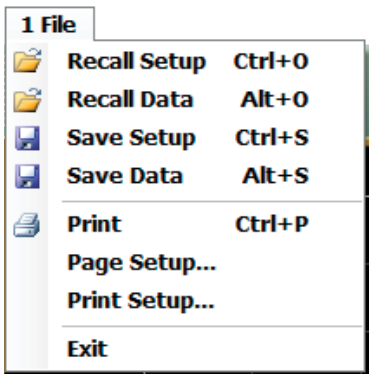
| Menu and Command Name | Menu and Command Descriptions |
|---|---|
| **FILE Drop-Down Menu** |  <br>• Keyboard: ALT + 1<br>• Menu Bar \| File<br>• MAIN \| File \| FILE |
| **Recall Setup Command** | Select displays the RECALL SETUP dialog box and allows the recall of previously saved setup and/or calibration files:<br>– Active Channel Setup and Calibration (.chx) File<br>– Active Channel Setup (.stx) File<br>– All Channel Setup (.sta) File<br>• Keyboard: CTRL + O (letter O)<br>• Menu Bar \| File \| Recall Setup<br>• 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:<br>– Active Channel S1P (.s1p), S2P (.s2p), S3P (.s3p), S4P (.s4p) Files<br>– Formatted Data into Active Trace (.tdf) File<br>– Unformatted Data into Active Trace (.tdu) File<br>– Formatted Data into Active Trace Memory (.tdf) File<br>– Unformatted Data into Active Trace Memory (.tdu) File<br>• Keyboard: ALT + O (letter O)<br>• Menu Bar \| File \| Recall Data<br>• 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.<br>• Keyboard: CTRL + S<br>• Menu Bar \| File \| Save Setup<br>• 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.<br>• Keyboard: ALT + S<br>• Menu Bar \| File \| Save Data<br>• MAIN \| File \| FILE \| Save Data \| SAVE DATA Dialog Box |
| **Print Command** | Select displays the Windows PRINT dialog box to print the current main display.<br>• Keyboard: CTRL + P<br>• Menu Bar \| File \| Print<br>• 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.<br>• Menu Bar \| File \| Exit |

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

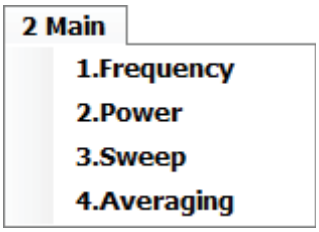
| Menu and Command Name | Menu and Command Descriptions |
|---|---|
| **MAIN Drop-Down Menu** |  <br>• Keyboard: ALT + 2<br>• Menu Bar \| Main |
| **Frequency Command** | Select displays the right-side FREQUENCY menu.<br>• Front Panel Key: **Frequency**<br>• Keyboard: ALT + 2, then 1<br>• Menu Bar \|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

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

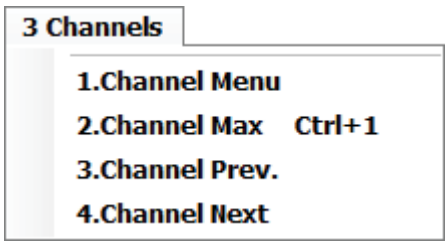
| Menu and Command Name | Menu and Command Descriptions |
|---|---|
| **CHANNELS Drop-Down Menu** |  <br>• Keyboard: ALT + 3<br>• Menu Bar \| Channels<br>• MAIN \| Channel \| CHANNEL |
| **Channel Menu Command** | Select displays the right-side CHANNEL menu.<br>• Keyboard: ALT + 3, then 1<br>• Menu Bar \| Channels \| Channel Menu<br>• MAIN \| Channel \| CHANNEL |
| **Channel Max Command** | Select maximizes the display of the active channel. Select again returns to the previous multi-channel display.<br>• Keyboard: ALT + 3, then 2<br>• Keyboard: CTRL + 1<br>• Menu Bar \| Channels \| Channel Max<br>• 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.<br>• Keyboard: ALT + 3, then 3<br>• Menu Bar \| Channels \| Channel Prev.<br>• 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.<br>• Keyboard: ALT + 3, then 4<br>• Menu Bar \| Channels \| Channel Next<br>• MAIN \| Channel \| CHANNEL \| Chan. Next |

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

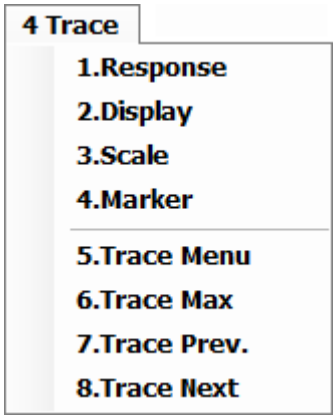
| Menu and Command Name | Menu and Command Descriptions |
|---|---|
| **TRACE Drop-Down Menu** |  <br>• Keyboard: ALT + 4<br>• Menu Bar \| Trace<br>• MAIN \| Trace \| TRACE |
| **Response Command** | Select displays the right-side RESPONSE menu.<br>• Keyboard: ALT + 4, then 1<br>• Menu Bar \| Trace \| Response<br>• MAIN \| Response \| RESPONSE |
| **Display Command** | Select displays the right-side DISPLAY menu.<br>• Keyboard: ALT + 4, then 2<br>• Menu Bar \| Trace \| Display<br>• 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:<br>– Scale (Log Mag)<br>– Scale (Lin Mag)<br>– Scale (Phase)<br>– Scale (Real)<br>– Scale (Imag)<br>– Scale (SWR)<br>• Keyboard: ALT + 4, then 3<br>• Menu Bar \| Trace \| Scale<br>• MAIN \| Scale \| SCALE |
| **Marker Command** | Select displays the right-side MARKERS [1] menu.<br>• Keyboard: ALT + 4, then 4<br>• Menu Bar \| Trace \| Marker<br>• MAIN \| Marker \| MARKER [1] |
| **Trace Menu Command** | Select displays the right-side TRACE menu.<br>• Keyboard: ALT + 4, then 5<br>• Menu Bar \| Trace \| Trace Menu<br>• MAIN \| Trace \| TRACE |

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

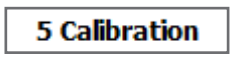
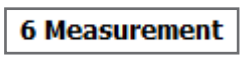
| Menu and Command Name | Menu and Command Descriptions |
|---|---|
| **Trace Max Command** | Select maximizes the active trace to full screen display. Selecting again, returns the trace to the standard multi-trace display.<br>• Keyboard: ALT + 4, then 6<br>• Menu Bar \| Trace \| Trace Max<br>• MAIN \| 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.<br>• Keyboard: ALT + 4, then 7<br>• Menu Bar \| Trace \| Trace Prev.<br>• 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.<br>• Keyboard: ALT + 4, then 8<br>• Menu Bar \| Trace \| Trace Next<br>• MAIN \| Trace \| TRACE \| Trace Previous |
| **CALIBRATION Drop-Down Menu** |  <br>The CALIBRATION drop-down menu has one command that selects the right-side CALIBRATION menu<br>• Keyboard: ALT + 5<br>• Menu Bar \| Calibration<br>• MAIN \| Calibration \| CALIBRATION |
| **MEASUREMENT Drop-Down Menu** |  <br>Select displays the right-side MEASUREMENT menu.<br>• Keyboard: ALT + 6<br>• Menu Bar \| Measurement<br>• MAIN \| Measurement \| MEASUREMENT |
| **APPLICATION Drop-Down Menu** |  <br>The APPLICATION menu/command selects the right-side APPLICATION menu.<br>• Keyboard: ALT + 7<br>• Menu Bar \| Application<br>• 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** |  <br>• Keyboard: Alt + 8<br>• Menu Bar \| Utilities |
| **System Command** | Select displays the right-side SYSTEM menu.<br>• Keyboard: Alt + 8, then 1<br>• Menu Bar \| Utilities \| System<br>• MAIN \| System \| SYSTEM |
| **Toolbar Off Command** | Toggles the ICON TOOLBAR, immediately below the Menu Bar, on and off.<br>• Keyboard: Alt + 8, then 2<br>• 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 20 icons can be displayed at one time. The Icon Toolbar configuration is saved when a Preset Save is completed.<br>• Keyboard: Alt + 8, then 3<br>• 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.<br>• Keyboard: Alt + 8, then 4<br>• Menu Bar \| Utilities \| Channel Title<br>• 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.<br>• Keyboard: Alt + 8, then 5<br>• Menu Bar \| Utilities \| Preset<br>• No right-side menu available to preset the instrument:<br>– 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.<br>• Keyboard: Alt + 8, then 6<br>• 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.<br>• Keyboard: Alt + 8, then 7<br>• 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.<br>• Keyboard: Alt + 8, then 8<br>• Menu Bar \| Utilities \| KeyPad Off Command |

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

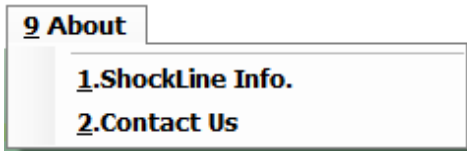
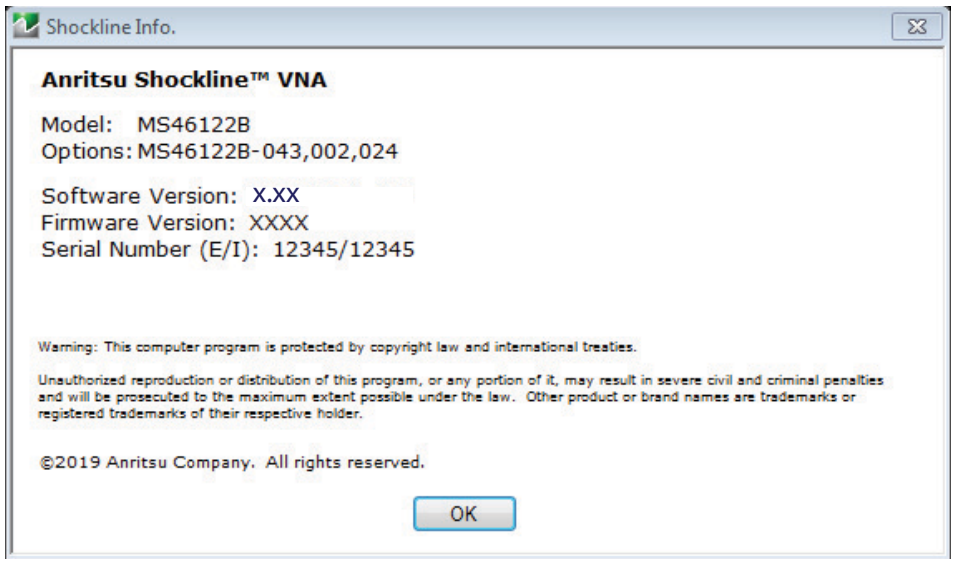
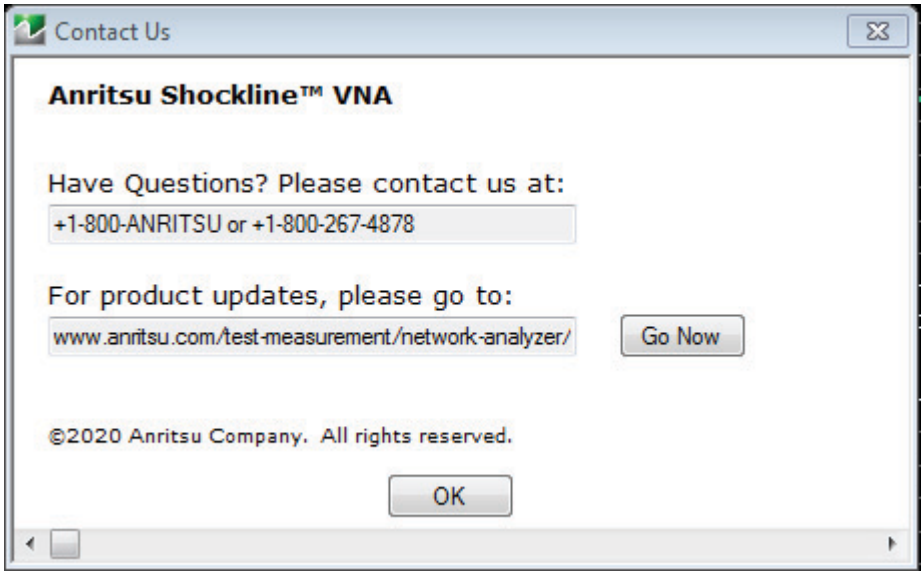
| Menu and Command Name | Menu and Command Descriptions |
|---|---|
| **About Drop-Down Menu** |  <br>• Keyboard: ALT + 9<br>• Menu Bar \| About |
| **ShockLine Info Command** | Select displays the SHOCKLINE INFO dialog box with typical information as shown below.<br>  <br>The dialog box provides instrument configuration information. Click OK to close the dialog box. The following information is provided:<br>– Copyright Statement<br>– Software Version<br>– Firmware Version<br>– Model Number<br>– Serial Number<br>– Options Installed<br><br>**Keypad**<br>• Keyboard: ALT + 9, then 1<br>• 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 20 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 4-2. 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 4-24. When a user-defined toolbar is configured, the first selected icon goes to the left-most position on the toolbar. Subsequent selected icons are added to the right-most position on the toolbar.

**Table 4-2.** Icon Descriptions - Listed Alphabetically (1 of 6)

| Icon Name | Icon | Description |
|---|---|---|
| ***Icon Description Definitions*** | | **Default Icons** – These are one of the 11 default icons and are provided after a return to the factory standard configuration.<br>**Keyboard** – If available, the keyboard shortcut to access this menu or function.<br>**Menu Bar** – If available, navigation path to access this menu or function.<br>**Navigation** – To navigate to this menu or function from the MAIN menu.<br>**Description** – If available, where this menu, dialog box, or function is described in greater detail in this document. |
| **Application Icon** |  <br>Application | Select displays the right-side APPLICATION menu.<br>• Front Panel Key: **Application**<br>• Keyboard: ALT + 6<br>• Menu Bar: MENU BAR \| 6 Application \| 6 APPLICATION<br>• MAIN \| Application \| APPLICATION |
| **Average Icon** |  <br>Average | Default Icon. Select displays the right-side AVERAGING menu.<br>• Front Panel Key: **Avg (Average)**<br>• Keyboard: ALT + 2, then 4<br>• MENU BAR \| Channel \| Averaging<br>• MAIN \| Averaging \| AVERAGING |
| **Calibration Icon** |  <br>Calibration | Default Icon. Select displays the right-side CALIBRATION menu.<br>• Keyboard: ALT + 5<br>• Menu Bar \| Calibration<br>• MAIN \| Calibration \| CALIBRATION |
| **Continue Icon** |  <br>Continue | After a system pause or hold with the Hold icon, the Continue icon resumes operation with all prior settings in effect.<br>• MAIN \| Sweep Setup \| SWEEP SETUP \| Hold Functions \| HOLD FUNCTIONS \| Continue |
| **Channel Icon** |  <br>Channel | Default Icon. Select displays the right-side CHANNEL menu.<br>• Front Panel Key: **Channel**<br>• MAIN \| Channel \| Channel Menu |
| **Ch->Max Icon** |  <br>Ch->Max | When multiple channels are used, select activates and displays the channel with the maximum trace value.<br>• MAIN \| Channel \| CHANNEL \| Channel Max |

**Table 4-2.** Icon Descriptions - Listed Alphabetically (2 of 6)

| Icon Name | Icon | Description |
|---|---|---|
| ***Icon Description Definitions*** | | **Default Icons** – These are one of the 11 default icons and are provided after a return to the factory standard configuration.<br>**Keyboard** – If available, the keyboard shortcut to access this menu or function.<br>**Menu Bar** – If available, navigation path to access this menu or function.<br>**Navigation** – To navigate to this menu or function from the MAIN menu.<br>**Description** – If available, where this menu, dialog box, or function is described in greater detail in this document. |
| **Ch->Next Icon** |  | 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.<br>• MAIN \| Channel \| CHANNEL \| Channel Next |
| **Ch->Prev Icon** |  | 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.<br>• MAIN \| Channel \| CHANNEL \| Channel Prev. |
| **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.<br>The steps to define a Custom-action Icon are described in the *MS46121A/B, MS46122A/B, MS46131A, MS46322A/B 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.<br>The steps to define a Custom-action Icon are described in the *MS46121A/B, MS46122A/B, MS46131A, MS46322A/B 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.<br>The steps to define a Custom-action Icon are described in the *MS46121A/B, MS46122A/B, MS46131A, MS46322A/B 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.<br>The steps to define a Custom-action Icon are described in the *MS46121A/B, MS46122A/B, MS46131A, MS46322A/B 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.<br>The steps to define a Custom-action Icon are described in the *MS46121A/B, MS46122A/B, MS46131A, MS46322A/B User Interface and Reference Manual* (10410-00337). |

