

User Guide

Spectrum Master™ MS2711D

100 kHz to 3 GHz Spectrum Analyzer

The Anritsu logo is located in the bottom right corner of the page. It consists of the word "Anritsu" in a bold, sans-serif font. The letter "A" is stylized with a diagonal slash through it. The logo is positioned above a horizontal line that spans the width of the page.

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DECLARATION OF CONFORMITY

Manufacturer's Name: ANRITSU COMPANY

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

declares that the product specified below:

Product Name: Site Master

Model Number: S331D, S332D, MS2711D

conforms to the requirement of:

EMC Directive 89/336/EEC as amended by Council Directive 92/31/EEC & 93/68/EEC
Low Voltage Directive 73/23/EEC as amended by Council directive 93/68/EEC

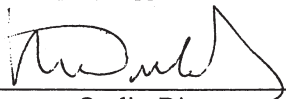
Electromagnetic Interference:

Emissions: CISPR 11:1990/EN55011: 1991 Group 1 Class A
EN 61000-3-2:1995 Class A
EN 61000-3-3:1995 Class A

Immunity: EN 61000-4-2:1995/EN50082-1: 1997 - 4kV CD, 8kV AD
EN 61000-4-3:1997/EN50082-1: 1997 - 3V/m
ENV 50204/EN50082-1: 1997 - 3V/m
EN 61000-4-4:1995/EN50082-1: 1997 - 0.5kV SL, 1kV PL
EN 61000-4-5:1995/EN50082-1: 1997 - 1kV L-L, 2kV L-E
EN 61000-4-6:1994/EN61326: 1998 - 3V
EN 61000-4-8:1994/EN61326: 1998 - 3A/m
EN 61000-4-11:1994/EN61326: 1998 - 1 cycle@100%

Electrical Safety Requirement:

Product Safety: The Product Complies when used with Company supplied Power Supply (tested to EN 60950)


Corporate Quality Director

Morgan Hill, CA

12-065-03
Date

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


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印刷线路板 (PCA)	×	○	×	×	○	○
机壳、支架 (Chassis)	×	○	×	×	○	○
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Chapter 1

General Information

Introduction

This chapter provides a description, performance specifications, optional accessories, preventive maintenance, and calibration requirements for the Anritsu Handheld Spectrum Analyzer model listed below. Throughout this manual, this instrument may be referred to as an Anritsu Spectrum Master™.

Model	Frequency Range
MS2711D	100 kHz to 3 GHz

Description

The Anritsu Spectrum Master is a synthesizer-based hand held spectrum analyzer that provides quick and accurate signal results. Measurements can be easily made by using the main instrument functions: frequency, span, amplitude and bandwidth. Dedicated keys for common functions and a familiar calculator-type keypad are available for fast data entry. Automatic time and date stamping of measurement data of up to 300 results is provided as is storage and recall of up to 10 measurement setups. A large, daylight-viewable TFT color display provides easy viewing in a variety of lighting conditions. The Anritsu Spectrum Master is capable of up to one and one-half hours of continuous operation from a fully charged battery and can be operated from an external power source (which also simultaneously charges the battery). Built-in energy conservation features can be used to extend battery life over an eight-hour workday.

The Anritsu Spectrum Master is designed for monitoring, measuring, and analyzing signal environments. Typical measurements include: in-band interference, transmit spectrum analysis, antenna isolation and cell area interference. A full range of marker capabilities such as peak, center and delta functions are provided for faster, more comprehensive measurement of displayed signals. Multiple limit lines are available for creating quick, simple pass/fail measurements. A menu option provides for an audible beep when the limit value is exceeded.

Standard Accessories

Anritsu Handheld Software Tools, a PC-based software program, provides an on-line database record for storing measurement data. Handheld Software Tools can also convert the Anritsu Spectrum Master display to a Microsoft Windows 95/98/NT4/2000/ME/XP graphic. Measurements stored in the Anritsu Spectrum Master internal memory can be down-loaded to a PC using the included null-modem serial cable. Once stored, the graphic trace can then be displayed, scaled, or enhanced with markers and limit lines. Historical graphs can be overlaid with current data using the PC mouse in a drag-and-drop fashion. The underlying data can be extracted and used in spreadsheets or for other analytical tasks.

The following standard accessories are supplied with the MS2711D:

- 10580-00097 MS2711D Spectrum Master User's Guide
- 65717 Soft Carrying Case, part number
- 40-168-R AC-DC Adapter with Power Cord
- 806-141 Automotive Cigarette Lighter 12 Volt DC Adapter
- 633-27 Rechargeable NiMH Battery
- 800-441 Serial Interface Cable (null modem type)
- 551-1691-R USB to RS-232 Adapter Cable
- 2300-347 Anritsu Handheld Software Tools CDROM
- One Year Warranty (includes battery, firmware, and software)

Options

- Option 19 High Accuracy Power Meter (sensor not included)
- Option 21 Transmission Measurement
- Option 25 Interference Analyzer - Requires directional antenna
- Option 27 Channel Scanner
- Option 29 Internal Power Meter

Optional Accessories

Part Number	Description
Precision Adapters	
34NN50A	Precision Adapter, N(m)-N(m), DC to 18 GHz, 50 Ω
34NFNF50	Precision Adapter, N(f)-N(f), DC to 18 GHz, 50 Ω
Adapters	
510-90-R	Adapter, 7/16 DIN(f)-N(m), DC to 7.5 GHz, 50 Ω
510-91-R	Adapter, 7/16 DIN(f)-N(f), DC to 7.5 GHz, 50 Ω
510-92-R	Adapter, 7/16 DIN(m)-N(m), DC to 7.5 GHz, 50 Ω
510-93-R	Adapter, 7/16 DIN(m)-N(f), DC to 7.5 GHz, 50 Ω
510-96-R	Adapter, 7/16 DIN(m)-7/16 DIN(m), DC to 7.5 GHz, 50 Ω
510-97-R	Adapter, 7/16 DIN(f)-7/16 DIN(f), DC to 7.5 GHz, 50 Ω
Test Port Cables, Armored	
15NN50-1.5C	Test Port Cable Armored, 1.5 meters N(m)-N(m), 6 GHz, 50 Ω
15NN50-3.0C	Test Port Cable Armored, 3.0 meters N(m)-N(m), 6 GHz, 50 Ω
15NNF50-1.5C	Test Port Cable Armored, 1.5 meters N(m)-N(f), 6 GHz, 50 Ω
15NNF50-3.0C	Test Port Cable Armored, 3.0 meters N(m)-N(f), 6 GHz, 50 Ω
15ND50-1.5C	Test Port Cable Armored, 1.5 meters N(m)-7/16 DIN(m), 6 GHz, 50 Ω
15NDF50-1.5C	Test Port Cable Armored, 1.5 meters N(m)-7/16 DIN(f), 6 GHz, 50 Ω
Antennas	
2000-1200	Portable Antenna, SMA (m), 806-866 MHz, 50 Ω
2000-1473	Portable Antenna, SMA (m), 870-960 MHz, 50 Ω
2000-1035	Portable Antenna, SMA (m), 896-941 MHz, 50 Ω
2000-1030	Portable Antenna, SMA(m), 1.71 to 1.88 GHz, 50 Ω
2000-1474	Portable Antenna, SMA(m), 1.71 to 1.88 GHz, 50 Ω
2000-1031	Portable Antenna, SMA(m), 1.85 to 1.99 GHz, 50 Ω
2000-1475	Portable Antenna, SMA(m), 1.92 to 1.98 and 2.11 to 2.17 GHz, 50 Ω
2000-1032	Portable Antenna, SMA(m), 2.4 to 2.4835 GHz, 50 Ω

Directional Antennas

2000-1411-R	Portable Yagi Antenna, N(f), 822 to 900 MHz, 10 dBd
2000-1412-R	Portable Yagi Antenna, N(f), 885 to 975 MHz, 10 dBd
2000-1413-R	Portable Yagi Antenna, N(f), 1710 to 1880 MHz, 10 dBd
2000-1414-R	Portable Yagi Antenna, N(f), 1850 to 1990 MHz, 9.3 dBd
2000-1416-R	Portable Yagi Antenna, N(f), 1920 to 2170 MHz, 12 dBd
2000-1415-R	Portable Yagi Antenna, N(f), 2400 to 2500 MHz, 12 dBd

Filters

1030-114-R	Filter, Bandpass, 806 to 869 MHz, N(m)-SMA(f), 50 Ω
1030-109-R	Filter, Bandpass, 824 to 849 MHz N(m)-SMA(f), 50 Ω
1030-110-R	Filter, Bandpass, 880 to 915 MHz, N(m)-SMA(f), 50 Ω
1030-105-R	Filter, Bandpass, 890 to 915 MHz, N(m)-N(f), 50 Ω
1030-111-R	Filter, Bandpass, 1850 to 1910 MHz, N(m)-SMA(f), 50 Ω
1030-106-R	Filter, Bandpass, 1710 to 1790 MHz, N(m)-N(f), 50 Ω
1030-107-R	Filter, Bandpass, 1910 to 1990 MHz, N(m)-N(f), 50 Ω
1030-112-R	Filter, Bandpass, 2400 to 2484 MHz, N(m)-SMA(f), 50 Ω

Attenuators

3-1010-119	Attenuator, 10 dB, 2 W, DC to 6 GHz
3-1010-122	Attenuator, 20 dB, 5 W, DC to 12.4 GHz, N(m)-N(f)
42N50-20	Attenuator, 20 dB, 5 W, DC to 18 GHz, N(m)-N(f)
3-1010-123	Attenuator, 30 dB, 50 W, DC to 8.5 GHz, N(m)-N(f)
42N50A-30	Attenuator, 30 dB, 50 W, DC to 18 GHz, N(m)-N(f)
1010-127-R	Attenuator, 30 dB, 150 W, DC to 3 GHz, N(m)-N(f)
3-1010-124	Attenuator, 40 dB, 100 W, DC to 8.5 GHz, N(m)-N(f), Uni-directional
1010-121	Attenuator, 40 dB, 100W, DC to 18 GHz, N(m)-N(f)
1010-128-R	Attenuator, 40 dB, 150W, DC to 3 GHz, N(m)-N(f)

Miscellaneous Accessories

633-27	Rechargeable Battery, Ni-MH
806-141	Automotive Cigarette Lighter/12 Volt DC Adapter
40-168-R	AC/DC Adapter
2000-1029	Battery Charger, NiMH, w/ Universal Power Supply
551-1691-R	USB to RS-232 Adapter Cable
800-441	Serial Interface Cable
65717	Soft Carrying Case
67135	Site Master Backpack
760-243-R	Transit Case
2300-347	Handheld Software Tools CDROM

Power Monitor Detectors

5400-71N50	Detector, .001 to 3 GHz, N(m), 50 Ω
5400-71N75	Detector, .001 to 3 GHz, N(m), 75 Ω
560-7N50B	Detector, 10 MHz to 20 GHz, N(m), 50 Ω
560-7S50B	Detector, 10 MHz to 20 GHz, WSMA(m), 50 Ω
560-7K50	Detector, 10 MHz to 40 GHz, K(m), 50 Ω
560-7VA50	Detector, 10 MHz to 50 GHz, V(m), 50 Ω

Power Monitor Extender Cables

800-109	7.6 m (25 ft)
800-111	30.5 m (100 ft)

High Accuracy Power Meter Accessories

PSN50	High Accuracy Power Sensor, 50 MHz to 6 GHz
MA24104A	Inline High Power Sensor, 600 MHz to 4 GHz
40-168-R	AC-DC Adapter
800-441	Serial Interface Cable
3-1010-122	Attenuator, 20 dB, 5 W, DC to 12.4 GHz, N(m)-N(f)
1010-127-R	Attenuator, 30 dB, 150 W, DC to 3 GHz, N(m)-N(f)
3-1010-123	Attenuator, 30 dB, 50 W, DC to 8.5 GHz, N(m)-N(f)
3-1010-124	Attenuator, 40 dB, 100 W, DC to 8.5 GHz, N(m)-N(f), Uni-directional
1010-128-R	Attenuator, 40 dB, 150W, DC to 3 GHz, N(m)-N(f)

Documentation

10580-00098	MS2711D Programming Manual (available on disk or at www.us.anritsu.com)
10580-00099	MS2711D Maintenance Manual

Performance Specifications

Performance specifications are provided in Table 1-2. Unless otherwise noted, specified values are obtained after a five minute warmup period at a constant ambient temperature. The typical values are provided for reference, and are not guaranteed.

Table 1-2. Performance Specifications (1 of 4)

Description	Value
<u>Frequency</u>	
Frequency Range	100 kHz to 3 GHz (tunable to 9 kHz)
Frequency Reference	
Aging	±1 ppm/yr
Accuracy	±2 ppm
Frequency Span	10 Hz to 2.99 GHz in 1, 2, 5 step selections in auto mode, plus zero span
Sweep Time	≤ 1.1s full span; ≤50 μs to 20s, selectable in zero span
SSB Phase Noise	-75 dBc/Hz, 30 kHz offset @ 1 GHz
Spurious Responses	
Input Related	≤ -45 dBc
Spurious	
Residual Responses	≤ -90 dBm, 10 kHz RBW, pre-amp on
<u>Resolution Bandwidth</u>	
Selections	100 Hz to 1 MHz in 1-3 sequence
Accuracy	5% typical
<u>Video Bandwidth</u>	
Selection	3 Hz to 1 MHz in 1-3 sequence
Accuracy	± 5%
<u>Amplitude</u>	
Measurement Range	+20 dBm to -135 dBm
Maximum Input Level	+43 dBm, peak, without damage ±50 VDC
Displayed Average Noise Level:	≤ -135 dBm typical, ≥10 MHz; ≤ -115 dBm typical, <10 MHz (input terminated, 0 dB attenuation, RMS detection, 100 Hz RBW, preamp on)
Dynamic Range	> 65 dB
Total Level Accuracy	±1.5 dBm max (±1 dBm typical) >10 MHz to 3 GHz ±2 dBm typical <10 MHz for input signal levels ≥ -60 dBm (excludes input VSWR mismatch)
<u>Amplitude Units</u>	
Scale Mode	dBm, dBV, dBmV, dBμV, V, W
Log Display	1 to 15 dB/division, in 1 dB steps, 10 divisions displayed
Linear Display	10 divisions
Attenuator	Range: 0 to 51 dB, selected manually or automatically coupled to the reference level. Resolution in 1 dB steps.

Table 1-2. Performance Specifications (2 of 4)

Description	Value
<u>High Accuracy Power Meter (Option 19)</u>	
<u>Compatible Sensors: PSN50 and MA24104A</u>	
<u>PSN50 High Accuracy Power Sensor:</u>	
Frequency Range	50 MHz to 6 GHz
Measurement Range	–30 dBm to +20 dBm
Sensor Linearity	± 0.13 dB
Input Connector	Type N, male, 50Ω
Refer to the PSN50 Technical Data Sheet, PN: 11410-00423, for complete specifications.	
<u>MA24104A Inline High Power Sensor:</u>	
Frequency Range	600 MHz to 4 GHz
Measurement Range	+3 dBm to +51.76 dBm (2 mW to 150 W)
Sensor Linearity	± 0.13 dB
Input Connector	Type N, female, 50Ω
Output Connector	Type N, female, 50Ω
Refer to the MA24104A Technical Data Sheet, PN: 11410-00483, for complete specifications.	
<u>Transmission Measurement</u>	
<u>(Option 21)</u>	
Frequency	25 MHz to 3.0 GHz
Freq. Resolution	10 Hz
Output Power Level:	–10 dBm typical (up to –90 dBm with external attenuator)
Dynamic Range:	80 dB, 25 MHz to 2 GHz
	60 dB, >2 GHz to 3 GHz
Output Impedance:	50Ω
<u>Interference Analysis (Option 25)</u>	
Signal strength with audible tone	
Strength of the interferer	
RSSI	
Spectrogram	
Signal ID	
<u>Channel Scanner (Option 27)</u>	
Frequency Range:	100 kHz to 3.0 GHz
Frequency Accuracy:	± 10 Hz + Time base error, 99% confidence level
Measurement Range:	+20 dBm to –110 dBm
Channel Power:	± 1 dB typical (± 1.5 dB max)
Adjacent Channel	
Power Accuracy:	± 0.75 dBc

Table 1-2. Performance Specifications (3 of 4)

Description	Value
<u>Power Meter (Option 29)</u>	
Frequency Range	>3 MHz to 3 GHz
Detection Range	-80 dBm to +20 dBm (+80 dBm with 60 dB external pad)
Offset Range	0 to +60 dB
Accuracy	±1.5 dBm maximum (±1 dBm typical) 10 MHz to 3 GHz ±2 dBm typical <10 MHz
VSWR	1.5:1 typical ($P_{in} > -30$ dBm, 10 MHz to 2.4 GHz)
Maximum Power (without damage)	+43 dBm without external attenuator
<u>Display</u>	
Type	TFT Color Display
Resolution	640 × 480
Marker Modes	Standard Delta Marker To Peak Marker Frequency To Center Marker To Valley (M5 & M6 only) Noise Markers
<u>Memory</u>	
Trace Storage	300 traces
Setup Storage	10 setups
Displayed Traces	2 traces
<u>Inputs</u>	
RF Input	Female, Type N, 50 Ω
RF Out	Female, Type N, 50 Ω (Option 21 only)
RF Input VSWR	1.5:1 typical (≥ 20 dB atten., 10 MHz to 2.4 GHz)
<u>RS232 Interface</u>	
Type	Null modem
Baud Rate	9600, 19.2k, 38.4k, 56k, 115.2k baud
<u>Printer Interface</u>	
Drivers	Refer to the list of supported printers on page 2-27

Table 1-2. Performance Specifications (4 of 4)

Description	Value
<i>General</i>	
Dimensions	10 × 7 × 2.4 inches 25.4 × 17.8 × 6.1 centimeters
Weight	base model: 4.5 pounds (2.02 kg) including battery with all options: 4.9 pounds (2.2 kg) including battery
Power Requirements	NiMH battery: 10.8 volts, 1800 mAh External DC input: +12 to +15 Vdc, 3A max.
Temperature	Operating: –10 to +50° C, 85% or less humidity Non-operating: –20 to +75° C
Electromagnetic Compatibility	Meets European community requirements for CE marking
Safety	Conforms to EN 61010-1 for Class 1 portable equipment

Preventive Maintenance

Anritsu Spectrum Master preventive maintenance consists of cleaning the unit and inspecting and cleaning the RF connector on the instrument and all accessories.

Clean the Anritsu Spectrum Master with a soft, lint-free cloth dampened with water or water and a mild cleaning solution.

CAUTION: *To avoid damaging the display or case, do not use solvents or abrasive cleaners.*

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

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

Calibration

The Anritsu Spectrum Master loads factory calibration data during start-up, eliminating the need for daily calibration checks.

Annual Calibration

Although the Anritsu Spectrum Master does not require daily field calibration, Anritsu recommends an annual calibration and performance verification by local Anritsu service centers. Anritsu service centers are listed in Table 1-3 beginning on the following page.

ESD Cautions

The MS2711D, like other high performance instruments, is susceptible to ESD damage. Very often, coaxial cables and antennas build up a static charge, which, if allowed to discharge by connecting directly to the MS2711D without discharging the static charge, may damage the MS2711D input circuitry. MS2711D operators should be aware of the potential for ESD damage and take all necessary precautions. Operators should exercise practices outlined within industry standards such as JEDEC-625 (EIA-625), MIL-HDBK-263, and MIL-STD-1686, which pertain to ESD and ESDS devices, equipment, and practices.

As these apply to the MS2711D, it is recommended that any static charges that may be present be dissipated before connecting coaxial cables or antennas to the MS2711D. This may be as simple as temporarily attaching a short or load device to the cable or antenna prior to attaching to the MS2711D. It is important to remember that the operator may also carry a static charge that can cause damage. Following the practices outlined in the above standards will insure a safe environment for both personnel and equipment.

Anritsu Service Centers

To locate the Anritsu Service Center nearest you, please visit:

www.anritsu.com/contact.asp

Chapter 2

Quick Start Guide

Introduction

This chapter provides a brief overview of the Anritsu MS2711D Spectrum Master. The intent of this chapter is to provide the user with a starting point for making basic measurements. For more detailed information, users may want to consult Chapter 3, *Key Functions* or Chapter 4, *Measurement Fundamentals*.

Turning the MS2711D On for the First Time

The Anritsu MS2711D Spectrum Master is a lightweight, hand held, battery operated unit designed specifically for field environments and applications requiring mobility. It is capable of up to 1.5 hours of continuous operation from a fully charged, field-replaceable battery. Built-in energy conservation features allow battery life to be extended over an eight-hour workday.

The Anritsu MS2711D Spectrum Master can also be operated from an external power source (which will also simultaneously charge the battery). This can be achieved with either the Anritsu AC-DC Adapter (P/N 40-168-R) or the Automotive Cigarette Lighter Adapter (P/N 806-141). Both items are included as standard accessories (see Chapter 1).

Press the **ON/OFF** front panel button (Figure 2-1).

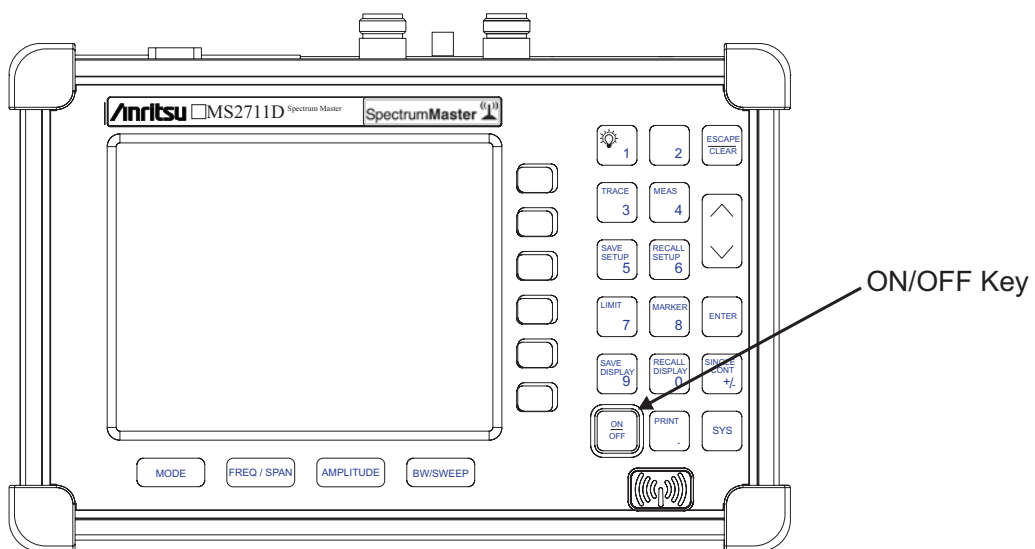


Figure 2-1. MS2711D Power ON/OFF Key

The Spectrum Master takes about five seconds to perform a series of self-diagnostic routines. At completion, the screen displays the Anritsu logo, the model number, and the version of firmware. It also prompts you to press **ENTER** to continue.

The Anritsu Spectrum Master is now ready for operation. No additional keystrokes or installation are required. For information on making measurements with the Anritsu Spectrum Master, refer to “Making a Basic Measurement,” on page 2-22. For advanced applications, refer to Chapter 4, *Measurement Fundamentals*, Chapter 5, *Field Measurements*, Chapter 6, *Power Measurement* and Chapter 7, *Transmission Measurement*.

Front Panel Overview

The Anritsu Spectrum Master menu-driven user interface is easy to use and requires little training. Hard keys on the front panel are used to initiate function-specific menus. There are four function hard keys located below the display: Mode, Frequency/Span, Amplitude and Bandwidth/Sweep.

There are seventeen keypad hard keys located to the right of the display. Twelve of the keypad hard keys are dual purpose, depending on the current mode of operation. The dual purpose keys are labeled with one function in black, the other in green.

There are also six soft keys that change function depending upon the current mode selection. The current soft key function is indicated in the active function block to the right of the display. The locations of the different keys are illustrated in Figure 2-2, below.

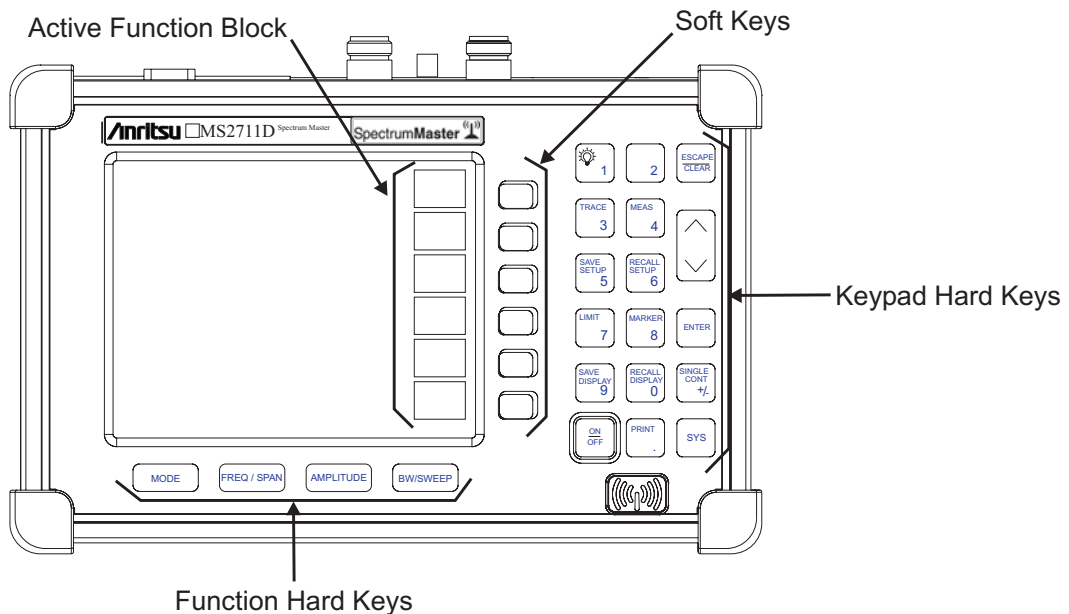


Figure 2-2. MS2711D Keys

Display Overview

Figure 2-3 illustrates some of the key information areas of the MS2711D display.

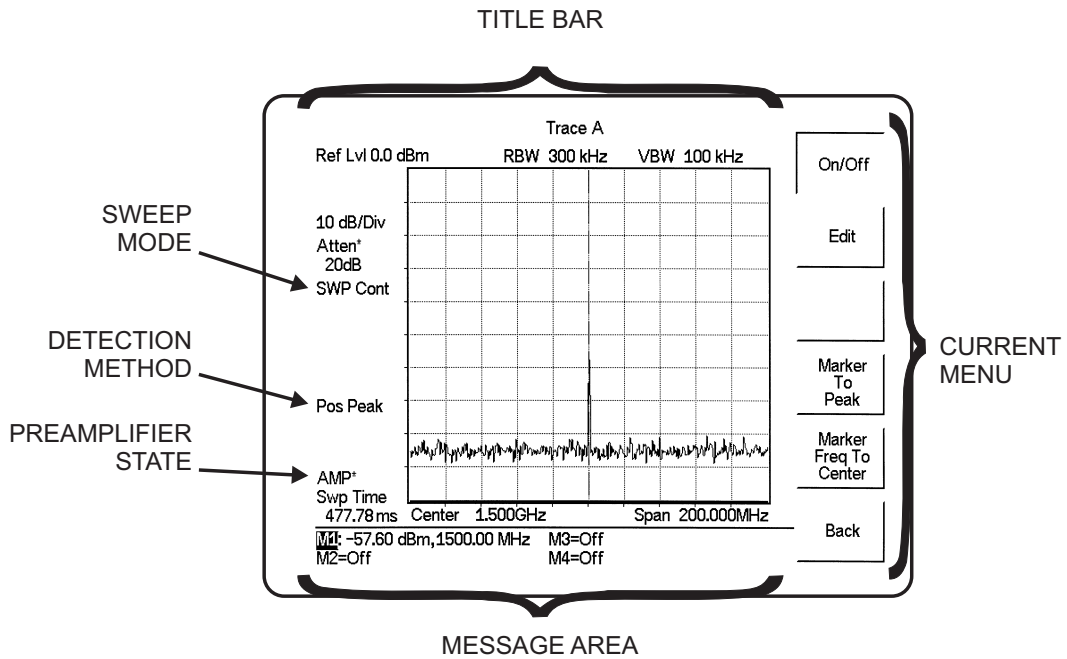


Figure 2-3. Display Overview

Figures 2-4 through 2-12 illustrate the menu structures and soft key labels for each menu selection. Refer to Chapter 3, *Key Functions*, for more detailed hard and soft key descriptions.

MODE=SPECTRUM ANALYZER

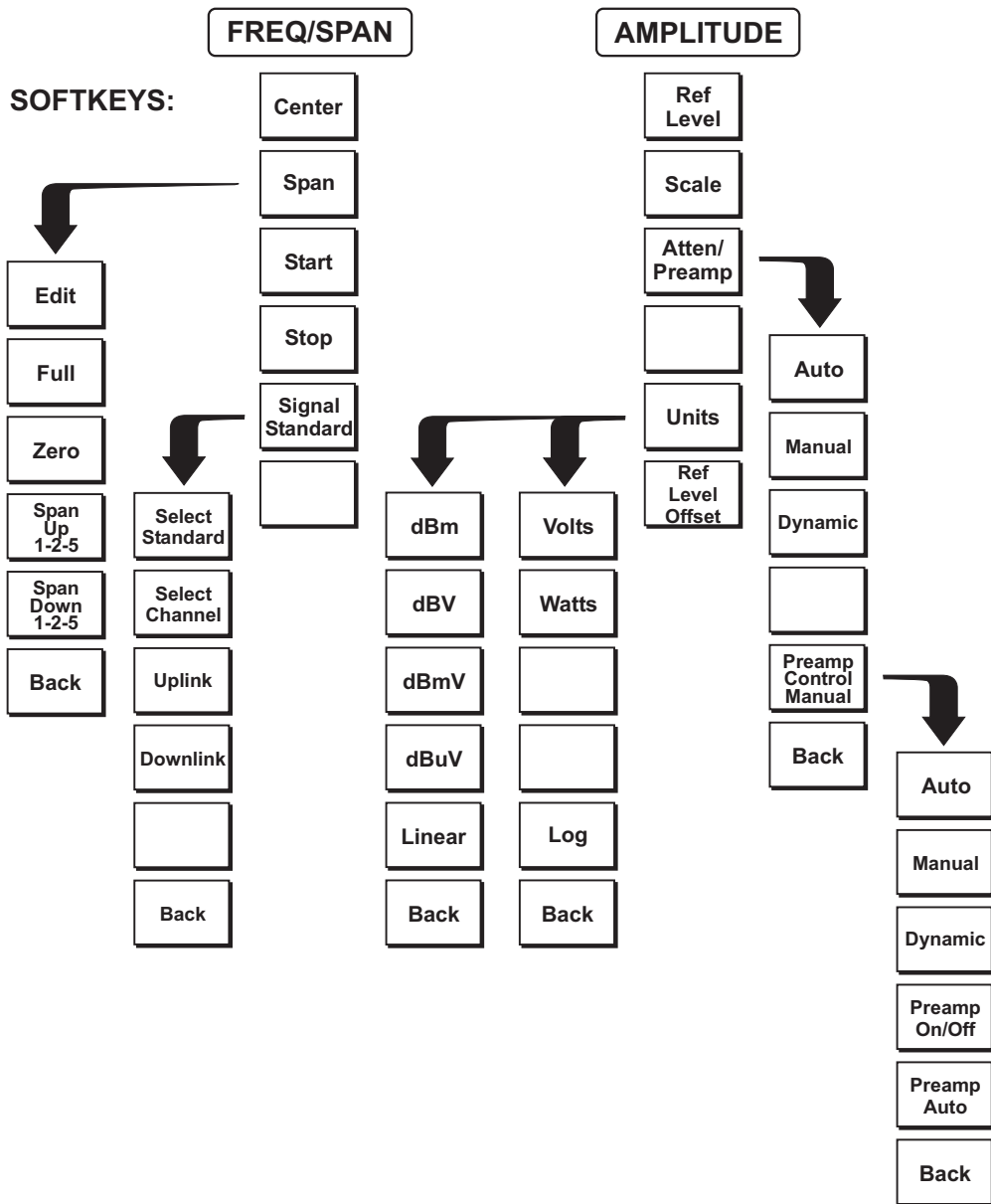


Figure 2-4. Menu Structure, FREQ/SPAN and AMPLITUDE Keys, Spectrum Analyzer Mode

MODE = SPECTRUM ANALYZER

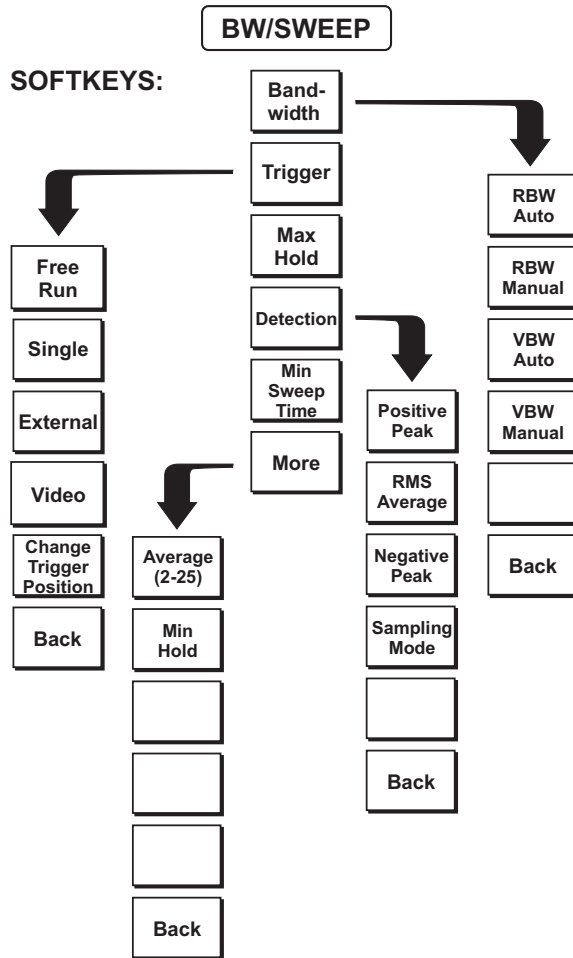


Figure 2-5. Menu Structure, BW/SWEEP Key, Spectrum Analyzer Mode

MODE = TRANSMISSION MEASUREMENT

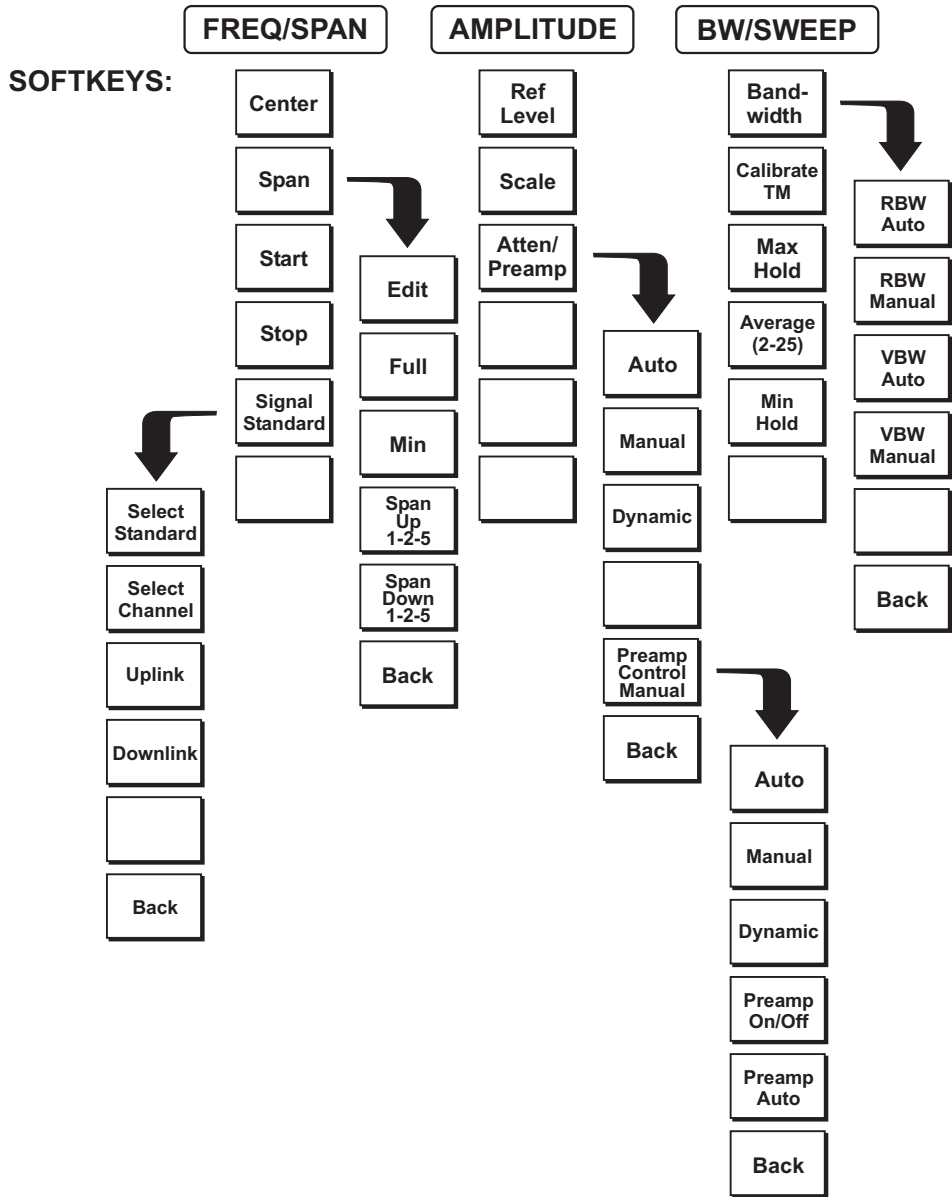


Figure 2-6. Menu Structure, Transmission Measurement Mode (Option 21)

MODE=POWER METER

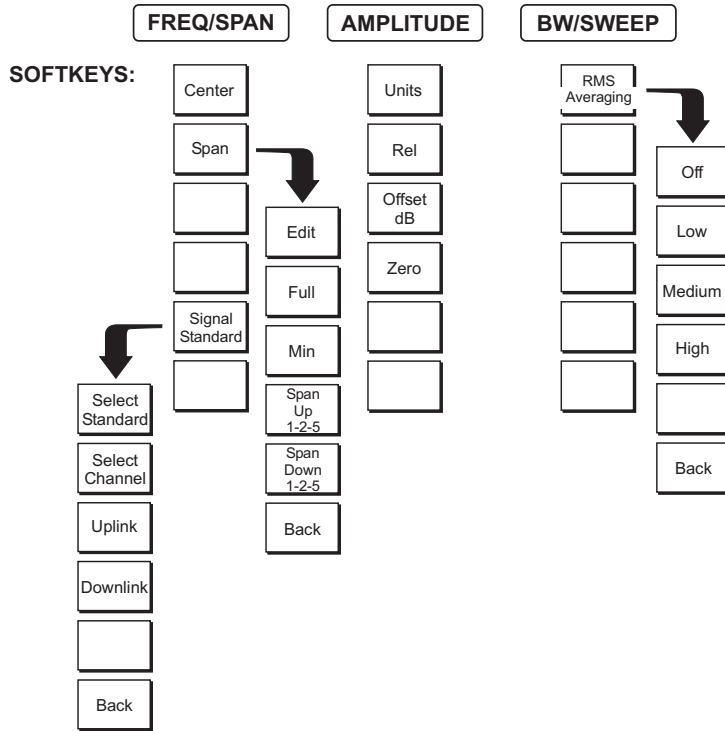


Figure 2-7. Menu Structure, Power Meter Mode (Option 29)

