User Guide

LMR Master™
S412E

An Integrated, Handheld Multi-function Land Mobile Radio Test Tool for Greater Flexibility and Technician Productivity

Appendix A provides a list of supplemental documentation for the LMR Master features and options. The documentation set is available as PDF files on the documentation disc and the Anritsu web site.

Anritsu

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The Anritsu products listed on the title page is warranted against defects in materials and workmanship for three years from the date of shipment.

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UPDATES

Updates, if any, can be downloaded from the Documents area of the Anritsu Website at:
http://www.anritsu.com

For the latest service and sales contact information in your area, please visit:
http://www.anritsu.com/contact.asp

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: LMR Master

    Model Number: S412E

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 DEC 2010
                                                   Date

产品中有毒有害物质或元素的名称及含量

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 [Cr(VI)]	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
印刷线路板 (PCA)	×	○	×	×	○	○
机壳、支架 (Chassis)	×	○	×	×	○	○
LCD	×	×	×	×	○	○
其他（电缆、风扇、 连接器等） (Appended goods)	×	○	×	×	○	○
○：表示该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T11363-2006 标准规 定的限量要求以下。 ×：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T11363-2006 标准规定的限量要求。						

环保使用期限

这个标记是根据 2006/2/28 公布的「电子信息产品污染控制管理办法」以及
SJ/T 11364-2006「电子信息产品污染控制标识要求」的规定，适用于在中国
销售的电子信息产品的环保使用期限。仅限于在遵守该产品的安全规范及使用
注意事项的基础上，从生产日起算的该年限内，不会因产品所含有害物质的泄
漏或突发性变异，而对环境污染，人身及财产产生深刻地影响。
注）电池的环保使用期限是 5 年。生产日期标于产品序号的前四码
　　（如 S/N 0728XXXX 为 07 年第 28 周生产）。

Equipment marked with the Crossed-out Wheelie
Bin symbol complies with the European
Parliament and Council Directive 2002/96/EC (the
"WEEE Directive") in the European Union.

For Products placed on the EU market after
August 13, 2005, please contact your local Anritsu
representative at the end of the product's useful
life to arrange disposal in accordance with your
initial contract and the local law.

CE Conformity Marking

Anritsu affixes the CE Conformity marking onto its conforming products in accordance with Council Directives of The Council Of The European Communities in order to indicate that these products conform to the EMC and LVD directive of the European Union (EU).

$$C \, \epsilon$$

C-tick Conformity Marking

Anritsu affixes the C-tick marking onto its conforming products in accordance with the electromagnetic compliance regulations of Australia and New Zealand in order to indicate that these products conform to the EMC regulations of Australia and New Zealand.

CN274

Notes On Export Management

This product and its manuals may require an Export License or approval by the government of the product country of origin for re-export from your country.

Before you export this product or any of its manuals, please contact Anritsu Company to confirm whether or not these items are export-controlled.

When disposing of export-controlled items, the products and manuals need to be broken or shredded to such a degree that they cannot be unlawfully used for military purposes.

Mercury Notification

This product uses an LCD backlight lamp that contains mercury. Disposal may be regulated due to environmental considerations. Please contact your local authorities for disposal or recycling information.

Perchlorate Material – Special Handling May Apply

Notification for California customers: this product uses a small Lithium battery installed internally on the circuit board that may contain perchlorate. Disposal may be regulated due to environmental considerations. Please contact your local authorities for disposal or recycling information. For information, see:
http://www.dtsc.ca.gov/hazardouswaste/perchlorate/

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 risk from a very dangerous condition or procedure that could result in serious injury or death and possible loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

Warning

WARNING ⚠

This indicates a risk from a hazardous condition or procedure that could result in light-to-severe injury or loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

Caution

This indicates a risk from a hazardous procedure that could result in loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

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.

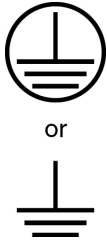These indicate that the marked part should be recycled.

For Safety

| 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 (or) | When supplying power to this equipment, connect the accessory 3-pin power cord to a 3-pin grounded power outlet. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock. |

| Warning **WARNING** ⚠ | This equipment can not 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. |

| Warning | This product is supplied with a rechargeable battery that could potentially leak hazardous compounds into the environment. These hazardous compounds present a risk of injury or loss due to exposure. Anritsu Company recommends removing the battery for long-term storage of the instrument and storing the battery in a leak-proof plastic container. Follow the environmental storage requirements specified in the product technical data sheet. |

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Chapter 1 — General Information

1-1 Introduction

This chapter provides information about frequency range, additional documents, general overview, preventive maintenance, and annual verification requirements for the Anritsu Handheld S412E LMR Master models. Available options are listed in Chapter 4, "Instrument Options".

Throughout this manual, the terms LMR Master and S412E refer to the same instrument.

1-2 Contacting Anritsu

To contact Anritsu, please visit:

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

From here, you can select the latest sales, select service, and support contact information in your country or region, provide online feedback, complete a "Talk to Anritsu" form to have your questions answered, or obtain other services offered by Anritsu. Updated product information can be found on the Anritsu web site:

http://www.anritsu.com/

Search for the product model number. The latest documentation is on the product page under the Library tab. Example URL for LMR Master S412E:

http://www.anritsu.com/en-us/products-solutions/products/s412e.aspx

1-3 Available Models

Table 1-1 lists the LMR Master models and frequency ranges that are described in this User Guide

Table 1-1. LMR Master Models and Frequency Ranges

Model	Frequency Range
S412E	Vector Network Analyzer: 500 kHz to 1.6 GHz[a] Spectrum Analyzer: 9 kHz to 1.6 GHz[b] Signal Generator: 500 kHz to 1.6 GHz NBFM Analyzer: 100 kHz to 1.6 GHz[b]

a. Upper frequency range is 6 GHz with Option 16.

b. Upper frequency range is 6 GHz with Option 6.

1-4 Additional Options

Additional options for the LMR Master are listed in Table 1-2. Most of these options are described in Measurement Guides (refer to Appendix A).

Table 1-2. LMR Master Models and Frequency Ranges

Model	Frequency Range
S412E-0006	6 GHz Spectrum Analyzer Frequency Extension
S412E-0010	Bias Tee
S412E-0015	Vector Voltmeter
S412E-0016	6 GHz VNA Frequency Extension
S412E-0019	High Accuracy Power Meter
S412E-0025	Interference Analyzer
S412E-0027	Channel Scanner
S412E-0031	GPS
S412E-0046	Fixed WiMAX RF Measurements
S412E-0047	Fixed WiMAX Demodulation
S412E-0066	Mobile WiMAX RF Measurements
S412E-0067	Mobile WiMAX Demodulation
S412E-0037	Mobile WiMAX Over-the-Air Measurements
S412E-0431	Coverage Mapping
S412E-0444	EMF Measurement (Requires Anritsu Isotropic Antenna)
S412E-0501	Distance Domain
S412E-0509	AM/FM/PM Analyzer
S412E-0521	P25/P25p2 Analyzer Measurements
S412E-0522	P25/P25p2 Coverage Measurements
S412E-0531	NXDN Analyzer Measurements
S412E-0532	NXDN Coverage Measurements
S412E-0541	LTE RF Measurements
S412E-0542	LTE Modulation Quality
S412E-0546	LTE Over-the-Air Measurements
S412E-0591	DMR 2 Analyzer Measurements
S412E-0592	DMR 2 Coverage Measurements
S412E-0721	PTC Analyzer Measurements
S412E-0722	PTC Coverage Measurements
S412E-0581	TETRA Analyzer Measurements
S412E-0582	TETRA Coverage Measurements

1-5   Additional Documents

This user guide is specific to the LMR Master S412E and includes a general description of the instruments. Additional instrument functions and descriptions of optional measurement capabilities are described in measurement guides.

Refer to Appendix A, "Measurement Guides" for a list of these guides and their Anritsu part numbers. Measurement guides are available on the document disc included with the instrument and for download (at no charge) from the Anritsu web site (http://www.anritsu.com). Refer to "Anritsu Reference Documents" on page 1-8.

General and performance specifications, instrument options, standard accessories, and optional accessories are described in the LMR Master Technical Data Sheet, (Anritsu part number 11410-00486).

1-6   Accessories

The LMR Master Technical Data Sheet contains a list and description of available accessories. The data sheet is available on the documentation disc and the Anritsu web site.

1-7   General Description

The S412E LMR Master is an integrated multi-functional test instrument that eliminates the need to carry and learn multiple test sets. The S412E combines a high performance receiver/spectrum analyzer with a vector network analyzer. The S412E can optionally be configured to include Coverage Mapping for P25/P25p2, NXDN™, ETSI DMR Tier 2, MotoTRBO™, ITC-R PTC, and TETRA. Other available options include Interference Analyzer with mapping, Channel Scanner, AM/FM/PM Analyzer, Vector Voltmeter, Fixed and Mobile WiMAX™, FirstNet LTE (RF, Modulations, and Over-the-Air), Distance Domain for VNA, and High Accuracy Power Meter for terminating and inline USB sensors.

The S412E includes a CW and NBFM Signal Generator with a 500 kHz to 1.6 GHz frequency range and +0 dBm (1 mW) maximum power level. In the available LMR modes (P25/P25p2, NXDN, DMR 2, or ITC-R PTC) the S412E signal generator can create mode specific patterns, CW, 1 kHz AM, and 1 kHz FM signals with adjustable frequency and power levels.

The LMR Master spectrum analyzer, NBFM, P25/P25p2, NXDN, DMR 2, and PTC frequency ranges are expanded to 6 GHz with Option 6. The VNA frequency range is expanded to 6 GHz with Option 16.

Additional options include a Bias Tee for TMA testing and a GPS receiver. Details on configuration and available options is provided in the LMR Master Technical Data Sheet.

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

The internal memory is large enough to store approximately 2,000 traces or setups. External USB memory is limited only by the size of the attached USB memory device. Measurements and setups can also be stored in a USB flash drive or transferred to a PC by using the included USB cable. Use Line Sweep Tools (LST) for certain VNA measurements and Master Software Tools (MST) for spectral analysis measurements (refer to Chapter 6, "Anritsu PC Software Tools" for a brief overview of these software tools).

Note	Not all after-market USB flash drives are compatible with the LMR Master. Many drives come with a second partition that contains proprietary firmware. This partition must be removed. Only one partition is allowed. Refer to the individual manufacturer for instructions on how to remove it. Some drives can be made to work by reformatting them using the FAT32 format.

1-8   LMR Master Specifications

Refer to the LMR Master Technical Data Sheet (Anritsu part number: 11410-00486) 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, available on the documentation disc, and it is available on the Anritsu Website: http://www.anritsu.com

1-9   Soft Carrying Case

The LMR Master 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 instrument into the soft carrying case:

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

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

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

3. Open the zippered back of the case.

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

Figure 1-1.   LMR Master Inserted into the Soft Carrying Case

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

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

1-10   Tilt Bail Stand

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

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

Figure 1-2.   Tilt Bail Extended

1-11   Rack Mounting

The LMR Master can be mounted into a standard 19-inch EIA cabinet using Anrtisu's Rack Mount Accessory kit (Anritsu part number: 66864).

The LMR Master is mounted in the universal bracket using the thin-case spacer and the compact-case brackets, both of which are included in the kit.

1-12   Preventive Maintenance

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

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

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

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

1-13   Calibration Requirements — Vector Network Analyzer

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

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

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

Caution	For best results, use an Anritsu phase stable Test Port Extension Cable, such as those listed in the Technical Data Sheet for your instrument (refer to Appendix A). Use of a typical laboratory cable to extend the LMR 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.

1-14   Annual Verification

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

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

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

1-15   ESD Cautions

The LMR 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 LMR 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 LMR Master, Anritsu Company recommends that any static charges that may be present be dissipated before connecting coaxial cables or antennas to the LMR Master. This may be as simple as

temporarily attaching a short or load device to the cable or antenna prior to attaching to the LMR 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.

1-16   Anritsu Reference Documents

To find the LMR Master product pages, enter "LMR Master" in the search box on the Anritsu Web page:

http://www.anritsu.com

A table at the bottom of the LMR Master product Web page provides links to related literature and software. Examples include the following types of documents:

- Application Notes
- Brochures
- Data Sheets
- Instruction Sheets
- Measurement Guides
- Master Software Tools
- Line Sweep Tools
- easyMap Tools™
- Firmware Updates
- Digital LMR Control Channel Decoder scripts

1-17   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.

1-18   Battery Replacement

The battery can be replaced without the use of tools. The battery compartment is located on the lower left side of the instrument (when you are facing the measurement display). Refer to Figure 1-3. To remove the battery:

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

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

3. Lift out the battery door.

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

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

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

Figure 1-3.   Battery Compartment

The battery that is supplied with the LMR Master may need charging before use. The battery can be charged while it is installed in the LMR Master by using either the AC-DC Adapter or the DC adapter, or outside the LMR Master with the optional Dual Battery Charger. Refer to "Battery Symbols" on page 2-13 for a description of battery symbols.

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

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

1-19   Secure Environment Workplace

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

LMR Master Memory Types

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

Disk-On-A-Chip (DOC)

DOC is used for storage of instrument firmware, factory calibration information, user measurements, setups, and `*.jpg` screen images. User information stored on the DOC is erased by the master reset process described in section "Erase All User Files in Internal Memory" on page 1-11.

EEPROM

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

RAM Memory

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

External USB Flash Drive (not included with the instrument)

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

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

Erase All User Files in Internal Memory

Perform a Master Reset:

1. Turn the instrument on.

2. If the Menu screen is displayed, press the **Esc** key.

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

4. Press the System Options submenu key.

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

6. A dialog box is displayed on the screen warning that all settings will be returned to factory default values and all user files will be deleted.

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

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

Recommended Usage in a Secure Environment

Set the LMR Master to save files to an external USB flash drive:

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

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

3. Press the Save submenu key.

4. Press the Change Save Location submenu key, then select the USB flash drive with the rotary knob, **Up/Down** arrow keys, or the touchscreen.

5. Press the Set Location submenu key.

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

Note	Not all after-market USB flash drives are compatible with the LMR Master. Many drives come with a second partition that contains proprietary firmware. This partition must be removed. Only one partition is allowed. Refer to the individual manufacturer for instructions on how to remove it. Some drives can be made to work by reformatting them using the FAT32 format.

Chapter 2 — Instrument Overview

2-1 Introduction

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

2-2 Turning On the LMR Master

The Anritsu LMR Master is capable of approximately three hours of continuous operation from a fully charged, field-replaceable battery (refer to Section 1-18 "Battery Replacement" on page 1-9).

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

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

To turn on the LMR Master, press the green **On/Off** button on the front panel (Figure 2-1). The LMR Master takes approximately sixty seconds to complete power warm-up and to load the application software. At the completion of this process, the instrument is ready for use.

2-3 Front Panel Overview

The LMR Master menu-driven interface is easy to use and requires little training. The LMR Master uses a touch screen and keypad for data input. The five bottom menu keys and eight submenu keys on the right side are touch screen keys. The menu and submenu keys vary depending upon the selected mode of operation. Refer to "Mode Selector Menu" on page 2-16.

Numeric 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 the alternate function is printed in blue above each of the keys. Use the blue **Shift** key to access the functions that are printed on the panel. The **Escape** key, used for aborting data entry, is the oval button located above numeric key 9. The rotary knob, the four arrow keys, and the keypad can be used to change the value of an active parameter.

The Menu key provides graphical icons of all of the installed measurement modes and user defined shortcuts (refer to "Menu Key" on page 2-3). The locations of the keys are shown in Figure 2-1.

Note	Keep the fan inlet and exhaust ports clear of obstructions at all times for proper ventilation and cooling of the instrument.
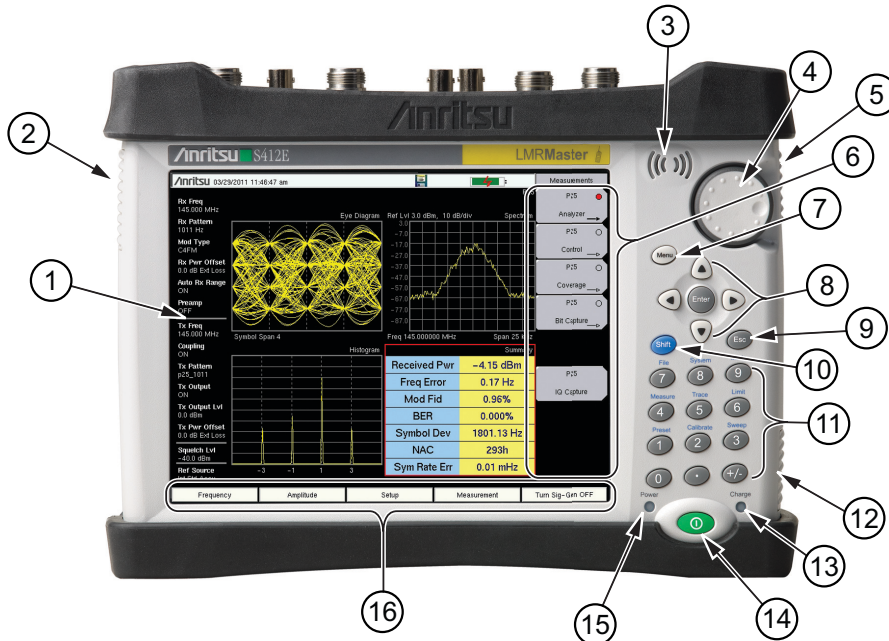
1	Instrument Settings Summary (unique to each trace). Many of displayed settings are used as menu shortcuts. Select a setting using the touch screen to display the menu and set the parameter for editing.
2	Fan Exhaust Port
3	Speaker
4	Rotary Knob
5, 12	Fan Inlet Port
6	Touch Screen Submenu Keys
7	Menu Key
8	Enter Key and Arrow Keys
9	Esc (Escape) Key
10	Shift Key
11	Numeric Keypad and Shift Menu Keys (printed in blue above 1 through 9)
13	Charge LED
14	On/Off Button
15	Power LED
16	Touch Screen Main Menu Keys

Figure 2-1.   LMR Master Overview

Front Panel Keys

Menu Key

Press this key to display a grid of shortcut icons for installed measurement modes and any user-selected menus and setup files that may have been added.

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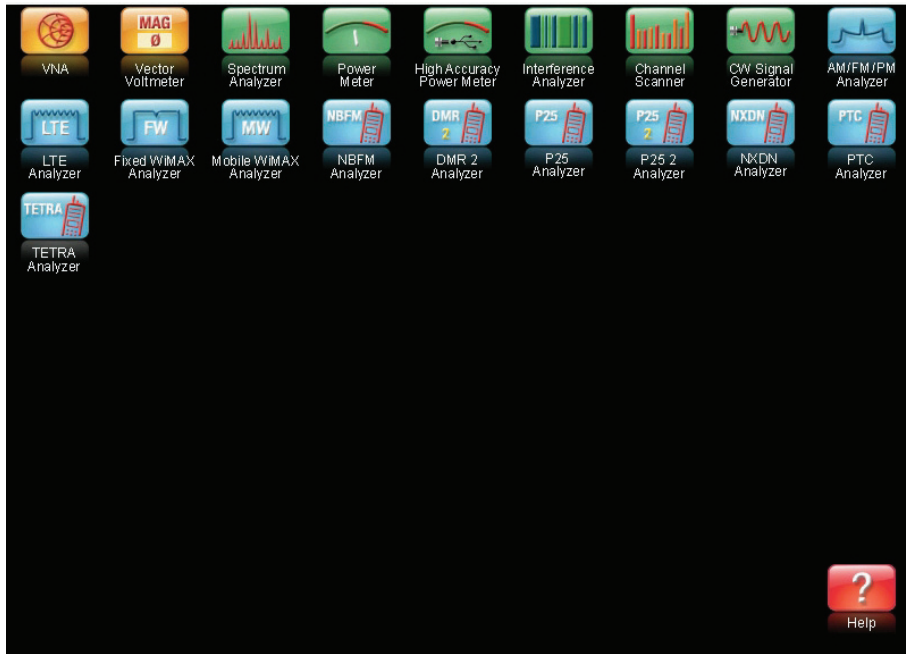
Figure 2-2. Menu Key Screen, Icons for Installed Measurements

Note	The display of the Menu screen varies depending on your LMR Master model and installed options.
	Only the **Esc** key and the touch screen icons are functional in the Menu screen.
	The instrument must be in a measurement mode to execute a function that is indicated in blue text above the number key. They do not function from the Menu screen.

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

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

Figure 2-3.   Menu Key Screen with User-Defined Shortcuts

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

Note	The Factory Default reset deletes all user created shortcut icons from the Menu screen. Refer to the "Reset Menu" on page 5-12 for additional information.

Help for the Menu shortcut screen is available by pressing the icon in the lower-right corner of the display.
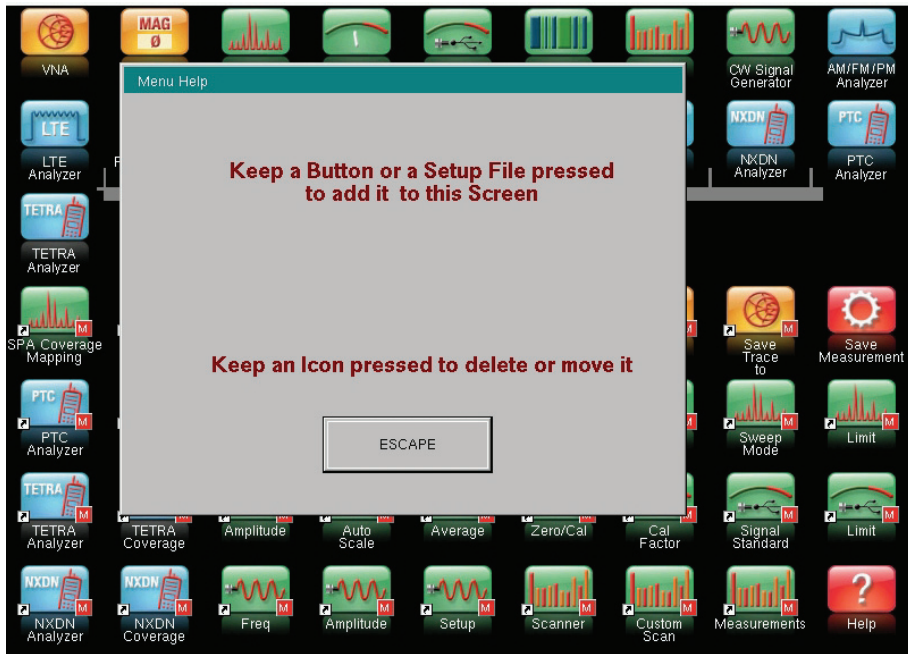
Figure 2-4.   Menu Help

Esc Key

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

Enter Key

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

Arrow Keys

The four arrow keys (around the **Enter** key) are used to scroll up, down, left, or right. 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 followed by pressing a number key executes the function that is indicated in blue text above the number key. When the **Shift** key is active, its icon is displayed at the top-right of the measurement display area near the battery charge indicator.

