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产品中有毒有害物质或元素的名称及含量

For Chinese Customers Only YLYB

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 [Cr(VI)]	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
印刷线路板 (PCA)	×	○	×	×	○	○
机壳、支架 (Chassis)	×	○	×	×	○	○
LCD	×	×	×	×	○	○
其他(电缆、风扇、 连接器等) (Appended goods)	×	○	×	×	○	○

○：表示该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T11363-2006 标准规定的限量要求以下。
 ×：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T11363-2006 标准规定的限量要求。

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DECLARATION OF CONFORMITY

Manufacturer's Name: ANRITSU COMPANY

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

declares that the product specified below:

Product Name: Broadband Handheld VNA

Model Number: S810D, S820D including options 2 and 22

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 Compatibility: EN61326-1:1997 +A1:1998 +A2:2001 +A3:2003

Emissions: EN55011: 1998 +A1:1999 +A2:2002 Group 1 Class A

Immunity:

EN 61000-4-2:1995+ A1:1998+ A2:2001	- 4kV CD, 8kV AD
EN 61000-4-3:2002+ A1:2002	- 10V/m
EN 61000-4-4:2004	- 0.5kV SL, 1kV PL
EN 61000-4-5:1995+ A1:2001	- 0.5kV L-L, 1kV L-E
EN 61000-4-6:1996+ A1:2001	- 3V
EN 61000-4-11:1994+ A1:2001	- 100% @ 20msec

Electrical Safety Requirement:

Product Safety: EN61010-1: 2001

Morgan Hill, CA


Eric McLean, Corporate Quality Director

1 Sept 2006
Date

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Chapter 1

General Information

Introduction

This chapter provides a description, performance specifications, optional accessories, preventive maintenance, and calibration requirements for the Site Master™ models S810D and S820D. Throughout this manual, the term Site Master will refer to the S810D and S820D.

<u>Model</u>	<u>Frequency Range</u>	
S810D	Cable and Antenna Analyzer:	0.025 to 10.5 GHz
S820D	Cable and Antenna Analyzer:	0.025 to 20 GHz

Description

The Site Master models S810D and S820D are hand held cable and antenna analyzers. Both models include a keypad to enter data and a thin film transistor liquid crystal display (TFT LCD) to provide graphic indications of various measurements.

The Site 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 Site Master is designed for measuring SWR, return loss, cable insertion loss and locating faulty RF components in antenna systems.

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 TFT LCD backlight intensity can be adjusted.

Options

Option 2	Low frequency extension (2 MHz low end frequency vs. standard 25 MHz)
Option 5	Power Monitor (sensor not included)
Option 11NF	Replaces standard K(f) Test Port Connector with N(f)
Option 22NF	2-Port Cable-loss mode (Includes external N(f) CW source module CWM220B-NF, 560-7N50B detector, and 66379 adaptor cable.) Low Frequency Extension (2 MHz) and Power Monitor modes are enabled with this option.
Option 22SF	2-Port Cable-loss mode (Includes external SMA (f) CW source module CWM220B-SF, 560-7S50B detector, and 66379 adaptor cable.) Low Frequency Extension (2 MHz) and Power Monitor modes are enabled with this option.
Option 31	GPS Receiver (antenna included)

Standard Accessories

The following items are supplied with the Site Master:

Part Number	Description
10680-00001	Site Master S810D/S820D User's Guide
65717	Soft Carrying Case
633-27	Rechargeable NiMH Battery
40-168	AC/DC Adapter
806-62	Automotive Cigarette Lighter/12 Volt DC Adapter
800-441	Serial Interface Cable (null modem type)
2300-347	Anritsu Handheld Software Tools CDROM
34RKNF50	Precision Adapter, Ruggedized K(m) to N(f) (not included when option 11NF is ordered)
551-1691-R	USB to RS-232 Adapter Cable
One year Warranty (includes battery, firmware, and software)	

The Handheld Software Tools PC-based software program provides a database record for storing measurement data. Software Tools can also convert the Site Master display to a Microsoft Windows™ 95/98/NT4/2000/ME/XP workstation graphic. Measurements stored in the Site 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 Site 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. Refer to Chapter 6, Handheld Software Tools, for more information.

Optional Accessories

The following optional accessories are available for the Site Master S8x0D:

Part Number	Description
10680-00002	Site Master S810D/S820D Programming Manual
10680-00003	Site Master S810D/S820D Maintenance Manual
2000-1410	Magnetic Mount GPS Antenna with 15 ft. cable
760-213	Transit Case for Microwave Site Master
2000-1029	Battery Charger, External
760-243-R	Transit Case with Wheels

Option 5 Power Monitor Accessories

Part Number	Description
560-7A50	Detector, 10 MHz to 18 GHz, GPC-7, 50 Ohm
560-7N50B	Detector, 10 MHz to 20 GHz, N(m), 50 Ohm
560-7S50B	Detector, 10 MHz to 20 GHz, WSMA(m), 50 Ohm
560-7S50-2	Detector, 10 MHz to 26.5 GHz, WSMA(m), 50 Ohm
560-7K50	Detector, 10 MHz to 40 GHz, K(m), 50 Ohm
560-7VA50	Detector, 10 MHz to 50 GHz, V(m), 50 Ohm
5400-71N50	Detector, 1 MHz to 3 GHz, N(m), 50 Ohm
800-109	Detector Extender Cable, 7.6m (25 ft.)
800-111	Detector Extender Cable, 30.5m (100 ft.)

Coaxial Calibration Components

K Connectors

Part Number	Description
22K50	Precision K(m) Short/Open, 40 GHz
22KF50	Precision K(f) Short/Open, 40 GHz
28K50	Precision Termination, DC to 40 GHz, 50Ω, K(m)
28KF50	Precision Termination, DC to 40 GHz, 50Ω, K(f)
15KKF50-1.5A	Armored Test Port Cable, 1.5 meter K(m) to K(f) 20 GHz
15RKKF50-1.5A	Ruggedized Armored Test Port Cable, 1.5 meter K(m) to K(f) 20 GHz
OSLK50	Precision Integrated Open/Short/Load K(m), DC to 20 GHz, 50Ω
OSLKF50	Precision Integrated Open/Short/Load K(f), DC to 20 GHz, 50Ω

N-Type Connectors

Part Number	Description
22N50	Precision N(m) Short/Open, 18 GHz
22NF50	Precision N(f) Short/Open, 18 GHz
28N50-2	Precision Termination, DC to 18 GHz, 50Ω, N(m)
28NF50-2	Precision Termination, DC to 18 GHz, 50Ω, N(f)
15NNF50-1.5B	Armored Test Port Cable, 1.5 meter N(m) to N(f) 18 GHz
42N50-20	5W Attenuator, N(m) to N(f), 18 GHz
OSLN50	Precision Integrated Open/Short/Load N(m), DC to 18 GHz, 50Ω
OSLNF50	Precision Integrated Open/Short/Load N(f), DC to 18 GHz, 50Ω

TNC Connectors

Part Number	Description
1091-55	TNC Open (f), 18 GHz
1091-53	TNC Open (m), 18 GHz
1091-56	TNC Short (f), 18 GHz
1091-54	TNC Short (m), 18 GHz
1015-54	TNC Termination (f), 18 GHz
1015-55	TNC Termination (m), 18 GHz

Coaxial Adapters

Part Number	Description
34NN50A	Precision Adapter, DC to 18 GHz, N(m)-N(m), 50 Ohm
34NFNF50	Precision Adapter, DC to 18 GHz, N(f) - N(f), 50 Ohm
34RKNF50	Precision Ruggedized Adapter, K(m)-N(f), DC to 18 GHz, 50 Ohms
34RSN50	Precision Ruggedized Adapter, WSMA(m)-N(m), DC to 18 GHz, 50 Ohms
K220B	Precision Adapter, DC to 40 GHz, 50 Ohm, K(m)-K(m)
K222B	Precision Adapter, DC to 40 GHz, 50 Ohm, K(f)-K(f)
513-62	Adapter, DC to 18 GHz, TNC(f) to N(f), 50 Ohm
1091-315	Adapter, DC to 18 GHz, TNC(m) to N(f), 50 Ohm
1091-324	Adapter, DC to 18 GHz, TNC(f) to N(m), 50 Ohm
1091-325	Adapter, DC to 18 GHz, TNC(m) to N(m), 50 Ohm
1091-317	Adapter, DC to 18 GHz, TNC(m) to SMA(f), 50 Ohm
1091-318	Adapter, DC to 18 GHz, TNC(m) to SMA(m), 50 Ohm
1091-323	Adapter, DC to 18 GHz, TNC(m) to TNC(f), 50 Ohm
1091-326	Adapter, DC to 18 GHz, TNC(m) to TNC(m), 50 Ohm
1091-26	Adapter, DC to 18 GHz, N(m) - SMA(m), 50 Ohm
1091-27	Adapter, DC to 18 GHz, N(m)-SMA(f), 50 Ohm
1091-80	Adapter, DC to 18 GHz, 50 Ohm, N(f)-SMA(m)
1091-81	Adapter, DC to 18 GHz, 50 Ohm, N(f)-SMA(f)

Performance Specifications

The specifications on the following pages describe the warranted performance of the instrument at $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$ when the unit is calibrated with the appropriate coaxial calibration kit for the built-in test port connector. A warm-up time of 15 minutes should be allowed prior to verifying system specifications. Performance parameters denoted as “typical” indicate non-warranted specifications.

Description	Value
Frequency Range: Site Master S810D Site Master S820D	0.025 to 10.5 GHz 0.025 to 20.0 GHz
Frequency Accuracy (Fixed CW ON)	≤ 3 ppm @ 25°C
Frequency Resolution	10 kHz (100 kHz for Distance To Fault)
Output Power (from RF Out port)	< 0 dBm (at any particular frequency)
Immunity to Interfering Signals	on-channel: +13 dBm
	on-frequency: -10 dBm
Measurement Speed Return Loss, SWR, DTF	≤ 2 sec/sweep for 517 data points (CW on)
	≤ 4 sec/sweep for 517 data points (CW off)
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 65.53
	Resolution: 0.01
Coax/Waveguide Insertion Loss	Range: 0.00 to 30.00 dB
	Resolution: 0.01 dB
Measurement Accuracy	≥ 42 dB corrected directivity after calibration for < 5 GHz ≥ 36 dB corrected directivity after calibration for < 15 GHz ≥ 32 dB corrected directivity after calibration for > 15 GHz (with option 11NF, the accuracy is only specified up to 18 GHz)

Chapter 1 General Information

Description		Value
Distance To Fault	Vertical Range:	Return Loss: 0.00 to 60 dB VSWR: 1.00 to 65.53
	Horizontal Range:	0 to (# of data points – 1) x Horizontal Resolution to a maximum of 1197m (3929 ft), # of data points = 130, 259, or 517
	Horizontal Resolution Coaxial Cable (rectangular windowing):	$\frac{(1.5 \times 10^8)(V_p)}{\Delta F}$ Where V_p is the relative propagation velocity of the cable and ΔF is the stop frequency minus the start frequency (Hz)
	Horizontal Resolution Waveguide:	$\frac{1.5 \times 10^8 (\sqrt{1 - (F_C / F_1)^2})}{\Delta F}$ Where F_C is the waveguide cutoff frequency (Hz); F_1 is the start frequency (Hz); ΔF is the stop frequency minus the start frequency (Hz)
Test Port Connector		Precision K(f) or N(f) (Option 11NF)
Language Support		English, Spanish, French, German, Chinese, Japanese
Internal Trace Memory		Up to 200 traces
Setup Configuration		21
Custom Cable Configuration Memory		up to 200 configurations
Display		TFT color display with adjustable backlight
Ports	RF Out:	Standard: Type K(f) test port, 50Ω +23 dBm (Peak), ±50 VDC, Maximum input without damage Optional (S8x0D/11NF): Type N(f) test port, 50Ω +23 dBm (Peak), ±50 VDC, Maximum input without damage
	Serial Interface:	9 pin D-sub RS-232 three wire serial
CE	Electromagnetic Compatibility:	Meets European Community requirement EN61326-1:1998
	Safety:	Meets European Community requirement EN61010-1:2001
Environmental (MIL-PRF- 28800F Class 2)	Temperature/ Humidity:	Operating: –10°C to 55°C, humidity 85% or less Non-operating: –51°C to +71°C (recommend storing the battery separately between 0°C and +40°C for any prolonged non-operating storage period)
	Mechanical:	Vibration: Sine (5-55 Hz); Random (10-500 Hz) Shock: 30 G, 11 msec, half sine
Power Supply	External:	DC input: +12 to +15 volt dc, 3A Internal: NiMH battery: 10.8 volts, 1800 mAh
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

Description		Value
Options		Value
Power Monitor (S8X0D/5)	Detector Range:	-50 to +20 dBm, 10 nW to 100 mW
	Offset Range:	0 to +60 dB
	Display Range:	-80 to 80 dBm
	Resolution:	0.1 dB, 0.1 xW (x = n, μ , m based on detector power)
	Measurement Accuracy:	± 1 dB maximum for > -40 dBm and < 18 GHz using 560-7N50B
Ports:	S8x0D: 4-pin DIN connector; for use with Anritsu detectors Detector (560-7N50B or 560-7S50B): Type N(m) or SMA(m), 50ohm, +20 dBm (Peak), Maximum input without damage	
GPS Location Indicator (S8X0D/31)		Latitude, Longitude, Altitude, and Universal Time on display
		Latitude, Longitude, Altitude, and Universal Time on trace storage
		Port: Reverse BNC(m), 50 ohm, for use with specified GPS antenna only
Low Frequency Extension (S8x0D/2)	Frequency Range:	2 MHz to 20000 MHz (S820D) 2 MHz to 10500 MHz (S810D) (All other specs remain the same as the standard S8x0D.)
2-Port Cable Loss (S8x0D/22xF)		
CW Source Module (CWM220B-xF)	Frequency Range	2 MHz to 20000 MHz (with S820D) 2 MHz to 10500 MHz (with S810D)
	Freq Accuracy	± 3 ppm @ 25° C
	Power at RF Out Port	+15dBm, maximum (typically > -10 dBm)
	Ports	CWM220B-NF: N(f), ± 15 VDC, +20 dBm, maximum input, no damage CWM220B-SF: SMA(f), ± 15 VDC, +20 dBm, maximum input, no damage
2- Port Cable Loss Measurement	Detector Range	-50 to +20 dBm, 10 nW to 100 mW
	Display Range	-60 to +60 dB(m)
	Resolution	0.1 dB
	Measurement Accuracy (following a calibration; accuracy only specified from 0 to 30 dB)	± 0.85 dB, maximum for < 10 dB cable loss ± 1.35 dB, maximum for < 30 dB cable loss (using 560-7S50B from 10MHz to 20GHz or 560-7N50B from 10MHz to 18 GHz)

Preventive Maintenance

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

Clean the Site 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 and pins of the 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 Site Master is a field portable unit operating in the rigors of the test environment. An Open-Short-Load (OSL) calibration should be performed prior to making a measurement in the field (see Calibration, page 3-3). A built-in temperature sensor in the Site 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 Site 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.

