User Guide

Anritsu

VNA Master™

MS2026C, MS2028C
Handheld Vector Network Analyzer

MS2036C, MS2038C
Handheld Vector Network Analyzer
plus Spectrum Analyzer

User Guide

VNA Master™
Model MS20xxC

MS2026C Vector Network Analyzer 5 kHz to 6 GHz

MS2028C Vector Network Analyzer 5 kHz to 20 GHz

MS2036C Vector Network Analyzer
VNA Frequency: 5 kHz to 6 GHz
SPA Frequency: 9 kHz to 9 GHz

MS2038C Vector Network Analyzer 5 kHz to 20 GHz
VNA Frequency: 5 kHz to 20 GHz
SPA Frequency: 9 kHz to 20 GHz

Anritsu Company
490 Jarvis Drive
Morgan Hill, CA 95037-2809
USA

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DECLARATION OF CONFORMITY

Manufacturer's Name: ANRITSU COMPANY

Manufacturer's Address: Microwave Measurements Division
490 Jarvis Drive
Morgan Hill, CA 95037-2809
USA

declares that the product specified below:

Product Name: **VNA Master**

Model Numbers: MS2026C, MS2028C, MS2036C, MS2038C

conforms to the requirement of:

EMC Directive:	2004/108/EC
Low Voltage Directive:	2006/95/EC

Electromagnetic Compatibility: EN61326:2006

Emissions:	EN55011: 2007 Group 1 Class A	
Immunity:	EN 61000-4-2:1995 +A1:1998 +A2:2001	4 kV CD, 8 kV AD
	EN 61000-4-3:2006 +A1:2008	3 V/m
	EN 61000-4-4:2004	0.5 kV S-L, 1 kV P-L
	EN 61000-4-5:2006	0.5 kV L-L, 1 kV L-E
	EN 61000-4-6: 2007	3 V
	EN 61000-4-11: 2004	100% @ 20 ms

Electrical Safety Requirement:

Product Safety: EN 61010-1:2001

Eric McLean, Corporate Quality Director

Morgan Hill, CA

6 AUG 2010
Date

European Contact: For Anritsu product EMC & LVD information, contact Anritsu LTD, Rutherford Close, Stevenage Herts, SG1 2EF UK, (FAX 44-1438-740202)

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N274

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印刷线路板 (PCA)	×	○	×	×	○	○
机壳、支架 (Chassis)	×	○	×	×	○	○
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To prevent the risk of personal injury or loss related to equipment malfunction, Anritsu Company uses the following symbols to indicate safety-related information. For your own safety, please read the information carefully *before* operating the equipment.

Symbols Used in Manuals

Danger

This indicates a very dangerous procedure that could result in serious injury or death, or loss related to equipment malfunction, if not performed properly.

Warning

This indicates a hazardous procedure that could result in light-to-severe injury or loss related to equipment malfunction, if proper precautions are not taken.

Caution

This indicates a hazardous procedure that could result in loss related to equipment malfunction if proper precautions are not taken.

Safety Symbols Used on Equipment and in Manuals

The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions *before* operating the equipment. Some or all of the following five symbols may or may not be used on all Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.

This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.

This indicates a compulsory safety precaution. The required operation is indicated symbolically in or near the circle.

This indicates a warning or caution. The contents are indicated symbolically in or near the triangle.

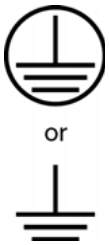
This indicates a note. The contents are described in the box.

These indicate that the marked part should be recycled.

Warning

Always refer to the operation manual when working near locations at which the alert mark, shown on the left, is attached. If the operation, etc., is performed without heeding the advice in the operation manual, there is a risk of personal injury. In addition, the equipment performance may be reduced. Moreover, this alert mark is sometimes used with other marks and descriptions indicating other dangers.

Warning



When supplying power to this equipment, connect the accessory 3-pin power cord to a 3-pin grounded power outlet. If a grounded 3-pin outlet is not available, use a conversion adapter and ground the green wire, or connect the frame ground on the rear panel of the equipment to ground. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock.

Warning

This equipment cannot be repaired by the operator. Do not attempt to remove the equipment covers or to disassemble internal components. Only qualified service technicians with a knowledge of electrical fire and shock hazards should service this equipment. There are high-voltage parts in this equipment presenting a risk of severe injury or fatal electric shock to untrained personnel. In addition, there is a risk of damage to precision components.

Caution

Electrostatic Discharge (ESD) can damage the highly sensitive circuits in the instrument. ESD is most likely to occur as test devices are being connected to, or disconnected from, the instrument's front and rear panel ports and connectors. You can protect the instrument and test devices by wearing a static-discharge wristband. Alternatively, you can ground yourself to discharge any static charge by touching the outer chassis of the grounded instrument before touching the instrument's front and rear panel ports and connectors. Avoid touching the test port center conductors unless you are properly grounded and have eliminated the possibility of static discharge.

Repair of damage that is found to be caused by electrostatic discharge is not covered under warranty.

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Chapter 1 — General Information

1-1 Introduction

This chapter covers general information that includes a description, optional accessories, preventive maintenance, ESD verifications, and calibration requirements for the VNA Master model MS20xxC. Throughout this manual, the terms VNA Master and MS20xxC refer to the Anritsu MS2026C, MS2028C, MS2036C, and MS2038C Vector Network Analyzers.

MS2026C VNA Frequency Range: 5 kHz to 6 GHz

MS2028C VNA Frequency Range: 5 kHz to 20 GHz

MS2036C VNA Frequency Range: 5 kHz to 6 GHz

SPA Frequency Range: 9 kHz to 9 GHz

MS2036C VNA Frequency Range: 5 kHz to 20 GHz

SPA Frequency Range: 9 kHz to 20 GHz

1-2 Additional Documents

This user guide is specific to the VNA Master MS20xxC (models MS2026C, MS2028C, MS2036C, and MS2038C), Additional instrument functions and descriptions of optional measurement capabilities are described in measurement guides.

Refer to Appendix A, "Measurement Guides" for a list of these guides and their Anritsu part numbers. Measurement guides are provided on the document disk that is shipped with each instrument. Measurement guides are also available for download (at no charge) from the VNA Master Web page. Refer to Section 1-11 "Anritsu Reference Documents" on page 1-7.

Refer to Chapter 3, "Instrument Options" for a list of options and their documentation.

General and performance specifications, instrument options, standard accessories, and optional accessories are described in the VNA Master Technical Data Sheet, Anritsu part number 11410-00548.

1-3 VNA Master Specifications

Refer to the VNA Master Technical Data Sheet (part number 11410-00548) for general specifications, detailed measurement specifications for all available measurement modes, ordering information, power sensors, and available accessories. The Technical Data Sheet is included with the instrument and is also available on the document disk that is shipped with each instrument. It is also available on the Anritsu Website: http://us.anritsu.com.

1-4 Identifying the Connections

The VNA Master MS2026C and MS2028C have the connectors shown in Figure 1-1.For details, refer to Figure 2-13 on page 2-20.

Figure 1-1. MS202xC Connectors

The VNA Master MS2036C and MS2038C have the connectors shown in Figure 1-2.For details, refer to Figure 2-14 on page 2-21

Figure 1-2. MS203xC Connectors

Model MS202xC physical characteristics:

Size: 31.5 x 21.1 x 7.82 cm (12.4 x 8.3 x 3.1 in.)

Weight: 4.5 kg (9.9 lbs)

Model MS203xC physical characteristics:

Size: 31.5 x 21.1 x 9.7 cm (12.4 x 8.3 x 3.8 in.)

Weight: 4.8 kg (10.7 lbs)

1-5 Description

The Anritsu VNA Master instruments are portable handheld vector network analyzers (VNAs) featuring precise performance and essential RF capabilities. These VNA Master instruments are designed to conduct accurate vector-corrected 1-port magnitude, phase, and fault location measurements and 2-port magnitude, phase, and group delay measurements from 5 kHz to 20 GHz. The MS203xC models add Spectrum Analyzer capabilities that provide quick and accurate measurement results for monitoring, measuring, and analyzing signal environments. The Spectrum Analyzer offers broad spectrum analysis with frequency coverage to 20 GHz, impressive dynamic range, and excellent phase noise performance. Standard measurements include field strength, occupied bandwidth (OBW), channel power, adjacent channel power ratio (ACPR), and carrier to interference (C/I) ratio.

This one instrument provides all essential RF capabilities in a portable, high-performance platform.

Measurements:

S-parameters, magnitude, phase, real, imaginary, SWR, Cable Loss, group delay, Smith Chart, time domain, distance domain, field strength, occupied bandwidth, channel power, adjacent channel power ratio, carrier to interference (C/I) ratio.

1-6 Soft Carrying Case and Tilt Bail

The soft carrying case for the MS202xC is part number 65729. The soft carrying case for the MS203xC is part number 65681. The tilt bail is factory-installed on the VNA Master for use with or without the soft carrying case.

VNA Master Soft Carrying Case

The MS20xxC can be operated while in the soft carrying case. On the back of the case is a large storage pouch for accessories and supplies.

To install the MS20xxC into the soft carrying case, perform the following:

1. The front panel of the case is secured with hook and loop fasteners. Fully open the front panel of the case.
2. Place the soft carrying case face down on a stable surface, with the front panel fully open and laying flat.
3. Fully open the zippered back of the case.

Note	Two zippers are located around the back of the case. The zipper closer to the MS20xxC compartment of the case opens the case back and allows access to install and remove the MS20xxC. The other zipper closer to the back of the case opens a support panel that can be used to provide support for improved stability and air flow while in the case. This support panel also contains the storage pouch.

4. Insert the MS20xxC face down into the case, taking care that the connectors are properly situated in the case top opening. Figure 1-3 shows the MS20xxC in the case.

Figure 1-3. Instrument Inserted Into the Soft Carrying Case

5. Close the back panel and secure it with the zipper .

Figure 1-4. VNA Master Installed in Soft Case

The soft carrying case includes a detachable shoulder strap that can be connected to the D-rings on the upper corners of the case as required for comfort or convenience. The velcro strap acts as a tilt bail when using the soft case as shown in Figure 1-4.

VNA Master Tilt Bail Stand

The supplied Tilt Bail can be used for desktop operation. The tilt bail provides a backward tilt for improved stability and air flow. Refer to Figure 1-5.

To deploy the tilt bail, pull the bottom of the tilt bail away from the back of the unit.

Figure 1-5. Tilt Bail Extended on VNA Master

To store the tilt bail, push the bottom of the bail toward the back of the unit and snap the bottom of the bail into the clip on the back of the unit.

1-7 Preventive Maintenance

VNA Master preventive maintenance consists of cleaning the unit and inspecting and cleaning the RF connector on the instrument and all accessories. Clean the VNA Master with a soft, lint-free cloth dampened with water or 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 N(f) and K(f) connectors and the pins of N(m) and K(m) connectors should be unbroken and uniform in appearance. If you are unsure whether the connectors are good, then gauge the connectors to confirm that their dimensions are correct. Type K(f) test port connectors are available with Option 11.

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

1-8 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 or SSLT, for example) must be performed prior to making a measurement in the field.

The VNA Master has no field-adjustable components. The RF (OSLT, SSLT, and SSST) calibration components, however, are crucial to the integrity of the calibration and should 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 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.

1-9 Annual Verification

Anritsu recommends an annual calibration and performance verification of the VNA Master and the calibration components by local Anritsu service centers. Anritsu service centers are listed our web site at www.anritsu.com.

1-10 ESD Cautions

The VNA Master, like other high performance instruments, is susceptible to ESD damage. Coaxial cables and antennas can easily build up a static charge, which (if allowed to discharge by connecting directly to the VNA Master without first discharging the static charge) may damage the instrument input circuitry. Operators must be aware of the potential for ESD damage and must 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 standards 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 these standards helps to ensure that a safe environment exists for both personnel and equipment.

1-11 Anritsu Reference Documents

The following URL is an Internet link to the VNA Master product page.

VNA Master product page link: http://www.anritsu.us/vnamaster

A table at the bottom of each VNA Master web page presents Internet links to related literature and software. Examples include the following types of documents:

- Application Notes
- Brochures
- Data Sheets
- Instruction Sheets
- Technical Notes
- White Papers
- Measurement Guides
- Master Software Tools

1-12 Anritsu Service Centers

For the latest service and sales information in your area, please visit the following URL:

http://www.anritsu.com/Contact.asp

and choose a country for regional contact information.

1-13 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. Slide the battery door down (towards the bottom of the instrument) to remove the door. Remove the battery pack from the instrument by pulling straight out on the battery lanyard. Replacement is the opposite of removal.

1	Battery Compartment Door

Figure 1-6. MS20xxC VNA Master Battery Compartment Door

The battery that is supplied with the VNA Master may need charging before use. The battery can be charged in the VNA Master by using either the AC-DC Adapter (40-168-R) or the 12 Volt DC adapter (806-141-R), or can be charged separately in the optional Dual Battery Charger (2000-1374).

Caution	When using the Automotive Cigarette Lighter 12 VDC Adapter, Anritsu Part Number 806-141, 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, then discontinue use immediately.

Caution	Use only Anritsu approved batteries, adapters and chargers with these instruments.

Chapter 2 — Quick Start Guide

2-1 Introduction

This chapter provides a brief overview of the Anritsu MS20xxC VNA Master handheld Vector Network Analyzer. The intent of this chapter is to provide you with a starting point for making basic measurements. For more detailed information, refer to the specific measurement mode chapters in this manual.

2-2 Turning the VNA Master On for the First Time

The Anritsu VNA Master is capable of greater than two hours of continuous operation from a fully charged, field-replaceable battery (refer to "Battery Replacement" on page 1-8 in Chapter 1, "General Information"). The VNA Master can also be operated from a 12 VDC source (which also simultaneously charges the battery). This can be achieved with either the Anritsu AC-DC Adapter (Anritsu part number 40-168-R) or 12 VDC Automotive Cigarette Lighter Adapter (Anritsu part number 806-141-R). Both items are included as standard accessories (refer to the Standard and Optional Accessories in the Technical Data Sheet for your instrument, as listed in Appendix A).

Caution	When using the Automotive Cigarette Lighter 12 VDC Adapter, Anritsu Part Number 806-141-R, 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, then discontinue use immediately.

To turn on the VNA Master, press the **On/Off** front panel button (Figure 2-1).

1	On/Off Button

Figure 2-1. VNA Master On/Off Button (MS2028C shown)

The VNA Master requires approximately thirty-five seconds to complete the power-on cycle and load the application software. At the completion of this process, the instrument is ready to use.

The VNA Master performs a self test during each power-on cycle. If the self test fails, then refer to "Self Test or Application Self Test Error Messages" on page C-2 in Appendix C, "Error Messages". For maximum accuracy, letting the instrument warm up for approximately 15 minutes is a good practice before performing a calibration.

2-3 Front Panel Overview

The VNA Master menu-driven flexible interface is intuitive and easy to use. Hard keys on the front panel are used to initiate function-specific menus. Five function hard keys (unlabeled) are located below the display. These keys vary in function depending upon the current mode of operation. If a function hard key has no function in the current mode, then the key label in the measurement display area is blank adjacent to that key.

Note	Users who are familiar with the operation of previous VNA Master instruments will find that those menus are quite different from the menus for this current MS20xxC VNA Master. Some menus are the same, but those related to measurement setups and sweeps are very different. The intent with the MS20xxC is to provide you with more flexibility and choice in measurement configurations even if these choices result in configurations that are not very practical (such as the overlay of a Smith Chart on top of a rectilinear chart).

Located to the right of the display, the VNA Master has eight soft keys (unlabeled buttons), hard keys, arrow keys, and a rotary knob. The locations of all of the keys are shown in Figure 2-2.

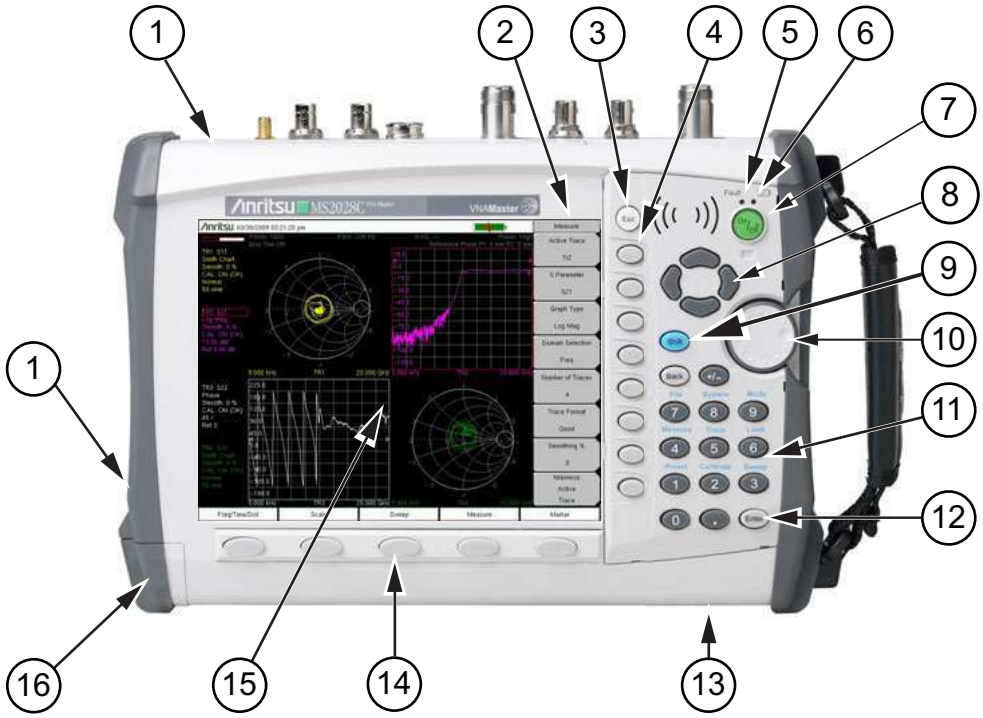
Nine of these hard keys (the number keys 1 through 9) are dual purpose, depending upon the current mode of operation. The dual-purpose keys are labeled with a number on the key itself and with the alternate function printed in blue (same color as the **Shift** key) on the panel above the key. Use the **Shift** key to access the functions printed on the panel above the number keys.