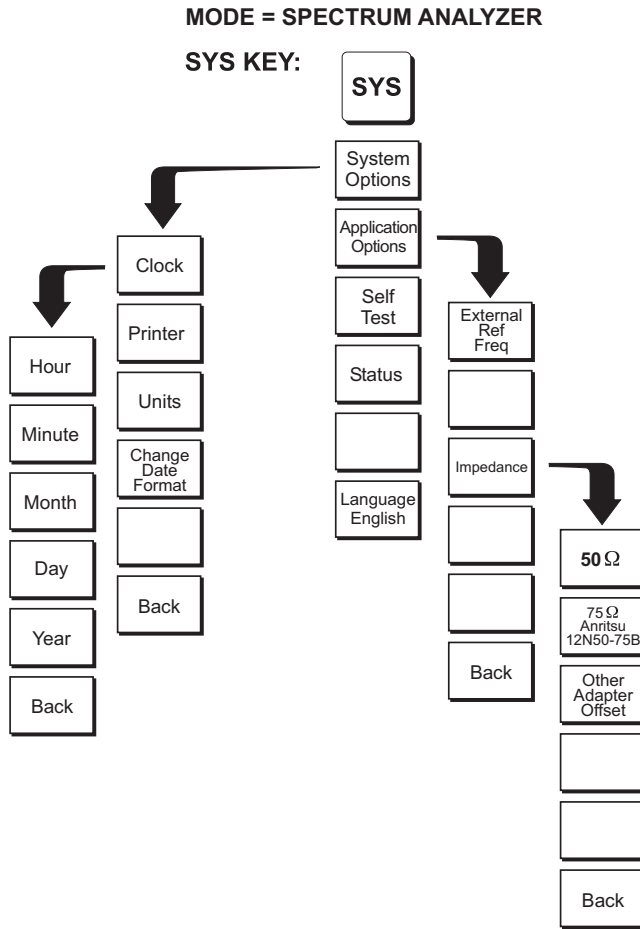


Figure 2-8. Menu Structure, SYS Key, Spectrum Analyzer Mode

**MODE = TRANSMISSION MEASUREMENT
OR POWER METER**

SYS KEY:

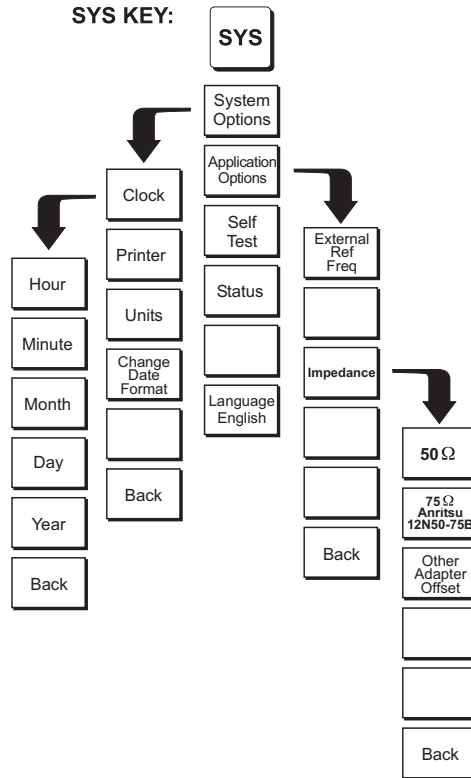


Figure 2-9. Menu Structure, SYS Key, Transmission Measurement and Power Meter Modes

MODE = SPECTRUM ANALYZER

TRACE KEY:

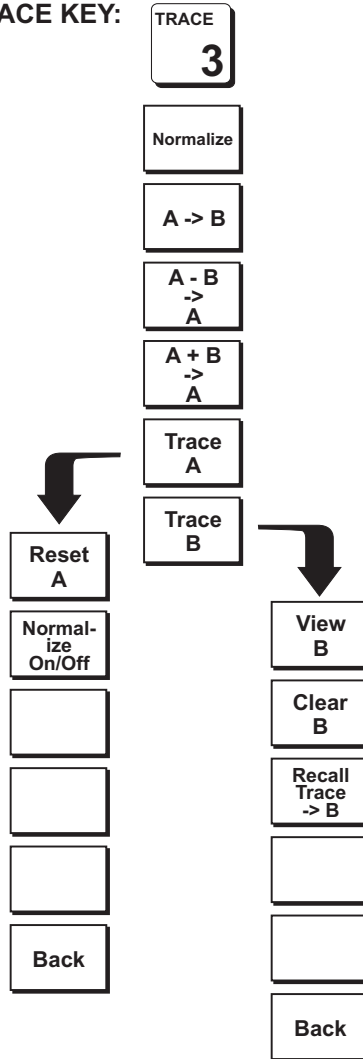


Figure 2-10. Menu Structure, TRACE Key, Spectrum Analyzer Mode

MODE = TRANSMISSION MEASUREMENT

TRACE KEY:

TRACE
3

Recall
Trace
-> B

View B/
Clear B

A -> B

A - B
->
A

A + B
->
A

Figure 2-11. Menu Structure, TRACE Key, Transmission Measurement Mode (Option 21)

MODE = SPECTRUM ANALYZER

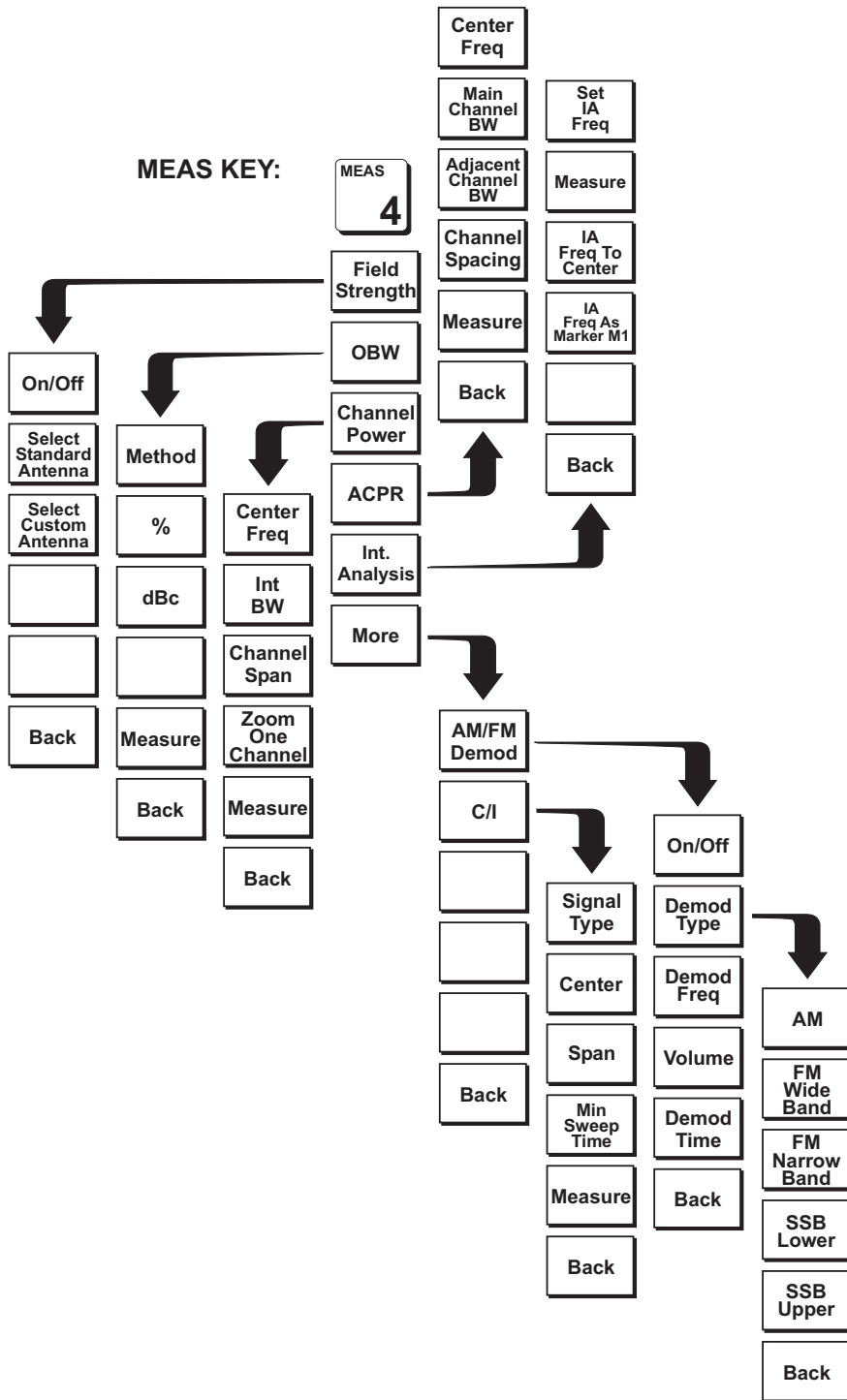


Figure 2-12. Menu Structure, MEAS Key, Spectrum Analyzer Mode

MODE = SPECTRUM ANALYZER/TRANSMISSION MEASUREMENT

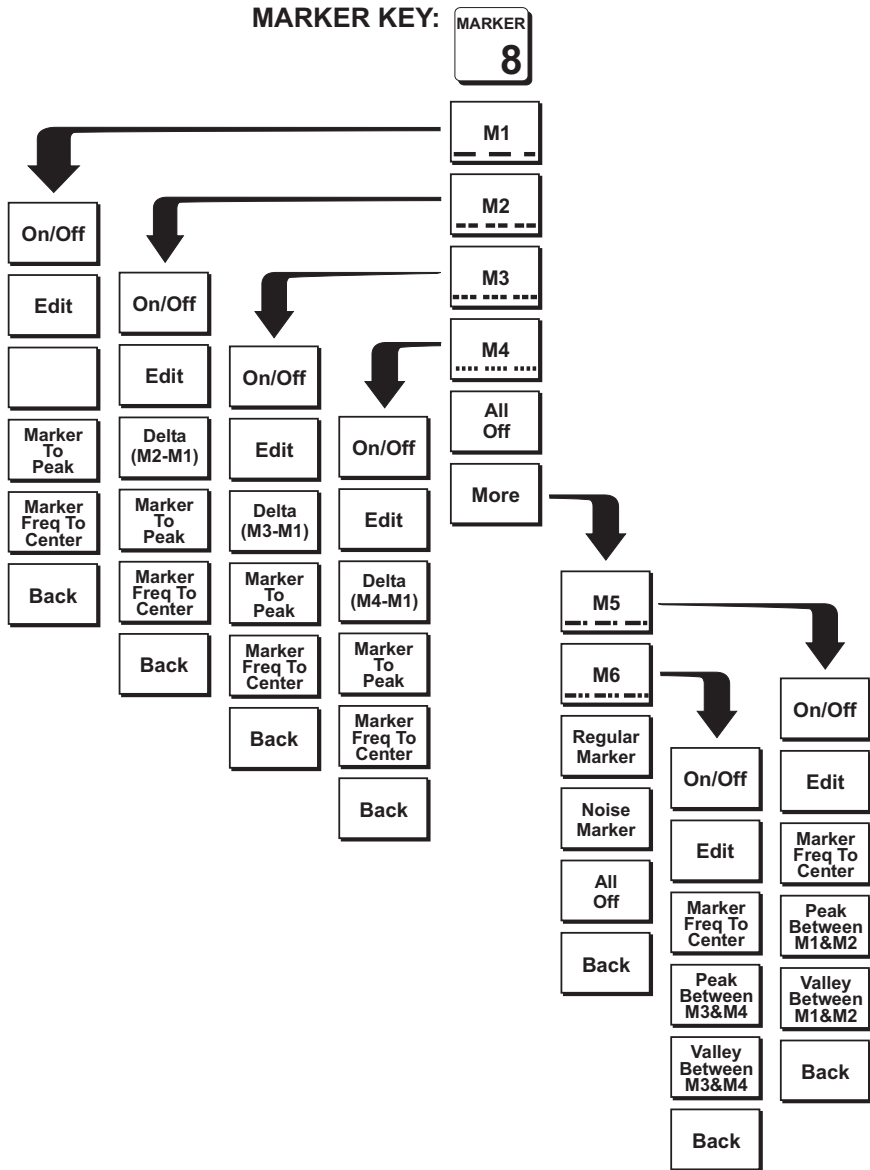


Figure 2-13. Menu Structure, MARKER Key, Spectrum Analyzer and Transmission Measurement (Option 21) Modes

**MODE = SPECTRUM ANALYZER OR
TRANSMISSION MEASUREMENT**

LIMIT KEY:

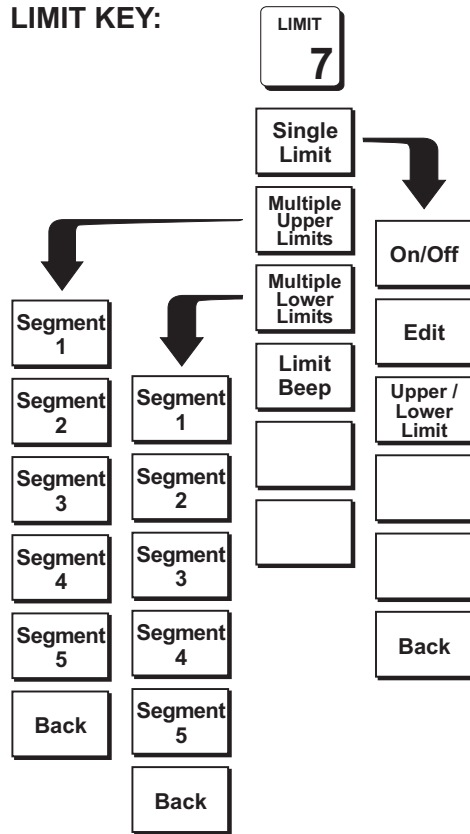


Figure 2-14. Menu Structure, LIMIT Key, Spectrum Analyzer and Transmission Measurement (Option 21) Modes

Test Panel Connectors

The connectors and indicators located on the test panel are listed and described below.

12-15VDC (3A) DC input to power the unit or for battery charging. Input is 12 to 15 Vdc @ 3A.

WARNING

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

Battery Charging Indicator light to show that the battery is being charged. The indicator light automatically shuts off when the battery is fully charged.

External Power Indicator light to show that the instrument is being powered by the external charging unit.

Serial Interface RS232 DB9 interface to a COM port on a personal computer (for use with the Anritsu Handheld Software Tools program). Also provides a serial interface to a printer. An optional serial to USB adapter, Anritsu part number 551-1691-R, is available for use in connecting printers and working with Handheld Software Tools. This serial to USB adapter is the only adapter thoroughly tested by Anritsu to be trouble free in communicating between the PC and Anritsu handheld products.

RF In 50 Ω RF input for spectrum analysis and stimulus-response measurements.

Ext Freq Ref / Ext Trigger BNC connector for connection of an external frequency reference or external trigger.

RF Out/ 50 Ω RF output, 50 Ω impedance, for transmission measurements (Option 21).

Headphone Jack Provides audio output for the built-in AM/FM demodulator for testing and troubleshooting wireless communication systems.

Battery Compartment Contains the NiMH battery, part number 633-27. To open, turn the fastener $\frac{1}{4}$ -turn counter-clockwise, pull up and remove the battery compartment door. Remove the battery by pulling straight up on the battery lanyard. Replacement is the opposite of removal.

Making Spectrum Analyzer Measurements

Required Equipment

- MS2711D Handheld Spectrum Analyzer

Selecting Spectrum Analyzer Mode

- Step 1.** Press the **ON/OFF** key.
- Step 2.** Press the **MODE** key and use the Up/Down arrow key to select Spectrum Analyzer mode. Press **ENTER** to set the mode.

Making a Measurement

- Step 1.** Connect the input cable to the **RF In** test port.
- Step 2.** Locate and display the signal(s) of interest by selecting the desired frequency, span, and amplitude value.

Selecting the Frequency

- Step 1.** Press the **FREQ/SPAN** key to display the Frequency menu.
- Step 2.** To enter a center frequency, select the **Center** soft key and use the keypad to enter the desired center frequency.
or
To set a specific frequency band, select the **Start** soft key and use the keypad to enter the desired start frequency, then select the **Stop** soft key and use the keypad to enter the desired stop frequency.

Selecting the Span

- Step 1.** Press the **FREQ/SPAN** key to display the Frequency menu.
- Step 2.** Press the **Span** soft key to display the Span menu.
- Step 3.** To set a specific span, use the Up/Down arrow key or enter the desired span on the keypad and select the **GHZ**, **MHZ**, **KHZ**, or **HZ** soft key as appropriate.
or
For a full span, select the **Full** soft key. Selecting Full will override the Start and Stop frequencies set above.
or
For a single frequency measurement, select the **Zero** soft key.

NOTE: To quickly move the span value up or down, select the Span Up 1-2-5 or Span Down 1-2-5 soft keys. These keys facilitate a zoom-in, zoom-out in a 1-2-5 sequence.

Selecting a Signal Standard

- Step 1.** Press the **FREQ/SPAN** key to display the Frequency menu.
- Step 2.** Press the Signal Standard soft key.
- Step 3.** Use the Up/Down arrow key to highlight the desired signal standard. Use the Top of List, Page Up, Page Down and Bottom of List soft keys to quickly navigate through the list. Press **ENTER** to select a signal standard. Selecting a signal standard sets the center frequency and span.

Selecting the Amplitude

- Step 1.** Press the **AMPLITUDE** key.
- Step 2.** Press the Units soft key and select the desired units from the soft keys presented. Press the Back soft key to return to the Amplitude menu.
- Step 3.** Press the Ref Level soft key and use the Up/Down arrow key or directly enter the desired reference level from the keypad. Press **ENTER** to set the amplitude level.
- Step 4.** Press the Scale soft key and use the Up/Down arrow key or directly enter the desired scale from the keypad. Press **ENTER** to set the scale.

NOTES: The Scale soft key is not available when the Units selection is Linear (see page 3-12).

*Press the **Atten/Preamp** soft key and select **Auto** coupling of the attenuator setting and the reference level to help insure that harmonics and spurs are not introduced into the measurements. See Attenuator Functions (page 4-3) for more information.*

Selecting Bandwidth Parameters

Both resolution bandwidth (RBW) and video bandwidth (VBW) can be automatically or manually coupled. Auto coupling of the RBW links the RBW to the span. That is, the wider the span, the wider the RBW. Auto coupling is indicated on the display as RBW XXX. When the RBW is manually coupled, it can be adjusted independently of the span. Manual RBW coupling is indicated on the display as RBW *XXX where XXX is the bandwidth.

Auto coupling of the VBW links the VBW to the RBW. That is, the wider the RBW, the wider the VBW. Auto coupling is indicated on the display as VBW XXX. When the VBW is manually coupled, it can be adjusted independently of the RBW. Manual VBW coupling is indicated on the display as VBW *XXX where XXX is the bandwidth.

- Step 1.** Press the **BW/SWEEP** key to display the bandwidth menu.
- Step 2.** To select the resolution or video bandwidth, press the Bandwidth soft key.
- Step 3.** Press RBW Auto for automatic resolution bandwidth selection, or press RBW Manual and use the Up/Down arrow key to select the resolution bandwidth. Press **ENTER** to set the resolution bandwidth.
- Step 4.** Press VBW Auto for automatic video bandwidth selection, or press VBW Manual and use the Up/Down arrow key to select the video bandwidth. Press **ENTER** to set the video bandwidth. Press the Back soft key to return to the bandwidth menu.

Selecting Sweep Parameters

Press the **BW/SWEEP** key to set the sweep parameters.

Max Hold

Maximum hold displays the maximum response of the input signal over multiple sweeps. To toggle maximum hold on or off, press the **Max Hold** soft key.

Min Hold

Minimum Hold displays the minimum response of the input signal over multiple sweeps. To toggle minimum hold on or off, press the **More** and **Min Hold** soft keys.

Trigger

To set the triggering, select the **Trigger** soft key. Selections are:

Free Run - This is the default triggering mode. The instrument sweeps continuously in this mode.

Single - When this soft key is pressed the instrument does a single sweep then waits in Hold mode until the **ENTER** key is pressed or another triggering mode is selected.

External - In this mode, a sweep is initiated by a TTL level signal applied to the Ext Freq Ref/Ext Trigger BNC connector.

Video - This mode is used in zero span to set the power level at which a sweep is initiated. The power level can be set from -120 dBm to $+20$ dBm. If there is no signal that reaches or exceeds the trigger level, there will be no trace on screen.

Change Trigger Position - This soft key is used in conjunction with video triggering to set the horizontal position on the display where a signal that meets the video triggering criterion will be placed. The value can be from 0% to 100%. Zero percent places the triggering event at the left edge of the screen while 100% places the triggering even at the right edge of the screen.

Detection Method

Each display point represents some number of measurements combined by a detection method. The number of measurements per display point is affected by the span and the resolution bandwidth. The four available detection methods are Positive Peak, RMS Average, Negative Peak and Sampling Mode. Positive peak displays the maximum value of all the measurements associated with that display point. RMS Average detection displays the RMS average of all the measurements associated with that display point. Negative peak displays the minimum value of all the measurements associated with that display point. Sampling Mode displays one of the measurements associated with each display point.

To set the detection method, press the **Detection** soft key and select either **Positive Peak**, **RMS Average**, **Negative Peak**, or **Sampling Mode**.

Minimum Sweep Time

The minimum sweep time allows a value from .05 ms to 200 seconds to be entered. The actual sweep time will be either the Min Sweep Time entered, or the time necessary to achieve accurate results, whichever is greater.

Sweep Average

In order to reduce the effects of noise, it may be desirable to average the results of several sweeps and display that average rather than the results of individual sweeps.

To set the number of sweeps to average, press the **More** soft key, then the **Average (2-25)** soft key and use the Up/Down arrow key or directly enter the desired number of sweeps from the keypad. Press **ENTER** to set the sweep average.

NOTE: Max Hold, Min Hold, and Average are mutually exclusive.

Adjusting Markers

- Step 1.** Press the **MARKER** key to call up the Markers menu (see page 3-31).
- Step 2.** Press the M1 soft key to select the M1 marker function.
- Step 3.** Press the **Edit** soft key and enter an appropriate marker frequency using the keypad or Up/Down arrow key. Pressing the **On/Off** soft key activates or deactivates the M1 marker function.
- Step 4.** Press the **Back** soft key to return to the Markers Menu.
- Step 5.** Repeat the steps for markers M2, M3, M4, M5 and M6. (Press the **More** soft key to access M5 and M6.)

Adjusting Limits

The MS2711D offers two types of limits: a single horizontal limit line and segmented limits.

Adjusting a Single Limit

- Step 1.** Press the **LIMIT** key.
- Step 2.** Press the **Single Limit** soft key.
- Step 3.** Press the **Edit** soft key.
- Step 4.** Either enter the value using the numeric keypad or scroll the limit line using the Up/Down arrow key.
- Step 5.** Press **ENTER** to set the location of the limit line.

The single limit line can be defined as either an upper limit or a lower limit.

Defining an Upper Limit

An upper limit is one where the measurement fails if the data appears ABOVE the limit line.

Press the **Upper/Lower Limit** soft key, if necessary, so that the status window says:
Fail if data is: Above Line.

Defining a Lower Limit

A lower limit is one where the measurement fails if the data appears BELOW the limit line.

Press the **Upper/Lower Limit** soft key, if necessary, so that the status window says:
Fail if data is: Below Line.

Adjusting Segmented Limits

Segmented limit lines are defined separately as five upper limit segments and five lower limit segments. This allows the definition of a spectral mask.

A limit segment is defined by its end points. That is, starting frequency, starting amplitude, ending frequency, and ending amplitude. This procedure describes the setting of two upper limit segments. The steps can be carried over to the other upper limit segments as well as to the lower limit segments.

Step 1. Press the **LIMIT** key.

Step 2. Press the Multiple Upper Limits soft key.

Step 3. Press the Segment 1 soft key.

Step 4. Press the Edit soft key. Successive dialog boxes allow you to change the values of the start frequency, start limit, end frequency and end limit. Either enter the value using the numeric keypad and the GHz, MHz, kHz, or Hz soft keys or scroll the limit line using the Up/Down arrow key. Press the **ENTER** key to continue after each entry.

Step 5. Press the Next Segment soft key to move on to Segment 2 (If the Next Segment soft key is not available, press **ENTER**). If the status of Segment 2 is Off, pressing the Next Segment soft key will automatically set the start point of Segment 2 equal to the end point of Segment 1.

Step 6. Repeat Steps 4 and 5 for the remaining segments.

The MS2711D does not allow overlapping limit segments of the same type. That is, two upper limit segments cannot overlap and two lower limit segments cannot overlap.

The MS2711D also does not allow vertical limit segments. A limit segment in which the start and end frequencies are the same, but the limit values are different, cannot be specified.

Enabling the Limit Beep

Both limit types can indicate a limit violation by enabling the Limit Beep. An audible "beep" will sound at each data point that violates the defined limit.

Step 1. Press the **LIMIT** key.

Step 2. Press the Limit Beep soft key.

The status window will indicate that the status of the limit beep is On, and the soft key will remain in the "down" state. Press the Limit Beep soft key again to disable the limit beep.

Adjusting Attenuator Settings

The spectrum analyzer attenuation can be automatically coupled, manually coupled, or dynamically adjusted.

Step 1. Press the **AMPLITUDE** key.

Step 2. Press the Atten/Preamplifier soft key.

Step 3. Select the soft key corresponding to the desired coupling mode, as described below.

Auto

Auto coupling of the attenuation links the attenuation to the reference level. That is, the higher the reference level, the higher the attenuation. Auto coupling is indicated on the display as Atten=Auto.

Manual

When manually coupled, the attenuation can be adjusted independently of the reference level. Manual attenuation coupling is indicated on the display as **Atten=Manual**.

IMPORTANT!

The attenuation should be adjusted such that the maximum signal amplitude at the input mixer is -30 dBm or less for any signal within the frequency range of the instrument. For example, if the reference level is $+20$ dBm, the attenuation should be 50 dB such that the input signal at the mixer is -30 dBm ($+20 - 50 = -30$). This prevents signal compression.

Dynamic

Dynamic attenuation sets the attenuation based on the overall signal environment. This prevents the input mixer from being saturated even by signals that are off screen. Dynamic attenuation is indicated on the display as **Atten=Dynamic**.

Adjusting the Display Brightness

The brightness of the MS2711D display can be adjusted to accommodate varying light conditions and to help discern traces when using the Trace Overlay feature (see page 4-19).

- Step 1.** Press the Brightness key (numeric keypad number 1).
- Step 2.** Adjust the brightness using the Up/Down arrow key.
- Step 3.** Press **ENTER** to save the new setting.

Setting the System Language

The MS2711D can operate in English, French, German, Spanish, Chinese or Japanese. To select a language:

- Step 1.** Press the **SYS** key.
- Step 2.** Press the Language soft key to advance through the available languages. Stop when the desired language is reached.

Setting the System Impedance

The MS2711D RF In and RF Out ports both have $50\ \Omega$ impedance. The firmware of the MS2711D can compensate for a 50 to $75\ \Omega$ adapter on the RF In port.

- Step 1.** Press the **SYS** key.
- Step 2.** Press the Impedance soft key.
- Step 3.** If using the Anritsu 12N50-75B adapter, press the $75\ \Omega$ Anritsu 12N50-75B soft key.
- Step 4.** If using a different adapter, press the Other Adapter Offset soft key. Enter the loss value using the numeric keypad or the Up/Down arrow key. Press the **ENTER** key to set the loss value.

NOTE: $75\ \Omega$ adapters cannot be used with frequency converter modules.

Making a Basic Measurement

Making a basic measurement with the Anritsu Spectrum Master is similar to making a measurement with a conventional spectrum analyzer. Users need simply to power-on and tune the Anritsu Handheld Spectrum Analyzer to locate and display a signal on the screen. Once a signal is displayed, the user can measure the signal input in four simple steps to determine the frequency and amplitude of the signal.

These steps are:

- Setting the center frequency
- Setting the frequency span
- Setting the amplitude
- Activating the marker

NOTE: Frequency, span and amplitude are the fundamental functions for spectrum analyzer measurements. However, by using marker functions, you are able to read out frequencies and amplitudes on the spectrum analyzer trace. This lets you make relative measurements, automatically locate the signal of the highest amplitude on a trace, and tune the spectrum analyzer to track a signal. For more information, refer to Chapter 4, "Measurement Fundamentals."

Example – Measuring a 900 MHz signal

NOTE: A "reset" step is recommended to return the instrument to the factory default settings if a known starting state is desired before beginning any measurement. Some of the factory defaults include preamp off, RBW, VBW, and Span automatically coupled, and attenuation coupled to the reference level. There are two methods that can be used to reset the MS2711D to the factory defaults:

*If the unit is off, hold down the **ESCAPE/CLEAR** key while pressing the **ON/OFF** key. This resets the instrument to the factory preset state for all modes.*

*If the unit is on, press the **RECALL SETUP** key on the keypad. When the key is pressed, a Recall Setup selection box for the current mode of operation appears on the display. Select setup location **0 <Default>** to recall the factory preset state for the currently selected mode.*

Step 1. Press the **ON/OFF** key, then the **ENTER** key when prompted.

Step 2. Connect a signal generator to the input of the Anritsu Spectrum Master and configure it to provide a -10 dBm, 900 MHz signal.

Set the Center Frequency

- Step 1.** Press the **FREQ/SPAN** key.
- Step 2.** Press the Center frequency soft key.

NOTE: To set the center frequency to 900 MHz, use the numerical keypad to the right of the display. The data keys allow you to select the exact numeric value of the active function, which in this example is the center frequency. When activating the center frequency function, the spectrum analyzer is set to the center-frequency span mode.

- Step 3.** Enter 900 on the keypad and select the MHz soft key, or ENTER which defaults to MHz. Observe that the signal resembles that shown in Figure 2-15.

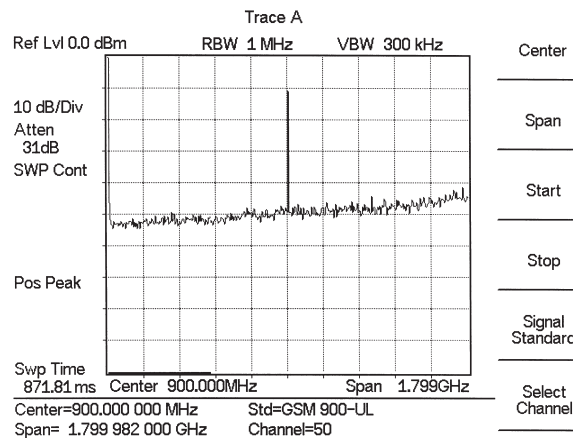


Figure 2-15. Signal at 900 MHz

Set the Frequency Span

- Step 1.** Press the **FREQ/SPAN** key.
- Step 2.** Press the Span soft key.

The **Edit** soft key will be in its down state and the span parameter will be open for editing. There are several methods by which to edit the open parameter.

Enter a New Value

Select a new value using the Up/Down arrow key and press **ENTER**, or enter a new value using the numeric keypad and select one of the four frequency terminator soft keys.

Automatically Set Full Span

Press the **Full** soft key. The span will automatically be set to the full range of the MS2711D.

Automatically Set Zero Span

Press the **Zero** soft key. The span will automatically be set to zero, at the current center frequency. Zero Span will reset the minimum RBW to 30 kHz.

Span Up in a 1-2-5 Sequence

Press the Span Up 1-2-5 soft key to increase the span to the nearest power of 10, times either 1, 2 or 5. For example, if the current span is 300 kHz, pressing the Span Up 1-2-5 soft key will change the span to 500 kHz. Pressing the Span Up 1-2-5 soft key again will change the span to 1 MHz.

Span Down in a 1-2-5 Sequence

Press the Span Down 1-2-5 soft key to decrease the span to the nearest power of 10, times either 1, 2 or 5. For example, if the current span is 300 kHz, pressing the Span Down 1-2-5 soft key will change the span to 200 kHz. Pressing the Span Down 1-2-5 soft key again will change the span to 100 kHz.

A span of 500 MHz is shown in Figure 2-16.

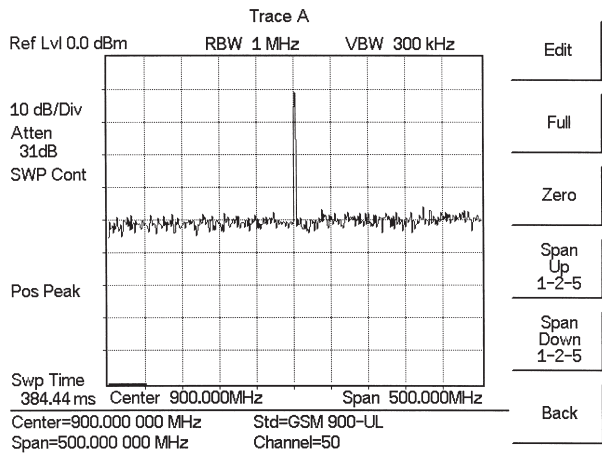


Figure 2-16. 500 MHz Frequency Span

Set the Amplitude

Generally, placing the signal peak at the reference level provides the best measurement accuracy. The following steps will adjust the signal peak to the reference level (Figure 2-17).

- Step 1.** Press the **AMPLITUDE** key.
- Step 2.** Press the Atten/Preamp soft key and the Auto soft key to select automatic attenuation.
- Step 3.** Press the Back soft key.
- Step 4.** Press the Units soft key and select dBm as the amplitude units.
- Step 5.** Press the Back soft key and then the Ref Level soft key.
- Step 6.** Press the +/- key and 10 on the keypad and then press **ENTER** to set the reference level to -10 dBm.
- Step 7.** Press the Scale soft key and use the key pad or Up/Down arrow key to select a scale of 10 dB/division. Press the **ENTER** key to set the scale.

Observe that the display resembles that shown in Figure 2-17.

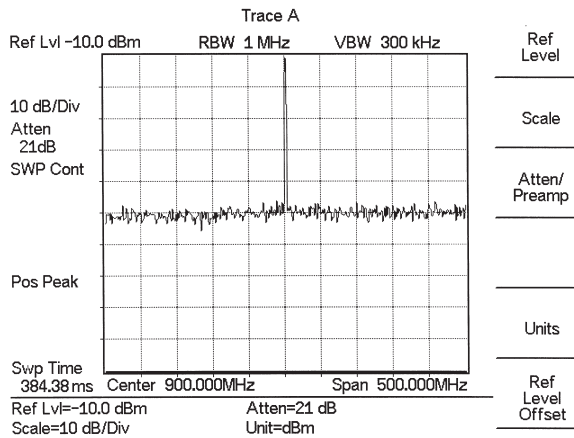


Figure 2-17 Reference Level set at -10 dBm

Activate the Marker

The marker reads both the frequency and the amplitude, and it displays these values in the message area at the bottom of the display. In this case, the marker will read 900 MHz and approximately -10.00 dBm, as shown in Figure 2-18.

- Step 1.** Press the **MARKER** key.
- Step 2.** Press the M1 soft key .
- Step 3.** Press the Marker To Peak soft key to turn on marker M1 and set it to the highest point on the trace.
- Step 4.** Read both frequency and the amplitude values identified by the selected marker. These values are displayed in the message area at the bottom of the display (Figure 2-18). The current marker is highlighted.

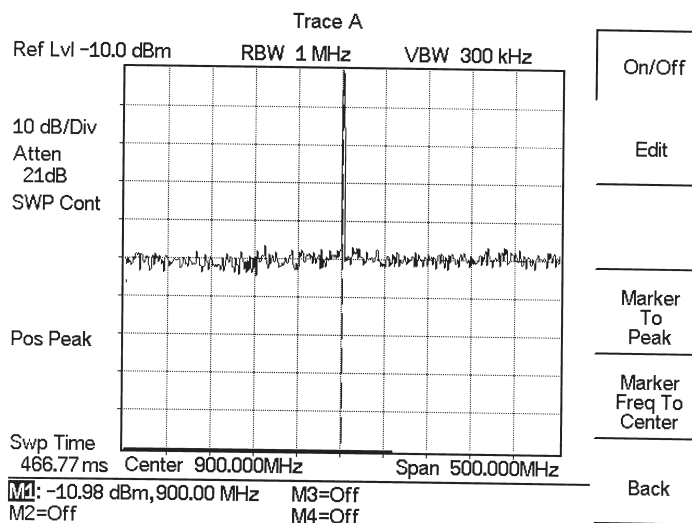


Figure 2-18. Activated Normal Marker

NOTE: A marker can be placed at the peak of the signal by pressing Marker To Peak, or by using the Up/Down arrow key to move the marker manually. When using more than one marker, it may be desirable to use the marker delta function, defined as delta ($M_x - M_1$) in the active function box. The marker delta function reads the difference in amplitude and frequency between two signals and displays the values in the area below the display.

Save and Recall Display

The MS2711D can store up to 200 trace displays in internal memory. Stored traces can be recalled to the display or uploaded to a PC using the Handheld Software Tools program (see Chapter 10, Handheld Software Tools).

Save the Display

- Step 1.** Press the **SAVE DISPLAY** key.
- Step 2.** To enter a name for the display, press the soft key letter group that contains the desired letter, then select the soft key for that letter. Continue to select letters up to a maximum of 16 characters.
- Step 3.** Press **ENTER** to set the saved display name.

Recall the Display

- Step 1.** Press the **RECALL DISPLAY** key.
- Step 2.** Select the desired display using the Up/Down arrow key.
- Step 3.** Press **ENTER** to recall the selected display.
- Step 4.** Press the **ESCAPE/CLEAR** key to return to measurement mode. The MS2711D will resume measuring.

Printing

Printing is accomplished using any printer listed in the MS2711D printer selection table. Available printers include:

Canon BJC 50	HP DJ 340, 350, 450
Canon BJC 80	HP DJ 500 Series
Canon BJC 250	HP DJ 600 Series
Canon BJC 4400	HP DJ 800 Series
Citizen PN Models	HP DJ 1120C
Epson Esc/P Compatible	HP LJ 6L, 6P, 4000
Epson Esc/P2 Compatible	HP PCL3 Compatible
Epson Esc/P Raster Compatible	NEC Superscript Models
Epson Stylus Models	NEC Silentwriter Models
Epson LQ Models	Seiko DPU 411, 414 Models

Figure 2-19 shows a setup diagram for two types of printers. Refer to the printer manual for setup details.

Printer Switch Settings

Set the switches on the serial-to-parallel interface cable to the HP Deskjet 450 ink jet printer or other parallel interface printer as follows:

SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
OFF	ON	OFF	OFF	OFF	OFF	ON	OFF

Printer Setup

Step 1. Connect the printer as shown in Figure 2-19.

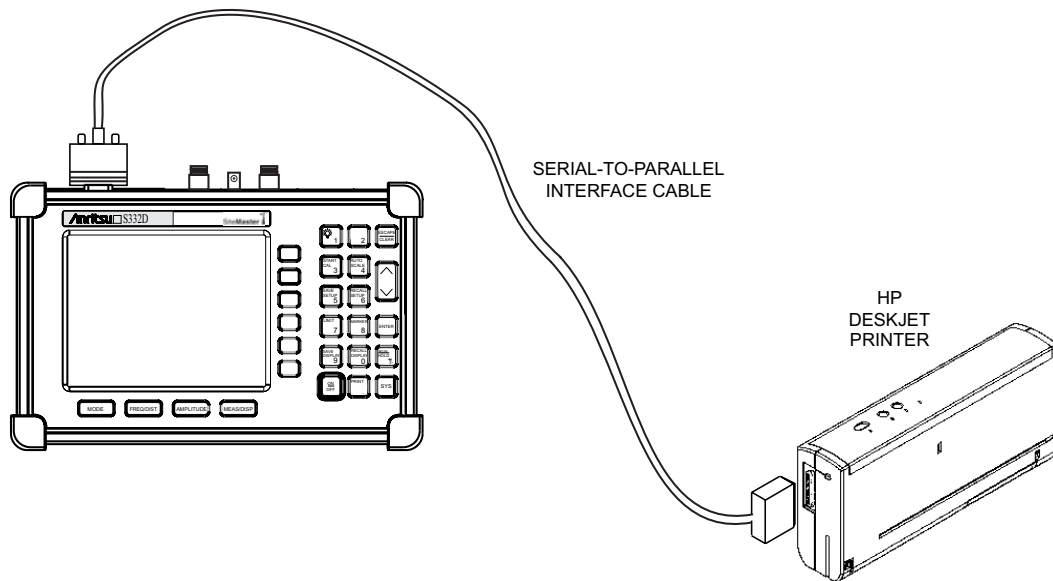


Figure 2-19. Printer Setup

- Step 2.** Press the **SYS** key and the Options soft key.
- Step 3.** Press the Printer soft key and select from the displayed menu of supported printers.
- Step 4.** Press **ENTER** to select the printer.