Annual Verification

Anritsu recommends an annual calibration and performance verification of the Site Master and the OSL calibration components by local Anritsu service centers. Anritsu service centers are listed in Table 1-2 on the following page.

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

Customer Service

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

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

Chapter 2

Functions and Operations

Introduction

This chapter provides a brief overview of the Site 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 Site 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 Site 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 40-168) 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.

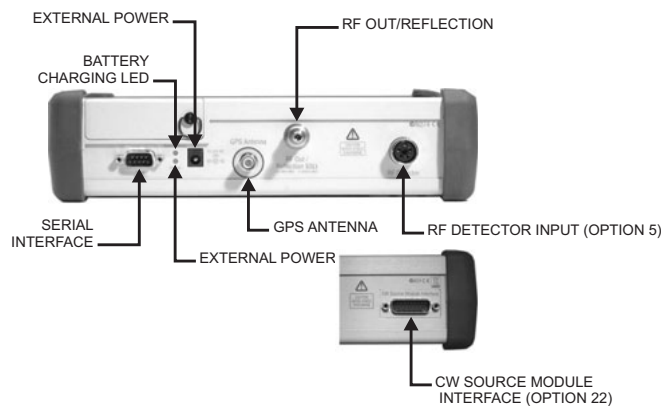


Figure 2-1. S8x0D Test Connector Panel

12-15 VDC (3A) 12 to 15 Vdc @ 3A 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, or damaging the equipment.

Chapter 2 Functions and Operations

Battery Charging	Illuminates when the battery is being charged. The indicator automatically shuts off when the battery is fully charged.
External Power	Illuminates when the Site Master is being powered by the external charging unit.
Serial Interface	RS232 DB9 interface to a COM port on a personal computer (for use with the Anritsu Handheld Software Tools program) or to a supported printer.
RF Out/Reflection	RF output, 50 Ω impedance, for reflection measurements. Maximum input is 50 Ω +23 dBm at \pm 50 Vdc.
GPS Antenna	GPS antenna connection. Do not connect anything other than the Anritsu GPS antenna to this port.

Display Overview

Figure 2-2 illustrates some of the key information areas of the S8x0D display.

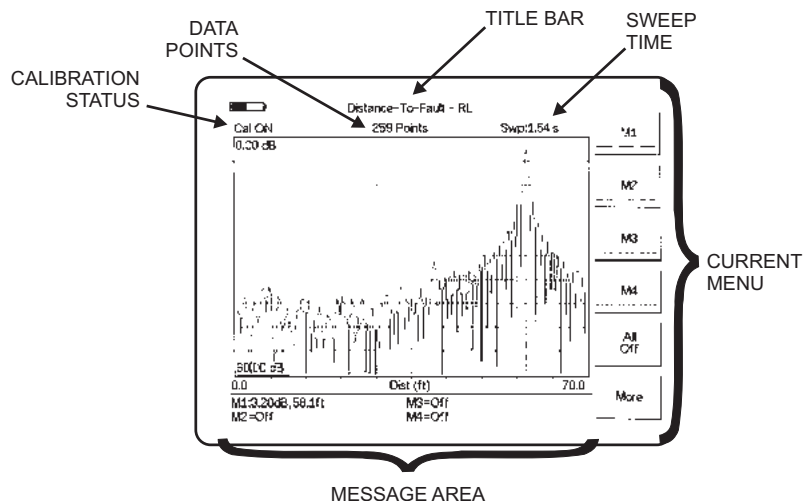


Figure 2-2. S8x0D Display Overview

Front Panel Overview

The Site 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 soft key menu area to the right of the status window. The locations of the different keys are illustrated in Figure 2-3.

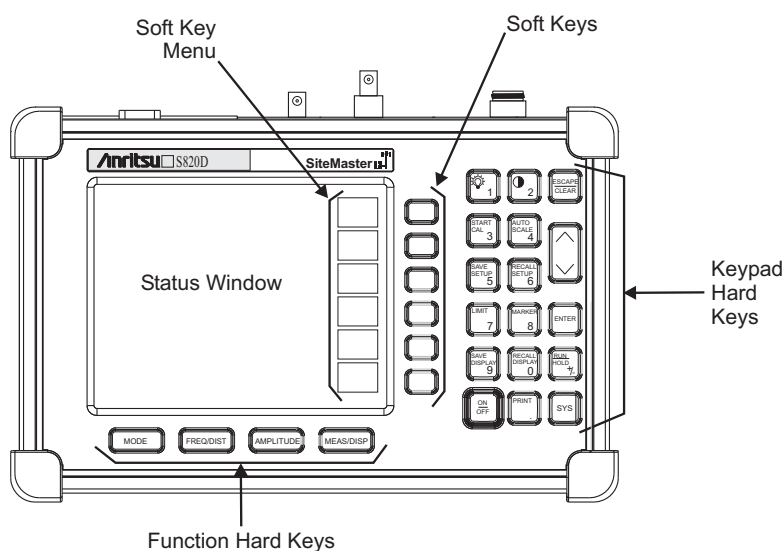


Figure 2-3. Site Master Front Panel

The following sections describe the various key functions.

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.

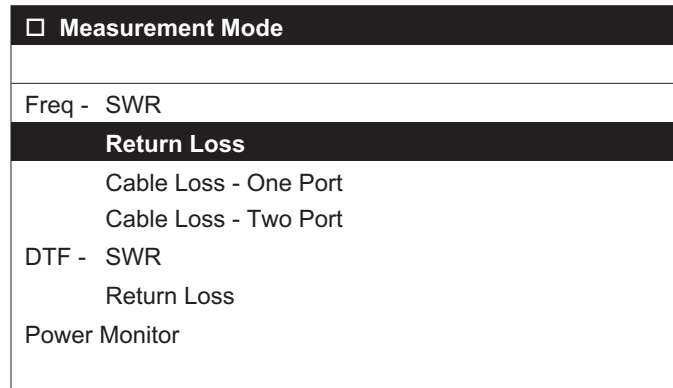


Figure 2-4. Mode Selection Box

NOTE: Available mode selections will vary according to model number and options installed.

FREQ/DIST Displays the Frequency or Distance to Fault soft key menus depending on the measurement mode (see page 2-11).

AMPLITUDE Displays the amplitude soft key menu for the current operating mode (see page 2-12).

MEAS/DISP Displays the measurement and display soft key menus for the current operating mode (see page 2-12).

Keypad Hard Keys

This section contains an alphabetical listing of the Site 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.

0-9	These keys are used to enter numerical data as required to setup or perform measurements.
+/-	The plus/minus key is used to enter positive or negative values as required to setup or perform measurements.
•	The decimal point is used to enter decimal values as required to setup or perform measurements.
<u>ESCAPE</u> CLEAR	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.
Up/Down Arrows	Increments or decrements a parameter value. The specific parameter value affected typically appears in the message area of the LCD.
ENTER	Implements the current action or parameter selection.
<u>ON</u> OFF	Turns the Anritsu Site Master on or off. When turned on, the saved system state at the last turn-off is restored. If the ESCAPE/CLEAR key is held down while the ON/OFF key is pressed, the factory preset state will be restored.
SYS	Allows selection of the system setup parameters and display language. In cable and antenna analyzer modes, the choices are Options, Clock, Self Test, Status and Language.

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



This key is used to adjust the brightness of the color display. Use the Up/Down arrow key and **ENTER** to adjust the display brightness.

**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 or antenna analyzer mode.

MARKER

Displays the marker menu of the current operating mode when in cable or antenna 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 display. Select a trace using the Up/Down arrow key and press the **ENTER** key to implement.

**RECALL
SETUP**

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

**RUN
HOLD**

When in the Hold mode, this key starts the Site 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 2-18) appears on the display. 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. The number of locations available varies with the model number and installed options. There are ten available locations in cable and antenna analyzer mode and five in Power Monitor mode (Option 5). 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 Power Monitor mode).

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.

The following figures show the soft key labels for each Mode selection.

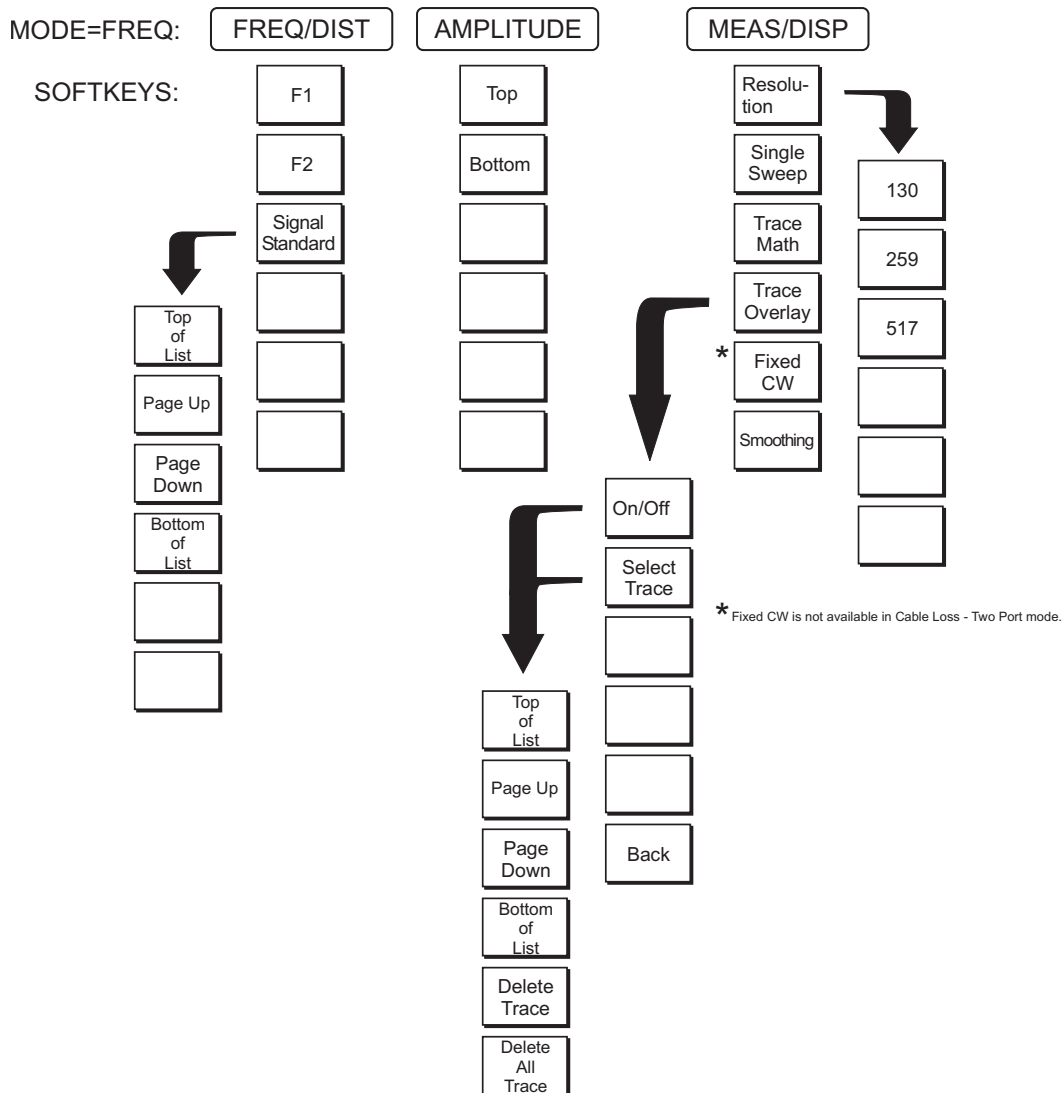


Figure 2-5. Return Loss Mode Soft Key Labels

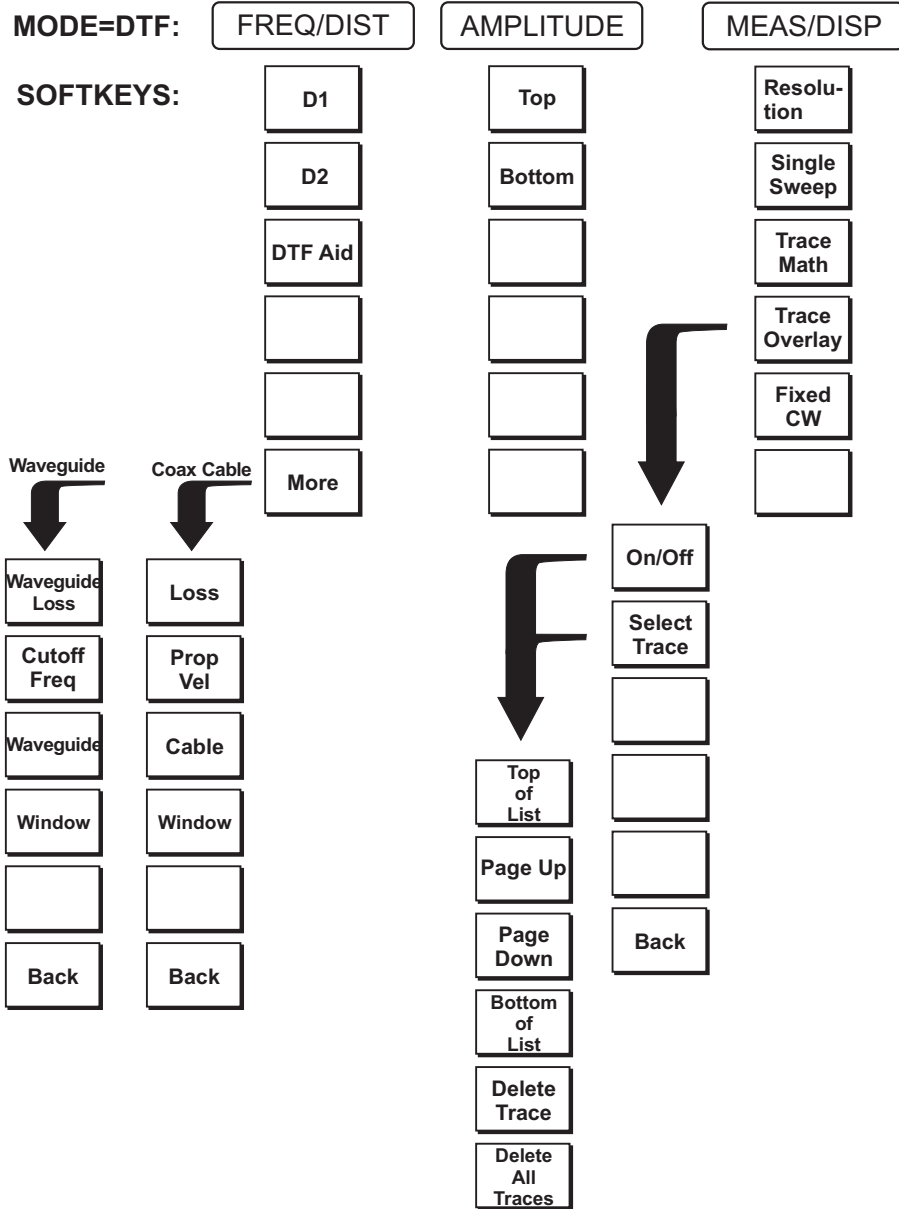


Figure 2-6. Distance to Fault Mode Soft Key Labels

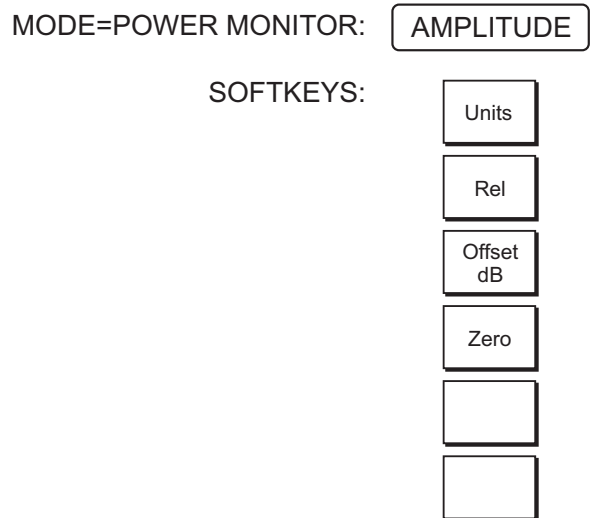


Figure 2-7. Power Monitor Mode Soft Key Labels (Option 5)

