User Guide

VNA Master™ MS20xxB Vector Network Analyzer with Spectrum Analyzer

MS2024B
 VNA Frequency: 500 kHz to 4 GHz

MS2025B
 VNA Frequency: 500 kHz to 6 GHz

MS2034B
 VNA Frequency: 500 kHz to 4 GHz,
 Spectrum Analyzer, 9 kHz to 4 GHz

MS2035B
 VNA Frequency: 500 kHz to 6 GHz,
 Spectrum Analyzer, 9 kHz to 6 GHz

Anritsu

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Chapter 1 — General Information

1-1 Introduction

This chapter provides information about frequency range, available options, additional documents, general overview, preventive maintenance, and annual verification requirements for the Anritsu Handheld MS2024B, MS2025B, MS2034B, and MS2035B VNA Master models.

Throughout this manual, the terms VNA Master and VNA Master refer to the MS2024B, MS2025B, MS2034B, and MS2035B. The term MS202xB refers to the MS2024B and the MS2025B, and the term MS203xB refers to the MS2034B and the MS2035B.

1-2 Contacting Anritsu for Sales and Service

To contact Anritsu, visit the following URL and select the services in your region: http://www.anritsu.com/contact-us.

1-3 Product Information, Compliance, and Safety

Read the Handheld Instruments Product Information, Compliance, and Safety Guide (PN: 10100-00065) for important safety, legal, and regulatory notices before operating the equipment. For additional information and literature covering your product, visit the product page of your instrument and select the Library tab.

http://www.anritsu.com/en-us/test-measurement/products/ms2024B

http://www.anritsu.com/en-us/test-measurement/products/ms2025B

http://www.anritsu.com/en-us/test-measurement/products/ms2034B

http://www.anritsu.com/en-us/test-measurement/products/MS2035B

1-4   Additional Documents

This user guide is specific to the VNA Master VNA Master (models MS2024B, MS2025B, MS2034B, and MS2035B) and includes a general description of the instruments. Additional instrument functions and descriptions of optional measurement capabilities are described in measurement guides.

Refer to Appendix A, "Supplemental Documentation" for a list of measurement guides and their Anritsu part numbers. Measurement guides are available for download from the VNA Master product Web pages listed previously.

1-5   VNA Master Specifications

General and performance specifications, instrument options, standard accessories, and optional accessories are described in the VNA Master Technical Data Sheet, (Anritsu part number 11410-00549). The technical data sheet is available on the Anritsu website: http://www.anritsu.com

1-6   Available Models and Accessories

Table 1-1 lists the VNA Master models and frequency ranges that are described in this User Guide. Refer to the VNA Master Technical Data Sheet for a list and descriptions of available accessories.

Table 1-1.   VNA Master Models and Frequency Ranges

Model	Frequency Range
MS2024B	Vector Network Analyzer, 500 kHz to 4 GHz
MS2025B	Vector Network Analyzer, 500 kHz to 6 GHz
MS2034B	Vector Network Analyzer, 500 kHz to 4 GHz and Spectrum Analyzer, 9 kHz to 4 GHz
MS2035B	Vector Network Analyzer, 500 kHz to 6 GHz and Spectrum Analyzer, 9 kHz to 6 GHz

1-7   Identifying the Connections

The MS2024B and MS2025B have the connectors shown in Figure 1-1. For details, refer to Figure 2-7.

Figure 1-1.   MS2024B and MS2025B Connectors

The MS2034B and MS2035B have the connectors shown in Figure 1-2. For details, refer to Figure 2-8.

Figure 1-2.   MS2034B and MS2035B Connectors

Model physical characteristics are in the Technical Data Sheet (refer to Table A-2, "VNA Master Related Documents" on page A-1).

1-8   General Description

The VNA Master VNA Master is an integrated multi-functional test instrument with a
1-path, 2-port Vector Network Analyzer that eliminates the need to carry and learn multiple
test sets. In addition, the MS203xB can be configured to include a Spectrum Analyzer,
Interference Analyzer with Interference Mapping capabilities, Coverage Mapping, Channel
Scanner, AM/FM/PM Analyzer, and High Accuracy Power Meter. A GPS receiver can be
added to both the MS202xB and the MS203xB VNA Master models.

The bright 8.4 inch TFT color display provides easy viewing in a variety of lighting conditions,
and the combination of a touch screen and keypad enables you to navigate menus with the
touch screen and to enter numbers with the keypad. All VNA Master models are equipped
with a Li-Ion battery delivering more than four hours of battery life for the MS202xB
VNA Masters and more than three hours of battery life for the MS203xB VNA Masters.

Time and date stamping of measurement data is automatic. The internal memory provides
for the storage and recall of up to 2000 measurement setups and up to 2000 traces. External
storage can be used for bulk measurement storage. Measurements and setups can be stored
in a USB flash drive or transferred to a PC by using the included USB cable. Use
Line Sweep Tools (LST) for certain VNA measurements and Master Software Tools for
spectrum analysis measurements. Cable parameters can be added to list boxes by creating
them in Line Sweep Tools. Signal Standard parameters can be added to list boxes by creating
them in Master Software Tools. Refer to Chapter 8, "Anritsu Tool Box" for a brief overview of
these software tools.

Note	Not all after-market USB drives are compatible with the VNA Master. Many drives come with a second partition that contains proprietary firmware. This partition must be removed. Only one partition is allowed. Refer to the individual manufacturer for instructions on how to remove it. You might also try reformatting a drive that contains a single partition using FAT32 format.

1-9   Soft Carrying Case

The VNA Master can be operated while in the soft carrying case (refer to the Technical Data Sheet for ordering information). On the back of the case is a large storage pouch for accessories and supplies.

To install the instrument into the soft carrying case:

1. The front panel of the case is secured with hook-and-loop fasteners. Fully close the front panel of the case. When closed, the front panel supports the shape of the case while you are inserting the VNA Master.

2. Place the soft carrying case face down on a stable surface, with the front panel fully closed and laying flat.

Note	The soft case has two zippers near the back. The zipper closer to the front of the case opens to install and remove the instrument. The zipper closer to the back of the case opens an adjustable support panel that can be used to provide support for improved stability and air flow while the instrument is in the case. This support panel also contains the storage pouch.

3. Open the zippered back of the case.

4. Insert the instrument face down into the case, take care that the connectors are properly situated in the case top opening. You may find it easier to insert the connectors first, then pull the corners over the bottom of the VNA Master.

Figure 1-3.   Instrument (MS2035B) Inserted into the Soft Carrying Case

5. Close the back panel and secure with the zipper to secure the VNA Master.

The soft carrying case includes a detachable shoulder strap, which can be connected to the D-rings of the case.

Caution	The soft case has panel openings for the fan inlet and exhaust ports. Do not block the air flow through the panels when the unit is operating.

1-10   Tilt Bail Stand

A Tilt Bail is attached to the back of the VNA Master for desktop operation. The tilt bail provides two settings of backward tilt for improved stability. To deploy the tilt bail, pull the bottom of the tilt bail away from the back of the instrument. To store the tilt bail, push the bottom of the bail towards the back of the instrument until it attaches to the VNA Master.

Note	Do not use the tilt bail while the instrument is in the soft case. The soft case has an adjustable support panel in the back zipper.

Figure 1-4.   Tilt Bail Extended

1-11   Preventive Maintenance

VNA Master preventive maintenance consists of cleaning the unit and inspecting and cleaning the RF connectors on the instrument and on all accessories. Clean the VNA Master with a soft, lint-free cloth dampened with water or with water and a mild cleaning solution.

Caution	To avoid damaging the display or case, do not use solvents or abrasive cleaners.

Clean the RF connectors and center pins with a cotton swab dampened with denatured alcohol. Visually inspect the connectors. The fingers of the N(f) connectors and the pins of the N(m) connectors must be unbroken and uniform in appearance. If you are unsure whether the connectors are undamaged, gauge the connectors to confirm that the dimensions are correct.

Visually inspect test port cables. The test port cable should be uniform in appearance and not stretched, kinked, dented, or broken.

1-12   Calibration Requirements — Vector Network Analyzer

The VNA Master is a field portable unit operating in the rigors of the test environment. In order to ensure measurement accuracy, RF calibration (OSLT, for example) must be performed prior to making a measurement in the field.

Anritsu recommends allowing the instrument to warm up to typical operation temperature (a minimum of 15 minutes) before calibrating. The instrument will require a new OSL calibration if the internal instrument temperature changes more than 15 ºC after calibration.

The VNA Master has no field-adjustable components. The RF calibration components, however, are crucial to the integrity of the calibration and must be periodically verified to ensure their performance. This is especially important if the components have been dropped or over-torqued.

Note	For best calibration results (compensation for all measurement uncertainties), ensure that the calibration is performed at the end of the test port or optional extension cable (that is, at the same point that the device that is to be tested (DUT) will be connected).

Caution	For best results, use an Anritsu phase stable Test Port Extension Cable, such as those listed in the Technical Data Sheet for your instrument (refer to Appendix A). Use of a typical laboratory cable to extend the VNA Master test port to the device under test, or any bending of the cable subsequent to the OSL or OSLT calibration, may cause uncompensated phase reflections inside the cable. Reflections of this type cause measurement errors, which are more pronounced at higher frequencies.

1-13   Annual Verification

Anritsu recommends an annual calibration and performance verification of the VNA Master and the OSL calibration components by local Anritsu service centers.

The VNA Master is self-calibrating and has no field-adjustable components. The OSL calibration components are crucial to the integrity of the calibration. As a result, they must be verified periodically to ensure performance conformity. This is especially important if the OSL calibration components have been accidentally dropped or over-torqued. Contact information for Anritsu Service Centers is available at anritsu.com/contact-us.

1-14   ESD Caution

The VNA Master, like other high performance instruments, is susceptible to ESD (electrostatic discharge) damage. Coaxial cables and antennas often build up a static charge, which may damage the VNA Master input circuitry (if allowed to discharge by connecting directly to the VNA Master without previously discharging the static charge). Operators **must be aware** of the potential for ESD damage and take all necessary precautions.

Operators should exercise practices outlined within industry standards such as JEDEC-625 (EIA-625), MIL-HDBK-263, and MIL-STD-1686, which pertain to ESD and ESDS devices, equipment, and practices. Because these apply to the VNA Master, Anritsu Company recommends that any static charges that may be present be dissipated before connecting coaxial cables or antennas to the VNA Master. This may be as simple as temporarily attaching a short or load device to the cable or antenna prior to attaching to the VNA Master. Remember that the operator may also carry a static charge that can cause damage. Following the practices outlined in the above standards helps to ensure a safe environment for both personnel and equipment.

1-15   RF Input Warning (MS203xB only)

The VNA Master is a sensitive measuring instrument designed to measure low power levels. Avoid damaging this sensitive circuitry by observing the maximum input levels printed on the instrument connector labeling and specified in the product technical data sheet.

On MS203xB instrument models, typical maximum input at the spectrum analyzer port is +30 dBm (±50 VDC) and could be less if additional features, such as a preamplifier, are in use. Be sure to review the product technical data sheet or Anritsu website for recommended components and accessories that can help you protect your instrument. These include a variety of adapters, attenuators, filters, and RF detection accessories.

1-16   Battery Replacement

The battery can be replaced without the use of tools. The battery compartment is located on the lower left side of the instrument (when you are facing the measurement display). Refer to Figure 1-5. To remove the battery:

1. Slide the catch toward the bottom of the instrument.

2. Tilt the top of the door away from the unit.

3. Lift out the battery door.

4. Remove the battery pack from the instrument by grabbing the battery lanyard and pulling out.

Replacement is the opposite of removal. The battery key-way side (slot below the contacts) must be facing the front on the unit and slides in first. Press the battery inward firmly to seat the contacts, then reinstall the door.

Note	When inserting the battery, the battery label must face the back of the instrument, and the guide slot on the battery must be below the contacts. If the battery door does not latch closed, the battery may be inserted incorrectly.

Figure 1-5.   Battery Compartment

The battery that is supplied with the VNA Master may need charging before use. The battery can be charged while it is installed in the VNA Master by using either the AC-DC Adapter or the DC adapter, or outside the VNA Master with the optional Dual Battery Charger. Refer to for a description of battery symbols.

| **Note** | Use only Anritsu Company approved batteries, adapters, and chargers with this instrument. |
| | Anritsu Company recommends removing the battery for long-term storage of the instrument. |

| **Caution** | When using the Automotive Cigarette Lighter Adapter, always verify that the supply is rated for a minimum of 60 Watts at 12 VDC, and that the socket is clear of any dirt or debris. If the adapter plug becomes hot to the touch during operation, discontinue use immediately. |

1-17   Secure Environment Workplace

This section describes the types of memory in the VNA Master, how to delete stored user files in internal memory, and recommended usage in a secure environment workplace.

VNA Master Memory Types

The instrument contains non-volatile disk-on-a-chip memory, EEPROM, and volatile DRAM memory. The instrument does not have a hard disk drive or any other type of volatile or non-volatile memory.

Disk-On-A-Chip (DOC)

DOC is used for storage of instrument firmware, factory calibration information, user measurements, setups, and `*.jpg` screen images. User information stored on the DOC is erased by the master reset process described in section "Erase All User Files in Internal Memory" on this page.

EEPROM

This memory stores the model number, serial number, and calibration data for the instrument. Also stored here are the user-set operating parameters such as frequency range. During the master reset process, all operating parameters that are stored in the EEPROM are set to standard factory default values.

RAM Memory

This is volatile memory used to store parameters needed for the normal operation of the instrument along with current measurements. This memory is reset whenever the instrument is restarted.

External USB Flash Drive (not included with the instrument)

This memory may be selected as the destination for saved measurements and setups for the instrument. You can also copy the contents of the internal disk-on-chip memory to the external flash memory for storage or data transfer. The external Flash USB can be reformatted or sanitized using software on a PC.

Refer to the Chapter 4, "File Management" for additional information on saving and copying files to the USB flash drive.

Erase All User Files in Internal Memory

Perform a Master Reset:

1.   Turn the instrument on.

2.   Press the **Shift** button then the **System** (**8**) button.

3.   Press the System Options submenu key.

4.   Press the Reset key, then the Master Reset key.

5.   A dialog box is displayed on the screen warning that all settings will be returned to factory default values and all user files will be deleted. This deletion is a standard file delete and does not involve overwriting exiting information.

6.   Press the **ENTER** button to complete the master reset.

7.   The instrument reboots, and the reset is complete.

Recommended Usage in a Secure Environment

Set the VNA Master to save files to an external USB Flash drive:

1. Attach the external Flash drive and turn on the instrument.

2. Press the **Shift** button then the **File** (**7**) button.

3. Press the Save submenu key.

4. Press the Change Save Location submenu key, then select the USB drive with the rotary knob, **Up/Down** arrow buttons, or the touch screen.

5. Press the Set Location submenu key.

The external USB drive is now the default location for saving files.

Note	Not all after-market USB drives are compatible with the VNA Master. Many drives come with a second partition that contains proprietary firmware. This partition must be removed. Only one partition is allowed. Refer to the individual manufacturer for instructions on how to remove it. You might also try reformatting a drive that contains a single partition using FAT32 format.

Chapter 2 — Instrument Overview

2-1   Introduction

This chapter provides a brief overview of the Anritsu VNA Master. The intent of this chapter is to acquaint you with the instrument. For detailed measurement information, refer to a specific measurement guide, as listed in Appendix A, "Supplemental Documentation".

2-2   Turning On the VNA Master

The Anritsu VNA Master MS202xB models are capable of approximately four hours, and the MS203xB models are capable of approximately three hours, of continuous operation from a fully charged, field-replaceable battery (refer to Section 1-16 "Battery Replacement" on page 1-9).

The VNA Master can also be operated from an external power source (which also simultaneously charges the battery). This can be achieved with either the Anritsu AC-DC Adapter or the Automotive Cigarette Lighter Adapter. Both items are included with the VNA Master.

Caution	When using the Automotive Cigarette Lighter Adapter, always verify that the supply is rated for a minimum of 60 Watts at 12 VDC, and that the socket is clear of any dirt or debris. If the adapter plug becomes hot to the touch during operation, discontinue use immediately.

To turn on the VNA Master, press the green **On/Off** button on the front panel (Figure 2-1). The VNA Master takes approximately sixty seconds to complete power warm-up and to load the application software. At the completion of this process, the instrument is ready for use.
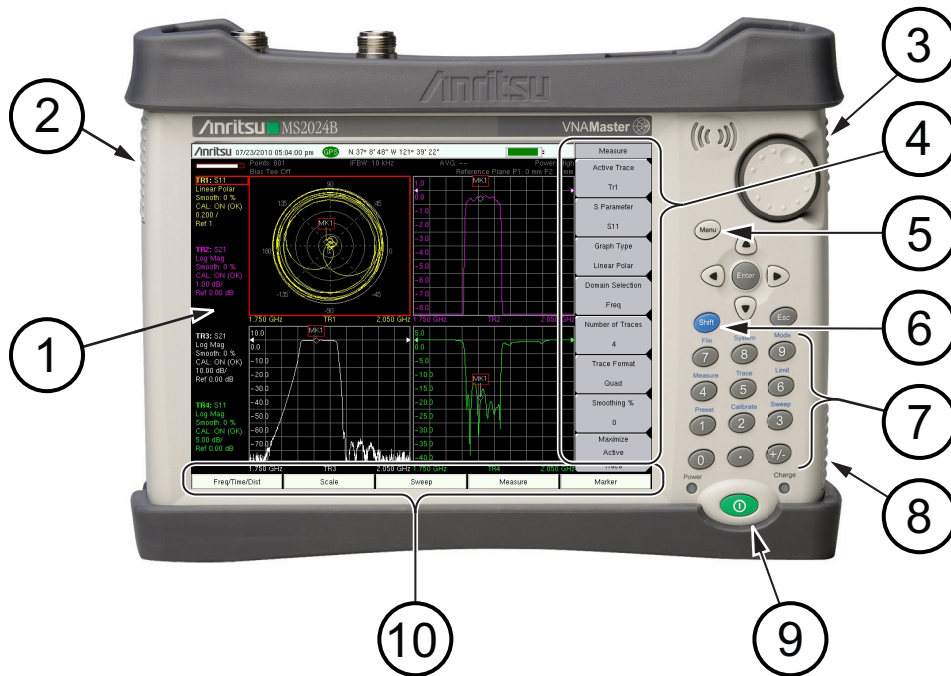
1	Instrument Settings Summary (unique to each trace)
2	Fan Exhaust Port
3	Fan Inlet Port
4	Touch Screen Submenu Keys
5	Menu Button
6	Shift Button
7	Numeric Keypad and Shift Menu Buttons (printed in blue above 1 through 9)
8	Fan Inlet Port
9	On/Off Button
10	Touch Screen Main Menu Keys

Figure 2-1.   VNA Master Overview

2-3   Front Panel Overview

The VNA Master menu-driven interface is easy to use and requires little training. The VNA Master uses a touch screen and keypad for data input. The five bottom main menu keys and eight submenu keys on the right side are touch screen keys. The main menu keys and submenu keys vary depending upon the selected mode of operation. Refer to "Mode Selector Menu" on page 2-22.

Numeric buttons 1 through 9 are dual purpose, depending upon the current mode of operation. The dual-purpose buttons are labeled with a number on the button itself, and the alternate function is printed in blue above each of the buttons. Use the blue **Shift** button to access the functions that are printed on the panel. The **Escape** button, used for aborting data entry, is the oval button located above numeric button 9. The rotary knob, the four arrow buttons, and the keypad may be used to change the value of an active parameter.

The **Menu** button provides graphical icons of all of the installed measurement modes and user defined shortcuts (refer to "Menu Button" on page 2-4). The locations of the keys and buttons are shown in Figure 2-1.

Caution	Keep the fan inlet and exhaust ports clear of obstructions at all times for proper ventilation and cooling of the instrument.

Front Panel Buttons

Menu Button

The **Menu** button is above the arrow buttons, which surround the **Enter** button. Press the **Menu** button to display a grid of shortcut icons for installed measurement modes and any user-selected menus and setup files that may have been added.

Figure 2-2 shows the **Menu** button screen with shortcut icons for the installed measurement modes. Touch one of the icons in the top row to change modes. These top-row icons are preinstalled and cannot be moved or deleted.
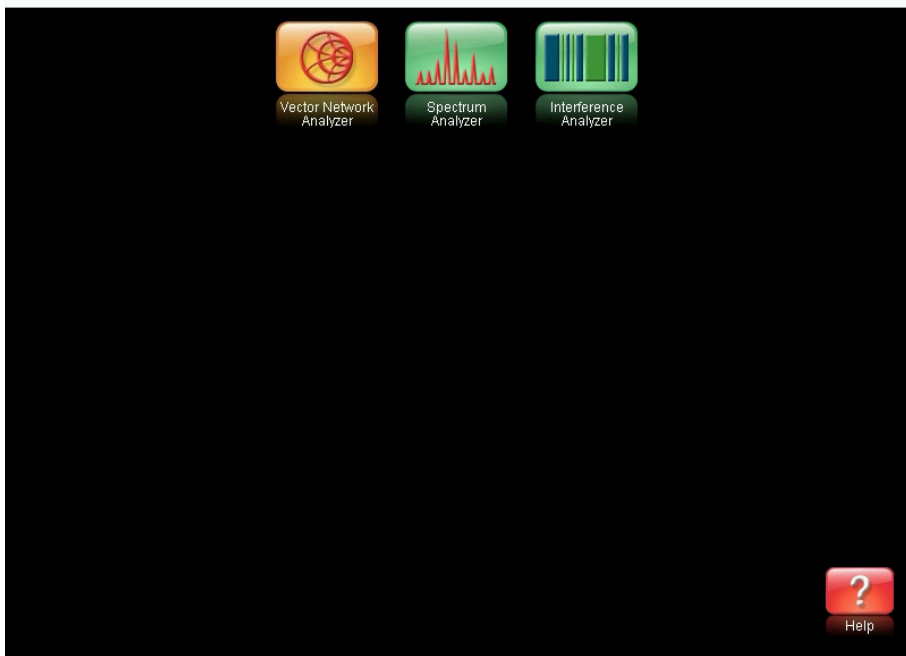
Figure 2-2.   Menu Button Screen, Icons for Installed Measurements

Note	The display of the Menu screen varies depending on your VNA Master model and installed options.

Figure 2-3 shows the **Menu** button screen with shortcut icons for the installed measurement modes plus four rows of user-defined shortcuts to menus and setup files.

Press and hold down any touch-screen key for a few seconds to add a shortcut of that key to this screen. To add shortcut setup files (`*.stp`), open the recall menu and hold down on the file name for several seconds. Then select the location for the shortcut.

Figure 2-3.   Menu Key Screen

User-defined shortcuts stay in memory until deleted. To delete or move a shortcut button, press the **Menu** button, then press and hold the shortcut for approximately 3 seconds. The Customize Button dialog box opens to allow a button to be deleted or moved. Press **Esc** to exit the Menu shortcut display.

Help for the Menu shortcut screen is available by pressing the Help icon in the lower-right corner of the display, as shown in Figure 2-4 on page 2-6.

Figure 2-4.   Menu Help

Esc Button

Press this button to cancel any setting that is currently being made.

Enter Button

Press this button to finalize data input or to select a highlighted item from a list.

Arrow Buttons

The four arrow buttons (around the **Enter** button) are used to scroll up, down, left. The arrow buttons can often be used to change a value or to change a selection from a list. The **Left/Right** arrow buttons sometimes change values or move through selections in different increments than the **Up/Down** arrow buttons. The arrow buttons are also used to move markers.

Shift Button

Pressing the **Shift** button followed by pressing a number button executes the function that is indicated in blue text above the number button. When the **Shift** button is active, its icon is displayed at the top-right of the measurement display area near the battery charge indicator.

Number Keypad

The Number keypad has two functions: The primary function is number entry. The secondary function is to list various menus. Refer to "Keypad Menu Buttons (1 to 9)" on page 2-7.

Rotary Knob

Turning the rotary knob changes numerical values, scrolls through selectable items from a list, and moves markers. Values or items may be within a dialog box or an edit window.

Touch Screen Keys

Main Menu Touch Screen Keys

These five main menu keys (also called hard keys or function hard keys in some supporting documents) are horizontally arranged along the lower edge of the touch screen. The main menu key functions change to match specific instrument Mode settings. The main menu keys generate function-specific submenus. The various measurement modes are selected by pressing the **Shift** button and then the **Mode** (**9**) button. Descriptions of the various measurement modes can be found in the applicable Measurement Guides listed in Appendix A.

Note	Available measurement modes are based on the model and the options that are purchased. Refer to Table 1-1 on page 1-2 for additional information.

Touch Screen Submenu Keys

These submenu keys (also called soft keys in some supporting documents) are arranged along the right-hand edge of the touch screen. The submenu key labels change as instrument measurement settings change. The current submenu title is shown at the top of the submenu key block.

Keypad Menu Buttons (1 to 9)

Pressing the **Shift** button followed by pressing a number button selects the menu function that is printed in blue characters above the number button. Refer to Figure 2-1 on page 2-2.

Not all Secondary Function Menus are active in various measurement modes. If any one of these menus is available in a specific instrument mode of operation, then it can be called from the number keypad. It may also be available from a main menu key or a submenu key.

The Preset Menu (1) and System Menu (8) are described in Chapter 5, "System Operations ". The Sweep Menu (3), Measure Menu (4), Trace Menu (5), and Limit Menu (6) vary depending on measurement mode, refer to the Measurement Guides listed in Appendix A for information. The File Menu (7) is described in Chapter 4, "File Management". The Mode Menu (9) is described in "Mode Selector Menu" on page 2-22.

Touch Points

Touch Points on the display screen provide additional functionality and convenience. These points are described in the measurement guides for specific measurement modes. The measurement guides are listed in Appendix A.

Touch Screen Calibration

Press **Shift** then **0** (zero) to open the Calibrate Touch Screen display. Press **Enter** to start the calibration or **Esc** to cancel.

LED Indicators

Power LED

The Power LED is located to the left of the **On/Off** button. The LED is solid green when the unit is on and slowly blinks when the unit is off but has external power.

Charge LED

The Charge LED is located to the right of the **On/Off** button. The LED slowly blinks when the battery is charging and is solid green when the battery is fully charged. It slowly blinks when the unit is off but has external power.