Figure 2-5.   Shift Key Icon

Number Keypad

The Number keypad has two functions: The primary function is number entry. The secondary function of the number keypad is to list various menus.

Rotary Knob

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

Touch Screen Keys

Main Menu Touch Screen Keys

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

Note	Available measurement modes are based on model and options purchased. Refer to Table 1-1 and the Technical Data Sheet for additional information.

Submenu Touch Screen Keys

These submenu keys are arranged along the right-hand edge of the touch screen. The submenu key labels change as instrument measurement settings change. The current submenu title is shown at the top of the submenu key block.

Keypad Menu Keys (1 to 9)

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

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

The Preset Menu (1) and System Menu (8) are described in Chapter 5, "System Operations ". The Sweep Menu (3), Measure Menu (4), Trace Menu (5), and Limit Menu (6) vary depending on measurement mode, refer to the Measurement Guides listed in Appendix A for information. The File Menu (7) is described in Chapter 4, "File Management". The Mode Menu (9) is described in "Mode Selector Menu" on page 2-16.

LED Indicators

Power LED

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

Charge LED

The Charge LED is located to the right of the **On/Off** key. The LED slowly blinks when the battery is charging and is solid green when the battery is fully charged.

2-4   Display Overview

Figure 2-6 illustrates some of the key information areas of the LMR Master sweep window in Vector Network Analyzer mode using "Field" menu structure. For detailed information, refer to the Measurement Guides that are listed in Appendix A, "Measurement Guides".
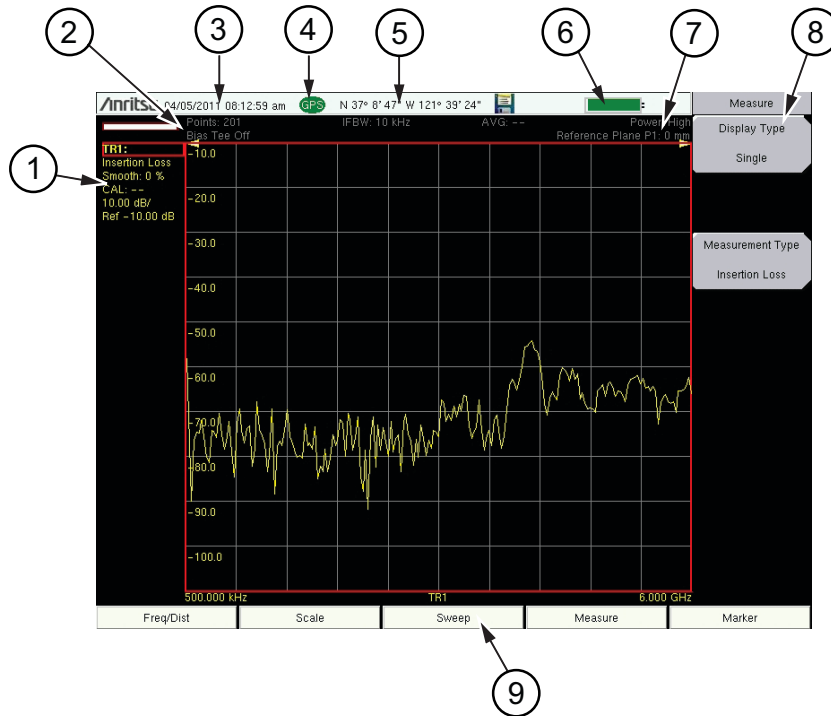
1	Trace 1 (TR1) data (within Instrument Settings Summary)
2	Instrument Settings Summary (applies to all traces)
3	Real Time Clock
4	GPS Icon
5	GPS location
6	Battery Charge indicator
7	Measurement description
8	Submenu Touch Screen Keys
9	Main Menu Touch Screen Keys

Figure 2-6.   Field Mode View VNA Display with GPS On

Note	Refer to "Field Mode Display vs. Standard VNA Display" on page 3-3 for information on the two LMR Master menu structures in VNA mode. Press **Shift-8 (System)** > Application Options > Meas Menu to toggle between the two structures.

Display Settings

In addition to the default color display, LMR Master offers the following display settings
(**System** > System Options > Display) in some measurement modes:

> **Black on White** for printing and viewing in broad daylight conditions

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

> **Night Vision** optimized for night-time viewing

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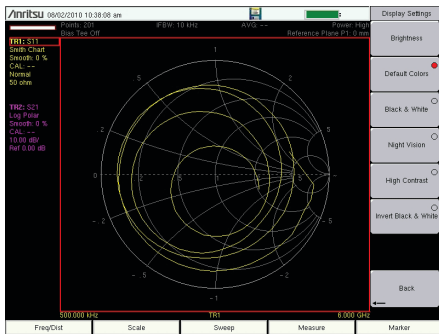
Default Colors
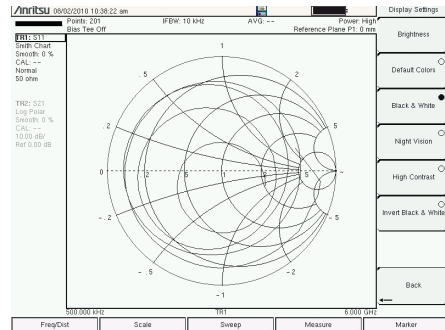
Black on White
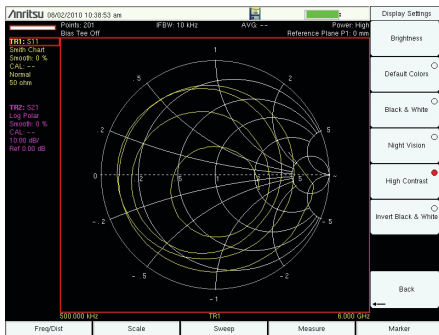
High Contrast
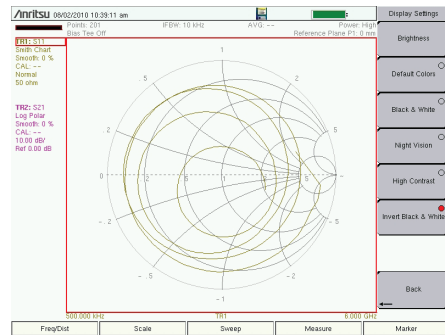
Color on White
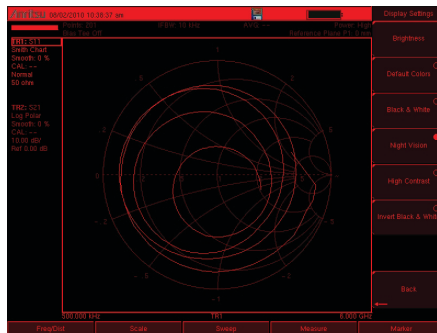
Night Vision

Figure 2-7.   LMR Master Display Settings

2-5   Test Panel Connector Overview

Test panel connectors for the LMR Master S412E is shown in Figure 2-8.
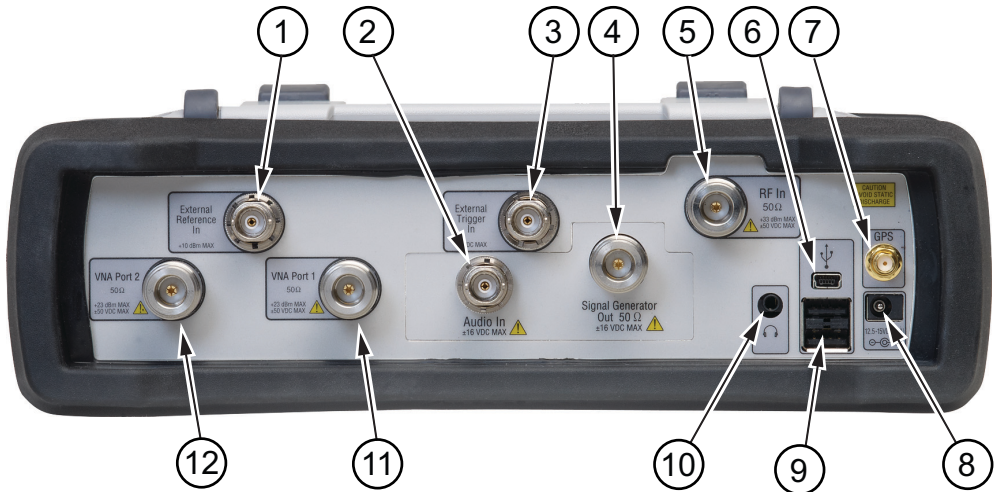
1	External Reference In
2	Audio In
3	External Trigger In
4	Signal Generator Out
5	RF In
6	USB Mini-B (Full Speed, USB 2.0)
7	GPS Antenna (with Option 31)
8	External Power
9	USB Type A (Full Speed, USB 2.0)
10	3.5 mm Headset Jack
11	VNA Port 1 50 ohm
12	VNA Port 2 50 ohm

Figure 2-8.   Test Panel Connectors

Note	This instrument is equipped with Type N connectors. To prevent damage, do not use pliers or a plain wrench. Do not over tighten.
	Recommended torque: 1.36 N·m to 1.70 N·m (12 lbf·in to 15 lbf·in).
	Do not twist cable or accessory body. Rotate the coupling nut only.

Test Panel Connectors

External Power

The external power connector (refer to item "8" in Figure 2-8 on page 2-9) is used to power the unit and for battery charging. Input is 12 VDC to 15 VDC at up to 5.0 A. The green flashing Power LED indicates that the instrument has external power.

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

USB Interface – Type A

The LMR Master has two Type A USB connectors (refer to item "9" in Figure 2-8) that accept USB Flash Memory devices for storing measurements, setup data, screen images, and firmware updates.

USB Interface – Mini-B

USB 2.0 Mini-B connector (refer to item "6" in Figure 2-8) can be used to connect the LMR Master directly to a PC, as shown in Figure 2-9. The first time the LMR Master is connected to a PC, the normal USB device detection by the computer operating system will take place. The CD-ROM that is shipped with the instrument contains a driver for 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, either Line Sweep Tools or Master Software Tools should be installed on the PC prior to connecting the LMR Master to the USB port.

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

Headset Jack

The headset jack provides audio output from the built-in AM/FM/SSB demodulator for testing and troubleshooting wireless communication systems. The jack accepts a 3.5 mm (1/8 inch) 3-wire miniature phone plug such as those commonly used with audio headsets (refer to item "10" in Figure 2-8).

External Trigger In

A TTL signal that is applied to the External Trigger In female BNC input connector causes a single sweep to occur. In the Spectrum Analyzer mode, it is used in zero span, and triggering occurs on the rising edge of the signal. After the sweep is complete, the resultant trace is displayed until the next trigger signal arrives (refer to item "3" in Figure 2-8).

External Reference In

The BNC female connector (refer to item "1" in Figure 2-8) is used for connection of an external frequency reference. The amplitude of the External Reference should be between −10 dBm and +10 dBm.

RF In (50 ohm)

This connector (refer to item "5" in Figure 2-8) provides the input 50 ohm interface for the Spectrum Analyzer function. With Option 10, Bias Tee, output is available on the center pin out of this port in Spectrum Analyzer mode.

GPS Antenna Connector (Option 31)

The GPS antenna connection on the LMR Master is type SMA-female (refer to item "7" in Figure 2-8). The GPS function is described in Chapter 8, "GPS (Option 31) ".

Audio In

Audio In (refer to item "2" in Figure 2-8) is used to support SINAD and Quieting measurements of analog FM radio sensitivity.

Signal Generator Out

Output of the built-in Signal Generator when the LMR Master is in CW, NBFM, P25/P25p2, NXDN, DMR 2, or PTC mode (refer to item "4" in Figure 2-8). Output is turned on with the **Turn Sig-Gen ON** main menu key.

VNA Port-1 (50 ohm)

This connector (refer to item "11" in Figure 2-8) provides the input/output 50 ohm interface for reflection measurements of the Vector Network Analyzer at Port 1.

VNA Port-2 (50 ohm)

This connector (refer to item "12" in Figure 2-8) provides the input 50 ohm interface for transmission measurements of the Vector Network Analyzer at Port 2. With Option 10, Bias Tee, output is available on the center pin out of this port in VNA mode.

2-6   Symbols and Indicators

The following symbols and indicators indicate the instrument status or condition on the display.

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 Figure 2-6). Each block contains the trace number followed by the S-parameter or information that is assigned to that trace (TR4: S21, for example). If the trace has Trace Math applied to it, then the math function is also displayed on that line (TR1: S11/M1, for example), where M1 is the memory that is associated with TR1, and the math function is Trace/Memory). The S-parameter that is assigned to the trace memory is shown (if enabled) at the top of each trace information block (M1: S11, for example). Each trace block also includes the Graph type, the smoothing percentage, the calibration status, and the scale (Resolution per Division and the Reference Value). The calibration status indicates whether the calibration is ON, OFF, or non-existent (--) for the specific S-parameter that is assigned to each trace. If the Calibration is ON, then its validity is also displayed (OK,?, or X).

For calibration procedures refer to the Vector Network Analyzer Measurement Guide (PN: 10580-00289) listed in Appendix A.

Battery Symbols

The battery symbol above the display indicates the charge remaining in the battery. The colored section inside the symbol changes size and color with the charge level.

Figure 2-10. Battery Status

Green with Black Plug body: Battery is fully charged and external power is applied

Green: Battery is 30 % to 100 % charged

Yellow: Battery is 10 % to 30 % charged

Red: Battery 0 % to 10 % charged

Lightning Bolt: Battery is being charged (any color symbol)

Detailed battery information is also available in the Status dialog box (**System** > Status).

When either the AC-DC Adapter or the Automotive Cigarette Lighter Adapter is connected, the battery automatically receives a charge, and the battery symbol with the lightning bolt is displayed (Figure 2-11).

Figure 2-11. Battery Charging Icon

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

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

When operating from external power without a battery installed, the battery symbol is replaced by a red plug body (Figure 2-12).

Figure 2-12. Battery Not Installed

Additional Symbols

Single Sweep

Single Sweep is selected. Press Continuous in the **Sweep** menu to resume continuous sweeping.

Floppy Icon

Shortcut to the Save submenu. Touch the icon to open the touch screen keyboard for saving measurements, setups, or screen displays.

Figure 2-13. Floppy Icon

2-7   Data Entry

Numeric Values

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

Parameter Setting

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

Finalize the input by pressing the **Enter** 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 for antennas or couplers) can be added to list boxes by creating them and importing them using Master Software Tools.

Text Entry

When entering text, as when saving a measurement, the touch screen keyboard is displayed (Figure 2-14). Characters are entered directly with the touch screen keyboard. The keypad can be used for numeric entry. The left and right arrow keys scroll the cursor through the filename. Refer to "Save Menu" on page 4-9 for additional information.
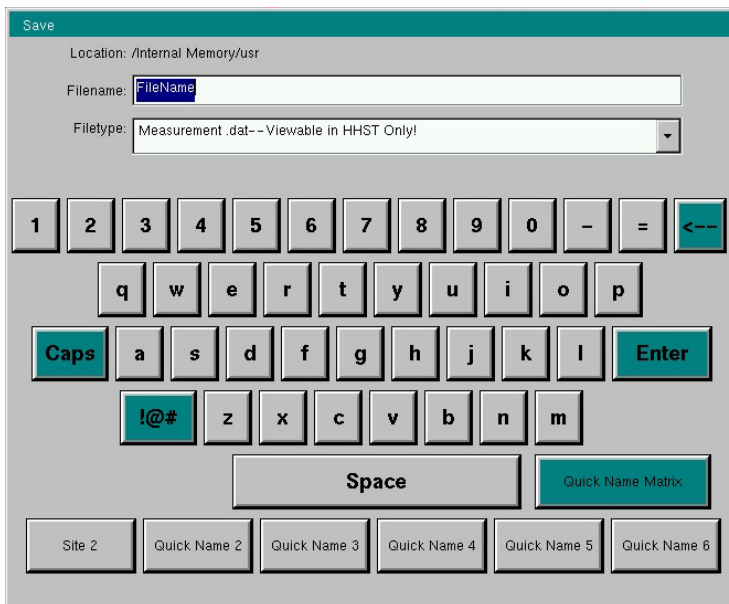
Figure 2-14. Touch Screen Keyboard

2-8   Mode Selector Menu

To access the functions under the Mode menu, press the **Shift** key, then the **Mode** (9) key. Use the directional arrow keys, the rotary knob, or the touch screen to highlight the selection, and press the **Enter** key to select. The list of modes that appear in this menu varies depending upon the options that are installed and activated in the instrument. Figure 2-15 is an example of the Mode menu. Your instrument may not show the same list. The current mode is displayed below the battery symbol.
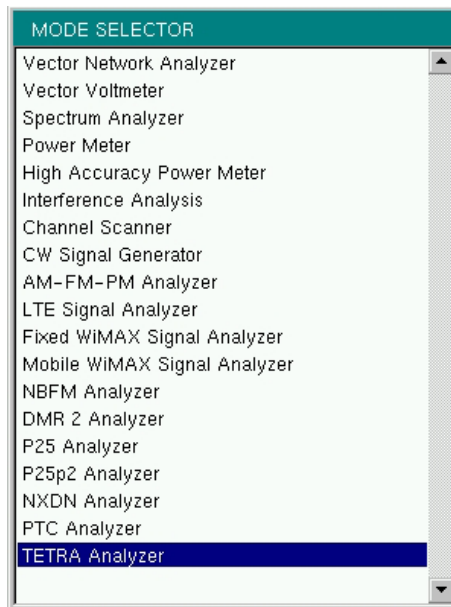
Figure 2-15. Mode Selector Menu

Note	The display of the Mode Selector varies depending on installed options.

The **Menu** key is another option to quickly change measurement modes. Press the **Menu** key then select one of the Measurement icons in the top rows (Figure 2-2 on page 2-3).

Chapter 3 — Quick Start Guide

3-1 Introduction

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

3-2 Measurement Mode Selection

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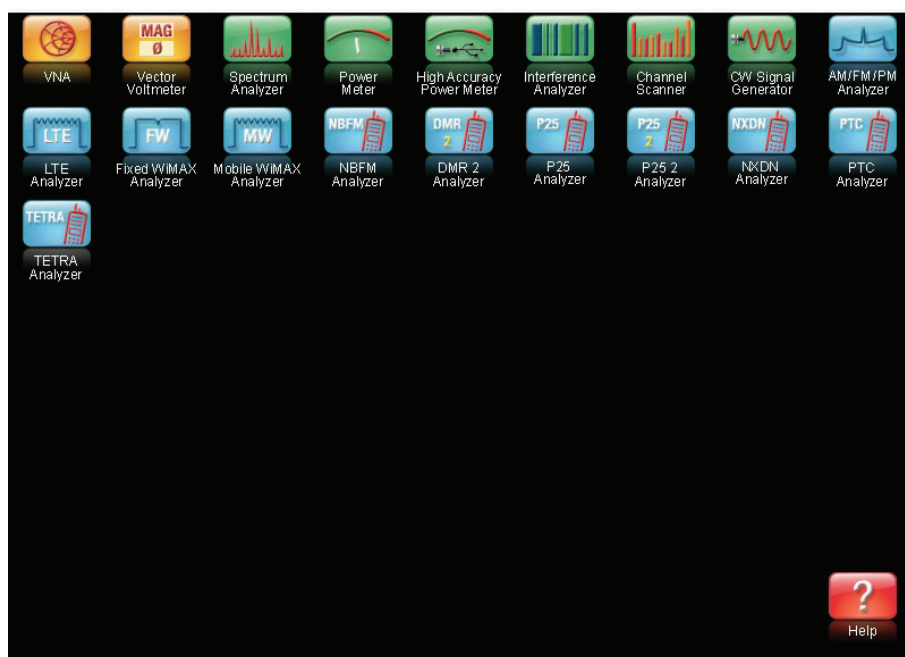
Figure 3-1. Menu Screen with Icons for Installed Measurement Modes

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

3-3   CW Signal Generator

The CW Signal Generator provides a continuous wave (CW) signal from the Signal Generator Out port of the LMR Master. The CW signal is primarily used for testing the sensitivity of receivers. To test receiver sensitivity, connect the output directly to the receiver that is being measured, and then reduce the signal generator amplitude until the receiver is unable to detect the signal.

Note	CW Output is turned on by default when entering CW Signal Generator mode and automatically turned off when exiting CW Signal Generator mode.

1. Set the instrument to CW Signal Generator mode as described in the previous section.

2. Press the **Freq** main menu key and set the transmit frequency of the CW signal.

3. Press the **Amplitude** main menu key and set the Power Level and Offset. Add a positive value offset value for any external gain or negative offset value for any external loss.