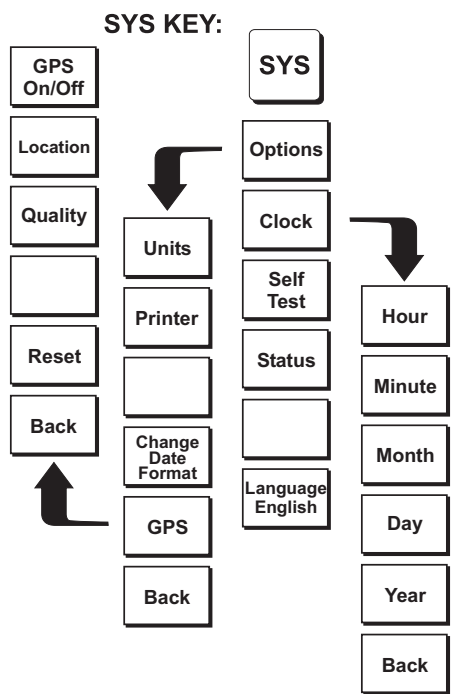


Figure 2-8. SYS Key Menu in Cable and Antenna Analyzer Mode

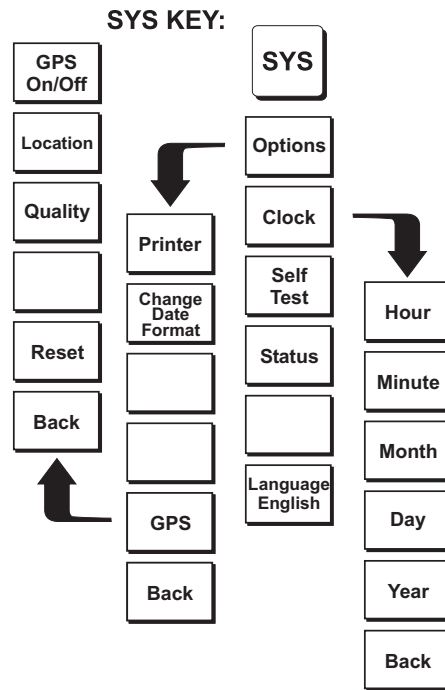


Figure 2-9. SYS Key Menu in Power Monitor Mode

FREQ/DIST	Displays the frequency and distance menu depending on the measurement mode.
Frequency Menu	<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"> <input type="checkbox"/> F1 — Opens the F1 parameter for data entry. This is the start value for the frequency sweep. Press ENTER when data entry is complete. <input type="checkbox"/> F2 — Opens the F2 parameter for data entry. This is the stop value for the frequency sweep. Press ENTER when data entry is complete. <input type="checkbox"/> Signal Standard — Allows selection of the signal standard to be used. Select from the available international standards (Appendix C).
Distance Menu	<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"> <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 ENTER when data entry is complete. <input type="checkbox"/> D2 — Opens the end distance (D2) parameter for data entry. This is the end value for the distance range. Press ENTER when data entry is complete. <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 ENTER when data entry is complete. <input type="checkbox"/> More — Selects one of the Distance Sub-Menus, detailed below, depending on whether the current calibration is for coaxial cable or waveguide media.
Distance Sub-Menu (Waveguide)	<p>Provides for setting the waveguide loss and cutoff frequency parameters of the waveguide. Selected values may be changed using the Up/Down arrow key or keypad.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Waveguide Loss — Opens the Waveguide Loss parameter for data entry. Enter the loss per meter (or foot) for the type of transmission line being tested. Press ENTER when data entry is complete. (Range is 0 to 5.000 dB/m.) <input type="checkbox"/> Cutoff Freq — Opens the cutoff frequency parameter for data entry. Enter the cutoff frequency for the type of waveguide being tested. Press ENTER when data entry is complete. (Range is 0 to 20) <input type="checkbox"/> Waveguide — Opens the waveguide list showing the currently selected waveguides. Highlight the desired waveguide and use the Up/Down arrow key and ENTER to make a selection. Press the Show All soft key to show the complete waveguide list, where the currently selected waveguides are marked with an asterisk. Press the Show Selected soft key to show only the selected waveguides. <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 ENTER key. <input type="checkbox"/> Back — Returns to the Distance Menu.

Distance Sub-Menu (Coax Cable) Provides for setting the cable loss and relative propagation velocity of the coaxial cable. Selected values may be changed using the Up/Down arrow key or keypad.

- ❑ Loss — Opens the Cable Loss parameter for data entry. Enter the loss per meter (or foot) for the type of transmission line being tested. Press **ENTER** when data entry is complete. (Range is 0 to 5.0 dB/m)
- ❑ 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 **ENTER** when data entry is complete. (Range is 0.010 to 1.000)
- ❑ Cable — Opens the coaxial cable list showing the currently selected coaxial cables. Highlight the desired coaxial cable and use the Up/Down arrow key and **ENTER** to make a selection. Press the Show All soft key to show the complete coaxial cable list, where the currently selected coaxial cables are marked with an asterisk. Press the Show Selected soft key to show only the selected coaxial cables.
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 at the frequencies listed.) When a cable is selected the nominal attenuation will be set to the value associated with the frequency in the table that is closest to the mid band of the frequency range for the measurement. Custom coaxial cables can be uploaded via the Handheld Software Tools program.
- ❑ 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 **ENTER** key. Refer to Appendix B for more details on windowing.
- ❑ Back — Returns to the Distance Menu.

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.

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 around the selected frequency is generated. This enhances the immunity of the Site Master to an interfering signal. When CW is ON, only a single frequency with a very narrow band width is generated by the Site Master. The sweep speed is faster in CW ON mode. If CW is ON during normal RL or SWR measurements, it may be more susceptible to interfering signals, so use this feature with caution. Interfering signals can make the measurement look better or worse than it really is.
- ❑ Smoothing — Sets the level of smoothing applied to a frequency measurement trace. A level of 0 turns smoothing OFF. Levels 1 through 20 turn smoothing ON and set the smoothing percentage (the higher the level, the higher the smoothing applied to the trace). Smoothing is a trace averaging process that reduces or removes ripples from frequency swept data. This is especially useful when making 1-port cable loss measurements with a short at the other end of the cable. The ripple that is usually present in this kind of measurement can be removed with smoothing resulting in a more accurate average cable loss frequency response trace. Care should be taken when applying smoothing so as not to remove ripples that are inherent parts of the data (as opposed to measurement artifacts).

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 locations 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.
- ❑ All Off — Turns all markers off
- 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 soft key to select the desired limit function. Then use the Up/Down arrow key to change its value, which is displayed in the message area at the bottom of the status window.

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

- Single Limit — Sets a single limit value in dB. 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 through Segment 5 — Opens the segment 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.

SYS

In cable and antenna analyzer or optional power monitor mode, pressing the **SYS** key displays the following System menu soft key selections:

- ❑ Options — Displays a second level of functions:
 - ❑ Units — Select the unit of measurement (metric or English).
 - ❑ Printer — Displays a menu of supported printers. Use the Up/Down arrow key and **ENTER** key to make the selection.
 - ❑ Change Date Format — Toggles the date format between MM/DD/YYYY, DD/MM/YYYY, and YYYY/MM/DD.
 - ❑ GPS — Opens the GPS soft key menu.

NOTE: The system may take as long as five minutes to locate and lock on to the satellites, depending upon conditions at the location.

- ❑ Press the GPS On/Off soft key to turn the GPS feature on or off.
- ❑ Press the Location soft key to view the latitude, longitude, altitude and UTC Time. The location will display N/A for all parameters until such time as the GPS has synched to five satellites.
- ❑ Press the Quality soft key to display the number of tracked satellites and the GPS quality.
- ❑ Press the Reset soft key to reset the GPS.
- ❑ Back — Returns to the top-level SYS Menu.
- ❑ 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 (2003-2036) using the Up/Down arrow key or the keypad. Press **ENTER** when data entry is complete or **ESCAPE** to restore the previous value.
 - ❑ Back — Returns to the top-level SYS menu.
- ❑ Self Test — Start an instrument self test.
- ❑ Status — In cable and antenna analyzer freq or dist measurement mode, displays the current instrument status, including calibration status, temperature, and battery charge state. Press **ESCAPE** to return to operation.
- ❑ Language — Pressing this soft key immediately changes the language used to display messages on the Site Master status window. Choices are English, French, German, Spanish, Chinese, and Japanese. The default language is English.

Power Monitor Menus

Selecting Power Monitor 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 **AMPLITUDE** key is pressed.

- **Units** — Toggles between dBm and Watts.
- **Rel** — Turns relative mode OFF, if currently ON. If relative mode is currently OFF, turns it ON and causes the power level to be measured and saved as the base level. Subsequent measurements are then displayed relative to this saved value. With units of dBm, relative mode displays dBr; with units of Watts, relative mode displays % (percent).
- **Offset** — Turns Offset OFF, if currently ON. If Offset is currently OFF, turns it ON and opens the Offset parameter for data entry (0-60). Press ENTER when data entry is complete.
Offset is the attenuation (in dB) inserted in the line between the DUT and the RF detector. The attenuation is added to the measured input level prior to display.
- **Zero** — Turns Zero OFF, if currently ON. If Zero is currently OFF, this softkey turns it ON and initiates collection of a series of power level samples, which are averaged and saved. This saved value is then subtracted from subsequent measurements prior to display.

Symbols

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

Table 2-1. TFT LCD Icon Symbols

<u>Icon</u>	<u>Symbol</u>
	Site Master is in Hold for power conservation. To resume sweeping, press the RUN/HOLD key. When running on battery power, after 10 minutes without a key press, the Site 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 Site Master to the nearest Anritsu service center for repair.
	Lock fail indication. Check battery. (If the Site Master fails to lock with a fully charged battery, call your Anritsu Service Center.)
	When calibration is performed, the Site 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 Site Master has been calibrated with discrete Open, Short and Load components.
Cal Off	The Site Master has not been calibrated.
	GPS is on and locked to the satellites.
	This symbol displayed in red means GPS is on and is searching for satellites. The same symbol in green means the Site Master has stored the GPS location information but is not currently locked to the satellites. The data will remain stored until the unit is turned off.

Self Test

At turn-on, the Site 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 Site 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>
PLL Lock Fail	The reference oscillator 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 Site 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 Site 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 Site Master. <i>If condition persists, call your Anritsu Service Center.</i>

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

Range Error Messages

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

Table 2-3. Range Error Messages

Error Message	Description
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 limited to 1197 meters (3929 ft.) and 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_f</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 scale parameter top value is less than or equal to its bottom value. This applies to SWR and Cable Loss - Two Port modes.
RANGE ERROR: TOP>=BOTTOM	The scale parameter top value is greater than or equal to its bottom value. This applies to Return Loss and Cable Loss - One Port modes.

General Error Messages

A listing of General Error Messages is provided below.

Table 2-4. 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 display with no printer selected. Select a printer, then retry.
Cannot zero input signal too high	Attempting to perform a Power Monitor zero adjust function with an input of greater than -20 dBm.
No detector installed	Power Monitor or Cable Loss - Two Port mode is selected, but there is no detector connected to the instrument.
No Module Attached	Cable Loss - Two Port mode is selected, but there is no CW module connected to the instrument or the CW module is not responding or not compatible with this instrument.

Battery Information

Charging a New Battery

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

The NiMH battery supplied with the Site 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 50° C or below 0° C.

Charging the Battery in the Site Master

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

- Step 1.** Turn the Site Master off.
- Step 2.** Connect the AC-DC adapter (Anritsu part number: 40-168) to the Site 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 Site Master will illuminate, indicating the presence of external DC power, the battery charge indicator will light, and the battery will begin charging. The charging indicator will remain lit as long as the battery is charging. Once the battery is fully charged, the charging indicator will turn off. If the battery fails to charge, contact your nearest Anritsu service center.

NOTES: The Site Master is designed to automatically adjust the charge/discharge cycles in order to maximize the life of the battery. If the system has been running for a long period of time, the temperature inside the instrument can exceed 50° C. This circumstance will cause a charge cycle to be suspended, or will prevent a new charge cycle from starting. Charging will automatically begin, or resume, once the internal temperature of the battery is allowed to cool below 50° C. The battery charger's internal function is fully automatic and will determine the appropriate charge duration and DC current level.

In the case where the battery has been completely discharged to zero volts, the charger will perform a pre-charge at a low DC current until the battery reaches a safe voltage level for a fast rate charge to begin.

After a battery completes a fast rate charge cycle, a "Top Off" charge rate will begin. The "Top Off" charge will continue to charge the battery, but at a lower rate. This assures that the battery achieves maximum charge capacity as it cools down from the fast rate charge. The charge LED will remain lit during the "Top Off" charge duration.

If the AC/DC adapter is left plugged into the system and the battery level drops below 11.9 Volts, the charger will automatically begin a unique charge cycle that will quickly recharge the battery to 100% capacity. This unique charge cycle will safely keep the battery at a full charge as long as the AC/DC adapter is left plugged in.

Charging the Battery in the Optional Charger

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

- Step 1.** Remove the NiMH battery from your Site 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 Site Master, the battery indicator symbol will be continuously displayed at the top left corner of the Site Master display (Figure 2-10). 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.

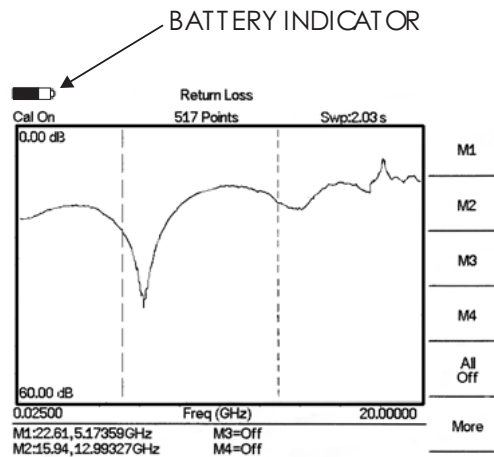


Figure 2-10. Site Master Battery Indicator

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

During operation, the battery condition can be viewed by pressing the **SYS** key and selecting the Self Test soft key (Figure 2-11). 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

Press **ESCAPE** to return.