2-4   Display Overview

Figure 2-5 illustrates some of the primary information areas of the VNA Master sweep window in Vector Network Analyzer mode. For detailed information, refer to the Measurement Guides that are listed in Appendix A, "Supplemental Documentation".
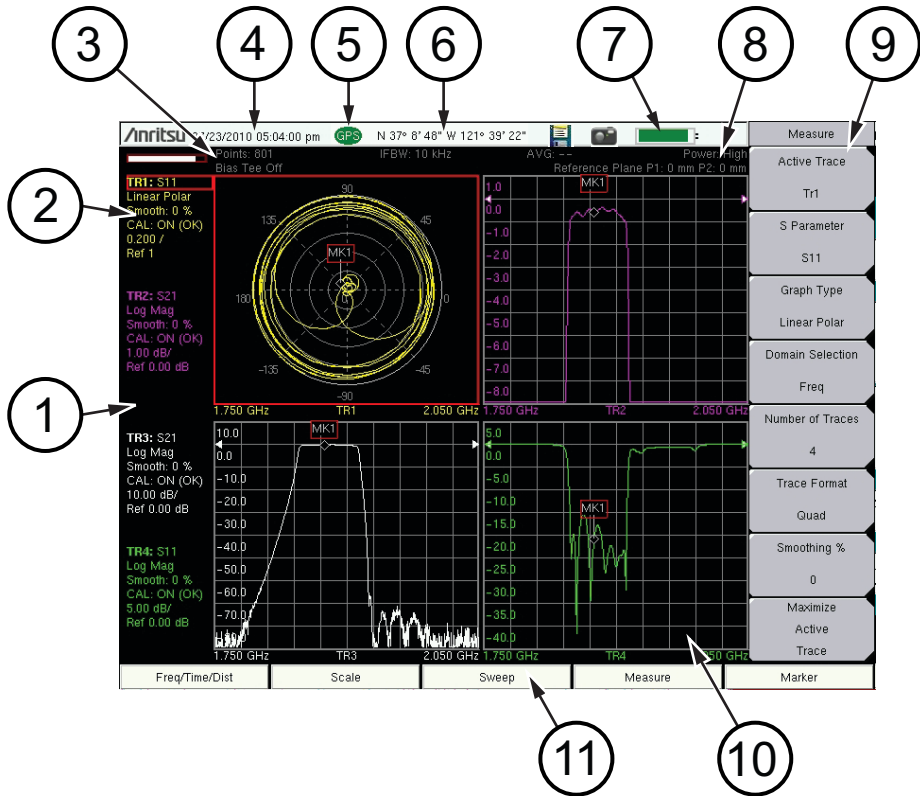
1	Instrument Settings Summary (unique to each trace)
2	Trace 1 (TR1) data (within Instrument Settings Summary)
3	Instrument Settings Summary (applies to all traces)
4	Real Time Clock
5	GPS Icon
6	GPS location
7	Battery Charge indicator
8	Measurement description (within the Instrument Settings Summary)
9	Touch Screen Submenu Keys
10	Trace 4 (TR4) display – S11 Log Mag
11	Touch Screen Main Menu Keys

Figure 2-5.   VNA Display with GPS On

Display Settings

In addition to the **Default Color** display, VNA Master offers the following display settings, illustrated in Figure 2-6:

Black on White for printing and viewing in broad daylight conditions (no color)

Color on White exchanges black for white on the display for best color printing

Night Vision optimized for night-time viewing

High Contrast for other challenging viewing conditions
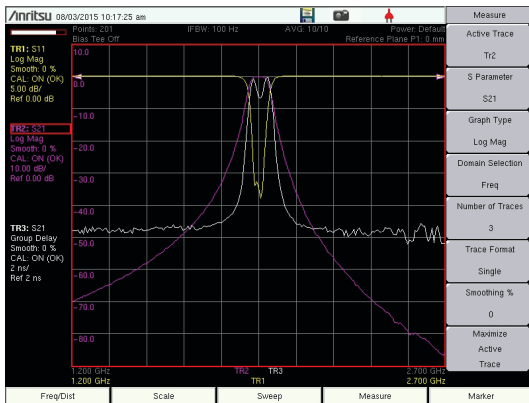
Default Colors
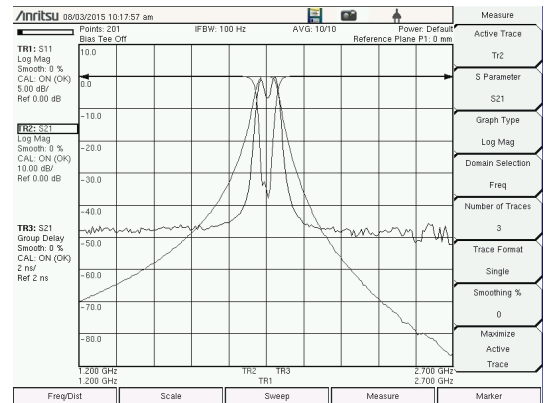
Black on White
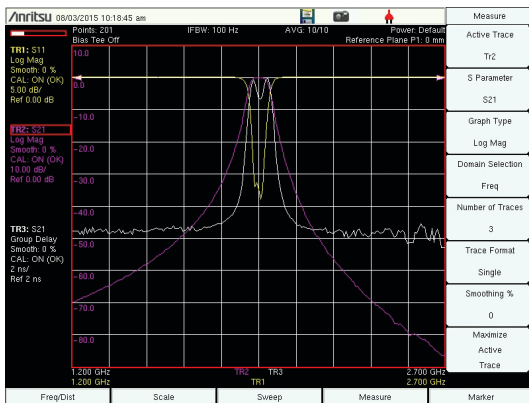
High Contrast
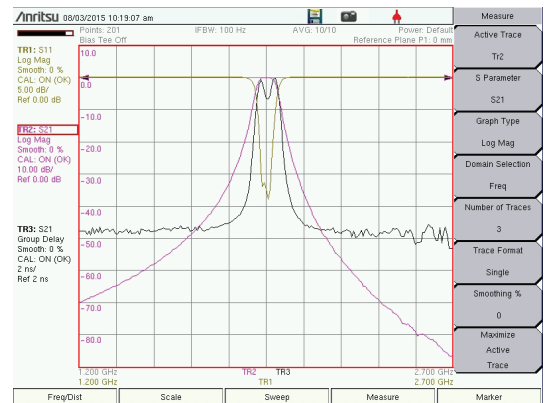
Color on White
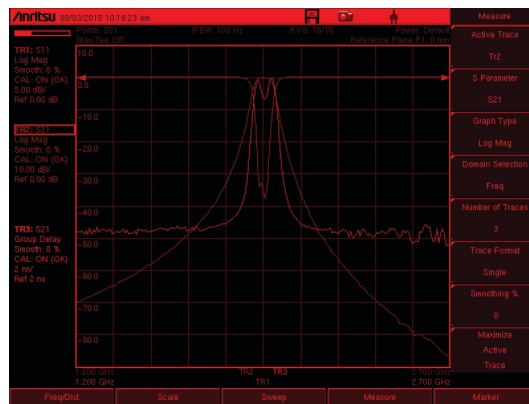
Night Vision

Figure 2-6. VNA Master Display Settings

2-5   Test Panel Connector Overview

MS2024B and MS2025B

Test panel connectors for the VNA Master MS2024B are shown in Figure 2-7.
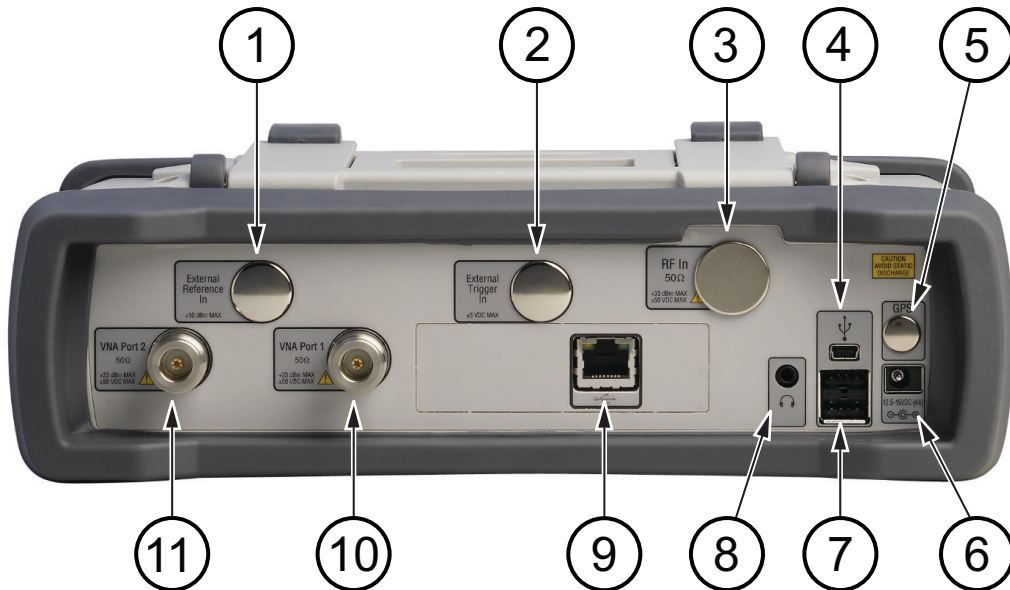
1	External Reference In (not installed in MS202xB models)
2	External Trigger In (not installed in MS202xB models)
3	RF In (not installed in MS202xB models)
4	USB Mini-B (Full Speed, USB 2.0)
5	GPS Antenna (location when installed with Option 31)
6	External Power
7	USB Type A (Full Speed, USB 2.0)
8	Headphone port
9	Ethernet Port
10	VNA Port 1 50 ohm
11	VNA Port 2 50 ohm

Figure 2-7.   MS2024B Test Panel Connectors

MS2034B and MS2035B

Test panel connectors for the VNA Master MS2035B are shown in Figure 2-8.
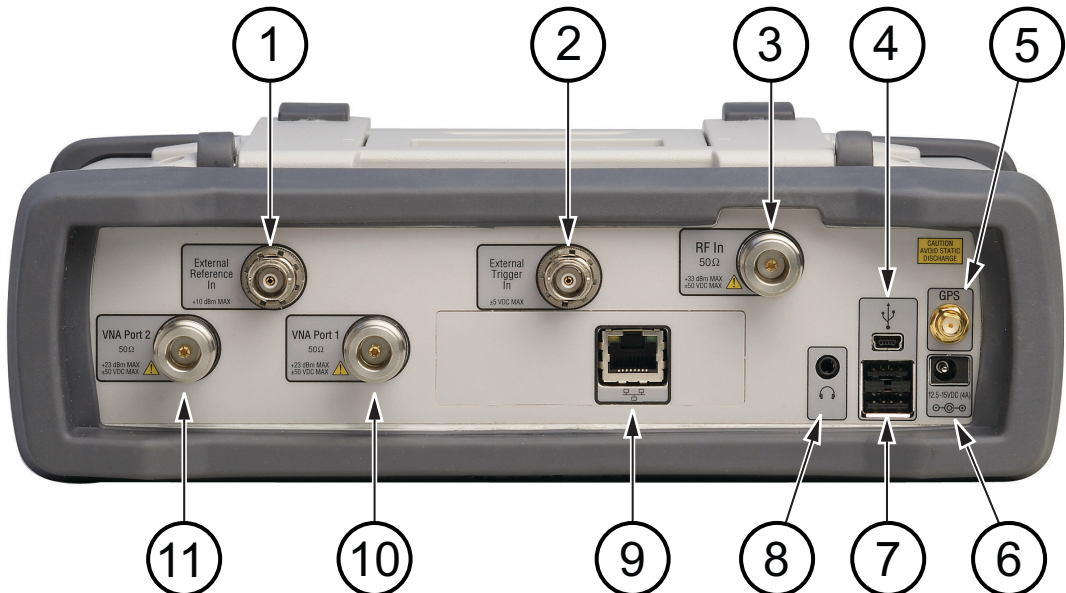
1	External Reference In
2	External Trigger In
3	RF In
4	USB Mini-B (Full Speed, USB 2.0)
5	GPS Antenna (with Option 31)
6	External Power
7	USB Type A (Full Speed, USB 2.0)
8	Headphone Port
9	Ethernet Port
10	VNA Port 1 50 ohm
11	VNA Port 2 50 ohm

Figure 2-8.   MS2035B Test Panel Connectors

External Power

The external power connector (refer to item "6" in Figure 2-8) is used to power the unit and for battery charging. Input is 12.5 VDC to 15 VDC at up to 4.0 A. The green flashing Power LED near the power switch indicates that the instrument has external power.

Warning	When using the AC-DC Adapter, always use a three-wire power cable that is connected to a three-wire power line outlet. If power is supplied without grounding the equipment in this manner, then the user is at risk of receiving a severe or fatal electric shock.

USB Interface – Type A

The VNA Master has two Type A USB connectors (refer to item "7" in Figure 2-8 on page 2-13) that accept USB Flash Memory devices for storing measurements, setup data, and screen images.

Figure 2-9.   MS2035B Connected to PC via USB Mini-B

USB Interface – Mini-B

The USB 2.0 Mini-B connector (refer to item "4" in Figure 2-8 on page 2-13) can be used to connect the VNA Master directly to a PC, as shown in Figure 2-9. The first time the VNA Master is connected to a PC, the normal USB device detection by the computer operating system will take place.

Note	For proper detection, either Line Sweep Tools or Master Software Tools must be installed on the PC prior to connecting the VNA Master to the USB port.

LAN Connection

The RJ-45 connector is used to connect the VNA Master to a local area network or directly to a PC with an Ethernet crossover cable. Integrated into this connector are two LEDs. The amber LED shows the presence of a 10 Mbit/s LAN connection when on, and a 100 Mbit/s LAN connection when off. The green LED flashes to show that LAN traffic is present. For more information on the LAN connection, Ethernet connection, and DHCP, refer to Appendix F.

Headset Jack

The headset jack provides audio output from the built-in AM/FM/SSB demodulator for testing and troubleshooting wireless communication systems. The jack accepts a 3.5 mm 2-wire or 3-wire miniature phone plug such as those commonly used with cellular telephones. (Refer to item "8" in Figure 2-8 on page 2-13.)

2-6   Connector Care

Visually inspect connectors for general wear, for cleanliness, and for damage, such as bent pins or connector rings. Repair or replace damaged connectors immediately. Dirty connectors can limit the accuracy of your measurements. Damaged connectors can damage the instrument. Connection of cables carrying an electrostatic potential, excess power, or excess voltage can damage the connector or the instrument or both. Connection of cables with inadequate torque settings can affect measurement accuracy. Over-torquing connectors can damage the cable, the connector, the instrument, or all of these items.

Connecting Procedure

1.   Carefully align the connectors.

     The male connector center pin must slip concentrically into the contact fingers of the female connector.

2.   Push connectors straight together. Do not twist or screw them together.

3.   To tighten, turn the connector nut, not the connector body. Major damage can occur to the center conductor and to the outer conductor if the connector body is twisted.

4.   If you use a torque wrench, then initially tighten by hand so that approximately 1/8 turn or 45 degrees of rotation remains for the final tightening with the torque wrench.

     Relieve any side pressure on the connection (such as from long or heavy cables) in order to assure consistent torque. Use an open-end wrench to keep the connector body from turning while tightening with the torque wrench.

     Do not over-torque the connector.

Disconnecting Procedure

1.   If a wrench is needed, use an open-end wrench to keep the connector body from turning while loosening with a second wrench.

2.   Complete the disconnection by hand, turning only the connector nut.

3.   Pull the connectors straight apart without twisting or bending.

2-7   VNA Master Connectors

External Trigger In (50 ohm)

This port is present only on MS203xB instrument models. A TTL signal that is applied to the External Trigger In female BNC input connector causes a single sweep to occur. Maximum input is ±5 VDC. In the Spectrum Analyzer mode, it is used in zero span, and triggering occurs on the rising edge of the signal. After the sweep is complete, the resultant trace is displayed until the next trigger signal arrives (refer to item "2" in Figure 2-8 on page 2-13).

To prevent damage to your instrument, do not use pliers or a wrench to tighten the BNC connector. Do not over tighten the connector.

External Reference In (50 ohm)

This port is present only on MS203xB instrument models. The BNC female connector (refer to item "1" in Figure 2-8 on page 2-13) is used for connection of an external frequency reference. Maximum input is ±5 VDC. Press the External Reference submenu key under the System menu and then the Application Options menu to set the reference to external (10 MHz). The amplitude of the External Reference should be between −10 dBm and +10 dBm.

To prevent damage to your instrument, do not use pliers or a wrench to tighten the BNC connector. Do not over tighten the connector.

Spectrum Analyzer RF In (50 ohm)

This port is present only on MS203xB instrument models (see item "3" in Figure 2-8 on page 2-13). It provides the input 50 ohm interface for the Spectrum Analyzer function. Maximum input is +30 dBm at ±50 VDC.

To prevent damage to your instrument, do not use pliers or a plain wrench to tighten the Type-N connector. Do not overly tighten the connector. The recommended torque is 12 lbf ·in to 15 lbf ·in (1.36 N ·m to 1.70 N ·m).

GPS Antenna Connector (Option 31)

The GPS antenna connection on the VNA Master is type SMA-female (refer to item "5" in Figure 2-8 on page 2-13). The GPS function is described in Chapter 6, "GPS (Option 31) ".

To prevent damage to your instrument, do not use pliers or a plain wrench to tighten the SMA connector. Do not overly tighten the connector. The recommended torque is 8 lbf ·in (0.9 N ·m or 90 N ·cm).

VNA Port-1 (50 ohm)

This Type-N connector (see item "10" in Figure 2-8 on page 2-13) provides the input/output 50 ohm interface for reflection measurements of the Vector Network Analyzer at Port 1. Maximum input is +23 dBm at ±50 VDC.

To prevent damage to your instrument, do not use pliers or a plain wrench to tighten the Type-N connector. Do not overtighten the connector. The recommended torque is 12 lbf ·in to 15 lbf ·in (1.36 N ·m to 1.70 N ·m).

VNA Port-2 (50 ohm)

This Type-N connector (see item "11" in Figure 2-8 on page 2-13) provides the input 50 ohm interface for transmission measurements of the Vector Network Analyzer at Port 2. Maximum input is +23 dBm at ±50 VDC. Bias Tee output is also available from this port (with Option 10).

To prevent damage to your instrument, do not use pliers or a plain wrench to tighten the Type-N connector. Do not over tighten the connector. The recommended torque is 12 lbf ·in to 15 lbf ·in (1.36 N ·m to 1.70 N ·m).

2-8   Symbols and Indicators

Indicators

The instrument settings that are unique to each trace are summarized in an information block on the left side of the measurement display screen (refer to item "1" in Figure 2-5). Each block contains the trace number followed by the S-parameter that is assigned to that trace (TR4: S21, for example). If the trace has Trace Math applied to it, then the math function is also displayed on that line (TR1: S11/M1, for example), where M1 is the memory that is associated with TR1, and the math function is Trace/Memory). The S-parameter that is assigned to the trace memory is shown (if enabled) at the top of each trace information block (M1: S11, for example). Each trace block also includes the Graph type, the smoothing percentage, the calibration status, and the scale (Resolution per Division and the Reference Value). The calibration status indicates whether the calibration is ON, OFF, or non-existent (--) for the specific S-parameter that is assigned to each trace. If the Calibration is ON, then its validity is also displayed (OK,?, or X).

For calibration procedures, refer to the Cable and Antenna Measurement Guide (PN: 10580-00241) listed in Appendix A.

Symbols and Icons

The following symbols and indicators indicate the instrument status or condition on the display. The colors shown here are in the standard or default display mode.

Table 2-1.   Symbols and Icons

Symbol	Description
	Green: Battery is 30 % to 100 % charged
	Yellow: Battery is 10 % to 30 % charged
	Red: Battery 0 % to 10 % charged
	Green with Black Plug body: Battery is fully charged, and external power is applied.
	Lightning Bolt: Battery is being charged (any color symbol).
	Red Plug body: External power is applied, and no battery is installed, or battery has lost communications with the instrument.
	Storage Icon: Image of a 3.5 inch floppy disk drive, shortcut to the Save Menu.
	Camera Icon: Saves a JPEG image of the current screen display.
	Shift Button Icon: This icon is displayed between the battery symbol and the submenu keys after the Shift button has been pressed, and until another button is pressed.
	GPS Icon: When GPS is available, this icon is displayed right after the date and time. Refer to the GPS chapter for details.
	Power Button with Power LED and Charge LED: This is a physical button with LED indicators. It is located near the numeric keypad.

Symbols and Icons on the Title Bar
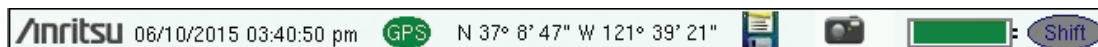
Figure 2-10. Title Bar with Icons

The instrument title bar displays the system date and time. When GPS is on and is tracking satellites, its icon is followed by latitude and longitude coordinates.

Touch the storage icon to open the touch screen keyboard for saving measurements, setups, limit lines, or screen display JPEG files.

Touch the camera icon to save a screen display JPEG file.

The battery symbol indicates the charge remaining in the battery. The colored section inside the symbol changes size and color with the charge level. When external power is applied, and no battery is installed, the red plug body is displayed as a substitute for the battery symbol.

The Battery Charge LED (adjacent to the On/Off button) flashes when the battery is charging, and remains on steady when the battery is fully charged.

Caution	Use only Anritsu-approved batteries, adapters, and chargers with this instrument. Anritsu Company recommends removing the battery for long-term storage of the instrument.

The **Shift** button icon is displayed after the **Shift** button is pressed, and it remains displayed until another button is pressed.

Additional Messages Displayed

Hold Mode

A HOLD MODE message is displayed when the VNA Master is on hold. To resume sweeping, toggle from Hold to Run in the Sweep menu.

Single Sweep

The Single Sweep message is displayed when Single Sweep is selected. Single, Continuous, or External Trigger can be selected in the Sweep Menu.

External Trigger

The External Trigger message is displayed when Ext is selected. Single, Continuous, or External Trigger can be selected in the Sweep Menu.

2-9   Data Entry

Numeric Values

Numeric values are changed using the rotary knob, arrow buttons, or the keypad. Pressing one of the main menu keys displays a list of submenus on the right side of the touch screen. When the value on a submenu key is displayed in red, it is ready for changing. When using the rotary knob or arrow buttons the changing value is shown on the submenu and in red on the graticule. When using the keypad, the new value is shown in red on the graticule and the submenu changes to Units. Selecting a unit for the new value completes the entry.

Parameter Setting

Pop-up list boxes or edit boxes are used to provide selection lists and selection editors. Scroll through a list of items or parameters with the arrow buttons, the rotary knob, or the touch screen. These list boxes and edit boxes frequently display a range of possible values or limits for possible values.

Finalize the input by pressing the **Enter** button. At any time before finalizing the input, press the escape (**Esc**) button to abort the change and retain the previously existing setting.

Cable parameters and Signal Standard parameters can be added to list boxes by creating them in Line Sweep Tools (LST) or Master Software Tools (MST).

Text Entry

When entering text, as when saving a measurement, the touch screen keyboard is displayed (Figure 2-11). Characters are entered directly with the touch screen keyboard. The keypad can be used for numeric entry. The **Left** and **Right** arrow buttons scroll the cursor through the filename. Refer to "Save Menu" on page 4-9 for additional information.
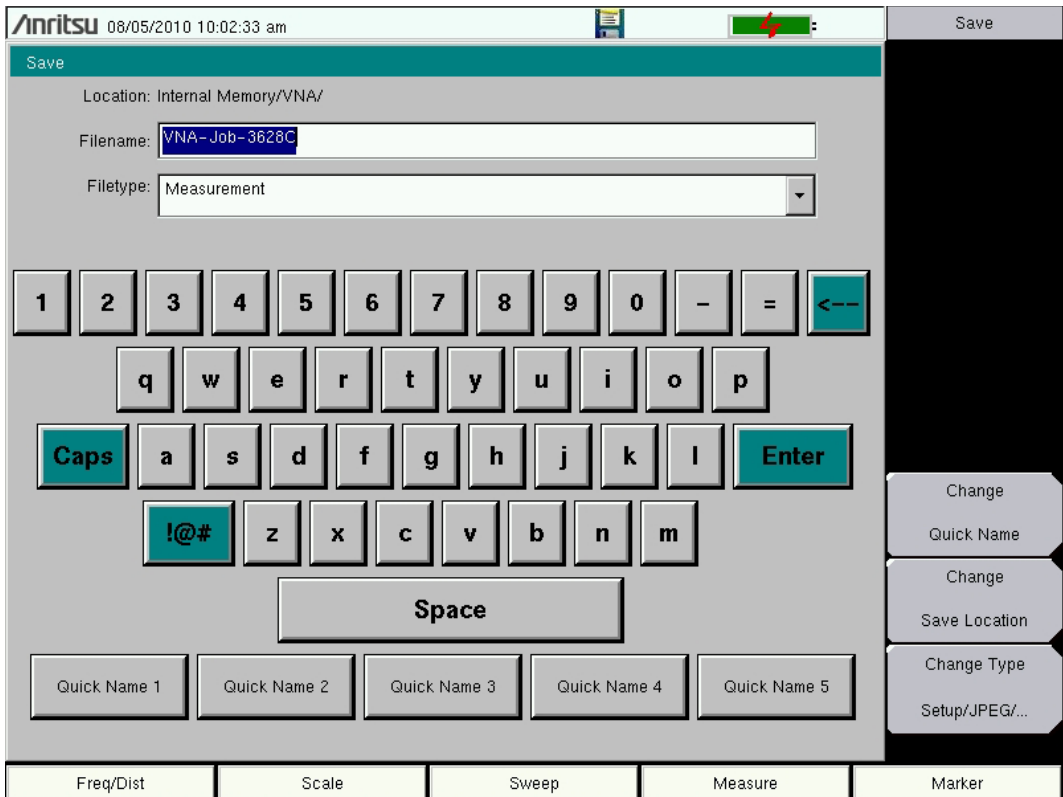
Figure 2-11. Touch Screen Keyboard

2-10   Mode Selector Menu

To access the functions under the Mode menu, press the **Shift** button, then the **Mode** (**9**) button. Use the directional arrow buttons, the rotary knob, or the touch screen to highlight the selection, and press the **Enter** button to select. The list of modes that appear in this menu varies depending upon the options that are installed and activated in the instrument. Figure 2-12 is an example of the Mode menu. Your instrument may not show the same list. On your instrument display, the current mode is displayed below the battery symbol.
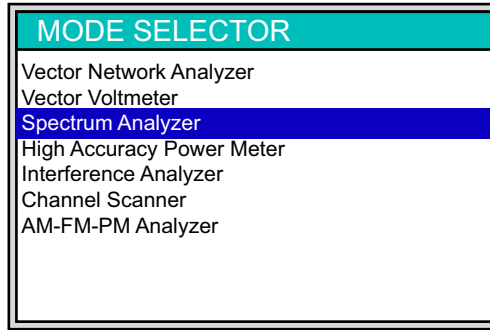
Figure 2-12.   Mode Selector Menu

Note	The display of the Mode Selector varies depending on VNA Master model and installed options.

The **Menu** button is another option to quickly change measurement modes. Press the **Menu** button then select one of the Measurement icons in the top two rows (Figure 2-2 on page 2-4).

Chapter 3 — Quick Start Guide

3-1 Introduction

This chapter provides a brief overview of basic measurement setups. For detailed measurement information, refer to a specific measurement guide listed in Appendix A, "Supplemental Documentation". This chapter provides quick start measurement information for the following measurement modes:

- Section 3-3 "Vector Network Analyzer" on page 3-2
- Section 3-5 "Spectrum Analyzer" on page 3-9

3-2 Measurement Mode Selection

Press the **Menu** button and use the touch screen to select the appropriate measurement icon.
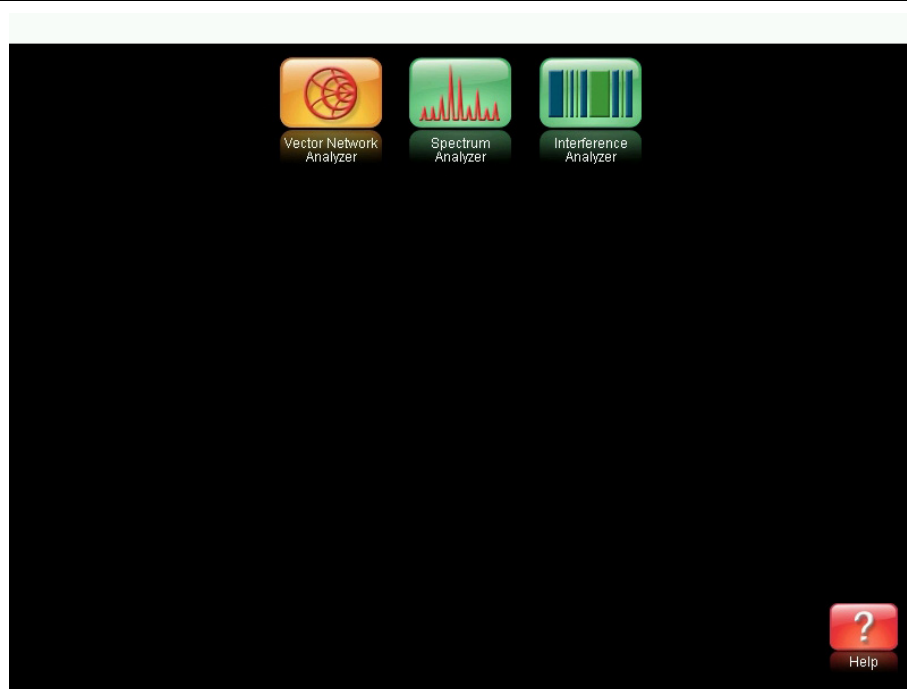
Figure 3-1. Menu Screen with Icons for Installed Measurement Modes

Note	The display of the Menu screen varies depending on installed options.

3-3   Vector Network Analyzer

Set the instrument to Vector Network Analyzer mode as described in the previous section.

Selecting the Measurement Type

Press the **Measure** main menu key and select the appropriate measurement.
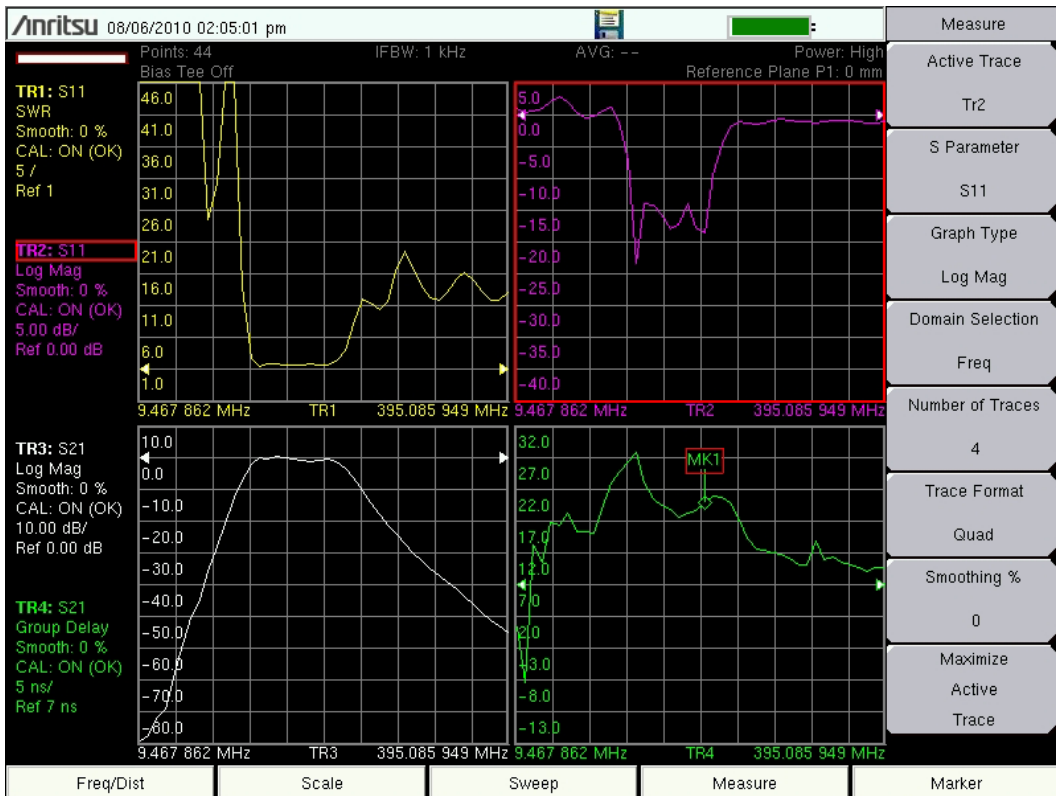
Figure 3-2.   Measurement Menu

Setting the Frequency

1. Press the **Freq/Dist** main menu key.

2. Press the Start Freq submenu key and use the keypad, rotary knob, or the arrow buttons to enter the start frequency.

3. Press the Stop Freq submenu key and use the keypad, rotary knob, or the arrow buttons to enter the stop frequency.

Setting the Scale

1. Press the **Scale** main menu key.

2. For Smith Charts, select the appropriate zoom level. The graph expands or compresses around the central reference impedance of the Smith Chart

3. For rectangular graphs, such as Log Mag or phase, press the Resolution per Div submenu key to change the scale between vertical divisions of the graph.

    a. Press the Reference Value submenu key to change the value indicated by the arrow-shaped Reference Line indicator.

    b. Press the Reference Line submenu key to change the location of the arrow-shaped reference line indicator. A value of 0 (zero) sets the reference line indicator to the bottom of the graph.

