

**Anritsu**

**MS2711B  
Hand Held  
Spectrum Analyzer**

*User's Guide*



Hand-Held Spectrum Analyzer for Measuring,  
Monitoring and Analyzing Signal Environments

## **WARRANTY**

The Anritsu product(s) listed on the title page is (are) warranted against defects in materials and workmanship for one year from the date of shipment. Anritsu's obligation covers repairing or replacing products which prove to be defective during the warranty period. Buyers shall prepay transportation charges for equipment returned to Anritsu for warranty repairs. Obligation is limited to the original purchaser. Anritsu is not liable for consequential damages.

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## **UPDATES**

Updates to this manual, if any, may be downloaded from the Anritsu internet site at: <http://www.us.anritsu.com>.

# 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:** MS2711B

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

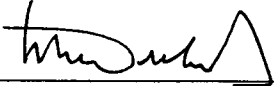
## **Electromagnetic Interference:**

**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 61000-4-11:1994/EN61326: 1998 - 100% @ 20msec

## **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

03 Dec 01  
Date

European Contact: For Anritsu product EMC & LVD information, contact Anritsu LTD, Rutherford Close,  
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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 Hand Held Spectrum Analyzer model listed below. Throughout this manual, this instrument may be referred to as an Anritsu HHSA.

<u>Model</u>	<u>Frequency Range</u>
MS2711B	100 kHz to 3000 MHz

### Description

The Anritsu HHSA 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 200 results is provided as is storage and recall of up to 10 measurement setups. A large, high-resolution liquid crystal display (LCD) provides easy viewing in a variety of lighting conditions. The Anritsu HHSA is capable of up to two and one-half hours of continuous operation from a fully charged battery and can be operated from a 12.5 Vdc source (which will also simultaneously charge the battery). Built-in energy conservation features can be used to extend battery life over an eight-hour workday.

The Anritsu HHSA 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. To permit use in low-light environments, the LCD can be back lit using a front panel key.

### Standard Accessories

Anritsu Software Tools, a PC-based software program, provides an on-line database record for storing measurement data. Software Tools can also convert the Anritsu HHSA display to a Microsoft Windows 95/98/NT4/2000/ME/XP graphic. Measurements stored in the Anritsu HHSA 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 MS2711B:

- Soft Carrying Case
- AC-DC Adapter
- Automotive Cigarette Lighter 12 Volt DC Adapter
- CD ROM containing the Software Tools program.
- Serial Interface Cable (Null Modem Type)
- Rechargeable NiMH Battery
- One year Warranty (includes battery, firmware, and software)
- User's Guide

## Options

- Option 5 — RF Wattmeter Power Monitor (RF detector not included)
- Option 8 — Built-in 20 dB Preamplifier, 1 MHz to 3 GHz
- Option 20 — Built-in Tracking Generator, 10 MHz to 3 GHz

## Printers

- 2000-766 HP DeskJet Printer, with Interface Cable, Black Print Cartridge, and U.S. Power Cable
- 2000-753 Serial-to-Parallel Converter Cable
- 2000-661 Black Print Cartridge
- 2000-1207 Rechargeable Battery Pack for HP 350 Deskjet
- 2000-663 Power Cable (Europe) for DeskJet Printer
- 2000-664 Power Cable (Australia) for DeskJet Printer
- 2000-665 Power Cable (U.K.) for DeskJet Printer
- 2000-667 Power Cable (So. Africa) for DeskJet Printer
- 2000-1008 Seiko DPU-414-30BU Thermal Printer with Internal Battery, Thermal Printer Paper, Serial Cable, Power Cable
- 2000-755 Five rolls of Thermal Paper
- 2000-1002 U.S. Adapter for Seiko DPU-414-30B
- 2000-1003 Euro Adapter for Seiko DPU-414-30B
- 2000-1194 Japan Adapter for Seiko DPU-414-30B
- 2000-1004 Battery Pack Adapter for Seiko DPU-414-30B
- 2000-1012 Serial 9-pin male to 9-pin female cable for Seiko DPU-414-30B

## Optional Accessories

Optional Accessories are shown in Table 1-1.

Table 1-1. *Optional Accessories*

Part Number	Description
5400-71N50	RF Detector, N(m), 50 ohm, 1 to 3000 MHz
42N50A-30	Attenuator, 30 dB, 50 Watt, bi-directional
15NN50-1.5C	Test Port Cable Armored, 1.5 meter, N(m) to N(m), 6 GHz
15NN50-3.0C	Test Port Cable Armored, 3.0 meter, N(m) to N(m), 6 GHz
15NN50-5.0C	Test Port Cable Armored, 5.0 meter, N(m) to N(m), 6 GHz
15NNF50-1.5C	Test Port Cable Armored, 1.5 meter, N(m) to N(f), 6 GHz
15NNF50-5.0C	Test Port Cable Armored, 3.0 meter, N(m) to N(f), 6 GHz
15NNF50-3.0C	Test Port Cable Armored, 5.0 meter, N(m) to N(f), 6 GHz
15ND50-1.5C	Test Port Cable Armored, 1.5 meter, N(m) to 7/16 DIN(m), 6 GHz
15NDF50-1.5C	Test Port Cable Armored, 1.5 meter, N(m) to 7/16 DIN(f), 6 GHz
800-109	Detector Extender Cable, 7.6m (25 ft.)
800-110	Detector Extender Cable, 15.2m (50 ft.)
800-111	Detector Extender Cable, 30.5m (100 ft.)
800-112	Detector Extender Cable, 61m (200 ft.)
510-90	Adapter 7/16 (f) to N(m), 3.5 GHz
510-91	Adapter 7/16 (f) to N(f), 3.5 GHz
510-92	Adapter 7/16 (m) to N(m), 3.5 GHz
510-96	Adapter 7/16 DIN (m) to 7/16 DIN (m), 3.5 GHz
510-97	Adapter 7/16 DIN (f) to 7/16 DIN (f), 3.5 GHz
1091-26	Adapter, DC to 18 GHz, 50 Ohm, N(m)-SMA(m)
1091-27	Adapter, DC to 18 GHz, 50 Ohm, N(m)-SMA(f)
1091-172	Adapter, DC to 1.3 GHz, 50 Ohm, N(m)-BNC(f)
34NN50A	Precision Adapter, DC to 18 GHz, 50 Ohm, N(m)-N(m)
34NFN50	Precision Adapter, DC to 18 GHz, 50 Ohm, N(f)-N(f)
61N50	RF SWR Bridge, 10-2500 MHz, 50 Ohm, N(m)
61NF50	RF SWR Bridge, 10-2500 MHz, 50 Ohm, N(f)
1030-86	Band Pass Filter, 800 MHz band, 806-869 MHz, RL=1.7 dB, N(m)-SMA(f)
1030-87	Band Pass Filter, 900 MHz band, 902-960 MHz, RL=1.7 dB, N(m)-SMA(f)
1030-88	Band Pass Filter, 1900 MHz band, 1.85-1.99 GHz, RL=1.8 dB, N(m)-SMA(f)
1030-89	Band Pass Filter, 2400 MHz band, 2.4-2.5 GHz, RL=1.9 dB, N(m)-SMA(f)
12N50-75B	Matching Pad, converts 75 Ohms to 50 Ohms, 7.5 dB loss



*Table 1-1. Optional Accessories (continued)*

<b>Part Number</b>	<b>Description</b>
48258	Spare Soft Carrying Case
40-115	Spare AC/DC Adapter
806-62	Spare Automotive Cigarette Lighter/12 Volt DC adapter
800-441	Spare Serial Interface Cable
551-1691	USB to Serial Adapter
760-215A	Transit Case for Anritsu Hand Held Spectrum Analyzer
633-27	Rechargeable Battery, NiMH
2300-347	Anritsu Hand Held Spectrum Analyzer Software Tools
10580-00074	Anritsu HHSA User's Guide, Model MS2711B
10580-00071	Anritsu HHSA Programming Manual, Model MS2711B
10580-00072	Anritsu HHSA Maintenance Manual, Model MS2711B
2000-1029	Battery Charger (NiMH), with Universal Power Supply
2000-1030	Portable Antenna, 50 Ohm, SMA (m), 1.71 to 1.88 GHz
2000-1031	Portable Antenna, 50 Ohm, SMA (m), 1.85 to 1.99 GHz
2000-1032	Portable Antenna, 50 Ohm, SMA (m), 2.4 to 2.5 GHz
2000-1200	Portable Antenna, 50 Ohm, SMA (m), 806-869 MHz
2000-1035	Portable Antenna, 50 Ohm, SMA (m), 902-960 MHz
70-28	Headset

# 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 3)

Description	Value
<u>Frequency</u>	
Frequency Range	100 kHz to 3.0 GHz
Frequency Reference	
Aging	±1 ppm/yr
Accuracy	±2 ppm
Frequency Span	1 kHz to 3 GHz in 1, 2, 5 step selections in auto mode, plus zero span
Sweep Time	≥ 6.5 seconds full span; 510 ms zero span
SSB Phase Noise	-75 dBc/Hz, 30 kHz offset
Spurious Responses	
Input Related	≤ -45 dBc
Spurious	
Residual Responses	≤ -90 dBm, ≥ 500 kHz
<u>Resolution Bandwidth</u>	
Selections	10 kHz, 30 kHz, 100 kHz and 1 MHz
Accuracy	± 20% typical
<u>Video Bandwidth</u>	
Selection	100 Hz to 300 kHz in 1-3 sequence
<u>Amplitude</u>	
Measurement Range	+20 dBm to -95 dBm (without options)
Maximum Input Level	+23 dBm, without damage ±50 VDC
Displayed Average Noise Level:	≤ -115 dBm (≥1 MHz typical with preamplifier on) ≤ -95 dBm (≥500 kHz, typical with preamplifier off) ≤ -80 dBm (<500 kHz, typical with preamplifier off)
Dynamic Range	> 65 dB
Total Level Accuracy	±2 dB ≥ 500 kHz, typical * ±3 dB < 500 kHz, typical * * For input signal levels ≥ -60 dBm, accuracy of 50 MHz @ -30 dBm = ± 1 dB
<u>Amplitude Units</u>	
Log Scale Mode	dBm/m, dBV/m, dBmV/m, dBμV/m
Display Range	2 to 15 dB/division, in 1 dB steps, 10 divisions displayed
Attenuator	Range: 0 to 50 dB, selected manually or automatically coupled to the reference level. Resolution in 10 dB steps.

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

Description	Value
<u>Display</u>	
Type	Monochrome LCD with back light capability
Resolution	640 × 480
Marker Modes	Standard delta marker to peak marker to center (M1 to M4 only) marker to valley (M5 & M6 only)
<u>Memory</u>	
Trace Storage	200 traces
Setup Storage	10 setups
Displayed Traces	2 traces
<u>Inputs</u>	
RF Input	50 Ω
Connector	Female, Type N
RF Input VSWR	(≥20 dB atten.) 2.0:1 typical
<u>RS232 Interface</u>	
Type	Null modem
Baud Range	9600, 19.2k, 38.4k, 56k, 115.2k baud
<u>Printer Interface</u>	
Drivers	Refer to the list of supported printers on page 2-20
<u>Tracking Generator</u>	
Frequency	
Range	10.0 MHz to 3.0 GHz
Resolution	5.0 kHz
Tracking Offset Range	±5 MHz
Output	
Output Power Level	0 to -60 dBm
Resolution	0.1 dB
Absolute Level Accuracy	±1.5 dB, 0 to -40 dBm, ±4.0 dB, -40 dBm to -60 dBm
Output Tracking VSWR	<2.0:1, <0 dBm; <1.5:1, <-12 dBm
Spurious Harmonics	≤-20 dBc
Non-Spurious Harmonics	≤-20 dBc
Measurement Range	+20 to -90 dBm (>10 MHz, typical w/ tracking generator on)

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

Description	Value
<u>Preamplifier</u>	
Frequency	1.0 MHz to 3.0 GHz
Amplitude	20 dB, 1.0 MHz to 3.0 GHz typical
Measurement Range	–25 dBm to –115 dBm (typical with preamplifier on)
Maximum Input Level	+13 dBm, without damage
	±50 VDC
Displayed Avg Noise Level	≤ –115 dBm (1 MHz to 3 GHz typical)
<u>General Characteristics</u>	
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 mA maximum External DC input: +11 to +15 Vdc, 1250 mA max.
Temperature	Operating: 0 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 HHS A preventive maintenance consists of cleaning the unit and inspecting and cleaning the RF connector on the instrument and all accessories.

Clean the Anritsu HHS A 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 HHS A loads factory calibration data during start-up, eliminating the need for daily calibration checks.

## Annual Calibration

Although the Anritsu HHS A 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 MS2711B, 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 to the MS2711B, may damage the MS2711B input circuitry. MS2711B operators should be aware of the potential for ESD damage and take all necessary precautions. Operators should exercise practices outlined within industry standards like 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 MS2711B, it is recommended to dissipate any static charges that may be present before connecting the coaxial cables or antennas to the MS2711B. This may be as simple as temporarily attaching a short or load device to the cable or antenna prior to attaching to the MS2711B. 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

Table 1-3 provides a listing of the Anritsu Service Centers.

Table 1-3. Anritsu Service Centers

## UNITED STATES

ANRITSU COMPANY  
685 Jarvis Drive  
Morgan Hill, CA 95037-2809  
Telephone: (408) 776-8300  
FAX: 408-776-1744

ANRITSU COMPANY  
10 NewMaple Ave., Suite 305  
Pine Brook, NJ 07058  
Telephone: 973-227-8999  
FAX: 973-575-0092

ANRITSU COMPANY  
1155 E. Collins Blvd  
Richardson, TX 75081  
Telephone: 1-800-ANRITSU  
FAX: 972-671-1877

## AUSTRALIA

ANRITSU PTY. LTD.  
Unit 3, 170 Foster Road  
Mt Waverley, VIC 3149  
Australia  
Telephone: 03-9558-8177  
FAX: 03-9558-8255

## BRAZIL

ANRITSU ELECTRONICA LTDA.  
Praia de Botafogo 440. Sala 2401  
CEP22250-040, Rio de Janeiro, RJ,  
Brasil  
Telephone: 021-527-6922  
FAX: 021-53-71-456

## CANADA

ANRITSU INSTRUMENTS LTD.  
700 Silver Seven Road, Suite 120  
Kanata, Ontario K2V 1C3  
Telephone: (613) 591-2003  
FAX: (613) 591-1006

## CHINA (SHANGHAI)

ANRITSU ELECTRONICS CO LTD  
2F,Rm.B, 52 Section Factory Bldg.  
NO 516 Fu Te Road (N)  
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Pudong, Shanghai 200131  
PR CHINA  
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FAX: 86-21-58680588

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FAX: 016-44-61-065

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FAX: 0211-968555

## INDIA

MEERA AGENCIES (P) LTD  
A-23 Hauz Khas  
New Delhi, India 110 016  
Telephone: 011-685-3959  
FAX: 011-686-6720

## ISRAEL

TECH-CENT, LTD  
4 Raul Valenberg St.  
Tel-Aviv, Israel 69719  
Telephone: 972-36-478563  
FAX: 972-36-478334

## ITALY

ANRITSU Sp.A  
Rome Office  
Via E. Vittorini, 129  
00144 Roma EUR  
Telephone: (06) 50-2299-711  
FAX: 06-50-22-4252

## JAPAN

ANRITSU CUSTOMER SERVICE LTD.  
1800 Onna Atsugi—shi  
Kanagawa-Prf. 243 Japan  
Telephone: 0462-96-6688  
FAX: 0462-25-8379

## KOREA

ANRITSU SERVICE CENTER  
8F Sanwon Bldg.  
1329-8 Seocho-Dong  
Seocho-Ku  
Seoul, Korea 137-070  
Telephone: 82-2-581-6603  
FAX: 82-2-582-6603

## SINGAPORE

ANRITSU (SINGAPORE) PTE LTD  
10, Hoe Chiang Road  
#07-01/02  
Keppel Towers  
Singapore 089315  
Telephone: 65-282-2400  
FAX: 65-282-2533

## SOUTH AFRICA

ETESCSA  
12 Surrey Square Office Park  
330 Surrey Avenue  
Ferndale, Randburt, 2194  
South Africa  
Telephone: 011-27-11-787-7200  
Fax: 011-27-11-787-0446

## SWEDEN

ANRITSU AB  
Botvid Center  
Fittja Backe 13A  
145 84  
Stockholm, Sweden  
Telephone: (08) 534-707-00  
FAX: (08)534-707-30

## TAIWAN

ANRITSU CO., LTD.  
6F, No. 96, Section 3  
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Taipei, Taiwan, R.O.C.  
Telephone: (02) 515-6050  
FAX: (02) 509-5519

## UNITED KINGDOM

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Luton, Bedfordshire  
LU1 3LU, England  
Telephone: 015-82-43-3200  
FAX: 015-82-73-1303

# Chapter 2

## Quick Start Guide

### Introduction

This chapter provides a brief overview of the Anritsu MS2711B HHSAs. 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 MS2711B On for the First Time

The Anritsu MS2711B HHSAs are a lightweight, hand held, battery operated unit designed specifically for field environments and applications requiring mobility. It is capable of up to 2.5 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 MS2711B HHSAs can also be operated from a 12.5 Vdc source (which will also simultaneously charge the battery). This can be achieved with either the Anritsu AC-DC Adapter (P/N 40-115) or 12.5 Vdc Automotive Cigarette Lighter Adapter (P/N 806-62). Both items are included as standard accessories (see Chapter 1).

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

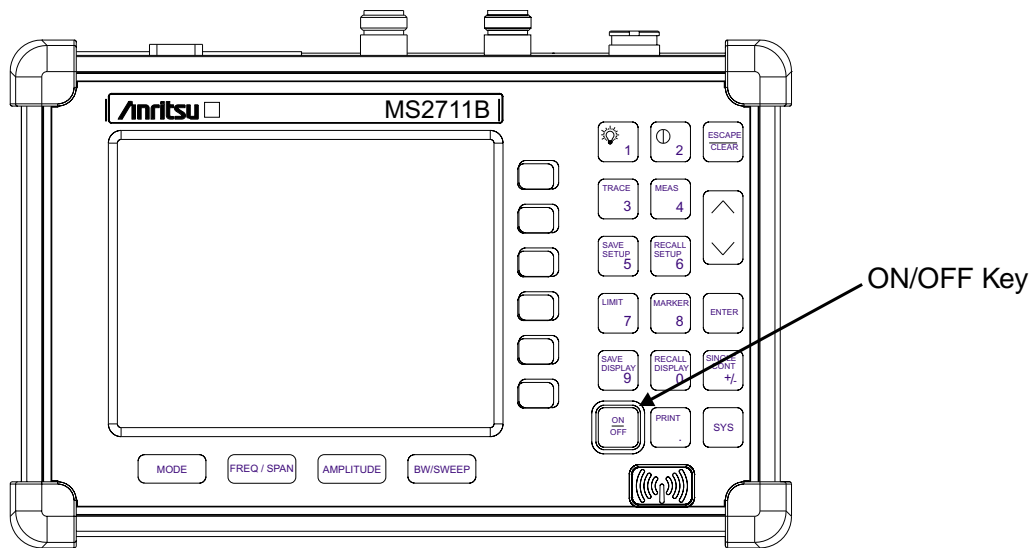


Figure 2-1. MS2711B Power ON/OFF Key

The HHSAs take 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 HHS A is now ready for operation. No additional keystrokes or installation are required. For information on making measurements with the Anritsu HHS A, refer to “Making a Basic Measurement,” on page 2-15. For advanced applications, refer to Chapter 4, *Measurement Fundamentals*, Chapter 6, *Preamplifier*, and Chapter 7, *Tracking Generator*.

## Front Panel Overview

The Anritsu HHS A 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 blue.

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.