Figure 2-11. 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 (Figure 2-12) and to degrade to 80% of original capacity after 12 months of continuous use.

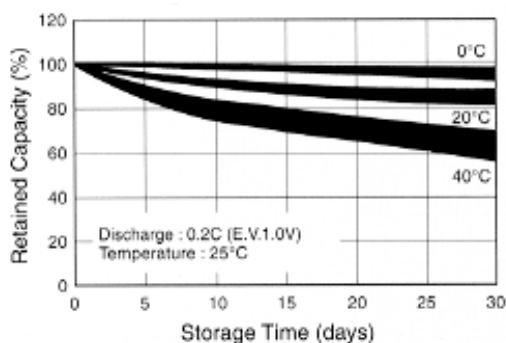


Figure 2-12. NiMH Battery Storage Characteristics

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 Site Master has already completed three charge and discharge cycles at the factory.
- Recharge the battery only in the Site Master, or in an Anritsu approved charger.
- When the Site Master or the charger is not in use, disconnect it from the power source.
- 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 (see Figure 2-12).
- 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!

Chapter 3

Getting Started

Introduction

This chapter provides a brief overview of the Anritsu Site Master. The intent of this chapter is to provide the user with a starting point for making basic cable and antenna analyzer and power monitor measurements. Procedures that are specific to cable and antenna analyzer mode and common to all modes are presented.

Power On Procedure

The Anritsu Site Master is capable of up to 1.5 hours of continuous operation from a fully charged, field-replaceable battery. Built-in energy conservation features allow battery life to be extended.

The Site Master can also be operated from a 12.5 Vdc source (which will also simultaneously charge the battery). This can be achieved with either the Anritsu AC-DC Adapter (P/N 40-168) or 12.5 Vdc Automotive Cigarette Lighter Adapter (P/N 806-62). Both items are included as standard accessories (see Chapter 1).

To power on the Site Master:

- Step 1.** Press the **ON/OFF** front panel key (Figure 3-1).

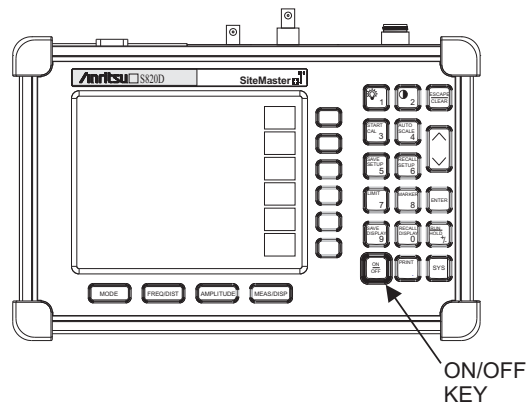


Figure 3-1. Site Master On/Off Key

- Step 2.** The Site Master will display the model number, the firmware revision, the internal temperature and voltage, and then perform a five second self test. At completion of the self-test, the screen displays a prompt to press **ENTER** to continue. If enter is not pressed, the Site Master will continue after a five second timeout.

- Step 3.** Press **ENTER** to continue.

The Site Master is now ready for operation.

CW Source Module Setup with Option 22

Before making Cable Loss - Two Port measurements with Option 22 enabled, the CW source module must be installed.

NOTE: To avoid damaging the Site Master, always turn off its power before connecting/disconnecting the cable from the CW source module to or from the CW Source Module Interface connector.

- Step 1.** With the Site Master turned off, connect the CW source module to the Site Master RF Out/Reflection port, as indicated on the module.
- Step 2.** Connect the cable from the source module to the CW Source Module Interface connector on the Site Master.
- Step 3.** Connect the RF detector cable to the Detector Input port on the CW source module.
- Step 4.** Press the **ON/OFF** front panel key (Figure 3-1).
- Step 5.** Press the **MODE** key.
- Step 6.** Select Cable Loss - Two Port mode and press **ENTER**.

The Site Master is now ready to make Cable Loss - Two Port measurements. To make standard measurements (Return Loss, Cable Loss - One Port, SWR), turn off power to the Site Master and remove the CW source module. When the module has been removed, turn on the Site Master and select the desired mode.

NOTE: The RF-Out port on the CW module can only be used for Cable Loss - Two Port measurements. For all other measurements (Return Loss, SWR, Cable Loss - One Port, and DTF), use the Site Master RF-Out/Reflection port.

Cable and Antenna Analyzer Mode

*NOTE: The Cable and Antenna Analyzer mode consists of the **FREQ** and **DTF** modes.*

Selecting the Frequency

For the OSL calibration the frequency range for the desired measurement must be set. The Site Master will automatically set the frequency when a particular signal standard is selected, or the frequency can be manually set using the F1 and F2 soft keys.

To set the frequency to a specific signal standard for an OSL calibration:

- Step 1.** Press the **FREQ/DIST** key.
- Step 2.** Press the Signal Standard soft key.
- Step 3.** Use the Up/Down arrow key to highlight the desired standard, then press the **ENTER** key to select.

To manually select 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 8.** Check that the start and stop frequencies displayed match the desired measurement range.

Calibration

Calibration Methods

For accurate results, the Site Master must be calibrated before making any measurements. The Site 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.

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.

NOTE: The OSL calibration applies to all measurements in the Cable and Antenna Analyzer modes except for the Cable Loss - 2 Port mode (Option 22) which uses a detector reference calibration.

If a Test Port Extension Cable is to be used, the Site 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, 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 Site 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 0-20 dB.
- ❑ When a SHORT is connected, a trace will be displayed between 0-20 dB.
- ❑ When a LOAD is connected, a trace will be displayed between 0-50 dB.

The following procedures explain standard OSL calibration. Refer to Figure 3-2 for a calibration setup diagram.

NOTE: An S820D with option 11NF has a special N-type test port connector that allows operation up to 20 GHz. However, the N-type calibration components are only specified up to 18 GHz. Therefore, when using these N-type calibration components with the S820D, data can be displayed up to 20 GHz, but specifications for data over 18 GHz are not guaranteed.

OSL Calibration Procedure

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.

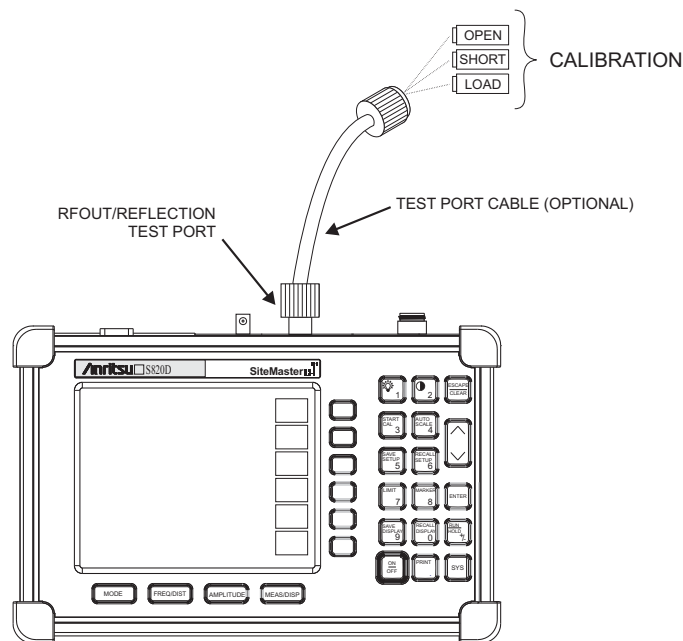


Figure 3-2. Calibration Setup

Coaxial OSL Calibration

- Step 1.** Select the appropriate frequency range, as described on page 3-2.
- Step 2.** Press the **START CAL** (3) key to start the OSL calibration procedure.
- Step 3.** Select the Coaxial soft key. The Coaxial DUT Connector Selection menu will appear, with the Start Calibration function highlighted. Check if the correct DUT

connector is selected. The selected connector type is marked by the symbol (*) and is also displayed at the bottom of the screen.

- Step 4.** If the correct DUT connector is selected, proceed with the calibration (go to Step 5). To choose a different connector, use the Up/Down arrow key to highlight the desired connector. Press the **ENTER** key to select the new connector and to go to its configuration listing, which lists the offset length values for the Short and Open, as well as the capacitance values for the Open. To choose a different connector, go back to the previous menu (use the Up/Down arrow key to highlight the text Coaxial DUT Connector Selection and then press the **ENTER** key). Otherwise, proceed with the calibration.
- Step 5.** Press the **ENTER** key or the Start Cal soft key to start the calibration. The message Connect OPEN to RF Out Port will appear in a message box.
- Step 6.** Connect the required Open component and press the **ENTER** key. After several seconds of measurements and calculations, the message Connect SHORT to RF Out Port will appear.
- Step 7.** Remove the Open, connect the required Short component and press the **ENTER** key. The message Connect LOAD to RF Out Port will appear.
- Step 8.** Remove the Short, connect the required calibrated Termination component and press the **ENTER** key. An audible tone will sound when the calibration is complete.
- Step 9.** 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 display.

*NOTE: When using calibration components with connectors not listed in the selection menu, highlight either of the Coax User Defined #1 or #2 selections and press the **ENTER** key to input the calibration coefficients for those particular components. In the configuration menu, use the Up/Down arrow key to highlight Short Offset Length and press the **ENTER** key. Enter the desired value in the pop-up window then press the **ENTER** key. Repeat this process for the remaining coefficients. Once the entries are completed, proceed with the calibration. The coefficients will be retained in memory even after the unit is powered down. Also, the coefficients will be saved as part of any Save Setup. However, if the unit is powered up in factory preset state, then the coefficients for both user defined connectors will be reset to 0 (this will not affect any coefficients that are part of the Save Setups). To store multiple user-defined configurations, enter the values for the OSL User Defined #1 or #2 settings, perform an actual calibration and then save the setup. Repeat this process for other user defined calibration components. Recalling any of the saved setups in the future will bring up the user defined values stored in that setup.*

Waveguide OSL Calibration

- Step 1.** Select the appropriate frequency range, as described on page 3-2.
- Step 2.** Press the **START CAL** (3) key to start the OSL calibration.
- Step 3.** Select the Waveguide soft key. The Waveguide Flange Selection menu will appear, with the Start Calibration function highlighted. Check if the correct DUT waveguide is selected from the list in the menu. The selected waveguide flange type is marked by the symbol (*) and is also displayed at the bottom of the screen.
- Step 4.** If the correct DUT waveguide is selected, proceed with the calibration (go to Step 5). To choose a different waveguide, use the Up/Down arrow keys to highlight the desired waveguide. Press the **ENTER** key to select the new waveguide flange and go to its configuration listing, which lists the lengths of the calibration 1/8th and 3/8th Offset Shorts as well as the waveguide Cutoff Frequency. To choose a different waveguide, go back to the previous menu (use the Up/Down arrow key to highlight Waveguide Flange Selection and press the **ENTER** key). Otherwise, proceed with the calibration.
- Step 5.** Press the **ENTER** key or the Start Cal soft key to start the calibration. The message Connect 1/8 OFFSET SHORT to RF Out Port will appear in a message box.
- Step 6.** Connect the required 1/8 offset short component and press the **ENTER** key. After several seconds of measurements and calculations, the message Connect 3/8 OFFSET SHORT to RF Out Port will appear.
- Step 7.** Remove the 1/8 offset short, connect the required 3/8 offset short component and press the **ENTER** key. The message Connect LOAD to RF Out Port will appear.
- Step 8.** Remove the 3/8 offset short, connect the required calibrated Termination component and press the **ENTER** key. An audible tone will sound when the calibration is complete.
- Step 9.** 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 display.

*NOTE: When using waveguide calibration components with flanges not listed in the selection menu, highlight either of the WG User Defined #1 or #2 selections and press the **ENTER** key to input the calibration parameters for those particular components. In the configuration menu, use the Up/Down arrow key to highlight 1/8 Offset Length and press the **ENTER** key. Enter the desired value in the pop-up window then press the **ENTER** key. Repeat this process for the remaining parameters. Once the entries are completed, proceed with the calibration. The parameters will be retained in memory even after the unit is powered down. Also, the parameters will be saved as part of any Save Setup. However, if the unit is powered up in factory preset state, then the parameters for both user defined calibration components will be reset (this will not affect any parameters that are part of the Save Setups). To store multiple user-defined configurations, enter the values for the WG User Defined #1 or #2 settings, perform an actual calibration and then save the setup. Repeat this process for other user defined calibration components. Recalling any of the saved setups in the future will bring up the user defined values stored in that setup.*

NOTE: The calibration coefficients stored in the Site Master and used during the OSL or WG calibrations are specific to the calibration components listed as accessories for the S810D or S820D. Using calibration components that are not listed as accessories may lead to inaccurate calibration results, unless the user-defined configurations are actually used to perform the calibration.

Calibration with a Test Port Extension Cable

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

Cable Loss - Two Port Calibration

In Cable Loss - Two Port mode (enabled with Option 22) the calibration process is not an OSL calibration but a detector reference calibration.

- Step 1.** With the CW source module installed, press the Start Cal (3) soft key to start the calibration.
- Step 2.** Connect the detector to the RF Out port of the CW source module (or to an extension cable connected to this port).
- Step 3.** Press the **Enter** key to start the calibration.
- Step 4.** 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 display. In addition, verify that the trace on the display is approximately at 0dB over the entire frequency band.

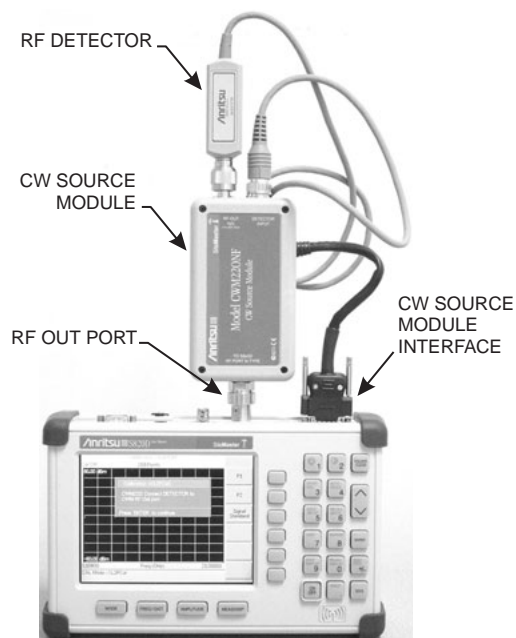


Figure 3-3. Cable Loss - Two Port Calibration Setup

Auto Scale

The Site Master can automatically set the scale to the minimum and maximum values of the measurement on the y-axis of the graph. This function is particularly useful for measurements in SWR mode. To automatically set the scale, press the **AUTO SCALE** key. The Site Master will automatically set the top and bottom scales to the minimum and maximum values of the measurement with some margin on the y-axis of the LCD.