*NOTE: The above procedure applies only to newly connected printers. If the currently connected printer is the same one that was most recently connected and used, simply pressing the **PRINT** key will initiate the print process.*

Printing a Screen

- Step 1.** Connect the printer as shown in Figure 2-19.
- Step 2.** Obtain the desired measurement display
- Step 3.** Press the **PRINT** key.
- Step 4.** Press **ENTER** when the printer is ready.

Battery Information

Charging a New Battery

The NiMH battery supplied with the instrument has already completed three charge and discharge cycles at the factory and full battery performance should be realized after your first charge.

NOTE: The battery will not charge if the battery temperature is above 45° C or below 0° C.

Charging the Battery in the Instrument

The battery can be charged while installed in the instrument.

- Step 1.** Turn the instrument off.
- Step 2.** Connect the AC-DC adapter (Anritsu part number: 40-168-R) to the instrument DC power input port.
- Step 3.** Connect the AC-DC adapter to a 120 VAC or 240 VAC power source as appropriate for your application.

The green external power indicator on the instrument will illuminate, indicating the presence of external DC power, the battery charge indicator will light, and the battery will begin fast charging. The charging indicator will remain lit as long as the battery is fast charging. Once the battery is fully charged, the fast charging indicator will turn off and a trickle charge will be started to maintain battery capacity. If the battery fails to charge, contact your nearest Anritsu service center.

NOTE: If a battery is excessively discharged, it may require several hours of trickle charging before the charger will allow a fast charge. Switching to fast charge mode is not automatic. You must either cycle the power on and off, or disconnect and reconnect the AC-DC adapter. Temperature extremes will affect the ability of the battery to charge. Allow the battery to cool down or warm up as necessary before use or charging.

Charging the Battery in the Optional Charger

Up to two batteries can be charged simultaneously in the optional battery charger.

- Step 1.** Remove the NiMH battery from your instrument and place it in the optional charger (Anritsu part number 2000-1029).
- Step 2.** Connect the lead from the AC-DC adapter to the charger.
- Step 3.** Connect the AC-DC adapter to a 120 VAC or 240 VAC power source as appropriate for your application.

Each battery holder in the optional charger has an LED charging status indicator. The LED color changes as the battery is charged:

- Red indicates the battery is charging
- Green indicates the battery is fully charged
- Yellow indicates the battery is in a waiting state (see below).

A yellow light may occur because the battery became too warm during the charge cycle. The charger will allow the battery to cool off before continuing the charge. A yellow light may also indicate that the charger is alternating charge to each of the two batteries.

A blinking red light indicates less than 13 VDC is being supplied to the charger stand. Check that the correct AC charger adapter is connected to the charger stand. If the battery fails to charge, contact your nearest Anritsu Service Center.

Determining Remaining Battery Life

When the AC-DC adapter is disengaged, a battery indicator symbol is continuously displayed at the top-left corner of the display (Figure 2-20). A totally black bar within the battery icon indicates a fully charged battery. When LOW BATT replaces the battery indicator bar at the top left corner, a couple of minutes of measurement time remain. If a flashing LOW BATT is accompanied by an audio beep at the end of each trace, the battery has approximately one minute of useable time remaining.

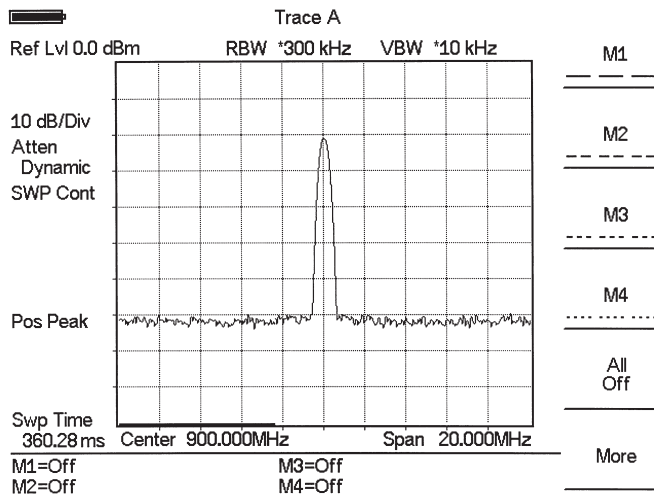


Figure 2-20. Battery Monitor

Once all the power has drained from the battery, the instrument display will fade. At this point, your instrument will switch itself off and the battery will need to be recharged.

During operation, the battery condition can be viewed by pressing the **SYS** key and selecting the **Self Test** soft key. The battery condition will be displayed as a percentage of the charge remaining.

Selftest

Temperature	24°C
Memory	PASSED
RTC Battery	3.1V
Voltage	External (12.7V)
Battery Cal	PASSED
Battery Charge	99% (I = 0 mA)
VNA PLL	PASSED
VNA Integrator	PASSED
SPA LO	PASSED

Press **ESCAPE** to return.

Figure 2-21. Self Test Battery Condition Display

Battery Life

The NiMH battery will last longer and perform better if allowed to completely discharge before recharging. For maximum battery life, it is recommended that the NiMH battery be completely discharged and recharged once every three months.

It is normal for NiMH batteries to self-discharge during storage, and to degrade to 80% of original capacity after 12 months of continuous use.

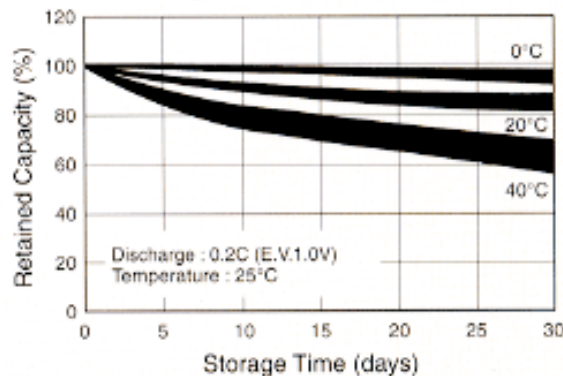


Figure 2-22. NiMH Battery Storage Characteristics

The battery can be charged and discharged 300 to 500 times, but it will eventually wear out. The battery may need to be replaced when the operating time between charging is noticeably shorter than normal.





Important Battery Information

- With a new NiMH battery, full performance is achieved after three to five complete charge and discharge cycles. The NiMH battery supplied with the Spectrum Master has already completed three charge and discharge cycles at the factory.
- Recharge the battery only in the Spectrum Master, or in an Anritsu approved charger.
- When the Spectrum Master or the charger is not in use, disconnect it from the power source.
- Do not charge batteries for longer than 24 hours, as overcharging may shorten battery life.
- Temperature extremes will affect the ability of the battery to charge. Allow the battery to cool down or warm up as necessary before use or charging.
- Discharge an NiMH battery from time to time to improve battery performance and battery life.
- The battery may need to be replaced when the operating time between charging is noticeably shorter than normal.
- The battery can be charged and discharged hundreds of times, but it will eventually wear out.
- If left unused, a fully charged battery will discharge itself over time.
- If a battery is allowed to totally discharge, the smart-memory capability of the battery may be lost, resulting in incorrect battery capacity readings or loss of communication with the battery.
- For long term storage, the battery should be removed from the unit, and stored within a controlled environment.
- Battery storage is recommended at less than 45° C. The battery will discharge faster at higher ambient temperatures.
- Storing the battery in extreme hot or cold places will reduce the capacity and lifetime of the battery.
- Do not short-circuit the battery terminals.
- Do not drop, mutilate or attempt to disassemble the battery.
- Never use a damaged or worn out charger or battery.
- Always use the battery for its intended purpose only.
- Batteries must be recycled or disposed of properly. Do not place batteries in the trash.
- Do not dispose of batteries in a fire!

Symbols

Table 2-1 provides a listing of the symbols used as condition indicators on the display.

Table 2-1. Display Icon Symbols

Icon	Symbol
	The instrument is in power conservation mode while operating from the battery. To resume sweeping, press the ENTER key. After 10 minutes without a key press, the instrument will automatically enter power conservation mode. This icon is also displayed at the end of a single sweep.
	PLL Lock fail indication. Check battery. (If the instrument fails to lock with a fully charged battery, call your Anritsu Service Center.)
	Indicates the remaining charge on the battery. The inner white rectangle grows longer as the battery charge depletes.
	Indicates internal data processing.

Self Test

At turn-on, the Anritsu Spectrum Master runs through a series of quick checks to ensure the system is functioning properly. Note that the battery voltage and temperature are displayed in the lower left corner below the self test message. If the battery is low, or if the ambient temperature is not within the specified operational range, Self Test will fail. If Self Test fails and the battery is fully charged and the Anritsu Spectrum Master is within the specified operating temperature range, call your Anritsu Service Center.

During operation, the self test can be executed by pressing the **SYS** key and selecting the Self Test soft key. The resulting display (Figure 2-21, page 2-31) provides current status or pass/fail test information on the following:

- Ambient Temperature
- Memory Test
- Real Time Clock Battery Voltage
- Battery or External Voltage
- Battery Calibration Test
- Battery Charge State (percentage of charge remaining)
- VNA Phase Lock Loop Test (Option 21 only)
- VNA Integrator Test (Option 21 only)
- Spectrum Analyzer Local Oscillator Test

Press the **ESCAPE** key to return to normal operation.

Error Messages

Self Test Errors

A listing of Self Test Error messages is given in Table 2-2.

Table 2-2. Self Test Error Messages

Error Message	Description
Battery Low	Battery voltage is less than 9.5 volts. Charge battery. <i>If condition persists, call your Anritsu Service Center.</i>
External Power Low	External supply voltage is less than 10 volts. <i>Call your Anritsu Service Center</i>
PLL Failed	Phase-locked loops failed to lock. Charge battery. <i>If condition persists with a fully charged battery, call your Anritsu Service Center</i>
EEPROM R/W Failed	Non-volatile memory system has failed. <i>Call your Anritsu Service Center.</i>
Out Of Temp. Range	Ambient temperature is not within the specified operating range. <i>If the temperature is within the specified operating range and the condition persists, call your Anritsu Service Center.</i>
RTC Battery Low	The internal real-time clock battery is low. A low or drained clock battery will affect the date stamp on saved traces. <i>Contact your nearest Anritsu Service Center.</i>
LO Lock Fail	The local oscillator in the spectrum analyzer has phase lock loop errors. <i>If condition persists with a fully charged battery, call your Anritsu Service Center.</i>
Battery Cal Lost	Battery communication failed. The indicated battery charge status may be invalid. <i>If condition persists, call your Anritsu Service Center.</i>
Memory Fail	The EEPROM test on the Spectrum Master main board has failed. <i>If condition persists, call your Anritsu Service Center.</i>
The time and date Have not been set on this Spectrum Master. To set it, after exiting here press the <SYS> [Clock] keys. Press ENTER or ESC to continue	The time and date are not properly set in the Spectrum Master. <i>If condition persists, call your Anritsu Service Center.</i>

Note: A listing of Anritsu Service Centers is provided on page 1-12.

Operation Error Messages

The following tables list possible error messages that could occur during operation of the Spectrum Master.

Table 2-3. Operation Error Messages

Error Message	Description
No Stored Sweep at This Location	Attempting to recall a display from a location that has not been previously written to or that contains invalid sweep data.
Use Options Menu to Select A Printer	Attempting to print a display with no printer selected. Select a printer, (see Printer, page 2-27) then retry.
Antenna Saved With The Setup Could Not Be Found! Please Reselect The Antenna To Make A Field Strength Measurement.	The setup was saved with the name of an antenna that is no longer present in that unit. Select another antenna name, or use the Handheld Software Tools program to reload the antenna.
Limit Segment Requires Start Freq <= End Freq	A limit segment must have a starting frequency less than or equal to the ending frequency. Edit the segment again to change the endpoint settings.
Limit Segments Cannot Overlap Press On/Off To Disable Limit Press Edit To Change Endpts	Two or more limit segments are defined such that their endpoints overlap. An upper limit segment and a lower limit segment may have overlapping frequency ranges. Two upper limit segments or two lower limit segments cannot overlap.
Vertical Limit Segments Are Not Allowed	A limit segment has been defined where the start and end frequencies are identical, but the limit values are different. This creates a vertical limit segment.
Trace Math Requires Units To Be dBm	For trace math to be performed, change the units to dBm.
Frequency Range Of Stored Sweep Does Not Match Current Frequency Range	The start and stop or center and span frequencies of two traces must be the same for one trace to be overlaid on the other.

Spectrum Analyzer Error Messages

A listing of Spectrum Analyzer Error Messages is provided in Table 2-4

Table 2-4. *Spectrum Analyzer Error Messages*

Error Message	Description
OVER LOAD Decrease Input Power	This error message is displayed when there is too much input power.
OVER RANGE! Increase Attenuation	The ADC is over range.
Mixer Saturation! Increase Atten	The Mixer has saturated.
Ext Ref Not Locked	This error is displayed when a signal is present at the external reference port, but is not locked to the specified frequency.
External reference unavailable Using internal reference.	This error is displayed when there is no signal detected at the External Reference port.
Must be in Zero Span to perform this operation	This error is displayed when the user attempts to change the following parameters when not in zero span: Change Trigger Position – (BW/SWEEP/Trigger) Video – (BW/SWEEP/Trigger)
Cannot Perform Operation in Zero Span	This error is displayed when the user tries to do field strength, occupied bandwidth, channel power and adjacent channel power measurements when in Zero Span.
Xref N MHz	The internal reference is locked to an N MHz external clock.
Min RBW for Zero Span is 30 kHz. RBW has been adjusted.	The RBW in Zero Span mode must be at least 30 kHz. If it is not, it will automatically be adjusted to 30 kHz and this message will be displayed.
Over Power Condition! Remove signals connected to RF In port and re-enter Spectrum Analyzer mode.	This error message is displayed when the spectrum analyzer mode cannot be properly calibrated due to too much signal power. The input signal must be removed, and the mode re-entered in order to calibrate the unit.

High Accuracy Power Meter (Option 19) Error Messages

The following error messages could be displayed on the Site Master when using the High Accuracy Power Meter mode with Power Sensor PSN50. If any error condition persists, contact your local Anritsu Service Center.

Table 2-5. Option 19 Error Messages

Error Message	Description
Warning! Power Supply Error	Verify that the supply is connected properly.
Warning! RF Power Level is too high	The specified upper measurement range is +20 dBm. Do not exceed the specification.
Warning! Sensor not zeroed properly. Zero sensor again	The sensor must be zeroed with nothing connected to it.
Warning! Specified temperature range (0 to 50°C) exceeded	The PSN50 sensor temperature range is 0 to 50°C.
Warning! Temperature has changed. Zero sensor again	The temperature changed more than the allowable limit after the sensor was zeroed.

Using the Soft Carrying Case

The soft carrying case has been designed such that the strap can be unsnapped to allow the case to be easily oriented horizontally; thus allowing the Anritsu controls to be more easily accessed (Figure 2-23).



Figure 2-23. Using the Soft Carrying Case

Chapter 3

Key Functions

Introduction

This chapter provides a description of the Anritsu MS2711D Spectrum Master keypad controls. There are two kinds of keys available on the MS2711D front panel: Hard Keys and Soft Keys.

Hard Keys

Hard keys are those keys on the front panel that are labeled in black and green and perform specific functions as explained below. There are four function hard keys, located below the display, and seventeen keypad hard keys located to the right of the display. Twelve of the keypad hard keys are dual purpose, depending on the current mode of operation. Some hard keys are only available in specific modes, while others are available in all modes. Refer to the following sections to determine which keys are available for each mode.

Function Hard Keys

MODE Sets the Anritsu Spectrum Master to a specific mode of operation. Use the Up/Down arrow key to select the mode of operation. Selections available will vary depending upon which options are installed. Press the **ENTER** key to implement the selection.

Measurement Mode
Power Meter (Internal)
Spectrum Analyzer
Transmission Measurement
Interference Analyzer
Channel Scanner

FREQ/SPAN Activates a menu of frequency- and span-related functions for selection using the soft keys. Available choices from this menu include **Center**, **Span**, **Start**, **Stop**, and **Signal Standard**. Soft key selection of any of these functions brings up a set of choices or selections specific to that procedure.

AMPLITUDE Activates a menu of amplitude-related functions including **Ref Level**, **Scale**, **Atten/Preamp**, **Units**, and **Ref Level Offset**. Soft key selection of any of these functions brings up a set of choices or selections specific to that procedure.

BW/SWEEP Activates a menu of bandwidth- and sweep-related functions including Bandwidth, Trigger, Max Hold, Detection, Min Sweep Time, Average (2-25) and Min Hold. Soft key selection of any of these functions brings up a set of choices or selections specific to that procedure.

Keypad Hard Keys

The following keypad hard key functions are printed in *black* on the keypad keys.

- 0-9** These keys are used to enter numerical data as required to setup or perform measurements.
- +/-** The plus/minus key is used to enter positive or negative values as required to setup or perform measurements.
- The decimal point is used to enter decimal values as required to setup or perform measurements.
- ESCAPE
CLEAR** Exits the present operation or clears the display. If a parameter is being edited, pressing this key will clear the value currently being entered and restore the last valid entry. Pressing this key again will close the parameter. During normal sweeping, pressing this key will move up one menu level. Press and hold this key while turning the unit on to restore all factory default settings.
- Up/Down
Arrows** Increments or decrements a parameter value or highlights a selection in a list.
- ENTER** Implements the current action or parameter selection.
- ON
OFF** Turns the Anritsu Spectrum Master on or off. When turned on, the last saved system state is restored. If the **ESCAPE/CLEAR** key is held down while the **ON/OFF** key is pressed, the factory preset state will be restored.
- SYS** Allows selection of system and application setup parameters and the display language.

The following keypad hard key functions are printed in *green* on the keypad keys.



- This key is used to adjust the display brightness. Use the Up/Down arrow key and **ENTER** to adjust the brightness.
- TRACE** Activates a menu that allows comparison of a current runtime trace (Trace A) to a saved trace (Trace B). The available soft keys will vary depending on the currently selected mode.
- MEAS** Activates a menu of measurement-related functions (Spectrum Analyzer mode only) including field strength, occupied bandwidth (OBW), channel power, adjacent channel power ratio (ACPR), interference analysis, AM/FM demodulation, and C/I measurement.

SAVE SETUP Saves the current system setup to 1 of 10 internal non-volatile memory locations. When the key is pressed, a Save Setup selection box appears on the display. Use the Up/Down arrow key to select a setup location and press the **ENTER** key to implement.

RECALL SETUP Recalls a previously saved setup from memory location 1 through 10. When the key is pressed, a Recall Setup selection box appears on the display. Select a setup using the Up/Down arrow key and press the **ENTER** key to implement. Setup location 0 recalls the factory preset state for the current measurement mode.

NOTE: There are two methods that can be used to reset the MS2711D to the factory defaults:

*If the unit is off, hold down the **ESCAPE/CLEAR** key while pressing the **ON/OFF** key. This resets the instrument to the factory preset state for all modes.*

*If the unit is on, press the **RECALL SETUP** key on the keypad. When the key is pressed, a Recall Setup selection box for the current mode of operation appears on the display. Select setup location **0 <Default>** to recall the factory preset state for the currently selected mode.*

LIMIT Activates a menu of Limit functions including single limit, multiple upper limits, multiple lower limits, and limit beep.

MARKER Activates a menu of marker functions for markers 1 through 6. Each marker, when selected, activates marker to peak and marker frequency to center functions. Markers 2 through 4 also include delta marker functions referenced to M1.

SAVE DISPLAY Saves the displayed trace to non-volatile memory. When the key is pressed, the Trace Name: edit box appears. Select the alphanumeric characters for that trace name and press the **ENTER** key to implement.

RECALL DISPLAY Recalls a previously-saved trace from memory. When the key is pressed, a Recall Trace selection box appears on the display. Select a trace using the Up/Down arrow key and press the **ENTER** key to implement.

SINGLE CONT Toggles the sweep mode between continuous sweep and single sweep. The default is continuous sweep. When single sweep is selected, the HOLD symbol appears to the left of the display and the Anritsu Spectrum Master will sweep once each time the **ENTER** key is pressed. Single sweep mode can be used to conserve battery power. Continuous sweeping can be re-activated by pressing the **SINGLE/CONT** key again.

PRINT Prints the current display to the selected printer. Refer to page 2-27 for information on selecting and setting up a printer.

Soft Keys

Soft keys are the six unlabeled keys (see Figure 2-2, page 2-2) that perform different functions depending on the currently-selected soft key menu. The available selections for the softkeys are displayed in the active function block. Selections may vary depending upon the currently selected mode.

The following sections relate the soft key menus displayed in the active function block when the various function hard keys or keypad hard keys are selected in each operating mode.

Power Meter (Internal)

Selecting Power Meter (Internal) from the mode menu causes the soft keys, described below, to be displayed and the corresponding values shown in the message area.

Frequency/Span Menu

Pressing the **FREQ/SPAN** key in Power Meter (Internal) mode activates a menu of frequency-related choices in the active function block. Use the corresponding softkey to select the desired function, explained below. Use the keypad or Up/Down arrow key to change or enter values shown in the edit box. Complete the entry by pressing the appropriate softkey frequency terminator.

Center	Activates the center frequency function and sets the power meter to the center frequency entered. A frequency from 4.5 MHz to 2998.500 MHz can be entered using the Up/Down arrow or keypad number keys.
Span	Opens the parameter for editing and activates a menu of span related choices.
Edit	Allows editing of the span to enter specific frequency.
Full	Sets the power meter to its maximum frequency span.
Min	Sets the power meter span to the minimum value of 3 MHz.
Span Up 1-2-5	Activates the span function so that the span may be increased quickly in a 1-2-5 sequence.
Span Down 1-2-5	Activates the span function so that the span may be reduced quickly in a 1-2-5 sequence.
Back	Returns to the previous menu level.
Signal Standard	Opens a menu of international signal standards. Select a standard using the Up/Down arrow key and press ENTER .
Select Channel	Allows selection of the signal standard to be used.

Select Standard	Allows selection of the signal standard to be used. Select a standard using the Up/Down arrow key and press the ENTER key to implement.
Select Channel	Sets the channel for the selected signal standard. Select a channel using the Up/Down arrow key and press the ENTER key to implement.
Uplink	Selects only uplink frequencies.
Downlink	Selects only downlink frequencies.
Back	Returns to the previous menu.

The following soft keys are available when the **AMPLITUDE** key is pressed.

Units	Choose either Watts or dBm as displayed in the message area.
Rel	Selects whether relative power is on or off. When on, the message Relative: On will show in the lower left of the status window.
Offset dB	Turns offset on or off. When on, a value from 0-60 dB can be entered.
Zero	Turns zero adjust on or off.

Bandwidth/Sweep Menus

Pressing **BW/SWEEP** in Power Meter (Internal) mode activates a menu of bandwidth- and sweep-related functions. Use the corresponding soft key to select the desired function.

RMS Averaging	Activates the RMS Averaging menu. The RMS average is calculated by taking the log of the average power and the power is calculated from voltage. The number of points to average can be set to low, medium or high.
Off	Turns RMS averaging off.
Low	A low amount of RMS averaging is performed.
Medium	A medium amount of RMS averaging is performed.
High	When high averaging is selected, response time is analogous to a traditional power meter.
Back	Returns to the previous menu level.

System Menu

Pressing **SYS** on the data keypad in Power Meter (Internal) mode activates a menu of system-related functions. Use the corresponding softkey to select the system function.

System Options	Displays a second level of system option functions:
-----------------------	---

Clock	Displays a second level of functions:	
	Hour	Enter the hour (0-23) using the Up/Down arrow key or the keypad. Press ENTER when data entry is complete or ESCAPE to restore the previous value.
	Minute	Enter the minute (0-59) using the Up/Down arrow key or the keypad. Press ENTER when data entry is complete or ESCAPE to restore the previous value.
	Month	Enter the month (1-12) using the Up/Down arrow key or the keypad. Press ENTER when data entry is complete or ESCAPE to restore the previous value.
	Day	Enter the day using the Up/Down arrow key or the keypad. Press ENTER when data entry is complete or ESCAPE to restore the previous value.
	Year	Enter the year (2003-2036) using the Up/Down arrow key or the keypad. Press ENTER when data entry is complete or ESCAPE to restore the previous value.
	Back	Returns to the top-level SYS menu.
Printer	Displays a menu of supported printers. Use the Up/Down arrow key and ENTER key to make the selection.	
Units	Select the unit of measurement (metric or English).	
Change Date Format	Toggles the date format between MM/DD/YYYY, DD/MM/YYYY, and YYYY/MM/DD.	
Back	Returns to the top-level SYS menu.	
Application Options	Application options displays options applicable to particular mode.	
External Ref Freq	Set the external reference frequency from 2 MHz to 20 MHz.	
Impedance	Sets the input impedance of the instrument.	
	50Ω	Sets the input impedance of the instrument to 50Ω, which is the default setting.
	75Ω Anritsu 12N50-75B	Displays measurements as if the input impedance was 75Ω. The actual input impedance is still 50Ω, but the displayed information is transformed to the equivalent 75Ω value based on the offset value specified by the adapter used in the measurement. This setting is commonly used for cable TV-related measurements. Pressing this soft key will also

compensate 7.5 dB for the loss of the Anritsu 12N50-75B adapter.

Other Adapter Offset This key allows the user to enter other adapter offset values. Enter the desired loss using the keypad or Up/Down arrow key and press the **ENTER** key to accept.

Back Returns to the previous menu.

Back Returns to the top-level SYS menu.

Self Test Start an instrument self test.

Status In cable and antenna analyzer freq or dist measurement mode, displays the current instrument status, including calibration status, temperature, and battery charge state. Press **ESCAPE** to return to operation.

Language Pressing this soft key immediately changes the language used to display messages on the Spectrum Master status window. Choices are English, French, German, Spanish, Chinese, and Japanese. The default language is English.

High Accuracy Power Meter (Option 19)

Choosing the **FREQ/SPAN** key causes the soft keys, below, to be displayed and the corresponding values to be shown in the message area.

Center	Sets the center frequency of the Spectrum Analyzer. Enter a value using the Up/Down arrow key or keypad, press ENTER to accept, ESCAPE to restore previous value.
Signal Standard	Opens a menu of soft keys used to select the signal standard to be used. For more information on signal standards, refer to Appendix C.
Select Standard	Opens the signal standard menu, showing the currently selected signal standards. Use the soft keys to navigate the list. Press the Show All soft key to show the complete signal standard list. When the complete list is displayed, the currently selected signal standards are marked with an asterisk. Press the Show Selected soft key to show only the currently selected signal standards.
Select Channel	Sets the channel information for the available standard.
Uplink	Selects only uplink frequencies.
Downlink	Selects only downlink frequencies.
Channel Increment	Changes the channel increment step size when the Up/Down arrows are used to select the channel number.
Back	Returns to the previous menu.

Choosing the **AMPLITUDE** key causes the soft keys, below, to be displayed and the corresponding values to be shown in the message area or scale menu depending on the measurement mode.

Rel	Selects whether relative power is on or off. When on, the message Relative: On will show in the message area.
Offset dB	Turns offset on or off. When on, a value from 0-60 dB can be entered.
Zero	Turns zero adjust on or off.

Choosing **BW/SWEEP** causes the soft keys below to be displayed.

Running Averages	Press the Running Averages soft key and use the keypad to enter the number of averages to use (up to 50)
Max Hold	Displays and holds the maximum responses of the input signal.

**Limit
ON/OFF**

Press the Limit ON/OFF soft key to turn on the limits.

**Lower
Limit**

Activate the lower limit line by toggling this soft key. The unit beeps if the data is below the set limit line and the status is displayed in the message area.

**Upper
Limit**

Activate the upper limit line by toggling this soft key. The unit beeps if the data is above the set limit line and the status is displayed in the message area.

**Limit
Units**

Press the Limit Units soft key to select the units.

Spectrum Analyzer Menus

Selecting Spectrum Analyzer from the mode menu causes the soft keys, described below, to be displayed and the corresponding values shown in the message area.

Frequency/Span Menu

Pressing the **FREQ/SPAN** key in Spectrum Analyzer mode activates a menu of frequency-related choices in the active function block. Use the corresponding softkey to select the desired function, explained below. Use the keypad or Up/Down arrow key to change or enter values shown in the edit box. Complete the entry by pressing the appropriate softkey frequency terminator.

- | | |
|------------------------|---|
| Center | Sets the center frequency. A specific center frequency can be entered using the Up/Down arrow key, or the keypad and the GHz, MHz, kHz, or Hz soft keys. |
| Span | Pressing the Span soft key activates a menu of span related choices in the active function block. |
| Edit | Allows direct entry of a specific frequency span. Use the keypad or Up/Down arrow key to select the span. |
| Full | Sets the Anritsu Spectrum Master to its maximum frequency span, 2999.991000 MHz. |
| Zero | Sets the span to 0 Hz. |
| Span Up 1-2-5 | Activates the span function so that the span may be increased quickly in a 1-2-5 sequence. |
| Span Down 1-2-5 | Activates the span function so that the span may be reduced quickly in a 1-2-5 sequence. |
| Back | Returns to the previous menu level. |
| Start | Activates the start frequency and sets the Anritsu Spectrum Master in the Start/Stop mode. Use the keypad to enter the desired start frequency and complete the entry by pressing the GHz, MHz, kHz, or Hz softkey to accept the start frequency input. |
| Stop | Activates the stop frequency and sets the Anritsu Spectrum Master in the Start/Stop mode. Use the keypad to enter the desired stop frequency and complete the entry by pressing the GHz, MHz, kHz, or Hz softkey to accept the stop frequency input. |
| Signal Standard | Allows selection of the signal standard to be used. |

Select Standard	Allows selection of the signal standard to be used. Select a standard using the Up/Down arrow key and press the ENTER key to implement.
Select Channel	Sets the channel for the selected signal standard. Select a channel using the Up/Down arrow key and press the ENTER key to implement.
Uplink	Selects only uplink frequencies.
Downlink	Selects only downlink frequencies.
Back	Returns to the previous menu.

Amplitude Menu

Pressing **AMPLITUDE** in Spectrum Analyzer mode activates a menu of amplitude-related functions.

Ref Level	Activates the amplitude reference level function. A specific reference level can be entered using the keypad or Up/Down arrow key. Press ENTER to accept the reference level value. Valid reference levels are +20 dBm to -120 dBm.
Scale	Activates the scale function in a 1 through 15 dB per division logarithmic amplitude scale. Enter the desired scale using the keypad or Up/Down arrow key. Press ENTER to accept. This soft key is not available when the Units selection is Linear (see below).
Atten/Preamp	Sets the Anritsu Spectrum Master input attenuator so that it is either coupled automatically to the reference level (Auto), manually adjustable (Manual), or dynamically controlled (Dynamic).
Auto	Press this softkey to automatically couple the attenuation to the reference level. The automatic attenuation value is displayed to the left of the display below the Atten .
Manual	Sets the attenuation to manual mode. The attenuation can be adjusted from 0 to 51 dB, in 1 dB increments, using the keypad or Up/Down arrow key. Press ENTER to accept the selected value. The value is displayed to the left of the display below the Atten* .

IMPORTANT! Attenuation is normally a coupled function and is automatically adjusted when the reference level changes. The reference level will not change however, when the attenuator changes. The attenuator should be adjusted so that the maximum signal amplitude at the input mixer is -30 dBm or less. For example, if the reference level is +20 dBm, the attenuation should be 50 dB for an input signal of -30 dBm at the mixer (+20 - 50 = -30). This prevents signal compression. (This is with the preamplifier off.)

Dynamic Turns on the dynamic attenuation control feature. Dynamic attenuation tracks the input signal level, automatically adjusting the attenuation and preamp to give the maximum dynamic range without compressing the input mixer.

Dynamic attenuation is based on a broadband detector. This means that an out of band signal may interfere and force the need to use a bandpass filter to eliminate the out of band interference and enable accurate measurements.

Preamp Control Manual Allows manual control of the preamplifier on/off state. The Preamp On/Off soft key turns the preamplifier on or off. The Preamp Auto soft key returns to automatic control of the preamplifier.

Units Choose from the menu of amplitude-related units, either Log or Linear. When units are Log, selection of dBm sets absolute decibels relative to 1 mW as the amplitude unit. Selection of dBV, dBmV or dB μ V sets absolute decibels relative to 1 volt, 1 millivolt, or 1 microvolt respectively as the amplitude unit. When Linear is selected, available selections are Volts or Watts.

Ref Level Offset Sets the reference level offset. This feature allows measurement of high gain devices in combination with an attenuator. It is used to offset the viewed reference level to compensate for an external attenuator.

For example, to measure a high gain amplifier with an output of 70 dBm, an external 50 dB attenuator must be inserted between the Spectrum Master and the device. To compensate displayed measurements for this external attenuator, set the reference level offset to -50 dB.

When the reference level offset is a value other than 0, the displayed and measured values will automatically have the offset value subtracted from the measurement, thus providing a direct readout of the actual measurement. See the preceding IMPORTANT notice concerning input considerations.

Bandwidth/Sweep Menu

Pressing **BW/SWEEP** in Spectrum Analyzer mode activates a menu of bandwidth- and sweep-related functions. Use the corresponding soft key to select the desired function.

Bandwidth Activates a menu that allows the resolution and video bandwidths to be either coupled automatically to the span (Auto) or manually adjustable (Manual).

RBW Auto Sets the resolution bandwidth so that it is coupled automatically to the span.

RBW Manual Allows the user to manually set the resolution bandwidth using the Up/Down arrow key.

VBW Auto Sets the video bandwidth so that it is coupled automatically to the resolution bandwidth.

	VBW Manual	Allows the user to manually set the video bandwidth using the Up/Down arrow key.
	Back	Returns to the previous menu level.
Trigger		Select the method used to trigger the sweep.
	Free Run	The sweep is continuous.
	Single	A single sweep will be performed with each press of the ENTER key.
	External	The sweep is triggered by an external source.
	Video	Sets the video trigger level if the span is set to zero.
	Change Trigger Position	Changes the trigger sweep position from 0 to 100% if zero span is selected. Zero percent positions the trigger at the left edge of the display; 100% positions the trigger at the right edge of the display.
	Back	Returns to the previous menu.
Max Hold		Displays and holds the maximum responses of the input signal over multiple sweeps.
Detection		Accesses a menu of detector modes including Positive Peak detection, RMS Average detection, Negative Peak detection and Sampling Mode . During a sweep, several frequency points are measured for each display point. The detection mode defines what measurement value is displayed.
	Positive Peak	The Spectrum Master reads and displays the highest measured point of the measured frequencies for each displayed point.
	RMS Average	The Spectrum Master displays the RMS average value of all the frequency samples measured for each displayed point.
	Negative Peak	The Spectrum Master displays the lowest measured data of the measured frequencies for each displayed point.
	Sampling Mode	The Spectrum Master selects the first frequency sample for each display point. For a wide sweep, this method may miss a narrowband signal.
	Back	Returns to the previous menu.
Min Sweep Time		Sets the minimum sweep time of the span.
More		Brings up a menu of additional measurement functions:

Average (2-25) Sets the number of the sweeps to be averaged. The number of the sweeps can be adjusted from 2 to 25 using the Up/Down arrow key, or entered directly with the keypad number keys. Select **OFF**, or enter 1 to turn off averaging. Press **ENTER** to accept the selected value.

This feature uses a measurement routine that averages samples over a user-defined number of successive sweeps. The averaging is done on a point-by-point basis. Each displayed point reflects the current measurement associated with that point averaged with the measurements associated with that point from previous sweeps. This feature can be used to minimize the impact of transients on the displayed signal and noise.

Min Hold Displays and holds the minimum responses of the input signal over multiple sweeps. This feature is useful for detecting small, discrete, stable signals in the presence of noise.

Back Returns to the previous menu.

Trace Menu

Pressing the **TRACE** key in Spectrum Analyzer mode activates a menu of trace-related functions. Use the corresponding softkey to select the desired trace function.

NOTE: For this function, Trace A is always the runtime trace, and Trace B is always a saved trace. Trace A is displayed as a yellow trace, and Trace B is displayed as a magenta trace. Some adjustment of the display brightness (see page 2-21) may be required for optimal viewing. Refer to page 3-47 for information on saving and recalling traces.

Normalize	This key is to be used to normalize the trace. When using this feature, error terms from cables and connectors are automatically subtracted from the measurement results. When the runtime trace (Trace A) is normalized, an asterisk (*) appears after the A in the title bar.
A → B	Stores the current runtime trace into the Trace B buffer.
A – B → A	Performs a subtraction trace math operation, subtracting Trace B from Trace A, and displaying the result as Trace A.
A + B → A	Performs an addition trace math operation, adding Trace B to Trace A, and displaying the result as Trace A.
Trace A	Accesses a menu of trace operations: Reset A – Clears the current runtime trace and restarts the sweep. Normalize On/Off – Turns the normalization function on and off. Normalization can only be turned on if there is valid normalization data for the current sweep. Back - Returns to the previous menu.
Trace B	Accesses a menu of saved trace options: View B - Provides a trace overlay of the saved trace (B) with the current runtime trace (A). If there is currently no trace associated with trace B, the Recall Trace → B function (see below) will be activated. Select a trace from the menu of saved traces to recall to the trace B buffer. Clear B - Turns off trace overlay. Recall Trace → B - Recalls a saved trace into the trace B buffer. Back - Returns to the previous menu.

Measurement Menu

Pressing **MEAS** on the data keypad in Spectrum Analyzer mode activates a menu of measurement-related functions. Use the corresponding softkey to select the measurement function.

Field Strength	Accesses a menu of field strength measurement options:
On/Off	Turns field strength measurements on or off.
Select Standard Antenna	Brings up a list of standard antenna profiles to be used for field strength measurements. Use the Up/Down arrow key to highlight a profile and select using the ENTER key.
Select Custom Antenna	Selects an antenna profile that has been uploaded into the instrument. Use the Up/Down arrow key to highlight a profile and select using the ENTER key. Refer to Chapter 10, <i>Handheld Software Tools</i> for more information on uploading antenna profiles and factors.
Back	Returns to the previous menu.
OBW	Activates the occupied bandwidth menu. Select either % or dBc method of occupied bandwidth measurement. Refer to Chapter 6 for further information on occupied bandwidth.
Method	Select either the % of Power (default) or dB Down measurement method as displayed in the message area.
%	Use the Up/Down arrow key or the keypad to enter the percent of power, from 0 to 99%.
dBc	Use the Up/Down arrow key or the keypad to enter the dBc value (0 to 120 dB).
Measure	Turns the OBW measurement on or off. When the measurement is on the Measure soft key will appear to be pressed, and OBW will appear to the left of the display.
Back	Returns to the previous menu.
Channel Power	Activates the Channel Power measurement function. Channel Power and Channel Power Density are measured based on the selection in the Units menu.
Center Freq	Activates the center frequency function, and sets the center frequency of the Anritsu Spectrum Master for the channel power measurement.

Int BW	Sets the integration bandwidth for channel power measurement. Modifying this value automatically adjusts the channel span to maintain the same ratio.
Channel Span	Sets the channel span for channel power measurement.
Zoom One Channel	Automatically sets the span to cover one channel. A standard and channel must be selected for this feature to be active.
Measure	Begins or ends the channel power measurement. When the measurement is on, the Measure soft key will appear to be pressed, and CH PWR will appear to the left of the display. The detection method will automatically be changed to RMS Average when the measurement is started. The detection method can be modified by pressing the BW/SWEEP key and selecting Detection .
Back	Returns to the previous menu.
ACPR	Accesses a menu of Adjacent Channel Power Ratio measurement options:
Center Freq	Activates the center frequency function and sets the center frequency for the ACPR measurement. A specific center frequency can be entered using the keypad or Up/Down arrow key. Select the GHZ , MHZ , KHZ , or HZ softkey to accept the center frequency input.
Main Channel BW	Sets the bandwidth of the main channel for ACPR measurement. A specific frequency can be entered using the keypad or Up/Down arrow key. Select the GHZ , MHZ , KHZ , or HZ softkey to accept the frequency input. Changing this value automatically changes the adjacent channel bandwidth and channel spacing.
Adj Channel BW	Sets the bandwidth of the adjacent channels for ACPR measurement. A specific frequency can be entered using the keypad or Up/Down arrow key. Select the GHZ , MHZ , KHZ , or HZ softkey to accept the frequency input.
Channel Spacing	Sets the channel spacing between the main and adjacent channels. A specific frequency can be entered using the keypad or Up/Down arrow key. Select the GHZ , MHZ , KHZ , or HZ softkey to accept the frequency input. This value must be greater than or equal to half of the main channel bandwidth, plus half of the adjacent channel bandwidth.
Measure	Begins or ends the ACPR measurement. When the measurement is on, the Measure soft key will appear to be pressed, and ACPR will appear to the left of the display.
Back	Returns to the previous menu.