Turning On Markers

1. Press the **Marker** main menu key.

    Marker 1 will automatically be activated and placed in its last stored location. If there is no previous stored location (such as after a preset), the marker will be placed in the center of the measurement grid.

2. Press the Marker submenu key to open the Select Marker list box, then select a marker by scrolling with the rotary knob or the arrow buttons, then press **Enter**. Unused markers are labeled OFF. The number on the Marker submenu key indicates the active marker.

3. Active markers default to live trace data. Alternatively, markers may be assigned to memory trace data (if memory trace data exists). Press the Marker on Trace submenu key to select which trace is associated with the marker, or select All traces to have markers on both live traces and memory traces.

4. Use the rotary knob, arrow buttons, or touch and drag to move the Marker. The frequency of the active Marker is shown in the upper-left corner of the display screen.

5. Delta Markers are available and may be used on live trace data or memory trace data, or between live and memory trace data. For a selected marker, toggle the Marker Type submenu key to select Ref, Delta, or Off. Assign the Delta marker to a reference marker by using the Avail Ref Mkr submenu key.

Peak and Valley Search Markers

When making measurements, the Peak Search and Valley Search features can be used to quickly place a Marker on a maximum or minimum point of a trace.

1. With an active marker, press the Marker Search submenu key.

2. Press the Peak Search or the Valley Search submenu key to find the maximum or minimum value on the trace that is associated with the current marker. If the Marker is on All traces, this action finds the peak or valley of the trace that is currently active.

Find Marker Value

Hunting for specific values on a trace can be useful, such as −3 dB points on a filter. The VNA Master allows you to do this quickly and easily. Each marker can be associated with a Find value.

1.   With an active marker, press the Marker Search submenu key.

2.   Press the Enter Marker submenu key to set the desired trace value for markers to find. When the value is entered, the active marker automatically finds the trace value closest to the entered value.

3.   At any time, the Find Marker Value submenu key can be used to find the next point to the right of the current marker location whose value is closest to the Find value.

Setting Up Delta Markers

If the intent is to conduct a delta measurement, two markers are required: one to be the Reference marker and one to be the Delta marker.

Setup Example:

1.   Press the **Marker** main menu key. This turns on Marker 1 (to be the Ref marker) and assigns it to the active trace.

2.   To place the marker on a trace other than the active trace, press Marker on Trace, then scroll in the Select One list box to choose a trace, and press **Enter**. Otherwise, skip to the next step.

3.   Turn on Marker 2 and toggle the Marker Type from Ref to Delta.

4.   Assign Marker 2 to Marker 1 by pressing the Avail Ref Mkr submenu key to open the Select One list box. Scroll to choose trace 1 (TR1), in this example, and press **Enter**.

     If there are markers assigned on other traces, those traces will also appear in the list box. You can assign the Delta marker on the same trace or a different trace from the Ref marker.

Note	The Select Marker list box includes the current location, readout style, and delta status (if they exist). Otherwise, it indicates Off.

Setting a Single Limit Line

1. Press **Shift** and then **Limit** (6) to enter the Limit menu.

2. Press the Limit On/Off key to turn on the Limit.

3. Press Single Limit and then use the numeric keypad, the arrow buttons, or the rotary knob to change the limit value and then press **Enter**.

Note	Refer to the Vector Network Analyzer Measurement Guide (listed in Appendix A) for creating multi-segment limit lines.

4. Press the Limit Alarm key to turn on or off the Limit Alarm.
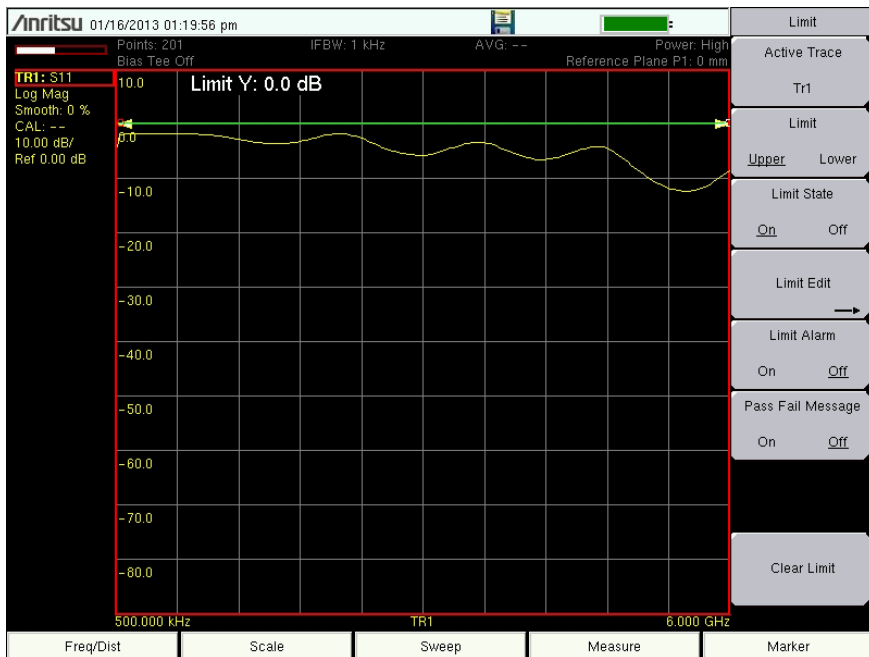
Figure 3-3.   Single Limit Lines

Setting Up Distance Domain

Distance Domain is available on instruments with installed firmware V1.20 and higher. Older firmware requires Anritsu Option 501. This feature is fully described in the Vector Network Analyzer Measurement Guide. Refer to Appendix A, "Supplemental Documentation" for a list of guides and their Anritsu part numbers. Measurement Guides are available as free downloads from the Anritsu website.

3-4   Calibration Considerations

Various 1-port and 2-port calibrations are available in the VNA Master. Transmission response is the simplest and requires only one connection during calibration, but it does not correct for test port match errors. 1-Path 2-Port calibration requires four calibration connections and corrects for the transmit port match, but does not correct for the receive port.

Note	The previously described calibration considerations omit isolation steps in which loads are connected to each test port. During the isolation step of the calibration procedure, the VNA Master measures the isolation between test ports in order to achieve best dynamic range performance.
	The Vector Network Analyzer Calibration menu is the same one that is used in the Vector Voltmeter menu. Refer to section "Calibration Menus" in Chapter 5 of the Vector Network Analyzer Measurement Guide (refer to Appendix A) for more information about the calibration menu. Note that some calibration parameters are shared between the Vector Network Analyzer and Vector Voltmeter mode, and that some parameters are different because they were optimized for the specific mode application.
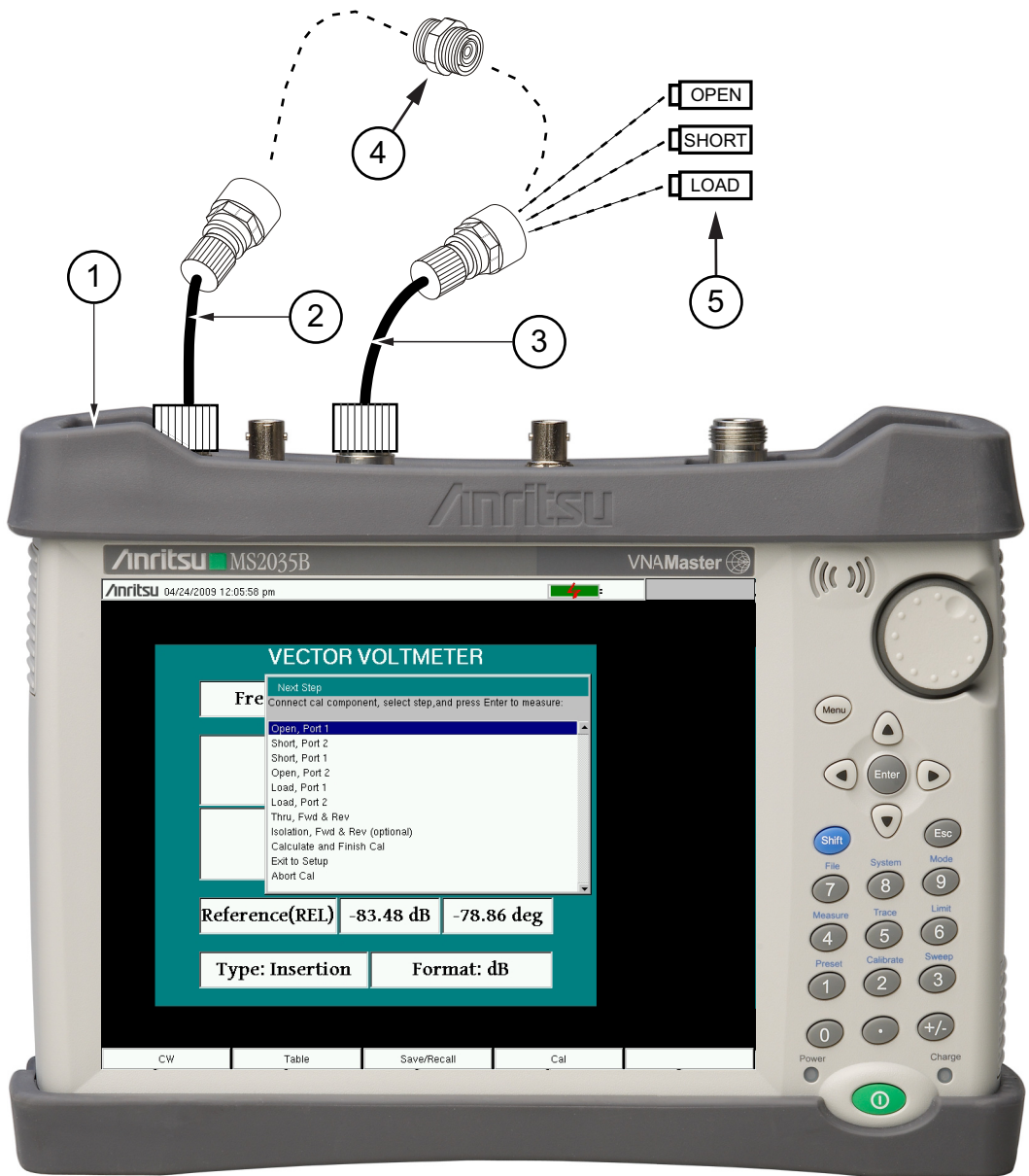
1	VNA Master
2	Optional Test Port Cable at Port 2
3	Optional Test Port Cable at Port 1
4	Through Connection (Port 1 Connects to Port 2)
5	OSL (Open, Short, Load) Precision Calibration Components

Figure 3-4.   2-Port Calibration

When you perform a calibration, the correction coefficients are calculated for specific S-parameters (depending on the type of calibration chosen) and for instrument settings (frequency range, number of points, and power level). The term "calibration correction" refers to the measurement correction coefficients that are applied to measurements as a result of your calibration.

When calibration correction is On, the correction is applied to all applicable S-parameters. For example, if a Full S_{11} (1-port) calibration is performed, then only traces that measure S_{11} have a valid calibration. For those traces, the calibration information data in the Instrument Settings Summary (item "1" in Figure 2-1 on page 2-2) shows "**CAL: ON (OK)**". All other traces that do not measure S_{11} display "**CAL: --**" to indicate that no valid calibration is available for those traces. The calibration correction can also be turned off manually under the Calibration menu by toggling the Cal Correction submenu key from On to Off. In that case, the display shows "**CAL: OFF**" for all traces that have valid correction data available.

When measuring with calibration Interpolation turned On, the calibration information data in the Instrument Settings Summary (item "1" in Figure 2-1) shows "**iCAL: ON (OK)**". This calibration setting information (including iCAL) is saved when a measurement is saved.

Note that "**CAL: OFF**" means that a calibration correction has been created, but it is not currently being used. This is different from "**CAL: --**", which means that no valid calibration correction is available for the current setting.

When you have Cal Correction on, you cannot increase the frequency range or the number of points. You can, however, reduce the frequency range or decrease the number of points without forcing the calibration to become invalid. When reducing the frequency range, the VNA Master uses the appropriate points within the new frequency range that have correction coefficients applied to them. In that case, you can observe that the number of points that are being used for calibration correction are automatically reduced.

If you reduce only the number of points, then the frequency range is not changed. The VNA Master finds a subset of the original points in the sweep that can be used. You can therefore notice that the instrument may not use the exact number of points that you have entered. It picks a specific number of points that allow the calibration correction to continue to be valid. If you use the rotary knob, you will more easily find the available number of points that can be set. For example, if you calibrated with 201 points, then you can observe that you can reduce the number of points to 101, 68, 51, 41, and so forth.

If you change the source power setting, the calibration status is changed to "**CAL: ON (?P)**", which indicates that source power has changed since the instrument was calibrated (from Low to High, or from High to Low). In this case, the calibration may still be valid, but a new calibration is recommended.

Another status information display that you may see is "**CAL: ON (?T)**" which indicates that the instrument temperature has deviated by more than a set amount since the time that the calibration was conducted. The calibration is most likely still valid, but a new calibration is recommended. If you see "**CAL: ON (X)**" on the display, then this indicates that the instrument temperature has deviated (since the time the calibration was conducted) by an amount that has more than likely rendered the calibration invalid. When this occurs, a new calibration is highly recommended before further measurements are conducted.

Only one calibration is available at a time. Performing a new calibration overwrites any existing calibration. You can, however, store a measurement setup (with CAL), which also stores the calibration. You can therefore have multiple calibrations available (as long as the calibration settings and conditions continue to apply).

Cal Type

The Cal Type submenu key is found in the Calibration Menu (shown in the VNA Measurement Guide). The Calibration Type list box provides the complete selection of available calibration types.

3-5   Spectrum Analyzer

Set the instrument to Spectrum Analyzer mode as described in Section 3-2 "Measurement Mode Selection" on page 3-1.

Set Start and Stop Frequencies

1. Press the **Freq** main menu key.

2. Press the Start Freq submenu key.

3. Enter the desired start frequency using the keypad, the arrow buttons, or the rotary knob. When entering a frequency using the keypad, the submenu key labels change to GHz, MHz, kHz, and Hz. Press the appropriate unit key. Pressing the **Enter** button has the same affect as pressing the MHz submenu key.

4. Press the Stop Freq submenu key.

5. Enter the desired stop frequency.

Enter the Center Frequency

1. Press the **Freq** main menu key.

2. Press the Center Freq submenu key.

3. Enter the desired center frequency using the keypad, the arrow buttons, or the rotary knob. When entering a frequency using the keypad, the submenu key labels change to GHz, MHz, kHz, and Hz. Press the appropriate unit key. Pressing the **Enter** button has the same affect as pressing the MHz submenu key.

The center frequency and span is shown at the bottom of the screen.

Select a Signal Standard

1. Press the **Freq** main menu key.

2. Press the Signal Standard submenu key. The Signal Standards dialog box opens.

3. Highlight a signal standard and press **Enter** to select.

4. Press the Channel submenu key to change the channel value in the Channel Editor.

The signal standard is shown in yellow at the top of the screen.

Set the Measurement Bandwidth

1. Press the **BW** main menu key to display the BW menu.

    • Press the RBW and/or the VBW submenu key to manually change the values.

- Set RBW and VBW automatically by pressing the Auto RBW submenu key or the Auto VBW submenu Key.

2. Press the RBW/VBW submenu Key to change the resolution bandwidth and video bandwidth ratio.

3. Press the Span/RBW submenu key to change the span width to resolution bandwidth ratio.

Set the Amplitude

Press the **Amplitude** main menu key to display the Amplitude menu.

Set Amplitude Reference Level and Scale

1. Press the Reference Level submenu key and use the arrow buttons, rotary knob, or the keypad to change the reference level. Press **Enter** to set the reference level value.

2. Press the Scale submenu Key and use the arrow buttons, rotary knob, or the keypad to enter the desired scale. Press **Enter** to set the scale value.

Set Amplitude Range and Scale

1. Press the Auto Atten submenu key to set an optimal reference level based on the measured signal.

2. Press the Scale submenu key.

3. Enter the desired scale units by using the keypad, the arrow buttons, or the rotary knob. Press **Enter** to set. The y-axis scale is automatically renumbered.

Power Offset Set Up for Compensating External Loss

To obtain accurate results, compensate for any external attenuation by using power offset. In power offset mode, the compensation factor is in dB. (External attenuation can be created by using an external cable or an external high power attenuator.)

Press the RL Offset submenu key and use the keypad, the arrow buttons, or the rotary knob to enter the desired offset value. When using the rotary knob, the value changes in increments of 0.1 dB. Using the **Left/Right** arrow buttons changes the value in 10% increments of the value shown on the Scale submenu key. When using the **Up/Down** arrow buttons, the value changes in the increment shown on the Scale submenu key. When using the keypad, enter the new value then press **Enter** or the dB submenu key to set the value. The power offset is displayed in the instrument settings summary column on the left side of the measurement display.

Set the Span

1. Press the **Span** main menu key or the **Freq** main Menu key followed by the Span submenu Key.

2. To select full span, press the Full Span submenu key. Selecting full span overrides any previously set Start and Stop frequencies.

3.   For a single frequency measurement, press the Zero Span submenu key.

Note	To quickly move the span value up or down, press the Span Up 1-2-5 or Span Down 1-2-5 submenu keys These keys facilitate a zoom-in, zoom-out feature in a 1-2-5 sequence.

Single Limit Line

Press the **Limit** menu key to display the Limit menu.

1.   Press the Limit (Upper / Lower) submenu key to select the desired limit line, Upper or Lower.

2.   Activate the selected limit line by pressing the On Off submenu key so that On is underlined.

3.   Press the Limit Move submenu key to display the Limit Move menu. Press the first Move Limit submenu key and use the arrows buttons, rotary knob, or keypad to change the dBm level of the limit line.

4.   Press the Back submenu key to return to the Limit menu.

5.   If necessary, press the Set Default Limit submenu key to redraw the limit line in view.

Create a Limit Envelope

1.   Press **Shift** then **Limit** (**6**) to open the Limit menu.

2.   Press Limit Envelope.

3.   Press the Create Envelope key.
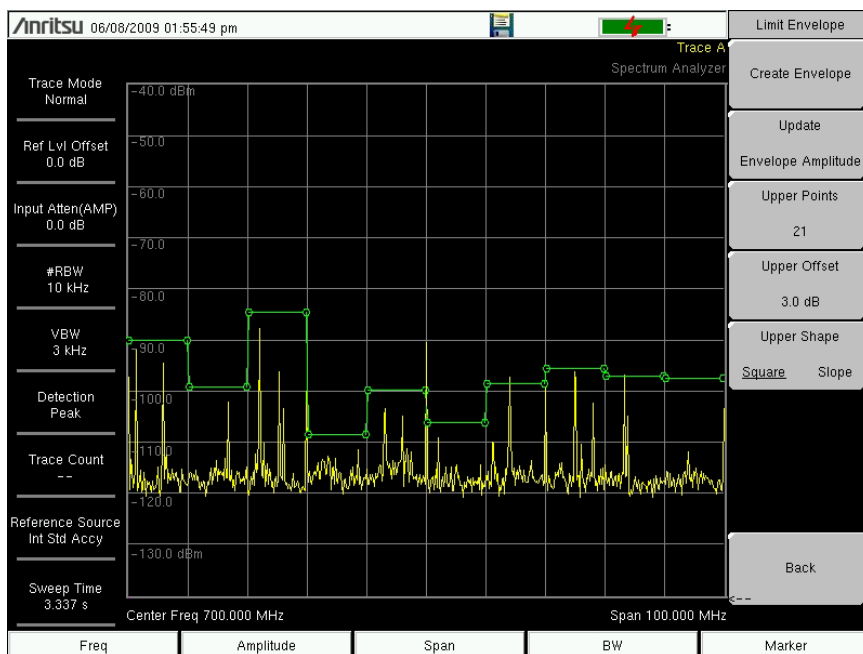
Figure 3-5.   Limit Envelope

Setting Up Markers

Press the **Marker** main menu key to display the Marker menu.

Selecting, Activating, and Placing a Marker

1. Press the Marker 1 2 3 4 5 6 submenu key and then select the desired marker by using the touch screen marker buttons. The selected marker is underlined on the Marker submenu key.

2. Press the On Off submenu key so that On is underlined. The selected marker is displayed in red and ready to be moved.

3. Use the rotary knob to place the marker on the desired frequency.

4. Repeat Step 1 through Step 3 to activate and move additional markers.

Selecting, Activating, and Placing a Delta Marker:

1. Press the Marker 1 2 3 4 5 6 submenu key and select the desired delta marker. The selected marker is underlined.

2. Press the Delta On Off submenu key so that On is underlined. The selected marker is displayed in red and ready to be moved.

3. Use the rotary knob to place the delta marker on the desired frequency.

4. Repeat Step 1 through Step 3 to activate and move additional markers.

Viewing Marker Data in a Table Format

1. Press the More submenu key.

2. Press the Marker Table On Off submenu key so that On is underlined. All marker and delta marker data are displayed in a table under the measurement graph.
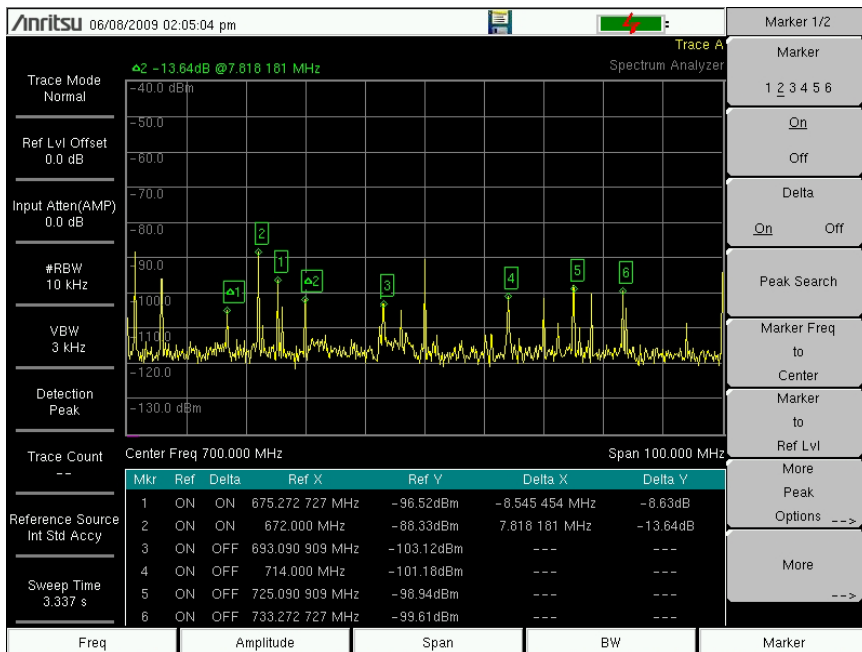
Figure 3-6.   Marker Table

Select a Smart Measurement Type

In Spectrum Analyzer mode, press **Shift** then **Measure** (**4**) and select a smart one-button measurement using the submenu keys. The Spectrum Analyzer Measurement Guide includes a Field Measurements section about smart measurements, which states:

In Spectrum Analyzer mode, smart one-button measurements are built-in for field strength, occupied bandwidth, channel power, adjacent channel power ratio, and carrier to interference ratio (C/I) tests. In addition, AM/FM/SSB demodulation is available to aid in the identification of interfering signals.
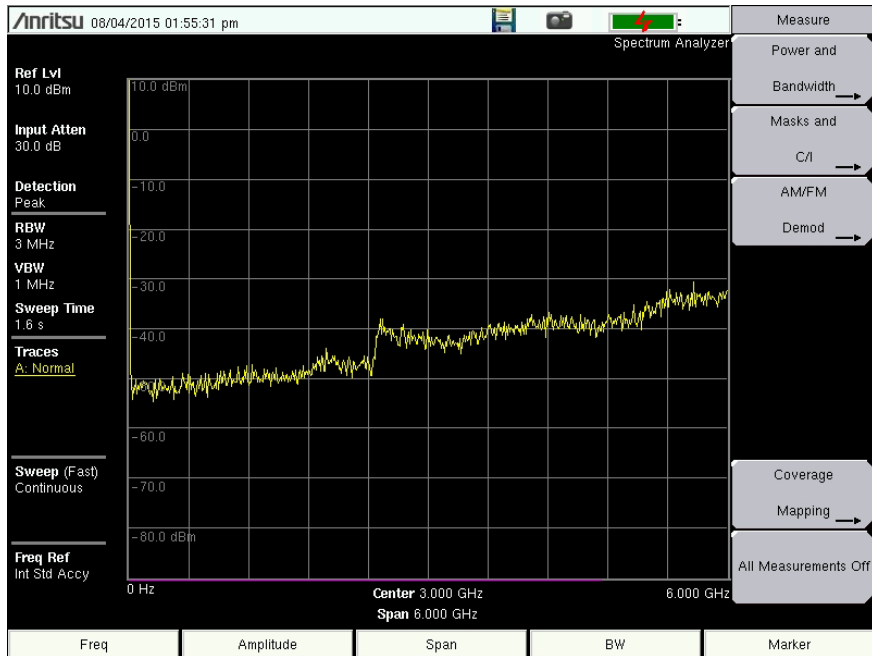
Figure 3-7.   Spectrum Analyzer Measure Menu

3-6   Saving Measurements

Available measurement file formats depend on the instrument model, installed options, and current measurement mode. Some of the commonly used file types include:

`*.jpg` JPEG images

`*.mna` VNA Measurements

`*.stp` Setups

`*.s2p` S2P (SnP)

`*.spa` Spectrum Analyzer Measurements

`*.csv` Text file with Comma Separated Values (CSV)

`*.txt` Text file with tab separated values

`*.lim` Limit lines

Saving VNA files in `.mna` format is recommended because it enables you to edit, view, and analyze traces with Line Sweep Tools. For more information, refer to the Line Sweep Tools Help file for the instrument and measurement files supported.

Procedure for saving files:

1. Press **Shift** then File (**7**).

2. Press Save Measurement.

3. Press Change Save Location and set the current location to be the USB flash drive or internal memory, and then press Set Location.

4. In vector network analyzer mode, press Change Type (Setup/JPG/…) and select the desired file type from the Select File Type list box.

5. In spectrum analyzer mode or interference analyzer mode, press one of the 4 submenu keys to specify a file type.

6. Enter the filename by using the keyboard, then press Enter.

Refer to Chapter 4, "File Management" for more details about working with files.

3-7   External Power On

The When DC Applied setting in the Power-On menu allows the VNA Master to restart automatically when external DC power is applied to the connector shown in Figure 2-7 on page 2-12 and Figure 2-8 on page 2-13. Refer to "External Power" on page 2-13 and the "Power–On Menu" on page 5-15.

When this feature is enabled, the VNA Master in the off state will turn on when external DC power is applied. The instrument turns off when external power is removed, even if a battery is installed. This is useful for high-reliability remote operation, where the instrument may need to be rebooted using a remotely-controlled power switch.

If the instrument is turned on with the power switch, then external power is removed, the instrument will continue to run until the battery is depleted. It will come on and the battery will begin recharging when external power is applied. This state is useful when the instrument is in a location where the power source may be interrupted.

Chapter 4 — File Management

4-1 Introduction

This chapter describes the file management features of the VNA Master and describe the **File** menu. The submenus under this menu allow you to save, recall, copy, and delete files in internal memory or an external USB flash drive.

4-2 File Types

Filename extensions that are used in the VNA Master:

`*.jpg`   JPEG images, `filename.jpg`

`*.mna`   Vector Network Analyzer Measurements, `filename.mna`

`*.stp`   Setups, `filename.stp`

`*.s2p`   S2P (SnP), `filename.s2p`

`*.spa`   Spectrum Analyzer Measurements, filename`.spa`

`*.csv`   Text file with Comma Separated Values (CSV), `filename.csv`

`*.txt`   Text file with tab separated values, `filename.txt`

`*.lim`   Limit lines, `filename.lim` (Limit lines are available only in Spectrum Analyzer mode.)

Note	S2P is a standard ASCII text file format that is used for scattering parameters from a 2-Port measurement. This is a subset of SnP (where n equals the number of ports). An S2P file can be used as input for signal analysis.
	The CSV and Text files contain setup information and final formatted data that are shown on the instrument display screen. This file information includes any post-processing that was done on the data (smoothing, trace math, time domain, and so forth). These files contain the data for any traces that are displayed, including the memory traces. They also contain the markers that are turned on when the file is saved.

4-3   Managing Files

Press the **Shift** button then the **File** (**7**) button on the numeric keypad to list the **File** menu.
Follow the additional steps below.

Note	When navigating through the **File** menu, pressing the **Esc** button returns to the previous menu.

Save Files

Set the Save Location

Press Save then the Change Save Location submenu keys and select the location to save files.
You can save files to the internal memory or to an external USB flash drive. You can also
create new folders. If an external USB flash drive is connected or disconnected, press Refresh
Directories to update the location tree. Press the Set Location key to store the save location.