The eight soft keys (unlabeled buttons) are located adjacent to the right edge of the measurement display screen (or sweep window). These eight soft keys change function depending upon the current mode of operation and the menu selection. The current soft key function is indicated at the top of the active function block, which is located within the measurement display screen (or sweep window). The active function block displays a label for each active soft key. If a soft key has no function in the current mode, then the active function block display is blank adjacent to that soft key.

The **Escape** key (labeled **Esc** and used for aborting data entry) is the round button located above the eight (unlabeled) soft keys.

The rotary knob and the keypad (and sometimes the arrow keys) can be used to change the value of an active parameter. The rotary knob can also be pressed to duplicate the action of the **Enter** key.

Front Panel Overview Image



1	Fan Exhaust Ports
2	Active Function Block or Soft Key Menu
3	Escape Key
4	Soft Keys (8 buttons)
5	Charge Fault LED
6	Battery Charge LED
7	On/Off Key
8	Directional Arrow Keys
9	Shift Key
10	Rotary Knob
11	Number Keypad
12	Enter Key
13	Fan Inlet Port
14	Function Hard Keys (5 buttons)
15	Measurement Display Screen (or Sweep Window)
16	Battery Compartment

Figure 2-2. Front Panel Overview

Other Features on the Front Panel

Battery Charge LED (Green)

The green Battery Charge LED (Figure 2-2, item 6) will flash if the battery is charging and will remain on and steady when the battery is fully charged.

Charge Fault LED (Red)

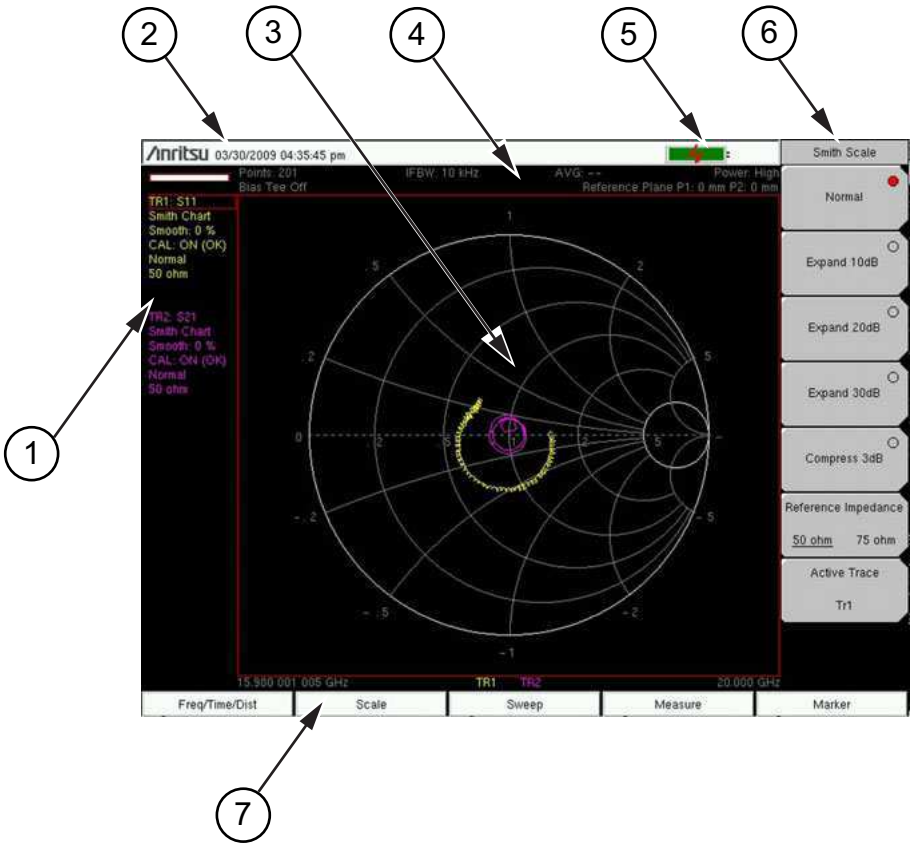
The red Charge Fault LED (Figure 2-2, item 5) will remain on and steady under a battery charger fault condition. Fault conditions include a battery cell voltage that is too low to charge, or a battery temperature outside the acceptable temperature range (–5° C to +50° C) to charge.

Fan Inlet and Exhaust Ports

The fan inlet (Figure 2-2, item 13) and exhaust ports (Figure 2-2, item 1) must be kept clear of obstructions at all times for proper ventilation and cooling of the instrument.

2-4 Typical Vector Network Analyzer Display

Figure 2-3 illustrates some of the key information areas of the vector network analyzer display screen on the VNA Master MS20xxC. The measurement and the display type that are illustrated here may not be the same as currently shown on your instrument. The purpose of the figure is to show the general areas of the display, which are labeled in the figure. Refer to Chapter 6, "VNA Menus" for more detailed soft key descriptions.



1	Instrument Settings Summary (unique to each trace)
2	Real Time Clock
3	Measurement Display Area (or Sweep Window)
4	Instrument Settings Summary (applies to all traces)
5	Battery Charge Indicator
6	Soft Key Labels (or Active Function Block)
7	Function Hard Key Labels

Figure 2-3. Vector Network Analyzer Smith Chart Display

The MS20xxC features a versatile new display option for better measurement convenience. Because the VNA Master measures all four S-parameters simultaneously, with fully-reversing test signals at both Port 1 and Port 2, the measurement display provides up to 4 simultaneous window images. As shown in Figure 2-4, each one of the S-parameters could be displayed in its own quarter window. Additionally, the display could be divided into three, two, or one graph areas. An example of four S-parameters overlaid onto one graph area is shown in Figure 2-5.

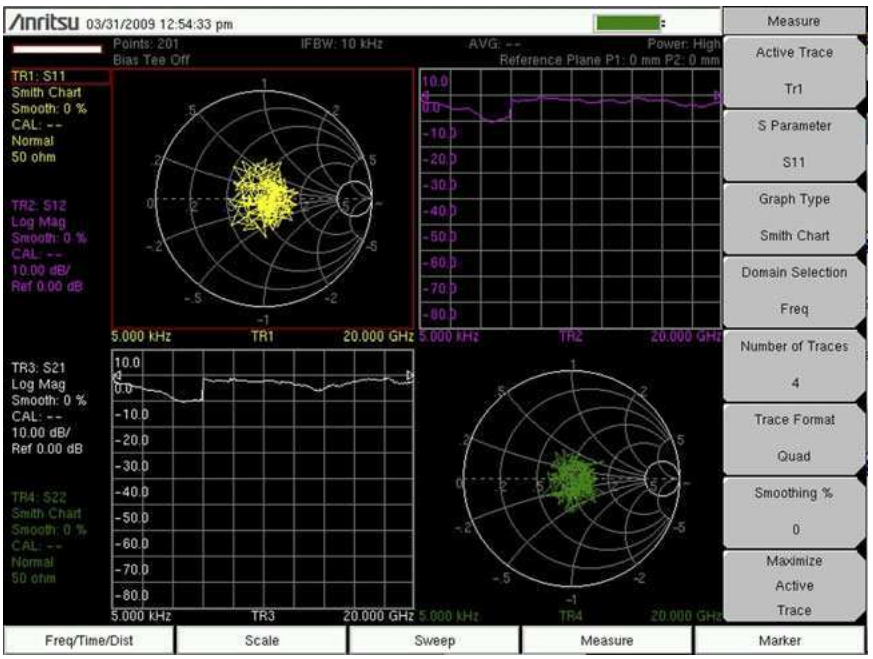


Figure 2-4. 4 Traces in 4 Window Images (Quad Trace Format)

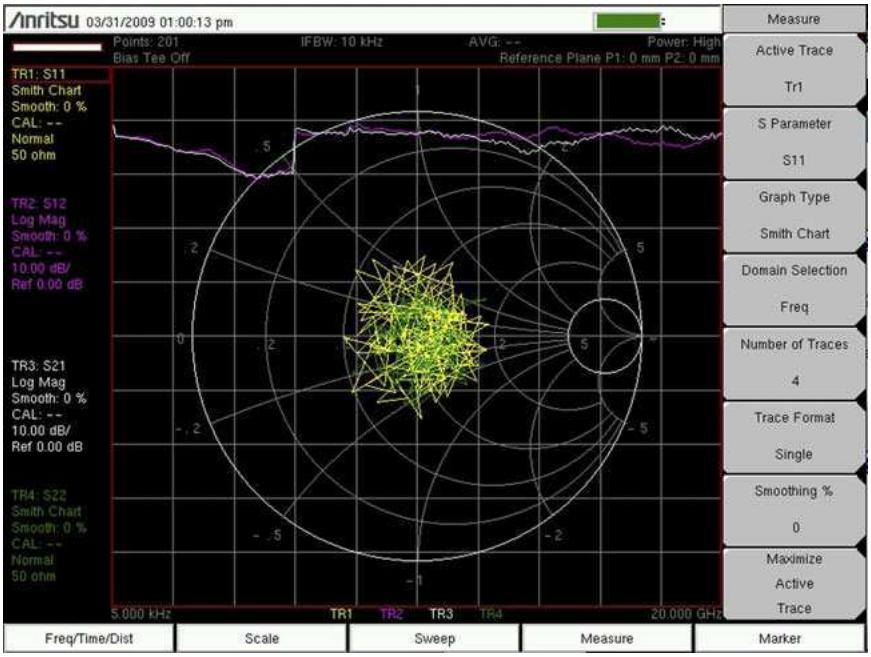
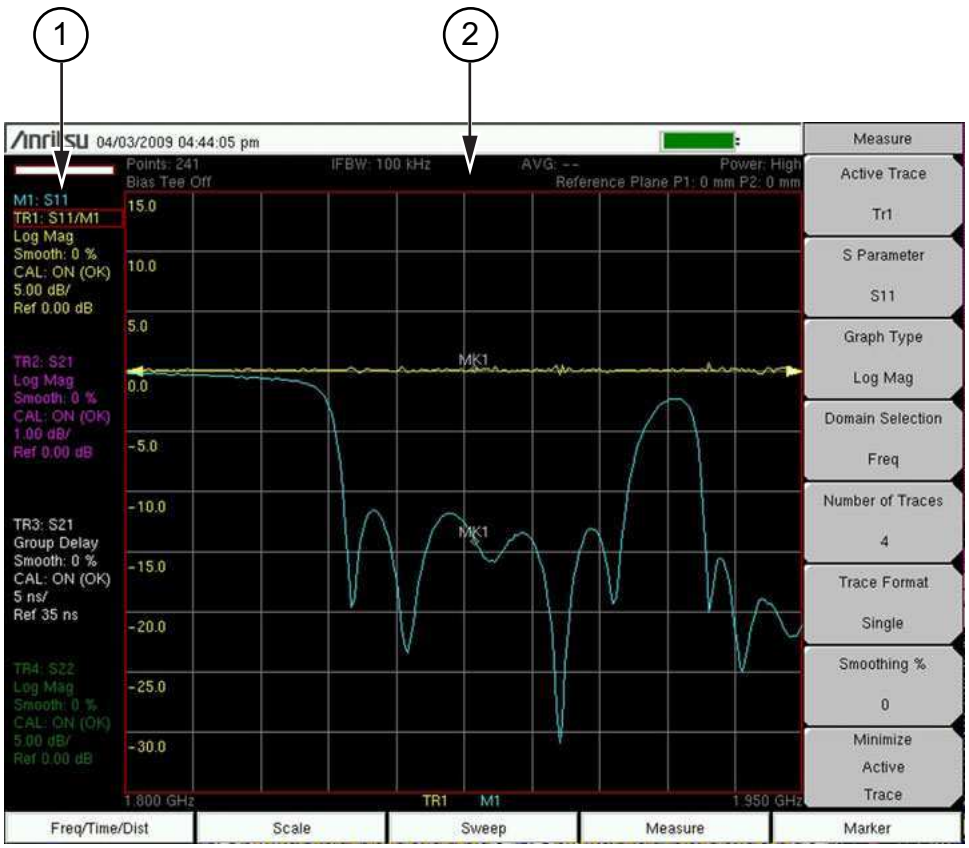


Figure 2-5. 4 Traces in 1 Window Image (Single Trace Format)

Instrument Settings Summary

The instrument settings that apply to all traces are summarized in the top two rows of the measurement display screen (refer to item 2 in Figure 2-6). The summary includes the Number of Points, the IF Bandwidth, the Averaging count, the Port Power level, and the Bias Tee status, all of which apply to both ports. The summary also includes the Reference Plane Extension values, which differ for each port.



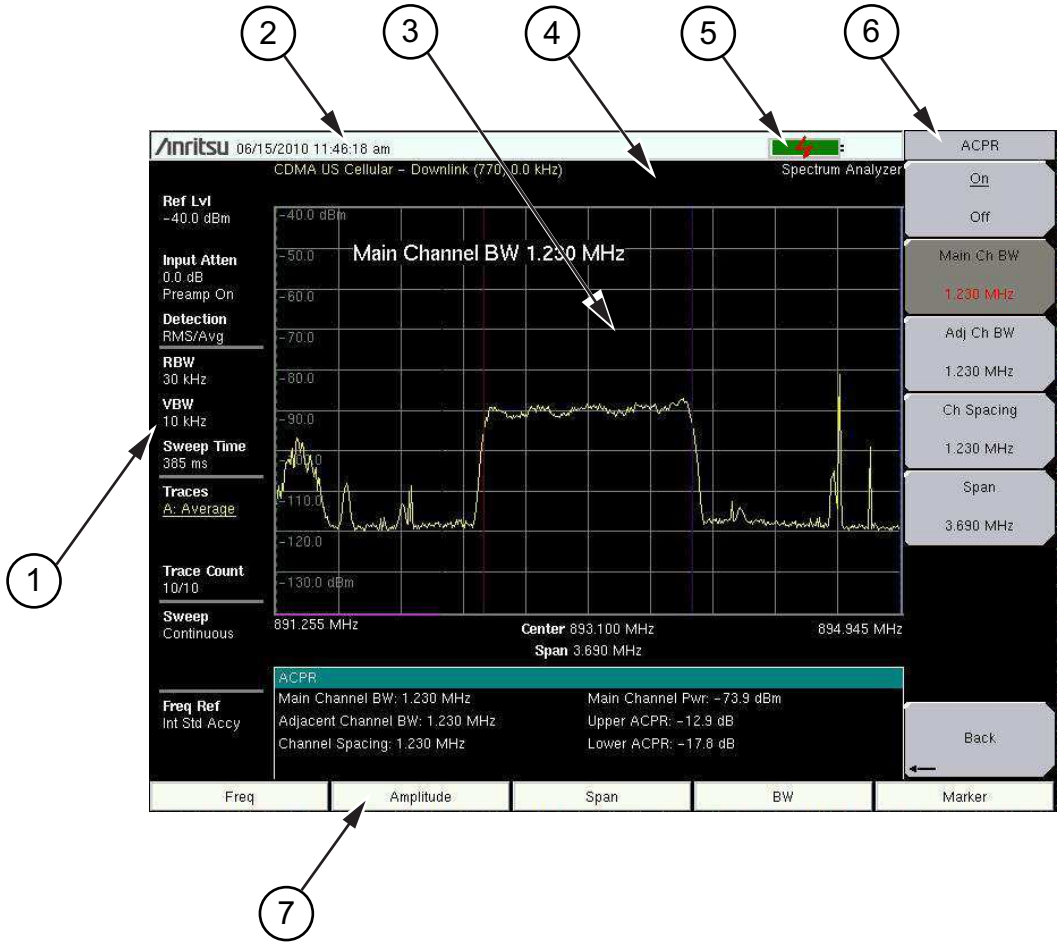
1	Instrument Settings Summary (unique to each trace)
2	Instrument Settings Summary (applies to all traces)

Figure 2-6. Instrument Settings Summary on Measurement Display Screen

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 2-6). Each block contains the trace number followed by the S-parameter that is assigned to that trace (**TR4: S22**, 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**).