**Table 4-2.** Icon Descriptions - Listed Alphabetically (3 of 6)

| Icon Name | Icon | Description |
|---|---|---|
| ***Icon Description Definitions*** | | **Default Icons** – These are one of the 11 default icons and are provided after a return to the factory standard configuration.<br>**Keyboard** – If available, the keyboard shortcut to access this menu or function.<br>**Menu Bar** – If available, navigation path to access this menu or function.<br>**Navigation** – To navigate to this menu or function from the MAIN menu.<br>**Description** – If available, where this menu, dialog box, or function is described in greater detail in this document. |
| **Display Icon** |  <br>Display | Default Icon. Select displays the right-side DISPLAY menu.<br>• Keyboard: Alt + 4, then 2<br>• Menu Bar \| Trace \| Display<br>• MAIN \| Trace \| TRACE |
| **Easy Test Icon** |  <br>Easy Test | 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.<br>• Keyboard ALT + 8 then 9<br>• Menu Bar \| Utilities \| EasyTest |
| **File Icon** |  <br>File | Select displays the right-side FILE menu.<br>• Keyboard: ALT + 1<br>• MAIN \| File \| FILE |
| **Freq Icon** |  <br>Freq | Default Icon. Select displays the right-side FREQUENCY menu.<br>• MAIN \| Frequency \| FREQUENCY |
| **Hold Icon** |  <br>Hold | Select pauses the system operation, retaining all system presets and current configuration settings.<br>• MAIN \| Sweep Setup \| SWEEP SETUP \| Hold Functions \| HOLD FUNCTIONS \| Hold |
| **Home Icon** |  <br>Home | Default Icon. Select displays the right-side main menu. Does not reset or lose previous set values.<br>• MAIN |
| **Marker->Max Icon** |  <br>Marker->Max | Displays marker with maximum value.<br>• MAIN \| Marker \| MARKER [1] \| Marker Search \| MARKER SEARCH \| Max |
| **Marker->Min Icon** |  <br>Marker->Min | Select displays the marker with minimum value.<br>• MAIN \| Marker \| MARKER [1] \| Marker Search \| MARKER SEARCH \| Min |

**Table 4-2.** Icon Descriptions - Listed Alphabetically (4 of 6)

| Icon Name | Icon | Description |
|---|---|---|
| ***Icon Description Definitions*** | | **Default Icons** – These are one of the 11 default icons and are provided after a return to the factory standard configuration.<br>**Keyboard** – If available, the keyboard shortcut to access this menu or function.<br>**Menu Bar** – If available, navigation path to access this menu or function.<br>**Navigation** – To navigate to this menu or function from the MAIN menu.<br>**Description** – If available, where this menu, dialog box, or function is described in greater detail in this document. |
| **Marker->Off Icon** |  <br>Marker->Off | Select turns all marker displays off.<br>• MAIN \| Marker \| MARKER [1] \| Marker Setup \| MARKER SETUP \| All Markers Off |
| **Marker->Peak Icon** |  <br>Marker->Peak | Select displays marker with the highest peak value.<br>• MAIN \| Marker \| MARKER [1] \| Marker Search \| MARKER SEARCH \| Peak \| PEAK \| Search Peak |
| **Marker->Pk Lft Icon** |  <br>Marker->Pk Lft | Select displays the next peak value marker to the left of current selected marker.<br>• MAIN \| Marker \| MARKER [1] \| Marker Search \| MARKER SEARCH \| Peak \| PEAK \| Search Left |
| **Marker->Pk Rt Icon** |  <br>Marker->Pk Rt | Select moves the current active marker to the next trace peak value to the right of its current position.<br>• MAIN \| Marker \| MARKER [1] \| Marker Search \| MARKER SEARCH \| Peak \| PEAK \| Search Right |
| **Marker Icon** |  <br>Marker | Default Icon. Select displays the right-side MARKERS [1] menu.<br>• Keyboard: Alt + 4, then 4<br>• Menu Bar \| Trace \| Marker<br>• MAIN \| Marker \| MARKER [1] |
| **Measurement Icon** |  <br>Measurement | Select displays the right-side MEASUREMENT menu.<br>• Keyboard: ALT + 6<br>• Menu Bar \| Measurement \| MEASUREMENT<br>• MAIN \| Measurement |
| **Power Icon** |  <br>Power | Default Icon. Select displays the right-side POWER menu.<br>• MAIN \| Power \| POWER |
| **Preset Icon** |  <br>Preset | Default Icon. Select returns the system to its prior preset status which is the status at the time of the last preset save.<br>• Keyboard: Alt + 8, then 5<br>• Menu Bar \| Utilities \| Preset |

**Table 4-2.** Icon Descriptions - Listed Alphabetically (5 of 6)

| Icon Name | Icon | Description |
|---|---|---|
| ***Icon Description Definitions*** | | **Default Icons** – These are one of the 11 default icons and are provided after a return to the factory standard configuration.<br>**Keyboard** – If available, the keyboard shortcut to access this menu or function.<br>**Menu Bar** – If available, navigation path to access this menu or function.<br>**Navigation** – To navigate to this menu or function from the MAIN menu.<br>**Description** – If available, where this menu, dialog box, or function is described in greater detail in this document. |
| **Print Icon** |  <br>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.<br>• Keyboard: ALT + 1, then P<br>• Menu Bar \| File \| Print<br>• MAIN \| File \| FILE \| Print \| PRINT Dialog Box |
| **Response Icon** |  <br>Response | Default Icon. Select displays the right-side RESPONSE menu.<br>• Keyboard: Alt + 4, then 1<br>• Menu Bar \| Trace \| Response<br>• MAIN \| Response \| RESPONSE |
| **Scale Icon** |  <br>Scale | Default Icon. Select displays the right-side SCALE menu.<br>• Keyboard: Alt + 4, then 3<br>• Menu Bar \| Trace \| Scale<br>• Main \| Scale \| SCALE |
| **Sweep Icon** |  <br>Sweep | Select displays the right-side SWEEP SETUP menu.<br>• MAIN \| Sweep Setup \| SWEEP SETUP |
| **System Icon** |  <br>System | Select displays the right-side SYSTEM menu.<br>• Keyboard: Alt + 8, then 1<br>• Menu Bar \| Utilities \| System<br>• MAIN \| System \| SYSTEM |
| **Time Domain Icon** |  <br>Time Domain | Select displays the right-side Time Domain menu.<br>• MAIN \| Time Domain |
| **Trace Icon** |  <br>Trace | Default Icon. Select displays the right-side TRACE menu.<br>• Keyboard: Alt + 4, then 5<br>• Menu Bar \| Trace \| Trace Menu<br>• MAIN \| Trace \| TRACE |
| **Tr->Max Icon** |  <br>Tr->Max | Select maximizes the display with the currently active trace.<br>• Keyboard: Alt + 4, then 6<br>• Menu Bar \| Trace \| Trace Max<br>• MAIN \| Trace \| TRACE \| Trace Max |

**Table 4-2.** Icon Descriptions - Listed Alphabetically (6 of 6)

| Icon Name | Icon | Description |
|---|---|---|
| ***Icon Description Definitions*** | | **Default Icons** – These are one of the 11 default icons and are provided after a return to the factory standard configuration.<br>**Keyboard** – If available, the keyboard shortcut to access this menu or function.<br>**Menu Bar** – If available, navigation path to access this menu or function.<br>**Navigation** – To navigate to this menu or function from the MAIN menu.<br>**Description** – If available, where this menu, dialog box, or function is described in greater detail in this document. |
| **Tr->Next Icon** |  <br>Tr->Next | Select displays the next higher trace number. When the highest number is reached, next click displays lowest trace number.<br>• Keyboard: Alt + 4, then 8<br>• Menu BAR \| Trace \| Trace Next<br>• MAIN \| Trace \| TRACE \| Trace Next |
| **Tr->Previous Icon** |  <br>Tr->Previous | Select displays the next lower trace number. When the lowest number is reached, next click displays the highest numbered trace.<br>• Keyboard: Alt + 4, then 7<br>• Menu Bar \| Trace \| Trace Prev.<br>• 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

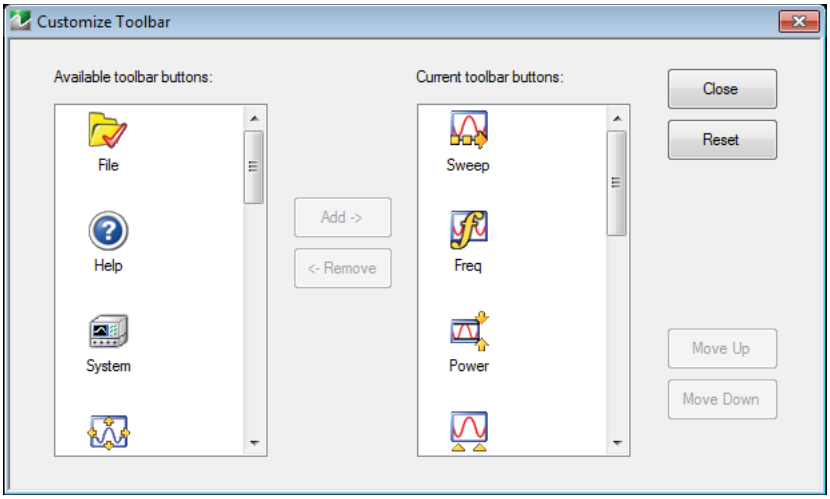



**Figure 4-7.** CUSTOMIZE TOOLBAR Dialog Box

### 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

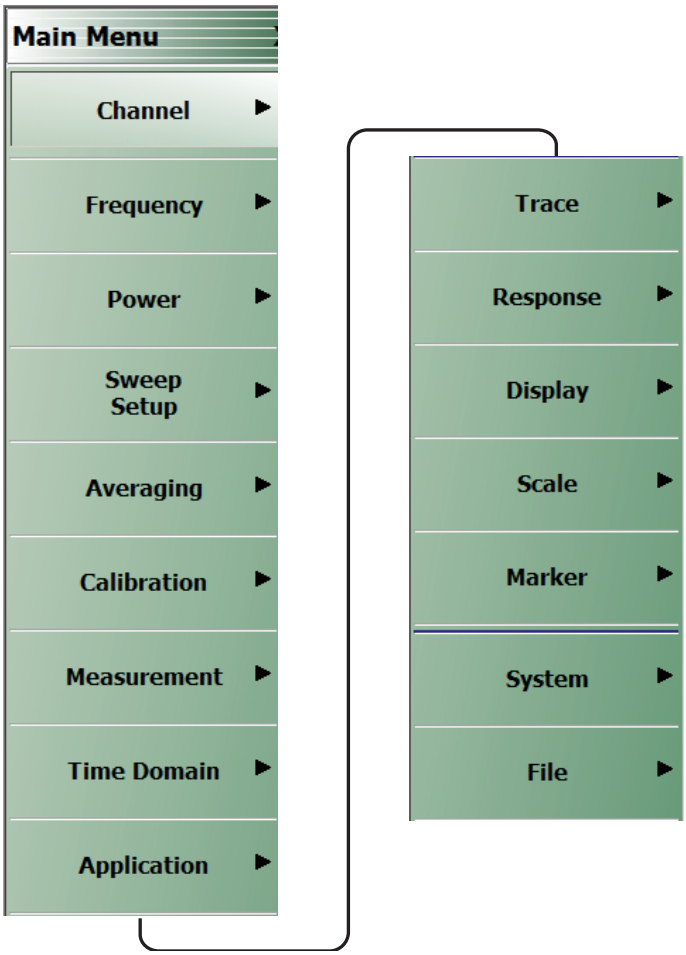



**Figure 4-8.** MAIN Menu

### 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.

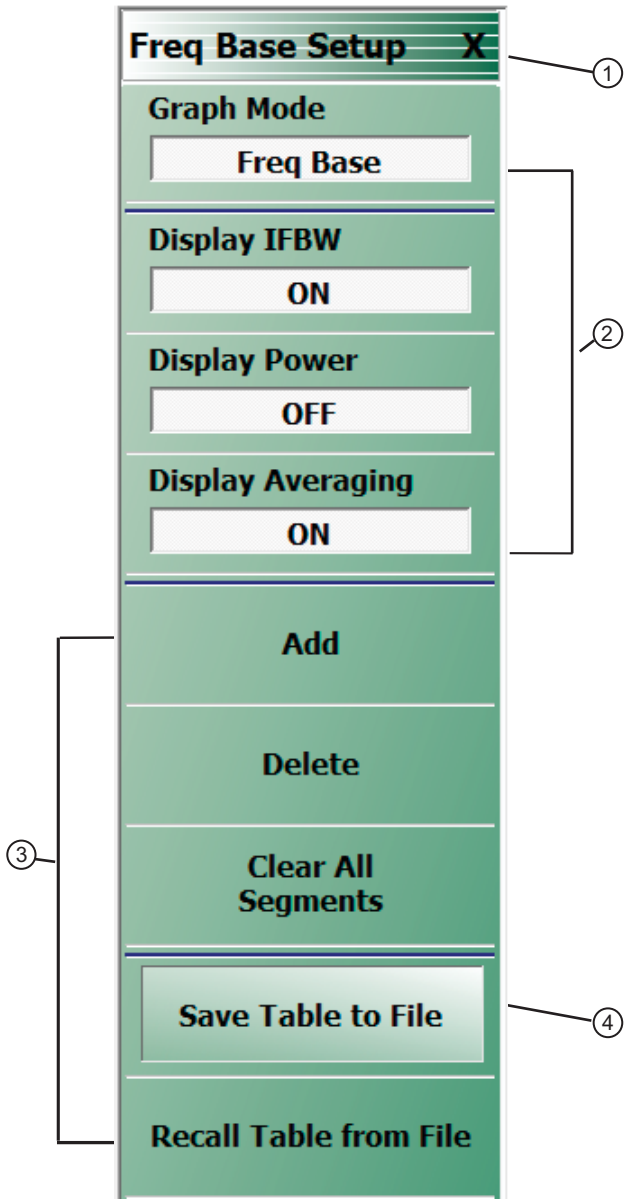
### File

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

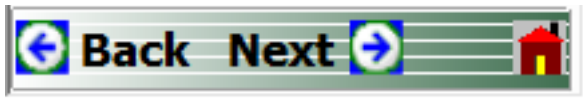
At the top of the menu, a unique menu title, which is not repeated on any other menu. For space reasons, menu names are often abbreviated. For definitions, see Appendix C, "Abbreviation Glossary".

## 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

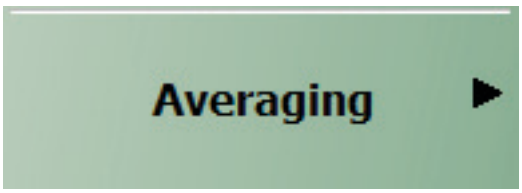
The Next button returns the menu display to the next deeper sub-menu that has already been selected. The availability of the Back and Next buttons (above) depends on the user's navigation path. The Home button (below) always appears.

### Home Button

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

## Menu Buttons

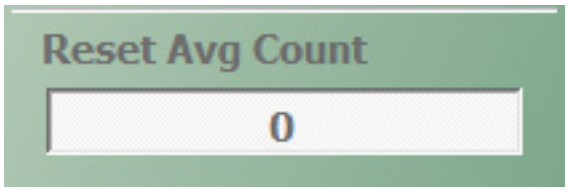
Menu buttons call lower-level menus.




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

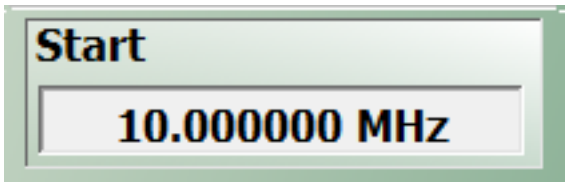
Toggle buttons toggle through two or more values with each click of the button and display their current setting in the button field. For example, in the MAIN MENU | Response | RESPONSE | User Defined | USER DEFINED menu, the Driver Port button displays the default Port 1 setting.


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.

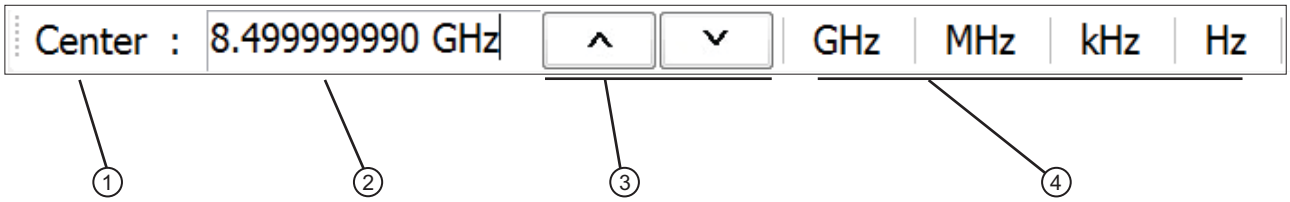

## Field Selection Buttons

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.

