



### **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:** Cell Master

**Model Number:** MT8212A

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

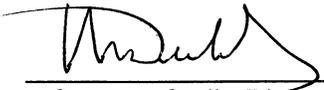
## **Electromagnetic Interference:**

**Emissions:** CISPR 11:1990/EN55011:1991 Group 1 Class A

**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

## **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

02 APR 03  
Date

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

# Table of Contents

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## Chapter 1 - General Information

Introduction . . . . .	1-1
Description . . . . .	1-1
Standard Accessories . . . . .	1-1
Printers . . . . .	1-2
Optional Accessories . . . . .	1-3
Performance Specifications . . . . .	1-4
Preventive Maintenance . . . . .	1-9
Calibration . . . . .	1-9
InstaCal Module . . . . .	1-10
Annual Verification . . . . .	1-10
ESD Precautions . . . . .	1-10

## Chapter 2 - Functions and Operations

Introduction . . . . .	2-1
Test Connector Panel . . . . .	2-1
Front Panel Overview . . . . .	2-2
Function Hard Keys . . . . .	2-3
Keypad Hard Keys . . . . .	2-4
Soft Keys . . . . .	2-6
Power Meter Menus . . . . .	2-26
T1 Tester Mode Menus . . . . .	2-27
E1 Tester Mode Menus . . . . .	2-30
Symbols . . . . .	2-32
Self Test . . . . .	2-32
Error Messages . . . . .	2-33
Battery Information . . . . .	2-38
Charging a New Battery . . . . .	2-38
Determining Remaining Battery Life . . . . .	2-39
Important Battery Information . . . . .	2-41

## Chapter 3 - Getting Started

Introduction . . . . .	3-1
Power On Procedure . . . . .	3-1
Cable and Antenna Analyzer Mode . . . . .	3-2
Spectrum Analyzer Mode . . . . .	3-10
All Modes . . . . .	3-13
Save and Recall a Setup . . . . .	3-13
Save and Recall a Display . . . . .	3-13
Changing the Units . . . . .	3-14
Changing the Language . . . . .	3-14
Adjusting Markers . . . . .	3-14
Adjusting Limits . . . . .	3-14
Adjusting the Status Window Contrast . . . . .	3-16

Adjusting the Backlight Intensity . . . . .	3-16
Printing . . . . .	3-17
Using the Soft Carrying Case. . . . .	3-18

## **Chapter 4 - Cable and Antenna Analyzer Measurements**

Introduction . . . . .	4-1
Line Sweep Fundamentals . . . . .	4-1
CW Mode . . . . .	4-2
Information Required for a Line Sweep . . . . .	4-3
Typical Line Sweep Test Procedures . . . . .	4-3

## **Chapter 5 - Spectrum Analyzer Measurements**

Introduction . . . . .	5-1
Selecting the Signal Standard and Channel . . . . .	5-1
Field Strength Measurements . . . . .	5-2
Occupied Bandwidth. . . . .	5-3
Channel Power Measurement . . . . .	5-5
Adjacent Channel Power Ratio . . . . .	5-7
Interference Analysis . . . . .	5-9

## **Chapter 6 - Power Measurement**

Introduction . . . . .	6-1
Power Measurement . . . . .	6-1

## **Chapter 7 - T1 Measurements**

Introduction . . . . .	7-1
T1 Fundamentals. . . . .	7-1
Network Equipment . . . . .	7-2
Testing T1 Circuits. . . . .	7-3
In Service Testing . . . . .	7-3
Out-Of-Service Testing . . . . .	7-6

## **Chapter 8 - E1 Measurements**

Introduction . . . . .	8-1
E1 Fundamentals . . . . .	8-1
Network Equipment . . . . .	8-2
Testing E1 Circuits. . . . .	8-3
In Service Testing . . . . .	8-3
Out-Of-Service Testing . . . . .	8-6

## **Chapter 9 - Handheld Software Tools**

Introduction . . . . .	9-1
Features . . . . .	9-1
System Requirements . . . . .	9-1
Installation . . . . .	9-2
Using Handheld Software Tools . . . . .	9-3
Downloading Traces . . . . .	9-3
Plot Capture to the PC . . . . .	9-4
Plot Upload to the Instrument . . . . .	9-4
Plot Properties . . . . .	9-4

## **Appendix A - Reference Data**

Coaxial Cable Technical Data. . . . .	A-1
---------------------------------------	-----

## **Appendix B - Windowing**

Introduction . . . . .	B-1
Examples . . . . .	B-1

# Chapter 1

## General Information

### Introduction

This chapter provides a description, performance specifications, optional accessories, preventive maintenance, and calibration requirements for the Cell Master model MT8212A. Throughout this manual, the term Cell Master will refer to the MT8212A.

<u>Model</u>	<u>Frequency Range</u>
MT8212A	Cable and Antenna Analyzer Mode: 25 to 4000 MHz Spectrum Analyzer Mode: 10 to 3000 MHz

### Description

The Cell Master is a hand held cable and antenna analyzer, spectrum analyzer, power meter, and T1/E1 analyzer. All models include a keypad to enter data and a liquid crystal display (LCD) to provide graphic indications of various measurements.

The Cell Master is capable of up to 1.5 hours of continuous operation from a fully charged field-replaceable battery and can be operated from a 12.5 Vdc source. Built-in energy conservation features can be used to extend battery life.

The Cell Master is designed for measuring SWR, return loss, cable insertion loss and locating faulty RF components in antenna systems. The Cell Master includes spectrum analysis capabilities including interference analysis, power meter capability, and T1/E1 analyzer capability to test the backhaul of wireless networks.

The displayed trace can be scaled or enhanced with frequency markers or limit lines. A menu option provides for an audible “beep” when the limit value is exceeded. To permit use in low-light environments, the LCD contrast and backlight intensity can be adjusted.

### Standard Accessories

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

The Handheld Software Tools program can display measurements made with the Cell Master (SWR, return loss, cable loss, distance-to-fault, field strength, occupied bandwidth, channel power, adjacent channel power and interference analysis) as well as providing other functions, such as converting display modes and Smith charts. The Handheld Software Tools program cannot display T1 and E1 measurements. Refer to Chapter 9, Handheld Software Tools, for more information.

The following items are supplied with the basic hardware:

- Soft Carrying Case
- Rechargeable Battery
- AC-DC Adapter
- Automotive Cigarette Lighter 12 Volt DC Adapter
- Handheld Software Tools CDROM
- Serial Interface Cable (null modem type)
- One year Warranty (includes battery, firmware, and software)
- User's Guide

## **Printers**

- 2000-1214 HP DeskJet Printer, Model 450 w/Interface Cable, Black Print Cartridge, and U.S. Power Cable
- 2000-1215 Color Print Cartridge for HP450 DeskJet
- 2000-1216 Black Print Cartridge for HP450 DeskJet
- 2000-1217 Rechargeable Battery Pack for HP450 DeskJet
- 2000-1218 Power Cable (U.K.) for DeskJet Printer
- 2000-663 Power Cable (Europe) for DeskJet Printer
- 2000-664 Power Cable (Australia) for DeskJet Printer
- 2000-666 Power Cable (Australia) for DeskJet Printer
- 2000-667 Power Cable (Japan) for DeskJet Printer
- 2000-753 Serial-to-Parallel Converter Cable, DB9 (f) to Centronics (m)
- 1091-310 Cable Adapter, Centronics (f) to DB25 (f)

## Optional Accessories

<u>Part Number</u>	<u>Description</u>
10580-00094	MT8212A Programming Manual (on disk only)
10580-00095	MT8212A Maintenance Manual
760-215A	Transit Case
633-27	Rechargeable Battery, NiMH
2000-1029	Battery Charger with universal power supply, NiMH only
48258	Soft Carrying Case
40-115	AC Adaptor Power Supply
806-62	Cable Assy, Cig Plug, Female
800-441	Serial Interface Cable Assy
551-1691	USB Adapter Cable
2300-347	Handheld Software Tools CD
ICN50	InstaCal™ Calibration Module, 50 Ohm, 2 MHz to 4 GHz, N (m)
OSLN50LF	Anritsu Precision N (m) Open/Short/Load, 42 dB
OSLNF50LF	Anritsu Precision N (f) Open/Short/Load, 42 dB
22N50	Anritsu Precision N (m) Short/Open
22NF50	Anritsu Precision N (f) Short/Open
SM/PL	Anritsu Precision N (m) Load, 42 dB
SM/PLNF	Anritsu Precision N (f) Load, 42 dB
2000-767	7/16 (m) Precision Open/Short/Load
2000-768	7/16 (f) Precision Open/Short/Load
34NN50A	Adapter, Precision N (m) to N (m) 18 GHz
34NFN50	Adapter, Precision N (f) to N (f) 18 GHz
510-90	Adapter, 7/16 (f) to N (m) 7.5 GHz
510-91	Adapter, 7/16 (f) to N (f) 7.5 GHz
510-92	Adapter, 7/16 (m) to N (m) 7.5 GHz
510-93	Adapter, 7/16 (m) to N (f) 7.5 GHz
510-96	Adapter, 7/16 DIN (m) to 7/16 DIN (m) 7.5 GHz
510-97	Adapter, 7/16 DIN (f) to 7/16 DIN (f) 7.5 GHz
15NNF50-1.5C	Armored Test Port Extension Cable, 1.5 meter, N (m) to N (f) 6 GHz
15NNF50-3.0C	Armored Test Port Extension Cable, 3.0 meter, N (m) to N (f) 6 GHz
15NNF50-5.0C	Armored Test Port Extension Cable, 5.0 meter, N (m) to N (f) 6 GHz
15NN50-1.5C	Armored Test Port Extension Cable, 1.5 meter, N (m) to N (m) 6 GHz
15NN50-3.0C	Armored Test Port Extension Cable, 3.0 meter, N (m) to N (m) 6 GHz
15NN50-5.0C	Armored Test Port Extension Cable, 5.0 meter, N (m) to N (m) 6 GHz
15NDF50-1.5C	Armored Test Port Extension Cable, 1.5 meter, N (m) to 7/16 DIN (f) 6 GHz
15ND50-1.5C	Armored Test Port Extension Cable, 1.5 meter, N (m) to 7/16 DIN (m) 6 GHz
2000-1030	Portable Antenna SMA (m), 50 Ω, 1.71 to 1.88 GHz
2000-1031	Portable Antenna SMA (m), 50 Ω, 1.85 to 1.99 GHz
2000-1032	Portable Antenna SMA (m), 50 Ω, 2.4 to 2.5 GHz
2000-1034	Portable Antenna SMA (f), 50 Ω, 806-869MHz
2000-1035	Portable Antenna SMA (m), 50 Ω, 896 to 941 MHz
2000-1200	Portable Antenna SMA (m), 50 Ω, 806-869MHz
806-16	Bantam to Bantam
806-116	Bantam to BNC
806-117	Bantam to RJ48

## Performance Specifications

Performance specifications are provided in Table 1-1. All specifications apply when calibrated at ambient temperature after a five minute warm up. Typical values are given for reference, and are not guaranteed.

Table 1-1. Performance Specifications (1 of 5)

---

### Cable and Antenna Analyzer

Frequency Range:	25 MHz to 4.0 GHz
Frequency Accuracy:	$\leq \pm 75$ ppm @ +25°C
Frequency Resolution:	100 kHz
Output Power:	< 0 dBm (-10 dBm nominal)
Immunity to Interfering Signals:	on-channel +17 dBm on-frequency -5 dBm
Measurement speed:	$\leq 3.5$ msec / data point (CW ON)
Number of data points:	130, 259, 517
Return Loss:	
Range:	0.00 to 60.00 dB
Resolution:	0.01 dB
VSWR:	
Range:	1.00 to 65.00
Resolution:	0.01
Cable Loss:	
Range:	0.00 to 30.00 dB
Resolution:	0.01 dB
Measurement Accuracy:	> 42 dB corrected directivity after calibration
Distance-To-Fault	
Vertical Range:	
Return Loss:	0.00 to 60.00 dB
VSWR:	1.00 to 65.00
Horizontal Range:	0 to (# of data pts -1) x Resolution to a maximum of 1197m (3929 ft) # of data pts = 130, 259, 517
Horizontal Resolution (rectangular windowing):	
Resolution (meters) = $(1.5 \times 10^8) \times (Vp)/DF$	
Where Vp is the relative propagation velocity of the cable and DF is the stop frequency minus the start frequency (in Hz).	

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Table 1-1. Performance Specifications (2 of 5)

**Spectrum Analyzer**

Frequency Range:	10 MHz to 3.0 GHz
Frequency Reference (internal timebase):	
Aging:	$\pm 1$ ppm/yr
Accuracy:	$\pm 2$ ppm
Frequency Span:	10 Hz to 2.99 GHz in 1, 2, 5 step selections in auto mode, plus zero span
Sweep Time:	$\leq 1.1$ sec full span; $\leq 50$ Fsec to 20sec zero span
Resolution Bandwidth (–3 dB):	100 Hz to 1 MHz in 1-3 sequence $\pm 5\%$ Accuracy
Video Bandwidth (–3 dB):	3 Hz to 1 MHz in 1-3 sequence $\pm 5\%$ Accuracy
SSB Phase Noise (1 GHz) @ 30 kHz Offset:	$\leq -75$ dBc/Hz
Spurious Responses:	$\leq -45$ dBc
Spurious Residual Responses:	$\leq -90$ dBm, (10 kHz RBW, pre-amp on)
Amplitude	
Total Level Accuracy:	$\pm 1$ dB max ( $\pm 0.5$ dB typical) for input signal levels $\geq -60$ dBm (10 MHz to 2 GHz, excludes input VSWR mismatch)
Measurement Range:	+20 dBm to –135 dBm
Input Attenuator Range:	0 to 51 dB, selected manually or automatically coupled to the reference level. Resolution in 1 dB steps.
Displayed Average Noise Level:	$\leq -135$ dBm typical (Input terminated, 0 dB attenuation, RMS detection, 100 Hz RBW, preamp on)
Dynamic Range:	>65 dB
Display Range:	1 to 15 dB/division, in 1 dB steps, 10 divisions displayed
Scale Units:	dBm, dBV, dBmV, dB $\mu$ V
RF Input VSWR:	(20 dB atten.) 1.5:1 typical, (10 MHz to 2.4 GHz)

Table 1-1. Performance Specifications (3 of 5)

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**Power Meter**

Frequency Range:	10 MHz to 3.0 GHz
Detection Range:	-80 dBm to +80 dBm
Offset Range:	0 to +60 dB
Accuracy:	$\pm 1$ dB max ( $\pm 0.5$ dB typical) for input signal levels $\geq -60$ dBm, 10 MHz to 2 GHz excludes input VSWR
VSWR:	1.5:1 typical ( $P_{in} > -30$ dBm, 10 MHz to 2.4 GHz)
Maximum Power:	20 dBm (0.1W) without external attenuator

**T1 Analyzer**

Line Coding:	AMI, B8ZS
Framing Modes:	D4 (Superframe), ESF (Extended Superframe)
Connection Configurations:	Terminate (100 $\Omega$ ) Bridge ( $\geq 1000\Omega$ ) Monitor (Connect via 20 dB pad in DSX)
Receiver Sensitivity:	0 to -36 dBdsx
Transmit Level:	0 dB, -7.5 dB, and -15 dB
Clock Sources:	External Internal: 1.544 MHz $\pm$ 30 ppm
Pulse Shapes:	Conform to ANSI T1.403
Pattern Generation and Detection:	PRBS: 2-9, 2-11, 2-15, 2-20, 2-23 Inverted and non-inverted, QRSS, 1-in-8 (1-in-7), 2-in-8, 3-in-24, All ones, All zeros, T1-Daly, User defined ( $\leq 32$ bits)
Circuit Status Reports:	Carrier present, Frame ID and Sync., Pattern ID and Sync.
Alarm Detection:	AIS (Blue Alarm), RAI (Yellow Alarm)
Error Detection:	Frame Bits, Bit, BER, BPV, CRC, Error Sec
Error Insertion:	Bit, BPV, Framing Bits, RAI, AIS
Loopback Modes:	Self loop, CSU, NIU, user defined, In-band or Data Link
Level Measurements:	Vp-p ( $\pm 5\%$ )
Data Log:	Continuous, up to 48 hrs

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*Table 1-1. Performance Specifications (4 of 5)*

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**E1 Analyzer**

Line Coding:	AMI, HDB3
Framing Modes:	PCM30, PCM30CRC, PCM31, PCM31CRC
Connection Configurations:	Terminate (75 $\Omega$ , 120 $\Omega$ ) Bridge ( $\geq 1\ 000\Omega$ ) Monitor (Connect via 20 dB pad in DSX)
Receiver Sensitivity:	0 to -43 dB
Clock Sources:	External Internal, 2.048 MHz $\pm$ 30 ppm
Pulse Shapes:	Conform to ITU G.703
Pattern Generation and Detection:	PRBS: 2-9, 2-11, 2-15, 2-20, 2-23 Inverted and non-inverted, QRSS, 1-in-8 (1-in-7), 2-in-8, 3-in-24, All ones, All zeros, T1-Daly, User defined ( $\leq 32$ bits)
Circuit Status Reports:	Carrier present, Frame ID and Sync., Pattern ID and Sync.
Alarm Detection:	AIS, RAI, MMF
Error Detection:	Frame Bits, Bit, BER, BPV, CRC, E-Bits, Error Sec
Error Insertion:	Bit, BPV, Framing Bits, RAI, AIS
Loopback Modes:	Self loopback
Level Measurements:	Vpp ( $\pm 5\%$ )
Data Log:	Continuous, up to 48 hrs

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Table 1-1. Performance Specifications (5 of 5)

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**General**

Language Support:	English, Spanish, French, German, Chinese, Japanese
Internal Trace Memory:	Up to 200 traces
Setup Configuration:	30
Display:	VGA, monochrome LCD with adjustable backlight
Inputs and Outputs Ports:	
RF Out:	Type N, female, 50 $\Omega$
Maximum Input without Damage:	+20 dBm, $\pm$ 50 VDC
RF In:	Type N, female, 50 $\Omega$
Maximum Input without Damage:	+43 dBm (Peak), $\pm$ 50 VDC
Ext. Trig In:	BNC, female (5 V TTL)
Ext. Freq Ref In (2 to 20 MHz):	Shared BNC, female, 50 $\Omega$ , (-15 dBm to +10 dBm)
T1/E1 (Receive & Transmit):	Bantam Jack
Serial Interface:	RS-232 9 pin D-sub, three wire serial
Electromagnetic Compatibility:	Meets European Community requirements for CE marking
Safety:	Conforms to EN 61010-1 for Class 1 portable equipment
Temperature:	
Operating:	-10°C to 50°C, humidity 85% or less
Non-operating:	-20°C to +75°C (recommended battery stored separately between 0°C to +40°C for any prolonged non-operating storage period)
Power Supply:	
External DC Input:	+12.5 to +15 volt dc, 1350 mA max
Internal:	NiMH battery: 10.8 volts, 1800 mA maximum
Dimensions:	
Size (w x h x d):	25.4 cm x 17.8 cm x 6.1 cm (10.0 in x 7.0 in x 2.4 in)
Weight:	< 2.28 kg (< 5 lbs) including battery

---

## Preventive Maintenance

Cell Master preventive maintenance consists of cleaning the unit and inspecting and cleaning the RF connectors on the instrument and all accessories.

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

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

Clean the RF connectors and center pins with a cotton swab dampened with denatured alcohol. Visually inspect the connectors. The fingers of the N (f) connectors and the pins of the N (m) connectors should be unbroken and uniform in appearance. If you are unsure whether the connectors are good, gauge the connectors to confirm that the 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 Cell Master is a field portable unit operating in the rigors of the test environment. An Open-Short-Load (OSL) or InstaCal calibration should be performed prior to making a measurement in the field (see Calibration, page 3-2). A built-in temperature sensor in the Cell Master advises the user when the internal temperature has exceeded a measurement accuracy window, and the user is advised to perform another calibration in order to maintain the integrity of the measurement.

**NOTES:**

*For best calibration results—compensation for all measurement uncertainties—ensure that the Open/Short/Load is at the end of the test port or optional extension cable; that is, at the same point that you will connect the antenna or device to be tested.*

*For best results, use a phase stable Test Port Extension Cable (see Optional Accessories). If you use a typical laboratory cable to extend the Cell Master test port to the device under test, cable bending subsequent to the OSL calibration will cause uncompensated phase reflections inside the cable. Thus, cables which are NOT phase stable may cause measurement errors that are more pronounced as the test frequency increases.*

*For optimum calibration, Anritsu recommends using precision calibration components.*

## **InstaCal Module**

The Anritsu InstaCal module can be used in place of discrete components to calibrate the Cell Master. The InstaCal module can be used to perform an Open, Short and Load (OSL) calibration procedure. Calibration of the Cell Master with the InstaCal takes approximately 45 seconds (see Calibration, page 3-2). Unlike a discrete calibration component, the InstaCal module can not be used at the top of the tower to conduct load or insertion loss measurements. The module operates from 2 MHz to 4 GHz and weighs eight ounces.

Anritsu recommends annual verification of the InstaCal module to verify performance with precision instrument data. The verification may be performed at a local Anritsu Service Center or at the Anritsu factory.

## **Annual Verification**

Anritsu recommends an annual calibration and performance verification of the Cell Master and the OSL calibration components and InstaCal module by local Anritsu service centers. Anritsu service centers are listed in Table 1- on the following page.

The Cell Master itself is self-calibrating, meaning that there are no field-adjustable components. However, the OSL calibration components are crucial to the integrity of the calibration and therefore, must be verified periodically to ensure performance conformity. This is especially important if the OSL calibration components have been accidentally dropped or over-torqued.

## **ESD Precautions**

The Cell Master, 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 Cell Master, may damage the Cell Master input circuitry. Cell Master 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 Cell Master, it is recommended to dissipate any static charges that may be present before connecting the coaxial cables or antennas to the Cell Master. This may be as simple as temporarily attaching a short or load device to the cable or antenna prior to attaching to the Cell Master. 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.

Table 1-2. 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)  
Waigaoqiao Free Trade Zone  
Pudong, Shanghai 200131  
PR CHINA  
Telephone: 86-21-58680226  
FAX: 86-21-58680588

**FRANCE**

ANRITSU S.A  
9 Avenue du Quebec  
Zone de Courtaboeuf  
91951 Les Ulis Cedex  
Telephone: 016-09-21-550  
FAX: 016-44-61-065

**GERMANY**

ANRITSU GmbH  
Grafenberger Allee 54-56  
D-40237 Dusseldorf  
Germany  
Telephone: 0211-968550  
FAX: 0211-968555

**INDIA**

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

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# Chapter 2

## Functions and Operations

### Introduction

This chapter provides a brief overview of the Cell Master functions and operations, providing the user with a starting point for making basic measurements. For more detailed information, refer to the specific chapters for the measurements being made.

The Cell Master is designed specifically for field environments and applications requiring mobility. As such, it is a lightweight, handheld, battery operated unit which can be easily carried to any location, and is capable of up to 1.5 hours of continuous operation from a field replaceable battery for extended time in the field. Built-in energy conservation features allow battery life to be further extended. The Cell Master can also be powered by a 12.5 Vdc external source. The external source can be 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 standard accessories.

### Test Connector Panel

The connectors and indicators located on the test panel (Figure 2-1) are listed and described below.

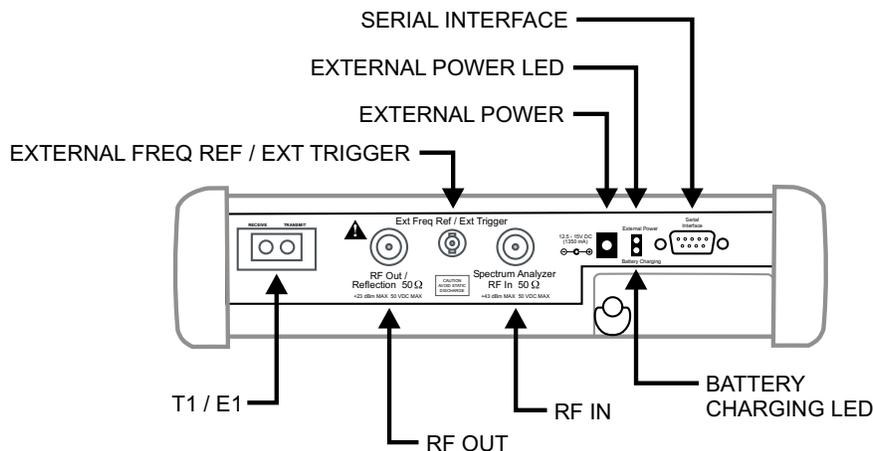


Figure 2-1. Test Connector Panel

**12.5-15VDC (1350 mA)** 12.5 to 15 Vdc @ 1350 mA input to power the unit or for battery charging.

#### 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>	Illuminates when the battery is being charged. The indicator automatically shuts off when the battery is fully charged.
<b>External Power</b>	Illuminates when the Cell Master is being powered by the external charging unit.
<b>Serial Interface</b>	RS232 DB9 interface to a COM port on a personal computer (for use with the Anritsu Handheld Software Tools program) or to a supported printer.
<b>RF Out/Reflection 50<math>\Omega</math></b>	RF output, 50 $\Omega$ impedance, for reflection measurements. Maximum input is +23 dBm at $\pm 50$ Vdc.
<b>Spectrum Analyzer RF In 50<math>\Omega</math></b>	RF input, 50 $\Omega$ impedance, for spectrum analysis measurements. Maximum input is +43 dBm at $\pm 50$ Vdc.
<b>Ext Freq Ref/Ext Trigger</b>	Input for an external reference signal or trigger in Spectrum Analyzer mode.
<b>T1/E1 Receive/Transmit</b>	Transmit and Receive connectors for T1 and E1 measurements.

## Front Panel Overview

The Cell Master menu-driven user interface is easy to use and requires little training. Hard keys on the front panel are used to initiate function-specific menus. There are four function hard keys located below the status window: Mode, Frequency/Distance, Amplitude and Measure/Display.

There are seventeen keypad hard keys located to the right of the status window. Twelve of the keypad hard keys perform more than one function, 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 softkey menu area to the right of the status window. The locations of the different keys are illustrated in Figure 2-2.

The following sections describe the various key functions.