2-5 Typical Spectrum Analyzer Display

Figure 2-7 illustrates some of the key information areas of the spectrum analyzer display screen on the VNA Master MS20xxC. The measurement and the display type that are illustrated here may not be the same as currently shown on your instrument. The purpose of the figure is to show the general areas of the display, which are labeled in the figure. Refer to the Spectrum Analyzer Measurement Guide for more detailed soft key descriptions. Measurement Guide part numbers are listed in Table A-1, “Measurement Guides” on page A-1



1	Instrument Settings Summary (unique to each trace)
2	Real Time Clock
3	Measurement Display Area (or Sweep Window)
4	Instrument Settings Summary (applies to all traces)
5	Battery Charge Indicator
6	Soft Key Labels (or Active Function Block)
7	Function Hard Key Labels (specific to instrument Mode settings)

Figure 2-7. Typical Spectrum Analyzer Display Screen

2-6 Front Panel Keys

The term hard key refers to all of the buttons on the instrument face except for the vertical row of gray buttons adjacent to the measurement display. These eight gray buttons are called soft keys, and they are used to activate virtual soft key buttons within the measurement display screen. This soft key display area (soft key menu) is also called the active function block. Refer to Figure 2-2 (item 2) and Figure 2-3 (item 6) and Figure 2-7 (item 6).

Esc Key

Pressing this key cancels any setting that is currently being made. Refer to Figure 2-2 (item 3). The **Esc** key is located directly above the eight soft keys.

Enter Key

Press this key to finalize data input. Pressing the rotary knob performs this same function. Refer to Figure 2-2 (item 12). The **Enter** key is located directly below the Number **3** key in the number keypad.

Arrow Keys

The four arrow keys (between the rotary knob and the **Esc** key) are used to scroll up, down, left, or right. Refer to Figure 2-2 (item 8). The arrow keys can often be used to change a value or to change a selection from a list. This function is similar to the function of the rotary knob. The arrow keys are also used to move markers.

Shift Key

Pressing the **Shift** key (refer to Figure 2-2, item 9 and Figure 2-8) and then a number key executes the function that is indicated in blue text above the number key. When the **Shift** key is pressed (when it is active), its icon is displayed in the upper right corner of the measurement display area between the battery charge indicator and the soft key menu label.

Figure 2-8. Shift Key Icon

Back Key

Press this key to delete only one character, one number, or the range that is specified by the cursor. The **Back** key is located directly above the Number **7** key in the number keypad.

Plus/Minus (+/–) Key

Press this key to change the sign of numbers that are entered with the number keys. The **Plus/Minus (+/-)** key is located directly above the Number **8** key in the number keypad.

Number Keypad

These keys are used to directly input numbers.

Rotary Knob

Turning the rotary knob (refer to Figure 2-2, item 10) 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. Markers are moved within the sweep window.

Pressing this knob finalizes the input function in the same manner as pressing the **Enter** key.

Function Hard Keys

These five function keys (refer to Figure 2-2, item 14) are horizontally arranged adjacent to the measurement display screen along the lower edge. These buttons have no labels. As with the soft keys, they are positioned to accompany virtual key labels that are displayed to match instrument modes and functions. These function hard key labels change to match specific instrument Mode settings. Each Mode uses a specific set of Function Hard Keys. For details about selecting the Mode, refer to the Section "Mode Selector" on page 2-19. In some manuals, such as Measurement Guides, the Function Hard Keys are referred to as Main Menu Keys.

Soft Keys

These eight gray keys have no labels (refer to Figure 2-2, item 4). They are arranged adjacent to the measurement display screen along the right-hand edge. They are positioned to accompany virtual soft key labels that are displayed to match instrument modes and measurement functions. These soft key labels (also called the Active Function Block) change as instrument measurement settings change. In some manuals, such as Measurement Guides, the Soft Keys are referred to as Submenu Keys.

The following Section 2-7 "Soft Key Types" describes how these keys are used:

2-7 Soft Key Types

Select

A **Select** soft key has a small circle in the upper right corner of the virtual key face and is used to select the function or item that is displayed on the virtual soft key label. When not selected, the circle is gray. When selected, the circle is red to indicate that the function is active.

Press the key to make the selection. Press a different key to make a different selection.

A **Select** soft key may also be a **Switching** soft key. Switching soft keys show both a gray circle and an arrow mark (-->).

A **Select** soft key may change to a **Switching** soft key when active. These keys show only the gray circle when not active, but show the arrow mark as well as the red circle when active. Refer to section "Switching" on page 2-14.

Input

An **Input** soft key is used to select an item or a value. This type of soft key displays the setting parameter and the setting value on the virtual key face. When the key is pressed, a select box or edit box may open on the display screen, or the key face may turn a darker gray color to show that the setting is being made. At any time before finalizing the input, press the escape (**Esc**) key to abort the change and retain the previously existing setting.

To set or select an item or a value, use the number keys, the arrow keys, or the rotary knob. Press the rotary knob or the **Enter** key to finalize data input. If a value is being selected or entered, then the soft key Active Function Block may change to provide one or more soft keys for units, such a Hz or dB. Pressing a unit soft key sometimes finalizes the data input in the same manner as pressing the **Enter** key. If more than one unit key is displayed, then pressing the **Enter** key without first pressing a unit key selects a specific unit by default. The specific default units are described along with soft key descriptions that are included in the analyzer chapters and the Measurement Guides.

With some functions, only a specific set of values are valid. When scrolling with the **Up/Down** arrow keys or the rotary knob, only valid values are offered. If different values are set with the number keypad, then those values might not be accepted. Even if different values are accepted on the soft key face, the values may not be valid for the selected measurement. Your knowledge of measurement functions must be used to determine acceptable values.

Toggle

A **Toggle** soft key displays the setup item and the toggle states. Toggle states may be On and Off or may be a selection of types or values such as Reference Impedance: 50 ohm or 75 ohm.

Each press of the **Toggle** soft key moves the selection to the next value or item in sequence. The selected item or value is underlined on the virtual key face.

Switching

A **Switching** soft key is used to open an additional soft key menu, and it has an arrow mark (-->) in the lower right corner of the virtual key face.

Some **Select** soft keys become **Switching** soft keys after being pressed (after becoming active). These keys may not display the arrow mark until they are active (their circle is red). An additional press, after the circle is red and the arrow mark is displayed, opens the additional soft key menu. Refer to section "Select" on page 2-13.

The **Switching** soft key that is labeled More opens a menu with additional soft key functions. The **Switching** soft key that is labeled Back returns to a previous soft key menu. The Back key has the arrow mark (<--) in the lower left corner of the virtual key face.

2-8 Parameter Setting

Pop-up list boxes, edit boxes, and dialog boxes are used to provide selection lists and selection editors. Scroll through a list of items or parameters with the arrow keys or the rotary knob. Select numerical values by scrolling with the arrow keys or rotary knob or by entering the digits directly from the number keypad. These list boxes and edit boxes frequently display a range of possible values or limits for possible values.

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

Some parameters (such as the list of cable parameters) can be added to list boxes by creating them and importing them through the use of Master Software Tools.

2-9 Text Entry

When entering text (as when saving a measurement) the soft key menu for Text Entry displays the characters (alphabet, hyphen, and underscore) in groups of 6 letters per soft key. Characters can be entered by using the rotary knob, the arrow keys, or the soft keys.

The rotary knob scrolls through the characters in a pop-up window and is pressed to select each character in sequence.

Alternatively, press the a b c / d e f soft key (for example) to open another soft key menu with a separate key for each of these letters. The menu returns to the complete character set after each individual letter is entered.

Use the arrow keys to navigate within a name or character string. Use the **Shift** key for capital letters. Press the **Enter** key or the rotary knob to finalize a text entry.

Refer to Figure 2-9, Figure 2-10, and Figure 2-11.

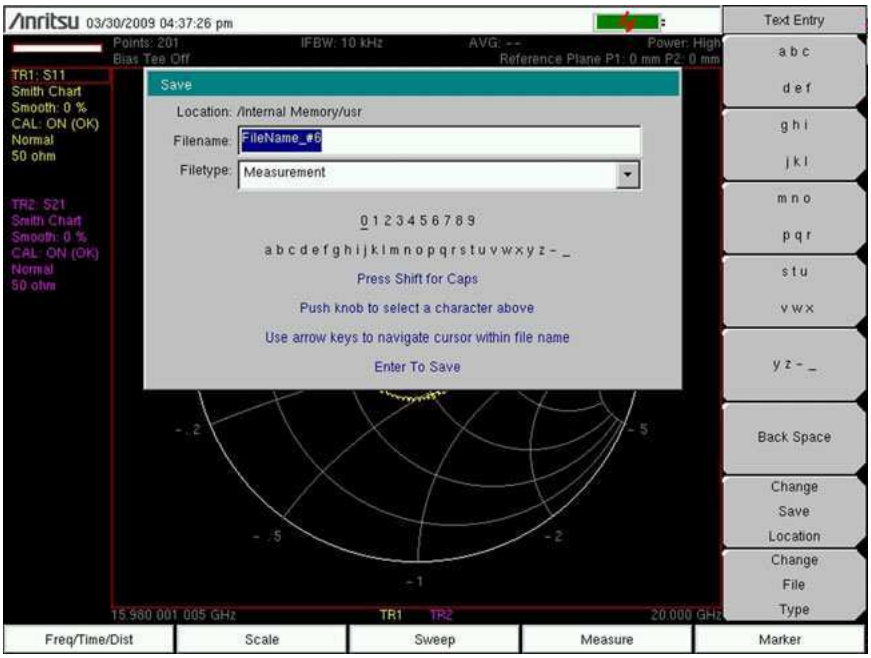


Figure 2-9. Text Entry Menu – Lower Case

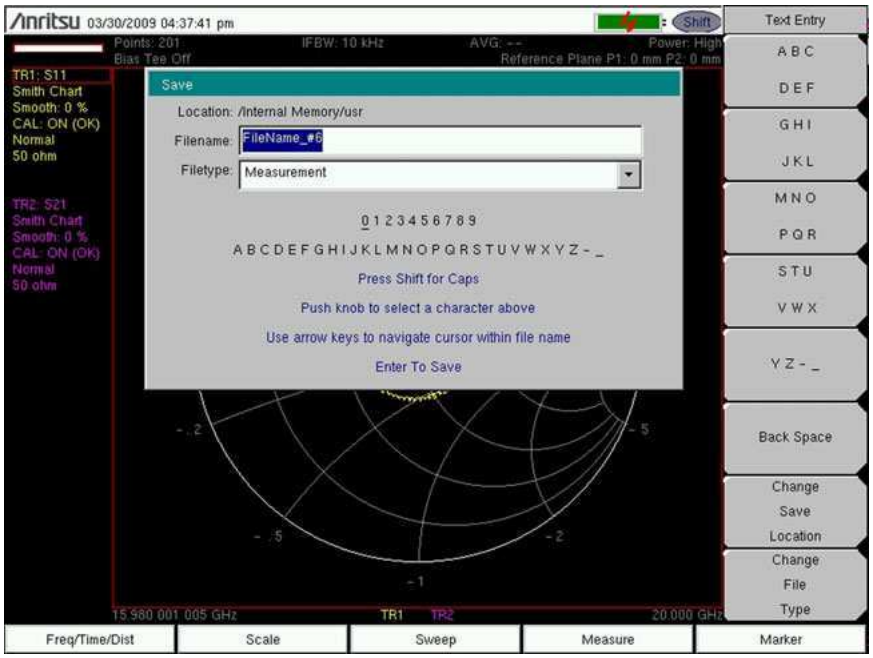


Figure 2-10. Text Entry Menu – Upper Case

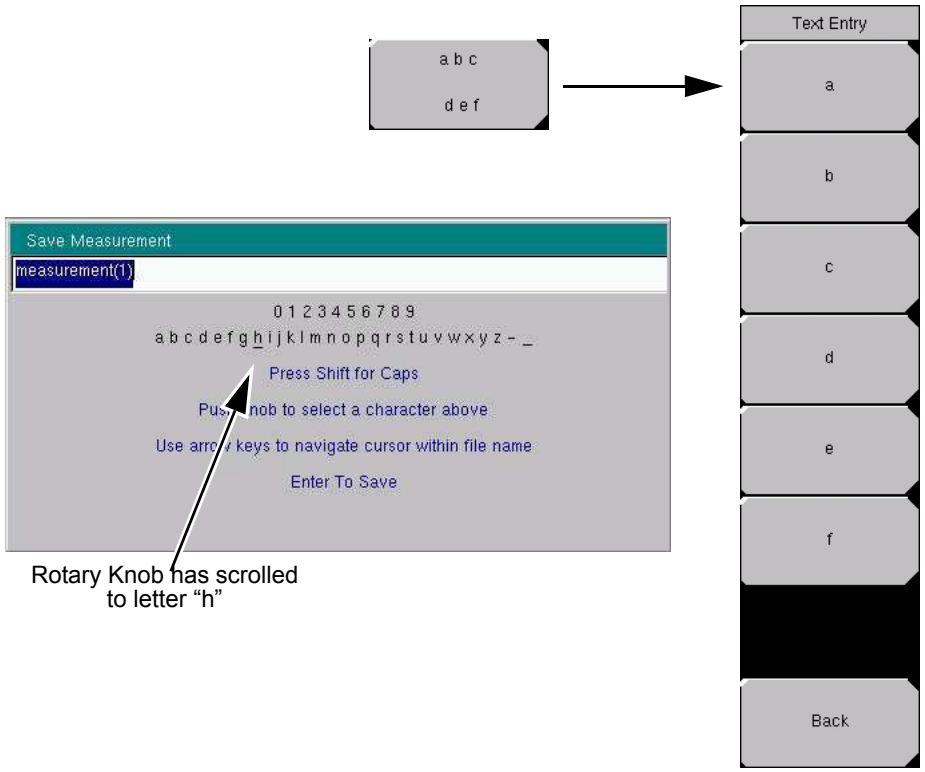


Figure 2-11. Text Entry Menu – Selecting Characters

2-10 Mode Selector

Select a VNA Master measurement mode (such as Vector Network Analyzer or Vector Volt Meter) by opening the Mode Selector List Box. Press the **Shift** key, then the **Mode** (9) key, and choose a mode from the menu. Use the directional arrow keys or the rotary knob to highlight your selection and then press the **Enter** key.

The modes that are available on your VNA Master depend upon the options that are installed and activated. Your instrument may not show the same list as Figure 2-12.

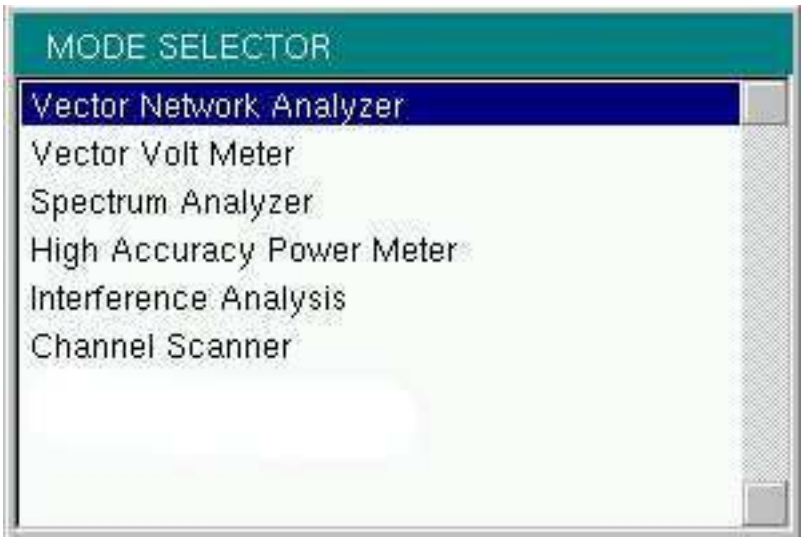


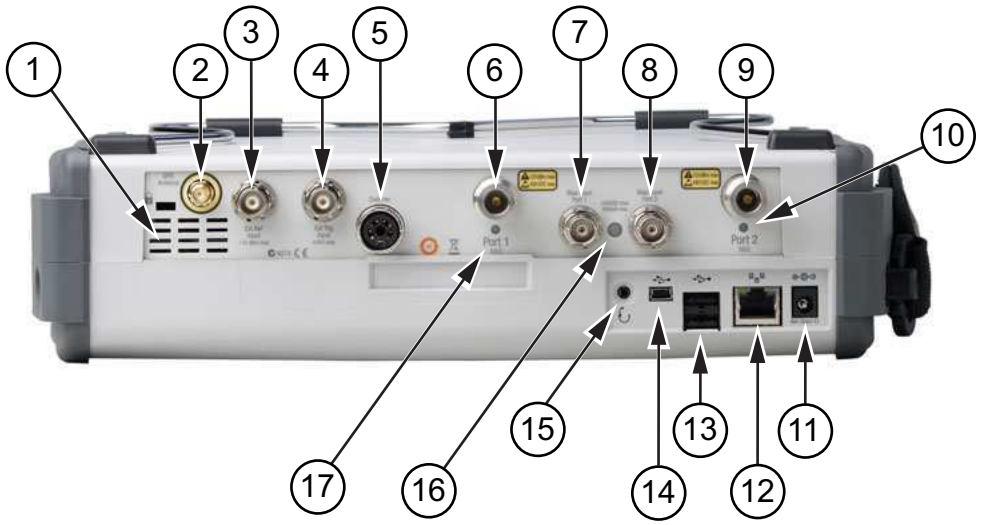
Figure 2-12. Mode Selector List Box

2-11 Test Panel Connectors

The connectors and indicators that are located on the test panel of the VNA Master are shown and described in the following sections.