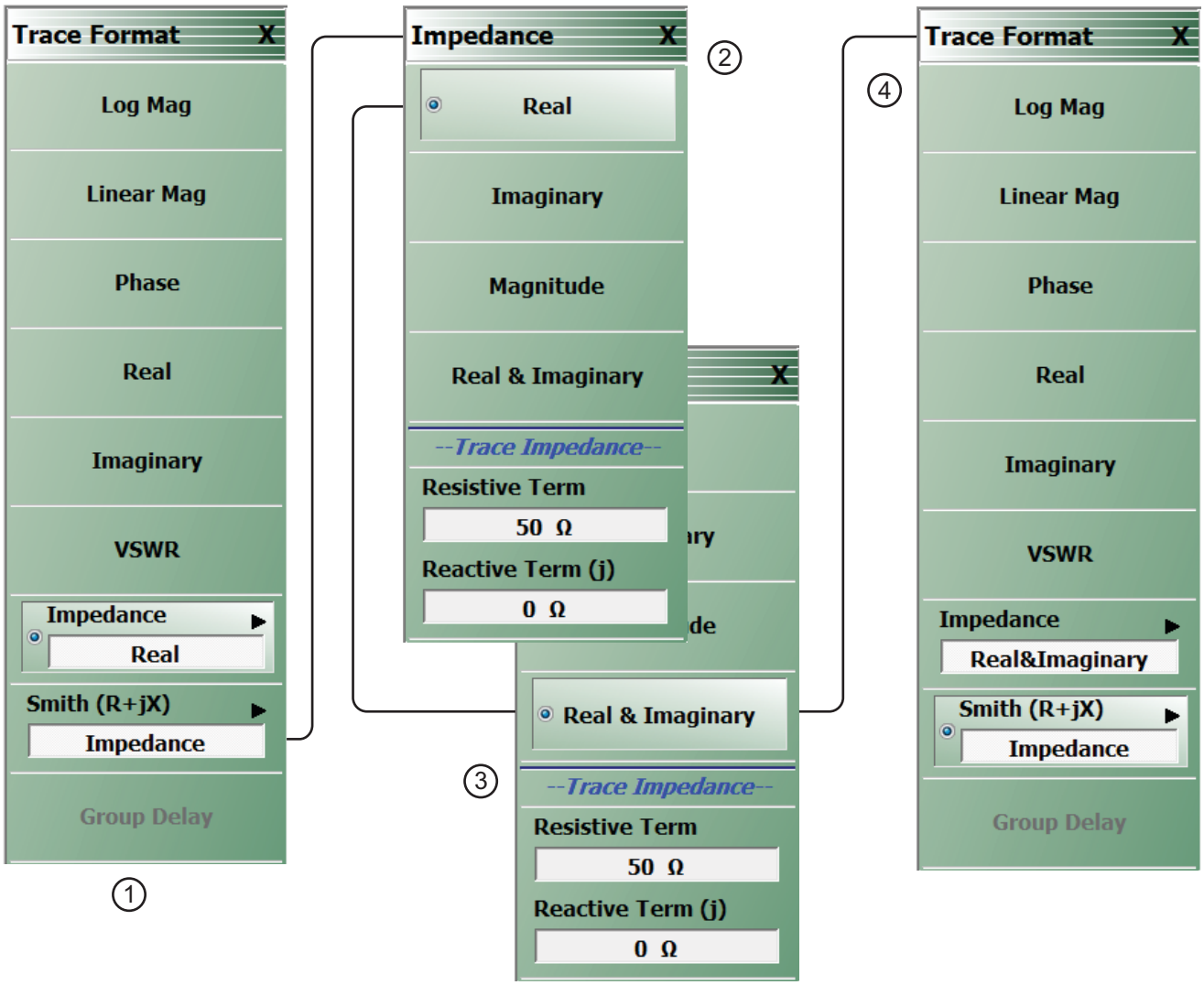

Some field toolbars display a single unit with no options. For example, in the MAIN MENU | Scale | SCALE menu, clicking the Reference Value button displays the Reference Value toolbar with a single dB unit value option.


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).



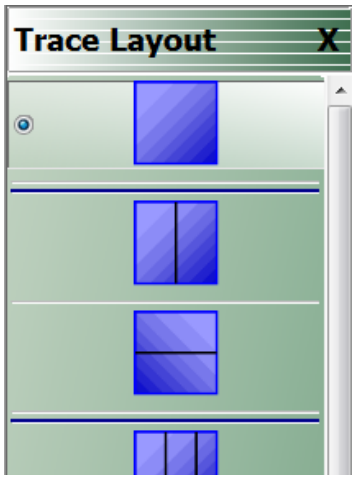

1. Original TRACE FORMAT Menu with Impedance setting as “Real”
   - The bottom Impedance field button is set to “Real
   - Clicking the Impedance button displays the IMPEDANCE menu.
2. Original IMPEDANCE Menu with “Real”
   - The IMPEDANCE menu appears with impedance set as “Real.”
3. IMPEDANCE Menu 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.

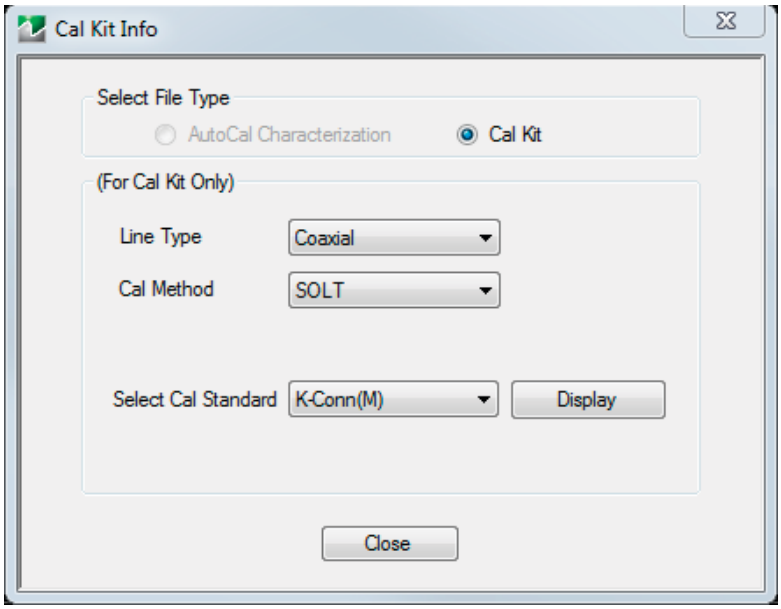



**Figure 4-12.** CAL KIT INFO Dialog Box Example

## 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.

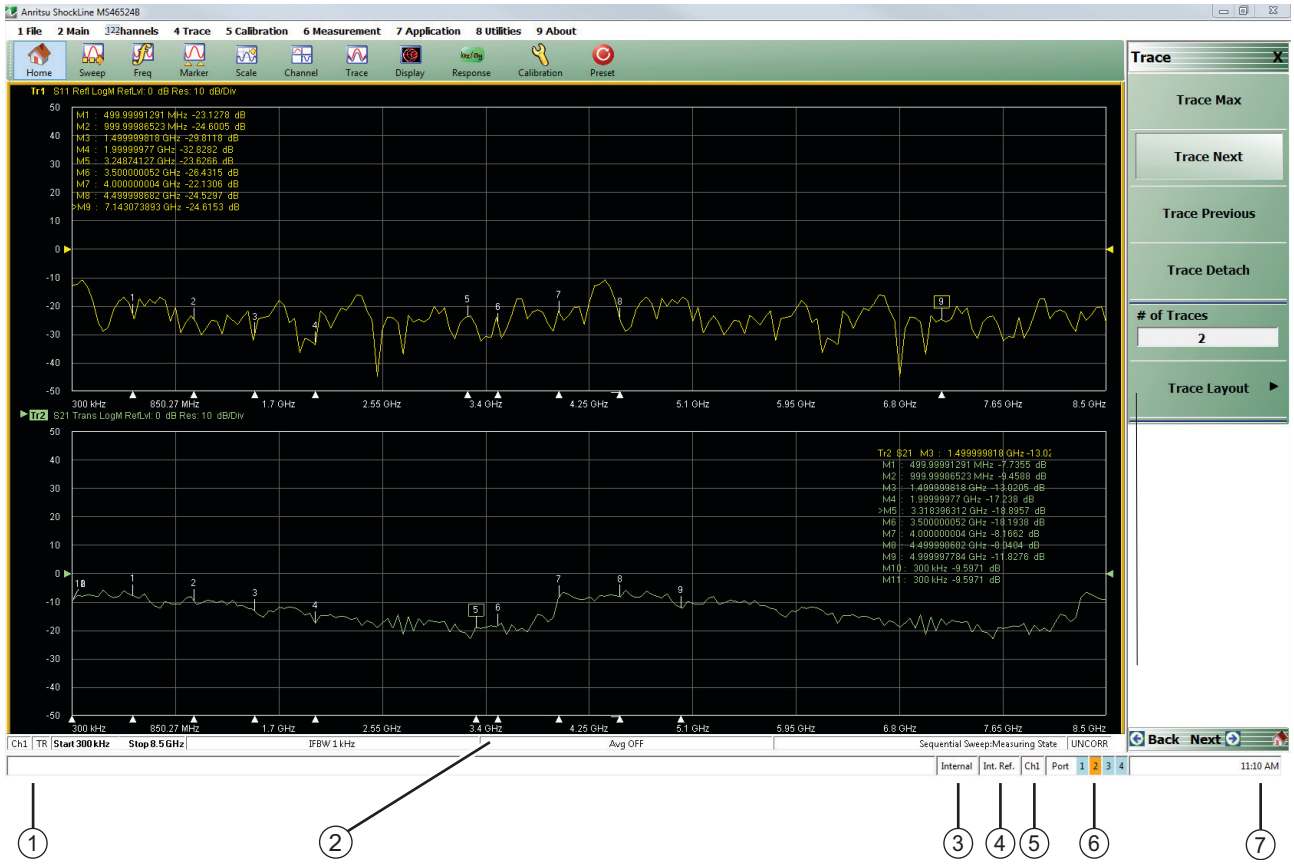



**Figure 4-13.** Instrument Status Area

## 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. |
| 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. |

# 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<br>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 |

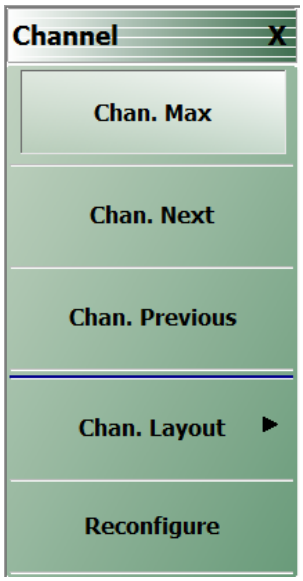



**Figure 4-15.** Channel Menu

### 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 - 12 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 |

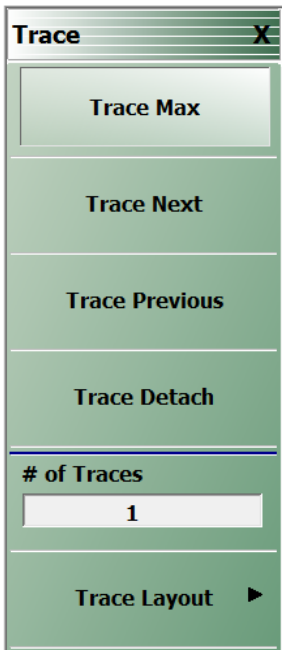



**Figure 4-16.** Trace Menu

### 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, μs, 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<br>Magnitude | | Y = dB | Return loss measurement<br>Insertion loss measurement<br>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 | $\mathrm{SWR} = \frac{1+\rho}{1-\rho}$<br>where $\rho$ = Reflection Coefficient | Linear units | Standing wave measurements<br>Antenna analysis |
| **Impedance** | Impedance rectilinear format graph<br>Four options are:<br>• Real<br>• Imaginary<br>• Magnitude<br>• Real & Imaginary<br>• Inductance<br>• 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<br>The polar graph format traces are used to display one magnitude value and phase on the same chart.<br>Plot options:<br>• Lin/Phase<br>• Real/Imag. | | Chart mode options:<br>• Magnitude/Phase<br>• Magnitude/Swap Position | |
| **Log Polar** | Plot options:<br>• Log/Phase<br>• Real/Imag. | | Chart mode options:<br>• Magnitude/Phase<br>• Magnitude/Swap Position | |
| **Smith Chart Graphs** | | | | |
| **Smith (R + jX)** | Smith Chart graphs with impedance (circuit resistance and reactance)<br>Four read out style options are available:<br>• Lin/Phase<br>• Log/Phase<br>• Real/Imag.<br>• 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, µs, or ms. | Time measured in ps, ns, µs, or ms. | Frequency | Bandpass filter design<br>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.<br>DD is user-defined denominator value.<br>Port number | User-defined numerator, denominator, and driver port are selected on the RESPONSE \| User-defined \| USER-DEFINED menu.<br>Numerator and denominator options are A1, B1, A2, B2, or 1.<br>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:<br>• Smith (R+jX) Linear/Phase Smith Chart<br>• Smith (R+jX) Log/Phase Smith Chart<br>• Smith (R+jX) Real/Imaginary Smith Chart<br>• 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.