Int. Analysis	The instrument attempts to identify the type of signal standard based on the modulation characteristics of the signal.
Set IA Freq	Enter the frequency of the interfering signal. A specific frequency can be entered using the keypad or Up/Down arrow key. Select the GHz, MHz, kHz, or Hz softkey to accept the frequency input. The default is 10 MHz.
Measure	Begins an analysis of the signal at the IA frequency. The analysis can take up to a minute.
IA Freq To Center	Places the interference analysis frequency at the center of the display.
IA Freq As Marker M1	Places the interference analysis frequency at the marker frequency.
Back	Returns to the previous menu.
More	Brings up a menu of additional measurement functions:
AM/FM Demod	Select AM, Narrow Band FM (300 μ s de-emphasis), Wide Band FM (50 μ s de-emphasis), USB or LSB. On/Off - Turns AM/FM Demodulation on or off. Demod Type - Select either AM, FM Wide Band, FM Narrow Band, SSB Lower or SSB Upper demodulation. Demod Freq - Use the Up/Down arrow key or the keypad to increase or decrease the demodulation frequency. Select the GHz, MHz, kHz, or Hz softkey to accept the frequency input. Volume - The current volume setting is displayed at the lower right of the screen. Use the Up/Down arrow key to increase or decrease the volume, and press the ENTER key to select. Demod Time - Use the Up/Down arrow key or the keypad to increase or decrease the demodulation time, and press the ENTER key to select. Back - Returns to the previous menu.
C/I	A two-step measurement sequence that first measures the amplitude of a signal, then, with the carrier turned off, measures the amplitude of all interfering signals. Signal Type - Opens a menu to select the carrier signal type. Selections are narrow band FHSS, wide band FHSS or a broadband signal.

Center - Activates the center frequency function and sets the Spectrum Master to the center frequency. A specific center frequency can be entered using the keypad or Up/Down arrow key.

Span - Sets the user-defined frequency span. Use the Up/Down arrow key or keypad to enter a value in MHz.

Min Sweep Time - Sets a sweep time of one second or more to improve the ability to capture instances of the interfering signal.

Measure - Starts the carrier to interference measurement.

Back - Returns to the previous menu.

Back Returns to the previous menu.

Limit Menu

Pressing **LIMIT** on the data keypad in Spectrum Analyzer mode activates a menu of limit-related functions. Use the corresponding softkey to select the desired limit function. Then use the Up/Down arrow key to change its value, which is displayed in the message area at the bottom of the display.

Single Limit	Sets a single limit value. Menu choices are:
On/Off	Turns the single limit function on or off.
Edit	Allows entry of the limit amplitude using the keypad or Up/Down arrow key. Press ENTER to accept the entered value.
Upper / Lower Limit	Selects whether the measurement will fail if the data is above the limit line or below the limit line, as indicated in the message area of the display.
Back	Return to the previous menu.
Multiple Upper Limits	Sets multiple user-defined upper limits, and can be used to create an upper limit mask for quick pass/fail measurements. An upper limit will result in a failure when the data falls above the limit line. Menu choices are:
Segment 1	View/edit the upper limit segment 1.
Segment 2	View/edit the upper limit segment 2.
Segment 3	View/edit the upper limit segment 3.

	Segment 4	View/edit the upper limit segment 4.
	Segment 5	View/edit the upper limit segment 5.
	Back	Return to the previous menu.
Multiple Lower Limits		Set multiple user-defined lower limits, and can be used to create a lower limit mask for quick pass/fail measurements. A lower limit will result in a failure when the data falls below the limit line. Menu choices are:
	Segment 1	View/edit the lower limit segment 1.
	Segment 2	View/edit the lower limit segment 2.
	Segment 3	View/edit the lower limit segment 3.
	Segment 4	View/edit the lower limit segment 4.
	Segment 5	View/edit the lower limit segment 5.
	Back	Return to the previous menu.
Limit Beep		Turns the audible limit beep indicator on or off. When the limit beep indicator is on, an audible beep will occur at every data point that appears above the upper limit or below the lower limit.
Limit Segment Menu		
The Limit Segment Menu displays when a segment is selected from the Multiple Upper Limits or Multiple Lower Limits menus above.		
On/Off		Turns the segment on or off.
Edit		Opens the segment parameters for editing (see Adjusting Segmented Limits, page 2-19).
Prev Segment		Edit or view the parameters of the previous segment.
Next Segment		Edit or view the parameters of the next segment. If the next segment is off when this button is pressed, the starting point of the next segment will be set equal to the ending point of the current segment (if the current segment is on).
Back		Return to the previous menu.

Marker Menu

Pressing **MARKER** on the data keypad in Spectrum Analyzer mode activates a menu for the six different markers. Use the corresponding softkey to select the desired marker. Then use the marker second level menu to turn the markers on or off, and to edit marker parameters and values.

M1	Selects the M1 marker parameter and opens the Markers second level menu with M1 highlighted.
M2	Selects the M2 marker parameter and opens the Markers second level menu with M2 highlighted.
M3	Selects the M3 marker parameter and opens the Markers second level menu with M3 highlighted.
M4	Selects the M4 marker parameter and opens the Markers second level menu with M4 highlighted.
All Off	Turns off all markers.
More	Press to access additional marker functions:
M5	Selects the M5 marker parameter and opens the M5 marker second level menu with M5 highlighted.
M6	Selects the M6 marker parameter and opens the M6 marker second level menu with M6 highlighted.
Regular Marker	Measures the signal level at the point of the marker in the unit type selected in the Amplitude - Units menu. When the regular marker option is selected, all markers are regular markers.
Noise Marker	Measures noise level normalized to a 1 Hz bandwidth. The unit of measure is dBm/Hz only. When Noise Marker is selected, the detection type is automatically changed to RMS average. When the Noise Marker option is selected, all markers are noise markers.
All Off	Turns off all markers.
Back	Return to the previous menu.

Markers Second Level Menu

The markers second level menu displays when one of the markers is selected in the above menus. For Markers M1 through M4, the second level menu is:

On/Off	Turns the selected marker on or off.
Edit	Opens the selected marker parameter for data entry. Enter the desired marker frequency using the keypad or Up/Down arrow key. Select the GHz, MHz, kHz, or Hz softkey to accept the marker frequency input.

Delta (Mx-M1)	Displays delta frequency and amplitude for the selected marker Mx (M2, M3 or M4) with respect to the M1 marker.
Marker To Peak	Places the selected marker at the maximum amplitude of a trace (M1 - M4 only).
Marker Freq To Center	Makes the center frequency equal to the frequency of the selected marker.
Back	Return to the previous menu.

The M5 marker second level menu includes the On/Off, Edit, Marker Freq To Center and Back softkeys, in addition to the following:

Peak Between M1& M2	Places the selected marker at the frequency with maximum amplitude value between marker M1 and M2.
Valley Between M1& M2	Places the selected marker at the frequency with minimum amplitude value between marker M1 and M2.

NOTE: If markers M1 and/or M2 are off, the Peak and Valley functions above are executed across the entire span.

The M6 marker second level menu includes the On/Off, Edit, Marker Freq To Center and Back softkeys, in addition to the following:

Peak Between M3& M4	Places the selected marker at the frequency with maximum amplitude value between marker M3 and M4.
Valley Between M3& M4	Places the selected marker at the frequency with minimum amplitude value between marker M3 and M4.

NOTE: If either marker M3 or marker M4 is off, the Peak and Valley functions above are executed across the entire span.

System Menu

Pressing **SYS** on the data keypad in Spectrum Analyzer mode activates a menu of system-related functions. Use the corresponding softkey to select the system function.

System Options	Displays a second level of system option functions:
Clock	Displays a second level of functions:

Hour	Enter the hour (0-23) using the Up/Down arrow key or the keypad. Press ENTER when data entry is complete or ESCAPE to restore the previous value.
Minute	Enter the minute (0-59) using the Up/Down arrow key or the keypad. Press ENTER when data entry is complete or ESCAPE to restore the previous value.
Month	Enter the month (1-12) using the Up/Down arrow key or the keypad. Press ENTER when data entry is complete or ESCAPE to restore the previous value.
Day	Enter the day using the Up/Down arrow key or the keypad. Press ENTER when data entry is complete or ESCAPE to restore the previous value.
Year	Enter the year (2003-2036) using the Up/Down arrow key or the keypad. Press ENTER when data entry is complete or ESCAPE to restore the previous value.
Back	Returns to the top-level SYS menu.
Printer	Displays a menu of supported printers. Use the Up/Down arrow key and ENTER key to make the selection.
Units	Select the unit of measurement (metric or English).
Change Date Format	Toggles the date format between MM/DD/YYYY, DD/MM/YYYY, and YYYY/MM/DD.
Back	Returns to the top-level SYS menu.
Application Options	Application options displays options applicable to particular mode.
External Ref Freq	Set the external reference frequency from 2 MHz to 20 MHz.
Impedance	Sets the input impedance of the instrument.
50Ω	Sets the input impedance of the instrument to 50Ω, which is the default setting.
75Ω Anritsu 12N50-75B	Displays measurements as if the input impedance was 75Ω. The actual input impedance is still 50Ω, but the displayed information is transformed to the equivalent 75Ω value based on the offset value specified by the adapter used in the measurement. This setting is commonly used for cable TV-related measurements. Pressing this soft key will also compensate 7.5 dB for the loss of the Anritsu 12N50-75B adapter.

Other Adapter Offset This key allows the user to enter other adapter offset values. Enter the desired loss using the keypad or Up/Down arrow key and press the **ENTER** key to accept.

Back Returns to the previous menu.

Back Returns to the top-level SYS menu.

Self Test Start an instrument self test.

Status In cable and antenna analyzer freq or dist measurement mode, displays the current instrument status, including calibration status, temperature, and battery charge state. Press **ESCAPE** to return to operation.

Language

Pressing this soft key immediately changes the language used to display messages on the Spectrum Master status window. Choices are English, French, German, Spanish, Chinese, and Japanese. The default language is English.

Transmission Measurement Menu

Selecting Transmission Measurement from the mode menu causes the soft keys, described below, to be displayed and the corresponding values shown in the message area.

Frequency/Span Menu

Pressing the **FREQ/SPAN** key in Transmission Measurement mode activates a menu of frequency-related choices in the active function block. Use the corresponding softkey to select the desired function, explained below. Use the keypad or Up/Down arrow key to change or enter values shown in the edit box. Complete the entry by pressing the appropriate softkey frequency terminator.

Center	Sets the center frequency. A specific center frequency can be entered using the Up/Down arrow key, or the keypad and the GHz, MHz, kHz, or Hz soft keys.
Span	Pressing the Span soft key activates a menu of span related choices in the active function block.
Edit	Allows direct entry of a specific frequency span. Use the keypad or Up/Down arrow key to select the span.
Full	Sets the Anritsu Spectrum Master to its maximum frequency span, 2.975 GHz.
Min	Sets the span to the minimum frequency.
Span Up 1-2-5	Activates the span function so that the span may be increased quickly in a 1-2-5 sequence.
Span Down 1-2-5	Activates the span function so that the span may be reduced quickly in a 1-2-5 sequence.
Back	Returns to the previous menu level.
Start	Activates the start frequency and sets the Anritsu Spectrum Master in the Start/Stop mode. Use the keypad to enter the desired start frequency and complete the entry by pressing the GHz, MHz, kHz, or Hz softkey to accept the start frequency input.
Stop	Activates the stop frequency and sets the Anritsu Spectrum Master in the Start/Stop mode. Use the keypad to enter the desired stop frequency and complete the entry by pressing the GHz, MHz, kHz, or Hz softkey to accept the stop frequency input.
Signal Standard	Allows selection of the signal standard to be used.

- Select Standard** Select a standard using the Up/Down arrow key and press the **ENTER** key to implement.
- Select Channel** Sets the channel for the selected signal standard. Select a channel using the Up/Down arrow key and press the **ENTER** key to implement.
- Uplink** Selects only uplink frequencies.
- Downlink** Selects only downlink frequencies.
- Back** Returns to the previous menu.

Amplitude Menu

Pressing **AMPLITUDE** in Transmission Measurement mode activates a menu of amplitude-related functions.

- Ref Level** Activates the amplitude reference level function. A specific reference level can be entered using the keypad or Up/Down arrow key. Press **ENTER** to accept the reference level value. Valid reference levels are +20 dBm to -120 dBm.
- Scale** Activates the scale function in a 1 through 15 dB per division logarithmic amplitude scale. Enter the desired scale using the keypad or Up/Down arrow key. Press **ENTER** to accept.
- Atten/Preamp** Sets the Anritsu Spectrum Master input attenuator so that it is either coupled automatically to the reference level (**Auto**), manually adjustable (**Manual**), or dynamically controlled (**Dynamic**).
 - Auto** Press this softkey to automatically couple the attenuation to the reference level. The automatic attenuation value is displayed to the left of the display below the **Atten**.
 - Manual** Sets the attenuation to manual mode. The attenuation can be adjusted from 0 to 51 dB, in 1 dB increments, using the keypad or Up/Down arrow key. Press **ENTER** to accept the selected value. The value is displayed to the left of the display below the **Atten***.

IMPORTANT! Attenuation is normally a coupled function and is automatically adjusted when the reference level changes. The reference level will not change however, when the attenuator changes. The attenuator should be adjusted so that the maximum signal amplitude at the input mixer is -30 dBm or less. For example, if the reference level is +20 dBm, the attenuation should be 50 dB for an input signal of -30 dBm at the mixer (+20 - 50 = -30). This prevents signal compression. (This is with the preamplifier off.)

- Dynamic** Turns on the dynamic attenuation control feature. Dynamic attenuation tracks the input signal level, automatically adjusting the attenuation and preamp to give the maximum dynamic range without compressing the input mixer.

Dynamic attenuation is based on a broadband detector. This means that an out of band signal may interfere and force the need to use a bandpass filter to eliminate the out of band interference and enable accurate measurements.

Preamp Control Manual Allows manual control of the preamplifier on/off state. The Preamp On/Off soft key turns the preamplifier on or off. The Preamp Auto soft key returns to automatic control of the preamplifier.

Back Returns to the previous menu level.

Bandwidth/Sweep Menu

Pressing **BW/SWEEP** in Transmission Measurement mode activates a menu of bandwidth- and sweep-related functions. Use the corresponding soft key to select the desired function.

Bandwidth Activates a menu that allows the resolution and video bandwidths to be either coupled automatically to the span (Auto) or manually adjustable (Manual).

RBW Auto Sets the resolution bandwidth so that it is coupled automatically to the span.

RBW Manual Allows the user to manually set the resolution bandwidth using the Up/Down arrow key.

VBW Auto Sets the video bandwidth so that it is coupled automatically to the resolution bandwidth.

VBW Manual Allows the user to manually set the video bandwidth using the Up/Down arrow key.

Back Returns to the previous menu level.

Calibrate TM Calibrates the Spectrum Master for transmission measurements.

Max Hold Displays and holds the maximum responses of the input signal over multiple sweeps.

Average (2-25) Sets the number of the sweeps to be averaged. The number of the sweeps can be adjusted from 2 to 25 using the Up/Down arrow key, or entered directly with the keypad number keys. Select **OFF**, or enter 1 to turn off averaging. Press **ENTER** to accept the selected value.

This feature uses a measurement routine that averages samples over a user-defined number of successive sweeps. The averaging is done on a point-by-point basis. Each displayed point reflects the current measurement associated with that point averaged with the measurements associated with that point from previous sweeps. This feature can be used to minimize the impact of transients on the displayed signal and noise.

Min Hold Displays and holds the minimum responses of the input signal over multiple sweeps. This feature is useful for detecting small, discrete, stable signals in the presence of noise.

Trace Menu

Pressing the **TRACE** key in Transmission Measurement mode activates a menu of trace-related functions. Use the corresponding softkey to select the desired trace function.

NOTE: For this function, Trace A is always the runtime trace, and Trace B is always a saved trace. Trace A is displayed as a yellow trace, and Trace B is displayed as a magenta trace. Some adjustment of the display brightness (see page 2-21) may be required for optimal viewing. Refer to page 3-47 for information on saving and recalling traces.

**Recall Trace
→ B** Recalls a stored trace into the Trace B buffer.

**View B /
Clear B** Overlays a stored trace over the current trace. If there is no trace in the Trace B buffer, the Recall Trace list will display. Select a trace from the menu of saved traces to recall to the Trace B buffer. Pressing the soft key again turns off the trace overlay.

A → B Moves the currently displayed trace into the Trace B buffer.

**A - B
→ A** Subtracts Trace B from Trace A and displays the result as Trace A.

**A + B
→ A** Adds Trace B to Trace A and displays the result as Trace A.

System Menu

Pressing **SYS** on the data keypad in Transmission Measurement mode activates a menu of system-related functions. Use the corresponding softkey to select the system function.

System Options Displays a second level of system option functions:

Clock Displays a second level of functions:

Hour Enter the hour (0-23) using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.

Minute Enter the minute (0-59) using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.

Month Enter the month (1-12) using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.

Day	Enter the day using the Up/Down arrow key or the keypad. Press ENTER when data entry is complete or ESCAPE to restore the previous value.
Year	Enter the year (2003-2036) using the Up/Down arrow key or the keypad. Press ENTER when data entry is complete or ESCAPE to restore the previous value.
Back	Returns to the top-level SYS menu.
Printer	Displays a menu of supported printers. Use the Up/Down arrow key and ENTER key to make the selection.
Units	Select the unit of measurement (metric or English).
Change Date Format	Toggles the date format between MM/DD/YYYY, DD/MM/YYYY, and YYYY/MM/DD.
Back	Returns to the top-level SYS menu.
Application Options	Application options displays options applicable to particular mode.
External Ref Freq	Set the external reference frequency from 2 MHz to 20 MHz.
Impedance	Sets the input impedance of the instrument.
50Ω	Sets the input impedance of the instrument to 50Ω, which is the default setting.
75Ω Anritsu 12N50-75B	Displays measurements as if the input impedance was 75Ω. The actual input impedance is still 50Ω, but the displayed information is transformed to the equivalent 75Ω value based on the offset value specified by the adapter used in the measurement. This setting is commonly used for cable TV-related measurements. Pressing this soft key will also compensate 7.5 dB for the loss of the Anritsu 12N50-75B adapter.
Other Adapter Offset	This key allows the user to enter other adapter offset values. Enter the desired loss using the keypad or Up/Down arrow key and press the ENTER key to accept.
Back	Returns to the previous menu.
Back	Returns to the top-level SYS menu.
Self Test	Start an instrument self test.

Status In cable and antenna analyzer freq or dist measurement mode, displays the current instrument status, including calibration status, temperature, and battery charge state. Press **ESCAPE** to return to operation.

Language

Pressing this soft key immediately changes the language used to display messages on the Spectrum Master status window. Choices are English, French, German, Spanish, Chinese, and Japanese. The default language is English.

Limit Menu

Pressing **LIMIT** on the data keypad in Transmission Measurement mode activates a menu of limit-related functions. Use the corresponding softkey to select the desired limit function. Then use the Up/Down arrow key to change its value, which is displayed in the message area at the bottom of the display.

Single Limit

Sets a single limit value. Menu choices are:

On/Off Turns the single limit function on or off.

Edit Allows entry of the limit amplitude using the keypad or Up/Down arrow key. Press **ENTER** to accept the entered value.

Upper / Lower Limit Selects whether the measurement will fail if the data is above the limit line or below the limit line, as indicated in the message area of the display.

Back Return to the previous menu.

Multiple Upper Limits

Sets multiple user-defined upper limits, and can be used to create an upper limit mask for quick pass/fail measurements. An upper limit will result in a failure when the data falls above the limit line. Menu choices are:

Segment 1 View/edit the upper limit segment 1.

Segment 2 View/edit the upper limit segment 2.

Segment 3 View/edit the upper limit segment 3.

Segment 4 View/edit the upper limit segment 4.

Segment 5 View/edit the upper limit segment 5.

Back Return to the previous menu.

Multiple Lower Limits Set multiple user-defined lower limits, and can be used to create a lower limit mask for quick pass/fail measurements. A lower limit will result in a failure when the data falls below the limit line. Menu choices are:

Segment 1 View/edit the lower limit segment 1.

Segment 2 View/edit the lower limit segment 2.

Segment 3 View/edit the lower limit segment 3.

Segment 4 View/edit the lower limit segment 4.

Segment 5 View/edit the lower limit segment 5.

Back Return to the previous menu.

Limit Beep Turns the audible limit beep indicator on or off. When the limit beep indicator is on, an audible beep will occur at every data point that appears above the upper limit or below the lower limit.

Limit Segment Menu

The Limit Segment Menu displays when a segment is selected from the Multiple Upper Limits or Multiple Lower Limits menus above.

On/Off Turns the segment on or off.

Edit Opens the segment parameters for editing (see Adjusting Segmented Limits, page 2-19).

Prev Segment Edit or view the parameters of the previous segment.

Next Segment Edit or view the parameters of the next segment. If the next segment is off when this button is pressed, the starting point of the next segment will be set equal to the ending point of the current segment (if the current segment is on).

Back Return to the previous menu.

Marker Menu

Pressing **MARKER** on the data keypad in Transmission Measurement mode activates a menu for the six different markers. Use the corresponding softkey to select the desired marker. Then use the marker second level menu to turn the markers on or off, and to edit marker parameters and values.

M1

	Selects the M1 marker parameter and opens the Markers second level menu with M1 highlighted.
M2	Selects the M2 marker parameter and opens the Markers second level menu with M2 highlighted.
M3	Selects the M3 marker parameter and opens the Markers second level menu with M3 highlighted.
M4	Selects the M4 marker parameter and opens the Markers second level menu with M4 highlighted.
All Off	Turns off all markers.
More	Press to access additional marker functions:
M5	Selects the M5 marker parameter and opens the M5 marker second level menu with M5 highlighted.
M6	Selects the M6 marker parameter and opens the M6 marker second level menu with M6 highlighted.
Regular Marker	Measures the signal level at the point of the marker in the unit type selected in the Amplitude - Units menu. When the regular marker option is selected, all markers are regular markers.
Noise Marker	Measures noise level normalized to a 1 Hz bandwidth. The unit of measure is dBm/Hz only. When Noise Marker is selected, the detection type is automatically changed to RMS average. When the Noise Marker option is selected, all markers are noise markers.
All Off	Turns off all markers.
Back	Return to the previous menu.

Markers Second Level Menu

The markers second level menu displays when one of the markers is selected in the above menus. For Markers M1 through M4, the second level menu is:

On/Off	Turns the selected marker on or off.
Edit	Opens the selected marker parameter for data entry. Enter the desired marker frequency using the keypad or Up/Down arrow key. Select the GHz, MHz, kHz, or Hz softkey to accept the marker frequency input.
Delta (Mx-M1)	Displays delta frequency and amplitude for the selected marker Mx (M2, M3 or M4) with respect to the M1 marker.

Marker To Peak	Places the selected marker at the maximum amplitude of a trace (M1 - M4 only).
Marker Freq To Center	Makes the center frequency equal to the frequency of the selected marker.
Back	Return to the previous menu.

The M5 marker second level menu includes the On/Off, Edit, Marker Freq To Center and Back softkeys, in addition to the following:

Peak Between M1& M2	Places the selected marker at the frequency with maximum amplitude value between marker M1 and M2.
Valley Between M1& M2	Places the selected marker at the frequency with minimum amplitude value between marker M1 and M2.

NOTE: If markers M1 and/or M2 are off, the Peak and Valley functions above are executed across the entire span.

The M6 marker second level menu includes the On/Off, Edit, Marker Freq To Center and Back softkeys, in addition to the following:

Peak Between M3& M4	Places the selected marker at the frequency with maximum amplitude value between marker M3 and M4.
Valley Between M3& M4	Places the selected marker at the frequency with minimum amplitude value between marker M3 and M4.

NOTE: If either marker M3 or marker M4 is off, the Peak and Valley functions above are executed across the entire span.

Interference Analyzer Mode (Option 25)

The Interference Analyzer option provides several different ways to determine the nature and source of an interfering signal. Selecting Interference Analyzer from the mode menu causes the soft keys, described below, to be displayed and the corresponding values shown in the message area.

To select Interference Analyzer mode, press the **MODE** key, use the Up/Down arrow key to highlight Interference Analysis and press **ENTER**.

FREQ/SPAN

Center — Sets the frequency at the center of the display. Frequencies can be entered in units of GHz, MHz, kHz or Hz. When the center frequency is entered, the labeling below the grid shows the center frequency and the span in the most appropriate units based on the value.

Span — Sets the width of the measurement window in GHz, MHz, kHz or Hz. The center frequency and span are displayed in the message area at the bottom of the status window.

Start — Enter a start frequency value (in GHz, MHz, kHz or Hz) using the Up/Down arrow key or keypad, press **ENTER** to accept, **ESCAPE** to restore. If the entered start frequency is greater than the current stop frequency, the stop frequency is automatically adjusted to be the same as the start frequency (zero span).

Stop — Enter a stop frequency value (in GHz, MHz, kHz or Hz) using the Up/Down arrow key or keypad, press **ENTER** to accept, **ESCAPE** to restore. If the entered stop frequency is lower than the current start frequency, the start frequency is automatically adjusted to be the same as the stop frequency (zero span).

Signal Standard — Opens a menu of soft keys used to select the signal standard to be used.

Select Standard — Opens the signal standard menu, showing the currently selected signal standards. Use the soft keys to navigate the list. Press the **Show All** soft key to show the complete signal standard list. When the complete list is displayed, the currently selected signal standards are marked with an asterisk. Press the **Show Selected** soft key to show only the currently selected signal standards.

Select Channel — Sets the channel information for the available standard. If the particular standard has not been used before, the channel number will default to the lowest legal channel number for that standard. If that standard has been used before, the last used channel will be the default.

Uplink — Selects the bank of frequencies that correspond to signals sent from the client transmitter to the base station.

Downlink — Selects the bank of frequencies that correspond to the signals sent from the base station to the client receivers.

Back — Returns to the previous menu.

AMPLITUDE

Choosing **AMPLITUDE** causes the soft keys, below, to be displayed and the corresponding values to be shown in the message area.

Ref Level — Activates the amplitude reference level function which sets the amplitude at the top of the display. Valid reference levels are from +20 to -120 dBm.

Scale — Activates the scale function which sets the dB/division value from 1 dB/div to 15 dB/div in 1 dB steps. This soft key is not active if the units are set to linear.

Atten/Preamp — Sets the internal input attenuator so that it is either coupled automatically to the reference level (**Auto**), manually adjustable (**Manual**) or dynamically coupled to the input signal (**Dynamic**) and provides control for the preamplifier.

Auto — Sets the input attenuator so that it is coupled automatically to the reference level.

Manual — Sets the input attenuator manually from 0 to 51 dB. Choose a value that does not overload the instrument.

Dynamic — Sets the value of the input attenuator so that it is dynamically coupled to the input signal and turns the preamp on or off based on the overall signal conditions across the entire frequency range of the instrument. The instrument will set the lowest input attenuation consistent with the need to not saturate the front end.

NOTE: A large signal that is not displayed on-screen can sometimes cause the instrument to turn off the preamplifier or add input attenuation, causing the noise floor to jump up or down suddenly as the large signal turns on or off.

Preamp Control Manual — Activates the preamp menu for manual control of the preamplifier.

Preamp On/Off — Sets the preamplifier on or off.

Preamp Auto — Automatically adjusts the preamplifier according to the reference level.

Back — Returns to the previous menu level.

Units — Choose from the menu of amplitude related units. When Linear is selected, the available selections are Volts or Watts. When Log is selected, the selection of dBm sets absolute decibels relative to 1 mW as the amplitude unit. Selection of dBV, dBmV or dB μ V sets absolute decibels relative to 1 volt, 1 millivolt, or 1 microvolt respectively as the amplitude unit.

Ref Level Offset — Sets the reference level offset, which is a value, in dB, of gain or loss external to the instrument. Negative values represent external attenuation. This feature allows measurement of high gain devices in combination with an attenuator, and is used to offset the reference level to view the correct output level. For example, to measure a high gain amplifier with an output of 70 dBm, an external 50 dB attenuator must be inserted between the instrument and the device. To compensate, set the reference level offset to -50 dB.

BW/SWEEP

Pressing **BW/SWEEP** activates a menu of bandwidth and sweep-related functions. Use the corresponding soft key to select the desired function.

Spectrum — Spectrum selects a traditional spectrum analyzer display.

Spectrogram — Selecting Spectrogram provides a three dimensional representation of frequency, time and power to aid in the identification of intermittent signals. The bottom portion of the display shows a traditional spectrum analyzer plot while the upper portion shows the power level in color with the most recent trace placed at the bottom of the display. A color scale on the left side of the display translates color into power level. The highest power level is displayed in red with the lowest power levels in dark blue and black.

Sweep Interval — Sweep Interval allows for the amount of time between sweeps to be set from a minimum of zero seconds up to 660 seconds (11 minutes). Enter the number using the Up/Down arrow key or use the keypad and select the appropriate soft key for minutes, seconds, milliseconds or microseconds. The current setting will be displayed in the message area. A sweep interval of 0 seconds will display as **Auto** and the instrument will sweep as fast as possible. Setting this value also determines the time span.

Time Span — Time Span sets the total time that will be taken to fill the waterfall display, from 0 to 4320 minutes (72 hours). Enter the number using the Up/Down arrow key or use the keypad and select the appropriate soft key for days, hours, minutes, seconds, milliseconds or microseconds. The current setting will be displayed in the message area. A time span of 0 seconds will display as **Auto** and the instrument will sweep as fast as possible. Setting this value also determines the sweep interval.

Auto Save — Auto Save saves the screen when the waterfall display is full. Select the **RECALL DISPLAY** (0) key to view and recall the saved displays (page 2-27).

Cursor — The cursor controls enable the user to look through the waterfall display and read the power level at a selected frequency and time. The time, frequency and power level at the measurement point are shown in the message block at the bottom of the screen. Selecting the Cursor soft key turns the cursors on.

Time Cursor — The Time Cursor is a white horizontal line that can be positioned anywhere in the waterfall display. Select **Time Cursor** and use the Up/Down arrow key to move the cursor to the desired time. The time the trace was taken is shown in the bottom message block. If the cursor is moved into a portion of the display where there is no data, the date is shown as January 1, 1970 at midnight.

Freq Cursor — The Frequency Cursor is a vertical white line that can be positioned at any frequency in the span range using the Up/Down arrow key. Pressing the Up arrow key moves the cursor to a higher frequency while pressing the Down arrow key moves the cursor to a lower frequency. The frequency is shown in the bottom message block.

Back — Returns to the previous menu level.

Spectrum — Selecting Spectrum returns to the traditional spectrum analyzer display and **BW/SWEEP** soft key menu.

Signal Strength — Selecting Signal Strength displays the power at a single frequency (in dBm) along with an optional audible indicator. The frequency of the audible indicator increases as the measured signal strength increases. This mode is especially useful when attempting to locate an emitter using a directional antenna.

Volume — Select the Volume soft key to adjust the sound level of the audible signal strength indicator using the Up/Down arrow key. The current volume setting is shown in the lower measurement block.

Speaker Tone On/Off — The Speaker Tone On/Off soft key toggles the audible indicator on or off. The default is On.

Back — Returns to the previous menu level.

RSSI — RSSI provides a way to see the scrolling display of received signal strength in zero span. Once a full screen of data has been acquired, the oldest data disappears off the left edge of the display.

Time Interval — Time Interval sets the time between data points. The interval can be set from 150 ms to 1 minute. Enter the number using the Up/Down arrow key or use the keypad and select the appropriate soft key for minutes, seconds, or milliseconds.

Time Span — Time Span sets the total duration of measurements. This value can be set from 1 minute to 7 days. A setting of zero (MANUAL) can also be entered if no limit on the time span is desired.

Auto Scale Data — Auto Scale Data sets the reference level and scale factor to values that spread the data vertically over as much of the screen as possible, with the reference level set in 0.1 dB steps and vertical scaling set in 1 dB steps from 1 dB to 15 dB per division.

Log Data Off/On — Log Data Off/On selects if data will be automatically logged. When data logging is on, information is stored after each full screen of data has been captured. Saved data is named by using the word "LOG" and a dash followed by the time to the nearest second in 24-hour clock format, such as "LOG - 14:43:01. Select the **RECALL DISPLAY** (0) key to view and recall the saved data (page 2-27).

Back — Returns to the previous menu level.

Signal ID — Signal Identification is used to determine, if possible, the air interface standard of a signal. If the instrument is unable to determine the modulation format, it will display the estimated bandwidth of the signal.

Set IA Freq — Set IA Freq is used to enter the center frequency of the interfering signal to be identified. Enter the frequency using the Up/Down arrow key or use the keypad and select the appropriate soft key for GHz, MHz, kHz, or Hz.

Measure — Pressing the Measure soft key starts the signal identification process. This process takes approximately one minute to complete. At the end of the measurement process, a dialog box displays the results. The results are also shown in the message area at the bottom of the display.

IA Freq to Center — The IA Freq to Center soft key moves the interference analysis frequency to the center of the screen.

IA Freq As Marker M1 — The IA Freq As Marker M1 soft key sets the interference analysis frequency to be the frequency of marker M1. This is the easiest way to enter the measurement frequency. Refer to the Marker key section on the next page for information on setting the markers.

Back — Returns to the previous menu level.

Setup — Sets the parameters for IA measurements.

Bandwidth — Activates a menu that allows the resolution and video bandwidths to be either coupled automatically to the span (Auto) or manually adjustable (Manual).

RBW Auto — Sets the resolution bandwidth so that it is automatically coupled to the span.

RBW Manual — Sets the resolution bandwidth manually, independent of the span, from 30 kHz to 1 MHz in zero span mode, 100 Hz to 1 MHz for a span greater than zero.

VBW Auto — Sets the video bandwidth so that it is automatically coupled to the RBW.

VBW Manual — Sets the video bandwidth manually, independent of the RBW, from 3 Hz to 1 MHz.

Back — Returns to the previous menu level.

Detection — Detection brings up a group of choices that change how the instrument deals with the multiple RF measurements that are made for each display point.

Positive Peak — Positive Peak displays the largest signal in each display point.

RMS Average — RMS Average causes the instrument to calculate the RMS average of all measurements done for each display point and display that average.

Negative Peak — Negative Peak displays the smallest value for each display point.

Sampling Mode — Sampling Mode displays a single frequency point for each display point. This is the fastest mode, but may miss displaying narrow signals.

Back — Returns to the previous menu level.

Volume — Select the Volume soft key to adjust the sound level of the audible signal strength indicator using the Up/Down arrow key. The current volume setting is shown in the lower measurement block.

MARKER

Pressing **MARKER** on the data keypad activates a menu for the six different markers. Use the corresponding soft key to select the desired marker. Then use the marker second level menu to turn the markers on or off, and to edit marker parameters and values.

NOTE: Markers are only available in IA-Spectrum mode.

M1 — Selects the M1 marker parameter and opens the Markers second level menu with M1 highlighted.

On/Off — Turns the selected marker on or off.

Edit — Opens the selected marker parameter for data entry. Enter the desired marker frequency using the keypad or Up/Down arrow key. Select the GHZ, MHz, kHz, or Hz soft key to accept the marker frequency input.

Delta (Mx-M1) — Displays delta frequency and amplitude for the selected marker Mx (M2, M3 or M4) with respect to the M1 marker.

Marker To Peak — Places the selected marker at the maximum amplitude of a trace (M1 - M4 only).

Marker Freq To Center — Makes the center frequency equal to the frequency of the selected marker.

Back — Returns to the previous menu level.

NOTE: The markers second-level menu above is identical for markers M2-M4.

M2 — Selects the M2 marker parameter and opens the Markers second level menu with M2 highlighted.

M3 — Selects the M3 marker parameter and opens the Markers second level menu with M3 highlighted.

M4 — Selects the M4 marker parameter and opens the Markers second level menu with M4 highlighted.

All Off — Turns off all markers.

More — Press to access additional marker functions:

M5 — Selects the M5 marker parameter and opens the M5 marker second level menu with M5 highlighted.

On/Off — Turns the selected marker on or off.

Edit — Opens the selected marker parameter for data entry. Enter the desired marker frequency using the keypad or Up/Down arrow key. Select the GHZ, MHz, kHz, or Hz soft key to accept the marker frequency input.

Marker Freq To Center — Makes the center frequency equal to the frequency of the selected marker.

Peak Between M1& M2 — Places the selected marker at the frequency with maximum amplitude value between marker M1 and M2.

Valley Between M1 & M2 — Places the selected marker at the frequency with minimum amplitude value between marker M1 and M2.

Back — Returns to the previous menu level.

NOTE: If markers M1 and/or M2 are off, the Peak and Valley functions above are executed across the entire span.

M6 — Selects the M6 marker parameter and opens the M6 marker second level menu with M6 highlighted.

On/Off — Turns the selected marker on or off.

Edit — Opens the selected marker parameter for data entry. Enter the desired marker frequency using the keypad or Up/Down arrow key. Select the GHz, MHz, kHz, or Hz soft key to accept the marker frequency input.

Marker Freq To Center — Makes the center frequency equal to the frequency of the selected marker.

Peak Between M3 & M4 — Places the selected marker at the frequency with maximum amplitude value between marker M1 and M2.

Valley Between M3 & M4 — Places the selected marker at the frequency with minimum amplitude value between marker M1 and M2.

Back — Returns to the previous menu level.

Regular Marker — Measures the signal level at the point of the marker in the unit type selected in the Amplitude - Units menu. When the regular marker option is selected, all markers are regular markers.

Noise Marker — Measures noise level normalized to a 1 Hz bandwidth. The unit of measure is dBm/Hz only. When Noise Marker is selected, the detection type is automatically changed to RMS average. When the Noise Marker option is selected, all markers are noise markers.

All Off — Turns off all markers.

Back — Returns to the previous menu level.

NOTE: If either marker M3 or marker M4 is off, the Peak and Valley functions above are executed across the entire span.

LIMIT

Pressing the **LIMIT** key activates a menu of limit related functions. Use the corresponding soft key to select the desired limit function. Then use the Up/Down arrow key to change its value, which is displayed in the message area at the bottom of the status window.

NOTE: Limit is only available in IA-Spectrum mode.

Single Limit — Sets a single limit value. Menu choices are:

On/Off — Turns the single limit function on or off.

Edit — Allows entry of the limit amplitude using the keypad or Up/Down arrow key. Press **ENTER** to accept the entered value.

Upper / Lower Limit — Selects whether the measurement will fail if the data is above the limit line or below the limit line, as indicated in the message area of the display.

Back — Returns to the previous menu level.

Multiple Upper Limits — Sets multiple user-defined upper limits, and can be used to create an upper limit mask for quick pass/fail measurements. An upper limit will result in a failure when the data falls above the limit line. Menu choices are:

Segment 1-5 — View/edit upper limit segment 1-5.

On/Off — Turns the segment on or off.

Edit — Opens the segment parameters for editing (see *Adjusting Segmented Limits*, page 2-19).

Prev Segment — Edit or view the parameters of the previous segment.

Next Segment — Edit or view the parameters of the next segment. If the next segment is off when this button is pressed, the starting point of the next segment will be set equal to the ending point of the current segment (if the current segment is on).

Back — Returns to the previous menu level

Back — Returns to the previous menu level

Multiple Lower Limits — Set multiple user-defined lower limits, and can be used to create a lower limit mask for quick pass/fail measurements. A lower limit will result in a failure when the data falls below the limit line. Menu choices are:

Segment 1-5 — View/edit lower limit segment 1-5.

On/Off — Turns the segment on or off.

Edit — Opens the segment parameters for editing (see *Adjusting Segmented Limits*, page 2-19).

Prev Segment — Edit or view the parameters of the previous segment.