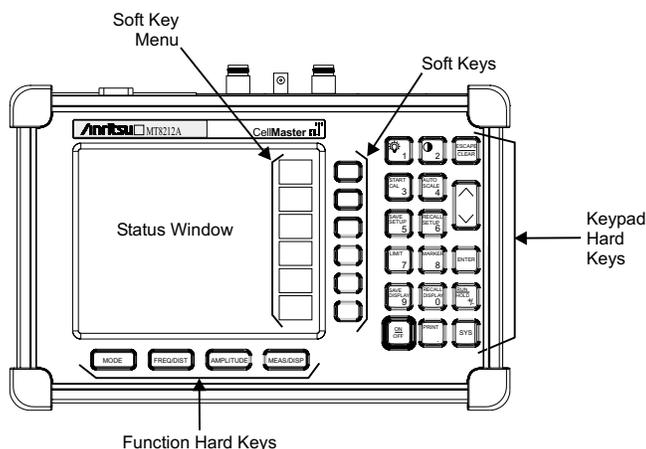


Figure 2-2. Cell Master Front Panel

## Function Hard Keys

**MODE** Opens the mode selection box (below). Use the Up/Down arrow key to select a mode. Press the ENTER key to implement.

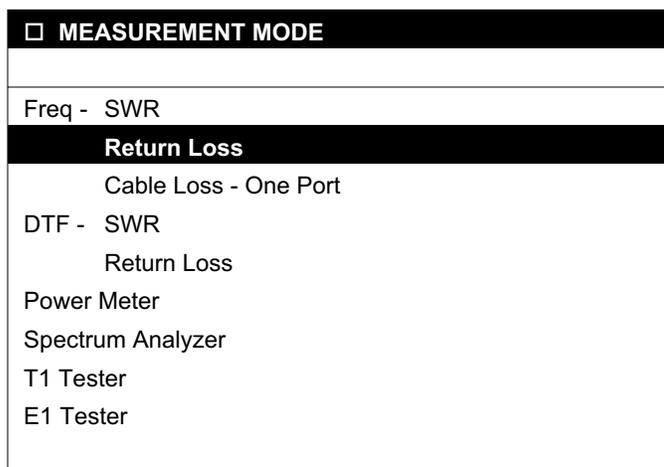


Figure 2-3. Mode Selection Box

**FREQ/DIST** Displays the Frequency or Distance to Fault softkey menus depending on the measurement mode.

**AMPLITUDE** Displays the amplitude softkey menu for the current operating mode.

**MEAS/DISP** Displays the measurement and display softkey menus for the current operating mode.

## Keypad Hard Keys

This section contains an alphabetical listing of the Cell Master front panel keypad controls along with a brief description of each. More detailed descriptions of the major function keys follow.

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<br/>CLEAR</b>   | Exits the present operation or clears the status window. 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. |
| <b>UP/DOWN<br/>ARROWS</b> | Increments or decrements a parameter value. The specific parameter value affected typically appears in the message area of the LCD.  |

*NOTE: At turn on, before any other keys are pressed, the Up/Down arrow key may be used to adjust the status window contrast. Press ENTER to return to normal operation.*

- |                   |  |
|-------------------|--|
| <b>ENTER</b>      | Implements the current action or parameter selection.  |
| <b>ON<br/>OFF</b> | Turns the Anritsu Cell Master on or off. When turned on, the system state at the last turn-off 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 display language and system setup parameters. Choices are Options, Clock, Self Test, Status and Language.  |

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 and activates the backlight intensity adjustment to accommodate varying light conditions. Use the Up/Down arrow key and **ENTER** to adjust the back light intensity. (Leaving back lighting off conserves battery power.)



LCD Contrast Adjust. Use the Up/Down arrow key and **ENTER** to adjust the display contrast.

**AUTO  
SCALE**

Automatically scales the status window for optimum resolution in cable and antenna analyzer mode.

**LIMIT**

Displays the limit line menu for the current operating mode when in cable, antenna analyzer or spectrum analyzer mode.

**MARKER**

Displays the marker menu of the current operating mode when in cable, antenna analyzer or spectrum analyzer mode.

**PRINT**

Prints the current display to the selected printer via the RS232 serial port.

**RECALL  
DISPLAY**

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

To erase a saved trace, highlight the trace, select the Delete Trace softkey and press the **ENTER** key. To erase all saved traces, select the Delete All Traces softkey and press the **ENTER** key.

**RECALL  
SETUP**

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

**RUN  
HOLD**

When in the Hold mode, this key starts the Cell Master sweeping and provides a Single Sweep Mode trigger; when in the Run mode, it pauses the sweep. When in the Hold mode, the hold symbol (page 2-32) appears on the status window. Hold mode can be used to conserve battery power.

**SAVE  
DISPLAY**

Saves up to 200 displayed traces to non-volatile memory. When the key is pressed, the Trace Name: box appears. Use the soft keys to enter up to 16 alphanumeric characters for that trace name and press the **ENTER** key to save the trace.

**SAVE  
SETUP**

Saves the current system setup to an internal non-volatile memory location. There are ten available locations in cable and antenna analyzer mode, and five each in SPA, T1 and E1 modes. When the key is pressed, a Save Setup selection box appears on the status window. Use the Up/Down arrow key to select a setup and press the **ENTER** key to implement.

**START  
CAL**

Starts the calibration in SWR, Return Loss, Cable Loss, or DTF measurement modes (not available in Spectrum Analyzer, Power Meter, T1, or E1 modes).

## Soft Keys

Each keypad key opens a set of soft key selections. Each of the soft keys has a corresponding soft key label area on the status window. The label identifies the function of the soft key for the current Mode selection.

Figures 2-4 through 2-10 show the soft key labels for each Mode selection.

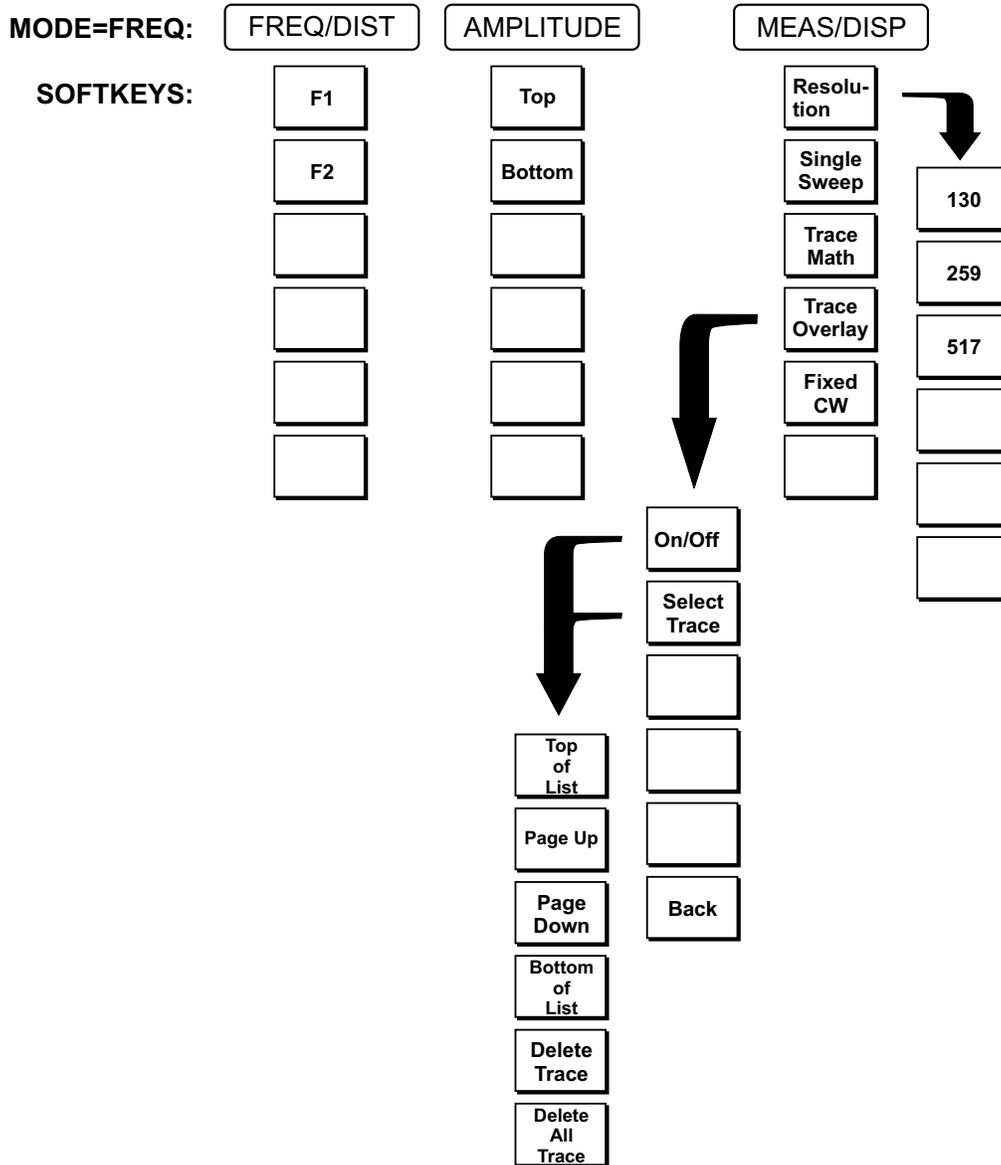


Figure 2-4. Frequency Mode Soft Key Labels

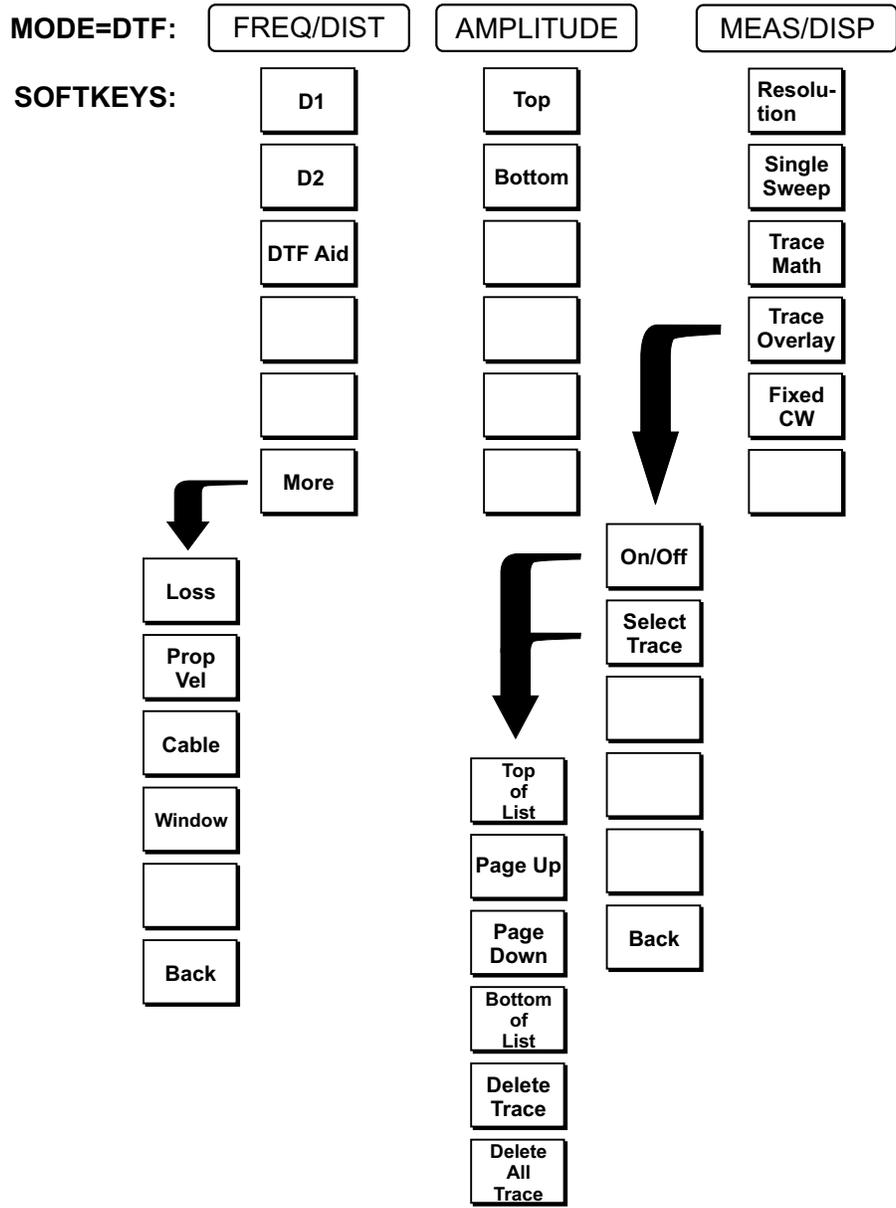


Figure 2-5. Distance to Fault Mode Soft Key Labels

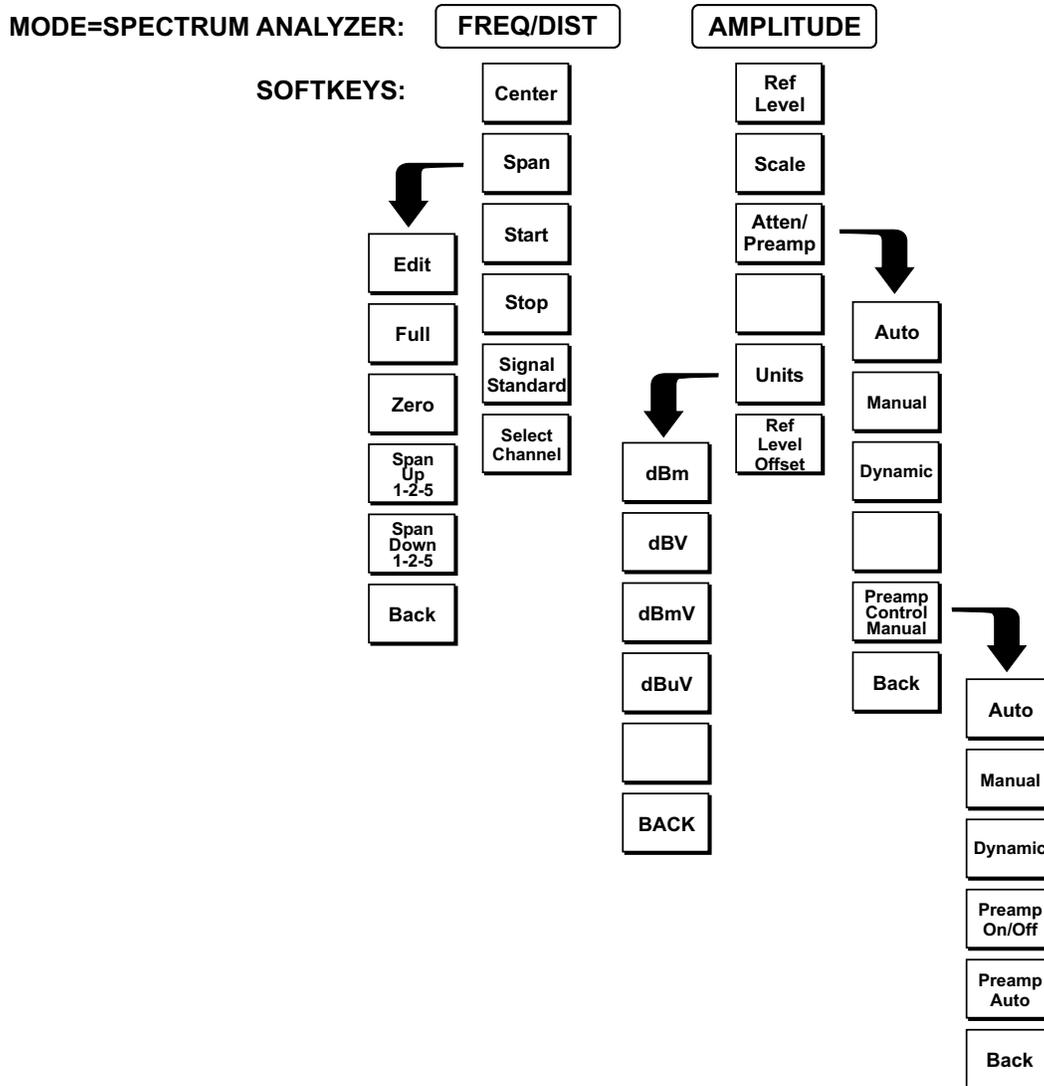


Figure 2-6. Spectrum Analyzer Mode Soft Key Labels

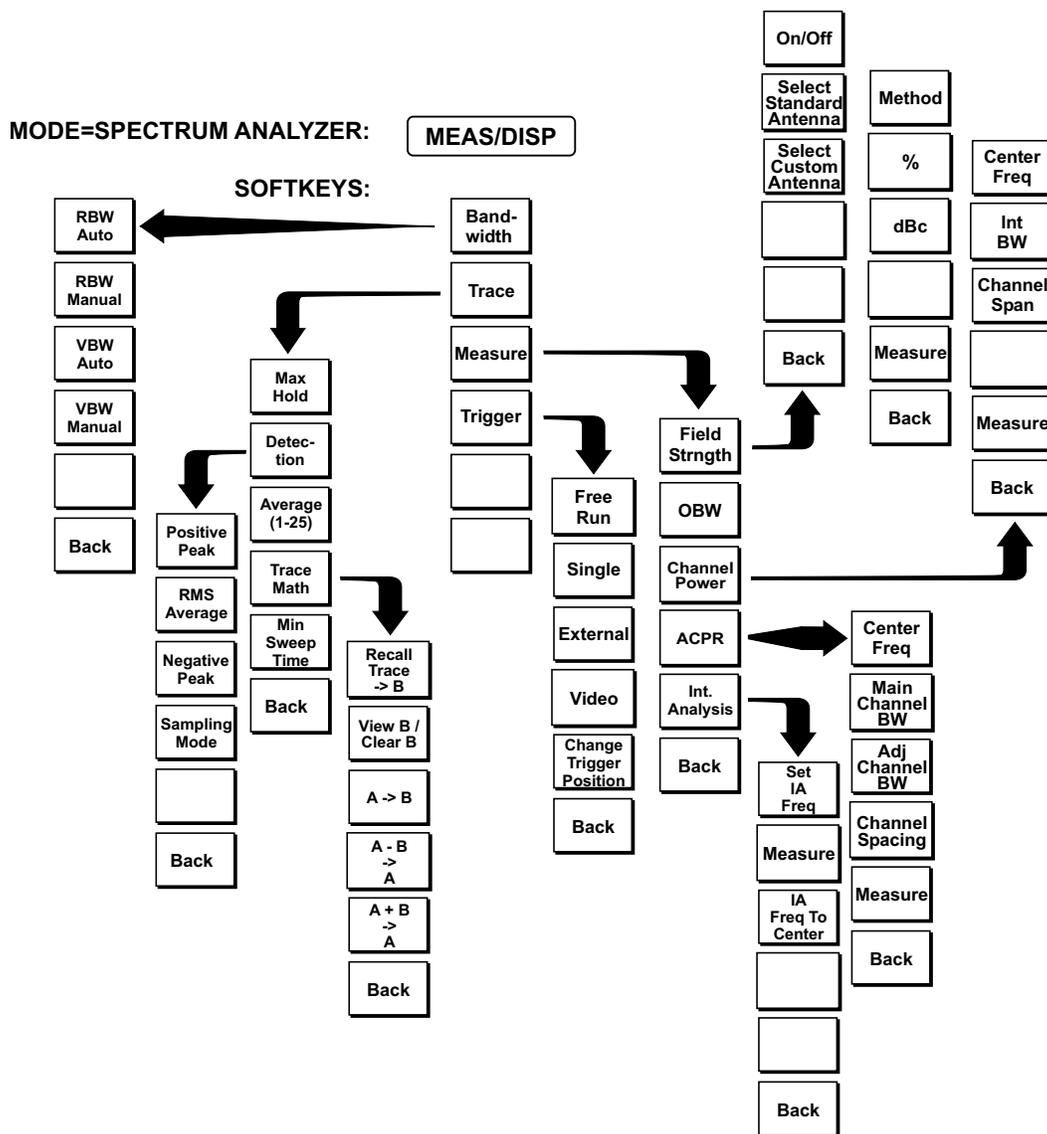


Figure 2-7. Spectrum Analyzer Mode Soft Key Labels (continued)

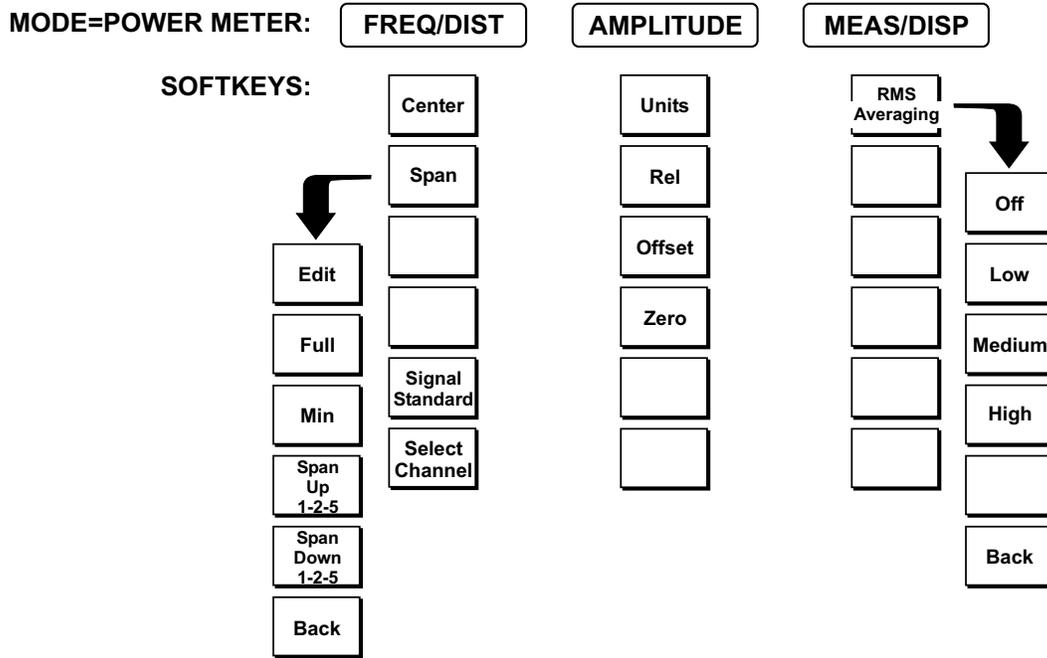


Figure 2-8. Power Meter Mode Soft Key Labels



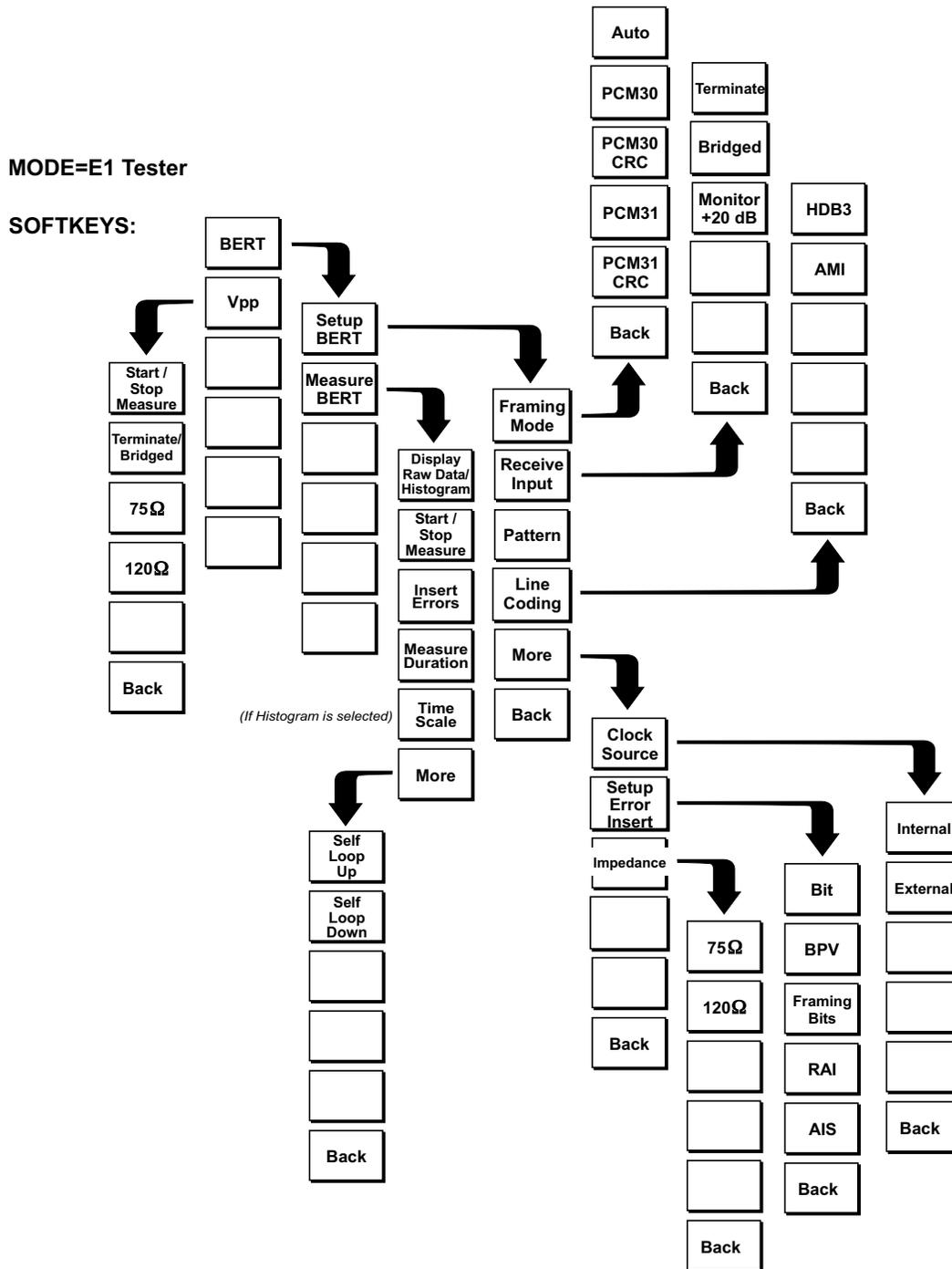


Figure 2-10. E1 Tester Mode Soft Keys

<b>FREQ/DIST</b>	Displays the frequency and distance menu depending on the measurement mode.
<b>Frequency Menu</b>	<p>The frequency and distance menu for cable and antenna analyzer measurements provides for setting sweep frequency end points when Freq mode is selected. Selected frequency values may be changed using the keypad or Up/Down arrow key.</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> F1 — Opens the F1 parameter for data entry. This is the start value for the frequency sweep. Press <b>ENTER</b> when data entry is complete.</li> <li><input type="checkbox"/> F2 — Opens the F2 parameter for data entry. This is the stop value for the frequency sweep. Press <b>ENTER</b> when data entry is complete.</li> </ul>
<b>Distance Menu</b>	<p>Provides for setting Distance to Fault parameters when a DTF mode is selected. Choosing DIST causes the soft keys, below, to be displayed and the corresponding values to be shown in the message area. Selected distance values may be changed using the keypad or Up/Down arrow key.</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> D1 — Opens the start distance (D1) parameter for data entry. This is the start value for the distance range (D1 default = 0). Press <b>ENTER</b> when data entry is complete.</li> <li><input type="checkbox"/> D2 — Opens the end distance (D2) parameter for data entry. This is the end value for the distance range. Press <b>ENTER</b> when data entry is complete.</li> <li><input type="checkbox"/> DTF Aid — Provides interactive help to optimize DTF set up parameters. Use the Up/Down arrow key to select a parameter to edit. Press <b>ENTER</b> when data entry is complete.</li> <li><input type="checkbox"/> More — Selects the Distance Sub-Menu, detailed below. <ul style="list-style-type: none"> <li><input type="checkbox"/> Loss — Opens the Cable Loss parameter for data entry. Enter the loss per foot (or meter) for the type of transmission line being tested. Press <b>ENTER</b> when data entry is complete. (Range is 0.5 to 5.000 dB/m, 1.524 dB/ft)</li> <li><input type="checkbox"/> Prop Vel (relative propagation velocity) — Opens the Propagation Velocity parameter for data entry. Enter the propagation velocity for the type of transmission line being tested. Press <b>ENTER</b> when data entry is complete. (Range is 0.010 to 1.000)</li> <li><input type="checkbox"/> Cable — Opens a list of cable three common coaxial folders (1000 MHz, 2000 MHz, and 2500 MHz) and one custom folder. Select either folder and use the Up/Down arrow key and <b>ENTER</b> to make a selection. This feature provides a rapid means of setting both cable loss and propagation velocity. (Refer to Appendix A for a listing of common coaxial cables showing values for Relative Propagation Velocity and Nominal Attenuation in dB/m or dB/ft @ 1000 MHz, 2000 MHz and 2500 MHz.) The custom cable folder can consist of up to 49 user-defined cable parameters uploaded via the Handheld Software Tools program.</li> <li><input type="checkbox"/> Window — Opens a menu of FFT windowing types for the DTF calculation. Scroll the menu using the Up/Down arrow key and make a selection with the <b>ENTER</b> key.</li> <li><input type="checkbox"/> Back — Returns to the Distance Menu.</li> </ul> </li> </ul>

Choosing **FREQ/DIST** in Spectrum Analyzer mode causes the soft keys, below, to be displayed and the corresponding values to be shown in the message area.