Save Measurement As

The Save Measurement As key is used to quickly save measurements with a specific file
name. The VNA Master saves the measurement with the latest file name that was used to
save a measurement and with a number that is automatically incremented and appended to
the end of the file name. For instance, if the last measurement was saved with the name
System Return Loss, Save Measurement As saves the next measurement as System Return
Loss_#1, System Return Loss_#2 etc. The file name used can be changed using the Save
dialog box (Figure 4-1).

Save a Measurement

Press the Save Measurement key and enter the name for the measurement file. The
measurement file can be stored as .MNA.

Save a Setup

Press the Save submenu key, type a name for the setup file, confirm that the file type is Setup
using the Change Type key or the touch screen, and then press **Enter** to save.

Create a Menu Shortcut for a Setup File

Press the Recall submenu key to display saved setup files. Locate the setup file to shortcut
and then press and hold on the file name for a few seconds. Select a location in the shortcut
grid to save the setup file.

Save a Measurement Screen as JPEG

Press the Save submenu key, type a name for the JPEG file, confirm that the file type is Jpeg,
and press **Enter** to save.

Save Dialog Box

The save dialog box (Figure 4-1) is used to store files on the internal memory or an external flash drive. The file type, file name, and save location are set starting with this display. Refer to "Save Menu" on page 4-9 and "Save Location Menu" on page 4-10 for details.
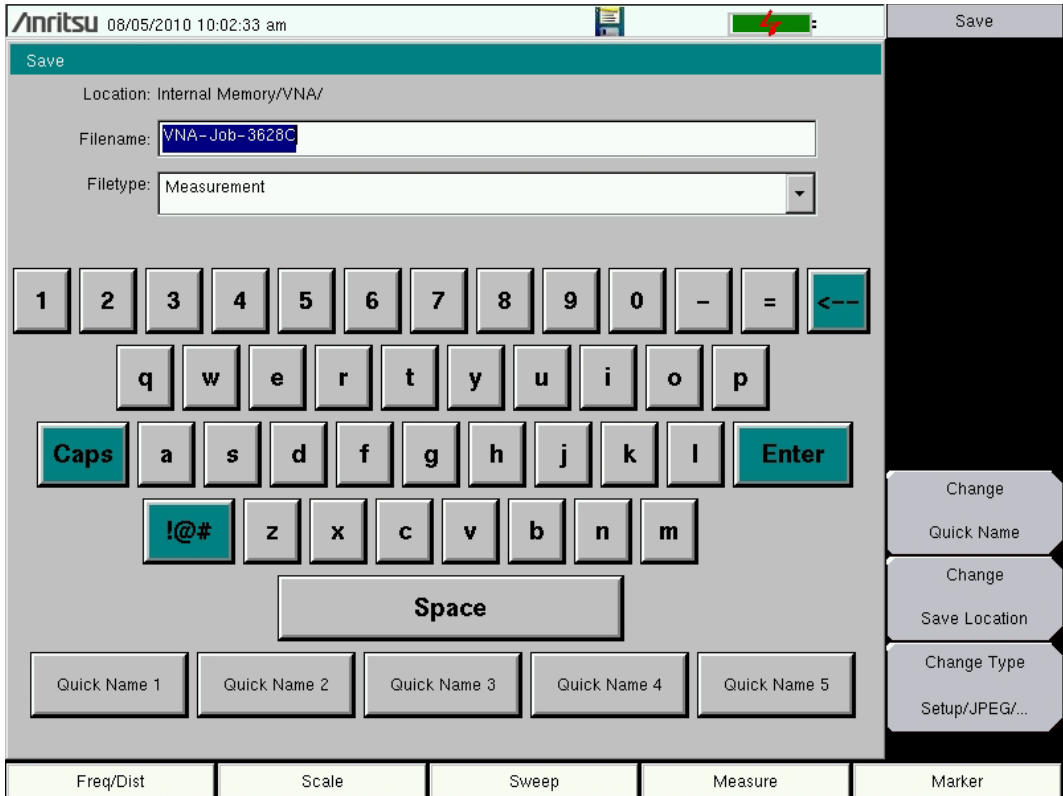
Figure 4-1.   Save Dialog Box

Quick Name Keys

Quick Name keys (located below the keyboard in Figure 4-1) allow you to enter quick names for frequently used parts of file measurement names. To edit the keys, press the **Shift** button, then the **File** (**7**) button. Press Save then the Change Quick Name key, and select one of the Quick Names for editing. Press **Enter** and enter the new name for the key. Press **Enter** again, and the new name is displayed on the Quick Name key.

When entering filenames, use the quick name keys in any order in combination with the keyboard to create measurement filenames.

Recall Files

The recall menu enables you to view all of the Measurement and Setup files in the internal memory and in an external USB flash drive.

You can sort the recall menu by name, date, or type. You can also choose to view only measurement files or setup files by pressing File Type on the Recall dialog box and selecting the file type that you want to view.

Recall a Measurement

From the **File** menu, press the Recall Measurement submenu key, select the measurement with the touch screen, rotary knob, or the **Up/Down** arrow buttons, and then press **Enter**.

Recall a Setup

Press the Recall submenu key. Confirm that the file type is Setup or All. Select the setup file (.stp) with the touch screen, rotary knob, or the **Up/Down** arrow buttons, and then press **Enter**.

Recall Dialog Box

The Recall dialog box (Figure 4-2) opens previously saved measurements and setups. Refer to the "Recall Menu" on page 4-12 for additional information.
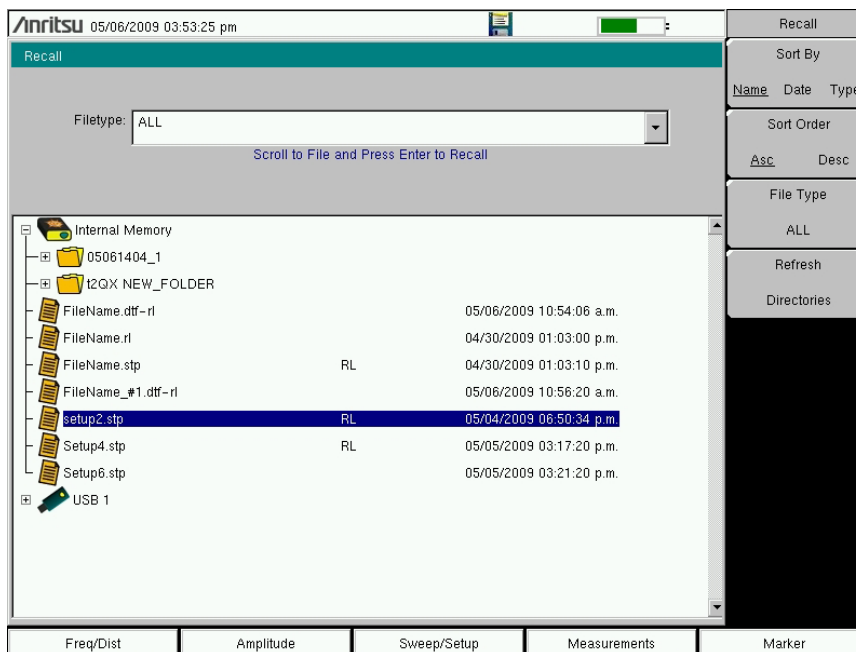
Figure 4-2.   Recall Dialog Box

Copy Files

The steps below describe copying a file from internal memory to an external flash drive. Select the files to copy in the top window and the location for the files (to be copied) in the bottom window (Figure 4-3). Refer to the "Copy Menu" on page 4-13 for additional information.

1. Insert a USB drive into either USB Type A port of the VNA Master.

2. From the **File** main menu, press the Copy submenu key. The Copy menu and Copy dialog box are displayed.

3. Select the files that are to be copied. To select multiple files, highlight the first file, then press the Select or De-Select key to keep the file selected. The selected file is outlined in blue. Repeat with all the files that are to be copied. To display files in a folder, select the folder and press the **Enter** button.

4. Press the Scroll key and highlight the USB drive in the lower window using the touch screen or the **Up/Down** arrow buttons. The Scroll submenu key toggles between source and destination, Src (top window) and Dst (bottom window).

5. Press the Copy key to copy the files to the flash drive.
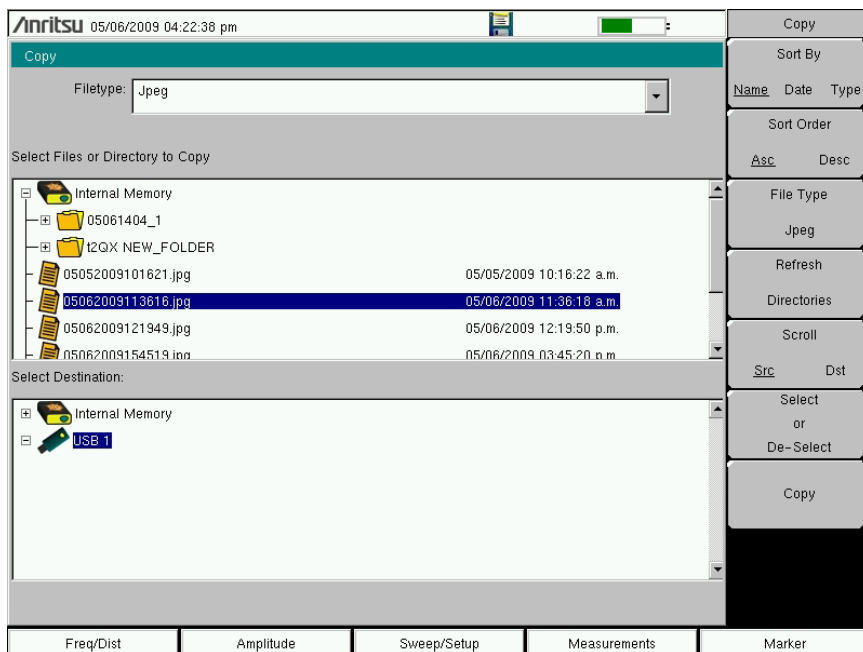
Figure 4-3. Copy Dialog Box

Delete Files

Press the Delete submenu key. Highlight the file to be deleted with the touch screen or the **Up/Down** arrow buttons. Press the Select or De-Select key. Selected files are outlined in blue. Press the Delete key and then press **Enter** to delete the selected file.

Delete Dialog Box

Press the Delete submenu key to open the Delete dialog box (Figure 4-4). The menus allow sorting by file type, name, and saved date. Refer to the "Delete Menu" on page 4-14 for additional information.
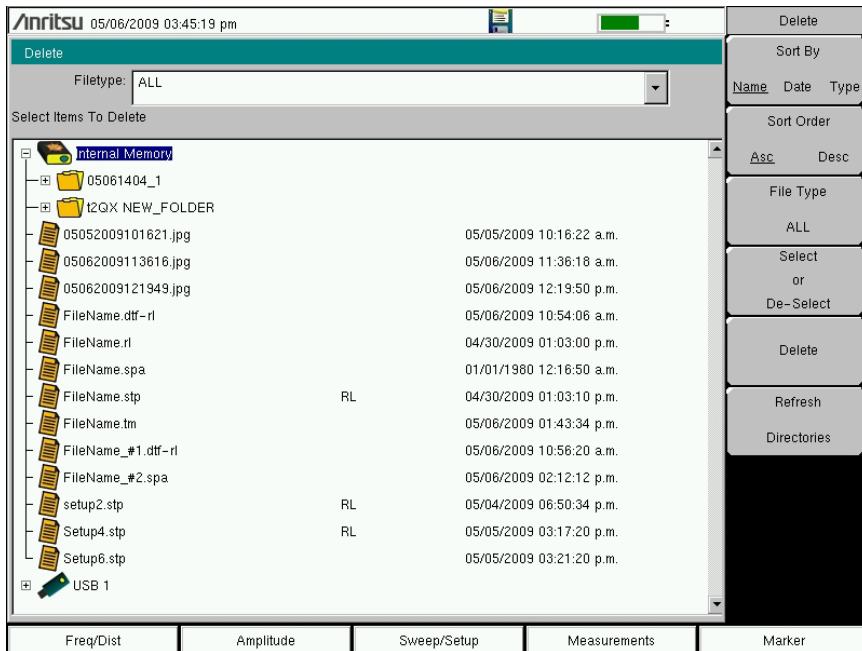
Figure 4-4.   Delete Dialog Box

4-4 File Menu Overview

Open this menu by pressing the **Shift** button, then the **File** (**7**) button.
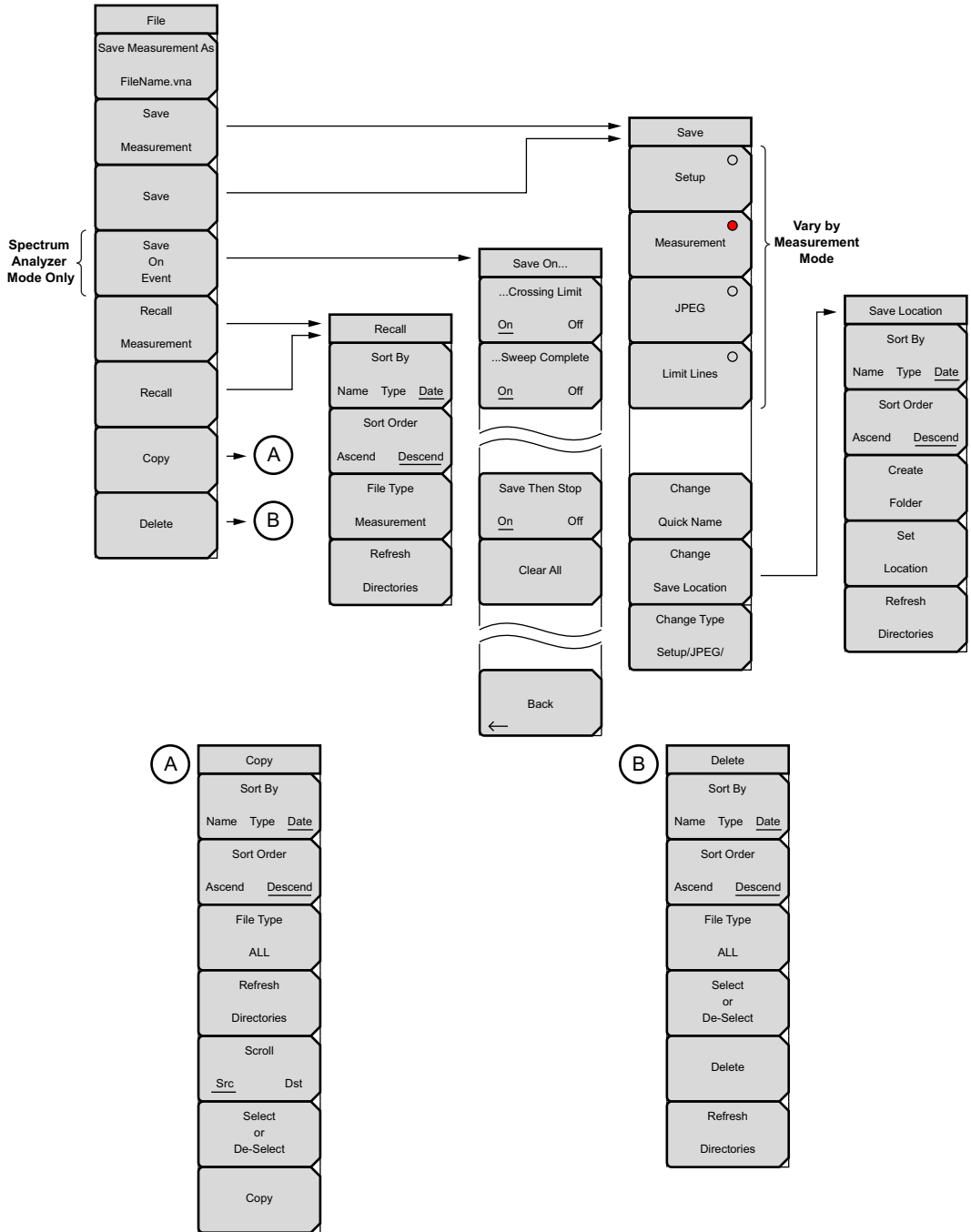
Figure 4-5. File Menu

4-5   File Menu

Key Sequence: **File**

File	**Save Measurement As:** Press this submenu key to save the current setup with a user defined filename. The default filename is changed using the Save menu. To change the default file name, type in a new file with the touch screen keyboard and press **Enter**. After a few seconds, the screen returns to File menu. Press the Save Measurement As key again and the new file name is used.
Save Measurement As	
FileName.mna	
Save Measurement	**Save Measurement:** Press this submenu key to display the "Save Menu" on page 4-9 and the touch screen keyboard. Measurements can be saved to internal memory or to a USB flash drive. The saved measurement can be named by using the touch screen keyboard. By default, measurements are saved to internal memory in a directory named /user. The save destination is set with the "Save Location Menu" on page 4-10.
Save	**Save:** Press this submenu key to display the "Save Menu" on page 4-9 and the touch screen keyboard. Measurements can be saved to internal memory or to a USB flash drive. The saved setup, measurement, or JPEG file can be named by using the touch screen keyboard. By default, measurements are saved to internal memory in a directory named /user. The save destination is set with the "Save Location Menu" on page 4-10.
Save On Event	**Save on Event:** Press this submenu key to display the "Save On ... Menu" on page 4-11. This submenu key is displayed only in Spectrum Analyzer and Interference Analyzer modes.
Recall Measurement	**Recall Measurement:** Press this submenu key to display the "Recall Menu" on page 4-12. This menu is for recalling measurements from internal memory or from a USB flash drive.
Recall	**Recall:** Press this submenu key to display the "Recall Menu" on page 4-12. This menu is for recalling measurement or setup data from internal memory or from a USB flash drive.
Copy	**Copy:** Press this submenu key to display the "Copy Menu" on page 4-13. The Copy menu is for copying files or folders from internal memory or a USB flash drive.
Delete	**Delete:** Press this submenu key to display the "Delete Menu" on page 4-14 and a selection box that shows the setup and measurement names and the type, date, and time that the information was saved. Use the rotary knob or the **Up/Down** arrow keys to highlight the file that is to be deleted and press the Delete submenu key, then press **Enter**. Press the **Esc** button to cancel the operation. Note that deleted files cannot be recovered.

Figure 4-6.   File Menu

Save Menu

Key Sequence: **File** > Save

Save

Restore Default Quick Name Buttons

Change

Quick Name

Change

Save Location

Change Type

Setup/JPEG/...

Restore Default Quick Name Buttons: Press this submenu key to undo any Quick Names previously entered and to return all Quick Name buttons to factory defaults.

Change Quick Name: Press this key to change the Quick Names that are displayed at the bottom of the touch screen keyboard (see Figure 4-1). Select the Quick Name to edit, then press **Enter**. Type the new Quick Name and press **Enter** again. The new Quick Name is displayed on the corresponding Quick Name button below the keyboard.

Change Save Location: Press this submenu key to open the "Save Location Menu", where you can set the location of the destination file for saved data.

Change Type Setup/JPEG/... Press this submenu key to select among the various file types available for setup and measurement data. This key also opens the File Type menu with a submenu key to select Full screen or Graph Only images for JPEG file types.

Figure 4-7.   Save Menu

Save Location Menu

This menu and dialog box are used to create folders and to select the location where the VNA
Master saves the current file. Select folders or drives with the **Up/Down** buttons, the rotary knob,
or the touch screen.

Note	Only folders (not files) are visible in the Save Location dialog box. To view files, use the "Recall Menu" on page 4-12.

Key Sequence: **File** > Save > Change Save Location

Sort By
Name   Type   Date: Press this submenu key to choose the item by which
folders are sorted in the Select Save Location list.

Sort Order
Ascend   Descend: Press this key to toggle the sort order of the folder list
between Ascending and Descending.

Create Folder: Press this submenu key to create a new folder inside the
selected directory. Enter the new folder name in the Create Directory dialog
and press **Enter**. To return to the Select Save Location dialog without creating
a new folder, press **Esc**.

Set Location: Press this submenu key to set the currently selected folder as
the destination where saved files will be stored, and to return to the "Save
Menu" on page 4-9. Press **Esc** to exit without saving.

Refresh Directories: Press this key to update the folder list after connecting
or disconnecting an external USB drive.

Figure 4-8.   Save Location Menu
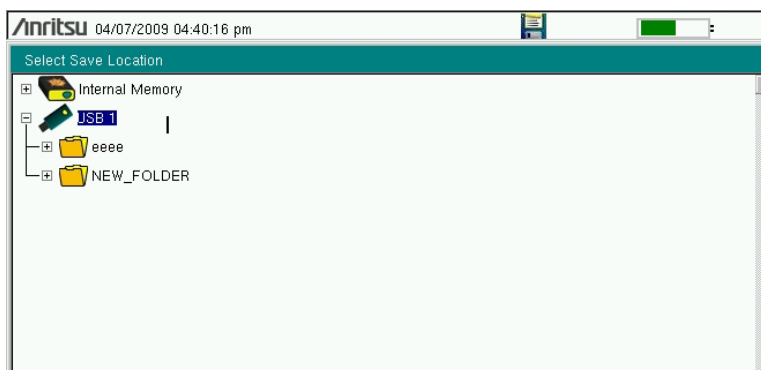
Figure 4-9.   Select Save Location Dialog Box

Save On ... Menu

In Spectrum Analyzer and Interference Analyzer modes, this menu is used to auto save measurements to internal memory after specific events occur.

Key Sequence: **File** > Save On Event

Save On...	
...Crossing Limit	**...Crossing Limit**
On Off	**On Off:** Press this submenu key to toggle the Crossing Limit On or Off. When On, measurements are saved to internal memory when the measurement has crossed a defined limit line that has been created with the **Limit** menu.
...Sweep Complete	**...Sweep Complete**
On Off	**On Off:** Press this key to toggle the Sweep Complete setting On or Off. When On, measurements are saved to internal memory after the current sweep is complete. When Off, a measurement is saved after every sweep.
Save Then Stop	**Save Then Stop**
On Off	**On Off:** Press this key to toggle the Save Then Stop setting On or Off. When On, the sweep is stopped after a measurement is saved. When Off with Sweep Complete On, a measurement is saved after every sweep.
Clear All	**Clear All:** Press this key to turn Off all three save-on-event keys:
	Crossing Limit
	Sweep Complete
	Save Then Stop
Back ←	**Back:** Press this key to return to the "File Menu" on page 4-8.

Figure 4-10. Save On Menu

Recall Menu

This menu and its dialog box are used to select the location from which the VNA Master recalls a file. Select folders or drives with the **Up/Down** arrow buttons, the rotary knob, or the touch screen.

Key Sequence: **File** > Recall

Recall Sort By Name Type <u>Date</u> Sort Order Ascend <u>Descend</u> File Type ALL Refresh Directories	Use these menu keys to change the way files are listed in the Recall dialog box. Navigate to the desired file, then press Enter to recall. When recalling a saved setup, all current instrument settings are replaced by the stored setup information. When recalling a saved measurement and multiple traces are displayed, parameter settings shown on the instrument screen may reflect those of the recalled trace or the active trace, depending on the measurement mode or other factors. **Sort By** **Name Type Date:** Press this submenu key to choose the item by which folders and files are sorted in the Recall dialog box. **Sort Order** **Ascend Descend:** Press this key to toggle the sort order of the file list between Ascending and Descending. **File Type:** Press this key to open the Select File Type list box. Press the desired file type on the list, then press **Enter** to apply the selection. JPEG image files cannot be recalled and are not listed. Alternatively, you can select directly from the Filetype drop down list in the Recall dialog box. **Refresh Directories:** Press this key to update the file list after connecting or disconnecting an external USB drive.

Figure 4-11. Recall Menu

Copy Menu

This menu and dialog box are used to copy folders and files. Select folders or files with the **Up/Down** arrow buttons, the rotary knob, or the touch screen. Figure 4-3 on page 4-5 shows the Copy dialog box with two JPEG images and one folder (including the folder contents) selected and ready to be copied to the USB flash drive. Highlight a folder and press **Enter** to view the contents.

Key Sequence: **File** > Copy

Copy
Sort By
Name   Type   Date
Sort Order
Ascend   Descend
File Type
ALL
Refresh
Directories
Scroll
Src   Dst
Select or De-Select
Copy

Sort By
Name   Type   Date: Press this submenu key to choose the item by which folders and files are sorted in the Copy dialog box.

Sort Order
Ascend   Descend: Press this key to toggle the sort order of the file list between Ascending and Descending.

File Type: Press this submenu key to open the Select File Type list box. Press the desired file type on the list, then press **Enter** to apply the selection.

Alternatively, you can select directly from the Filetype drop down list in the Copy dialog box.

Refresh Directories: Press this key to update the file list after connecting or disconnecting an external USB drive.

Scroll
Src   Dst: Press this submenu key to shift navigation control between the source and destination panes in the Copy dialog box.

Select or De-Select: Press this key to select or deselect the current file or folder. Selected items are highlighted in blue.

Copy: Copies the selected files and folders, highlighted in blue in the top pane of the Copy dialog box, to the selected location in the bottom pane. If a file by the same name already exists in the destination location, an Error message is displayed, prompting you to press **Enter** to overwrite, or **Esc** to skip the conflicting file.

Figure 4-12. Copy Menu

Delete Menu

This menu and dialog box are used to delete folders and files. Select folders or files with the **Up/Down** arrow buttons, the rotary knob, or the touch screen.

Key Sequence: **File** > Delete

|	
Delete Sort By Name Type Date Sort Order Ascend Descend File Type ALL Select or De-Select Delete Refresh Directories	**Sort By** **Name Type Date:** Press this submenu key to choose the item by which folders and files are sorted in the Delete dialog box. **Sort Order** **Ascend Descend:** Press this key to toggle the sort order of the file list between Ascending and Descending. **File Type:** Press this submenu key to open the Select File Type list box. Press the desired file type on the list, then press **Enter** to apply the selection. Alternatively, you can select directly from the Filetype drop down list in the Delete dialog box. **Select or De-Select:** Press this key to select or deselect the current file or folder. Selected items are highlighted in blue. **Delete:** Deletes the selected files or folders, which are highlighted in blue. In the confirmation box, press Yes to delete, No to cancel. You can also press **Esc** to cancel the deletion. **Refresh Directories:** Press this key to update the file list after connecting or disconnecting an external USB drive.

Figure 4-13. Delete Menu

Chapter 5 — System Operations

5-1 Introduction

This chapter describes the VNA Master system operations.

- "System Menu Overview" on page 5-2
- "System Menu" on page 5-4
- "Preset Menu" on page 5-15
- "Power On Self Test" on page 5-16
- "Firmware Update" on page 5-17

The other menus (Sweep, Measure, Trace, and Limit) are described in the Measurement Guides listed in Appendix A.