4. Press the **Turn Sign-Gen OFF** main menu key to stop transmitting.
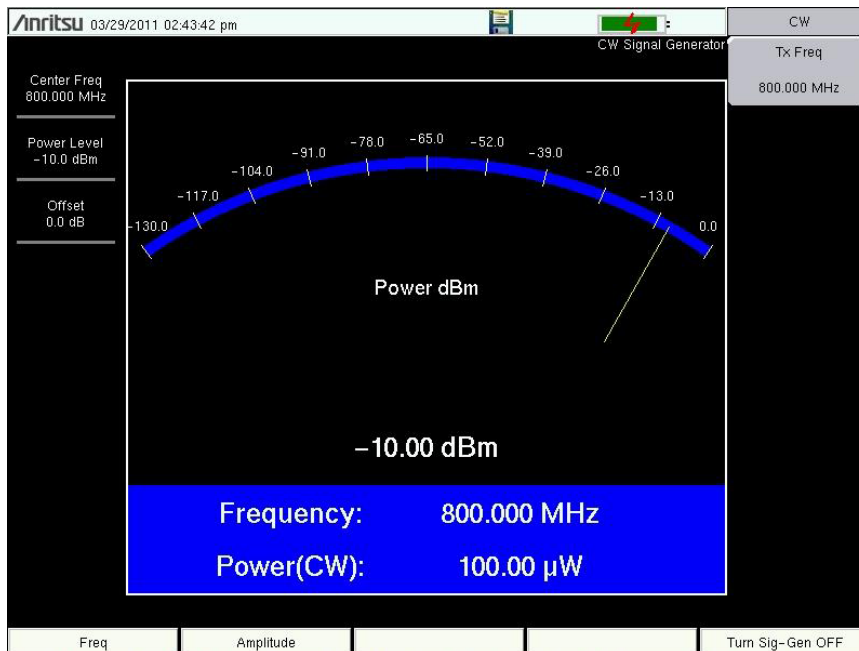
Figure 3-2.   CW Signal Generator

3-4   Vector Network Analyzer

Set the instrument to Vector Network Analyzer (VNA) mode as described in Section 3-2.

Field Mode Display vs. Standard VNA Display

Field Mode is the default display of the LMR Master when the instrument is turned on for the first time or reset. Field Mode display may be more familiar to users who have experience making Cable and Antenna measurements using the Anritsu Site Master. Standard VNA display allows the full Vector Network Analyzer functionality of the LMR Master.

Press **Shift-8 (System)** > Application Options > Meas Menu to toggle between the two views. Figure 3-3 shows an example of typical VNA measurements in Field Mode Display and Standard VNA display. Refer to the Vector Network Analyzer Measurement Guide listed in Appendix A for detailed information on VNA measurements and the menu differences between the two display structures.
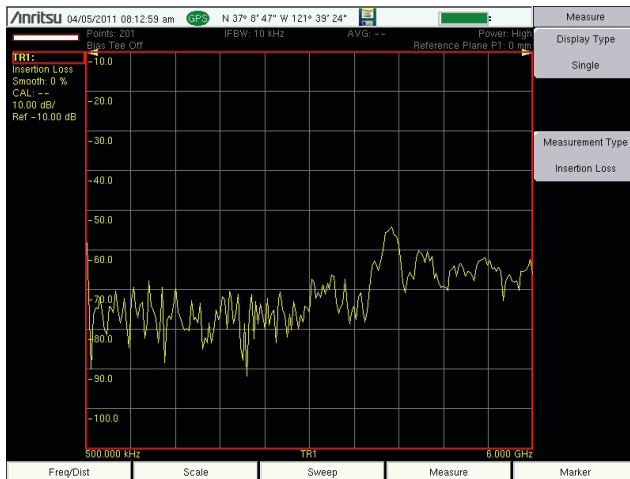
Field Mode Display
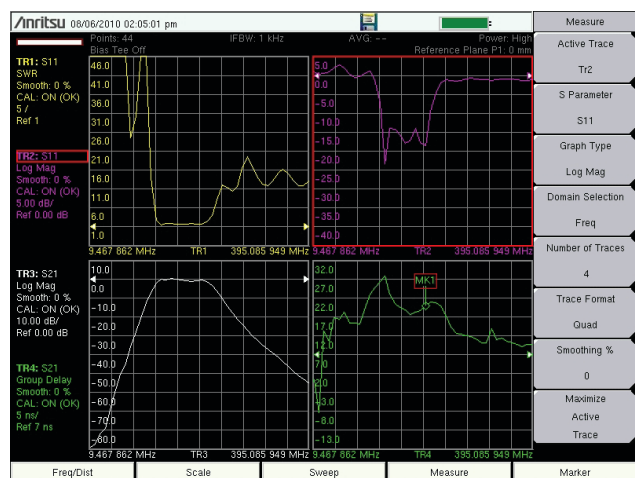
Standard VNA Display

Figure 3-3.   Measurement Menu in Field Mode Display and Standard VNA Display

Select the Measurement Type

Note	The following Quick Start instructions apply to VNA Field Mode. For detailed measurement instructions, refer to the Vector Network Analyzer Measurement Guide P/N 10580-00289, listed in Appendix A.

Press the **Measure** main menu key and then the Measurement Type submenu key. Select a measurement graph and press **Enter**.

Set the Frequency

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

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

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

Set the Scale

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

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

3. For other graphs, set the Top and Bottom of the scale or press Autoscale.

Turn On Markers

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

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

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

Peak and Valley Search Markers

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

1. With an active marker, press the Peak Search or the Valley Search submenu key to find the maximum or minimum value on the trace that is associated with the current marker.

Set Up Delta Markers

If the intent is to conduct a delta measurement, then two markers are necessary: one to be the reference marker and one to be the delta marker.

Delta Marker Setup:

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

   2. Turn on Marker 1 (to be the Ref marker) and assign it to a trace.

     a. Press Marker and select MK1 from the list box. Then press **Enter**.

     b. The Marker Type submenu key is set by default to Ref.

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

   4. Assign Marker 2 to Marker 1 by pressing the Avail Ref Mkr submenu key to open the Select One list box. Scroll to choose MK1 and press **Enter**.

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

Set a Single Limit Line

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

   2. Set Limit State to On. Press the Limit key to set the limit line to either Upper or Lower.

   3. Use the numeric keypad, the arrow keys, or the rotary knob to change the limit value and then press **Enter**.

Note	Limit lines are not available for Smith charts. Refer to the Vector Network Analyzer Measurement Guide (listed in Appendix A) for creating multi-segment limit lines.

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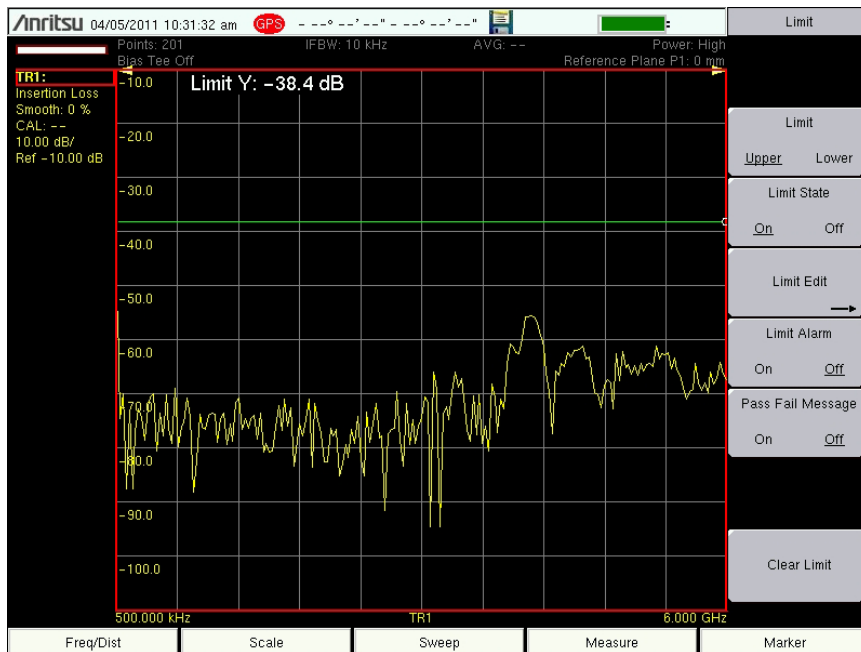
Figure 3-4.   Single Limit Lines

Set Up Distance Domain

This option is fully described in the Vector Network Analyzer Measurement Guide.
Refer to Appendix A, "Measurement Guides". Measurement Guides are available
on the documentation disc and as free downloads from the Anritsu Web site
(refer to "Anritsu Reference Documents" on page 1-8).

Calibration Considerations

Various calibrations are available in the LMR Master. Press **Shift-2 (Calibration)** to open the
calibration menu. Press Start Cal and follow the instruction onscreen. 1-Port calibration is the
simplest and requires three connections during calibration. 2-Port calibration requires
four calibration connections and corrects for the transmit port match.

VNA calibration requires external precision OSL calibration components. 2-Port calibration
also requires a through connector (Figure 3-5 on page 3-7).

Note	The Vector Network Analyzer Calibration menu is the same one that is used in the Vector Voltmeter menu (Option 15). Refer to section "Calibration Menus" in Chapter 6 of the Vector Network Analyzer Measurement Guide (refer to Appendix A) for more information about the calibration menu. Note that some calibration parameters are shared between the Vector Network Analyzer and Vector Voltmeter mode, and that some parameters are different because they were optimized for the specific mode application.
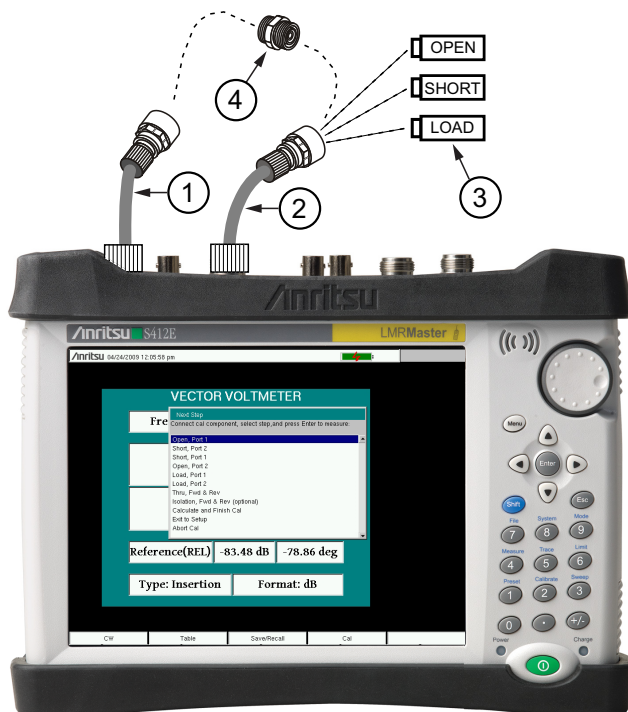
1	Optional Test Port Cable at VNA Port 2
2	Optional Test Port Cable at VNA Port 1
3	OSL (Open, Short, Load) Precision Calibration Components
4	Through Connection for 2 Port Calibration (Port 1 Connects to Port 2)

Figure 3-5.   Calibration

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

When calibration correction is On, the correction is applied to all applicable measurements. For example, if a 1-port calibration is performed, then only traces that measure reflection have a valid calibration. For those traces, the calibration information data in the Instrument Settings Summary (item 1 in Figure 2-6 on page 2-7) shows "**CAL: ON (OK)**". Other traces that do not measure reflection display "**CAL: --**" to indicate that no valid calibration is available for those traces. The calibration correction can also be turned off manually under the Calibration menu by toggling the Cal Correction submenu key from On to Off. In that case, the display shows "**CAL: OFF**" for all traces that have valid correction data available.

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

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

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

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

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

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

Existing Cal Info

The Cal Info submenu key is found in the **Calibration** main menu and lists the current calibration settings.

3-5   Spectrum Analyzer

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

Note	The following Quick Start instructions apply to Spectrum Analyzer Mode. For detailed measurement instructions, refer to the Spectrum Analyzer Measurement Guide listed in Appendix A.

Set Start and Stop Frequencies

1. Press the **Freq** main menu key then the Start Freq submenu key.

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

3. Press the Stop Freq submenu key and enter the desired stop frequency.

Enter the Center Frequency

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

2. Press the Center Freq submenu key.

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

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

Select a Signal Standard

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

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

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

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

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

Set the Measurement Bandwidth

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

- Press the RBW and/or the VBW submenu key to manually change the values.
- Set RBW and VBW automatically by pressing the Auto RBW submenu key or the Auto VBW submenu key.

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

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

Set the Amplitude

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

Set Amplitude Reference Level and Scale

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

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

Set Amplitude Range and Scale

1. The Auto Atten submenu key sets an optimal reference level based on the measured signal.

2. Press the Scale submenu key.

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

Power Offset Set Up for Compensating External Loss

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

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

Set the Span

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

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

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

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

Single Limit Line

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

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

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

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

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

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

Create a Limit Envelope

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

2. Press Limit Envelope.

3. Press the Create Envelope key.
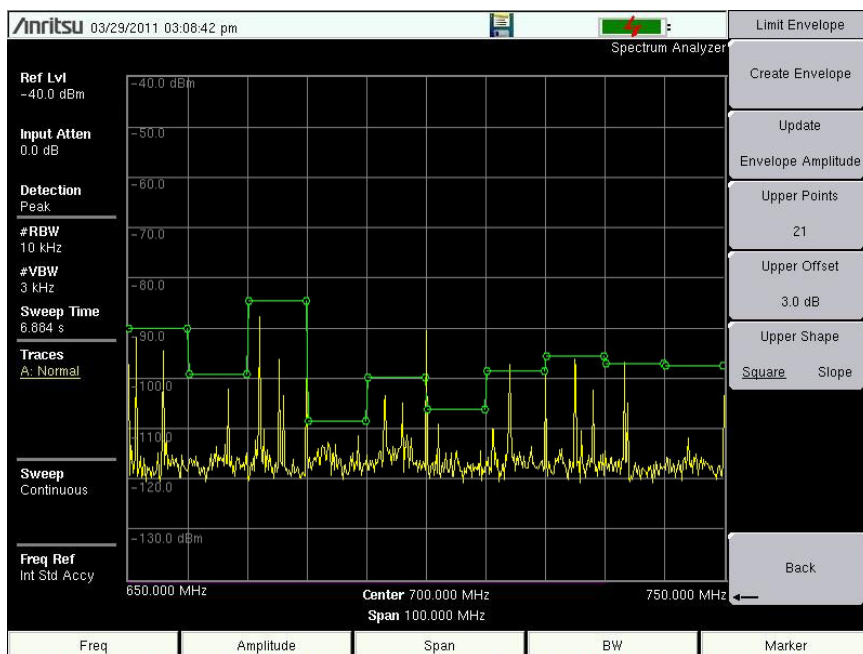
Figure 3-6.   Limit Envelope

Setting Up Markers

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

Selecting, Activating, and Placing a Marker

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

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

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

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

Selecting, Activating, and Placing a Delta Marker:

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

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

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

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

Viewing Marker Data in a Table Format

1. Press the More submenu key.

2. Press the Marker Table On Off submenu key so that On is underlined. All marker and delta marker data are displayed in a table under the measurement graph.
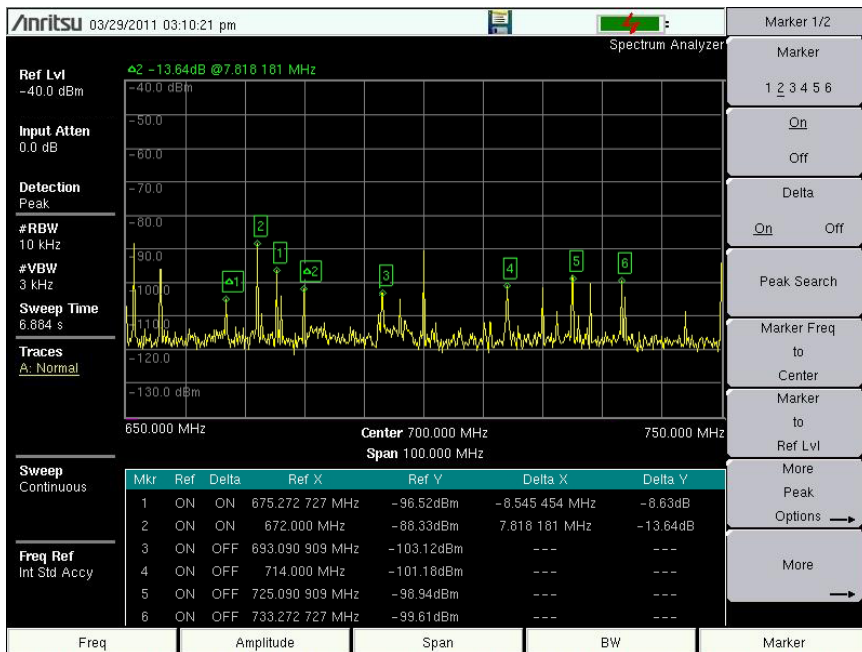
Figure 3-7.   Marker Table

Select a Smart Measurement Type

In Spectrum Analyzer mode, press **Shift** then **Measure** (4) and select a smart one-button measurement using the submenu keys. The smart one-button measurements are built-in for field strength, occupied bandwidth, channel power, adjacent channel power ratio, and carrier to interference ratio (C/I) tests. In addition, AM/FM demodulation is available to aid in the identification of interfering signals. Refer to the Spectrum Analyzer Measurement Guide listed in Appendix A, "Measurement Guides" for additional information.

Figure 3-8.   Spectrum Analyzer Measure Menu with Smart Measurements

3-6 NBFM Analyzer

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

Note	The following Quick Start instructions apply to the NBFM mode. For detailed measurement instructions, refer to the Land Mobile Measurement Guide P/N 10580-00243, listed in Appendix A.

Set the Receiver (Rx) Frequency

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

2. Press the Rx Freq submenu key.

3. Enter the desired center frequency using the keypad, the arrow keys, or the rotary knob. When entering a frequency using the keypad, the submenu key labels change to GHz, MHz, kHz, and Hz. Press the appropriate unit key. Pressing the **Enter** key has the same affect as pressing the MHz submenu key. The center frequency and span is shown at the bottom of the spectrum display. Press the Span submenu key to adjust the measurement span.

4. Press **Setup** main key. Use the submenu keys to select the Tone Type.

5. Under the **Amplitude** main menu, the Auto Rx Range default will adjust the reference level to display the received signal. To adjust the settings, press Adjust Rx Range then set the Ref Level and Scale.

Caution	The maximum input power without damage is 2 Watts (+33 dBm) to the RF In 50 Ohm connector. To prevent damage, use a coupler or attenuator to reduce the input power to below this level when measuring high output power devices.

Set the Signal Source Transmit (Tx) Frequency

The LMR Master contains a signal generator and test patterns for analog FM land mobile radios. The maximum output power is 1.0 milliwatt.
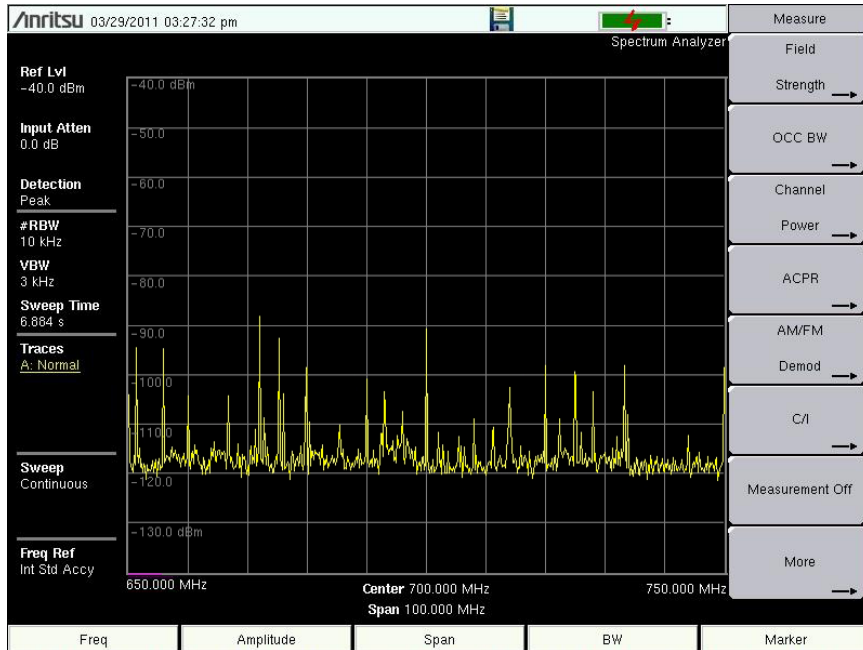
1. Press the **Freq** main menu key.

2. Press the Tx Freq submenu key.

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

Note	Bind the transmit frequency to receive frequency using the Rx/Tx Coupling and Coupling offset submenus under the **Frequency** menu.

4. Press **Setup** main key and use the Tx pattern submenu key to set the transmit pattern. Press **Enter** after selecting a pattern. Based on the pattern selected, set the AM Percentage or the FM Deviation and Tone Deviation (under the More menu).

5. Under the **Amplitude** main menu, set the signal generator output power using the Tx Output Lvl submenu.

6. Press the **Turn Sig-Gen ON** main menu key to turn on the internal signal generator. The menu button display *Turn Sig-Gen OFF* when the generator is running.

Rx and Tx Power Offset

To obtain accurate results, compensate for any external attenuation or gain by using the Rx Power Offset or Tx Power offset submenus under the **Amplitude** main menu key. In power offset mode, the compensation factor is in dB.

Press the Rx Power Offset or Tx Power Offset submenu key and use the keypad, the arrow keys, or the rotary knob to enter the desired offset value. When using the rotary knob, the value changes in increments of 0.1 dB. Using the **Left/Right** arrow keys changes the value in 10% increments of the value shown on the Scale submenu key. The power offsets for Tx and Rx are displayed in the instrument settings summary column on the left side of the measurement display.