- Center** — Sets the center frequency of the Spectrum Analyzer. Enter a value using the Up/Down arrow key or keypad, press **ENTER** to accept, **ESCAPE** to restore previous value.
- Span** — Sets the user-defined frequency span. Use the Up/Down arrow key or keypad to enter a value in MHz. Also brings up Full and Zero softkeys.
  - Edit** allows editing of the frequency span. Enter a value using the number keys.
  - Full span** sets the Spectrum Analyzer to its maximum frequency span.
  - Zero span** sets the span to 0 Hz. This displays the input signal in an amplitude versus time mode, which is useful for viewing modulation.
  - Span Up 1-2-5** activates the span function so that the span may be increased quickly in a 1-2-5 sequence.
  - Span Down 1-2-5** activates the span function so that the span may be reduced quickly in a 1-2-5 sequence.
  - Back** returns to the previous menu level.
- Start** — Sets the Spectrum Analyzer in the START-STOP mode. Enter a start frequency value (in kHz, MHz, or GHz) using the Up/Down arrow key or keypad, press **ENTER** to accept, **ESCAPE** to restore.
- Stop** — Sets the Spectrum Analyzer in the START-STOP mode. Enter a stop frequency value (in kHz, MHz, or GHz) using the Up/Down arrow key or keypad, press **ENTER** to accept, **ESCAPE** to restore.
- Signal Standard** — Allows selection of the signal standard to be used. Select from the available international standards.
- Select Channel** — Sets the channel information for the available standard from a minimum of 0 to a maximum of 1199.

- AMPLITUDE** Displays the amplitude or scale menu depending on the measurement mode.
- Amplitude Menu** Provides for changing the status window scale. Selected values may be changed using the Up/Down arrow key or keypad.
- Choosing **AMPLITUDE** in cable and antenna analyzer measurement modes causes the soft keys, below, to be displayed and the corresponding values to be shown in the message area.
- Top** — Opens the top parameter for data entry and provides for setting the top scale value. Press **ENTER** when data entry is complete.
  - Bottom** — Opens the bottom parameter for data entry and provides for setting the bottom scale value. Press **ENTER** when data entry is complete.
- Choosing **AMPLITUDE** in Spectrum Analyzer mode causes the soft keys, below, to be displayed and the corresponding values to be shown in the message area.
- Ref Level** — Activates the amplitude reference level function. Valid reference levels are from +20 to -120 dBm.
  - Scale** — Activates the scale function in a 1 through 15 dB logarithmic amplitude scale.
  - Atten/Preamp** — Sets the Anritsu input attenuator so that it is either coupled automatically to the reference level (**Auto**), manually adjustable (**Manual**), dynamically coupled to the reference level (**Dynamic**) and sets the preamplifier on or off.
    - Auto** — Sets the input attenuator so that it is coupled automatically to the reference level.
    - Manual** — Sets the input attenuator so that it is manually coupled to the reference level.
    - Dynamic** — Sets the input attenuator so that it is dynamically coupled to the reference level.
    - Preamp Control Manual** — Activates the preamp menu.
      - Preamp On/Off** — Sets the preamplifier on or off.
      - Preamp Auto** — Automatically adjusts the preamplifier.
    - Back** — Returns to the previous menu level.
  - 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.
  - 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 reference level to view the correct output level. For example, to measure a high gain amplifier with an output of 70 dBm, an external 50 dB attenuator must be inserted between the Cell Master and the device. To compensate, set the reference level offset to -50 dB to set the level at the top of the status window.

**MEAS/DISP** Displays the Meas/Disp soft key menu for the current operating mode.

**Meas/Disp Menu** Provides for changing the status window resolution, single or continuous sweep, and access to the Trace Math functions.

Choosing **MEAS/DISP** in cable and antenna analyzer freq or DTF measurement modes causes the soft keys below to be displayed.

- Resolution — Opens the status window to change the resolution. Choose 130, 259, or 517 data points. (In DTF mode, resolution can only be adjusted through the DTF Aid table.)
- Single Sweep — Toggles the sweep between single sweep and continuous sweep. In single sweep mode, each sweep must be activated by the **RUN/HOLD** button.
- Trace Math — Opens up the Trace Math functions (trace-memory or trace+memory) for comparison of the real time trace in the status window with any of the traces from memory. (Not available in DTF mode.)
- Trace Overlay — Opens up the Trace Overlay functions menu to allow the current trace to be displayed with a trace in memory overlaid on it. Choose On or Off and Select Trace to select the trace from memory to be overlaid.
- Fixed CW — Toggles the fixed CW function ON or OFF. When OFF, a narrow band of frequencies centered on the selected frequency is generated. When CW is ON, only the center frequency is generated. Output power is pulsed in all modes.

Choosing **MEAS/DISP** in Spectrum Analyzer mode causes the soft keys below to be displayed.

- Bandwidth — Activates a menu that allows the resolution and video bandwidths to be either coupled automatically to the span (Auto) or manually adjustable (Manual).
  - RBW Auto — Sets the resolution bandwidth so that it is automatically coupled to the span.
  - RBW Manual — Sets the resolution bandwidth manually, independent of the span.
  - VBW Auto — Sets the video bandwidth so that it is automatically coupled to the RBW.
  - VBW Manual — Sets the video bandwidth manually, independent of the RBW.
  - Back — Returns to the previous menu level.
- Trace — Activates a menu of trace related functions. Use the corresponding softkey to select the desired trace function.
  - Max Hold — Displays and holds the maximum responses of the input signal.
  - Detection — Accesses a menu of detector modes including Positive Peak detection, RMS Average detection, Negative Peak detection, and Sampling Mode.
    - Positive Peak — The Unit reads and displays the highest measured data point within a display point.

- ❑ **RMS Average** — The unit reads and displays the RMS average of the measured data. RMS average is calculated by taking the log of the average power within a display point and the power is calculated from the voltage.
- ❑ **Negative Peak** — The unit reads and displays the lowest measured data point within a display point.
- ❑ **Sampling Mode** — The unit reads and displays a sweep sampled at each display point.
- ❑ **Average (1-25)** — The display will be an average of the number of sweeps specified here. For example, if the number four is entered here, the data displayed will be an average of the four most recent sweeps.
- ❑ **Trace Math** — Opens up the Trace Math functions for comparison of the real time trace in the status window with any of the traces from memory.
  - ❑ **Recall Trace → B** — Recalls the selected saved trace to trace B.
  - ❑ **View B / Clear B** — Views the recalled trace as trace B, or clears trace B from the status window.
  - ❑ **A → B** — Moves trace A to trace B.
  - ❑ **A – B → A** — Moves the results of trace A minus trace B to trace A.
  - ❑ **A + B → A** — Moves the results of trace A plus trace B to trace A.
  - ❑ **Back** — Returns to the previous menu level.
- ❑ **Min Sweep Time** — Displays the sweep time of the span. Zero span must be selected to perform this operation.
- ❑ **Back** — Returns to the previous menu level.
- ❑ **Measure** — Activates a menu of measurement related functions. Use the corresponding softkey to select the measurement function.
  - ❑ **Field Strength** — Accesses a menu of field strength measurement options.
    - ❑ **On/Off** — Turns field strength measurements on or off.
    - ❑ **Select Standard Antenna** — Select from the list of antenna profiles provided.
    - ❑ **Select Custom Antenna** — Select a custom antenna profile as uploaded to the Cell Master using the Handheld Software Tools program.
    - ❑ **Back** — Returns to the previous menu.
  - ❑ **OBW** — Activates the occupied bandwidth menu.
    - ❑ **Method** — Allows selection of either % of power or dB Down.
    - ❑ **%** — Allows entry of the desired % of occupied bandwidth to be measured.
    - ❑ **dBc** — Allows entry of the desired power level (dBc) to be measured.
    - ❑ **Measure** — Enables and disables the OBW measurement.
    - ❑ **Back** — Returns to the previous menu level.
  - ❑ **Channel Power** — Activates Channel Power measurement. Channel power is measured in dBm. Channel Power density is measured in dBm/Hz. The displayed units is determined by the setting of the Units soft key in the **AMPLITUDE** menu.
    - ❑ **Center Freq** - Activates the center frequency function and sets the Cell Master to the center frequency. A specific center frequency can be entered using the keypad or Up/Down arrow key.

- Int BW — Enter the integration bandwidth frequency appropriate for the application.
- Channel Span — Sets the channel span to a value appropriate for the application
- Measure — Enables and disables the channel power measurement.
- Back — Returns to the previous menu level.
- ACPR — Accesses a menu of Adjacent Channel Power Ratio measurement options:
  - Center Freq - Activates the center frequency function and sets the Cell Master to the center frequency. A specific center frequency can be entered using the keypad or Up/Down arrow key.
  - Main Channel BW - Sets the bandwidth of the main channel.
  - Adjacent Channel BW - Sets the bandwidth of the adjacent channel.
  - Channel Spacing - Sets the channel spacing.
  - Measure -Enables and disables the ACPR measurement.
  - Back - Returns to the previous menu.
- Int. Analysis — Opens the interference analysis measurement menu..
  - Set IA Freq. — Set the interference analysis frequency from 10 MHz to 3000 MHz to measure the interference.
  - Measure — Measures the interference.
  - IA Freq. To Center — Set the interference analysis frequency to the center of the interference frequency.
  - Back — Returns to the previous menu.
- Back — Returns to the previous menu.
- Trigger — Select the method used to trigger the sweep.
  - Free Run — The sweep is continuous.
  - Single — A single sweep will be performed with each press of the **Run/Hold** key.
  - Video — Sets the video trigger level if the span is set to zero.
  - Change Trigger Position — Changes the trigger sweep position from 5 msec to 2000 msec.
  - Back - Returns to the previous menu.

**MARKER**

Choosing **MARKER** in cable and antenna analyzer freq and dist mode causes the soft keys, below, to be displayed and the corresponding values to be shown in the message area. Selected frequency marker or distance marker values may be changed using the keypad or Up/Down arrow key.

- M1 — Selects the M1 marker parameter and opens the M1 marker second level menu.
  - On/Off — Turns the selected marker on or off.
  - Edit — Opens the selected marker parameter for data entry. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.
  - Marker To Peak — Places the selected marker at the frequency or distance with the maximum amplitude value.

- Marker To Valley — Places the selected marker at the frequency or distance with the minimum amplitude value.
- BACK — Returns to the Main Markers Menu.
- M2 through M4 — Selects the marker parameter and opens the marker second level menu.
  - On/Off — Turns the selected marker on or off.
  - Edit — Opens the selected marker parameter for data entry. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.
  - Delta (Mx-M1) — Displays delta amplitude value as well as delta frequency or distance for the selected marker with respect to the M1 marker.
  - Marker To Peak — Places the selected marker at the frequency or distance with the maximum amplitude value.
  - Marker To Valley — Places the selected marker at the frequency or distance with the minimum amplitude value.
  - BACK — Returns to the Main Markers Menu.
- All Off — Turns all markers off.
- MORE — Opens the continuation of the Marker Menus.
  - M5 — Selects the M5 marker parameter and opens the M5 second level menu.
    - On/Off — Turns the selected marker on or off.
    - Edit — Opens the selected marker parameter for data entry. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.
    - Peak Between M1 & M2 — Places the selected marker at the frequency or distance with the maximum amplitude value between marker M1 and marker M2.
    - Valley Between M1 & M2 — Places the selected marker at the frequency or distance with the minimum amplitude value between marker M1 and marker M2.
    - Back — Returns to the Main Markers Menu.
  - M6 — Selects the M6 marker parameter and opens the M6 second level menu.
    - On/Off — Turns the selected marker on or off.
    - Edit — Opens the selected marker parameter for data entry. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.
    - Peak Between M3 & M4 — Places the selected marker at the peak between marker M3 and marker M4.
    - Valley Between M3 & M4 — Places the selected marker at the valley between marker M3 and marker M4.
    - Back — Returns to the Main Markers Menu.

Choosing **MARKER** in Spectrum Analyzer mode causes the soft keys, below, to be displayed and the corresponding values to be shown in the message area.

- ❑ M1 — Selects the M1 marker parameter and opens the M1 marker second level menu.
  - ❑ On/Off — Turns the selected marker on or off.
  - ❑ Edit — Opens the selected marker parameter for data entry. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.
  - ❑ Marker To Peak — Places the selected marker at the frequency or distance with the maximum amplitude value.
  - ❑ Marker Freq To Center — Places the selected marker at the center frequency.
  - ❑ BACK — Returns to the Main Markers Menu.
- ❑ M2 through M4 — Selects the marker parameter and opens the marker second level menu.
  - ❑ On/Off — Turns the selected marker on or off.
  - ❑ Edit — Opens the selected marker parameter for data entry. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.
  - ❑ Delta (Mx-M1) — Displays delta amplitude value as well as delta frequency or distance for the selected marker with respect to the M1 marker.
  - ❑ Marker To Peak — Places the selected marker at the frequency or distance with the maximum amplitude value.
  - ❑ Marker Freq To Center — Makes the center frequency of the Cell Master equal to the frequency of the selected marker.
  - ❑ BACK — Returns to the Main Markers Menu.
- ❑ All Off — Turns all markers off.
- ❑ MORE — Opens the continuation of the Marker Menus.
  - ❑ M5 — Selects the M5 marker parameter and opens the M5 second level menu.
    - ❑ On/Off — Turns the selected marker on or off.
    - ❑ Edit — Opens the selected marker parameter for data entry. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.
    - ❑ Peak Between M1 & M2 — Places the selected marker at the frequency with the maximum amplitude value between marker M1 and marker M2.
    - ❑ Valley Between M1 & M2 — Places the selected marker at the frequency with the minimum amplitude value between marker M1 and marker M2.
    - ❑ Back — Returns to the Main Markers Menu.
  - ❑ M6 — Selects the M6 marker parameter and opens the M6 second level menu.
    - ❑ On/Off — Turns the selected marker on or off.

- ❑ Edit — Opens the selected marker parameter for data entry. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.
- ❑ Peak Between M3 & M4 — Places the selected marker at the frequency with the maximum amplitude value between marker M3 and marker M4.
- ❑ Valley Between M3 & M4 — Places the selected marker at the frequency with the minimum amplitude value between marker M3 and marker M4.
- ❑ Back — Returns to the Main Markers Menu.

## LIMIT

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

Choosing **LIMIT** in Freq or DTF measurement modes causes the soft keys below to be displayed.

- ❑ Single Limit — Sets a single limit value in dBm. Menu choices are:
  - ❑ On/Off — Turns the single limit function on or off
  - ❑ Edit — Allows entry of the limit amplitude.
  - ❑ Back — Returns to the previous menu.
- ❑ Multiple Limits — Sets multiple user defined limits, and can be used to create a limit mask for quick pass/fail measurements.
  - ❑ Segment 1 — Opens the segment 1 menu.
    - ❑ On/Off — Turns the segment on or off.
    - ❑ Edit — Opens the parameter for data entry.
    - ❑ 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 — Returns to the previous menu.
  - ❑ Segment 2 — Opens the segment 2 menu.
    - ❑ On/Off — Turns the segment on or off.
    - ❑ Edit — Opens the parameter for data entry.
    - ❑ 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 — Returns to the previous menu.
  - ❑ Segment 3 — Opens the segment 3 menu.
    - ❑ On/Off — Turns the segment on or off.
    - ❑ Edit — Opens the parameter for data entry.
    - ❑ 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 — Returns to the previous menu.
- Segment 4 — Opens the segment 4 menu.
  - On/Off — Turns the segment on or off.
  - Edit — Opens the parameter for data entry.
  - 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 — Returns to the previous menu.
- Segment 5 — Opens the segment 5 menu.
  - On/Off — Turns the segment on or off.
  - Edit — Opens the parameter for data entry.
  - 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 — Returns to the previous menu.
- Back — Returns to the previous menu.
- Limit Beep — Turns the audible limit beep indicator on or off.

Choosing **LIMIT** in Spectrum Analyzer measurement mode causes the soft keys below to be displayed.

- Single Limit — Sets a single limit value in dBm. Menu choices are:
  - On/Off — Turns the limit on or off.
  - Edit — Opens the parameter for data entry.
  - Upper / Lower Limit — Activate the upper and Lower limit lines by toggling this softkey. The unit beeps if the data is above or below the set limit lines and the status is displayed on the lower corner of the status window.
  - Back — Returns to the previous menu.
- Multiple Upper Limits — Sets multiple user-defined upper limits, and can be used to create an upper limit mask for quick pass/fail measurements. An upper limit will result in a failure when the data falls above the limit line. Menu choices are:
  - Segment 1 — Opens the segment 1 menu.
    - On/Off — Turns the segment on or off.
    - Edit — Opens the parameter for data entry.
    - 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 — Returns to the previous menu.
- Segment 2 — Opens the segment 2 menu.
  - On/Off — Turns the segment on or off.
  - Edit — Opens the parameter for data entry.
  - 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 — Returns to the previous menu.
- Segment 3 — Opens the segment 3 menu.
  - On/Off — Turns the segment on or off.
  - Edit — Opens the parameter for data entry.
  - 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 — Returns to the previous menu.
- Segment 4 — Opens the segment 4 menu.
  - On/Off — Turns the segment on or off.
  - Edit — Opens the parameter for data entry.
  - 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 — Returns to the previous menu.
- Segment 5 — Opens the segment 5 menu.
  - On/Off — Turns the segment on or off.
  - Edit — Opens the parameter for data entry.
  - 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 — Returns to the previous menu.
- Multiple Lower Limits — Set multiple user defined lower limits, and can be used to create a lower limit mask for quick pass/fail measurements. A lower limit will result in a failure when the data falls below the limit line. Menu choices are:
  - Segment 1 — Opens the segment 1 menu.

- On/Off — Turns the segment on or off.
- Edit — Opens the parameter for data entry.
- 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 — Returns to the previous menu.
- Segment 2 — Opens the segment 2 menu.
  - On/Off — Turns the segment on or off.
  - Edit — Opens the parameter for data entry.
  - 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 — Returns to the previous menu.
- Segment 3 — Opens the segment 3 menu.
  - On/Off — Turns the segment on or off.
  - Edit — Opens the parameter for data entry.
  - 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 — Returns to the previous menu.
- Segment 4 — Opens the segment 4 menu.
  - On/Off — Turns the segment on or off.
  - Edit — Opens the parameter for data entry.
  - 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 — Returns to the previous menu.
- Segment 5 — Opens the segment 5 menu.
  - On/Off — Turns the segment on or off.
  - Edit — Opens the parameter for data entry.
  - 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 — Returns to the previous menu.

- ❑ Limit Beep — Turns the audible limit beep indicator on or off.

**SYS**

Displays the System menu softkey selections.

- ❑ Options — Displays a second level of functions:
  - ❑ Units — Select the unit of measurement (English or metric).
  - ❑ Printer — Displays a menu of supported printers. Use the Up/Down arrow key and **ENTER** key to make the selection.
  - ❑ CAL Mode — In cable and antenna analyzer modes, selects either OSL Cal or FlexCal™. FlexCal is a broadband frequency calibration valid from 25 MHz to 4 GHz. Refer to Calibration, page 3-2, for more information.
  - ❑ Change Date Format — Toggles the date format between MM/DD/YYYY, DD/MM/YYYY, and YYYY/MM/DD.
  - ❑ Back — Returns to the top-level SYS Menu.
- ❑ Clock — Displays a second level of functions:
  - ❑ Hour — Enter the hour (0-23) using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.
  - ❑ Minute — Enter the minute (0-59) using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.
  - ❑ Month — Enter the month (1-12) using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.
  - ❑ Day — Enter the day using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.
  - ❑ Year — Enter the year (1997-2036) using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.
  - ❑ Back — Returns to the top-level SYS menu.
- ❑ Self Test — Start an instrument self test.
  - ❑ T1/E1 Test — Starts a test of the T1/E1 circuitry.
- ❑ Status — In cable and antenna analyzer freq or dist measurement mode, displays the current instrument status, including calibration status, temperature, and battery charge state. Press **ESCAPE** to return to operation.
- ❑ Language — Pressing this soft key immediately changes the language used to display messages on the Cell Master status window. Choices are English, French, German, Spanish, Chinese, and Japanese. The default language is English.

## Power Meter Menus

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

The following soft keys are available when the **FREQ/DIST** key is pressed.

- Center — Activates the center frequency function and sets the power meter to the center frequency. A frequency from 10 MHz to 3000 MHz can be entered.
- Span — Opens the parameter for editing and activates a menu of span related choices.
  - Edit — Allows editing of the span to enter specific frequency.
  - Full — Sets the power meter to its maximum frequency span.
  - Zero — Sets the power meter span to zero.
  - Span Up 1-2-5 — Activates the span function so that the span may be increased quickly in a 1-2-5 sequence.
  - Span Down 1-2-5 — Activates the span function so that the span may be reduced quickly in a 1-2-5 sequence.
  - Back — Returns to the previous menu level.
- Signal Standard — Opens a menu of international signal standards. Select a standard using the Up/Down arrow key and press **ENTER**.
- Select Channel — Select the appropriate channel for the selected standard.

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

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

The following soft key is available when the **MEAS/DISP** key is pressed.

- RMS Averaging — Activates the RMS Averaging menu. The RMS average is calculated by taking the log of the average power and the power is calculated from voltage. The number of points to average can be set to low, medium or high.
  - Off — Turns off RMS averaging.
  - Low
  - Medium
  - High
  - Back

## T1 Tester Mode Menus

In T1 Tester mode, the **FREQ/DIST** and **AMPLITUDE** hard keys are not used. Pressing the **MEAS/DISP** key in T1 Tester mode causes the soft keys, below, to be displayed:

- **BERT** — Activates menus that are used Bit Error Rate Testing (BERT).
  - **Setup BERT** — Activates menus that are used to set BERT testing options.
    - **Framing Mode** — Selects the framing mode to be used.
      - **Auto** — Automatically detects the received framing mode.
      - **D4 SF** — Sets the T1 framing mode to Super Frame.
      - **ESF** — Sets the T1 framing mode to Extended Super Frame.
      - **Back** — Returns to the previous menu.
    - **Receive Input**
      - **Terminate** — Terminates the circuit under test with 100 $\Omega$ . Terminate mode is used to test out of service or newly installed T1 lines when there is no traffic data.
      - **Bridged** — Bridged mode provides greater than 1 k $\Omega$  impedance to test the in-service line by bridging the receiver input across T1 lines.
      - **Monitor +20 dB** — Monitor mode adds 20 dB of gain, and is used when the connection to the circuit under test is through a 20 dB pad. In the monitor mode the Cell Master sensitivity is increased by 20 dB to account for the resistive loss at the port, and is set for 100 $\Omega$  nominal input impedance. In this mode the technician should be careful not to disturb the signal by using the wrong connector.
      - **Back** — Returns to the previous menu.
    - **Pattern** — Opens a list of available BERT patterns. Use the soft keys or the Up/Down arrow key to highlight a pattern and press **ENTER** to select.
    - **Line Coding** — Selects the line coding to be used.
      - **B8ZS** — Bipolar with eight-zero substitution. A T1 code in which bipolar violations are deliberately inserted if the user data contains a string of eight or more consecutive zeros. B8ZS is used to ensure a sufficient number of transitions to maintain system synchronization.
      - **AMI** — Alternate Mark Inversion. A bipolar signal in which ones are encoded as pulses with alternating polarity, and zeros are encoded as zero amplitude.
      - **Back** — Returns to the previous menu.
  - **More**
  - **Clock Source** — Selects the clock source.
    - **Internal** — Uses the internal clock.
    - **External** — The Cell Master clock is synchronized with the received signal clock.
    - **Back** — Returns to the previous menu.