5-2   System Menu Overview

To access the System menu, press the **Shift** key, then the **System** (**8**) key. Menu maps illustrated in this document typically show all possible submenu keys. Some keys may appear only under certain conditions, such as installed options and current measurement mode.
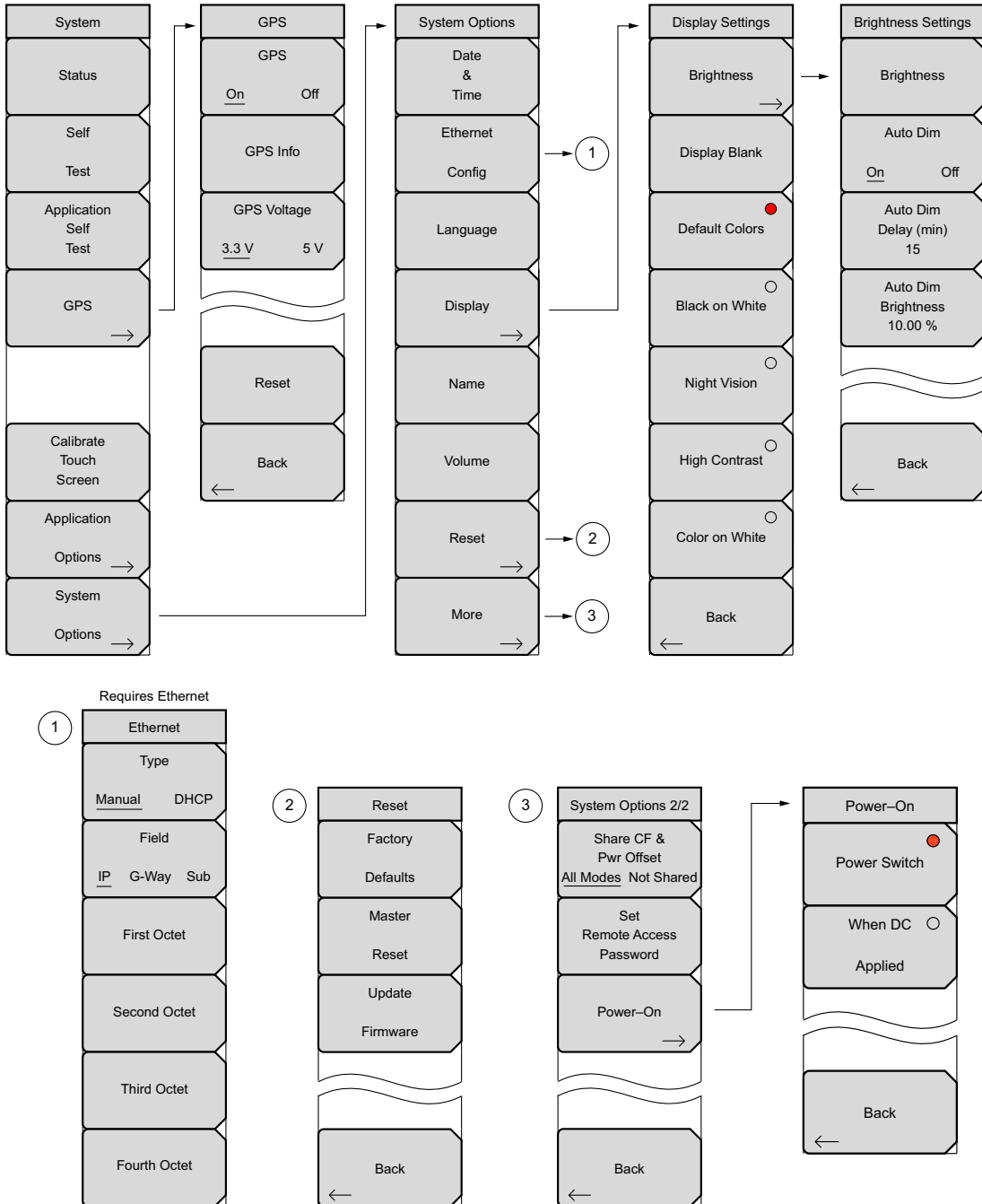
Figure 5-1.   System Menu Map

5-3   Application Options Menus

Application Options are specific to each operating mode, such as VNA or SPA (refer to
"Application Options Menu (VNA Mode)" on page 5-5 and "Application Options Menu (SPA
Mode)" on page 5-9). Refer to the measurement guides for other Application Options.
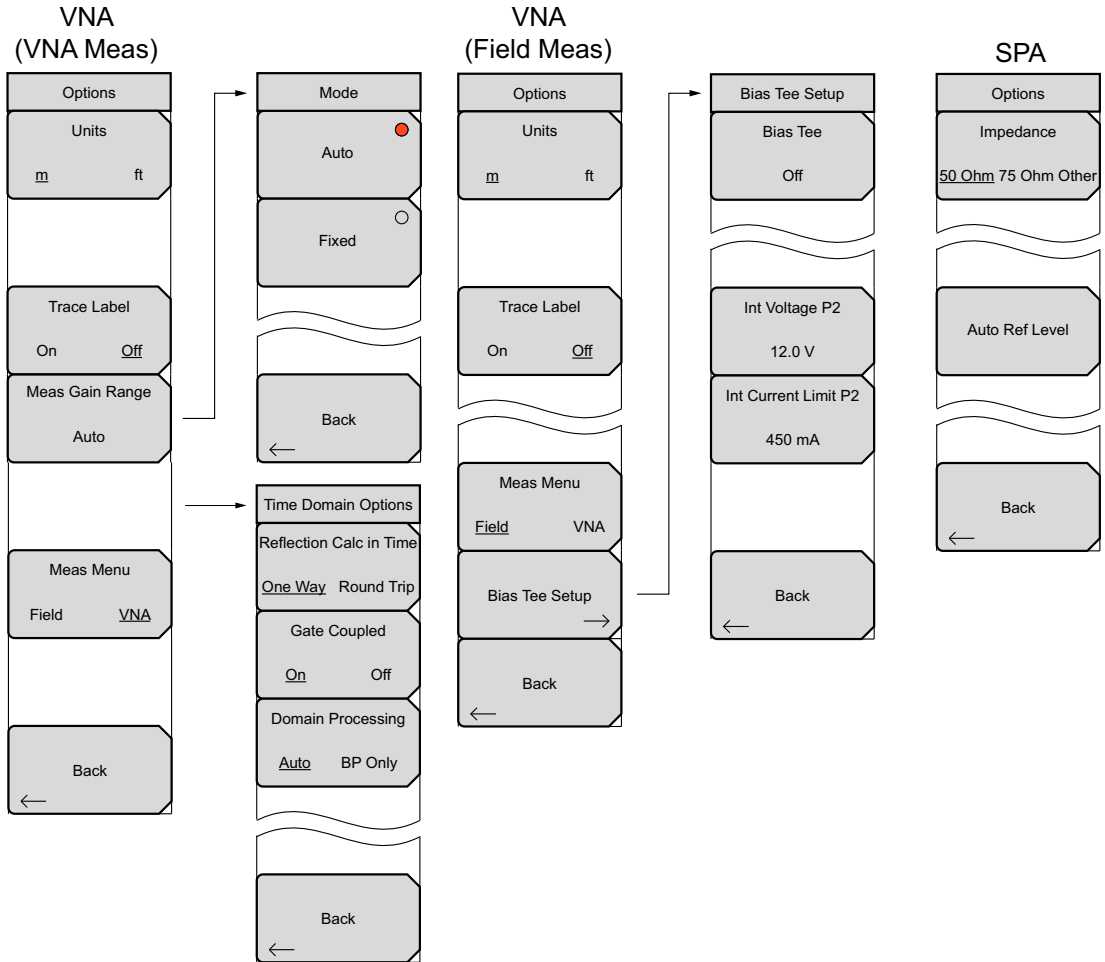
Figure 5-2.   Application Options Menus

5-4   System Menu

Key Sequence: **Shift**, **System** (**8**)

<table>
<tr>
<td>

System

Status

Self

Test

Application
Self
Test

GPS

→

Calibrate
Touch
Screen

Application

Options →

System

Options →

</td>
<td>

Status: Press this submenu key to display the current system status, including the operating system and firmware versions, temperatures, and other details such as current battery information. Press **Esc** or **Enter** to return to normal operation.

Self Test: Press this submenu key to initiate a series of diagnostic tests related to the performance of the motherboard hardware. A Self Test message box will list the individual tests with a Pass or Fail indication. Press **Esc** or **Enter** to return to normal operation.

If the self test fails when the battery is fully charged and the instrument is within the specified operating temperature, contact your Anritsu Service Center and report the test results. Refer to "Contacting Anritsu for Sales and Service" on page 1-1.

Application Self Test: Press this submenu key to initiate a series of diagnostic tests related to the performance of the instrument for specific applications. A warning message advises you to disconnect any power-sensitive devices. Press the **Esc** key to abort, or press **Enter** to continue. Following completion, the Application Self Test window will list the tests with a Pass or Fail indication. Press **Esc** or **Enter** to return to normal operation.

GPS: Press this submenu key to open the "GPS Menu" on page 6-4.

Calibrate Touch Screen: If the instrument does not respond as expected when you press the touch screen, press this key to display the touch screen calibration message box. Refer to "Touch Screen Calibration" on page 2-7.

Application Options: This submenu changes with the measurement mode. Refer to "Application Options Menu (VNA Mode)" on page 5-5 and "Application Options Menu (SPA Mode)" on page 5-9.

System Options: Press this submenu key to open the "System Options Menu" on page 5-10.

</td>
</tr>
</table>

Figure 5-3.   System Menu

5-5   Application Options Menu (VNA Mode)

Key Sequence: **Shift**, **System** (**8**) > Application Options

Options **Units** m ft	Standard VNA menus selected. **Units** **m ft:** Press this submenu key to toggle the units setting to metric (meters, or m) or to U.S. (feet, or ft). Press **Enter** to accept the changes, or press the **Esc** button to return to normal operation without changing the setting.
Trace Label On Off	**Trace Label** **On Off:** Press this submenu key to toggle the trace labels On or Off.
Meas Gain Range Auto	**Meas Gain Range:** Press this submenu key to open the "Mode (Meas Gain Range) Menu (VNA Mode)". Then select Auto or Fixed.
Meas Menu Field VNA	**Meas Menu** **Field VNA:** Press this submenu key to toggle between Field measurements (a simplified subset of the standard VNA menu structure) and VNA measurements (standard menu structure).
Back ←	**Back:** Press this submenu key to return to the "System Menu" on page 5-4.

Figure 5-4.   Application Options Menu (VNA Mode)

5-6   Mode (Meas Gain Range) Menu (VNA Mode)

Key Sequence: **Shift**, **System** (**8**) > Application Options > Meas Gain Range

Auto: Press this submenu key to set the Measurement Gain Range Mode to Auto. In this mode, the instrument adjusts the gain automatically to provide the best overall system performance (dynamic range and high level noise).

Fixed: Press this submenu key to set the Measurement Gain Range Mode to Fixed. In this mode, the gain of the instrument is always set to the low gain setting. For most applications, Auto mode is recommended. For certain types of filter measurements (mostly in the range less than 500 MHz), the instrument may toggle between low gain and high gain modes as the signal level rises from the noise to the pass band of the filter, resulting in extra ripple. Setting the Gain Range to fixed may address that problem.

Back: Press this submenu key to return to the "Application Options Menu (VNA Mode)".

Figure 5-5.   VNA Mode (Measurement Gain Range) Menu

5-7 Application Options Menu (Field Mode)

Key Sequence: **Shift**, **System** (**8**) > Application Options

	Field menus selected.
Options Units m ft	
	Units **m ft:** Press this submenu key to toggle the units setting to metric (meters, or m) or to U.S. (feet, or ft). Press **Enter** to accept the changes, or press the **Esc** button to return to normal operation without changing the setting.
Trace Label On Off	**Trace Label** **On Off:** Press this submenu key to toggle the trace labels On or Off.
Meas Menu Field VNA	**Meas Menu** **Field VNA:** Press this submenu key to toggle between Field measurements (a simplified subset of the standard VNA menu structure) and VNA measurements (standard menu structure).
Bias Tee Setup →	**Bias Tee Setup:** Press this submenu key to open the "Bias Tee Setup Menu (Field Mode)". Refer to Chapter 7, "Bias Tee (Option 10)" for more information.
Back ←	**Back:** Press this submenu key to return to the "System Menu" on page 5-4.

Figure 5-6. Application Options Menu (Field Mode)

5-8   Bias Tee Setup Menu (Field Mode)

Key Sequence: **Shift**, **System** (**8**) > Application Options > Bias Tee Setup

Bias Tee Setup	Field Meas Menu selected.
Bias Tee Off	**Bias Tee:** Press this submenu key to turn Bias Tee On or Off. The default setting is Off.
Int Voltage P2 12.0 V	**Int Voltage P2:** Press this submenu key to set the internal Bias Tee voltage that is applied to Port 2. The default setting is 12.0 V.
Int Current Limit P2 450 mA	**Int Current Limit P2:** Press this submenu key to set the internal Bias Tee maximum current through Port 2. The default setting is 450 mA.
Back ←	**Back:** Press this submenu key to return to the "System Menu" on page 5-4.

Figure 5-7.   Bias Tee Setup Menu (Field Mode)

# 5-9	Application Options Menu (SPA Mode)

Key Sequence: **Shift**, **System** (**8**) > System Options > Application Options

Impedance
50 Ohm   75 Ohm   Other: Press this submenu key to toggle the impedance setting to 50 ohm, 75 ohm, or Other impedance value. Selecting 75 ohm selects the 7.5 dB loss of the Anritsu 12N50-75B adapter. For other adapters, select Other and enter the appropriate loss.

Bias Tee: Press this submenu key to display the Bias Tee menu, Figure 5-9.

Auto Ref Level: Press this submenu key to adjust the position of a displayed signal so that it is approximately two divisions down from the top of the sweep window, if possible. When the key is pressed, the reference level is adjusted once. Auto Ref Level may turn off the low-noise front-end preamplifier, but does not turn it on. It has no effect on vertical scaling.

Back: Press this submenu key to return to the "System Menu" on page 5-4.

Figure 5-8.	Application Options Menu (SPA Mode)

# 5-10	Bias Tee Menu (SPA Mode)

Key Sequence: **Shift**, **System** (**8**) > System Options > Application Options > Bias Tee

Bias Tee: Press this submenu key to toggle Bias Tee voltage Off and On.

Bias Tee Voltage: Press this submenu key to set the the Bias Tee Voltage. The minimum is 12.0 V, and the maximum is 32.0 V. Set with the **Arrow** Buttons, the rotary knob, or the numeric keypad. Increments are 0.1 V.

Current: Press this submenu key to toggle Bias Tee current to Low and High. The Low setting provides up to approximately half the maximum current, and the High setting provid es up to the maximum current of 450 mA. Refer to your Technical Data Sheet for additional details.

Back: Press this submenu key to return to the "Application Options Menu (VNA Mode)".

Figure 5-9.	SPA Mode Bias Tee Menu

5-11   System Options Menu

Key Sequence: **Shift**, **System** (**8**) > System Options

<table>
<tr>
<td>

System Options

Date
&
Time

Ethernet

Config

Language

Display

→

Name

Volume

Reset

→

More

→

</td>
<td>

Date & Time: Press this submenu key to display a dialog box for setting the current date and time. Use the submenu keys or the **Left/Right** arrow keys to select the field to be modified. Use the keypad, the **Up/Down** arrow keys, or the rotary knob to select the date and time. Press **Enter** to accept the changes, or press the **Esc** key to return to normal operation without making changes.

Ethernet Config: Press the key to display the Ethernet submenu and to open the Ethernet Editor dialog box, where you can set the instrument IP address. For details, refer to "Ethernet Configuration" on page F-1.

Language: Press this submenu key to open a list box and select a built-in language for the instrument display. Press **Enter** to apply the change, or press **Esc** to cancel.

The languages that are currently available are: English, French, German, Spanish, Japanese, Chinese, Korean, Italian, Russian, and Portuguese. You can edit non-English language captions using Master Software Tools (MST). If a mode does not have language translations available, then English is the default language.

> **Caution:** A firmware update or any instrument reset will overwrite modifications you may have made in any of the language files.

Display: The Display submenu key opens the "Display Settings Menu" on page 5-11, allowing brightness control and the selection of different display attributes.

Name: Press this submenu key to open the Unit Name dialog, where you can enter a name for the instrument, using the touch screen keyboard. Press **Enter** to save the name.

The assigned instrument name appears in measurement files, setup files, limit line files, and MST reports. It is displayed on the browser title bar when the instrument is connected to a remote PC or mobile device.

Volume: Press this submenu key to view or adjust the speaker volume. The current volume setting is displayed in the Volume input box. Use the numeric keypad, the **Up/Down** arrow keys, or the rotary knob to change the value, and press **Enter** to apply the change.

Reset: Press this submenu key to open the "Reset Menu" on page 5-13.

More: Press this submenu key to open the "System Options 2/2 Menu" on page 5-14.

</td>
</tr>
</table>

Figure 5-10. System Options Menu

5-12 Display Settings Menu

Key Sequence: **Shift**, **System** (**8**) > System Options > Display

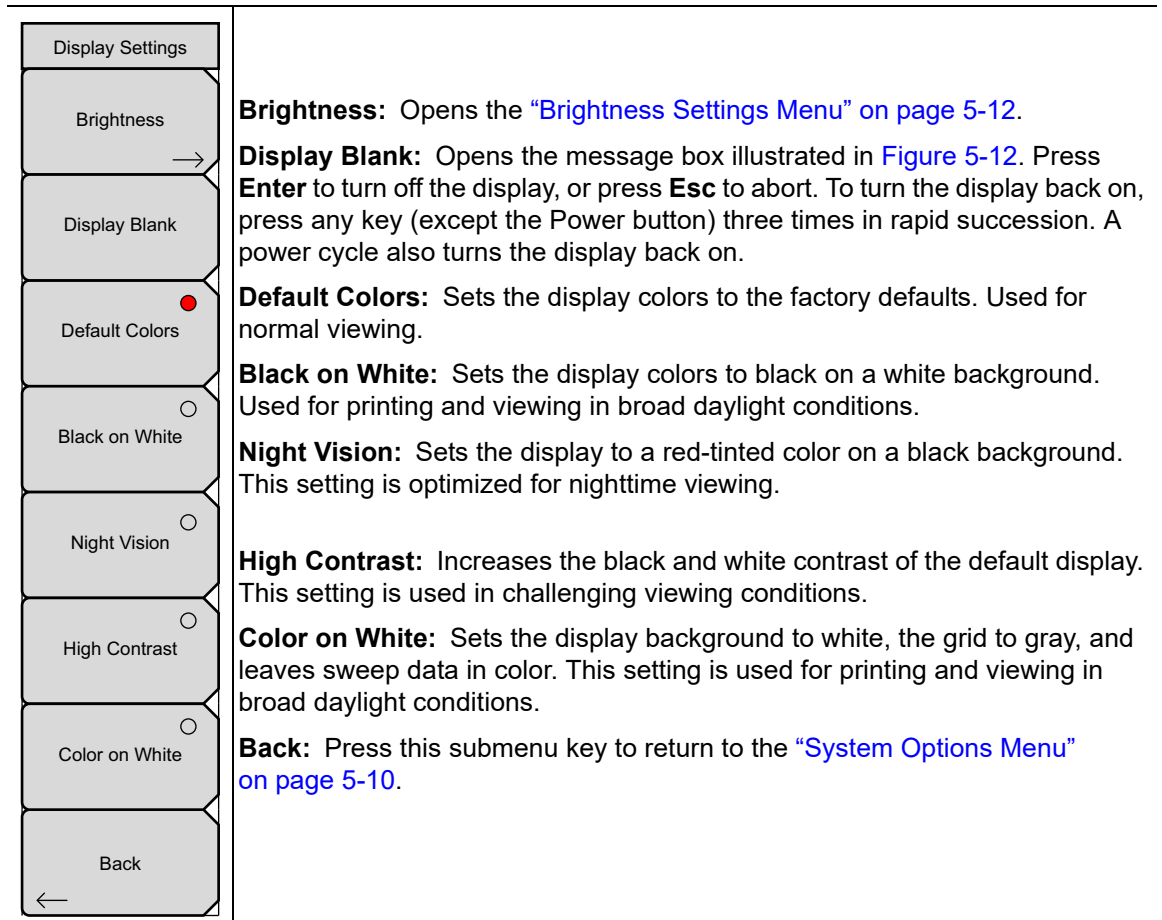| Display Settings	
Brightness	**Brightness:** Opens the "Brightness Settings Menu" on page 5-12.
→	**Display Blank:** Opens the message box illustrated in Figure 5-12. Press **Enter** to turn off the display, or press **Esc** to abort. To turn the display back on, press any key (except the Power button) three times in rapid succession. A power cycle also turns the display back on.
Display Blank	
● Default Colors	**Default Colors:** Sets the display colors to the factory defaults. Used for normal viewing.
○ Black on White	**Black on White:** Sets the display colors to black on a white background. Used for printing and viewing in broad daylight conditions.
○ Night Vision	**Night Vision:** Sets the display to a red-tinted color on a black background. This setting is optimized for nighttime viewing.
○ High Contrast	**High Contrast:** Increases the black and white contrast of the default display. This setting is used in challenging viewing conditions.
○ Color on White	**Color on White:** Sets the display background to white, the grid to gray, and leaves sweep data in color. This setting is used for printing and viewing in broad daylight conditions.
Back ←	**Back:** Press this submenu key to return to the "System Options Menu" on page 5-10.

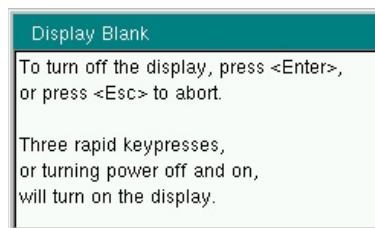**Figure 5-11.** Display Settings Menu

Figure 5-12. Display Blank Message Box

5-13   Brightness Settings Menu

Key Sequence: **Shift**, **System** (**8**) > System Options > Display > Brightness

Brightness Settings
Brightness
Auto Dim On   Off
Auto Dim Delay (min) 3
Auto Dim Brightness 10.00 %
Back ←

The brightness of the display can be adjusted to optimize viewing under a wide variety of lighting conditions.

Brightness: Press this submenu key to open the Brightness Editor window, where you can adjust the display brightness level from 0 to 100, with 100 being the brightest. See Figure 5-14. Use the rotary knob to adjust the value in increments of 5, or press the **Up/Down** arrow keys to change the value in increments of 25. Press the **Left** or the **Right** arrow key to jump to 0 or 100, respectively. Press **Enter** to accept the change. All display elements on the instrument screen are affected by the Brightness setting.

Auto Dim
On   Off: Press this key to toggle the display auto-dimming feature on and off. Enabling auto-dim can extend battery life.

Auto Dim Delay: Press this key to adjust the amount of idle time, from 1 to 15 minutes, before the instrument display goes dim. Use the arrow keys or the rotary knob to adjust the value in increments of 1. You can also use the numeric keypad, then press **Enter**. Out-of-range values are ignored.

Auto Dim Brightness: Press this submenu key to select the brightness percentage level of the display when it is dimmed. Use the arrow keys or the rotary knob to adjust the value in increments of 5%, from 0% to 25%. You can also use the numeric keypad, then press **%** or the **Enter** key. Out-of-range values are ignored.

Back: Press this key to return to the "System Options Menu" on page 5-10.
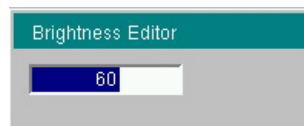
Figure 5-13. Brightness Settings Menu

Figure 5-14. Brightness Editor Input Box

5-14 Reset Menu

Key Sequence: **Shift**, **System** (**8**) > System Options > Reset

Reset
 	
Factory
 	
Defaults
 	
Master
 	
Reset
 	
Update
 	
Firmware
 	
Back
←
	Factory Defaults: Press this key to restore the instrument to the default settings for all measurement modes and system settings, including connectivity, language, and the display and audio settings. The instrument will power cycle when the operation is complete. Press the **Enter** key to initiate the reset, or press **Esc** to abort.
	
	    Note: This same reset sequence can be initiated when turning on the instrument by pressing **Power** while holding down the **Esc** key until the Anritsu splash screen is displayed.
	
	Master Reset: Press this submenu key to restore the instrument to factory defaults as described above and to delete all user files from the instrument internal memory. The instrument will power cycle when the operation is complete. Press **Enter** to initiate the reset, or press **Esc** to abort.
	
	    Note: This same reset sequence can be initiated when turning on the instrument by pressing **Power** while holding down the **System** (**8**) key until the Anritsu splash screen is displayed.
	
	Update Firmware: This key is used for updating the instrument firmware. Refer to "Firmware Update" on page 5-17 for detailed instructions.
	
	Back: Press this submenu key to return to the "System Options Menu" on page 5-10.

Figure 5-15. Reset Menu

5-15   System Options 2/2 Menu

Key Sequence: **Shift**, **System** (**8**) > System Options > More
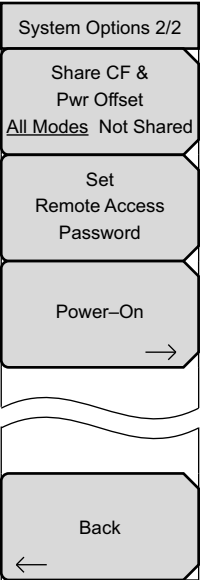

Share CF & Pwr Offset

All Modes   Not Shared: Press this submenu key to toggle the setting between All Modes and Not Shared. Select All Modes to have the current center frequency setting and power offset setting carried over when changing measurement modes. This function is not applicable to measurements that do not have a center frequency or power offset setting or to measurements in which the current center frequency or power offset setting is outside the range of the new measurement.

Note: The key is used only for spectrum analysis.

Set Remote Access Password: Press this submenu key to open the Password entry dialog (see Figure 5-17). Use the touch screen keyboard to enter the new password. Passwords may contain digits, uppercase and lowercase letters, and the symbols: – _ + . (hyphen, underscore, plus, period). Press **Enter** to save or **Esc** to cancel.

Connecting to the instrument via Master Software Tools (v2.21.1 or later) will require the set password. An empty Password field means the instrument is not password-protected. The password is also removed following a Master Reset, Factory Defaults reset, or a firmware update.

Power–On: Press this submenu key to open the "Power–On Menu" on page 5-15.

Back: Press this submenu key to return to the "System Options Menu" on page 5-10.

Figure 5-16. System Options Menu 2/2)

Warning	Do not set a remote access password when using SCPI commands to communicate with the instrument.

Figure 5-17. Remote Access Password Dialog

5-16   Power–On Menu

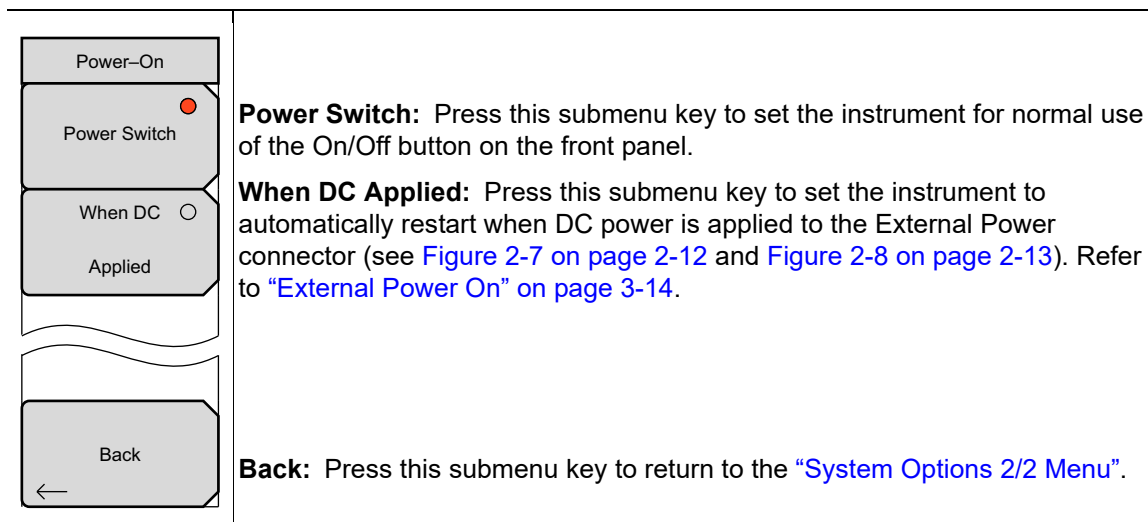Key Sequence: **Shift** > **System** (**8**) > System Options > More > Power–On

Power Switch: Press this submenu key to set the instrument for normal use of the On/Off button on the front panel.

When DC Applied: Press this submenu key to set the instrument to automatically restart when DC power is applied to the External Power connector (see Figure 2-7 on page 2-12 and Figure 2-8 on page 2-13). Refer to "External Power On" on page 3-14.

Back: Press this submenu key to return to the "System Options 2/2 Menu".

Figure 5-18. Power–On Menu

5-17   Preset Menu

Key Sequence: **Shift, Preset** (**1**)

Preset: This key resets all parameter settings for the current measurement mode to their factory default values, and switches the display to the default view for that mode. Measurement settings specific to other modes, or applications, are not affected.

Save: Press this key to open the Save dialog box (Figure 4-1) to name and save the current operating settings, allowing them to be recalled later to return the instrument to the state it was in at the time the setup was saved.

Note: Set the File type as Setup. Refer to "Save Menu" on page 4-9 for details.

The saved setup can be named using the touch screen keyboard. Use the Caps key to select an upper case letter. Use the **Left/Right** directional arrows to move the cursor position. Press **Enter** to save the setup.

Recall: Press this submenu key to select and recall a previously stored instrument setup using the "Recall Menu" on page 4-12. Use the rotary knob, the **Up/Down** arrow buttons, or the touch screen to highlight the saved setup, and press **Enter**. All current instrument settings are replaced by the stored setup information.
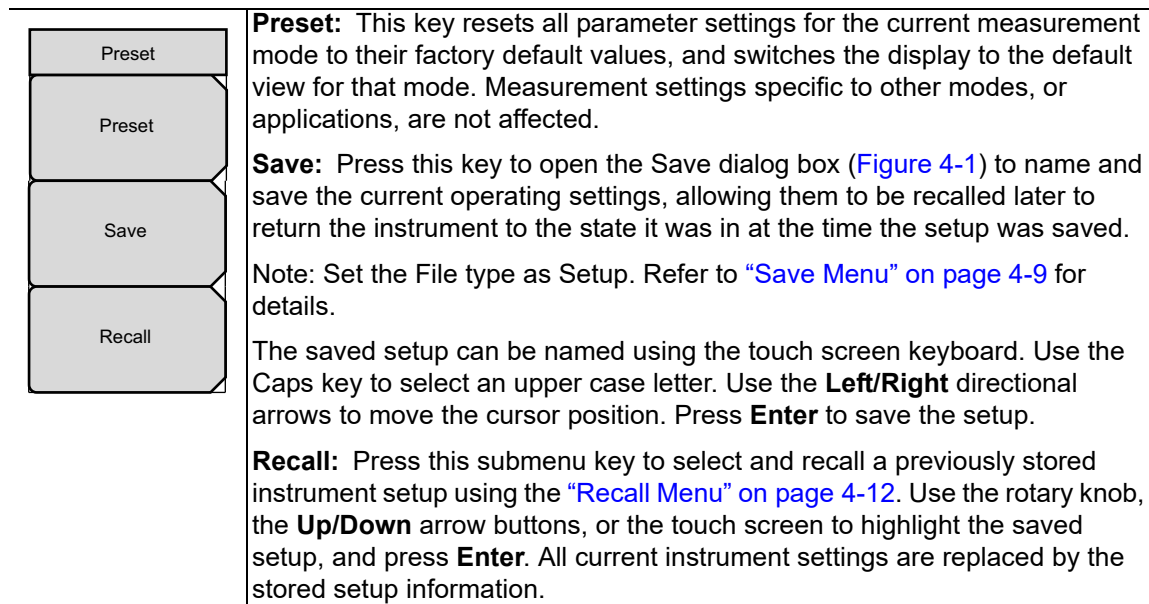
Figure 5-19. Preset Menu

5-18   Power On Self Test

At power on, the VNA Master runs through a series of quick checks to ensure that the system is functioning properly.