MS202xC Test Panel Connectors

The connectors and indicators that are located on the test panel of the MS2026C and MS2028C are shown in Figure 2-13 and are described in the table below the figure.

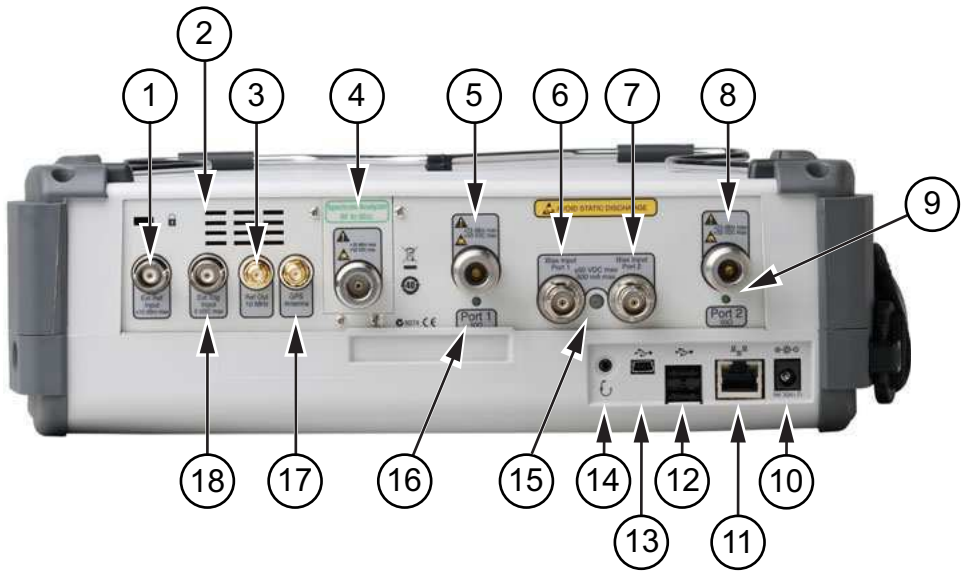


1	Fan Exhaust Port
2	GPS Antenna Input for Option 31
3	External Reference Input
4	External Trigger Input
5	RF Detector Interface (for Option 5)
6	Test Port 1 (50 ohm) The corresponding LED turns green when the port is transmitting.
7	Bias Input Port 1
8	Bias Input Port 2
9	Test Port 2 (50 ohm) The corresponding LED turns green when the port is transmitting.
10	Port 2 LED
11	External Power Input
12	LAN Connection
13	USB Interface, Type A (2 connectors, Full Speed USB 2.0)
14	USB Interface, Type Mini-B (Full Speed USB 2.0)
15	Headset Jack
16	Bias Status LED
17	Port 1 LED

Figure 2-13. MS202xC Test Panel Connectors

MS203xC Test Panel Connectors

The connectors and indicators that are located on the test panel of the MS2036C and MS2038C are shown in Figure 2-14 and are described in the table below the figure.



1	External Reference Input
2	Fan Exhaust Port
3	Reference Out (10 MHz)
4	Spectrum Analyzer RF Input (50 ohm)
5	Test Port 1 (50 ohm) The corresponding LED turns green when the port is transmitting.
6	Bias Input Port 1
7	Bias Input Port 2
8	Test Port 2 (50 ohm) The corresponding LED turns green when the port is transmitting.
9	Port 2 LED
10	External Power Input
11	LAN Connection
12	USB Interface, Type A (2 connectors, Full Speed USB 2.0)
13	USB Interface, Type Mini-B (Full Speed USB 2.0)
14	Headset Jack
15	Bias Status LED
16	Port 1 LED
17	GPS Antenna Input for Option 31
18	External Trigger Input

Figure 2-14. MS203xC Test Panel Connectors

In Figure 2-15, a waveguide-coax adapter at Test Port 1 provides test connections, and typical waveguide calibration components are shown below the VNA Master.

Figure 2-15. Waveguide-Coax Adaptor and Waveguide Calibration Components

External Power

The external power connector is used to power the unit and for battery charging. Refer to Figure 2-13, item "11" on page 2-20. Input is 12 VDC to 15 VDC at up to 5.0 A. A green flashing indicator light near the power switch shows that the instrument battery is being charged by the external charging unit. The indicator is steadily illuminated when the battery is fully charged.

Warning	When using the AC-DC Adapter, always use a three-wire power cable 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.

Note	If the battery is completely depleted, then the VNA Master may not turn on even when the external power supply is plugged into the unit. In that case, allow the battery to charge while the instrument is turned off before attempting to turn on the instrument.

LAN Connection

The RJ-45 connector is used to connect the VNA Master to a local area network. Refer to Figure 2-13, item "12" on page 2-20. Integrated into this connector are two LEDs. The amber LED indicates the speed of the LAN connection (ON for 10 Mb/s and OFF for 100 Mb/s), and the green LED flashes to show that LAN traffic is present. The instrument IP address is set by pressing the **Shift** key, then the **System** (8) key followed by the System Options soft key and the Ethernet Config soft key. The instrument Ethernet address can be set automatically using DHCP, or manually by entering the desired IP address, gateway address, and subnet mask. These settings are described in more detail in Appendix G, "More About DHCP".

Note	An active Ethernet cable must be connected to the MS20xxC before it is turned ON in order to enable the Ethernet port for DHCP or for a static IP address. Depending upon local conditions, the port may remain enabled when changing from DHCP to static IP address, when changing from static IP address to DHCP, or when temporarily disconnecting the Ethernet cable. If the port becomes disabled, then ensure that an active Ethernet cable is attached to the MS20xxC before cycling the power OFF and back ON.

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 the most common method of configuring a device for network use. To determine if a network is set up for DHCP, connect the VNA Master to the network and select DHCP protocol in the Ethernet Config menu.

Turn the VNA Master off, and then on. If the network is set up for DHCP, then the assigned IP address should be displayed briefly after the power-on sequence.

Note	In order to acquire an address from a DHCP protocol network, the VNA Master MUST be connected to the network BEFORE being switched on.

To display the IP address with the instrument on, press the **Shift** key, then the **System** (8) key, then the System Options soft key and the Ethernet Config soft key. The IP address is displayed as shown in Figure 2-16. For more information about DHCP, refer to Appendix G, "More About DHCP".

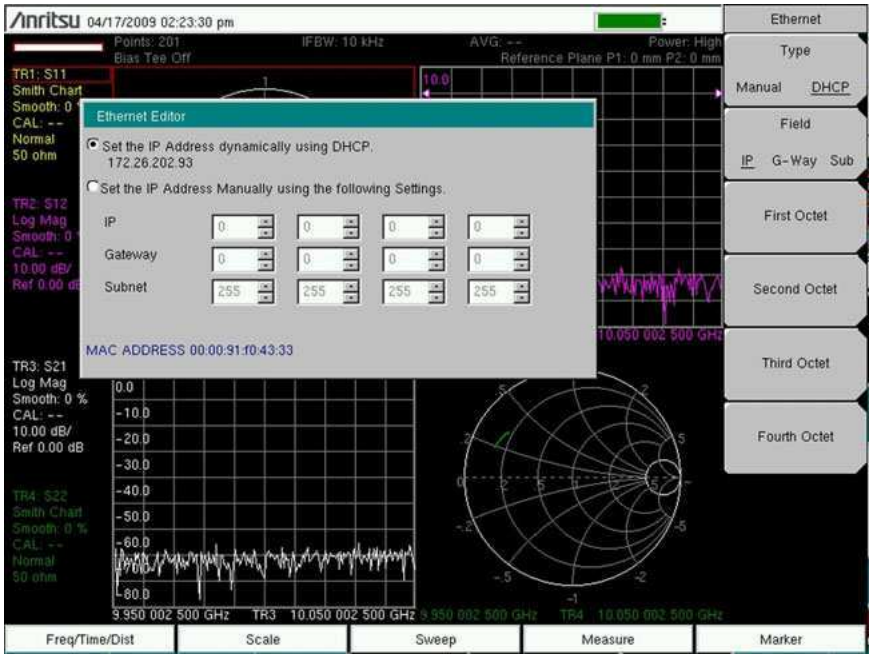


Figure 2-16. IP Address Assigned Using DHCP

USB Interface - USB Type Mini-B

The USB 2.0 interface can be used to connect the VNA Master directly to a PC. Refer to Figure 2-13, item "14" on page 2-20 for the USB connector location. Refer to Figure 2-17 for an example of a PC connection that is also using Master Software Tools. The first time that the VNA Master is connected to a PC, the normal USB device detection will be performed by the computer operating system. The CD-ROM that is shipped with the instrument contains a driver (for Windows 2000 and Windows XP) that is installed when Master Software Tools is installed. Drivers are not available for earlier versions of the Windows operating system. During the driver installation process, place the CD-ROM in the computer drive and specify that the installation wizard should search the CD-ROM for the driver.

Note	For proper detection, Master Software Tools should be installed on the PC prior to connecting the VNA Master to the PC USB port.

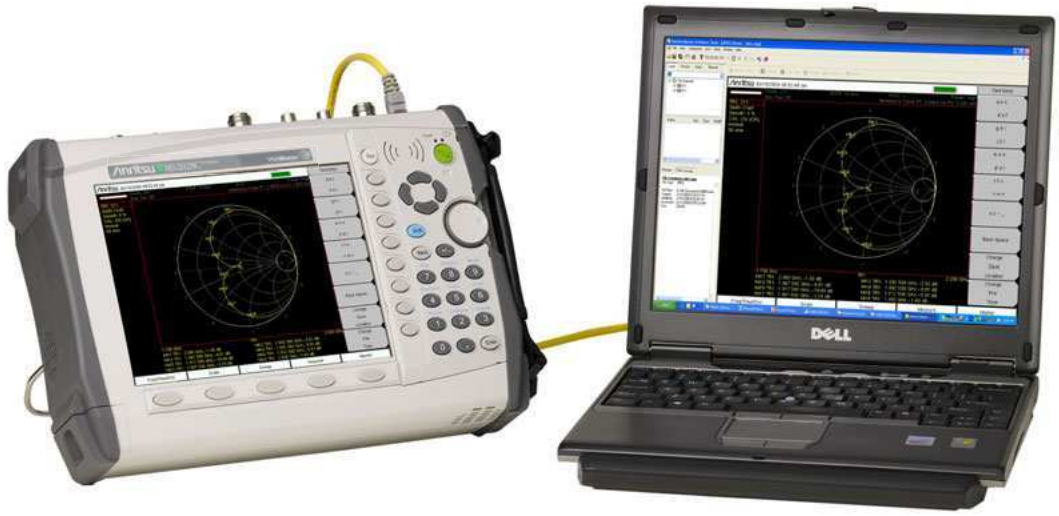


Figure 2-17. MS2028C Connected to PC via USB Mini-B

USB Interface - USB Type A

The VNA Master can also act as a USB Host, which allows various USB Flash Memory devices to be connected to the instrument for storing measurements and setups. Refer to Figure 2-13, item "13" on page 2-20.

Note	For proper operation with the instrument, USB Flash Drives should be formatted using either FAT (for drives that are 2GB or less) or FAT32. USB drives with NTFS formatting may not be correctly recognized by the instruments.

Headset Jack

This connector (refer to Figure 2-13, item "15" on page 2-20) is not currently in service. The headset jack accepts a 2.5 mm 3-wire miniature phone plug such as those commonly used with cellular telephones.

Ext Trigger

Refer to Figure 2-13, item "4" on page 2-20. This connector is currently supported only in Spectrum Analyzer mode. It may be supported in the Vector Analyzer mode in future firmware releases.

Ext Freq Ref

The BNC female connector (refer to Figure 2-13, item "3" on page 2-20) is used for connection of an external frequency reference. Press the External Reference soft 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.

RF Detector

The RF detector connector (refer to Figure 2-13, item "5" on page 2-20) is used for Power Monitor measurements (Option 5). Refer to the table of available RF Detectors in the Technical Data Sheet for your instrument (refer to Appendix A). Note that this option is available only on the MS202xC models.

Port 1 (50 ohm)

This connector (refer to Figure 2-13, item "6" on page 2-20) provides the input/output 50 ohm interface for transmission and reflection measurements of the Vector Network Analyzer at Port 1. Maximum input is +23 dBm at ±50 VDC. Bias Tee output is also available from this port (with Option 0010). The Port 1 green LED (refer to Figure 2-13, item "17" on page 2-20) indicates (is illuminated) when the port is transmitting power.

Port 2 (50 ohm)

This connector (refer to Figure 2-13, item "9" on page 2-20) provides the input/output 50 ohm interface for transmission and reflection 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 0010). The Port 2 green LED (refer to Figure 2-13, item "10" on page 2-20) indicates (is illuminated) when the port is transmitting power.

Bias Input Port 1

The BNC female connector (refer to Figure 2-13, item "7" on page 2-20) is used for external bias tee input that will be routed to Port 1 of the Vector Network Analyzer. Maximum input is ±50 VDC and 500 mA.

Bias Input Port 2

The BNC female connector (refer to Figure 2-13, item "8" on page 2-20) is used for external bias tee input that will be routed to Port 2 of the Vector Network Analyzer. Maximum input is ±50 VDC and 500 mA.

Bias Status LED

This LED (refer to Figure 2-13, item "16" on page 2-20) illuminates green when Internal or External Bias is selected. It illuminates red for any overload condition (current or voltage).

GPS Antenna Connector

This GPS antenna connection is for GPS only (Option 31 only). Refer to Figure 2-13, item "2" on page 2-20.

Note	The GPS antenna connection on the VNA Master is fitted with an SMA connector. A DC voltage (3.3 V or 5.0 V) is present on this connector to support active GPS antennas. Connect only supported antennas, such as the Anritsu GPS antenna (part number 2000-1528-R) to this port.

Reference Output, 10 MHz

The SMA female connector (refer to Figure 2-14, item "3" on page 2-21) provides an output to the internally generated 10 MHz reference signal.

Spectrum Analyzer RF In (50 ohm)

This connector (refer to Figure 2-14, item "4" on page 2-21) provides the input 50 ohm interface for the Spectrum Analyzer function.

2-12 Symbols and Indicators

The symbols and indicators that appear on the display screen convey the instrument status or condition on the display.

Battery Symbol

The battery symbol (Figure 2-18) above the display indicates the charge remaining in the battery. The colored section that is inside the symbol changes size and color with the charge level.

Figure 2-18. Battery Symbol

- Green: Battery is 30% to 100% charged.
- Yellow: Battery is 10% to 30% charged.
- Red: Battery is 0% to 10% charged. When the Battery Indicator is red, approximately 8 to 10 minutes of battery life remain.

When the battery is charging, either from the AC-DC Adapter (40-168-R) or the 12 Volt DC adapter (806-141-R), the symbol will change to that shown in Figure 2-19:

Figure 2-19. Battery Symbol While charging

The Battery Charge LED flashes when the battery is charging and remains on and steady when the battery is fully charged.

Note	Use only Anritsu approved batteries, adapters, and chargers with this instrument.

When the battery is not present, the battery symbol is replaced by a red plug body (Figure 2-20) to indicate that the instrument is running from external power. When the external AC adaptor is connected, the battery automatically receives a charge, and the battery symbol with the lightning bolt is displayed (Figure 2-19). When the battery is fully charged, the charging circuit shuts off and the green battery symbol (100% charged) is displayed without the lighting bolt (Figure 2-18)..

Figure 2-20. Battery Not Charging or Not Available

Hold

The Hold symbol 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 symbol is displayed when Single Sweep is selected. Single or Continuous sweep can be selected under the Sweep Menu.

2-13 Memory Profile and Security Issues

This section describes the profiles of the various types of memory that are used in the MS20xxC VNA Master and the associated security issues that are related to those memory devices.

The MS20xxC has 1 GB of Flash non-volatile memory, has EEPROM memory, and has sufficient DRAM volatile memory for normal operation. The instrument is supplied with a USB memory device that plugs into the USB Type A connector. The MS20xxC does not have a hard drive or any other type of volatile or non-volatile memory.

The following sections describe how memory is used in the VNA Master and how it can be erased.

