Measurement Guide and Programming Examples

Agilent CSA Spectrum Analyzer

This manual provides documentation for the following instruments:

N1996A-503 (100 kHz to 3 GHz)
N1996A-506 (100 kHz to 6 GHz)

For firmware revision A.02.00 and above

Agilent Technologies

Manufacturing Part Number: N1996-90028
Supersedes N1996-90018

Printed in USA

April 2011

Notice

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Where to Find the Latest Information

Documentation is updated periodically. For the latest information about Agilent Technologies CSA spectrum analyzers, including firmware upgrades and application information, please visit the following URL:

http://www.agilent.com/find/csa

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1 Installation and Setup

This chapter provides the following information that you may need when you first receive your spectrum analyzer:

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Figure 1-1 CSA 1.0

Figure 1-2 CSA 2.0

Introduction

The Agilent CSA spectrum analyzer is designed to enable engineers and technicians in a wide variety of industries to make precision RF measurements with speed, ease and confidence. Flexible measurement functionality and high performance are combined with an intuitive user interface to allow faster insight into engineering challenges. Innovative measurement science ensures fast, accurate, and repeatable results. Equipped with USB and LAN connectivity, the Agilent CSA simplifies common tasks such as remote control, data transfer and firmware update.

Basic test functionality includes:

- Spectrum Analyzer:
  - Channel Power
  - Occupied Bandwidth
- Channel Analyzer:
  - Adjacent Channel Power (ACP (I&M))
- AM/FM Tune & Listen (requires N1996A with Option AFM)

Stimulus/Response Mode (requires N8995A with either Option SR3 or SR6) includes the following measurements:

- Two Port Insertion Loss
- One Port Insertion Loss
- Return Loss
- Distance to Fault

Modulation Analyzer Mode (requires N8996A with Option 1FP) includes the following measurements:

- Frequency Modulation
- Amplitude Modulation

In this chapter, you will learn how to set up the N1996A.

After the Installation and Setup chapter, you will find chapters on each CSA measurement mode with each measurement in that mode, general information on batteries, caring for the CSA, and how to return the instrument for service.

Initial Inspection

Inspect the shipping container and the cushioning material for signs of stress. Retain the shipping materials for future use, as you may wish to ship the analyzer to another location or to Agilent Technologies for service. Verify that the contents of the shipping container are complete. The following table lists the items shipped with the analyzer.

Item	Description
Accessories	
AC/DC converter	External power supply 15 VDC 150 W
Power Cable (See Table 1-2 on page 29)	Connection for AC/DC converter power source.
Stimulus /Response Calibration kit Option SRK (pn N1996A-SRK) includes: Coax Accessories Case Open/Short Termination	*This item is included ONLY when you have ordered Option SRK.* Coax Accessories Case, plastic and foam (5000-0912) Open/Short, 50 ohm, N-type male (85032-60011) Termination, 50 ohm, N-type male (00909-60009)
Standard Documentation Set	
Documentation CD-ROM	Includes electronic (PDF) versions of the documents in the standard set ("Manual Set on CD-ROM" on page 45). In addition, this Installation and Setup chapter is no the accessible in a standalone electronic (PDF) version and a text file of the complete firmware copyright information. You can view and print the information as needed. See the front of the CD-ROM for installation information.

If There Is a Problem

If the shipping materials are damaged or the contents of the container are incomplete:

- Contact the nearest Agilent Technologies office to arrange for repair or replacement (see "Calling Agilent Technologies" on page 229). You will not need to wait for a claim settlement.
- Keep the shipping materials for the carrier's inspection.
- If you must return an analyzer to Agilent Technologies, use the original (or comparable) shipping materials (see "Returning an Analyzer for Service" on page 231).

Safety Information

General

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product has been designed and tested in accordance with IEC 61010-1:2001 Second Edition, and has been supplied in a safe condition. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

Safety Earth Ground

An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

Chassis Ground Terminal

To prevent a potential shock hazard, always connect the rear-panel chassis ground terminal to earth ground when operating this analyzer from a dc power source.

Safety Information

The following safety conventions are used throughout this manual. Familiarize yourself with the symbols and their meaning before operating this instrument.

WARNING **A *Warning* denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.**

CAUTION A *Caution* denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.

NOTE A *Note* calls out special information for the user's attention. It provides operational information or additional instructions of which the user should be aware.

Safety Symbols and Product Markings

The following safety symbols and product markings are located on the analyzer or the external power supply. Familiarize yourself with the symbols and their meaning before operating this analyzer.

⚠	The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the documentation.
	Indicates hazardous voltages.
⏚	Indicates earth (ground) terminal
	Indicates chassis ground terminal
|	This symbol is used to mark the on position of the power line switch.
⏻	This symbol is used to mark the standby position of the power line switch.
~	This symbol indicates that the input power required is AC.
CE	The CE mark shows that the product complies with all relevant European legal Directives (if accompanied by a year, it signifies when the design was proven).
	The CSA mark (not to be confused with the Agilent CSA spectrum analyzer) is a registered trademark of the Canadian Standards Association.
N10149	The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency.
ISM 1-A	This is a symbol of an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 4).
ICES/NMB-001 ISM GRP.1 CLASS A	This is a marking of an Industrial Scientific and Medical Group 1 Class A product, and to indicate product compliance with the Canadian Interference-Causing Equipment Standard (ICES-001).
	Separate collection symbol. The Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC), adopted by EU Commission on 13 Feb. 2003, is introducing producer responsibility on all Electric and Electronic appliances from 13 Aug. 2005. Under EU law, all electric and electronic equipment (EEE) are required to be separated from normal waste for disposal.

Safety Considerations For This Analyzer

WARNING **This is a Safety Class 1 Product (provided with a protective earth ground incorporated in the power cord). The mains plug shall be inserted only in a socket outlet provided with a protected earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.**

WARNING **Failure to ground the analyzer properly when using the external power supply can result in personal injury. Before turning on the analyzer, you must connect its protective earth terminals to the protective conductor of the main power cable. Only insert the main power cable plug into a socket outlet that has a protective earth contact. DO NOT defeat the earth-grounding protection by using an extension cable, power cable, or autotransformer without a protective ground conductor.**

WARNING **If this analyzer is to be energized via an autotransformer (for voltage reduction), make sure the common terminal is connected to the earth terminal of the power source.**

WARNING **If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used only in a normal condition (in which all means for protection are intact).**

WARNING **Whenever it is likely that the protection has been impaired, the analyzer must be made inoperative and be secured against any unintended operation.**

WARNING **To prevent electrical shock, disconnect the Agilent Technologies spectrum analyzer from mains before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.**

WARNING **When operating from an AC power source, always use the three-prong ac power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause personal injury and/or product damage.**

This product is designed for use in Installation Category II and Pollution Degree 3 per IEC 61010 and IEC 60664 respectively.

WARNING **The front panel switch is a standby switch *only*; it is *not* a LINE switch (power disconnecting device).**

WARNING **Install the product so that the detachable power cord is readily identifiable**

and easily reached by the operator. The detachable power cord is the product disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the product. The front panel switch is only a standby switch and is not a LINE switch. Alternatively, an externally installed switch or circuit breaker (which is readily identifiable and is easily reached by the operator) may be used as a disconnecting device.

WARNING **Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended. Discard used batteries according to manufacturer's instructions.**

WARNING **This instrument has a recharge circuit. Never install non-rechargeable cells or batteries of a different type.**

WARNING **No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.**

WARNING **Servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.**

The opening of covers or removal of parts is likely to expose dangerous voltages. Disconnect the product from all voltage sources while it is being opened.

Adjustments described in the service manual are performed with power supplied to the analyzer while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

CAUTION If you are charging the batteries internally—even while the analyzer is powered off—the analyzer may become warm. Take care to provide proper ventilation.

CAUTION To avoid overheating, always disconnect the analyzer from the external power supply before storing the analyzer in the soft carrying case.

If you prefer to leave the analyzer connected to the external power supply while inside the soft carrying case, you can disconnect the external power supply from its power source to prevent overheating.

CAUTION The external power supply has autoranging line voltage input. Be sure the supply voltage is within the specified range. (Refer to the specifications guide for your analyzer.)

CAUTION When operating this product with the external power supply, always use the three-prong power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord can cause product damage.

CAUTION VENTILATION REQUIREMENTS: When installing the product in a cabinet, the convection into and out of the product must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the product by 4°C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 watts, then forced convection must be used.

Lifting and Handling

When lifting and handling the Agilent N1996A Spectrum Analyzer use ergonomically correct procedures. If so equipped, lift and carry the analyzer by the bail handle.

Battery Pack Product Safety Data Sheet

INSPIRED ENERGY
SOLUTIONS FOR PORTABLE POWER

Product Safety Data Sheet

PRODUCT NAME: Inspired Energy Rechargeable Battery Pack	Model: NF2040A22
TRADE NAME: NF2040	Volts: 10.8
CHEMICAL SYSTEM: Lithium Ion	Approximate Weight: 340 g

SECTION I – MANUFACTURER INFORMATION

Inspired Energy, Inc.
12705 N US Hwy 441
Alachua, FL 32615

Telephone: (888) 5-INSPIRE (888-546-7747)

Date Prepared: Jan 13th 2003

SECTION II – HAZARDOUS INGREDIENTS

Important Note:
The battery should not be opened or burned. Exposure to the ingredients contained within or their combustion products could be harmful

Material Safety Data Sheet Attached:
Review cell manufacturer's MSDS

SECTION III – OPERATING PARAMETERS

Maximum Charge Voltage:	12.6 V
Minimum Charge Voltage:	7.5 V
Maximum Charge Current:	3.0 A
Maximum Discharge Current:	3.0 A
Recommended Charging Method:	Use an SMBus charger of level 2 or higher to provide a 3.0 A current limited constant voltage of 12.6 V. The charging cycle shall terminate when the average current falls below 150mA.

The information contained within is provided for your information only. This battery is an article pursuant to 29 CFR 1910.1200 and, as such, is not subject to the OSHA Hazard Communication standard requirement for preparation of a material safety data sheet. The information and recommendations set forth herein are made in good faith and are believed to be accurate as of the date of preparation. However, INSPIRED ENERGY, INC. MAKES NO WARRANTY, EITHER EXPRESSED OR IMPLIED, WITH RESPECT TO THIS INFORMATION AND DISCLAIMS ALL LIABILITY FROM RELIANCE ON IT.

Battery Pack Declaration of Conformity

INSPIRED ENERGY
SOLUTIONS FOR PORTABLE POWER

Declaration of Conformance

PRODUCT: Standard Battery for Inspired Energy

Inspired Energy Part Number: NF2040

SECTION I – MANUFACTURER INFORMATION

Inspired Energy, Inc.
25440 NW 8th Place, Newberry FL 32669, USA

Telephone: +1 386 462 3676
Date Prepared: December 21st 2004

SECTION II – CONFORMANCE INFORMATION

The listed products have been tested in accordance with the UN document ST/SG/AC.10/11/Rev.3*: "Amendments to the Third Revised Edition of the Recommendations on the Transport of Dangerous Goods, Manual of Tests & Criteria"* and found to comply with the stated criteria

Test #	Description	Date Tested	Test result
T1	Altitude Simulation	June 21, 2004	Pass
T2	Thermal Cycling	July 23, 2004	Pass
T3	Shock	September 30 2004	Pass
T4	Vibration	October 01 2004	Pass
T5	Short Circuit	November 09, 2004	Pass
T6	Impact (Cell-Level test)	July 2nd 2003	Pass
T7	Overcharge	November 15, 2004	Pass
T8	Forced Discharge (Cell-level test)	July 2nd 2003	Pass

Signed:

David W. Hellriegel
Product Test Laboratory manager

The information contained within is provided for your information only. The information and recommendations set forth herein are made in good faith and are believed to be accurate as of the date of preparation. However, INSPIRED ENERGY, INC. MAKES NO WARRANTY, EITHER EXPRESSED OR IMPLIED, WITH RESPECT TO THIS INFORMATION AND DISCLAIMS ALL LIABILITY FROM RELIANCE ON IT.

Batteries: Safe Handling and Disposal

COBALT CELL — MATERIAL SAFETY DATA SHEET — Feb 14, 2003

FSSF00001AG - FOR CUSTOMER DISTRIBUTION

SECTION 1 - PRODUCT IDENTIFICATION AND USE		
Product:	Molicel - Cobalt based Lithium-Ion cell (up to and including 2.4 Ah)	P.I.N.: Not Regulated
Use:	High performance lithium-ion rechargeable battery system.	W.H.M.I.S.: exempt. manufactured article
Manufacturer:	**E-One Moli Energy (Canada) Limited 20,000 Stewart Cres. Maple Ridge, BC, Canada V2X 9E7 (604) 466-6654** **FAX: (604) 466-6600**	24 HOUR EMERGENCY NUMBER (604) 466-6654 (MOLI)

SECTION 2 - HAZARDOUS INGREDIENTS

Hazardous Ingredients	%	CAS Number	LD_{50}(mg/kg) (oral-rat)	LC_{50} (mg/L)
Aluminium foil	0.1- 1 w/w	7429-90-5	N/AV	N/AV
Biphenyl (BP)	0-0.3 w/w	92-52-4	2400	N/AV
Copper foil	0.1- 1 w/w	7440-50-8	3.5 (ipr-mouse)	N/AV
Dioxathiolane 2,2-Dioxide (DTD)	0 – 3 w/w	1072-53-3	1600	N/AV
Linear and Cyclic Carbonate Solvents (See "Other Information")	5- 17w/w	N/APP	~11000 (weighted avg)	N/AV
Graphite, powder	10- 30 w/w	7440-44-0	440 (ivn-mouse)	N/AV
Lithium Carbonate	0–0.3 w/w	554-13-2	525	N/APP
Lithium Cobaltite ($LiCoO_2$)	10- 30 w/w	12190-79-3	N/AV	N/AV
Lithium Hexaflurophosphate ($LiPF_6$)	1- 5 w/w	21324-40-3	1702	Rat: >20
Poly (vinylidene fluoride) (PVDF)	0.1- 1 w/w	24937-79-9	N/AV	N/AV
Propane Sultone (PS)	0 – 3 w/w	1120-71-4	100	N/AV
Steel, nickel and inert polymer	Balance	N/APP	N/APP	N/APP

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COBALT CELL — MATERIAL SAFETY DATA SHEET — Feb 14, 2003
FSSF00001AG - FOR CUSTOMER DISTRIBUTION

SECTION 3 - PHYSICAL DATA

Physical state:	Odour	Odour threshold:
Nickel plated metal canister under label	None	N/APP

Vapour pressure (mmHg)	Vapour Density (air =1)	Evaporation rate :	Boiling Point	Freezing point
N/APP	N/APP	N/APP	N/APP	N/APP

pH (10% in water)	Specific gravity:	Coeff. of water/oil distribution	Water solubility:	Percent Volatiles:
N/APP	1.5-2.0	N/APP	insoluble	NONE

SECTION 4 - FIRE AND EXPLOSION DATA

Flammability	Conditions:
NO	Organic components will burn if cell incinerated. Combustion of cell contents will cause evolution of Hydrogen Fluoride.

Means of Extinction and Special Procedures:
Water spray, Carbon Dioxide, Dry chemical powder or appropriate foam. Use agent appropriate for surrounding materials.
Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes. Extremely corrosive Hydrogen Fluoride gas is produced upon combustion of cell contents.

Flashpoint:	Upper Flammable Limit:	Lower Flammable Limit:
NONE	NONE	NONE

Auto-ignition Temp:	Hazardous Combustion Products:
NONE	Hydrogen Fluoride, Phosphorus Oxides, Carbon oxides, Lithium Hydroxide, Cobalt Oxides, Aluminium Oxide, Sulphuric acid, Sulphur oxides, possible fluoro-compounds, Carbon soot

Impact sensitive:	Static Discharge Sensitive:
NO	NO, but cell may contain up to 4.2 volts.

SECTION 5 - REACTIVITY DATA

Stability:	
STABLE	Hazardous polymerization will not occur. Spontaneous decomposition at normal temperatures will not occur.

Incompatibilities:
Do not crush, puncture, incinerate, immerse in water or heat over 100•C. Steel casing slowly dissolves in strong mineral acids.

Reactivities:
None known

Hazardous Decomposition Products:
Hydrogen Fluoride, Phosphorus Oxides, Carbon oxides, Lithium Hydroxide, Cobalt Oxides, Aluminium Oxide, Sulphuric acid, Sulphur oxides, possible fluoro-compounds, Carbon soot

COBALT CELL MATERIAL SAFETY DATA SHEET Feb 14, 2003
FSSF00001AG - FOR CUSTOMER DISTRIBUTION

SECTION 6 - TOXICOLOGICAL PROPERTIES

Routes of Entry:
Skin Contact: NO Skin Absorption NO Eye contact: NO Inhalation NO Ingestion NO

Acute Exposure

Skin:	No effect noticed in routine handling of product.
Eyes:	The bulk solid has no effect on the eye beyond blunt impact.
Inhalation:	Not applicable.
Ingestion:	Ingestion is not likely, given the physical size and state of the cell.

Chronic Exposure

Skin:	None anticipated.
Eyes:	Not applicable.
Inhalation:	Not applicable.
Ingestion:	Ingestion is not a likely exposure route.

Exposure Limits	Irritancy:	Sensitization:	Carcinogenicity
None listed	None	Not anticipated	Not anticipated

Teratogenicity:	Mutagenicity:
Not anticipated	Not anticipated.

Reproductive toxicity:	Synergistic Products:
Not anticipated	None expected

SECTION 7- PREVENTIVE MEASURES

Personal protective equipment:

Gloves:	Respirator:	Eyewear:
Not required for handling individual cells. Fabric gloves for warehouse container handling.	No respirator required for normal handling. SCBA required for fires.	Not required beyond employer policy.

Clothing:	Footwear:
Standard industrial clothing in normal use. Impervious suit in fires.	Wear steel-toed footwear if large containers of cells are being handled.

Engineering controls:
Keep away from heat and open flames. Store in a cool, dry place.

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COBALT CELL — MATERIAL SAFETY DATA SHEET — Feb 14, 2003
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Leak and spill procedure:
Evacuate area if fire present or likely. Wear SCBA for fire-related emergencies. Using gloves, pick up or sweep up fire-damaged cells, bag individually in plastic bags and place in closed metal containers. 205 Litre lined steel drums are appropriate. Cardboard boxes may be used for small quantities. Avoid raising dust while sweeping. Transport container outdoors. Hold burned cells and fire cleanup solids for disposal as potential hazardous waste. Unburned cells are not hazardous waste.
A fire with over 100 kg of cells burnt will likely require reporting to environment officials. Always consult and obey all international, federal and local environmental laws.

Waste disposal:
Always consult and obey all international, federal, provincial/state and local hazardous waste disposal laws. Some jurisdictions require recycling of this spent product.

Handling procedures and equipment:
Store in a cool, dry place away from sparks and flame. Keep below 125•C. Keep above -60•C. Charge between 0•C and 45•C. Use only approved charging equipment. Do not disassemble battery or battery pack. Do not puncture, crush or dispose of in fire.

Storage requirements:
Store at room temperature for best results.