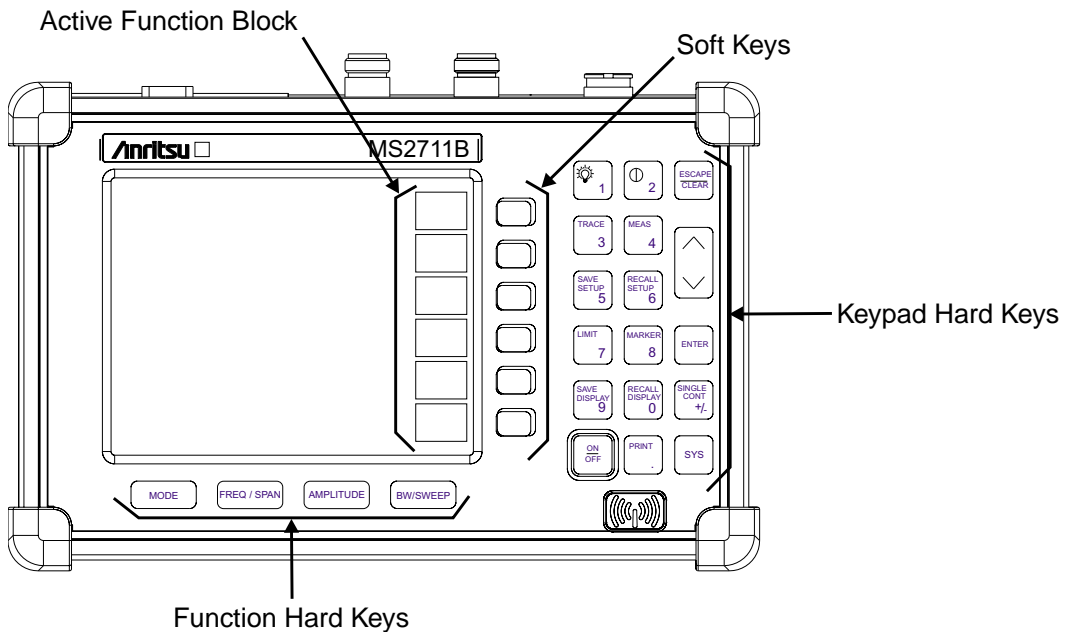


Figure 2-2. MS2711B Keys



## Display Overview

Figure 2-3 illustrates some of the key information areas of the MS2711B display.

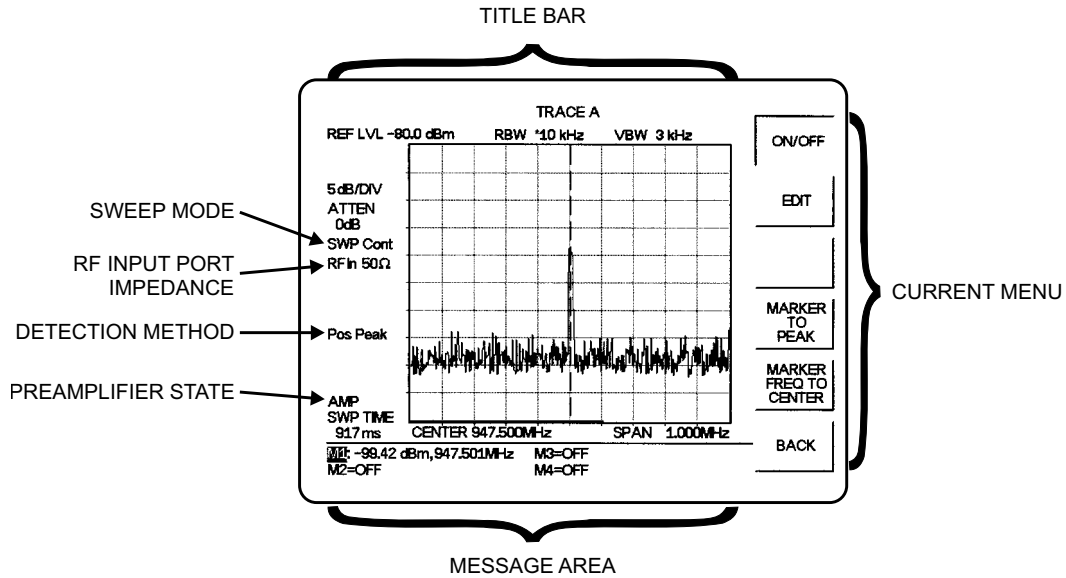


Figure 2-3. Display Overview

Figures 2-4 through 2-7 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	MENU	SOFT KEYS						
SPECTRUM ANALYZER (DEFAULT)	FREQ/SPAN	CENTER	SPAN	START	STOP			
	CENTER START STOP	GHz	MHz	kHz	Hz			
	SPAN	EDIT	FULL	ZERO	SPAN UP 1-2-5	SPAN DOWN 1-2-5	BACK	
	AMPLITUDE	REF LEVEL	SCALE	ATTEN	UNITS	REF LEVEL OFFSET		
	ATTEN	AUTO	MANUAL	DYNAMIC			BACK	
	UNITS	dBm	dBV	dBmV	dBuV	mW READOUT	BACK	
	BW/SWEEP	RBW	VBW	MAX HOLD	DETECTION	AVERAGE (1-25)		
	RBW	AUTO	MANUAL				BACK	
	VBW	AUTO	MANUAL				BACK	
	DETECTION	POSITIVE PEAK	AVERAGE	NEGATIVE PEAK			BACK	
	POWER MONITOR	POWER MONITOR	UNITS	REL	OFFSET	ZERO		

Figure 2-4. Function Hard Keys Menu Structure, Spectrum Analyzer and Power Monitor Modes

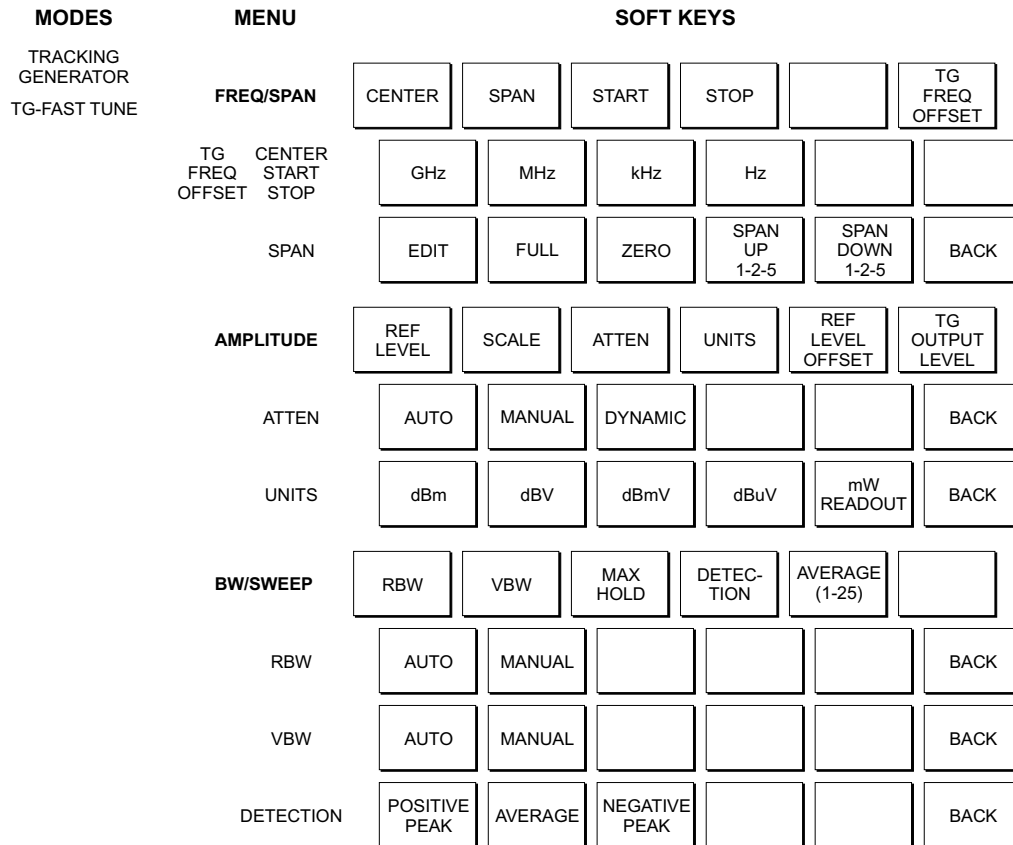


Figure 2-5. Function Hard Keys Menu Structure, Tracking Generator Modes

MODE	MENU	SOFT KEYS					
SPECTRUM ANALYZER (DEFAULT)	TRACE	NORMALIZE	A->B	A - B -> A	A + B -> A	TRACE A	TRACE B
	TRACE A	RESET A	NORMALIZE ON/OFF				BACK
	TRACE B	VIEW B	CLEAR B	RECALL TRACE ->B			BACK
	MEAS	FIELD STRNGTH	OBW	CHANNEL POWER	ACPR	PREAMP	MORE
	FIELD STRNGTH	ON/OFF	SELECT ANTENNA				BACK
	OBW	METHOD	%	dBc		MEASURE ON/OFF	BACK
	CHANNEL POWER	CENTER FREQ	INT BW	CHANNEL SPAN		MEASURE ON/OFF	BACK
	ACPR	CENTER FREQ	MAIN CH BW	ADJ CH BW	CHANNEL SPACING	MEASURE ON/OFF	BACK
	MORE	AM/FM DEMOD					BACK
	AM/FM DEMOD (SSB/CW)	ON/OFF	DEMOD TYPE	VOLUME	BFO ADJUST		BACK
	AM/FM DEMOD (AM, FM-NARROW, FM-WIDE)	ON/OFF	DEMOD TYPE	VOLUME	SET CTR FREQ STEP SIZE	STEP CENTER FREQ	BACK
	LIMIT	SINGLE LIMIT	MULTIPLE UPPER LIMITS	MULTIPLE LOWER LIMITS	LIMIT BEEP		
	SINGLE LIMIT	ON/OFF	EDIT	BEEP AT LEVEL			BACK
	MULTIPLE UPPER LIMITS	SEGMENT 1	SEGMENT 2	SEGMENT 3	SEGMENT 4	SEGMENT 5	BACK
	MULTIPLE LOWER LIMITS	SEGMENT 1	SEGMENT 2	SEGMENT 3	SEGMENT 4	SEGMENT 5	BACK
	SEGMENT	ON/OFF	EDIT		PREV SEGMENT	NEXT SEGMENT	BACK

Figure 2-6. Keypad Hard Keys Menu Structure

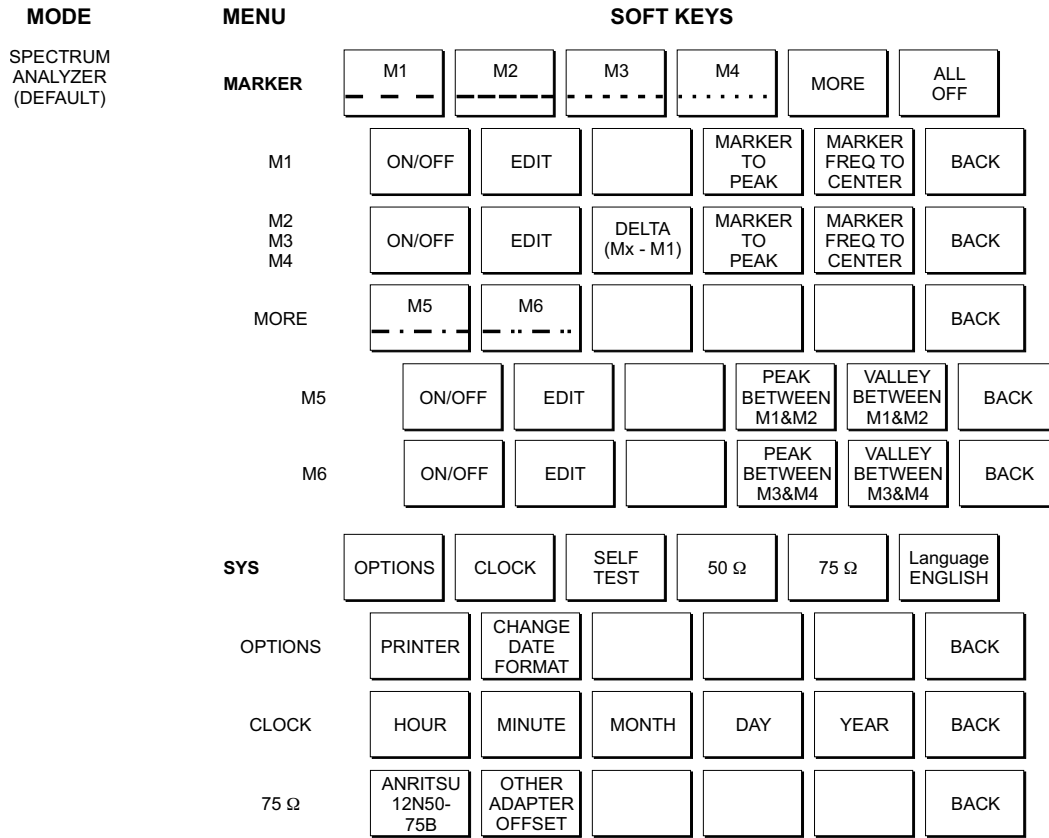


Figure 2-7. Keypad Hard Keys Menu Structure (continued)

## Test Panel Connectors

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

**12.5-15VDC (1100 mA)** DC input to power the unit or for battery charging.  
Input is 12.5 to 15 Vdc @ 1100 mA.

### 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.*

<b>Battery Charging</b>	Indicator light to show that the battery is being charged. The indicator light automatically shuts off when the battery is fully charged.
<b>External Power</b>	Indicator light to show that the HHS A is being powered by the external charging unit.
<b>Headphone Jack</b>	Allows connection of audio headphones for monitoring AM/FM demodulation.
<b>Serial Interface</b>	RS232 DB9 interface to a COM port on a personal computer (for use with the Anritsu Software Tools program). Also provides a serial interface to a printer.
<b>RF In</b>	50 $\Omega$ RF input for spectrum analysis and stimulus-response measurements.
<b>RF Out</b>	50 $\Omega$ RF output for Tracking Generator measurements (Option 20).
<b>RF Det</b>	RF detector input for the Power Monitor (Option 5).
<b>Battery Compartment</b>	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

- MS2711B Hand Held Spectrum Analyzer
- Test Port Extension Cable, Anritsu 15NNF50-1.5C

## 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 enter the desired center frequency on the keypad. Select the **GHZ**, **MHZ**, **KHZ**, or **HZ** softkey to accept the center frequency input.  
*or*  
To set a specific frequency band, select the **START** soft key and enter the desired start frequency on the keypad. Select the **GHZ**, **MHZ**, **KHZ**, or **HZ** softkey to accept the start frequency input. Then select the **STOP** soft key and enter the desired stop frequency on the keypad. Select the **GHZ**, **MHZ**, **KHZ**, or **HZ** softkey to accept the stop frequency input.

## 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, enter the desired span on the keypad and select the **GHZ**, **MHZ**, **KHZ**, or **HZ** soft key to accept the input.  
*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 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.

*NOTE: Press the **ATTEN** 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**.

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"**.

- Step 1.** Press the **BW/SWEEP** key to display the bandwidth menu.
- Step 2.** To select the resolution bandwidth, press the **RBW** soft key.
- Step 3.** Press **AUTO** for automatic resolution bandwidth selection, or press **MANUAL** and use the Up/Down arrow key to select the resolution bandwidth. Press **ENTER** to set the resolution bandwidth. Press the **BACK** soft key to return to the bandwidth menu
- Step 4.** To select the video bandwidth, press the **VBW** soft key.
- Step 5.** Press **AUTO** for automatic video bandwidth selection, or press **MANUAL** and use the Up/Down arrow key to select the video bandwidth. Press **ENTER** to set the video bandwidth.

## Selecting Sweep Parameters

### Max Hold

To toggle maximum hold ON or OFF, press the **MAX HOLD** soft key. Maximum hold displays the maximum response of the input signal over multiple sweeps.



### 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 three available detection methods are Positive Peak, Average, and Negative Peak. Positive peak displays the maximum value of all the measurements associated with that display point. Average detection displays the mean of all the measurements associated with that display point. Negative peak displays the minimum value of all the measurements associated with that display point.

To set the detection method, press the **DETECTION** soft key and select either **POSITIVE PEAK**, **AVERAGE**, or **NEGATIVE PEAK** detection.

### 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 **AVERAGE (1-25)** 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 and AVERAGE are mutually exclusive.*

### Selecting Units

The output can be displayed in dBm, dBV, dBmV, or dB $\mu$ V. To select the display units:

- Step 1.** Press the **AMPLITUDE** key.
- Step 2.** Press the **UNITS** soft key
- Step 3.** Select the soft key for the desired units.

To display marker and channel power results in mW:

- Step 4.** Press the **AMPLITUDE** key.
- Step 5.** Press the **UNITS** soft key
- Step 6.** Select the **mW READOUT** soft key.

*NOTE: When mW READOUT is selected, values  $\geq 1000$  mW will be displayed in Watts (W). Values  $< 0.0001$  mW will be displayed in nano-Watts (nW). Values  $< 1$  nW will be displayed in pico-Watts (pW).*

### Adjusting Markers

- Step 1.** Press the **MARKER** key to call up the Markers menu.
- Step 2.** Press the **M1** soft key to select the M1 marker function.
- Step 3.** Press the **EDIT** soft key and enter an appropriate value using the keypad or Up/Down arrow key. Select the **GHz**, **MHz**, **kHz**, or **Hz** softkey to accept the marker frequency input. 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.

## Adjusting Limits

The MS2711B 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 **BEEP AT LEVEL** 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 **BEEP AT LEVEL** 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. The status window will display the value of the segment endpoints: **ST FREQ, ST LIMIT, END FREQ, END LIMIT**. The current parameter is highlighted. When you first press the **EDIT** soft key, the value of the **ST FREQ** parameter is highlighted.
- Step 5.** Either enter the value using the numeric keypad or scroll the limit line using the **UP/DOWN** arrow key.

- Step 6.** When editing the start frequency or end frequency, the unit terminator keys (GHz, MHz, kHz, Hz) will appear on the soft keys. Press the appropriate terminator key to continue. The ST LIMIT parameter will now be highlighted.
- Step 7.** Either enter the value using the numeric keypad or scroll the limit line using the UP/DOWN arrow key.
- Step 8.** Press the **ENTER** key to continue.
- Step 9.** Repeat Steps 5 and 6 for the end frequency.
- Step 10.** Repeat Step 7 for the end limit.
- Step 11.** 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 12.** Repeat Steps 4 through 11 for the remaining segments.
- Step 13.** When the final segment is defined, press the EDIT soft key again to end the editing process.

The MS2711B 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 MS2711B 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 soft key.

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

### Auto Coupling

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 XX dB.

### Manual Coupling

When manually coupled, the attenuation can be adjusted independently of the reference level. Manual attenuation coupling is indicated on the display as ATTEN\* XX dB.

**IMPORTANT!**

*The attenuation should be adjusted such 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 such that the input signal at the mixer is  $-30$  dBm ( $+20 - 50 = -30$ ). This prevents signal compression.*

**Dynamic Attenuation**

Dynamic attenuation tracks the input signal level, automatically adjusting the reference level to the peak input signal. When dynamic attenuation is enabled, the attenuation is automatically coupled to the reference level. If the MS2711B is configured with the optional preamplifier, dynamic attenuation automatically activates or de-activates the preamplifier according to the signal environment.

Dynamic attenuation is indicated on the display as **ATTEN# XX dB**.

**Adjusting the Display Contrast**

The contrast of the MS2711B display can be adjusted to accommodate varying light conditions and to help discern traces when using the Trace Overlay feature (see page 4-16).

- Step 1.** Press the contrast key (numeric keypad number 2).
- Step 2.** Adjust the contrast using the UP/DOWN arrow key.
- Step 3.** Press **ENTER** to save the new setting.

**Setting the System Language**

The MS2711B can operate in English, French, German, Spanish, Chinese and 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 MS2711B RF In and RF Out ports both have  $50 \Omega$  impedance. The firmware of the MS2711B can compensate for a  $50$  to  $75 \Omega$  adapter on the RF In port.