Internal Flash Memory

This memory space is used to store the instrument firmware and factory calibration, and can be used to store measurements and setups that are saved by the user.

Saved measurements and setups that are stored in the Flash memory are all deleted by the master reset process that is described in Section "MS20xxC Master Reset Instructions" on the following page.

Note	With Option 7 enabled, the user is not able to store any measurements or setups to this internal flash memory.

USB Memory Device

The USB memory device is not required for proper operation of the instrument. The instrument may be directed to store measurements and setups directly to the USB memory device, or you may transfer the contents of the internal flash memory into the USB memory device for storage or data transfer purposes. The device is removable and therefore does not pose a security risk because it can remain in a secured area, can be externally erased by a computer, or can be destroyed.

Note	With Option 7 enabled, the user does not have access to the internal flash memory and, therefore, cannot transfer any contents of the internal flash memory into the USB memory device.

RAM Memory

This is volatile memory that is used to store many parameters that are needed for the normal operation of the MS20xxC along with current measurements. This memory is reset whenever the instrument is restarted.

EEPROM

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

MS20xxC Master Reset Instructions

1. Turn the MS202xC or MS203xC On.
2. Press the **Shift** key then the **System** (8) key.
3. Press the System Options soft key.
4. Press the Reset soft key.
5. Press the Master Reset soft key.
6. A dialog box is displayed on the instrument screen to warn that all settings will be returned to factory default values, and that all user files will be deleted.
7. Press the **Enter** key to complete the master reset, or press the **Esc** key to abort.
8. After several seconds (which can grow to several minutes if a very large number of measurements have been saved in the instrument), the instrument reboots.

2-14 System Settings

To access the System menu (refer also to Figure 6-57 on page 6-58), press the **Shift** key, then the **System** (8) key. System Status, Self Test, Application Self Test, Application Options, and System Options can be found in this menu.

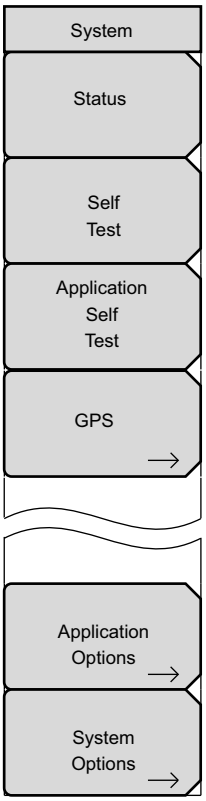


Figure 2-21. System Menu

The functions of these soft keys are described in the following paragraphs.

Status

Pressing this soft key displays 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

At power on, the VNA Master runs through a series of quick checks to ensure that the system is functioning properly. The system Self Test runs a series of tests that are related to the instrument. In the MS20xxC, the Application Self Test runs a series of tests related to the VNA portion of the instrument. If the self test fails, although the battery is fully charged and the VNA Master is within the specified operating temperature range, then contact your Anritsu Service Center (refer to "Anritsu Service Centers" on page 1-7). To initiate a self test when the system is already powered up, perform the following:

1. Press the **Shift** key and then the **System** (8) key.
2. Select the Self Test soft key. The Self Test results are displayed.
3. Press the **Esc** key to continue.

Application Self Test

Press this soft key to initiate a series of diagnostic tests that are related to the performance of the VNA Master and are unique to each instrument application (refer to Section 2-10 "Mode Selector" on page 2-19). A display lists the individual tests with a pass or fail indication. Press **Esc** or **Enter** to return to normal operation.

GPS

Pressing this soft key opens the GPS Menu. (This soft key appears only if the GPS option is enabled in your VNA Master. Refer to Figure 6-4 in Chapter 6, "GPS Receiver, Option 31").

Vector Network Analyzer Mode

The Application Options menu for the Vector Network Analyzer mode contains the selections for Units, External Reference, Trace Label, Measurement Gain Range, and Time Domain (if applicable). Press the Back soft key to return to the System menu.

Units

Press this soft key to toggle the measurement units between meters and feet.

External Reference

Press this soft key to toggle between the two choices of turning Off the external reference or selecting the external reference.

Trace Label

Press this soft key to toggle the trace label On and Off. When On, a label is shown next to each trace (TR1 next to Trace 1, and so forth).

Measurement Gain Range

Press this soft key to toggle between Auto and Fixed mode. In Auto mode, the instrument adjusts the gain automatically to provide the best overall system performance (dynamic range and high level noise). In Fixed 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.

Time Domain

When the Time Domain Option (Option 2) is enabled, certain aspects of the measurements are determined by the settings in this menu. Refer to the Vector Network Analyzer Measurement Guide (listed in Appendix A) for a detailed description of this menu.

Spectrum Analyzer Mode

The Application Options menu for the Spectrum Analyzer mode contains only the Impedance setting selection. Press the Back soft key to return to the System menu.

Impedance

Press this soft key to toggle the impedance setting to 50 ohm, 75 ohm, or Other. Selecting 75 ohm sets the instrument for the 7.5 dB loss of the Anritsu 12N50-75B adapter. For other adapters, select Other and enter the appropriate loss value.

System Options

The System Options menu includes basic instrument settings and reset options. On your instrument, the function hard keys may differ from those shown in Figure 2-22 depending upon selected instrument options.

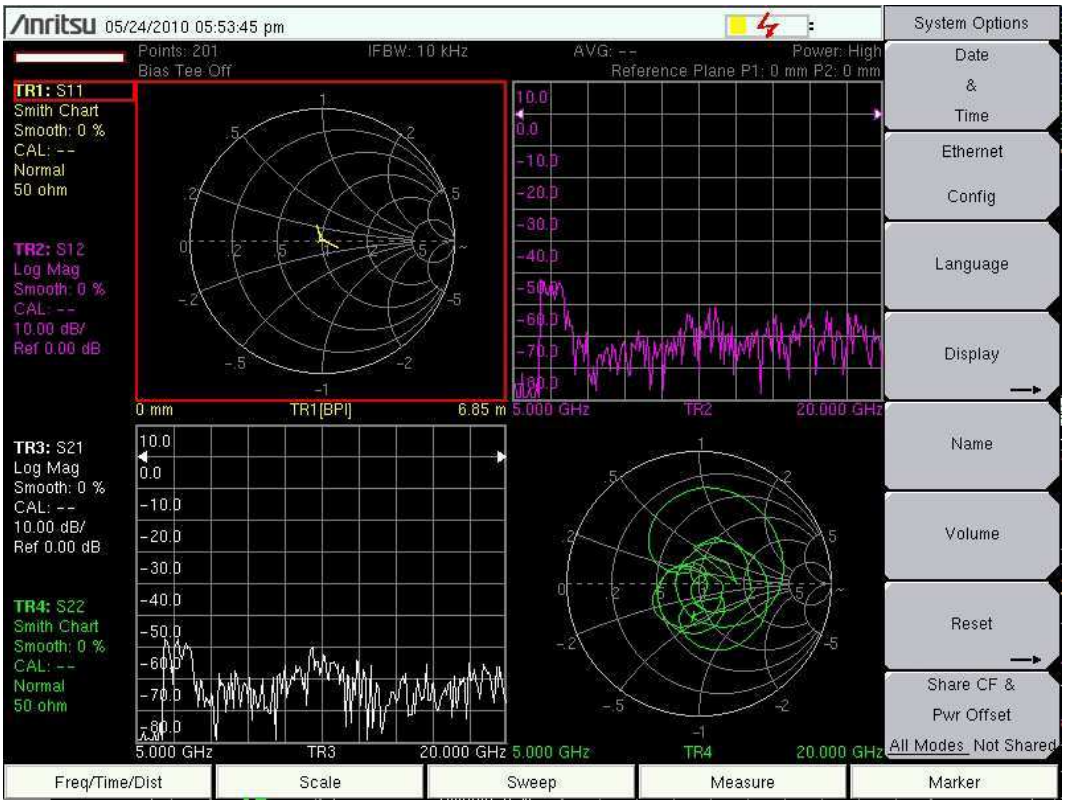


Figure 2-22. System Options Soft Key Menu

The System Options soft keys perform as described in the following paragraphs:

Date and Time

This soft key brings up a dialog box for setting the current date and time. Use the keypad, the arrows, or the rotary knob to select the date and time.

Ethernet Configuration

This soft key bring up a dialog box to set the IP address of the instrument. Use the Type: Manual/DHCP soft key to select whether the address will be entered manually or will be supplied automatically by a network DHCP server. If manual is selected, then use the soft keys or the arrow keys to select the field to be modified. For more information about LAN connections and DHCP, refer to "LAN Connection" on page 2-23 and Appendix G, "More About DHCP".

Language

This soft key allows selection from a list of built-in languages. Use the rotary knob or Up/Down arrow keys to highlight a selection and press **Enter** to select. The languages currently available are English, French, German, Spanish, Japanese, Chinese, Korean, and Italian. In addition, two custom languages may be selected if they have been defined in the Master Software Tools Software Language Editor and loaded into the unit. For more information about how to create custom defined languages, refer to the Master Software Tools user guide.

Language

This soft key brings up the Display Settings menu, which allows you to adjust brightness and color schemes, including settings for night vision and inverted black and white. The Display Settings menu is described in the System Menus chapter of the VNA Measurement Guide (refer to Appendix A).

Name

The VNA Master can be named. For more information about entering a name, refer to section "Text Entry" on page 2-15.

Volume

Opens a dialog box to change the speaker volume of the unit. Use the keypad, the **Up/Down** arrow keys, or the rotary knob to select a volume level from 0 to 90, and press **Enter** to select.

Reset

Opens a menu of reset and update options.

Factory Defaults

Press this soft key to restore the instrument to the factory default values, including mode of operation, sweep settings, Ethernet, language, and brightness settings. Press the Factory Defaults soft key to initiate the reset. A dialog box opens with the following message:

> Attention.
>
> This will apply factory default settings. The following will be reset to default values: Ethernet settings, Language, Volume and Brightness. The instrument will power cycle when the operation is complete. Press **ENTER** to continue, **ESC** to abort.

Master Reset

Press this soft key to restore factory settings to all system parameters, including Time/Date, Ethernet, language, and brightness settings. Also, all user files in the internal memory are deleted, and the original language and antenna files are restored. Press the Master Reset soft key to initiate the reset. A dialog box opens with the following message:

> Attention.
>
> This will perform a Master Reset. All settings will return to factory defaults and all user files will be deleted. The instrument will power cycle when the operation is complete. Press **ENTER** to continue, **ESC** to abort.

Press the **Enter** key to initiate the reset, and turn the unit off, then on again to complete.

Update Firmware

Press this soft key to update the instrument firmware via an external USB memory device. After you press this key, the instrument loads a default application screen. Press the Load Firmware soft key that appears in the bottom left side corner of the display. Connect an external USB device with the appropriate firmware package to the Type A USB input. Press the Update Application Firmware soft key that appears in the top right hand corner of the display. A pop-up selection window appears. Select one of the three options: Save none, Save user data, Save & restore user data. Each selection is explained in that selection window. After a selection has been made, initiate the firmware update by pressing the Update from USB Memory soft key that appears in the top right hand corner of the display. Verify the selection that is shown in the window, and press **Enter** to proceed.

This update takes several minutes. The MS20xxC VNA Master automatically reboots when it is completed. An hourglass symbol slowly rotates while it is downloading the code.

Frequency Blanking

This feature is available with Option 7 installed. Refer to "Frequency Blanking" on page 5-5.

Back

Returns to the previous menu.

2-15 File Types

Filename extensions that are used in the VNA Master:

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

`*.mna` 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.

File Management

A description of the file menu group is in the VNA Menus chapter of the VNA Measurement Guide (refer to Appendix A). That section includes instructions for saving, recalling, copying, and deleting files.

Chapter 3 — Instrument Options

3-1 Introduction

The VNA Master is available with multiple options. This chapter lists the analyzer options and describes where to find the instructions for using each option. For additional information about the specific options that are available for each instrument model, refer to the Technical Data Sheet, Anritsu part number 11410-00548. The Technical Data Sheet also describes hardware options,

3-2 List of Instrument Options

Check the Technical Data Sheet for your model of VNA Master for a list of available options.

1. Time Domain (Option 0002)

   The Time Domain option includes DTF (Option 0501)

2. Power Monitor (Option 0005)

   Power Monitor requires an external detector. Note that the power monitor option is available only for models MS2026C and MS2028C.

3. Secure Data Operaton (Option 0007)
4. Bias Tee (Option 0010)
5. K(f) Test Port Connectors (Option 0011)

   This is a hardware option.

6. Vector Voltmeter (Option 0015)
7. High Accuracy Power Meter (Option 0019)
8. Interference Analyzer (Option 0025)

   The Interference Analyzer option is available only for models MS2036C and MS2038C.

9. Channel Scanner (Option 0027)

   The Channel Scanner option is available only for models MS2036C and MS2038C.

10. GPS (Option 0031)

    The GPS option requires an external GPS antenna.

11. Balanced/Differential S-Parameters, 1-Port (Option 0077)
12. Z-540 Calibration (Option (0098)

    This is a hardware option.

13. Premium Calibration (Option 0099)

    This is a hardware option.

14. Distance to Fault (Option 0501)

    The DTF option is included in the Time Domain Option (Option 0002).

3-3 Option Descriptions

The functions of some analyzer options are described in Measurement Guides, and others are described in this User Guide. Measurement Guides are available from the document disk that is supplied with the instrument and are also available as free downloads from the Anritsu Web site (refer to "Anritsu Reference Documents" on page 1-7).

Time Domain (Option 0002)

The Time Domain option includes DTF (Option 0501).

This option is fully described in the Vector Network Analyzer Measurement Guide, Anritsu part number 10580-00289.

Power Monitor (Option 0005)

Power Monitor requires an external detector.

This option is fully described in this User Guide in Chapter 4, "Power Monitor, Option 5".

Secure Data Operation (Option 0007)

This option is fully described in this User Guide in Chapter 5, "Secure Data Option 7".

Bias Tee (Option 0010)

This option is fully described in the Vector Network Analyzer Measurement Guide, Anritsu part number 10580-00289.

Vector Voltmeter (Option 0015)

This option is fully described in the Vector Network Analyzer Measurement Guide, Anritsu part number 10580-00289.

High Accuracy Power Meter (Option 0019)

This option is fully described in the Power Meter Measurement Guide, Anritsu part number 10580-00240.

Interference Analyzer (Option 0025)

The Interference Analyzer option is available only for models MS2036C and MS2038C.

This option is fully described in the Spectrum Analyzer Measurement Guide, Anritsu part number 10580-00244.

Channel Scanner (Option 0027)

The Channel Scanner option is available only for models MS2036C and MS2038C.

This option is fully described in the Spectrum Analyzer Measurement Guide, Anritsu part number 10580-00244.

GPS (Option 0031)

The GPS option requires an external GPS antenna.

This option is fully described in this User Guide in Chapter 6, “GPS Receiver, Option 31”.

Balanced/Differential S-Parameters, 1-Port (Option 0077)

This option is fully described in the Vector Network Analyzer Measurement Guide, Anritsu part number 10580-00289.

Distance to Fault (Option 0501)

The DTF option is a subset of the Time Domain Option (Option 0002). With Option 501, the following advanced features are disabled:

- Time domain transformation (distance only is enabled)
- Waveguide support (dispersion compensation)
- Low pass processing
- Band pass phasor impulse
- Gating.

This option is fully described in the Vector Network Analyzer Measurement Guide, Anritsu part number 10580-00289.

Chapter 4 — Power Monitor, Option 5

4-1 Introduction

When equipped with Option 5, Power Monitor, the MS202xC VNA Master can be used for making power measurements with broadband RF detectors, such as those listed in the Technical Data Sheet for your instrument, as listed in Appendix A. The power monitor displays the measured power results in dBm or Watts.

Note	Option 5 is not available in the MS203xC VNA Master models.

The function hard keys that are displayed in this mode are:

Freq, Scale, Save/Recall, Measure, Marker

Only the **Save/Recall** and **Measure** function hard keys are functional in this mode. The other three function hard keys provide no valid functions.