Select the Measurement Types

NBFM Analyzer Measurement

1. Press the **Measurement** main menu key, then press the NBFM Analyzer submenu key. Press Graph Type to set the displayed graph types (Figure 3-11).

2. Select the graph to change with the Active Graph submenu key or the touchscreen. Change the graph with the Graph Type submenu key.
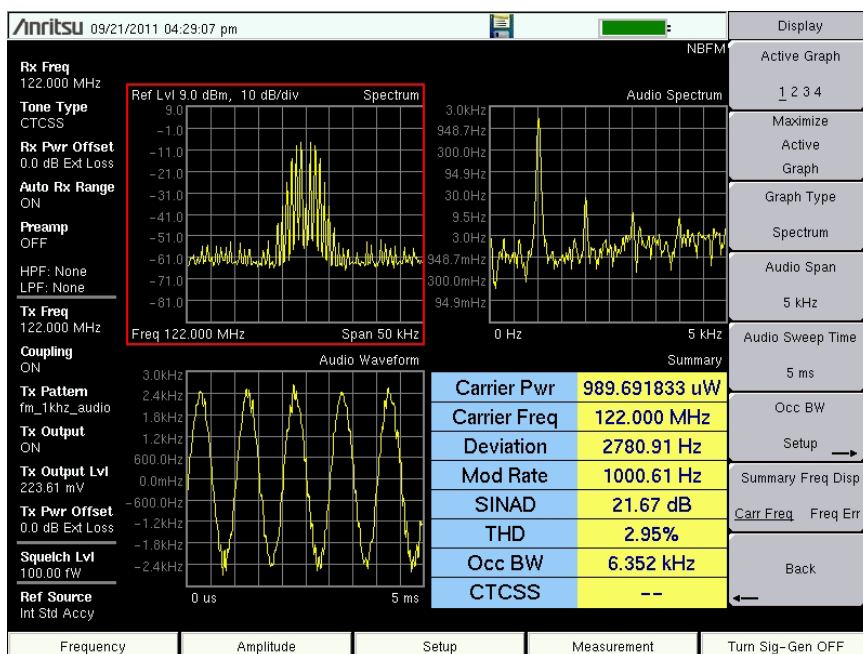
Figure 3-9.   NBFM Analyzer Measurements (Active Graph has the Red Outline)

NBFM Coverage Measurement

1. Press the **Measurement** main menu key, then press the NBFM Coverage submenu key twice (Figure 3-13).

2. Refer to the Land Mobile Radio Measurement Guide listed in Appendix A for details on creating a map and coverage mapping.
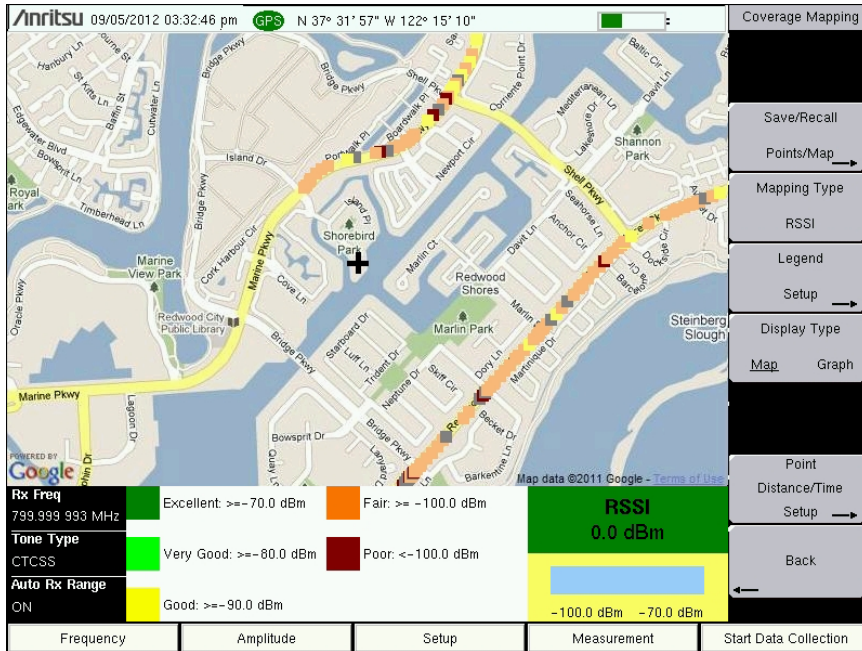
Figure 3-10. NBFM Coverage Measurements

NBFM Quieting and NBFM SINAD Measurements

Refer to the Land Mobile Radio Measurement Guide listed in Appendix A for details on radio sensitivity testing using the 12 dB SINAD and 20 dB Quieting methods.

3-7   P25/P25p2, NXDN™, DMR 2, ITC-R PTC, or TETRA Signal Analyzer

Set the instrument to P25/P25p2 Analyzer, NXDN Analyzer, DMR 2 Analyzer, PTC Analyzer, or TETRA Analyzer mode as described in Section 3-2 "Measurement Mode Selection" on page 3-1.

Note	The following Quick Start instructions apply to the Land Mobile Radio modes. For detailed measurement instructions, refer to the Land Mobile Measurement Guide P/N 10580-00243, listed in Appendix A.

Set the Receiver (Rx) Frequency

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

2. Press the Rx Freq submenu key.

3. Enter the desired center frequency using the keypad, the arrow keys, or the rotary knob. When entering a frequency using the keypad, the submenu key labels change to GHz, MHz, kHz, and Hz. Press the appropriate unit key. Pressing the **Enter** key has the same affect as pressing the MHz submenu key. The center frequency and span is shown at the bottom of the spectrum display. Press the Span submenu key to adjust the measurement span.

4. Press **Setup** main key. Use the submenu keys to select the Mod Type (Mod Bandwidth in NXDN) and Rx pattern (not applicable to PTC mode).

5. Under the **Amplitude** main menu, the Auto Rx Range default will adjust the reference level to display the received signal. To adjust the settings, press Adjust Rx Range then set the Ref Level and Scale.

Set the Signal Source Transmit (Tx) Frequency

The LMR Master contains a signal generator and test patterns for LMR antenna and receive system verification. The maximum output power is +0 dBm (1.0 mW).

|	
Note	Generation of TETRA signals is not currently supported by the LMR Master.

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

2. Press the Tx Freq submenu key.

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

Note	If desired, the transmit frequency can be bound to the receive frequency using the Rx/Tx Coupling and Coupling offset submenus under the **Frequency** menu.

4. Press **Setup** main key and use the Tx pattern submenu key to set the transmit pattern. Press **Enter** after selecting a pattern. *PTC Only:* Set the Symbol Rate.

---

5. Under the **Amplitude** main menu, set the signal generator output power using the Tx Output Lvl submenu.

6. Press the **Turn Sig-Gen ON** main menu key to turn on the internal signal generator. The menu button display *Turn Sig-Gen OFF* when the generator is running.

Rx and Tx Power Offset

To obtain accurate results, compensate for any external attenuation or gain by using the Rx Power Offset or Tx Power offset submenus under the **Amplitude** main menu key. In power offset mode, the compensation factor is in dB. (External attenuation can be created by using an external cable or an external high power attenuator.)

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

Select the Measurement Types

Analyzer Measurements

1. Press the **Measurement** main menu key, then press the P25 Analyzer, P25p2 Analyzer, NXDN Analyzer, DMR 2 Analyzer, PTC Analyzer, or the TETRA Analyzer submenu key. Press Graph Type to set the displayed graph types (Figure 3-11).

2. Select the graph to change with the Active Graph submenu key or the touchscreen. Change the graph with the Graph Type submenu key.
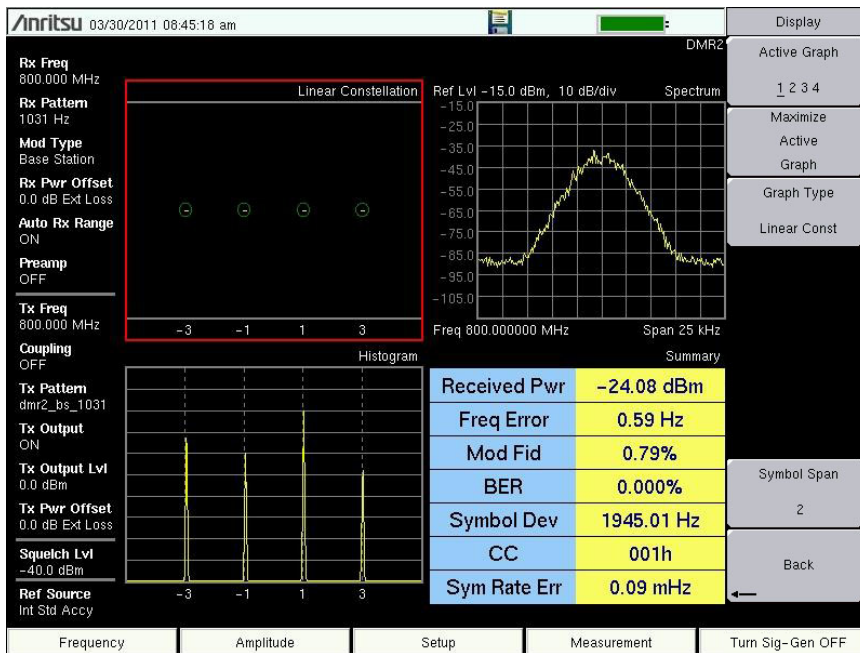
Figure 3-11. Analyzer Measurements (Active Graph has the Red Outline)

Control Channel Measurement (not available in PTC or TETRA modes)

1. Press the **Setup** main menu and set the Rx Pattern to Ctrl Channel or Voice.

2. Press the **Measurement** main menu key, then press the P25 Control, P25p2 Control, NXDN Control or DMR 2 Control submenu key twice.

3. To save control channel data for additional analysis, insert a formatted USB flash drive into the LMR Master and turn Log Data On.

4. Set the Hex Trigger, Sweep and Set Trigger Value (Figure 3-12). The Hex Trigger menu and Hex Trigger Value menu are used to find a specific opcode in the Control Channel data. To set the hex trigger value, press the Set Trigger Value menu. An on screen keyboard will display and with the numbers 0 to 9 and the letters A to F. Enter the two character hex value to search for. After entering the value, press **Enter** to set the trigger value. Press **Esc** to cancel entry or changing the current hex value.

   Setting Hex Trigger to On will set the Sweep function to Hold when the hex trigger value is found in the first octet of a packet. The octet row with the found trigger value will be displayed in the middle of the table. If Log Data is set to On, all of the data on the screen is saved and Log Data is set to Off. When Sweep is set back to Run, the unit will continue to collect data and stop on the next instance of the hex trigger value. To continue to capture data to the USB flash drive, set Log Data back to On before setting Sweep to Run mode.
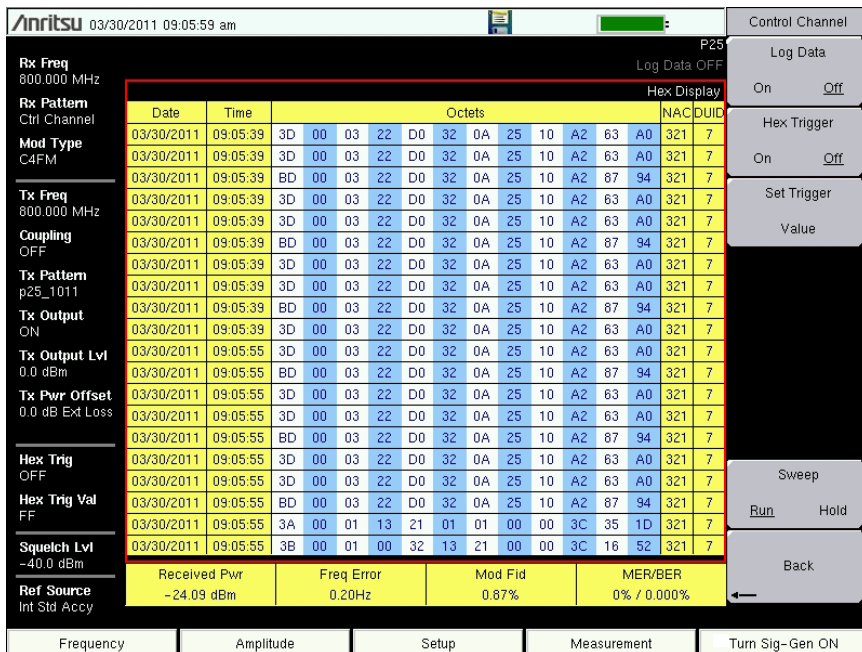
Figure 3-12. Control Channel Measurement

Note	This measurement is captured on an external USB flash drive. The captured data file can not be recalled and displayed on the instrument screen.

Coverage Measurements

1. Press the **Measurement** main menu key, then press the P25 Coverage, P25p2 Coverage, NXDN Coverage, DMR 2 Coverage, PTC Coverage, or TETRA Coverage submenu key twice (Figure 3-13).

2. Refer to the Land Mobile Radio Measurement Guide listed in Appendix A for details on creating a map and coverage mapping.
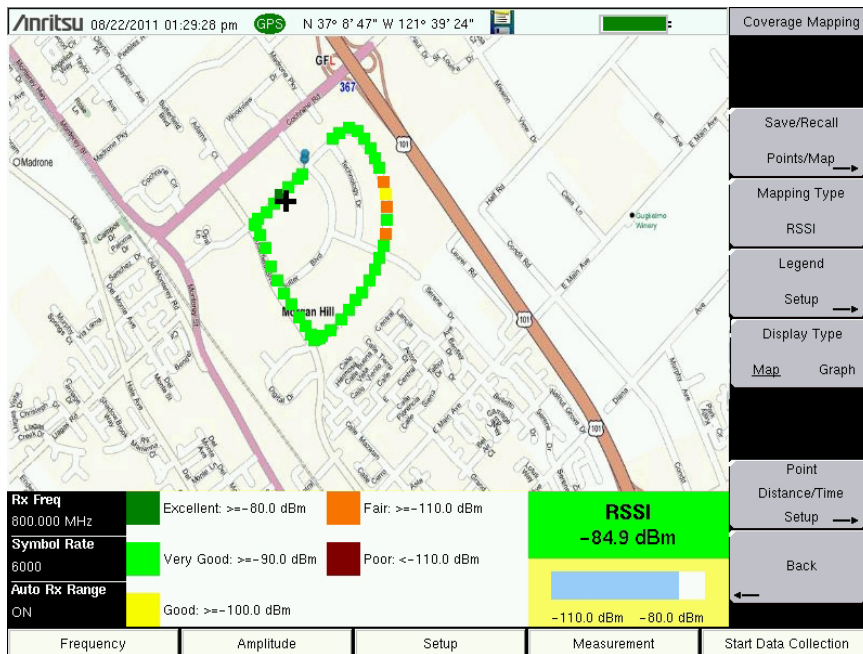
Figure 3-13. Coverage Measurements

Bit Capture Measurement (not available in PTC or TETRA modes)

1. Press the **Setup** main menu and set the Rx Pattern to Voice.

2. Press the **Measurement** main menu key, then press the P25 Bit Capture, P25p2 Bit Capture, NXDN Bit Capture or DMR 2 Bit Capture submenu key.

3. To save bit capture data for additional analysis, insert a formatted USB flash drive into the LMR Master and turn Log Data On. (Figure 3-14).
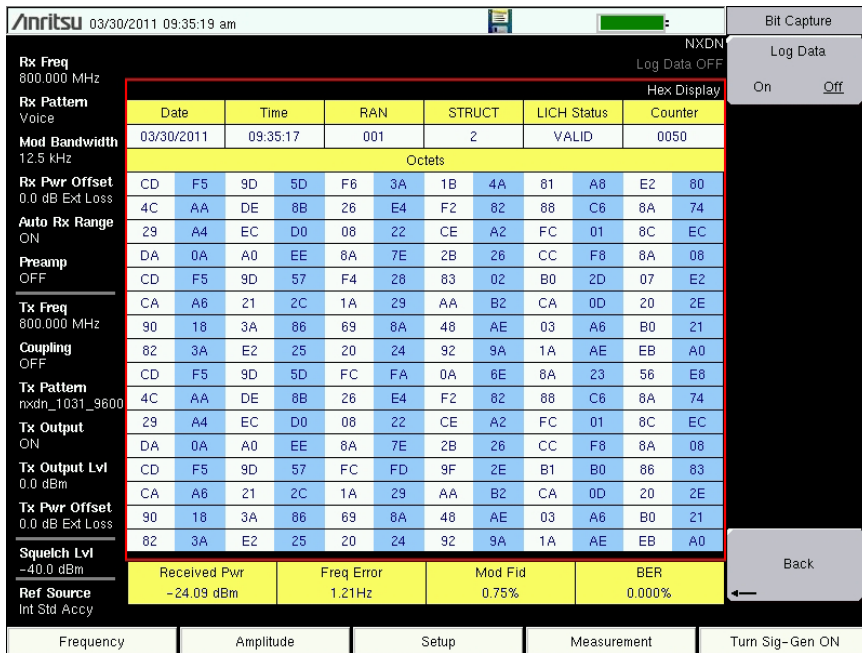
Figure 3-14. Bit Capture Measurement

IQ Capture Measurement

1. Insert a formatted USB flash drive in the USB port of the LMR Master.

2. Press the **Measurement** main menu key, then press the P25 IQ Capture, P25p2 IQ Capture, NXDN IQ Capture, DMR 2 IQ Capture, PTC IQ Capture, or TETRA IQ Capture submenu key.

3. After a few second the LMR Master will display the message "IQ Capture Complete".

4. The IQ data is stored on the USB flash drive under the /usr folder in a date stamped folder. The file will be IQ_CAPTUREyearmonthdaytime.p25 (or .p252, .nxdn, .dmr2, .ptc, or .tetra).

Note	These measurements are captured on an external USB flash device. The captured data file can not be recalled and displayed on the instrument screen.

3-8 Saving Measurements

The LMR Master can save files in the following formats based on measurement mode and installed options:

`filename.spa` for SPA measurement

`filename.mna` for VNA and VVM measurements

`filename.s2p` S2P (SnP) for VNA S-parameter measurements

`filename.hipm` for High Accuracy Power Meter measurements

`filename.pm` for Power Meter measurements.

`filename.cwsg` for CWSG measurements.

`filename.afp` for AM/FM/PM measurements

`filename.ia` for Interference Analysis measurements

`filename.cs` for Channel Scanner measurements

`filename.wmxd` for WiMAX

`filename.wmxe` for Mobile WiMAX

`filename.lte` for LTE measurements

`filename.nbfm` for NBFM measurements

`filename.p25` for P25 measurements

`filename.p252` for P25p2 measurements

`filename.nxdn` for NXDN measurements

`filename.dmr2` for DMR 2 measurements

`filename.ptc` for PTC measurements

`filename.tetra` for TETRA measurements

`filename.jpg` for JPEG images

`filename.stp` for Setup files

`filename.lim` for Limit lines

Note	The LMR Master is not fully supported in Master Software Tools.

Procedure for Saving Files:

1. Press **Shift** then File (7).
2. Press Save.
3. Press Change Save Location and set the current location to be the USB flash drive or internal memory, and then press Set Location.
4. Press Change Type (Setup/JPG/…) and select the desired file type from the Select File Type list box and press Enter.
5. Enter the filename by using the keyboard and then press Enter.

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

3-9   External Power On

This feature allows the LMR Master to restart when external DC power is applied.

This source of external power is applied to the power connector as described in "External Power" on page 2-10. This connector is shown as item 8 in Figure 2-8 on page 2-9. When this feature is enabled from the Power–On menu, the LMR Master (when Off) automatically restarts when external DC power is applied. Refer to "Power–On Menu" on page 5-10.

Chapter 4 — File Management

4-1 Introduction

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

4-2 File Types

Filename extensions that are used in the LMR Master:

`*.spa` for SPA measurement

`*.mna` for VNA and VVM measurements

`*.s2p` S2P (SnP) for VNA S-parameter measurements

`*.hipm` for High Accuracy Power Meter measurements

`*.pm` for Power Meter measurements.

`*.cwsg` for CWSG measurements.

`*.afp` for AM/FM/PM measurements

`*.ia` for Interference Analysis measurements

`*.cs` for Channel Scanner measurements

`*.wmxd` for WiMAX

`*.wmxe` for Mobile WiMAX

`*.lte` for LTE measurements

`*.nbfm` for NBFM measurements

`*.p25` for P25 measurements

`*.p252` for P25p2 measurements

`*.nxdn` for NXDN measurements

`*.dmr2` for DMR 2 measurements

`*.ptc` for PTC measurements

`*.tetra` for TETRA measurements

`*.jpg` for JPEG images

`*.stp` for Setup files

`*.lim` for Limit lines

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).

4-3   Managing Files

Press the **Shift** key then the **File** (7) key on the numeric keypad to list the File menu.

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

Save Files

Set the Save Location

Press Save then the Change Save Location submenu key and select the location to save files. Files can be saved to the internal memory or to an external USB flash drive. New folders can be created at either location. Press Refresh Directories to update the location tree. Press the Set Location key to set the save location.

Save Measurement As

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

Save a Measurement

Press the Save Measurement key and enter the name for the measurement file.