From the "System Menu", the System Self Test ("Self Test" on page 5-4) runs a series of tests that are related to the instrument itself. The Application Self Test ("Application Self Test" on page 5-4) runs a series of tests that are related to the current operating mode of the instrument.

If the VNA Master is within the specified operating range with a charged battery, and if the self test fails, contact your Anritsu Service Center (anritsu.com/contact-us).

To start a self test when the system is already powered up:

1.   Press the **Shift** button and then the **System** (**8**) button.

2.   Press the Self Test submenu key. The Self Test results are displayed.

3.   Press **Esc** to continue.

5-19 Firmware Update

To update your Anritsu instrument firmware, use a high quality USB memory device with at least 250 MB of free space and FAT32 file system format.

1. Insert the memory device into your PC or laptop.

2. From a browser, go to the following Anritsu Products page:

   https://www.anritsu.com/en-US/test-measurement/rf-microwave/vector-network-analyzers-handheld

3. If the Web page lists more than one product, find your instrument model number and click the link.

4. On the product page, press the Downloads button.

5. Under the Drivers/Firmware/Software tab, you can optionally follow the Firmware Revision/Release History link to download a document detailing current and past firmware changes.

6. Click on the link Firmware Update for the VNA Master MS20xxB.

7. Click the Download button, then choose Save or Save As. Do not run the executable file directly from the Web page.

8. Go to the Save location designated in Step 7 and double-click the installer file, Model_Ver_USBLoader.exe.

9. In the Firmware Update dialog, click to view, then accept the software license agreement.

10. Click Browse and select the Removable Disk drive where the USB device is inserted.

11. Click Prepare USB Memory Stick to create the firmware update USB device.

12. After the firmware update tool has finished, click through the final steps in the Firmware Update dialog to close the installer program.

13. Eject the memory device from the computer.

Note	The file structure created on the USB memory device by the installer program is necessary for a successful firmware update and must not be altered in any way.

14. Turn off the VNA Master and insert the USB memory device into the instrument.

15. Make sure the VNA Master is plugged into an AC power source and not running on battery alone, then turn on the instrument.

16. At bootup, the instrument should detect new firmware on the USB device and ask if you wish to upgrade. Press Yes.

17. The Automatic Firmware Update dialog should open at this time. Skip to Step 19.

Note	If the same firmware code as contained on the USB device is already loaded on the instrument, a message indicating that firmware update is skipped will display briefly on the instrument screen.
	If the firmware update on the memory device does not match your instrument model, an error message will display briefly, indicating that it is not compatible.

---

18. If there is no error but the instrument does not enter upgrade mode automatically:

    a. Press **Shift** > **System** (**8**) > System Options > Reset > Update Firmware.

    b. Press Load Firmware at the bottom left of the instrument screen.

    c. Press Update Application Firmware.

    d. The Firmware Update dialog opens.

19. Use the **Up/Down** arrow keys or the rotary knob to select one of the Save modes.

    • Save none: No attempt is made to save any user data.

    • Save user data: User data is saved to the selected external media device.

    • Save & restore user data: User data is saved to the selected external media device. The instrument also attempts to restore the files to the instrument after the update.

Warning	Some user data may be lost if not enough memory space is available on the selected device.

20. Press **Enter**.

21. Press **Enter** again to confirm your intention to proceed with the firmware upgrade.

    To cancel the operation, press **Esc**. In this case, you need to press **Shift** > **Mode** (**9**) and select an application from the Mode Selector list in order to exit upgrade mode and resume normal instrument operation.

Warning	You cannot stop the upgrade once it has started. To avoid potential permanent damage, do not turn off the instrument or remove the USB memory device during the firmware update.

22. After the update is complete, the instrument should reboot automatically.

Note	If the instrument turns off and does not restart on its own, remove the USB memory device and turn on the instrument by holding down the **System (8)** key, then pressing the **Power** button. Keep pressing **System (8)** until the Anritsu splash screen is displayed. Be sure to use this key combination in order to perform a Master Reset while turning on the instrument. Pressing the **Power** button alone may put the instrument in an unrecoverable error state.

Chapter 6 — GPS (Option 31)

6-1   Introduction

The VNA Master is available with a built-in GPS receiver feature (Option 31) that can provide latitude, longitude, altitude, and UTC timing information. This option also enhances frequency reference oscillator accuracy in the Spectrum Analyzer mode (MS203xB). When GPS is actively locked to satellites, this information is saved with all saved measurements and can be displayed with Master Software Tools. No accuracy specifications apply if no GPS satellites are acquired.

Note	The VNA Master Technical Data Sheet provides a list of the options and measurements that require GPS (Option 31). In addition to having Option 31 installed, a GPS antenna is required. Refer to the instrument Technical Data Sheet for compatible GPS antennas.

6-2   Activating the GPS Feature

Attach the GPS antenna to the GPS Antenna connector on the VNA Master.

1. Press the **Shift** key, then the **System** (**8**) key on the numeric keypad to display the System menu.

2. Press the GPS submenu key.

3. Activate GPS by pressing the GPS On/Off submenu key so that On is underlined. When GPS is first turned On, the GPS icon is displayed in red to indicate that fewer than four satellites are currently being tracked.

Figure 6-1.   GPS Icon, Red

4. When the GPS receiver is tracking at least four satellites, the GPS icon changes to
    green. Latitude and longitude information is displayed in the title bar at the top of the
    display. Acquiring satellites may take as long as three minutes.

Figure 6-2.   GPS Icon, Green

5. Press the GPS Info submenu key to display the following information:

    - Tracked satellites

    - Latitude and longitude

    - Altitude

    - UTC timing information

    - Fix available

    - Almanac complete

    - Antenna and receiver status

    - GPS antenna voltage and current

        Refer to "GPS Menu" on page 6-4 for details on the above GPS Info items.

After GPS location fix is attained, the internal reference oscillator begins to correct its
frequency to match the GPS standard. After the internal frequency is adjusted to match the
GPS standard, the status is indicated by "GPS High Accuracy" showing in the Status menu,
which is displayed on the left side of the measurement display. When the GPS feature is not
enabled, the reference source displays either "Internal Standard Accuracy" or a user-selected
external reference frequency in the Status menu.

Within three minutes of satellite acquisition, the reference oscillator will have an accuracy of
better than 50 ppb (parts per billion).

In order to acquire data from the GPS satellites, you must have line-of-sight to the satellites,
or the antenna must be placed outside with no obstructions.

If no GPS is connected, the Frequency Reference annotation reads Int Std Accy. When GPS is
connected, with a fix, and the tuning process has completed (which may take a few minutes),
the Frequency Reference annotation shows GPS Hi Accy. If GPS is subsequently lost (for
example, GPS is turned off, disconnected, or there is no signal due to physical obstruction),
the instrument goes back to Int Std Accy after a few moments.

6-3   Resetting GPS

To reset the GPS, press the Reset submenu key. The green GPS icon shows a red cross mark when satellite tracking is lost after tracking four or more satellites. The GPS latitude and longitude are saved in the instrument memory until the VNA Master is turned off or until GPS is turned off by using the GPS On/Off key.

Figure 6-3.   GPS Icon, Tracking Lost

6-4   Saving and Recalling Traces with GPS Information

Saving Traces with GPS Information

The GPS coordinates of a location can be saved along with a measurement trace. Refer to the "Save Menu" on page 4-9 for more information. The current GPS coordinates will be saved with the measurement traces whenever GPS is on and actively tracking satellites.

Recalling GPS Information

If the GPS coordinates were saved with a measurement, the coordinates will be recalled when the measurement is recalled. Refer to "Recall Menu" on page 4-12 for more information on recalling a saved trace.

6-5   GPS Menu

Key Sequence: **Shift**, **System** (**8**) > GPS

GPS
 	
GPS
 	
On   Off
 	
GPS Info
 	
GPS Voltage
 	
3.3 V   5 V
 	
Reset
 	
Back
←
	GPS: Press this submenu key to turn GPS on or off.
	
	GPS Info: Press this submenu key to display the current GPS information.
	
	    Tracked Satellites: Shows the number of tracked satellites (three are required to retrieve latitude and longitude, four are required to resolve altitude). Generally, the larger the number of satellites tracked, the more accurate the GPS information.
	
	    Latitude and Longitude: Shows location in degrees, minutes, and seconds.
	
	    Altitude: Shows altitude information in meters.
	
	    UTC: Universal Coordinated Time.
	
	    Fix Available: The cold start search sets are established to ensure that at least three satellites are acquired within the first couple of minutes. When three satellites are found, the receiver will compute an initial fix (typically in less than two minutes). **Fix Available: No** means that the initial position has not been established.
	
	    Almanac Complete: The system almanac contains information about the satellites in the constellation, ionospheric data, and special system messages. In a cold start, the GPS receiver has no navigation data, so the receiver does not have a current almanac. A complete system almanac is not required to achieve a first position fix. However, UTC time is not correct until the almanac is complete, and the availability of the almanac can significantly reduce the time to first fix.
	
	    Antenna Status:
	    OK: Active antenna is connected and is working properly.
	
	    Short/Open: If an active antenna is in use, a short or open exists between the antenna and the connection. If this message is displayed, replace the antenna. If the message persists, try another Anritsu GPS antenna. If needed, contact your nearest Anritsu Service Center. If a passive antenna is in use, the message should display: Antenna OPEN Detected or Passive Antenna Used.
	
	    Receiver Status: Current status of the receiver.
	
	    GPS Antenna Voltage and Current: Shows voltage and current.
	
	GPS Voltage: Press this submenu key to set the source voltage at 3.3 V or 5 V, depending on the GPS receiver being used. The default setting is 3.3 V to prevent accidental damage to lower-voltage GPS antennas.
	
	Reset: The Reset key sets the number of tracked satellites to 0 and erases any almanac data and saved coordinates. The process of searching for and reacquiring satellites will begin again.
	
	Back: Press this submenu key to return to the "System Menu" on page 5-4.

Figure 6-4.   GPS Menu

Chapter 7 — Bias Tee (Option 10)

7-1 Overview

The use of this option is fully described in the Vector Network Analyzer Measurement Guide (refer to Appendix A). Some instrument-specific information is provided in this introduction to Bias Tee.

Option 10 provides a bias tee that is installed inside the instrument. The bias arm is connected to a 12 VDC to 32 VDC power source that can be turned on as needed to place the voltage on the center conductor of the instrument VNA Port 2, or the Spectrum Analyzer RF In port when in spectrum analyzer mode.

The bias can be turned on when the instrument is in vector network analyzer mode when the Start Frequency is 2 MHz or greater. The bias can be turned on when the instrument is in spectrum analyzer mode with any Start Frequency set. When bias is turned on, the bias voltage and current are displayed in the Instrument Settings Summary area at the top-left corner of the sweep window. The 12 VDC to 32 VDC power supply is designed to continuously deliver a maximum of 6 watts.

The bias tee menu can be accessed in several ways depending on how the instrument is configured:

- From the Sweep menu when in standard VNA Mode:

  Key Sequence: **Sweep** > Configure Ports > Bias Tee Setup

- From the System Options menu when VNA Field menus are selected:

  Key Sequence: **Shift**, **System** (**8**) > Application Options > Bias Tee Setup

- From the System Options menu when in Spectrum Analyzer mode:

  Key Sequence: **Shift**, **System** (**8**) > Application Options > Bias Tee

Figure 7-1 shows how the MS20xxB can provide an internal voltage between 12 volts and 32 volts that is applied to the center conductor of Port 2 or the spectrum analyzer RF In port. That voltage would be available at the port along with the RF signals.
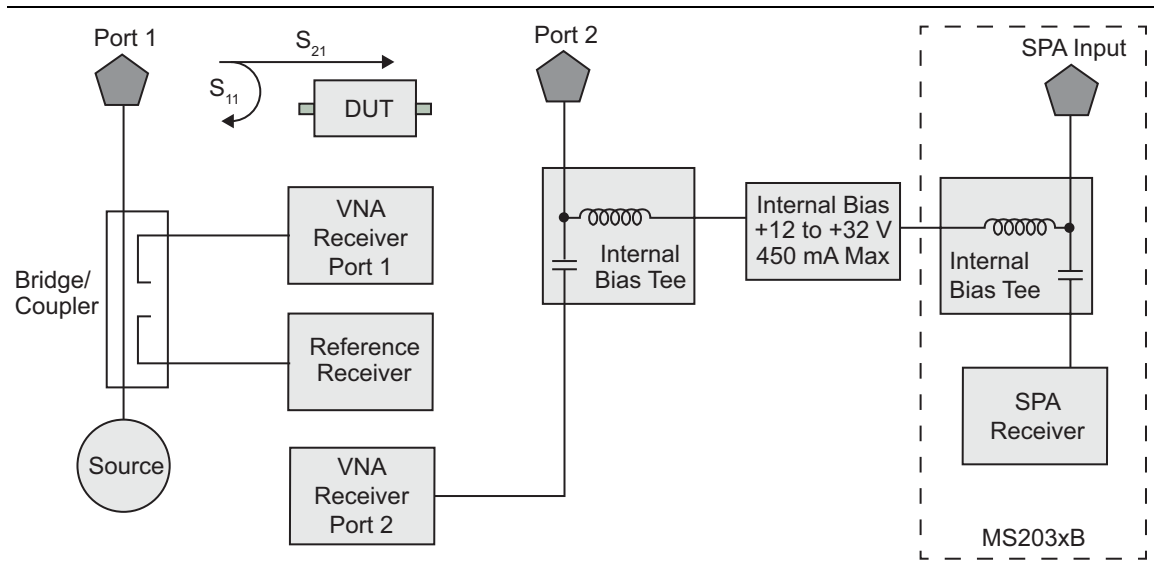
Figure 7-1.   Internal Bias

Chapter 8 — Anritsu Tool Box

8-1   Introduction

The Anritsu Tool Box is a suite of applications that provide an interface between Anritsu handheld RF instruments and a PC. The instrument connects to the computer via a USB, Ethernet, or serial port. Depending on the application, available functions range from the capture, transfer, and reporting of measurement data for trace analysis, to map preparation, creation and delivery of work instructions, and remote instrument monitoring and control.

Tool Box applications are available for download from the Anritsu website at anritsu.com/en-US/test-measurement/support/technical-support/handheld-tools-tool-box. Click the link to one of the Tool Box applications, then click Downloads and choose either the Full Installer or Web Installer. There is no difference between the two if you run the installer without saving. If you elect to save, the Full Installer will download all Anritsu software needed in a single executable file, which allows you to perform the installation later on a computer with no Internet access required. The Web Installer is a much smaller file that will require Internet access to execute the software installation.

8-2   Software Installation

Whether running the installer directly or executing the saved file, follow the instructions on screen. The Setup screen illustrated in Figure 8-1 may change with the software version.

You will be asked to select which applications you wish to install. Not all instrument models are supported by every software tool. To view the list of instrument models supported by a Tool Box application, click the Instruments tab on the application Web page.
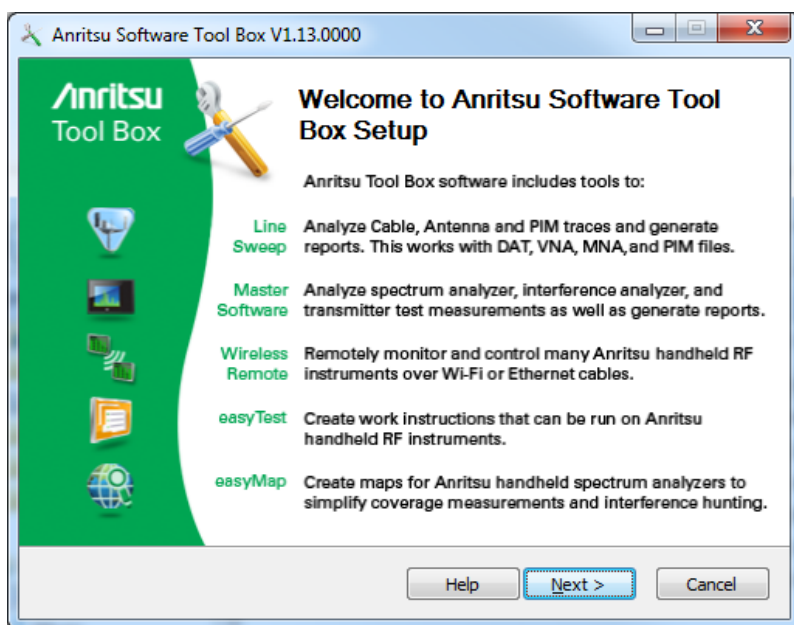
Figure 8-1.   Anritsu Tool Box Setup Wizard

8-3   Anritsu Software Tool Box

The Anritsu Tool Box serves as a central location from which you can open a previously saved measurement, visit the Anritsu website, or launch an application. To open the Tool Box, either double-click the desktop shortcut or select Anritsu Tool Box from the Windows Start menu. On the Tool Box screen, hover the mouse pointer over any of the application icons to view a short description of the application. See Figure 8-2.

Figure 8-2.   Anritsu Tool Box Screen

8-4   Software Tools

The Anritsu Tool Box provides links to the software tools installed on your PC. Alternatively, you can launch an application using its desktop shortcut or through the Windows Start menu.

The following sections list the top features and functions of the tools contained in the Anritsu Tool Box. For a detailed description of these features and how to perform specific tasks, refer to each application's Help system. The program Help also lists the instrument models, measurement modes, trace types, and file types that are compatible with that application.

Line Sweep Tools (LST)

Line Sweep Tools is post-capture trace processing software designed for users who need to analyze and generate reports on large numbers of cable, antenna, and PIM traces. Software features include:

- Measurement plot data capture and transfer from the instrument to a PC
- Marker and limit line presets
- Return Loss, Distance-to-Fault, PIM analysis
- VNA Master Field Mode compatibility
- Plot overlay for comparison of up to ten traces of the same measurement type
- Plot area zooming
- A naming grid for renaming files, titles, and subtitles
- Automated report generation
- Output to printer or to PDF or HTML format
- Export of plot data to text, image, or VNA files

Master Software Tools (MST)

Master Software Tools is designed for users of Anritsu handheld spectrum analyzers, interference analysis tools, transmission testers, and backhaul testers. Supported functions include the following:

- Transfer of captured measurement data to and from a PC for storage and analysis
- RF Spectrum Analyzer traces
- RF Interference analysis
- Spectrum monitoring
- Transmitter signal quality tests
- T1, T3, and E1 backhaul tests
- Trace overlay features for comparing multiple Spectrum Analyzer measurements
- Limit lines and markers
- Script Master for the creation of automated test procedures
- Export of measurement data as text, graphic, or Comma Separated Value format (CSV) files
- Reports created in HTML format for use in other applications

easyMap Tools

easyMap Tools is the new name for Anritsu Map Master. The application allows users to find and prepare geo-referenced maps and to build floor plans suitable for Anritsu Handheld Spectrum Analyzers with Interference Analysis or Coverage Mapping capabilities (Option 25 or Option 431, respectively).

Software functions include:

- Creation of geo-referenced maps with pan and zoom capability
- Conversion of maps and floor plans to a form suitable for use on Anritsu Handheld Spectrum Analyzers and Interference Analyzers
- Introduction of GPS information into previously non-geo-referenced maps

Wireless Remote Tools

Wireless Remote Tools enables the user to remotely monitor and control the instrument over a wireless LAN connection.

- The wireless connection is typically established using a USB-powered Wi-Fi router attached to the instrument and a matching Wi-Fi link on the PC end.
- Remote monitoring and control of the instrument enhance operator safety and efficiency when conditions make it unsafe or impractical to be close to the instrument.

Appendix A — Supplemental Documentation

A-1   Introduction

This appendix provides a list of supplemental documentation for VNA Master features and options. These measurement guides are available on the Anritsu website.

Table A-1.   Measurement Guides for Analyzers and Analyzer Options

VNA Master Feature (Available Option)	Document and Part Number
Vector Network Analyzer Bias-Tee (Option 10) Vector Voltmeter (Option 15) Distance Domain (formerly Option 501)	Vector Network Analyzer Measurement Guide (10580-00289)
High-Accuracy Power Meter (Option 19)	Power Meter Measurement Guide (10580-00240)
Spectrum Analyzer PIM Hunting Interference Analyzer (Option 25) Channel Scanner (Option 27) Coverage Mapping (Option 431) AM/FM/PM Analyzer (Option 509)	Spectrum Analyzer Measurement Guide (10580-00349)

Table A-2.   VNA Master Related Documents

VNA Master Related Documents	Related Document and Part Number
Performance Specifications	VNA Master Technical Data Sheet (11410-00549)
SCPI Programming Manual	VNA Master Programming Manual (10580-00302)

Software applications are available for download at
anritsu.com/en-US/test-measurement/support/technical-support/handheld-tools-tool-box.

Appendix B — Signal Standards

B-1   Introduction

This appendix provides a sample list of signal standards. This list can be used as a reference when making measurements with the VNA Master.

Table B-1.   Signal Standards

Signal Standard	Center (MHz)	Span (MHz)	Valid Channels
AMPS / EIA 553 - Uplink	859	70	1-799, 990-1023
AMPS / EIA 553 - Downlink	859	70	1-799, 990-1023
C-450 (P) - Uplink	463.5	21	1-800
C-450 (P) - Downlink	463.5	21	1-800
C-450 (SA) - Uplink	462.5	15	1-247
C-450 (SA) - Downlink	462.5	15	1-247
CDMA US Cellular - Uplink	859	70	1-799, 990-1023
CDMA US Cellular - Downlink	859	70	1-799, 990-1023
CDMA US PCS - Uplink	1920	140	1-1199
CDMA US PCS - Downlink	1920	140	1-1199
CDMA Korea PCS - Uplink	1810	120	1-599
CDMA Korea PCS - Downlink	1810	120	1-599
CDMA Japan / ARIB - Uplink	878.5	93	1-799, 801-1039, 1041-1199
CDMA Japan / ARIB - Downlink	878.5	93	1-799, 801-1039, 1041-1199
CDMA China - 1 - Uplink	916	88	0-1000, 1329-2047
CDMA China - 1 - Downlink	916	88	0-1000, 1329-2047
CDMA China - 2 - Uplink	910	76	0-1000
CDMA China - 2 - Downlink	910	76	0-1000
cdma2000 Class 0, Korea Cellular - Uplink	859	70	1-799, 990-1023
cdma2000 Class 0, Korea Cellular - Downlink	859	70	1-799, 990-1023
cdma2000 Class 0, N.A. Cellular - Uplink	859	70	1-799, 990-1023
cdma2000 Class 0, N.A. Cellular - Downlink	859	70	1-799, 990-1023
cdma2000 Class 1, N.A. PCS - Uplink	1920	140	0-1199
cdma2000 Class 1, N.A. PCS - Downlink	1920	140	0-1199
cdma2000 Class 2, (TACS Band) - Uplink	916	88	0-1100, 1329-2047
cdma2000 Class 2, (TACS Band) - Downlink	916	88	0-1100, 1329-2047

Table B-1.   Signal Standards

Signal Standard	Center (MHz)	Span (MHz)	Valid Channels
cdma2000 Class 3, (JTACS Band) - Uplink	878.5	93	1-799, 801-1039, 1041-1199
cdma2000 Class 3, (JTACS Band) - Downlink	878.5	93	1-799, 801-1039, 1041-1199
cdma2000 Class 4, Korea PCS - Uplink	1810	120	0-599
cdma2000 Class 4, Korea PCS - Downlink	1810	120	0-599
cdma2000 Class 5, (NMT-450-20 kHz) - Uplink	472.5	43	1039-1473, 1792-2016
cdma2000 Class 5, (NMT-450-20 kHz) - Downlink	472.5	43	1039-1473, 1792-2016
cdma2000 Class 5, (NMT-450-25 kHz) - Uplink	439.5	57	1-300, 539-871
cdma2000 Class 5, (NMT-450-25 kHz) - Downlink	439.5	57	1-300, 539-871
cdma2000 Class 6, IMT-2000 - Uplink	2045	250	0-1199
cdma2000 Class 6, IMT-2000 - Downlink	2045	250	0-1199
cdma2000 Class 7, N.A. 700 MHz Cellular - Uplink	770	48	0-359
cdma2000 Class 7, N.A. 700 MHz Cellular - Downlink	770	48	0-359
ETACS - Uplink	916	88	0-1000, 1329-2047
ETACS - Downlink	916	88	0-1000, 1329-2047
GSM 900 - Uplink	897.4	40	1-124, 975-1023
GSM 900 - Downlink	942.4	40	1-124, 975-1023
GSM 1800 - Uplink	1747.4	80	512-885
GSM 1800 - Downlink	1842.4	80	512-885
GSM 1900 - Uplink	1879.8	80	512-810
GSM 1900 - Downlink	1959.8	80	512-810
JTACS - Uplink	878.5	93	0-1198 (even numbers only)
JTACS - Downlink	878.5	93	0-1198 (even numbers only)
MATS-E - Uplink	925	70	1-1000
MATS-E - Downlink	925	70	1-1000
N-AMPS / IS-88L - Uplink	859	70	1-799, 990-1023
N-AMPS / IS-88L - Downlink	859	70	1-799, 990-1023
N-AMPS / IS-88M - Uplink	859	70	1-799, 990-1023
N-AMPS / IS-88M - Downlink	859	70	1-799, 990-1023
N-AMPS / IS-88U - Uplink	897.5	147	1-799, 990-1023

Table B-1.   Signal Standards

Signal Standard	Center (MHz)	Span (MHz)	Valid Channels
N-AMPS / IS-88U - Downlink	897.5	147	1-799, 990-1023
NADC IS136 Cellular - Uplink	859	70	1-799, 990-1023
NADC IS136 Cellular - Downlink	859	70	1-799, 990-1023
NADC IS136 PCS - Uplink	1920	140	1-1199
NADC IS136 PCS - Downlink	1920	140	1-1199
NMT-411-25 kHz - Uplink	420.5	19	539-871
NMT-411-25 kHz - Downlink	420.5	19	539-871
NMT-450-20 kHz - Uplink	460.5	19	1039-1473
NMT-450-20 kHz - Downlink	460.5	19	1039-1473
NMT-450-25 kHz - Uplink	459	18	1-300
NMT-450-25 kHz - Downlink	459	18	1-300
NMT-470-20 kHz - Uplink	486.5	15	1972-2016
NMT-470-20 kHz - Downlink	486.5	15	1972-2016
NMT-900 - Uplink	925	70	1-1000
NMT-900 - Downlink	925	70	1-1000
NMT-900 (Offset) - Uplink	925	70	1025-2023
NMT-900 (Offset) - Downlink	925	70	1025-2023
NTACS - Uplink	878.5	93	1-1199
NTACS - Downlink	878.5	93	1-1199
PDC 800 Analog - Uplink	891.5	97	0-1680
PDC 800 Analog - Downlink	891.5	97	0-1680
PDC 1500 (JDC) - Uplink	1513	72	0-960
PDC 1500 (JDC) - Downlink	1513	72	0-960
PHS - Uplink	1906.5	23	1-77
PHS - Downlink	1906.5	23	1-77
SMR 800 - 12.5 kHz - Uplink	836	60	1-1199
SMR 800 - 12.5 kHz - Downlink	836	60	1-1199
SMR 800 - 25 kHz - Uplink	836	60	1-600
SMR 800 - 25 kHz - Downlink	836	60	1-600
SMR 1500 - Uplink	1483	60	1-479
SMR 1500 - Downlink	1483	60	1-479
TACS - Uplink	925	70	1-1000
TACS - Downlink	925	70	1-1000
UMTS/WCDMA - Uplink	1920	70	9600-9900
UMTS/WCDMA - Downlink	2110	70	10550-10850

Table B-1. Signal Standards

Signal Standard	Center (MHz)	Span (MHz)	Valid Channels
UMTS/Region 2 - Uplink	1850	70	9250-9550
UMTS/Region 2 - Downlink	1930	70	9650-9950
802.11a	5170	84	34-161 (not all valid)
802.11b	2442	84	1-14
802.11 DS	2448	72	1-14
802.11 FH	2448.5	93	2-95
802.11g	2442	84	1-14

Appendix C — Error Messages

C-1   Introduction

This appendix provides a list of information and error messages that could be displayed on the VNA Master. If any error condition persists, contact your local Anritsu Service Center.

C-2   Reset Options

You can reset your VNA Master to Factory Defaults or use a Master Reset to return to the FULL Factory Default condition from the menu system or from the Off condition.

Caution	Use of Master Reset (**System**+**On**), will permanently erase all user saved setups and measurement traces and will return the VNA Master to a full Factory Default condition. Be sure to make backup copies of any important files before proceeding with a Master Reset. If the error persists, contact your Anritsu Service Center.

Reset Via Instrument Menus

From the VNA Master menu system, press the **Shift** button, then the **System** (**8**) button to open the System menu. Then press the System Options submenu key to open the System Options menu. Then press the Reset submenu key to open the Reset menu (refer to section "Reset Menu" on page 5-13). From the Reset menu, press either the Factory Defaults submenu key or the Master Reset submenu key.

Reset from OFF Condition

You can also reset the VNA Master by turning it Off and then restarting under one of the following conditions:

Factory Defaults Reset:

Hold the **Esc** button while pressing the **On/Off** button. Continue holding the **Esc** button until the Anritsu splash screen appears. You can then release the button. The VNA Master starts up with many Factory Default settings (refer to section "Factory Defaults" on page 5-13). Throughout this appendix, this sequence is abbreviated as Factory Defaults (**Esc**+**On**).