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.

NOTES: The default y-axis scale of the graph varies between the different modes, as indicated below:

<i>Return Loss:</i>	<i>0 to 60 dB</i>
<i>SWR:</i>	<i>1 to 65.53</i>
<i>Cable Loss - One Port:</i>	<i>0 to 30 dB</i>
<i>Cable Loss - Two Port:</i>	<i>+60 to -60 dB(m)</i>

If the scale is not changed, some measurement results may not be easily viewed on the screen.

The scale for Return Loss and Cable Loss - One Port modes is always positive and inverted when displayed on the screen (with 0 dB being at the top and 60 dB or 30 dB at the bottom). In those two modes, the negative scale is implied but is not displayed on the screen. For Cable Loss - Two Port mode, the scale extends from positive to negative. Therefore, the display shows both positive and negative numbers in the more traditional scale of +60 dB(m) at the top and -60 dB(m) at the bottom.

Set the Distance and Waveguide or Cable Type

In Distance-To-Fault (DTF) mode, the length of the transmission line (distance) and the waveguide or cable type are selected. The waveguide type determines the cutoff frequency and waveguide loss, and 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 waveguide or cable is very important for accurate measurements and for identifying faults in the transmission line. Selecting the incorrect waveguide or cable type will shift the DTF trace vertically and horizontally making it difficult to accurately locate faults. Depending upon whether the current calibration is for coaxial cable or waveguide media, the DTF Aid soft key will display the DTF parameters for the appropriate media.

- Step 1.** Press the **MODE** key.
- Step 2.** Select DTF Return Loss or DTF SWR mode. The Site 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, highlight Cable = or Waveguide = and press **ENTER**. Use the Up/Down arrow key to select the cable or waveguide from the list. The custom cable list can be created and uploaded using the Handheld Software Tools application provided with the Site Master (Chapter 10).
- Step 7.** The Propagation Velocity and Cable loss for the selected coaxial cable, or the Cutoff Frequency and Loss of the selected waveguide, will be displayed, and can be changed using the Up/Down arrow key to select the parameter. Press **ENTER** to edit, and **ENTER** again to accept the change.
- Step 8.** When all parameters have been set, press **ENTER**.

Save and Recall a Setup

Saving a Setup

Saving a cable and antenna analyzer 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.
- Step 2.** Use the key pad or the Up/Down arrow key to select a location.
- Step 3.** Press **ENTER** to save the setup.

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.

NOTE: Only setups from the current mode are displayed.

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 soft keys 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 Site Master displays information in metric units. Use the following procedure to change the display to English units when in cable and antenna analyzer mode.

- Step 1.** Press the **SYS** key.
- Step 2.** Select the Options soft key.
- Step 3.** Press the Units soft key 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 Site 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 1.** Press the **MARKER** key to call up the Markers menu.
- Step 2.** Press the M1 soft key to select the M1 marker function.

- Step 3.** Press the Edit soft key and enter an appropriate value using the keypad or Up/Down arrow key to move the marker without redrawing the trace. Pressing the **ON/OFF** soft key activates or deactivates the M1 marker function.
- Step 4.** Press the Back soft key to return to the Markers Menu.
- Step 5.** Repeat the steps for markers M2, M3, M4, M5 and M6.

Adjusting Limits

The Site 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.

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: Start Freq, Start 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 Site 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 Site 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.
- Step 3.** Press the Limit Beep soft key again to disable the limit beep.

NOTE: The audible "beep" will sound when the trace goes higher than the limit in SWR and Return Loss modes (Freq and DTF). The "beep" will sound when the trace goes lower than the limit in Cable Loss Mode.

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

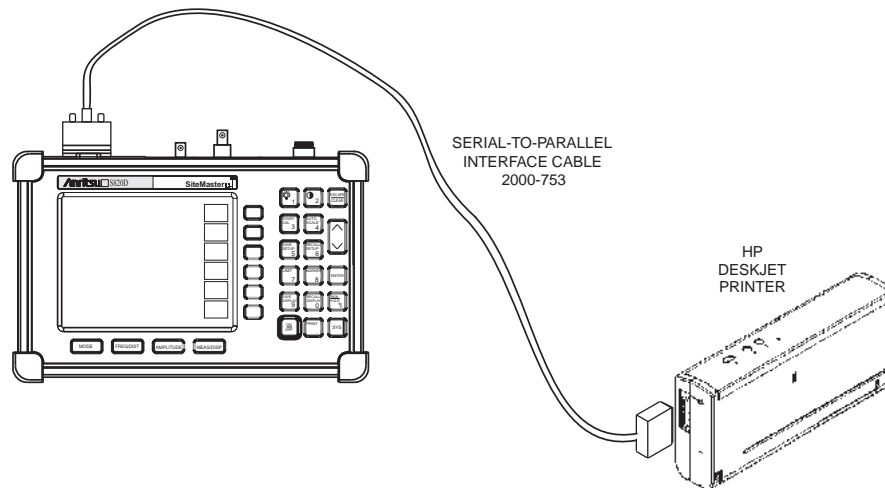


Figure 3-4. Site Master Printer Setup

Printer Switch Settings

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

SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
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).

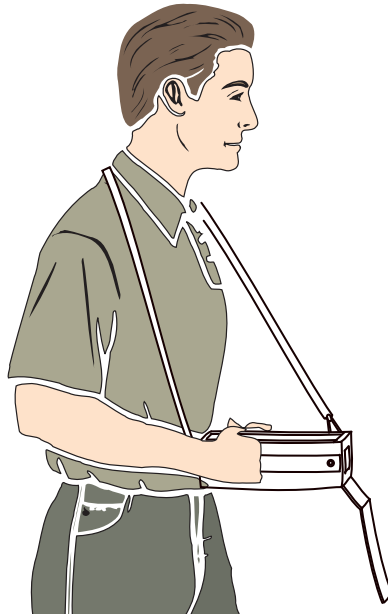


Figure 3-5. Using the Site Master Soft Carrying Case

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 Site 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.

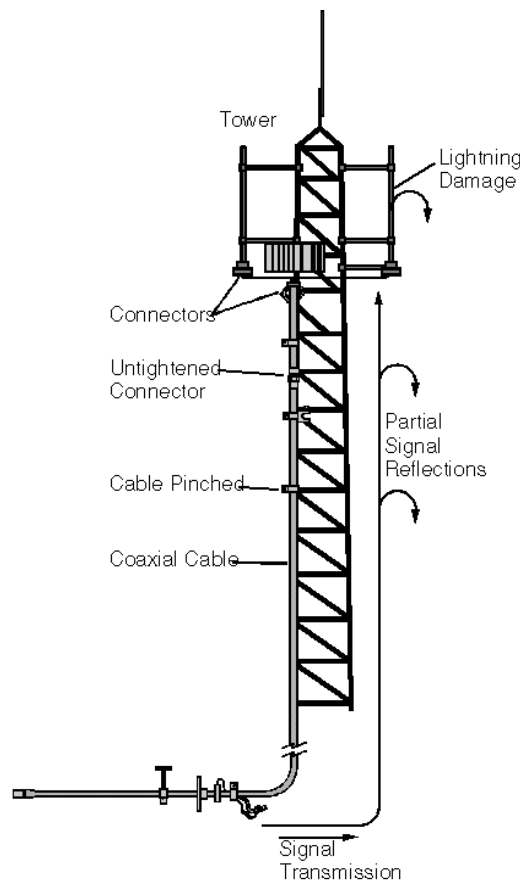


Figure 4-1. A Typical Transmission Feed Line System

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 Ω 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 (in Cable Loss - One Port mode), or using the external CW source module and detector (in Cable Loss - Two Port mode). This measurement 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.

Fixed CW Mode

Fixed CW mode can be used to maximize sweep speeds of both frequency and DTF measurements. With Fixed CW on, sweep times can be twice as fast as with Fixed CW off. However, making measurements with Fixed CW on may 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 Fixed CW on and off can verify that the Site Master is reducing the interfering signals. If there is no appreciable difference, then it should be safe to make measurements with Fixed 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.

If Fixed CW is on during a normal RL or SWR measurement, the Site Master may be more susceptible to interfering signals. Interfering signals can make the measurement look better or worse than it really is.

NOTE: Fixed CW is always on when the Site Master is in Cable Loss - Two Port mode.

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

Coaxial Cable	Waveguide
Site Master Model S810D or S820D	Site Master Model S810D or S820D
Precision Open/Short/Load kits, Anritsu OSLK50 or OSLN50 (or use individual components below)	1/8 Offset Short
Precision Open/Short, Anritsu 22K50, 22KF50, 22N50 or 22NF50	3/8 Offset Short
Precision Load, Anritsu 28K50, 28KF50, 28N50-2 or 28NF50-2	Precision Waveguide Load
Test Port Extension Cable, Anritsu 15NNF50-1.5B or 15KKF50-1.5A	Test Port Extension Cable, Anritsu 15NNF50-1.5B or 15KKF50-1.5A

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, automatically by selecting a signal standard or manually using the F1 and F2 soft keys, as described on page 3-3.
- Step 4. Calibrate the Site Master as described on page 3-3.
- Step 5. Connect the Device Under Test to the Site Master. A trace will be displayed on the screen when the Site Master is in the sweep mode.
- Step 6. Press **SAVE DISPLAY** (page 3-9), 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 measurement trace:

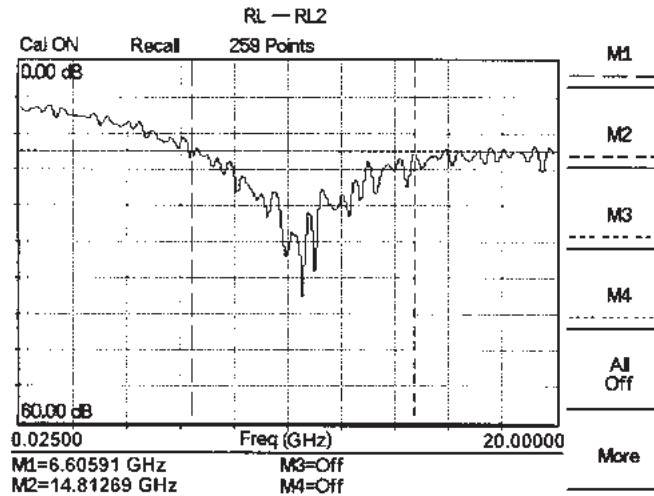


Figure 4-2. Typical System Return Loss Trace

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

Cable/Waveguide 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 Site Master in one of two ways: One Port Testing, using either Cable Loss - One Port mode or Return Loss mode, or Two Port Testing, using Cable Loss - Two Port mode. For cable loss values less than 10dB, either method can be used. For cable loss values greater than 10dB, the two-port method must be used to obtain accurate results.

Figure 4-3 shows a comparison between measurements made using the One Port and Two Port Cable Loss modes. Measurements made on a cable with a maximum of 10dB of loss show good correlation between the two modes. Measurements made when the cable is attached to a 20 dB coupler show that the One Port mode is not able to accurately measure the loss, whereas, the Two Port mode measures the overall (cable plus coupler) loss accurately.

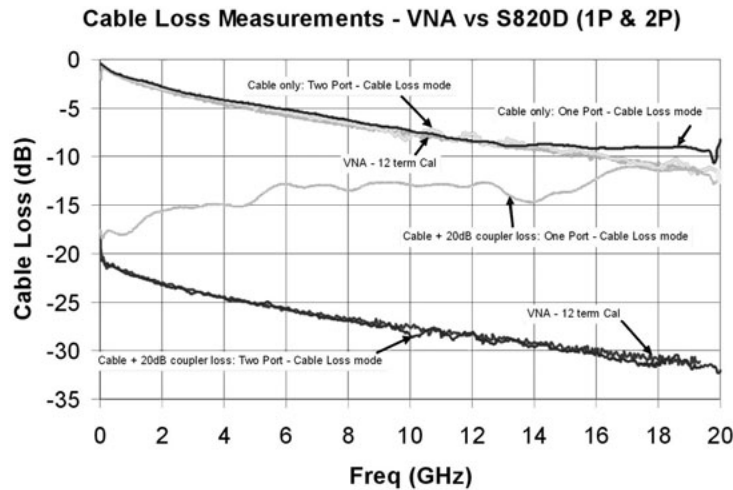


Figure 4-3. Comparison of One Port and Two Port Cable Loss Mode Measurements

One Port Testing

Required Equipment

Coaxial Cable	Waveguide
Site Master Model S810D or S820D	Site Master Model S810D or S820D
Precision Open/Short/Load kits, Anritsu OSLK50 or OSLN50 (or use individual components below)	1/8 Offset Short
Precision Open/Short, Anritsu 22K50, 22KF50, 22N50 or 22NF50	3/8 Offset Short
Precision Load, Anritsu 28K50, 28KF50, 28N50-2 or 28NF50-2	Precision Waveguide Load
Test Port Extension Cable, Anritsu 15NNF50-1.5B or 15KKF50-1.5A	Test Port Extension Cable, Anritsu 15NNF50-1.5B or 15KKF50-1.5A

Device Under Test

- Transmission Feed Line

Procedure - Cable Loss - One Port Mode

- Step 1.** Press the MODE key.
- Step 2.** Select FREQ-CABLE LOSS - ONE PORT using the Up/Down arrow key and press ENTER.
- Step 3.** Set the start and stop frequencies, F1 and F2, as described on page 3-3.
- Step 4.** Connect the Test Port Extension cable to the RF port and calibrate the Site Master as described on page 3-3.
- Step 5.** Save the calibration setup (page 3-9).
- Step 6.** Connect the Device Under Test to the Site Master phase stable Test Port Extension cable. A trace will be displayed on the screen as long as the Site Master is in sweep mode. Connect a Short to the other end of the Device Under Test cable.
- Step 7.** Press the MARKER key.
- Step 8.** Set M1 to MARKER TO PEAK. The value measured is the minimum loss value.
- Step 9.** Set M2 to MARKER TO VALLEY. The value measured is the maximum loss value.
- Step 10.** The average cable loss value (over the entire frequency range in the sweep) is calculated and shown in the message area at the bottom of the display.
- Step 11.** Press SAVE DISPLAY (page 3-9), name the trace, and press ENTER.
- Step 12.** Verify the measured insertion loss against the calculated insertion loss. For example:

	Type	Attenuation (dB/ft)	× Length (ft)	= Loss (dB)
First Jumper	LDF4-50A	0.0325	20	0.65
Main Feeder	LDF5-50A	0.0186	150	2.79
Top Jumper	LDF4-50A	0.0325	10	0.325

Number of connector pairs (3) times the loss per pair (in dB) equals the connector loss: $3 \times 0.28 = 0.84$.

The insertion loss of the transmission system is equal to:

$$\text{First Jumper loss} + \text{Main Feeder Loss} + \text{Top Jumper Loss} + \text{Connector Loss} \\ 0.65 + 2.79 + 0.325 + 0.84 = 4.61 \text{ dB}$$

Procedure - Return Loss Mode

- 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 3-3.
- Step 4.** Connect the Test Port Extension cable to the RF port and calibrate the Site Master as described on page 3-3.
- Step 5.** Save the calibration set up (page 3-9).