Special Shipping Information:
Not regulated. This product is made from materials with no detectable mercury.
Equivalent lithium content
as per Section 38.3.2 of the UN Manual of Tests and Criteria (ST/SG/AC.10/11/27 Add. 2):
Equivalent grams of lithium is equal to 0.3 times the rated Amp-hour capacity of the individual cell, regardless of cell size.
1.8 Ah = 0.54 g 2.0 Ah = 0.60 g 2.2 Ah = 0.66g 2.4 Ah = 0.72 g

SECTION 8 - FIRST AID MEASURES

Skin:	Not a health hazard.
Eyes:	Not an eye hazard
Inhalation:	Not an inhalation hazard.
Ingestion:	If swallowed, seek emergency medical aid. If patient choking and can partially breathe, encourage patient to cough. Do not strike patient's back. This may lodge cell further in throat. If patient is not breathing, perform standing Heimlich manoeuvre until object is dislodged or patient becomes unconscious. An unconscious patient should be lowered gently to the floor on their back and abdominal thrusts performed continuously until cell is ejected from throat or medical aid arrives.

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SECTION 9 - PREPARATION INFORMATION			
Prepared by: Martin RIDGWAY, B.Sc. Safety Co-ordinator	Phone: (604) 466-6654	Date Created: Mar 31, 1995	Revision Information: First Issue
		Date Last Revised: Jul 31, 1998	Revision Information: Assign document control number. Company name change.
		Date Last Revised: Jun 15, 2000	Revision Information: Company name change.
		Date Last Revised: Jan 23, 2001	Revision Information: Shipping: Contains no mercury.
		Date Last Revised: May 1, 2001	Revision Information: Incompatibilities – Do not heat over 100C (to match UL warning statement)
		Date Last Revised: Jan 28, 2003	Revision Information: Shipping Information – Added equivalent lithium content information
		Date Last Revised: Feb 4, 2003	Revision Information: Product – Up to and including 2.4 Ah Ingredients - Added PS, $LiCO_2$ and DTD Decomposition - Added sulphur compounds
Approval			

OTHER INFORMATION

The above information is believed to be correct but does not purport to be all-inclusive and shall be used only as a guide. Exact composition information is immediately available on a confidential basis to medical professionals treating exposure to cell components or combustion by-products.

HYDROFLUORIC ACID EXPOSURE DURING FIRE FIGHTING

This information is given for the use of professional fire fighters responding to a warehouse fire where fire from other materials may incinerate Molicels. This section is provided solely in case of exposure, during fire fighting, to the combustion by-products. Hydrofluoric acid is not present in the product. Contact with Molicels causes none of the following symptoms.

Hydrofluoric acid is extremely corrosive. Contact with hydrogen fluoride fumes is to be avoided. Permissible exposure limit is 3 ppm. In case of contact with hydrogen fluoride fumes, immediately leave the area and seek first aid **and** emergency medical attention. Symptoms may have delayed onset. Fluoride ions penetrate skin readily causing destruction of deep tissue layers and even bone. Fluoride interferes with nerve impulse conduction causing severe pain or absence of sensations. Immediately flush eyes or skin with water for at least 20 minutes to neutralize the acidity and remove some fluoride. Remove and destroy all contaminated clothing and permeable personal possessions. Before re-use, impermeable possessions should be soaked in benzalkonium chloride after water washing. Following flushing of the affected areas, an iced aqueous solution of benzalkonium chloride or 2.5 % calcium gluconate gel should be applied to react with the fluoride ion. Compresses and wraps may be used for areas where immersion is not practical. Medicated dressing should be changed every 2 minutes. Exposure to hydrofluoric acid fumes sufficient to cause pain requires immediate hospitalization for monitoring for pulmonary edema.

Power Requirements

Typically, the only physical installation of your Agilent spectrum analyzer is a connection to a power source.

WARNING **Before operating or connecting this analyzer to an external power source, please read and understand safety information in “Safety Information” on page 14 and the safety considerations and all safety warnings in “Safety Considerations For This Analyzer” on page 16.**

Line voltage does *not* need to be selected.

This analyzer does *not* contain customer serviceable fuses.

NOTE If your test system requires a common ground, use the grounding lug provided on the back of the instrument.

NOTE For detailed analyzer specifications, see the Specifications guide.

NOTE In addition to operating the analyzer on AC power using the external AD/DC converter, you can operate it using internal batteries. For information on the installation and use of those batteries, refer to Chapter 10, “Working with Batteries,” on page 179.

Table 1-1 **AC Power Requirements**

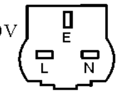
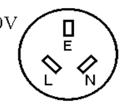
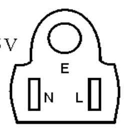
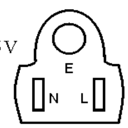
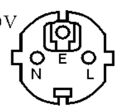
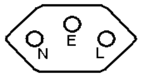
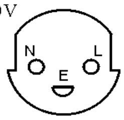
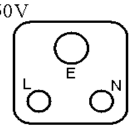
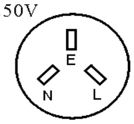
Description	Specifications
Voltage	90 to 132 Vrms (47 to 440 Hz)
Voltage	195 to 250 Vrms (47 to 66 Hz)
Power Consumption, On	< 115 W
Power Consumption, Standby	< 7 W

AC Power Cord

The analyzer is equipped with a three-wire power cord, in accordance with international safety standards. This cord connects to the external power supply adapter and grounds the external power supply when connected to an appropriate power line outlet. The cord appropriate to the original shipping location is included with the analyzer.

Various AC power cables are available that are unique to specific geographic areas. You can order additional AC power cables for use in different areas. AC Power Cords, on page 29 lists the available AC power cables, illustrates the plug configurations, and identifies the geographic area in which each cable is appropriate.

Table 1-2 AC Power Cords

Plug Type[a]	Cable Part Number	Plug[b] Description	Length cm (in.)	Cable Color	For Use in Country
250V 	8120-1351 8120-1703	Straight BS 1363A 90°	229 (90) 229 (90)	Mint Gray Mint Gray	Option 900 United Kingdom, Hong Kong, Cyprus, Nigeria, Singapore, Zimbabwe
250V 	8120-1369 8120-0696	Straight AS 3112 90°	210 (79) 200 (78)	Gray Gray	Option 901 Argentina, Australia, New Zealand, Mainland China
125V 	8120-1378 8120-1521	Straight NEMA 5-15P 90°	203 (80) 203 (80)	Jade Gray Jade Gray	Option 903 United States, Canada, Brazil, Colombia, Mexico,Philippines, Saudi Arabia, Taiwan
125V 	8120-4753 8120-4754	Straight NEMA 5-15P 90°	229 (90) 229 (90)	Gray Gray	Option 918 Japan
250V 	8120-1689 8120-1692	Straight CEE 7/VII 90°	200 (78) 200 (78)	Mint Gray Mint Gray	Option 902 Continental Europe, Central African Republic, United Arab Republic
230V 	8120-2104 8120-2296	Straight SEV Type 12 90°	200 (78) 200 (78)	Gray Gray	Option 906 Switzerland
220V 	8120-2956 8120-2957	Straight SR 107-2-D 90°	200 (78) 200 (78)	Gray Gray	Option 912 Denmark
250V 	8120-4211 8120-4600	Straight IEC 83-B1 90°	200 (78) 200 (78)	Mint Gray Mint Gray	Option 917 South Africa, India
250V 	8120-5182 8120-5181	Straight SI 32 90°	200 (78) 200 (78)	Jade Gray Jade Gray	Option 919 Israel

a. E =earth ground, L = line, and N = neutral.
b. Plug identifier numbers describe the plug only. The part number is for the complete cable assembly.

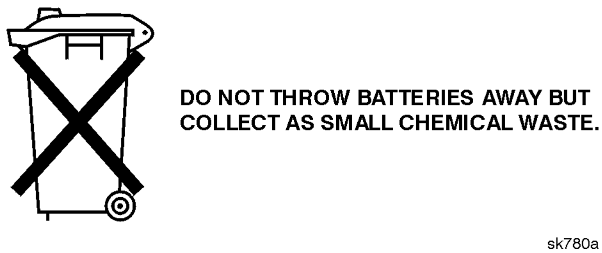
formt119

Clock Battery Information

The analyzer uses a Poly-carbonmonofluoride Lithium Coin battery to power the analyzer clock. The battery is located on the CPU board.

NOTE If the analyzer's clock does not work, the problem is probably the battery. See "Returning an Analyzer for Service" on page 231.

WARNING **Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended. Discard used batteries according to the manufacturer's instructions.**



Physically Securing Your Analyzer

To prevent unauthorized removal of your analyzer, you can use a Kensington Slim MicroSaver security cable to attach the analyzer to an immovable object. Your analyzer has a Kensington Security Slot located on the back of the analyzer. The Kensington Security Slot is identified on the analyzer with this logo: . For more information, visit

http://www.microsaver.com.

Basic Instructions for Using the Kensington Slim MicroSaver

Step 1. Wrap the steel cable around an immovable object.

Step 2. Insert the lock into the Kensington Security Slot.

Step 3. Turn the key.

Turning on the Analyzer for the First Time

WARNING **Before operating or connecting this analyzer to an external power source, please read and understand safety information in "Safety Information" on page 14 and the safety considerations and all safety warnings in "Safety Considerations For This Analyzer" on page 16.**

- o Plug in the power cord. If the analyzer is to be operated on the internal batteries, ensure that both batteries are installed. They are approximately 50% charged when you receive them and will provide full performance if you choose to operate the analyzer without charging them at this time. (View the charge level for each battery on the battery end display.) If the batteries are showing 1 bar or less, recharging is recommended at this time.

NOTE For maximum runtime, it is best to have approximately equal charge levels on both batteries. The instrument will shut down if either battery becomes fully discharged during operation.

NOTE Do not connect anything else to the analyzer yet.

- o Press the power switch (located in the lower left-hand corner of the analyzer's front panel) to turn the analyzer on. See "Front Panel Overview" on page 50.

NOTE The instrument requires <2 minutes to power-on.

Information Screen An information screen appears during the initialization process. The information screen contains the analyzer product number and a URL for accessing product support information on the World Wide Web. See "Where to Find the Latest Information" on page 3.

NOTE It is important for you to Record the firmware revision and serial number, and keep it for reference. If you should ever need to call Agilent Technologies for service or with any questions regarding your analyzer, it will be helpful to have this information readily available. You can also obtain the firmware revision and serial number by pressing **System**, **System Stats**, **Rev Info**.

- o Allow the spectrum analyzer to warm-up for 30 minutes before making a calibrated measurement. To meet its specifications, the analyzer must meet operating temperature conditions.

CAUTION Ensure protection of the input mixer by limiting the input level to 50 Vdc, +33 dBm.

- o If using non-DHCP LAN, set the IP address of the analyzer to an appropriate number for your network (one that the network recognizes, but that is not yet in use):

— Press **System**, **Controls**, **IP Admin** and note the IP address. This is the IP address that will be used if IP Config is set to Static. To view the IP Address selected by DHCP, press **Mode**.

— If the current address is not appropriate, press **IP Config**, **Static**, **IP Address** and use the keypad to change it. In addition, you may also need to change the **Net Mask** and **Gateway** settings.

— Press **Save**.

— Connect the LAN cable to the LAN connector (not the Timing LAN connector) located on the rear panel of your analyzer (see "Rear-Panel Features" on page 61).

— Cycle the analyzer power. Refer to "Configuring for Network Connectivity" on page 169

NOTE It is necessary to cycle the power to the analyzer after plugging in the LAN for the analyzer to recognize the network.

NOTE If you are not using a LAN connection, you may want to set the IP Configuration to None to reduce the instrument power-on time.

Why Aren't All the Personality Options Available?

Many measurement personality options are available for your use and are loaded in the instrument. To make an option available, you must also have a license key entered.

Using an External Reference

If you wish to use an external source as the reference frequency, you must connect an external reference source and set the reference frequency as follows:

1. Connect an external source to the **EXT REF IN** connector on the rear panel (see "Rear-Panel Features" on page 61). The signal level should be greater than –15 dBm.

2. Select the frequency of the external reference into the analyzer:

   a. Press **System**, **Freq/Time/Ref**
   b. Select the up and down arrow navigation keys to highlight the desired reference frequency.
   c. Press **Select** to set the reference source and frequency that you have highlighted.
   d. Press **Cancel** to abort your reference change and retain the previously selected frequency reference. See "Setting System References" on page 163 for more information.

Firmware Revision

To view the firmware revision of your analyzer, Press **System**, **System Stats**, **Rev Info**. If you call Agilent Technologies regarding your analyzer, it is helpful to have this revision and the analyzer serial number available.

TIP You can get automatic electronic notification of new firmware releases and other product updates/information by subscribing to the *Agilent Technologies Test & Measurement E-Mail Notification Service* for the Agilent CSA spectrum analyzer at:

http://www.agilent.com/find/notifyme

Printer Setup and Operation

The Agilent CSA spectrum analyzer does not print directly to a printer. You can print a screen image or measurement data by first saving the information to a USB memory device and then use a PC with an attached printer to print the file. You can save a screen image by pressing 🖨 (**Print**) (for detail instructions, refer to "Printing a Screen To a File" on page 165). Also, you can save a screen image or measurement results by pressing **Save** and Save Now (for detail instructions, refer to "Saving Data" on page 166).

Protecting Against Electrostatic Discharge

Electrostatic discharge (ESD) can damage or destroy electronic components (the possibility of unseen damage caused by ESD is present whenever components are transported, stored, or used).

Test Equipment and ESD

To help reduce ESD damage that can occur while using test equipment:

- Before connecting any coaxial cable to an analyzer connector for the first time each day, momentarily short the center and outer conductors of the cable together.
- Personnel should be grounded with a 1 MΩ resistor-isolated wrist-strap before touching the center pin of any connector and before removing any assembly from the analyzer.
- Be sure that all instruments are properly earth-grounded to prevent build-up of static charge.

WARNING **Do not use these first three techniques above when working on circuitry with a voltage potential greater than 500 volts.**

- Perform work on all components or assemblies at a static-safe workstation.
- Keep static-generating materials at least one meter away from all components.
- Store or transport components in static-shielding containers.
- Always handle printed circuit board assemblies by the edges. This reduces the possibility of ESD damage to components and prevent contamination of exposed plating.

For information on ordering static-safe accessories, see “Accessories” on page 45.

Additional Information about ESD

For more information about ESD and how to prevent ESD damage, contact the Electrostatic Discharge Association (http://www.esda.org). The ESD standards developed by this agency are sanctioned by the American National Standards Institute (ANSI).

Using the Soft Carrying Case

The N1996A soft carrying case is designed to hold the analyzer as well as its cables and accessories.

WARNING **Always disconnect the analyzer from the external power supply before storing the analyzer in the soft carrying case.**

2 Options and Accessories

This chapter lists options and accessories available for your analyzer.

Ordering Options and Accessories

Options and accessories help you configure the analyzer for your specific applications.

Options (see page 41)

Unless specified otherwise, all options are available when you order a spectrum analyzer; some options are also available as kits that you can order and install after you receive the analyzer. Order kits through your local Agilent Sales and Service Office.

At the time of analyzer purchase, options can be ordered using your product number and the number of the option you are ordering. For example, if you are ordering Option SRK for an Agilent N1996A, you would order N1996A-SRK.

If you are ordering an option after the purchase of your analyzer, you will need to add a K (for kit) to the product number and then specify which option you are ordering (for example, N1996AK-SRK.)

If you know the option you wish to order, refer to “Options” on page 41 which is in ascending order by option number and type. Complete option descriptions can be found in the following section, listed in alphabetical order by option name under “Option Descriptions” on page 43.

For the latest information on Agilent Spectrum Analyzer options and upgrade kits, visit the following URL:

http://www.agilent.com/find/sa_upgrades

Accessories (see page 45)

Order accessories through your local Agilent Sales and Service Office. For information on contacting Agilent Sales and Service, refer to “Calling Agilent Technologies” on page 229.

Options

Each option is described below in alpha/numeric order according to option number.

Option Number	Name	Description
0950-5023	External AC/DC Power Supply	External power supply 16 VDC 150 W
0BW	Service Documentation	The Service guide describes assembly-level troubleshooting procedures, provides a parts list, and documents post-repair procedures.
1CM	Rack Mount Kit	Includes rack mount flanges and hardware. Used to rack mount analyzers *without* front handles (available as P/N N1996-60028).
1CP	Rack Mount Kit with Handles	Includes the parts necessary to rack mount an analyzer with front handles attached (available as P/N N1996-60029). (Includes handles.)
271	Spectrogram	Provides a display with a history of the spectrum. You can use it to: • Locate intermittent signals. • Track signal levels over time.
503	100 kHz to 3 GHz[1]	Spectrum Analyzer Frequency Range: 100 kHz to 3 GHz
506	100 kHz to 6 GHz[1]	Spectrum Analyzer Frequency Range: 100 kHz to 6 GHz
ABA	Measurement Guide	An English language printed copy of the standard Measurement Guide in addition to the standard documentation on the Manual Set on CD-ROM shipped with the analyzer. For additional information on the contents of the Documentation CD-ROM, refer to "Manual Set on CD-ROM" on page 45. Provides details on how to measure various signals, and how to use catalogs and files. In addition, this manual covers unpacking and setting up the analyzer, analyzer features, and how to make a basic measurement. Includes information on options and accessories, and what to do if you have a problem.
AB2	Measurement Guide, Simplified Chinese Localization	A Simplified Chinese language version of the standard Measurement Guide. Provides the same information as Option ABA listed above.
AFM	AM/FM Tune & Listen	Provides the audible detection of AM or FM signals at specific frequency.
BAT	Battery Pack	Two batteries: 10.8 V 4.56 A-HR LI-ION (pn 1420-0891) (2 batteries are required for the operation of the instrument).
BCG	External Battery Charger	External charger/DC adapter, includes: External power supply AC/DC adapter Dual battery charger

Option Number	Name	Description
HTC	Hard Transit Case	The hard transit case will survive commercial transportation. This rugged case has two wheels and an extendible handle for easy transport. The case can also accommodate two battery packs and ac adapters. To order the option HTC which requires the soft carrying case (option SCC) for filling the space in the hard transit case.
N8995A - SR3	Stimulus/Response Measurement Suite to 3 GHz[2]	Provides Stimulus/Response measurements: • Distance to Fault • Two Port Insertion Loss • One Port Insertion Loss • Return Loss
N8995A - SR6	Stimulus/Response Measurement Suite to 6 GHz[3]	Provides Stimulus/Response measurements: • Distance to Fault • Two Port Insertion Loss • One Port Insertion Loss • Return Loss
N8996A-1FP	AM/FM Modulation Analysis	Provides AM/FM demodulation measurements: • Amplitude Modulation • Frequency Modulation
0B0	Manual Set on CD-ROM *Only*	The documentation CD-ROM contains the standard documentation set as well as Adobe Acrobat Reader with Search.
P03	3 GHz Preamplifier	An internal preamplifier assembly. For use with Option 503 only. *Frequency Range*: 100 kHz to 3 GHz
P06	6 GHz Preamplifier	An internal preamplifier assembly. For use with Option 506 only. *Frequency Range*: 100 kHz to 6 GHz
R-50C-011-3	3 Year Inclusive Calibration Contract	Provides your analyzer with a 3 year analyzer calibration contract.
R-51B-001-3C	3-Year Warranty Service Support[1]	A total of 3 years of return-to-Agilent warranty service support. This adds a 2-year service contract to the base analyzer 1-year warranty
SCC	Soft Carrying Case	An ergonomically designed case to hold the analyzer as well as its cables and accessories.
SRK	Stimulus/Response Calibration Kit	The kit includes: • Coax Accessories Case, plastic and foam (5000-0912) • Open/Short, 50 ohm, N-type male (85032-60011) • Termination, 50 ohm, N-type male (00909-60009)

1. Available *only* at time of purchase
2. The option replaces N1996A/TG3 + N8995A/1FP in CSA1.0.
3. The option replaces N1996A/TG6 + N8995A/1FP in CSA1.0.