- ❑ Setup Error Insert — Opens the error insert menu which allows insertion of the following errors in the transmitting signal.
  - ❑ Bit — Configures the unit to insert bit errors.
  - ❑ BPV — Configures the unit to insert Bipolar Violations.
  - ❑ Framing Bits — Configures the unit to insert framing bit errors.
  - ❑ RAI — Configures the unit to send a Remote Alarm Indication (yellow alarm).
  - ❑ AIS — Configures the unit to send an Alarm Indication Signal (blue alarm).
  - ❑ Back
- ❑ Loop Code — Selects the loop code to be used.
  - ❑ CSU — Channel Service Unit. Configures the unit to send CSU loopback codes.
  - ❑ NIU — Network Interface Unit. Configures the unit to send NIU loopback codes.
  - ❑ User 1 — Configures the unit to send a user-defined loopback code.
  - ❑ User 2 — Configures the unit to send a user-defined loopback code.
  - ❑ In Band/Data Link — Configures the unit to send the loopback code either in the data stream or in the Facility Data Link. The Data Link mode cannot be selected with D4SF framing.
  - ❑ Back
- ❑ Transmit Level — Selects the T1 transmit level.
  - ❑ 0 dB
  - ❑ -7.5 dB
  - ❑ -15 dB
  - ❑ Back
- ❑ ANSI CRC/Japan CRC — Selects either the ANSI or Japanese methods for calculating CRC. Also selects between the ANSI and Japanese methods of generating RAI.
  - ❑ Back
- ❑ Measure BERT — Activates menus that are used to control the BERT measurement.
  - ❑ Display Raw Data/Histogram — Selects whether to display the raw data or a histogram.
  - ❑ Start/Stop Measure — Starts or stops the measurement.
  - ❑ Insert Errors — Injects the selected error(s) into the data stream, or sends the selected alarm when in transmitting mode.
  - ❑ Measure Duration — Selects the duration of the measurement. The duration can be 3 minutes, 15 minutes, 30 minutes, 1 hour, 3 hours, 6 hours, 12 hours, 1 day, 2 days or the duration can be manually set. Use the Up/Down arrow key to display the desired duration and press **ENTER** to select, or **ESCAPE** to restore the previous value.

- ❑ Time Scale — When histogram is selected, the time scale can be set from one second to one hour in the following steps: 1 second, 15 seconds, 30 seconds, 45 seconds, 1 minute, 15 minutes, 30 minutes, 45 minutes, 60 minutes, or AUTO. When AUTO is selected, the time scale is adjusted so that the measurement duration will fill the status window. Use the Up/Down arrow key to display the desired duration and press **ENTER** to select, or **ESCAPE** to restore the previous value.
- ❑ More — Opens the loop code menu.
  - ❑ Self Loop Up — Loops the received signal to the transmitted signal.
  - ❑ Self Loop Down — Turns off the internal loopback.
  - ❑ Remote Loop Up — Transmits the selected loopback activate code. After the loop activate code has been transmitted for the specified time, the circuit is tested to see if the attempt was successful and the result is reported.
  - ❑ Remote Loop Down — Transmits the selected loopback deactivate code. After the loopback deactivate code has been transmitted for the specified time, the circuit is tested to see if the attempt was successful and the result is reported.
  - ❑ Back — Returns to the previous menu.
- ❑ Vpp — Measures and displays the peak-to-peak voltage.
  - ❑ Start/Stop Measure — Starts or stops the measurement.
  - ❑ Terminate/Bridged — Select terminated or bridged measurement.
  - ❑ Back — Returns to the previous menu.

## E1 Tester Mode Menus

In E1 Tester mode, the **FREQ/DIST** and **AMPLITUDE** hard keys are not used. Pressing the **MEAS/DISP** key in E1 Tester mode causes the soft keys, below, to be displayed:

- BERT — Activates menus that are used Bit Error Rate Testing (BERT).
  - Setup BERT — Activates menus that are used to set BERT testing options.
    - Framing Mode — Selects the framing mode to be used.
      - Auto — Automatically detects the received framing mode.
      - PCM30 — Sets the E1 framing mode to PCM30.
      - PCM30 CRC — Sets the E1 framing mode to PCM30 with CRC.
      - PCM31 — Sets the E1 framing mode to PCM31.
      - PCM31 CRC — Sets the E1 framing mode to PCM31 with CRC.
    - Back
  - Receive Input
    - Terminate — Terminates the circuit under test with either 75 or 120 ohms. Terminate mode is used to test out of service or newly installed E1 lines when there is no traffic data.
    - Bridged — Bridged mode provides greater than 1 k $\Omega$  impedance to test the in-service line by bridging the receiver input across E1 lines.
    - Monitor +20 dB — Monitor mode adds 20 dB of gain, and is used when the connection to the circuit under test is through a 20 dB pad.
    - Back — Returns to the previous menu.
  - Pattern — Opens a list of available BERT patterns. Use the soft keys or the Up/Down arrow key to highlight a pattern and press **ENTER** to select.
  - Line Coding — Selects the line coding to be used.
    - HDB3 — High Density Bipolar. An E1 code in which bipolar violations are inserted if the user data contains more than three consecutive zeros.
    - AMI — Alternate Mark Inversion. A bipolar signal in which ones are encoded as pulses with alternating polarity, and zeros are encoded as zero amplitude.
  - More
    - Clock Source — Selects the clock source.
      - Internal — Uses the internal clock.
      - External — The clock is recovered from the receiver signal.
      - Back — Returns to the previous menu.
    - Setup Error Insert — Opens the error insert menu.
      - Bit — Configures the unit to insert bit errors.
      - BPV — Configures the unit to insert Bipolar Violations.
      - Framing Bits — Configures the unit to insert framing bit errors.
      - RAI — Configures the unit to send a Remote Alarm Indication (yellow alarm).

- AIS — Configures the unit to send an Alarm Indication Signal (blue alarm).
- Back — Returns to the previous menu.
- Impedance — Sets the Tx and Rx impedance.
  - 75Ω — Select 75 ohm impedance.
  - 120Ω — Select 120 ohm impedance.
  - Back — Returns to the previous menu.
- Back — Returns to the previous menu.
- Measure BERT — Activates menus that are used to control the BERT measurement.
  - Display Raw Data/Histogram — Selects whether to display the raw data or a histogram.
  - Start/Stop Measure — Starts or stops the measurement.
  - Insert Errors — Injects the selected error(s) into the data stream when transmitting, or sends the selected alarm.
  - Measure Duration — Selects the duration of the measurement. The duration can be 3 minutes, 15 minutes, 30 minutes, 1 hour, 3 hours, 6 hours, 12 hours, 1 day, 2 days or manual. Use the Up/Down arrow key to display the desired duration and press **ENTER** to select, or **ESCAPE** to restore the previous value.
  - Time Scale — When histogram is selected, the time scale can be set from one second to one hour in the following steps: 1 second, 15 seconds, 30 seconds, 45 seconds, 1 minute, 15 minutes, 30 minutes, 45 minutes, 60 minutes, or AUTO. Use the Up/Down arrow key to display the desired time scale and press **ENTER** to select, or **ESCAPE** to restore the previous value.
- More
  - Self Loop Up — Loops the received signal to the transmitted signal.
  - Self Loop Down — Turns off the internal loopback.
  - Back — Returns to the previous menu.
- Vpp — Measures and displays the peak-to-peak voltage.
  - Start/Stop Measure — Starts or stops the measurement.
  - Terminate/Bridged — Select terminate or bridging for the Vpp measurement.
  - 75Ω — Select 75Ω impedance.
  - 120Ω — Select 120Ω impedance.
  - Back — Returns to the previous menu.

## Symbols

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

Table 2-1. LCD Icon Symbols

<u>Icon</u>	<u>Symbol</u>
	Cell Master is in Hold for power conservation. To resume sweeping, press the RUN/HOLD key. After 10 minutes without a key press, the Cell Master will automatically activate the power conservation mode.
	Integrator Failure. Intermittent integrator failure may be caused by interference from another antenna. Persistent integrator failure indicates a need to return the Cell Master to the nearest Anritsu service center for repair.
	Lock fail indication. Check battery. (If the Cell Master fails to lock with a fully charged battery, call your Anritsu Service Center.)
	When calibration is performed, the Cell Master stores the temperature. If the temperature drifts outside the specified range, this icon will appear at the top of the status window, and the Cal Off message will be displayed. A recalibration at the current temperature is recommended.
	Indicates the remaining charge on the battery. The inner white rectangle grows longer as the battery charge depletes.
	Indicates internal data processing.
Cal On	The Cell Master has been calibrated with discrete Open, Short and Load components.
Cal On!	The Cell Master has been calibrated with the InstaCal Module.
Cal Off	The Cell Master has not been calibrated.
FlexCal On	The Cell Master has been calibrated with discrete Open, Short and Load components for the frequency supported by the unit (25 MHz to 4000 MHz).
FlexCal On!	The Cell Master has been calibrated with the InstaCal Module for the frequency supported by the unit (25 MHz to 4000 MHz).

## Self Test

At turn-on, the Cell Master runs through a series of quick checks to ensure the system is functioning properly. Note that the 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 Cell Master is within the specified operating temperature range, call your Anritsu Service Center.

# Error Messages

## Self Test Error Messages

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

*Note: A listing of Anritsu Service Centers is provided on page 1-11.*

## Range Error Messages

A listing of Range Error messages is provided in Table 2-3.

Table 2-3. Range Error Messages

<u>Error Message</u>	<u>Description</u>
RANGE ERROR:F1 > F2	The start (F1) frequency is greater than the stop (F2) frequency.
RANGE ERROR:D1 > D2	The start (D1) distance is greater than the stop (D2) distance.
RANGE ERROR:D2 > DMax=xx.x ft (m)	<p>The stop distance (D2) exceeds the maximum unaliased range. This range is determined by the frequency span, number of points, and relative propagation velocity:</p> $\text{MaximumUnaliased Range} = \frac{(1.5 \times 10^8)(dp - 1)(V_f)}{F2 - F1}$ <p>Where: <i>dp</i> is the number of data points (130, 259, or 517)  <i>V<sub>f</sub></i> is the relative propagation velocity  <i>F2</i> is the stop frequency in Hz  <i>F1</i> is the start frequency in Hz                      Maximum Unaliased Range is in meters</p>
RANGE ERROR: TOP<=BOTTOM	The SWR scale parameter top value is less than or equal to its bottom value.
RANGE ERROR: TOP>=BOTTOM	The RL scale parameter top value is greater than or equal to its bottom value.

---

## Spectrum Analyzer Error Messages

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

Table 2-4. *Spectrum Analyzer Error Messages*

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

## InstaCal Error Messages

If the serial number of the connected InstaCal module does not match the serial number stored in the Cell Master, the following message is displayed:

*The InstaCal characterization data stored in the Cell Master is for a module different than the one currently connected.  
Cell Master contains data for InstaCal module S/N: xxxxx  
Currently connected InstaCal Module S/N: xxxxx  
Would you like to overwrite the previously loaded InstaCal characterization?*

Press the YES soft key to update the stored InstaCal characterization to use the currently connected module.

Press the NO soft key to keep the stored InstaCal characterization.

A listing of possible InstaCal error messages is provided in Table 2-5.

Table 2-5. InstaCal Error Messages

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<b><u>Error Message</u></b>	<b><u>Description</u></b>
Failed to read serial number of InstaCal module	The Cell Master was unable to read the InstaCal module serial number.
Failed to successfully transfer instacal module data to Cell Master	The Cell Master was unable to transfer all necessary data between the InstaCal module and the Cell Master.
Failed to set baud with InstaCal module	The Cell Master was unable to establish communication with the InstaCal module.

---

## General Error Messages

A listing of General Error Messages is provided below.

Table 2-6. General Error Messages

---

<u>Error Message</u>	<u>Description</u>
CAL Incomplete	A complete open, short, and load calibration must be performed before calibration can be turned on.
Dist Requires F1 < F2	Valid distance to fault plots require a non-zero frequency span.
Invalid Sweep Data	The sweep data is invalid.
Use Options menu to select a printer	Attempting to print a status window with no printer selected. Select a printer, then retry.
Flexcal is not suitable for this case, Change To OSL CAL mode (SYS-Options)	The cable is too long or too reflective for FlexCal to work. OSL cal must be used instead.
Cannot zero input signal too high	Attempting to perform a Power Meter zero adjust function with an input of greater than -20 dBm.

---

## Battery Information

### Charging a New Battery

The NiMH battery supplied with the Cell Master 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 Cell Master

The battery can be charged while installed in the Cell Master.

- Step 1.** Turn the Cell Master off.
- Step 2.** Connect the AC-DC adapter (Anritsu part number: 40-115) to the Cell Master charging 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 Cell Master 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.

*NOTES: 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.*

*If the battery temperature exceeds 45° C while charging, the charging will stop and the charge indicator will turn off. Charging will resume automatically when the temperature drops below 45° C.*

### 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 Cell Master 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 unplugged from the Cell Master, the battery indicator symbol will be continuously displayed at the top left corner of the Cell Master status window (Figure 2-11). 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.

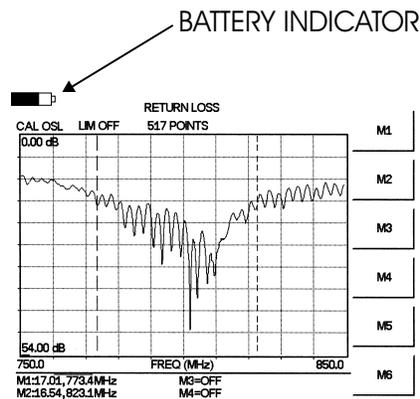


Figure 2-11. Cell Master Battery Indicator

Once all the power has drained from the battery, the Cell Master status window will fade. At this point, your Cell Master will switch itself off and the battery will need to be re-charged.

During operation, the battery condition can be viewed by pressing the **SYS** key and selecting the Self Test soft key (Figure 2-12). The battery condition will be displayed as a percentage of charge remaining.

Selftest

Temperature . . . . . 24°C  
Memory . . . . . PASSED  
RTC Battery . . . . . 3.1V  
Voltage . . . . . Battery (11.1V)  
Battery Cal . . . . . PASSED  
Battery Charge . . . . . 84% (I = -743mA)

VNA PLL . . . . . PASSED  
VNA Integrator . . . . . PASSED  
SPA LO . . . . . PASSED

Press **ESCAPE** to return.

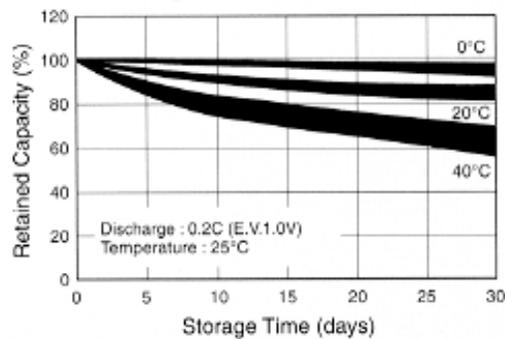
---

Figure 2-12. Self Test 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 2-13).



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Figure 2-13. 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 Cell Master has already completed three charge and discharge cycles at the factory.
- Recharge the battery only in the Cell Master, or in an Anritsu approved charger.
- When the Cell Master or the charger is not in use, disconnect it from the power source.
- Do not charge batteries for longer than 24 hours, as overcharging may shorten battery life.
- 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.
- Battery storage is recommended at less than 45° C.
- Batteries must be recycled or disposed of properly. Do not place batteries in the trash.
- Do not dispose of batteries in a fire!



# Cable and Antenna Analyzer Mode

## Selecting the Frequency or Distance

For the OSL calibration method (the default), the frequency range for the desired measurement must be set. For the FlexCal method, the Cell Master automatically sets the frequency from 25 MHz to 4000 MHz. The following procedure selects the frequency range for an OSL calibration.

- Step 1.** Press the **FREQ/DIST** key.
- Step 2.** Press the F1 soft key.
- Step 3.** Enter the desired start frequency using the key pad or the Up/Down arrow key.
- Step 4.** Press **ENTER** to set F1 to the desired frequency.
- Step 5.** Press the F2 soft key.
- Step 6.** Enter the desired stop frequency using the keypad or the Up/Down arrow key.
- Step 7.** Press **ENTER** to set F2 to the desired frequency.
- Step 1.** Check that the start and stop frequencies displayed match the desired measurement range.

## Calibration

### Calibration Methods

For accurate results, the Cell Master must be calibrated before making any measurements. The Cell Master must be re-calibrated whenever the setup frequency changes, the temperature exceeds the calibration temperature range or when the test port extension cable is removed or replaced.

There are two methods of calibrating the Cell Master: FlexCal and OSL calibration. FlexCal is a broadband frequency (25 MHz to 4000 MHz) calibration that remains valid if the frequency is changed. An OSL calibration is an Open, Short and Load calibration for a selected frequency range, and is no longer valid if the frequency is changed. The default calibration mode is OSL.

With either calibration method, the Cell Master may be calibrated manually with Open, Short, Load (OSL) calibration components, or by using the InstaCal module.

If a Test Port Extension Cable is to be used, the Cell Master must be calibrated with the Test Port Extension Cable in place. The Test Port Extension Cable is a phase stable cable and is used as an extension cable on the test port to ensure accurate and repeatable measurements. This phase stable cable can be moved and bent while making a measurement without causing errors in the measurement.

*NOTE: The test port extension cable should have the appropriate connectors for the measurement. Use of additional connector adapters after the test port extension cable can contribute to measurement errors not compensated for during calibration.*

## **Calibration Verification**

During the calibration process in Return Loss mode, either with discrete calibration components or with the InstaCal module, there are typical measurement levels expected. Verifying the measurement levels displayed on the screen during calibration can save valuable time in the field.

### **Trace Characteristics in Return Loss Mode**

As the discrete calibration components are connected to the Cell Master RF out port, the following measurement levels will be displayed on the screen:

- ❑ When an OPEN is connected, a trace will be displayed between 0-10 dB.
- ❑ When a SHORT is connected, a trace will be displayed between 0-10 dB.
- ❑ When a LOAD is connected, a trace will be displayed between 0-50 dB.

When an InstaCal module is connected to the Cell Master RF out port, the following measurement levels will be displayed on the screen:

- ❑ When the Cell Master is measuring an equivalent OPEN, a trace will be displayed between 0-20 dB.
- ❑ When the Cell Master is measuring an equivalent SHORT, a trace will be displayed between 0-20 dB.
- ❑ When the Cell Master is measuring an equivalent LOAD, a trace will be displayed between 0-50 dB.

The following procedures explain standard OSL, FlexCal, and InstaCal calibration methods. Refer to Figure 3-2 for a calibration setup diagram.

## OSL Calibration Procedures

In Cable and Antenna Analyzer Mode, if the Cal Off message is displayed, or the test port cable has been changed, a new calibration is required. The following procedures detail how to perform the OSL calibration.

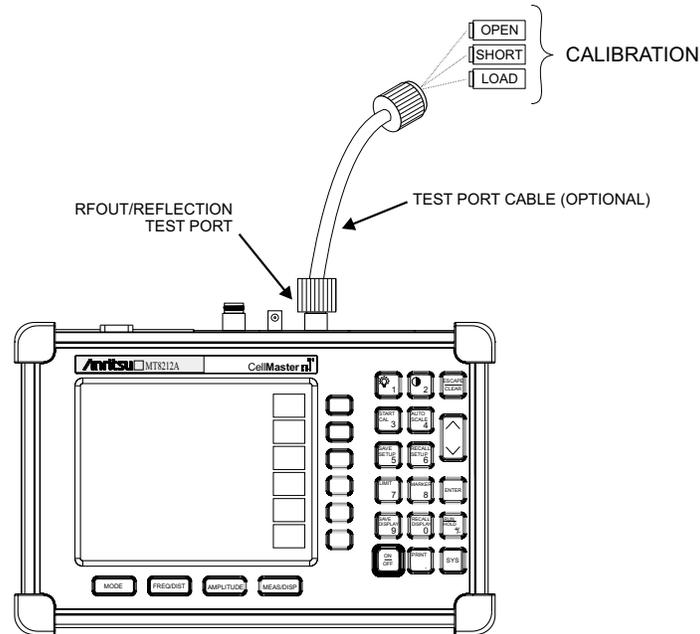


Figure 3-2. Calibration Setup

### Standard OSL Calibration

- Step 1.** Select OSL Cal by pressing the **SYS** key, followed by the Options soft key. The currently selected calibration method is indicated at the bottom of the status window. Use the CAL Mode softkey to select the OSL calibration method.
- Step 2.** Select the appropriate frequency range, as described on page 3-2.
- Step 3.** Press the **START CAL** key. The message “Connect OPEN or INSTACAL module to RF Out Port” will appear in the status window.
- Step 4.** Connect the calibrated Open and press the **ENTER** key. The messages “Measuring OPEN” and “Connect SHORT to RF Out” will appear.
- Step 5.** Remove the Open, connect the calibrated Short and press the **ENTER** key. The messages “Measuring SHORT” and “Connect LOAD to RF Out” will appear.
- Step 6.** Remove the Short, connect the calibrated Termination and press the **ENTER** key. The message “Measuring LOAD” will appear.
- Step 7.** Verify that the calibration has been properly performed by checking that the Cal ON message is now displayed in the upper left corner of the status window.

### FlexCal OSL Calibration

- Step 1.** Select FlexCal by pressing the **SYS** key, followed by the Options soft key. The currently selected calibration method is indicated at the bottom of the status window. Use the CAL Mode softkey to select the FlexCal calibration mode.
- Step 2.** Press the **START CAL** key. The message “Connect OPEN or INSTACAL module to RF Out Port” will appear in the status window.
- Step 3.** Connect the calibrated Open and press the **ENTER** key. The messages “Measuring OPEN” and “Connect SHORT to RF Out” will appear and the frequency is automatically set by the Cell Master from 25 MHz to 4000 MHz.
- Step 4.** Remove the Open, connect the calibrated Short and press the **ENTER** key. The messages “Measuring SHORT” and “Connect LOAD to RF Out” will appear.
- Step 5.** Remove the Short, connect the calibrated Termination and press the **ENTER** key. The message “Measuring LOAD” will appear.
- Step 6.** Verify that the calibration has been properly performed by checking that the FlexCal ON message is now displayed in the upper left corner of the status window.

### InstaCal Module Verification

Verifying the InstaCal module before any line sweeping measurements is critical to the measured data. InstaCal module verification identifies any failures in the module due to circuitry damage or failure of the control circuitry. This test does not attempt to characterize the InstaCal module, which is performed at the factory or the service center.

The performance of the InstaCal module can be verified by the Termination method or the Offset method. The termination method is the preferred method in the field, and is similar to testing a bad load against a known good load.

#### Termination Method

The Termination method compares a precision load against the InstaCal Module and provides a baseline for other field measurements. A precision load provides better than 42 dB directivity.

- Step 1.** Set the frequency according to the device under test (cellular, PCS, GSM).
- Step 2.** Press the **MODE** key and select Freq-Return Loss mode.
- Step 3.** Connect the InstaCal module to the Cell Master RF Out port and calibrate the Cell Master using the InstaCal module (page 3-6).
- Step 4.** Remove the InstaCal module from the RF Out port and connect the precision load to the RF Out port.
- Step 5.** Measure the return loss of the precision load. The level should be less than 35 dB across the calibrated frequency range.
- Step 6.** Press the **MARKER** key and set the M1 marker to Marker To Peak. The M1 value should be less than 35 dB return loss.
- Step 7.** Press **SAVE DISPLAY** (page 3-13) name the trace, and press **ENTER**.

### Offset Method

An alternative to the termination method is to measure the return loss of a 20 dB offset. This is similar to measuring an antenna that has been specified to have a 20 dB return loss across the frequency of operation. A 20 dB offset provides a 20 dB return loss across a very wide frequency range. Measuring the return loss with the 20 dB offset will provide a relatively flat response across the operating frequency range of the Cell Master.

- Step 1.** Set the frequency according to the device under test (cellular, PCS, GSM).
- Step 2.** Press the **MODE** key and select Freq-Return Loss mode.
- Step 3.** Connect the InstaCal module to the Cell Master RF Out port and calibrate the Cell Master using the InstaCal module (page 3-6).
- Step 4.** Remove the InstaCal module from the RF Out port and connect the 20 dB Offset to the RF Out port.
- Step 5.** Measure the return loss of the 20 dB Offset. The level should be 20 dB,  $\pm 2$  dB across the calibrated frequency range.
- Step 6.** Press the **MARKER** key and set the M1 marker to Marker To Peak. The M1 value should be approximately 20 dB return loss.
- Step 7.** Press **SAVE DISPLAY** (page 3-13) name the trace, and press **ENTER**.

### InstaCal Module Calibration Procedures

*NOTE: The InstaCal module is not a discrete calibration component and it can not be used at the top of the tower to perform line sweep measurements.*

Check that the CAL Off message is displayed in the upper left corner of the status window. This indicates that the Cell Master has not been calibrated. The following procedures detail how to perform a calibration using the InstaCal module.

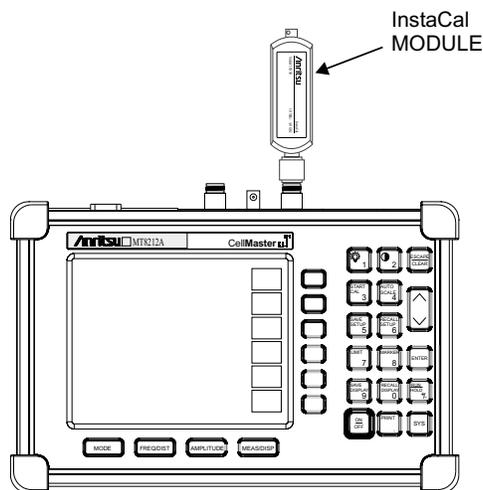


Figure 3-3. InstaCal Module Calibration

### Standard InstaCal Calibration

- Step 1.** Select OSL Cal by pressing the **SYS** key, followed by the Options soft key. The currently selected calibration method is indicated at the bottom of the status window. Use the CAL Mode softkey to select the OSL calibration method.
- Step 2.** Select the appropriate frequency range, as described on page 3-2.
- Step 3.** Press the **START CAL** key. The message “Connect OPEN or InstaCal to RF Out port” will appear in the status window.
- Step 4.** Connect the InstaCal module to the RF Out port (Figure 3-3).
- Step 5.** Press the **ENTER** key. The Cell Master senses the InstaCal module and automatically calibrates the unit using the OSL procedure. The calibration should take about 45 seconds.
- Step 6.** Verify that the calibration has been properly performed by checking that the Cal On! message is displayed in the upper left corner of the status window.