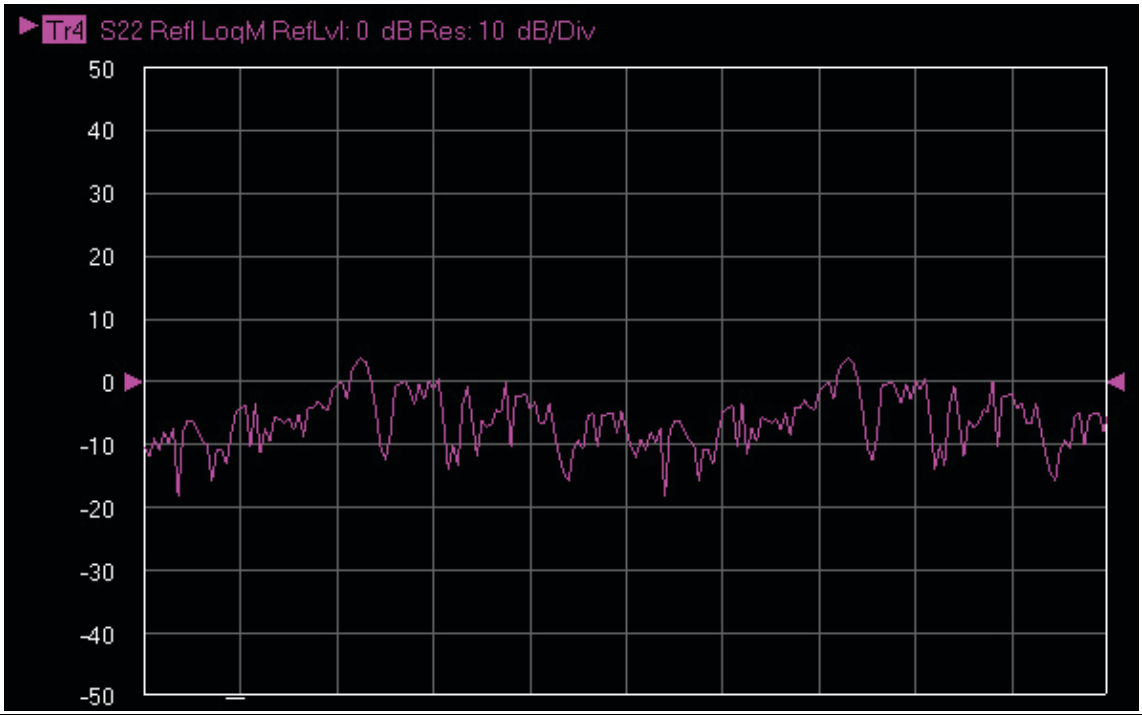



**Figure 4-18.** Trace Graph - Rectilinear Single - Log Magnitude (Log Mag) Trace Display Graph

## 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.

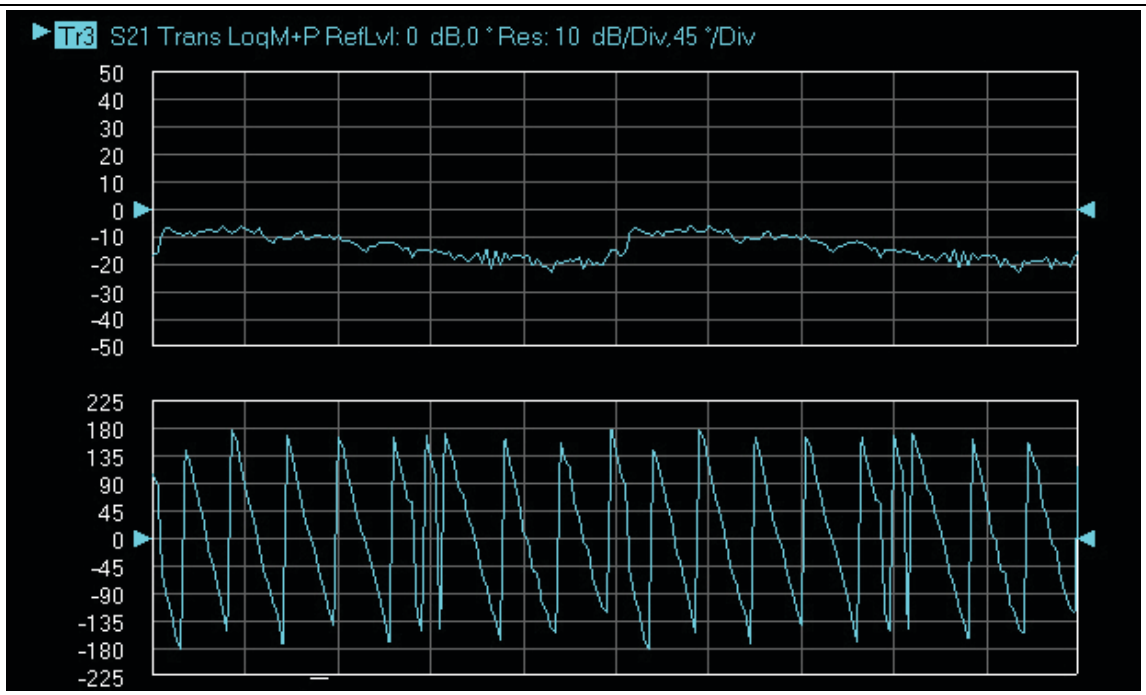



**Figure 4-19.** Trace Graph - Rectilinear Paired - Trace Log Magnitude and Phase Trace Display

## 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.

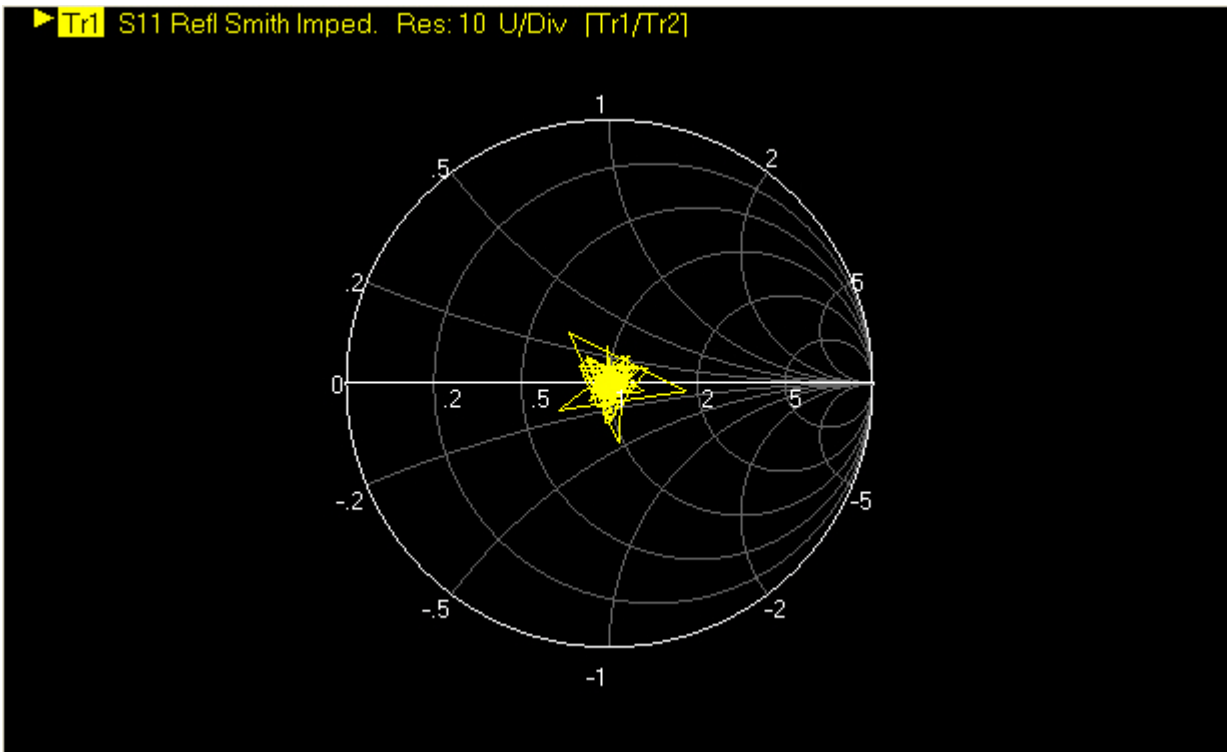



**Figure 4-20.** Smith Chart with Impedance (R+jX)

## 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.

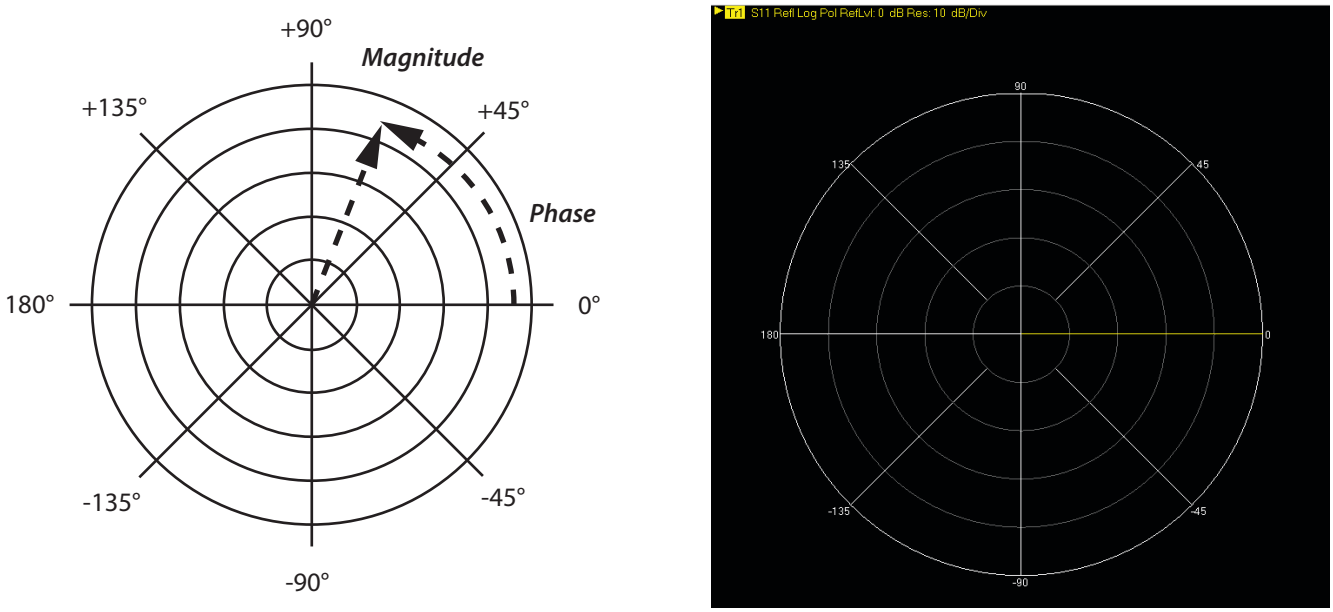



**Figure 4-21.** Log Polar Diagram and Trace Graph Example

## 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, µs, 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.

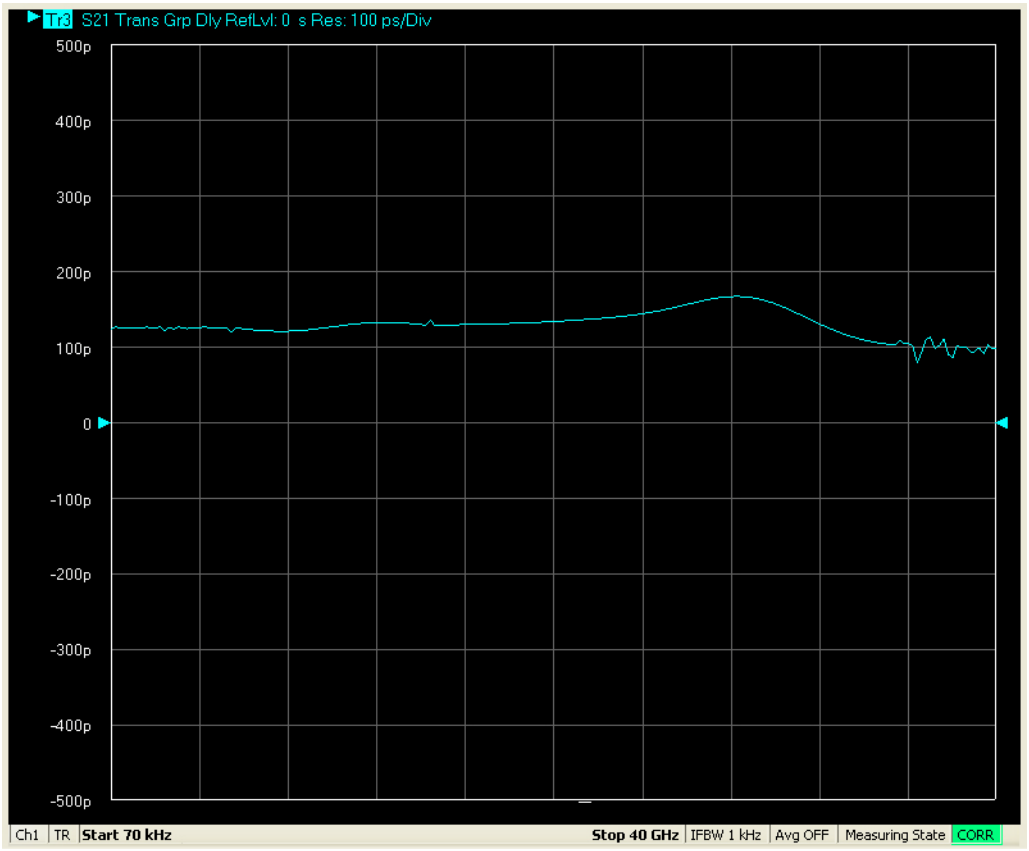
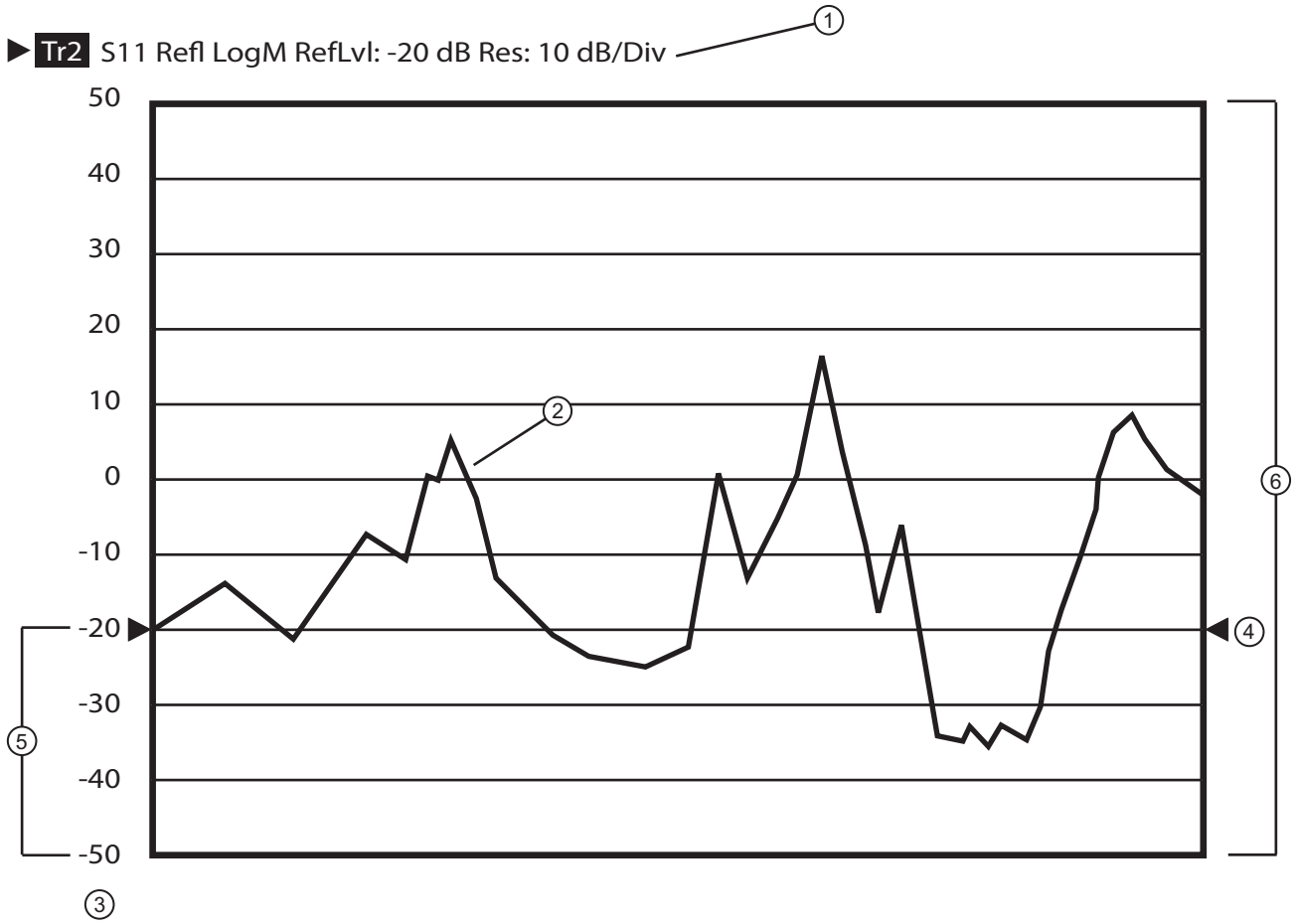



**Figure 4-22.** Group Delay Trace Graph Example

# 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..

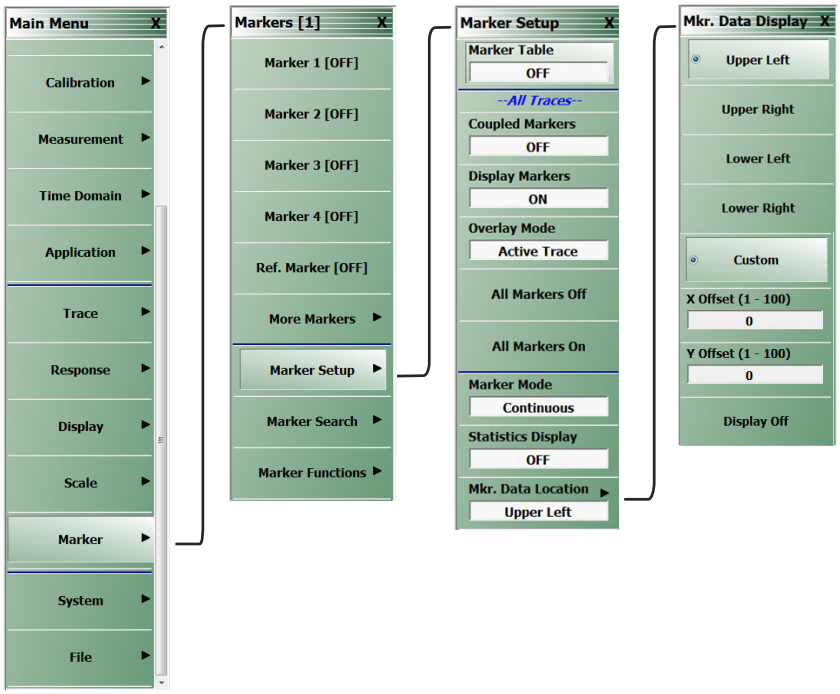
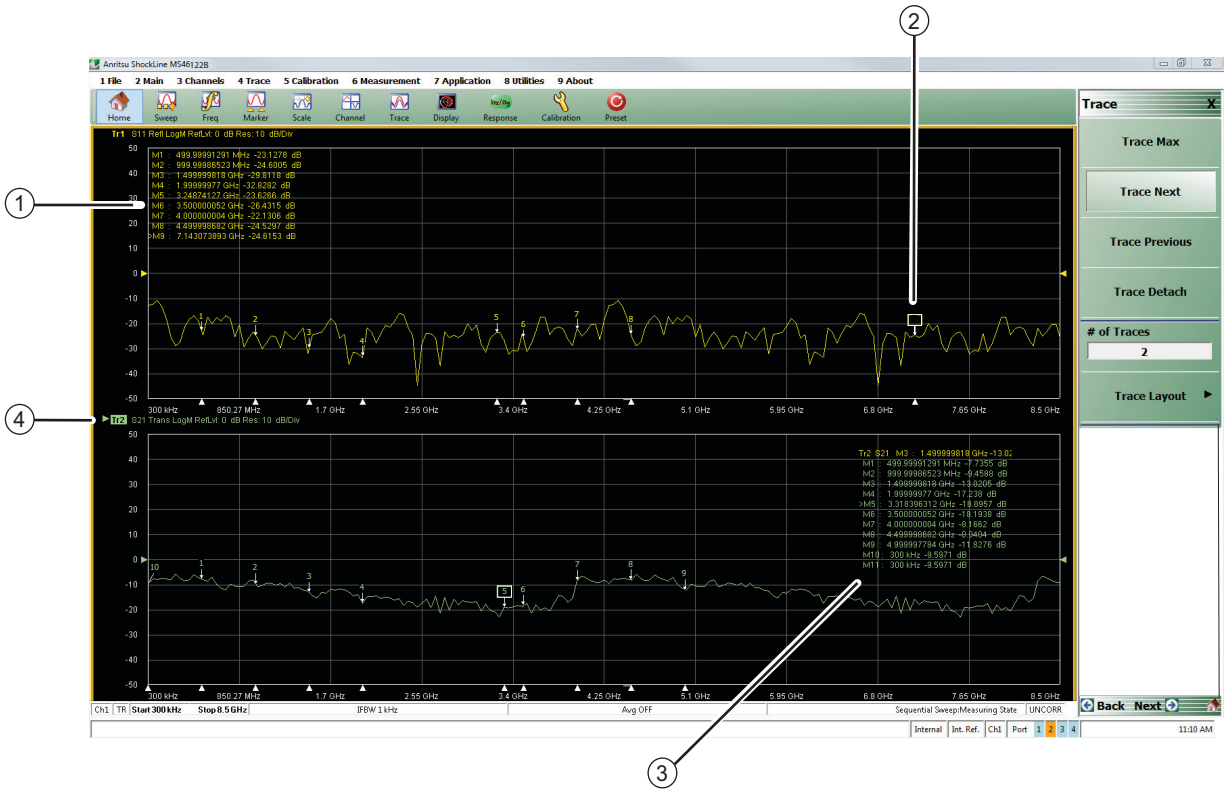



**Figure 4-24.** Marker Menus

### 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<br>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<br>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. .