Master Reset:

Hold the **8** button in the number keypad (also referred to as the **System** (**8**) button) while pressing the **On/Off** button. Continue holding the **8** button until the Anritsu splash screen appears. You can then release the button. The VNA Master starts up in FULL Factory Default condition (refer to section "Master Reset" on page 5-13). Throughout this appendix, this sequence is abbreviated as Master Reset (**System**+**On**).

|	
Caution	Use of Master Reset (**System**+**On**), will permanently erase all user saved setups and measurement traces and will return the VNA Master to a full Factory Default condition. Be sure to make backup copies of any important files before proceeding with a Master Reset. If the error persists, contact your Anritsu Service Center.
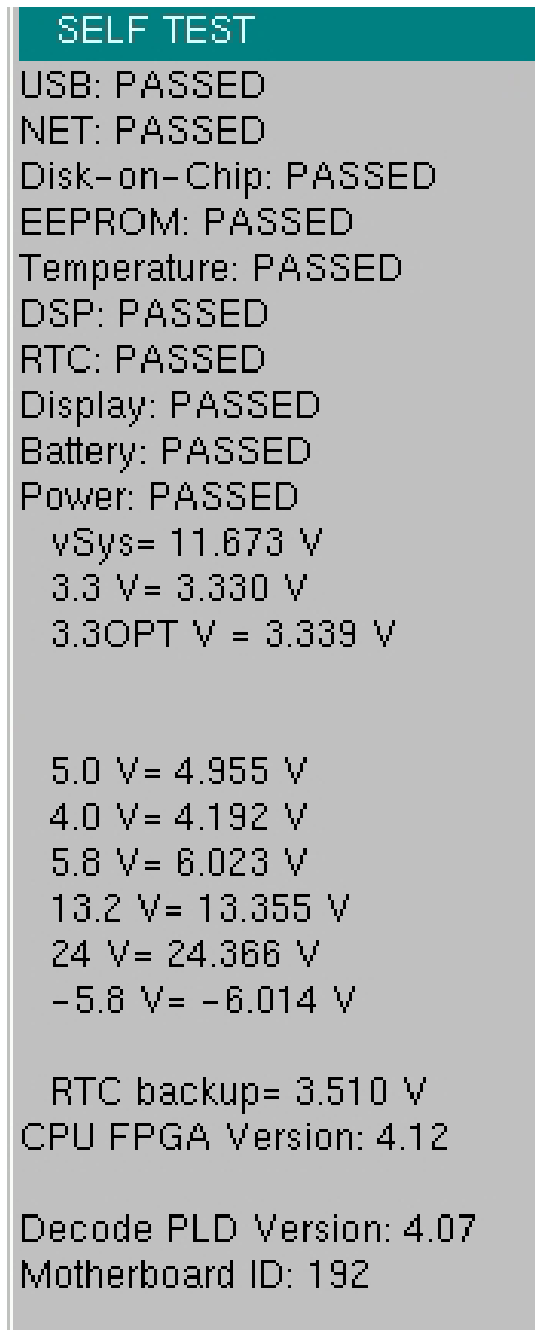
C-3   Self Test or Application Self Test Error Messages

Self Test

To run self test, press **Shift** and **System** (**8**) and then Self Test. Refer to the results window in Figure C-1, which summarizes the status of several primary functions in the instrument that are common to all applications (note that your instrument display may differ from this image). If any subtest shows FAILED, then check that the battery level is adequate for operation, or check that the temperature is within acceptable limits. Reset to factory defaults with either Factory Defaults (**Esc**+**On**), or Master Reset (**System**+**On**).

Caution	Use of Master Reset (**System**+**On**), will permanently erase all user saved setups and measurement traces and will return the VNA Master to a full Factory Default condition. Be sure to make backup copies of any important files before proceeding with a Master Reset. If the error persists, contact your Anritsu Service Center.

```
SELF TEST
USB: PASSED
NET: PASSED
Disk-on-Chip: PASSED
EEPROM: PASSED
Temperature: PASSED
DSP: PASSED
RTC: PASSED
Display: PASSED
Battery: PASSED
Power: PASSED
    vSys= 11.673 V
    3.3 V= 3.330 V
    3.3OPT V = 3.339 V


    5.0 V= 4.955 V
    4.0 V= 4.192 V
    5.8 V= 6.023 V
    13.2 V= 13.355 V
    24 V= 24.366 V
    -5.8 V= -6.014 V

    RTC backup= 3.510 V
CPU FPGA Version: 4.12

Decode PLD Version: 4.07
Motherboard ID: 192
```

Figure C-1.   Self Test Results Window (Vector Network Analyzer mode)

Application Self Test Results Window — VNA


```
APPLICATION SELF TEST

Overal Status: PASSED
1. Power Supply Test = PASSED
2. VCO Calibration = PASSED
3. Frequency Sweep = PASSED
4. EEPROM = PASSED




VNA FPGA: V1.00
DSP FPGA: 4.10
Board ID: 67655
```
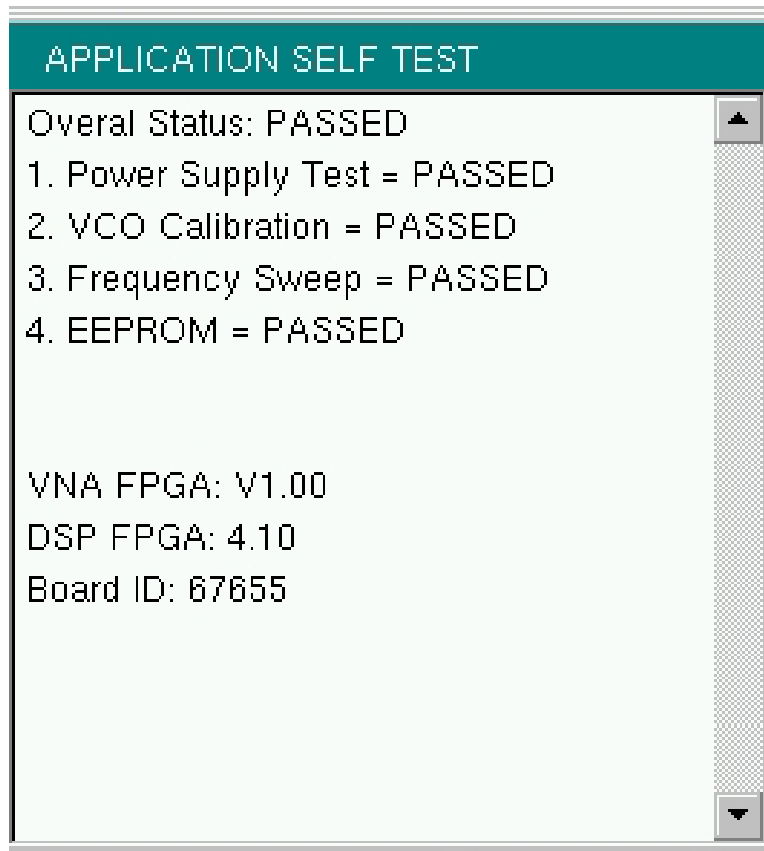
Figure C-2.   Application Self Test Results Window (Vector Network Analyzer mode)

Application Self Test (Vector Network Analyzer mode only)

To run the application self test, press **Shift** and **System** (**8**) and then Application Self Test from within the desired mode. When you are in Vector Network Analyzer mode, you will see the results window that is shown in Figure C-2 (note that your instrument display may differ from this image), which summarizes the status of several primary functions that are specific to this application.

If the Overall Status shows Failed, then one or more elements of the Application Self Test have failed. This self test consists of 4 subtests:

Power Supply Test: Lists any power supply voltages that are not meeting tolerance specification

VCO Calibration: Lists any frequency range over which the VCO calibration is failing

Frequency Sweep: Lists any frequency range over which errors in the sweep are occurring

EEPROM: Indicates whether reading or writing (or both) to the EPPROM has failed

If any of the subtests shows FAILED, then check that the battery level is adequate for operation or that temperature is within acceptable limits. Reset to factory defaults with either Factory Defaults (**Esc**+**On**), or Master Reset (**System**+**On**).

Caution	Use of Master Reset (**System**+**On**), will permanently erase all user saved setups and measurement traces and will return the VNA Master to a full Factory Default condition. Be sure to make backup copies of any important files before proceeding with a Master Reset. If the error persists, contact your Anritsu Service Center.

Application Self Test Results Window — SPA
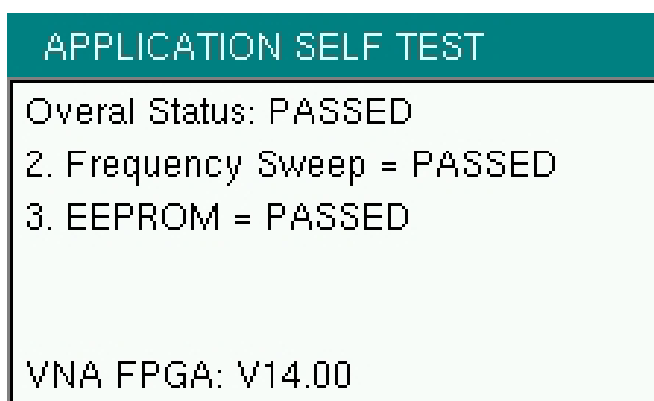
Figure C-3.   Application Self Test Results Window (Spectrum Analyzer mode)

C-4   Operation Error Messages

Fan Failure

The system has determined that the fan should be running due to the internal temperature of the unit, but cannot detect that the fan is actually running.

It is important to keep the fan inlet and exhaust ports clear of obstructions. The cooling fan will vary the speed in relation to the internal temperature of the instrument (refer to Figure C-4). The fan will turn on at low speed when the internal temperature of the instrument reaches 44°C, and will increase the fan speed to maximum at 54°C. As the internal temperature of the instrument decreases, the fan will reduce speed until the temperature reaches 39°C, at which point the fan will turn off.
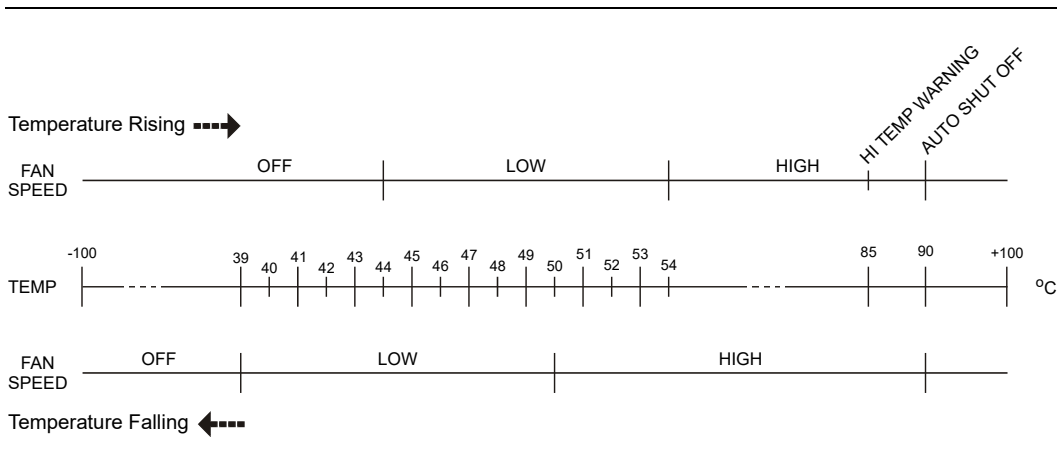
Figure C-4.   Fan Speed vs. Temperature

High Temp Warning

The internal temperature has reached an excessive level, 85°C. Verify that the ventilation openings are unobstructed and that the fan is running. Internal temperatures may be manually verified by using the SELF TEST function. Turn off the unit and allow the temperature to cool down. If the fault is not resolved and the internal temperature reaches 90°C, then a countdown of 10 seconds will begin. The countdown gives the user a chance to save the current setup before the instrument turns itself off (before internal temperatures can cause any damage). If the error persists after removing any obstructions and allowing the unit to cool, then reset to the factory defaults with Factory Defaults (**Esc**+**On**), or Master Reset (**System**+**On**).

Caution	Use of Master Reset (**System**+**On**), will permanently erase all user saved setups and measurement traces and will return the VNA Master to a full Factory Default condition. Be sure to make backup copies of any important files before proceeding with a Master Reset. If the error persists, contact your Anritsu Service Center.

Operation not Permitted in Recall Mode

Attempted to perform an operation on a recalled trace. Many operations are valid only on a live or active trace.

PMON PLD Fail

Unable to communicate with the Power Monitor PCBA.

Power Supply

Power Supply failed. Charge the battery.

Error Saving File. General Error Saving File

An error was detected while saving a file. Try again.

C-5   Vector Network Analyzer Specific Warning Messages

Bias Tee cannot be enabled for start freq < 2MHz.

Adjust frequency before turning On the Bias Tee.

The start frequency cannot be set less than 2 MHz when the internal or external Bias Tee is turned On. Set the frequency to a value larger than or equal to 2 MHz, and then turn on the Bias Tee.

Bias Tee is not allowed for start freq < 2MHz.

Turn Off Bias Tee before changing the freq.

The internal or external Bias Tee cannot be turned on when the start frequency is set to less than 2 MHz. Turn off the Bias Tee, and then adjust the start frequency to the desired value less than 2 MHz.

Changing Source Power

Changing Source Power will affect the accuracy of the current calibration.

While Cal Correction is turned On, changing the source power level will affect the accuracy of the current calibration. The correction will remain On and can be used, but an indicator (?P) will appear next to the left-hand status column (CAL: ON) to note that the current power setting is different from the one used during the calibration processes.

No valid calibration to change correction.

There is no valid calibration in volatile memory that can be used to turn Cal Correction On. A new calibration must be performed.

Cannot continue with calculating.

Cannot continue with calculating. Not all required cal steps are completed.

When performing a calibration, you must complete all of the required steps before applying the "Calculate and Finish Cal" step.

Bias Tee state cannot be changed during calibration.

While performing a calibration, and before completing all of the calibration steps, you cannot turn on the Bias Tee. You must wait till after all of the calibration steps are complete before turning on the Bias Tee. This precaution is enforced to protect the calibration components from getting damaged by the Bias Tee current.

Turning Bias Tee to OFF.

Bias Tee is turned on when a new calibration sequence is started. The Bias Tee is turned off to protect the calibration components. After all the calibration steps are completed, you can turn the Bias Tee back on as required.

Turning Bias Tee to OFF.

Turning Bias Tee to OFF. Recalling measurement does not match with current setup.

The recalled setup or measurement file does not match the current setup. To ensure DUT safety, the Bias Tee function is turned off.

Calibration will be lost after change.

Calibration will be lost after change. Press the button again to continue.

While performing a calibration, and before completing all the calibration steps, if you change any of the frequency parameters (start, stop, center, span) or the number of points, then the calibration must be invalidated.

Changes not allowed during calibration.

Changes not allowed during calibration. Press Esc to abort calibration.

Certain parameters (such as frequency and number of points) can be changed while the calibration process is underway. Changing these parameters is not allowed unless the calibration is aborted first.

Option 10 (Bias Tee) not enabled.

To turn on the internal or external Bias Tee, Option 10 must be enabled in the instrument. Contact your Anritsu Service Center to inquire about enabling this option.

No External Reference signal detected.

External Reference was switched to 10 MHz but no external 10 MHz signal was detected. The External Reference setting is turned back to Off. Check the external reference level and frequency, and then try again.

Limit is not available for this Graph type.

Limits are supported only for rectilinear graph types (not for Smith Charts, for example).

Appendix D — Tower Mounted Amplifiers

D-1   Introduction

A Tower Mounted Amplifier (TMA) can be used to amplify the received signal. There are different types of TMA depending on the system requirements. Three commonly used types are:

- TMA-D - A duplex tower mounted amplifier that combines transmit and receive ports from the radio system and connects to a single antenna. This configuration is specific to systems that use a single antenna configuration.
- TMA-S - A receive-only tower mounted amplifier is installed between the receiving antenna and the radio to boost weak signals. This configuration is common on systems that implement separate antennas for transmitting and receiving.
- TMA-DD - A dual-duplex tower mounted amplifier used for radios systems with a single transmission line connection for transmit and receive. These systems are commonly called transceivers.
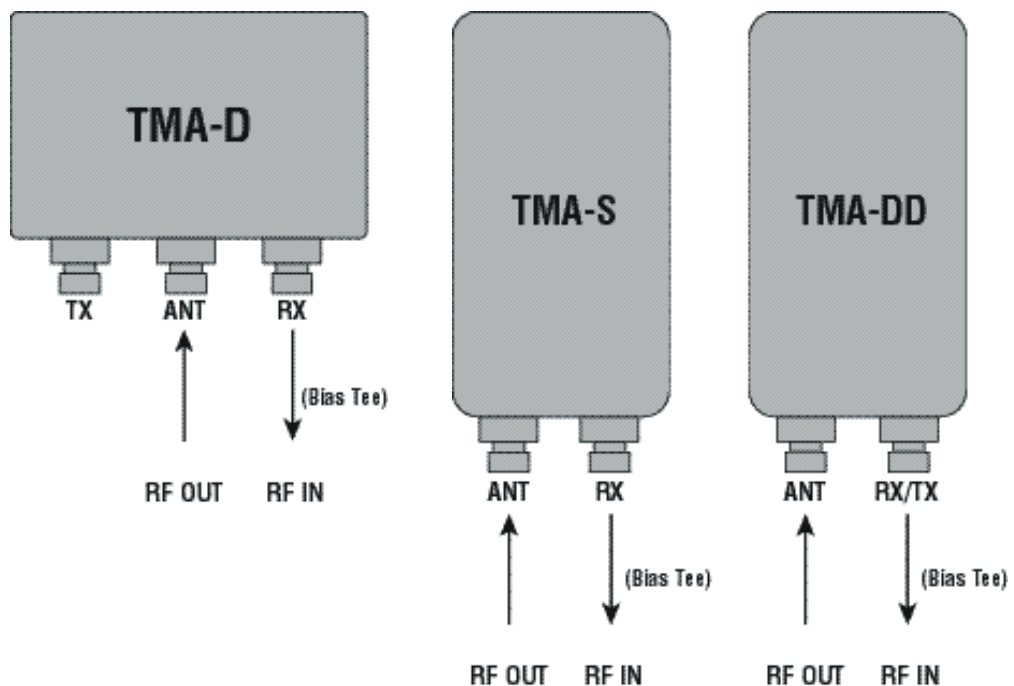
Figure D-1.   Tower Mounted Amplifiers

Appendix E — Coaxial Cable Technical Data

E-1   Coaxial Cable Technical Data

The table below provides a sample list of common coaxial cables. Your instrument cable list may be different.

Table E-1.   Coaxial Cable Technical Data (Sheet 1 of 4)

Manufacturer	Cable	Prop. Vel.	Freq 1	Loss 1	Freq 2	Loss 2	Freq 3	Loss 3
Andrew	FSJ1-50A (6 GHz)	0.84	1000	0.196	2500	0.313	6000	0.532
Andrew	FSJ2-50 (6 GHz)	0.83	1000	0.133	2500	0.223	6000	0.374
Andrew	FSJ4-50B (6 GHz)	0.81	1000	0.118	2500	0.201	6000	0.348
Andrew	EFX2-50 (6 GHz)	0.85	1000	0.121	2500	0.202	6000	0.341
Andrew	LDF1-50 (6 GHz)	0.86	6000	0.306	6000	0.306	6000	0.306
Andrew	LDF2-50 (6 GHz)	0.88	6000	0.323	6000	0.323	6000	0.323
Andrew	LDF4-50A (6 GHz)	0.88	1000	0.073	2500	0.121	6000	0.218
Andrew	HJ4-50 (6 GHz)	0.914	1000	0.092	2500	0.156	6000	0.257
Andrew	HJ4.5-50 (6 GHz)	0.92	1000	0.054	2500	0.089	6000	0.148
Andrew	AVA5-50 7/8	0.91	1000	0.038	2000	0.055	2500	0.063
Andrew	AVA7-50 1-5/8	0.92	1000	0.022	2000	0.034	2500	0.038
Andrew	EFX2-50	0.85	1000	0.121	2000	0.177	2500	0.202
Andrew	FLC 12-50J	0.88	1000	0.075	2000	0.11	2500	0.134
Andrew	FLC 38-50J	0.88	1000	0.115	2000	0.169	2500	0.19
Andrew	FLC 78-50J	0.88	1000	0.041	2000	0.061	2500	0.072
Andrew	FLC 114-50J	0.88	1000	0.033	2000	0.05	2500	0.059
Andrew	FLC 158-50J	0.88	1000	0.025	2000	0.038	2500	0.042
Andrew	FSJ1-50A	0.84	1000	0.196	2000	0.285	2500	0.313
Andrew	FSJ2-50	0.83	1000	0.133	2000	0.196	2500	0.223
Andrew	FSJ4-50B	0.81	1000	0.118	2000	0.176	2500	0.201
Andrew	HJ4-50	0.91	1000	0.092	2000	0.137	2500	0.156
Andrew	HJ4.5-50	0.92	1000	0.054	2000	0.079	2500	0.089
Andrew	HJ5-50	0.916	1000	0.042	2000	0.063	2500	0.071
Andrew	HJ7-50A	0.921	1000	0.023	2000	0.034	2500	0.039
Andrew	HJ12-50	0.931	1000	0.019	2000	0.029	2000	0.029
Andrew	HL4RP-50A	0.88	1000	0.074	2000	0.109	2500	0.123

Table E-1.   Coaxial Cable Technical Data (Sheet 2 of 4)

Manufacturer	Cable	Prop. Vel.	Freq 1	Loss 1	Freq 2	Loss 2	Freq 3	Loss 3
Andrew	LDF4-50A	0.88	1000	0.073	2000	0.107	2500	0.12
Andrew	LDF4.5-50	0.89	1000	0.054	2000	0.08	2500	0.091
Andrew	LDF5-50A	0.89	1000	0.041	2000	0.061	2500	0.07
Andrew	LDF5-50B	0.91	1000	0.041	2000	0.061	2500	0.07
Andrew	LDF6-50	0.89	1000	0.028	2000	0.042	2500	0.048
Andrew	LDF7-50A	0.88	1000	0.024	2000	0.037	2500	0.043
Andrew	LDF12-50	0.88	1000	0.021	2000	0.033	2000	0.033
Andrew	VXL5-50 7/8	0.88	1000	0.045	2000	0.066	2500	0.075
Andrew	VXL6-50 1-1/4	0.88	1000	0.032	2000	0.048	2500	0.055
Andrew	VXL7-50 1-5/8	0.88	1000	0.024	2000	0.037	2500	0.043
Belden	RG-8/8A	0.86	1000	0.132	2000	0.33	2500	0.22
Belden	RG-9/9A	0.659	1000	0.289	1000	0.289	1000	0.289
Belden	RG-17/17A	0.659	1000	0.18	1000	0.18	1000	0.18
Belden	RG-55/55A/55B	0.659	1000	0.541	1000	0.541	1000	0.541
Belden	RG-58/58B	0.77	1000	0.356	2000	0.528	2500	0.6
Belden	RG-58A/58C	0.73	1000	0.594	1000	0.594	1000	0.594
Belden	RG-142	0.7	1000	0.43	2000	0.663	2500	0.713
Belden	RG-174	0.66	1000	1.115	1000	1.115	1000	1.115
Belden	RG-178B	0.695	1000	1.509	1000	1.509	1000	1.509
Belden	RG-188	0.69	1000	0.951	1000	0.951	1000	0.951
Belden	RG-213	0.66	1000	0.262	1000	0.269	1000	0.269
Belden	RG-214	0.659	1000	0.229	1000	0.292	1000	0.292
Belden	RG-223	0.66	1000	0.476	1000	0.478	1000	0.478
Cablewave	HCC 12-50J	0.915	1000	0.087	2000	0.126	2500	0.137
Cablewave	HCC 78-50J	0.915	1000	0.041	2000	0.061	2500	0.066
Cablewave	HCC 158-50J	0.95	1000	0.022	2000	0.031	2500	0.033
Cablewave	HCC 300-50J	0.96	1000	0.015	1000	0.015	1000	0.015
Cablewave	HCC 312-50J	0.96	1000	0.013	1000	0.013	1000	0.013
Cablewave	HF 4 1/8 Cu2Y	0.97	1000	0.01	1000	0.01	1000	0.01
Cablewave	HF 5 Cu2Y	0.96	1000	0.007	1000	0.007	1000	0.007
Cablewave	HF 6 1/8 Cu2Y	0.97	1000	0.006	1000	0.006	1000	0.006
Cellflex	LCF78-50JA	0.9	1000	0.039	2000	0.058	2500	0.066
Cellflex	LCFS114-50JA	0.9	1000	0.029	2000	0.044	2500	0.051
Cellflex	LCF158-50JA	0.9	1000	0.024	2000	0.036	2500	0.042
Cellflex	LCF214-50JA	0.88	1000	0.021	2000	0.033	2000	0.033

Table E-1.   Coaxial Cable Technical Data   (Sheet 3 of 4)

Manufacturer	Cable	Prop. Vel.	Freq 1	Loss 1	Freq 2	Loss 2	Freq 3	Loss 3
Cellflex	UCF114-50JA	0.89	1000	0.031	2000	0.047	2000	0.047
Comscope	CR50 540PE	0.88	1000	0.069	2000	0.103	2500	0.116
Comscope	CR50 1070PE	0.88	1000	0.037	2000	0.055	2500	0.064
Comscope	CR50 1873PE	0.88	1000	0.022	2000	0.034	2500	0.04
Eupen	EC4-50-HF 1/2	0.82	1000	0.108	2000	0.161	2500	0.183
Eupen	EC4-50 1/2	0.88	1000	0.074	2000	0.109	2500	0.121
Eupen	EC4.5-50 5/8	0.88	1000	0.056	2000	0.083	2500	0.094
Eupen	EC5-50 7/8	0.88	1000	0.04	2000	0.058	2500	0.066
Eupen	EC6-50 1-1/4	0.88	1000	0.028	2000	0.043	2500	0.048
Eupen	EC7-50 1-5/8	0.88	1000	0.024	2000	0.037	2500	0.042
Eupen	EC7-50A 1-5/8	0.89	1000	0.023	2000	0.035	2500	0.039
Eupen	EC12-50 2-1/4	0.88	1000	0.022	2000	0.034	2500	0.039
Nk Cables	RF1/2-50	0.88	1000	0.073	2000	0.107	2500	0.127
Nk Cables	RF1/2-50GHF	0.88	1000	0.073	2000	0.107	2500	0.127
Nk Cables	RF1/2-50BHF	0.88	1000	0.073	2000	0.107	2500	0.127
Nk Cables	RF5/8-50	0.88	1000	0.051	2000	0.075	2500	0.087
Nk Cables	RF5/8-50GHF	0.88	1000	0.051	2000	0.075	2500	0.087
Nk Cables	RF5/8-50BHF	0.88	1000	0.051	2000	0.075	2500	0.087
Nk Cables	RF7/8-50	0.88	1000	0.04	2000	0.059	2500	0.07
Nk Cables	RF7/8-50GHF	0.88	1000	0.04	2000	0.059	2500	0.07
Nk Cables	RF7/8-50BHF	0.88	1000	0.04	2000	0.059	2500	0.07
Nk Cables	RF1 5/8-50	0.88	1000	0.024	2000	0.036	2500	0.042
Nk Cables	RF1 5/8-50GHF	0.88	1000	0.024	2000	0.036	2500	0.042
Nk Cables	RF1 5/8-50BHF	0.88	1000	0.024	2000	0.036	2500	0.042
Nk Cables	RF2 1/4-50	0.88	1000	0.021	2000	0.032	2500	0.041
Nk Cables	RF2 1/4-50GHF	0.88	1000	0.021	2000	0.032	2500	0.041
Nk Cables	RF2 1/4-50BHF	0.88	1000	0.021	2000	0.032	2500	0.041
Nk Cables	RFF3/8-50	0.81	1000	0.147	2000	0.218	2500	0.25
Nk Cables	RFF3/8-50GHF	0.81	1000	0.147	2000	0.218	2500	0.25
Nk Cables	RFF3/8-50BHF	0.81	1000	0.147	2000	0.218	2500	0.25
Nk Cables	RFF1/2-50	0.82	1000	0.112	2000	0.167	2500	0.19
Nk Cables	RFF1/2-50GHF	0.82	1000	0.112	2000	0.167	2500	0.19
Nk Cables	RFF1/2-50BHF	0.82	1000	0.112	2000	0.167	2500	0.19
Nk Cables	RFF7/8-50	0.88	1000	0.04	2000	0.066	2500	0.076
Nk Cables	RFF7/8-50GHF	0.88	1000	0.04	2000	0.066	2500	0.076

Table E-1. Coaxial Cable Technical Data (Sheet 4 of 4)

Manufacturer	Cable	Prop. Vel.	Freq 1	Loss 1	Freq 2	Loss 2	Freq 3	Loss 3
Nk Cables	RFF7/8-50BHF	0.88	1000	0.04	2000	0.066	2500	0.076
Times	LMR100	0.66	1000	0.789	2000	1.15	2500	1.31
Times	LMR200	0.83	1000	0.342	2000	0.49	2500	0.554
Times	LMR240	0.84	1000	0.261	2000	0.377	2500	0.424
Times	LMR400	0.85	1000	0.135	2000	0.196	2500	0.222
Times	LMR500	0.86	1000	0.109	2000	0.159	2500	0.18
Times	LMR600	0.87	1000	0.087	2000	0.128	2500	0.145
Times	LMR900	0.87	1000	0.059	2000	0.086	2500	0.098
Times	LMR1200	0.88	1000	0.044	2000	0.065	2500	0.074
Times	LMR1700	0.89	1000	0.033	2000	0.049	2500	0.057
	310801	0.821	1000	0.115	1000	0.115	1000	0.115
	311201	0.82	1000	0.18	1000	0.18	1000	0.18
	311501	0.8	1000	0.23	1000	0.23	1000	0.23
	311601	0.8	1000	0.262	1000	0.262	1000	0.262
	311901	0.8	1000	0.377	1000	0.377	1000	0.377
	352001	0.8	1000	0.377	1000	0.377	1000	0.377

Appendix F — LAN and DHCP

F-1   Introduction

This appendix describes network connections for the VNA Master. (Ethernet connectivity was formerly supplied as Option 411. Revision 2 instruments have Ethernet connectivity built in. The instrument label (located on the rear of the instrument) will clearly state Revision 2.)