4-2 Procedure

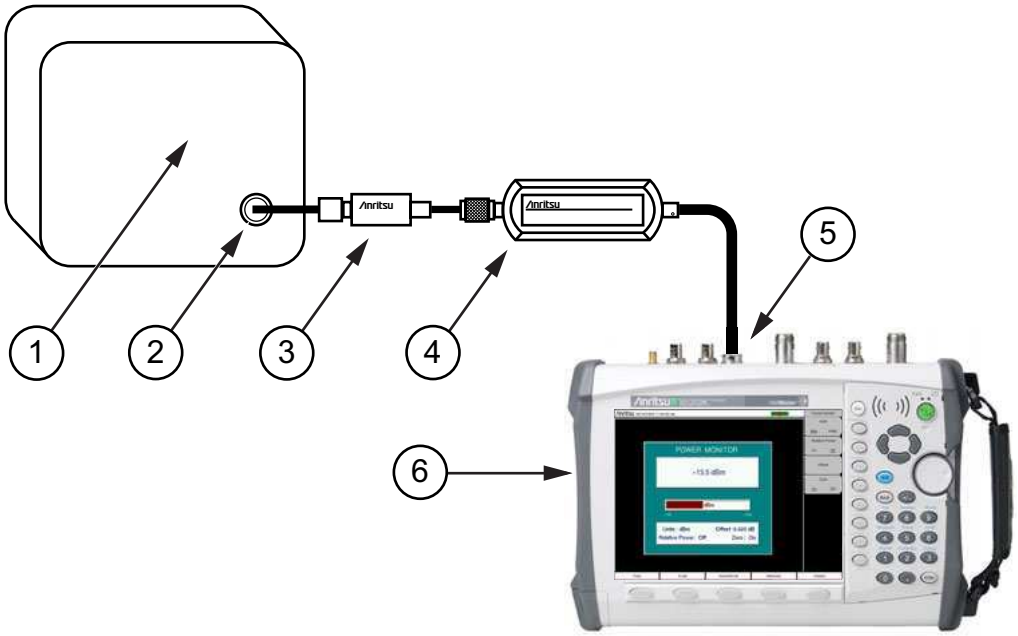
1. On the VNA Master, press the **Shift** key, then the **Mode** (9) key.
2. Use the directional arrow keys or the rotary knob to highlight Power Monitor and then press the **Enter** key.
3. Connect the power sensor to the VNA Master RF Detector port.

Zeroing the Power Monitor

1. With no power applied to the Power Detector input, press the Zero soft key. Wait for a few seconds while the VNA Master accumulates data samples of the quiescent power.
2. When complete, Zero: On is displayed in the message area.

Measuring High Input Power Levels

1. Insert an attenuator between the DUT and the RF Detector to protect the VNA Master so that the power level is less than or equal to +16 dBm.
2. Press the Offset soft key and enter the attenuation by using the keypad, the arrow keys, or the rotary knob.
3. Press the **Enter** key to complete the entry.



1	DUT (Device Under Test)
2	RF Out
3	Attenuator
4	RF Detector (Power Sensor)
5	RF Detector Interface (for Option 5)
6	VNA Master

Figure 4-1. Power Measurement Setup With Attenuator

Displaying Power in dBm or in Watts

Press the Units soft key to toggle between dBm and Watts.

Setting Relative Power

1. With the desired base power level input to the VNA Master, press the Relative soft key. The power reading shows 100% because it is measuring the same power level.
2. If the power is lowered by 3 dB, then the relative power will show 50%.
3. If the power in Watts is increased from 1 Watt to 2 Watts, then the relative power will show 200%.

In Figure 4-2, the Units are set for dBm, the Relative Power function is Off, the Offset is 1 dBm, and the Zero function is set to Off. The figure is intended to illustrate the general layout of the Power Monitor display. The displayed image on your instrument may be different.

4-3 Power Monitor Display

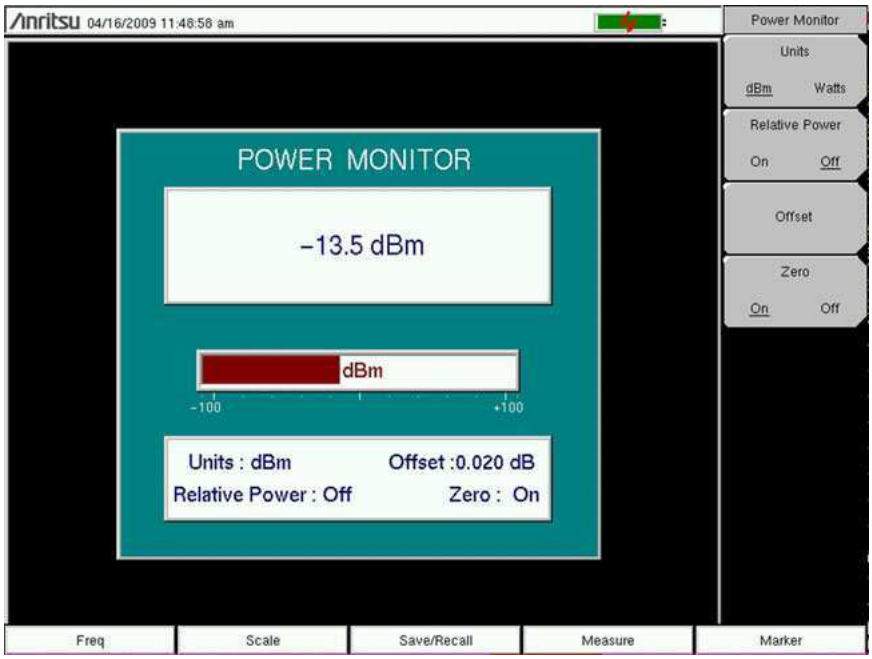
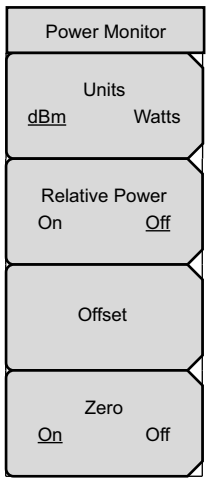


Figure 4-2. Power Monitor Display

4-4 Power Monitor Menu



Units
dBm Watts: Press this soft key to toggle units between dBm and Watts.

Relative Power
On Off: Press this soft key to turn relative power On or Off.

Offset: Press this soft key to enter an offset value to account for any external attenuator that is used during a measurement.

Zero
On Off: Press this soft key to toggle zeroing On in order to perform Zeroing of the power monitor detector.

Figure 4-3. Power Monitor Menu

Chapter 5 — Secure Data Option 7

5-1 Introduction

When equipped with Option 7, the MS20xxC VNA Master provides for careful management of confidential data for both the setup parameters and the resulting measured data.

Highly sophisticated systems and equipment have technical applications that must remain secure in their operations. The particular parameters that must remain secure usually involve operating frequencies and a variety of other setup configurations.

To accommodate the measurements and yet preserve the data as confidential, Option 7 can be used to prevent any setup data or measured data from being stored on any internal memory location of the VNA Master. Instead, all such data are forced to be stored on removable memory such as an external USB memory device.

Caution	Note that even with Option 7 enabled, operating parameters (such as frequency range, power level, number of points) that are set by the user are stored in the VNA Master EEPROM when the VNA Master is turned OFF. These parameters can be erased, however, via a Master Reset operation, as described later in this chapter.

5-2 Procedure

When saving data (setups, measurements, JPEG, and so forth) in a VNA Master with Option 7, the save location must be an external USB memory device. If a USB memory device is not connected to the instrument, then you cannot perform the save function.

You can use the following steps to change the save location while saving a file:

1. Press the **Shift** key, then the **File** (7) key.
2. Press the Save soft key.
3. Press the Change Save Location soft key.
4. Use the rotary knob or arrow keys to highlight the external USB memory device or any desired folder on that device.
5. Press the Create Folder soft key to create a new folder, if desired.
6. Press the Set Location soft key to set the highlighted folder or drive as the target location.
7. Press the Change File Type soft key to pick a different file type, if desired.
8. Use the Text Entry soft keys to enter the desired file name.
9. Press **Enter** to save the file.

5-3 Calibration Setup

After any user calibration, the VNA Master automatically writes the calibration file to internal memory. This is done so that when the instrument is turned Off and then back On, the user calibration data are recalled, and the calibration can be applied.

With Option 7 enabled, however, the VNA Master cannot write to internal memory. Therefore, the user calibration file is not automatically saved. With Option 7 enabled, when the instrument is turned Off and then back On, the user calibration data are not recalled, and the calibration cannot be applied. To save and recall the calibration, use the file save menu to save the setup with calibration. Then use the file recall menu to retrieve the calibration.

5-4 Memory Profile and Security Issues

This section describes the profiles of the various types of memory that are used in the MS20xxC VNA Master and the associated security issues that are related to those memory devices.

The MS20xxC has 1 GB of Flash non-volatile memory, has EEPROM memory, and has sufficient DRAM volatile memory for normal operation. The instrument is supplied with a USB memory device that plugs into the USB Type A connector. The MS20xxC does not have a hard drive or any other type of volatile or non-volatile memory.

The following sections describe how memory is used in the VNA Master and how it can be erased.

Internal Flash Memory

This memory space is used to store the instrument firmware and factory calibration, and can be used to store measurements and setups that are saved by the user.

Saved measurements and setups that are stored in the Flash memory are all deleted by the master reset process that is described in Section "MS20xxC Master Reset Instructions" on the following page.

Note	With Option 7 enabled, the user is not able to store any measurements or setups to this internal flash memory.

USB Memory Device

The USB memory device is not required for proper operation of the instrument. The instrument may be directed to store measurements and setups directly to the USB memory device, or you may transfer the contents of the internal flash memory into the USB memory device for storage or data transfer purposes. The device is removable and therefore does not pose a security risk because it can remain in a secured area, can be externally erased by a computer, or can be destroyed.

Note	With Option 7 enabled, the user does not have access to the internal flash memory and, therefore, cannot transfer any contents of the internal flash memory into the USB memory device.

RAM Memory

This is volatile memory that is used to store many parameters that are needed for the normal operation of the MS20xxC along with current measurements. This memory is reset whenever the instrument is restarted.

EEPROM

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

MS20xxC Master Reset Instructions

1. Turn the MS202xC or MS203xC On.
2. Press the **Shift** key then the **System** (8) key.
3. Press the System Options soft key.
4. Press the Reset soft key.
5. Press the Master Reset soft key.
6. A dialog box is displayed on the instrument screen to warn that all settings will be returned to factory default values, and that all user files will be deleted.
7. Press the **Enter** key to complete the master reset, or press the **Esc** key to abort.
8. After several seconds (which can grow to several minutes if a very large number of measurements have been saved in the instrument), the instrument reboots.

5-5 Frequency Blanking

With Option 7 enabled, you have the ability to blank the frequency values that are displayed on the screen, as shown in Figure 5-1. This extra security measure allows you to use the instrument in a secure environment with sensitive frequency information blanked from the screen. To enable frequency blanking, navigate to the Reset menu and toggle the Frequency Blanking button to On (**Shift-8** (System), System Options, Reset). The Reset menu and the Frequency Blanking button are shown in Figure 5-2.

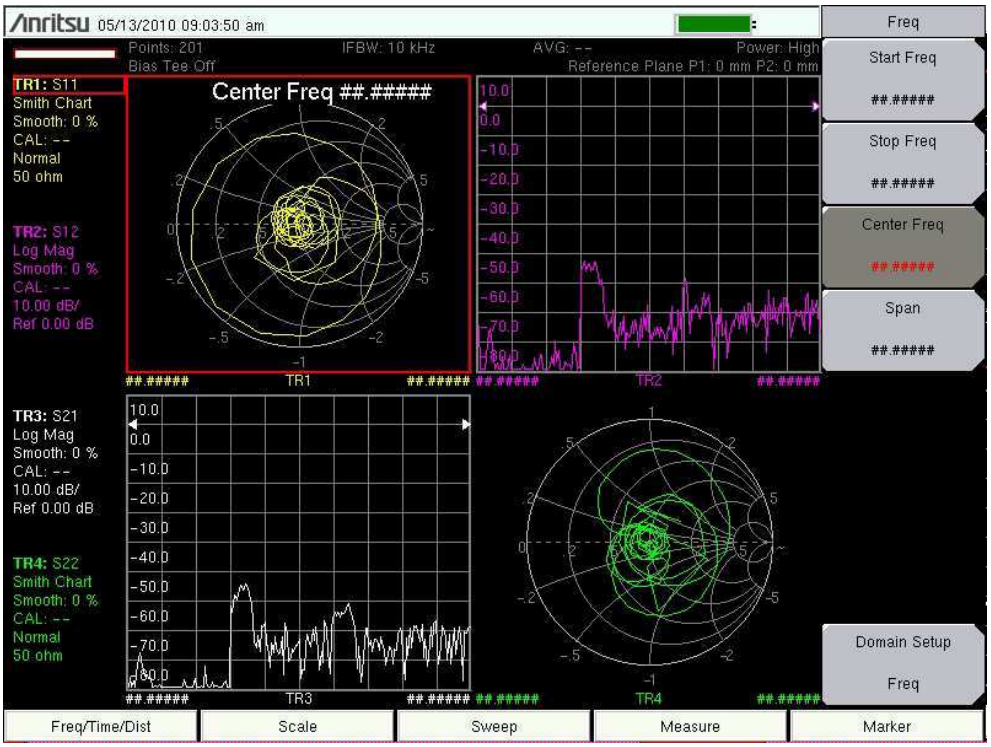


Figure 5-1. Frequency Blanking Turned On

Warning	Note that user files can still be stored to an external USB drive, and that frequency information is not blanked in those files. You must therefore ensure that no external USB devices are used to unintentionally store measurement or setup files when working with secure frequencies. Also, frequency information is not blanked from the SCPI commands that are used to remotely control the instrument. It is therefore up to you to ensure that no remote connections are made to the instrument when frequency information is being protected.

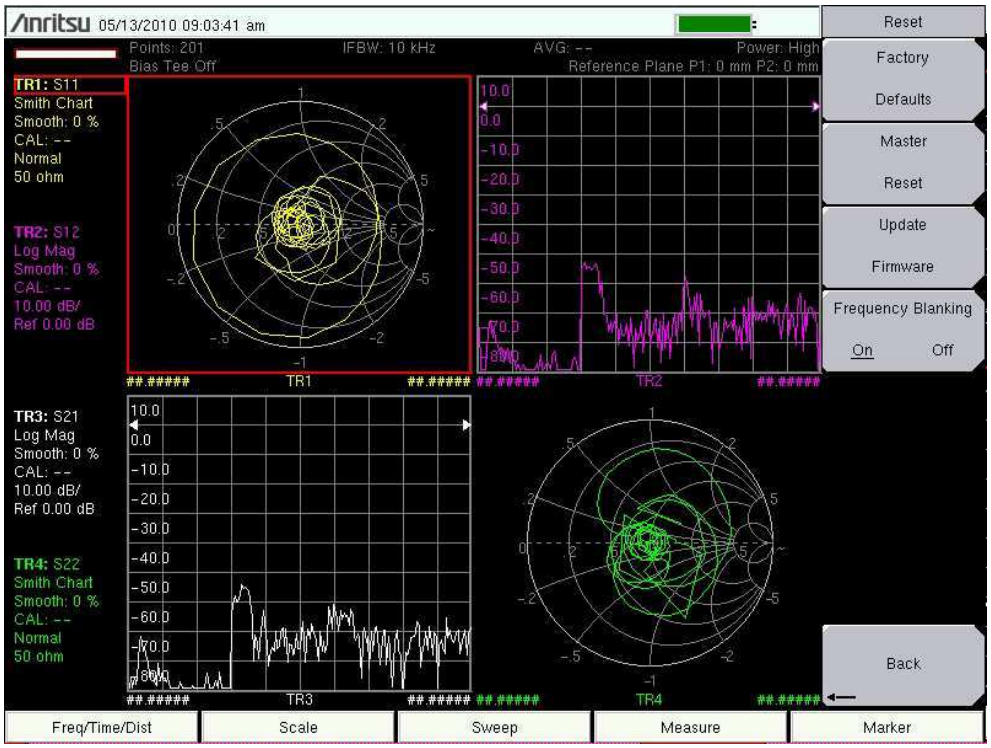


Figure 5-2. Frequency Blanking Menu

After frequency blanking is enabled, you are not able to restore the frequency readouts. This feature was designed as an added security measure to ensure that the sensitive frequency information is protected and cannot be recovered. Following is a list of the security measures that have been taken to protect the frequency information:

1. Turning off frequency blanking presets the instrument (and the frequencies) to the factory default settings.
2. Turning off the instrument presets the instrument to the factory default settings and turns off frequency blanking.
3. Presetting the instrument turns off frequency blanking and restores the factory default settings.
4. Frequency blanking is available only with Option 7 to ensure that user files and calibration files are not stored in the internal memory of the instrument.

When you have completed making your measurements with frequency blanking turned on, simply turn off frequency blanking or turn off the instrument, and you can be assured that your sensitive frequency information cannot be restored or viewed by any other user.

Chapter 6 — GPS Receiver, 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. A GPS antenna is not included with Option 31. The antenna must be ordered separately.

In order to acquire data from the GPS satellites, the user must have line-of-sight to the satellites or the antenna must be placed outside without any obstructions. The following GPS antenna must be ordered separately:

2000-1528-R Magnet Mount GPS Antenna with 4.6 m (15 ft) cable

6-2 Activating the GPS Feature

Install the Anritsu GPS antenna onto the GPS Antenna connector on the VNA Master.

Note	The GPS antenna connection on the VNA Master is fitted with an SMA female connector. A DC voltage is present on this connector. Do not connect anything other than the Anritsu GPS antenna to this port.

1. Press the **Shift** key, then the **System** (8) key.
2. Press the GPS soft key.
3. Press the GPS On/Off soft key to toggle the GPS feature On or Off. When GPS is first turned on, a RED GPS icon appears at the top of the display.