Options and Accessories

Option Descriptions

Each option is described below in alphabetical order according to option name.

Name	Option Number	Description
3 Year Inclusive Calibration Contract	R-50C-011-3	Provides your analyzer with a 3 year analyzer calibration contract.
3-Year Warranty Service Support [1]	R-51B-001-3C	A total of 3 years of return-to-Agilent warranty service support. This adds a 2-year service contract to the base analyzer 1-year warranty.
100 kHz to 3 GHz Spectrum Analyzer[1]	503	Spectrum Analyzer Frequency Range: 100 kHz to 3 GHz
100 kHz to 6 GHz Spectrum Analyzer[1]	506	Spectrum Analyzer Frequency Range: 100 kHz to 6 GHz
AM/FM Modulation Analysis	N8996A-1FP	Provides AM/FM demodulation measurements: • Amplitude Modulation • Frequency Modulation
AM/FM Tune & Listen	AFM	Provides the audible detection of AM or FM signals at specific frequency.
Battery Pack	BAT	Two batteries: 10.8 V 4.56 A-HR LI-ION (pn 1420-0891) (2 batteries are required for the operation of the instrument.)
External AC/DC Power Supply	0950-5023	External power supply 16 VDC 150 W
External Battery Charger	BCG	External charger/DC adapter, includes: External power supply AC/DC adapter 24 VDC 2.7 A Dual battery charger
Hard Transit Case	HTC	The hard transit case will survive commercial transportation. This rugged case has two wheels and an extendible handle for easy transport. The case can also accommodate two battery packs and AC adapters. To order the option HTC which requires the soft carrying case (option SCC) for filling the space in the hard transit case.
Manual Set on CD-ROM *Only*	0B0	The documentation CD-ROM contains the standard documentation set as well as Adobe Acrobat Reader with Search.
Measurement Guide	ABA	An English language printed copy of the standard Measurement Guide in addition to the standard documentation in the Manual Set on CD-ROM shipped with the analyzer. For additional information on the contents of the Documentation CD-ROM, refer to “Manual Set on CD-ROM” on page 45. Provides details on how to measure various signals, and how to use catalogs and files. In addition, this manual covers unpacking and setting up the analyzer, analyzer features, and how to make a basic measurement. Includes information on options and accessories, and what to do if you have a problem.

Name	Option Number	Description
Measurement Guide, Simplified Chinese Localization	AB2	A Simplified Chinese language version of the standard Measurement Guide. Provides the same information as Option ABA listed above.
Preamplifier, 3 GHz	P03	An internal preamplifier assembly. *Frequency Range*: 100 kHz to 3 GHz
Preamplifier, 6 GHz	P06	An internal preamplifier assembly. *Frequency Range*: 100 kHz to 6 GHz
Rack Mount Kit	1CM	Includes rack mount flanges and hardware. Used to rack mount analyzers *without* front handles (available as P/N 5063-9215 and N1996-60021).
Rack Mount Kit with Handles	1CP	Includes the parts necessary to rack mount an analyzer with front handles attached (available as P/N 5063-9222 and N1996-60021). (Includes handles.)
Service Documentation	0BW	The Service guide describes assembly-level troubleshooting procedures, provides a parts list, and documents post-repair procedures.
Soft Carrying Case	SCC	An ergonomically designed case to hold the analyzer as well as its cables and accessories.
Spectrogram	271	Provides a display with a history of the spectrum. You can use it to: • Locate intermittent signals. • Track signal levels over time.
Stimulus/Response Calibration Kit	SRK	The kit includes: • Coax Accessories Case, plastic and foam (5000-0912) • Open/Short, 50 ohm, N-type male (85032-60011) • Termination, 50 ohm, N-type male (00909-60009)
Stimulus/Response Measurement Suite to 3 GHz[2]	N8995A - SR3	Provides Stimulus/Response measurements: • Distance to Fault • Two Port Insertion Loss • One Port Insertion Loss • Return Loss
Stimulus/Response Measurement Suite to 6 GHz[3]	N8995A - SR6	Provides Stimulus/Response measurements: • Distance to Fault • Two Port Insertion Loss • One Port Insertion Loss • Return Loss

1. Available *only* at time of purchase
2. The option replaces N1996A/TG3 + N8995A/1FP in CSA1.0.
3. The option replaces N1996A/TG6 + N8995A/1FP in CSA1.0.

Accessories

A number of accessories are available from Agilent Technologies to help you configure your analyzer for your specific applications. They can be ordered through your local Agilent Sales and Service Office and are listed below.

Manual Set on CD-ROM

The documentation CD-ROM contains the standard documentation set in electronic (PDF) format as well as Adobe Acrobat Reader with Search.

The standard documentation set includes:

- User's/Programmer's Guide: Describes analyzer features in detail, including front-panel key descriptions, basic spectrum analyzer programming information, and SCPI command descriptions.
- Measurement Guide: Provides details on how to measure various signals, and how to use catalogs and files. In addition, this manual covers unpacking and setting up the analyzer, analyzer features, and how to make a basic measurement. Includes information on options and accessories, and what to do if you have a problem.
- Specifications Guide: Documents specifications, safety, and regulatory information.
- Instrument Messages and Functional Tests: Includes instrument messages (and suggestions for troubleshooting them), and manual functional tests.

NOTE Refer to the front of the CD-ROM, for installation information.

NOTE Service documentation is *not* included in the standard documentation set. See "Options" on page 41 for information on ordering.

50 Ohm Load

The Agilent 909 series loads come in several models and options providing a variety of frequency ranges and VSWRs. Also, they are available in either 50 ohm or 75 Ohm. Some examples include the:

909A: DC to 18 GHz
909C: DC to 2 GHz
909D: DC to 26.5 GHz

50 Ohm/75 Ohm Minimum Loss Pad

The Agilent 11852B is a low VSWR minimum loss pad that allows you to make measurements on 75 Ohm devices using an analyzer with a 50 Ohm input. It is effective over a frequency range of dc to 2 GHz.

75 Ohm Matching Transformer

The Agilent 11694A allows you to make measurements in 75 Ohm systems using an analyzer with a 50 Ohm input. It is effective over a frequency range of 3 to 500 MHz.

AC Probe

The Agilent 85024A high frequency probe performs in-circuit measurements without adversely loading the circuit under test. The probe has an input capacitance of 0.7 pF shunted by 1 MΩ of resistance and operates over a frequency range of 300 kHz to 3 GHz. High probe sensitivity and low distortion levels allow measurements to be made while taking advantage of the full dynamic range of the spectrum analyzer.

AC Probe (Low Frequency)

The Agilent 41800A low frequency probe has a low input capacitance and a frequency range of 5 Hz to 500 MHz.

Broadband Preamplifiers and Power Amplifiers

Preamplifiers and power amplifiers can be used with your spectrum analyzer to enhance measurements of very low-level signals.

- The Agilent 8447D preamplifier provides a minimum of 25 dB gain from 100 kHz to 1.3 GHz.
- The Agilent 87405A preamplifier provides a minimum of 22 dB gain from 10 MHz to 3 GHz. (Power is supplied by the probe power output of the analyzer.)
- The Agilent 83006A preamplifier provides a minimum of 26 dB gain from 10 MHz to 26.5 GHz.
- The Agilent 85905A CATV 75 ohm preamplifier provides a minimum of 18 dB gain from 45 MHz to 1 GHz. (Power is supplied by the probe power output of the analyzer.)
- The 11909A low noise preamplifier provides a minimum of 32 dB gain from 9 kHz to 1 GHz and a typical noise figure of 1.8 dB.

RF and Transient Limiters

The Agilent 11867A and N9355/6 RF Limiters protect the analyzer input circuits from damage due to high power levels. The 11867A operates over a frequency range of dc to 1800 MHz and begins reflecting signal levels over 1 mW up to 10 W average power and 100 watts peak power. The N9355/6 microwave limiter (0.1 to 12.4 GHz, usable to 18 GHz) guards against input signals over 1 milliwatt up to 1 watt average power and 10 watts peak power.

The Agilent 11947A Transient Limiter protects the analyzer input circuits from damage due to signal transients. It specifically is needed for use with a line impedance stabilization network (LISN). It operates over a frequency range of 9 kHz to 200 MHz, with 10 dB of insertion loss.

Power Splitters

The Agilent 11667A/B power splitters are two-resister type splitters that provide excellent output SWR, at 50 Ω impedance. The tracking between the two output arms, over a broad frequency range, allows wideband measurements to be made with a minimum of uncertainty.

11667A: DC to 18 GHz
11667B: DC to 26.5 GHz

System II Bottom Feet kit,

System II Feet kit (p/n 5000-0913) is used to make the instrument stackable. Bottom feet are added to the analyzer. (See Installation Note: 5000-0914). The kit includes:

- System II Bottom Feet
- Tilt Stand
- Key Lock

Static Safe Accessories

9300-1367	Wrist-strap, color black, stainless steel. Four adjustable links and a 7 mm post-type connection.
9300-0980	Wrist-strap cord 1.5 m (5 ft.)

3 Front and Rear Panel Features

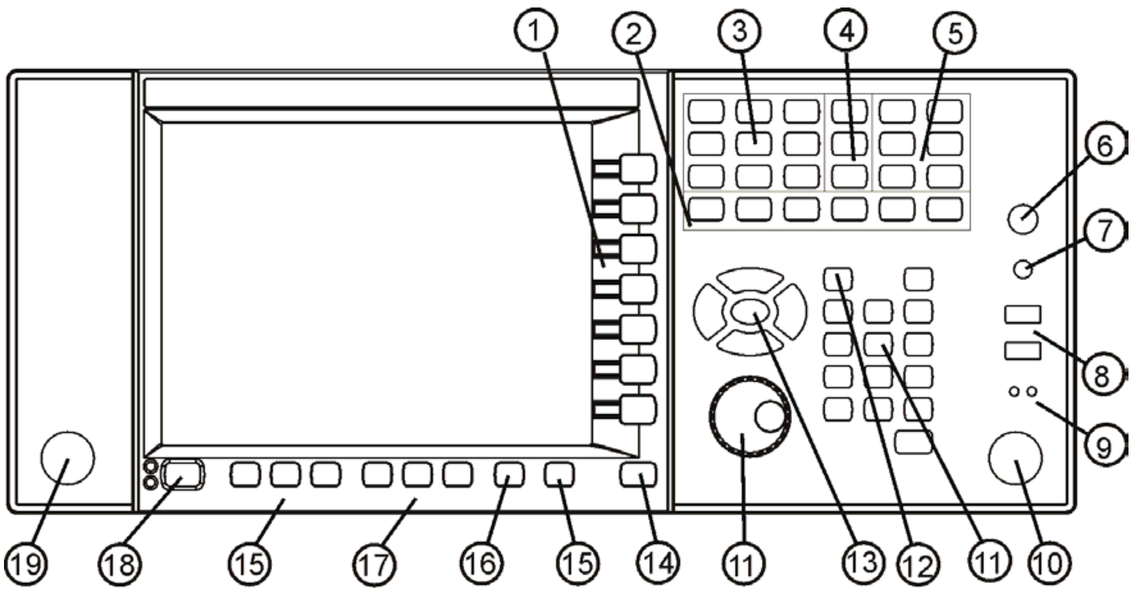
This chapter gives you an overview of the front and rear panels of your analyzer. For details on analyzer keys and remote programming, refer to the User’s and Programmer’s Reference. For connector specifications (including input/output levels), see the Specifications guide.

Front Panel Overview

This section provides information on the analyzer's front panel, including:

- "Front-Panel Connectors and Keys", see below.
- "Display Annotations: Spectrum Display" on page 53.
- "Display Annotations: Spectrogram (Option 271)" on page 57.

Front-Panel Connectors and Keys



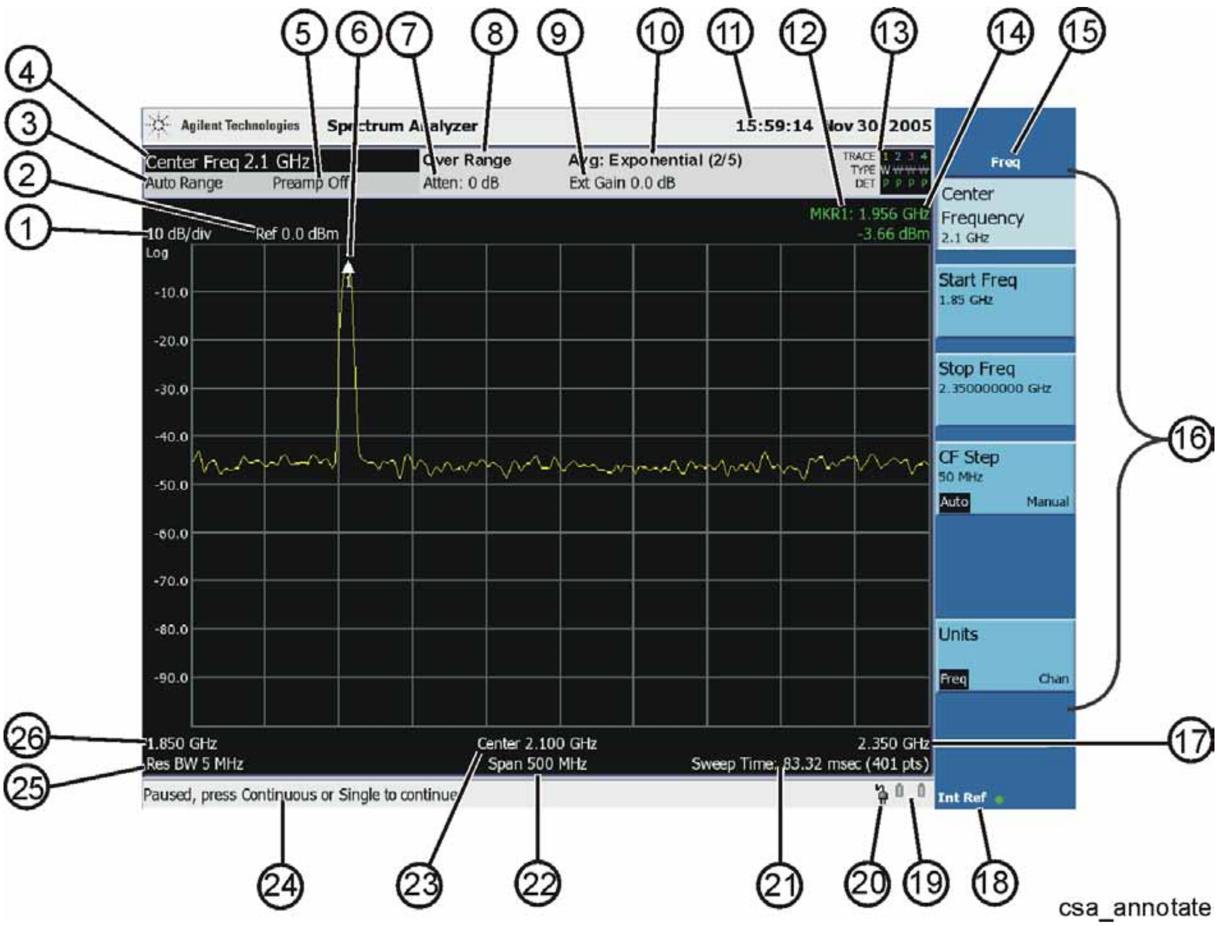
Item #	Item Name	Description
1	**Menu Keys**	Menu labels identifying the current function of each menu key appear to the left of each key. Key menus are dependent on the active menu. Also see "Using Menu Keys" on page 69.
2	**Measurement Keys**	Select measurement mode. Select and set up specific measurements and mode parameters within the current mode.
3	**Analyzer Setup Keys**	Set parameters used for making measurements. These settings will affect measurements in all modes.
4	**Marker Keys**	Enable markers to obtain specific information about the displayed measurement.

Item #	Item Name	Description
5	**Utility Keys**	Access features used with all analyzer modes and affects the state of the entire spectrum analyzer. See your User's Guide for more details. **System** functions affect the state of the entire analyzer. Various setup and adjustment routines are accessed with the **System** key. The **Mode Preset** and **User Preset** keys reset the analyzer to a known state. The **Save** and **Recall** keys enable you to save and to recall measurement results, traces, states, and screens. The **Print** key saves the currently displayed screen to a file.
6	**PROBE PWR**	Supplies power for external high frequency probes and accessories.
7	**Earphone Jack**	Jacks for earphone.
8	**USB Jacks**	Jacks for connecting USB devices. For example, an external memory device.
9	**Battery Indicators**	LEDs indicate the status of batteries 1 and 2.
10	**RF INPUT 50Ω**	Input for an external signal. Make sure that the total power of all signals at the analyzer input does *not* exceed +33 dBm (2 watts).
11	**Data Controls**	Change the numeric value of an active function. Entries appear in the active function area of the display. Also see "Entering Data" on page 69.
12	**Cancel (Esc)**	Pressing this key when operating remotely will put the analyzer in local mode.
13	**Navigation Keys**	Moves cursor between fields on the display. Increments and decrements active function values.
14	**Return Key**	Exits the current menu and returns to the previous menu.
15	**Volume Control Keys/**	Enables you to Mute or increase and decrease sound at the internal speaker or the earphones. Used with AM/FM Tune and Listen, N1996A with Option AFM.
16	**Help Key**	Press the **Help** key to access the embedded help information. Use the menu keys or navigation keys (item 13) to select the desired help topic. Two types of help are available: 1. Task help that will guide you through making a measurement. 2. Key function explanations that provide a short description of a key and the associated remote command. You can exit help by pressing **Cancel (Esc)**.
17	**Window Keys** (Not currently implemented.)	**Next Window**: On displays with multiple windows, changes the highlighted window that is currently active. **Zoom**: Zooms in on the highlighted window. **Multiple Windows**: On displays with multiple windows, switches the view to multiple window.

Item		Description
#	Name	
18	**Power On/Standby**	Turns the analyzer on. A green light indicates power on. A yellow light indicates standby mode. **NOTE** The front-panel switch is a standby switch, *not* a LINE switch (disconnecting device); the analyzer continues to draw power even when the line switch is in standby. Use the detachable power cord to disconnect the analyzer from the mains supply. **NOTE** The internal frequency reference is not powered when in standby mode.
19	**RF OUTPUT 50Ω**	The output for the built-in signal source. This connector is present on all N1996A analyzers, but the output is enabled only on analyzers with either N8995A, N8995A-SR3 or N8995A-SR6.