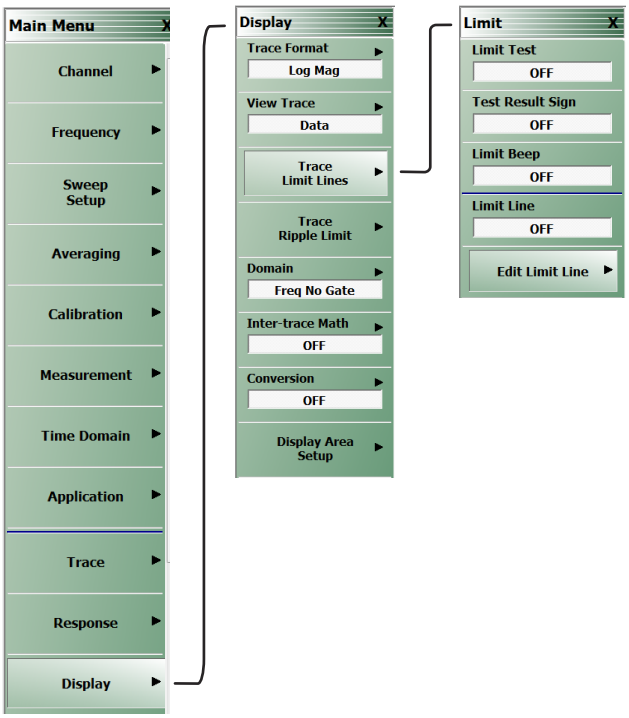



**Figure 4-26.** Display Trace Limit Lines Menu

### 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.

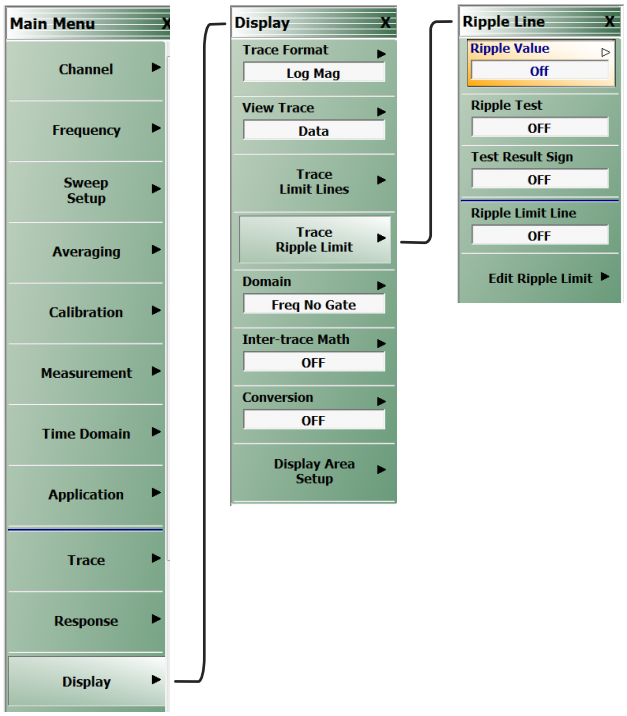



**Figure 4-27.** Display Trace Ripple Lines Menu

### 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 MS46122A/B 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 MS46122A/B Series VNA can make.

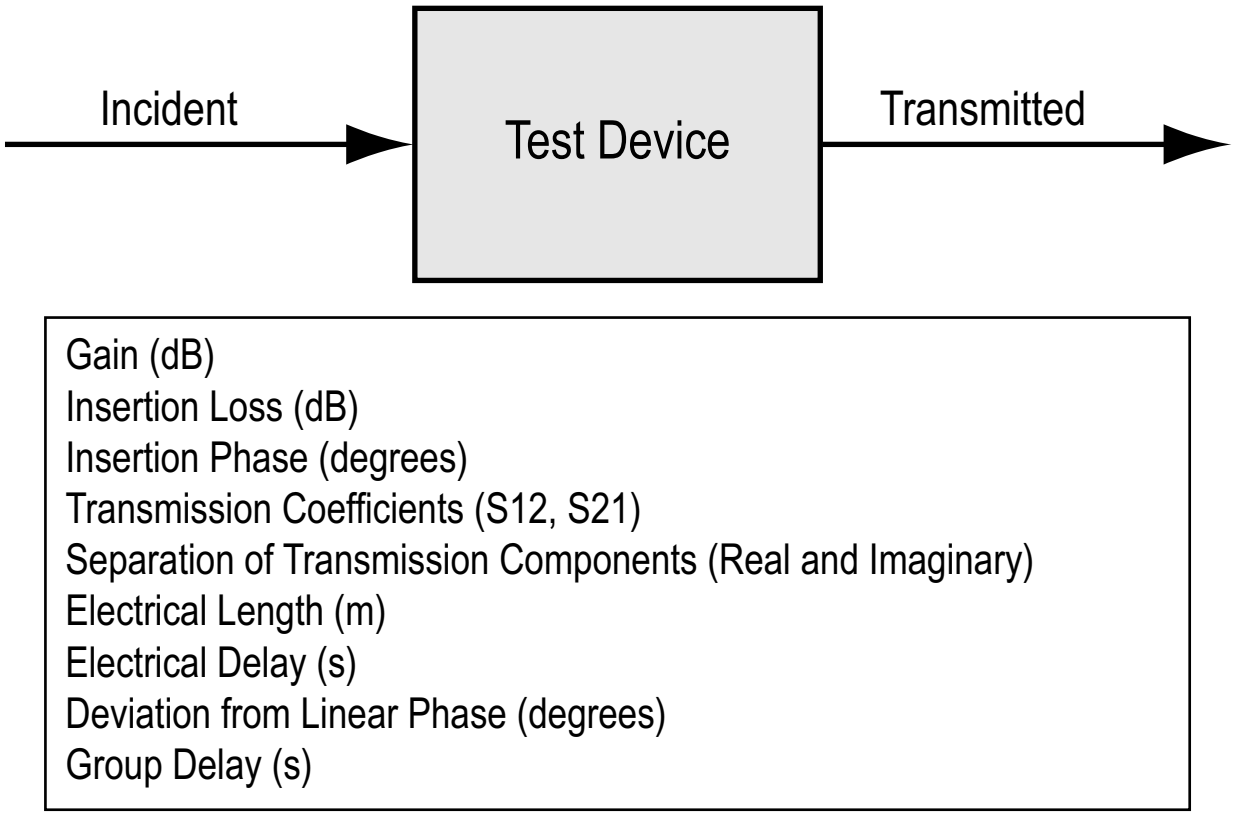



**Figure A-1.** Transmission Measurements

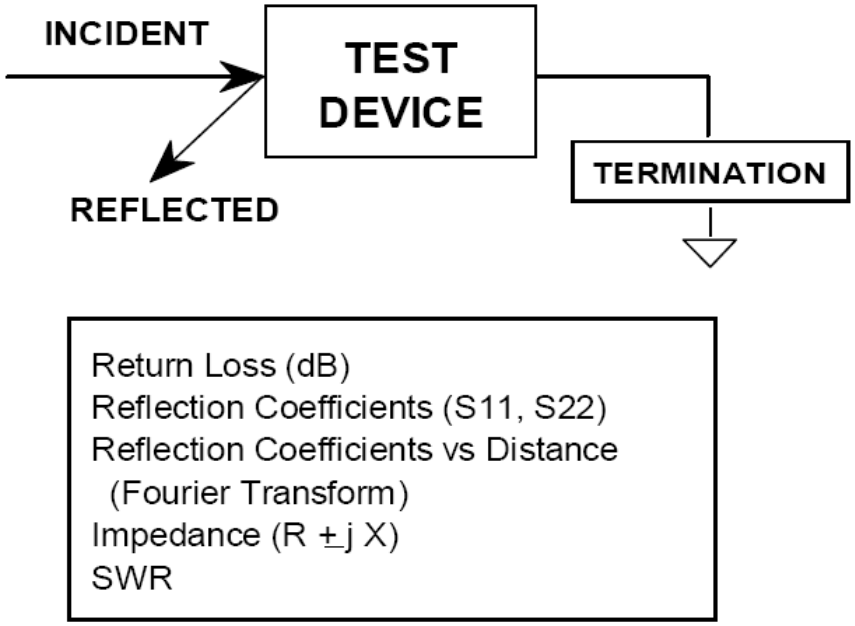



**Figure A-2.** Reflection Measurements

## A-3 Instrument Description

The ShockLine MS46122A/B 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 MS46122A/B 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

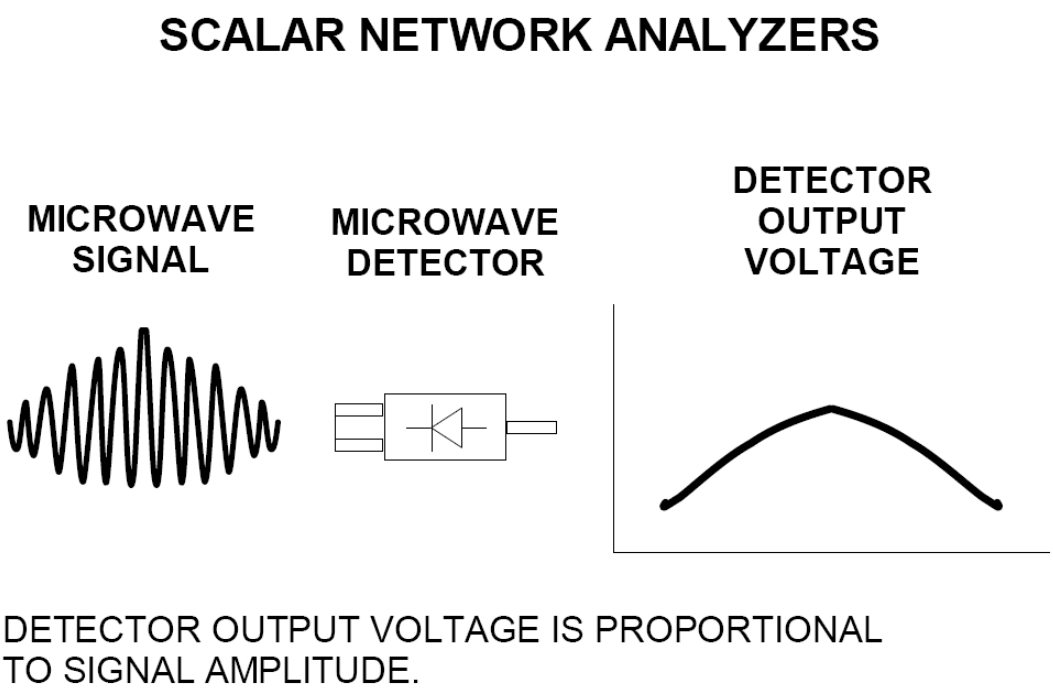



**Figure A-3.** Scalar Analyzer Detection

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).

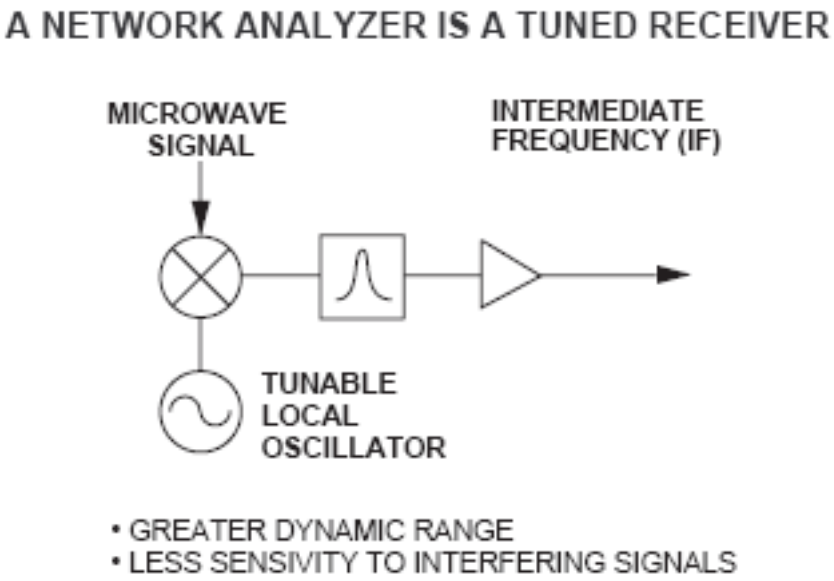



**Figure A-4.** Network Analyzer as a Tuned Receiver

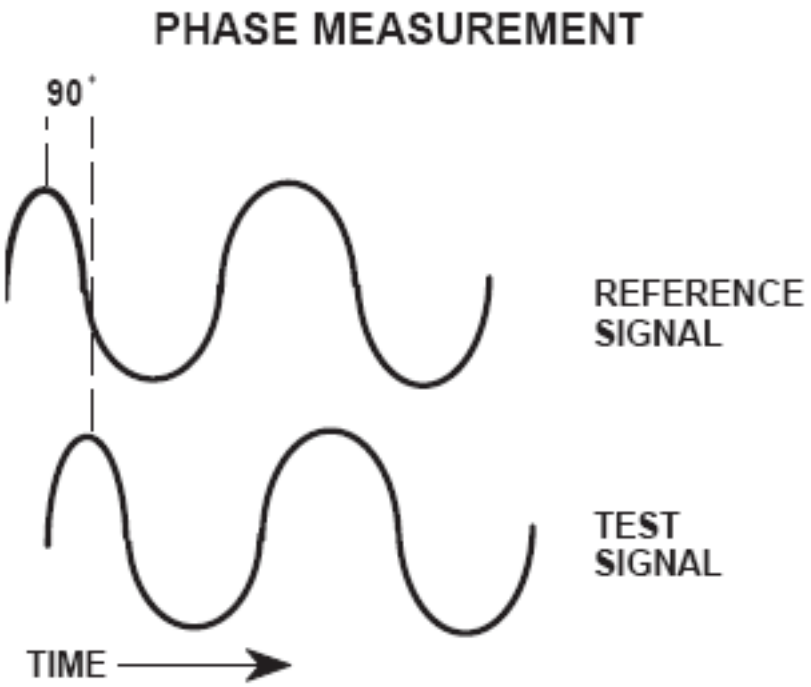



**Figure A-5.** Signals with a 90 Degree Phase Difference

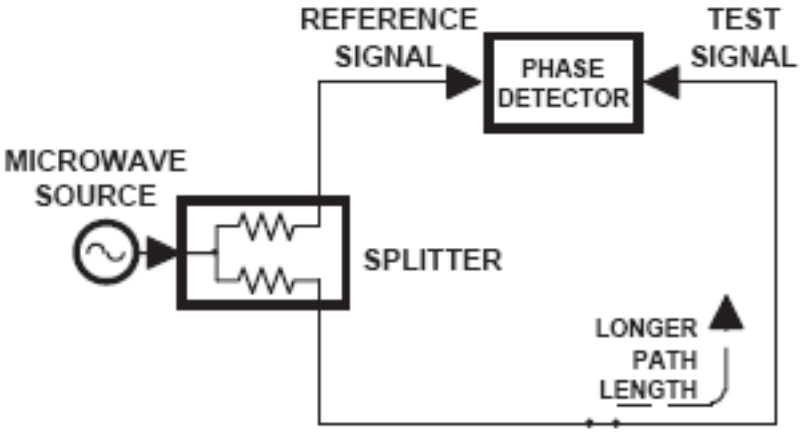



**Figure A-6.** Split Signal where a Length of Line Replaces the DUT

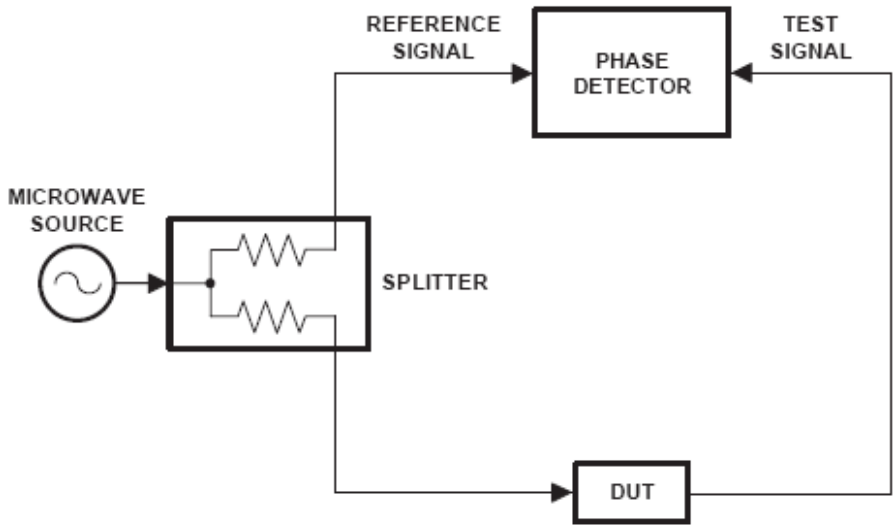



**Figure A-7.** Splitting the Microwave Signal

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.