- Step 1.** Press the **SYS** key.
- Step 2.** Press the  $75 \Omega$  soft key.
- Step 3.** Press the soft key corresponding to the adapter. The loss of the Anritsu 12N50-75B is pre-programmed, and no further action is required.
- Step 4.** If an adapter other than the Anritsu 12N50-75B is to be used, press the **OTHER ADAPTER OFFSET** soft key.
- Step 5.** Either enter the loss value using the numeric keypad or scroll the value using the UP/DOWN arrow key.
- Step 6.** Press **ENTER** to set the loss value.

## Making a Basic Measurement

Making a basic measurement with the Anritsu HHSA is similar to making a measurement with a conventional spectrum analyzer. Users need simply to power-on and tune the Anritsu Hand Held 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 HHSA to the factory default settings if a known starting state is desired before beginning any measurement. Some of the factory defaults include preamp off (if installed), RBW, VBW, and Span mathematically coupled, attenuation coupled to the reference level. There are two methods that can be used to reset the MS2711B to the factory defaults:  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 <DEFAULT> to recall the factory preset state.*

- 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 HHSA 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 hand held spectrum analyzer is set to the center-frequency span mode.*

- Step 3.** Enter 900 on the keypad and select the **MHz** soft key . Observe that the signal resembles that shown in Figure 2-8.

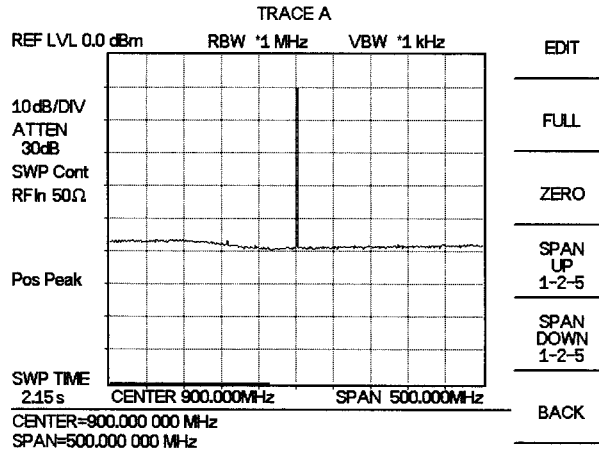


Figure 2-8. Signal at 900 MHz

## 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 in the status window. There are several methods by which to edit the open parameter.

### Enter a New Value

Enter a new value using the numeric keypad. As soon as a number is pressed, the soft keys change to the frequency terminator keys (**GHZ**, **MHZ**, **KHZ**, **HZ**). Select the appropriate terminator key.

### Automatically Set Full Span

Press the **FULL** soft key. The span will automatically be set to the full range of the MS2711B.

### Automatically Set Zero Span

Press the **ZERO** soft key. The span will automatically be set to zero, centered at the current center frequency.

### 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 20 MHz is shown in Figure 2-9.

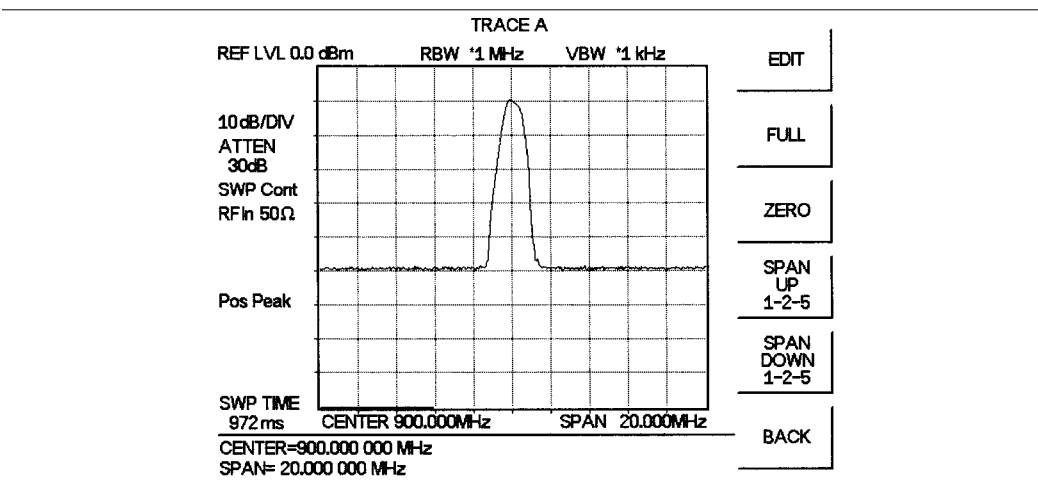


Figure 2-9. 20 MHz Frequency Span

## 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 2-10).

- Step 1.** Press the **AMPLITUDE** key.
- Step 2.** Press the **ATTEN** 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 keypad 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 2-10.

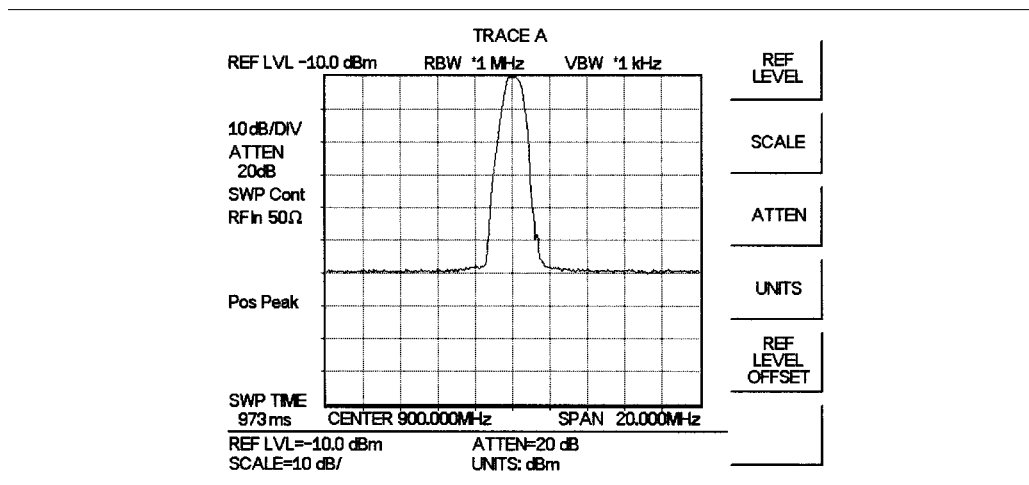


Figure 2-10 Reference Level set at  $-10$  dBm



## 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 -10.00 dBm, as shown in Figure 2-11.

- 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 2-11). The current marker is highlighted.

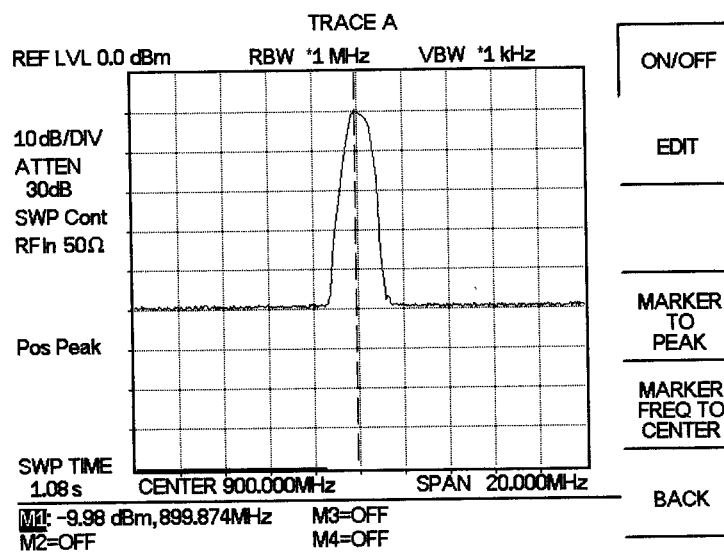


Figure 2-11. Activated Normal Marker

**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 MS2711B 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 Software Tools program (see Chapter 8, 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 MS2711B will resume measuring.

## Printing

Printing is accomplished using any printer listed in the MS2711B printer selection table. Available printers include:

Canon BJC 50	HP DJ 340, 350
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 1120
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 Model

Figure 2-12 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 350 ink jet printer or other parallel interface printer as follows:

<b>SW1</b>	<b>SW2</b>	<b>SW3</b>	<b>SW4</b>	<b>SW5</b>	<b>SW6</b>	<b>SW7</b>	<b>SW8</b>
OFF	ON	OFF	OFF	OFF	OFF	ON	OFF

Set the switches, SW1, SW2, and SW3, on the Seiko DPU-414 thermal printer as follows:

Switch	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>
SW1	OFF	ON	ON	ON	ON	OFF	ON	ON
SW2	ON	ON	ON	ON	ON	ON	ON	OFF
SW3	ON	ON	ON	OFF	OFF	ON	ON	ON

## Printer Setup

**Step 1.** Connect the printer as shown in Figure 2-12.

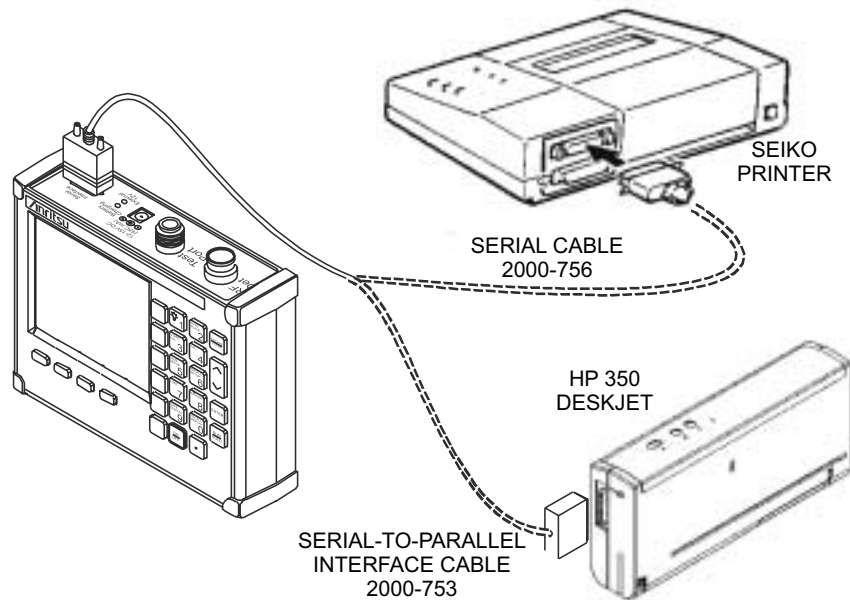


Figure 2-12. Printer Setup

- 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 a printer has been previously 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 2-12.
- 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 HHSA 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 HHSA

The battery can be charged while installed in the HHSA.

- Step 1.** Turn the HHSA off.
- Step 2.** Connect the AC-DC adapter (Anritsu part number: 40-115) to the HHSA DC power input port.
- Step 3.** Connect the AC adapter to a 120 VAC or 240 VAC power source as appropriate for your application.

The green external power indicator on the HHSA 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.*

### 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 HHSA 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 2-13). 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 remains. 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.

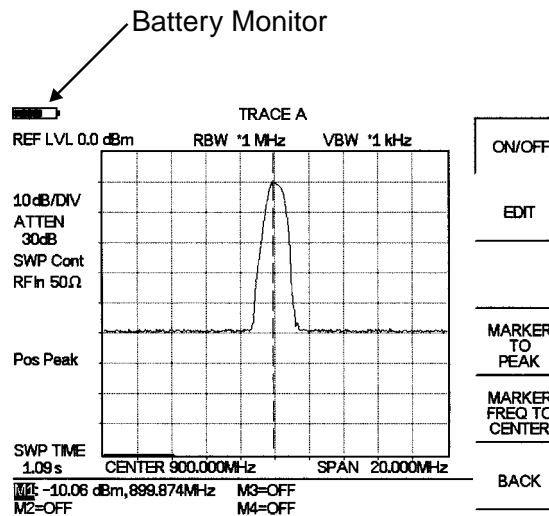


Figure 2-13. Battery Monitor

Once all the power has drained from the battery, the HHSA display will fade. At this point, your HHSA 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 charge remaining.

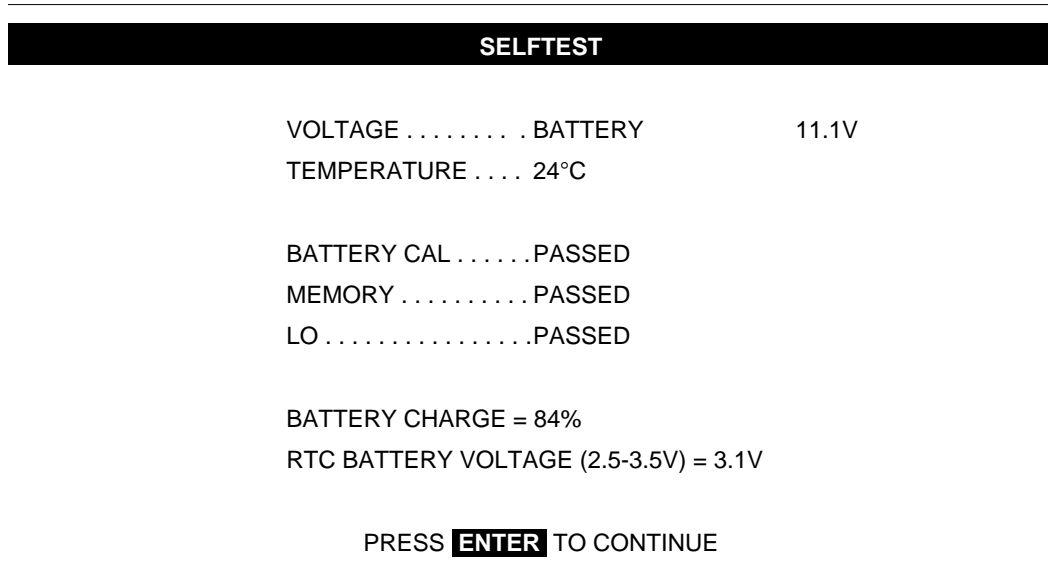


Figure 2-14. Self Test Battery Condition Display

## 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.

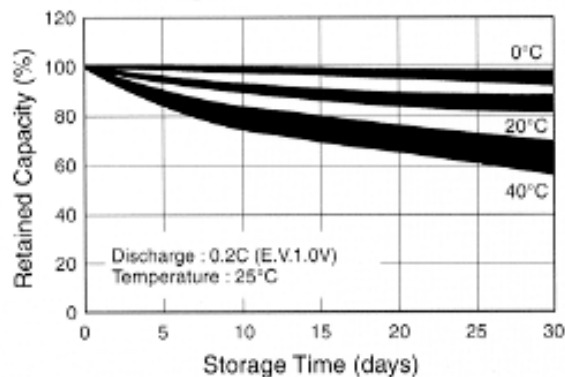


Figure 2-15. NiMH Battery Storage Characteristics

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 HHSA has already completed three charge and discharge cycles at the factory.
- Recharge the battery only in the HHSA or in an Anritsu approved charger.
- When the HHSA or the charger is not in use, disconnect it from the power source.
- Do not charge batteries for longer than 24 hours; overcharging may shorten battery life.
- If left unused a fully charged battery will discharge itself over time. Storing the battery in extreme hot or cold places will reduce the capacity and lifetime of the battery. The battery will discharge faster at higher ambient temperatures.
- Discharge an NiMH battery from time to time to improve battery performance and battery life.
- The battery can be charged and discharged hundreds of 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.
- 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.
- 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.
- 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.
- Batteries must be recycled or disposed of properly. Do not place batteries in garbage.
- Do not dispose of batteries in a fire!

## Symbols

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

Table 2-1. LCD Icon Symbols

---

<u>Icon</u>	<u>Symbol</u>
HOLD	Anritsu HHSAs are in power conservation mode while operating from the battery. To resume sweeping, press the <b>ENTER</b> key. After 10 minutes without a key press, the Anritsu HHSAs will automatically enter power conservation mode.
	PLL Lock fail indication. Check battery. (If the Anritsu HHSAs fail 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.

---

## Self Test

At turn-on, the Anritsu HHSAs run 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 HHSAs are within the specified operating 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 2-14, page 2-24) provides current status or pass/fail test information on the following:

- Battery Voltage
- Ambient Temperature
- Battery Calibration Test
- Memory Test
- Local Oscillator Test
- Tracking Generator Phase Lock Loop Test (if Option 20 is installed)
- Battery Charge State (percentage of charge remaining)
- Real Time Clock Battery Voltage



## 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*

<u>Error Message</u>	<u>Description</u>
BATTERY LOW	Battery voltage is less than 10 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>
LO LOCK FAIL	The spectrum analyzer phase-locked loops failed to lock. Charge battery. <i>If condition persists with a fully charged battery, call your Anritsu Service Center.</i>
TG PLL FAIL	The tracking generator 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>
POWER MONITOR FAIL	Failure of the power monitor system board voltages. <i>If condition persists, 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 main board has failed. <i>If 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>

**NOTE:** A listing of current Anritsu service centers is given in Table 1-3 , page 1-9.

### Operation Error Messages

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

Table 2-3. Error Messages (continued)

<u>Error Message</u>	<u>Description</u>
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 Setup, page 2-20) then retry.
CANNOT ZERO NO DETECTOR INSTALLED	Attempting to perform a Power Monitor zero adjust function with no RF detector connected to the Anritsu HHSA.
CANNOT ZERO INPUT SIGNAL TOO HIGH	Attempting to perform a Power Monitor zero adjust function with an input of greater than -20 dBm.
POWER MONITOR OPTION NOT INSTALLED	Attempting to enter Power Monitor mode with no Option 5 installed.
CHECK FOR OUT-OF-BAND INTERFERENCE	The preamp input is saturated, but there is no peak in the specified frequency range that has enough power to saturate the preamp. This error message can only appear when attenuation is set to DYNAMIC and Option 8 is installed.
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 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.

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## 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 2-16).

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*Figure 2-16. Using the Soft Carrying Case*

# Chapter 3

## Key Functions

### Introduction

This chapter provides a description of the Anritsu MS2711B Hand Held Spectrum Analyzer keypad controls. There are two kinds of keys available on the MS2711B front panel: Hard Keys and Soft Keys.

### Hard Keys

Hard keys are those keys on the front panel that are labeled in black and blue 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.

#### Function Hard Keys



- |                  |  |
|------------------|--|
| <b>MODE</b>      | Sets the Anritsu HHSA 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 <b>ENTER</b> key to implement the selection.  |
| <b>FREQ/SPAN</b> | Activates a menu of frequency and span related functions for selection using the soft keys. Available choices from this menu include <b>CENTER FREQUENCY</b> , <b>SPAN</b> , <b>START</b> frequency and <b>STOP</b> frequency. Soft key selection of any of these functions brings up a set of choices or selections specific to that procedure. |
| <b>AMPLITUDE</b> | Activates a menu of amplitude related functions including <b>REF LEVEL</b> , <b>SCALE</b> , <b>ATTEN</b> , <b>REF LEVEL OFFSET</b> , and <b>UNITS</b> . Soft key selection of any of these functions brings up a set of choices or selections specific to that procedure.  |
| <b>BW/SWEEP</b>  | Activates a menu of bandwidth and sweep related functions including <b>RBW</b> , <b>VBW</b> , <b>MAX HOLD</b> , <b>AVERAGE</b> , and <b>DETECTION</b> . 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.

<b>0-9</b>	These keys are used to enter numerical data as required to setup or perform measurements.
<b>+/-</b>	The plus/minus key is used to enter positive or negative values as required to setup or perform measurements.
<b>.</b>	The decimal point is used to enter decimal values as required to setup or perform measurements.
<b>ESCAPE CLEAR</b>	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.
<b>UP/DOWN ARROWS</b>	Increments or decrements a parameter value. The specific parameter value affected typically appears in the message area of the LCD.
<b>ENTER</b>	Implements the current action or parameter selection.
<b>ON OFF</b>	Turns the Anritsu HHSA on or off. When turned on, the last saved system state is restored. If the <b>ESCAPE/CLEAR</b> key is held down while the <b>ON/OFF</b> key is pressed, the factory preset state will be restored.
<b>SYS</b>	Allows selection of system setup parameters. Choices are <b>OPTIONS</b> , <b>CLOCK</b> , <b>50 Ω</b> , <b>75 Ω</b> , <b>Language</b> , and <b>SELF TEST</b> .