Display Annotations: Spectrum Display

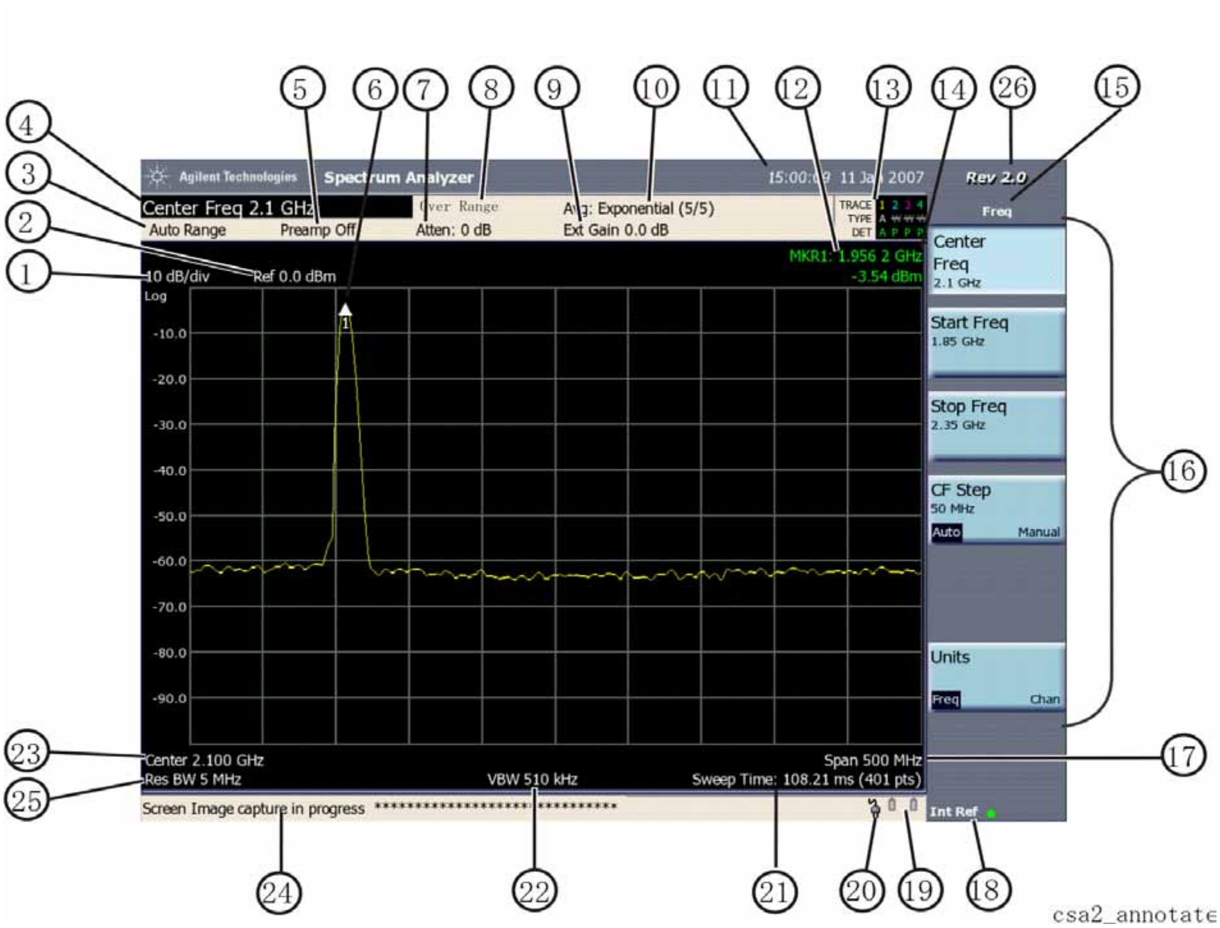
For firmware revisions < A.02.00



Item	Description	Associated Function Keys
1	Amplitude scale	**AMPTD Y Scale, Scale Type** or **AMPTD Y Scale, Scale/Div**
2	Reference level	**AMPTD Y Scale, Ref Level**
3	Auto Range On indicator	**AMPTD Y Scale, Auto Range**
4	Active function block	Refer to the description of the activated function.
5	Internal preamp status	**AMPTD Y Scale**, **Internal Preamp**
6	Marker	**Marker**
7	RF attenuation	**AMPTD Y Scale, Elec Atten**

Item	Description	Associated Function Keys
8	Over Range: Indicates that the attenuation and preamp (if installed) settings are supplying too much power to the detector. Distortion may result. Set **Auto Range** (On) to clear. or <8Smpl/Pt: Indicates that the current instrument settings have reduced the number of samples/display point to fewer than 8. The most accurate averaged amplitude measurement will be made when you have at least 8 samples in each display point.	**AMPTD Y Scale, Elec Atten** **AMPTD Y Scale, Internal Preamp** **AMPTD Y Scale, Auto Range** **Trace/Detector**, More, **Detector**, **Average**
9	Ext Gain	**AMPTD Y Scale, Ext Gain**
10	Averaging	**Trace/Detector, Trace Average** or **Meas Setup**, **Avg Mode, Avg Number**: The numbers shown indicates current average number and the desired number of averages.
11	Time and date display	**System, Time/Date/Location, Date/Time**
12	Active marker	**Marker**
13	Trace and detector information	**Trace/Detector**, **Clear Write (W) Trace Average (A) Max Hold (M) Min Hold (m)** **Trace/Detector**, **More, Detector, Peak (P) Sample(S) Negative Peak (p) Average (A)**
14	Active marker frequency and amplitude If in zero span, active marker time and amplitude is displayed.	**Marker**
15	Key menu title	Dependent on menu selection.
16	Key menu	Menu key labels
17	Stop frequency or if in zero span, stop time	**FREQ Channel, Stop Freq**
18	Reference frequency source indicator	**System, Freq/Time Reference**
19	Battery 1 & 2 status indicator	**System, System Stats, Battery**
20	AC power indicator	Indicates that the analyzer is currently powered by the external AC/DC power converter
21	Sweep time	**Control/Sweep, Sweep Time**
22	Span	**SPAN X Scale**
23	Center frequency	**FREQ Channel, Center Freq**
24	Display status line	Displays informational and error messages (see “Types of Spectrum Analyzer Messages” on page 227).
25	Resolution Bandwidth	**BW, Res BW**
26	Start frequency or if in zero span, 0 sec	**FREQ Channel, Start Freq**

For firmware revision A.02.00 or greater

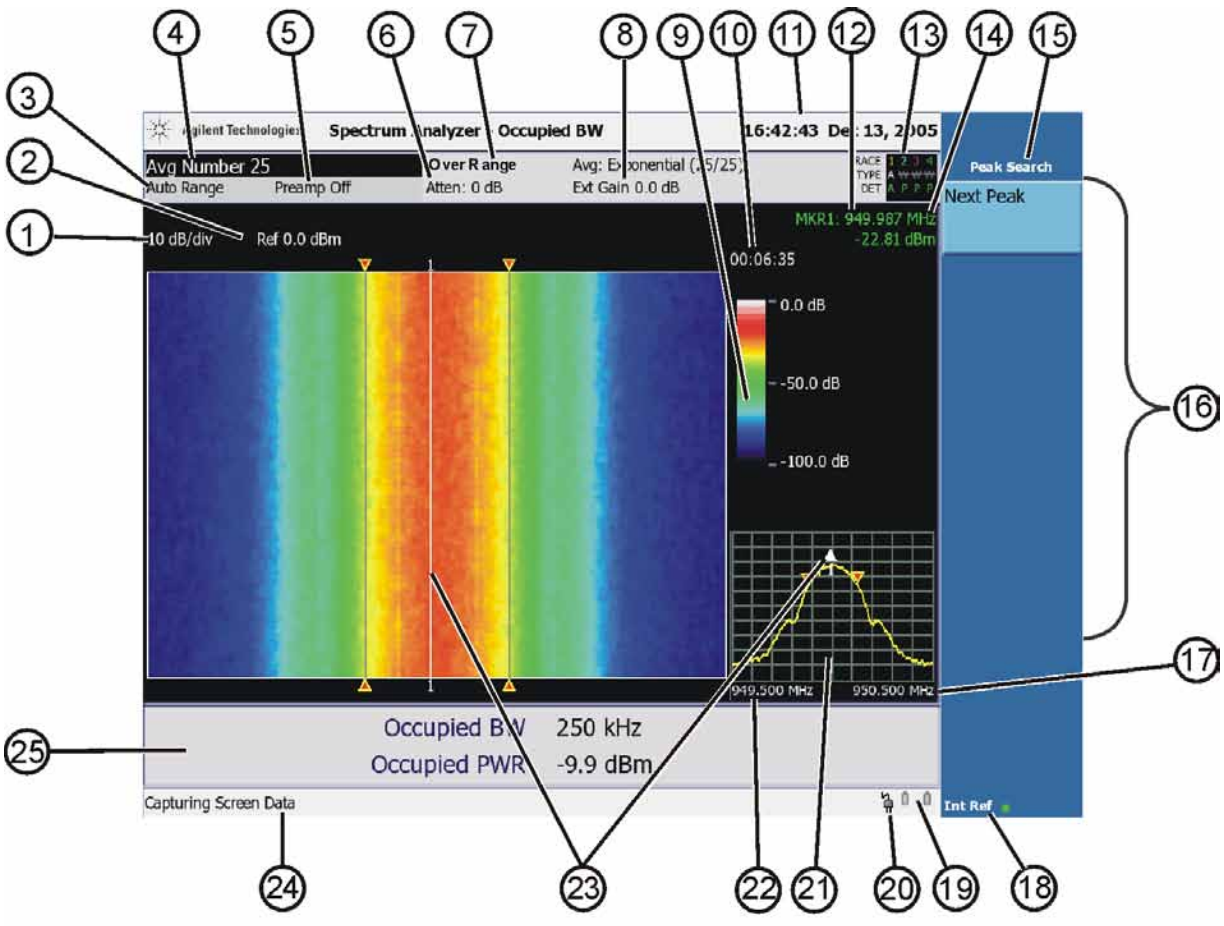


Item	Description	Associated Function Keys
1	Amplitude scale	**AMPTD Y Scale, Scale Type** or **AMPTD Y Scale, Scale/Div**
2	Reference level	**AMPTD Y Scale, Ref Level**
3	Auto Range On indicator	**AMPTD Y Scale, Auto Range**
4	Active function block	Refer to the description of the activated function.
5	Internal preamp status	**AMPTD Y Scale, Internal Preamp**
6	Marker	**Marker**
7	RF attenuation	**AMPTD Y Scale, Elec Atten**

Item	Description	Associated Function Keys
8	Over Range: Indicates that the attenuation and preamp (if installed) settings are supplying too much power to the detector. Distortion may result. Set **Auto Range** (On) to clear. or <8Smpl/Pt: Indicates that the current instrument settings have reduced the number of samples/display point to fewer than 8. The most accurate averaged amplitude measurement will be made when you have at least 8 samples in each display point.	**AMPTD Y Scale, Elec Atten** **AMPTD Y Scale, Internal Preamp** **AMPTD Y Scale, Auto Range** **Trace/Detector**, **More, Detector**, **Average**
9	Ext Gain	**AMPTD Y Scale, Ext Gain**
10	Averaging	**Trace/Detector, Trace Average** or **Meas Setup**, **Avg Mode, Avg Number**: The numbers shown indicates current average number and the desired number of averages.
11	Time and date display	**System, Time/Date/Location, Date/Time**
12	Active marker	**Marker**
13	Trace and detector information	**Trace/Detector**, **Clear Write (W) Trace Average (A) Max Hold (M) Min Hold (m)** **Trace/Detector**, **More, Detector, Peak (P) Sample(S) Negative Peak (p) Average (A)**
14	Active marker frequency and amplitude If in zero span, active marker time and amplitude is displayed.	**Marker**
15	Key menu title	Dependent on menu selection.
16	Key menu	Menu key labels
17	Span	SPAN X Scale
18	Reference frequency source indicator	**System, Freq/Time Reference**
19	Battery 1 & 2 status indicator	**System, System Stats, Battery**
20	AC power indicator	Indicates that the analyzer is currently powered by the external AC/DC power converter
21	Sweep time	**Control/Sweep, Sweep Time**
22	VBW	**BW, Video BW**
23	Center frequency	**FREQ Channel, Center Freq**
24	Display status line	Displays informational and error messages (see “Types of Spectrum Analyzer Messages” on page 227).
25	Resolution Bandwidth	**BW, Res BW**
26	Revision indicator	**System, System Stats, Show System**

Display Annotations: Spectrogram (Option 271)

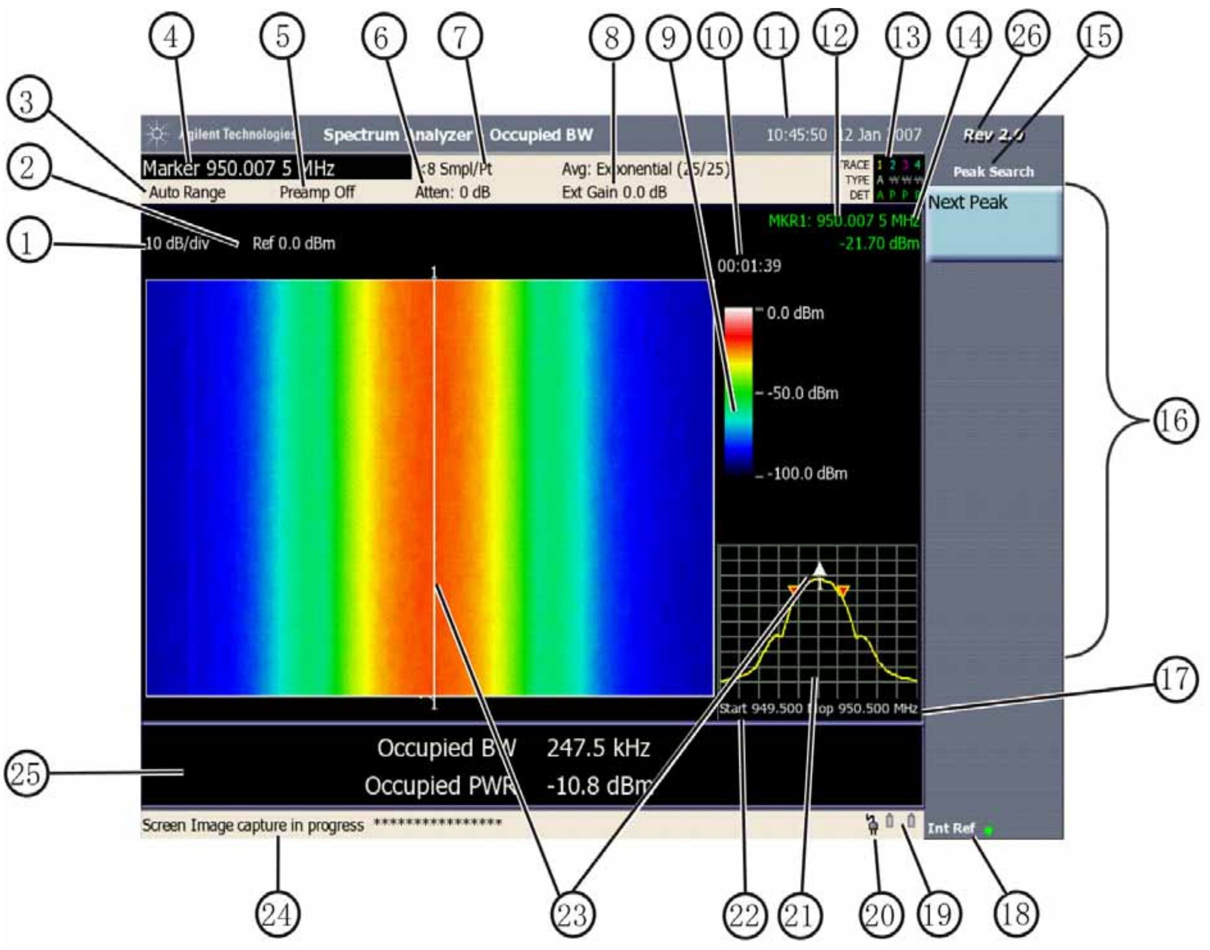
For firmware revisions < A.02.00



Item	Description	Associated Function Keys
1	Amplitude scale	**AMPTD Y Scale, Scale Type** or **AMPTD Y Scale, Scale/Div**
2	Reference level	**AMPTD Y Scale, Ref Level**
3	Auto Range On indicator	**AMPTD Y Scale, Auto Range**
4	Active function block	Data entry field for the active function.
5	Internal preamp status	**AMPTD Y Scale, Internal Preamp**
6	RF attenuation	**AMPTD Y Scale, Elec Atten**

Item	Description	Associated Function Keys
7	Over Range: Indicates that the attenuation and preamp (if installed) settings are supplying too much power to the detector. Distortion may result. Set **Auto Range** (On) to clear. or <8Smpl/Pt: Indicates that the current instrument settings have reduced the number of samples/display point to fewer than 8. The most accurate averaged amplitude measurement will be made when you have at least 8 samples in each display point.	**AMPTD Y Scale, Elec Atten** **AMPTD Y Scale, Internal Preamp** **AMPTD Y Scale, Auto Range** **Trace/Detector**, More, **Detector**, **Average**
8	Ext Gain	**AMPTD Y Scale, Ext Gain**
9	Color scale legend	Provides a reference for the color scale.
10	Elapsed time clock	Provides an indicator of the data collection time interval of the displayed spectrogram.
11	Time and date display	**System, Time/Date/Location, Date/Time**
12	Active marker	**Marker**
13	Trace information	**Trace/Detector**, **Clear Write (W) Trace Average (A) Max Hold (M) Min Hold (m)** **Trace/Detector**, **More, Detector, Peak (P) Sample (S) Negative Peak (p) Average (A)**
14	Active marker frequency and amplitude	**Marker**
15	Key menu title	Dependent on menu selection.
16	Key menu	Menu key labels
17	Stop frequency or if in zero span, stop time	**FREQ Channel, Stop Freq**
18	Reference frequency source indicator	**System, Freq/Time Reference**
19	Battery 1 & 2 status indicator	**System, System Stats, Battery**
20	AC power indicator	Indicates that the analyzer is currently powered by the external AC/DC power converter
21	Spectrum display	**View/Display, Spectrogram** Provides a Spectral display of the spectrum sampled to create the spectrogram.
22	Start frequency or if in zero span, 0 sec	**FREQ Channel, Start Freq**
23	Marker	**Marker**
24	Display status line	Displays informational and error messages (see “Types of Spectrum Analyzer Messages” on page 227).
25	Metrics Panel	Displays measurement results data metrics.