- Step 6.** Connect the Device Under Test to the Site Master phase stable Test Port Extension cable. A trace will be displayed on the screen as long as the Site Master is in sweep mode. Connect a Short to the other end of the Device Under Test cable.
- Step 7.** Press the AMPLITUDE key and set TOP and BOTTOM values of the display.
- Step 8.** Press the MARKER key.
- Step 9.** Set M1 to MARKER TO PEAK.
- Step 10.** Set M2 to MARKER TO VALLEY.
- Step 11.** Calculate the insertion loss by averaging M1 (marker to peak) and M2 (marker to valley) and dividing by two as follows:

$$\text{Insertion Loss} = \frac{\frac{M1 + M2}{2}}{2}$$

- Step 12.** Press SAVE DISPLAY (page 3-9), name the trace, and press ENTER.

Figure 4-4 is an example of a typical transmission line cable loss measurement trace using a standard calibration.

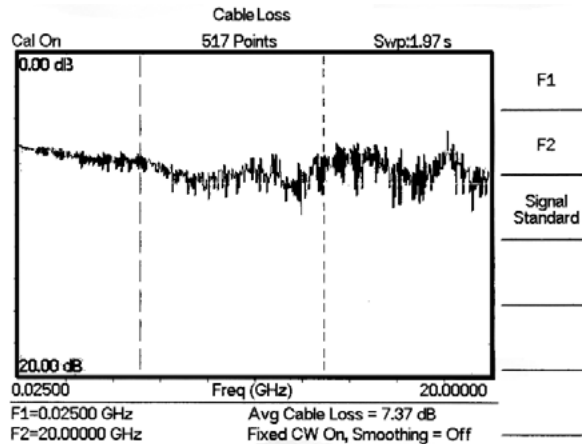


Figure 4-4. Typical Transmission Line Cable Loss Trace

NOTE: In either of the above procedures, apply a smoothing level between 1 and 20 to remove the ripple in the trace data. The ripple, which is produced by multiple reflections from the cable connectors, can cause measurement errors. Removing the ripple allows for more accurate cable loss measurements. Below is an example of how smoothing can remove the ripple in a cable loss measurement to produce a frequency swept average of the data.

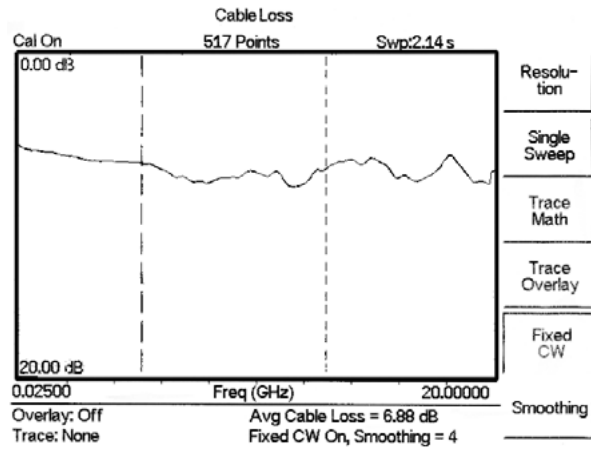


Figure 4-5. Typical Transmission Line Cable Loss Trace with Smoothing Applied

Two Port Testing

For cable system loss values of less than 10dB, the standard Cable Loss – One Port measurement described in the previous section produces accurate results. However, for systems with cables losses greater than 10dB, a two port measurement is required. With Options 22SF or 22NF, the S810D or S820D use an external CW source module and a detector to make two port measurements. The CW source module generates the stimulus for one end of the cable. The detector connects to the other end of the cable and receives the stimulus. Depending on the return loss of the cables under test, this measurement can produce accurate results for loss values up to 30dB.

Required Equipment

- ❑ Site Master Model S810D or S820D with Option 22SF or 22NF
- ❑ CW Source Module CWM220B-SF or CWM220B-NF (included in option 22xF)
- ❑ Detector 560-7S50B or 560-7N50B (included in option 22xF)
- ❑ Test Port Extension Cable, Anritsu 15NNF50-1.5B or 15KKF50-1.5A

Procedure - Cable Loss – Two Port Mode

- Step 1.** Press the MODE key.
- Step 2.** Select FREQ-CABLE LOSS – TWO PORT 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-Out port of the CWM220B-xF module and calibrate the Site Master as described on page 3-7.
- Step 5.** Save the calibration setup (page 3-9).
- Step 6.** Connect the Device Under Test between the Site Master phase stable Test Port Extension cable and the detector. A trace will be displayed on the screen as long as the Site Master is in sweep mode.
- Step 7.** Press the **MARKER** key.
- Step 8.** Set M1 to MARKER TO PEAK. The value read is the minimum cable loss value
- Step 9.** Set M2 to MARKER TO VALLEY. The value read is the maximum cable loss value.
- Step 10.** The average cable loss value (over the entire frequency range in the sweep) is calculated and shown in the message area at the bottom of the display.
- Step 11.** Press SAVE DISPLAY (page 3-9), name the trace, and press **ENTER**.

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

Coaxial Cable	Waveguide
Site Master Model S810C or S820C	Site Master Model S810C or S820C
Precision Open/Short, Anritsu 22K50, 22KF50, 22N50 or 22NF50	1/8 Offset
Precision Load, Anritsu 28K50, 28KF50, 28N50-2 or 28NF50-2	3/8 Offset
Test Port Extension Cable, Anritsu 15NNF50-1.5C or 15KKF50-1.5C	Precision Waveguide Load
Optional 510-90 Adapter, DC to 7.5 GHz, 50 ohm, 7/16(F)-N(M)	Test Port Extension Cable, Anritsu 15NNF50-1.5C or 15KKF50-1.5C
Ruggedized Adapter, Precision RK (m) to N (f) Anritsu 34RKNF50	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 Site Master as described on page 3-3.
- Step 4.** Save the calibration set up (page 3-9).
- Step 5.** Connect the Device Under Test to the Site Master phase stable Test Port Extension cable. A trace will be displayed on the screen as long as the Site Master is in sweep mode.
- Step 6.** Press the **FREQ/DIST** key.
- Step 7.** Set the D1 and D2 values. The Site Master default for D1 is zero.

If the media being tested is coaxial cable:

- 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.

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

Step 10. Record the connector transitions.

Figure 4-6 shows an example of a typical DTF return loss measurement trace.

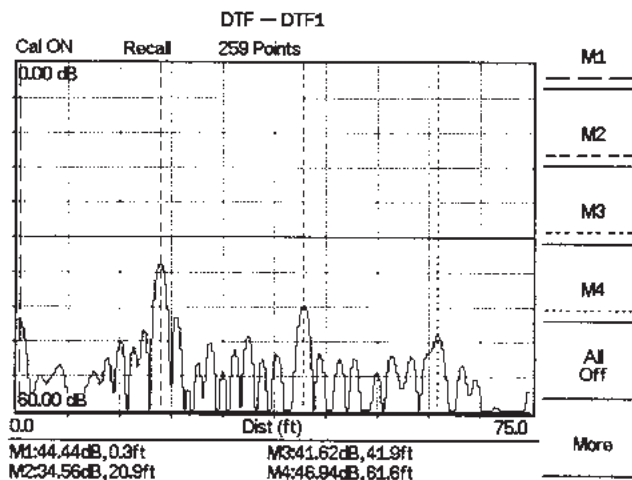


Figure 4-6. Typical DTF Return Loss Trace

In the above example:

- Marker M1 marks the first connector, the end of the Site 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.

If the media being tested is waveguide:

Step 11. Press the DTF AID soft key and select the appropriate waveguide type to set the cutoff frequency and loss factor.

NOTE: Selecting the right cutoff frequency and propagation loss is very important for accurate measurements, otherwise the faults can not be identified accurately and insertion loss will be incorrect.

Step 12. Press **SAVE DISPLAY** (page 3-9) name the trace, and press **ENTER**.

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 Site 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 ΔF 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

Coaxial Cable	Waveguide
Site Master Model S810D or S820D	Site Master Model S810D or S820D
Precision Open/Short, Anritsu 22K50, 22KF50, 22N50 or 22NF50	1/8 Offset
Precision Load, Anritsu 28K50, 28KF50, 28N50-2 or 28NF50-2	3/8 Offset
Test Port Extension Cable, Anritsu 15NNF50-1.5C or 15KKF50-1.5C	Precision Waveguide Load
Optional 510-90 Adapter, DC to 7.5 GHz, 50 ohm, 7/16(F)-N(M)	Test Port Extension Cable, Anritsu 15NNF50-1.5C or 15KKF50-1.5C
Ruggedized Adapter, Precision RK (m) to N (f) Anritsu 34RKNF50	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 Site Master as described on page 3-3.
- Step 4.** Press **SAVE SETUP** and save the calibration set up (page 3-9).
- Step 5.** Connect the Device Under Test to the Site 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 3-9) name the trace, and press **ENTER**.

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

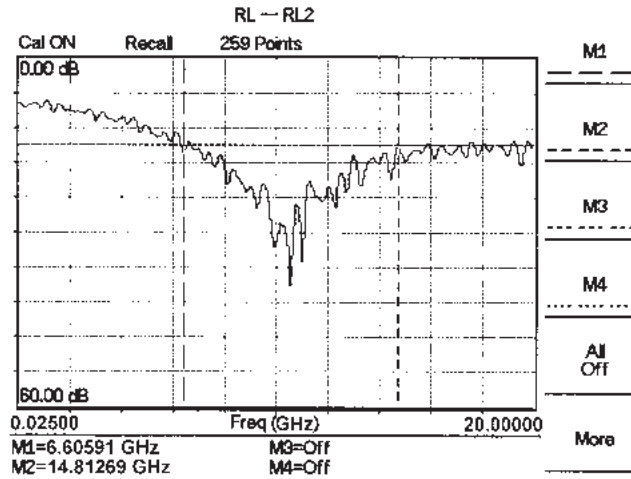


Figure 4-7. Antenna Return Loss Trace

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

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

NOTES:

VSWR is the antenna manufacturer's specified VSWR.

Use Handheld Software Tools to convert VSWR to Return Loss, or Return Loss to VSWR.

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

Chapter 5

Power Measurement

Introduction

The Site Master can be used for making power measurements with broadband RF detectors, such as the 10 MHz to 20 GHz Anritsu 560-7N50B or 560-7S50B. The power monitor displays the measured power results in dBm or Watts.

Power Measurement

Required Equipment

- ❑ Site Master Model S810D or S820D
- ❑ Broadband RF detector, Anritsu P/N 560-7N50B
- ❑ 30 dB, 50 Watt, bi-directional, DC –18 GHz, N(m) – N(f), Attenuator, 42N50A-30

Procedure

- Step 1.** Press the **ON/OFF** key on the Site Master.
- Step 2.** Press the **MODE** key.
- Step 3.** Use the Up/Down arrow key to select the Power Monitor mode and press **ENTER**.

NOTE: If the detector is not installed, the Site Master will display an error message (page 2-21). If the detector is installed and the error message appears, check the connections between the detector cable and the Site Master connector. If the error message persists, contact the nearest Anritsu Service Center.

Zeroing the Power Monitor

- Step 4.** With no power applied to the DUT, press the Zero soft key. Wait for a few seconds while the Site Master accumulates data samples of the quiescent power. When complete, Zero Adj: On is displayed in the message area.

Measuring High Input Power Levels

- Step 5.** Insert an attenuator between the DUT and the RF detector to protect the Site Master so that the input power level is less than or equal to 20 dBm.
- Step 6.** Press the Offset dB soft key.
- Step 7.** Enter the attenuation in dB using the keypad. Press the **ENTER** key to complete the entry. The message area will show Relative: On along with the entered value in dB.

Displaying Power in dBm and Watts

- Step 8.** Press the Units soft key to display power in Watts.

Displaying Relative Power

NOTE: With option 22, the Site Master can make this relative power measurement over a swept frequency range (page 4-8).

- Step 9.** With the desired base power level input to the Site Master, press the REL soft key. The message area will show Relative: On and the power reading will indicate 100%.
- Step 10.** Press the Units soft key to display power in dBm. Since Relative is ON, the power reading will be in dBm, relative to the base power level.

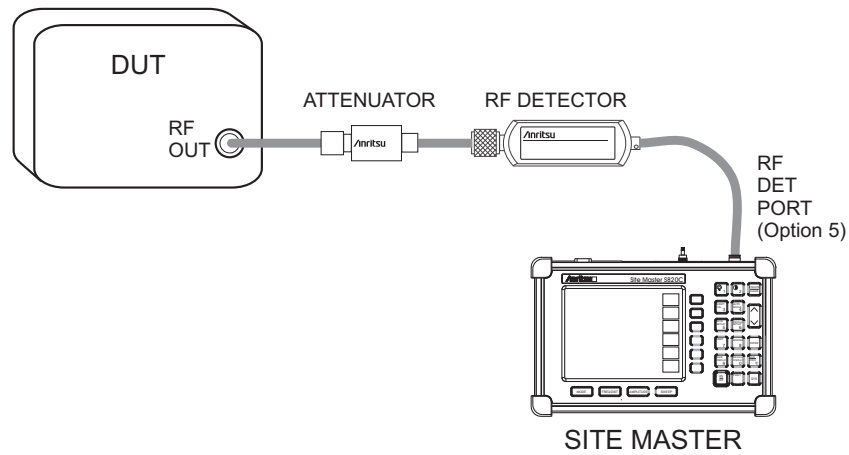


Figure 5-1. Power Monitor Measurement Setup for Absolute Power Measurements

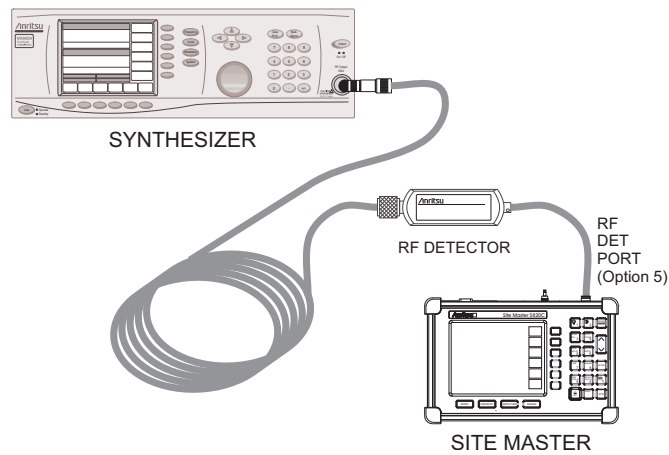


Figure 5-2. Power Monitor Measurement Setup for Thru Line Insertion Measurements

NOTE: With Option 5, the Site Master is equipped with an interface connector that mates directly with the RF detector.

With Option 22, the Site Master is equipped with a different interface connector that mates to the CW source module. With the CW source module installed on the Site Master, power monitor measurements can still be made using the detector attached to the module. Use the standard Power Monitor mode to make such measurements.