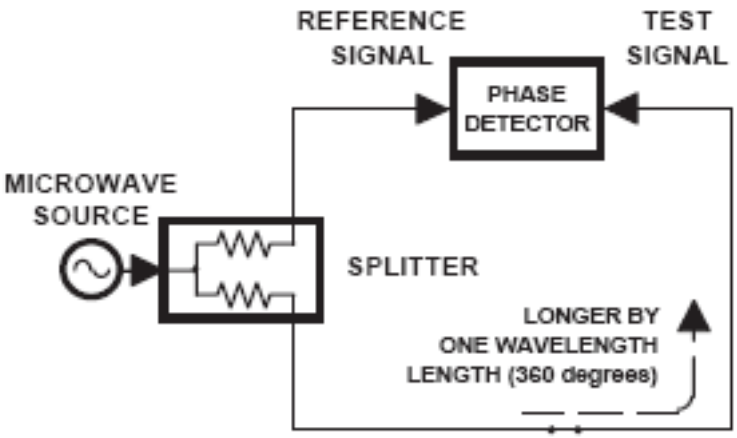



**Figure A-8.** Split Signal where Path Length is Different by Exactly One Wavelength

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.

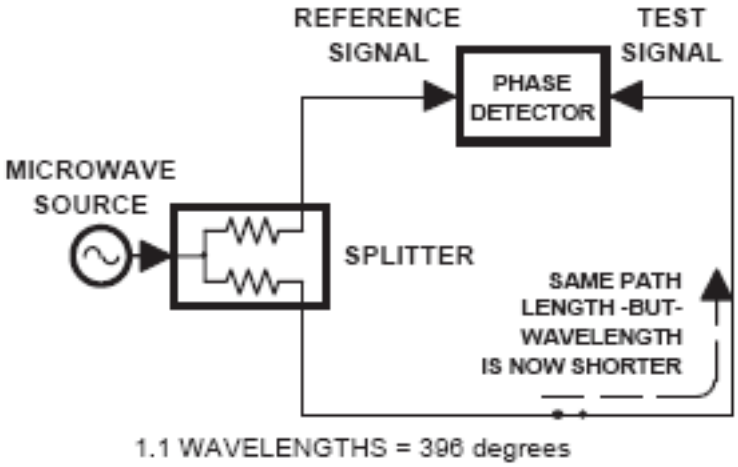



**Figure A-9.** Split Signal where Path Length is Longer than One Wavelength


**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.

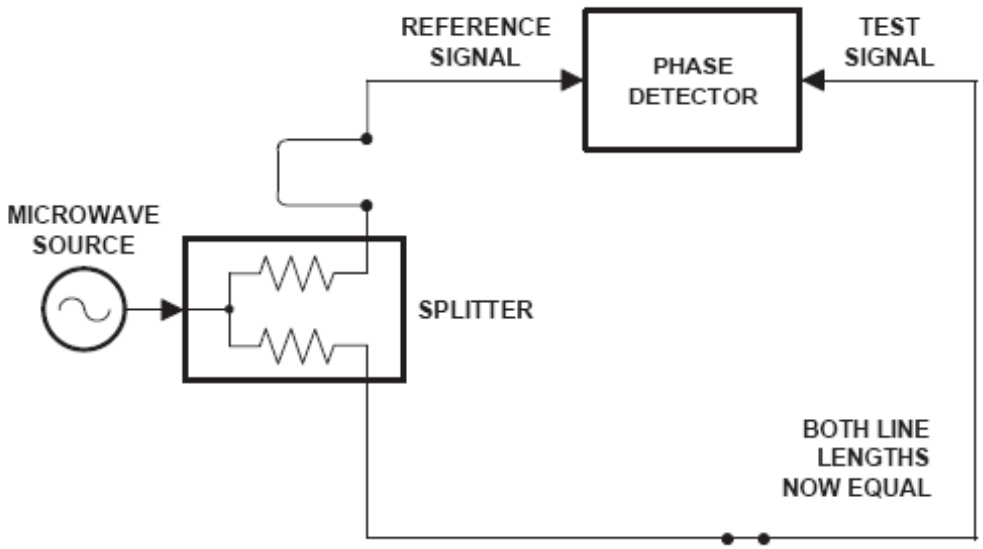



**Figure A-11.** Split Signal where Paths are of Equal Length

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.

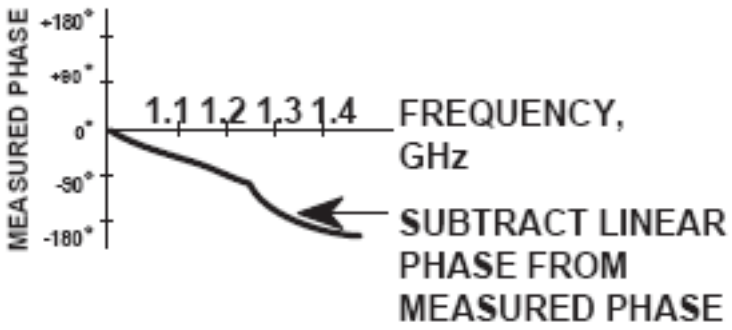



**Figure A-12.** Phase Difference Increases Linearly with Frequency

The ShockLine MS46122A/B 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.

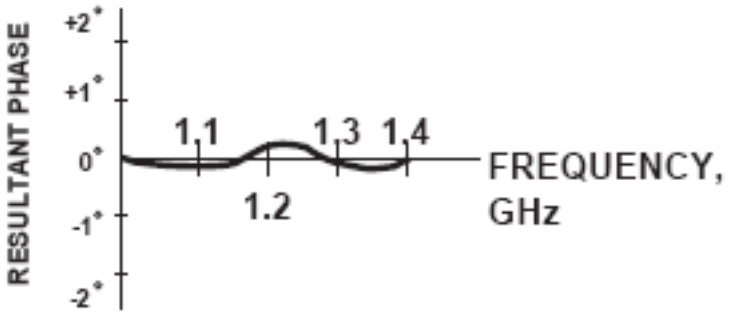



**Figure A-13.** Resultant Phase with Path Length

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).

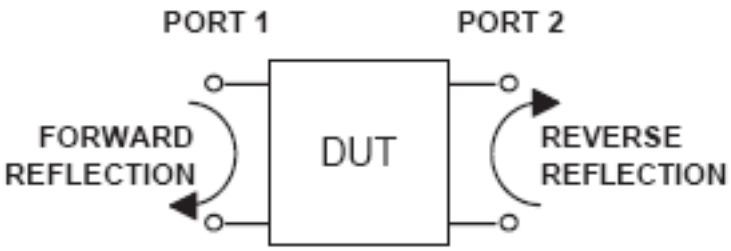



**Figure A-14.** Forward and Reverse Measurements

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.

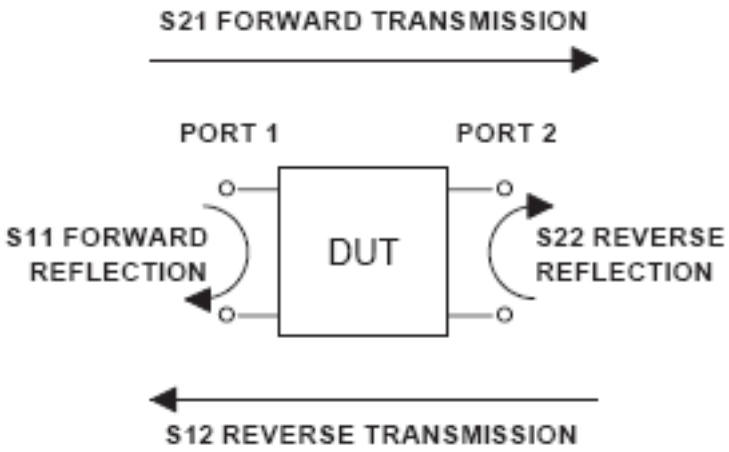



**Figure A-15.** S-Parameters

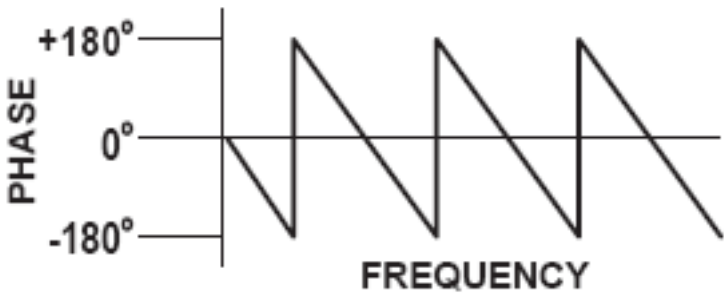



**Figure A-16.** Linear Phase with Frequency Waveform

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.

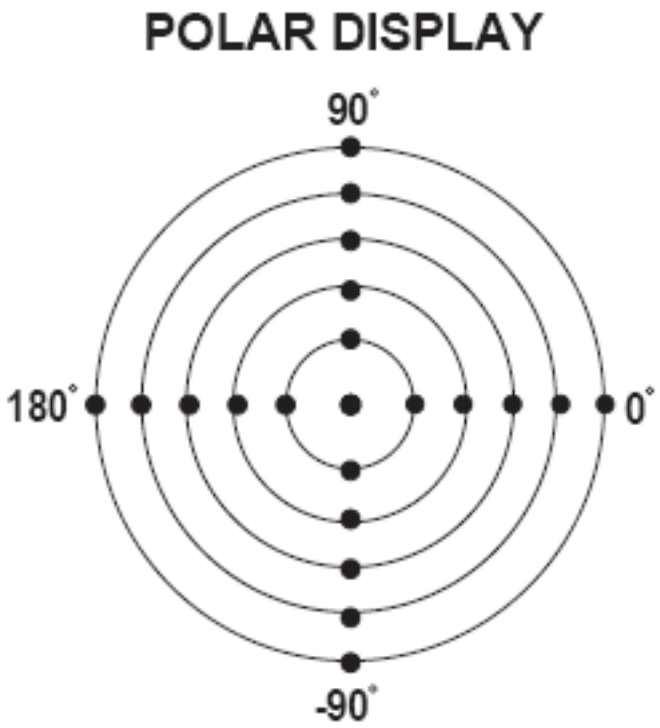



**Figure A-17.** Polar Display

# 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.

MS46122A/B Series VNA.

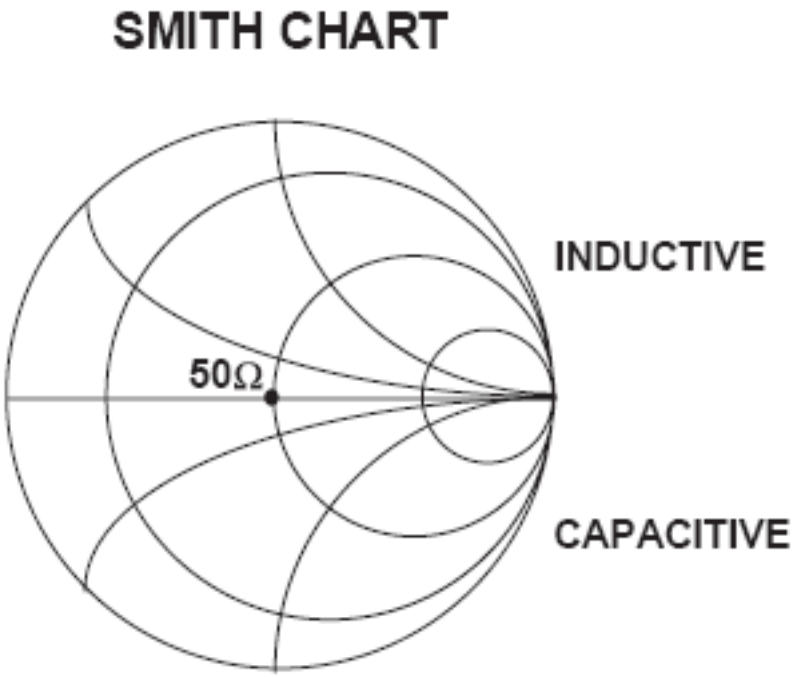



**Figure A-18.** Smith Chart

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.

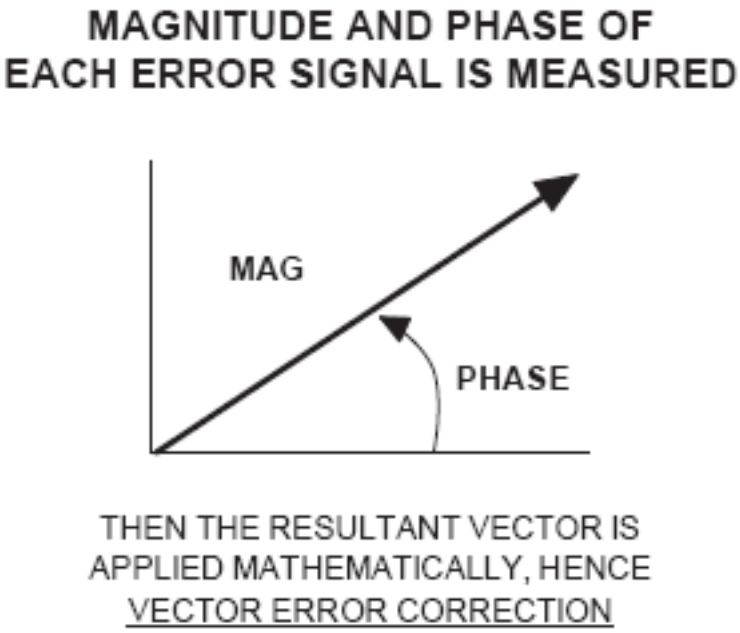



**Figure A-19.** Magnitude and Phase

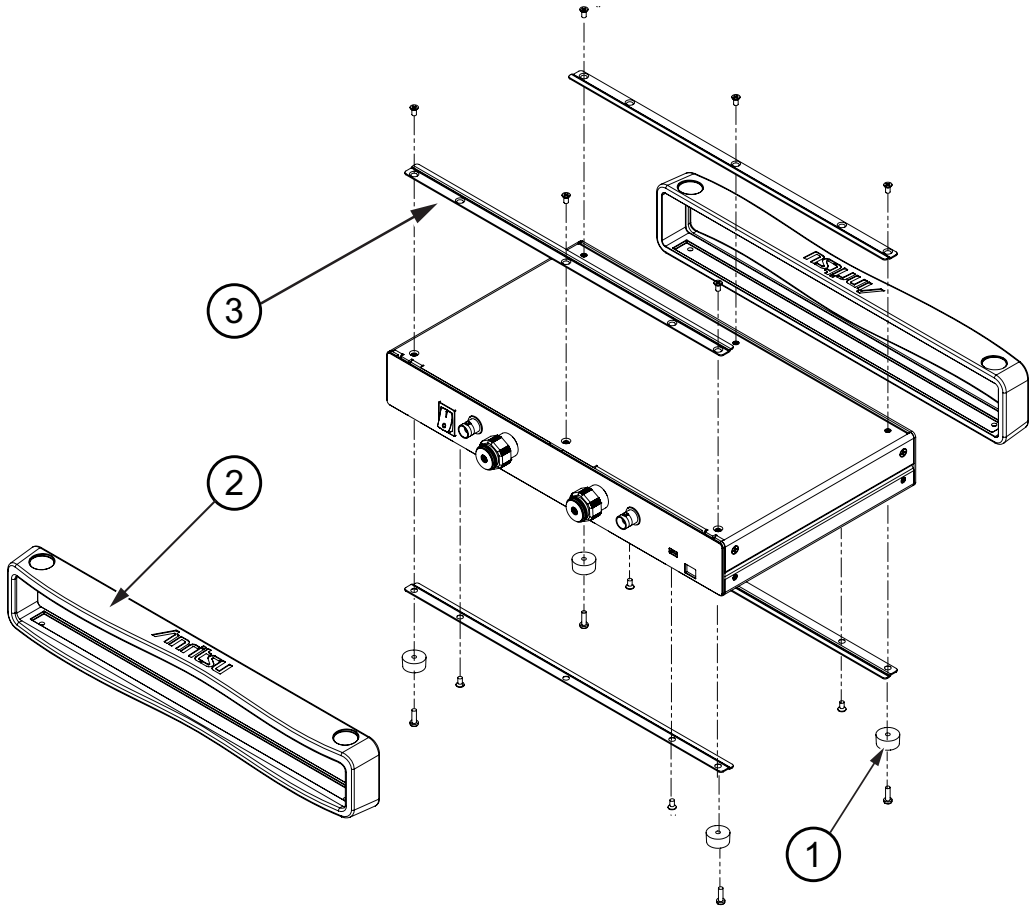
To accomplish this error correction, we measure the magnitude and phase of each error signal (Figure A-19). Magnitude and phase information appear as a vector that is mathematically applied to the measurement signal. This process is termed *vector error correction*.