For firmware revision A.02.00 or greater

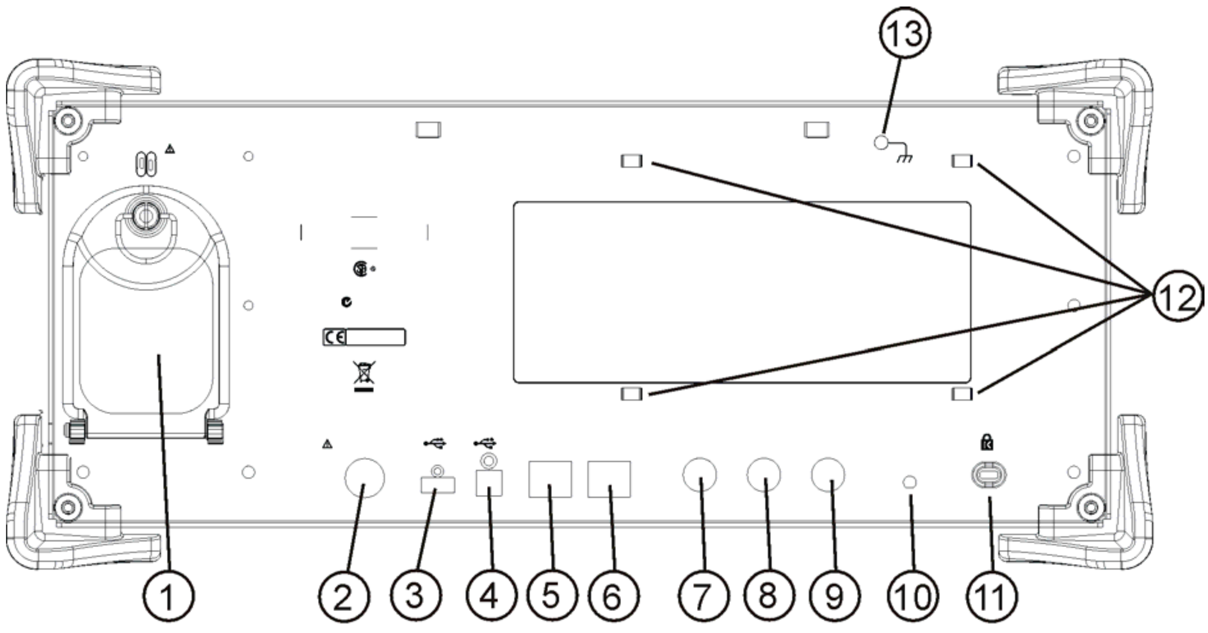


csa2_annotate-spectrc

Item	Description	Associated Function Keys
1	Amplitude scale	**AMPTD Y Scale, Scale Type** or **AMPTD Y Scale, Scale/Div**
2	Reference level	**AMPTD Y Scale, Ref Level**
3	Auto Range On indicator	**AMPTD Y Scale, Auto Range**
4	Active function block	Data entry field for the active function.
5	Internal preamp status	**AMPTD Y Scale**, **Internal Preamp**
6	RF attenuation	**AMPTD Y Scale, Elec Atten**

Item	Description	Associated Function Keys
7	Over Range: Indicates that the attenuation and preamp (if installed) settings are supplying too much power to the detector. Distortion may result. Set **Auto Range** (On) to clear. or <8Smpl/Pt: Indicates that the current instrument settings have reduced the number of samples/display point to fewer than 8. The most accurate averaged amplitude measurement will be made when you have at least 8 samples in each display point.	**AMPTD Y Scale, Elec Atten** **AMPTD Y Scale, Internal Preamp** **AMPTD Y Scale, Auto Range** **Trace/Detector**, **More, Detector**, **Average** (Log/RMS/V)
8	Ext Gain	**AMPTD Y Scale, Ext Gain**
9	Color scale legend	Provides a reference for the color scale.
10	Elapsed time clock	Provides an indicator of the data collection time interval of the displayed spectrogram.
11	Time and date display	**System, Time/Date/Location, Date/Time**
12	Active marker	**Marker**
13	Trace information	**Trace/Detector**, **Clear Write (W) Average (A) Max Hold (M) Min Hold (m)** **Trace/Detector**, **More, Detector, Peak (P) Sample (S) Negative Peak (p) Average (A)**
14	Active marker frequency and amplitude	**Marker**
15	Key menu title	Dependent on menu selection.
16	Key menu	Menu key labels
17	Stop frequency or if in zero span, stop time	**FREQ Channel, Stop Freq**
18	Reference frequency source indicator	**System, Freq/Time Reference**
19	Battery 1 & 2 status indicator	**System, System Stats, Battery**
20	AC power indicator	Indicates that the analyzer is currently powered by the external AC/DC power converter
21	Spectrum display	**View/Display, Spectrogram** Provides a Spectral display of the spectrum sampled to create the spectrogram.
22	Start frequency or if in zero span, 0 sec	**FREQ Channel, Start Freq**
23	Marker	**Marker**
24	Display status line	Displays informational and error messages (see “Types of Spectrum Analyzer Messages” on page 227).
25	Metrics Panel	Displays measurement results data metrics.
26	Revision indicator	**System, System Stats, Show System**

Rear-Panel Features



Item		Description
#	**Name**	
1	**Battery Compartment**	Location of the two batteries that provide DC power to the analyzer.
2	**DC Power**	The input for the dc power source. Refer to "Power Requirements" on page 27.
3	**USB, Type A**	Allows connections of external devices such as an external memory device.
4	**USB, Type B**	Allows connections of external devices such as a PC controller. (not implemented)
5	**Timing LAN**	A TCP/IP Interface for connecting internal options to external devices. (not implemented)
6	**LAN**	A TCP/IP Interface. • For information on setting the IP address, refer to "Turning on the Analyzer for the First Time" on page 32. • For information on using the analyzer remotely, refer to the User's/Programmer's Guide.
7	**REF OUT (10 MHz)**	An output of the analyzer's internal 10 MHz frequency reference signal used to lock the frequency reference of the analyzer to other test equipment.
8	**EXT REF IN**	Input for an external frequency reference signal. For additional information on using an external reference, refer to "Using an External Reference" on page 33.
9	**EXT TRIGGER INPUT**	A TTL input that accepts the positive or negative edge (selectable) of an external voltage input that triggers the analyzer internal sweep source.
10	Reserved for future use.	

Item		Description
#	Name	
11	**Kensington lock Slot**	Used in conjunction with Kensington Lock to secures analyzer to work space.
12	**Mounting tabs**	Mounting tabs for mounting the external power supply when analyzer is rack mounted.
13	**Grounding lug**	Chassis ground connection.

Key Overview

The keys labeled **FREQ Channel**, **System**, and **Marker** are all examples of front-panel keys. The front-panel keys are dark gray, light gray, green, beige, or white in color. Front-panel keys that are white perform an immediate action rather than bringing up a menu. The only green keys are the **Mode Preset**, **User Preset**, and **Help** keys. The Mode Preset and User Preset keys perform an analyzer reset and the Help key accesses the embedded help system. (A summary of all front panel keys and their related menu keys can be found in the User's Guide for your analyzer). Pressing most of the dark gray, the light gray, or the beige front-panel keys accesses menus of functions that are displayed along the right side of the display. These are called menu keys.

Menu keys list functions other than those accessed directly by the front panel keys. To activate a menu key function, press the key immediately to the right of the annotation on the screen. The menu keys that are displayed depend on which front-panel key is pressed and which menu level is enabled.

If a menu key function value can be changed, it is called an active function. The function label of the active function is highlighted after that key has been selected. For example, press **AMPTD Y Scale**. This calls up the menu of related amplitude functions. Note the function labeled **Ref Level** (the default selected key in the Amplitude menu) is highlighted. **Ref Level** also appears in the active function block (as well as the reference level value), indicating that it is the active amplitude function and can now be changed using any of the data entry controls.

A menu key with On and Off in its label can be used to turn the menu key function on or off. To turn the function on, press the menu key so that On is underlined. To turn the function off, press the menu key so that Off is underlined. In the manual, when On should be underlined, it will be indicated as **Function** (On).

A function with Auto and Man in the label can either be auto-coupled or have its value manually changed. The value of the function can be changed manually using the numeric keypad, knob, or step keys. To auto-couple a function, press the menu key so that Auto is underlined. In the manual, when **Auto** should be underlined, it will be indicated as **Function** (Auto).

In some key menus, one key label will always be highlighted to show which key has been selected. For example, when you press **Marker**, you will access a menu of keys in which some of the keys are grouped together by a yellow highlighted region of the menu. The **Normal** key, which is the **Marker** menu default key, will be highlighted. When you press another key within the yellow region, such as **Delta**, a yellow border around that key becomes visible to show it has been selected.

In other key menus, one key label will always be highlighted to show which key has been selected but the menu is immediately exited when a selection is made. For example, when you press the **Avg Type** key (on the **Meas Setup** menu), it will bring up its own menu of keys. The **Log-Pwr Avg** key, which is the Avg Type menu default key, will be highlighted. When you press the **Pwr Avg** key, the highlight will move to that key to show it has been selected and the screen will return to the **Meas Setup** menu.

The arrow keys located around the Select key to the left of the analyzer display can be used to navigate within tables or lists, for example the Chan Std table. These keys are used to move between rows. The cursor (inverse video highlight) indicates the active item.

4 Recommended Test Equipment

Recommended Test Equipment

Test Equipment for Making Measurements

Test Equipment

The table below summarizes the test equipment needed to perform all of the measurements shown in this guide. Alternate equipment model numbers are given in case the recommended equipment is not available.

If neither the recommended nor the alternative test equipment are available, substitute equipment that meets or exceeds the critical specifications listed.

NOTE To find descriptions of specific analyzer functions, refer to the *Agilent Technologies N1996A Spectrum Analyzer User's/Programmer's Reference Guide*.

Item	Critical Specifications	Recommended Agilent Model	Alternate Agilent Model
Adapters			
Type-N (m) to BNC (f) (3)		1250-0780	
Type N (m) to Type N (m)	*Frequency*: 10 MHz to 6 GHz *VSWR*: 1.08:1	1250-1472	
Type N (f) to 3.5 mm (f) (for use with 20 GHz or 26.5 GHz source)	*Frequency*: 10 MHz to 6 GHz *VSWR*: 1.08:1	1250-1745	
Type N (f) to 2.4 mm (f) (for use with >26.5 GHz source)	*Frequency*: 10 MHz to 6 GHz *VSWR*: ≤1.08:1	11903B	
Cables			
BNC, 122-cm (48-in) (3)		10503A	
Type N (m) to Type N (m), <=36 inches long	*Frequency*: 10 MHz to 6 GHz *VSWR*: 1.4:1	11500B	
Cable, BNC (m) to BNC (m), ≥36 inches long	*Frequency*: 10 MHz nominal	10503	
Signal Source (two are required)			
Synthesized Signal Generator (if 8360-Series sweeper is not used)	*Frequency Range*: 10 MHz to 6 GHz *Power Level*: -10 to +5 dBm	8665B, E8257D, E8267D, or E4438C Opt 506	
Synthesized Sweeper (if 8665B, ESG or PSG is not available)	*Frequency Range*: 10 MHz to 6 GHz *Power Level*: -10 to +5 dBm	83620A/B, 83630A/B, 83640A/B, 83650A/B	

5 Spectrum Analyzer

This Chapter provides information making the following measurements.

Making a Basic Measurement

This section provides information on basic analyzer operation. For more information on making measurements, see the appropriate measurement chapter.

This section is divided into the following sections:

"Entering Data" on page 69

"Using Menu Keys" on page 69

"Presetting the Spectrum Analyzer" on page 71

"Creating a User Preset and Power-Up State" on page 71

"Viewing a Signal" on page 72

CAUTION Ensure that the total power of all signals at the analyzer input does *not* exceed +33 dBm (2 watts).

Basic Assumption

The material in this chapter is presented with the assumption that you understand the front and rear panel layout, and display annotations of your analyzer. If you do not, refer to the *Measurement Guide* "Front and Rear Panel Features" on page 49.

Entering Data

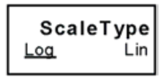
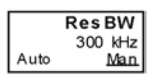
When setting measurement parameters, there are several ways to enter or modify the value of the *active* function:

Knob	Increments or decrements the current value.
Arrow Keys	Increments or decrements the current value.
Numeric Keypad	Enters a specific value. Then press the desired terminator (either a unit menu key, or the **Enter** key).
Unit Menu Keys	Terminate a value that requires a unit-of-measurement.
Enter Key	Terminates an entry when either no unit of measure is needed, or you want to use the default unit.

Using Menu Keys

Menu Keys (which appear along the right side of the display) provide access to many analyzer functions. Here are examples of menu key types:

Toggle	Allows you to activate/deactivate states.	Toggles the selection (underlined choice) each time you press the key.

	Example: 	
Submenu	Displays a new menu of menu keys.	A submenu key allows you to view a new menu of menu keys related to the submenu key category.
	Example: 	
Choice	Allows you to make a selection from a list of values.	A choice key displays the currently selected submenu choice, in this example, dBm. When the choice is made, the submenu automatically returns.
	Example: 	
Adjust	Highlights the menu key and sets the active function.	Press this type of key and enter a value. The default for menu keys with an automatic (**Auto**) or manual (**Man**) choice is automatic. *After* pressing the key, the selection changes to manual.
	Examples:  	

Presetting the Spectrum Analyzer

Preset provides a known starting point for making measurements. The analyzer has two types of preset:

Mode Preset	This type of preset restores the currently selected mode to a known factory-defined state.
User Preset	Restores the analyzer to a user-defined state. User Preset uses the factory-defined state until you create a custom user preset file.

For details, see the User’s and Programmer’s Reference manual.

Creating a User Preset and Power-Up State

User Preset recalls the power-up state, applying the defaults you define using the Save State button. When you save a state to be used as the User Preset power-up state, you must name the state “Powerup”. If you want to use the Agilent-defined defaults at power-up, press Mode Preset to restore the Agilent-defined defaults and save that state as a new Powerup state file.

If you constantly use settings which are not the factory defaults, use the following steps to create a user-defined preset:

NOTE If “Powerup” state already exists in the catalog list, you can set the state to your preferences and then select “Powerup” in the list. The catalog list can be viewed by selecting **Save**, **Catalog**.

1. Set analyzer parameters as desired.
2. Set filename to “Ask”. Press **Save**, **Name**, **Filename** (Ask).
3. Save to the internal hard drive. Press **Save**, **Location**, **Internal**.
4. Save Powerup state. Press **Type**, **State**, **Save Now**.
5. Using the knob or arrow keys, select the letters from the alphabet window to create the word, “Powerup” and press **OK**. The message, “`State was saved successfully: C:Powerup`” is displayed. Press **OK** again to return to the **Save** key menu.

   The parameters saved in this “Powerup” state file are now enabled as the user preset option and as the default power-up state.

NOTE This process is easier for firmware revision A.02.00 or greater. After configuring the desired parameter settings, press **User Preset**, **Save User Preset**.

Disabling User Preset

To restore the factory defined Power On settings, press **Mode Preset** and follow the steps listed above to save the resulting state as the new “Powerup” state file. This will restore the factory-defined default settings as the power-on settings and as the user preset settings.

NOTE For firmware revision A.02.00 or greater, to disable User Preset, the process is easier, press **Mode Preset**, then press **User Preset**, **Save User Preset**.

Viewing a Signal

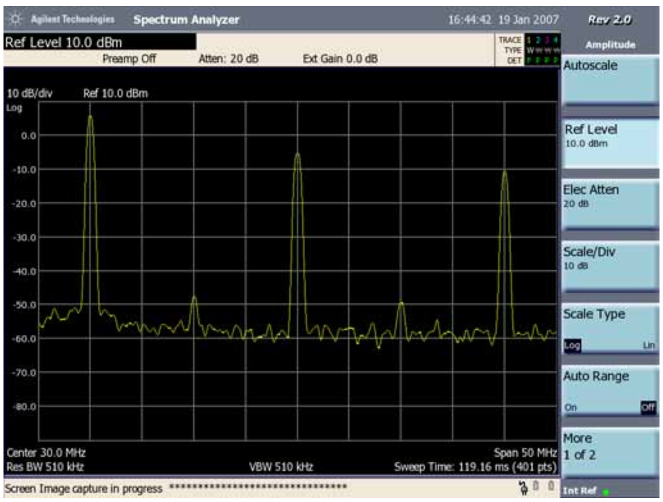
1. Select the spectrum analyzer mode. Press Mode, Spectrum Analyzer.
2. Preset the analyzer: Press **Mode Preset**.
3. Connect the analyzer's rear panel `REF OUT (10 MHz)` to the front-panel input.

Setting Center Frequency, Span, Attenuation, and Reference Level.

1. Set the center frequency to 30 MHz: Press **FREQ Channel, Center Freq**, 30, **MHz**.
2. Set the Span to 50 MHz: Press **SPAN X Scale**, 50, **MHz**.
3. Adjust the attenuation to 20 dB: Press **AMPTD Y Scale**, **Elec Atten**, 20, **dB**.
4. Adjust the reference level (if the peak of the 10 MHz signal component is not visible): Press AMPTD Y Scale, Ref Level, 10, dBm. For more information on this, refer to "Changing Reference Level" on page 73.

   The 10 MHz reference signal spectrum appears on the display, as shown in Figure 5-1.

Figure 5-1 10 MHz Internal Reference Signal and Associated Spectrum



Reading Frequency & Amplitude

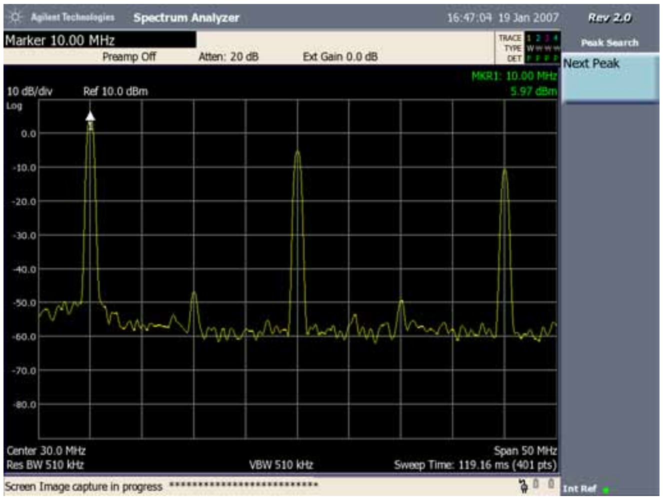
1. Place a marker (labeled `1`) on the 10 MHz peak, as shown in Figure 5-2.

   Press **Peak Search**. If necessary, use the menu keys to move the marker to the proper peak. In addition, you can go to the Marker menu (press Marker) and use the knob or arrow keys to move the marker.

   Note that the frequency and amplitude of the marker appear in the upper-right corner of the screen.

2. If you have moved the marker, return it to the peak of the 10 MHz signal.

Figure 5-2 A Marker on the 10 MHz Peak



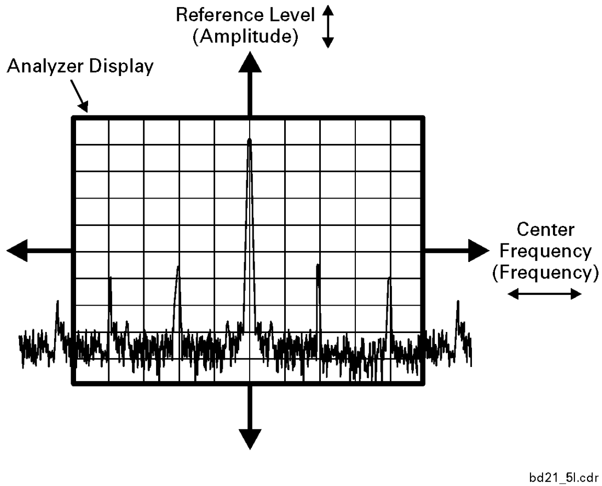
Changing Reference Level

1. Press AMPTD Y Scale, and note that reference level (`Ref Level`) is now the active function. Press Marker ⇒, Mkr ⇒ RL.

   Note that changing the reference level changes the amplitude value of the top graticule line.