Alternatively, to use the Power Monitor mode without the CW source module, the RF detector can be connected directly to the Site Master via the adaptor cable, Anritsu part number 66379.

Chapter 6

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 ten 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
- Create custom cables 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:

- Step1.** Insert the Anritsu Handheld Software Tools disk in the CDROM drive.
- Step2.** From the Windows Start menu, select **Run**.
- Step3.** Type: **X:\Setup.exe** where X is the drive letter of your CDROM drive.
- Step4.** 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.

- Step1.** Select **Start, Programs** and select **Software Tools**.
- Step2.** When the program has loaded, select **Settings, Communication**.
- Step3.** 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.)

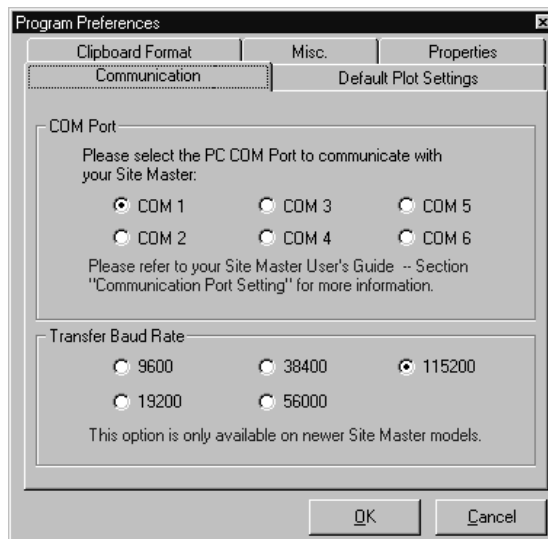


Figure 6-1. Communication Setting Dialog Box

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 adapter, part number 551-1691, if required).

- Step1.** Install the null modem serial interface cable to the RS232 Serial Interface connector on the test connector panel.
- Step2.** Connect the other end of the serial interface cable to the appropriate COM port connector on the PC.
- Step3.** Turn on both the instrument and the PC.

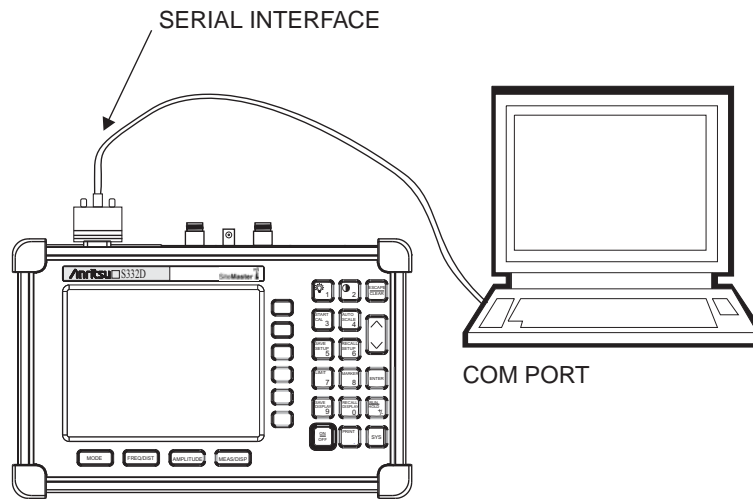


Figure 6-2. Serial Cable Connection

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 | Power Monitor |
| Transmission Measurement | |

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, dB μ V, V or W 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 **Export to 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:

- Step1.** Select the trace to be copied with the mouse cursor.
- Step2.** Select **Edit** and then **Copy**. The file will copied to the clipboard, or select **File** and then **Export** to a Windows metafile.
- Step3.** Open the target application (Microsoft Word, etc.).
- Step4.** 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:

- Step1.** Select the trace to be copied with the mouse cursor.
- Step2.** Click on the **File** menu and select **Export to Text File for a Spreadsheet** from the pull down menu.
- Step3.** Save the file to a local directory.
- Step4.** Exit the Handheld Software Tools program and open the spreadsheet application.
- Step5.** 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.

Step1. Select the **File** menu and select the **Database**.

Step2. 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: The Antenna Factor parameter is only applicable to 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

V₁ = 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

λ = 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

- Step1.** 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.
- Step2.** 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. Enter an antenna frequency and gain only, and Software Tools will automatically calculate the antenna factor.

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

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

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

- Step3.** 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:

- Step1.** Connect the RS232 cable between the PC and the instrument.
- Step2.** 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.
- Step3.** The antennas available can be viewed by pressing the **MEAS/DISP** key, then the Measure, Field Strength and Select Custom 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:

- Step1.** Connect the RS232 cable between the PC and the instrument.
- Step2.** Verify that the instrument is sweeping at a minimum sweep rate of 5 seconds/sweep.
- Step3.** Select the **Query Antenna Factors** button in the Antenna Editor.
- Step4.** Modify the desired antenna(s), then upload again as required.

Cable and Waveguide Lists

A custom cable list and waveguide list can be created in Software Tools and uploaded to the Site Master. Some standard cables and waveguides are stored in the Site 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). The waveguide list contains information on the waveguide cutoff frequency and loss. These parameters are important when identifying faults and discontinuities of transmission lines.

NOTE: Values for the cable list are taken from manufacturers specifications. Complex digital communications systems may require adjustment to attenuation values at the higher frequencies. Contact the manufacturer for the appropriate cable losses.

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

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

To open an existing cable or waveguide list file, select File and Open. Select the desired cable or waveguide list and press Enter. To open the factory default cable or waveguide list, select File and Default S8x0D Cable (or Default Waveguide).

Creating a Custom Cable or Waveguide List

To create a custom cable or waveguide list:

- Step1.** Select the File menu and select New.
- Step2.** Type in or cut and paste the cable or waveguide types and specifications for the desired entries.

Uploading a Cable or Waveguide List

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

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

Querying the Site Master Cable or Waveguide List

Query Cable or Waveguide List allows the user to check and review the contents of the custom cable or waveguide list in the Site Master.

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

DTF Plots

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

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

- Step1.** Capture a plot or load a previously saved plot.
- Step2.** 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.
- Step3.** 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 un-aliased range (D-Max), 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:

- Step1.** Capture a plot or load a previously saved Return Loss or VSWR plot.
- Step2.** 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.
- Step3.** 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

Tables A-1 and A-2 provide standard listings of common coaxial cables along with their Relative Propagation Velocity and Nominal Attenuation values in dB/m @ 1, 2, and 2.5 GHz. (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 @ 1 GHz	Nominal Attenuation dB/m @ 2 GHz	Nominal Attenuation dB/m @ 2.5 GHz
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
Andrew	AVA5-50 7/8"	0.91	0.0376	0.0553	0.0627
Andrew	AVA7-50 1 5/8"	0.92	0.0225	0.0336	0.0384
Andrew	VXL5-50 7/8"	0.88	0.0446	0.0659	0.0750
Andrew	VXL6-50 1 1/4"	0.88	0.0320	0.0483	0.0560
Andrew	VXL7-50 1 5/8"	0.88	0.0243	0.0371	0.0427
Andrew	EFX2-50	0.85	0.0368	0.0541	0.0615
Andrew	HL4RP-50A	0.88	0.0226	0.0331	0.0376

Appendix A Reference Data

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

Manufacturer	Cable Type	Relative Propagation Velocity (Vf)	Nominal Attenuation dB/m @ 1 GHz	Nominal Attenuation dB/m @ 2 GHz	Nominal Attenuation dB/m @ 2.5 GHz
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
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

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

Manufacturer	Cable Type	Relative Propagation Velocity (Vf)	Nominal Attenuation dB/m @ 1 GHz	Nominal Attenuation dB/m @ 2 GHz	Nominal Attenuation dB/m @ 2.5 GHz
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
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

Appendix A Reference Data

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

Manufacturer	Cable Type	Relative Propagation Velocity (V _f)	Nominal Attenuation dB/m @ 1 GHz	Nominal Attenuation dB/m @ 2 GHz	Nominal Attenuation dB/m @ 2.5 GHz
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
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

Table A-2. Coaxial Cable Technical Data

Cable Type	Maximum Frequency (GHz)	Relative Propagation Velocity (V _f)	Nominal Attenuation dB/m @ 6 GHz
FSJ1-50A	20.4	0.84	0.53
FSJ2-50	13.4	0.83	0.37
FSJ4-50B	10.2	0.81	0.35
EFX2-50	13.5	0.85	0.34
LDF1-50	15.8	0.86	0.31
LDF2-50	13.5	0.88	0.32
LDF4-50A	8.8	0.88	0.22
HJ4-50	10.9	0.914	0.26
HJ4.5-50	6.6	0.92	0.15

Calibration Components

The calibration components part numbers in the following table are broken down as follows:

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

Table A-3. Precision Waveguide Calibration Components

Part Number	Freq. Range	Waveguide Type	Compatible Flanges
xxUM70	5.85 to 8.20 GHz	WR137, WG14	CAR70, PAR70, UAR 70, PDR70
xxUM84	7.05 to 10.00 GHz	WR112, WG15	CBR84, UBR84, PBR84, PDR84
xxUM100	8.20 to 12.40 GHz	WR90, WG16	CBR100, UBR100, PBR100, PDR100
xxUM120	10.00 to 15.00 GHz	WR75, WG17	CBR120, UBR120, PBR120, PDR120
xxUA187	3.95 to 5.85 GHz	WR187, WG12	CPR187F, CPR187G, UG-1352/U, UG-1353/U, UG-1728/U, UG-1729/U, UG-148/U, UG-149A/U
xxUA137	5.85 to 8.20 GHz	WR137, WG14	CPR137F, CPR137G, UG-1356/U, UG-1357/U, UG-1732/U, UG-1733/U, UG-343B/U, UG-344/U, UG-440B/U, UG-441/U
xxUA112	7.05 to 10.00 GHz	WR112, WG15	CPR112F, CPR112G, UG-1358/U, UG-1359/U, UG-1734/U, UG-1735/U, UG-52B/U, UG-51/U, UG-137B/U, UG-138/U
xxUA90	8.20 to 12.40 GHz	WR90, WG16	CPR90F, CPR90G, UG-1360/U, UG-1361/U, UG-1736/U, UG-1737/U, UG-40B/U, UG-39/U, UG-135/U, UG-136B/U
xxUA62	12.40 to 18.00 GHz	WR62, WG18	UG-541A/U, UG-419/U, UG-1665/U, UG1666/U
xxUA42	17.00 to 26.50 GHz	WR42, WG20	UG-596A/U, UG-595/U, UG-597/U, UG-598A/U

Waveguide-to-Coaxial Adapters

Part numbers that end with N = N type connector, part numbers that end with K = K type connectors.

Table A-4. Coaxial to Universal Waveguide Adapters

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

Flange Compatibility

Table A-5. Universal Flange Compatibility (1 of 3)

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

Appendix A Reference Data

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

Calibration Component Part Number	Start Frequency (GHz)	Stop Frequency (GHz)	Waveguide Type	Flange Type	Compatible Flanges
xxUA187	3.950	5.850	WR187 WG12	UnivUS-187	CPR187F CPR187G UG-1352/U UG-1353/U UG-1728/U UG-1729/U UG-148/U UG-149A/U
xxUA159	4.900	7.050	WR159 WG13	UnivUS-159	CPR159F CPR159G UG-1354/U UG-1355/U UG-1730/U UG-1731/U
xxUA137	5.850	8.200	WR137 WG14	UnivUS-137	CPR137F CPR137G UG-1356/U UG-1357/U UG-1732/U UG-1733/U UG-343B/U UG-344/U UG-440B/U UG-441/U
xxUA112	7.050	10.00	WR112 WG15	UnivUS-112	CPR112F CPR112G UG-1358/U UG-1359/U UG-1734/U UG-1735/U UG-52B/U UG-51/U UG-137B/U UG-138/U
xxUA90	8.200	12.400	WR90 WG16	UnivUS-90	CPR90F CPR90G UG-1360/U UG-1361/U UG-1736/U UG-1737/U UG-40B/U UG-39/U UG-135/U UG-136B/U
xxUA75	10.000	15.000	WR75 WG17	UnivUS-75	WR75

Table A-4. Universal Flange Compatibility (3 of 3)

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

Waveguide Technical Data

Table A-6. Waveguide Offset Short* Specifications

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

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

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

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

Appendix A Reference Data

Table A-6. Waveguide Technical Data (2 of 2)

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

Appendix B

Windowing

Introduction

The **FREQ/DIST** menu (page 2-11) 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.