Figure 6-1. GPS - Red

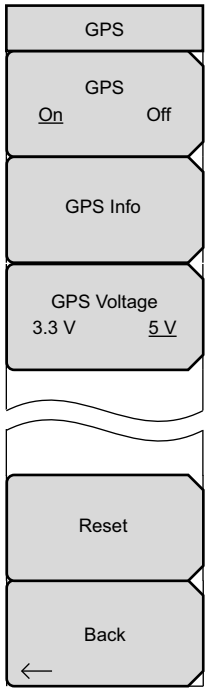
4. When the GPS receiver has tracked at least three satellites, the GPS icon changes to GREEN. Latitude and Longitude information is displayed in the white bar on top of the measurement display screen. Acquiring satellites may take as long as three minutes.

Figure 6-2. GPS - Green

5. Press the GPS Info soft key to view the number of tracked satellites, latitude, longitude, altitude, and UTC timing information, and so forth.
6. Press the Reset soft key to reset the GPS.
7. The GREEN GPS icon with a RED CROSS through it, as shown below, appears when GPS satellite tracking is lost (after actively tracking 3 or more satellites). The GPS longitude and latitude 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 soft key.

Figure 6-3. GPS - Crossed

6-3 GPS Menu



GPS
On Off: Press this soft key to toggle the GPS feature On and Off.

GPS Info: Press this soft key to open a window with additional GPS information. Press the **Esc** key to close the window.

GPS Voltage
3.3 V 5 V: Press this soft key to toggle the voltage to 3.3 volts or 5 volts. This voltage is supplied by the instrument to the GPS antenna.

Reset: Press this soft key to set the number of tracked satellites to 0 and to erase any almanac data, along with saved coordinates. The process of searching for and reacquiring satellites will begin again.

Back: Press this soft key to return to the.previous menu

Figure 6-4. GPS Menu

6-4 GPS Info Window

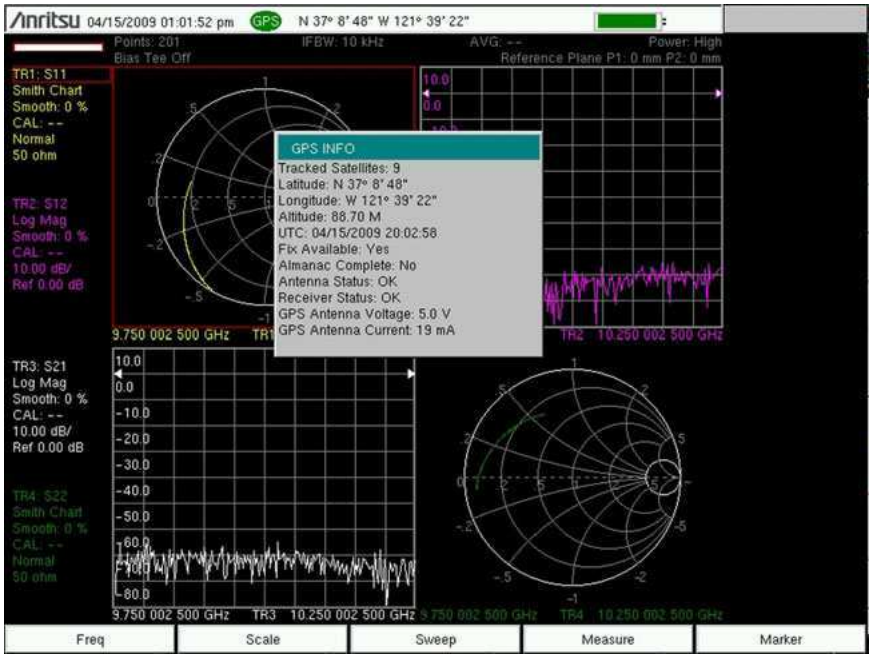


Figure 6-5. GPS Info Window

The GPS Info window provides the following 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 information.

Latitude and Longitude

Shows location in degrees, minutes, and seconds.

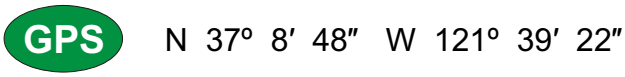


Figure 6-6. GPS Latitude and Longitude

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 minutes of GPS activation. When three satellites are found, the receiver computes an initial fix (typically in less than two minutes). Fix Not Available 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 does not have any navigation data, so the receiver does not have a current almanac. A complete system almanac is not required to achieve a first position fix. The availability of the almanac, however, can significantly reduce the time to first fix.

Antenna Status

OK:

Antenna is connected properly, and antenna is working properly.

Short/Open:

A short or open exists between the antenna and the connection. If this message is displayed, then remove and replace the GPS antenna. If the message persists, then try another Anritsu GPS antenna (part number 2000-1528-R). If the message still persists, then contact your nearest Anritsu Service Center (refer to section "Anritsu Service Centers" on page 1-7).

Receiver Status

OK:

Receiver is working properly.

No GPS Time Yet:

The receiver does not have any input signal, which is usually the case when the antenna status is not OK. Check the antenna connection. If the antenna status is OK and if this message persists, then contact your nearest Anritsu Service Center.

Other Status Messages

If any of the status messages (in the following list) persist, then the GPS receiver may be not working properly. In that case, contact your nearest Anritsu Service Center.

- Only 1 Satellite
- Only 2 Satellites
- Only 3 Satellites
- No Usable Satellites
- Satellite unusable
- Need Initialization
- PDOP is Too Hi
- Undecoded Error

GPS Antenna Voltage

Lists the voltage that is being used by the GPS antenna (3.3 V or 5 V).

GPS Antenna Current

Lists the current draw from the GPS antenna when the voltage is applied.

6-5 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 File menu in Chapter 5 of the VNA Measurement Guide (listed in Appendix A) for Save and Recall menu information.

The current GPS coordinates are 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 trace, then when the trace is recalled, the coordinates that were saved are recalled as well. Refer to the File menu in Chapter 5 of the VNA Measurement Guide (listed in Appendix A) for more information about recalling a saved trace.

Appendix A — Measurement Guides

A-1 Introduction

This appendix provides a list of the Measurement Guides (Table A-1) that accompany this User Guide and additional documents that are related to the VNA Master (Table A-2). The VNA Master Technical Data Sheets list the analyzers and the required options that are described in each measurement guide.

Table A-1. Measurement Guides

Title	Part Number
Vector Network Analyzer Measurement Guide	10580-00289
Spectrum Analyzer Measurement Guide – Interference Analyzer, Channel Scanner, IF Output, Gated Sweep, CW Generator	10580-00244
Power Meter Measurement Guide – Power Meter, High Accuracy Power Meter	10580-00240

Table A-2. VNA Master-Related Documents

Title	Part Number
VNA Master MS20xxC Technical Data Sheet	11410-00548
Programming Manual	10580-00306
VNA Master MS20xxC Maintenance Manual	10580-00307

The measurement guides are available as PDF files from the Master Software Tools CD-ROM (when Master Software Tools is installed on a PC). All of these documents are also available from the Anritsu Web site (refer to Section 1-11 “Anritsu Reference Documents” on page 1-7). The Web site also has links to download application notes, brochures, and online help documents.

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
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

Table B-1. Signal Standards

Signal Standard	Center (MHz)	Span (MHz)	Valid Channels
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
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

Table B-1. Signal Standards

Signal Standard	Center (MHz)	Span (MHz)	Valid Channels
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
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, then 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.

Reset Via Instrument Menus

From the VNA Master menu system, press the **Shift** key, then the **System** (8) key to open the System menu. Then press the System Options soft key to open the System Options menu. Then press the Reset soft key to open the Reset menu (refer to the Reset menu in Chapter 5 of the VNA Measurement Guide (listed in Appendix A). From the Reset menu, press either the Factory Defaults soft key or the Master Reset soft 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 2-35). Throughout this appendix, this sequence is abbreviated as Factory Defaults (**Esc**+**On**).

Master Reset:

Hold the **8** key in the number keypad (also referred to as the **System** (8) key) while pressing the **On/Off** button. Continue holding the **8** key until the Anritsu splash screen appears. You can then release the key. The VNA Master starts up in FULL Factory Default condition (refer to section "Master Reset" on page 2-36). Throughout this appendix, this sequence is abbreviated as Master Reset (**System**+**On**).

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 key 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 erase all user saved setups and measurement traces and will return the VNA Master to a full Factory Default condition. If the error persists, then contact your Anritsu Service Center.

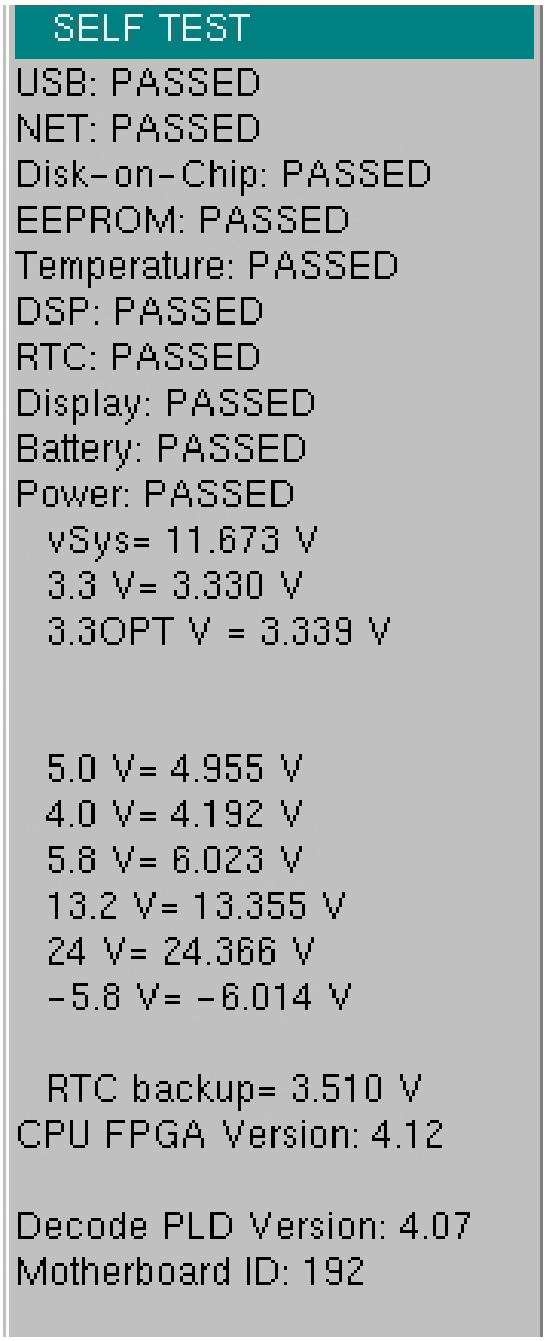


Figure C-1. Self Test Results Window (Vector Network Analyzer mode)

Caution	Depending upon the set mode of instrument operation, you may (or may not) see the full results in the Self Test list.

Application Self Test Results Window — VNA

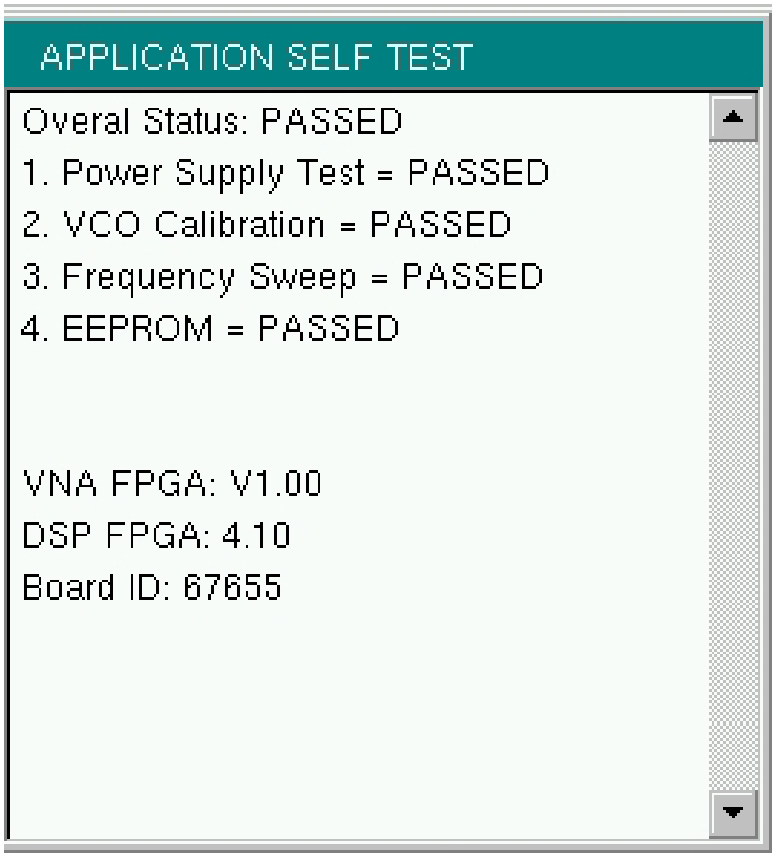


Figure C-2. Application Self Test Results Window (Vector Network Analyzer mode)

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 key 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 erase all user saved setups and measurement traces and will return the VNA Master to a full Factory Default condition. If the error persists, then contact your Anritsu Service Center.

Application Self Test Results Window — SPA

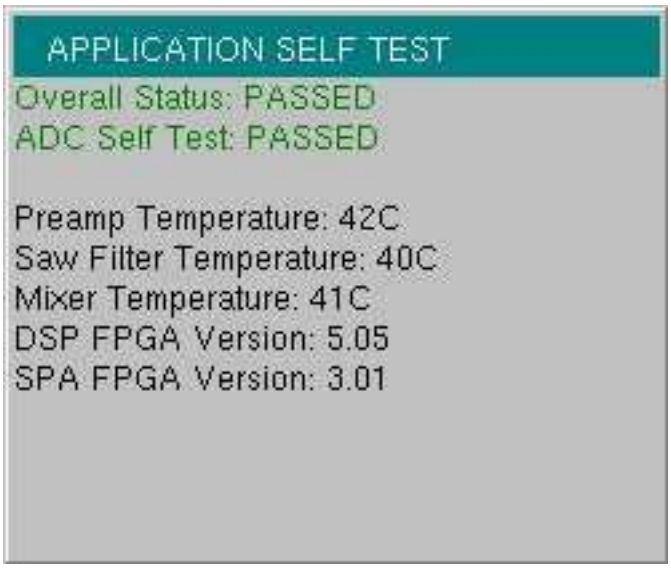


Figure C-3. Application Self Test Results Window (Spectrum Analyzer mode)

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.

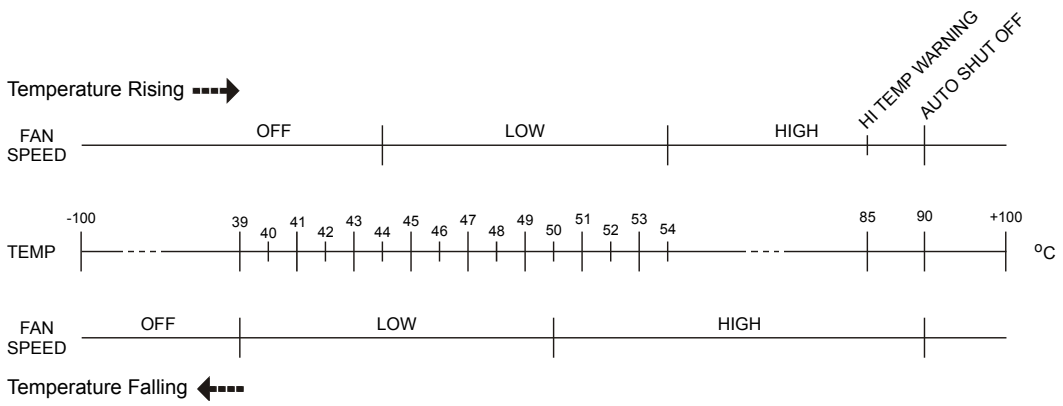


Figure C-4. Fan Speed vs. Temperature

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 erase all user saved setups and measurement traces and will return the VNA Master to a full Factory Default condition. If the error persists, then 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 was turned on when a new calibration sequence was started. The Bias Tee was 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 measurement file does not match the current setup. To ensure DUT safety, the Bias Tee function is turned off.

Turning Bias Tee to OFF.

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

The recalled setup 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.