   Figure 5-3 shows the relationship between center frequency and reference level. The box represents the analyzer display. Changing the center frequency changes the horizontal placement of the signal on the display. Changing the reference level changes the vertical placement of the signal on the display. Increasing the span increases the frequency range that appears horizontally across the display.

Figure 5-3 Relationship Between Frequency and Amplitude



Measuring Multiple Signals

This section provides information on measuring multiple signals.

This section is divided into the following sections:

CAUTION Ensure that the total power of all signals at the analyzer input does *not* exceed +33 dBm (2 watts).

Basic Assumption

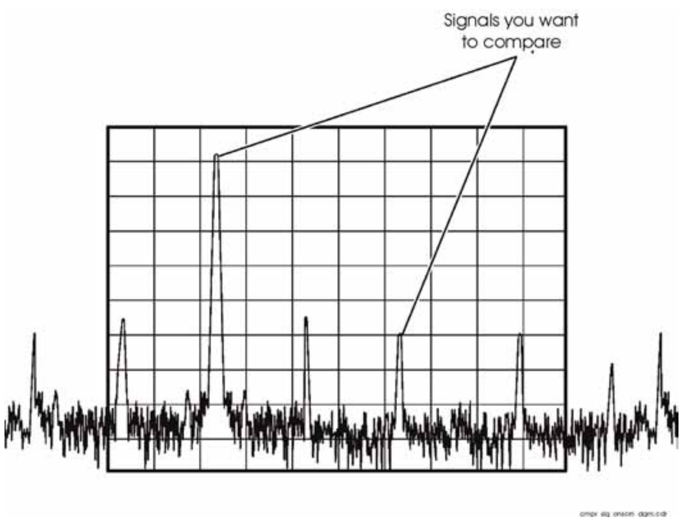
The material in this chapter is presented with the assumption that you understand the front and rear panel layout, and display annotations of your analyzer. If you do not, refer to the *Measurement Guide* "Front and Rear Panel Features".

Comparing Signals on the Same Screen Using Marker Delta

Using the analyzer, you can easily compare frequency and amplitude differences between signals, such as radio or television signal spectra. The analyzer delta marker function lets you compare two signals when both appear on the screen at one time.

In this procedure, harmonics of the 10 MHz reference signal available at the rear of the analyzer are used to measure frequency and amplitude differences between two signals on the same screen. Delta marker is used to demonstrate this comparison.

Figure 5-4 An Example of Comparing Signals on the Same Screen



Step 1. Select the spectrum analyzer mode:

Press **Mode**, **Spectrum Analyzer.**

Step 2. Preset the analyzer:

Press **Mode Preset**.

Step 3. Connect the rear panel REF OUT `(10 MHz)` to the front panel RF input.

Step 4. Set the analyzer center frequency, span and reference level to view the fundamental and 2nd through fifth harmonics of the 10 MHz reference signal:

Press **FREQ Channel**, **Center Frequency**, 30, **MHz**.
Press **SPAN X Scale**, **Span**, 50, **MHz**.
Press **AMPTD Y Scale**, **Ref Level**, 10, **dBm**
Press **AMPTD Y Scale**, **Elec Atten**, 20, **dB** or **Auto Range** (On).

Step 5. Place a marker at the highest peak on the display (10 MHz):

Press **Peak Search**.

The **Next Peak** menu key is available to move the marker from peak to peak. The marker should be on the 3rd harmonic of the 10 MHz reference signal.

Step 6. Anchor the first marker and activate the Delta marker:

Press **Marker, Delta**.

The label on the second marker reads Δ1, indicating that it is the movable marker.

Step 7. Move the second marker to another signal peak or by using the **Peak Search** key:

Press **Peak Search**, **Next Peak**.

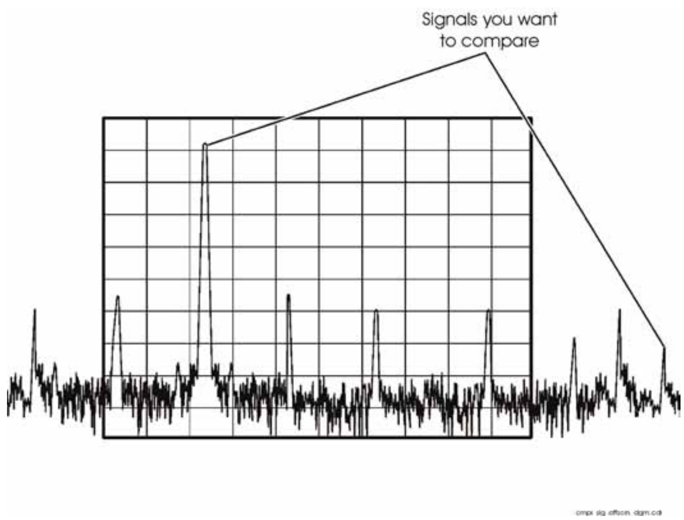
The amplitude and frequency *difference* between the markers is shown in the upper right corner of the display.

Comparing Signals not on the Same Screen Using Marker Delta

Measure the frequency and amplitude difference between two signals that do not appear on the screen at one time. (This technique is useful for harmonic distortion tests when narrow span and narrow bandwidth are necessary to measure the low level harmonics.)

In this procedure, frequency and amplitude differences are measured between harmonics of the analyzer's 10 MHz reference; one harmonic on screen and one harmonic off screen. Delta marker is used to demonstrate this comparison.

Figure 5-5 Comparing One Signal on Screen with One Signal Off Screen



Step 1. Select the spectrum analyzer mode:

Press **Mode**, **Spectrum Analyzer.**

Step 2. Preset the analyzer:

Press **Mode Preset**.

Step 3. Connect the rear panel `REF OUT (10 MHz)` to the front panel RF input.

Step 4. Set the center frequency, span and reference level to view only the 30 MHz signal:

Press **FREQ Channel**, **Center Freq**, 30, **MHz**.
Press **SPAN X Scale**, **Span**, 5, **MHz**.

Step 5. Place a marker on the 30 MHz peak:

Press **Peak Search**.

Step 6. Set the center frequency step size equal to 10 MHz:

Press **FREQ Channel**, **CF Step** (Manual), 10, **MHz**.

Step 7. Activate the marker delta function:

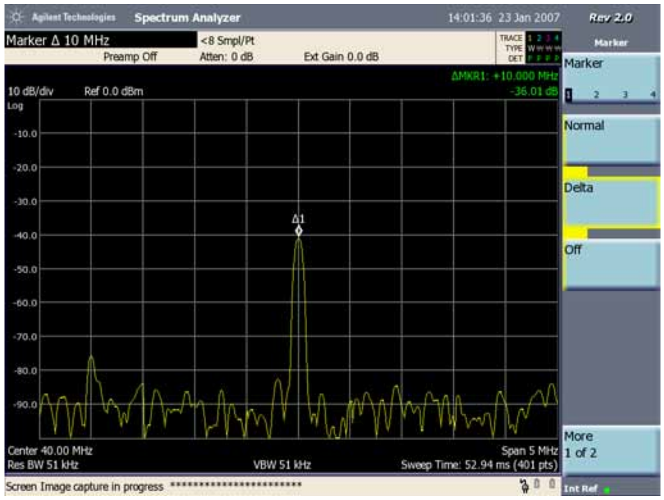
Press **Marker, Delta**.

Step 8. Increase the center frequency by 10 MHz:

Press **FREQ Channel**, **Center Freq**, ↑, **Peak Search**.

The delta marker (Δ1) appears on the peak of the 40 MHz harmonic. The delta marker annotation displays the amplitude and frequency difference between the 30 and 40 MHz signal peaks. Refer to Figure 5-6.

Figure 5-6 Delta Marker with Reference Signal Off-Screen



Step 9. Turn the markers off:

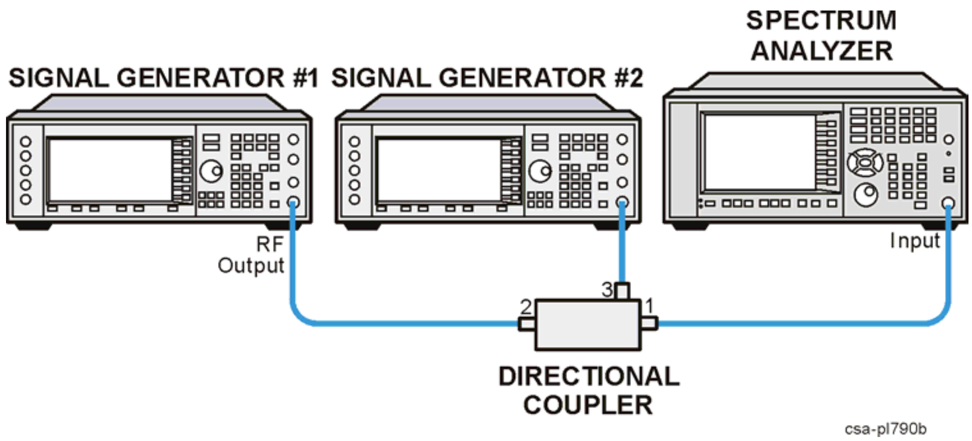
Press **Marker, Off**.

Resolving Signals of Equal Amplitude

In this procedure a decrease in resolution bandwidth is used to resolve two signals of equal amplitude with a frequency separation of 100 kHz. Notice that the final RBW selection to resolve the signals is the same width as the signal separation.

Step 1. Connect the output of signal generator #1 to port 2 of the directional coupler and connect the output of signal generator #2 to port 3 (the coupled port) of the directional coupler as shown in Figure 5-7.

Figure 5-7 **Setup for Obtaining Two Signals**



Step 2. Set the signal sources as follows:

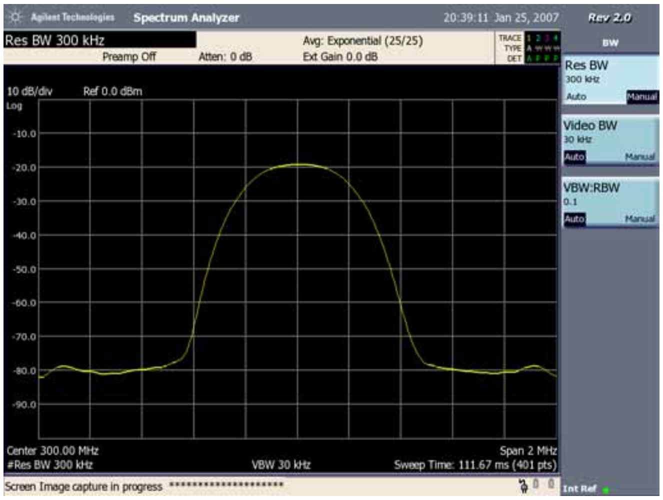
Set signal generator #1 to 300 MHz at –19 dBm. Set signal generator #2 to 300.1 MHz at –4 dBm (this higher power level overcomes the nominal 16 dB loss through the coupled arm of the directional coupler).
The amplitude of both signals should be approximately –20 dBm at the output of the bridge.

Step 3. Setup the analyzer to view the signals:

Press **Mode Preset**.
Press **FREQ Channel**, **Center Freq**, 300, **MHz**.
Press **SPAN X Scale**, **Span**, 2, **MHz**.
Press **Meas Setup**, **Avg Mode**, **Exponential**.
Press **Avg Number**, 25, **Enter**.
Press **Trace/Detector**, **Trace Average**.
Press **BW**, **Res BW** (Manual), 300, **kHz**.

A single signal peak is visible. See Figure 5-8 for an example.

Figure 5-8 **Unresolved Signals of Equal Amplitude**

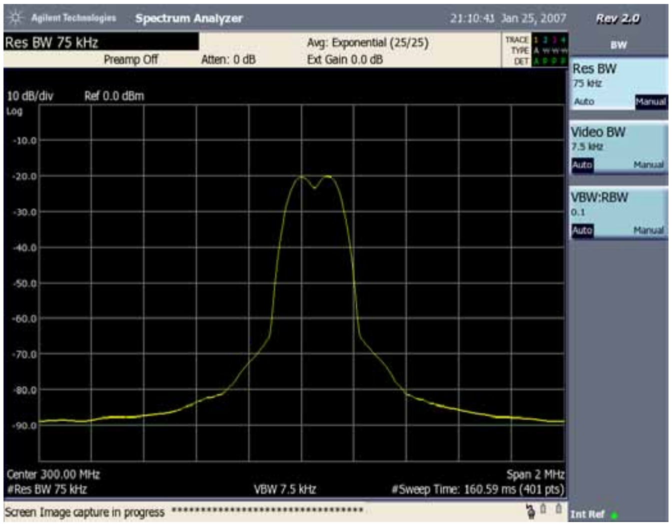


Step 4. Change the resolution bandwidth (RBW) to 75 kHz so that the RBW setting is less than or equal to the frequency separation of the two signals:

Press **BW, Res BW** (Manual), 75, **kHz**.

Notice that the peak of the signal has become flattened indicating that two signals may be present.

Figure 5-9 **Resolving Signals of Equal Amplitude**



As the resolution bandwidth is decreased, resolution of the individual signals is improved and the sweep time is increased. For fastest measurement times, use the widest possible resolution bandwidth. Under factory preset conditions, the resolution bandwidth is “coupled” (or linked) to the span.

Since the resolution bandwidth has been changed from the coupled value, a # mark appears next to `Res BW` in the lower-left corner of the screen, indicating that the resolution bandwidth is uncoupled. (For more information on resolution bandwidth, refer to the **Res BW** description in the Agilent CSA Spectrum Analyzers User’s and Programmer’s Reference guide.)

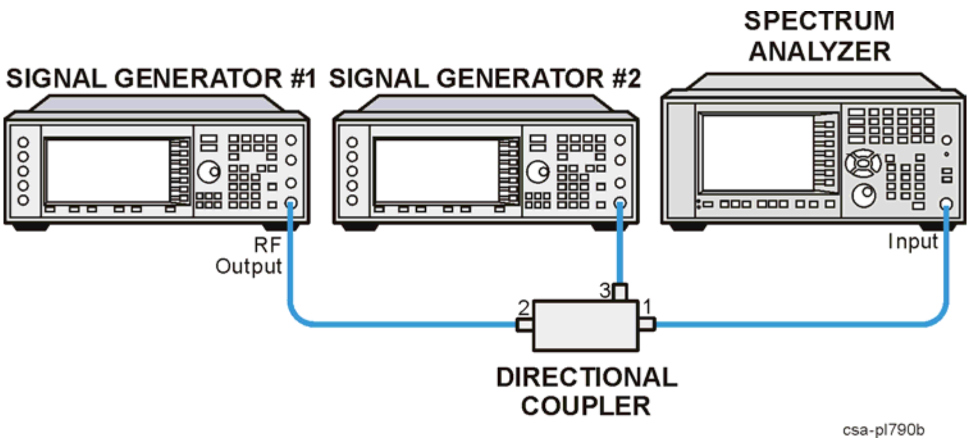
NOTE To resolve two signals of equal amplitude, the resolution bandwidth must be less than the signal separation. For example, if the signal separation is 200 kHz and the analyzer only has resolution bandwidth settings in a 1-3-10 sequence, a 100 kHz RBW is the best choice for the 200 kHz signal separation. But some analyzers, such as the Agilent CSA and PSA spectrum analyzers, can select a 180 kHz RBW.

Resolving Small Signals Hidden by Large Signals

This procedure uses narrow resolution bandwidths to resolve two input signals with a frequency separation of 50 kHz and an amplitude difference of 60 dB.

Step 1. Connect two sources to the analyzer input as shown in Figure 5-7. Connect the output of signal generator #1 to port 2 of the directional coupler and connect the output of signal generator #2 to port 3 (the coupled port) of the directional coupler.

Figure 5-10 **Setup for Obtaining Two Signals**



Step 2. Set the signal sources as follows:

Set signal generator #1 to 300 MHz at –9 dBm. Set signal generator #2 to 300.450 MHz at –54 dBm. (These power levels plus the nominal 16 dB loss through the coupled arm and the nominal 1 dB loss through the main arm of the directional coupler results in a signal 60 dB below the first signal).

Step 3. Set the analyzer as follows:

Press **Mode Preset**.
Press **FREQ Channel**, **Center Freq**, 300, **MHz**.
Press **SPAN X Scale**, **Span**, 5, **MHz**.
Press **BW**, **Res BW**, 100, **kHz**.

Step 4. Set the 300 MHz signal peak to the reference level:

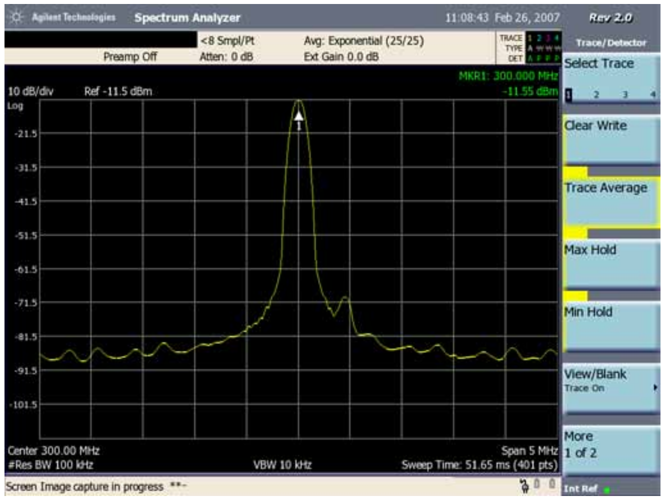
Press **Peak Search**, **Mkr →**, **Mkr → R L**.

Note that the Agilent CSA 100 kHz filter shape factor of 8:1 has a bandwidth of 840 kHz at the 60 dB point. The half-bandwidth (420 kHz) is NOT narrower than the frequency separation of 450 kHz, so the input signals can not be resolved.

Step 5. Activate averaging to smooth the noise:

Press **Meas Setup**, **Avg Mode**, **Exponential**.
Press **Avg Number**, 25, **Enter**.
Press **Trace/Detector**, **Trace Average**

Figure 5-11 **Signal Resolution with a 100 kHz RBW**

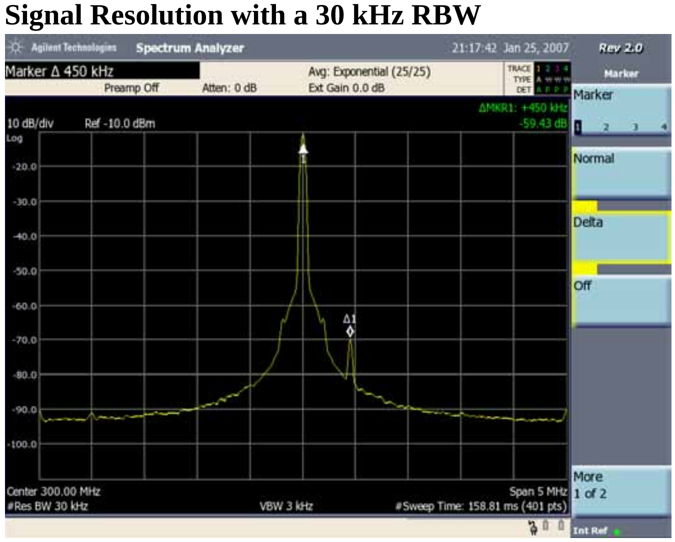


Step 6. Reduce the resolution bandwidth filter to view the smaller hidden signal. Place a delta marker on the smaller signal:

Press **BW**, 30, **kHz**.
Press **Peak Search**, **Marker**, **Delta**, 450, **kHz**.