# Appendix B — Maintenance and Security

## B-1 Rack Ear Installation

The rack ear hardware is shipped with the unit and can be installed whenever required by the user, The general procedure to install the rack ear kit is described below.

1. Disconnect the power supply and any other attachments from the instrument.
2. Carefully place the instrument on a secure and stable work surface.
3. Refer to Figure B-1. Using a type #1 Phillips screwdriver, remove the screws from the four feet (#1) on the bottom of the unit.
4. Pull off the front and rear shroud (#2) exposing the mounting strips.
5. Remove the four mounting strips (#3) from the top and bottom of the unit.
6. Remove the two flat head screws on the sides of the top cover.

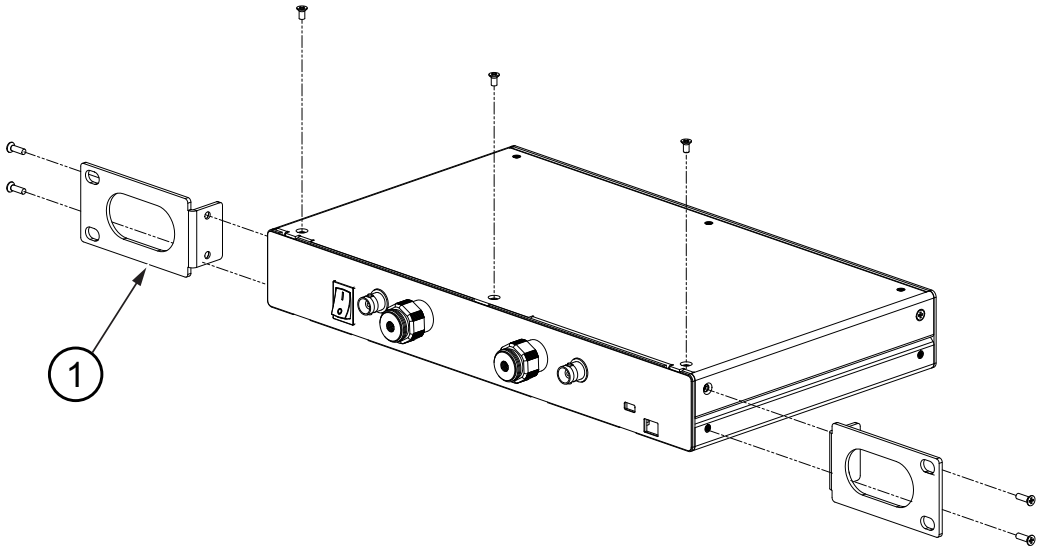



| | |
|---|---|
| 1. Bottom Feet (one of four) | 2. Mounting Strips (one of four) |
| 3. Shrouds (one of two) | |

**Figure B-1.** Rack Ear Preparation

| | |
|---|---|
| **Note** | The rack ear kit (3-80790) is shipped with the MS46122A/B. |

7. Refer to Figure B-2. Install the rack ears in the orientation as shown using the four flat heads screws provided.
8. Re-install the three flat head screws into the top panel.
9. Install the four pan head M3 x 6 mm screws supplied with the rack ear bracket to the side panel.




1. Rack Ears (one of two)

**Figure B-2.** Rack Ear Installation

## B-2 Security and Memory Overview

The ShockLine MS46122A/B Series VNA does not require memory purging after it has ben removed from a secure location, since there is no data memory in the unit.

# B-3 Preparation for Storage or Shipment

Use the following information for preparing the ShockLine MS46122A/B 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 MS46122A/B 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.<br>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.<br>Used in the SCPI command:SENSe{1-16}:CORRection:COLLect[:METHod]:1P2PR to simulate the calibration. |
| A1<br>a1 | Reference 1 or Reference a |
| A2<br>a2 | Reference 2 or Reference b |
| Actv. | Active |
| Addr. | Address |
| ALC | Automatic Level Control |

| Abbreviation or Term | Meaning / Definition (2 of 14) |
|---|---|
| ALRM<br>A-LRM™ | Calibration menu. Advanced-Line-Reflect-Match calibration algorithm and method. A-LRM is a trademark of Anritsu Company. |
| Auto-Return<br>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<br>b1 | S-Parameter. Test 1 or Test a |
| B2<br>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<br>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)<br>C(S)<br>C(S)-L(P)<br>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<br>Cal. | Calibrate<br>Calibration |
| Cals<br>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<br>Characterization |
| cm | Distance units abbreviation. Centimeter. |
| Cnt | Count |
| Coax | Coaxial cable |
| Coef. | Coefficient |
| Comm. | Communication |
| Compress | Compression |
| Config. | Configure<br>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.<br>• 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.<br>• 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.<br>• 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.<br>• 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<br>De-Embed<br>Deembed | De-embedding. Process where calibration parameters for a test fixture are removed from the calibrated instrument and connection cables. |
| Deg<br>Degs | Degree<br>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<br>EDE<br>Embed<br>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<br>Freq. | Frequency |
| FreqIniTable.ini | File type. |
| FreqTable.mft | File type. |
| Full 2-port<br>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<br>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)<br>L(S)<br>L(P)-C(S)<br>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<br>Mag. | Magnitude |
| max Num | Maximum Number |

| Abbreviation or Term | Meaning / Definition (6 of 14) |
|---|---|
| Max<br>max | Maximum |
| MB/s | Megabytes per second |
| Mb<br>Mbit | Megabit. 1 megabit equals 10E6 bits or 1,000,000 bits. |
| MB<br>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<br>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<br>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<br>Mkrs | Marker, Markers |
| mm | Units abbreviation. Millimeter. |
| MM | Anritsu Maintenance Manual |
| mmWave<br>mm-Wave | Millimeter wavelength |
| Model# | Model Number |
| ms | Time units abbreviation. Millisecond. |
| MS46122A/B Series VNA | The function or feature refers to any VNA model in the series: MS46122A/B. |

| 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:<br>MAIN \| Button \| MENU \| ... \| Button \| DESTINATION MENU/DIALOG BOX<br>For example, the navigation path to the REFERENCE PLANE menu is:<br>MAIN \| Measurement \| MEASUREMENT \| Reference Plane \| REFERENCE PLANE |
| NIST | National Institute of Standards and Technology. |
| ns | Time units abbreviation. Nanosecond. |
| Ntwk<br>Ntwk. | Network |
| Ohms/Div | SCALE menu toolbar function. Ohms (Ω) per trace display division. |
| OM | Anritsu Operations Manual |
| Op. | Operand<br>Operation<br>Operations |
| Out. | Output |
| P2P | Pulse-to-Pulse |
| Param. | Parameter<br>Parameters |
| PDF | Proprietary Portable Document Format from Adobe Corporation. |
| PG | Pulse Generator |
| PIP | Point-in-Pulse |
| PM | Anritsu Programming Manual |
| Prev<br>Prev. | Previous |
| PRF | Pulse Repetition Frequency |
| PRI | Pulse Repetition Interval |
| Profile | Pulse Profile |
| ps | Time units abbreviation. Picosecond. |
| Pwr<br>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<br>Rcvr. | Receiver |

| Abbreviation or Term | Meaning / Definition (8 of 14) |
|---|---|
| Rect. | Reactance<br>Rectangle<br>Rectangular |
| Ref.Mkr | Reference Marker |
| Ref<br>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.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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<br>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 MS46122A/B 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<br>s-parameters | Scattering parameters. |
| Src<br>Src. | Source |
| SRPRP<br>SRR<br>SXR<br>SRX<br>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.<br>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.<br>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.<br>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<br>Transf. | Transfer<br>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<br>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 (μs). |
| 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.<br>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.<br>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<br>Voltage |
| V AC | Volts Alternating Current. |
| V Connector™ | Anritsu Company trademarked connector name.<br>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 MS46122A/B. 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”
- Section D-11 “Printout Does Not Capture the Entire ShockLine Screen”
- Section D-12 “Running ShockLine as Non-administrator”

## D-2 No Hardware Detected

If the ShockLine installation download results in a “No Hardware Detected” message, check the PC Device Manager. If installed successfully, the device should be present under Universal Serial Bus controllers as “Anritsu Programmed USB”, or under Other devices as MS46122x. See Figure D-1.

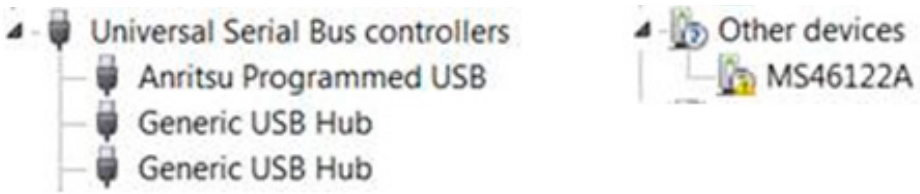



**Figure D-1.** USB Controller or Other Devices

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-2.


**Figure D-2.** 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/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”.

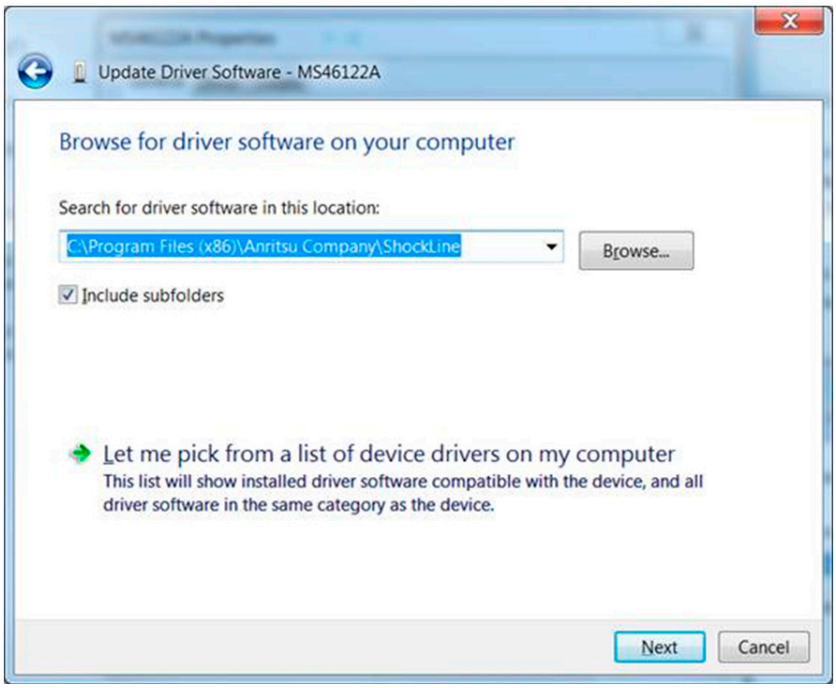



**Figure D-3.** Update Driver Software

# 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-4. If this occurs, wait until the IVI client finishes and retry after to run ShockLine GUI.

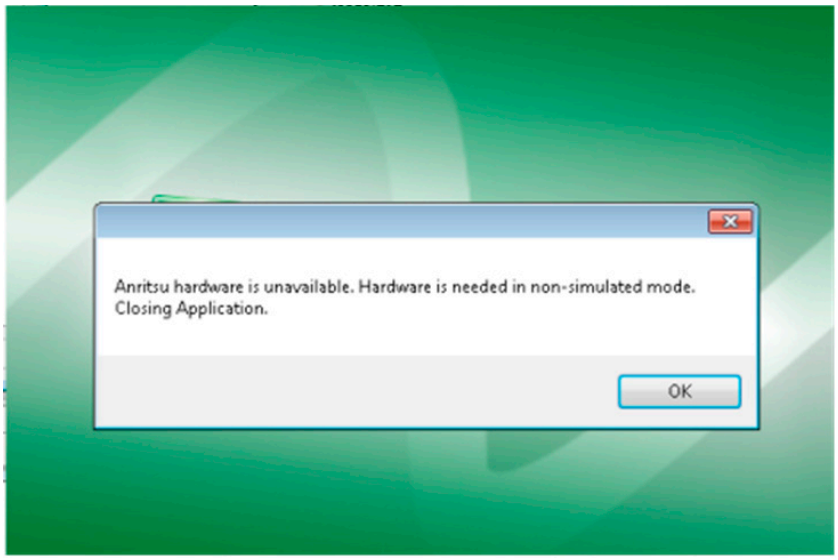



**Figure D-4.** Anritsu Hardware Is Unavailable

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.

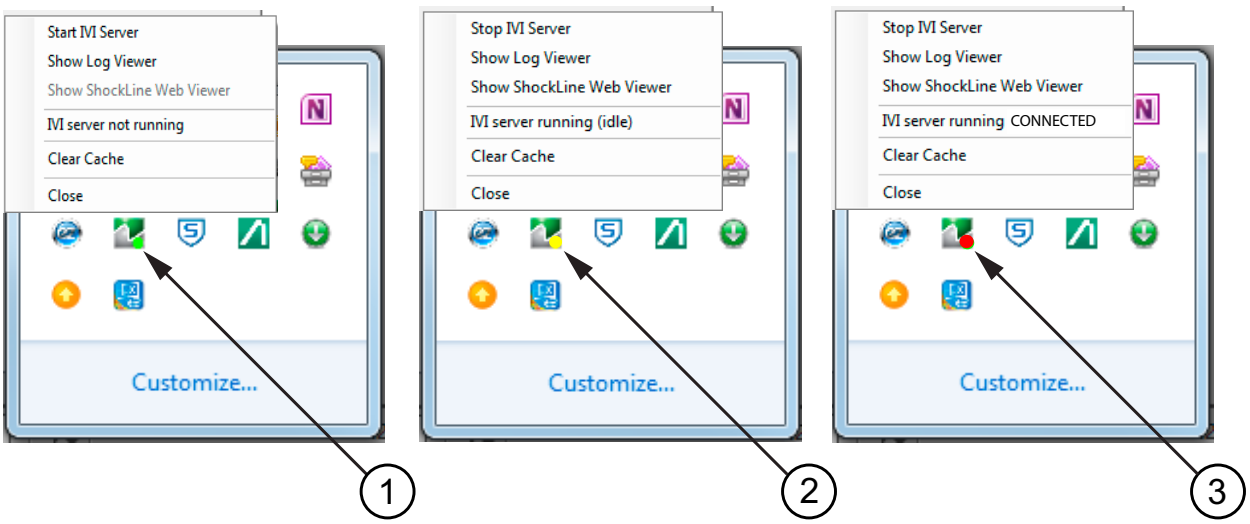



**Figure D-5.** ShockLine Tray Daemon (1 of 2)

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

**Figure D-5.** ShockLine Tray Daemon (2 of 2)

### 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-6, then the IVI Server has to be restarted as described in "Anritsu Hardware is Unavailable" on page D-3.


**Figure D-6.** Driver Initialization Error

## D-5 Application Launch Failure

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

1. Download the MVC++ 2015 package
   - https://www.microsoft.com/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/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 MS46122A/B, 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-7. Users are recommended to always update firmware to the latest revision. Users must be in administrator mode in order to program the firmware.

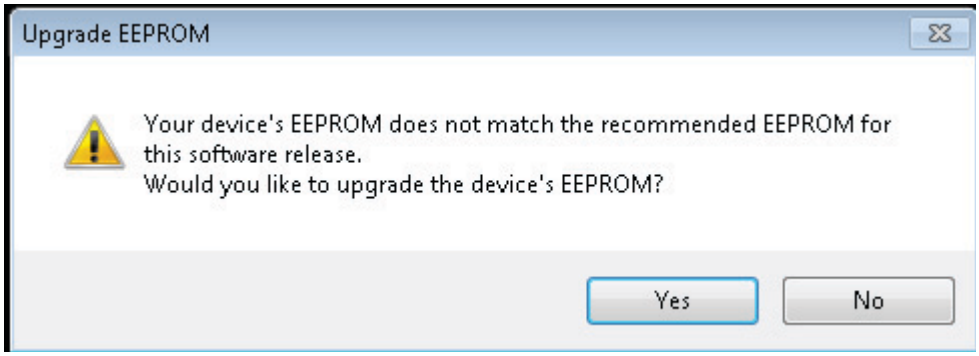



**Figure D-7.** EEPROM Does Not Match Warning Message

While the firmware update is proceeding, the message shown in Figure D-8 will be displayed. Do not cycle the power or close the application while the firmware update is in process.