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

	Turns the liquid crystal display (LCD) back-lighting ON or OFF. (Leaving back lighting off conserves battery power.)
	LCD Contrast adjust. Use the Up/Down arrow key and <b>ENTER</b> to adjust the display contrast to suit ambient conditions.
<b>TRACE</b>	Activates a menu that allows comparison of a current runtime trace (Trace A) to a saved trace (Trace B).
<b>MEAS</b>	Activates a menu of measurement related functions including field strength, occupied bandwidth (OBW), channel power, adjacent channel power ratio (ACPR), AM/FM Demodulation and Preamp (if Option 8 is installed).
<b>SAVE SETUP</b>	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 <b>ENTER</b> key to implement.

<b>RECALL SETUP</b>	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 <b>ENTER</b> key to implement. Setup location 0 recalls the factory preset state.
<b>LIMIT</b>	Activates a menu of Limit functions including single limit, multiple upper limits, multiple lower limits, and limit beep.
<b>MARKER</b>	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.
<b>SAVE DISPLAY</b>	Saves the displayed trace to non-volatile memory. When the key is pressed, TRACE NAME: appears in the message area of the display. Select the alphanumeric characters for that trace name and press the <b>ENTER</b> key to implement.
<b>RECALL DISPLAY</b>	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 <b>ENTER</b> key to implement.
<b>SINGLE CONT</b>	Toggles the units sweep mode between continuous sweep mode and single sweep mode. The default is continuous sweep. When single sweep is selected, the Anritsu HHSA will sweep once and hold until activated again by pressing the <b>ENTER</b> key. The currently selected sweep mode appears on the LCD. Single sweep mode can be used to conserve battery power.
<b>PRINT</b>	Prints the current display to the selected printer. Refer to page 2-20 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.

The following paragraphs relate the menus displayed in the active function block when the various function hard keys or keypad hard keys are selected.

### Mode Menu

Pressing the **MODE** key activates a menu of mode related choices. Use the **Up/Down** arrow key to highlight the desired mode and press **ENTER** to select. The selections available on this menu will vary depending upon which options are installed in the MS2711B.

- |                           |   |
|---------------------------|---|
| <b>SPECTRUM ANALYZER</b>  | Selects Spectrum Analyzer mode of operation.  |
| <b>POWER MONITOR</b>      | Selects Power Monitor mode of operation.  |
| <b>TRACKING GENERATOR</b> | Selects Tracking Generator mode of operation.   |
| <b>TG-FAST TUNE</b>       | Selects Fast Tune Tracking Generator mode of operation. This mode optimizes the RBW, VBW parameters and number of frequency points for fastest sweep speed. |

### Frequency/Span Menu

Pressing the **FREQ/SPAN** key 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 message area. Complete the entry by pressing the appropriate softkey frequency designation.

- |               |   |
|---------------|---|
| <b>CENTER</b> | Activates the center frequency function and sets the Anritsu HHS to the center frequency mode. A specific center frequency can be entered by using the keypad or Up/Down arrow key. Select the GHz, MHz, kHz, or Hz softkey to accept the center frequency input. |
| <b>SPAN</b>   | Pressing the <b>SPAN</b> soft key activates a menu of span related choices in the active function block.  |
| <b>EDIT</b>   | Allows direct entry of a specific frequency span. Use the keypad or Up/Down arrow key to select the span of choice and complete the entry by pressing the GHz, MHz, kHz, or Hz softkey.   |
| <b>FULL</b>   | Sets the Anritsu HHS to its maximum frequency span, 2.9999 GHz.   |
| <b>ZERO</b>   | Sets the span to 0 Hz.  |

<b>SPAN UP</b> <b>1-2-5</b>	Activates the span function so that the span may be increased quickly in a 1-2-5 sequence.
<b>SPAN DOWN</b> <b>1-2-5</b>	Activates the span function so that the span may be reduced quickly in a 1-2-5 sequence.
<b>BACK</b>	Returns to the previous menu level.
<b>START</b>	Activates the start frequency and sets the Anritsu HHSA in the Start/Stop mode. Enter the desired start frequency and complete the entry by pressing the GHz, MHz, kHz, or Hz softkey to accept the start frequency input.
<b>STOP</b>	Activates the stop frequency and sets the Anritsu HHSA in the Start/Stop mode. Enter the desired stop frequency and complete the entry by pressing the GHz, MHz, kHz, or Hz softkey to accept the stop frequency input.
<b>TG FREQ OFFSET</b>	(Option 20 only) Sets the tracking generator frequency offset in TG or TG-Fast Tune mode. The offset frequency range can be set from -5 MHz to 5 MHz.

## Amplitude Menu

Pressing **AMPLITUDE** activates a menu of amplitude related functions.

<b>REF LEVEL</b>	Activates the amplitude reference level function. A specific reference level can be entered using the keypad or up/down arrow key. Press <b>ENTER</b> to accept the reference level value. Valid reference levels are +20 dBm to -120 dBm.
<b>SCALE</b>	Activates the scale function in a 2 through 15 dB logarithmic amplitude scale. Enter the desired scale using the keypad or up/down arrow key. Press <b>ENTER</b> to accept.
<b>ATTEN</b>	Sets the Anritsu HHSA input attenuator so that it is either coupled automatically to the reference level ( <b>AUTO</b> ), manually adjustable ( <b>MANUAL</b> ), or dynamically controlled ( <b>DYNAMIC</b> ).
<b>AUTO</b>	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 <b>ATTEN</b> .
<b>MANUAL</b>	Sets the attenuation to manual mode. The attenuation can be adjusted from 0 to 50 dB, in 10 dB increments, using the Up/down arrow key. Press <b>ENTER</b> to accept the selected value. The value is displayed to the left of the display below the <b>ATTEN*</b> .



**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. The value is displayed to the left of the display below the ATTEN#. The dynamic attenuation feature automatically adjusts the reference level to the optimum display level for the peak signal. Attenuation is coupled to the reference level when dynamic attenuation is enabled. It will also turn on the preamplifier, if installed, in a low-level signal situation and turn off the preamplifier when it is no longer needed.

**UNITS** Choose from the menu of amplitude related units. Selection of dBm sets absolute decibels relative to 1 mW as the amplitude unit. Selection of dBV, dBmV or dB $\mu$ V sets absolute decibels relative to 1 volt, 1 millivolt, or 1 microvolt respectively as the amplitude unit. The selection of mW READOUT is independent of the selection of other units. Selection of mW READOUT causes the Marker values and Channel power measurement results to be displayed in mW.

**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 HHSA 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 IMPORTANT notice at the top of this page concerning input considerations.

**TG OUTPUT LEVEL** Sets the output power level of the tracking generator in TG or TG-Fast Tune mode from 0.0 dBm to  $-60$  dBm in 0.1 dB steps.

## Bandwidth/Sweep Menu

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

**RBW** Sets the resolution bandwidth so that it is either coupled automatically to the span (**AUTO**) or manually adjustable (**MANUAL**) using the Up/down arrow key.

**VBW** Sets the video bandwidth so that it is either coupled automatically to the resolution bandwidth (**AUTO**) or manually adjustable (**MANUAL**) using the Up/down arrow key.

*NOTE: In TG Fast Tune mode, RBW and VBW are optimized by the HHS, and cannot be changed by the user (Option 20 only).*

**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, **AVERAGE** detection and **NEGATIVE PEAK** detection.

**POSITIVE PEAK** The HHS reads and displays the highest measured point.

**AVERAGE** The HHS averages the measured data and displays the average value.

**NEGATIVE PEAK** The HHS reads and displays the lowest measured data.

**AVERAGE (1-25)** Sets the number of the sweeps to be averaged. The number of the sweeps can be adjusted from 1 to 25 using the Up/down arrow key, or entered directly with the keypad number keys. 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.

## Trace Menu

Pressing the **TRACE** key 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 darker trace, while Trace B is lighter. It may be necessary to adjust the contrast for optimal viewing (page 3-2). Refer to page 3-14 for information on saving and recalling traces.*

**NORMALIZE** This key is to be used to normalize the trace (Trace A) after a through calibration in the tracking generator and TG-Fast Tune modes. 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.

*NOTE: Normalization, if desired, must be performed again whenever the HHS is powered off and back on, or whenever the measurement setup is changed.*

**A → B** Stores the current runtime trace into the Trace B buffer.

**A – B** Performs a subtraction trace math operation, subtracting Trace B from  
→ Trace A.  
**A**

**A + B** Performs an addition trace math operation, adding Trace B to Trace A.  
→  
**A**

**TRACE** Accesses a menu of trace operations.  
**A** **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** Accesses a menu of saved trace options.  
**B** **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 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.

*NOTE: Trace A is displayed as a black trace and Trace B is displayed as a gray trace. Some adjustment of the display contrast (see page 3-2) may be required for optimal viewing.*

## Measurement Menu

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

<b>FIELD STRENGTH</b>	<p>Accesses a menu of field strength measurement options.</p> <p><b>ON/OFF</b> - Turns field strength measurements on or off.</p> <p><b>SELECT ANTENNA</b> - Selects an antenna profile to be used for field strength measurements. Refer to Chapter 8, <i>Software Tools</i> for more information on uploading antenna profiles and factors.</p> <p><b>BACK</b> - Returns to the previous menu.</p>
<b>OBW</b>	<p>Activates the occupied bandwidth menu. Select either % or dBc method of occupied bandwidth measurement. Refer to Chapter 6 for further information on occupied bandwidth.</p> <p><b>METHOD</b> – Select either the % of Power (default) or dB Down measurement method.</p> <p><b>%</b> – Use the Up/down arrow key or the keypad to enter the percent of power.</p> <p><b>dBc</b> – Use the Up/down arrow key or the keypad to enter the dBc value (0 to 120 dB).</p> <p><b>MEASURE ON/OFF</b> – Turns the OBW measurement on or off. When the measurement is on, <b>OBW</b> will appear to the left of the display.</p> <p><b>BACK</b> – Returns to the previous menu.</p>
<b>CHANNEL POWER</b>	<p>Activates the Channel Power measurement function. Channel Power and Channel Power Density can be measured in dBm or mW, depending on the mW READOUT selection in the <b>UNITS</b> menu.</p> <p><b>CENTER FREQ</b> – Activates the center frequency function, and sets the center frequency of the Anritsu HHSa for the channel power measurement.</p> <p><b>INT BW</b> – Sets the integration bandwidth for channel power measurement.</p> <p><b>CHANNEL SPAN</b> – Sets the channel span for channel power measurement.</p> <p><b>MEASURE ON/OFF</b> – Begins or ends the channel power measurement. When the measurement is on, <b>CH PWR</b> will appear to the left of the display.</p> <p><b>BACK</b> – Returns to the previous menu.</p>
<b>ACPR</b>	<p>Accesses a menu of Adjacent Channel Power Ratio measurement options:</p> <p><b>CENTER FREQ</b> - 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 <b>GHZ</b>, <b>MHZ</b>, <b>KHZ</b>, or <b>HZ</b> softkey to accept the center frequency input.</p> <p><b>MAIN CHANNEL BW</b> - Sets the bandwidth of the main channel for ACPR measurement.</p>

ADJACENT CHANNEL BW - Sets the bandwidth of the adjacent channels for ACPR measurement.

CHANNEL SPACING - Sets the channel spacing between the main and adjacent channels.

MEASURE ON/OFF - Begins or ends the ACPR measurement. When the measurement is on, ACPR will appear to the left of the display.

BACK - Returns to the previous menu.

**PREAMP** Press this key to turn the preamplifier on and off (if Option 8 is installed).

*NOTE: If the MS2711B is equipped with the Preamplifier option (Option 8) and the preamplifier is ON, the RF power in should be less than or equal to -50 dBm (with 0 dB of internal attenuation and never more than -25 dBm regardless of attenuation.*

*If the MS2711B is not equipped with the Preamplifier option, or the Preamplifier is OFF, the RF power in should be less than or equal to -30 dBm with 0 dB of internal attenuation. This level can increase to +20 dBm with 50 dB of internal attenuation.*

**MORE** Press to access additional measurement functions:

**AM/FM DEMOD** Accesses a menu of AM/FM demodulation options.  
ON/OFF - Turns AM/FM demodulation on or off.  
DEMOM TYPE - Selects the type of demodulation to perform:  
FM - WIDE BAND  
FM - NARROW BAND  
AM  
SSB/CW (VBW: 100 kHz)

*NOTE: FM - WIDEBAND should be used to properly demodulate FM signals.*

VOLUME - Adjust the demodulation speaker volume from 0 to 100 percent.

SET CTR FREQ STEP SIZE - Allows checking of equally spaced frequencies without leaving the AM/FM DEMOD menu. Set the step value (positive or negative frequency) and when the STEP CENTER FREQ soft key is pressed, the center frequency will be adjusted by this value.

STEP CENTER FREQ - Change the center frequency by the value entered with the SET CTR FREQ STEP SIZE soft key.

*NOTE: The STEP CENTER FREQ and SET CTR FREQ STEP SIZE soft key selections will only appear when the DEMOD TYPE is set to FM - WIDE BAND, FM - NARROW BAND, or AM.*

BFO ADJUST - Beat Frequency Oscillator Adjustment for Single Sideband Demod operation. Valid selections are 0 to 255. The value is adjusted using the up/down arrow key.

When the value is 0 and is scrolled down, the frequency will be adjusted up by 1 kHz and the BFO value will be set to 128. If the value is 255 and is scrolled up, the frequency will be adjusted down by 1 kHz and the BFO value will be set to 128.

**NOTE:** The BFO ADJUST soft key selection only appears when SSB/CW is selected.

**BACK** Returns to the previous menu.

## Save Setup Menu

Pressing **SAVE SETUP** on the data keypad 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 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. When the key is pressed, a Recall Trace 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.

## Limit Menu

Pressing **LIMIT** on the data keypad 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.

- |                                      |  |
|--------------------------------------|--|
| <b>SINGLE<br/>LIMIT</b>              | Sets a single limit value in dBm. Menu choices are:<br><b>ON/OFF</b> - Turns the single limit function on or off.<br><b>EDIT</b> - Allows entry of the limit amplitude using the keypad or up/down arrow key. Press <b>ENTER</b> to accept the entered value.<br><b>BEEP AT LEVEL</b> - Beep if data is above the limit line to specify an upper limit; beep if data is below the limit line to specify a lower limit.<br><b>BACK</b> - Return to the previous menu.   |
| <b>MULTIPLE<br/>UPPER<br/>LIMITS</b> | 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:<br><b>SEGMENT 1</b> - View/edit the upper limit segment 1<br><b>SEGMENT 2</b> - View/edit the upper limit segment 2<br><b>SEGMENT 3</b> - View/edit the upper limit segment 3<br><b>SEGMENT 4</b> - View/edit the upper limit segment 4<br><b>SEGMENT 5</b> - View/edit the upper limit segment 5<br><b>BACK</b> - Return to the previous menu. |
| <b>MULTIPLE<br/>LOWER<br/>LIMITS</b> | 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.

- ON/OFF** Turns the segment on or off.
- EDIT** Opens the segment parameters for editing (see Adjusting Segmented Limits, page 2-12).
- 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.
- BACK** Return to the previous menu.

### Marker Menu

Pressing **MARKER** on the data keypad 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.
- MORE** Press to access additional marker functions:
  - M5** Selects the M5 marker parameter and opens the M5 marker second level menu with M5 highlighted.

<b>M6</b>	Selects the M6 marker parameter and opens the M6 marker second level menu with M6 highlighted.
<b>ALL OFF</b>	Turns off all markers.

### Markers Second Level Menu

The markers second level menu is used to turn the markers on or off, and to edit marker parameters and values.

<b>ON/OFF</b>	Turns the selected marker on or off.
<b>EDIT</b>	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.
<b>DELTA</b>	Displays delta frequency and amplitude for the selected marker (M2, M3 or M4) with respect to the M1 marker.
<b>MARKER TO PEAK</b>	Places the selected marker at the maximum amplitude of a trace (M1 - M4 only).
<b>MARKER FREQ TO CENTER</b>	Makes the center frequency equal to the frequency of the selected marker (M1 - M4 only).

The M5 marker second level menu includes the ON/OFF, EDIT, and BACK softkeys, in addition to the following:

<b>PEAK BETWEEN M1&amp;M2</b>	Places the selected marker at the frequency with maximum amplitude value between marker M1 and M2.
<b>VALLEY BETWEEN M1&amp;M2</b>	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, and BACK softkeys, in addition to the following:

<b>PEAK BETWEEN M3&amp;M4</b>	Places the selected marker at the frequency with maximum amplitude value between marker M3 and M4.
<b>VALLEY BETWEEN M3&amp;M4</b>	Places the selected marker at the frequency with minimum amplitude value between marker M3 and M4.



*NOTE: If markers M3 and/or M4 are off, the PEAK and VALLEY functions above are executed across the entire span.*

### Save Display Menu

Pressing the **SAVE DISPLAY** key saves the displayed trace to non-volatile memory. When the key is pressed, TRACE NAME: appears in the message area. Select the alphanumeric characters for that trace name and press **ENTER** key to implement.

*NOTE: Pressing the SAVE DISPLAY key will bring up the last saved trace name on the input line. Pressing the BACK SPACE soft key will erase the last character in that trace name. This feature can be useful when naming traces sequentially, such as: Trace 1, Trace 2, etc.*

### Recall Display Menu

Pressing the **RECALL DISPLAY** key 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. Press the **ESCAPE/CLEAR** key to return to measurement mode.

### Single - Continuous

Toggles between continuous and single sweep modes, as indicated to the left side of the display. The default is continuous sweep. When single sweep is activated, the Anritsu HHS A will sweep once and hold until a new trace is activated by pressing the **ENTER** key. Single sweep mode can be used to conserve battery power.

### Print

Selecting the **PRINT** key prints the current display to the selected printer.

### System Menu

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

- |                  |  |
|------------------|--|
| <b>OPTIONS</b>   | Displays a second level menu of options functions (see below).   |
| <b>CLOCK</b>     | Displays a second level menu of clock functions (see below).   |
| <b>SELF TEST</b> | Starts an instrument self test featuring battery calibration, memory, and local oscillator testing.  |
| <b>50 Ω</b>      | Sets the input impedance of the instrument to 50 ohms, which is the default setting. The input impedance setting is also displayed on the left side of display, as RF In 50Ω.  |
| <b>75 Ω</b>      | Displays measurements as if the input impedance was set to 75 ohms. 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 measurement. The input impedance setting is displayed on the left side of display as RF In 75Ω. |

**ANRITSU 12N50-75B** - Sets the loss setting for the Anritsu 12N50-75B adapter. Pressing this soft key will compensate 7.5 dB for the loss of the adapter.

**OTHER ADAPTER OFFSET** – This key allows the users to enter other adapter offset values. Enter the desired loss using keypad and press the **ENTER** key to accept.

**BACK** - Returns to the previous menu level.

**Language** Pressing this soft key immediately changes the language used to display messages on the display. Choices in order are English, French, German, Spanish, Chinese (simplified), and Japanese. The default language is English.

### Options Menu Second Level

Provides access to a second level menu of options related functions. Use the corresponding softkey to select the desired function.

**PRINTER** Displays a menu of supported printers. Use the Up/Down arrow key and **ENTER** key to select the connected printer.

**CHANGE DATE FORMAT** Pressing this soft key changes the format of the date as displayed in the message area. Choices are MM/DD/YYYY, DD/MM/YYYY, YYYY/MM/DD, MM/DD/YY, DD/MM/YY, or YY/MM/DD.

### Clock Menu Second Level

Provides access to a second level menu of clock related functions. Use the corresponding softkey to select the desired function.

**HOUR** The hour is displayed in the message area. Enter the desired hour (0-23) using the keypad and press **ENTER** to accept.

**MINUTE** The minute is displayed in the message area. Enter the desired minute (0-59) using the keypad and press **ENTER** to accept.

**MONTH** The month is displayed in the message area. Enter the desired month (1-12) using the keypad and press **ENTER** to accept.

**DAY** The day as displayed in the message area. Enter the desired day (1-31) using the keypad and press **ENTER** to accept.