Next Segment — Edit or view the parameters of the next segment. If the next segment is off when this button is pressed, the starting point of the next segment will be set equal to the ending point of the current segment (if the current segment is on).

Back — Returns to the previous menu level

Back — Returns to the previous menu level.

Limit Beep — Turns the audible limit beep indicator on or off. When the limit beep indicator is on, an audible beep will occur at every data point that appears above the upper limit or below the lower limit.

SYS

In Interference Analyzer mode, pressing the **SYS** key displays the following System menu soft key selections:

System Options — Displays a second level of system option functions:

Clock — Displays a second level of functions:

Hour — Enter the hour (0-23) using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.

Minute — Enter the minute (0-59) using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.

Month — Enter the month (1-12) using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.

Day — Enter the day using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.

Year — Enter the year (2003-2036) using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.

Back — Returns to the top-level SYS menu.

Printer — Displays a menu of supported printers. Use the Up/Down arrow key and **ENTER** key to make the selection.

Units — Select the unit of measurement (metric or English).

Change Date Format — Toggles the date format between MM/DD/YYYY, DD/MM/YYYY, and YYYY/MM/DD.

Back — Returns to the top-level SYS menu.

Application Options — Application options displays options applicable to particular mode.

External Ref Freq — Set the external reference frequency from 2 MHz to 20 MHz.

Impedance — Sets the input impedance of the instrument

50Ω — Sets the input impedance of the instrument to 50Ω, which is the default setting.

75Ω Anritsu 12N50-75B — Displays measurements as if the input impedance was 75Ω. The actual input impedance is still 50Ω, but the displayed information is transformed to the equivalent 75Ω value based on the offset value specified by the adapter used in the measurement. This setting is commonly used for cable TV-related measurements. Pressing this soft key will also compensate 7.5 dB for the loss of the Anritsu 12N50-75B adapter.

Other adapter Offset — This key allows the user to enter other adapter offset values. Enter the desired loss using the keypad or Up/Down arrow key and press the **ENTER** key to accept.

Back — Returns to the previous menu.

Back — Returns to the top-level SYS menu.

Self Test — Start an instrument self test.

Status — In cable and antenna analyzer freq or dist measurement mode, displays the current instrument status, including calibration status, temperature, and battery charge state. Press **ESCAPE** to return to operation.

Language — Pressing this soft key immediately changes the language used to display messages on the Spectrum Master status window. Choices are English, French, German, Spanish, Chinese, and Japanese. The default language is English.

Channel Scanner Mode (Option 27)

The Channel Scanner option provides the choice of a bar graph or a text display showing the amplitude of selected channels for a given air interface standard. The interface settings can be manually entered if none of the available air interface standards meet the measurement need.

To select Channel Scanner mode, press the **MODE** key and use the up and down arrows to highlight Channel Scanner and press **ENTER**.

FREQ/SPAN

The operating frequency range for Channel Scanner mode can either be set manually, or the desired air interface standard can be selected from the Signal Standard list in the instrument. When the frequency range is selected from the Signal Standard list, all frequency related parameters are automatically set to the appropriate values for that particular standard.

Start Freq — Enter a start frequency from 9 kHz to 3000 MHz using the Up/Down arrow key, or the keypad and the appropriate soft key for Hz, kHz, MHz or GHz. Press **ENTER** to accept the input.

Freq Step Size — The value entered here is the channel spacing. Enter a step size from 0 to 3000 MHz using the Up/Down arrow key, or the keypad and the appropriate soft key for Hz, kHz, MHz or GHz. Press **ENTER** to accept the input.

Signal Standard — Opens a menu of soft keys used to select the signal standard to be used.

Select Standard — Opens the signal standard menu, showing the currently selected signal standards. Use the soft keys to navigate the list. Press the **Show All** soft key to show the complete signal standard list. When the complete list is displayed, the currently selected signal standards are marked with an asterisk. Press the **Show Selected** soft key to show only the currently selected signal standards.

Start Channel — Sets the channel information for the available standard. If the particular standard has not been used before, the channel number will default to the lowest legal channel number for that standard. If that standard has been used before, the last used channel will be the default.

Uplink — Selects the bank of frequencies that correspond to signals sent from the client transmitter to the base station.

Downlink — Selects the bank of frequencies that correspond to the signals sent from the base station to the client receivers.

Back — Returns to the previous menu.

Channel Step Size — This integer value tells the system how many channels to skip when scanning. Enter a step size from 1 to 1023 using the Up/Down arrow key or the keypad and press **ENTER** to accept the input. Channel Step Size is especially useful when channels overlap, such as CDMA and WiFi channels.

Channel Span — Channel Span sets the width of each channel. Enter a Channel Span from 0 to 3000 MHz using the Up/Down arrow key, or the keypad and the appropriate soft key for Hz, kHz, MHz or GHz. Press **ENTER** to accept the input.

AMPLITUDE

Choosing **AMPLITUDE** causes the soft keys, below, to be displayed and the corresponding values to be shown in the message area.

Ref Level — Reference Level sets the power level at the top of the display. Enter a value from +20.0 to -120.0 dBm, in 0.1 dB steps, using the Up/Down arrow key or the keypad and press **ENTER** to accept the input. The currently selected reference level is shown in the message area at the bottom of the display.

Scale — Scale sets the number of dB per division. Enter a value from 1 dB per division to 15 dB per division using the Up/Down arrow key or the keypad and press **ENTER** to accept the input. The currently selected scale is shown in the message area at the bottom of the display.

BW/SWEEP

Pressing **BW/SWEEP** activates a menu of channel and display functions. Use the corresponding soft key to select the desired function.

Number of Channels — Number of Channels sets how many channels are simultaneously shown on the display. Enter a value from 1 to 20 channels using the Up/Down arrow key or the keypad and press **ENTER** to accept the input.

Display Channel/Freq — Display Channel/Frequency toggles between displaying the channel number or the channel frequency (with a resolution of 100 MHz).

Display Graph/Text — Display Graph/Text toggles between displaying a bar chart showing power levels, or a table showing channel number or frequency (depending upon the current setting of Display Channel Freq) and the power level.

SYS

In Channel Scanner mode, pressing the **SYS** key displays the following System menu soft key selections:

System Options — Displays a second level of system option functions:

Clock — Displays a second level of functions:

Hour — Enter the hour (0-23) using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.

Minute — Enter the minute (0-59) using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.

Month — Enter the month (1-12) using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.

Day — Enter the day using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.

Year — Enter the year (2003-2036) using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.

Back — Returns to the top-level SYS menu.

Printer — Displays a menu of supported printers. Use the Up/Down arrow key and **ENTER** key to make the selection.

Units — Select the unit of measurement (metric or English).

Change Date Format — Toggles the date format between MM/DD/YYYY, DD/MM/YYYY, and YYYY/MM/DD.

Back — Returns to the top-level SYS menu.

Application Options — Application options displays options applicable to particular mode.

External Ref Freq — Set the external reference frequency from 2 MHz to 20 MHz.

Impedance — Sets the input impedance of the instrument

50Ω — Sets the input impedance of the instrument to 50Ω, which is the default setting.

75Ω Anritsu 12N50-75B — Displays measurements as if the input impedance was 75Ω. The actual input impedance is still 50Ω, but the displayed information is transformed to the equivalent 75Ω value based on the offset value specified by the adapter used in the measurement. This setting is commonly used for cable TV-related measurements. Pressing this soft key will also compensate 7.5 dB for the loss of the Anritsu 12N50-75B adapter.

Other adapter Offset — This key allows the user to enter other adapter offset values. Enter the desired loss using the keypad or Up/Down arrow key and press the **ENTER** key to accept.

Back — Returns to the previous menu.

Back — Returns to the top-level SYS menu.

Self Test — Start an instrument self test.

Status — In cable and antenna analyzer freq or dist measurement mode, displays the current instrument status, including calibration status, temperature, and battery charge state. Press **ESCAPE** to return to operation.

Back — Returns to the previous menu.

Language — Pressing this soft key immediately changes the language used to display messages on the Spectrum Master status window. Choices are English, French, German, Spanish, Chinese, and Japanese. The default language is English.

All Modes

The following key menus are available and function identically in all modes.

Save Setup Menu

Pressing **SAVE SETUP** on the data keypad saves the current system setup to 1 of 10 (1 of 5 in Power Meter (Option 29) mode) internal non-volatile memory locations. When the key is pressed, a Save Setup selection box appears on the display. Use the Up/Down arrow key to select a setup and press the **ENTER** key to implement. Selecting a location that has already been used will cause the new saved setup information to overwrite the old.

Recall Setup Menu

Pressing **RECALL SETUP** on the data keypad recalls a previously saved setup from memory location 1 through 10 (1 through 5 in Power Meter (Option 29) mode). When the key is pressed, a Recall Setup selection box appears on the display. Select a setup using the Up/Down arrow key and press the **ENTER** key to implement. Setup location 0 <Default> recalls the factory preset state for the current measurement mode.

Save Display Menu

The **SAVE DISPLAY** key is used to save the displayed trace to non-volatile memory. When the key is pressed, a trace name dialog box appears on the screen with the previous trace name (if any) shown in the entry area. The Up/Down arrow key can be used to position the cursor within that name for editing. If the Up/Down arrow key is not pressed, as soon as the first letter of a new name is entered, the previous trace name is replaced by the first letter of the new trace name. Select the alphanumeric characters for that trace name and press the **ENTER** key to save the trace. The message area at the bottom of the display shows how many more traces can be saved.

NOTE: Pressing the SAVE DISPLAY key will bring up the last saved trace name on the input line. Pressing the Down arrow key will position the cursor under the last character in that trace name. This feature can be useful when naming traces sequentially, such as: Trace 1, Trace 2, etc.

The Up/Down arrow key moves the cursor within the trace name, and pressing the Delete soft key will erase the character under which the cursor is positioned. Pressing a number key or one of the letter soft keys will insert a character before the position of the cursor.

Recall Display Menu

Pressing the **RECALL DISPLAY** key recalls a previously-saved display from memory. When the key is pressed, a Recall Display selection box appears. Select a display using the Up/Down arrow key and press the **ENTER** key. After viewing the saved display, press the **ESCAPE/CLEAR** key to return to measurement mode.

Single - Continuous

Pressing the **SINGLE - CONT** key toggles the sweep mode between continuous sweep mode and single sweep mode. The default is continuous sweep. When single sweep is selected, the Anritsu Spectrum Master will sweep once and hold until activated again by pressing the **ENTER** key. The currently selected sweep mode appears to the left of the display. Single sweep mode can be used to conserve battery power.

Print

Pressing the **PRINT** key prints the current display to the selected printer. If no printer has been selected, an error message will be displayed providing information on how to select a printer.

Chapter 4

Measurement

Fundamentals

Introduction

This chapter demonstrates spectrum analyzer measurement techniques using the Anritsu Spectrum Master, with measurement techniques and examples of typical applications. Each application focuses on different features of the Anritsu Spectrum Master. Measurement applications and procedures covered in this section include:

- Preamplifier Operation
- Resolving Closely Spaced Signals
- Harmonic Distortion
- AM/FM Modulation
- Segmented Limit Lines
- Trace Overlay

Measurement Fundamentals

Measurement fundamentals include the use of additional spectrum analyzer functions beyond frequency, span, amplitude and marker functions. In particular, this section focuses on resolution bandwidth, video bandwidth, sweep, and attenuator functions.

Effect of Resolution Bandwidth

Resolution Bandwidth is determined by the intermediate frequency (IF) filter bandwidth. The spectrum analyzer traces the shape of its IF filter as it tunes past a signal. If more than one IF filter is used in a spectrum analyzer, the narrowest one dominates and is considered the resolution bandwidth.

The choice of resolution bandwidth depends on several factors. Filters take time to settle. That is, when a signal first appears at the input of the filter, it will take a while before the signal appears at the output. Additionally, the output of the filter will take some time to settle to the correct value, so that it can be measured. The narrower the filter bandwidth (resolution bandwidth) the longer the settling time.

The choice of resolution bandwidth will depend on the signal being measured. If two closely-spaced signals are to be measured individually, then a narrow bandwidth is required. If a wider bandwidth is used, then the energy of both signals will be included in the measurement. Thus, the wider bandwidth does not have the ability to look at frequencies selectively but instead simultaneously measures all signals falling within the resolution bandwidth.

Therefore, a broadband measurement would aggregate all signals and noise within the measurement bandwidth into a single measurement. On the other hand a narrow-band measurement will separate the frequency components, resulting in a measurement that includes separate peaks for each signal. There are advantages to each. The ultimate decision will be dependent on the type of measurement required by the user.

There is always some amount of noise present in a measurement. Noise is often broadband in nature; that is, it exists at a broad range of frequencies. If the noise is included in the measurement, the measured value will be in error (too large) depending on the noise level. With a wide bandwidth, more noise is included in the measurement. With a narrow bandwidth, less noise enters the resolution bandwidth filter, and the measurement is more accurate. If the resolution bandwidth is narrower, the noise floor will drop on the display of the spectrum analyzer. This is because the IF filter of the analyzer has been made narrower in bandwidth, which lets in less noise. As the measured noise level drops, smaller signals that were previously obscured by the noise can now be measured.

Effect of Video Bandwidth

Spectrum analyzers typically use another type of filtering after the detector called video filtering. This filter also affects the noise on the display but in a different manner than the resolution bandwidth. In video filtering, the average level of the noise remains the same but the variation in the noise is reduced. Hence, the effect of video filtering is a “smoothing” of the signal noise. The resultant effect on the analyzer’s display is that the noise floor compresses into a thinner trace, while the position of the trace remains the same. Thus, changing the video bandwidth (VBW) does not improve sensitivity; however, it does improve discernability and repeatability when making low-level measurements.

As a general rule of thumb, most field spectrum analyzer measurements are made at a video bandwidth that is a factor of 10 to 100 less than the resolution bandwidth. Thus, for a resolution bandwidth of 30 kHz, the typical video bandwidth setting options are either 3 kHz or 300 Hz.

Sweep Limitations

With some spectrum analyzers, the user has control over sweep time (the elapsed time of each sweep, sometimes called scan time). An analyzer cannot be swept arbitrarily fast while maintaining its specified accuracy, but will have a sweep rate limitation depending on the resolution bandwidth, video bandwidth, and frequency range selected. The sweep rate is not usually chosen by the user but is determined by the frequency range swept divided by the sweep time. The limitation on sweep rate comes from the settling or response time of the resolution and video bandwidth filters. If an analyzer is swept too quickly, the filters do not have time to respond, and the measurement is inaccurate. Under such conditions, the analyzer display tends to have a “smeared” look to it, with the spectral lines being wider than normal and shifted to the right.

Fortunately, the Anritsu Handheld Spectrum Analyzer has mechanisms designed into it that relieve the user from having to calculate the sweep rate. When changing the RBW and VBW, the sweep rate will change accordingly. The sweep rate will be faster for a wide RBW or VBW and slower for a narrow RBW or VBW. The sweep rate can also be changed manually, by pressing the **BW/SWEEP** key and selecting the **Min Sweep Time** soft key. Enter a sweep time from 0.05 ms to 2000 seconds. If the minimum sweep time entered by the user is less than the value calculated by the Spectrum Master to assure accurate results, the calculated value will prevail. Regardless of the minimum sweep time setting, the Spectrum Master will never sweep faster than the RBW and VBW settings will allow.

Attenuator Functions

Attenuation adjusts the hand held spectrum analyzer input attenuator. In **Auto** mode, as the reference level is increased, the attenuation is increased. In **Manual** mode, the input attenuation can be adjusted using the keypad or the Up/Down arrow key. The attenuator range is 0 to 51 dB, in 1 dB steps. When **Dynamic** attenuation is selected, the instrument automatically sets the input attenuation and preamplifier to achieve the best possible dynamic range (See page 5-22).

IMPORTANT! Attenuation is normally a coupled function and is automatically adjusted when the reference level changes. The reference level does not change however, when the attenuator changes. The attenuator should be adjusted so that the maximum signal amplitude at the input mixer is -30 dBm or less. For example, if the reference level is $+20$ dBm, the attenuation should be 50 dB for an input signal of -30 dBm at the mixer ($+20 - 50 = -30$). This prevents signal compression. The nominal gain of the preamplifier is $+25$ dB, therefore always select attenuation values so that the input to the preamp does not exceed -50 dBm.

NOTE: It is best to begin all measurements in **AUTO** attenuation mode.

Preamplifier

The MS2711D includes a built-in preamplifier which provides the MS2711D with an additional 25 dB of sensitivity. The preamplifier is a broadband preamplifier and thus the use of discrete filters should be considered when using it. Four different bandpass filters have been added to the list of optional accessories to accommodate this need (see Table 1-1, Optional Accessories). This chapter provides an overview of preamplifier operation. A measurement example is included.

Preamplifier Operation

To turn the preamplifier on or off:

- Step 1.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 2.** Press the **AMPLITUDE** function hard key.
- Step 3.** Select the **Atten/Preamp** soft key, then the **Preamp Control Manual** softkey. Press the **Preamp On/Off** soft key to turn the preamplifier on or off. When the preamplifier is on, the word **AMP** will be displayed on the left side of the display.

NOTES: The preamplifier is a broadband amplifier. It can become saturated by a signal outside of the defined frequency span.

The dynamic attenuation feature will automatically activate the preamplifier when the MS2711D detects that the input signal level is below a certain level (see page 5-22). This condition could result in the preamplifier being automatically turned back on even after it has been manually turned off.

*When dynamic attenuation is on, **Atten=Dynamic** appears to the left of the display.*

Preamplifier Measurement Example

This section provides an overview of how to detect a low-level signal with the help of the preamplifier of a MS2711D Handheld Spectrum Master.

Required Equipment

- MS2711D Handheld Spectrum Master
- Test Port extension cable, Anritsu 15NNF50 – 1.5C
- A signal source (Anritsu 69xxxB Synthesized Signal Generator or equivalent)

Procedure

- Step 1.** If necessary, set the MS2711D to Spectrum Analyzer mode.
- Step 2.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 3.** Connect the RF output of the signal source to the **RF In** port of the MS2711D.
- Step 4.** Press the **FREQ/SPAN** key and select the **Center** soft key. Enter the center frequency of the measurement using the Up/Down arrow key or the keypad. Select the **GHz**, **MHz**, **kHz**, or **Hz** softkey to accept the center frequency input.
- Step 5.** Press the **Span** soft key and use the Up/Down arrow key or the keypad to enter a span of 1 MHz.
- Step 6.** Set the signal source output level to -120 dBm.
- Step 7.** Press the **AMPLITUDE** key and select the **Ref Level** soft key to set the reference level to -80 dBm.
- Step 8.** Press the **Scale** soft key and set the scale to 10 dB/division.
- Step 9.** Press the **Atten/Preamp** soft key and set the attenuation to **Auto** and press the **Back** soft key.
- Step 10.** Press the **BW/SWEEP** key, and the **Detection** soft key and set the detection mode to **Positive Peak**.
- Step 11.** Press the **Back** soft key, then the **Bandwidth** soft key. Select the **RBW Manual** soft key and set the RBW to 100 Hz.
- Step 12.** Select the **VBW Auto** soft key.
- Step 13.** Press the **AMPLITUDE** function hard key.
- Step 14.** Select the **Atten/Preamp** soft key, then the **Preamp Control Manual** softkey. Press the **Preamp On/Off** soft key to turn the preamplifier on or off.

Figure 4-1 shows the measurement results with the preamplifier off.

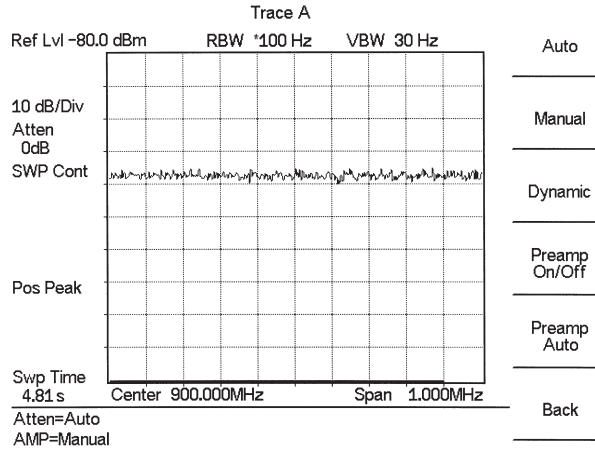


Figure 4-1. Preamplifier Off

- Step 15.** Turn the preamplifier on. When the preamplifier is ON, the word AMP should appear in the lower left corner of the display. The displayed noise level should be lowered by approximately 20 dB on the display, and the signal should appear on top of the displayed noise. The noise level will drop further if the RBW is reduced.

Figure 4-2 shows the measurement results with the preamplifier on.

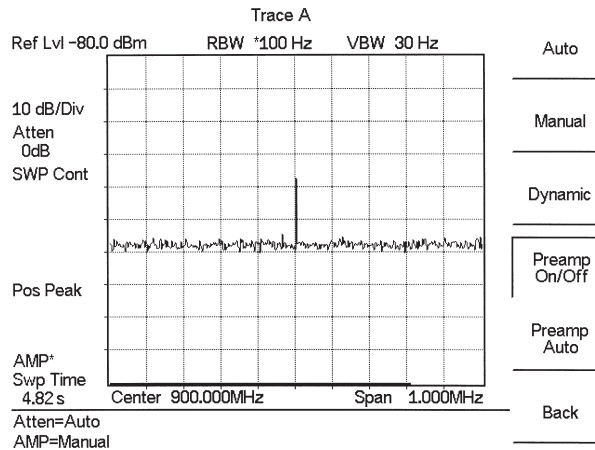


Figure 4-2. Preamplifier On

Example 1: Resolving Closely Spaced Signals

Signal resolution is determined by the intermediate frequency (IF) filter bandwidth. The hand held spectrum analyzer, as do conventional spectrum analyzers, traces the shape of its IF filter as it tunes past a signal. Thus, if two equal-amplitude signals are close enough in frequency, the filter shapes for the two signals can fall on top of one another and appear as a single response. Conversely, if two signals are not equal in amplitude but are still close together, the smaller signal can be hidden under the response of the larger one.

Measurement of Two Signals Having Equal Amplitudes

To resolve two signals of equal amplitude, the resolution bandwidth must be less than or equal to the frequency separation of the two signals. For example, to resolve two signals of equal amplitude with a frequency separation of 30 kHz, a resolution bandwidth of 30 kHz or less should be used. IF filter bandwidths can vary by $\pm 5\%$. This should be taken into consideration whenever testing for closely spaced signals. Thus, you may want to select the resolution bandwidth within the lower end of the specification (i.e., -5% , or 28.5 kHz) to ensure accurate measurements on two signals spaced to within 30 kHz. In this case the next smaller resolution bandwidth would be 10 kHz.

Example

Connect two signal sources to the spectrum analyzer input through a signal combiner/splitter and set the frequency of one source to 900.0 MHz and the other source to 900.030 MHz. Set both sources to the same amplitude, preferably -20 dBm. On the MS2711D Spectrum Master:

- Step 1.** Set the input attenuator to 20 dB.
- Step 2.** Set the Ref Level to -10 dBm.
- Step 3.** Set the Scale to 10 dB/div.
- Step 4.** Set the Span to 300 kHz and the Center Frequency to 900 MHz.
- Step 5.** Set the Resolution Bandwidth to 30 kHz and the video bandwidth to Auto.

Even with averaging on, it could be difficult to discern the presence of two signals. Figure 4-3 shows the results of the example using a signal combiner/splitter with a loss of 6 dB.

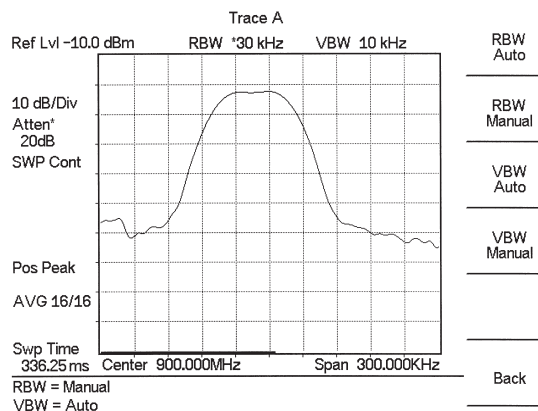


Figure 4-3. Measurement of Two Signals Having Equal Amplitudes, RBW = 30 kHz

Step 6. Change the Resolution Bandwidth to 3 kHz.

Figure 4-4 shows the results after changing the RBW using a signal combiner/splitter with a loss of 6 dB. Averaging has been turned off for this display, as the signals can be discerned without it.

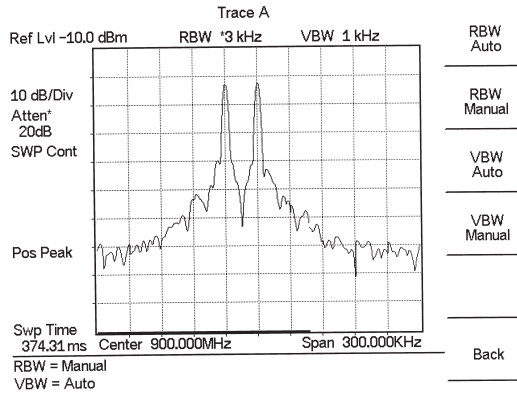


Figure 4-4. Measurement of Two Signals Having Equal Amplitudes, RBW = 3 kHz

Remember, the resolution bandwidth must be equal to or less than the frequency separation of the signal. Therefore, a 10 kHz or less resolution bandwidth must be used. In this case we used 3 kHz resolution bandwidth to clearly resolve the two signals. The next larger filter, 30 kHz, containing some variation, would not resolve the two signals. Also, keep in mind that noise side-bands (phase noise) can also affect resolution.

Measurement of Two Signals Having Unequal Amplitudes

Typically, in real world environments, closely spaced signals do not have equal amplitudes. Often, the difference between closely spaced signals can be as much as 60 dB. To resolve two signals of unequal amplitude, the resolution bandwidth must be less than or equal to the frequency separation of the two signals (the same as resolving two equal amplitude signals). However, in this case the largest resolution bandwidth that will resolve the two unequal signals is determined primarily by the shape factor of the IF filter, rather than by the 3 dB bandwidth. Shape factor is defined as the ratio of the 60 dB bandwidth to the 3 dB bandwidth of the IF filter.

Therefore, to resolve two signals of unequal amplitude, the half-bandwidth of a filter at the point equal to the amplitude separation of the two signals must be less than the frequency separation of the two signals. If you do not know the specific shape factor of the IF Filter, perform this measurement as if the signals had equal amplitudes paying close attention to potential signals having unequal power levels that are closely spaced. This will take some adjusting among the various resolution and video bandwidth and span functions.

Example

Connect two signal sources to the spectrum analyzer input with a combiner/splitter. Set the frequency of one source to 1900.0 MHz and the other source to 1900.05 MHz. Set one source to -20 dBm, and the other to -35 dBm.

Step 7. Set the input attenuator to 20 dB.

Step 8. Set the Reference Level to -10 dBm.

Step 9. Set the scale to 10 dB/div.

Step 10. Set the span to 1 MHz and the center frequency to 1900 MHz.

Step 11. Set the resolution bandwidth to 10 kHz and the video bandwidth to 1 kHz.

The two signals should be observed on the spectrum analyzer, each with different amplitudes and spaced 50 kHz apart.

Figure 4-5 shows the results of the example using a signal combiner/splitter with a loss of 6 dB. Marker 2 is set as a delta marker, and shows the difference in frequency and amplitude between the two peaks.

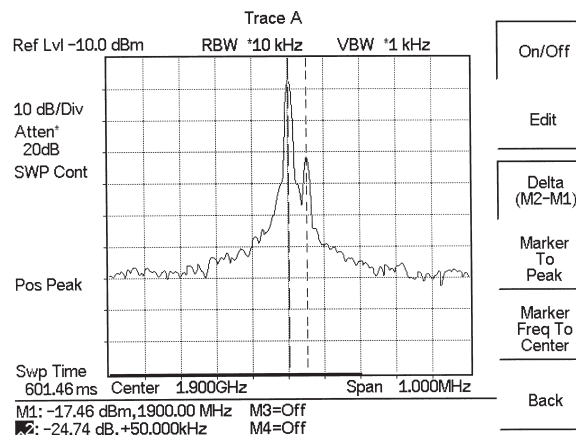


Figure 4-5. Measurement of Two Signals Having Unequal Amplitudes

Step 1. Change the resolution bandwidth to 30 kHz. Figure 4-6 shows the results after changing the RBW using a signal combiner/splitter with a loss of 6 dB.

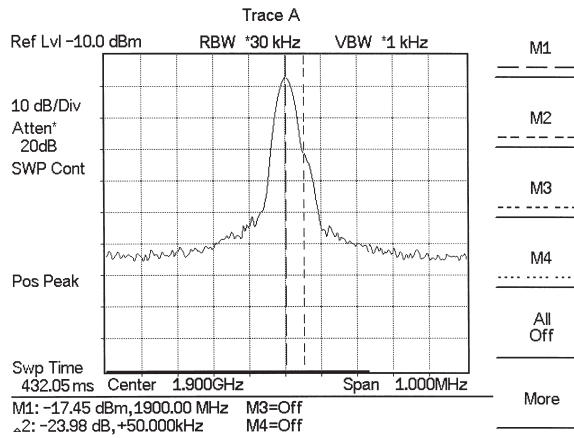


Figure 4-6. Measurement of Two Signals Having Unequal Amplitudes

The two signals should still be observable with the 10 kHz resolution bandwidth, but may be difficult to detect with the 30 kHz resolution bandwidth. Narrowing the span may help in detecting the differences in these two signals.

Example 2: Harmonic Distortion

Most transmitting devices and signal sources contain harmonics. Measuring the harmonic content of such sources is frequently required. In fact, measuring harmonic distortion is one of the most common uses of spectrum analyzers.

The following harmonic distortion measurement applies an important group of spectrum analyzer operating skills: setting the reference level, using start and stop frequencies; setting the video bandwidth and RBW; and making relative measurements using two markers. It also demonstrates setting a signal to center frequency using a marker.

Example

- Step 1.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 2.** Press **AMPLITUDE** and then select Ref Level
- Step 3.** Enter the desired Reference Level (+20 dBm) using the keypad and press **ENTER**.
- Step 4.** Connect a signal source to the Anritsu Spectrum Master.
- Step 5.** Set the signal source frequency to 10 MHz and the signal level to +10 dBm.
- Step 6.** Set the **Start** frequency at 7 MHz
- Step 7.** Set the **Stop** frequency to 40 MHz
- Step 8.** Set the resolution bandwidth to improve visibility by lowering the noise floor:
 - a. Press **BW/SWEEP**
 - b. Press the **Bandwidth** soft key, then the **RBW Manual** soft key.
 - c. Use the Up/Down arrow key to select the desired resolution bandwidth, 300 Hz in this case.
 - d. Press **ENTER** once the desired resolution bandwidth has been selected.
- Step 9.** Set the video bandwidth to improve visibility by smoothing the noise:
 - a. Press the **VBW Manual** soft key.
 - b. Use the Up/Down arrow key to select the desired resolution bandwidth, 100 Hz in this case.
 - c. Press **ENTER** once the desired resolution bandwidth has been selected.
- Step 10.** Press the **MARKER** key and select the M1 soft key
- Step 11.** Press the **Marker To Peak** soft key to set marker M1 to the peak signal (fundamental frequency). Note that marker M1 will automatically be turned on.
- Step 12.** Press the **Back** soft key and select the M2 soft key.
- Step 13.** Use the Up/Down arrow key to place Marker M2 at the center of the second harmonic. Press **ENTER** to set the marker position.
- Step 14.** Press the **Delta (M2-M1)** soft key. This will provide frequency and amplitude information with respect to marker M1.
- Step 15.** Press the **Back** soft key and select the M3 soft key.
- Step 16.** Use the Up/Down arrow key to place Marker M3 at the center of the third harmonic.

Step 17. Press the Delta (M3-M1) soft key. This will provide frequency and amplitude information with respect to marker M1.

Figure 4-7 shows the distortion characteristics of the signal source just measured. Marker 1 indicates the fundamental frequency. Marker 2 shows that the second order distortion of the source is 65.70 dB below the carrier. Marker 3 shows that the third order harmonic is 70.07 dB below the fundamental frequency.

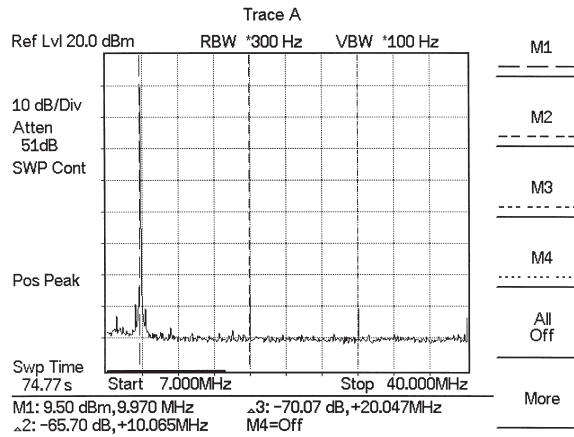


Figure 4-7. Harmonic Distortion

Example 3: AM/FM

Modulation is the process of translating some low frequency or baseband signal (voice, music, or data) to a higher frequency. In the modulation process, some characteristic of a carrier signal (usually amplitude or frequency) is changed in direct proportion to the instantaneous amplitude of the baseband signal.

The following procedure describes how to measure signals with AM and FM types of modulation. It shows how to tune the signal on the spectrum analyzer display.

Amplitude Modulation

- Step 1.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 2.** Connect a signal source to the spectrum analyzer input.
- Step 3.** Set the source to a carrier frequency of 900 MHz, -20 dBm, with an amplitude modulation of about 35 kHz at 10% modulation.
- Step 4.** Set the spectrum analyzer center frequency to 900 MHz and the span to 500 kHz.
- Step 5.** Set the Reference Level to -20 dBm.
- Step 6.** Set the attenuation to dynamic.
- Step 7.** Set the RBW to 3 kHz.
- Step 8.** Set the VBW to 100 Hz.
- Step 9.** To determine the frequency of the carrier, press the **MARKER** key and M1 soft key. Then press the **Marker To Peak** soft key to automatically turn marker M1 on and set it to the center frequency.

Additional modulation information can be determined from the carrier signal and sideband. For example, the difference between the carrier frequency and the sideband frequency can be found by pressing turning on and positioning Marker M2 over an upper or lower side-

band frequency and pressing the Delta (M2-M1) soft key. Figure 4-8 shows the modulating frequency of 35 kHz as the value of delta Marker 2.

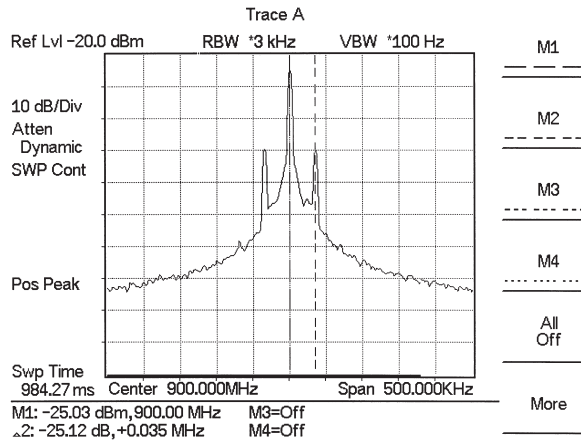


Figure 4-8. Amplitude Modulation

The markers read the frequency difference between the two signals, which is equal to the modulating frequency. The marker also reads the difference in amplitude. This difference in amplitude between the two signals can be used to determine the percentage of modulation. Use the following formula to calculate the percentage of modulation:

$$E_{SB}(dB) - E_C(dB) = 20 \log \frac{m}{2}$$

Where E(dB) is the energy in the sidebands in dB, E(dB) is the energy in the carrier in dB, and m is the degree of modulation (multiply by 100 to get the percentage).

NOTE: Unequal amplitudes of the lower and upper sidebands indicate incidental FM on the input signal. Incidental FM can reduce the accuracy of percentage-of-modulation measurements.

Frequency Modulation

This section contains general information about frequency modulation, and an example of using the MS2711D to display a FM signal.

Frequency modulations are generated when a modulating signal, f_{mod} , causes an instantaneous frequency deviation of the modulated carrier. The peak frequency deviation, Δf_{peak} , is proportional to the instantaneous amplitude of f_{mod} , and the rate of deviation is proportional to the frequency of the f_{mod} .

The FM index, β , is defined as:
$$\beta = \frac{\Delta f_{peak}}{f_{mod}}$$

In general, the spectrum analyzer is a very useful tool for measuring Δf_{peak} and β adjustments of FM transmitters. FM is composed of an infinite number of sidebands. In practice,

the spectrum of a FM signal is not infinite. The sideband amplitudes become negligibly small beyond a certain frequency offset for the carrier, depending on the value of β .

To demonstrate the properties of an FM signal, we will use a carrier frequency of 900 MHz and test for FM deviation of 17.5 kHz. With a β value of 2, we need a 35 kHz modulating signal.

- Step 1.** Connect the FM signal source to the input of the MS2711D.
- Step 2.** Set the reference level to -20 dBm.
- Step 3.** Set the attenuation coupling to Dynamic.
- Step 4.** On the signal source, set the carrier frequency to 900 MHz, modulating frequency to 35 kHz, carrier power to -20 dBm, and deviation to 17.5 kHz.
- Step 5.** Set the center frequency of the MS2711D to 900 MHz, span to 500 kHz, resolution bandwidth and video bandwidth are Auto. The carrier signal will be at 900 MHz with three sidebands on each side. The side bands are separated by 35 kHz (shown by the value of $\Delta M2$), which is the f_{mod} .
- Step 6.** Press the **MARKER** key, and the M1 soft key, followed by the Marker To Peak soft key to place marker M1 at the highest point of the signal.
- Step 7.** Press the **Back** soft key and select marker M2. Position marker M2 at the first sideband and select the Delta (M2-M1) soft key.
- Step 8.** Repeat the above step with markers M3 and M4, selecting the delta functions for each marker. The side bands should be separated by 35 kHz, as shown by the delta values displayed at the bottom of the screen (Figure 4-9).

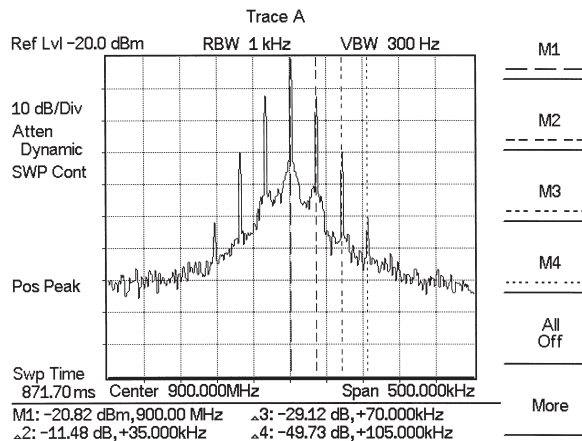


Figure 4-9. Frequency Modulation

Example 4: Field Strength Measurements

All antennas have loss or gain that must be accounted for in measurements. The MS2711D can correct for antenna loss or gain when performing Field Strength Measurements.

The antenna factors for custom antennas may be uploaded to the MS2711D using the Anritsu Handheld Software Tools provided with the unit. These antenna factors can then be used to enhance measurement accuracy.

- Step 1.** Enter the antenna factor information for the specific antenna into the antenna editor of the Handheld Software Tools (see page 10-8).
- Step 2.** Upload the antenna factors to the MS2711D.
- Step 3.** Press the **MEAS** function key on the MS2711D.
- Step 4.** Select the Field Strength soft key from the measurement menu.
- Step 5.** Press the Select Standard Antenna soft key. To use one of the standard antennas recognized by the MS2711D, use the Up/Down arrow key to select the desired antenna and press the **ENTER** key to select.
To use a custom antenna definition uploaded from the Handheld Software Tools Antenna Editor (see Chapter 10), select **Select Custom Antenna** and press the **ENTER** key. Use the Up/Down arrow key to select the desired antenna factor file and press the **ENTER** key to select.

The MS2711D will now automatically adjust the measurement results based on the antenna factors entered. A **Field Str** icon appears to the left of the graph, and **FSA** along with the antenna name appears in the title bar at the top. Note that antenna factors are applied only over the frequency range specified for the antenna. Outside the frequency range of the antenna, measurements are not enhanced and should not be relied on as an accurate measurement of field strength.