### FlexCal InstaCal Calibration

- Step 1.** Select FlexCal by pressing the **SYS** key, followed by the Options soft key. The currently selected calibration method is indicated at the bottom of the status window. Use the CAL Mode softkey to select the FlexCal calibration method.
- Step 2.** Press the **START CAL** key. The message “Connect OPEN or InstaCal to RF Out port” will appear in the status window.
- Step 3.** Connect the InstaCal module to the RF Out port (Figure 3-3). The Cell Master automatically sets the frequency from 25 MHz to 4000 MHz.
- Step 4.** Press the **ENTER** key. The Cell Master senses the InstaCal module and automatically calibrates the unit using the OSL procedure. The calibration should take about 45 seconds.
- Step 5.** Verify that the calibration has been properly performed by checking that the FlexCal On! message is displayed in the upper left corner of the status window.

### Calibration with the Test Port Extension Cable

If a Test Port Extension Cable is to be used, the Cell Master must be calibrated with the Test Port Extension Cable in place. Follow the same calibration procedures as above with the OSL components or the InstaCal module in place at the end of the test port extension cable.

## Auto Scale

The Cell Master can automatically set the scales to the minimum and maximum values of the measurement on the y-axis of the status window. This function is particularly useful for measurements in SWR mode. To automatically set the scales, press the **AUTO SCALE** key. The Cell Master will automatically set the top and bottom scales to the minimum and maximum values of the measurement on the y-axis of the status window.

## Amplitude Scale

The following procedure sets the top and bottom scale display.

- Step 1.** Press the **AMPLITUDE** key to call up the Scale Menu.
- Step 2.** Press the Top soft key and use the keypad or Up/Down arrow key to edit the top scale value. Press **ENTER** to set.
- Step 3.** Press the Bottom soft key and use the keypad or Up/Down arrow key to edit the bottom scale value. Press **ENTER** to set.

*NOTE: Typically the y-axis scale of the status window is 0-60 dB (return loss) but for some measurements (for example, insertion loss) the scale should be changed to 0-10 dB. If the scale is not changed, some measurement results may not be easily viewed on the screen.*

## Set the Distance and Cable Type

In Distance-To-Fault (DTF) mode, the length of the transmission line (distance) and cable type are selected. The cable type determines the velocity propagation and cable attenuation factor. The following procedure can be used to set the distance and select the appropriate cable type.

*NOTE: Selecting the correct cable is very important for accurate measurements and for identifying faults in the transmission line. Selecting the incorrect cable, or using the correct cable out of its proper frequency characteristics type, will shift the DTF trace vertically and horizontally making it difficult to accurately locate faults.*

- Step 1.** Press the **MODE** key.
- Step 2.** Select DTF Return Loss or DTF SWR mode. The Cell Master automatically sets D1 to zero.
- Step 3.** Press the D2 soft key.
- Step 4.** Enter the appropriate D2 value for the maximum length of the transmission line and press the **ENTER** key to set the D2 value.
- Step 5.** Press the DTF Aid soft key.

- Step 6.** Using the Up/Down arrow key, select the Cable = and press **ENTER**. Use the Up/Down arrow key to select the Standard cable types stored in the standard Cell Master cable lists (which cannot be edited) or choose Custom, for additional cables. A custom cable list can be created and uploaded using the Handheld Software Tools application provided with the Cell Master (Chapter 9).
- Step 7.** Using the Up/Down arrow key, select the appropriate type of cable and press the **ENTER** key. The selected cable type, Prop Vel and Cable Loss in dB/m (or dB/ft) will be displayed on the DTF parameters screen.
- Step 8.** Press **ENTER**.

# Spectrum Analyzer Mode

## 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

### Selecting the Start and Stop Frequencies

- Step 1.** To set a specific frequency band, select the **Start** soft key and enter the desired start frequency using the Up/Down arrow key or the keypad and press **ENTER** to accept the input.
- Step 2.** Select the **Stop** soft key and enter the desired stop frequency using the Up/Down arrow key or the keypad and press **ENTER** to accept the input.

### Selecting the Center Frequency and Span

- Step 1.** To enter a center frequency, select the **Center** soft key and enter the desired center frequency using the Up/Down arrow key or the keypad and press **ENTER** to accept the input.
- Step 2.** Press the **Span** soft key to display the Span menu.
- Step 3.** To set a specific span, enter the desired span using the Up/Down arrow key or the keypad and press **ENTER** 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 Signal Standard and Channel

- Step 1.** Press the **Signal Standard** soft key and select the appropriate signal standard for the measurement.
- Step 2.** Press the **Select Channel** soft key and select the appropriate channel for the measurement.

## 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/Preamp soft key and select Auto coupling of the attenuator setting to the reference level to help insure that harmonics and spurs are not introduced into the measurements.

## 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 status window as RBW XXX. When the RBW is manually coupled, it can be adjusted independently of the span. Manual RBW coupling is indicated on the status window 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 status window as VBW XXX. When the VBW is manually coupled, it can be adjusted independently of the RBW. Manual VBW coupling is indicated on the status window as VBW\* XXX.

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

## Selecting Sweep Parameters

### Max Hold

To toggle maximum hold on or off, press the **MEAS/DISP** key, the Trace soft key and 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 four available detection methods are Positive Peak, RMS Average, Negative Peak, and Sampling Mode. Positive peak display the maximum value of all the measurements associated with that display point. RMS Average detection displays the mean

power of all the measurements associated with that display point. Negative peak displays the minimum value of all the measurements associated with that display point. Sampling mode displays one measured value for the measurements associated with the display point.

To set the detection method, press the Detection soft key and select either Positive Peak, RMS Average, Negative Peak or Sampling Mode 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 (2-25) soft key and use the up/down arrow key or directly enter the desired number of sweeps from the keypad. Press **ENTER** to set the sweep average.

**NOTE:** Max Hold and Average are mutually exclusive.

## **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/Preamp 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 status window 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 status window 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 attenuation and preamp to give the maximum dynamic range without compressing the input mixer.

Dynamic attenuation is indicated on the status window as Atten=Dynamic.

## All Modes

### Save and Recall a Setup

#### Saving a Setup

Saving a setup configuration in memory will preserve the calibration information.

- Step 1.** To save the configuration in one of the available user setup locations, press **SAVE SETUP**. There are ten locations in cable and antenna analyzer modes, and five each in Spectrum Analyzer, T1 and E1 modes.
- Step 2.** Use the key pad or the Up/Down arrow key to select a location.
- Step 3.** Press **ENTER** to save the setup.

*NOTE: For cable and antenna analyzer modes, an OSL calibration is saved with an OSL designation, an InstaCal OSL calibration is saved with an OSL!, a FlexCal OSL calibration is saved with an FLX, and an InstaCal FlexCal calibration is saved with an FLX!.*

#### Recalling a Setup

The following procedure recalls a setup from memory.

- Step 1.** Press the **RECALL SETUP** key.
- Step 2.** Select the desired setup using the Up/Down arrow key.
- Step 3.** Press **ENTER** to recall the setup.

### Save and Recall a Display

#### Saving a Display

The following procedure saves a display to memory.

- Step 1.** Press the **SAVE DISPLAY** key to activate the alphanumeric menu for trace storage.
- Step 2.** Use the soft keys to enter a label for the saved trace.

For example, to save a display with the name “TX1 RETURN LOSS” press the soft key group that contains the letter “T” then press the “T” soft key. Press the soft key group that contains the letter “X” then press the “X” soft key. Press the number “1” key on the numeric keypad. Use the softkeys and keypad as necessary to enter the entire name, then press **ENTER** to complete the process.

*NOTES: More than one trace can be saved using the same alphanumeric name, as traces are stored chronologically, using the time/date stamp.*

*Pressing the **SAVE DISPLAY** key will bring up the last saved trace name on the input line. Pressing the Delete soft key will erase the entire trace name. To erase only one character of a trace name, press the Up/Down arrow key to select the character, then press the Delete soft key. This feature can be useful when naming traces sequentially, such as: Trace 1, Trace 2, etc.*

## Recalling a Display

The following procedure recalls a previously saved display from memory.

- 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 display.

## Changing the Units

By default, the Cell Master displays information in metric units. Use the following procedure to change the display to English units.

- Step 1.** Press the **SYS** key.
- Step 2.** Select the Options soft key.
- Step 3.** Press Units to change from metric to English measurement units, or vice versa. The current selection is displayed at the bottom left corner of the screen.

## Changing the Language

By default, the Cell Master displays messages in English. To change the display language:

- Step 1.** Press the **SYS** key.
- Step 2.** Select the Language soft key.
- Step 3.** Select the desired language. Choices are English, French, German, Spanish, Chinese, and Japanese. The default language is English.

## Adjusting Markers

- Step 4.** Press the **MARKER** key to call up the Markers menu.
- Step 5.** Press the M1 soft key to select the M1 marker function.
- Step 6.** Press the Edit soft key and enter an appropriate value using the keypad or Up/Down arrow key to move the marker without redrawing the trace. Pressing the **ON/OFF** soft key activates or deactivates the M1 marker function.
- Step 7.** Press the Back soft key to return to the Markers Menu.
- Step 8.** Repeat the steps for markers M2, M3, M4, M5 and M6.

## Adjusting Limits

The Cell Master 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 in Spectrum Analyzer mode only.

### Defining an Upper Limit

An upper limit in Spectrum Analyzer mode is one where the measurement fails if the data appears above the limit line.

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

### Defining a Lower Limit

A lower limit in Spectrum Analyzer mode is one where the measurement fails if the data appears below the limit line.

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

### Adjusting Segmented Limits

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

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

- Step 1.** Press the **LIMIT** key.
- Step 2.** Press the Multiple Upper Limits soft key.
- Step 3.** Press the Segment 1 soft key.
- Step 4.** Press the Edit soft key. The status window will successively display the value of the segment endpoints: St Freq, St Limit, End Freq, End Limit.
- Step 5.** Edit each value using the numeric keypad or scroll the limit line using the Up/Down arrow key and press **ENTER** to set.
- Step 6.** Press the Next Segment soft key to move on to Segment 2. 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 7.** Repeat these steps for the remaining segments.
- Step 8.** When the final segment is defined, press the Back soft key to end the editing process.

**NOTES:** The Cell Master 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 Cell Master 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 (numeric keypad number 7).
- 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 the Status Window Contrast

The contrast of the Cell Master status window can be adjusted to accommodate varying light conditions and to help discern traces when using the Trace Overlay feature (see page 9-5).

- 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**.

### Adjusting the Backlight Intensity

The intensity of the Cell Master backlight can be adjusted to accommodate varying light conditions and to help discern traces.

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

## Printing

Printing is accomplished by selecting an available printer and pressing the print key as described below. Refer to the particular printer operating manual for specific printer settings.

### Printing a Screen

**Step 1.** Connect the printer as shown in Figure 3-4.

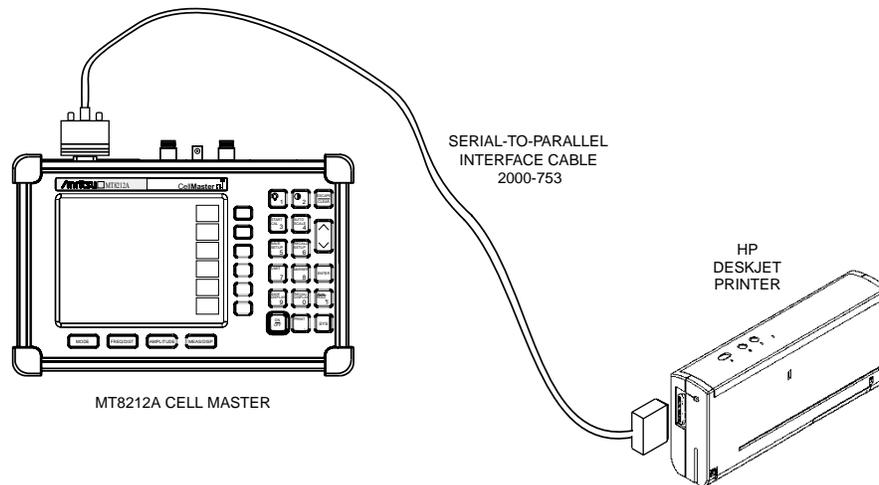


Figure 3-4-. Cell Master Printer Setup

- Step 2.** Obtain the desired measurement display
- Step 3.** Press the **SYS** key and the Options soft key.
- Step 4.** Press the Printer soft key and select from the displayed menu of supported printers.
- Step 5.** Press the **PRINT** key (Figure

### Printer Switch Settings

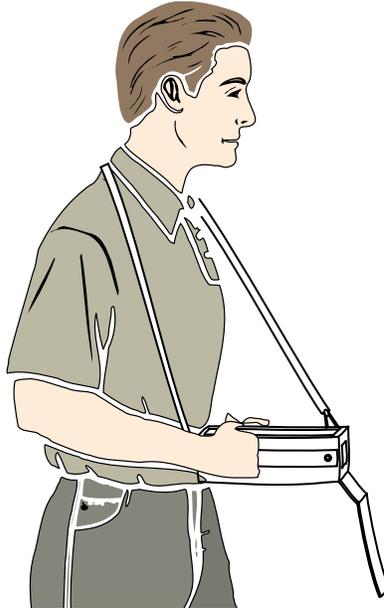
Set the switches on the serial-to-parallel interface cable to the HP Deskjet 450 ink jet printer as follows:

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

## 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 3-5).

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*Figure 3-5. Using the Cell Master Soft Carrying Case*

# Chapter 4

## Cable and Antenna Analyzer Measurements

### Analyzer Measurements

#### Introduction

This chapter provides a description of cable and antenna analyzer measurements, including line sweeping fundamentals and line sweeping measurement procedures, available when the Cell Master is in frequency or DTF mode.

#### Line Sweep Fundamentals

In wireless communication, the transmit and receive antennas are connected to the radio through a transmission line. This transmission line is usually a coaxial cable or waveguide. This connection system is referred to as a transmission feed line system. Figure 4-1 shows an example of a typical transmission feed line system.

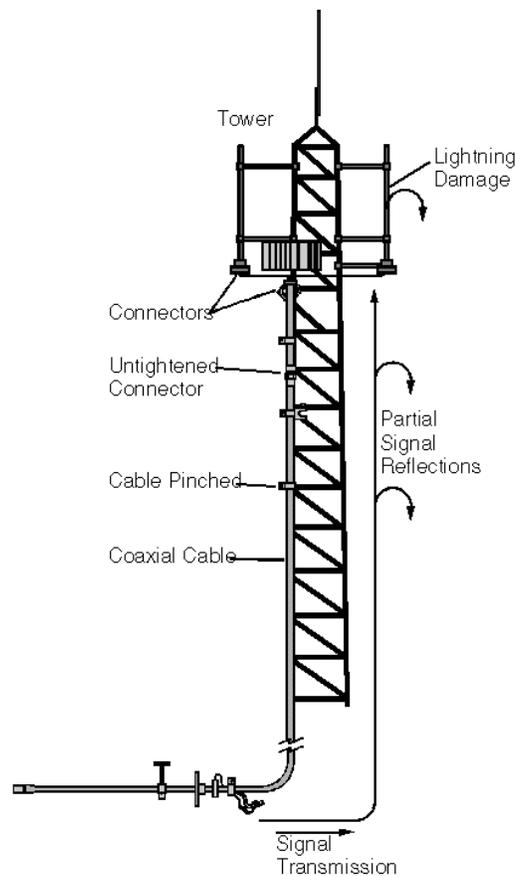


Figure 4-1. A Typical Transmission Feed Line System

The performance of a transmission feed line system may be affected by excessive signal reflection and cable loss. Signal reflection occurs when the RF signal reflects back due to an impedance mismatch or change in impedance caused by excessive kinking or bending of the transmission line. Cable loss is caused by attenuation of the signal as it passes through the transmission line and connectors.

To verify the performance of the transmission feed line system and analyze these problems, three types of line sweeps are required:

**Return Loss Measurement**—Measures the reflected power of the system in decibels (dB). This measurement can also be taken in the Standing Wave Ratio (SWR) mode, which is the ratio of the transmitted power to the reflected power.

**Cable Loss Measurement**—Measures the energy absorbed, or lost, by the transmission line in dB/meter or dB/ft. Different transmission lines have different losses, and the loss is frequency and distance specific. The higher the frequency or longer the distance, the greater the loss.

**Distance-To-Fault (DTF) Measurement**—Reveals the precise fault location of components in the transmission line system. This test helps to identify specific problems in the system, such as connector transitions, jumpers, kinks in the cable or moisture intrusion.

The different measurements are defined as:

**Return Loss - System Sweep**—A measurement made when the antenna is connected at the end of the transmission line. This measurement provides an analysis of how the various components of the system are interacting and provides an aggregate return loss of the entire system.

**Distance To Fault - Load Sweep**—A measurement is made with the antenna disconnected and replaced with a  $50\Omega$  precision load at the end of the transmission line. This measurement allows analysis of the various components of the transmission feed line system in the DTF mode.

**Cable Loss Sweep**—A measurement made when a short is connected at the end of the transmission line. This condition allows analysis of the signal loss through the transmission line and identifies the problems in the system. High insertion loss in the feed line or jumpers can contribute to poor system performance and loss of coverage.

This whole process of measurements and testing the transmission line system is called Line Sweeping.

## **CW Mode**

CW mode can be used to maximize sweep speeds of both frequency and DTF measurements. With CW on, sweep times can be two times faster than with CW off. However, making measurements with CW on will reduce the instrument's immunity to interfering signals. In a controlled environment, this reduced immunity should not be a problem. In the field however, there can be stray signals from nearby or co-located transmitters that can affect frequency and DTF measurements. Turning CW on and off can verify that the MT8212A is reducing the interfering signals. If there is no appreciable difference, then it should be safe to make measurements with CW on.

Use this feature with caution, as the later introduction of an interfering signal might be mistaken for a problem with the antenna or cable run.

## Information Required for a Line Sweep

The following information must be determined before attempting a line sweep measurement:

- System Frequency Range, to set the sweep frequency
- Cable Type, to set the cable characteristics for DTF measurements
- Distance of the Cable Run, to set the distance for DTF measurements

## Typical Line Sweep Test Procedures

This section provides typical line sweep measurements used to analyze the performance of a transmission feed line system.

### System Return Loss Measurement

System return loss measurement verifies the performance of the transmission feed line system with the antenna connected at the end of the transmission line. To measure the system return loss:

#### Required Equipment

- Cell Master Model MT8212A
- Precision Open/Short, Anritsu 22N50 *or*  
Precision Open/Short/Load, Anritsu OSLN50LF *or*  
InstaCal Module ICN50
- Precision Load, Anritsu SM/PL
- Test Port Extension Cable, Anritsu 15NNF50-1.5C
- Optional 510-90 Adapter, DC to 7.5 GHz, 50 ohm, 7/16(F)-N(M)

#### Device Under Test

- Transmission Feed Line with Antenna

#### Procedure

- Step 1.** Press the **MODE** key.
- Step 2.** Select Freq-Return Loss using the Up/Down arrow key and press **ENTER**.
- Step 3.** Set the start and stop frequencies, F1 and F2, as described on page 3-2.
- Step 4.** Calibrate the Cell Master as described on page 3-2.
- Step 5.** Connect the Device Under Test to the Cell Master. A trace will be displayed on the screen when the Cell Master is in the sweep mode.
- Step 6.** Press **SAVE DISPLAY** (page 3-13) name the trace, and press **ENTER**.

*NOTE: The antenna must be connected at the end of the transmission feed line when conducting a System Return Loss measurement.*

Figure 4-2 is an example of a typical system return loss trace:

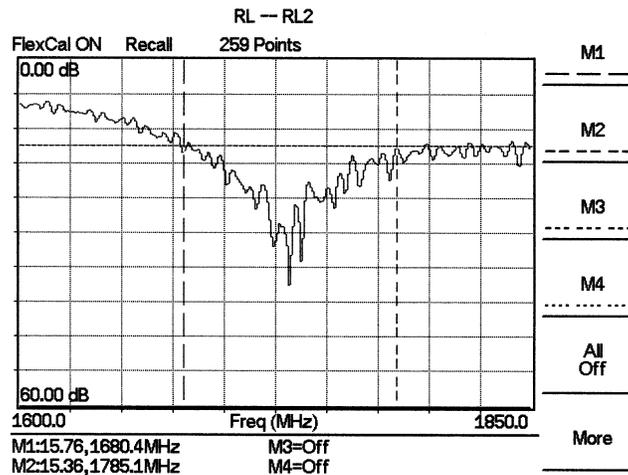


Figure 4-2. Typical System Return Loss Trace

*NOTE: The system sweep trace should appear at an approximate return loss of 15 dB ( $\pm 3$  dB) in the status window. Typically, a 15 dB return loss is measured in the passband of the antenna system.*

## Cable Loss Loss Measurement

The transmission feed line insertion loss test verifies the signal attenuation level of the cable system in reference to the specification. This test can be conducted with the Cell Master in Freq-Cable Loss mode.

### Required Equipment

- Cell Master Model MT8212A
- Precision Open/Short, Anritsu 22N50 *or*  
Precision Open/Short/Load, Anritsu OSLN50LF *or*  
Anritsu InstaCal Module, ICN50
- Precision Load, Anritsu SM/PL
- Test Port Extension Cable, Anritsu 15NNF50-1.5C
- Optional 510-90 Adapter, DC to 7.5 GHz, 50 ohm, 7/16(F)-N(M)

### Device Under Test

- Transmission Feed Line with Short

### Procedure - Cable Loss Mode

- Step 1.** Press the **MODE** key.
- Step 2.** Select Freq-Cable Loss using the Up/Down arrow key and press **ENTER**.
- Step 3.** Set the start and stop frequencies, F1 and F2, as described on page 3-2.
- Step 4.** Connect the Test Port Extension cable to the RF port and calibrate the Cell Master as described on page 3-2.

- Step 5. Save the calibration set up (page 3-13).
- Step 6. Connect the Device Under Test to the Cell Master phase stable Test Port Extension cable. A trace will be displayed on the screen as long as the Cell Master is in sweep mode.
- Step 7. Cable loss is displayed in the status window.
- Step 8. Press **SAVE DISPLAY** (page 3-13) name the trace, and press **ENTER**.

Figure 4-3 is an example of a typical transmission line cable loss trace.

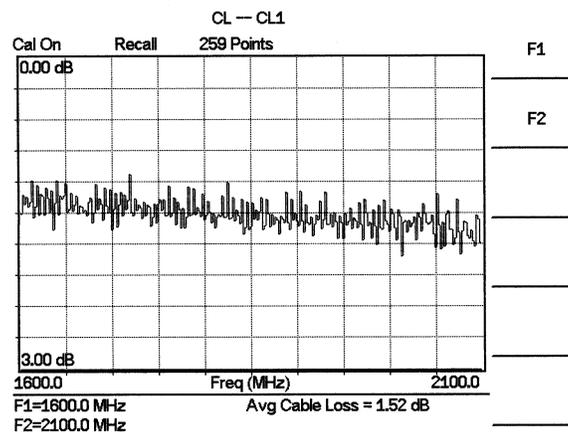


Figure 4-3. Typical Transmission Line Cable Loss Trace

## Distance-To-Fault (DTF) Transmission Line Test

The Distance-To-Fault transmission line test verifies the performance of the transmission line assembly and its components and identifies the fault locations in the transmission line system. This test determines the return loss value of each connector pair, cable component and cable to identify the problem location. This test can be performed in the DTF–Return Loss or DTF–SWR mode. Typically, for field applications, the DTF–Return Loss mode is used. To perform this test, disconnect the antenna and connect the load at the end of the transmission line.

### Required Equipment

- ❑ Cell Master Model MT8212A
- ❑ Precision Open/Short, Anritsu 22N50 *or*  
Precision Open/Short/Load, Anritsu OSLN50LF *or*  
Anritsu InstaCal Module, ICN50
- ❑ Precision Load, Anritsu SM/PL
- ❑ Test Port Extension Cable, Anritsu 15NNF50-1.5C
- ❑ Optional 510-90 Adapter, DC to 7.5 GHz, 50 ohm, 7/16(F)-N(M)

### Device Under Test

- ❑ Transmission Feed Line with Load

### Procedure - Return Loss Mode

The following steps explain how to make a DTF measurement in return loss mode.

- Step 1.** Press the **MODE** key.
- Step 2.** Select DTF-Return Loss using the Up/Down arrow key and press **ENTER**.
- Step 3.** Connect the Test Port Extension cable to the RF port and calibrate the Cell Master as described on page 3-2.
- Step 4.** Save the calibration set up (page 3-13).
- Step 5.** Connect the Device Under Test to the Cell Master phase stable Test Port Extension cable. A trace will be displayed on the screen as long as the Cell Master is in sweep mode.
- Step 6.** Press the **FREQ/DIST** key.
- Step 7.** Set the D1 and D2 values. The Cell Master default for D1 is zero.
- Step 8.** Press the DTF Aid soft key and select the appropriate Cable Type to set the correct propagation velocity and attenuation factor.

*NOTE: Selecting the right propagation velocity, attenuation factor and distance is very important for accurate measurements, otherwise the faults can not be identified accurately and insertion loss will be incorrect.*

**Step 9.** Press **SAVE DISPLAY** (page 3-13) name the trace, and press **ENTER**.

**Step 10.** Record the connector transitions.

Figure 4-4 shows an example of a typical DTF return loss trace.

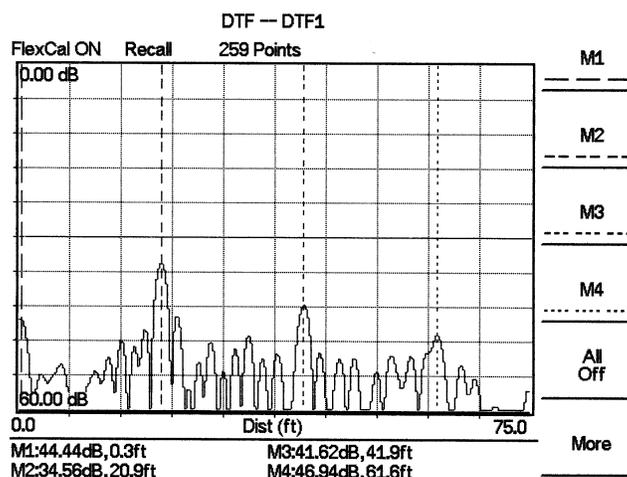


Figure 4-4. Typical DTF Return Loss Trace

In the above example:

- Marker M1 marks the first connector, the end of the Cell Master phase stable Test Port Extension cable.
- Marker M2 marks the first jumper cable.
- Marker M3 marks the end of the main feeder cable.
- Marker M4 is the load at the end of the entire transmission line.