F-2   LAN Connection

The RJ-45 connector is used to connect the VNA Master to a local area network. Integrated into this connector are two LEDs. The amber LED shows the presence of a 10 Mbit/s LAN connection when on, and a 100 Mbit/s LAN connection when off. The green LED flashes to show that LAN traffic is present.

F-3   Ethernet Configuration

The instrument IP address is set by pressing the **Shift** key, then the **System** (**8**) key followed by the System Options submenu key and the Ethernet Config submenu key. The instrument Ethernet address can be set automatically using DHCP, or manually by entering the static IP address, gateway address, and subnet mask.

Dynamic Host Configuration Protocol (DHCP) is an Internet protocol that automates the process of setting IP addresses for devices that use TCP/IP, and is a common method of configuring a device for network use.

Ethernet Menu

Key Sequence: **Shift**, **System** (**8**) > **System Options >** Ethernet Config

Ethernet Type Manual DHCP Field IP G-Way Sub First Octet Second Octet Third Octet Fourth Octet	**Type** **Manual DHCP:** Press the Type submenu key to select whether the IP address will be entered manually or will be supplied automatically by a network DHCP server. See Figure F-2 and Figure F-3 on page F-3. If Manual is selected, use the submenu keys or the **Left/Right** arrow keys to select the field that is to be modified in the Ethernet Editor dialog. Use the numeric keypad, the **Up/Down** arrow keys, or the rotary knob to enter the values. Press **Enter** to apply the changes, or press the **Esc** key to exit Ethernet Configuration without making changes. If DHCP is selected with the Type key, press **Enter** to close the Ethernet Editor dialog, then press **Shift**, **System**, and Status to view the IP address assigned by the DHCP server. Press **Esc** to close the Status screen. **Field** **IP G-Way Sub:** Press this submenu key to select the desired Internet Protocol Property to be edited. **First Octet:** Moves the cursor to the leftmost column of the selected IP properties field. **Second Octet:** Moves the cursor to the second column from the left of the selected IP properties field. **Third Octet:** Moves the cursor to the third column from the left of the selected IP properties field. **Fourth Octet:** Moves the cursor to the fourth column from the left of the selected IP properties field.

Figure F-1.   Ethernet Menu
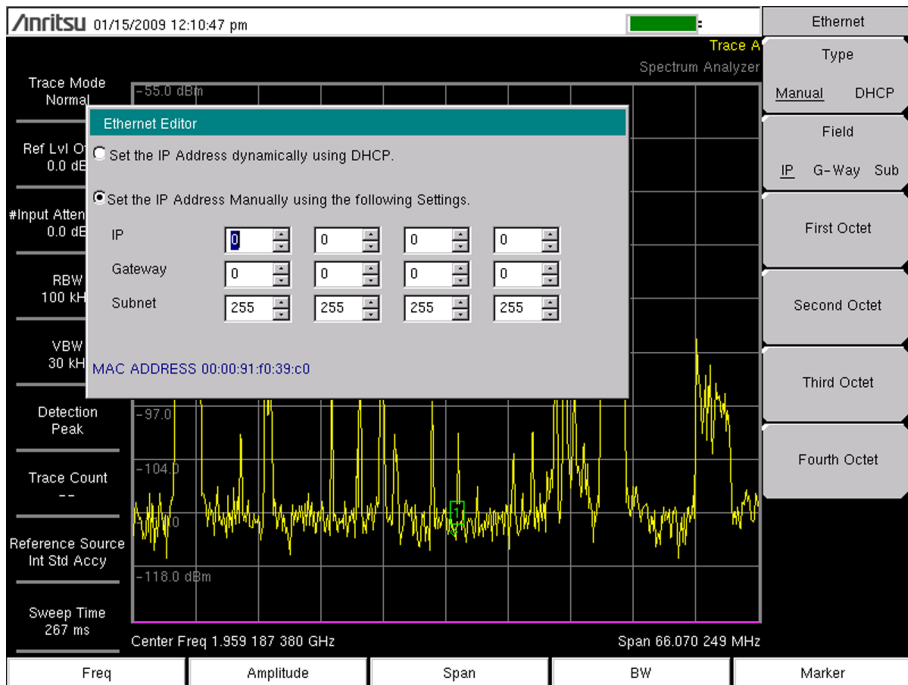
Figure F-2.   Setting IP Address Manually
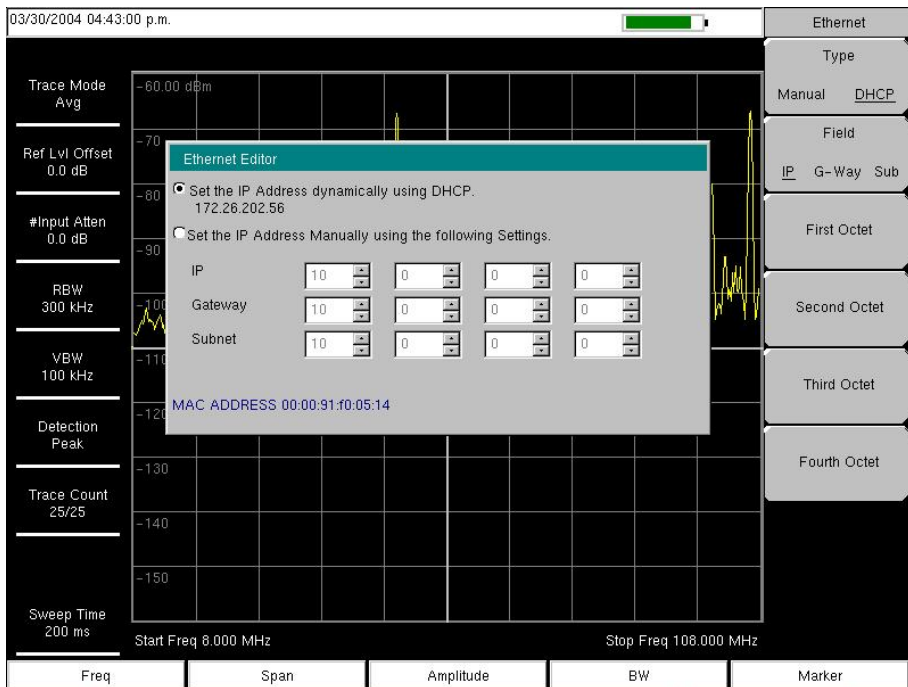
Figure F-3.   IP Address Assigned Using DHCP

DHCP

DHCP stands for Dynamic Host Configuration Protocol. It is a protocol that allows a server to dynamically assign IP addresses to devices that are connected to the network. Most networks include a DHCP server to manage IP addresses.

When using DHCP, no setup is required to lease and use a dynamic IP address. In a dynamic IP operation, the IP address in use may change from use to use. The DHCP server hands out IP addresses on a first come, first served basis. As soon as the device is disconnected from the network, the IP address that it was using becomes available to lease to the next unit that requests an IP address. Normally, some amount of lag time is present on the DHCP server end, so if the device is connected again reasonably soon, then it may end up with the same address.

When a DHCP server is not available, a static IP address can be used. A static IP address is a fixed address. After being set, it will always remain the same, and care must be taken to not conflict with other equipment on the network.

When using a static IP address on an established network, always request the static IP address from the network administrator. Randomly choosing a static IP address on an established network may result in duplicate IP addresses or other conflicts.

Three parameters must be set prior to using a static IP address:

IP Address

This is the static IP address on the network. Static IP addresses are necessary when you have no physical access to the instrument, or any other way to determine the instrument's IP address assigned by the DHCP server.

Default Gateway

Often when a static IP address is assigned, a default gateway is also identified. If the default gateway is unknown, type in the static IP address so that the static IP address and default gateway are the same number.

Subnet Mask

This parameter is usually extracted from the static IP address based on the class of the address and determines the destination of any broadcast messages that might be sent from the instrument. It can be customized if necessary. The subnet mask may also be provided with the static IP address.

Example 1

In this example, a static IP address has been chosen because no network DHCP service is available. The instrument is connected to the network port on the PC with a crossover Ethernet cable (not included). This is also referred to as Direct Connect:

```
IP Address: 10.0.0.2
Default Gateway: 10.0.0.2
Subnet Mask: 255.255.0.0
```

Example 2

In this example, the static IP address has been assigned with an associated gateway and subnet mask:

```
IP Address: 153.56.100.42
Default Gateway: 153.56.100.1
Subnet Mask: 255.255.252.0
```

F-4   ipconfig Tool

A few tools that are built into the Microsoft Windows operating system can assist in making some determinations about the network to which the PC is connected. Typing ipconfig at a command prompt produces a display of information about the in-use parameters of the PC and its network connection. Following is an example of the typical results expected:

Note	The ipconfig display does not report whether the information is from a DHCP server or from a static IP setup.

```
Y:\>ipconfig
Windows 2000 IP Configuration
Ethernet adapter Local Area Connection:
Connection-specific DNS Suffix. : us.anritsu.com
IP Address. . . . . . . . . . . : 172.26.202.172
Subnet Mask . . . . . . . . . . : 255.255.252.0
Default Gateway . . . . . . . . : 172.26.200.1
```

F-5   Ping Tool

Another tool that can find out if a selected IP address is already on the network is ping. Ping is a harmless way to determine if an address is found on the network, and (if it is found) to receive a reply. Basically, the ping function sends out a request to a specific address to determine if a computing device is connected to the network at that address. If a valid connection is found, then a copy of the signal (that was sent) is returned. If a connection is not found, then the response is "request timed out", which means that no reply was received from that IP address.

```
Y:\>ping 172.26.202.172

Pinging 172.26.202.172 with 32 bytes of data:

Reply from 172.26.202.172: bytes=32 time<10ms TTL=128

Reply from 172.26.202.172: bytes=32 time<10ms TTL=128

Reply from 172.26.202.172: bytes=32 time<10ms TTL=128

Reply from 172.26.202.172: bytes=32 time<10ms TTL=128

Ping statistics for 172.26.202.172:

Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milliseconds:

Minimum = 0 ms, Maximum = 0 ms, Average = 0 ms
```

Appendix G — Glossary of Terms

Introduction

The following terms are related to this product and technology.

Glossary Terms

3 dB rule : The 3 dB rule provides a means to estimate relative power values. A 3 dB gain indicates that power increases to twice the power (a multiple of 2). A 3 dB loss indicates that power decreases to half the power (a multiple of 1/2). A system with 40 watts of input power and a 6 dB insertion loss will have only 10†watts of output power (a multiple of 1/2 for each 3 dB loss, or 1/4 of 40 watts).

Adapter : A fitting that supplies a passage between two sets of equipment when they cannot be directly interconnected.

Adaptive Array Antenna : Adaptive array antenna is a type of advanced 'smart' antenna technology that continually monitors a received signal and dynamically adapts signal patterns to optimize wireless system performance. The arrays use signal processing algorithms to adapt to user movement, to changes in the radio-frequency environment, and to multi-path and co-channel interference.

ADC : Analog-to-Digital Converter (ADC, A/D or A to D) is an electronic device that converts continuous signals to discrete digital numbers. The reverse operation is performed by a digital-to-analog converter (DAC). ADC can uniquely represent all analog input values within a specified total input range by a limited number of digital output codes. Refer also to DAC.

Analog System : An Analog system uses an analog transmission method to send voice, video and data-using analog signals, such as electricity or sound waves, that are continuously variable rather than discreet units as in digital transmissions. Mobile analog systems include AMPS, NMT and ETACS.

Analog Transmission : Analog Transmission refers to signals propagated through the medium as continuously varying electromagnetic waves.

Antenna : Antenna is a device which radiates and/or receives radio signals, including RF, microwave, and RADAR.

Antenna
beamwidth : Antenna beamwidth, also known as the half-power beamwidth, is the
angle of an antenna pattern or beam over which the relative power is at
or above 50% of the peak power.

Antenna Directivity : Antenna directivity, also known as antenna gain, is the relative gain of
the main beam of an antenna pattern to a reference antenna, usually an
isotropic or standard dipole. Antenna Directivity is the percentage of
radiated signal transmitted or received in a given direction related to
beamwidth.

Antenna Efficiency : Antenna Efficiency is the percentage of theoretical gain actually
realized from an antenna.

Antenna Gain : Antenna gain, also known as antenna directivity, is the relative gain of
the main beam of an antenna pattern to a reference antenna, usually an
isotropic or standard dipole. Antenna Gain is the effectiveness of a
directional antenna expressed as the ratio of input power of the
directional antenna to input power of an isotropic radiator to provide
the same field strength in the desired direction. Sometimes related to a
dipole antenna.

Antenna, Isotropic : An isotropic antenna is a theoretical point source radiating a spherical
power envelope.

Antenna, Parabolic : A parabolic antenna is an antenna utilizing a reflector that is shaped as
a paraboloid in order to both concentrate the radiated signal into a
beam and to provide considerable gain. Beamwidth varies inversely and
gain varies directly with the size of the antenna and with frequency.

Attenuation : Attenuation refers to decreasing in signal magnitude between two
points. These points may be along a radio path, transmission line or
other devices.

Attenuator : Attenuator is a device specifically designed to decrease the magnitude
of a signal transmitted through it.

Average power : Average power is the peak power averaged over time and is usually
applied to pulsed systems where the carrier power is switched on and
off.

Band Pass Filter : A Band Pass Filter is a radio wave filter with a specific range of frequencies in which it is designed to pass. It rejects frequencies outside the pass-band range. A resistor-inductor-capacitor circuit is an example of a Band Pass Filter.

Bandwidth : Bandwidth usually identifies the capacity of a circuit or amount of data that can be sent through a given circuit. It may be user-specified in a PVC. It is an indication of the amount of data that is passing over a medium. Also, bandwidth is the portion of the frequency spectrum required to transmit desired information. Each radio channel has a center frequency and additional frequencies above and below this carrier frequency which is used to carry the transmitted information. The range of frequencies from the lowest to the highest used is called the bandwidth.

BER : Bit Error Rate or Bit Error Ratio (link quality specification/testing) (BER) is a measure of transmission quality. The ratio of error bits to the total number of bits transmitted. A bit error rate of 10-6 refers to an average of one error per million bits. It is generally shown as a negative exponent, (for example, 10-7 which means 1 out of 107 bits are in error or 1 out of 10,000,000 bits are in error). Bit Error Rate is the fraction of a sequence of message bits that are in error.

BERT : Bit Error Rate Test/Tester (BERT) is a test that gauges the quality of the T1 or digital line. By sending a known pattern to another device across the span, the far end device can compare incoming pattern to its own, thereby indicating bit errors on the line.

Broadband : Broadband refers to telecommunication that provides multiple channels of data over a single communications medium, typically using some form of frequency or wave division multiplexing. It is a service or system requiring transmission channels capable of supporting rates greater than the Integrated Services Digital Network (ISDN) primary rate.

Calibration : When making measurements, the instrument must be calibrated in order to remove residual errors due to measurement setup conditions. Anritsu recommends performing the calibration under the same conditions as the measurement: temperature, frequency, number of points, source power, and IFBW. Calibrations standards with known reflection coefficients are used to calculate the correction factors. The calibration must be conducted using the appropriate standards at the open end of any test port cables and adapters that are connected to the instrument. This ensures that the match, phase length, and loss of these cables and adapters are all accounted for. For optimal performance, high quality phase-stable cables and precision adapters must be used.

Cell Site : Cell Site, also called Base Station, is the local cellular tower and radio antenna (including the radios, controller, switch interconnect, etc.) that handles communication with subscribers in a particular area or cell. A cellular network is made up of many cell sites, all connected back to the switch via landline or microwave.

Coaxial Cable : Coaxial Cable (Coax) is a type of electrical communications medium used in the LAN environment. This cable consists of an outer conductor concentric to an inner conductor, separated from each other by insulating material, and covered by some protective outer material. This medium offers large bandwidth, supporting high data rates with high immunity to electrical interference and a low incidence of errors. Coax is subject to distance limitations and is relatively expensive and difficult to install.

CW : Continuous Wave (CW)

DANL : Displayed Average Noise Level (DANL): Displayed average noise level is sometimes confused with the term Sensitivity. While related, these terms have different meanings. Sensitivity is a measure of the minimum signal level that yields a defined signal-to-noise ratio (SNR) or bit error rate (BER). It is a common metric of radio receiver performance. Spectrum analyzer specifications are always given in terms of the DANL. One of the primary uses of a spectrum analyzer is to search out and measure low-level signals. The limitation in these measurements is the noise generated within the spectrum analyzer itself. This noise, generated by the random electron motion in various circuit elements, is amplified by multiple gain stages in the analyzer and appears on the display as a noise signal. On a spectrum analyzer, this noise is commonly referred to as the Displayed Average Noise Level, or DANL 1. While there are techniques to measure signals slightly below the DANL, this noise power ultimately limits our ability to make measurements of low-level signals.

dB : Decibel or deciBel (dB) is a logarithmic ratio of the difference between two values (a logarithm ratio is equal to 10 times). dB is a unit for measuring relative power ratios in terms of gain or loss. The units of dB are expressed in terms of the logarithm to base 10 of a ratio and typically are expressed in watts. For example, a -3 dB loss indicates a 50% loss in power; a +3 dB reading is a doubling of power; 10 dB indicates an increase (or a loss) by a factor of 10; 20 dB indicates an increase (or a loss) of a factor of 100; 30 dB indicates an increase (or a loss) by a factor of 1000. Common values of dB expressed in ratios: 0 dB = 1:1, 10 dB = 10:1, 20 dB = 100:1, 30 dB = 1000:1, -30 dB = 0.001:1 [or (1/1000):1].

dBc : Decibels referenced to the carrier (dBc) is a technique for expressing a power measurement in logarithmic form using the carrier power as a reference. The units are used to describe how far down signals and noise are relative to a known signal. Typical use of this term is to describe spurious signals and noise compared to a desired transmit signal.

dBm : dBm is an absolute measurement of power relative to 1 milliwatt. In other words, dBm is a decibel value referenced to a milliWatt (dBm). This is a technique for expressing a power measurement in logarithmic form using 1 mW as a reference. dBm is a decibel ratio (log 10) of Watts (W) to one milliwatt (1mW). dBm, therefore, represents absolute power. Examples are: 0 dBm = 1.0 milliwatt, 10 dBm = 10 milliwatt, 30 dBm = 1000 milliwatt = 1 watt.

DHCP : Dynamic Host Configuration Protocol (DHCP)

DSP : Digital Signal Processing (DSP)

DTF : Distance-To-Fault (DTF) is the distance from the instrument output connector (or the end of a test lead) to a problem area, as indicated by a peak in the displayed signal. DTF measures the location and reflection size of impedance mismatches. This is typically a diagnostic measurement, not a pass/fail judgement measurement. DTF is used to identify and locate faults within an antenna system when the system is failing to meet the specified return loss or VSWR limits. DTF is also useful to verify the total length of a coaxial cable assembly.

FFT : Fast Fourier Transform (FFT) is an efficient algorithm to compute the Discrete Fourier transform (DFT) and its inverse. FFTs are of great importance to a wide variety of applications, from digital signal processing to solving partial differential equations to algorithms for quickly multiplying large integers.

Flash Memory : Flash memory is a non-volatile solid state storage device that is packaged as a chip. It can be electrically erased and reprogrammed. It is primarily used in memory cards, USB flash drives, MP3 players, and solid-state drives for general storage and transfer of data between computers and other digital products. It is a specific type of EEPROM (electrically erasable programmable read-only memory) that is erased and programmed in large blocks.

GPS : The Global Positioning System (GPS) is a space-based global navigation satellite system (GNSS) that provides reliable location and time information in all weather and at all times when and where an unobstructed line of sight is available to four or more GPS satellites. The system is maintained by the United States government and is freely accessible by anyone with a GPS receiver. The Global Positioning System is making it possible for people using ground receivers to determine their geographic location within 10 meters to 100 meters. The satellites use simple mathematical calculations to broadcast information that is translated as longitude, latitude, and altitude by Earth-based receivers.

IF : Intermediate Frequency (IF) is a frequency to which a carrier frequency is shifted as an intermediate step in transmission or reception. An intermediate electromagnetic frequency is generated by a superheterodyne radio receiver.

Impedance : Impedance is a measure of RF component electrical resistance, measured in ohms. In most cable and antenna systems, the standard impedance is 50 ohms.

Insertion Loss : Insertion Loss (or Cable Loss) is a measure of the total amount of signal energy absorbed (lost) by the cable assembly. It is measured in dB. S21 (an S-Parameter) is another name for this measurement.

IP Address : An Internet Protocol address (IP address) is usually a numerical label that is assigned to each device (computer or printer for example) that is participating in a computer network that uses the Internet Protocol for communication. An IP address serves two main functions: location addressing and host (or network) interface identification. The Internet Protocol originally defined an IP address as a 32-bit number. This was known as Internet Protocol Version 4 (IPv4), which is still in use. Growth of the Internet requires a new addressing system. An Internet Protocol Version 6 (IPv6) that uses 128 bits for the address was developed in 1995, and it is standardized as RFC 2460. IPv6 began being deployed worldwide in the year 2000. IP adresses are binary

numbers, but they are usually stored in text files and displayed in human-readable notations, such as decimal nnn.nnn.nnn.nnn or 172.16.255.1 (for IPv4), and hexadecimal nnnn.nnnn.nnnn.nnnn.nnnn.nnnn.nnnn.nnnn or 2C01:AB18:0:1234:FF03:567C:8:1 (for IPv6). In IPv4, each decimal group (nnn) represents values from 000 to 255, or binary values of 8 bits. In IPv6, each hexadecimal group (nnnn) represents values from 0000 to FFFF, or binary values of 16 bits (0000 0000 0000 0000 to 1111 1111 1111 1111).

IPv6 : Internet Protocol Version 6 (IPv6) is a numerical label that is used to identify a network interface of a computer or other network node participating in an IPV6-enabled computer network. IPv6 uses 128 bits for the address (as compared to an IPv4 address, which is defined as a 32-bit number). Pv6 was developed in 1995, and it is standardized as RFC 2460. V6 began being deployed worldwide in the year 2000. I addresses are binary numbers, but they are usually stored in text files and displayed in human-readable notations, such as hexadecimal nnnn.nnnn.nnnn.nnnn.nnnn.nnnn.nnnn.nnnn or 2C01:AB18:0:1234:FF03:567C:8:1 (where FFFF [Hex] = 65535 [Dec]). Ea hexadecimal group (nnnn) represents values from 0000 to†FFFF, or binary values of 16 bits (0000 0000 0000 0000 to 1111 1111 1111 1111).

LPA : Linear Power Amplifier (LPA) is the final amplification stage in a multicarrier transmitter that has been designed and optimized to produce a linear response. By operating in the linear mode, the amplifier reduces the non-linear effects that produce intermodulation products and side-lobe spectra that cause adjacent channel interference.

LST : Line Sweep tools (LST) is PC-based post-processing software that efficiently manipulates line sweep and PIM traces for reporting purposes.

NF : Noise Figure (NF) is a measure of degradation of the signal-to-noise ratio (SNR) that is caused by components in a radio frequency (RF) device. The noise factor (F) of a system is defined as the signal-to-noise ratio of the input power of the system divided by the signal-to-noise ratio of the output power of that system. F (the noise figure) is defined as the decibel value of the noise factor. NF = 10log (F) where log uses the base 10, or common log. This formula is valid only then the input termination is at standard noise temperature.

OBW : Occupied Bandwidth (OBW) is a measure of the bandwidth containing 99% of the total integrated power of the transmitted spectrum, centered on the assigned channel frequency. Interference to other channels or to other systems can occur if OBW is too large.

OSL : OSL or Open Short Load calibration method for coaxial line types. Calibrations standards with known reflection coefficients are used to calculate the correction factors. Refer to Calibration. Compare this with SSL or Offset Short 1, Offset Short 2, Load calibration method for waveguide line types.

OSLT : OSLT or Open Short Load Thru calibration method for coaxial line types. Calibrations standards with known reflection coefficients are used to calculate the correction factors. Refer to Calibration. Compare this with SSLT or Offset Short 1, Offset Short 2, Load, Thru calibration method for waveguide line types.

OTA : Over The Air (OTA): OTA refers generally to any transfer of information or signal that takes place in a wireless environment, rather than using a wired connection. OTA is usually used in connection with a standard defining the provisioning of mobile devices and applications, such as downloading or uploading content or software, and commonly used in conjunction with the Short Messaging Service (SMS). SMS OTA Messages contain information that is used to configure the settings of a WAP browser in a mobile phone (refer to SMS and WAP).

RBW : Resolution Bandwidth (RBW) With spectrum analyzers, a narrow band filter is swept across a frequency span to create the spectrum display. The filter bandwidth (RBW) determines the frequency resolution across the frequency axis.

Return Loss : Return Loss is a measurement (in dB) of reflected energy caused by impedance mismatch. May also be referred to as S11. Although S11 values are expressed as negative numbers, Return Loss values are expressed as positive numbers because by definition the ìLossî expression implies a negative sign. The higher the value, the better the impedance match (think of a large negative number being less than a smaller negative number). 40 dB is nearly ideal. Only 0.01 % of the total transmitted power is reflected if the Return Loss measurement value is 40 dB. A measured value of 0 dB would be a complete reflection, or stated another way, 100 % of the transmitted power is reflected back. Return Loss is typically a pass/fail measurement.

RF : Radio Frequency (RF) is the frequency of radio sine waves. RF generally refers to wireless communications within a frequency range of 3 kHz to 300 GHz. Formally, according to the Article 2 of the Radio Law, radio frequency is below 3,000 GHz. Radio frequencies can be used for communications between a mobile telephone and an antenna mast.

RSSI : Received Signal Strength Indicator (RSSI) is a measurement of the power present in a radio signal when received and measured. RSSI is useful for observing signal strength at a single frequency over time.

SCPI : Standard Commands for Programmable Instruments (SCPI)

Signal loss : Signal loss is the amount of signal strength that is lost in antenna cable, connectors, and free space. Signal loss is measured in decibels.

Smith Chart : A Smith Chart is a graphical aid for electrical and electronics characteristics in radio frequency (RF) circuits. Smith Chart was invented by Phillip Smith at Bell Laboratories in 1939. The chart can be used to display multiple parameters, such as impedance, and admittance.

SOLT : SOLT or Short Open Load Thru calibration method for coaxial line types with simple and redundant standards. It is not band-limited. It requires well-defined standards. It has lower accuracy at higher frequencies. Calibrations standards with known reflection coefficients are used to calculate the correction factors. Refer to Calibration. Compare this with SSLT or Offset Short 1, Offset Short 2, Load, Thru calibration method for waveguide line types.

S-parameter : S-parameters are scattering parameters, and are a signal ratio of reflection and transmission measurements. For a 2-port network, four fundamental S-parameters can be measured, and they are defined as Sxy (where x and y are subscripts of S). The first number (x) is the port number into which the signal is being injected, and the second number (y) is the port number from which the signal is leaving. The S-parameter is the ratio of these two signals. S11 is Forward Reflection. S21 is Forward Transmisssion. S12 is Reverse Transmission. S22 is Reverse Reflection.

SSL : SSL or Short Short Load or Offset Short 1, Offset Short 2, Load calibration method for waveguide line types uses Shorts with different offset lengths. It is a calibration (common in waveguide) with simple and redundant standards, but it is band-limited. It requires well-defined standards. It has lower accuracy at higher frequencies. Offset Short 1 is 1/8 wavelength, and Offset Short 2 is 3/8 wavelength. Calibrations standards with known reflection coefficients are used to calculate the correction factors. Refer to Calibration. Compare this with OSL or Open Short Load calibration method for coaxial line types.

SSLT : SSLT or Short Short Line Thru or Offset Short 1, Offset Short 2, Load, Thru calibration method for waveguide line types uses Shorts with different offset lengths. It is a calibration (common in waveguide) with simple and redundant standards, but it is band-limited. It requires well-defined standards. It has lower accuracy at higher frequencies. Offset Short 1 is 1/8 wavelength, and Offset Short 2 is 3/8 wavelength. Calibrations standards with known reflection coefficients are used to calculate the correction factors. Refer to Calibration. Compare this with OSLT or Open Short Load Thru calibration method for coaxial line types.

TMA : A Tower Mounted Amplifier (TMA) amplifies signals from an antenna to reduce the signal to noise ratio of a base transceiver station (BTS). This helps to improve the overall sensitivity of the BTS. A TMA is a low-noise amplifier (LNA) that is usually mounted as close as practical to the antenna in Base Transceiver Stations or in mobile masts. When using a TMA, the antenna is able to receive weaker signals.

VSWR : Voltage Standing Wave Ratio (VSWR). VSWR is another method to measure reflected energy caused by impedance mismatch. It is expressed as a ratio of X:1. VSWR measures the voltage peaks and valleys. A ratio of 1:1 would be a perfect match. A typical cable and antenna system would be around 1.43:1 (VSWR) or 15 dB Return Loss.

Watt : Watt (W) is a unit of measure for power.

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