**YEAR** The year as displayed in the message area. Enter the desired year (1997-2038) using the keypad and press **ENTER** to accept.

**BACK** Returns user to the top-level systems menu.

## Power Monitor Menu

When the mode of operation is changed to Power Monitor, the power monitor menu provides for setting power monitor parameters.

- |               |   |
|---------------|---|
| <b>UNITS</b>  | Toggles between dBm and Watts.  |
| <b>REL</b>    | Turns relative mode OFF, if currently ON. If Relative mode is currently OFF, turns it ON and causes the power level to be measured and saved as the base level. Subsequent measurements are then displayed relative to this saved value. With units of dBm, relative mode displays dB; with units of Watts, relative mode displays % (percent).               |
| <b>OFFSET</b> | Turns offset OFF, if currently ON. If Offset is currently OFF, turns it ON and opens the Offset parameter for data entry using the keypad. Press <b>ENTER</b> when data entry is complete. Offset is the attenuation (in dB) inserted in the line between the DUT and the RF detector. The attenuation is added to the measured input level prior to display. |
| <b>ZERO</b>   | Turns Zero OFF, if currently ON. If Zero is currently OFF, turns it ON and initiates collection of a series of power level samples, which are averaged and saved. This saved value is then subtracted from subsequent measurements prior to display.  |

# **Chapter 4**

## **Measurement**

### **Fundamentals**

#### **Introduction**

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

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

#### **Measurement Fundamentals**

Advanced measurements require the use of additional spectrum analyzer functions beyond frequency, span, amplitude and marker functions. In particular, this section will focus 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 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 must measure across their entire frequency range at all times.

Therefore, a broadband measurement would include the fundamental frequency, harmonics, spurious responses, and noise in the measurement. On the other hand a narrow-band measurement will filter out all but the desired frequency components, resulting in a measurement that includes only the fundamental. 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 in the frequency domain. 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, very little 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. As a general rule of thumb, most field spectrum analyzer measurements are made at a resolution bandwidth of 30 kHz.

### **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). The 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 very 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 Hand Held Spectrum Analyzer has mechanisms designed into it that unburden 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.

## 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 by using the Up/down arrow key. The attenuator range is 0 to 50 dB, in 10 dB steps.

**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.

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

### 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. However, most spectrum analyzer IF filter bandwidths are not exact, varying by as much as  $\pm 20\%$ . 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.,  $-20\%$ , or 24 kHz) to ensure accurate measurements on two signals spaced to within 30 kHz. In this case the next smallest 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 MS2711B HHSA:

- Step 1.** Set attenuator coupling to AUTO.
- Step 2.** Set the Reference 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 1 kHz.

It should be difficult to discern the presence of two signals. Figure 4-1. shows the results of the example using a signal combiner/splitter with a loss of 6 dB.

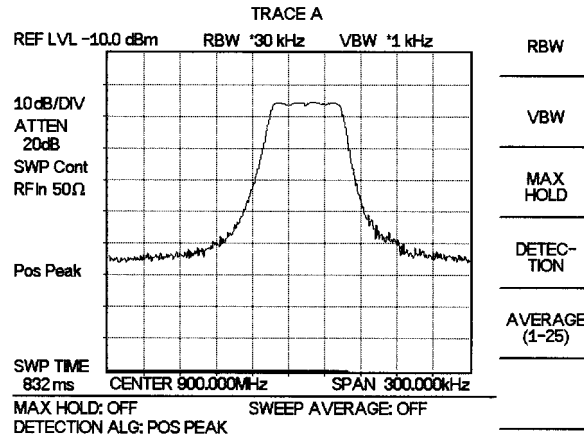


Figure 4-1. Measurement of Two Signals Having Equal Amplitudes , RBW = 30 kHz

**Step 6.** Change the resolution bandwidth to 10 kHz.

Figure 4-2 shows the results after changing the RBW using a signal combiner/splitter with a loss of 6 dB.

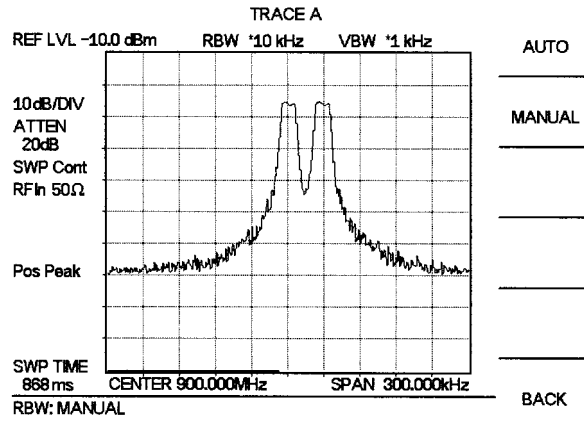


Figure 4-2. Measurement of Two Signals Having Equal Amplitudes , RBW = 10 kHz

Remember, the resolution bandwidth must be equal to or less than the frequency separation of the signal. Therefore, a 10 kHz resolution bandwidth must be used. 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 1900.1 MHz. Set one source to  $+20$  dBm, and the other to  $-15$  dBm.

- Step 1.** Set attenuator coupling to AUTO.
  - Step 2.** Set the Reference Level to  $+20$  dBm.
  - Step 3.** Set the scale to 10 dB/div.
  - Step 4.** Set the span to 1 MHz and the center frequency to 1900 MHz.
  - Step 5.** Set the resolution bandwidth to 10 kHz and the video bandwidth to 300 Hz.
- The two signals should be observed on the spectrum analyzer, each with different amplitudes and spaced 100 kHz apart.

Figure 4-3. 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.

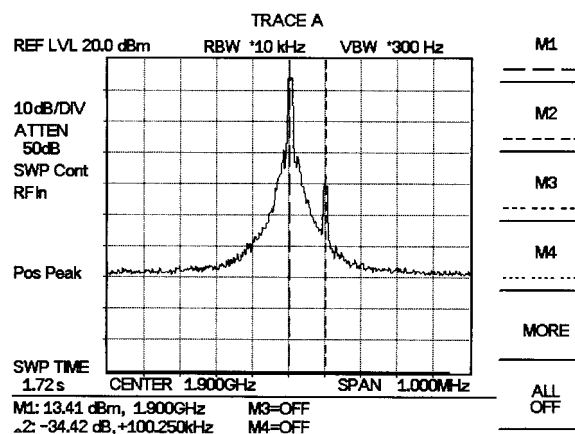


Figure 4-3. Measurement of Two Signals Having Unequal Amplitudes



**Step 6.** Change the frequency in the second source from 1900.100 MHz to 1900.050 MHz gradually and observe the effect. Figure 4-4 shows the results with the two signals spaced 50 kHz apart using a signal combiner/splitter with a loss of 6 dB.

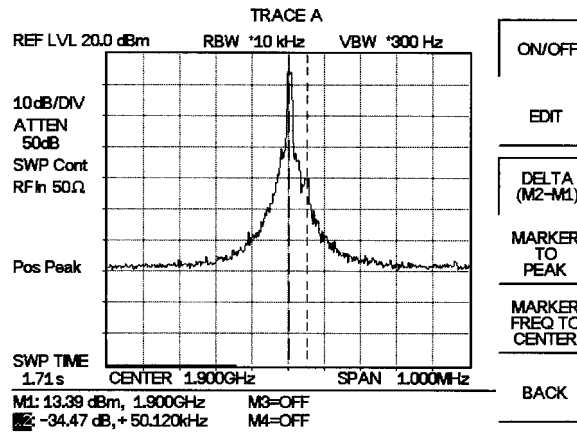


Figure 4-4. Measurement of Two Signals Having Unequal Amplitudes

**Step 7.** Change the resolution bandwidth to 30 kHz. Figure 4-5 shows the results after changing the RBW using a signal combiner/splitter with a loss of 6 dB.

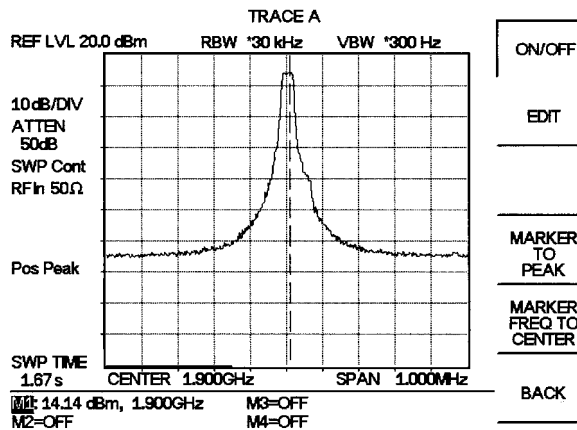


Figure 4-5. Measurement of Two Signals Having Unequal Amplitudes

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 MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 to recall the factory preset state.
- Step 2.** Press **AMPLITUDE** and then select REF LEVEL
- Step 3.** Enter the desired Reference Level (+20 dB) using the keypad and press **ENTER**.
- Step 4.** Connect a signal source to the Anritsu HHS A spectrum analyzer.
- Step 5.** Set the signal source frequency to 10 MHz and the signal level to +10 dBm.
- Step 6.** Set the **START** frequency at 1 MHz
- Step 7.** Set the **STOP** frequency to 50 MHz
- Step 8.** Set the resolution bandwidth to improve visibility by smoothing the noise:
  - a. Press **BW/SWEEP**
  - b. Press RBW, then **MANUAL**.
- Step 9.** Use the Up/down arrow key to select the desired resolution bandwidth, 100 kHz in this case.
- Step 10.** Press **ENTER** once the desired resolution bandwidth has been selected.
- Step 11.** Set the video bandwidth to improve visibility by smoothing the noise:
  - a. Press **BW/SWEEP**
  - b. Press VBW, then **MANUAL**.
- Step 12.** Use the Up/down arrow key to select the desired video bandwidth, 3 kHz in this case.
- Step 13.** Press **ENTER** once the desired video bandwidth has been selected.
- Step 14.** Press the **MARKER** key and select the M1 soft key
- Step 15.** 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 16.** Press the **MARKER** key and select the M2 soft key.
- Step 17.** Press the **EDIT** soft key to turn Marker M2 ON and use Up/down arrow key to place Marker M2 at the center of the second harmonic. Press **ENTER** to set the marker position.
- Step 18.** Press the **DELTA (M2-M1)** soft key. This will provide frequency and amplitude information with respect to marker M1.
- Step 19.** Press the **MARKER** key and select the M3 soft key.
- Step 20.** Press the **EDIT** soft key to turn Marker M3 ON and use the Up/down arrow key to place Marker M3 at the center of the third harmonic.
- Step 21.** Press the **DELTA (M3-M1)** soft key. This will provide frequency and amplitude information with respect to marker M1.

Figure 4-6 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 46.24 dB below the carrier. Marker 3 shows that the third order harmonic is 48.44 dB below the fundamental frequency.

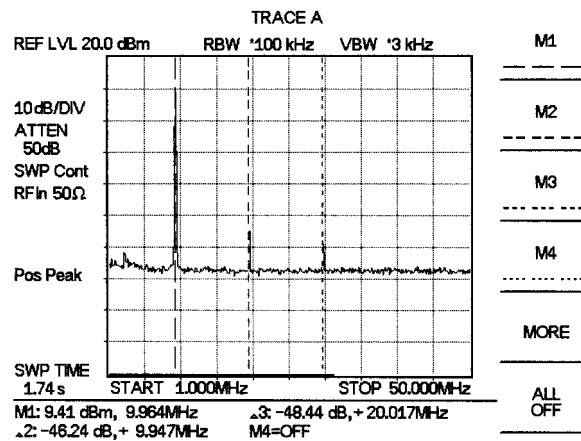


Figure 4-6. Harmonic Distortion

**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 MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 to recall the factory preset state.
- Step 2.** Connect a signal source to the spectrum analyzer input.
- Step 3.** Set the source to a carrier frequency of 100 MHz,  $-25$  dBm, with an amplitude modulation of about 35 kHz at 10% modulation.
- Step 4.** Set the spectrum analyzer center frequency to 100 MHz. Set the span to 500 kHz.
- Step 5.** 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 sideband frequency and pressing the **DELTA (M2-M1)** soft key. Figure 4-7 shows the modulating frequency of 35 kHz as the value of delta Marker 2.

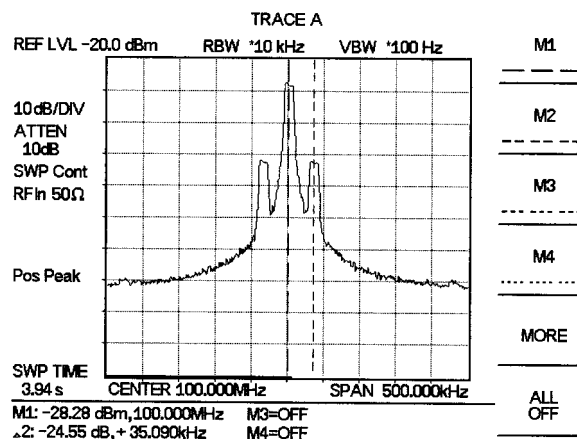


Figure 4-7. Amplitude Modulation

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  $E_{SB}(dB)$  is the energy in the sidebands in dB,  $E_C(dB)$  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 MS2711B 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,  $\Delta f_{peak}$ , 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,  $\beta$ , is defined as: 
$$\beta = \frac{\Delta f_{peak}}{f_{mod}}$$

In general, the spectrum analyzer is a very useful tool for measuring  $\Delta f_{peak}$  and  $\beta$  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 side band amplitudes become negligibly small beyond a certain frequency offset for the carrier, depending on the value of  $\beta$ .

To demonstrate the properties of an FM signal, we will use a carrier frequency of 100 MHz and test for FM deviation accuracy at 25 kHz. With a  $\beta$  value of 2, we need a 50 kHz modulating signal.

- Step 1.** Connect the FM signal source to the input of the MS2711B.
- Step 2.** Set the reference level to 0 dBm.
- Step 3.** Set the attenuation coupling to AUTO.
- Step 4.** On the signal source, set the carrier frequency to 100 MHz, modulating frequency to 50 kHz, carrier power to -10 dBm, and deviation to 25 kHz.
- Step 5.** Set the center frequency of the MS2711B to 100 MHz, span to 500 kHz, resolution bandwidth to 10 kHz, and video bandwidth to 1 kHz.

You will see a carrier signal at 100 MHz and 3 sidebands on each side (Figure 4-8). The side bands are separated by 50 kHz (shown by the value of  $\Delta M2$ ), which is the  $f_{mod}$ .

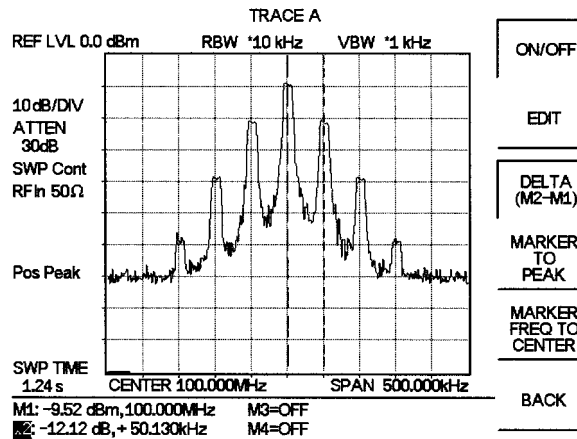


Figure 4-8. Frequency Modulation

#### Example 4: AM/FM Demodulation

Amplitude modulation (AM) and frequency modulation (FM) are common modulation techniques used to broadcast information. In the United States and Canada, the AM broadcast band is 535 kHz to 1605 kHz, while the FM broadcast band covers 88 MHz to 108 MHz.

Demodulation of AM and FM signals can be done with zero span capability and with a wide enough bandwidth to fully encompass the modulated signal, using the Anritsu HHSA internal speaker or headset jack and built-in AM/FM demodulator.

#### Example

- Step 1.** Reset the MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 to recall the factory preset state.
- Step 2.** Provide a signal to the spectrum analyzer by connecting an antenna to the input port of the spectrum analyzer.
- Step 3.** Press the **MEASURE** soft key, then the **MORE** soft key.
- Step 4.** Press the **AM/FM DEMOD** soft key.
- Step 5.** Press the **DEMOD TYPE** soft key and select **FM WIDEBAND**.
- Step 6.** Activate FM demodulation by pressing the **ON/OFF** soft key.
- Step 7.** Select the appropriate resolution bandwidth, video bandwidth and reference level to enhance the selection of desired signal. (For wide-band FM, the resolution bandwidth should be 1 MHz. Reference level should be roughly  $-30$  dBm, or less for weak signals.)

- Step 8.** Position Marker 1 on the signal of interest. If the signal of interest is the highest in amplitude, press MARKER TO PEAK directly, then MARKER FREQ TO CENTER to center the peak signal on the display.
- Step 9.** To obtain continuous demodulation of the signal, a span of zero is needed. If the current span is narrow, press the **FREQ/SPAN** key then press the SPAN and ZERO soft keys. Skip to Step 15.
- Step 10.** If the current span is wide, slowly reduce the span and adjust the marker location/center frequency (see steps 11-14).
- Step 11.** Press the **FREQ/SPAN** key then press the SPAN and SPAN DOWN 1-2-5 soft keys.
- Step 12.** Press the **MARKER** key, the M1 soft key followed by the MARKER TO PEAK and MARKER FREQ TO CENTER soft keys.
- Step 13.** Repeat Steps 11 and 12 until the center frequency is the frequency to be demodulated.
- Step 14.** Press the **FREQ/SPAN** key then press the SPAN and ZERO soft keys.
- Step 15.** Press **MEASURE**, then MORE, then DEMOD to return to the AM/FM Demod menu. Adjust the volume of the speaker by pressing the VOLUME soft key and using the Up/down arrow key.

Setting the hand held spectrum analyzer to zero span will ensure continuous demodulation. Otherwise, demodulation will occur only during the spectrum analyzer sweep.

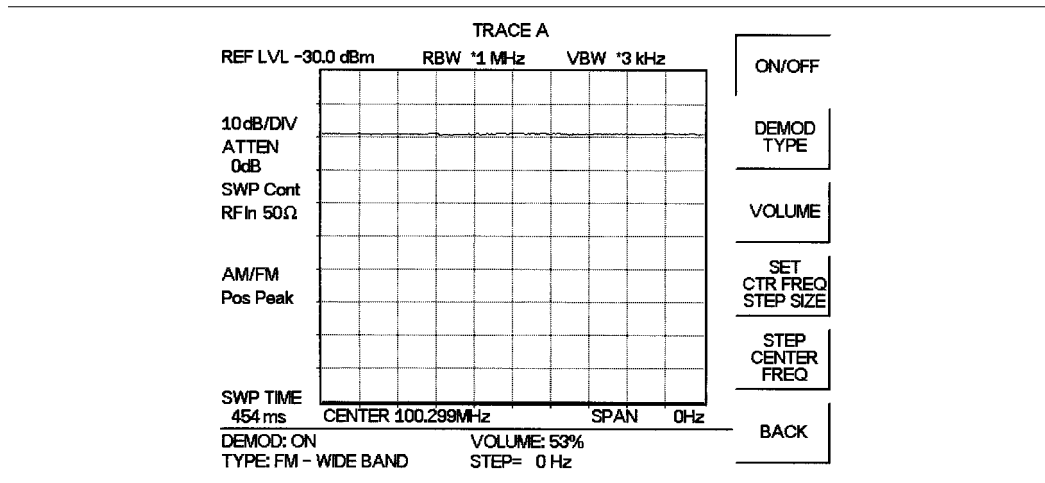


Figure 4-9. AM/FM Demodulation

### Example 5: Field Strength Measurements

All antennas have loss or gain that can cause errors in measurements. The MS2711B can correct for antenna loss or gain errors using Field Strength Measurements.

The antenna factors must be uploaded to the MS2711B using the Anritsu Software Tools provided with the unit. These antenna factors can then be used to correct for the measurement error.