#### Procedure - DTF-SWR Mode

The following steps explain how to measure DTF in SWR mode.

- Step 1.** Press the MODE key.
- Step 2.** Select the DTF-SWR using the Up/Down arrow key and press **ENTER**.
- Step 3.** Follow the same procedure as DTF-Return Loss mode, above.

#### Resolution

There are three sets of data points (130, 259 and 517) available in the Cell Master. The factory default is 259 data points. By increasing the number of data points the measurement accuracy and transmission line distance to measure will increase.

$$\text{Step size} = \frac{(1.5 \times 10^8)(V_p)}{\Delta F}$$

Where  $V_p$  is the relative propagation velocity of the cable and  $\Delta F$  is the stop frequency minus the start frequency (Hz).

The maximum distance is:  $D_{\max} = \text{step size} \times (\# \text{ of datapoints} - 1)$

Increasing the data points increases the sweep time and increases the accuracy of the measurement. CW mode On or Off can also affect sweep speed (see CW Mode, page 4-2 for details).

## Antenna Subsystem Return Loss Test

Antenna Subsystem return loss measurement verifies the performance of the transmit and receive antennas. This measurement can be used to analyze the performance of the antenna before installation. The antenna can be tested for the entire frequency band, or tested to a specific frequency range. Transmit and receive frequency measurements are conducted separately. The following steps explain how to measure the antenna loss in return loss mode.

### Required Equipment

- Cell Master Model MT8212A
- Precision Open/Short, Anritsu 22N50 *or*  
Precision Open/Short/Load, Anritsu OSLN50LF *or*  
Anritsu InstaCal Module, ICN50
- Precision Load, Anritsu SM/PL
- Test Port Extension Cable, Anritsu 15NNF50-1.5C
- Optional 510-90 Adapter, DC to 7.5 GHz, 50 ohm, 7/16(F)-N(M)

### Device Under Test

- Antenna Sub Assembly

### Procedure

- Step 1.** Press the **MODE** key.
- Step 2.** Select Freq-Return Loss using the Up/Down arrow key and press **ENTER**.
- Step 3.** Connect the Test Port Extension cable to the RF port and calibrate the Cell Master as described on page 3-2.
- Step 4.** Press **SAVE SETUP** and save the calibration set up (page 3-13).
- Step 5.** Connect the Device Under Test to the Cell Master phase stable Test Port Extension cable.
- Step 6.** Press the **MARKER** key.
- Step 7.** Set markers M1 and M2 to the desired frequencies.
- Step 8.** Record the lowest return loss over the specified frequency range.
- Step 9.** Press **SAVE DISPLAY** (page 3-13) name the trace, and press **ENTER**.

The following trace is an example of an antenna return loss trace.

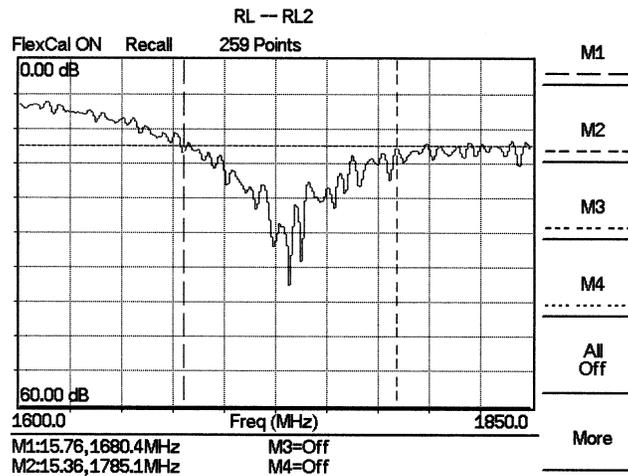


Figure 4-5. Antenna Return Loss Trace

Calculate the threshold value and compare the recorded Lowest Return Loss to the calculated threshold value.

$$\text{Maximum Return Loss} = \frac{-20 \log(VSWR - 1)}{(VSWR + 1)}$$

**NOTE:** VSWR is the antenna manufacturer's specified VSWR.

If the measured return loss is less than the calculated threshold value, the test fails and the antenna must be replaced.

# ***Chapter 5***

## ***Spectrum Analyzer***

### ***Measurements***

#### **Introduction**

This chapter provides a description of Spectrum Analyzer measurements and procedures when the Cell Master is in Spectrum Analyzer Mode. The following field measurements are explained in detail:

- ❑ Setting up signal standard and channel
- ❑ Field Strength Measurement
- ❑ Occupied Bandwidth
- ❑ Channel Power
- ❑ ACPR (Adjacent Channel Power Ratio)
- ❑ Interference Analysis

#### **Selecting the Signal Standard and Channel**

Before making measurements, the Cell Master must be set to the appropriate wireless network air interface standard and channel number. The most common standards and channel numbers are stored in the Cell Master and, when selected, the Cell Master automatically selects the correct frequency and span. The frequency and span can also be manually entered if necessary.

The following procedure sets the signal standard and channel number automatically by selecting from the standards stored in the Cell Master:

#### **Procedure**

- Step 1.** On the Cell Master, press the **MODE** key.
- Step 2.** Use the Up/Down arrow key to select the Spectrum Analyzer mode and press **ENTER**.
- Step 3.** Select the Signal Standard softkey, use the Up/Down arrow key to select a signal standard, and press **ENTER**.
- Step 4.** Select the Select Channel softkey and use the Up/Down arrow key or the numeric keypad to enter a valid channel number. Press **ENTER** to accept the value, or **ESCAPE** to restore the previous value.

The currently selected Center Frequency, Span, Signal Standard, and Channel are displayed at the bottom of the status window.

## Field Strength Measurements

All antennas have loss or gain that can cause errors in measurements. The Cell Master can correct for antenna loss or gain errors using Field Strength Measurements. The antenna factors must be uploaded to the Cell Master using the Anritsu Handheld Software Tools provided with the unit.

- Step 1.** Enter the antenna factor information for the specific antenna into the antenna editor of the Software Tools (see page 9-7).
- Step 2.** On the Cell Master, press the **MODE** key.
- Step 3.** Use the Up/Down arrow key to select the Spectrum Analyzer mode and press **ENTER**.
- Step 4.** Select the measurement frequency by using Center and Span softkeys or Start and Stop keys or Signal Standard and Select Channel keys
- Step 5.** Upload the antenna factors to the Cell Master.
- Step 6.** Press the **MEAS/DISP** key and select the Measure soft key.
- Step 7.** Select the Field Strength soft key from the measurement menu.
- Step 8.** Press the Select Antenna soft key and use the Up/Down arrow key to select the desired antenna factor file. Press the **ENTER** key to select.

The Cell Master will now automatically adjust the measurement results based on the antenna factors entered. Field Strength: appears to the left of the status window and indicates that the measurement is enabled. The measurement status also appears in the lower status window along with the name of the selected antenna.

Figure 5-1 shows the results of a measurement.

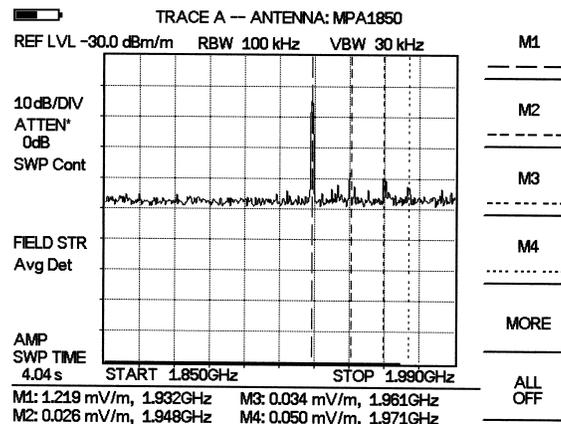


Figure 5-1. Field Strength Measurements

## 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 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

- Cell Master MT8212A
- Portable antenna for the selected signal frequency

### Procedure

- Step 1.** Connect the antenna to the Spectrum Analyzer connector.
- Step 2.** On the Cell Master, press the **MODE** key, use the Up/Down arrow key to select the Spectrum Analyzer mode and press **ENTER**.
- Step 3.** Press the **FREQ/DIST** key, select the frequency for the measurement by using Center and Span softkeys, the Start and Stop soft keys or the Signal Standard and Select Channel soft keys.
- Step 4.** Press the **AMPLITUDE** key and select the Ref Level soft key to set the appropriate reference level.
- Step 5.** Select the Atten/Preamp soft key to set the input attenuation level.
- Step 6.** Select the Preamp Control Manual soft key to activate the preamplifier menu, then press Preamp On/Off to activate the preamplifier and press **ENTER**. The default preamplifier mode is auto.
- Step 7.** Press the **MEAS/DISP** key and select the Bandwidth soft key to set the resolution bandwidth and video bandwidth.
- Step 8.** Press the Measure soft 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 status window.
- Step 9.** Press the dBc or % soft keys to adjust the settings as appropriate.
- Step 10.** Press the Measure soft key to initiate the measurement.

Figure 5-2 shows the occupied bandwidth results using the % of power method of a CDMA signal.

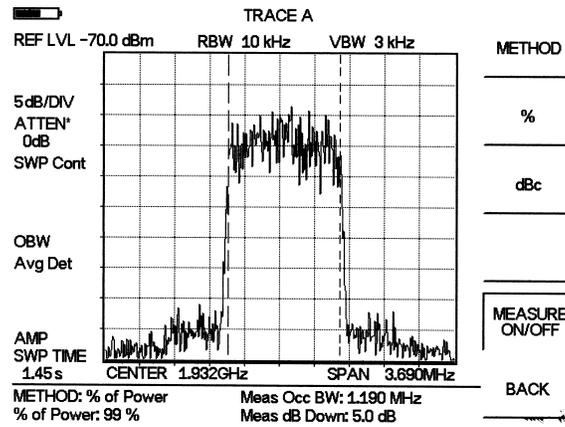


Figure 5-2. Occupied Bandwidth

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

Markers M1 and M2 indicate the occupied band on the graph. The measurement results appear beneath the graph. As the data changes, press the Measure softkey again to update the results.

## 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 or local regulations
- Keep overall system interference at a minimum

### Required Equipment

- Cell Master MT8212A
- Portable antenna for the selected signal frequency

### Procedure

- Step 1.** On the Cell Master, press the **MODE** key, use the Up/Down arrow key to select the Spectrum Analyzer mode and press **ENTER**.
- Step 2.** Press the Signal Standard soft key, select the appropriate network standard, and press **ENTER**.
- Step 3.** Press the Select Channel soft key, enter a value and press **ENTER**.
- Step 4.** Press the **AMPLITUDE** key and select the Ref Level soft key to set the reference level.
- Step 5.** Press the Scale soft key and set the scale to 10 dB/division.
- Step 6.** Press the Atten/Preamp soft key followed by the MANUAL soft key and set the attenuation to an appropriate attenuation setting.
- Step 7.** Press the **MEAS/DISP** key, select the Bandwidth soft key and set the resolution bandwidth and the video bandwidth to Auto.
- Step 8.** Press the Back soft key to return to the previous menu.
- Step 9.** Press the Trace soft key and the Max Hold soft key to set max hold to ON as indicated in the lower section of the status window.
- Step 10.** Press the Back soft key to return to the previous menu.
- Step 11.** Press the Measure soft key and press the Channel Power soft key.
- Step 12.** Select the Int BW soft key and enter the integration bandwidth frequency appropriate for the particular application and press **ENTER**.
- Step 13.** Select the Channel Span soft key and set the channel span to a value appropriate for the particular application and press **ENTER**.
- Step 14.** Make the measurement by pressing the Measure soft key. The detection method is automatically changed to Average. The Cell Master will display the measurement results.

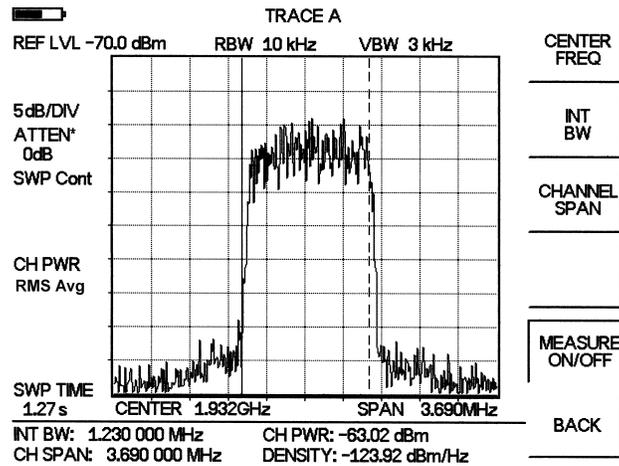


Figure 5-3. Channel Power Measurement

When the channel power measurement is on, a CH PWR icon appears to the left of the status window. 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, the Cell Master will set the channel span equal to the integration span. When the integration bandwidth and channel span are set to the same value, the Cell Master 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 Cell Master 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 Cell Master requires the specification of four parameters:

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

### Required Equipment

- Cell Master MT8212A
- Portable antenna for the selected signal frequency

### Procedure

- Step 1.** On the Cell Master, press the **MODE** key, use the Up/Down arrow key to select the Spectrum Analyzer mode and press **ENTER**.
- Step 2.** Press the Signal Standard soft key, select the appropriate network standard, and press **ENTER**.
- Step 3.** Press the Select Channel soft key, enter a value and press **ENTER**.
- Step 4.** Press the **AMPLITUDE** key and select the Ref Level soft key to set the reference level to an appropriate value.
- Step 5.** Press the Atten/Preamp soft key and set the attenuation to Auto.
- Step 6.** Press the **MEAS/DISP** key and select the Bandwidth soft key to set the resolution bandwidth and the video bandwidth to Auto.
- Step 7.** Press the Back soft key to return to the previous menu.
- Step 8.** Press the Trace soft key and the Max Hold soft key to set max hold to On as indicated in the lower section of the status window.
- Step 9.** Press the Measure soft key and press the ACPR soft key.
- Step 10.** Select the Center Freq soft key, and enter the center frequency.
- Step 11.** Select the Main Channel BW soft key, and enter the main channel bandwidth.
- Step 12.** Select the Adj Channel BW soft key, and enter the adjacent channel bandwidth.
- Step 13.** Select the Channel Spacing soft key, and enter the channel spacing.
- Step 14.** Make the measurement by pressing the Measure soft key. The detection method is automatically changed to Average. Solid vertical lines are drawn in the status window to indicate the main channel. Dashed vertical lines define the adjacent channels. The Cell Master will display the measurement results.

Figure 5-4 shows the results of the measurement.

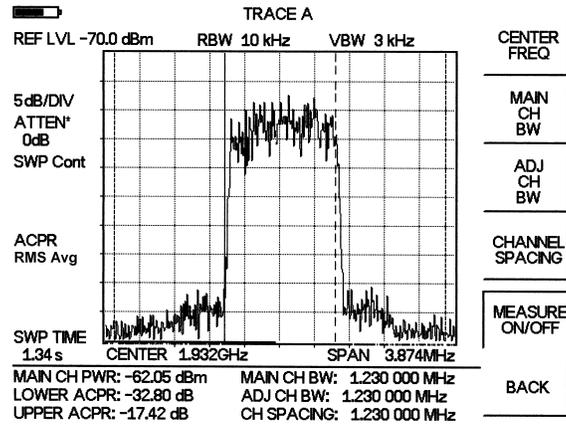


Figure 5-4. Adjacent Channel Power Measurement

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

## Interference Analysis

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

### Procedure

- Step 1.** On the Cell Master, press the **MODE** key, use the Up/Down arrow key to select the Spectrum Analyzer mode and press **ENTER**.
- Step 2.** Press the **MEAS/DISP** key and select the Measure soft key.
- Step 3.** Press Int.Analysis soft key.
- Step 4.** Press the Set IA Freq soft key, enter the appropriate frequency to analyze the interfering signal, and press **ENTER**.
- Step 5.** Press the Measure soft key to start the measurement. A message box on the screen states that the analysis is in process, then, when the measurement is complete, displays the Cell Standard and estimated bandwidth of the interfering signal.

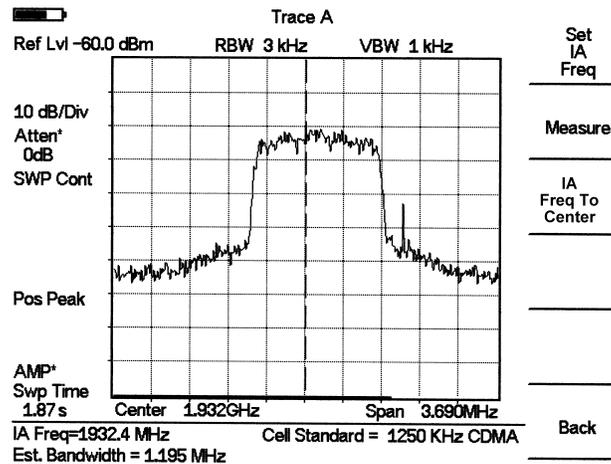


Figure 5-5. Interference Analysis

# Chapter 6

## Power Measurement

### Introduction

The Cell Master can make power measurements based on the spectrum analyzer measurements, and can display the measured power in dBm or Watts.

### Power Measurement

#### Required Equipment

The following equipment is required to make a power measurement with the Cell Master.

- ❑ Cell Master Model MT8212A
- ❑ Test Port Extension Cable, Anritsu 15NNF50 – 1.5C

#### Procedure

The following procedure details making a power measurement with the Cell Master.

- Step 1.** Press the **ON/OFF** key on the Cell Master.
- Step 2.** Press the **MODE** key.
- Step 3.** Use the Up/Down arrow key to select the Power Meter mode and press **ENTER**.
- Step 4.** Press the Center soft key to set the power meter to the desired center frequency. A center frequency from 10 MHz to 3000 MHz can be entered.  
*or*  
Press the Signal Standard soft key and choose the appropriate signal standard for the network, and press the Select Channel soft key and choose the appropriate channel for the selected standard.
- Step 5.** Press Span to activate a menu of span related choices:
  - Edit — Allows editing of the span to enter specific frequency.
  - Full — Sets the power meter to its maximum frequency span.
  - Min — Sets the power meter span to minimum.
  - Span Up 1-2-5 — Activates the span function so that the span may be increased quickly in a 1-2-5 sequence.
  - Span Down 1-2-5 — Activates the span function so that the span may be reduced quickly in a 1-2-5 sequence.
  - Back — Returns to the previous menu level.
- Step 6.** Press the **MEAS/DISP** key to activate the RMS Averaging menu. The RMS average is calculated by taking the log of the average power, and the power is calculated from voltage. The number of points to average can be set to low, medium or high.

### **Changing the Display Units**

The power reading can be displayed in dBm or Watts.

- Step 1.** Press the **AMPLITUDE** key.
- Step 2.** Press the Units soft key to toggle the display between Watts and dBm.
- Step 3.** Press the **FREQ/DIST** key to return to the Power Meter menu.

### **Displaying Relative Power**

Relative power can be selected through the **AMPLITUDE** menu.

- Step 1.** With the desired base power level input to the Cell Master, press the **AMPLITUDE** key, then the Rel soft key. The message Relative: On will show in the lower left of the status window.
- Step 2.** Pressing the UNITS soft key will toggle the display between dB and %. With Relative: On, the power reading will be in dB<sub>r</sub>, relative to the base power level.
- Step 3.** Choose Offset or Zero depending upon the measurement (see Chapter 2).

# Chapter 7

## T1 Measurements

### Introduction

This chapter provides a brief description of T1 and T1 measurements, and also explains how to setup and measure T1 performance using the Anritsu Cell Master.

### T1 Fundamentals

Wireless service providers use wired T1 circuits as the backhaul links to connect a Base Transceiver Station (BTS) to a Mobile Switching Center (MSC). The quality of the service provided over those T1 lines has a direct effect on the quality of service experienced by the wireless service provider customers. Call setup failures, dropped calls, data errors and noise can often be attributed to the T1 backhaul facilities. An example of a typical wireless network backhaul T1 link is shown in the Figure 7-1.

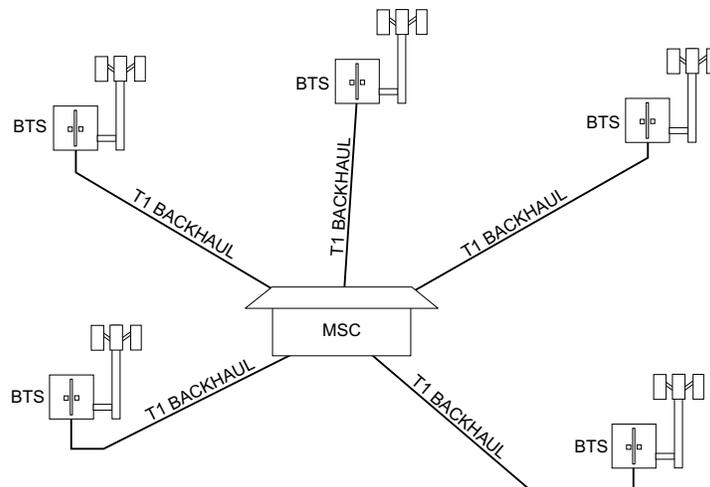


Figure 7-1. Typical Wireless Network T1 Backhaul Link

In the United States, wireless service providers generally lease T1 lines from a Local Exchange Carrier (LEC), so it often requires a joint effort to analyze and troubleshoot a T1 line.

T1 is an American National Standard Institute (ANSI) standard, used mostly in North America, parts of Japan and some Asian countries. Technically, a T1 line is a digital transmission facility consisting of wire pairs and regenerators, or optical media, carrying a DS1 signal. T1 refers to the physical properties of the line, for example, 1.544 MHz with a specific pulse shape, etc. DS1 refers to the digital signal carrying the information at a rate of 1.544 Mb/s. The DS1 signal may be formatted using various framing patterns, most commonly (but not always) divided into 24 channels each carrying encoded voice or data.

## Network Equipment

One possible network topology is shown in Figure 7-2.

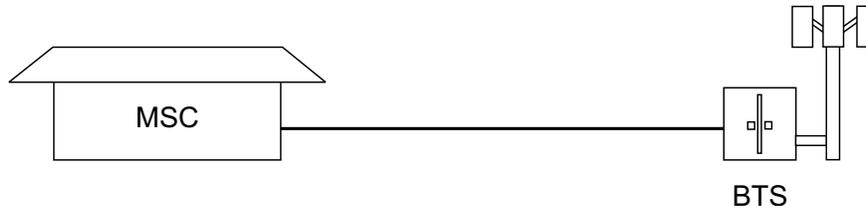


Figure 7-2. One Possible T1 Network Topology

The circuit between the MSC and BTS passes through the LEC central office, and in fact may pass through multiple central offices. Within each office, it will in turn pass through multiple pieces of transmission equipment. The Network Interface Unit (NIU) at the MSC and the BTS may be a very simple device having only a remote loop back capability, or it may provide very sophisticated performance monitoring capabilities. Its capabilities may or may not be accessible to the wireless service provider technician. Some repeaters may exist in the circuit when the signal is traveling long distances. Repeaters are full duplex devices that regenerate or restore the pulse shape and amplitude.

Another possible configuration between BTS and MSC is shown in Figure 7-3.

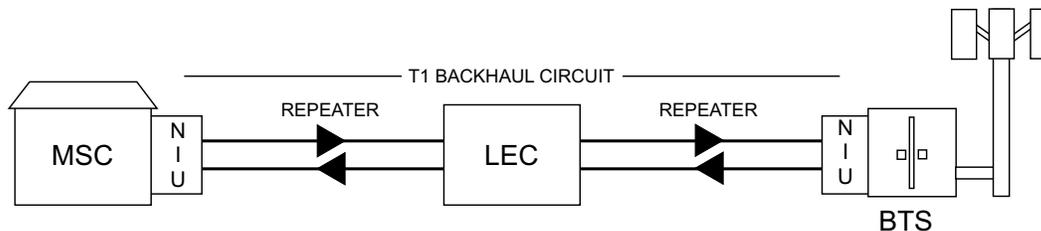


Figure 7-3. BTS and MSC Configuration

This configuration uses a High-speed Digital Subscriber Line (HDSL) in the T1 circuit, which enables full duplex T1 service over a single pair of wires without repeaters. In most cases the wireless service provider technician may not be concerned with the repeaters or HDSL.

## Testing T1 Circuits

T1 circuit testing can be done with either of two methods: In service and Out of service testing.

In service testing is done during routine maintenance and troubleshooting phase. This can be done without removing the T1 circuit from service or done on live data. Monitoring live data allows wireless service provider technicians to detect alarms, bipolar violations (BPV) and frame errors but bit errors cannot be measured. However they may be estimated by measuring CRC errors or frame errors.

Out of Service testing is done when T1 is initially installed and before final acceptance from the LEC. At that time the circuit should be subjected to critical testing to guarantee the level of service per contract. Out of service testing may also be performed when the circuit performance is very poor. For Out of service testing T1 should be removed from service which allows detailed performance testing of the T1 circuit.

### In Service Testing

In service testing can only be done when the equipment has a test port. When testing a T1 circuit in service it is always better to perform a bridged or monitoring test, to avoid disrupting service. Even when the T1 circuit is down these tests will help to verify and identify the correct fault circuit. The following measurements can be used to check the T1 performance during regular maintenance:

- $V_{pp}$  Measurement
- Carrier
- Frame Sync
- CRC Errors, for Extended Super Frame (ESF)

#### Required Equipment

- Cell Master MT8212A
- Bantam Cables, Anritsu Part Number 806-16 (2)

#### Vpp Measurement Procedure

- Step 1.** Press the **MODE** key, select T1 Tester, and press **ENTER**.
- Step 2.** Select the Vpp softkey.
- Step 3.** Press the Terminate/Bridged soft key and select Bridged mode.
- Step 4.** Press the Start/Stop Measure soft key to start or stop the peak to peak voltage measurement.

If the measurement meets the customer requirements for this system, proceed to the BERT measurement.

#### BERT Measurement Setup

- Step 1.** Press the **MODE** key, select T1 Tester, and press **ENTER**.
- Step 2.** Select the BERT softkey and the press the Setup BERT softkey.