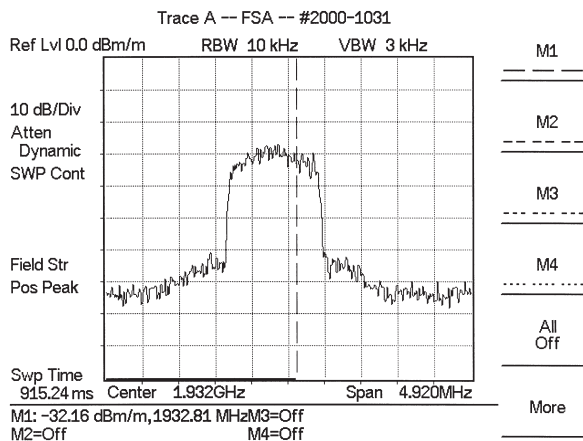


Figure 4-10. Field Strength Measurements

Example 5: Creating a Spectral Mask

Quick go/no-go measurements can be performed by establishing test limits. When using test limits, the user is able to quickly identify signals exceeding established limits as failing. To aid users in establishing limits, the Anritsu Spectrum Master features both single limit and multiple limit functions.

Example

- Step 1.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 2.** Connect a signal source to the Anritsu Spectrum Master.
- Step 3.** Set attenuator coupling to Dynamic.
- Step 4.** Set the Reference Level to 0 dBm.
- Step 5.** Set the scale to 10 dB/div.
- Step 6.** Set the signal source frequency to 900 MHz and the signal level to -20 dBm.
- Step 7.** Set the Spectrum Master center frequency at 900 MHz, the span to 20 MHz, and resolution bandwidth and video bandwidth to Auto.
- Step 8.** Press **LIMIT** and select Multiple Upper Limits.
- Step 9.** Select **Segment 1** using the appropriate softkey, press **Edit** and enter the start frequency, start limit, end frequency, and end limit as prompted in the message area. (The span is ten divisions wide; therefore divide the span by 10 to determine the span per division and desired starting point.) Enter start frequency = 890 MHz, start limit = -40, end frequency = 898 MHz, end limit = -40.
- Step 10.** Press the **Next Segment** soft key. The starting point of segment 2 will automatically be set equal to the ending point of segment 1. Press **Edit** and enter the start frequency, start limit, end frequency, and end limit as prompted in the message area. Enter start frequency = 898 MHz, start limit = -40, end frequency = 899 MHz, end limit = -10.
- Step 11.** Press the **Next Segment** soft key. The starting point of segment 3 will automatically be set equal to the ending point of segment 2. Press **Edit** and enter the start frequency, start limit, end frequency, and end limit as prompted in the message area. Enter start frequency = 899 MHz, start limit = -10, end frequency = 901 MHz, end limit = -10.
- Step 12.** Press the **Next Segment** soft key. The starting point of segment 4 will automatically be set equal to the ending point of segment 3. Press **Edit** and enter the start frequency, start limit, end frequency, and end limit as prompted in the message area. Enter start frequency = 901 MHz, start limit = -10, end frequency = 902 MHz, end limit = -40.
- Step 13.** Press the **Next Segment** soft key. The starting point of segment 5 will automatically be set equal to the ending point of segment 4. Press **Edit** and enter the start frequency, start limit, end frequency, and end limit as prompted in the message area. Enter start frequency = 902 MHz, start limit = -40, end frequency = 910 MHz, end limit = -40.

Figure 4-11 shows the resulting display. The mask created in this example serves as an upper bound on the measurement results. Any of the data points appearing above the line indicates a failed measurement.

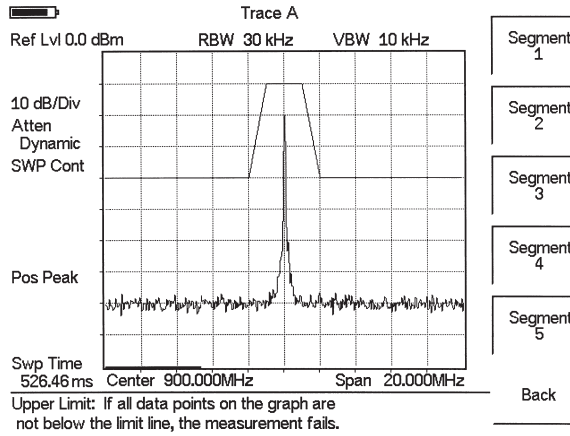


Figure 4-11. Creating a Spectral Mask

Example 6: Trace Overlay

The MS2711D Spectrum Master can be used to compare frequency spectrums.

Example:

- Step 1.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 2.** Connect a signal source to the Anritsu Spectrum Master and set the signal source frequency to 900 MHz and the signal level to -20 dBm.
- Step 3.** Press the **AMPLITUDE** key and set the attenuation to Dynamic.
- Step 4.** Set the center frequency at 900 MHz, resolution bandwidth and video bandwidth to Auto, and the span to 20 MHz.
- Step 5.** Press the **Trace** key.
- Step 6.** Select the A \rightarrow B soft key to save the current runtime trace to the Trace B buffer.
- Step 7.** Set the input frequency to 901 MHz and the signal level to -20 dB.
- Step 8.** Press the Trace B soft key to go to the Trace B menu.
- Step 9.** Select the View B soft key to view the traces simultaneously.

NOTE: Trace A is displayed as a yellow trace, and Trace B is displayed as a magenta trace. Some adjustment of the display brightness (see page 2-21) may be required for optimal viewing.

Figure 4-12 shows the resulting display. Note that the title bar shows both traces.

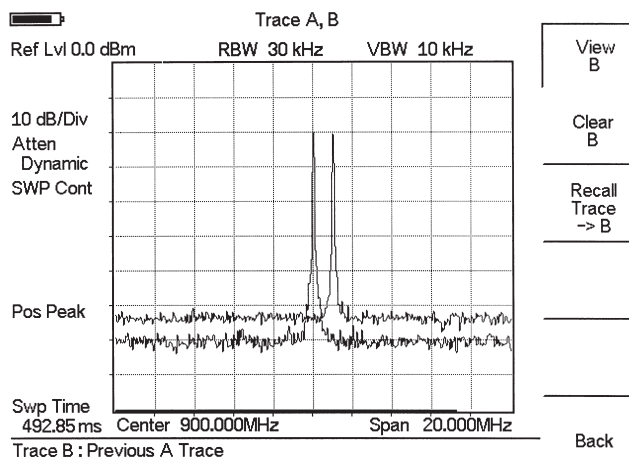


Figure 4-12. Trace Overlay

NOTE: Two traces cannot be overlaid if they have different resolution bandwidths or different frequency ranges.

Chapter 5

Field Measurements

Introduction

This chapter provides examples of various field measurements:

- Occupied Bandwidth
- Channel Power
- Adjacent Channel Power Ratio
- Out-of-Band Spurious Emissions
- In-Band Spurious Emissions
- Field Strength
- Dynamic Attenuation Control
- Frequency Converter Interface
- Bias Tee
- AM/FM Demodulation
- Carrier to Interference Ratio
- Interference Analysis

NOTE: When using an external attenuator or amplifier, set the reference level offset adjustment to compensate for the value of the attenuator or amplifier.

Occupied Bandwidth

A common measurement performed on radio transmitters is that of occupied bandwidth (OBW). This measurement calculates the bandwidth containing the total integrated power occupied in a given signal bandwidth. There are two different methods of calculation depending on the technique used to modulate the carrier.

Percent of Power Method

The occupied frequency bandwidth is calculated as the bandwidth containing the specified percentage of the transmitted power.

XdB Down Method

The occupied frequency bandwidth is defined as the bandwidth between the upper and lower frequency points at which the signal level is X dB below the peak carrier level.

Required Equipment

- MS2711D Handheld Spectrum Analyzer
- 30 dB, 50 watt, Bi-directional, DC – 18 GHz, N(m) – N(f), Attenuator, Anritsu 42N50A-30
- Test Port extension cable, Anritsu 15NNF50 – 1.5C

Procedure

- Step 1.** If the MS2711D is not currently in Spectrum Analyzer mode, press the **MODE** key, scroll to **Spectrum Analyzer** mode, and press **ENTER**.
- Step 2.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 3.** Using the test port extension cable and 30 dB, 50 watt, Bi-directional attenuator, connect the MS2711D to the appropriate transmit test port.
- Step 4.** Select the **CENTER** soft key and enter the center frequency of the measurement using the keypad. Select the **GHZ**, **MHZ**, **KHZ**, or **HZ** softkey to accept the center frequency input.
- Step 5.** Press the **AMPLITUDE** key and select the **Ref Level** soft key to set the appropriate reference level.
- Step 6.** Select the **Ref Level Offset** soft key to set the reference level offset to -30 dB.
- Step 7.** Select the **Atten/Preamp** soft key to set the input attenuation level, or select **Dynamic** as shown in this example.
- Step 8.** Press the **BW/SWEEP** key, the **Bandwidth** soft key, and select the **RBW Manual** and **VBW Manual** soft keys to set the resolution bandwidth and video bandwidth if desired.
- Step 9.** Press the **MEAS** key and press the **OBW** soft key. Select the measurement method (**dB Down** or **% of Power**) by pressing the **Method** soft key. The currently selected method is shown in the lower left of the display.
- Step 10.** Press the **dBc** or **%** soft keys to adjust the settings as appropriate.
- Step 11.** Press the **Measure** soft key to initiate the measurement. **OBW** will appear to the left of the graph when the occupied bandwidth measurement is on. Markers **M1** and **M2** are automatically enabled to depict the occupied bandwidth.

Figure 5-1 shows the OBW results using the % of power method on a CDMA signal.

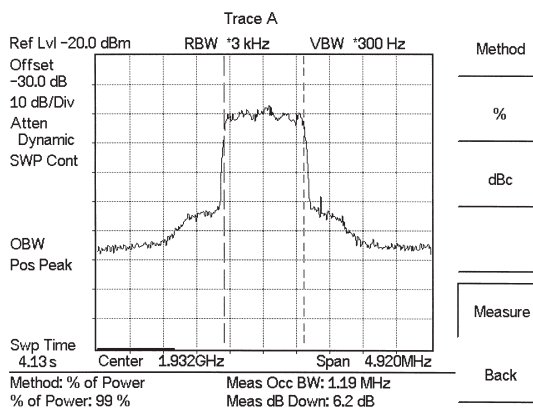


Figure 5-1. Occupied Bandwidth

Occupied Bandwidth is a constant measurement. Once it is turned on, it will remain on until it is turned off by pressing the **Measure** key again. When the occupied bandwidth measurement is on, an **OBW** icon appears to the left of the display. Occupied bandwidth is

calculated at the end of a sweep. An hourglass is displayed as the calculations are performed.

Channel Power Measurement

Channel power measurement is one of most common measurements for a radio transmitter. This test measures the output power, or channel power, of a transmitter over the frequency range in a specific time interval. Out-of-specification power measurements indicate system faults, which can be in the power amplifiers and in filter circuits. Channel Power measurements can be used to:

- Validate transmitter performance
- Comply with government regulations
- Keep overall system interference at a minimum

Frequency and span settings for many signal standards can be automatically set by pressing the **Frequency** key and then the **Signal Standard** soft key. Choose the desired standard and press **ENTER**.

CDMA Channel Power Measurement

MS2711D can be used to measure CDMA signals in terms of channel power. It is necessary to use precise settings to accurately measure the CDMA signal because the CDMA signal is different from a CW signal in many respects.

The following are the recommended settings for accurate IS-95 CDMA measurements:

- CDMA Channel Bandwidth: 1.23 MHz
- RBW setting: 10 kHz
- VBW setting $\geq 3 \times$ RBW, or at least 30 kHz
- Averaging function OFF

Required Equipment

- MS2711D Handheld Spectrum Master
- 30 dB, 50 Watt, bi-directional, DC –18 GHz, N(m) – N(f), Attenuator
- Test Port extension cable, Anritsu 15NNF50 – 1.5C

Procedure

- Step 1.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 2.** Using the test port extension cable and 20 dB attenuator, connect the signal source to the input of the attenuator, and connect the output of the attenuator to the RF In test port of the MS2711D.
- Step 3.** Press the **AMPLITUDE** key and select the Ref Level soft key to set the reference level to –50 dBm.
- Step 4.** Select the Ref Level Offset soft key to set the reference level offset to –30 dB.

- Step 5.** Press the **Scale** soft key and set the scale to 10 dB/division.
- Step 6.** Press the **Atten/Preamp** soft key followed by the **Dynamic** soft key to use dynamic attenuation.
- Step 7.** Press the **MEAS** key, and then the **Channel Power** soft key.
- Step 8.** Select the **Center Freq** soft key and set the center frequency of the Spectrum Master to that of the CDMA signal, 1.932 GHz in this example.
- Step 9.** Select the **Int BW** soft key and enter 1.23 MHz for the integration bandwidth.
- Step 10.** Select the **Channel Span** soft key and set the span to 4.92 MHz.

NOTE: The integration bandwidth is defined as the frequency span in which the spectrum analyzer integrates measured power readings, while the channel span is the frequency range of the analyzer sweeps.

- Step 11.** Make the measurement by pressing the **Measure** soft key. The detection method is automatically changed to RMS Average. Solid vertical lines are drawn on the display to indicate the integration bandwidth. The MS2711D displays the measurement results in the message area.

Figure 5-2 shows the results of the measurement using an off-the-air CDMA signal.

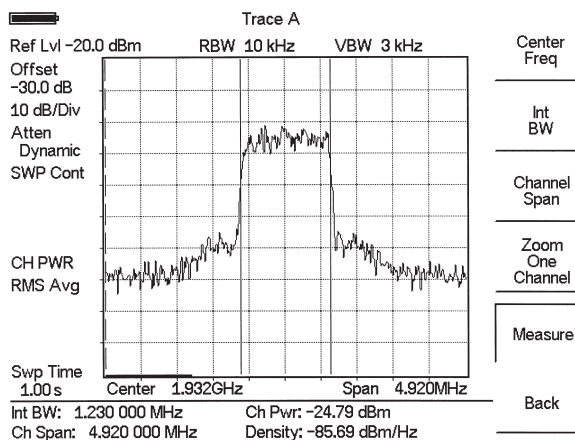


Figure 5-2. CDMA Channel Power Measurement

Channel power is a constant measurement. Once it is turned on, it will remain on until it is turned off by pressing the **Measure** key again. When the channel power measurement is on, a **CH PWR** icon appears to the left of the display. Channel power is calculated at the end of a sweep. An hourglass is displayed as the calculations are performed.

NOTE: The channel span must be set equal to or larger than the integration bandwidth. If not, MS2711D will set the channel span equal to the integration bandwidth. When the integration bandwidth and channel span are set to the same value, the MS2711D uses all the sampling points for integration, providing the most accurate measurements. The ratio of the integration bandwidth to channel span is kept constant. When the integration bandwidth is changed, the ratio remains the same. The ratio can be changed by changing the channel span. For example, when the integration bandwidth is doubled, the MS2711D will double the channel span.

GSM Channel Power Measurement

Global Systems for Mobile (GSM) communication is a globally accepted standard for digital cellular communication. There are two frequency bands allocated to GSM mobile phones, one at 900 MHz, and the other at 1800 MHz. GSM uses a combination of Frequency Division Multiple Access (FDMA) and Time Division Multiple Access (TDMA). Within each band are approximately one hundred available carrier frequencies on 200 kHz spacing (FDMA), and each carrier is broken up into time-slots so as to support eight separate conversations (TDMA). Each channel has an uplink and a downlink, 80 MHz apart. GSM uses the Gaussian Minimum Shift Keying (GMSK) modulation method.

Due to the nature of TDMA, GSM transmitters ramp RF power rapidly. If the transmitter keys on too quickly, users on different frequencies (especially those close to the channel of interest) may experience significant interference. This is one of the reasons that spurious measurements are extensively used in GSM applications.

Required Equipment

- MS2711D Handheld Spectrum Master
- 30 dB, 50 Watt, bi-directional, DC –18 GHz, N(m) – N(f), Attenuator, Anritsu 42N50A-30
- Test Port extension cable, Anritsu 15NNF50 – 1.5C

Procedure

- Step 1.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 2.** Using the test port extension cable and 30 dB attenuator, connect the signal source to the input of the attenuator, and connect the output of the attenuator to the RF In test port of the MS2711D.
- Step 3.** Press the **AMPLITUDE** key and select the Ref Level soft key to set the reference level to –50 dBm.
- Step 4.** Select the Ref Level Offset soft key to set the reference level offset to –30 dB.
- Step 5.** Press the Scale soft key and set the scale to 10 dB/division.
- Step 6.** Press the Atten/Preamp soft key followed by the Dynamic soft key to use dynamic attenuation.

- Step 7.** Press the **BW/SWEEP** key, press the Bandwidth soft key, and press the RBW Auto and the VBW Auto soft keys.
- Step 8.** Press the **MEAS** key and press the Channel Power soft key.
- Step 9.** Select the Center Freq soft key and set the center frequency of the Spectrum Master to that of the GSM signal, in this case 947.4 MHz.
- Step 10.** Select the Int BW soft key and enter 200 kHz for the integration bandwidth, or set the integration bandwidth appropriate for the particular application.
- Step 11.** Select the Channel Span soft key and enter 800 kHz as the channel span, or set the channel span to a value appropriate for the particular application.
- Step 12.** Make the measurement by pressing the Measure soft key. The detection method is automatically changed to RMS Average. Solid vertical lines are drawn on the display to indicate the integration bandwidth. The MS2711D will display the measurement results in the message area.

Figure 5-3 shows the results of the measurement using a GSM signal source with an output power level of -85 dBm.

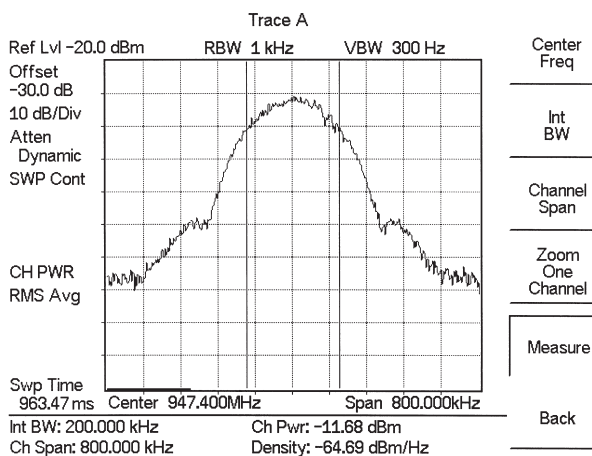


Figure 5-3. GSM Channel Power Measurement

Channel Power is a constant measurement. Once it is turned on, it will remain on until it is turned off by pressing the Measure key again. When the channel power measurement is on, a CH PWR icon appears to the left of the display. Channel power is calculated at the end of a sweep. An hourglass is displayed as the calculations are performed.

NOTE: The channel span must be set equal to or larger than the integration bandwidth. If not, MS2711D will set the channel span equal to the integration bandwidth. When the integration bandwidth and channel span are set to the same value, the MS2711D uses all the sampling points for integration, providing the most accurate measurements. The ratio of the integration bandwidth to channel span is kept constant. When the integration bandwidth is changed, the ratio remains the same. The ratio can be changed by changing the channel span. For example, when the integration bandwidth is doubled, the MS2711D will double the channel span.

AMPS Channel Power Measurement

The MS2711D can be used to test Advanced Mobile Phone System (AMPS) base stations. AMPS base stations for cellular telephone systems are FM voice transceivers with system control functionality. The energy of the AMPS signal is represented by multiple narrow band FM channels spread over a wide frequency range.

AMPS allocates frequency ranges within the 800 and 900 MHz spectrum to cellular telephone. Each service provider can use half of the 825-845 MHz range for receiving signals from cellular phones and half the 870-890 MHz range for transmitting to cellular phones. The bands are divided into 30 kHz channels with 12 kHz maximum frequency deviation.

Required Equipment

- MS2711D Handheld Spectrum Master
- 30 dB, 50 Watt, bi-directional, DC –18 GHz, N(m) – N(f), Attenuator, Anritsu 42N50A-30
- Test Port extension cable, Anritsu 15NNF50 – 1.5C

Procedure

- Step 1.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 2.** Using the test port extension cables and 30 dB attenuator, connect the signal source to the input of the attenuator, and connect the output of the attenuator to the RF In test port of the MS2711D.
- Step 3.** Press the **AMPLITUDE** key and select the **Ref Level** soft key to set the reference level to –50 dBm.
- Step 4.** Press the **Scale** soft key and set the scale to 10 dB/division.
- Step 5.** Press the **Atten/Preamp** soft key followed by the **Dynamic** soft key
- Step 6.** Select the **Ref Level Offset** soft key to set the reference level offset to –30 dB or as necessary to match any external attenuator being used.
- Step 7.** Press the **BW/SWEEP** key, then the **Bandwidth** soft key, and the **RBW Auto** and **VBW Auto** soft keys.
- Step 8.** Press the **MEAS** key, then the **Channel Power** soft key.
- Step 9.** Select the **Center Freq** soft key and set the center frequency of the Spectrum Master to that of the signal, in this example 869.97 MHz.
- Step 10.** Select the **Int BW** soft key and enter 30 kHz for the integration bandwidth.
- Step 11.** Select the **Channel Span** soft key and enter 120 kHz as the channel span, or set the channel span to a value appropriate for the particular application.

Step 12. Make the measurement by pressing the **Measure** soft key. The detection method is automatically changed to RMS Average. Solid vertical lines are drawn on the display to indicate the integration bandwidth. The MS2711D will display the measurement results in the message area.

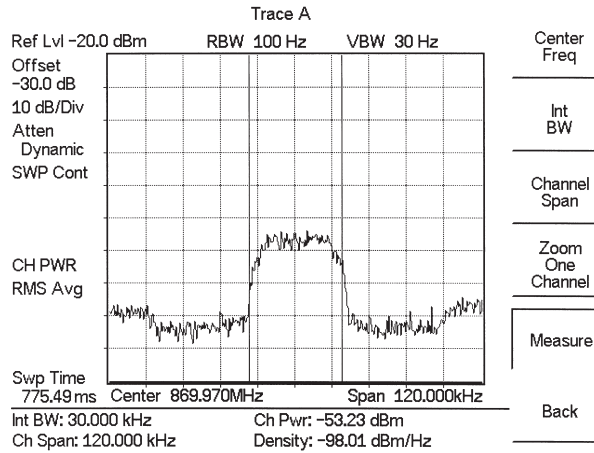


Figure 5-4. AMPS Channel Power Measurement

Channel Power is a constant measurement. Once it is turned on, it will remain on until it is turned off by pressing the **Measure** soft key again. When the channel power measurement is on, a **CH PWR** icon appears to the left of the display. Channel power is calculated at the end of a sweep. An hourglass is displayed as the calculations are performed.

NOTE: The channel span must be set equal to or larger than the integration bandwidth. If not, MS2711D will set the channel span equal to the integration bandwidth. When the integration bandwidth and channel span are set to the same value, the MS2711D uses all the sampling points for integration, providing the most accurate measurements. The ratio of the integration bandwidth to channel span is kept constant. When the integration bandwidth is changed, the ratio remains the same. For example, when the integration bandwidth is doubled, the MS2711D will double the channel span. The ratio can be changed by changing the channel span.

Adjacent Channel Power Ratio

Another common transmitter measurement is that of adjacent channel leakage power. This is defined as the ratio of the amount of leakage power in an adjacent channel to the total transmitted power in the main channel. This measurement can be used to replace the traditional two-tone intermodulation distortion (IMD) test for system non-linear behavior.

The result of an ACPR measurement is expressed as a power ratio. In order to calculate the upper and lower adjacent channel values, the MS2711D requires the specification of four parameters:

- Main Channel Center Frequency
- Measurement Channel Bandwidth
- Adjacent Channel Bandwidth
- Channel Spacing

Adjacent Channel Power Measurement

Required Equipment

- MS2711D Handheld Spectrum Analyzer
- 30 dB, 50 watt, Bi-Directional, DC – 18 GHz, N(m) – N(f), Attenuator, Anritsu 42N50A-30
- Test Port extension cable, Anritsu 15NNF50 – 1.5C

Procedure

- Step 1.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 2.** Using the test port extension cable and 30 dB, 50 watt, Bi-directional attenuator, connect the MS2711D to appropriate transmit test port.
- Step 3.** Press the **AMPLITUDE** key and select the Ref Level soft key to set the appropriate reference level.
- Step 4.** Select the Atten/Preamp soft key to set the input attenuation level.
- Step 5.** Press the **BW/SWEEP** key and press the Bandwidth soft key. Use the RBW Auto, RBW Manual, VBW Auto and VBW Manual soft keys to set the resolution bandwidth and video bandwidth.
- Step 6.** There are two ways to set the measurement parameters. If the signal standard and channel are known, press the **FREQ/SPAN** key and set the Signal Standard and Select Channel soft keys for the signal to be measured and proceed to step 7. Alternatively, follow the procedure below:
 - a. Press the **MEAS** key and press the ACPR soft key.
 - b. Select the Center Freq soft key, and enter the desired center frequency.
 - c. Select the Main Channel BW soft key, and enter the desired main channel bandwidth. For an IS-95 CDMA signal, enter 1.23 MHz.

- d. Select the Adj Channel BW soft key, and enter the desired adjacent channel bandwidth. For an IS-95 CDMA signal, enter 30 kHz.
- e. Select the Channel Spacing soft key, and enter the desired channel spacing. For an IS-95 CDMA signal, enter 885 kHz.

Step 7. Press the **MEAS** key and press the **ACPR** soft key and make the measurement by pressing the **Measure** soft key. The detection method is automatically changed to RMS Average. Solid vertical lines are drawn on the display to indicate the main channel. Dashed vertical lines define the adjacent channels. The MS2711D will display the measurement results in the message area.

Figure 5-5 displays the results of the measurement using a CDMA signal generator with an output power level of -25 dBm.

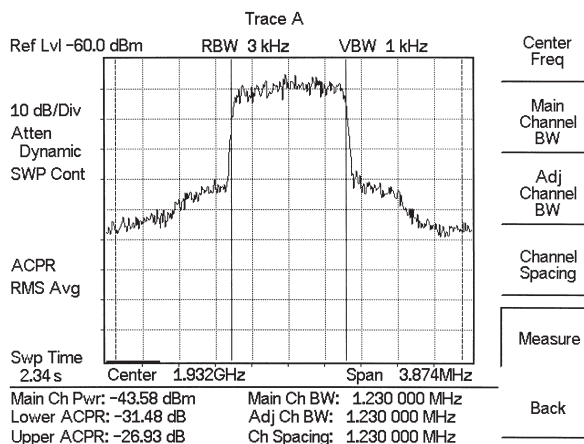


Figure 5-5. Adjacent Channel Power Measurement

Adjacent Channel Power Ratio is a constant measurement. Once it is turned on, it will remain on until it is turned off by pressing the **Measure** key again. When the ACPR measurement is on, an ACPR icon appears to the left of the display. ACPR is calculated at the end of a sweep. An hourglass is displayed as the calculations are performed.

GSM Adjacent Channel Power Measurement

Required Equipment

- MS2711D Handheld Spectrum Analyzer
- Test Port extension cable, Anritsu 15NNF50 – 1.5C

Procedure

- Step 1.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 2.** Using the test port extension cable, connect the signal source to the input of the attenuator, and connect the output of the attenuator to the RF In test port of the MS2711D.
- Step 3.** Press the **AMPLITUDE** key and select the Ref Level soft key to set the reference level to -60 dBm.
- Step 4.** Press the Atten/Preamp soft key and set the attenuation to Dynamic.
- Step 5.** Press the **BW/SWEEP** key and select the RBW Auto and VBW Auto soft keys to set the resolution and video bandwidths to Auto.
- Step 6.** There are two ways to set the measurement parameters. If the signal standard and channel are known, press the **FREQ/SPAN** key and set the Signal Standard and Select Channel soft keys for the signal to be measured and proceed to step 7. Alternatively, follow the procedure below:
 - a.** Press the **MEAS** key and press the ACPR soft key.
 - b.** Select the Center Freq soft key, and the desired center frequency.
 - c.** Select the Main Channel BW soft key, and enter the main channel bandwidth.
 - d.** Select the Adj Channel BW soft key, and enter the adjacent channel bandwidth.
 - e.** Select the Channel Spacing soft key, and enter the channel spacing.
- Step 7.** Make the measurement by pressing the Measure soft key. The detection method is automatically changed to RMS Average. Solid vertical lines are drawn on the display to indicate the main channel. Dashed vertical lines define the adjacent channels. The MS2711D will display the measurement results in the message area.

Figure 5-6 shows the results of the measurement using a GSM signal source with an output power level of -35 dBm.

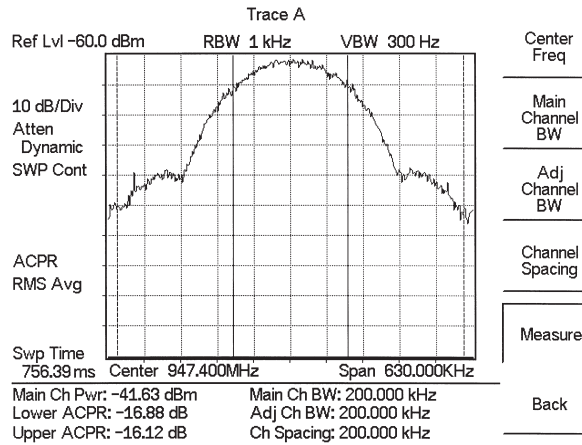


Figure 5-6. GSM Adjacent Channel Power Measurement

Adjacent Channel Power Ratio is a constant measurement. Once it is turned on, it will remain on until it is turned off by pressing the **Measure** soft key again. When the ACPR measurement is on, an ACPR icon appears to the left of the display. ACPR is calculated at the end of a sweep. An hourglass is displayed as the calculations are performed.

AMPS (TDMA) Adjacent Channel Power Measurement

Required Equipment

- MS2711D Handheld Spectrum Analyzer
- 30 dB, 50 watt, Bi-Directional, DC – 18 GHz, N(m) – N(f), Attenuator, Anritsu 42N50A-30
- Test Port extension cable, Anritsu 15NNF50 – 1.5C

Procedure

- Step 1.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 2.** Using the test port extension cable and 30 dB attenuator, connect the signal source to the input of the attenuator, and connect the output of the attenuator to the RF In test port of the MS2711D.
- Step 3.** Press the **AMPLITUDE** key and select the **Ref Level** soft key to set the reference level to –50 dBm.
- Step 4.** Select the **Ref Level Offset** soft key to set the reference level offset to –30 dB.
- Step 5.** Press the **Atten/Preamp** soft key and set the attenuation to **Dynamic**.
- Step 6.** Select the **Center Freq** soft key, and enter 869.97 MHz.
- Step 7.** Select the **Main Channel BW** soft key, and enter the main channel bandwidth. For the AMPS signal, enter 30 kHz.
- Step 8.** Select the **Adj Channel BW** soft key, and enter the adjacent channel bandwidth. For the AMPS signal, enter 30 kHz.
- Step 9.** Select the **Channel Spacing** soft key, and enter the channel spacing. For the AMPS signal, enter 30 kHz.
- Step 10.** Make the measurement by pressing the **Measure** soft key. The detection method is automatically changed to **RMS Average**. Solid vertical lines are drawn on the display to indicate the main channel. Dashed vertical lines define the adjacent channels. The MS2711D will display the measurement results in the message area.

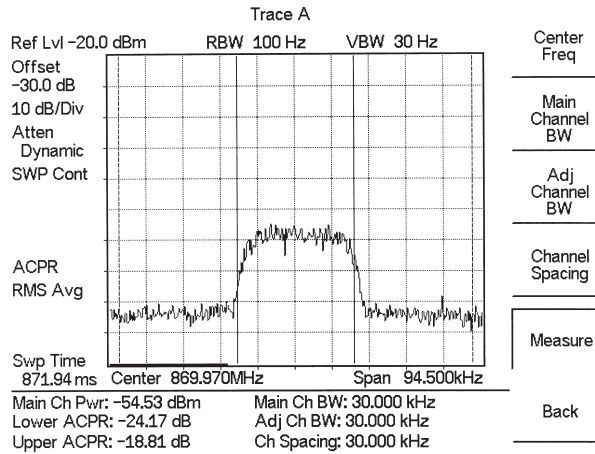


Figure 5-7. AMPS Adjacent Channel Power Measurement

Adjacent Channel Power Ratio is a constant measurement. Once it is turned on, it will remain on until it is turned off by pressing the **Measure** key again. When the ACPR measurement is on, an ACPR icon appears to the left of the display. ACPR is calculated at the end of a sweep. An hourglass is displayed as the calculations are performed.

Out-of-Band Spurious Emissions

Out-of-band spurious measurements are made on signals outside the system main band. These signals, which can interfere with other communication systems, can be categorized into harmonics and random spurious emissions. Real time monitoring of spurious emissions from a transmitter can uncover unwanted signals before they interfere with other channels.

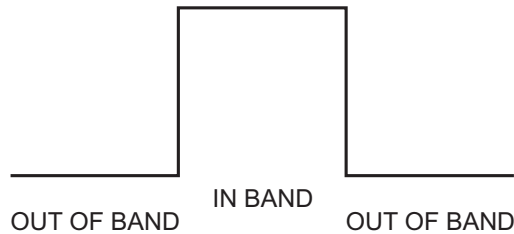


Figure 5-8. Example of In- and Out-of Bandwidth Signals

Out-of-Band Spurious Emission Measurement

Required Equipment

- MS2711D Handheld Spectrum Analyzer
- Test Port extension cable, Anritsu 15NNF50 – 1.5C

Procedure

- Step 1.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 2.** Using the test port extension cable, connect the signal source to the input of the attenuator, and connect the output of the attenuator to the RF In test port of the MS2711D.
- Step 3.** Press the **FREQ/SPAN** key and select the **Center** soft key. Enter the center frequency.
- Step 4.** Press the **Span** soft key. Set the span wide enough to include the primary channel bandwidth and upper and lower channel bandwidths.
- Step 5.** Press the **AMPLITUDE** key and select the **Ref Level** soft key to set the reference level to -20 dBm.
- Step 6.** Press the **Atten/Preamp** soft key and set the attenuation to **Auto**.
- Step 7.** Press the **BW/SWEEP** key and press the **Bandwidth** soft key. Use the **RBW Manual** and **VBW Manual** soft keys to set the resolution bandwidth to 3 kHz and the video bandwidth to 300 Hz.
- Step 8.** Press the **MARKER** key and press the **M1** soft key.
- Step 9.** Press the **EDIT** soft key. Use the Up/Down arrow key to move the marker over the carrier. Press the **ENTER** key to set the marker.

- Step 10.** Press the Back soft key and select the M2 soft key. Move the M2 marker over one of the spurs and press **ENTER** to set the marker.
- Step 11.** Compare the value of the marker to the specified allowable level of out-of-band spurious emissions for the corresponding channel transmit frequency.
- Step 12.** Press the Delta (M2-M1) soft key to see the distance of the spur from the carrier.

Figure 5-9 shows a simulated out-of-band spurious signal at 21.000 MHz from the carrier.

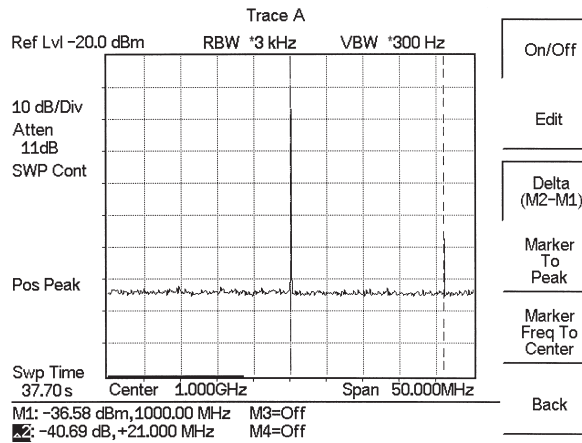


Figure 5-9. Simulated Out-of-Band Spurious Emission Measurement

In-band/Out-of-Channel Measurements

The in-band/out-of-channel measurements are those measurements that measure distortion and interference within the system band, but outside of the transmitting channel. These measurements include (1) in-band spurious emissions and (2) adjacent channel power ratio (also called spectral regrowth). There are stringent regulatory controls on the amount of interference that a transmitter can spill to neighboring channels. In order to determine compliance with the allowable level of spurious emissions, two parameters need to be specified:

- Measurement channel bandwidth
- Allowable level of spurious emissions

In-band Spurious Measurement

Required Equipment

- MS2711D Handheld Spectrum Analyzer
- 30 dB, 50 watt, Bi-Directional, DC – 18 GHz, N(m) – N(f), Attenuator, Anritsu 42N50A-30
- Test Port extension cable, Anritsu 15NNF50 – 1.5C

Procedure

- Step 1.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 2.** Using the test port extension cable and 30 dB, 50 watt, Bi-directional attenuator, connect the MS2711D to appropriate transmit test port.
- Step 3.** Press the **FREQ/SPAN** key and select the **Center** soft key. Enter the center frequency.
- Step 4.** Press the **FREQ/SPAN** key and select the **Span** soft key. Set the span wide enough to include the primary channel bandwidth and upper and lower channel bandwidths.
- Step 5.** Press the **AMPLITUDE** key and select the **Ref Level** soft key to set the reference level to –20 dBm.
- Step 6.** Select the **Ref Level Offset** soft key to set the reference level offset to –30 dB.
- Step 7.** Press the **Atten/Preamp** soft key and set the attenuation to **AUTO**.
- Step 8.** Press the **BW/SWEEP** key and press the **Bandwidth** soft key. Use the **RBW Manual** and **VBW Manual** soft keys to set the resolution bandwidth to 10 kHz and the video bandwidth to 300 Hz.
- Step 9.** Press the **MARKER** key and press the **M1** soft key.
- Step 10.** Press the **Edit** soft key. Use the **Up/Down** arrow key to move the marker over the carrier. Press the **ENTER** key to set the marker.
- Step 11.** Press the **Back** soft key and select the **M2** soft key. Move the **M2** marker over one of the spurs and press **ENTER** to set the marker.

- Step 12.** Compare the value of the marker to the specified allowable level of in-band/out-of-channel spurious emissions for the corresponding channel transmit frequency.
- Step 13.** Press the Delta (M2-M1) soft key to see the distance of the spur from the carrier.
- Step 14.** Repeat steps 11-12 for the remaining spurs. Use either Marker 2 again, or choose another marker.

Figure 5-10 shows a simulated in-band spur at 1.625 MHz from the carrier frequency. The carrier is measured by M1. The delta marker M3 shows the signal at $f + 1.625$ MHz to be 60.17 dB down from the carrier, and delta marker M4 shows a signal at $f + 6$ MHz that is 52.30 dB down from the carrier. These values should be compared against the specification.

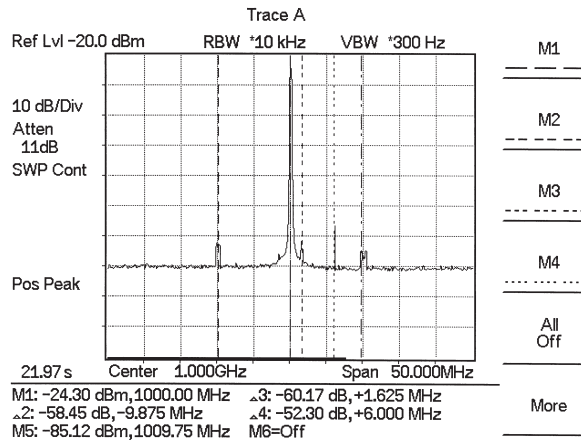


Figure 5-10. In-band Spurious Measurement

NOTE: The resolution bandwidth of a spectrum analyzer is determined by the intermediate frequency (IF) filter bandwidth. The MS2711D traces the shape of the IF filter as it sweeps past a signal. Therefore, if two equal-amplitude signals are very close to each other, the measurement result can appear to be one single response because the IF or resolution bandwidth is not small enough to resolve the two signals. Similarly, if two signals are not equal in amplitude but are very close together, the smaller signal may not be seen because it is hidden under the large response.