Save a Setup

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

Create a Menu Shortcut for a Setup File

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

Save a Measurement Screen as JPEG

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

Save Dialog Box

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

Note	The Save Dialog Box will vary based on current measurement mode.
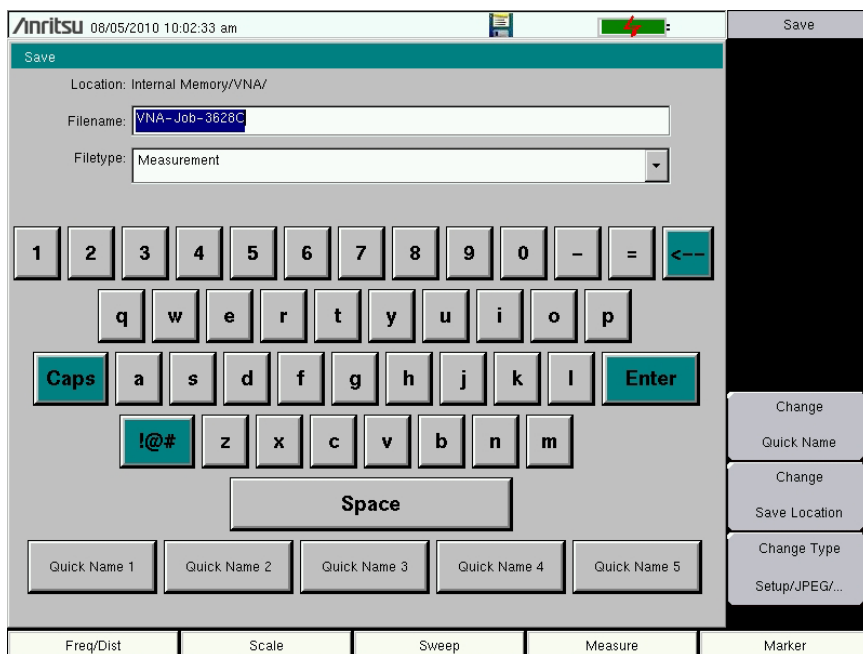
Figure 4-1. Save Dialog Box

Quick Name Keys

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

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

Recall Files

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

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

Recall a Measurement

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

Recall a Setup

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

Recall Dialog Box

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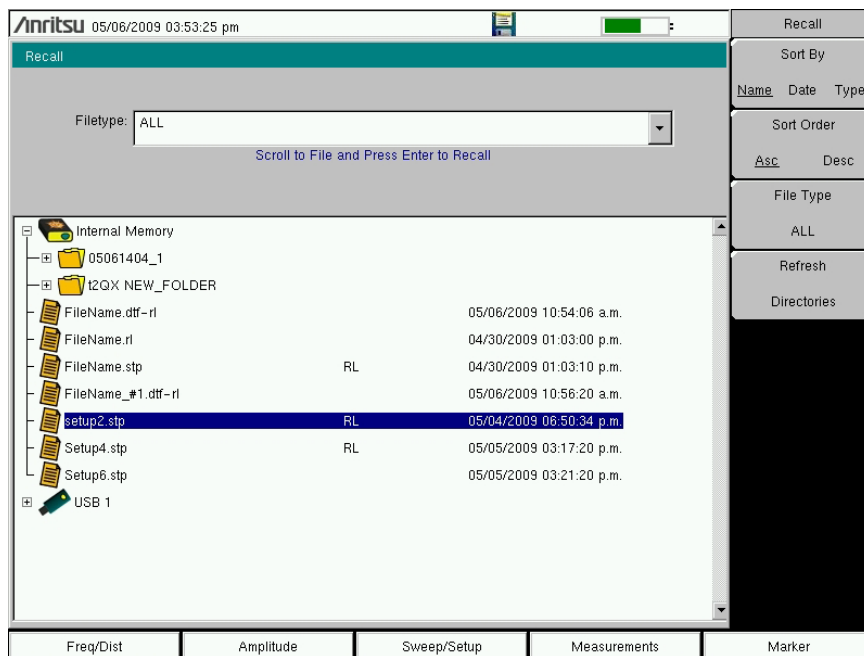
Figure 4-2.   Recall Dialog Box

Copy Files

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

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

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

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

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

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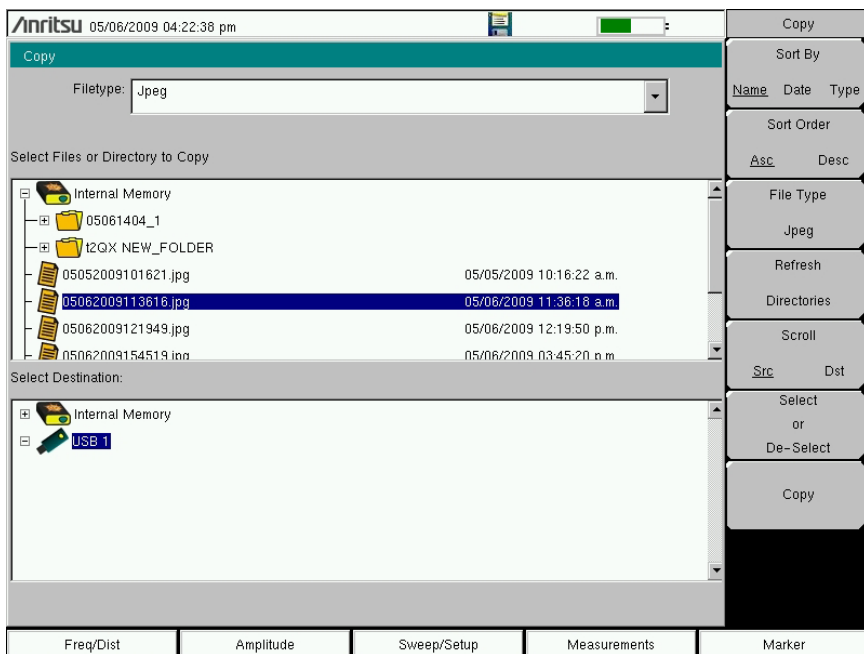
Figure 4-3. Copy Dialog Box

Delete Files

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

Delete Dialog Box

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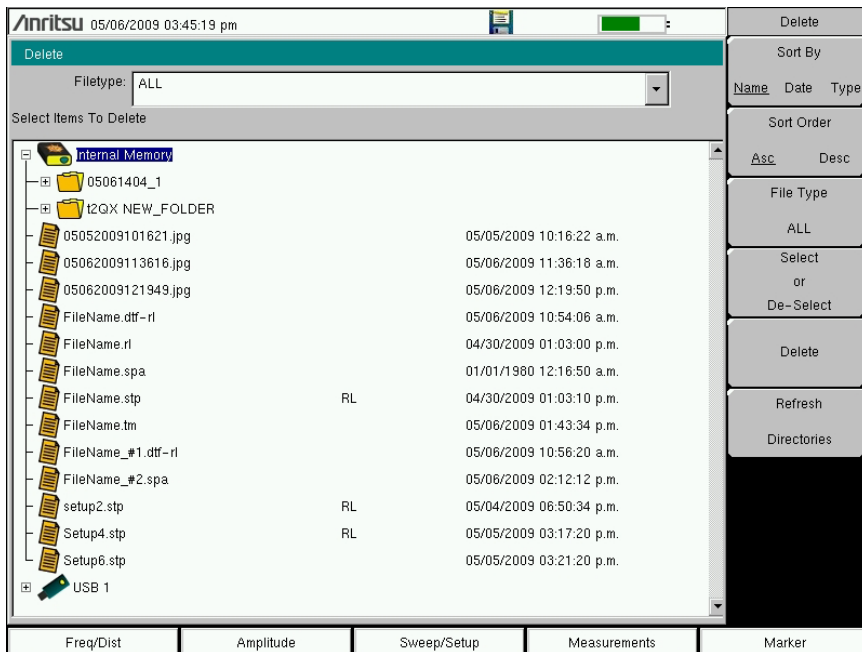
Figure 4-4.   Delete Dialog Box

4-4   File Menu Overview

Open this menu by pressing the **Shift** key, then the **File** (7) key.

Figure 4-5.   File Menu

4-5   File Menu

Key Sequence: **File**

<table>
<tr>
<td>

File

Save Measurement As

FileName.vna

Save

Measurement

Save

Save
On
Event

Recall

Measurement

Recall

Copy

Delete

</td>
<td>

Save Measurement As: Press this submenu key to save the current setup with a user defined filename. The default filename is changed using the Save menu. To change the default file name, type in a new file with the touch screen keyboard and press **Enter**. After a few seconds, the screen returns to File menu. Press the Save Measurement As key again and the new file name is used.

Save Measurement: Press this submenu key to display the "Save Menu" on page 4-9 and the touch screen keyboard. Measurements can be saved to internal memory or to a USB flash drive. The saved measurement can be named by using the touch screen keyboard. By default, measurements are saved to internal memory in a directory named /user. The save destination is set with the "Save Location Menu" on page 4-10.

Save: Press this submenu key to display the "Save Menu" on page 4-9 and the touch screen keyboard. Measurements can be saved to internal memory or to a USB flash drive. The saved setup, measurement, or JPEG file can be named by using the touch screen keyboard. By default, measurements are saved to internal memory in a directory named /user. The save destination is set with the "Save Location Menu" on page 4-10.

Save on Event: Press this submenu key to display the "Save On Event Menu" on page 4-11. This submenu key is displayed only in LMR Analyzer modes.
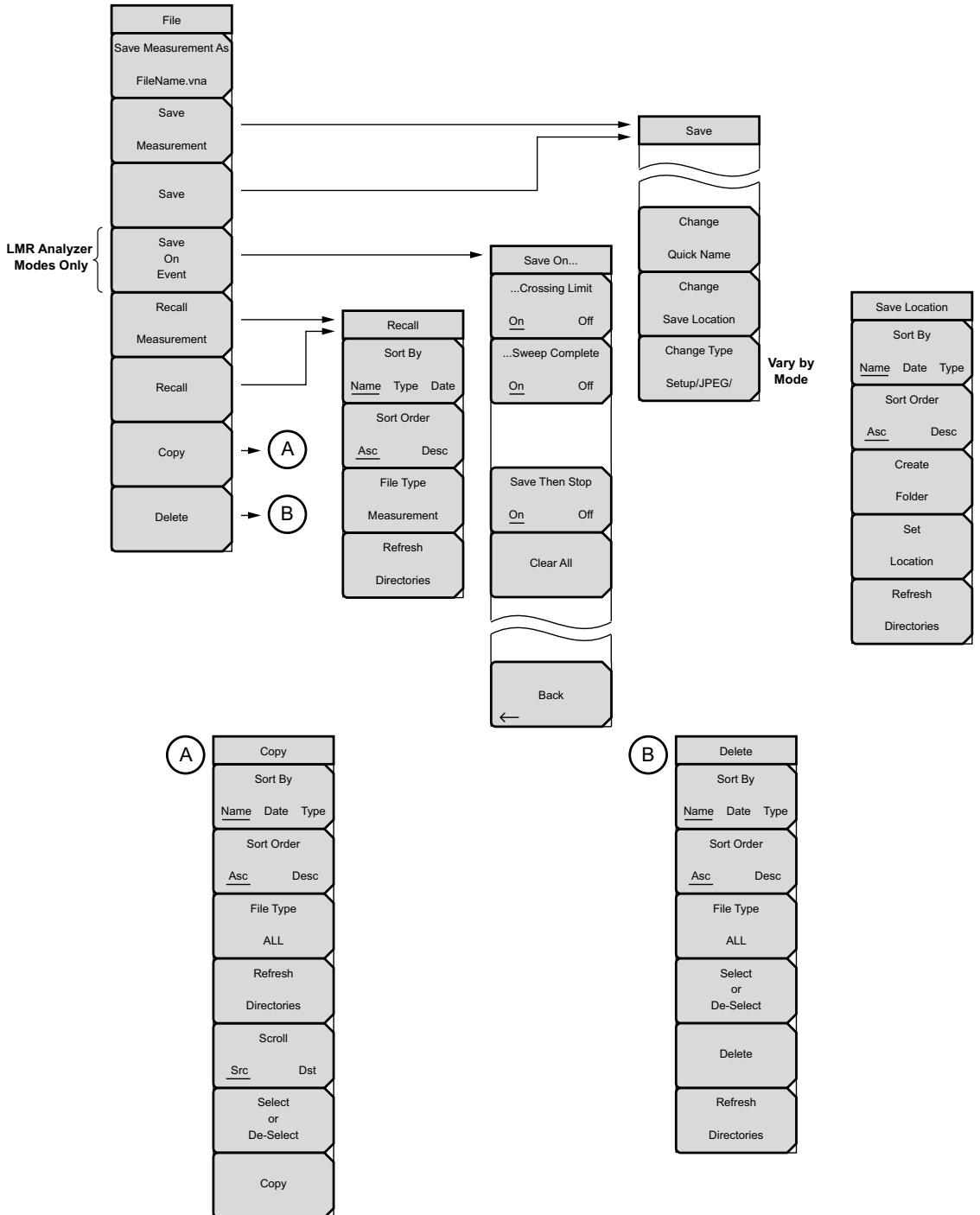
Recall Measurement: Press this submenu key to display the "Recall Menu" on page 4-12. This menu is for recalling measurements from internal memory or from a USB flash drive.

Recall: Press this submenu key to display the "Recall Menu" on page 4-12. This menu is for recalling measurement or setup data from internal memory or from a USB flash drive.

Copy: Press this submenu key to display the "Copy Menu" on page 4-13. The Copy menu is for copying files or folders from internal memory or a USB flash drive.

Delete: Press this submenu key to display the "Delete Menu" on page 4-14 and a selection box that shows the setup and measurement names and the type, date, and time that the information was saved. Use the rotary knob or the **Up/Down** arrow keys to highlight the file that is to be deleted and press the Delete submenu key, then press **Enter**. Press the **Esc** key to cancel the operation. Note that deleted files cannot be recovered.

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

Figure 4-6.   File Menu

Save Menu

The top keys in the Save menu display the available file-type save options based on the current measurement mode.

Key Sequence: **File** > Save

Save	**Change Quick Name:** Press this submenu key to change the Quick Names that are displayed at the bottom of the touch screen keyboard (Figure 4-1). Select the Quick Name to edit and press **Enter**. Type the new Quick Name and press **Enter** again. The new Quick Name is displayed on the corresponding Quick Name button below the keyboard.
Change Quick Name	**Change Save Location:** Press this submenu key to open the "Save Location Menu".
Change Save Location	**Change Type Setup/JPG/...** Press this submenu key in VNA and VVM modes to select among the various file types available for setup and measurement data. This submenu key also opens the File Type menu with a submenu key to select Full screen or Graph Only images for JPEG file types. This submenu key is not displayed in Spectrum Analyzer or Interference Analyzer modes
Change Type Setup/JPEG/...	

Figure 4-7.   Save Menu

Save Location Menu

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

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

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

Sort By
Name   Date   type: Press this submenu key to sort the folders by Name, Type, or Date.

Sort Order
Asc   Desc: Press this submenu key to display the folder names in ascending or descending order.

Create Folder: Press this submenu key to create a new folder in the highlighted location or folder. Name the new folder in the create directory dialog box.

Set Location: Press this submenu key to set the current location for saving files and then return to the "Save Menu" on page 4-9.

Refresh Directories: Press this submenu key to update the display.

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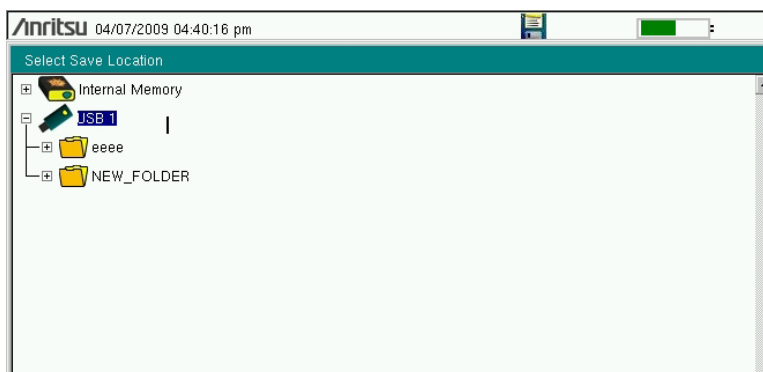
Figure 4-9.   Select Save Location Dialog Box

Save On Event Menu

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

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

...Crossing Limit
On   Off: Toggling this submenu key to On sets the LMR Master to save the measurement to internal memory when the measurement has crossed a defined limit line that has been created with the **Limit** menu.

...Sweep Complete
On   Off: Toggling this submenu key to On sets the LMR Master to save the measurement to internal memory after the current sweep is complete. If Save Then Stop is toggled Off, then a measurement is saved after every sweep.

Save Then Stop
On   Off: Toggling this key to On sets the LMR Master to stop the sweep after a measurement is saved. With this key Off and Sweep Complete On, a measurement is saved after every sweep.

Clear All: Press this key to turn Off all three save-on-event keys:

Crossing Limit

Sweep Complete

Save Then Stop

Back: Press this key to return to the "File Menu" on page 4-8.

Figure 4-10. Save On Event Menu (Spectrum and Interference Analyzer Modes)

Squelch Crossing
On   Off: Toggling this submenu key to On sets the LMR Master to save the measurement to internal memory when the measurement has crossed a defined squelch level that has been set via the **Setup** menu.

Back: Press this key to return to the "File Menu" on page 4-8.

Figure 4-11. Save On Event Menu (LMR Analyzer Modes)

Recall Menu

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

Key Sequence: **File** > Recall

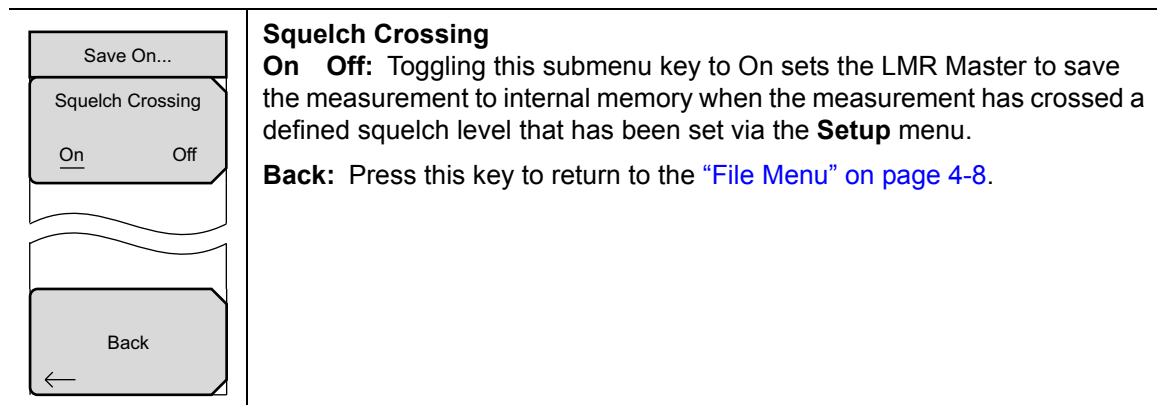|	
Recall	**Sort By**
Sort By	**Name Date Type:** Press this submenu key to sort files and folders by the file name, by the type of file, or by the date that the file or folder was saved.
Name Date Type	
Sort Order	**Sort Order**
Asc Desc	**Asc Desc:** Displays the folder or file in ascending or descending order based on the selection in the Sort By key.
File Type	**File Type:** Press this submenu key to select the type of file to be viewed. The file type can be changed with the **Up/Down** arrow keys, the rotary knob, or the touch screen. Press **Enter** to make the selection. Refer to Section 4-2 "File Types" for file type descriptions.
ALL	
Refresh	**Refresh Directories:** Press this key to update the display.
Directories	

Figure 4-12. Recall Menu

Copy Menu

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

Key Sequence: **File** > Copy

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

Sort By
Name   Type   Date: Press this submenu key to sort file and folder lists by name, by type of file, or by the date that a file was saved.

Sort Order
Asc   Desc: Press this submenu key to display the folders or files in ascending or descending order based on the selection in the Sort By key.

File Type: Press this submenu key to select the type of files to view for copying. The file type can be changed with the **Up/Down** arrow keys, the rotary knob, or the touch screen. Press **Enter** to make the selection. Refer to Section 4-2 "File Types" for file type descriptions.

Refresh Directories: Press this submenu key to update the display.

Scroll
Src   Dst: Press this submenu key to use the scroll function in the Source Folder (Src or top panel) or in the Destination Folder (Dst or bottom panel). Refer to Figure 4-3.

Select or De-Select: Press this submenu key to select or deselect the files or folders to be copied. When selected, a file or folder is outlined in blue. Refer to Figure 4-3.

Copy: Press this submenu key to copy the files or folders that are selected in the top window to the destination that is selected in the bottom window. A dialog box indicates when the copying is complete. If a file with the same name exists in the destination folder, then a warning box is displayed to allow file overwrite or cancel.