- Step 3.** Press the Framing Mode soft key and choose the Auto, D4 SF or ESF framing type. Press Back to return to the previous menu.
- Step 4.** Press the Receive Input soft key and select Bridged mode. Press Back to return to the previous menu.
- Step 5.** Press the Line Coding soft key and select B8ZS or AMI coding. Press Back to return to the previous menu.
- Step 6.** Select the More soft key to access more menu selections.
- Step 7.** Press the Clock Source soft key and select External to synchronize to the transmitting equipment. Press Back to return to the previous menu.
- Step 8.** Press the ANSI CRC/Japan CRC soft key and choose the appropriate CRC error scheme soft key. Press Back to return to the previous menu.

Figure 7-4 illustrates some of the key information of the T1 setup measurement display.

T1 Tester Setup Keys		
Measurement Stopped		
Frame Bits		Framing Mode
Bit Errors		Receive Input
BER		Pattern
BPV		Line Coding
CRC		More
Errored Seconds		Back
Msr Dur: Manual		
Framing = ESF ANSI CRC	Tx Level = 0 dB	
Rx Config = Bridged	Clock Source = External	
Pattern = QRSS	Error Ins = 1 Bits	
Line Code = B8ZS	Loop Code = CSU In Band	

Figure 7-4. T1 Setup Measurement Display

**BERT Measurement**

- Step 1.** Press the **MEAS/DISP** key, select BERT and then the Measure BERT softkey.
- Step 2.** Press the Measure Duration soft key and use the Up/Down arrow key to select the duration of the measurement, and press **ENTER**.

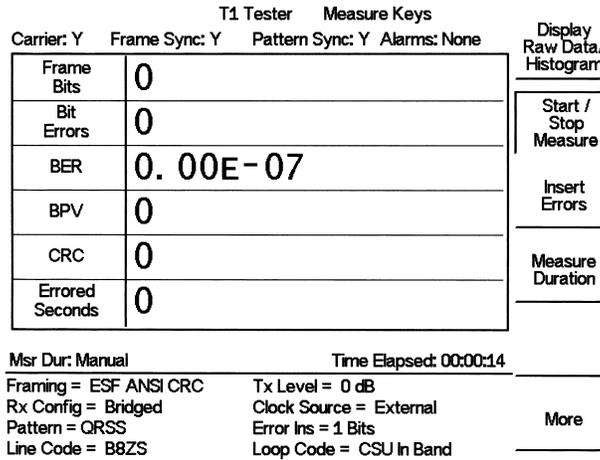


Figure 7-5. T1 BERT Measurement Display

- Step 3.** To display the measurement data in a histogram format, press the Display Raw Data/Histogram soft key.
- Step 4.** Press the Time Scale soft key and use the Up/Down arrow key to select the duration of the measurement, and press **ENTER**.
- Step 5.** Press the Start/Stop Measure soft key to begin the measurement.

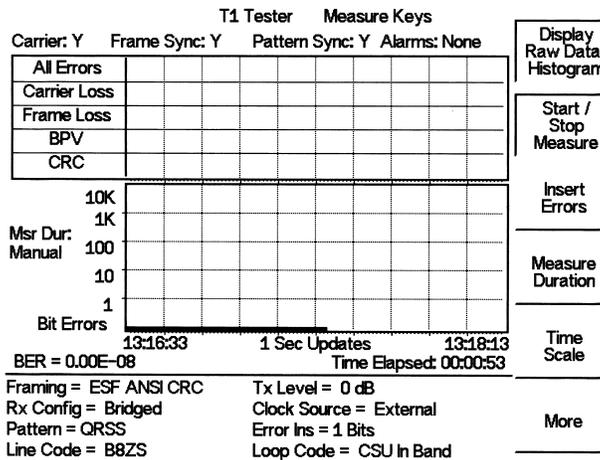


Figure 7-6. T1 BERT Measurement Display with Histogram

## Out-Of-Service Testing

Out-of-service measurements are performed when the T1 circuit is not in service or inactive. Typically these tests are done during initial installation, during circuit acceptance by the wireless service provider or when the results of the in-service measurements indicate errors. These measurements provide detailed information on the T1 circuit.

There are two methods of performing out-of-service testing: end-to-end and loopback testing. End-to-end testing requires a technician and a unit at each end of the circuit. Loopback testing requires a loopback at one end of the circuit and a unit and technician at the other end to measure the round trip of the T1 performance.

The ANSI T1 standard defines in-band and out of band loopcodes. In band codes are transmitted in place of payload data and are repeated continuously for a period of five seconds. They can be used either with D4 SF or ESF. Out of band loopcodes can only be used with the ESF framing format as an out of band communication link does not exist for D4 SF.

The following measurements can be used to check T1 performance during out of service testing:

- V<sub>pp</sub>
- Frame
- Sync
- Carrier
- Insert Errors/Alarms
- Remote/Self Loop Codes

### Required Equipment

- MT8212A Cell Master
- Bantam Cables, Anritsu Part Number 806-16 (2)

### V<sub>pp</sub> Measurement Procedure

- Step 1.** Press the **MODE** key, select T1 Tester, and press **ENTER**.
- Step 2.** Select the V<sub>pp</sub> softkey.
- Step 3.** Press the Terminate/Bridged soft key and select Terminate mode.
- Step 4.** Press the Start/Stop Measure soft key to start or stop the peak to peak voltage measurement.

### BERT Setup Procedure

- Step 1.** Press the **MODE** key, select T1 Tester, and press **ENTER**.
- Step 2.** Select the BERT softkey and the press the Setup BERT softkey.
- Step 3.** Press the Framing Mode soft key and choose the Auto, D4 SF or ESF framing type. Press Back to return to the previous menu.
- Step 4.** Press the Receive Input soft key and select Terminate. Press Back to return to the previous menu.
- Step 5.** Press the Pattern soft key, select the appropriate pattern for this test, and press **ENTER**.

- Step 6.** Press the Line Coding soft key and select either the B8ZS or AMI soft key, as appropriate. Press Back to return to the previous menu.
- Step 7.** Press the Transmit Level soft key and select either the 0 dB, -7.5 dB or -15 dB transmitter signal level soft key as appropriate for this measurement. Press Back to return to the previous menu.
- Step 8.** Select the More soft key to access more menu selections.
- Step 9.** Press the Clock Source soft key and select External for an external clock source or Internal to use the internal clock. Press Back to return to the previous menu.
- Step 10.** Press the Setup Error Insert soft key and set the appropriate error or alarm type by selecting the Bit, BPV, Framing Bits, RAI or AIS soft key. Press Back to return to the previous menu.
- Step 11.** Press the Loop Code soft key and select the appropriate loop code by selecting the CSU, NIU, User defined or In-Band/Data Link soft key. Press Back to return to the previous menu.
- Step 12.** Press the ANSI CRC/Japan CRC soft key and choose the appropriate CRC error scheme soft key. Press Back to return to the previous menu.

Figure 7-7 illustrates some of the key information of the T1 measurement setup.

T1 Tester		Setup Keys		
Measurement Stopped				Framing Mode
All Errors				Receive Input
Carrier Loss				
Frame Loss				
BPV				
CRC				Pattern
10K				Line Coding
1K				
Msr Dur: 100				
3 Min 10				
1				
Bit Errors				More
1 Sec Updates				Back
Framing = ESF ANSI CRC	Tx Level = 0 dB			
Rx Config = Terminate	Clock Source = External			
Pattern = QRSS	Error Ins = 50 Frame Bits			
Line Code = B8ZS	Loop Code = CSU In Band			

Figure 7-7. T1 Out-of-Service Measurement



**Activating Loopback Code**

- Step 1.** Press the More soft key to activate the Loopback menu.
- Step 2.** Press the Self Loop Up or the Remote Loop Up soft key depending on the location to activate the loopback code.
- Step 3.** Press the Self Loop Down or Remote Loop Down soft key to stop the loopback code.

# Chapter 8

## E1 Measurements

### Introduction

This chapter provides a brief description of E1 and E1 measurements, and also explains how to setup and measure E1 performance using the Anritsu Cell Master.

### E1 Fundamentals

Wireless service providers use wired E1 circuits as the backhaul links to connect a Base Transceiver Station (BTS) to a Mobile Switching Center (MSC). The quality of the service provided over those E1 lines has a direct effect on the quality of service experienced by the wireless service provider customers. Call setup failures, dropped calls, data errors and noise can often be attributed to the E1 backhaul facilities. An example of a typical wireless network backhaul E1 link is shown in the Figure 8-1.

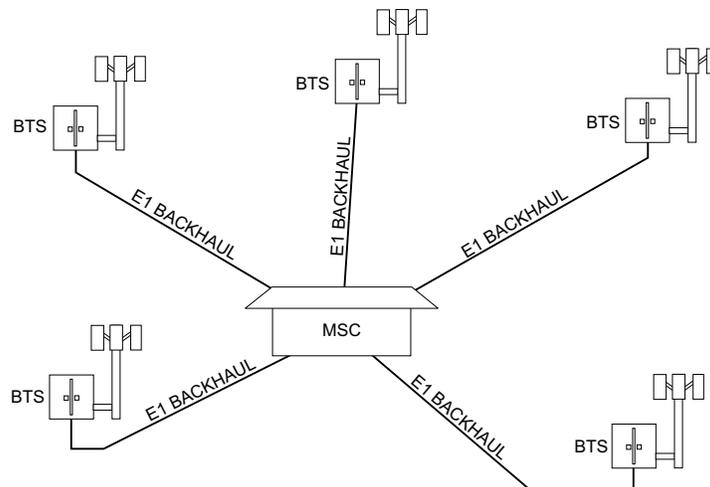


Figure 8-1. Typical Wireless Network Backhaul E1 Link

E1 is an International Telecommunication Union, Telecommunication Standardization Sector standard for E1 and is widely used in Europe and Asian countries. E1 is a digital signal carrying the information at a rate of 2 Mbps, with each 2 Mbps frame containing 256 bits in 32 time slots. Each slot has 8 bits at a repetition rate of exactly 8 kHz. The first time slot is reserved for framing, error checking and alarm signals.

ITU-T G.704 specifies a CRC-4 cyclic redundancy check for E1 performance. CRC-4 framing provides monitoring for a Bit Error Rate (BER) during normal operation. When the equipment detects an incoming CRC-4 error, it transmits an E-bit error which is received by the measuring equipment. Counting E-bit changes is equivalent to counting CRC errors, which provides BER information for the data.

## Network Equipment

One possible network topology is shown in Figure 8-2.

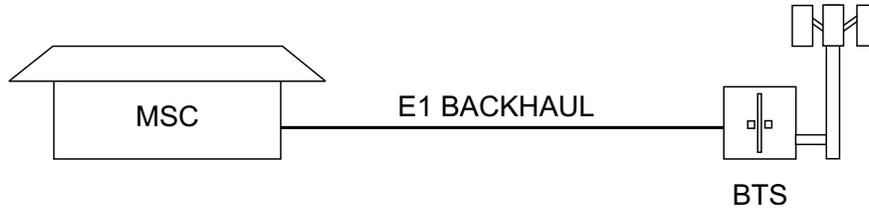


Figure 8-2. One Possible E1 Network Topology

The circuit between the MSC and BTS passes through the central office, or through multiple central offices. Within each office it may in turn pass through multiple pieces of transmission equipment. An interface Unit is located at the MSC and the BTS. The interface unit may be a very simple device having only a remote loop back capability, or it may provide very sophisticated performance monitoring capabilities. Its capabilities may or may not be accessible to the wireless service provider technician.

## Testing E1 Circuits

E1 circuit testing can be done with either of two methods: In Service and Out of Service testing.

In Service testing is done during a routine maintenance and troubleshooting phase. This can be accomplished without removing the E1 circuit from service on live data. Monitoring live data allows the wireless service provider technician to detect alarms, bipolar violations (BPV) and frame errors, but bit errors cannot be measured. However, bit errors may be estimated by measuring CRC errors and E-bit errors.

Out of Service testing is done when the E1 is initially installed and before final acceptance from the service provider. At that time the circuit should be subjected to critical testing to guarantee the level of service per contract. Out of service testing may also be performed when the circuit performance is very poor. For Out of service testing, the E1 circuit should be removed from service to allow detailed performance testing.

### In Service Testing

The Bridged mode must be used when testing a E1 circuit in service to avoid disrupting service. Even when the E1 circuit is down, these tests will help to verify and identify the correct fault circuit. E-bits and CRC are very useful for in service testing to monitor E1 performance. When the equipment detects an incoming CRC-4 error, it will transmit an E-bit error toward the equipment at other end which will be seen by the test unit. E-bits determine the trouble location of the circuit. Without E-bits, the entire circuit will be determined as failure by loss of signal or alarm indication, so E-bits are critical to analyze the performance of the circuit and point to the trouble locations.

The following measurements are used to check the E1 performance during regular maintenance:

- Vpp measurement
- Carrier
- Frame Sync
- CRC errors and E-bits

#### Required Equipment

- MT8212A Cell Master
- Bantam Cables, Anritsu Part Number 806-16 (2)

#### Vpp Measurement Procedure

- Step 1.** Press the **MODE** key, select E1 Tester, and press **ENTER**.
- Step 2.** Select the Vpp softkey.
- Step 3.** Press the Terminate/Bridged soft key and select Bridged mode, as indicated on the bottom left of the status window.
- Step 4.** Press the 75  $\Omega$  or 120  $\Omega$  soft key, depending on the requirements for the system impedance value. The selection will be indicated at the bottom left of the status window.

**Step 5.** Press the Start/Stop Measure soft key to start or stop the peak to peak voltage measurement.

**BERT Measurement Setup**

- Step 6.** Press the **MODE** key, select E1 Tester, and press **ENTER**.
- Step 7.** Select the BERT softkey.
- Step 8.** Select the Setup BERT softkey.
- Step 9.** Press the Framing Mode soft key and choose Auto, PCM30, PCM30CRC, PCM31 or PCM31CRC framing type. Press Back to return to the previous menu.
- Step 10.** Press the Receive Input soft key and select Bridged mode. Press Back to return to the previous menu.
- Step 11.** Press the Line Coding soft key and select HDB3 or AMI coding. Press Back to return to the previous menu.
- Step 12.** Select the More soft key to access more menu selections.
- Step 13.** Press the Clock Source soft key and select External clock. Press Back to return to the previous menu.
- Step 14.** Press the Impedance soft key and choose 75Ω or 120Ω. Press Back to return to the previous menu.

Figure 8-3 illustrates some of the key information of the E1 setup measurement display.

E1 Tester Setup Keys			
Measurement Stopped			
Frame Bits			Framing Mode
Bit Errors			Receive Input
BER			Pattern
BPV			Line Coding
CRC		E Bits	
Errored Seconds			More
Msr Dur: Manual			
Framing = PCM31 CRC		Impedance = 120 Ω	
Rx Config = Bridged		Clock Source = External	
Pattern = QRSS		Error Ins = 1 Bits	
Line Code = HDB3			
Back			

Figure 8-3. E1 BERT Setup Measurement Display



## Out-Of-Service Testing

Out-of-service measurements are performed when the E1 circuit is not in service or inactive. Typically these tests are done during initial installation, during circuit acceptance by the wireless service provider or when the performance of the in service measurements indicates extensive errors. These measurements provide detailed information about the E1 circuit.

Out-of-service testing is performed using end-to-end testing, which requires a technician and a unit at each end of the circuit.

The following measurements are used to check the T1 performance during out of service testing:

- Vpp
- Frame
- Sync
- Carrier
- CRC Errors
- E-Bits
- Insert Errors/Alarms
- Self Loop Code

### Required Equipment

- MT8212A Cell Master
- Bantam Cables, Anritsu Part Number 806-16 (2)

### Procedure

- Step 1.** Press the **MODE** key, select E1 Tester, and press **ENTER**.
- Step 2.** Select the BERT softkey.
- Step 3.** Select the Setup BERT softkey.
- Step 4.** Press the Framing Mode soft key and choose Auto, PCM30, PCM30CRC, PCM31 or PCM31CRC framing type. Press Back to return to the previous menu.
- Step 5.** Press the Receive Input soft key and select Terminate. Press Back to return to the previous menu.
- Step 6.** Press the Pattern soft key and use the Up/Down arrow key to select the appropriate pattern for the test.
- Step 7.** Press the Line Coding soft key and select HDB3 or AMI coding. Press Back to return to the previous menu.
- Step 8.** Press the Impedance soft key and choose 75Ω or 120Ω. Press Back to return to the previous menu.
- Step 9.** Select the More soft key to access more menu selections.
- Step 10.** Press the Clock Source soft key and select External clock. Press Back to return to the previous menu.

**Step 11.** Press the Setup Error Insert soft key and select Bit, BPV, Framing Bits, RAI or AIS as appropriate for the measurement.

Figure 8-6 illustrates some of the key information of the E1 measurement Setup.

E1 Tester Setup Keys			Measurement Stopped	
Frame Bits			Framing Mode	
Bit Errors			Receive Input	
BER			Pattern	
BPV			Line Coding	
CRC	E	Bits	More	
Errored Seconds			Back	
Msr Dur: Manual				
Framing = PCM31 CRC		Impedance = 120 Ω		
Rx Config = Terminate		Clock Source = External		
Pattern = QRSS		Error Ins = 1 Bits		
Line Code = HDB3				

Figure 8-6. Key Information of the E1 Measurement Setup

### BERT Measurement

- Step 1.** Press the **MEAS/DISP** key, select BERT and then the Measure BERT softkey.
- Step 2.** Press the Measure Duration soft key and use the Up/Down arrow key to select the duration of the measurement, and press **ENTER**.

E1 -- 3			Carrier: Y Frame Sync: Y Pattern Sync: Y Alarms: None	
Frame Bits	0		BERT	
Bit Errors	2		Vpp	
BER	3.64E-08			
BPV	0			
CRC	2	E Bits	0	
Errored Seconds	2			
Msr Dur: Manual			Time Elapsed: 00:00:28	
Framing = PCM31 CRC		Impedance = 120 Ω		
Rx Config = Terminate		Clock Source = External		
Pattern = QRSS		Error Ins = 1 BPV		
Line Code = HDB3				

Figure 8-7. E1 Measurement Display

- Step 3.** To display the measurement data in a histogram format, press the Display Raw Data/Histogram soft key.
- Step 4.** Press the Time Scale soft key and use the Up/Down arrow key to select the duration of the measurement, and press **ENTER**.
- Step 5.** Press the Start/Stop Measure soft key to begin the measurement.

**To Insert Setup Errors**

Press the Insert Errors soft key to inject errors in the transmit signal while performing the is E1 measurements.

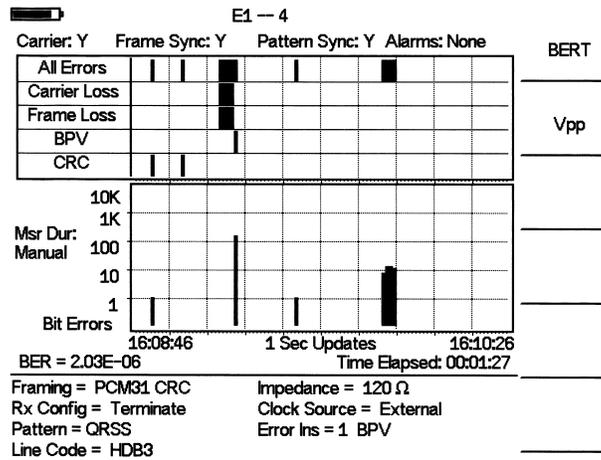


Figure 8-8. E1 Measurement Display with Errors Inserted

# Chapter 9

## Handheld Software Tools

### Introduction

This chapter provides a description of the Anritsu Handheld Software Tools program. Handheld Software Tools is a Windows 95/98/NT4/2000/ME/XP program for transferring measured traces, along with markers and limit lines, to the PC display. The program help function provides on screen instructions on display modification, trace overlay, uploading and downloading traces, and multiple plot printing.

### Features

Handheld Software Tools provides the following features:

- Download traces saved in the instrument memory to the PC for storage and analysis
- Upload traces from the PC to the instrument memory
- Trace Overlay allows the viewing of three plots simultaneously
- Ability to save captured plots as data files (.dat file format) or as records representing site information in a database file
- Ability to export plot data as text files for use in a spreadsheet (.txt file format)
- Ability to save captured plots as graphic files (.wmf file format)
- Ability to 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 Handheld Software Tools program will run on most any computer running Windows 95/98/NT4/2000/ME/XP. Minimum requirements and recommendations are:

- Intel Pentium 100 MHz microprocessor (Pentium II 350 MHz or better recommended)
- 16 MB of RAM (64 MB or above recommended)
- Hard disk drive with approximately 15 MB of available space (An additional 20 MB free space for storage of captured plots is recommended.)
- A serial (COM) port or a USB port and USB 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 Handheld Software Tools program:

- Step 1.** Insert the Anritsu Handheld Software Tools disk in the CDROM drive.
- Step 2.** From the Windows Start menu, select **Run**.
- Step 3.** Type: **X:\Setup.exe** where X is the drive letter of your CDROM drive.
- Step 4.** When prompted, press the **Enter** key to accept the default directory C:\Program Files\ Software Tools and the installation will begin.

The *readme.doc* file on the disk provides updated information about the program, and the Help function provides detailed operating information.

## Communication Port Setting

The Handheld Software Tools communicates with the instrument through a standard serial COM port on the PC. Set the baud rate of the COM port to 115200.

- 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**. (For the optional USB Adapter Cable (551-1691) set the COM port to COM 4, and the baud rate to 38400.)

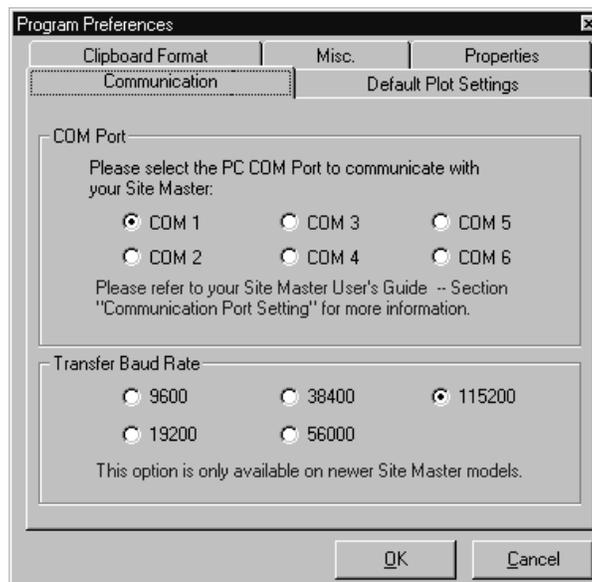


Figure 9-1. Communication Setting Dialog Box

## 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 RS232 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.

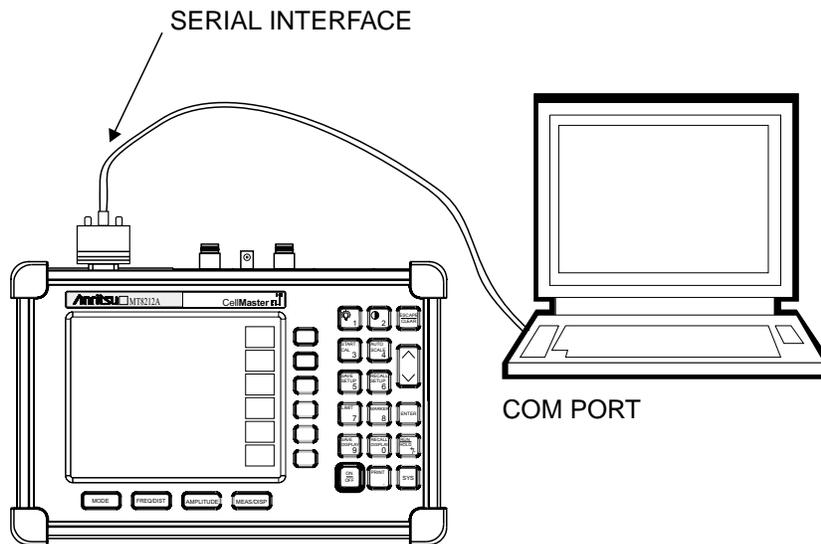


Figure 9-2. Serial Cable Connection

## Using Handheld 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 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
SWR	

*NOTE: Not all selections apply to every Anritsu Handheld instrument.*

## Plot Capture to the PC

To open the plot capture menus, select the capture icon on the button bar, or select the **Capture** drop down menu from the menu bar.

Select **Capture to Screen** to download traces to the PC.

Select a folder, or individual traces within a folder, to be downloaded to the PC. The traces will appear on the PC display as they are downloaded.

When 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/yyyy                                       |   |
| dd/mm/yyyy                                       |   |
| yyyy/mm/dd                                       |   |

*NOTE: While all possible selections are displayed, some of these selections apply only to specific models of Anritsu hand held instruments.*

## Trace Overlay or Plot Overlay

Trace Overlay is activated by the Mouse Function icon. Single-click on the Mouse Function icon to toggle. Toggling this icon switches the mouse function between Marker/Limit/Zoom and Plot Overlaying.

To overlay two plots, click-and-drag from one plot to the other plot. The final display will be the two plots superimposed on one another.

Refer to the Handheld Software Tools **HELP** function for more information on the steps necessary to perform a trace overlay.

## **Saving Traces**

Once the plots are captured to the PC they can be saved as individual files or as a block of files to a database.

### **Saving a Plot as a Windows Metafile or to a Spreadsheet**

Plots can be saved as a Windows metafile (.wmf), a Handheld Software Tools .dat file, a text file (.txt) or an .mdb database. The metafile may be imported into graphic programs and the text file can be imported into a spreadsheet. The .dat and .mdb files are used exclusively by Handheld 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 be copied to the clipboard, or select **File** and then **Export** to a Windows metafile.
- Step 3.** Open the target application (Microsoft Word, etc.).
- Step 4.** Select **Edit** and then **Paste**. The file will be inserted as a graphic file or a bitmap.

### **Saving a Plot to a Spreadsheet**

Plots can be saved as a text file (.txt) which can then be imported into a spreadsheet program.

To save a plot as a text file:

- Step 1.** Select the trace to be copied with the mouse cursor.
- Step 2.** Click on the **File** menu and select **Export to Text File for a Spreadsheet** from the pull down menu.
- Step 3.** Save the file to a local directory.
- Step 4.** Exit the Handheld Software Tools program and open the spreadsheet application.
- Step 5.** Import the .txt file into the spreadsheet program.