Field Strength

Required Equipment

- MS2711D Handheld Spectrum Analyzer
- Portable Antenna

Procedure

- Step 1.** Use the Antenna Editor feature of the Handheld Software Tools to define an antenna (see page 10-9).
- Step 2.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 3.** Upload the antenna information to the MS2711D (see page 10-10).
- Step 4.** Connect the antenna to the MS2711D.
- Step 5.** Press the **FREQ/SPAN** key and select the **Center** soft key. Enter the center frequency.
- Step 6.** Press the **FREQ/SPAN** key and select the **Span** soft key. Set the span wide enough to include the primary channel bandwidth and upper and lower channel bandwidths.
- Step 7.** Press the **BW/SWEEP** key and select the **RBW Auto** and **VBW Auto** soft keys to set the resolution and video bandwidths to **Auto**.
- Step 8.** Press the **MEAS** key.
- Step 9.** Select the **Field Strength** soft key.
- Step 10.** To use a custom antenna definition uploaded from the Handheld Software Tools Antenna Editor (see Chapter 10), press the **Select Custom Antenna** soft key. Use the Up/Down arrow key to select the desired antenna factor file and press the **ENTER** key to select.
To use one of the standard antennas recognized by the MS2711D, select the **Select Standard Antenna** soft key. Use the Up/Down arrow key to select the desired antenna and press the **ENTER** key to select.
- Step 11.** To change the units of measurement, press the **AMPLITUDE** hard key, then press the **Units** soft key and select **dBm**, **dBV**, **dBmV** or **dB μ V**. Pressing the **Linear** soft key will allow a units selection of **Volts** or **Watts**.

The MS2711D will automatically adjust the measurement by the antenna factors selected. Marker values will be displayed in the same units as selected for the amplitude. A **Field Str** icon will appear to the left of the graph and **FSA** and the antenna name will be in the title bar above the graph.

Figure 5-11 shows the results of a measurement using a 2000-1031 antenna.

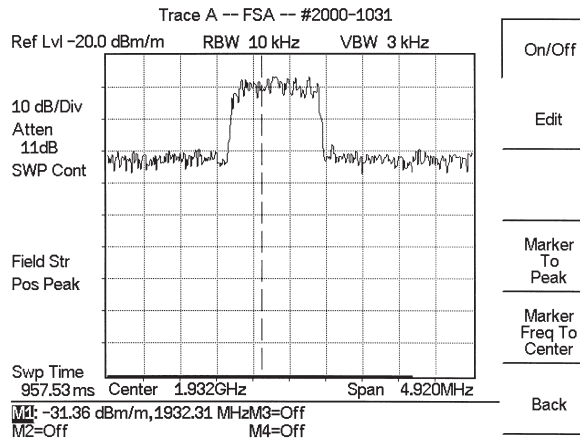


Figure 5-11. Field Strength

Antenna Calculations

The following is a list of various antenna calculations should you find it necessary to convert from one to another:

Conversion of signal levels from W to V in a 50Ω system:

$$P = \frac{V^2}{R}$$

where: P = power in Watts
V = voltage level in Volts
R = resistance in Ohms

Note that 1 mW = 10⁻³W and 1μV = 10⁻⁶V.

For power in dBm, and voltage in dB(μV) :

$$V_{dB(\mu V)} = P_{dBm} + 107$$

Power density to field strength. An alternate measure of field strength to electric field is power density:

$$P_d = \frac{E^2}{120\pi}$$

where: E = field strength in V/m
P = Power density in W/m²

Power density at a point:

$$P_d = \frac{P_t G_t}{4\pi r^2}$$

In the far field, where electric and magnetic fields are related by the impedance of free space:

P = power density in W/m^2

P = power transmitted in Watts

G = gain of transmitting antenna

r = distance from the antenna in meters

Dynamic Attenuation Control

The dynamic attenuation control feature tracks the peak input signal level and automatically adjusts the attenuator to protect the MS2711D in situations of high RF signal levels. This feature also enhances the instrument sensitivity in situations of low-level RF signals by deactivating and activating the internal preamplifier resulting in improved measurement accuracy.

When dynamic attenuation is on, the MS2711D is in control of the attenuation and preamp. Manual settings will be overwritten based on the input signal. To manually control these parameters, set the attenuation to **Manual**.

The following is an example identifying interference in a PCS 900 MHz band with the aid of the preamplifier and dynamic attenuation control.

Required Equipment

- MS2711D Handheld Spectrum Master
- A PCS band Pass Filter, such as K & L Electronics 5DR30-921 or equivalent
- A PCS band antenna

Procedure

- Step 1.** If necessary, press the **MODE** key and use the Up/Down arrow key to select the **Spectrum Analyzer** mode. Press the **ENTER** key to select.
- Step 2.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 3.** Connect the PCS antenna to the input of the band pass filter, and the output of the band pass filter to the RF In connector of the MS2711D.
- Step 4.** Press the **FREQ/SPAN** key.
- Step 5.** Press the **Start** soft key and enter 1.93 MHz.
- Step 6.** Press the **Stop** soft key and enter 1.935 MHz.
- Step 7.** Press the **AMPLITUDE** key and select the **Scale** key. Set the scale to 10 dB/division.
- Step 8.** Press the **Atten/Preamp** soft key and set the attenuation to **Dynamic**.

As the MS2711D sweeps, it continually monitors the overall input signal level and, as required, adjusts the input attenuation value and the preamplifier on/off state to achieve the best possible sensitivity.

Figure 5-12 shows the results with dynamic attenuation enabled.

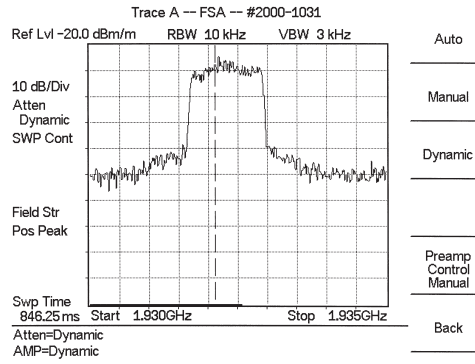


Figure 5-12. Dynamic Attenuation

NOTE: Decreasing the VBW to 100 kHz or lower will reduce noise around PCS signals.

AM/FM Demodulation

The Spectrum Master built-in demodulator for AM, narrowband FM, wideband FM and single sideband (selectable USB and LSB) allows a technician to hear an interfering signal for easy identification. The demodulated signal can be heard using either the built-in speaker, or through a monaural headset connected to the 1/8-inch jack on the test panel.

Demodulation Procedure

- Step 1.** Press the **MEAS** key followed by the **More** soft key and the **AM/FM Demod** soft key.
- Step 2.** Press the **Demod Type** soft key and select **AM**, **FM Wide Band**, **FM Narrow Band**, **SSB Lower**, or **SSB Upper** to match the modulation format of the signal.

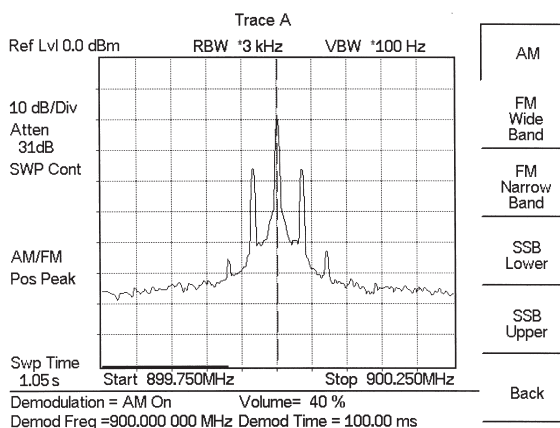


Figure 5-13 . Select Demodulation Type

- Step 3.** Press the **Back** soft key.
- Step 4.** For AM or FM signals, press the **Demod Freq** soft key and use the keypad to enter the center frequency of the signal to be demodulated. By default, the demodulation frequency is the center of the frequency span.

For SSB Upper and SSB Lower signals, press the **Demod Freq/BFO Adj.** soft key. By default the demodulation frequency is the center of the frequency span. If the demodulation frequency needs to be changed, press the **Demod Freq** soft key and enter the correct demodulation frequency. The **BFO Adjust** soft key allows adjustment of the beat frequency oscillator to fine tune the signal through a span of ± 10000 Hz.

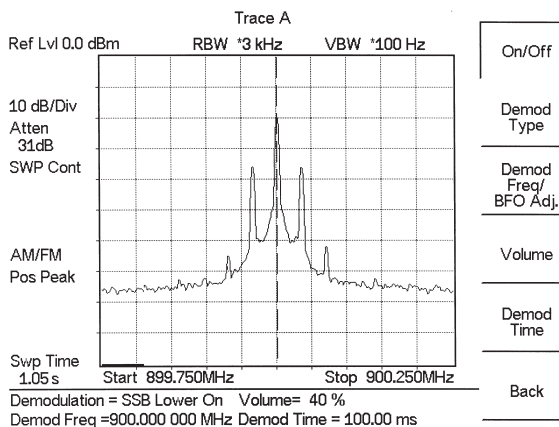


Figure 5-14. SSB Demodulation

Step 5. Press the **On/Off** soft key to enable the measurement. **AM/FM** will appear to the left of the graph.

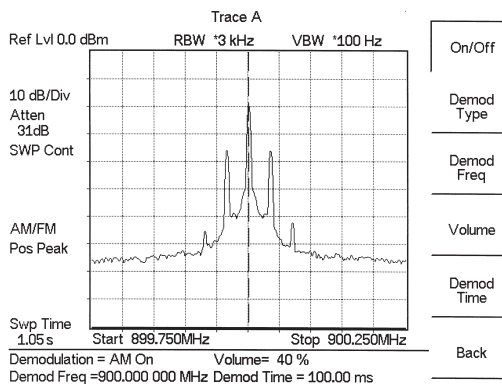


Figure 5-15. AM Demodulation

Step 6. Use the **Volume** soft key and the Up/Down arrow key to change the audio volume from 0% to 100%. For most headsets a volume of 40% is adequate.

Step 7. The **Demod Time** soft key sets the time the Spectrum Master will demodulate the signal. Enter a value from 100 ms to 500 seconds.

Carrier to Interference Ratio Measurement

Carrier to Interference Ratio (C/I) Measurement is a two-step process, first measuring the carrier level and then, with the carrier turned off, measuring the remaining signals and noise in the band of interest. After the two measurements are complete, the ratio of the carrier level to the noise plus interference is displayed using three assumptions:

- The interferer is a narrowband frequency hopping signal (NB FHSS)
- The interferer is a wideband frequency hopping signal (WB FHSS)
- The interferer is a broadband signal (BB).

The primary application for this type of measurement is determining the magnitude of interference problems for 802.11b, 802.11g and 802.11a access points (hot spots).

Procedure

- Step 1.** If necessary, press the **MODE** key and use the Up/Down arrow key to select the Spectrum Analyzer mode. Press the **ENTER** key to select.
- Step 2.** Reset the MS2711D to the factory default settings for the current mode by pressing the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Setup selection box appears on the display. Select setup location 0 <Default> to recall the factory preset state for the currently selected mode.
- Step 3.** Press the **FREQ/SPAN** key followed by the Signal Standard soft key. Select the appropriate signal standard based on the signal to be measured and press **ENTER**.
- Step 4.** Press the Select Channel soft key, select the operating channel of the access point being measured and press **ENTER**.

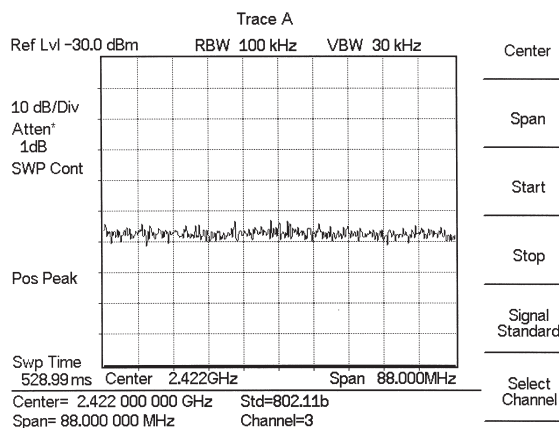


Figure 5-16. Signal Standard and Channel Selected

Step 5. Press the **MEAS** key followed by the **More** soft key and the **C/I** soft key.

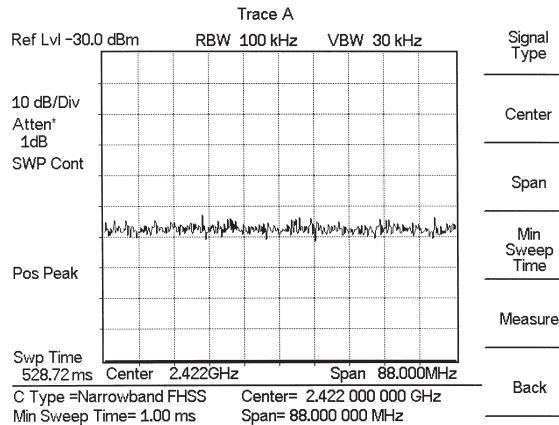


Figure 5-17. Carrier to Interference Ratio Measurement Screen

Step 6. Press the **Signal Type** soft key and select the correct carrier signal type from the three choices, **Narrow Band FHSS**, **Wide Band FHSS**, or **Broadband**.

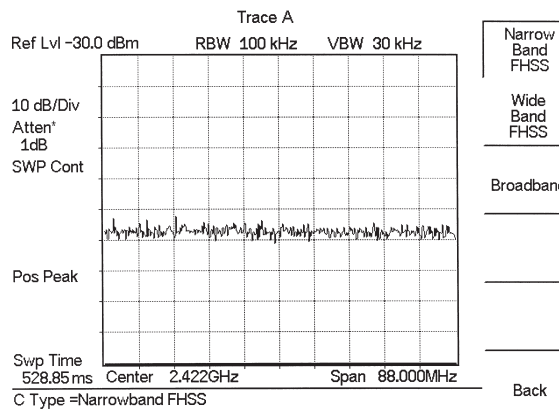


Figure 5-18. Select Signal Type

- Step 7.** Press the **Back** soft key to return to the previous menu.
- Step 8.** Unless a **Signal Standard** and **Channel** have already been selected in the **FREQ/SPAN** menu, press the **Center** soft key and enter the desired frequency.
- Step 9.** If needed, press the **Span** soft key and set an appropriate span width for the signal to be measured.
- Step 10.** If the signal environment includes slow frequency hopping signals, such as cordless telephones, press the **Min Sweep Time** soft key to set a sweep time of one second or more to give a good chance of capturing instances of the interfering signal.

Step 11. Press the **Measure** soft key and follow the on-screen prompts to complete the measurement.

NOTE: Access to the transmitter is required to complete this procedure as the transmitted carrier must be turned off for the second portion of the measurement.

Step 12. After the measurement is complete, a message box will give results for the three different signal types. Some measurement results may show as N/A, and this is to be expected. Press the **ENTER** key to continue. All of the information in the message box will still be available.

Step 13. Press the appropriate soft key for the signal type being measured to view the measurement results. The results are shown at the bottom of the screen.

Step 14. Press the **Save C/I Meas** soft key to save both traces. Select the alphanumeric characters for the trace name and press the **ENTER** key to save the traces. The Spectrum Master will save both the carrier and interferer traces with the same name, and automatically append a “-C” to the saved carrier trace, and a “-I” to the saved interference trace.

Step 15. Press the **C/I Done** soft key to return to normal sweeping mode.

Step 16. To recall the carrier and interferer traces, select the **RECALL DISPLAY** key and use the Up/Down arrow key to select either the -C or -I trace. Both traces will be displayed, with the selected trace data shown at the bottom of the display. The selected trace is displayed as a yellow trace, and the other as a magenta trace. (Some adjustment of the display brightness (see page 2-21) may be required for optimal viewing.)

Step 17. To review the specific data for the measurement, select the **MEAS** key, and press the **More** and **C/I** soft keys. Select either the **C Data**, **I Data**, or **C/I Data** soft keys to view the corresponding data at the bottom of the display.

Step 18. Press the **ESCAPE** key to return to normal sweep mode.

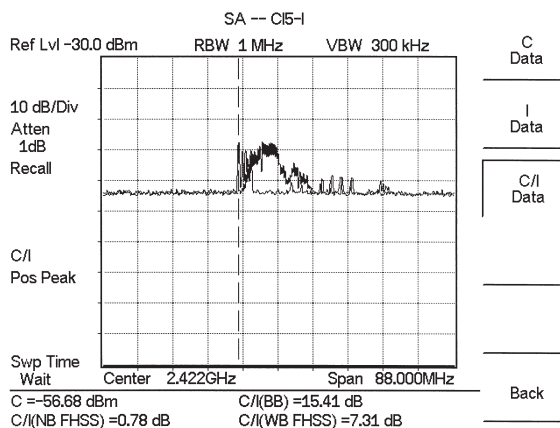


Figure 5-19. Recalled C/I Trace

Interference Analysis

Interference analysis, as performed by the Spectrum Master MS2711D, is a process of measuring the bandwidth and skirt shapes of a signal and determining what type of cellular signal it is from those characteristics.

Procedure

Step 1. Press the **MEAS** key and the Int. Analysis soft key.

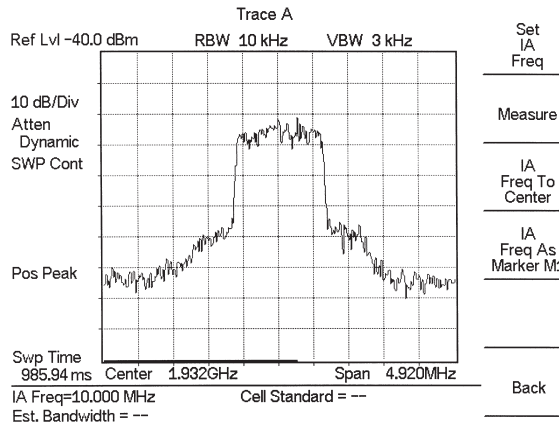


Figure 5-20. Interference Analysis

Step 2. Press the **Set IA Freq** soft key and enter the frequency of the signal to be analyzed. The default IA frequency is 10 MHz. Alternatively, marker M1 can be placed on the signal of interest and can be used to enter the IA frequency. With the marker on the signal, press the **IA Freq As Marker M1** to set that frequency as the IA frequency. After the frequency is entered, the instrument is ready to begin the analysis.

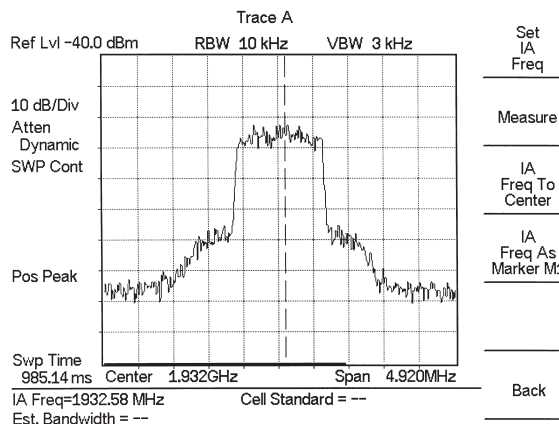


Figure 5-21. Ready to Measure

Step 3. Press the **Measure** soft key to initiate the measurement. After about one minute, the instrument will display the results. If the signal is of a known cellular type, the cellular standard and the estimated bandwidth will be displayed in a dialog box. If the instrument is unable to determine the signal type, the cell standard will be shown as "unknown" and only the estimated bandwidth will be displayed. Press **ENTER** to continue.

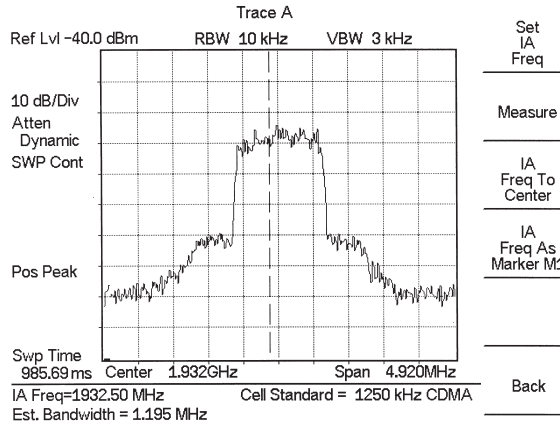


Figure 5-22. Measurement Result

Noise Marker

Noise markers are used to measure the level of noise received by the Spectrum Master. For results to be accurate there must be no discrete signals within the resolution bandwidth of the position of the marker. The measured noise is normalized and displayed as dBm/Hz.

Measurement units must be set to dBm to use noise markers. To change the measurement units, press the **AMPLITUDE** key, followed by the **Units** soft key, and select the **dBm** soft key.

To turn on Noise Markers, press the **MARKER** key, then the **More** soft key and select the **Noise Marker** soft key. All markers will then become noise markers.

When the Noise Marker option is selected, the detection type is automatically changed to RMS Average, and will remain so until the **Regular Marker** soft key is selected. For the most accurate results, the detection type should remain RMS Average while using noise markers.

Chapter 6

Power Measurements

Introduction

The MS2711D Spectrum Master with Option 29 can make power measurements based on the spectrum analyzer measurements, and can display the measured power in dBm or Watts.

Anritsu's High Accuracy Power Meter (Option 19) enables users to make high accuracy RMS measurements. This option requires sensor PSN50 or MA24104A. The PSN50 sensor provides high accuracy terminating measurements from 50 MHz to 6 GHz with a dynamic range from -30 dBm to +20 dBm. The MA24104A is an Inline High Power Sensor with a frequency range from 600 MHz to 4 GHz and can measure signals as high as 150 Watts.

Making Power Measurements with the Option 29 Power Meter (Internal)

When the Power Meter option (Option 29) is installed, it provides bandwidth-selectable power measurement capability from 3 MHz to 3 GHz with a measurement bandwidth from 3 MHz to 2.997 GHz. The power meter displays measured power in dBm or Watts. No external detector is required to use the power meter.

The center frequency and span can be set to allow measurements to be made over a desired bandwidth. Alternatively, the signal standard and channel can be selected to automatically set these parameters.

Entering Power Meter Mode

- Step 1.** Press the **MODE** key.
- Step 2.** Use the Up/Down arrow key to scroll to Power Meter mode and press **ENTER**.

Setting the Measurement Frequency Range

The measurement frequency range parameters can be set manually or automatically.

Manually Setting Frequency Range Parameters

Using this procedure, the instrument can be tuned to measure over any frequency span that is within the capability of the instrument.

- Step 1.** Press the **Center** soft key and enter the desired frequency between 4.5 and 2998.5 MHz. If the existing span value would cause the instrument to be tuned outside of its available frequency range, the span is automatically changed to the maximum value for the given center frequency.
- Step 2.** Press the **Span** soft key and enter the desired frequency span for the measurement between 3 and 2997 MHz. If the existing center frequency value would cause the instrument to be tuned outside of its available frequency range, the center frequency is automatically changed so that the entered span range can be

used. Pressing the **Span** soft key also opens activates a menu of span related choices:

Edit	Allows editing of the span to enter a specific frequency.
Full	Sets the power meter to its maximum frequency span of 2997 MHz and the center frequency to 1501.5 MHz.
Min	Sets the power meter span to the minimum value of 3 MHz.
Span Up 1-2-5	Increases the span from the current value to the next higher value that starts with a 1, 2 or 5. For example, if the span is 3 MHz, pressing this key increases the span to 5 MHz. The next press would increase the span to 10 MHz, then 20 MHz and so on. If the button is pressed enough times, the span will end up at the full span of the instrument, which is 2997 MHz.
Span Down 1-2-5	Decreases the span from the current value to the next lower value that starts with a 1, 2 or 5. If the button is pressed enough times, the span will end up at the minimum span of the instrument, which is 3 MHz.
Back	Returns to the Freq/Span menu.

Automatically Setting Frequency Range Parameters

Using this procedure, the instrument can be tuned to measure a single channel of a particular air interface standard.

- Step 1.** Press the **Signal Standard** soft key. Use the **Top of List**, **Page Up**, **Page Down**, **Bottom of List** soft keys, along with the **Up/Down** arrow key to the highlight the desired signal standard.
- Step 2.** Press the **ENTER** key.
- Step 3.** Press the **Select Channel** soft key and use the **Up/Down** arrow key or the numeric keypad to enter the channel to measure.

Measuring High Input Power Levels

- Step 1.** The maximum input signal for measurements is +20 dBm. If the signal is larger than +20 dBm, use an attenuator on the input to reduce the power level. Insert an attenuator between the DUT and the RF detector, of sufficient rating to insure that the input power to the MS2711D is no greater than +20 dBm. Refer to Figure 6-1.
- Step 2.** Press the **Offset dB** soft key.
- Step 3.** Enter the attenuation in dB using the keypad to match the value of the external attenuator. Press **ENTER** to complete the entry. The message area will show **Offset: On** along with the entered value in dB.

Displaying Power in dBm and Watts

Press the **Units** soft key to toggle the power display units between Watts and dBm.

Displaying Relative Power

- Step 1.** With the desired base power level input to the Anritsu Spectrum Master, press the **AMPLITUDE** key, then the **Rel** soft key. The message area will show **Relative: On** and the power reading will indicate 100%.
- Step 2.** Pressing the **Units** soft key will toggle the display between dBm and Watts. When the units are dB, the **Rel** softkey toggles the reading from dB to dBm. When the units are Watts, the **Rel** soft key will toggle between % and nW.

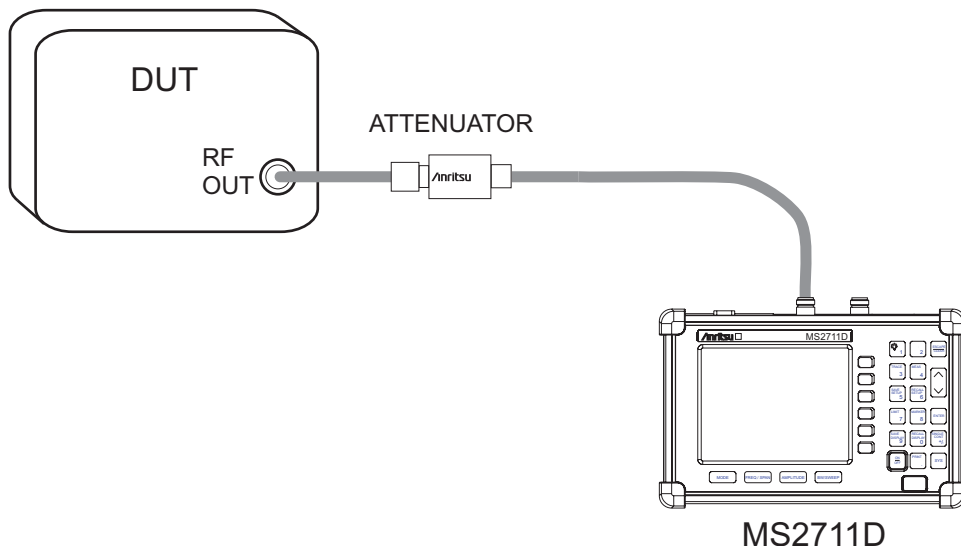


Figure 6-1. Power Meter Measurement Setup, Internal Power Meter

RMS Averaging

The RMS Average is calculated by taking the log of the average power, and the power is calculated from voltage. The number of points to average can be set to off, low, medium or high. When high averaging is selected, response time is analogous to a traditional power meter. To enable or disable RMS Averaging:

- Step 1.** Press the **BW/SWEEP** key.
- Step 2.** Select the **RMS Averaging** soft key.
- Step 3.** Select the **Off, Low, Medium or High** soft key.
- Step 4.** Select the **Back** soft key to return to the previous menu level.

Zero

Pressing this key tells the instrument to assume that the residual power being measured should be zeroed out. The instrument displays -80 dBm or 0.01 nW after the key is pressed.

Making Power Measurements with the Option 19 High Accuracy Power Meter

Anritsu's High Accuracy Power Meter (Option 19) enables high accuracy, RMS measurements for both CW and digitally modulated signals such as CDMA/EV-DO, GSM/EDGE, and WCDMA/HSDPA. This option requires either the PSN50 or MA24104A power sensors. The PSN50 power sensor provides high accuracy terminating measurements from 50 MHz to 6 GHz with a dynamic range from -30 dBm to $+20$ dBm. The MA24104A is an Inline High Power sensor with a frequency range from 600 MHz to 4 GHz and can measure signals as high as 150 Watts. Both of the power sensors are equipped with an RS232 interface for fast and easy connection to the Spectrum Master.

Units and Relative Power

The display shows the power values in both dBm and Watts. The Relative Power feature displays power changes with respect to a reference value in both dB and %.

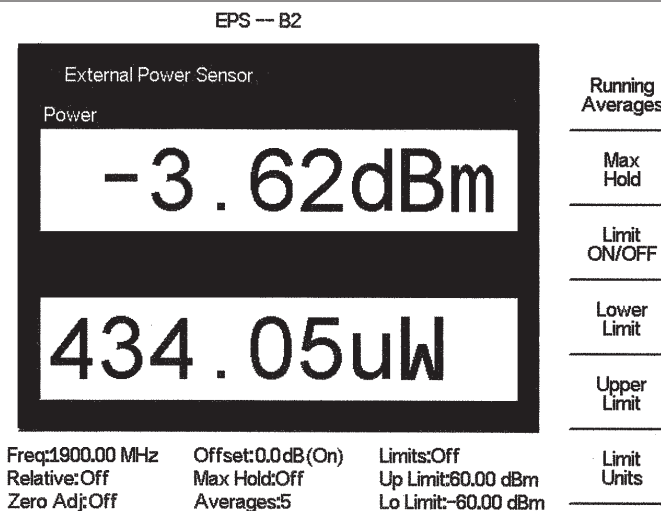


Figure 6-2. High Accuracy Power Measurement Display

Limit Lines

Limits can be used to determine if a measurement is within specified limits, and running averaging is available along with Max/Hold and Run/Hold.

Connecting the Power Sensor

The Option 19 High Accuracy Power Meter connects to the PSN50 or MA24104A power sensor using an RS232 cable (Anritsu part number 800-441). A 9 to 18 Vdc (<100 mA) power supply is needed to power either sensor (the MA24104A power sensor can also be powered with three AA batteries). Anritsu power supply (40-168-R), supplied with the Site Master, is recommended.

Zeroing the Sensor

The zero feature improves accuracy between -20 and -30 dBm by removing measured system noise. Cal Factors correct both efficiency and mismatch loss. The frequency information must be entered to obtain the correct calibration factor.

Using Attenuators

When necessary, attenuators should be used to ensure that the power does not exceed the specified measurement range. The Offset dB feature can be used to enter the value of any cables and attenuators. It is possible to measure the loss of a cable or attenuator, up to 3 GHz, using Option 21 (Transmission Measurement).

Required Equipment

- ❑ MS2711D Spectrum Master
- ❑ RS232 Serial Cable, Anritsu P/N 800-441
- ❑ Battery Supply, Anritsu P/N 3-40-172, or Power Supply, Anritsu P/N 40-168
- ❑ High Accuracy Power Sensor Anritsu P/N PSN50
- ❑ 30 dB, 50W, bi-directional, DC-8.5 GHz, N(m)-N(f), Attenuator, 3-1010-123

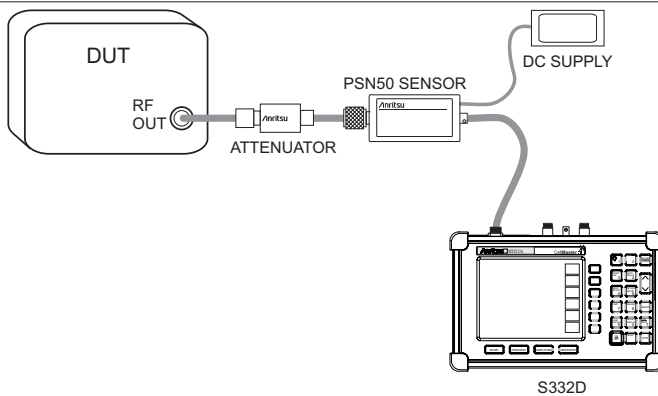


Figure 6-3. High Accuracy Power Meter Setup

Procedure

- Step 1.** Connect the RS232 serial cable between the PSN50 High Accuracy Power Sensor and the Spectrum Master serial port.
- Step 2.** Connect the DC power supply to the DC input of the PSN50 sensor.
- Step 3.** Press the **ON/OFF** key on the Spectrum Master.
- Step 4.** Press the **MODE** key.
- Step 5.** Use the Up/Down arrow key to select High Accuracy Power Meter mode and press **ENTER**.

Zero and Cal

- Step 6.** Press the **FREQ/SPAN** key.
- Step 7.** To enter the frequency manually using the number keys, select the **Center** soft key. To select a known signal standard, press the **Signal Standard** soft key and use the Up/Down arrow key to select the desired standard. The Cal Factors will be derived for the corresponding center frequency.

NOTE: The channel number is not required because the cal factor frequencies are rounded to the nearest 500 MHz.

- Step 8.** With no power applied to the sensor, press the **AMPLITUDE** key then the **Zero** soft key to zero the sensor. Zeroing the sensor is recommended when making power measurements below -20 dBm.

Using Attenuators

- Step 9.** Press the **AMPLITUDE** key and select the **Offset dB** soft key.
- Step 10.** Connect the phase stable cable and the attenuator between the DUT and the sensor.
- Step 11.** Enter the combined offset value of the attenuator and the pad.

Averaging/Max Hold/Run Hold

- Step 12.** Press the **BW/SWEEP** key.
- Step 13.** Press the **Running Averages** soft key and use the keypad to enter the number of averages to use (up to 50).
- Step 14.** Press the **Max Hold** soft key to display the maximum value. If **Averaging** is selected, **Max/Hold** will display the maximum value of the non-averaged data.
- Step 15.** Press the **RUN/HOLD** key to hold the display in the current condition.

Setting Limits

- Step 16.** Press the **BW/SWEEP** key.
- Step 17.** Press the **Limit Units** soft key to select the units.
- Step 18.** Press the **Lower Limit** soft key and enter the lower limit value in dBm or in Watts.
- Step 19.** Press the **Upper Limit** soft key and enter the upper limit value in dBm or in Watts.
- Step 20.** Press the **Limit ON/OFF** soft key to turn on the limits. The number display will turn green if the measurement is passing, or red if the measurement is failing. The word **PASS** or **FAIL** will also be displayed in between the logarithmic and linear display windows.

Displaying Relative Power

Step 21. Press the **AMPLITUDE** key.

Step 22. With the desired base power level input to the sensor, press the **Rel** soft key. The message area will show **Relative On** and the power reading will show 0 dB and 100%. If measuring a 10 dBm signal with the **Rel** key selected, a drop to 7 dBm will show -3dB and 50%.

Saving the Measurement

Step 23. Press the **SAVE DISPLAY** key.

Step 24. Use the soft keys to enter a Trace Name.

Transferring Data to Handheld Software Tools

The Site Master has only one serial port, so it is not possible to communicate with both the PSN50 or MA24104A power sensor and a PC running Handheld Software Tools (HHST) at the same time. Therefore, only saved measurements can be viewed in HHST when using the sensor. To view saved measurements, disconnect the serial cable from the sensor and connect it to the serial port of the PC running HHST. Refer to the Handheld Software Tools chapter in this manual for further information.

Chapter 7

Transmission Measurement

Introduction

The Transmission Measurement option (Option 21) provides the capability to perform two-port measurements of passive devices over the 25 MHz to 3 GHz frequency range. The signal source provided by Option 21 is un-leveled, with a power output of approximately -10 dBm. Figure 7-1 shows the typical signal level of the Option 21 signal source.

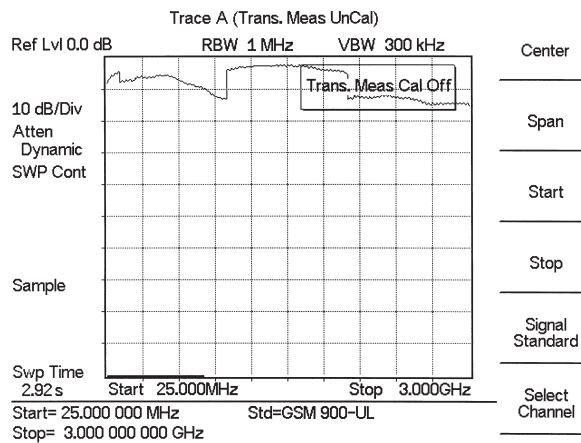


Figure 7-1. Option 21 Signal Source Typical Signal Level

NOTE: Ripple can be reduced by including a 6 dB attenuator in the transmission path during both calibration and measurement.

Measuring Active Devices

Amplifiers can also be measured with Option 21, provided an external attenuator is installed between the **RF Out** port of the MS2711D and the input of the amplifier. The value of this attenuator depends on the required input signal level into the amplifier. Note that the output power of the signal source is not leveled, making it most suitable for gain measurements in the linear region of an amplifier.

Calibration

- Step 1.** Press the **FREQ/SPAN** key and set the desired frequency range.
- Step 2.** Press the **BW/SWEEP** key, and then the Calibrate TM soft key.
- Step 3.** Following the on-screen prompt, connect a phase-stable cable between the **RF Out** port and the **RF In** port of the MS2711D. If an attenuator is required for the measurement, connect it directly to the **RF Out** port and connect the cable to the attenuator output. The displayed trace before calibration should be similar to the one shown in Figure 7-2.

Step 4. Press the **ENTER** key.

The unit will sweep once and store transmission correction information. On the next sweep, the trace should be flat at the zero dB reference line and ready for measurements. The calibration information is lost when the instrument is turned off.

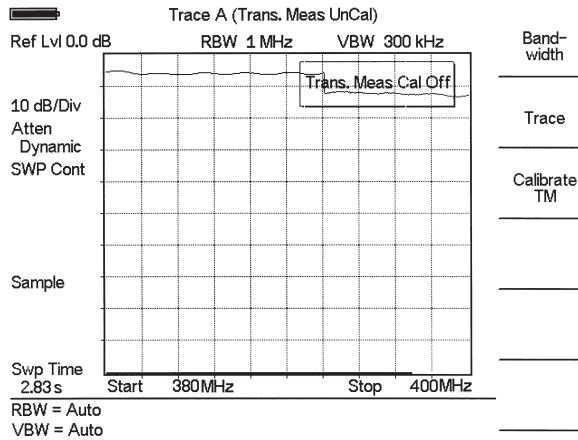


Figure 7-2. Uncalibrated Narrowband Trace

Transmission Measurement Procedure

Step 1. Connect the filter between the Spectrum Master RF In and RF Out ports.

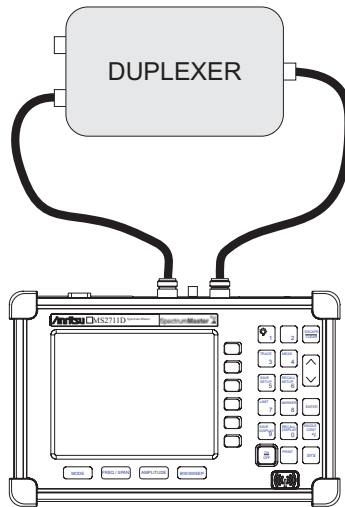


Figure 7-3. Transmission Measurement Connections

Step 2. Set the start and stop frequencies to cover the frequency range of the filter.

Step 3. Disconnect the duplexer and connect the cables together. If possible use all adapters and cables that are needed to connect the duplexer to the Spectrum Master.

- Step 4.** Calibrate the Spectrum Master for transmission measurements as described in the previous section.
- Step 5.** Reconnect the duplexer and make the measurements.

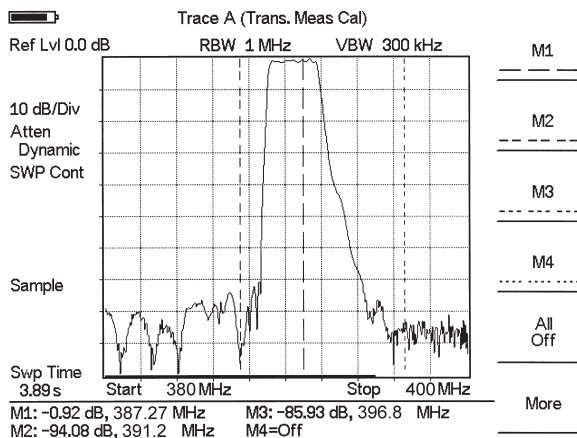


Figure 7-4. Transmission Measurement

Chapter 8

Interference Analyzer Mode

Introduction

This chapter presents Interference Analyzer (Option 25) information and procedures.