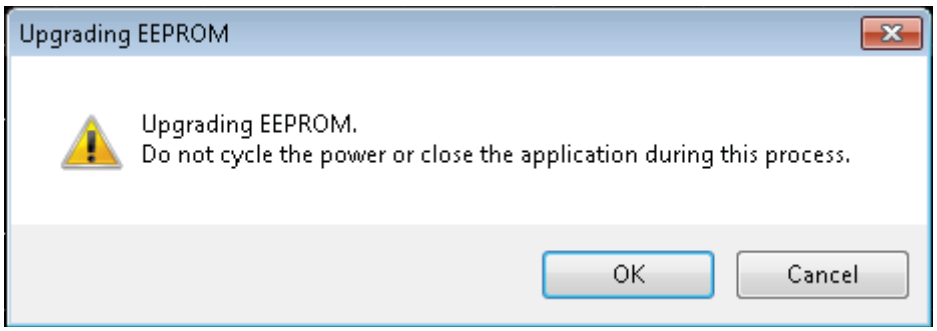



**Figure D-8.** Upgrading EEPROM (Firmware) Message

If the firmware update fails (see Figure D-9), but the display is active, proceed to the trouble-shooting tip: "Updating EEPROM Unsuccessful (Firmware Update Failed)".

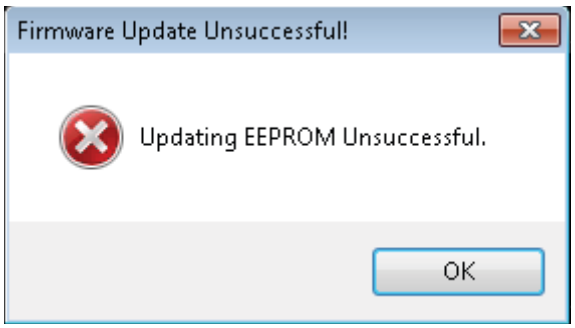



**Figure D-9.** Firmware Update Unsuccessful Message

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-9) 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-9), 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. Use the MS46322A/B folders for MS46122A/B.

| **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:<br>https://www.anritsu.com/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-9) 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 MS46122A/B 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:

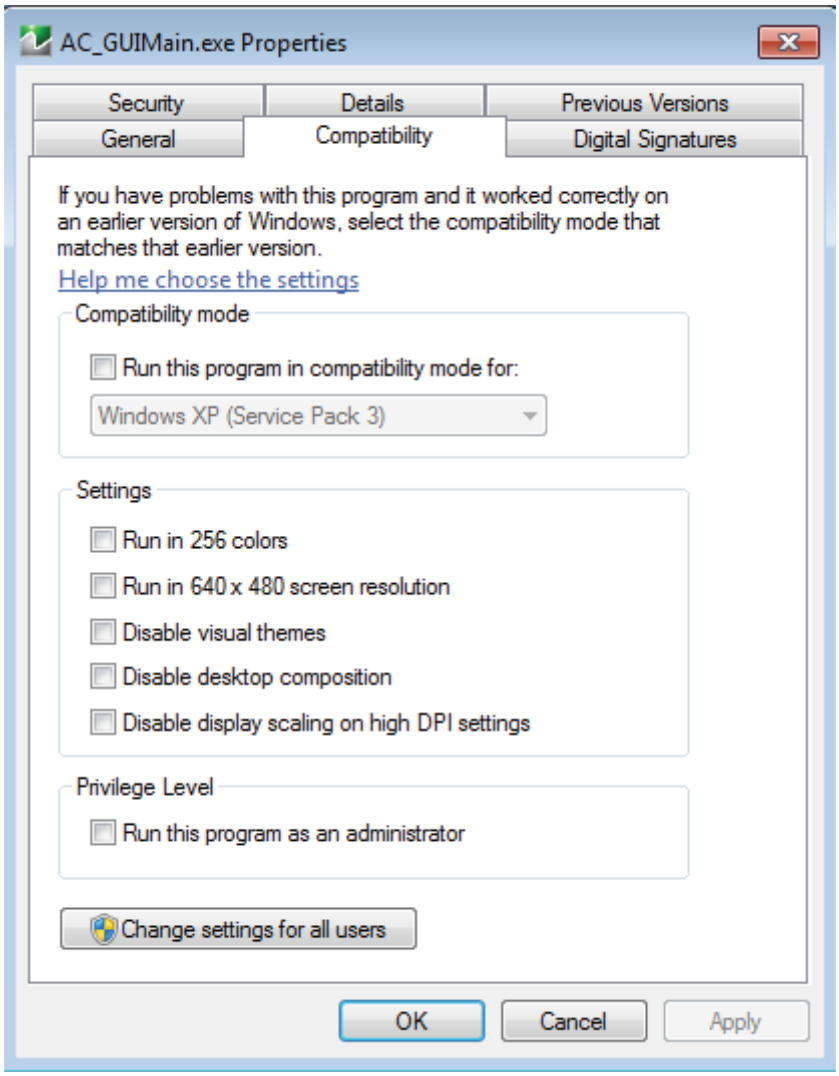



**Figure D-10.** Compatibility Tab: Windows 7 and Windows 10 version 1607 and prior

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

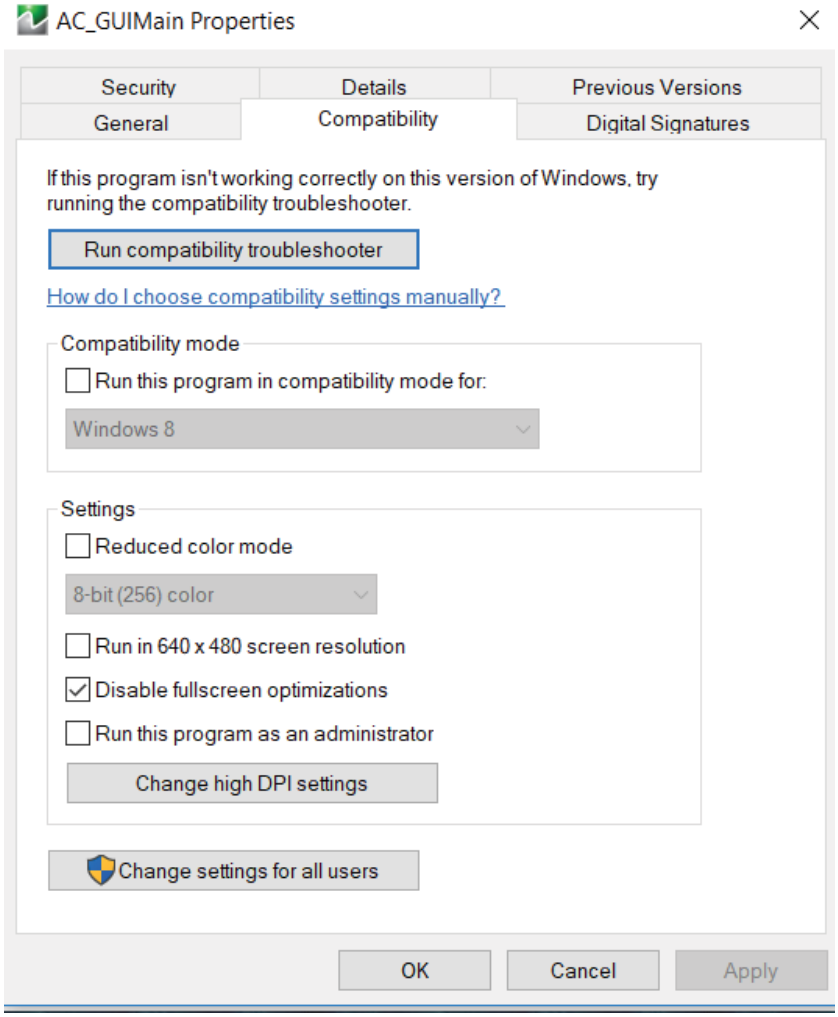



**Figure D-11.** Compatibility Tab: Windows 10 version 1703 and later

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

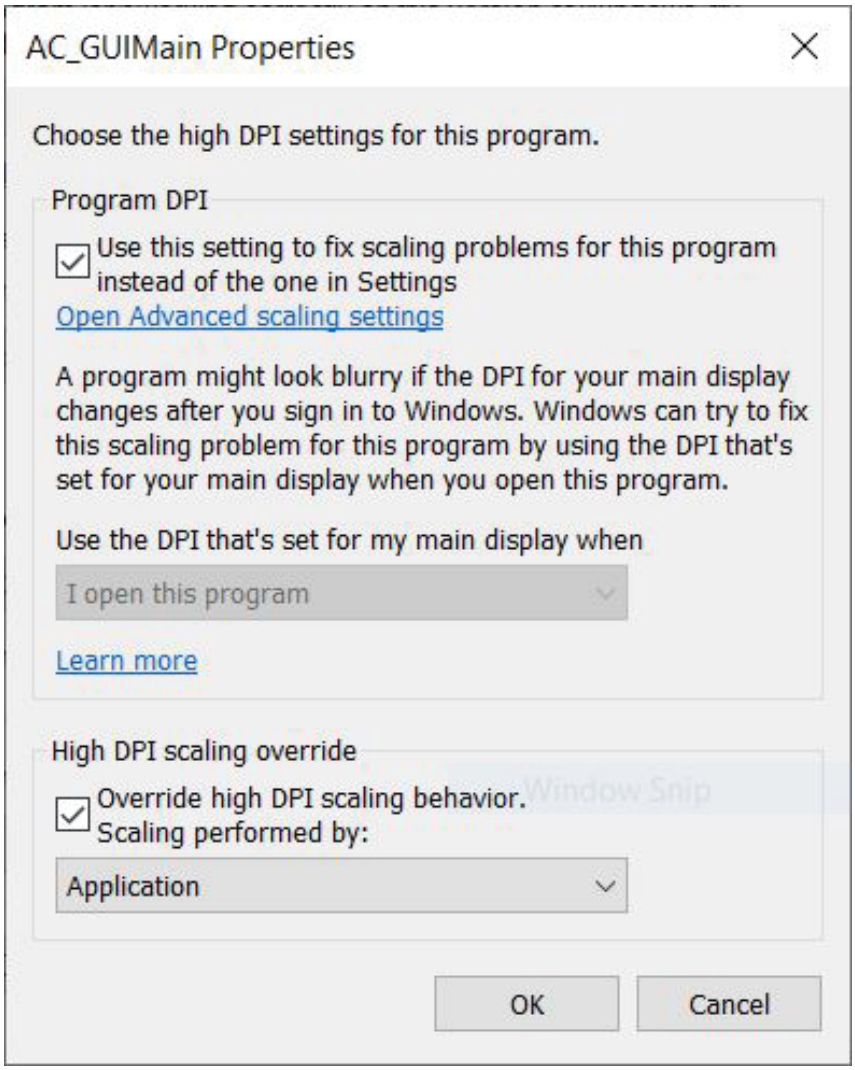


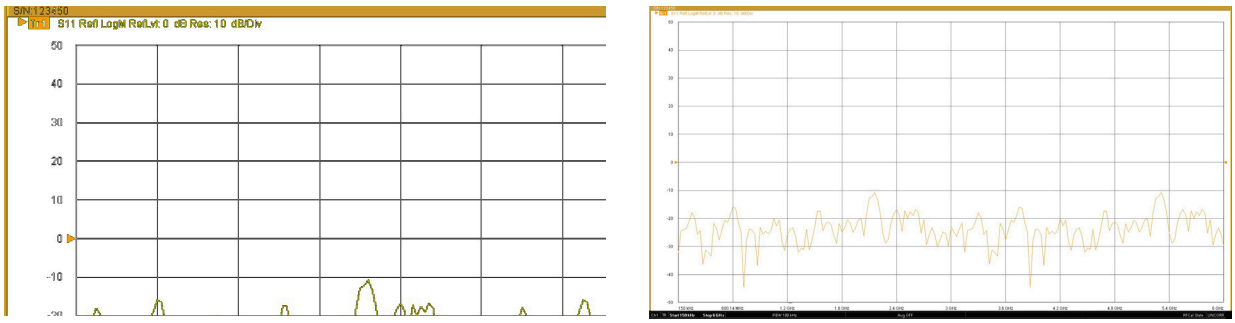

**Figure D-12.** Change High DPI Settings Dialog

**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.

# D-11 Printout Does Not Capture the Entire ShockLine Screen



| Scaling Too Large | Scaling 100% |
|---|---|

**Figure D-13.** Windows System Display Settings: Scale and Layout

If the printout does not capture the entire screen, perform the following steps:

1. Set the Windows Settings > System > Display > Scale and Layout to 100%.

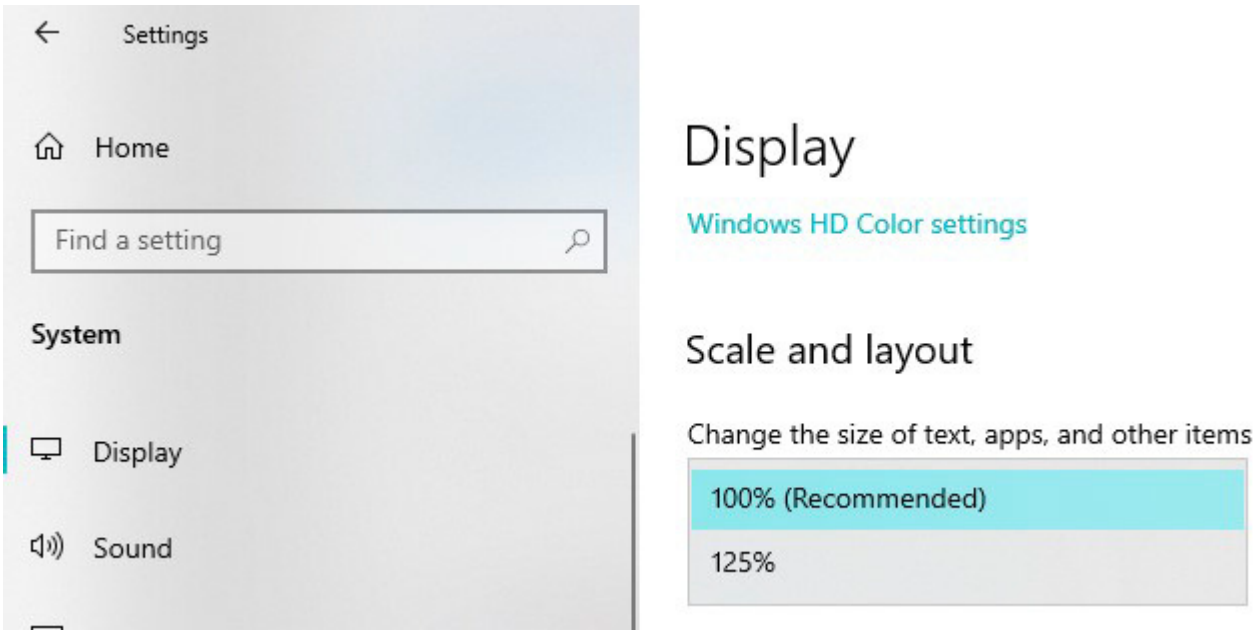



**Figure D-14.** Windows System Display Settings: Scale and Layout

# D-12 Running ShockLine as Non-administrator

1. Right-click on the ShockLine Icon.
2. Select Properties from the drop-down menu.
3. Go to the Shortcut tab.
4. Click the Advanced button.
5. Un-click "Run as administrator"

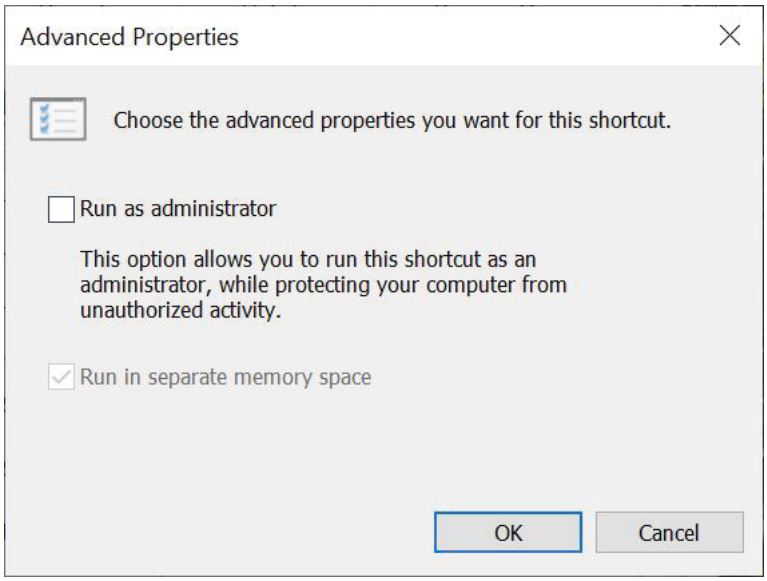



**Figure D-15.** Setting ShockLine to Run as Non-Administrator

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