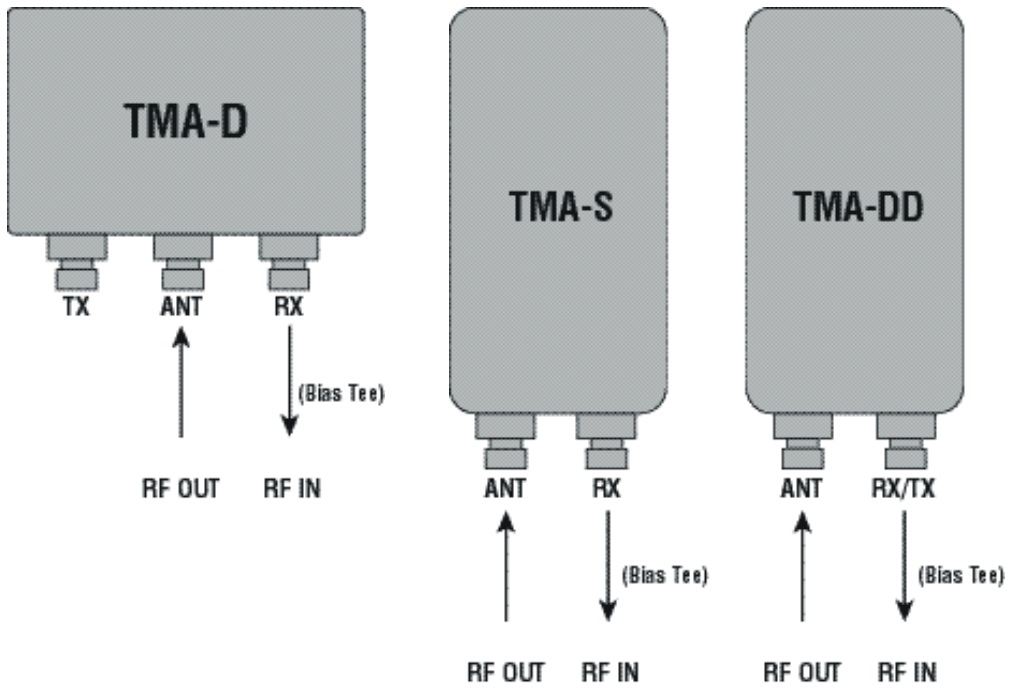


Figure D-1. Tower Mounted Amplifiers

Appendix E — Coaxial Cable Technical Data

E-1 Coaxial Cable Technical Data

The table below provides a list of common coaxial cables.

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
Andrew	LDF4-50A	0.88	1000	0.073	2000	0.107	2500	0.12

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	LDF4.5-50	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
Cellflex	UCF114-50JA	0.89	1000	0.031	2000	0.047	2000	0.047

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
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
Nk Cables	RFF7/8-50BHF	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
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 — Waveguide Data

F-1 Introduction

This appendix provides lists of waveguide components and their characteristics.

F-2 Calibration Components

The calibration components part numbers in the following table are broken down as follows, where the **xx** in the part number column (as in **xx**UM70) is replaced as follows:

```
xx:    23 = 1/8 Offset Short
       24 = 3/8 Offset Short
       26 = Precision Load
```

Table F-1. Precision Waveguide Calibration Components

Part Number	Freq. Range (GHz)	Waveguide Type	Compatible Flanges
xxUM70	5.85 to 8.20	WR137, WG14	CAR70, PAR70, UAR 70, PDR70
xxUM84	7.05 to 10.00	WR112, WG15	CBR84, UBR84, PBR84, PDR84
xxUM100	8.20 to 12.40	WR90, WG16	CBR100, UBR100, PBR100, PDR100
xxUM120	10.00 to 15.00	WR75, WG17	CBR120, UBR120, PBR120, PDR120
xxUA187	3.95 to 5.85	WR187, WG12	CPR187F, CPR187G, UG-1352/U, UG-1353/U, UG-1728/U, UG-1729/U, UG-148/U, UG-149A/U
xxUA137	5.85 to 8.20	WR137, WG14	CPR137F, CPR137G, UG-1356/U, UG-1357/U, UG-1732/U, UG-1733/U, UG-343B/U, UG-344/U, UG-440B/U, UG-441/U
xxUA112	7.05 to 10.00	WR112, WG15	CPR112F, CPR112G, UG-1358/U, UG-1359/U, UG-1734/U, UG-1735/U, UG-52B/U, UG-51/U, UG-137B/U, UG-138/U
xxUA90	8.20 to 12.40	WR90, WG16	CPR90F, CPR90G, UG-1360/U, UG-1361/U, UG-1736/U, UG-1737/U, UG-40B/U, UG-39/U, UG-135/U, UG-136B/U
xxUA62	12.40 to 18.00	WR62, WG18	UG-541A/U, UG-419/U, UG-1665/U, UG1666/U

Table F-1. Precision Waveguide Calibration Components (Continued)

Part Number	Freq. Range (GHz)	Waveguide Type	Compatible Flanges
xxUA42	17.00 to 26.50	WR42, WG20	UG-596A/U, UG-595/U, UG-597/U, UG-598A/U

F-3 Waveguide-to-Coaxial Adapters

Part numbers that end with N have Type N connectors, part numbers that end with K have K Connectors.

Table F-2. Coaxial to Universal Waveguide Adapters

Part Number	Freq. Range (GHz)	Waveguide Type	Compatible Flanges
35UM70N	5.85 to 8.20	WR137, WG14	CAR70, PAR70, UAR 70, PDR70
35UM84N	7.05 to 10.00	WR112, WG15	CBR84, UBR84, PBR84, PDR84
35UM100N	8.20 to 12.40	WR90, WG16	CBR100, UBR100, PBR100, PDR100
35UM120N	10.00 to 15.00	WR75, WG17	CBR120, UBR120, PBR120, PDR120
35UA187N	3.95 to 5.85	WR187, WG12	CPR187F, CPR187G, UG-1352/U, UG-1353/U, UG-1728/U, UG-1729/U, UG-148/U, UG-149A/U
35UA137N	5.85 to 8.20	WR137, WG14	CPR137F, CPR137G, UG-1356/U, UG-1357/U, UG-1732/U, UG-1733/U, UG-343B/U, UG-344/U, UG-440B/U, UG-441/U
35UA112N	7.05 to 10.00	WR112, WG15	CPR112F, CPR112G, UG-1358/U, UG-1359/U, UG-1734/U, UG-1735/U, UG-52B/U, UG-51/U, UG-137B/U, UG-138/U
35UA90N	8.20 to 12.40	WR90, WG16	CPR90F, CPR90G, UG-1360/U, UG-1361/U, UG-1736/U, UG-1737/U, UG-40B/U, UG-39/U, UG-135/U, UG-136B/U
35UA62N	12.40 to 18.00	WR62, WG18	UG-541A/U, UG-419/U, UG-1665/U, UG1666/U
35UA42K	7.00 to 26.50	WR42, WG20	UG-596A/U, UG-595/U, UG-597/U, UG-598A/U

F-4 Flange Compatibility

Table F-3. Universal Flange Compatibility (1 of 3)

Calibration Component Part Number	Start Frequency (GHz)	Stop Frequency (GHz)	Waveguide Type	Flange Type	Compatible Flanges
xxUM40	3.300	4.900	WR229 WG11A	UnivM-229	PDR40
xxUM48	3.950	5.850	WR187 WG12	UnivM-187	CAR48 PAR48 UAR48 PDR48
xxUM58	4.900	7.050	WR159 WG13	UnivM-159	CAR58 PAR58 UAR58 PDR58
xxUM70	5.850	8.200	WR137 WG14	UnivM-137	CAR70 PAR70 UAR70 PDR70
xxUM84	7.050	10.000	WR112 WG15	UnivM-112	CBR84 UBR84 PBR84 PDR84
xxUM100	8.200	12.400	WR90 WG16	UnivM-90	CBR100 UBR100 PBR100 PDR100
xxUM120	10.000	15.000	WR75 WG17	UnivM-75	CBR120 UBR120 PBR120 PDR120
xxUM140	12.400	18.000	WR62 WG18	UnivM-62	CBR140 UBR140 PBR140 PDR140
xxUM220	17.000	26.500	WR42 WG20	UnivM-42	CBR220 UBR220 PBR220 PDR220
xxUA229	3.300	4.900	WR229 WG11A	UnivUS-229	CPR229F CPR229G UG-1350/U UG-1351/U UG-1726/U UG-1727/U

Universal Flange Compatibility

Table F-4. Universal Flange Compatibility (2 of 3)

Calibration Component Part Number	Start Frequency (GHz)	Stop Frequency (GHz)	Waveguide Type	Flange Type	Compatible Flanges
xxUA187	3.950	5.850	WR187 WG12	UnivUS-187	CPR187F CPR187G UG-1352/U UG-1353/U UG-1728/U UG-1729/U UG-148/U UG-149A/U
xxUA159	4.900	7.050	WR159 WG13	UnivUS-159	CPR159F CPR159G UG-1354/U UG-1355/U UG-1730/U UG-1731/U
xxUA137	5.850	8.200	WR137 WG14	UnivUS-137	CPR137F CPR137G UG-1356/U UG-1357/U UG-1732/U UG-1733/U UG-343B/U UG-344/U UG-440B/U UG-441/U
xxUA112	7.050	10.00	WR112 WG15	UnivUS-112	CPR112F CPR112G UG-1358/U UG-1359/U UG-1734/U UG-1735/U UG-52B/U UG-51/U UG-137B/U UG-138/U

Table F-4. Universal Flange Compatibility (2 of 3) (Continued)

Calibration Component Part Number	Start Frequency (GHz)	Stop Frequency (GHz)	Waveguide Type	Flange Type	Compatible Flanges
xxUA90	8.200	12.400	WR90 WG16	UnivUS-90	CPR90F CPR90G UG-1360/U UG-1361/U UG-1736/U UG-1737/U UG-40B/U UG-39/U UG-135/U UG-136B/U
xxUA75	10.000	15.000	WR75 WG17	UnivUS-75	WR75

Universal Flange Compatibility

Table F-5. Universal Flange Compatibility (3 of 3)

Calibration Component Part Number	Start Frequency (GHz)	Stop Frequency (GHz)	Waveguide Type	Flange Type	Compatible Flanges
xxUA62	12.400	18.000	WR62 WG18	UnivUS-62	UG-541A/U UG-419/U UG-1665/U UG-1666/U
xxUA42	17.000	26.500	WR42 WG20	UnivUS-42	UG-596A/U UG-595/U UG-597/U UG-598A/U
xxCMR229	3.300	4.900	WR229 WG11A	CMR229	CMR229
xxCMR187	3.950	5.850	WR187 WG12	CMR187	CMR187 UG-1475/U UG-1480/U
xxCMR159	4.900	7.050	WR159 WG13	CMR159	CMR159
xxCMR137	5.850	8.200	WR137 WG14	CMR137	CMR137 UG-1476/U UG-1481/U
xxCMR112	7.050	10.000	WR112 WG15	CMR112	CMR112 UG-1477/U UG-1482/U
xxCMR90	8.200	12.400	WR90 WG16	CMR90	CMR90 UG-1478/U UG-1483/U
xxUER40	3.300	4.900	WR229 WG11A	UER40	UER40
xxUER48	3.950	5.850	WR187 WG12	UER48	UER48
xxUER58	4.900	7.050	WR159 WG13	UER58	UER58
xxUER70	5.850	8.200	WR137 WG14	UER70	UER70
xxUER84	7.050	10.000	WR112 WG15	UER84	UER84
xxUER100	8.200	12.400	WR90 WG16	UER100	UER100

F-5 Waveguide Technical Data

Table F-6. Waveguide Offset Short[a] Specifications

Offset Short P/N	Frequency (GHz)	Length (mm)
24UM70	6.926	20,710 +/- 0.08
24UM84	8.396	17,040 +/- 0.05
24UM100	10.084	14,675 +/- 0.05
24UM120	12.247	11,978 +/- 0.04
24UA187	4.807	30,979 +/- 0.11
24UA137	6.926	20,710 +/- 0.08
24UA112	8.396	17,040 +/- 0.05
24UA90	10.084	14,675 +/- 0.05
24UA62	14.940	9,742 +/- 0.04
24UA42	21.225	7,067 +/- 0.03
24CMR187	4.807	30,979 +/- 0.11
24CMR137	6.926	20,710 +/- 0.08
24CMR112	8.396	17,040 +/- 0.05
24CMR90	10.084	14,675 +/- 0.05
24UER70	6.926	20,710 +/- 0.08
24UER84	8.396	17,040 +/- 0.05
24UER100	10.084	14,675 +/- 0.05

a.Offset shorts are 3/8 wave at the geometric mean frequency waveguide band and dimensionally accurate to <0.5 degree at the maximum operating frequency of the corresponding wavelength.

Waveguide Technical Data

Table F-7. Waveguide Technical Data (1 of 2)

Waveguide Type/Model	Start Frequency (GHz)	Stop Frequency (GHz)	Cutoff Frequency (GHz)	Mid-Band Loss (dB/m, GHz)
WR229, WG11A	3.300	4.900	2.577	0.0374
WR187, WG12	3.950	5.850	3.152	0.0515
WR159, WG13	4.900	7.050	3.711	0.0591
WR137, WG14	5.850	8.200	4.301	0.0738
WR112, WG15	7.050	10.000	5.259	0.1024
WR102	7.000	11.000	5.786	0.1083
WR90, WG16	8.200	12.400	6.557	0.1578
WR75, WG17	10.000	15.000	7.868	0.1913
WR67	11.000	17.000	8.578	0.2159
WR62, WG18	12.400	18.000	9.486	0.2411
WR51, WG19	15.000	22.000	11.574	0.3691
WR42, WG20	17.000	26.500	14.047	0.5200
Andrew				
EW17	1.700	2.400	1.364	0.012
EW20	1.900	2.700	1.57	0.015
EW28	2.600	3.400	2.2	0.021
EW34	3.100	4.200	2.376	0.0223
EW37	3.300	4.300	2.790	0.0292
EW43	4.400	5.000	2.780	0.0289
EW52	4.600	6.425	3.650	0.042
EW63	5.580	7.125	4.000	0.0453
EW64	5.300	7.750	4.320	0.052
EW77	6.100	8.500	4.720	0.061
EW85	7.700	9.800	6.460	0.1086
EW90	8.300	11.700	6.500	0.108
EW127	10.000	13.250	7.670	0.124

Waveguide Technical Data

Table F-8. Waveguide Technical Data (2 of 2)

Waveguide Type/Model	Start Frequency (GHz)	Stop Frequency (GHz)	Cutoff Frequency (GHz)	Mid-Band Loss (dB/m, GHz)
EW132	11.000	15.350	9.220	0.17
EW180	14.000	19.700	11.150	0.1939
EW220	17.000	23.600	13.340	0.2822
Cablewave				
WE37	3.600	4.200	2.830	0.0269
WE46	4.400	5.000	3.000	0.0354
WE61	5.925	6.425	3.600	0.0390
WE65	6.425	7.125	4.000	0.0453
WE70	7.125	7.750	4.300	0.0404
WE78	7.125	8.500	4.670	0.0446
WE108	10.500	11.700	6.570	0.0978
WE130	11.700	13.250	7.430	0.1142
WE150	14.000	15.350	8.600	0.1398
WE191	17.700	19.700	10.680	0.1952
RFS Cablewave				
E20	1.700	2.300	1.38	0.012
E30	2.300	3.100	1.8	0.016
E38	3.000	4.200	2.4	0.025
E46	3.650	5.000	2.88	0.028
ES46	3.900	5.000	3.08	0.036
E60	4.500	6.425	3.65	0.045
E65	5.000	7.125	4.01	0.05
E78	5.900	8.500	4.72	0.06
E105	8.100	11.700	6.49	0.09
E130	9.300	13.250	7.43	0.12
E150	10.800	15.350	8.64	0.15
E185	13.700	19.700	11.06	0.2
E220	16.700	23.600	13.36	0.29

Appendix G — More About DHCP

G-1 Introduction

DHCP stands for Dynamic Host Configuration Protocol. This protocol 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 a DHCP server is available on the network, DHCP is the preferred IP address mode.

G-2 Using DHCP

When using DHCP, no setup is required to lease and use a dynamic IP address. In a dynamic IP operation, the assigned IP address may change from use to use. The DHCP server assigns IP addresses on a time rotation 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 requesting an IP address. Normally, some amount of lag time occurs on the DHCP server end, so if the device is connected again reasonably soon, it may receive the same address.

Note	The VNA Master must be connected to the network *before* it is turned on in order to allow DHCP to work. Key elements of the DHCP lease are performed only during the instrument startup operations or when switching from manual to DHCP.

G-3 Static IP 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 avoid conflict with other equipment on the network.

When using a static IP address on an established network, always request a 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.

Default Gateway

Often when a static IP address is assigned, a default gateway is also identified. If the default gateway is unknown, then 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 upon the class of the address. It 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 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
```

G-4 Operating System Tools

A few tools that are built into the Microsoft Windows operating system can assist in making some determinations about the network that the PC is plugged into.

Ipconfig Tool

Typing ipconfig at a command prompt will display information about the in-use parameters of the PC and its network connection. Below is an example of the typical results expected.

Note	The ipconfig display does not report if the information is from a DHCP server or 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
```

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, for it to reply. Greatly simplified, ping sends out a request to a specific address to determine if it is there. If the specific address is found, then it will respond by sending back the same message that was received. If it is not found, then the response will be "request timed out." This 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 = 0ms, Maximum = 0ms, Average = 0ms
```

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