## Creating a Database

A single trace or a block of traces can be transferred from the instrument to the PC. A separate database can be created for each cellular site. The site name can be used as the database name.

- Step 1.** Select the **File** menu and select the **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 Formats

One to multiple plots per page can be set up under the print format in Handheld Software Tools. Orientation of how the plots are printed on the page can be changed from vertical to horizontal.

## Entering Antenna Factors in Handheld 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:

$$AF = \frac{E}{V_1}$$

Where AF = Antenna Factor,  $m^{-1}$

E = Electric field in Volts per meter

$V_1$  = 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

Antenna 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 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 arrow keys on the keyboard to move between entries.

*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 Handheld Software Tools to the instrument:

- Step 1.** Connect the RS232 cable between the PC and the instrument.
- Step 2.** Click on the **Upload** button on the tool bar (or select **Upload** from the **Tools** menu). It is important to note that the instrument must sweep very quickly during the data transfer, at least every 5 seconds, or the Handheld Software Tools program may “time-out.” To improve the chances of a successful upload, increase the RBW and VBW settings to the maximum, or set the span to 0, temporarily.
- Step 3.** The antennas available can be viewed by pressing the **MEAS/DISP** key, then the Field Strength and SELECT ANTENNA soft keys.

## Downloading Antennas

All ten 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 minimum sweep rate of 5 seconds/sweep.
- Step 3.** Select the **Query Antenna Factors** button in the Antenna Editor.
- Step 4.** Modify the desired antenna(s), then upload again as required.

## Cable List

A custom cable list can be created in Software Tools and uploaded to the Cell Master. Some standard 1000 MHz, 2000 MHz, and 2500 MHz cables are stored in the Cell Master and are listed in Appendix A of this User's Guide.

The cable list contains vital information such as propagation velocity ( $V_p$ ) and insertion loss (dB/m or dB/ft). These parameters are important when identifying faults and discontinuities of transmission lines.

*NOTE: Values for the cable list are taken from manufacturers specifications and are normalized for a sweep frequency setting of 1 GHz. Complex digital communications systems may require adjustment to attenuation values at the higher frequencies. Contact the manufacturer for the appropriate cable losses.*

The Cable Editor is specifically designed to provide contractors, service providers, and network operators with a list of cable types that are tailored to their use.

To open the Cable Editor, select the Tools menu and select Cable Editor.

To open an existing cable list file, select File and Open. Select the desired cable list and press Enter.

## Creating a Custom Cable List

To create a custom cable list:

- Step 1.** Select the File menu and select New.
- Step 2.** Type in or cut and paste the cable types and specifications for the desired cables.

## Uploading a Cable List

After custom cable list has been created in Handheld Software Tools, it can be uploaded to the Cell Master. The serial communication null modem cable must be connected from the Cell Master to the PC.

In the Cable Editor, select Tools and Upload Cable List. The software will confirm the upload with a message "Upload Complete" when the operation is finished.

## Querying the Cell Master Cable List

Query Cable List allows the user to check and review the contents of the custom cable list in the Cell Master.

In the Cable Editor, select Tools and Query Cable List. The software will download the cable list from the Cell Master to the PC.

## DTF Plots

Handheld Software Tools can convert Return Loss in Frequency Domain (FD-RL) plots and SWR in Frequency Domain (FD-SWR) plots to DTF plots.

To convert from Frequency Domain to Distance to Fault, follow these steps:

- Step 1.** Capture a plot or load a previously saved plot.
- Step 2.** Click the Distance-to-fault button on the toolbar (or choose Distance-to-Fault from the Tools menu). A dialog will open allowing you to specify the cable parameters, start distance, and stop distance. The cable type may be selected from the pull-down list. Selecting a cable from the list automatically sets the propagation velocity and insertion loss. To manually enter the dielectric constant and insertion loss, select the Custom cable type from the top of the list. Click OK when finished. A new window will open showing the converted plot.
- Step 3.** Use the cursor to read out values shown in the bottom tray of the PC screen, at each point along the DTF trace. Maximize the plot window for best cursor resolution.

*NOTES: The distance units (meters or feet) can be changed by selecting Default Plot Settings from the Settings menu.*

*The stop distance entry must be less than or equal to the maximum unaliased range, and the start distance must be less than the stop distance.*

## Smith Chart

The Smith Chart is a commonly used graphical format for the analysis of the impedance of transmission lines. It can be a useful tool for fine tuning an antenna system.

Handheld Software Tools can convert the following types of plots to Smith Charts:

- Return Loss (Frequency Domain)
- VSWR (Frequency Domain)

To convert a plot to a Smith Chart:

- Step 1.** Capture a plot or load a previously saved Return Loss or VSWR plot.
- Step 2.** Click the Smith Chart button on the toolbar (or choose Convert to Smith Chart from the Tools menu). A new window will open showing the plot in Smith Chart form.
- Step 3.** To read values from a Smith Chart, move the mouse pointer over a data point. When the mouse pointer turns into a hand, click once with the left button. A pop-up window will appear with various measurement data.

# Appendix A

## Reference Data

### Coaxial Cable Technical Data

Table A-1 provides a standard listing of common coaxial cables along with their Relative Propagation Velocity and Nominal Attenuation values in dB/m @1000, 2000, and 2500 MHz. (N/A indicates that the specification is not applicable to the listed cable.)

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

Manufacturer	Cable Type	Relative Propagation Velocity (Vf)	Nominal Attenuation dB/m @ 1000 MHz	Nominal Attenuation dB/m @ 2000 MHz	Nominal Attenuation dB/m @ 2500 MHz
Andrew	FSJ1-50A	0.84	0.197	0.285	0.313
Andrew	FSJ2-50	0.83	0.134	0.196	0.222
Andrew	FSJ4-50B	0.81	0.119	0.176	0.201
Andrew	LDF4-50A	0.88	0.073	0.107	0.121
Andrew	LDF5-50A	0.89	0.041	0.061	0.070
Andrew	LDF6-50	0.89	0.029	0.044	0.051
Andrew	LDF7-50A	0.88	0.024	0.037	0.043
Andrew	LDF12-50	0.88	0.021	0.033	N/A
Andrew	LDF4.5-50	0.89	0.054	0.08	0.091
Andrew	LDF5-50B	0.91	0.041	0.061	0.07
Andrew	HJ4-50	0.914	0.087	0.137	0.15
Andrew	HJ4.5-50	0.92	0.054	0.079	0.084
Andrew	HJ5-50	0.916	0.042	0.063	0.07
Andrew	HJ7-50A	0.921	0.023	0.034	0.04
Andrew	HJ12-50	0.931	0.019	0.029	N/A
Andrew	VXL5-50	0.88	0.045	0.066	0.075
Andrew	VXL6-50	0.88	0.032	0.048	0.055
Andrew	VXL7-50	0.88	0.024	0.037	0.043
Belden	RG8, 8A	0.659	0.262	N/A	N/A
Belden	RG9, 9A	0.659	0.289	N/A	N/A
Belden	RG17, 17A	0.659	0.18	N/A	N/A
Belden	RG55, 55A, 55B	0.659	0.541	N/A	N/A
Belden	RG58, 58B	0.659	0.558	N/A	N/A
Belden	RG58A, 58C	0.659	0.787	N/A	N/A
Belden	RG142	0.659	0.443	N/A	N/A

**Appendix A Reference Data**

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

<b>Manufacturer</b>	<b>Cable Type</b>	<b>Relative Propagation Velocity (Vf)</b>	<b>Nominal Attenuation dB/m @ 1000 MHz</b>	<b>Nominal Attenuation dB/m @ 2000 MHz</b>	<b>Nominal Attenuation dB/m @ 2500 MHz</b>
Belden	RG174	0.659	0.984	N/A	N/A
Belden	RG178B	0.659	1.509	N/A	N/A
Belden	RG188	0.659	1.017	N/A	N/A
Belden	RG213	0.659	0.292	N/A	N/A
Belden	RG214	0.659	0.292	N/A	N/A
Belden	RG223	0.659	0.535	N/A	N/A
Cablewave	HCC12-50J	0.915	0.087	0.126	0.137
Cablewave	HCC78-50J	0.915	0.041	0.061	0.066
Cablewave	HCC158-50J	0.95	0.022	0.031	0.033
Cablewave	HCC300-50J	0.96	0.015	N/A	N/A
Cablewave	HCC312-50J	0.96	0.013	N/A	N/A
Cablewave	HF 4-1/8" Cu2Y	0.97	0.01	N/A	N/A
Cablewave	HF 5" Cu2Y	0.96	0.007	N/A	N/A
Cablewave	HF 6-1/8" Cu2Y	0.97	0.006	N/A	N/A
Cablewave	FLC 38-50J	0.88	0.115	0.169	0.19
Cablewave	FLC 12-50J	0.88	0.072	0.11	0.134
Cablewave	FLC 78-50J	0.88	0.041	0.061	0.072
Cablewave	FLC 114-50J	0.88	0.033	0.05	0.059
Cablewave	FLC158-50J	0.88	0.025	0.038	0.042
Comscope	CR50 540 PE	0.88	0.069	0.103	0.116
Comscope	CR50 1070PE	0.88	0.037	0.055	0.064
Comscope	CR50 1873PE	0.88	0.022	0.0344	0.04
Eupen	EC4-50 1/2	0.88	0.074	0.109	0.124
Eupen	EC4.5-50 5/8	0.88	0.056	0.083	0.094
Eupen	EC5-50 7/8	0.88	0.041	0.061	0.069
Eupen	EC6-50 1-1/4	0.88	0.03	0.045	0.052
Eupen	EC7-50 1-5/8	0.88	0.025	0.038	0.043
Eupen	EC12-50 2-1/4	0.88	0.022	0.034	0.039
NK Cables	RF 1/2" -50	0.88	0.0757	0.112	0.127
NK Cables	RF 1/2" -50 GHF	0.88	0.0757	0.112	0.127
NK Cables	RF 1/2" -50 BHF	0.88	0.0757	0.112	0.127
NK Cables	RF 5/8"-50	0.88	0.0518	0.0768	0.087

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

Manufacturer	Cable Type	Relative Propagation Velocity (Vf)	Nominal Attenuation dB/m @ 1000 MHz	Nominal Attenuation dB/m @ 2000 MHz	Nominal Attenuation dB/m @ 2500 MHz
NK Cables	RF 5/8"-50 GHF"	0.88	0.0518	0.0768	0.087
NK Cables	RF 5/8"-50 BHF"	0.88	0.0518	0.0768	0.087
NK Cables	RF 7/8"-50	0.88	0.0413	0.062	0.07
NK Cables	RF 7/8"-50 GHF"	0.88	0.0413	0.062	0.07
NK Cables	RF 7/8"-50 BHF"	0.88	0.0413	0.062	0.07
NK Cables	RF 1 5/8" -50	0.88	0.0248	0.038	0.044
NK Cables	RF 1 5/8" -50 GHF"	0.88	0.0248	0.038	0.044
NK Cables	RF 1 5/8" -50 BHF"	0.88	0.0248	0.038	0.044
NK Cables	RF 2 1/4" -50	0.88	0.021	0.034	N/A
NK Cables	RF 2 1/4" -50 GHF	0.88	0.021	0.034	N/A
NK Cables	RF 2 1/4" -50 BHF	0.88	0.021	0.034	N/A
NK Cables	RFF 3/8" -50	0.81	0.147	0.218	0.25
NK Cables	RFF 3/8" -50 GHF	0.81	0.147	0.218	0.25
NK Cables	RFF 3/8" -50 BHF	0.81	0.147	0.218	0.25
NK Cables	RFF 1/2" -50	0.82	0.112	0.167	0.19
NK Cables	RFF 1/2" -50 GHF	0.82	0.112	0.167	0.19
NK Cables	RFF 1/2" -50 BHF	0.82	0.112	0.167	0.19
NK Cables	RFF 7/8" -50	0.84	0.052	0.078	0.089
NK Cables	RFF 7/8" -50 GHF	0.84	0.052	0.078	0.089
NK Cables	RFF 7/8" -50 BHF	0.84	0.052	0.078	0.089
Times	LMR100	0.8	0.792	1.15	1.31
Times	LMR200	0.83	0.344	0.49	0.554
Times	LMR240	0.84	0.262	0.377	0.424
Times	LMR400	0.85	0.135	0.196	0.222
Times	LMR500	0.86	0.109	0.159	0.18
Times	LMR600	0.87	0.087	0.128	0.145

***Appendix A Reference Data***

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*Table A-1. Coaxial Cable Technical Data (4 of 4)*

<b>Manufacturer</b>	<b>Cable Type</b>	<b>Relative Propagation Velocity (Vf)</b>	<b>Nominal Attenuation dB/m @ 1000 MHz</b>	<b>Nominal Attenuation dB/m @ 2000 MHz</b>	<b>Nominal Attenuation dB/m @ 2500 MHz</b>
Times	LMR900	0.87	0.056	0.086	0.098
Times	LMR1200	0.88	0.044	0.065	0.074
Times	LMR1700	0.89	0.033	0.049	0.056
-	310801	0.821	0.115	N/A	N/A
-	311201	0.82	0.18	N/A	N/A
-	311501	0.8	0.23	N/A	N/A
-	311601	0.8	0.262	N/A	N/A
-	311901	0.8	0.377	N/A	N/A
-	352001	0.8	0.377	N/A	N/A

# Appendix B

## Windowing

### Introduction

The **FREQ/DIST** menu (page 2-13) provides for setting the cable loss and relative propagation velocity of the coaxial cable. The Window key opens a menu of FFT windowing types for the DTF calculation.

The theoretical requirement for inverse FFT is for the data to extend from zero frequency to infinity. Side lobes appear around a discontinuity due to the fact that the spectrum is cut off at a finite frequency. Windowing reduces the side lobes by smoothing out the sharp transitions at the beginning and at the end of the frequency sweep. As the side lobes are reduced the main lobe widens thereby reducing the resolution.

In situations where there may be a small discontinuity close to a large one, side lobe reduction windowing should be used. When distance resolution is critical windowing can be reduced.

### Examples

The types of windowing in order of increasing side lobe reduction are: rectangular, nominal side lobe, low side lobe, and minimum side lobe. Figures B-1 thru B-4 show examples of the types of windowing.

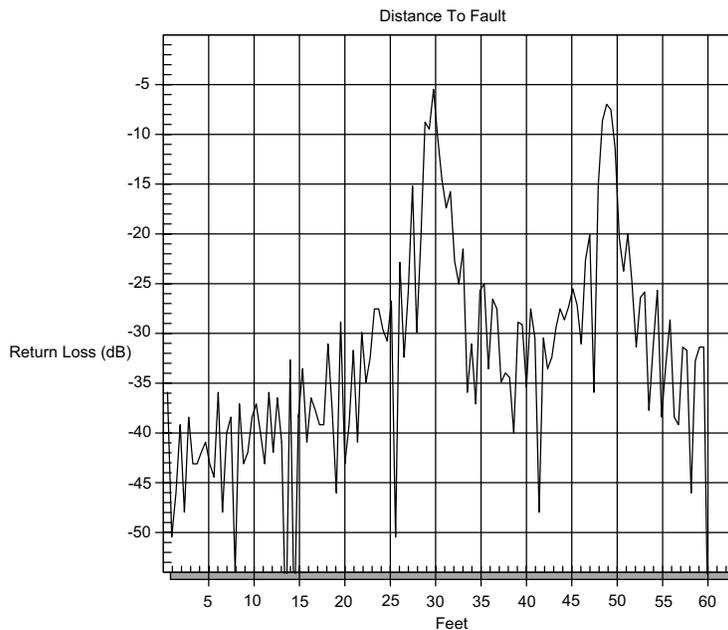


Figure B-1. Rectangular Windowing Example

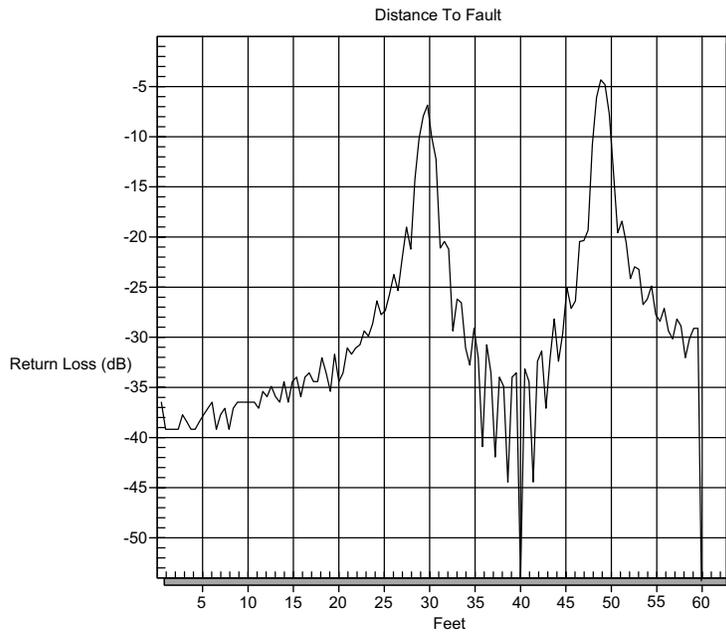


Figure B-2. Nominal Side Lobe Windowing Example

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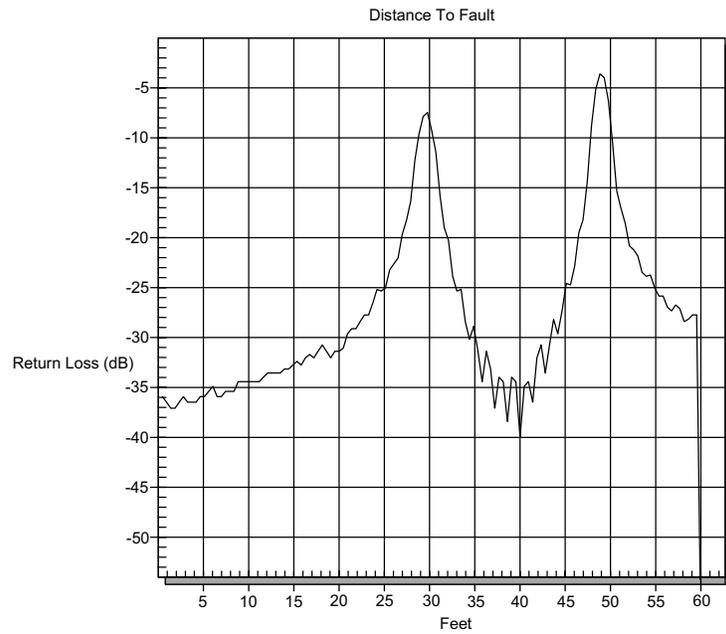


Figure B-3. Low Side Lobe Windowing Example

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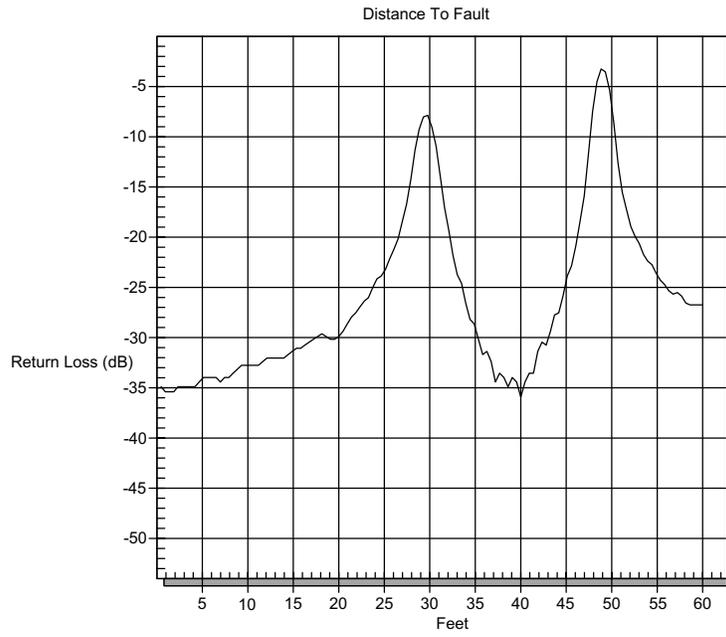


Figure B-4. Minimum Side Lobe Windowing Example

# Index

## A

accessories . . . . . 1-1, 1-3  
ACPR. . . . . 2-18, 5-1, 5-7  
aging. . . . . 1-5  
AIS . . . . . 2-28  
AMI . . . . . 2-27, 2-30  
amplitude. . . . . 3-11  
ANSI. . . . . 7-1  
antenna factors  
    downloading . . . . . 9-9  
    entering . . . . . 9-7  
    uploading . . . . . 9-8  
attenuation . . . . . 3-12  
attenuator . . . . . 2-15, 3-11 - 3-12

## B

B8ZS . . . . . 2-27, 7-4  
backlight . . . . . 3-16  
bandwidth . . . . . 3-11  
bandwidths . . . . . 2-16  
battery . . . . . 2-38  
battery life . . . . . 2-39  
BER . . . . . 8-1  
BERT. . . . . 2-27  
blue alarm . . . . . 2-28  
BPV . . . . . 2-28, 2-30, 7-3, 8-3  
bridged. . . . . 2-27, 2-30  
BTS . . . . . 7-1, 8-1

## C

cable loss . . . . . 4-2, 4-4  
calibration. . . . . 1-9, 3-2  
case. . . . . 3-18  
channel . . . . . 2-14, 2-26, 3-10, 5-1, 6-1  
channel power . . . . . 5-1, 5-5  
channel spacing . . . . . 2-18  
clock . . . . . 2-25

clock source . . . . . 2-27  
connectors . . . . . 2-1  
contrast . . . . . 2-4, 3-16  
CRC . . . . . 2-28, 2-30, 7-4, 8-3  
CRC-4 . . . . . 8-1  
CSU . . . . . 2-28  
CW. . . . . 4-2

## D

D4 . . . . . 7-6  
D4 SF. . . . . 2-27  
date format . . . . . 2-25  
detection . . . . . 3-11  
detector. . . . . 2-16  
DS1 . . . . . 7-1  
DTF. . . . . 2-13, 3-8, 4-2, 4-6, 9-3, 9-10  
DTF Aid. . . . . 2-13, 2-16, 3-8

## E

error insertion . . . . . 2-28  
error messages . . . . . 2-33  
ESD . . . . . 1-10  
ESF . . . . . 2-27, 7-3, 7-6

## F

FFT . . . . . B-1  
field strength. . . . . 5-2  
fixed CW . . . . . 2-16  
FlexCal . . . . . 2-25, 2-37, 3-2  
framing. . . . . 2-27, 2-30  
frequency . . . . . 2-13  
frequency range . . . . . 1-1

## G

grounding . . . . . 2-1

## H

- hard keys . . . . . 2-3
- HDB3 . . . . . 2-30
- HDSL . . . . . 7-2
- histogram . . . . . 2-28
- hold . . . . . 2-5, 2-16, 2-32, 3-11

## I

- In Service Testing
  - E1 . . . . . 8-3
  - T1 . . . . . 7-3
- InstaCal . . . . . 1-10, 2-36, 3-2
- integration bandwidth . . . . . 2-18, 5-6
- interference analysis . . . . . 5-9
- ITU-T . . . . . 8-1

## K

- keys
  - hard . . . . . 2-3
  - soft . . . . . 2-6

## L

- language . . . . . 2-25, 3-14
- LEC . . . . . 7-1
- limits . . . . . 2-21, 3-14
- line sweep . . . . . 4-1
- loopback . . . . . 2-29, 7-9

## M

- maintenance . . . . . 1-9
- markers . . . . . 3-14, 9-5
- measurements
  - cable and antenna . . . . . 4-1
  - channel power . . . . . 5-5
  - E1 . . . . . 8-1
  - field strength . . . . . 5-2
  - power . . . . . 6-1
  - Spectrum Analyzer . . . . . 3-10
  - T1 . . . . . 7-1
- memory . . . . . 2-5

- metafile . . . . . 9-6
- MSC . . . . . 7-1, 8-1

## N

- NIU . . . . . 2-28, 7-2

## O

- OBW . . . . . 5-3
- occupied bandwidth . . . . . 5-1, 5-3
- offset . . . . . 2-15, 2-26, 3-6
- OSL . . . . . 2-25, 3-2
- Out-Of-Service Testing
  - E1 . . . . . 8-6
  - T1 . . . . . 7-6

## P

- PCM30 . . . . . 2-30
- PCM30 CRC . . . . . 2-30
- PCM31 . . . . . 2-30
- PCM31 CRC . . . . . 2-30
- plot overlay . . . . . 9-5
- preamplifier . . . . . 2-15
- printers . . . . . 1-2, 3-17
- propagation velocity . . . . . 2-13

## R

- RAI . . . . . 2-28
- RBW . . . . . 2-16, 3-11
- reference level . . . . . 2-15
- relative power . . . . . 2-26, 6-2
- resolution . . . . . 2-16, 4-7
- resolution bandwidth . . . . . 2-16, 3-11
- return loss . . . . . 4-2, 4-8
- RMS . . . . . 2-17, 2-26, 6-1
- RS232 . . . . . 2-2 - 9-3

## S

- sampling . . . . . 2-17
- scale . . . . . 2-15, 3-8

self test . . . . . 2-25, 2-32, 2-39, 3-1  
serial interface . . . . . 9-3  
service centers . . . . . 1-11  
signal standard . . . 2-14, 2-26, 3-10, 5-1, 6-1  
Smith Chart . . . . . 1-1, 9-10  
soft keys . . . . . 2-6  
Software Tools . . . . . 9-1  
span . . . . . 2-14, 2-18, 2-26, 3-10, 5-6, 6-1  
specifications . . . . . 1-4  
spreadsheet . . . . . 9-1  
static . . . . . 1-10  
sweep . . . . . 3-11  
SWR . . . . . 1-1, 2-34, 3-8, 4-2, 4-6, 9-3  
symbols. . . . . 2-32

## **T**

trigger . . . . . 2-18

## **U**

units . . . . . 2-15, 3-14, 6-2  
USB. . . . . 1-3, 9-1

## **V**

VBW . . . . . 2-16, 3-11  
verification . . . . . 1-10  
video bandwidth . . . . . 2-16, 3-11  
Vpp . . . . . 7-3, 8-3

## **W**

windowing . . . . . 2-13, B-1  
Windows . . . . . 1-1, 9-1 - 9-2

## **X**

XdB . . . . . 5-3

## **Y**

yellow alarm . . . . . 2-28



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