- Step 1.** Enter the antenna factor information for the specific antenna into the antenna editor of the Software Tools (see page 8-5).
- Step 2.** Upload the antenna factors to the MS2711B.
- Step 3.** Press the **MEAS** function key on the MS2711B.
- Step 4.** Select the **FIELD STRENGTH** soft key from the measurement menu.
- Step 5.** Press the **SELECT ANTENNA** soft key. To use one of the standard antennas recognized by the MS2711B, select **STANDARD** and press the **ENTER** key. 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 Software Tools Antenna Editor (see Chapter 8), select **CUSTOM** 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 MS2711B 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 the antenna name appears in the title bar at the top. All marker values are displayed in V/m.

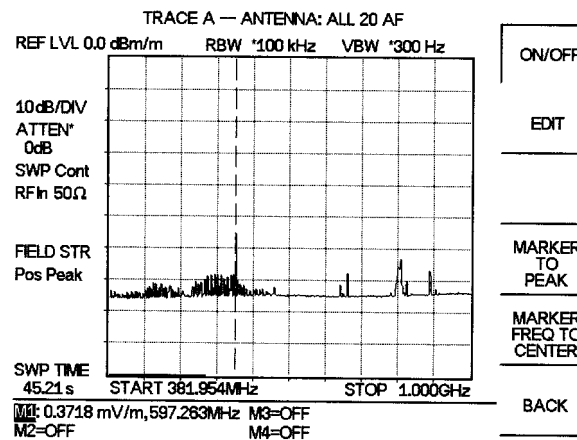


Figure 4-10. Field Strength Measurements



### Example 6: 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 HHSAs feature both single limit and multiple limit functions.

#### Example

- Step 1.** Reset the MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 to recall the factory preset state.
- Step 2.** Connect a signal source to the Anritsu HHSAs spectrum analyzer.
- Step 3.** Set attenuator coupling to AUTO.
- 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 HHSAs center frequency at 900 MHz, the span to 20 MHz, resolution bandwidth to 30 kHz, and video bandwidth to 300 Hz.
- Step 8.** Press **LIMIT** and select MULTIPLE UPPER LIMITS using the appropriate softkey.
- 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 and press **EDIT** when done.

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.

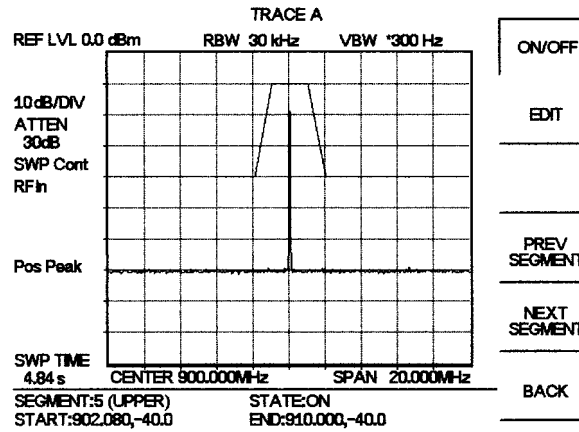


Figure 4-11. Creating a Spectral Mask

**Example 7: Trace Overlay**

The MS2711B HHSA can be used to compare frequency spectrums.

**Example:**

- Step 1.** Reset the MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key. If the unit is already on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 to recall the factory preset state.
- Step 2.** Connect a signal source to the Anritsu HHSA spectrum analyzer.
- Step 3.** Set the signal source frequency to 900 MHz and the signal level to -20 dBm.
- Step 4.** Set the center frequency at 900 MHz, resolution bandwidth to 30 kHz, video bandwidth to 300 Hz, and the span to 20 MHz.
- Step 5.** Press the **TRACE** key.
- Step 6.** Select the **A → 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 black trace and Trace B is displayed as a gray trace. Some adjustment of the display contrast (see page 3-2) may be required for optimal viewing.*

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

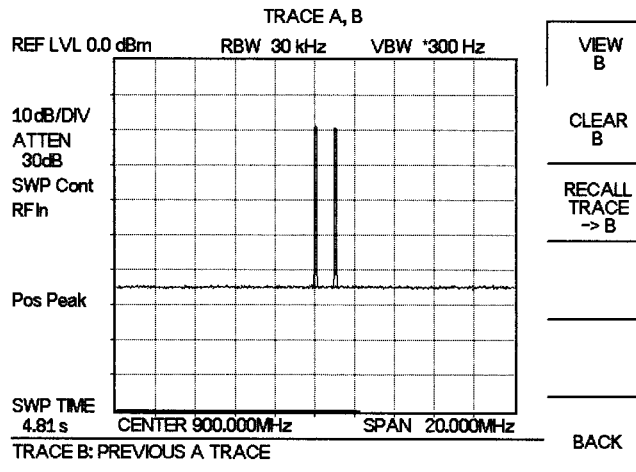


Figure 4-12. Trace Overlay

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

# 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
- AM/FM Demodulation
- Power Monitor

### 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 XdB below the peak carrier level.

#### Required Equipment

- MS2711B Hand Held 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 MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad.  
When the key is pressed, a Recall Trace selection box appears on the display.  
Select setup location 0 to recall the factory preset state.
- Step 2.** Using the test port extension cable and 30 dB, 50 watt, Bi-directional attenuator, connect the MS2711B to appropriate transmit test port.

- Step 3.** If the MS2711B is not currently in Spectrum Analyzer mode, press the **MODE** key, scroll to SPECTRUM ANALYZER mode, and press **ENTER**.
- 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. See the table below for recommended settings for CW and CDMA signals.
- Step 6.** Select the **ATTEN** soft key to set the input attenuation level. See the table below for recommended settings for CW and CDMA signals.
- Step 7.** Press the **BW/SWEEP** key and select the **RBW** and **VBW** soft keys to set the resolution bandwidth and video bandwidth. See the table below for recommended settings for CW and CDMA signals.

	<b>CW</b>	<b>IS-95 CDMA</b>
Reference Level	-15 dBm	-10 dBm
Input Attenuation Level	Auto	Auto
Resolution Bandwidth	Auto	10 kHz
Video Bandwidth	Auto	30 kHz

- Step 8.** 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 9.** Press the **dBc** or **%** soft keys to adjust the settings as appropriate.
- Step 10.** Press the **MEASURE ON/OFF** soft key to initiate the measurement. **OBW** will appear to the left of the graph when the occupied bandwidth measurement is on.

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

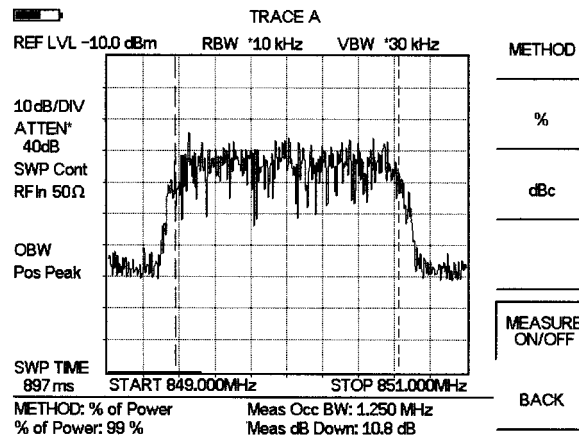


Figure 5-1. Occupied Bandwidth

Occupied Bandwidth is a constant measurement. Once it is turned on, it will remain on until it is turned off by pressing the **MEASURE ON/OFF** 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 FCC regulations
- Keep overall system interference at a minimum

## CDMA Channel Power Measurement

MS2711B 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

- MS2711B Hand Held Spectrum Analyzer (HHSA)
- 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 MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad.  
When the key is pressed, a Recall Trace selection box appears on the display.  
Select setup location 0 to recall the factory preset state.
- 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 MS2711B.
- Step 3.** Press the **AMPLITUDE** key and select the REF LEVEL soft key to set the reference level to –10 dBm.
- Step 4.** Press the **SCALE** soft key and set the scale to 10 dB/division.

- Step 5.** Press the ATTEN soft key followed by the MANUAL soft key and set the attenuation to 20 dB.
- Step 6.** Press the **BW/SWEEP** key and select the RBW and VBW soft keys to set the resolution bandwidth to 10 kHz and the video bandwidth to 30 kHz or greater.
- Step 7.** Press the **MEAS** key and press the CHANNEL POWER soft key.
- Step 8.** Select the CENTER FREQ soft key and set the center frequency of the CDMA signal to 850 MHz.
- 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 2.5 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 ON/OFF soft key. The detection method is automatically changed to Average. Solid vertical lines are drawn on the display to indicate the integration bandwidth. The MS2711B will display the measurement results in the message area.

Figure 5-2 shows the results of the measurement using a CDMA signal generator with an output power level of -25 dBm.

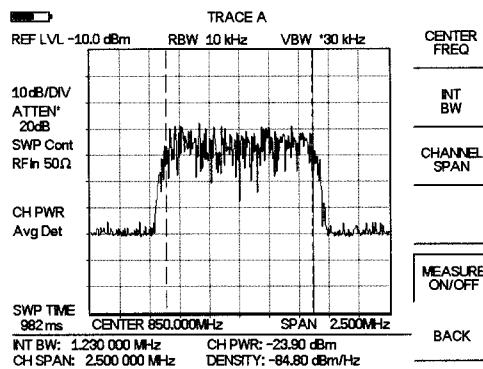


Figure 5-2. CDMA Channel Power Measurement

Channel power is a constant measurement. Once it is turned on, it will remain on until it is turned off by pressing the MEASURE ON/OFF 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, MS2711B will set the channel span equal to the integration bandwidth. When the integration bandwidth and channel span are set to the same value, the MS2711B 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 MS2711B 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 will experience significant interference. This is one of the reasons that spurious measurements are extensively used in GSM applications.

To make accurate and repeatable GSM measurements, there are a few simple rules to follow:

- The resolution bandwidth of the MS2711B should be set to 1.0 MHz to cover the wide GSM band.
- The video bandwidth must be set to 100 kHz or greater to obtain the details of multiple channels in the GSM band.
- Max Hold on the MS2711B should be set to ON.

*NOTE: When Max Hold is on, the MS2711B automatically turns the sweep averaging function off.*

### Required Equipment

- MS2711B Hand Held Spectrum Analyzer (HHSA)
- 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 MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad.  
When the key is pressed, a Recall Trace selection box appears on the display.  
Select setup location 0 to recall the factory preset state.
- 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 MS2711B.



- Step 3.** Press the **AMPLITUDE** key and select the REF LEVEL soft key to set the reference level to  $-10$  dBm.
- Step 4.** Press the **SCALE** soft key and set the scale to 10 dB/division.
- Step 5.** Press the **ATTEN** soft key followed by the **MANUAL** soft key and set the attenuation to 20 dB.
- Step 6.** Press the **BW/SWEEP** key and select the RBW and VBW soft keys to set the resolution bandwidth to 1 MHz and the video bandwidth to AUTO.
- Step 7.** Press the **MAX HOLD** soft key to set max hold to ON as indicated in the lower left of the display.
- 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 GSM signal to 947.5 MHz.
- Step 10.** Select the **INT BW** soft key and enter 2.0 MHz for the integration bandwidth, or set the integration bandwidth appropriate for the particular application.
- Step 11.** Select the **CHANNEL SPAN** soft key and enter 4.0 MHz 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 ON/OFF** soft key. The detection method is automatically changed to Average. Solid vertical lines are drawn on the display to indicate the integration bandwidth. The MS2711B 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  $-35$  dBm.

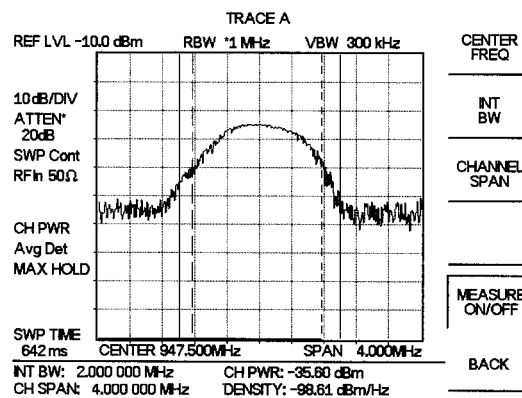


Figure 5-3. GSM Channel Power Measurement

Channel Power is a constant measurement. Once it is turned on, it will remain on until it is turned off by pressing the MEASURE ON/OFF 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, MS2711B will set the channel span equal to the integration bandwidth. When the integration bandwidth and channel span are set to the*

same value, the MS2711B 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 MS2711B will double the channel span.

## AMPS Channel Power Measurement

The MS2711B can be used to test Advanced Mobile Phone System (AMPS) base stations. AMPS base stations for cellular telephone systems are continuous wave (CW) FM voice transceivers with system control functionality. The energy of the AMPS signal is represented by multiple bits of data 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

- MS2711B Hand Held Spectrum Analyzer (HHSA)
- 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 MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 to recall the factory preset state.
- 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 MS2711B.
- Step 3.** Press the **AMPLITUDE** key and select the REF LEVEL soft key to set the reference level to 0 dBm.
- Step 4.** Press the **SCALE** soft key and set the scale to 10 dB/division.
- Step 5.** Press the **ATTEN** soft key followed by the **AUTO** soft key to set the attenuation to AUTO.
- Step 6.** Press the **BW/SWEEP** key and select the RBW and VBW soft keys to set the resolution bandwidth to 1 MHz and the video bandwidth to 300 kHz.
- Step 7.** Press the **MAX HOLD** soft key to set max hold to ON as indicated in the lower left of the display.
- 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 CDMA signal to 835 MHz as the center frequency of the cellular signal.
- Step 10.** Select the INT BW soft key and enter 20 MHz for the integration bandwidth.
- Step 11.** Select the CHANNEL SPAN soft key and enter 20 MHz 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 ON/OFF soft key. The detection method is automatically changed to Average. Solid vertical lines are drawn on the display to indicate the integration bandwidth. The MS2711B will display the measurement results in the message area.

Channel Power is a constant measurement. Once it is turned on, it will remain on until it is turned off by pressing the MEASURE ON/OFF 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, MS2711B will set the channel span equal to the integration bandwidth. When the integration bandwidth and channel span are set to the same value, the MS2711B 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 MS2711B will double 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 can be expressed either as a power ratio or a power density. In order to calculate the upper and lower adjacent channel values, the MS2711B requires the specification of four parameters:

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

## Adjacent Channel Power Measurement

### Required Equipment

- MS2711B Hand Held 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 MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 to recall the factory preset state.
- Step 2.** Using the test port extension cable and 30 dB, 50 watt, Bi-directional attenuator, connect the MS2711B to appropriate transmit test port.
- Step 3.** Press the **AMPLITUDE** key and select the REF LEVEL soft key to set the appropriate reference level. See the table below for recommended settings for CW and CDMA signals.
- Step 4.** Select the **ATTEN** soft key to set the input attenuation level. See the table below for recommended settings for CW and CDMA signals.
- Step 5.** Press the **BW/SWEEP** key and select the RBW and VBW soft keys to set the resolution bandwidth and video bandwidth. See the table below for recommended settings for CW and CDMA signals.

	CW	IS-95 CDMA
Reference Level	-15 dBm	-10 dBm
Input Attenuation Level	Auto	Auto
Resolution Bandwidth	Auto	10 kHz
Video Bandwidth	Auto	30 kHz

- Step 6.** Press the **MEAS** key and press the **ACPR** soft key.
- Step 7.** Select the **CENTER FREQ** soft key, and enter the desired center frequency.
- Step 8.** Select the **MAIN CHANNEL BW** soft key, and enter the desired main channel bandwidth. For an IS-95 CDMA signal, enter 1.23 MHz.
- Step 9.** Select the **ADJ CHANNEL BW** soft key, and enter the desired adjacent channel bandwidth. For an IS-95 CDMA signal, enter 30 kHz.
- Step 10.** Select the **CHANNEL SPACING** soft key, and enter the desired channel spacing. For an IS-95 CDMA signal, enter 885 kHz.
- Step 11.** Make the measurement by pressing the **MEASURE ON/OFF** soft key. The detection method is automatically changed to Average. Solid vertical lines are drawn on the display to indicate the main channel. Dashed vertical lines define the adjacent channels. The MS2711B will display the measurement results in the message area.

Figure 5-4 displays the results of the measurement using a CDMA signal generator with an output power level of -25 dBm.

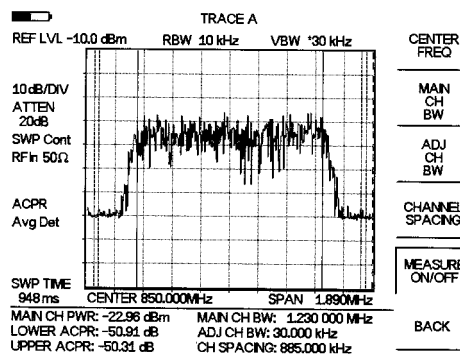


Figure 5-4. Adjacent Channel Power Measurement

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 ON/OFF** 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

- MS2711B Hand Held 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 MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 to recall the factory preset state.
- 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 MS2711B.
- Step 3.** Press the **AMPLITUDE** key and select the REF LEVEL soft key to set the reference level to 0 dBm.
- Step 4.** Press the ATTEN soft key and set the attenuation to AUTO.
- Step 5.** Press the **BW/SWEEP** key and select the RBW and VBW soft keys to set the resolution bandwidth to 1 MHz and the video bandwidth to AUTO.
- Step 6.** Press the MAX HOLD soft key to set max hold to ON as indicated in the lower left of the display.
- Step 7.** Press the **MEAS** key and press the ACPR soft key.
- Step 8.** Select the CENTER FREQ soft key, and enter 945.7 MHz or another desired center frequency.
- Step 9.** Select the MAIN CHANNEL BW soft key, and enter the main channel bandwidth. For the GSM signal, enter 2.0 MHz.
- Step 10.** Select the ADJ CHANNEL BW soft key, and enter the adjacent channel bandwidth. For the GSM signal, enter 30 kHz.
- Step 11.** Select the CHANNEL SPACING soft key, and enter the channel spacing. For the GSM signal, enter 19.5 MHz.
- Step 12.** Make the measurement by pressing the MEASURE ON/OFF soft key. The detection method is automatically changed to Average. Solid vertical lines are drawn on the display to indicate the main channel. Dashed vertical lines define the adjacent channels. The MS2711B will display the measurement results in the message area.

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

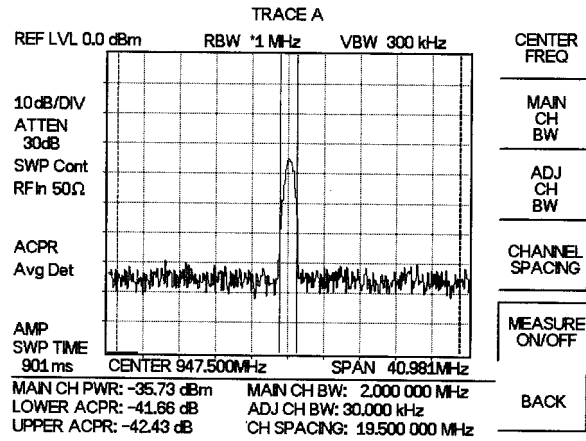


Figure 5-5. GSM Adjacent Channel Power Measurement

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 ON/OFF 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

- MS2711B Hand Held 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 MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 to recall the factory preset state.
- 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 MS2711B.
- Step 3.** Press the **AMPLITUDE** key and select the REF LEVEL soft key to set the reference level to 0 dBm.
- Step 4.** Press the **ATTEN** soft key and set the attenuation to AUTO.
- Step 5.** Press the **BW/SWEEP** key and select the RBW and VBW soft keys to set the resolution bandwidth to 1 MHz and the video bandwidth to 300 kHz.
- Step 6.** Press the **BACK** soft key and then the **MAX HOLD** soft key to set max hold to ON as indicated in the lower left of the display.
- Step 7.** Select the **CENTER FREQ** soft key, and enter 835 MHz.
- Step 8.** Select the **MAIN CHANNEL BW** soft key, and enter the main channel bandwidth. For the AMPS signal, enter 20 MHz.
- Step 9.** Select the **ADJ CHANNEL BW** soft key, and enter the adjacent channel bandwidth. For the AMPS signal, enter 30 kHz.
- Step 10.** Select the **CHANNEL SPACING** soft key, and enter the channel spacing. For the AMPS signal, enter 12 MHz.
- Step 11.** Make the measurement by pressing the **MEASURE ON/OFF** soft key. The detection method is automatically changed to Average. Solid vertical lines are drawn on the display to indicate the main channel. Dashed vertical lines define the adjacent channels. The MS2711B will display the measurement results in the message area.