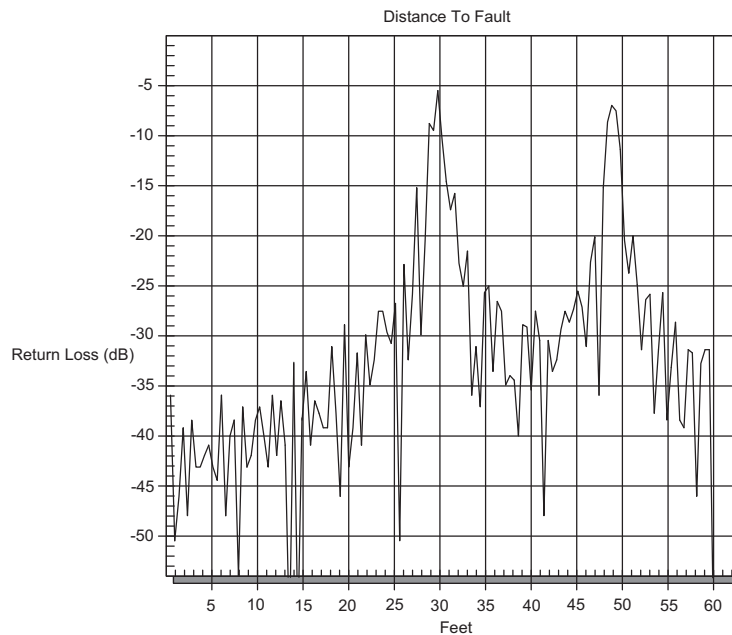


Figure B-1. Rectangular Windowing Example

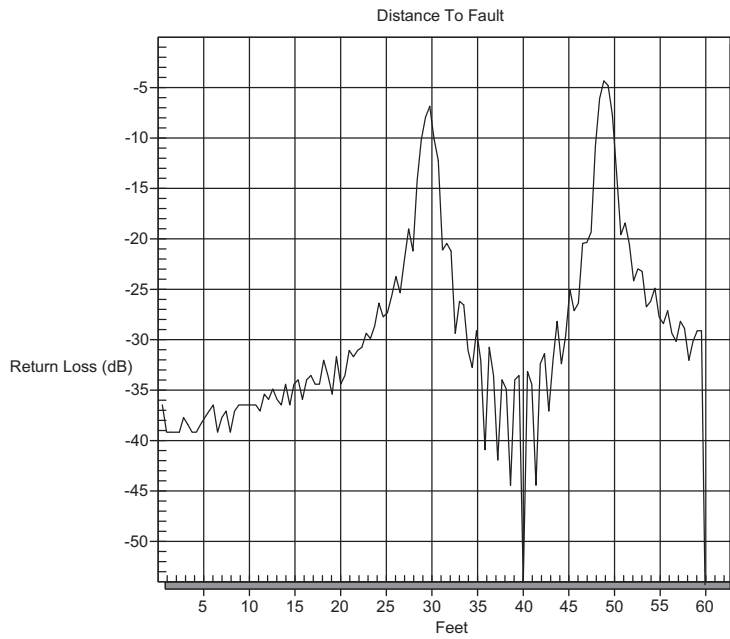


Figure B-2. Nominal Side Lobe Windowing Example

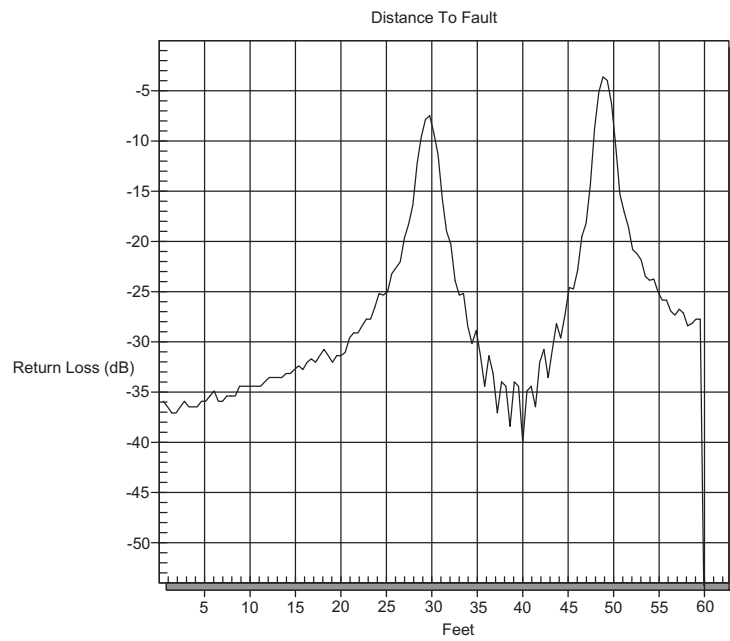


Figure B-3. Low Side Lobe Windowing Example

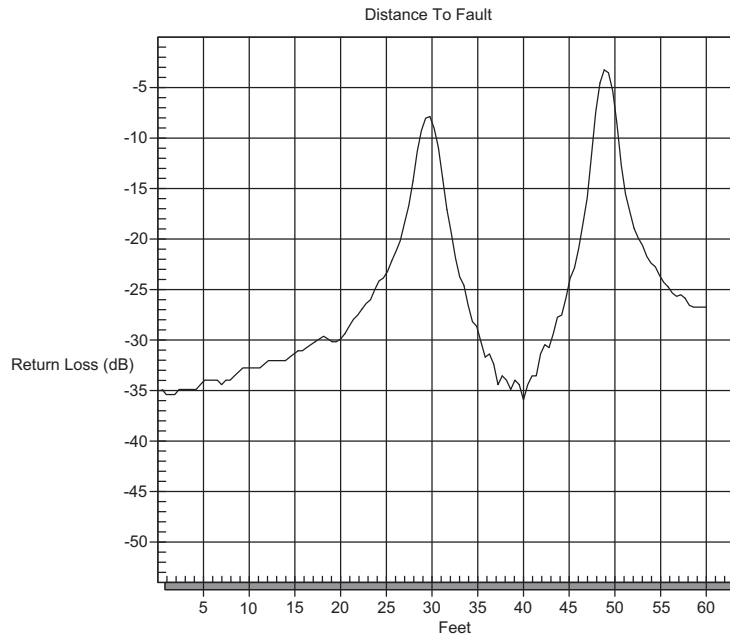


Figure B-4. Minimum Side Lobe Windowing Example

Appendix C

Signal Standards

Introduction

Table C-1 provides a listing of common Spectrum Analyzer signal standards.

Table C-1. Spectrum Analyzer Signal Standards

Standard	Center (MHz)	Span (MHz)	Valid Channels
AMPS / EIA 553 - Uplink	859	70	1-799, 990-1023
AMPS / EIA 553 - Downlink	859	70	1-799, 990-1023
C-450 (P) - Uplink	463.5	21	1-800
C-450 (P) - Downlink	463.5	21	1-800
C-450 (SA) - Uplink	462.5	15	1-247
C-450 (SA) - Downlink	462.5	15	1-247
CDMA US Cellular - Uplink	859	70	1-799, 990-1023
CDMA US Cellular - Downlink	859	70	1-799, 990-1023
CDMA US PCS - Uplink	1920	140	1-1199
CDMA US PCS - Downlink	1920	140	1-1199
CDMA Korea PCS - Uplink	1810	120	1-599
CDMA Korea PCS - Downlink	1810	120	1-599
CDMA Japan / ARIB - Uplink	878.5	93	1-799, 801-1039, 1041-1199
CDMA Japan / ARIB - Downlink	878.5	93	1-799, 801-1039, 1041-1199
CDMA China - 1 - Uplink	916	88	0-1000, 1329-2047
CDMA China - 1 - Downlink	916	88	0-1000, 1329-2047
CDMA China - 2 - Uplink	910	76	0-1000
CDMA China - 2 - Downlink	910	76	0-1000
CDMA2000 Class 0, Korea Cellular - Uplink	859	70	1-799, 990-1023
CDMA2000 Class 0, Korea Cellular - Downlink	859	70	1-799, 990-1023
CDMA2000 Class 0, N.A. Cellular - Uplink	859	70	1-799, 990-1023
CDMA2000 Class 0, N.A. Cellular - Downlink	859	70	1-799, 990-1023
CDMA2000 Class 1, N.A. PCS - Uplink	1920	140	0-1199
CDMA2000 Class 1, N.A. PCS - Downlink	1920	140	0-1199
CDMA2000 Class 2, (TACS Band) - Uplink	916	88	0-1100, 1329-2047

Appendix C Signal Standards

Standard	Center (MHz)	Span (MHz)	Valid Channels
CDMA2000 Class 2, (TACS Band) - Downlink	916	88	0-1100, 1329-2047
CDMA2000 Class 3, (JTACS Band) - Uplink	878.5	93	1-799, 801-1039, 1041-1199
CDMA2000 Class 3, (JTACS Band) - Downlink	878.5	93	1-799, 801-1039, 1041-1199
CDMA2000 Class 4, Korea PCS - Uplink	1810	120	0-599
CDMA2000 Class 4, Korea PCS - Downlink	1810	120	0-599
CDMA2000 Class 5, (NMT-450-20 kHz) - Uplink	472.5	43	1039-1473, 1792-2016
CDMA2000 Class 5, (NMT-450-20 kHz) - Downlink	472.5	43	1039-1473, 1792-2016
CDMA2000 Class 5, (NMT-450-25 kHz) - Uplink	439.5	57	1-300, 539-871
CDMA2000 Class 5, (NMT-450-25 kHz) - Downlink	439.5	57	1-300, 539-871
CDMA2000 Class 6, IMT-2000 - Uplink	2045	250	0-1199
CDMA2000 Class 6, IMT-2000 - Downlink	2045	250	0-1199
CDMA2000 Class 7, N.A. 700 MHz Cellular - Uplink	770	48	0-359
CDMA2000 Class 7, N.A. 700 MHz Cellular - Downlink	770	48	0-359
ETACS - Uplink	916	88	0-1000, 1329-2047
ETACS - Downlink	916	88	0-1000, 1329-2047
GSM 900 - Uplink	897.4	40	1-124, 975-1023
GSM 900 - Downlink	942.4	40	1-124, 975-1023
GSM 1800 - Uplink	1747.4	80	512-885
GSM 1800 - Downlink	1842.4	80	512-885
GSM 1900 - Uplink	1879.8	80	512-810
GSM 1900 - Downlink	1959.8	80	512-810
JTACS - Uplink	878.5	93	0-1198 (even numbers only)
JTACS - Downlink	878.5	93	0-1198 (even numbers only)
MATS-E - Uplink	925	70	1-1000
MATS-E - Downlink	925	70	1-1000
N-AMPS / IS-88L - Uplink	859	70	1-799, 990-1023
N-AMPS / IS-88L - Downlink	859	70	1-799, 990-1023
N-AMPS / IS-88M - Uplink	859	70	1-799, 990-1023
N-AMPS / IS-88M - Downlink	859	70	1-799, 990-1023
N-AMPS / IS-88U - Uplink	897.5	147	1-799, 990-1023

Standard	Center (MHz)	Span (MHz)	Valid Channels
N-AMPS / IS-88U - Downlink	897.5	147	1-799, 990-1023
NADC IS136 Cellular - Uplink	859	70	1-799, 990-1023
NADC IS136 Cellular - Downlink	859	70	1-799, 990-1023
NADC IS136 PCS - Uplink	1920	140	1-1199
NADC IS136 PCS - Downlink	1920	140	1-1199
NMT-411-25 kHz - Uplink	420.5	19	539-871
NMT-411-25 kHz - Downlink	420.5	19	539-871
NMT-450-20 kHz - Uplink	460.5	19	1039-1473
NMT-450-20 kHz - Downlink	460.5	19	1039-1473
NMT-450-25 kHz - Uplink	459	18	1-300
NMT-450-25 kHz - Downlink	459	18	1-300
NMT-470-20 kHz - Uplink	486.5	15	1972-2016
NMT-470-20 kHz - Downlink	486.5	15	1972-2016
NMT-900 - Uplink	925	70	1-1000
NMT-900 - Downlink	925	70	1-1000
NMT-900 (Offset) - Uplink	925	70	1025-2023
NMT-900 (Offset) - Downlink	925	70	1025-2023
NTACS - Uplink	878.5	93	1-1199
NTACS - Downlink	878.5	93	1-1199
PDC 800 Analog - Uplink	891.5	97	0-1680
PDC 800 Analog - Downlink	891.5	97	0-1680
PDC 1500 (JDC) - Uplink	1513	72	0-960
PDC 1500 (JDC) - Downlink	1513	72	0-960
PHS - Uplink	1906.5	23	1-77
PHS - Downlink	1906.5	23	1-77
SMR 800 - 12.5 kHz - Uplink	836	60	1-1199
SMR 800 - 12.5 kHz - Downlink	836	60	1-1199
SMR 800 - 25 kHz - Uplink	836	60	1-600
SMR 800 - 25 kHz - Downlink	836	60	1-600
SMR 1500 - Uplink	1483	60	1-479
SMR 1500 - Downlink	1483	60	1-479
TACS - Uplink	925	70	1-1000
TACS - Downlink	925	70	1-1000
UMTS/WCDMA - Uplink	1920	70	9600-9900
UMTS/WCDMA - Downlink	2110	70	10550-10850

Appendix C Signal Standards

Table C-2 provides a listing of common VNA signal standards.

Table C-2. *VNA Signal Standards*

Standard	Start Freq (MHz)	Stop Freq (MHz)
Bluetooth US & Europe Uplink	2400	2484
Bluetooth US & Europe Downlink	2400	2484
Bluetooth US & Europe Fullband	2400	2484
Bluetooth Japan Uplink	2472	2497
Bluetooth Japan Downlink	2472	2497
Bluetooth Japan Fullband	2472	2497
C 450 P Uplink	453	464
C 450 P Downlink	463	474
C 450 P Fullband	453	474
C 450 SA Uplink	465	470
C 450 SA Downlink	455	460
C 450 SA Fullband	455	470
CDMA China 1 2 Uplink	872	915
CDMA China 1 2 Downlink	917	960
CDMA China 1 2 Fullband	872	960
Cellular Uplink	824	849
Cellular Downlink	869	894
Cellular Fullband	824	894
Cellular 700 MHZ Uplink	776	794
Cellular 700 MHZ Downlink	746	764
Cellular 700 MHZ Fullband	746	794
DCS GSM 1800 Uplink	1710	1785
DCS GSM 1800 Downlink	1805	1880
DCS GSM 1800 Fullband	1710	1880
GSM 900 Uplink	880	915
GSM 900 Downlink	925	960
GSM 900 Fullband	880	960
IEEE 802 11 FH Uplink	2402	2495
IEEE 802 11 FH Downlink	2402	2495
IEEE 802 11 FH Fullband	2402	2495
IEEE 802 11 DS Uplink	2412	2484
IEEE 802 11 DS Downlink	2412	2484

Standard	Start Freq (MHz)	Stop Freq (MHz)
IEEE 802 11 DS Fullband	2412	2484
IEEE 802 11 B G Uplink	2400	2484
IEEE 802 11 B G Downlink	2400	2484
IEEE 802 11 B G Fullband	2400	2484
IMT 2000 UMTS WCDMA Uplink	1920	1980
IMT 2000 UMTS WCDMA Downlink	2110	2170
IMT 2000 UMTS WCDMA Fullband	1920	2170
ISM 2 4 GHZ Uplink	2400	2484
ISM 2 4 GHZ Downlink	2400	2484
ISM 2 4 GHZ Fullband	2400	2484
JTACS/NTAC Japan ARIB Uplink	887	925
JTACS/NTAC Japan ARIB Downlink	832	870
JTACS/NTAC Japan ARIB Fullband	832	925
NMT 411 Uplink	411	420
NMT 411 Downlink	421	430
NMT 411 Fullband	411	430
NMT 450 Uplink	450	460
NMT 450 Downlink	460	470
NMT 450 Fullband	450	470
NMT 450 20 kHz CDMA2000 Uplink	451	484
NMT 450 20 kHz CDMA2000 Downlink	461	494
NMT 450 20 kHz CDMA2000 Fullband	451	494
NMT 450 25 kHz CDMA2000 Uplink	411	458
NMT 450 25 kHz CDMA2000 Downlink	421	468
NMT 450 25 kHz CDMA2000 Fullband	411	468
NMT 900 MATS E Uplink	890	915
NMT 900 MATS E Downlink	935	960
NMT 900 MATS E Fullband	890	960
PCS GSM 1900 Uplink	1850	1910
PCS GSM 1900 Downlink	1930	1990
PCS GSM 1900 Fullband	1850	1990
PCS Korea Uplink	1750	1780
PCS Korea Downlink	1840	1870
PCS Korea Fullband	1750	1870
PDC 800 Uplink	898	940

Appendix C Signal Standards

Standard	Start Freq (MHz)	Stop Freq (MHz)
PDC 800 Downlink	843	885
PDC 800 Fullband	843	940
PDC 1500 Uplink	1525	1549
PDC 1500 Downlink	1477	1501
PDC 1500 Fullband	1477	1549
PHS Uplink	1895	1918
PHS Downlink	1895	1918
PHS Fullband	1895	1918
SMR 800 Uplink	806	821
SMR 800 Downlink	851	866
SMR 800 Fullband	806	866
SMR 1500 Uplink	1453	1465
SMR 1500 Downlink	1501	1513
SMR 1500 Fullband	1453	1513
TACS/ETACS Uplink+C22	872	915
TACS ETACS Downlink	917	960
TACS ETACS Fullband	872	960
Tetra Uplink	380	430
Tetra Downlink	380	430

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