Note that the Agilent CSA 30 kHz filter shape factor of 8.4 has a bandwidth of 252 kHz at the 60 dB point, however noise sidebands will make the 60 dB bandwidth appear wider. The half-bandwidth (including effects of noise sidebands) is narrower than 250 kHz, so the input signals can be resolved.

Figure 5-12 **Signal Resolution with a 30 kHz RBW**



NOTE To determine the resolution capability for intermediate amplitude differences, assume the filter skirts between the 3 dB and 60 dB points are parabolic, like an ideal Gaussian filter. The resolution capability is approximately:

$$12.04\ \text{dB} \bullet \left(\frac{\Delta f}{RBW}\right)^2$$

where Δf is the separation between the signals.

Measuring a Low-Level Signal

This section provides information on measuring low-level signals and distinguishing them from spectrum noise.

This section is divided into the following sub-sections:

"Reducing Input Attenuation" on page 87

"Decreasing the Resolution Bandwidth" on page 89

"Trace Averaging" on page 91

CAUTION Ensure that the total power of all signals at the analyzer input does *not* exceed +33 dBm (2 watts).

Basic Assumption

The material in this section is presented with the assumption that you understand the front and rear panel layout, and display annotations of your analyzer. If you do not, refer to the *Measurement Guide* "Front and Rear Panel Features".

Reducing Input Attenuation

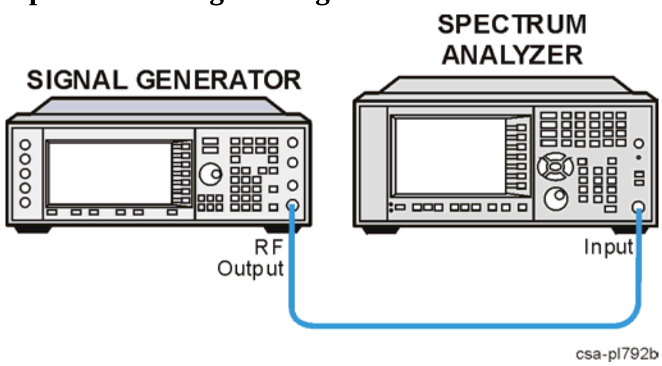
The ability to measure a low-level signal is limited by internally generated noise in the spectrum analyzer. The measurement setup can be changed in several ways to improve the analyzer sensitivity.

The input attenuator affects the level of a signal passing through the instrument. If a signal is very close to the noise floor, reducing input attenuation can bring the signal out of the noise.

CAUTION Ensure that the total power of all input signals at the analyzer RF input does not exceed +33 dBm (2 watts).

Step 1. Connect the RF Output of the signal generator to the analyzer RF Input as shown in Figure 5-7.

Figure 5-13 Setup for Obtaining One Signal



Step 2. Set the frequency of the signal source to 295 MHz. Set the source amplitude to –80 dBm. Connect the source RF OUTPUT to the analyzer RF INPUT.

Step 3. Select the spectrum analyzer mode:

Press **Mode**, **Spectrum Analyzer**.

Step 4. Preset the analyzer:

Press **Mode Preset**.

Step 5. Set the center frequency, span and reference level:

Press **FREQ Channel**, **Center Freq**, 295, **MHz**.
Press **SPAN X Scale**, **Span**, 1, **MHz**.
Press **AMPTD Y Scale**, **Ref Level**, 40, **–dBm**.

Step 6. Place the marker at the desired peak (in this example, 295 MHz)

Press **Peak Search**.

Step 7. Activate averaging to smooth the noise:

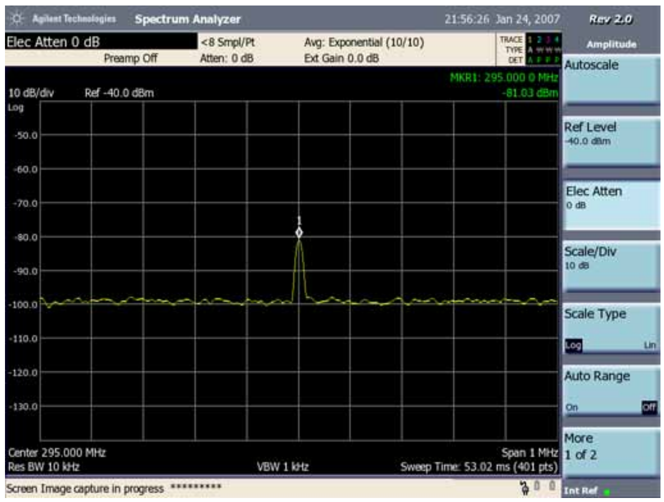
Press **Meas Setup, Avg Number,** 10**, Enter**.
Press **Avg Mode, Exponential**.
Press **Trace/Detector, Trace Average**.

Step 8. To see the signal more clearly, set the attenuation to 0 dB:

Press **AMPTD Y Scale**, **Elect Atten**, 0, **dB**.

Figure 5-14 shows 0 dB input attenuation.

Figure 5-14 Measuring a Low-Level Signal Using 0 dB Attenuation



Step 9. Set the attenuation to 20 dB: (as shown in Figure 5-15)

Press AMPTD Y Scale, Elec Atten, 20, dB.

Note that increasing the attenuation moves the noise floor closer to the signal level.

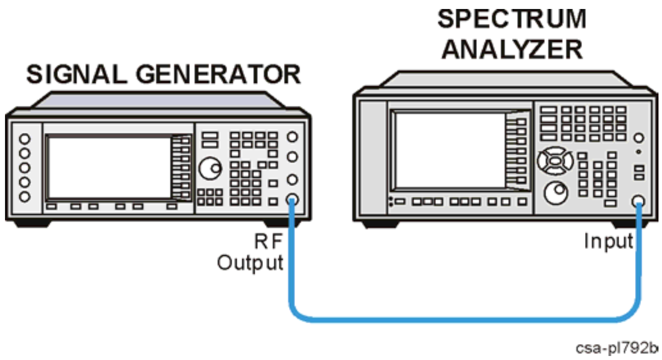
Figure 5-15 Measuring a Low-Level Signal

Decreasing the Resolution Bandwidth

Resolution bandwidth settings affect the level of internal noise without affecting the level of continuous wave (CW) signals. Decreasing the RBW by a decade reduces the noise floor by 10 dB.

Step 1. Connect the RF Output of the signal generator to the analyzer RF Input as shown in Figure 5-7.

Figure 5-16 **Setup for Obtaining One Signal**



Step 2. Set the frequency of the signal source to 295 MHz. Set the source amplitude to –80 dBm. Connect the source RF OUTPUT to the analyzer RF INPUT.

Step 3. Select the spectrum analyzer mode:

Press **Mode**, **Spectrum Analyzer**.

Step 4. Preset the analyzer:

Press **Mode Preset**.

Step 5. Set the center frequency, span and reference level:

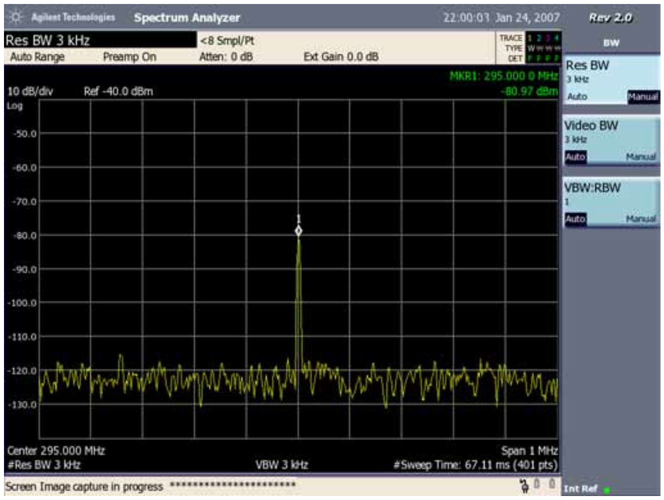
Press **FREQ Channel**, **Center Freq**, 295, **MHz**.
Press **SPAN X Scale**, **Span**, 1, **MHz**.
Press **AMPTD Y Scale**, **Ref Level**, 40, **–dBm**.

Step 6. Decrease the resolution bandwidth:

Press **BW**, **Res BW** (Manual), ↓.

The low-level signal appears more clearly because the noise level is reduced (see Figure 5-17).

Figure 5-17 **Decreasing Resolution Bandwidth**



RBW Selections

All Agilent CSA RBWs are digital. Refer to the *Agilent Technologies Specifications Guide* to determine the selectivity ratio for the particular RBW of interest. Choosing the next lower RBW for better sensitivity increases the sweep time. Using the knob or keypad, you can select individual RBW from the full range of values. This enables you to make the trade off between sweep time and sensitivity with finer resolution.

Spectrum Analyzer

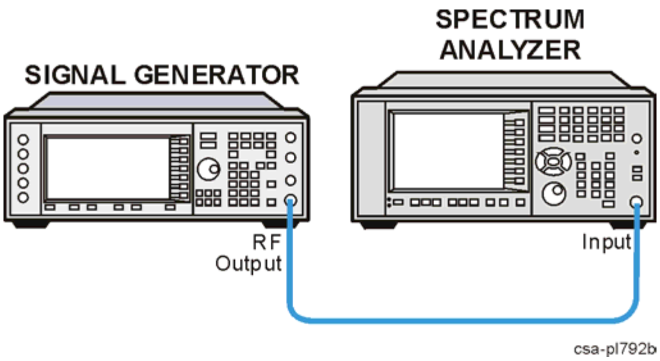
Trace Averaging

Averaging is a digital process in which each trace point is averaged with the previous average for the same trace point. Trace averaging can facilitate identifying and characterizing a CW or narrowband signal, such as a carrier or tone in the presence of noise or other broadband signals.

Selecting averaging, when the analyzer is auto coupled, changes the detection mode from peak to average, smoothing the displayed noise level.

Step 1. Connect the RF Output of the signal generator to the analyzer RF Input as shown in Figure 5-7.

Figure 5-18 **Setup for Obtaining One Signal**



Step 2. Set the frequency of the signal source to 295 MHz. Set the source amplitude to –80 dBm. Connect the source RF OUTPUT to the analyzer RF INPUT.

Step 3. Select the spectrum analyzer mode:

Press **Mode**, **Spectrum Analyzer**.

Step 4. Preset the analyzer:

Press **Mode Preset**.

Step 5. Set the center frequency, span and reference level:

Press **FREQ Channel**, **Center Frequency**, 295, **MHz**.
Press **SPAN X Scale**, **Span**, 5, **MHz**.
Press **AMPTD Y Scale**, **Ref Level**, 40, **–dBm**.

Step 6. Turn trace averaging on:

Press **Meas Setup**, **Avg Number**, `100`, **Enter**.
Press **Trace/Detector**, **Trace Average**.

As the averaging routine smooths the trace, low level signals become more visible. `Avg: Exponential (100/100)` appears above the graticule.

Step 7. With the average number as the active function, set the number of averages to 25:

Press **Meas Setup**, **Avg Number**, 25, **Enter**.

Annotation above the graticule shows the type of averaging, the number of traces averaged, and the number of averages selected.

Changing most active functions restarts the averaging, as does toggling **Trace Type** back and forth from **Clear Write** to **Trace Average**. Once the set number of sweeps completes, the analyzer continues to provide a running average based on this set number, if the Avg Mode is set to Exponential.

NOTE If you want the measurement to stop after the set number of sweeps, use single sweep and the Repeat Average Mode:
Press the front panel key **Meas Setup**, then **Avg Mode**, **Repeat**, and press the front panel key **Control/Sweep**, **Restart**, and then press the front panel key **Single**.

Making Distortion Measurements

This section provides information on measuring and identifying signal distortion.

This section is divided into the following sections:

"Identifying Distortion Products" on page 94

"Third-Order Intermodulation Distortion" on page 98

CAUTION Ensure that the total power of all signals at the analyzer input does *not* exceed +33 dBm (2 watts).

Basic Assumption

The material in this section is presented with the assumption that you understand the front and rear panel layout, and display annotations of your analyzer. If you do not, refer to the *Measurement Guide* "Front and Rear Panel Features".

Identifying Distortion Products

This section provides information on measuring and identifying signal distortion.

This section is divided into the following sections:

Distortion from the Analyzer

High level input signals may cause analyzer distortion products that could mask the real distortion measured on the input signal. Using Trace 2 and the RF attenuator, you can determine which signals, if any, are internally generated distortion products.

Identifying Analyzer Generated Distortion Example:

Using a signal from a signal generator, determine whether the harmonic distortion products are generated by the analyzer.

Step 1. Connect a signal generator to the analyzer INPUT.

Step 2. Set the signal generator frequency to 200 MHz and the amplitude to 0 dBm.

Step 3. On the analyzer, perform a mode preset by pressing **Mode Preset**.

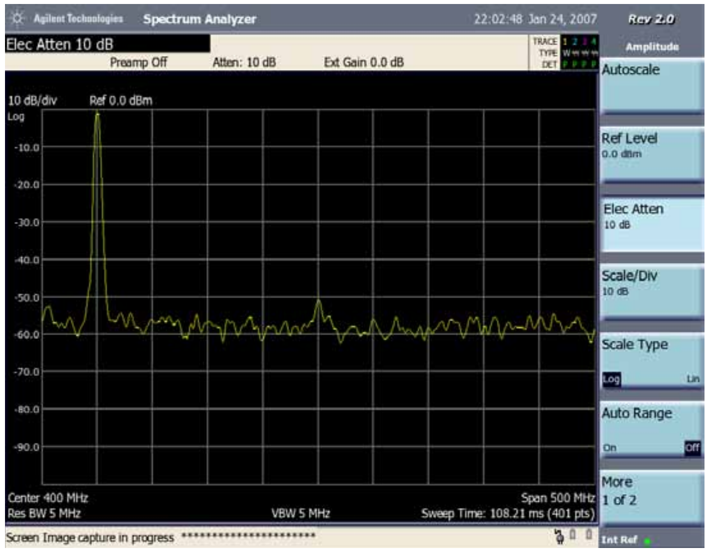
Step 4. Set the center frequency of the analyzer to 400 MHz by pressing **FREQ Channel**, **Center Freq**, 400, **MHz**.

Step 5. Set the span to 500 MHz by pressing **SPAN X Scale**, **Span**, 500, **MHz**.

Step 6. Set the attenuation to 10 dB by pressing **AMPTD Y Scale, Elec Atten,** 10 **dB**.

The signal produces harmonic distortion products in the analyzer input mixer as shown in Figure 5-19.

Figure 5-19 **Harmonic Distortion**

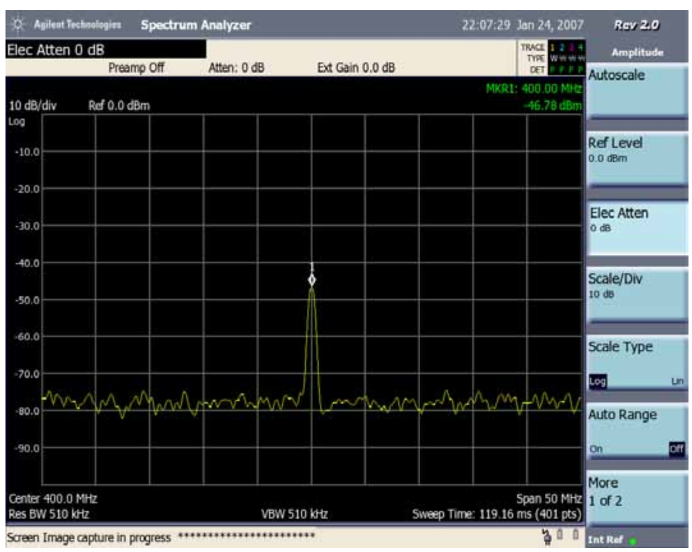


Step 7. Change the span to 50 MHz: press **SPAN X Scale**, **Span**, 50, **MHz**.

Step 8. Ensure that the signal is at the center frequency. If necessary press **Peak Search**, **Marker→**, **Mkr→CF**.

Step 9. Change the attenuation to 0 dB: press AMPTD Y Scale, Elec Atten, 0, dB. Your display should be similar to Figure 5-20.

Figure 5-20 **Harmonic Distortion with 0 dB Attenuation**



Step 10. To determine whether the harmonic distortion products are generated by the analyzer, first save the screen data in trace 2 as follows:

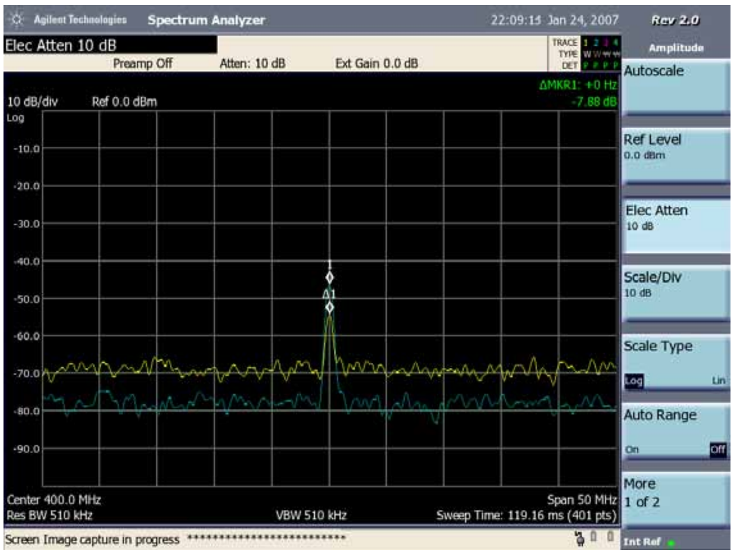
Press **Trace/Detector**, **Select Trace (2)**, then **Clear Write**.
Allow the trace to update (two sweeps) and press **Trace/Detector**, **View/Blank (View)**, **Marker**, **Delta**.

The analyzer display shows the stored data in trace 2 and the measured data in trace 1.

Step 11. Next, press **Trace/Detector**, **Select Trace (1)**, increase the RF attenuation by 10 dB: press **AMPTD Y Scale**, **Elec Atten**, 10, **dB**. See Figure 5-21.

Notice the ΔMkr1 amplitude reading. This is the difference in the distortion product amplitude readings between 0 dB and 10 dB input attenuation settings. If the ΔMkr1 amplitude absolute value is approximately ≥1 dB for an input attenuator change, then distortion is being generated, at least in part, by the analyzer. In this case more input attenuation is necessary.