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 ON/OFF** 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.

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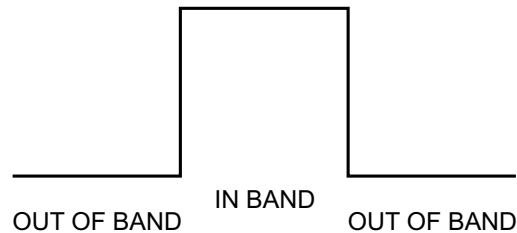


Figure 5-6. Example of In- and Out-of Bandwidth Signals

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## Out-of-Band Spurious Emission Measurement

### Required Equipment

- MS2711B Hand Held 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 MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 to recall the factory preset state.
- 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 MS2711B.
- 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 0 dBm.
- Step 6.** Press the **ATTEN** soft key and set the attenuation to **AUTO**.
- Step 7.** Press the **BW/SWEEP** key and select the **RBW** and **VBW** soft keys to set the resolution bandwidth to 10 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 one of the spurs. Press the **ENTER** key to set the marker.
- Step 10.** Compare the value of the marker to the specified allowable level of out-of-band spurious emissions for the corresponding channel transmit frequency.
- Step 11.** Repeat Steps 8-11 for the remaining spurs. Use either Marker 1 again, or choose another marker.

Figure 5-7 shows a simulated out-of-band spurious signal at 21.052 MHz from the carrier.

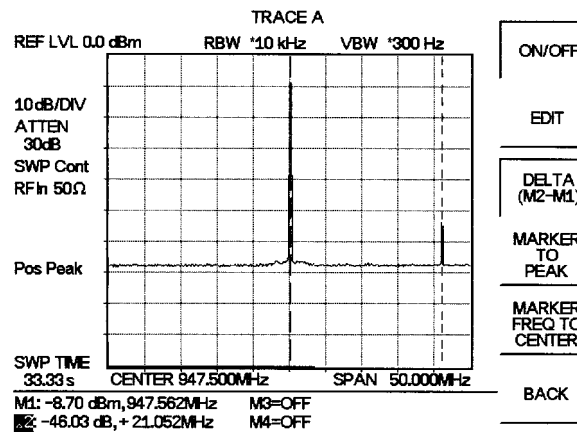


Figure 5-7. Simulated Out-of-Band Spurious Emission Measurement

## 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

- MS2711B Hand Held 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 MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad.  
When the key is pressed, a Recall Trace selection box appears on the display.  
Select setup location 0 to recall the factory preset state.
- Step 2.** Using the test port extension cable and 30 dB, 50 watt, Bi-directional attenuator, connect the MS2711B 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 0 dBm.
- Step 6.** Press the **ATTEN** soft key and set the attenuation to **AUTO**.
- Step 7.** Press the **BW/SWEEP** key and select the **RBW** and **VBW** soft keys to set the resolution bandwidth to 10 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 one of the spurs. Press the **ENTER** key to set the marker.

- Step 10.** 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 11.** Repeat steps 8-11 for the remaining spurs. Use either Marker 1 again, or choose another marker.

Figure 5-8 shows a simulated in-band spur check at 6 MHz from the carrier frequency. The carrier is measured by M1. The delta marker M3 shows the signal at  $f_c + 6$  MHz to be 73.55 dB down from the carrier. This value should be compared against the specification.

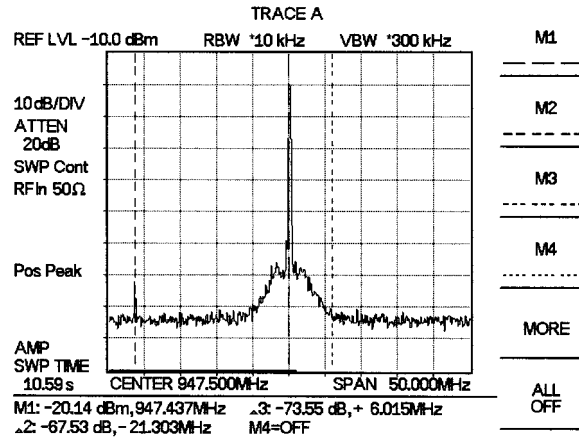


Figure 5-8. In-band Spurious Measurement

**NOTE:** The resolution bandwidth of a spectrum analyzer is determined by the intermediate frequency (IF) filter bandwidth. The MS2711B 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

- MS2711B Hand Held Spectrum Analyzer
- Portable Antenna

### Procedure

- Step 1.** Use the Antenna Editor feature of the Software Tools to define an antenna (see page 8-8).
- Step 2.** Reset the MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 to recall the factory preset state.
- Step 3.** Upload the antenna information to the MS2711B (see page 8-9).
- Step 4.** Connect the antenna to the MS2711B.
- 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** and **VBW** soft keys to set the resolution bandwidth to 10 kHz and the video bandwidth to 300 Hz.
- Step 8.** Press the **MEAS** key.
- Step 9.** Select the **FIELD STRENGTH** soft key.
- Step 10.** Press the **SELECT ANTENNA** soft key.
- Step 11.** To use a custom antenna definition uploaded from the Software Tools Antenna Editor (see Chapter 8), select **CUSTOM** 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.  
To use one of the standard antennas recognized by the MS2711B, select **STANDARD** and press the **ENTER** key. Use the Up/Down arrow key to select the desired antenna and press the **ENTER** key to select.
- Step 12.** To change the unit of measurement, press the **AMPLITUDE** hard key, then press the **UNITS** soft key and select **dBm**, **dBV**, **dBmV** or **dB $\mu$ V** using the designated soft key.

The MS2711B HHSA will automatically adjust the measurement by the antenna factors selected. Marker values will be displayed in V/m. A **FIELD STR** icon will appear to the left of the graph and the antenna name will be in the title bar above the graph.

Figure 5-9 shows the results of a measurement using an R&S HE200 antenna.

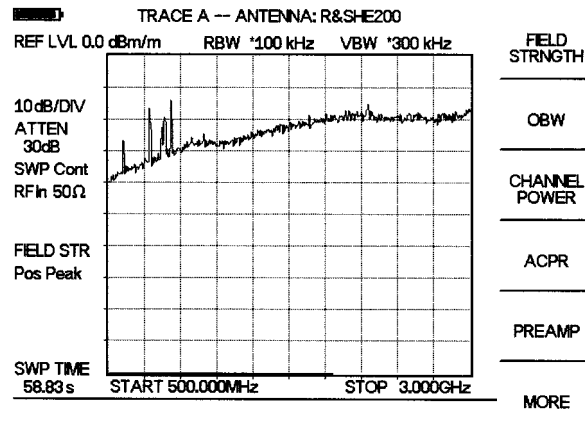


Figure 5-9. Field Strength

## 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 50-ohm system:

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

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

Note that 1 mW =  $10^{-3}$ W and 1  $\mu$ V =  $10^{-6}$ V.

For power in dBm, and voltage in dB( $\mu$ V) :

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

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<sub>d</sub> = Power density in W/m<sup>2</sup>

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:

- $P_d$  = power density in  $W/m^2$
- $P_t$  = power transmitted in Watts
- $G_t$  = gain of transmitting antenna
- $r$  = distance from the antenna in meters

## Making Power Measurements with the Power Monitor (Option 5)

Power measurement is accomplished using a broadband (1 MHz to 3000 MHz) RF detector, P/N 5400-71N50. The power monitor displays the measured power in dBm or Watts.

### Entering Power Monitor Mode

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

### Zeroing the Power Monitor

- Step 1.** Connect the RF detector to the DUT.
- Step 2.** With no power applied to the DUT, press the **ZERO** soft key from the Power menu. Wait a few seconds while the Anritsu HHSa accumulates samples of the quiescent power level. When complete, **ZERO ADJ: ON** is displayed in the message area.

### Measuring High Input Power Levels

- Step 1.** Insert an attenuator between the DUT and the RF detector, sufficient to insure that the input power to the MS2711B is no greater than +20 dBm. Refer to Figure 5-10.
- Step 2.** Press the **OFFSET** soft key.
- Step 3.** Enter the attenuation in dB using the keypad to match the value of the attenuator. Press **ENTER** to complete the entry. The message area will show **OFFSET is ON** along with the entered value in dB.

### Displaying Power in dBm and Watts

Press the **UNITS** soft key to display power in Watts.

### Displaying Relative Power

- Step 1.** With the desired base power level input to the Anritsu HHSa, press the **REL** soft key. The message area will show **REL: ON** and the power reading will indicate 100%.
- Step 2.** Press the **UNITS** soft key to display power in dBm. Since **REL** is **ON**, the power reading will be in dB<sub>r</sub>, relative to the base power level.

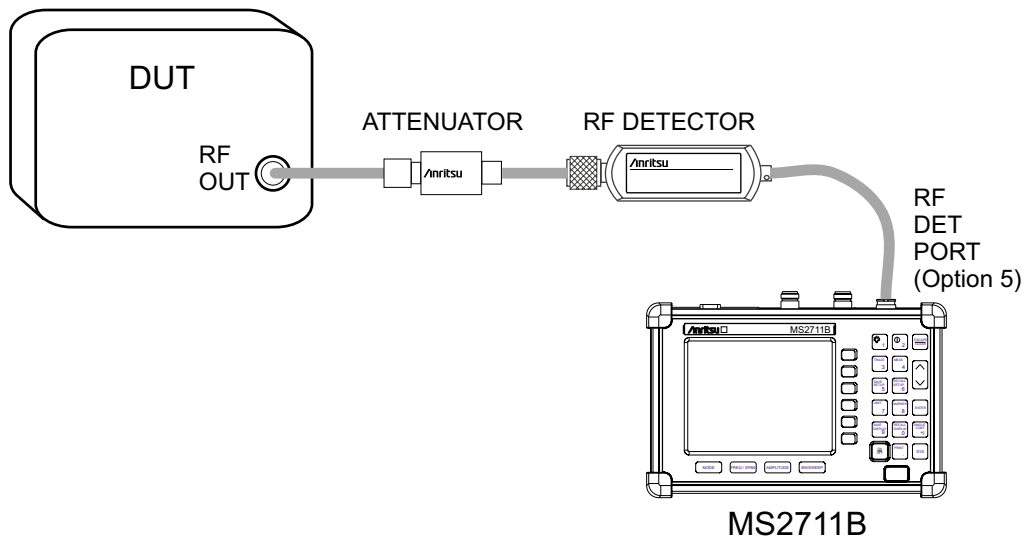


Figure 5-10. Power Monitor Measurement Setup



## Dynamic Attenuation Control

The dynamic attenuation control feature tracks the peak input signal level and automatically adjusts the attenuator and reference level to protect the MS2711B 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, if installed, resulting in improved measurement accuracy.

The dynamic attenuation feature attempts to display the peak signal somewhere between 2 and 15 dBm below the reference level. It first attempts to do this by adjusting the reference level (and thereby the attenuation, since they are coupled). The attenuation cannot be reduced any further than 0 dB. At this point, if the peak signal is still low (it might be buried in the noise floor) the preamplifier is turned on (if Option 8 is installed). This happens with signal levels that are between -60 and -70 dBm.

If the input signal becomes larger, the preamp may saturate, causing the MS2711B to add attenuation. When the attenuation is at 50 dB, the preamp will turn off. This happens with signal levels that are between -30 and -20 dBm.

When dynamic attenuation is on, the MS2711B is in control of the reference level, attenuation and preamp. Manual settings will be overwritten based on the input signal. To manually control these parameters, set the attenuation to either **AUTO** or **MANUAL**.

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

*NOTE: Dynamic attenuation cannot overcome the “zero beat.” Make sure that it is not visible in the display when enabling this feature.*

### Required Equipment

- MS2711B Hand Held Spectrum Analyzer (HHSA)
- A PCS band Pass Filter, such as K & L Electronics 5DR30-921 or equivalent
- A PCS band antenna

### Procedure

- Step 1.** Reset the MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 to recall the factory preset state.
- Step 2.** 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 MS2711B.
- Step 3.** 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 4.** Press the **FREQ/SPAN** key.

- Step 5.** Press the **START** soft key and enter 910 MHz.
- Step 6.** Press the **STOP** soft key and enter 950 MHz.
- Step 7.** Press the **AMPLITUDE** key and select the **SCALE** key. Set the scale to 10 dB/division.
- Step 8.** Press the **ATTEN** soft key and set the attenuation to **AUTO**.

Figure 5-11 shows this example through Step 8.

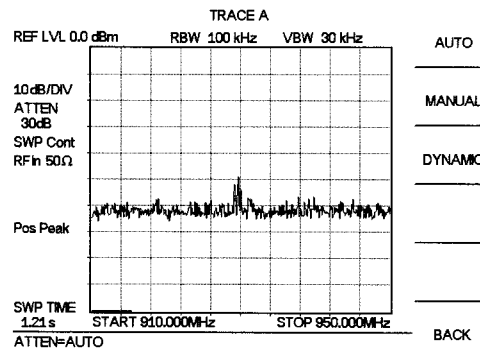


Figure 5-11. Dynamic Attenuation

- Step 9.** Press the **AMPLITUDE** key and select the **ATTEN** soft key.
- Step 10.** Press the **DYNAMIC** soft key to turn on dynamic attenuation. The **ATTEN** icon to the left of the graph will become **ATTEN#** to indicate that dynamic attenuation is on.

The unit will complete one sweep. At that time it will look at the peak signal compared to the current parameter settings. If it can automatically enhance the display of the peak signal, the message **ADJUSTING DYNAMIC ATTENUATION PARAMETERS** will appear in the message area and an hourglass will be displayed to the top right of the graph. During this time, the MS2711B will be adjusting parameters and collecting data to determine the optimal configuration for the current input signal. Measurement results will not be displayed on the screen until the correct combination of parameters is determined. This will speed up the adjustment process.

Figure 5-12 shows the results with dynamic attenuation enabled. Note that in this case, the optional preamplifier was automatically turned on.

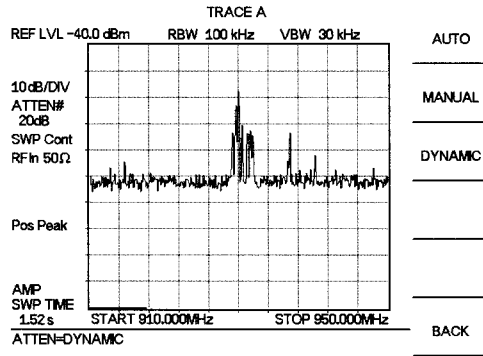


Figure 5-12. Dynamic Attenuation

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

# Chapter 6

## Preamplifier

### Description

The MS2711B is available with an optional, built-in preamplifier. Option 8 provides the MS2711B with an additional 20 dB of sensitivity from 1 MHz to 3 GHz. 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 MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 to recall the factory preset state.
- Step 2.** Press the **MEAS** hard key.
- Step 3.** Select the **PREAMP** 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.  
If the preamplifier becomes saturated, the message **AMP-SAT** will be displayed, and measurement results could be inaccurate.

*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 MS2711B 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. Dynamic attenuation is on when the # symbol appears after the ATTEN icon on 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 option of a MS2711B Hand Held Spectrum Analyzer.

### Required Equipment

- MS2711B Hand Held Spectrum Analyzer (HSA) with Preamplifier Option 8
- Test Port extension cable, Anritsu 15NNF50 – 1.5C
- A signal source (Anritsu 69xxxB Synthesized Signal Generator or equivalent)

### Procedure

- Step 1.** Reset the MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 to recall the factory preset state.
- Step 2.** Connect the RF output of the signal source to the RF In port of the MS2711B.
- Step 3.** If necessary, set the MS2711B to Spectrum Analyzer mode.
- Step 4.** Press the **FREQ/SPAN** key and 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.** Set the signal source output level to  $-100$  dBm.
- Step 6.** Press the **AMPLITUDE** key and select the **REF LEVEL** soft key to set the reference level to  $-80$  dBm.
- Step 7.** Press the **SCALE** soft key and set the scale to 5 dB/division.
- Step 8.** Press the **ATTEN** soft key and set the attenuation to **AUTO** and press the **BACK** soft key.
- Step 9.** Press the **DETECTION** soft key and set the detection mode to **POSITIVE PEAK**.
- Step 10.** Press the **BW/SWEEP** key and select the **RBW** and **VBW** soft keys to set the resolution bandwidth to 10 kHz and the video bandwidth to **AUTO**.
- Step 11.** Press the **MEAS** hard key and press the **PREAMP** soft key to toggle the preamplifier state. With the Preamp set to off, there may be no signal on the display, or the signal may be difficult to see.

Figure 6-1 shows the measurement results with the preamplifier off.

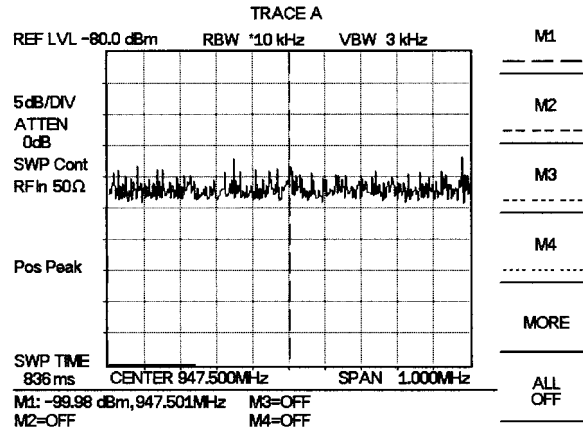


Figure 6-1. Preamplifier OFF

- Step 12.** 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 6-2 shows the measurement results with the preamplifier on.

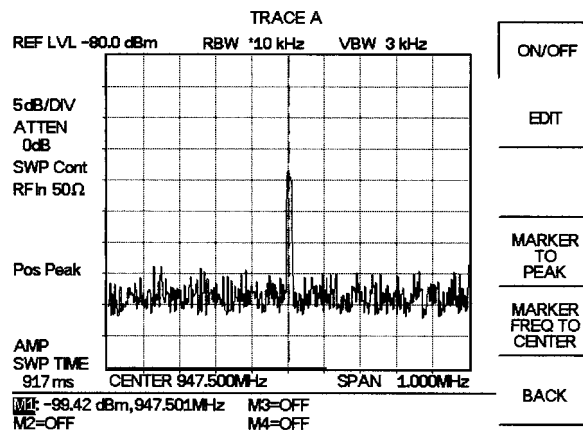


Figure 6-2. Preamplifier ON

# Chapter 7

## Tracking Generator

### Description

This chapter provides an overview of the Tracking Generator option (Option 20). Examples of field measurements performed by MS2711B Hand Held Spectrum Analyzer, in combination with the tracking generator, are included.

A tracking generator (TG) is a signal generator with an output that tracks, or follows, the tuning of the spectrum analyzer and allows the MS2711B to perform network measurements. The tracking generator can be used to measure gain, frequency response flatness, and return loss in wireless communications systems from 10 MHz to 3000 MHz. The MS2711B provides a one-button normalization feature to compensate for measurement errors caused by RF cables and other connectors in a measurement setup.

### Tracking Generator

The output of the tracking generator is connected to the input of the device under test (DUT) and the frequency response of the DUT is measured with the spectrum analyzer receiver. The transfer characteristics of the DUT can be obtained and documented. The TG will sweep in synchronization with the spectrum analyzer, that is, it can be tuned to the exact frequency and span of the analyzer, or it can be offset up to  $\pm 5$  MHz. The output power level of the tracking generator can be set from 0 dBm to  $-60$  dBm in 0.1 dB increments.

### Tracking Generator Modes

The Anritsu HHS provides two tracking generator modes:

- Tracking Generator
- Tracking Generator – Fast Tune

In Tracking Generator mode, the user can adjust the RBW, VBW, and Attenuation to any combination of available settings to provide the most appropriate measurement for the circumstances.