Figure 4-13. Copy Menu

Delete Menu

This menu and dialog box are used to delete folders and files. Select folders or files with the **Up/Down** arrow keys, the rotary knob, or the touch screen.
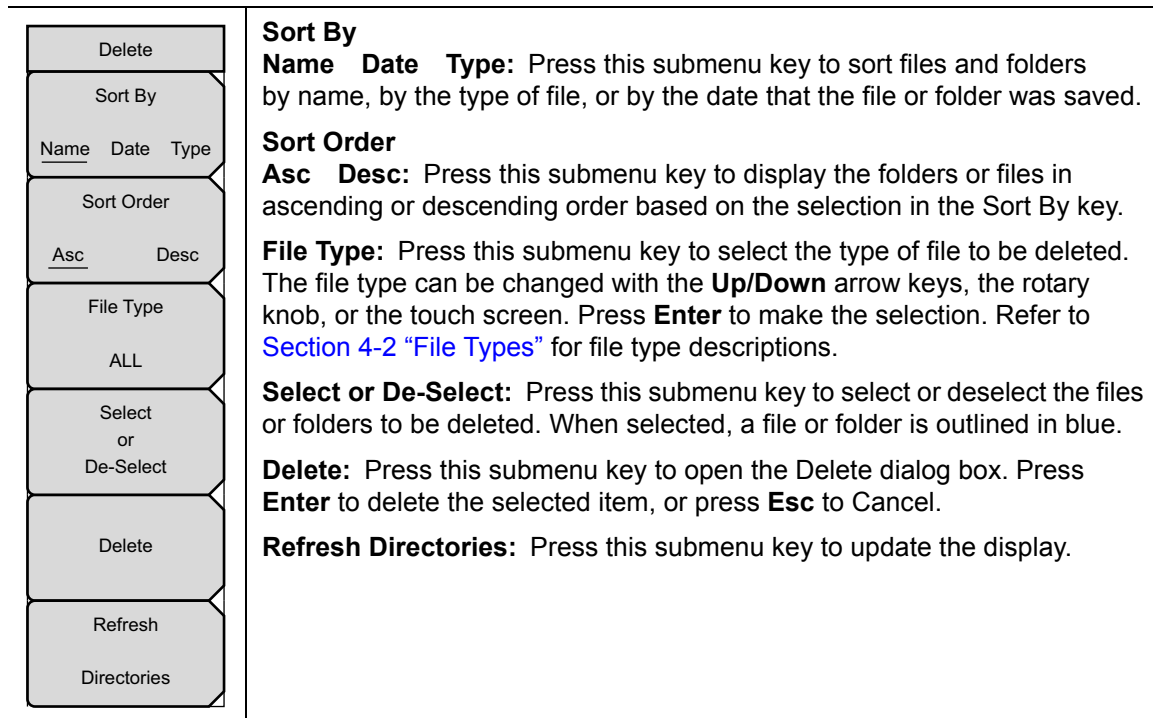
Key Sequence: **File** > Delete

Delete Sort By Name Date Type Sort Order Asc Desc File Type ALL Select or De-Select Delete Refresh Directories	**Sort By** **Name Date Type:** Press this submenu key to sort files and folders by name, by the type of file, or by the date that the file or folder was saved. **Sort Order** **Asc Desc:** Press this submenu key to display the folders or files in ascending or descending order based on the selection in the Sort By key. **File Type:** Press this submenu key to select the type of file to be deleted. The file type can be changed with the **Up/Down** arrow keys, the rotary knob, or the touch screen. Press **Enter** to make the selection. Refer to Section 4-2 "File Types" for file type descriptions. **Select or De-Select:** Press this submenu key to select or deselect the files or folders to be deleted. When selected, a file or folder is outlined in blue. **Delete:** Press this submenu key to open the Delete dialog box. Press **Enter** to delete the selected item, or press **Esc** to Cancel. **Refresh Directories:** Press this submenu key to update the display.

Figure 4-14. Delete Menu

Chapter 5 — System Operations

5-1 Introduction

This chapter describes the LMR Master system operations.

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

5-2   System Menu Group Overview

To access the functions under the System menu, press the **Shift** key, then the **System** (**8**) key.
Figure 5-1 and Figure 5-2 show the menu group that is accessible from the System menu.
Menu maps typically display all possible submenu keys, although some keys are displayed on
the instruments only under special circumstances (refer to the menu descriptions on the
following pages).

Note that the menus that are indicated by numbered circles are shown in Figure 5-2.
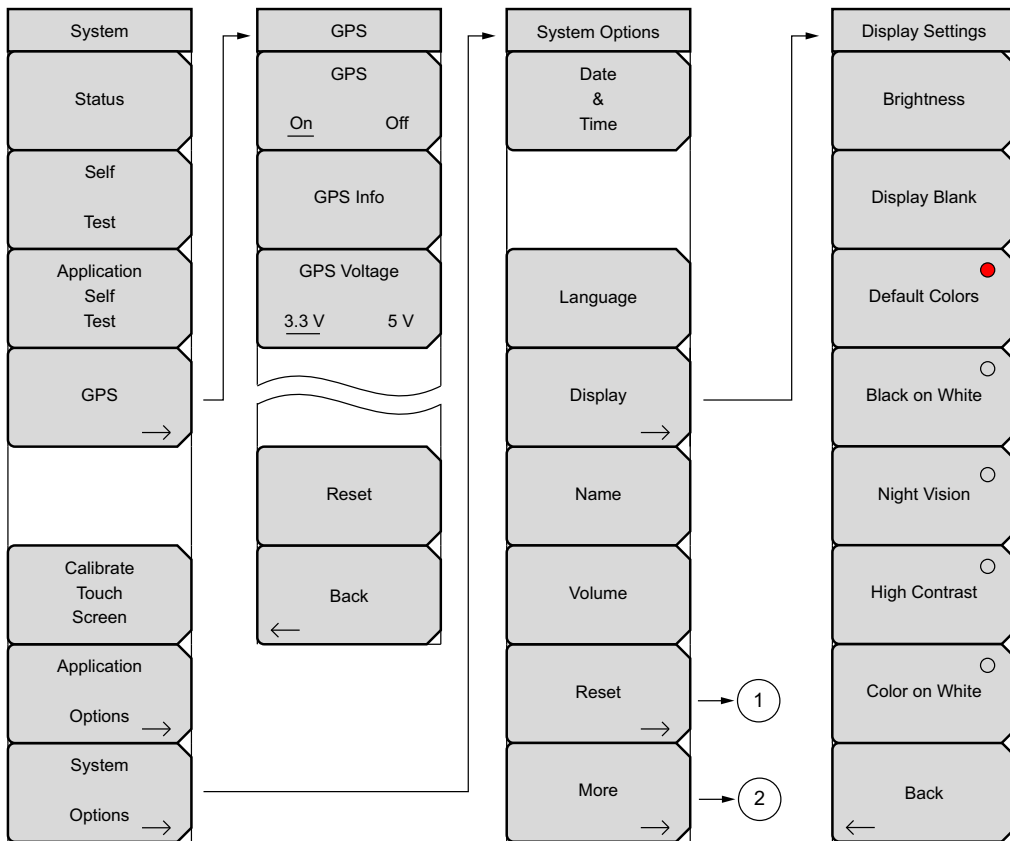
System Menu Map 1

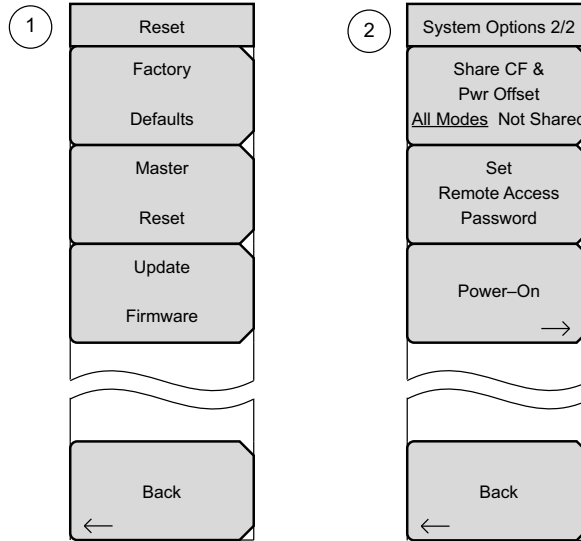**Figure 5-1.**   System Menu Map – Part 1

System Menu Map 2

Figure 5-2.   System Menu Map – Part 2

To access the functions under the System menu, press the **Shift** key, then the **System** (8) key.

Note	The display settings will vary based on the current measurement mode.

5-3   System Menu

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

System **Status** **Self** **Test** **Application** **Self** **Test** **GPS** $\longrightarrow$ **Calibrate** **Touch** **Screen** **Application** **Options** $\longrightarrow$ **System** **Options** $\longrightarrow$	**Status:** Press this submenu key to display the current system status, including the operating system and firmware versions, temperatures and other details such as current battery information. Press **Esc** or **Enter** to return to normal operation. **Self Test:** Press this submenu key to initiate a series of diagnostic tests that check the components of the instrument. A display lists the individual tests with a pass or fail indication. Press **Esc** or **Enter** to return to normal operation. **Application Self Test:** Press this submenu key to initiate a series of diagnostic tests related to the performance of the instrument for specific applications. A display lists the individual tests with a pass or fail indication. Press **Esc** or **Enter** to return to normal operation. **GPS:** Opens the "GPS Menu" on page 8-3. This submenu key is displayed only when the GPS (Option 31) is installed. **Calibrate Touch Screen:** Press this submenu key to start the touch screen calibration. Run the calibration procedure when the instrument is not responding to your screen taps as expected. **Application Options:** Press this submenu key to open a menu to select application options. This varies depending upon the measurement (application) mode. Refer to "Application Options Menu" on page 5-5. **System Options:** Press this submenu key to open the "System Options Menu" on page 5-7.

Figure 5-3.   System Menu

	Calibrate Touch Screen Shortcut
Note	Press **Shift** then **0** to open the Calibrate Touch Screen display. Press **Enter** to start the calibration or **Esc** to cancel.

5-4   Application Options Menu

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

The display of this menu varies based on the current measurement mode. In addition to the following information, refer to the appropriate Measurement Guide listed in Appendix A.

VNA Mode

Options **Units** m ft **Trace Label** On Off **Meas Gain Range** Auto **Meas Menu** Field VNA **Back** ←	**Units** **m ft:** Press this submenu key to toggle the units setting to metric (meters, or m) or to U.S. (feet, or ft). Press **Enter** to accept the changes, or press the **Esc** key to return to normal operation without changing the setting. **Trace Label** **On Off:** Press this submenu key to toggle the trace labels On or Off. **Meas Gain Range:** Press this submenu key to open the Mode Menu. Select Auto or Fixed. 　**Auto:** Press this submenu key to set the Measurement Gain Range Mode to Auto. In this mode, the instrument adjusts the gain automatically to provide the best overall system performance (dynamic range and high level noise). 　**Fixed:** Press this submenu key to set the Measurement Gain Range Mode to Fixed. In this mode, the gain of the instrument is always set to the low gain setting. For most applications, Auto mode is recommended. For certain types of filter measurements (mostly in the range less than 500 MHz), the instrument may toggle between low gain and high gain modes as the signal level rises from the noise to the pass band of the filter, resulting in extra ripple. Setting the Gain Range to fixed may address that problem. **Meas Menu** **Field VNA:** Press this submenu key to toggle between Field (a simplified subset of the standard VNA menu structure) and VNA (standard menu structure. **Back:** Press this submenu key to return to the "System Menu" on page 5-4.

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

SPA Mode

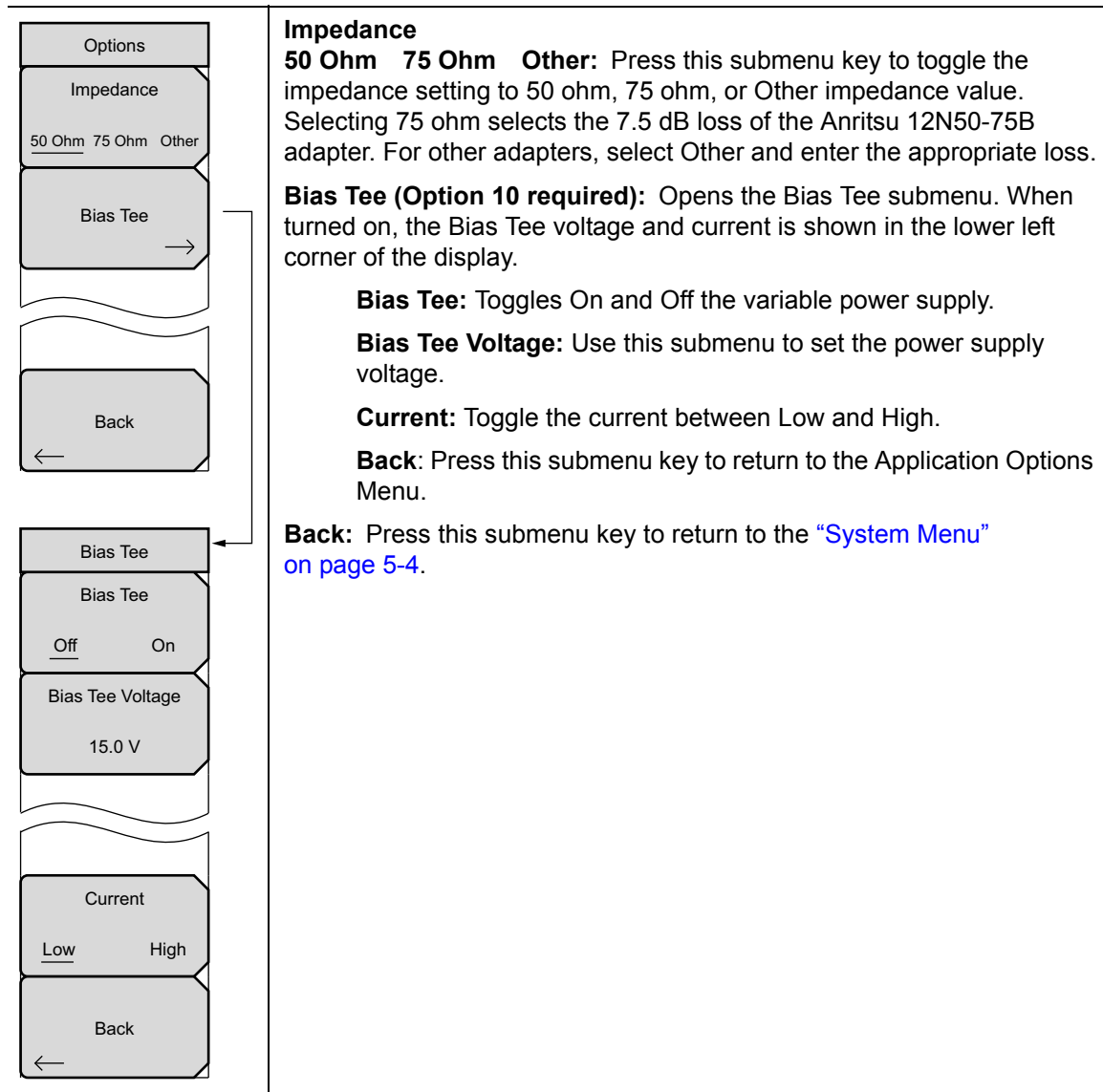Key Sequence: **Shift**, **System** (8) > Application Options

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

Bias Tee (Option 10 required): Opens the Bias Tee submenu. When turned on, the Bias Tee voltage and current is shown in the lower left corner of the display.

> **Bias Tee:** Toggles On and Off the variable power supply.

> **Bias Tee Voltage:** Use this submenu to set the power supply voltage.

> **Current:** Toggle the current between Low and High.

> **Back**: Press this submenu key to return to the Application Options Menu.

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

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

5-5 System Options Menu

System Options Menu

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

System Options Date & Time Language Display $\rightarrow$ Name Volume Reset $\rightarrow$ More $\rightarrow$	**Date & Time:** Press this submenu key to display a dialog box for setting the current date and time. Use the submenu keys or the **Left/Right** arrow keys to select the field to be modified. Use the keypad, the **Up/Down** arrow keys, or the rotary knob to select the date and time. Press **Enter** to accept the changes, or press the **Esc** key to return to normal operation without changing anything. **Language:** Press this submenu key to open a list box and select a built-in language for the VNA Master displays. The languages that are currently available are: English, French, German, Spanish, Japanese, Chinese, Korean, Italian, and Russian. In addition, a custom language may be selected if it has been defined by using Master Software Tools and loaded into the VNA Master. One custom language may be loaded into the instrument via Master Software Tools. If a mode does not have language translations available, then English is the default language. Press **Enter** to accept the change, or press the **Esc** key to return to normal operation without changes. In addition, any existing language (except English) may be edited for a better local translation. **Caution:** A reset will overwrite any custom settings within the VNA Master and will require that you reload the custom language files via Master Software Tools. **Display:** The Display submenu key opens the "Display Settings Menu" on page 5-11 allowing brightness control and the selection of different display attributes. **Name:** Press this submenu key to open a dialog box to name the instrument. The VNA Master can be named by using the text entry controls as described in section "Text Entry" on page 2-15. Press **Enter** to save the name. **Volume:** Press this submenu key to set the speaker volume. The current volume setting is displayed on the screen. Use the keypad, the **Up/Down** arrow keys, or the rotary knob to change the volume, and press the **Enter** key to accept the change. **Reset:** Press this submenu key to open the "Reset Menu" on page 5-12. **More:** Press this submenu key to open the "System Options 2/2 Menu" on page 5-8.

Figure 5-6. System Options Menu

System Options 2/2 Menu

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

Share CF & Pwr Offset

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

Set Remote Access Password: Press this submenu key to open the Password text box (Figure 5-8) and Text Entry menu. Type in the desired password. Upper case and lower case letters and the symbols – _ + . are the allowed password characters. Press **Enter** to save or **Esc** to cancel.

Power–On: Press this submenu key to open the "Power–On Menu" on page 5-10.

Back: Press this submenu key to return to the "System Options Menu" on page 5-7.

Figure 5-7.   System Options Menu 2/2)

Remote Access Password

Warning	Do not use SCPI commands with this feature.

This function is valid only with Master Software Tools (MST) v2.21.1 or later. After setting the password, reboot the instrument (normal power **OFF** then **ON**) to provide remote access security. Only one user then has remote access at any one time.

The password is first set into the instrument, then used in MST. When prompted in MST, enter the password into the password text box. The password text box shown in Figure 5-8 may differ from the text box that is displayed on your instrument.
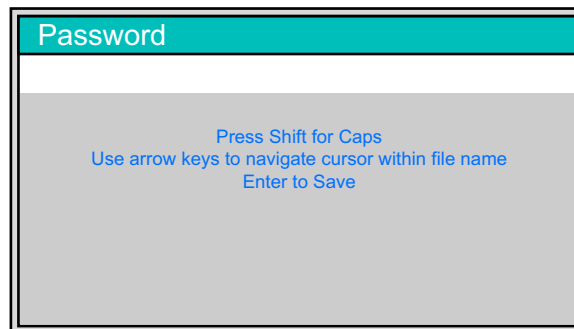
Figure 5-8. Remote Access Password Text Box

The password can be removed or reset by a Master Reset, by a Factory Default reset, or by a firmware update (which includes a restart).

Power–On Menu

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

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

When DC Applied: Press this submenu key to set the VNA Master to automatically restart when DC power is applied to the External Power connector (item 8 in Figure 2-8 on page 2-9). Refer to "External Power On" on page 3-24.

Back: Press this submenu key to return to the "System Options 2/2 Menu" on page 5-8.

Figure 5-9.   Power–On Menu

5-6 Display Settings Menu

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

Display Settings

Brightness

Display Blank

● Default Colors

○ Black on White

○ Night Vision

○ High Contrast

○ Color on White

Back
←

Brightness: Press this submenu key to adjust the brightness of the display to optimize viewing under a wide variety of lighting conditions. Use the keypad, the **Up/Down** arrow keys or the rotary knob to select a brightness level from 1 to 9, with 9 being the brightest. Press **Enter** to accept the change.

Display Blank: Opens a note box. Press **Enter** to turn off the display, or press **Esc** to abort. When the display is off, turn on the display with three rapid key presses of any key except the power key (or turn instrument power Off and On).

Default Colors: Press this submenu key to set the display colors to their factory default condition. Use for normal viewing.

Black on White: Press this submenu key to set the display colors to black and white. Use for printing and viewing in broad daylight conditions.

Night Vision: Press this submenu key to set the display to a red-tinted color, which is optimized for night-time viewing.

High Contrast: Press this submenu key to increase the contrast of the default display colors. Used for other challenging viewing conditions.

Color on White: Press this submenu key to invert the black background color to produce a white background and black graticule lines with colored traces. Use for viewing in broad daylight conditions and for color printing.

Back: Press this submenu key to return to the "System Options Menu" on page 5-7.

Figure 5-10. Display Settings Menu

5-7   Reset Menu

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

Reset Factory Defaults Master Reset Update Firmware Back ←	**Factory Defaults:** Press this submenu key to restore the instrument to the factory default values, including language, volume, brightness setting, and user created shortcut icons on the Menu screen. Press the **Enter** key to initiate the reset, and power-cycle the instrument. **Master Reset:** In addition to the functions described in Factory Defaults above, all user files in the internal memory are deleted, and the original language and antenna files are restored. Press the **Enter** key to initiate the Master Reset and power-cycle the instrument. Press **Esc** to return to normal operation without resetting. **Update Firmware:** Press this submenu key to update the instrument operating system with a USB flash drive. Press **Enter** and follow the onscreen instructions to update the firmware or press **Esc** to return to normal operation without updating. Refer to "Updating the LMR Master Firmware" on page 5-14 for additional information on firmware update. **Back:** Press this submenu key to return to the "System Options Menu" on page 5-7.

Figure 5-11. Reset Menu

5-8   Preset Menu

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

Preset Preset Save Setup Recall Setup	**Preset:** Press this submenu key to reset the instrument to the default starting conditions. **Save Setup:** Press this submenu key to open the Save dialog box (Figure 4-1) to name and save the current operating settings, allowing them to be recalled later to return the instrument to the state it was in at the time the setup was saved. The saved setup can be named using the touch screen keyboard. Use the Caps key to select an upper case letter. Use the **Left/Right** directional arrows to move the cursor position. Press **Enter** to save the setup. Note: Set the File type as Setup. Refer to "Save Menu" on page 4-9 for details. **Recall Setup:** Press this submenu key to select and recall a previously stored instrument setup using the "Recall Menu" on page 4-12. Use the rotary knob, the **Up/Down** arrow keys, or the touchscreen to highlight the saved setup, and press **Enter**. All current instrument settings are replaced by the stored setup information.

Figure 5-12. Preset Menu

5-9   Self Test

At power on, the LMR 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 itself. The Application Self Test runs a series of tests that are related to the current operating mode of the instrument.

If the LMR Master is within the specified operating range with a charged battery, and if the self test fails, then contact your Anritsu Service Center (http://www.anritsu.com/Contact.asp).

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

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

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

3. Press **Esc** to continue.

5-10 Updating the LMR Master Firmware

The LMR Master is updated using a USB memory stick. Updated product information can be found on the Anritsu web site:

http://www.anritsu.com/

Search for the product model number. The firmware updates are on the product page under the Library tab in the "Drivers, Software Downloads" section.

Caution	**Do not** turn off the instrument during the firmware update to avoid potential permanent damage to the instrument. The "Release History" link provides a summary of the firmware changes.