Interference Analysis

Multiple wireless networks often operate in complicated signal environments. Three or four base station antennas may be located on the same tower, and can create interference problems. Interference is one of the most common problems affecting wireless network systems capacity and coverage. The Spectrum Master captures and analyzes a received signal and displays the air interface standard and estimated bandwidth of the received signal, which is critical in recognizing and analyzing the interfering signals.

The Interference Analyzer option adds four measurements to the capability of the MS2711D:

- Spectrogram
- Signal Strength
- RSSI
- Signal ID

Spectrogram

Spectrogram is a three dimensional representation of frequency, time and power useful for identifying intermittent interference.

Procedure

The following procedure demonstrates common Interference Analyzer Spectrogram setup options. To select Interference Analyzer mode:

- Step 1.** On the Spectrum Master, press the **MODE** key, use the Up/Down arrow key to select the **Interference Analyzer** mode and press **ENTER**.
- Step 2.** Press the **BW/SWEEP** key followed by the **Spectrogram** soft key.
- Step 3.** Press the **FREQ/SPAN** key to set up the desired frequency sweep. Choose the appropriate soft keys and enter the start and stop frequency, the center frequency and the span, or select the **Signal Standard** soft key and select the channel and Uplink or Downlink.
- Step 4.** To get the most effective spectrogram display, press the **AMPLITUDE** key, select the **Ref Level** soft key and set the reference level such that the largest signal to be displayed will be near the top of the spectrum analyzer area of the screen. The reference value required can be determined by observing the color of the highest signal and changing the reference level to place that value near the top of the spectrum analyzer area.
- Step 5.** Select the **Scale** soft key and set the scale value to place the lowest signal near the bottom of the screen. In general, 4 or 5 dB/division will be good values.

- Step 6.** Press the **BW/SWEEP** key followed by the Spectrogram soft key to set the spectrogram sweep parameters. There are two ways to set up spectrogram time parameters: set the time between sweeps or set the total time for a full spectrogram display.
- Step 7.** To change the time between sweeps, press the **Sweep Interval** soft key and use the keypad to set the time from 0 seconds to 660 seconds. Entering the time interval value causes the corresponding time span value to be automatically computed. The time span can be viewed or changed by selecting the **Time Span** soft key and using the keypad to set the span. As expected, changing the time span will automatically change the sweep interval.
- Step 8.** To set the total time span for a complete display, press the **Time Span** soft key and use the keypad to enter a time between 0 and 4320 minutes (72 hours.) Entering a time span value causes the corresponding sweep interval value to be automatically computed and shown when the **Sweep Interval** soft key is pressed.
- Step 9.** Spectrogram plots may be automatically saved when the waterfall display is full by pressing the **Auto Save** soft key, which toggles between OFF and ON as shown at the bottom of the screen.
- Step 10.** There are two cursors that can be used to investigate the frequency and time of any spot in the spectrogram display. Before using the cursors, press the **SINGLE/CONT** key to suspend the acquisition of new data to avoid having the point of interest scroll off the top of the screen. Press the **Cursor** soft key to turn on the time cursor and frequency cursor.
- Step 11.** Press the **Time Cursor** soft key to turn on the horizontal time cursor. Use the Up/Down arrow key to move the cursor vertically through the spectrogram. The date and time that the measurement at the cursor position was taken is displayed in the message area below the graph.
- Step 12.** Press the **Freq Cursor** soft key to turn on the vertical frequency cursor. Use the Up/Down arrow key to move the cursor through the spectrogram. The frequency and corresponding amplitude level of the measurement at the cursor position is displayed in the message area below the graph.
- Step 13.** Press the **Back** soft key to turn off the cursors and return to the previous menu.

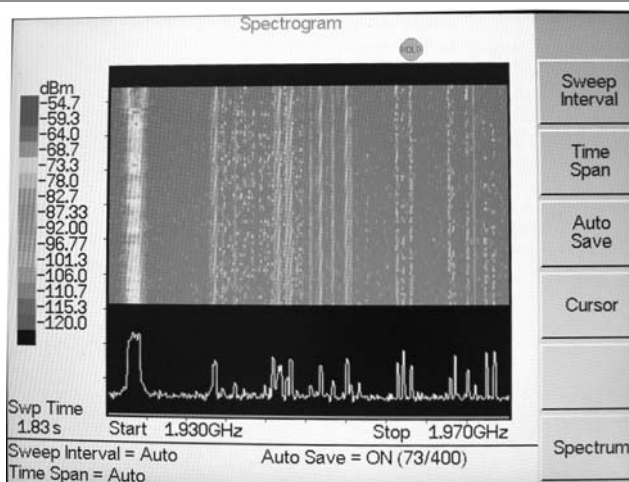


Figure 8-1. Spectrogram Display

Signal Strength

Signal Strength is useful for tracking down the source of an interfering signal. This measurement is done at a single frequency in zero span. Signal Strength displays the power at a single frequency (in dBm) along with an optional audible indicator. Connect a directional antenna and the frequency of the audible indicator increases as the measured signal strength increases. This mode is especially useful when attempting to locate an emitter using a directional antenna.

Procedure:

The following procedure demonstrates a common Interference Analyzer Signal Strength setup. To select Interference Analyzer mode:

- Step 1.** On the Spectrum Master, press the **MODE** key, use the Up/Down arrow key to select the Interference Analyzer mode and press **ENTER**.
- Step 2.** Press the **BW/SWEEP** key and select the Spectrum soft key.
- Step 3.** Press the **FREQ/SPAN** key, select the Center soft key, and use the soft keys to tune the center frequency to place the signal of interest in the center of the display.
- Step 4.** Connect the appropriate directional antenna to the RF In port and press the **BW/SWEEP** key.
- Step 5.** Press the Signal Strength soft key.
- Step 6.** Press the **AMPLITUDE** key.
- Step 7.** Press the Ref Level soft key and set the top of the measurement range to place the measured signal level near the right side of the bar chart.
- Step 8.** Press the Scale soft key and set the sensitivity of the audio output frequency to amplitude changes. For most signal strength application, a value of 4 dB/division works well.
- Step 9.** Press the **BW/SWEEP** key followed by the Signal Strength soft key.
- Step 10.** Press the Speaker Tone On/Off soft key to turn on the audio output.
- Step 11.** If necessary, press the Volume soft key to set the speaker or headphone volume to a comfortable level. Use the Up/Down arrow keys to adjust the volume.

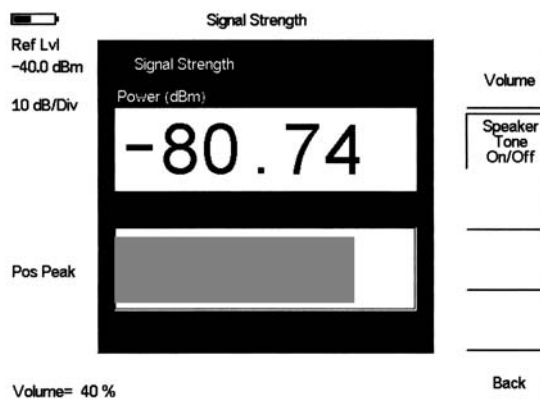


Figure 8-2. Signal Strength Display

RSSI

RSSI is useful to observe signal strength at a single frequency over time.

Procedure:

The following procedure demonstrates a common Interference Analyzer RSSI setup. To select Interference Analyzer mode:

- Step 1.** On the Spectrum Master, press the **MODE** key, use the Up/Down arrow key to select the Interference Analyzer mode and press **ENTER**.
- Step 2.** Press the **BW/SWEEP** key and select the Spectrum soft key.
- Step 3.** Press the **FREQ/SPAN** key, select the Center soft key, and use the soft keys to tune the center frequency to place the signal of interest in the center of the display.
- Step 4.** Press the **BW/SWEEP** key and select the RSSI soft key.
- Step 5.** Press the Time Interval soft key to set the time between adjacent measurement points. This time may be set from 150 ms to 1 minute.
- Step 6.** Press the Time Span soft key to set the overall time span for the RSSI measurement. This time can be set from zero, to give manual control of the time span, to a maximum of seven days. After the specified time span, measurement is halted. Depending on the time interval selected, the data will scroll to the left once the trace fills the screen.
- Step 7.** Press the **AMPLITUDE** key to set the reference level and scale factor to place the trace on the screen. Alternatively, the data may be scaled to place it all on screen by pressing the **BW/SWEEP** key, the RSSI soft key then the Auto Scale Data soft key.
- Step 8.** To store the RSSI data, press the Log Data On/Off soft key to turn on data logging. The data is named Log - followed by the time at which the data was stored. Each screen full of 401 data points will be stored as a separate display, and can be saved for up to seven days.

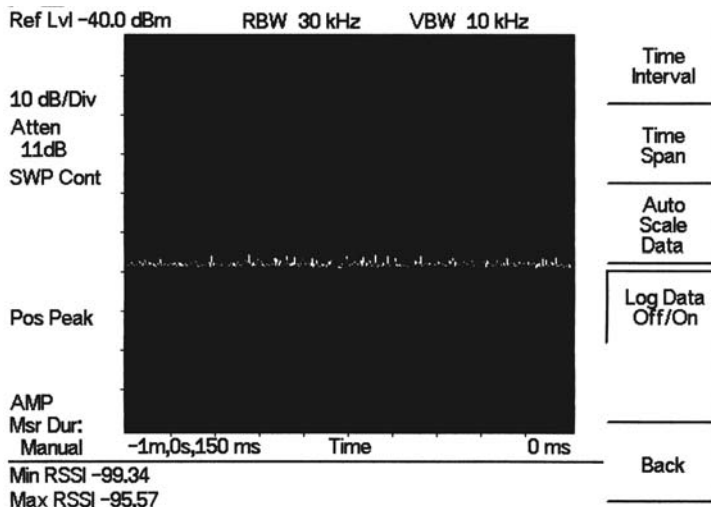


Figure 8-3. RSSI Display

Signal ID

Signal Identification is used to determine, if possible, the air interface standard of a signal. If the instrument is unable to determine the modulation format, it will display the estimated bandwidth of the signal.

Procedure:

The following procedure demonstrates a common Interference Analyzer Signal ID setup. To select Interference Analyzer mode:

- Step 1.** On the Spectrum Master, press the **MODE** key, use the Up/Down arrow key to select the Interference Analyzer mode and press **ENTER**.
- Step 2.** Press the **BW/SWEEP** key and select the Signal ID soft key.
- Step 3.** Press the Set IA Freq soft key, enter the appropriate frequency to analyze the interfering signal, and press **ENTER**. Alternatively, if marker M1 is on, press the IA Frequency as Marker M1 soft key to set the IA frequency to the current M1 frequency.
- Step 4.** Press the Measure soft key to start the measurement. A message box on the screen states that the analysis is in process, then, when the measurement is complete, displays the cell standard and estimated bandwidth of the interfering signal.

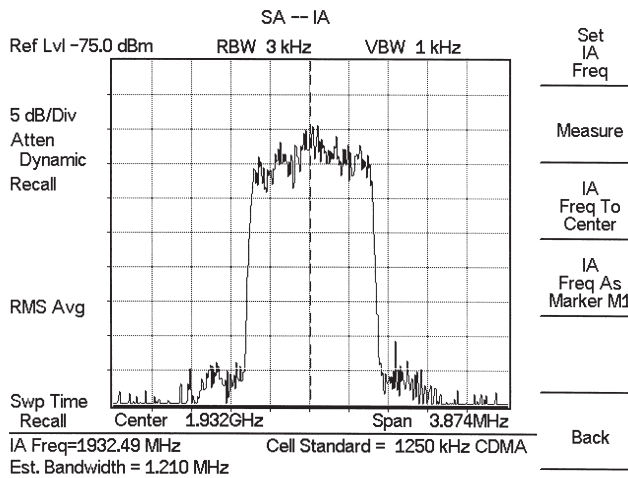


Figure 8-4. Signal ID Display

NOTE: Use IA Freq To Center to center the frequency on the display.

Chapter 9

Channel Scanner Mode

Introduction

This chapter presents Channel Scanner (Option 27) information and procedures.

Channel Scanner

The Channel Scanner option measures the output power of multiple transmitted signals. The output power can be displayed as a bar graph or a text display showing the amplitude of selected channels for a given air interface standard. Up to 20 channels can be measured.

The operating frequency range for Channel Scanner mode can either be set manually, or the desired air interface standard can be selected from the Signal Standard list in the instrument. When the frequency range is selected from the Signal Standard list, all frequency related parameters are automatically set to the appropriate values for the selected standard.

The Channel Scanner option provides the choice of a bar graph or a text display showing the amplitude of selected channels for a given air interface standard. The interface settings can be manually entered if none of the available air interface standards meet the measurement need.

Procedure

The following procedure demonstrates a common channel scanner setup. To select Channel Scanner mode:

- Step 1.** Press the **MODE** key and use the up and down arrows to highlight Channel Scanner and press **ENTER**.
- Step 2.** Press the Signal Standard soft key, the Select Standard soft key, and use the Up/Down arrow key to highlight the CDMA US PCS standard. Press the **ENTER** key to select.
- Step 3.** Press the Start Channel soft key, use the keypad to enter 50 and press the **ENTER** key.

Step 1. Press the **BW/SWEEP** key and select the Number of Channels soft key. Use the keypad to enter 20 and press the **ENTER** key. The channels will be displayed as bar graphs.

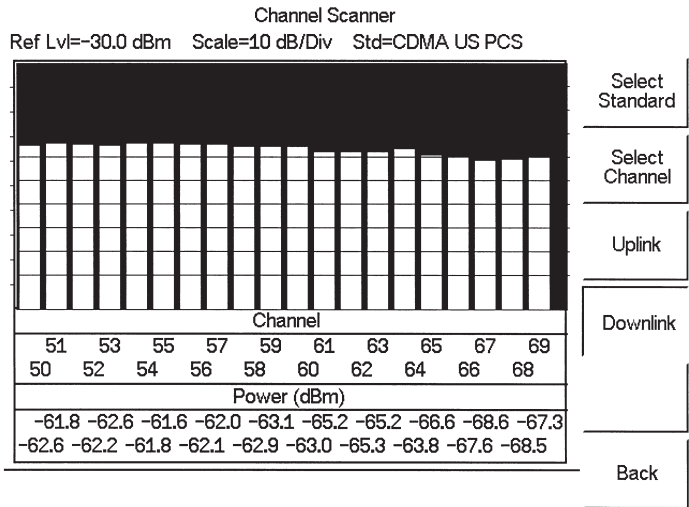


Figure 9-1. Example of Channels Displayed as Bar Graphs

Step 2. Press the Display/Graph Text soft key and the data will be displayed in text format.

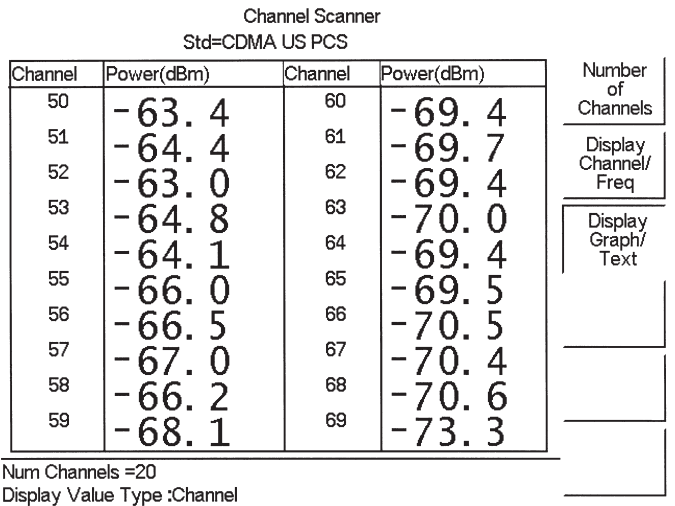


Figure 9-2. Example of Channels Displayed in Text Format

NOTE: The measurement can be made when the base station is either in service, out of service, or over the air.

Step 3. To set up the channel step size, press the **FREQ/SPAN** key and select the Channel Step Size soft key. Use the keypad to enter 5 and press the **ENTER** key.

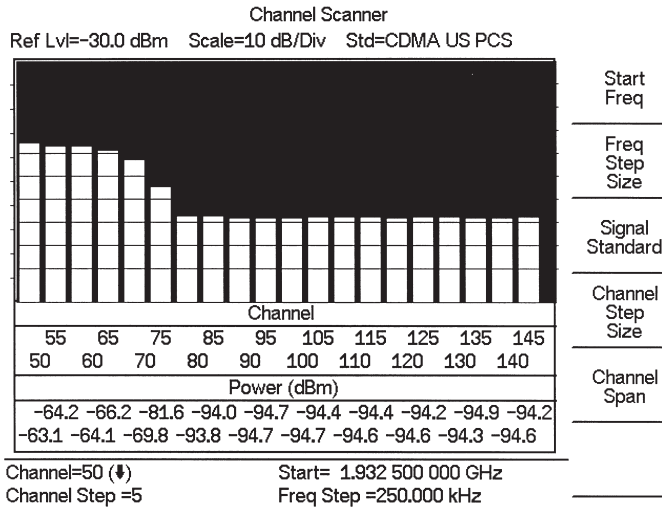


Figure 9-4. Example of Channels Displayed as Bar Graphs with Channel Step Size = 5

Step 4. Press the **BW/SWEEP** key and select the Display/Graph Text soft key and the data will be displayed in text format.

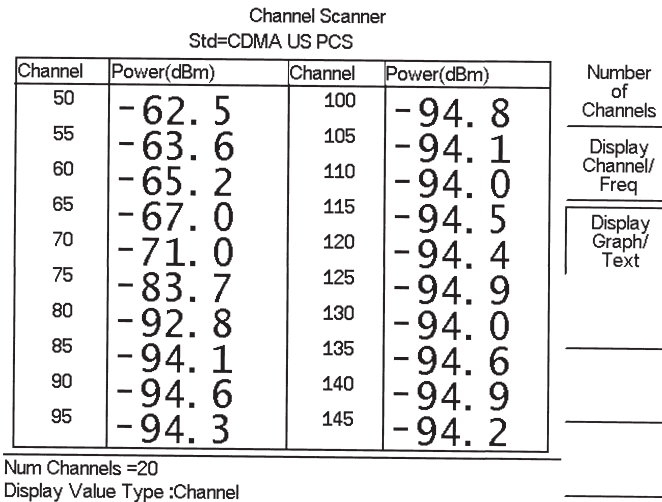


Figure 9-3. Example of Channels Displayed in Text Format with Channel Step Size = 5

NOTE: Follow the same procedure for frequency step size as used for channel step size.

Chapter 10

Handheld Software Tools

Introduction

This chapter provides a description of the Anritsu Handheld Software Tools program. Handheld Software Tools is a Windows 95/98/NT4/2000/ME/XP program for transferring measured traces, along with markers and limit lines, to the PC display. The program Help function provides on-screen instructions on display modification, trace overlay, uploading and downloading traces, and multiple plot printing.

NOTE: Master Software Tools (MST) now works with the Spectrum Master MS2711D. We strongly recommend users to migrate to MST. This platform has numerous productivity advantages over HHST and all future product enhancements will be done via MST. See Chapter 11 for more information on MST.

Features

Handheld Software Tools provides the following features:

- Download traces saved in the instrument memory to the PC for storage and analysis
- Upload traces from the PC to the instrument memory
- Trace Overlay allows the viewing of three plots simultaneously
- Ability to save captured plots as data files (.dat file format) or as records representing site information in a database file
- Ability to export plot data as text files for use in a spreadsheet (.txt file format)
- Ability to save captured plots as graphic files (.wmf file format)
- Ability to capture plots directly to data files (.dat) or to a database
- Ability to zoom in or out to analyze a particular region of the plot
- Ability to modify Plot Properties
- Ability to output plots to a printer for hard copy records
- Capture the current trace from the unit
- Create antenna factor files to be uploaded to the instrument

System Requirements

The Handheld Software Tools program will run on most any computer running Windows 95/98/NT4/2000/ME/XP. Minimum requirements and recommendations are:

- Intel Pentium 100 MHz microprocessor (Pentium II 350 MHz or better recommended)
- 16 MB of RAM (64 MB or above recommended)

- Hard disk drive with approximately 15 MB of available space (An additional 20 MB free space for storage of captured plots is recommended.)
- A serial (COM) port or a USB port and USB adapter cable for communication with the instrument

NOTE: It is recommended that Windows NT 4.0 users install NT 4.0 Service Pack 3 (SP3) or above. In addition, Windows 2000 and Windows ME may require installation of the latest Service Pack. Please contact Microsoft Corporation for further information on obtaining and installing service packs.

Installation

To install the Handheld Software Tools program:

- Step 1.** Insert the Anritsu Handheld Software Tools disk in the CDROM drive.
- Step 2.** From the Windows Start menu, select **Run** .
- Step 3.** Type: **X:\Setup.exe** where X is the drive letter of your CDROM drive.
- Step 4.** When prompted, press the **Enter** key to accept the default directory C:\Program Files\ Handheld Software Tools and the installation will begin.

The *readme.doc* file on the disk provides updated information about the program, and the Help function provides detailed operating information.

Communication Port Setting

The Handheld Software Tools communicates with the instrument through a standard serial COM port on the PC.

- Step 1.** Select **Start, Programs** and select **Handheld Software Tools**.
- Step 2.** When the program has loaded, select **Settings, Communication**.
- Step 3.** Select the appropriate PC COM port and Transfer Baud Rate for your system, and click **OK**.

NOTE: The 115200 Baud rate is not available on all models.

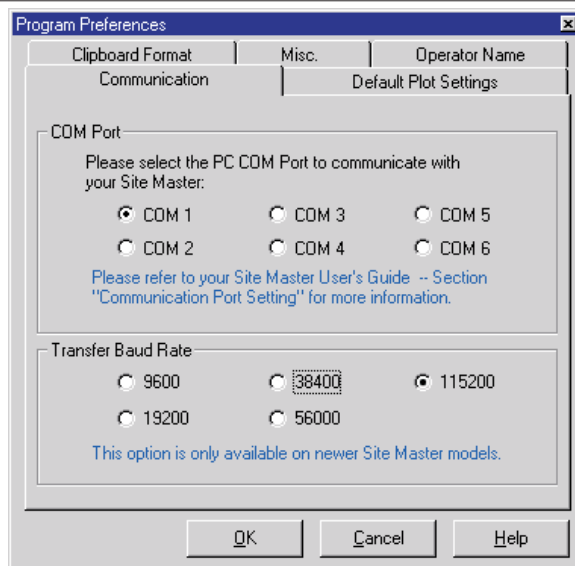


Figure 10-1. Communication Settings Dialog Box

Interface Cable Installation

Communication between the instrument and the PC is accomplished over a null modem serial cable provided with the instrument (Anritsu part number 800-441) An optional USB to serial adapter, part number 551-1691, can be added if required. Note that this USB adapter is the only adapter thoroughly tested by Anritsu to be trouble-free when used with Anritsu Handheld products and Handheld Software Tools.

- Step 1.** Install the null modem serial interface cable to the Serial Interface connector on the test connector panel.
- Step 2.** Connect the other end of the serial interface cable to the appropriate COM port connector on the PC.

Step 3. Turn on both the instrument and the PC.

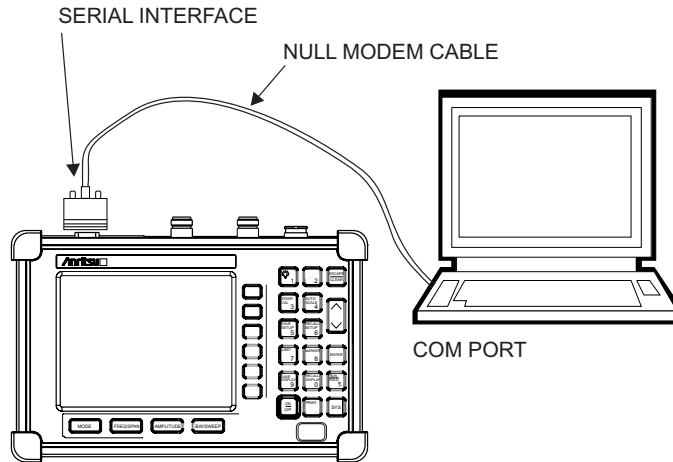


Figure 10-2. Serial Cable Connection

Using Handheld Software Tools

Select **Start, Programs** and select **Handheld Software Tools**.

Downloading Traces

Traces that can be downloaded from the instrument are grouped by the date on which they were saved. They are further organized in chronological order for each date, with the oldest trace at the top of the list. Each trace listing displays the trace name (see page 3-3) and measurement type for that trace. Available measurement types are:

SA (Spectrum Analyzer)	DTF (Distance to Fault)
TG (Tracking Generator)	Cable Loss
TGF (Tracking Generator Fast Tune)	Insertion Loss
Return Loss	Insertion Gain
VSWR	Power Meter
Transmission Measurement	

NOTE: Not all of the selections apply to every Anritsu Handheld instrument.

Plot Capture to the PC

To open the plot capture menus, select the capture icon on the button bar, or select the **Capture** drop down menu from the menu bar.

Select **Capture to Screen** to download traces to the PC.

Select a folder, or individual traces within a folder, to be downloaded to the PC. The traces will appear on the PC display as they are downloaded.

When Handheld Software Tools is communicating with the instrument, **Remote** will be displayed to the left of the graph.

Plot Upload to the Instrument

Open a plot to be uploaded to the instrument. Plot properties can be modified on the PC before it is uploaded if desired.

Select the **Capture** drop down menu from the menu bar.

Select **Upload the Current Plot** to upload the plot to the instrument. The plot will be stored in the instrument non-volatile memory with the original date and time that the plot was saved. The uploaded trace can be viewed on the instrument by pressing the **RECALL DISPLAY** button on the instrument keypad.

Plot Properties

After downloading, certain plot properties and information can be modified. Select the Plot Properties or Plot Information icon.

Plot Properties that can be changed include:

- Graph Titles
- Display Mode
- Scale/Limit
- Markers
- Misc. (Plot Display Parameters)

Graph Titles

After downloading the plot, the **Main Title** can be changed to reflect the site name or other descriptive information. The **Sub Title** field can be used to describe the specifics of the measurement and configuration.

Display Mode

Display Mode allows changing the display type without having to retest. Measurements can be changed to dBm, dBV, dBmV, or dB μ V with a single click of mouse button.

Scale/Limit

The scale of the displayed plot can be modified to help analyze whether the plot meets pass/fail criteria. The Scale/Limit submenu activates options to manually enter the scale limits, or to use the Auto Scale mode.

Manual adjustment sets the upper and lower limits of the display under the Scale/Limit Submenu.

Auto Scale automatically adjusts the scale for maximum and minimum measurement readings.

Limit Line Off turns off all limit lines.

Single Limit Line can be activated to help identify faults.

Multi-Segment Limit Lines can be activated to set different limits within the same measurement display for specification requirements.

Markers

Markers M1 through M6 can be activated from the Plot Properties menu.

The six active markers can be displayed on the plot to help identify faults from the line sweep data.

Misc.

The Miscellaneous tab allows adjustment of the Plot/Limit Line Width, the setting of the Plot Footer, and the date format.

Plot/Limit Line Width can be used when preparing reports for the carrier, service providers, and network operators where the trace data must be visible and legible for documentation. The line density of the trace can be set to **Normal (Thin Line)** or **Thick Line** to make the data appear easily when copies are made.

Plot Footer allows selection of information to be displayed in the trace display. Selections are:

- | | |
|--|---|
| <input type="checkbox"/> Time/Date | <input type="checkbox"/> Impedance |
| <input type="checkbox"/> Model and Serial Number | <input type="checkbox"/> Measurements |
| <input type="checkbox"/> Bias Tee | <input type="checkbox"/> DTF Parameters |
| <input type="checkbox"/> Date Format: | |
| mm/dd/yyyy | |
| dd/mm/yyyy | |
| yyyy/mm/dd | |

NOTE: While all possible selections are displayed, some of these selections apply only to specific models of Anritsu hand held instruments.

Trace Overlay or Plot Overlay

Trace Overlay is activated by the Mouse Function icon. Single-click on the Mouse Function icon to toggle. Toggling this icon switches the mouse function between Marker/Limit/Zoom and Plot Overlaying.

To overlay two plots, click-and-drag from one plot to the other plot. The final display will be the two plots superimposed on one another.

Refer to the Handheld Software Tools **HELP** function for more information on the steps necessary to perform a trace overlay.

Saving Traces

Once the plots are captured to the PC they can be saved as individual files or as a block of files to a database.

Saving a Plot as a Windows Metafile or to a Spreadsheet

Plots can be saved as a Windows metafile (.wmf), a HHST .dat file, a text file (.txt) or .mdb database. The metafile may be imported into graphic programs and the text file can be imported into spreadsheet. The .dat and .mdb files are used exclusively by the Handheld Software Tools.

To save a plot as a Windows metafile, click on the **File** menu and select **Export** from the pull down menu. Once the trace is saved as a metafile, it can be copied and transferred into other applications as a picture or graphic file.

To copy a metafile:

- Step 1.** Select the trace to be copied with the mouse cursor.
- Step 2.** Select **Edit** and then **Copy**. The file will be copied to the clipboard, or select **File** and then **Export** to a Windows metafile.
- Step 3.** Open the target application (Microsoft Word, etc.).
- Step 4.** Select **Edit** and then **Paste**. The file will be inserted as a graphic file or a bitmap.

Saving a Plot to a Spreadsheet

Plots can be saved as a text file (.txt) which can then be imported into a spreadsheet program.

To save a plot as a text file:

- Step 1.** Select the trace to be copied with the mouse cursor.
- Step 2.** Click on the **File** menu and select **Export to Text File for a Spreadsheet** from the pull down menu.
- Step 3.** Save the file to a local directory.
- Step 4.** Exit the Handheld Software Tools program and open the spreadsheet application.
- Step 5.** Import the .txt file into the spreadsheet program.

Creating a Database

A single trace or a block of traces can be transferred from the instrument to the PC. A separate database can be created for each cellular site. The site name can be used as the database name.

- Step 1.** Select the **File** menu and select **Database**.
- Step 2.** Open an existing database or create a new database with a descriptive filename that represents the site name.

Once the database has been created, files can be saved and site information can be added, such as Plot Description, Date/Time, Operator, record/trace number and session description (Transmitter type etc.)

Individual plots will be labeled with the Database Site Name. Each record has its own plot description and measurement type.

Printing

One to multiple plots per page can be set up under the print format in Handheld Software Tools. Orientation of how the plots are printed on the page can be changed from vertical to horizontal.

To print a single trace, or multiple traces:

- Step 1.** Click on the printer icon, or select the **File** menu and select **Print**.
- Step 2.** In the Print dialog box, click on the **Setup** button to select the paper source and orientation.
- Step 3.** In the Print dialog box, click on the appropriate **Print Style** to define the number of plots per page and the plot layout.

Entering Antenna Factors in Handheld Software Tools

The Antenna Factor (AF) is a fundamental parameter of an antenna used in field measurements. AF is used in the calculation of field strength during radiated emissions measurements, and relates the value of the incident electric or electromagnetic field to the voltage at the output of the antenna. For an electric field antenna, this is expressed as:

$$AF = \frac{E}{V_l}$$

Where AF = Antenna Factor, m⁻¹

E = Electric field in Volts per meter

V = Voltage at the antenna terminals in Volts

It also can be shown that in a 50 ohm system:

$$AF = \frac{9.73}{\lambda\sqrt{G_r}}$$

Where G = the gain of the receiving antenna in dB

λ = wave length in meters

Antennas used for radiated emissions testing are individually calibrated (the antenna factors can be measured directly) at all appropriate distances. The calibrations produce values that are defined as the “equivalent free space antenna factor.” The calibration procedure corrects for the presence of the reflection of the antenna in the ground plane, giving the value that would be measured if the antenna were in “free space.”

Antenna Editor

- Step 1.** Once Handheld Software Tools has been opened, select **Antenna Editor** from the **Tools** menu on the tool bar. A pop-up box will appear on the screen of the PC.
- Step 2.** Click on “Edit Antenna” to enter an antenna name, description, frequencies, and antenna factors. Enter the frequencies in ascending order, starting with lowest frequency first. A maximum of 60 antenna factors may be entered. Use the tab key on the keyboard to move between entries.
- Step 3.** If the antenna gain in dBi is known, then frequency and gain can be entered and the antenna factor will be automatically calculated when the tab key is pressed to move from Antenna Gain to Antenna Factor as shown in this example.

NOTE: Only one input of frequency, antenna gain and antenna factor is allowed per row. Multiple antenna factors for a single antenna must be entered on separate lines. For example, an antenna having an antenna gain of 5 from 2.0 to 2.25 GHz, and an antenna gain of 4 from 2.25 to 2.5 GHz should be entered as follows:

Frequency (MHz)	Antenna Gain (dBi)	Antenna Factor
2000	5	31.24
2251	4	33.27
2500	4	34.18

If necessary, an antenna gain or factor of zero (0) may be entered.

- Step 4.** Select **Save** from the **File** menu to save the antenna factors to the hard disk.

Uploading Antenna Factors

All 10 available antennas are transferred to the instrument at the same time. To modify only a single antenna in the instrument, first download the current antennas (see below) then modify the appropriate antenna, then re-upload the antennas to the instrument.

To upload antenna information from Handheld Software Tools to the CUSTOM list in the instrument:

- Step 1.** Connect the RS232 cable between the PC and the instrument.
- Step 2.** Click on the **Upload** button on the tool bar (or select **Upload** from the **Tools** menu). It is important to note that the instrument must sweep very quickly during the data transfer, at least every 5 seconds, or the Handheld Software Tools program may “time-out.” To improve the chances of a successful upload, increase the RBW and VBW settings to the maximum, or set the span to 0, temporarily.
- Step 3.** The antennas available can be viewed by pressing the **MEAS** key, then the Field Strength and Select Custom Antenna soft keys.

Downloading Antenna Factors

All 10 antennas can be downloaded to the PC from the instrument. This allows for modifications to the antenna factors of an antenna or the addition or deletion of available antennas from the list.

The antennas can then be uploaded to the instrument. To download the antennas:

- Step 1.** Connect the RS232 cable between the PC and the instrument.
- Step 2.** Verify that the instrument is sweeping at a sweep rate faster than 5 seconds/sweep.
- Step 3.** Select the **Query Antenna Factors** button in the Antenna Editor.
- Step 4.** Modify the desired antenna(s).

Chapter 11

Master Software Tools

Introduction

This chapter provides an introduction to the Anritsu Master Software Tools (MST) program. Users of the legacy Handheld Software Tools (HHST) program are strongly encouraged to migrate to new MST platform. This new platform has numerous productivity advantages over HHST as described below in the list of features. All future product enhancements will be implemented via MST.

Master Software Tools is a suite of Microsoft Windows programs for transferring saved measurements, along with markers and limit lines, to a PC display. The programs provide the ability to modify display parameters, overlay multiple traces, upload and download traces, print traces using local or networked printers, create or modify language files, edit the cable and signal standard lists, and convert .dat files to the new .vna format.

Master Software Tools requires Windows 2000 (Service Pack 4 or above), Windows XP (Service Pack 2 or above), or Windows VISTA. MST will not function on earlier versions of the Microsoft Windows operating system as the program relies on the Microsoft .NET Framework.

Key Features of Master Software Tools

- **DAT File Conversion Tool** – this utility imports .DAT files from Handheld Software Tools and converts them to the new MST format. The .DAT file is unchanged by the process. Once converted, these new files can be opened and edited using the Measurement Editor.
- **Cable Editor** – This application allows you to delete, modify, and add new cables to the instrument memory.
- **Signal Standard Editor** – If there is a standard that is not included in the instrument, MST can modify, edit, and append the signal standard list.
- **Product Update** – This feature keeps you informed of the latest instrument firmware version.
- **Integrated Codeloader** – No need to install a separate program to upgrade instrument Firmware. Everything can be addressed with MST.
- **Trace Rename Utility** – Allows you to rename hundreds of traces in a couple of minutes. This is a real time saver for people spending a lot of time renaming traces.
- **Group Edit** – If you have a folder with hundreds of traces and you forgot to turn on the markers or limit lines, you can use the Group Edit tool to copy the markers and limit line from one trace to all traces in a specific folder.
- **Advanced limit line editor** – Create and upload complex limit line masks to the instrument.
- **Standard Windows File Management** – simplify the process of downloading, dragging, and dropping files.

- Language Editor – this utility allows you to add new or modify existing language tables. Languages available for selection are English, French, German, Spanish, Italian, Japanese, Chinese and Korean. All of these languages except for English can be edited. Up to two more custom languages can be loaded using this utility.
- AVI Files – Create video files of your favorite Spectrogram measurement.

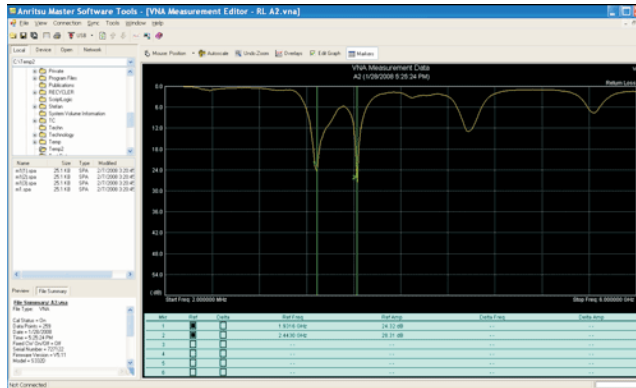


Figure 11-3. VNA measurement using the marker table

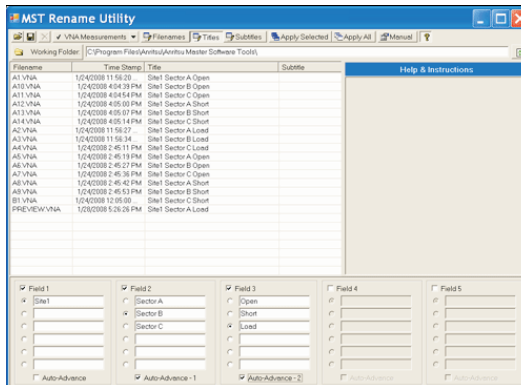


Figure 11-4. Trace Rename utility enables you to rename hundreds of traces in minutes

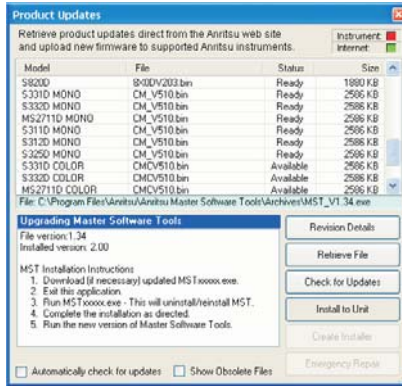


Figure 11-6. MST Product Update Tools used to download the latest software and firmware

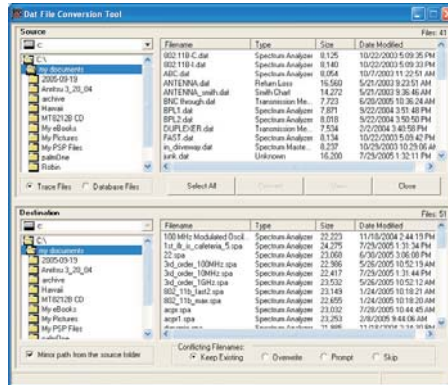


Figure 11-5. DAT file conversion tool used to convert existing SPA and Cable & Antenna traces to MST

NOTE: New firmware is not compatible with Master Software Tools version 1.25 or older. Insure that you have maximum functionality by updating your Master Software Tools to the latest version.

Minimum System Requirements

- Microsoft Windows 2000 (Service Pack 4 or above), Windows XP (Service Pack 2 or above), or Windows VISTA
- Microsoft .NET Framework, Version 2.0
- Intel Pentium 233 MHz microprocessor (Pentium III 350 MHz or better recommended)
- 128 MB of available RAM (256 MB or above recommended)
- Hard disk drive with approximately 80 MB of available space (an additional 80 MB free space for storage of captured plots is recommended.)
- A USB port (USB 1.2 required, USB 2.0 recommended) or an Ethernet 10/100 Base-T connection for communication with the instrument

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