In the Tracking Generator - Fast Tune mode, the MS2711B selects the best combination of RBW and VBW settings and makes only one measurement per display point to provide a faster measurement. When the MS2711B is operating in Fast Tune mode, the RBW, VBW, and Attenuation cannot be adjusted by the user.

### Tracking Generator Operation

To select the Tracking Generator option, press the **MODE** key and use the Up/Down arrow key to select TRACKING GENERATOR. Press **ENTER** to confirm the selection. Set the Start Frequency at  $\geq 10$  MHz.

To select the Tracking Generator–Fast Tune option, press the **MODE** key and use the Up/Down arrow key to select TG–FAST TUNE. Press **ENTER** to confirm the selection. Set the Start Frequency at  $\geq 10$  MHz.

## Tracking Generator Output Level

To select the TG output level, press the **AMPLITUDE** key and select the TG OUTPUT LEVEL soft key. Use the Up/Down arrow key or the keypad to enter the desired TG output level (0.0 to -60.0 dBm) and press **ENTER** to confirm the entry.

Figure 7-1 shows the results of a through line from RF Out to RF In. The tracking generator output level is set at -20 dBm.

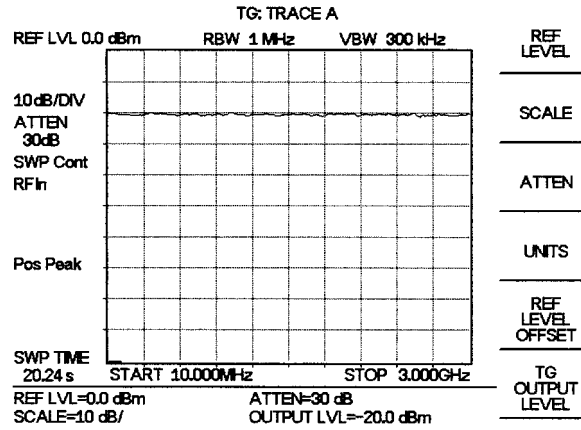


Figure 7-1. Tracking Generator Output Level

## Tracking Generator Frequency Offset

The Tracking Generator Frequency offset can be set from -5 MHz to +5 MHz. Press the **FREQ/SPAN** key and select the TG FREQ OFFSET soft key. Use the Up/Down arrow key or the keypad to enter the desired frequency offset and select either the GHz, MHz, kHz or Hz soft key to confirm the selection.



## Normalization

The normalization feature is used to remove the insertion loss due to the cable(s) or connector(s) in the measurement setup. Normalization should be done before the actual measurement takes place.

- Step 1.** Attach the measurement cables and connectors.
- Step 2.** Replace the DUT with a through line.
- Step 3.** Press the **FREQ/SPAN** key and select the **START** and **STOP** soft keys to set the frequency range.
- Step 4.** Press the **BW/SWEEP** key and select the **RBW** and **VBW** soft keys to set the resolution bandwidth and video bandwidth.
- Step 5.** Press the **AMPLITUDE** key and adjust the reference level and attenuation such that the RF In is not saturated.

*NOTE: In Tracking Generator–Fast Tune mode, the RBW, VBW, and attenuation mode settings are optimized to provide a faster measurement and cannot be changed.*

- Step 6.** Press the **AMPLITUDE** key and select the **TG OUTPUT LEVEL** soft key. Use the Up/Down arrow key or the keypad to enter the desired TG output level (0.0 to –60.0 dBm) and press **ENTER** to confirm the entry.
- Step 7.** Press the **TRACE** key and select the **NORMALIZE** softkey.

After the MS2711B has finished sweeping over the frequency range, a straight line should appear at the top of the LCD display and the message **NORMALIZATION DONE** will be displayed momentarily in the center of the screen. The reference level offset value will be automatically adjusted so that the top of the display is 0 dBm. An asterisk (\*) will be displayed at the top of the display after the A, as in: **TG: TRACE A\***.

While normalization is enabled, the trace taken during the “normalization sweep” is subtracted from the current measured data. When the DUT is put back in place of the through line, only the characteristics of the DUT will be included in the measurement results. Marker values will display the normalized data.

Use the **REFERENCE LEVEL OFFSET** to adjust the position of the data on the graph. If the attenuation is coupled to the reference level and the reference level is changed, the attenuation change will affect the noise floor and possibly the result. When normalization is enabled, the reference level offset is not included in the marker values and is used only for the display.

## Chapter 7 Tracking Generator

Figure 7-2 shows the results of normalization on the setup from Figure 7-1. Since the reference level is 0, the reference level offset remains 0. The marker reads the normalized value.

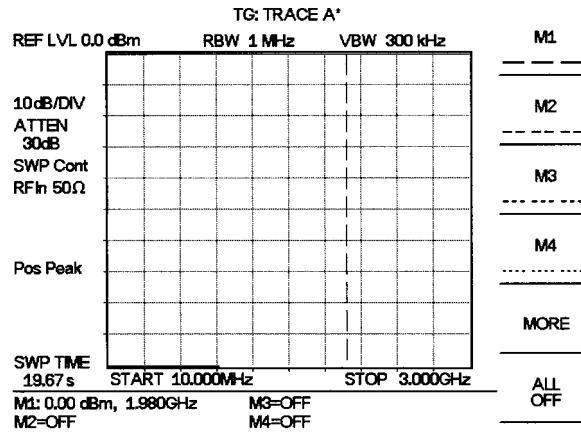


Figure 7-2. Results of Normalization

*NOTES: Normalization should be performed whenever the frequency range, tracking generator output level, RBW, attenuation or the ambient temperature have changed.*

*Normalization will not normalize an already normalized trace. It will only normalize measured data.*

*When the trace is normalized, adjust the display using the reference level OFF-SET under the AMPLITUDE menu, not the reference level. Changing the reference level itself will cause the coupled attenuation to change which will affect the noise floor of the MS2711B.*

*If the MS2711B is equipped with the Preamplifier option (Option 8) and the preamplifier is ON, the RF power in should be less than or equal to  $-50$  dBm.*

*If the MS2711B is not equipped with the Preamplifier option, or the Preamplifier is OFF, the RF power in should be less than or equal to  $-30$  dBm.*

## Making a Transmission Measurement

This section provides an overview of how to make a transmission measurement with the Anritsu MS2711B Hand Held Spectrum Analyzer equipped with the internal tracking generator option. This example measures a 60 MHz wide bandpass filter with a center frequency of 1960 MHz.

### Required Equipment

- MS2711B Hand Held Spectrum Analyzer (HSA) with TG (Option 20)
- Test Port extension cable, Anritsu 15NNF50 – 1.5C (2)
- Anritsu 34NN50A Adapter
- Test filter (DUT)

### Procedure

- Step 1.** Reset the MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 to recall the factory preset state.
- Step 2.** Connect the RF Out port of the MS2711B to the input of the DUT using a test port extension cable.
- Step 3.** Connect the output of the DUT to the RF In port of the MS2711B using a test port extension cable.
- Step 4.** Press the **MODE** key and the Up/Down arrow key to select **TRACKING GENERATOR**. Press **ENTER** to confirm the selection.
- Step 5.** Press the **FREQ/SPAN** key and select the **CENTER** soft key. Enter the center frequency of the measurement. This example uses 1960 MHz.
- Step 6.** Press the **SPAN** soft key and set the span. This example uses 200 MHz.
- Step 7.** With the DUT connected, press the **BW/SWEEP** key and select the **RBW** and **VBW** soft keys to set the resolution bandwidth and the video bandwidth. For this example, set both to **AUTO**.
- Step 8.** Press the **AMPLITUDE** key and set the **REFERENCE LEVEL**. This example uses 0 dBm.
- Step 9.** Press the **ATTEN** soft key to set the input attenuation level. This example uses **AUTO**.
- Step 10.** Press the **AMPLITUDE** key and set the **TG OUTPUT LEVEL**. Make sure the output signal from the DUT will not drive the MS2711B into saturation. This example uses 0 dBm.

*NOTE: If the MS2711B is equipped with the Preamplifier option (Option 8) and the preamplifier is ON, the RF power in plus the attenuation, should be less than or equal to -50 dBm.*

If the MS2711B is not equipped with the Preamplifier option, or the Preamplifier is OFF, the RF power in plus the attenuation, should be less than or equal to -30 dBm.

For example, for an input power of +10 dBm:  $+10 - 40 \text{ dB atten} = -30 \text{ dBm}$ . Therefore, the attenuation must be 40 dB or greater.

**Step 11.** Establish a reference level by removing the device and replacing the DUT with a through adapter to normalize the frequency response.

**Step 12.** Press the **TRACE** key and select the **NORMALIZE** softkey.

*NOTE: To adjust the vertical location of the trace on the display, use the reference level OFFSET under the AMPLITUDE menu, not the reference level. If attenuation is coupled to the reference level and that is modified to adjust the data display, the noise floor could be affected.*

*When normalization is complete, the reference level offset is automatically adjusted so that the top of the graph displays a 0 result after normalization. This means  $RL + RL \text{ offset} = 0$ . Since the through line is still connected, the measured data minus the normalization trace should result in a straight line at the top of the graph.*

**Step 13.** Reconnect the DUT to obtain the transmission measurement by sweeping the DUT over the desired frequency span.

**Step 14.** Press the **AMPLITUDE** key and adjust the REF LEVEL OFFSET to modify the location of the data on the graph.

Figure 7-3 shows the results of the filter measurement.

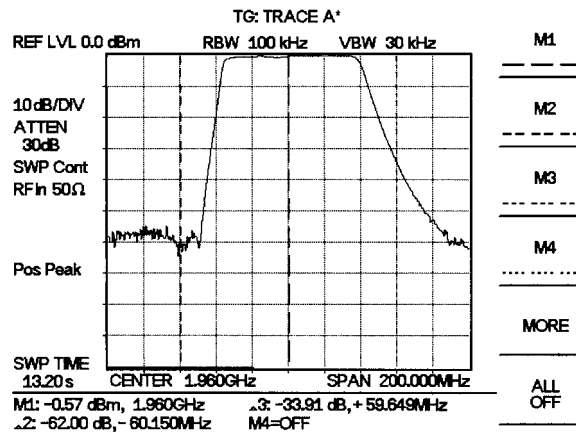


Figure 7-3. Results of the Filter Measurement

## Filter Alignment

The following measurement is an example of filter alignment using the MS2711B with the built-in tracking generator option.

### Required Equipment

- MS2711B Hand Held Spectrum Analyzer (HHSA) with TG (Option 20)
- Test Port extension cable, Anritsu 15NNF50 – 1.5C (2)
- Anritsu 34NN50A Adapter
- Test filter

### Procedure

- Step 1.** Reset the MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 to recall the factory preset state.
- Step 2.** Press the **MODE** key and use the Up/Down arrow key to select **TRACKING GENERATOR**. Press **ENTER** to confirm the selection.
- Step 3.** Press the **FREQ/SPAN** key and select the **START** and **STOP** soft keys to set the start and stop frequencies. For an 1800 MHz application, set the start frequency to 1800 MHz, and the stop frequency to 1950 MHz.
- Step 4.** Press the **AMPLITUDE** key and set the **REF LEVEL** to +10 dBm.
- Step 5.** Press the **ATTEN** soft key and set the attenuation to **AUTO**.
- Step 6.** Press the **AMPLITUDE** key and set the **TG OUTPUT LEVEL** to 0 dBm.
- Step 7.** Press the **BW/SWEEP** key and select the **RBW** and **VBW** soft keys to set the resolution bandwidth and the video bandwidth. Set the resolution bandwidth to 1 MHz, and the video bandwidth to 300 kHz.
- Step 8.** Connect the **RF Out** port of the MS2711B to the **RF In** port of the MS2711B, using the two cables and the adapter.
- Step 9.** Press the **TRACE** key and select the **NORMALIZE** softkey. Wait for the **NORMALIZATION DONE** message to be displayed.
- Step 10.** Remove the adapter, connect the cable from the **RF Out** port of the MS2711B to the “J1” port of the filter, and connect the cable from the **RF In** port of the MS2711B to the “J2” port of the filter.
- Step 11.** To measure the lowest insertion loss of the filter, press the **MARKER** button and the **M1** soft key.
- Step 12.** Press the **MARKER TO PEAK** soft key. The value of Marker 1 is the lowest insertion loss of the filter.
- Step 13.** Adjust the filter to align for the best flatness across the band.

## Antenna Isolation Test

This section contains an example of an antenna isolation test using the Anritsu MS2711B with built-in tracking generator option. The following antennas are used in this example:

- Antenna 1: Maxrad MFB8965, 896–940 MHz, 360° Omnidirectional
- Antenna 2: Huber + Suhner Cellular, 824–896 MHz, 90° Directional

## Required Equipment

- MS2711B Hand Held Spectrum Analyzer (HSA) with TG (Option 20)
- Test Port extension cable, Anritsu 15NNF50 – 1.5C

## Procedure

- Step 1.** Reset the MS2711B to the factory default settings if a known starting state is desired.  
If the unit is off, hold down the **ESC/CLEAR** key while pressing the **ON/OFF** key.  
If the unit is already on, press the **RECALL SETUP** key on the data keypad. When the key is pressed, a Recall Trace selection box appears on the display. Select setup location 0 to recall the factory preset state.
- Step 2.** Press the **MODE** key and use the Up/Down arrow key to select **TRACKING GENERATOR**. Press **ENTER** to confirm the selection.
- Step 3.** Press the **FREQ/SPAN** key and select the **START** and **STOP** soft keys to set the start and stop frequencies. Set the start frequency to 806 MHz, and stop frequency to 960 MHz.
- Step 4.** Press the **AMPLITUDE** key and set the **REFERENCE LEVEL** to 0 dBm.
- Step 5.** Set the **SCALE** to 10 dB/div.
- Step 6.** Set the **TG OUTPUT LEVEL** to 0 dBm.
- Step 7.** Press the **BW/SWEEP** key and select the **RBW** and **VBW** soft keys to set the resolution bandwidth and the video bandwidth. Set the resolution bandwidth to 1 MHz, and the video bandwidth to 300 kHz.
- Step 8.** Normalize the test setup to remove the effects of the components, if necessary (see page 7-3).
- Step 9.** Connect the RF Out port of the MS2711B to Antenna 1, and connect the RF In port of the MS2711B to Antenna 2. The resulting sweep is the isolation across the specified frequency range.
- Step 10.** Press the **MARKER** key and set markers M1=830 MHz and M2=890 MHz to identify the isolation level at those frequencies.
- Step 11.** If necessary, adjust the reference level, or reference level offset if normalized, and scale to improve the display.

Figure 7-4 shows an isolation of  $-23$  dBm at 830 MHz and an isolation of  $-26$  dBm at 890 MHz.

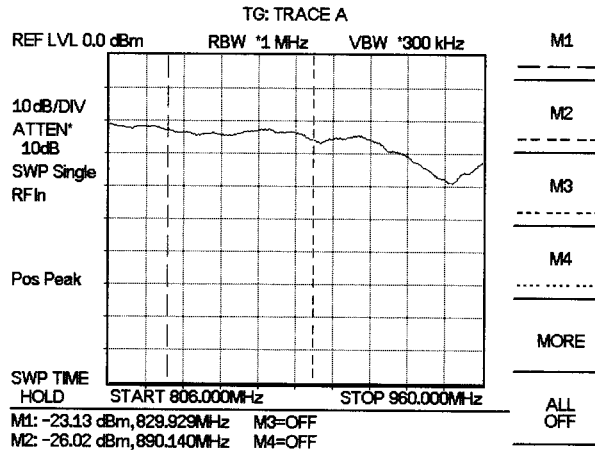


Figure 7-4. Initial Antenna Isolation

Change the angle of the panel antenna by adjusting the mounting position. Adjust both antennas for maximum isolation (more negative means better isolation).

Figure 7-5 shows the results of adjusting the positions of the antennas. The isolation at 830 MHz improved to  $-54.5$  dBm and the isolation at 890 MHz improved to  $-34$  dBm.

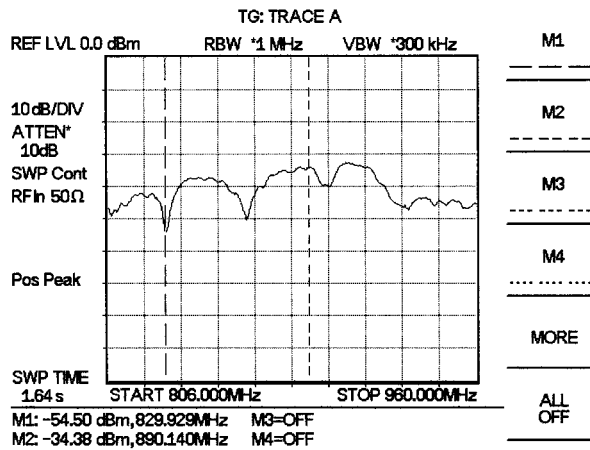


Figure 7-5. Antenna Isolation After Antenna Adjustment

# Chapter 8

## Software Tools

### Introduction

This chapter provides a description of the Anritsu Software Tools program. 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.

### Features

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 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 on the unit
- Create antenna factor files to be uploaded to the instrument

### System Requirements

The 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 power 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 Software Tools program:

- Step 1.** Insert the Anritsu 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\ 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 Software Tools communicates with the instrument through a standard serial COM port on the PC.

- Step 1.** Select **Start, Programs** and select **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 8-1. 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, and optional USB to serial adaptor, part number 551-1691, if required).

- 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.

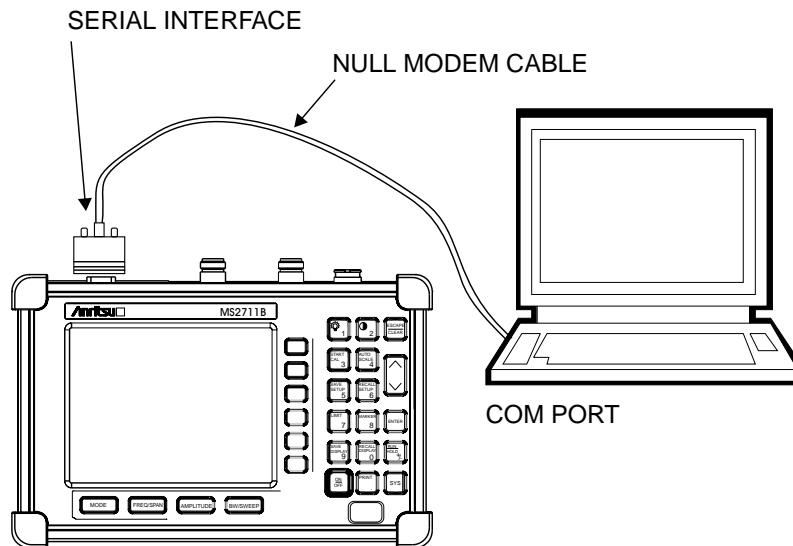


Figure 8-2. Serial Cable Connection

## Using Software Tools

Select **Start, Programs** and select **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	

**NOTE:** Not all selections apply to every Anritsu Hand Held 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 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 $\mu$ 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 sub menu 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/yyy  |   |
| 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. A maximum of two traces can be overlaid on a third trace.

Refer to the 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 SMST .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 Software Tools.

To save a plot as a Windows metafile, click on the **File** menu and select **Save as Metafile** 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 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 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 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 Software Tools

*NOTE: Antenna Factors are available only on Anritsu Hand Held Spectrum Analyzers.*

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<sup>-1</sup>

E = Electric field in Volts per meter

V<sub>l</sub> = 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  $G_r$  = the gain of the receiving antenna in dB

$\lambda$  = 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 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.

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 Gain to Antenna Factor.

*NOTE: Only one input of frequency and antenna factor is allowed per row. Multiple antenna factors for a single antenna must be entered individually. For example, an antenna having an antenna factor of 5 from 2.0 to 2.25 GHz and an antenna factor of 4 from 2.25 to 2.5 GHz should be entered as follows:*

Frequency (MHz)	Antenna Factor
2000	5
2251	4
2500	4

*If necessary, an antenna factor of zero (0) may be entered.*

**Step 3.** 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 Software Tools to the CUSTOM list in the HHSA:

- 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 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 STRNGTH** and **SELECT ANTENNA** soft keys, and selecting the **CUSTOM** list.

## 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).



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