1. Click the "Firmware Update for the LMR Master S412E" link.

2. Download and run the firmware update software:

   a. Internet Explorer: Click the "Download" button and then "Run". After the download is complete, press "Run" again and follow the onscreen instructions. Press "Help (?)" for additional information.

   b. Other Browsers: Save the file locally, then run the downloaded file for the download folder.

3. After the firmware update is saved on the USB memory stick, eject the memory stick from the computer.

4. Turn the LMR Master off and insert the USB memory stick into the LMR Master.

5. Connect the AC adapter and turn the LMR Master On.

6. The instrument should update automatically. Follow the instrument prompts.

7. If the automatic update did not start, complete the following steps:

   a. On the instrument press the **Shift** key and then the **System** (8) key.

   b. Press the following key sequence: System Options > Reset > Update Firmware. The Load Firmware menu opens.

   c. Press the **Load Firmware** main menu key (located at the bottom-left corner of the instrument screen).

   d. Press the Update Application Firmware submenu key.

   e. From the choices presented, select the desired "Save" mode.

   f. Press the **Enter** key to begin the firmware update.

   g. Press the **Enter** key one more time to confirm that you want to upgrade the instrument firmware.

8. After the update is compete, the LMR Master will restart.

Note	Occasionally, improvements in the VNA firmware will require a self-alignment of the VNA after a firmware update. Criteria for a successful self-calibration are (1) the instrument should be at a stable operating temperature, and (2) nothing should be attached to either VNA port. If a self-alignment is required, upon entering VNA mode the user will be promoted by a dialog box and repeating tone. Follow the on-screen instructions to ensure a successful self-alignment.

Chapter 6 — Anritsu PC Software Tools

6-1   Introduction

This chapter provides a brief overview of the available PC software tools from Anritsu. For detailed information about specific software, refer to the Anritsu web site or the program's built-in Help. Software is included with the instrument and is also available from the Anritsu web site: http://www.anritsu.com/en-US/Services-Support/Handheld-Tools-Tool-Box.aspx.

6-2   Anritsu Tool Box

The Anritsu Tool Box is a central location to open an Anritsu measurement, visit the Anritsu web site, or launch several Anritsu applications. To open the Anritsu Tool Box, either click on the shortcut icon on the desktop or click Start and navigate through the Programs folder to the Anritsu folder and select Anritsu Tool Box.

Once the Tool Box is open, move the mouse pointer over any of the application icons to view a short description of the application. The following pages describe three software programs that can be launched from the Tool Box, Line Sweep Tools, Master Software Tools (MST), and easyMap Tools™.

Figure 6-1.   Anritsu Tool Box

> The Anritsu PC Software tools do not support all of Anritsu's handheld instruments or all of their measurements. Compatibility information is provided in the program's Help.
>
> **Note** Line Sweep Tools (LST) can be used for downloading and post-processing of certain VNA measurements and cable & antenna analysis sweeps.
>
> Master Software Tools (MST) is primarily used for spectrum analysis measurements.

6-3   Line Sweep Tools

Line Sweep Tools is a program designed to increase productivity for people who work with dozens of Cable traces, Antenna traces, and Passive Intermodulation (PIM) traces every day. Line Sweep Tools will:

- Collect sweeps from Anritsu PIM and Line Sweep gear.
- Help verify that those sweeps are done properly and that the Cable, Antenna and PIM sweeps meet specifications.
- Help create reports of the findings quickly and to a professional standard.

Figure 6-2.   Line Sweep Tools

6-4   Master Software Tools

Anritsu Master Software Tools is a PC program for transferring and editing saved measurements, markers, and limit lines to a PC. MST is recommended for Spectrum Analyzer instruments or instruments that perform spectrum analysis measurements.
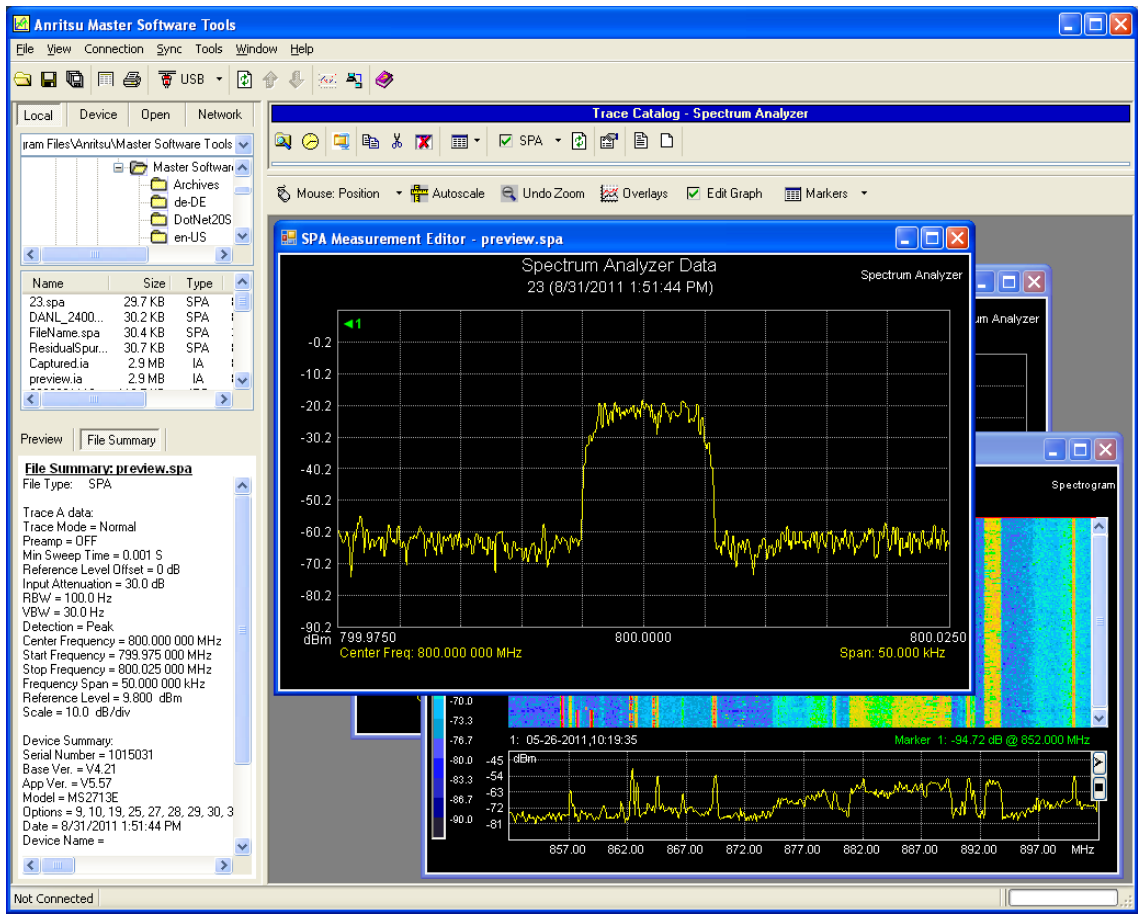
Figure 6-3.   Master Software Tools

6-5   easyMap Tools

easyMap Tools creates geo-referenced maps and can also convert floor plans for use by Anritsu mapping spectrum analyzers. It can also create single panel maps (.map) for legacy instruments or pan and zoom maps (.azm) for current instruments. Mapping of both interference and coverage is available while indoors or outdoors.
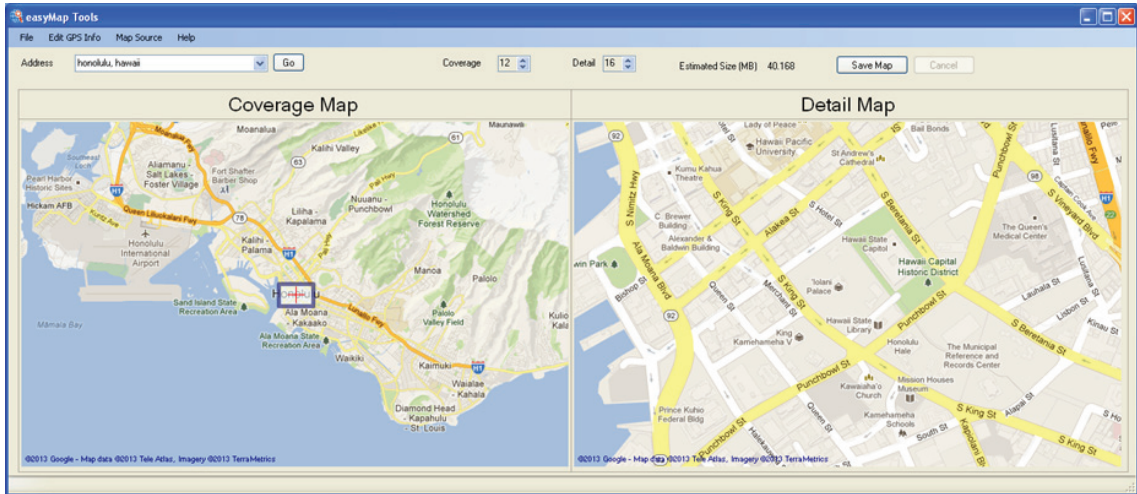
Figure 6-4.   Captured Geo-referenced Map Ready for the Analyzer

Chapter 7 — Bias Tee (Option 10)

7-1   Overview

Option 10 provides a bias tee that is installed inside the instrument. The bias arm is connected to a 12 VDC to 32 VDC power source that can be turned on as needed to place the voltage on the center conductor of the VNA Port 2 (in VNA mode) or the center conductor of RF In (in SPA mode). This supply of bias is useful when conducting two-port transmission measurements and can also be used to provide power to block down-converters in satellite receivers or to power some tower-mounted amplifiers (TMAs).

Bias Tee in VNA Mode

The bias can be turned on only when the Start Frequency is 2 MHz or greater. When bias is turned on, the bias voltage and current are displayed in the Instrument Settings Summary area of the screen. The 12 VDC to 32 VDC power supply is designed to continuously deliver a maximum of 6 watts.

When in VNA mode, the bias tee menu can be accessed as follows:

- From the Sweep menu when in standard VNA mode:

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

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

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

Bias Tee Bias Tee Off Int Voltage P2 16.1 V Int Current Limit P2 450 mA Back ←	**Bias Tee:** Toggles On and Off the variable power supply. **Int Voltage P2:** Use this submenu to set the power supply voltage. **Int Current Limit P2:** Use this submenu to set the power supply current. **Back:** Press this submenu key to return to the Configure Ports menu.
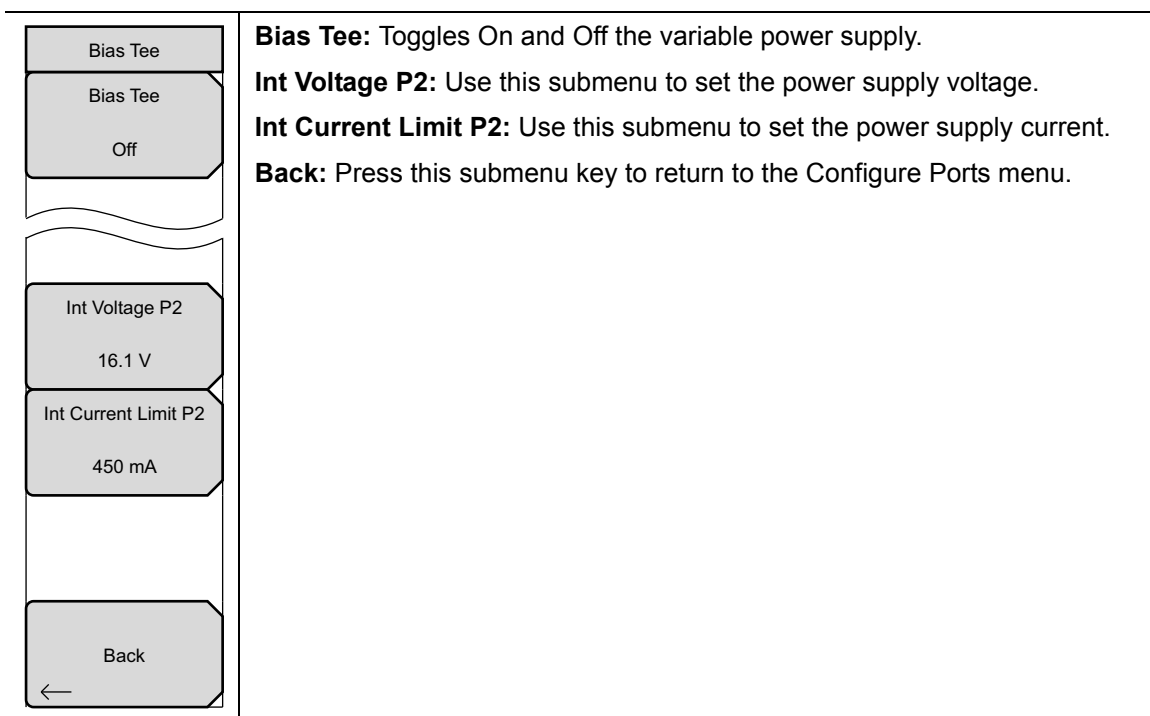
Figure 7-1.   Bias Tee Menu

Figure 7-2 shows how the LMR Master provides an internal voltage between 12 volts and 32 volts that is applied to the center conductor of Port 2. That voltage would be available at the port along with the RF signals.
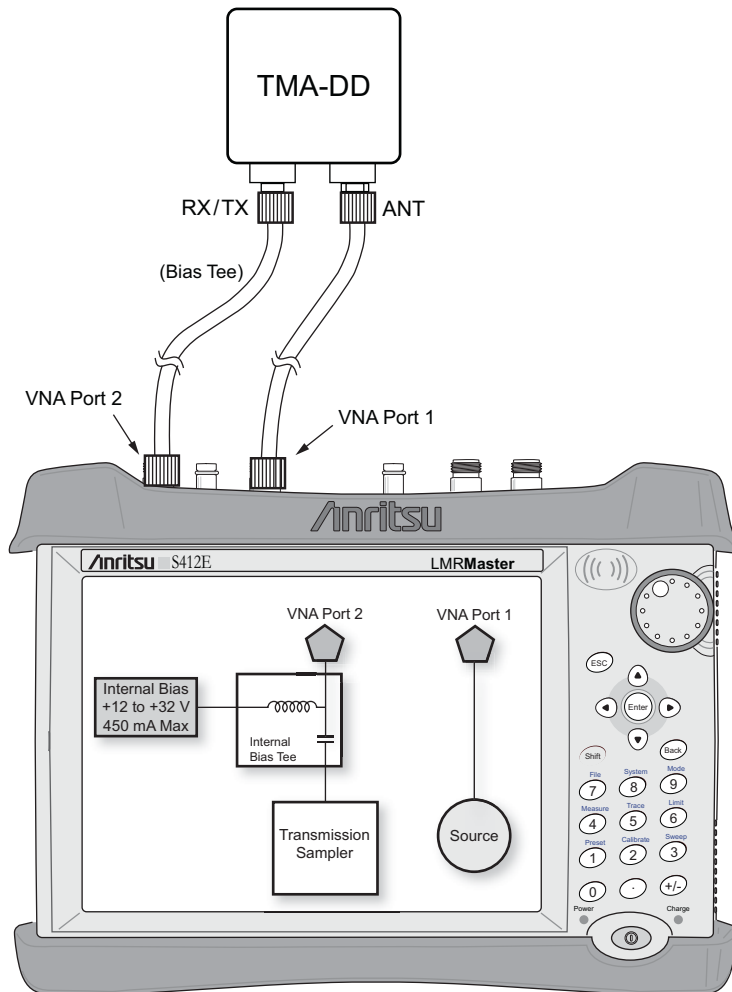
Figure 7-2.   Bias Tee Setup in VNA Mode

Additional information for Option 10 is provided in the Vector Network Analyzer Measurement Guide (refer to Appendix A).

Bias Tee in SPA Mode

When bias is turned on, the bias voltage and current are displayed in the Instrument Settings Summary area of the window. The 12 VDC to 32 VDC power supply is designed to continuously deliver a maximum of 6 watts.

The bias tee menu can be accessed from the Application Options menu in SPA mode:

System > Application Options > Bias Tee

Bias Tee Bias Tee Off On Bias Tee Voltage 16.1 V Current Low High Back ←	**Bias Tee:** Toggles On and Off the variable power supply. **Bias Tee Voltage:** Use this submenu to set the power supply voltage. **Current:** Toggle the bias tee current between Low and High. **Back:** Press this submenu key to return to the Application Options menu.
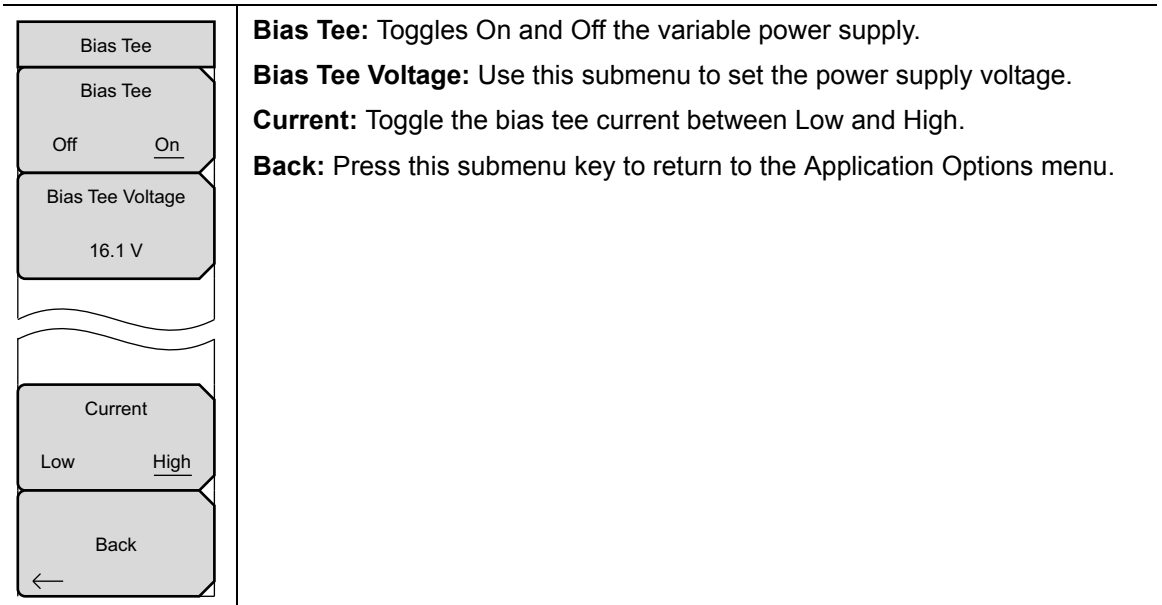
Figure 7-3.   Bias Tee Menu
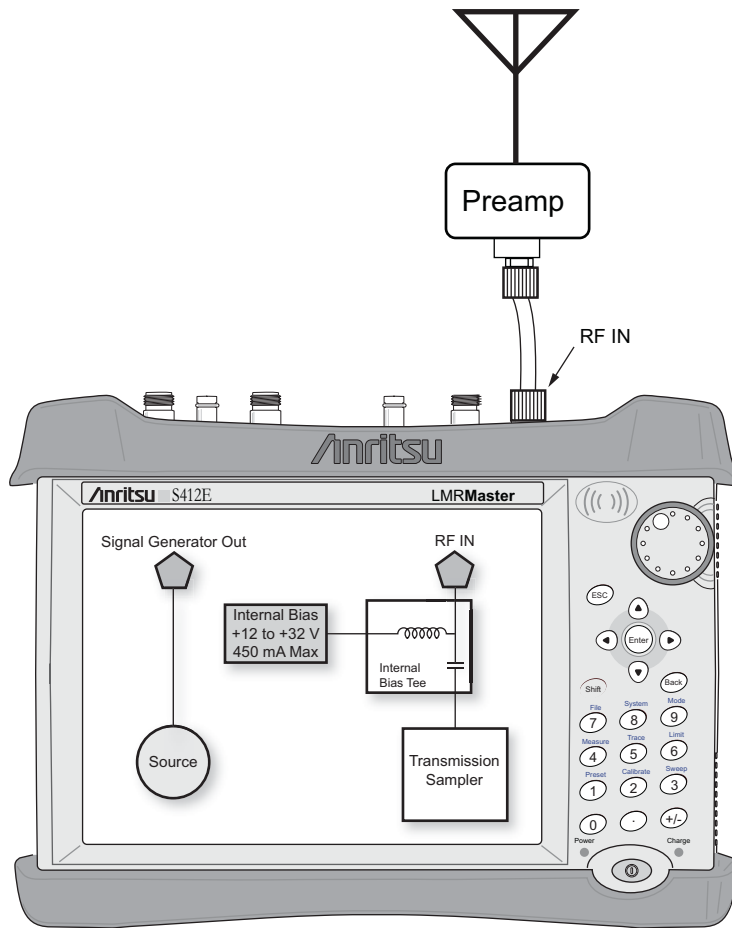
Figure 7-4.   Bias Tee Setup in SPA Mode

Chapter 8 — GPS (Option 31)

8-1   Introduction

The LMR Master is available with a built-in GPS receiver feature (Option 31) that can provide latitude, longitude, altitude, and UTC timing information. This option also enhances the frequency reference oscillator accuracy in the Spectrum Analyzer mode. Within three minutes of satellite acquisition, the reference oscillator will have an accuracy of better than 50 ppb (parts per billion).

In order to acquire data from the GPS satellites, you must have line-of-sight to the satellites, or the antenna must be placed outside without any obstructions. An Anritsu GPS antenna is required.

Note	The LMR Master Technical Data Sheet provides a list of options and the measurements that require GPS (Option 31).

8-2   Activating the GPS Feature

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

   1. Press the **Shift** key, then the **System** (8) key.

   2. Press the GPS submenu key.

   3. Press the GPS On/Off submenu 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 8-1.   GPS Icon, 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 display. Acquiring satellites may take as long as three minutes.

Figure 8-2.   GPS Icon, Green

5. Press the GPS Info submenu key to view information about:

- Tracked Satellites
- Latitude and Longitude
- Altitude
- UTC
- Fix Available
- Almanac Complete
- Antenna and Receiver Status
- GPS Antenna Voltage and Current

  Refer to Section 8-4 "GPS Menu" on page 8-3 for details about the GPS Info dialog box.

6. Press the Reset submenu 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 LMR Master is turned off or until GPS is turned off by using the GPS On/Off key.

Figure 8-3.   GPS Icon, Tracking Lost

8-3   Saving and Recalling Traces with GPS Information

Saving Traces with GPS Information

The GPS coordinates of a location can be saved along with a measurement trace. Refer to the "Save Menu" on page 4-9 for more information. The current GPS coordinates 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, then when the measurement is recalled, the coordinates that were saved are recalled as well. Refer to the "Recall Menu" on page 4-12 for more information about recalling a saved trace.

8-4   GPS Menu

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

GPS: Press this submenu key to turn GPS on or off.

GPS Info: Press this submenu key to display the current GPS information. Refer to "GPS Info" on page 8-4.

GPS Voltage: Press this submenu key to set the source voltage to be either 3.3 V or 5 V depending on the GPS receiver being used. GPS antenna voltage is set to 3.3 V by default in order to prevent accidental damage to lower-voltage GPS antennas.

5 V is the recommended setting for Anritsu GPS antennas.

Reset: Press this submenu 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 begins again.

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

Figure 8-4.   GPS Menu

GPS Info

- **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 number of satellites tracked, the more accurate the information.

- **Latitude and Longitude**

  Shows location in degrees, minutes, and seconds.

- **Altitude**

  Shows altitude information in meters.

- **UTC**

  Universal Coordinated Time.

- **Fix Available**

  The cold start search sets are established to ensure that at least three satellites are acquired within the first couple of minutes. When three satellites are found, the receiver 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. If the message persists, then contact your nearest Anritsu Service Center.

- **Receiver Status**

  Current status of the receiver.

- **GPS Antenna Voltage and Current**

  Shows voltage and current.

Appendix A — Measurement Guides

A-1   Introduction

This appendix provides a list of supplemental documentation for LMR Master features and options. Measurement guides are available as PDF files on the documentation disc and the Anritsu Website (http://www.anritsu.com).

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

LMR Master Feature (Available Option)	Document and Part Number
Vector Network Analyzer VNA Bias-Tee (0010) Vector Voltmeter (0015) Distance Domain	Vector Network Analyzer Measurement Guide (10580-00289)
High-Accuracy Power Meter (0019)	Power Meter Measurement Guide (10580-00240)
Spectrum Analyzer Interference Analyzer (0025) Channel Scanner (0027) Coverage Mapping (0431) AM/FM/PM Analyzer (0509) EMF Measurements (0444)	Spectrum Analyzer Measurement Guide (10580-00349)
LTE RF Measurements (0541) LTE Modulation Quality (0542) LTE OTA Measurements (0546) EMF Measurements (0444)	3GPP Signal Analyzer Measurement Guide (10580-00234)
Fixed WiMAX RF Measurements (0046) Fixed WiMAX Demodulation (0047) Mobile WiMAX RF Measurements (0066) Mobile WiMAX Demodulation (0067) Mobile WiMAX Over-the-Air Measurements (0037)	WiMAX Signal Analyzer Measurement Guide (10580-00236)
NBFM Analyzer P25/P25p2 Analyzer (0521) P25/P25p2 Coverage (0522) NXDN Analyzer (0531) NXDN Coverage (0532) DMR 2 Analyzer (0591) DMR 2 Coverage (0592) PTC Analyzer (0721) PTC Coverage (0722) TETRA Analyzer (0581) TETRA Coverage (0582)	Land Mobile Radio Measurement Guide (10580-00243)

Table A-2.   LMR Master-Related Documents

LMR Master Related Documents	Related Document and Part Number
Performance Specifications	LMR Master Technical Data Sheet (11410-00486)
SCPI Programming Manual	LMR Master Programming Manual (10580-00319)

A complete suite of computer software applications are available for download:

http://www.anritsu.com/en-US/Services-Support/Handheld-Tools-Tool-Box.aspx

Appendix B — Error Messages

B-1 Introduction

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

B-2 Reset Options

You can reset your LMR 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 LMR Master menu system, press the **Shift** key, then the **System** (8) key to open the System menu. Then press the System Options submenu key to open the System Options menu. Then press the Reset submenu key to open the Reset menu (refer to section "Reset Menu" on page 5-12). From the Reset menu, press either the Factory Defaults submenu key or the Master Reset submenu key.

Reset from OFF Condition

You can also reset the LMR 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 LMR Master starts up with many Factory Default settings (refer to section "Factory Defaults" on page 5-12). 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 LMR Master starts up in FULL Factory Default condition (refer to section "Master Reset" on page 5-12). Throughout this appendix, this sequence is abbreviated as Master Reset (**System**+**On**).

B-3   Self Test

To run self test, press **Shift** and **System** (8) and then Self Test. Refer to the results window in Figure B-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 LMR Master to a full Factory Default condition. If the error persists, then contact your Anritsu Service Center.
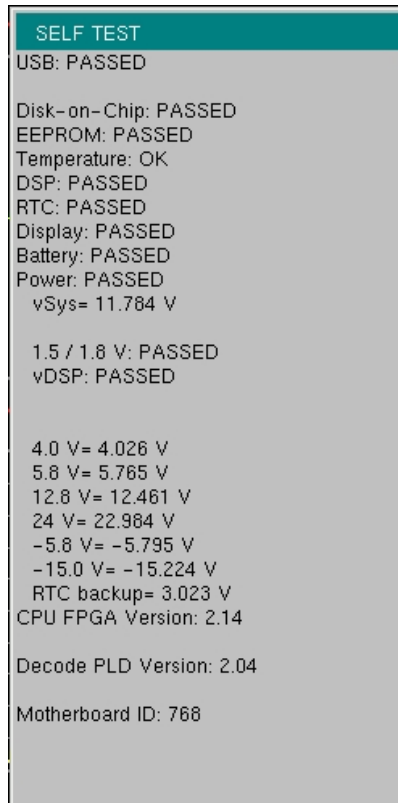
Figure B-1.   Self Test Results Window

Application Self Test

VNA Mode 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 B-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.


```
APPLICATION SELF TEST

Overal Status: PASSED
2. Frequency Sweep = PASSED
3. EEPROM = PASSED


VNA FPGA: V5.00
```
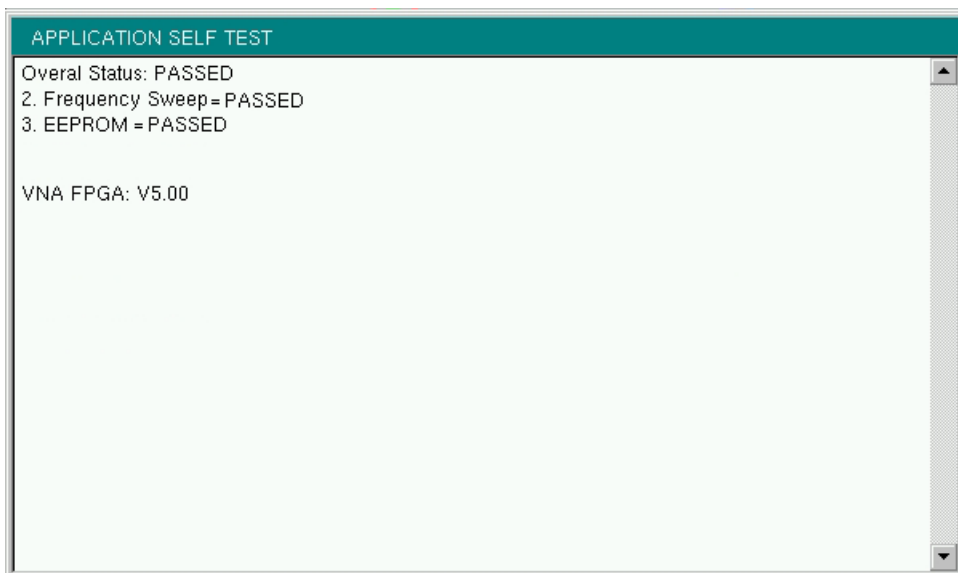
Figure B-2.   Application Self Test

If the Overall Status shows Failed, then one or more elements of the Application Self Test have failed. This self test consists of 2 subtests:

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 LMR Master to a full Factory Default condition. If the error persists, then contact your Anritsu Service Center.

Spectrum Analyzer Mode Self Test

```
APPLICATION SELF TEST
Overall Status: PASSED
ADC Self Test: PASSED

Mixer Temperature: 43C
DSP FPGA Version: 1.13
SPA FPGA Version: 1.14
```

Figure B-3.   Application Self Test

CW Signal Generator Mode Self Test

```
APPLICATION SELF TEST

Overall Status: PASSED

Sys PLL: PASSED
IQ PLL: PASSED
LO PLL: PASSED
VR PLL: PASSED
SigGen FPGA Ver: 1.01
Sinad: PASSED
Sinad Lvl: 8.4 dB
Sinad Freq: 832.3 Hz
Sinad PP: 1483.174 mV

Level Cal Ver: 1
```

Figure B-4.   Application Self Test

NBFM, P25/P25p2, NXDN, DMR 2, PTC, and TETRA Self Test
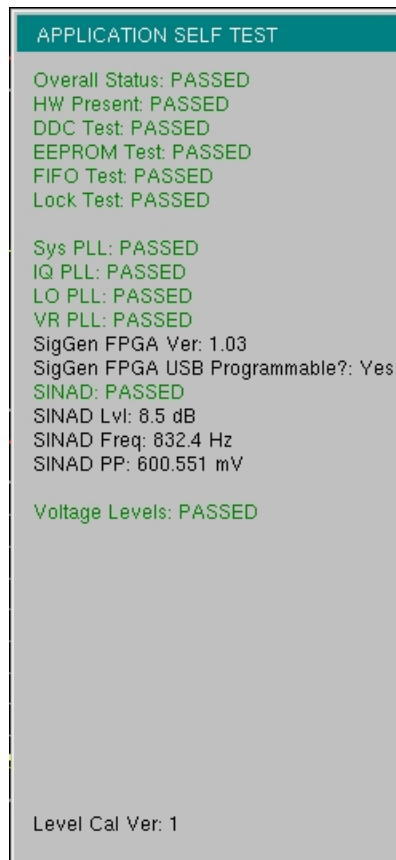
Figure B-5.   Application Self Test

B-4 Operation Error Messages

Note	Measurement mode specific error messages are listed in the Measurement Guides. Refer to Appendix A.

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 B-6). 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.
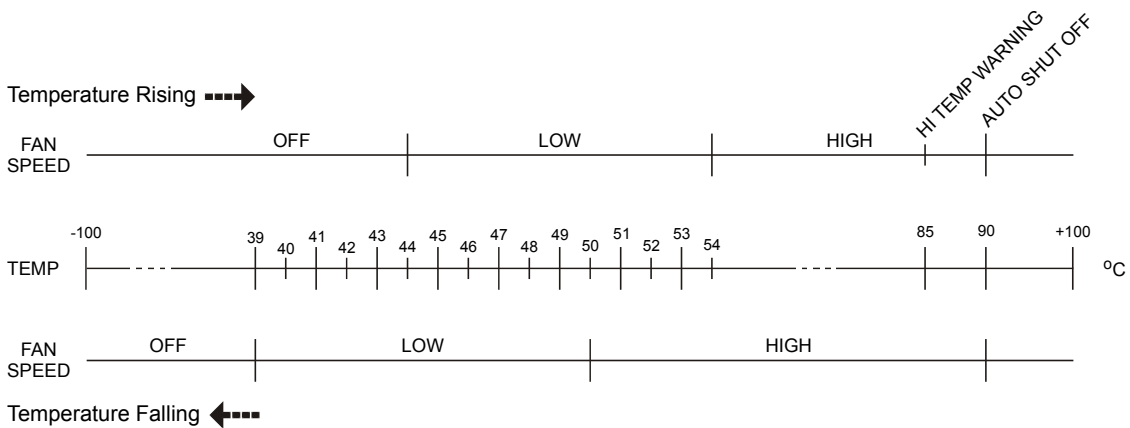
Figure B-6. Fan Speed vs. Temperature

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 LMR 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.

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.

Appendix C — Tower Mounted Amplifiers

C-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.
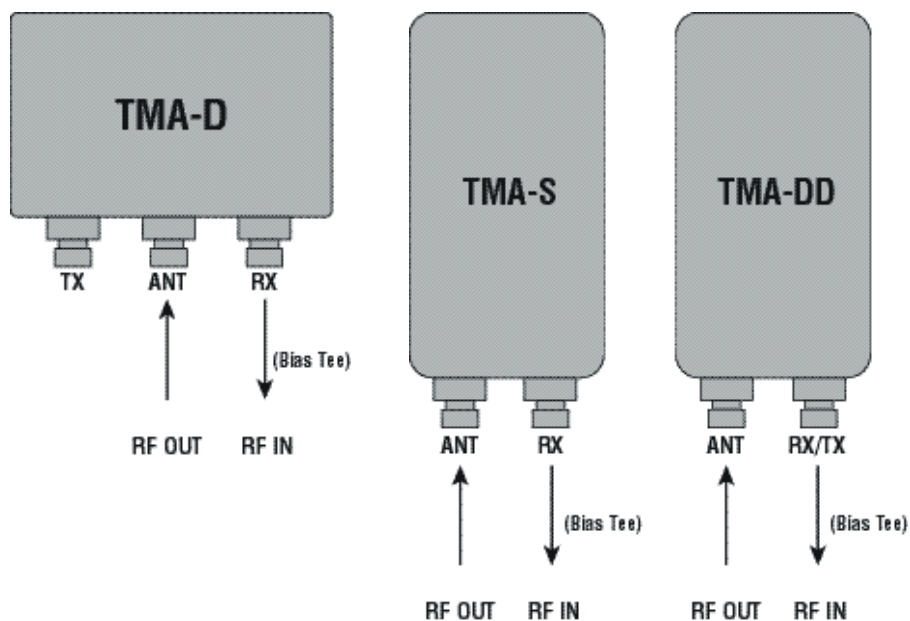
Figure C-1. Tower Mounted Amplifiers

Appendix D — Glossary of Terms

D-1   Introduction

The following terms are related to this product and its technology.

D-2   Glossary of Terms

3GPP :
: The 3rd Generation Partnership Project (3GPP) is a collaboration agreement that was established in December, 1998. It is a co-operation between ETSI (Europe), ARIB/TTC (Japan), CCSA (China), ATIS (North America), and TTA (South Korea). The scope of 3GPP was to make a globally applicable third generation (3G) mobile phone system specification within the scope of the ITU's IMT-2000 project. 3GPP specifications are based on the evolved GSM specifications, now generally known as the UMTS system.

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

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

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

Adjacent Channel :
: Adjacent Channel is a channel or frequency that is directly above or below a specific channel or frequency. First-adjacent is immediately next to another channel, and second-adjacent is two channels away, and so forth. Information on adjacent channels is used in keeping stations from interfering with one another.

Adjacent channel interference :
: Adjacent channel interference refers to signal impairment to one frequency due to the presence of another signal on a nearby frequency.

AM : Amplitude Modulation (AM) uses amplitude variation in proportion to the amplitude of the modulating signal, and is usually taken as DSB-LC (Double-Sideband Large Carrier) for commercial broadcast transmissions and DSB-SC (Double-Sideband Suppressed Carrier) for multiplexed systems.

AMC : Adaptive Modulation and Coding (AMC) is an alternative link adaptation method in 3G mobile wireless communication. AMC provides the flexibility to match the modulation-coding scheme to the average channel conditions for each user. With AMC, the power of the transmitted signal is held constant over a frame interval, and the modulation and coding format is changed to match the current received signal quality or channel conditions.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Bias Tee : A three-port network used to supply an isolated DC signal.

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

C/I : Carrier-to-Interference ratio (C/I) is the ratio of power in an RF carrier to the interference power in the channel.

Carrier Frequency : Carrier Frequency refers to the nominal frequency of a carrier wave, the frequency of the unmodulated electrical wave at the output of an amplitude modulated, the center frequency of a frequency modulation signal, frequency modulated, or phase modulated transmitter of the output of a transmitter when the modulation is zero.

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

Coupler : A coupler is a passive device used to split or combine a transmission line.

CW :   Continuous Wave (CW)

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

dB :   Decibel or deciBel (dB) is a unit for measuring relative power ratios in terms of gain or loss. The units of dB are expressed in terms of the logarithm to base 10 of a ratio and typically are expressed in watts. For example, a -3dB loss indicates a 50% loss in power; a +3dB reading is a doubling of power; 10 dB indicates an increase (or a loss) by a factor of 10; 20 dB indicates an increase (or a loss) of a factor of 100; 30 dB indicates an increase (or a loss) by a factor of 1000.

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

dBm :   dBm is a decibel value referenced to a milliWatt (dBm). This is a technique for expressing a power measurement in logarithmic form using 1 mW as a reference. dBm is a decibel ratio (log 10) of Watts (W) to one milliwatt (1mW). dBm, therefore, represents absolute power.

Demodulate :   To extract information from a transmitted (modulated) signal.

Demodulor :   A device that extracts information from a transmitted (modulated) signal.

Deviation : The difference between signal parameters (generally in frequency modulated signals, the difference between the maximum modulated frequency and the base carrier frequency).

DHCP : Dynamic Host Configuration Protocol (DHCP)

Directional Coupler : A Directional Coupler is a device to split an incident transmission into two separate paths, and to absorb reflections from the sampled (coupled) line.

Discriminator : A Discriminator is a demodulation circuit that is used to recover the modulation from frequency modulated signals. A Discriminator responds to frequency variations.

Distributed antenna system : Distributed antenna system is a type of antenna system that is distributed or remotely located away from the transmitter. Such an antenna or series of antennas can be connected via coaxial cable, leaky feeder, or optical fiber link.

DMR : Digital Mobile Radio (DMR)

DSP : Digital Signal Processing (DSP)

Duplex : Duplex refers to two way communication.

EMF : Electromagnetic Field

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

FM : Frequency Modulation (FM) is a form of angle modulation in which the instantaneous frequency of a sine-wave carrier is caused to depart from the carrier frequency by an amount proportional to the instantaneous value of the modulating wave. In FM, signals of different frequencies represent different data values.

FM Modulation
Index :   In FM modulated systems, the FM Modulation Index is the ratio of the peak frequency deviation to the maximum modulating frequency. The higher the index, the greater the received quality. M Modulation Index = (peak frequency deviation / maximum modulation frequency)

FM Threshold :   FM Threshold is the point at which the input signal power is just strong enough to enable the receiver demodulator circuitry to successfully detect and recover a good quality television picture from the incoming video carrier.

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

Graticule :   A reticle or grid.

IQ :   In-phase and Quadrature (IQ) or (I/Q) IQ is a method of representing digital modulation. Ll baseband signals can be represented by an I (In-Phase) portion and a Q (Quadrature-Phase) portion. Vectors describe the I and Q states (or equivalently the amplitude and phase) of a signal, so that all possible information about that signal can be derived from them. I text files contain pairs of I/Q values for signals that they represent. IQ odulators are 90 degrees out of phase with each other. IQ dulation combines two channels of information into one signal and then separates them later.

LMR :   Land Mobile Radio

LTE : Long Term Evolution (LTE), sometimes also referred to as 3G LTE or Super-3G, is the 3GPP radio technology evolution architecture. Its full name is UTRA-UTRAN Long Term Evolution (LTE) and 3GPP System Architecture Evolution (SAE). TE refers to a mobile technology upgrade path for 3G networks that will provide faster data speeds and new services through new radio access technology optimized for IP-based traffic. E is part of the GSM evolutionary path beyond 3G, following EDGE, UMTS/W-CDMA, and HSPA (HSDPA and HSUPA combined). L uses Orthogonal Frequency Division Multiple Access (OFDMA) on the downlink to achieve high peak data rates in high spectrum bandwidth. LT systems will coexist with 3G systems as well as 2G systems. Mul mode devices will likely function across LTE/3G or even LTE/3G/2G, depending on market circumstances.

LVD : Low Voltage Directive (LVD)

NBFM : Narrow Band Frequency Modulation

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

NXDN : A narrowband frequency-domain multiple access communication protocol.

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

OSL : Open Short Load

OSL : Open Short Load Through

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

P25 : An set of open interface communication standards.

PTC : Positive Train Control (PTC) is a system that provides railway safety for trains and workers. The American Railway Engineering and Maintenance-of-Way Association (AREMA) organization describes PTC as having the following primary characteristics: 1] train separation for collision avoidance, [2] enforcement of line speeds, [3] temporary speed restrictions, and safety of wayside rail workers. Ing PTC, movement authority and train location (via GPS) are available by utilizing wireless technologies.

SINAD : Signal-to-Noise And Distortion (ratio) (SINAD)

TETRA : Terrestrial Trunked Radio (TETRA) (new name)

TFT : Thin-Film Transistor/Thin-Film Technology (TFT)

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

TTL : Transistor-Transistor Logic (TTL)

VSWR : Voltage Standing Wave Ratio (VSWR)

WiMax :   Worldwide Interoperability for Microwave Access (WiMax), is a popular
name of the 802.16 wireless metropolitan-area network standard,
including both 802.16-2004 for fixed WiMAX and 802.16-2005 for mobile
WiMAX. WiMax has a range of up to 31 miles. Data rates for WiMax
can reach up to 75 Mbps (Fixed) or 15 Mbps (Mobile). A number of
wireless signaling options exist ranging anywhere from the 2 GHz
range up to 66 GHz. WiMax is primarily aimed at making broadband
network access widely available without the expense of stringing wires
(as in cable-access broadband) or the distance limitations of Digital
Subscriber Line. WiMax technology can deliver high-speed Internet
access to rural areas and other locations. WiMax also offers an
alternative to satellite Internet services.

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