Figure 5-21 RF Attenuation of 10 dB

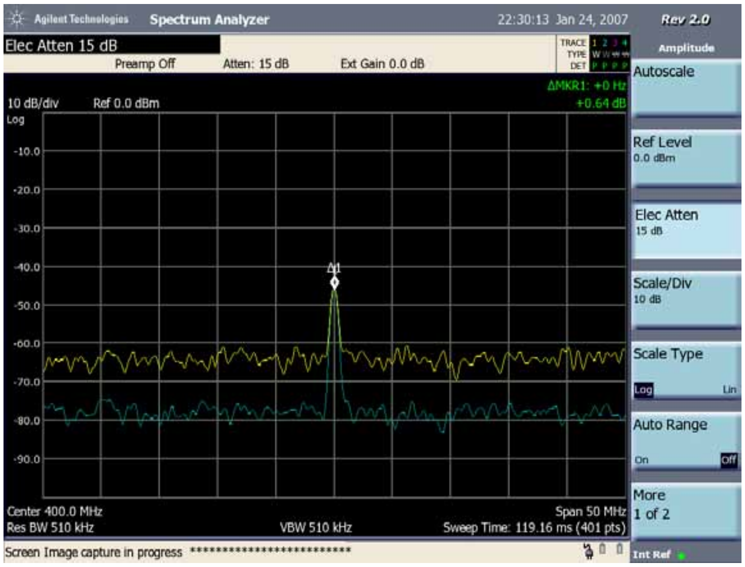


Step 12. Press **Peak Search**, **Marker**, **Delta**

Change the attenuation to 15 dB by pressing AMPTD Y Scale, Elec Atten, 15, dB.

If the ΔMkr1 amplitude absolute value is approximately ≥1 dB, then more input attenuation is required; some of the measured distortion is internally generated. If there is no change in the signal level, the distortion is not generated internally. For example, the signal that is causing the distortion, in this case, shown in Figure 5-22, is not high enough in amplitude to cause internal distortion in the analyzer so any distortion that is displayed is present on the input signal.

Figure 5-22 No Harmonic Distortion



Spectrum Analyzer

Third-Order Intermodulation Distortion

Two-tone, third-order intermodulation distortion is a common test in communication systems. When two signals are present in a non-linear system, they can interact and create third-order intermodulation distortion products that are located close to the original signals. These distortion products are generated by system components such as amplifiers and mixers.

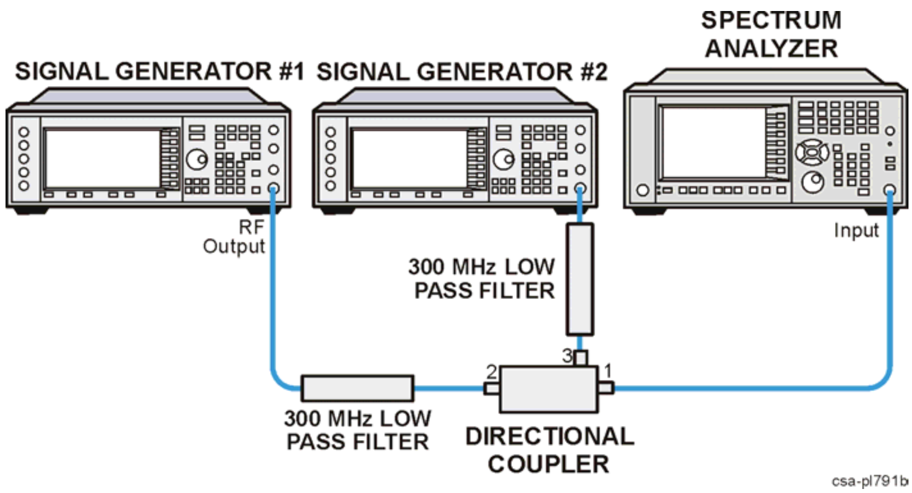
This procedure tests a device for third-order intermodulation using markers. Two sources are used.

Step 1. Connect two signal generators, two low pass filters, and a directional coupler to the analyzer input as shown in Figure 5-23. Connect the output of signal generator #1 to port 2 of the directional coupler through one of the low pass filters and connect the output of signal generator #2 to port 3 (the coupled port) of the directional coupler through the remaining low pass filter.

This combination of signal generators, low pass filters, and directional coupler (used as a combiner) results in a two-tone source with very low intermodulation distortion. Although the distortion from this setup may be better than the specified performance of the analyzer, it is useful for determining the TOI performance of the source/analyzer combination. After the performance of the source/analyzer combination has been verified, the device-under-test (DUT) (for example, an amplifier) would be inserted between the directional coupler output and the analyzer input.

NOTE The coupler should have a high degree of isolation between the two input ports so the sources do not intermodulate.

Figure 5-23 Third-Order Intermodulation Equipment Setup



Step 2. Set the signal sources as follows:

Set signal generator #1 to 295 MHz at –5 dBm. Set signal generator #2 to

296 MHz at 11 dBm (this higher power level overcomes the nominal 16 dB loss through the coupled arm of the directional coupler). This will result in a frequency separation of 1 MHz.
The amplitude of both signals should be approximately –5 dBm at the output of the bridge.

Step 3. Set the analyzer center frequency and span:

Press **Mode Preset**.
Press **FREQ Channel**, **Center Freq**, 295.5, **MHz**.
Press **SPAN X Scale**, **Span**, 5, **MHz**.
Press **AMPTD Y Scale**, **Elec Atten**, 10, **dB**.

Step 4. Reduce the RBW until the distortion products are visible:

Press **BW**, **Res BW** (Manual), ↓.

Step 5. Move the signal to the reference level:

Press **Peak Search**, **Marker →**, **Mkr →RL**.

Step 6. Calculate the attenuator setting required for a –30 dBm mixer level based upon the current reference level setting: Atten = Ref Level – (–30 dBm)

Press **AMPTD Y Scale**, **Elec Atten**, enter the attenuation value for the calculation above and press **dB**.

Step 7. Reduce the RBW until the distortion products are visible:

Press **BW**, **Res BW** (Manual), ↓.

Step 8. Turn on averaging to increase the visibility of the distortion products:

Press **Avg Mode**, **Exponential**, **Avg Number**, 10, **Enter**.

Step 9. Activate the second marker and place it on the peak of the distortion product (beside the test signal) using the **Next Peak** key.

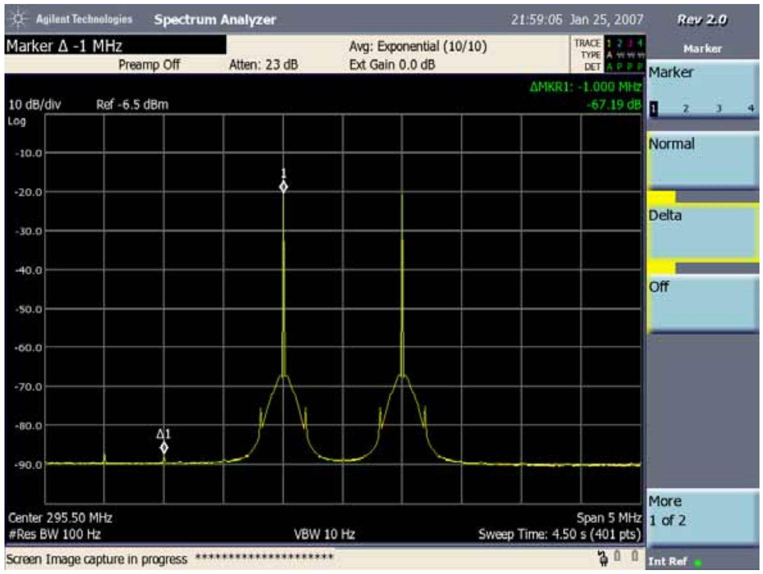
Press **Peak Search**, **Marker**, **Delta**, **Peak Search**, **Next Peak** (active marker should be on the other input signal), **Next Peak** (active marker should be on a distortion product).

Step 10. Measure the other distortion product:

Press **Next Peak**. (see Figure 5-24)

Spectrum Analyzer

Figure 5-24 Measuring the Distortion Product



Using the Analyzer as a Fixed Tuned Receiver

This section provides information on using the analyzer as an AM receiver to measure modulation parameters.

This section includes the following measurement:

"Measuring the Modulation Rate of an AM Signal" on page 101

CAUTION Ensure that the total power of all signals at the analyzer input does *not* exceed +33 dBm (2 watts).

Basic Assumption

The material in this section is presented with the assumption that you understand the front and rear panel layout, and display annotations of your analyzer. If you do not, refer to the *Measurement Guide* "Front and Rear Panel Features".

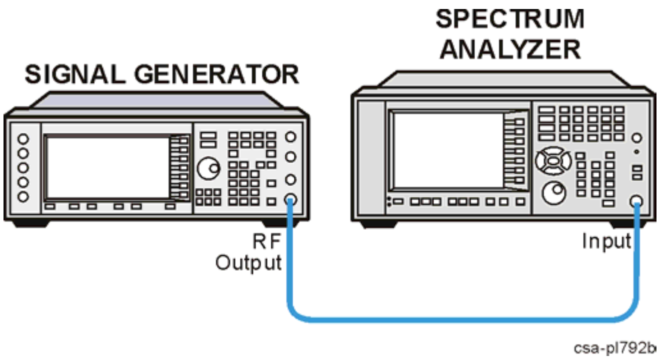
Measuring the Modulation Rate of an AM Signal

This section demonstrates how to determine parameters of an AM signal, such as modulation rate and modulation index (depth) by using frequency and time domain measurements (refer to the concepts chapter in the *Measurement Guide* "AM and FM Demodulation Concepts" on page 197 for more information).

To obtain an AM signal, you can either connect a source transmitting an AM signal, or connect an antenna to the analyzer input and tune to a commercial AM broadcast station. For this demonstration an RF source is used to emulate an AM signal.

Step 1. Connect the RF Output of the signal generator to the analyzer RF Input as shown in Figure 5-25.

Figure 5-25 Setup for AM Demodulation Measurement



Step 2. Set the Agilent ESG RF signal source frequency to 300 MHz and the amplitude to –10 dBm. Set the AM depth to 80%, the AM rate to 1 kHz and turn AM on.

Step 3. Select the spectrum analyzer mode:

Press **Mode**, **Spectrum Analyzer**.

Step 4. Preset the analyzer.

Press **Mode Preset**.

Step 5. Set the center frequency, span, RBW and the sweep time.

Press **FREQ Channel**, **Center Freq**, 300, **MHz**.
Press **SPAN X Scale**, **Span**, 500, **kHz**.
Press **BW**, **Res BW**, 30, **kHz**.

Step 6. Set the y-axis units to volts:

Press **AMPTD Y Scale**, **More**, **Y-Axis Units**, **Volts**.

Step 7. Position the signal peak near the reference level:

Press **AMPTD Y Scale**, **Ref Level**, (rotate front-panel knob).

Step 8. Change the y-scale type to linear:

Press **AMPTD Y Scale**, **Scale Type** (Lin).

Step 9. Set the analyzer in zero span to make time-domain measurements:

Press **SPAN X Scale**, **Zero Span**.
Press **Control/Sweep**, **Sweep Time**, 5, **ms**.

Step 10. Use the video trigger to stabilize the trace:

Press **Meas Setup**, **Trigger**, **Video**. Adjust the trigger level by using knob for a stable trace.

Since the modulation is a steady tone, you can use video trigger to trigger the analyzer sweep on the waveform and stabilize the trace, much like an oscilloscope. See Figure 5-26.

NOTE If the trigger level is set too high or too low when video trigger mode is activated, the sweep stops. You need to adjust the trigger level up or down with the front-panel knob until the sweep begins again.

Step 11. Measure the AM rate using delta markers:

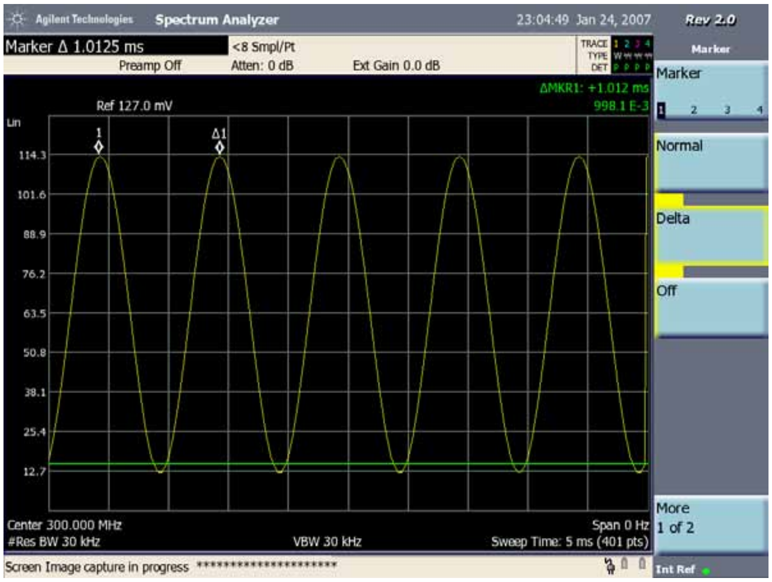
Press **Peak Search**, **Marker**, **Delta**, **Peak Search**, **Next Pk**.

Use markers and delta markers to measure the AM rate. Place the marker on a peak and then use a delta marker to measure the time difference between adjacent peaks (this is the AM rate of the signal)

NOTE Make sure the delta markers above are placed on adjacent peaks. See Figure 5-26. The frequency or the AM rate is 1 divided by the time between adjacent peaks:

AM Rate = 1/1.0 ms = 1 kHz

Figure 5-26 Measuring Time Parameters



You can also use the marker inverse time readout to calculate AM rate in Hz. Press **Marker**, **More 1 of 2**, **Marker Readout**, **Inverse Time**. Then put the markers properly on adjacent peaks.

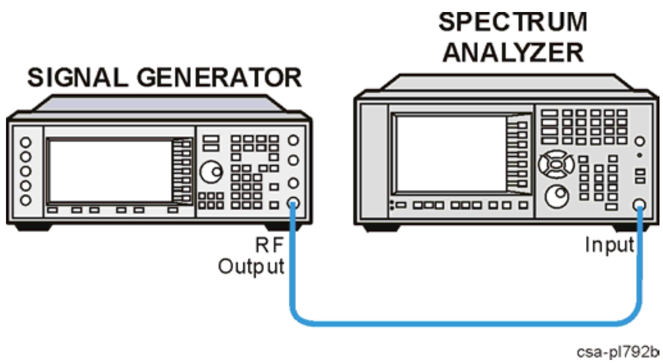
Channel Power

Measuring Signals Using the Channel Power Measurement

You may want to measure the total power of a signal that occupies some bandwidth. The channel power measurement is used to measure the total (channel) power in a selected bandwidth. However, if you are not certain of the characteristics of the signal, or if there are discrete spectral components in the band of interest, you can use the channel power measurement. This example uses the analyzer to measure channel power of standard W-CDMA signal at 1 GHz. The Agilent ESG is used for generating the W-CDMA signal.

Step 1. Connect the RF Output of the signal generator to the analyzer RF Input as shown in Figure 5-27.

Figure 5-27 Setup for Channel Power Measurement



Step 2. Select the spectrum analyzer mode:

Press **Mode**, **Spectrum Analyzer**.

Step 3. Preset the analyzer:

Press **Mode Preset**.

Step 4. Set the center frequency:

Press **FREQ Channel**, **Center Freq**, **1**, **GHz**.

Step 5. Start the channel power measurement:

Press **Meas**, **Channel Power**.

Step 6. Set the integration BW:

Press **Meas Setup, Integ BW, 5, MHz**.

Step 7. Configure the display to show the combined spectrum view with bar graph (span highlighted in blue):

Press **View/Display**, **Bar Graph** (On).

Step 8. To adjust the measurement settings, press **Meas Setup**, then:

1. **Averaging:** To set the averaging **On** or **Off**, switch the **Avg Number** key between **On** and **Off**. When averaging is **On**, enter the number of results used in the averaging calculations. The default average setting is **Off** and the default number is 10 when averaging is **On**. If your input signal changes during the average period, wait until the averaging has completed or the next averaging period has started.
2. **Averaging Mode:** To change the average mode, press the **Avg Mode** key and select **Exponential** or **Repeat**. The default average mode is **Repeat**.
3. **RRC Filter:** Press **More 1 of 2, RRC Filter** to turn the Root Raised Cosine filter **On** or **Off**.
4. **Filter BW:** Press **More 1 of 2, Filter BW** to set the Root Raised Cosine filter bandwidth.
5. **Filter Alpha:** Press **More 1 of 2, Filter Alpha** to set the alpha value for the Root Raised Cosine filter.
6. **Meas Preset:** Press **More 1 of 2, Meas Preset** to set the default value.
7. **Limits:** To set limit settings, press **Limits**:

   Press **Upper Limit** to switch the upper limit between **On** and **Off**, the trace points within the Integ BW are checked to see if they are less than Total Pwr Ref + Upper Limit. If all the points are less than this value, the upper limit test is passed. If any point is greater than the limit, the test is failed.

   Press **Lower Limit** to switch the lower limit between **On** and **Off**, the trace points within the Integ BW are checked to see if they are greater than Total Pwr Ref + Lower Limit. If all the points are greater than this value, the lower limit test is passed. If any point is less than the limit, the test is failed.

   Press **Total Pwr Ref** to set the absolute power value for computing the limit. When set to **Auto**, the total power reference is the measured channel power value. When set to **Man**, the result takes on the last measured value or you can enter the value manually.

Figure 5-28 **Channel Power measurement**

NOTE When Upper Limit or Lower Limit is set to On, a status bar in the top left corner of the display will show whether the measurement result has passed or failed the limit test.

Occupied Bandwidth (OBW) Measurement

Occupied Bandwidth integrates the power of the displayed spectrum and puts markers at the frequencies between which a selected percentage of the power is contained. The measurement defaults to 99% of the occupied bandwidth power. The power-bandwidth routine first computes the combined power of all signal responses contained in the trace. For 99% occupied power bandwidth, markers are placed at the frequencies on either side of 99% of the power. This would leave 1% of the power evenly distributed outside the markers. The frequency difference between the two markers is the displayed occupied bandwidth. The difference between the marker frequencies is the 99% power bandwidth and is the value displayed.

The Occupied BW result corresponds to a span between the markers and is a multiple of the span between two points. So, for a 10 MHz span, the OBW will come in multiples of 25 kHz (10 MHz divided by 400 display points). Values will be 25 kHz, 50 kHz, 75 kHz, etc. For narrow signals (TDMA, PDC, etc.) you will need to zoom in on the signal to get a reasonably accurate Occupied BW result. For a 100 kHz span, the OBW resolution will be 250 Hz (100 kHz divided by 400 display points).

The occupied bandwidth measurement can be made in single or continuous sweep mode. The center frequency and reference level may be set by you.

NOTE Zero-span is disabled in OBW measurement.

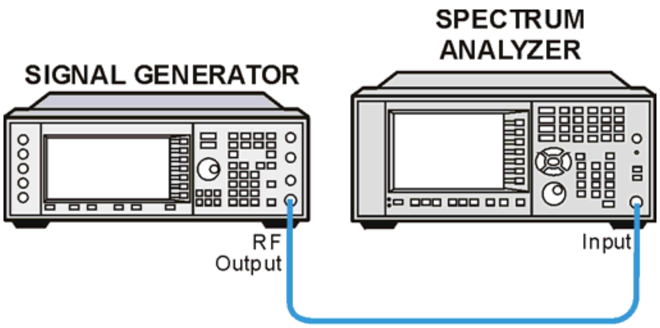
Making a Basic Occupied BW Measurement

NOTE For accurate OBW measurements, it is recommended that you use the sample or average trace detectors. The default detector type is sample. In addition, you should use Exponential Average or Repeat Average with 100 or more averages.

The following example shows how to make an OBW measurement on a GSM signal broadcasting at 950 MHz.

Step 1. Connect the RF Output of the signal generator to the analyzer RF Input as shown in Figure 5-29.

Figure 5-29 **Setup for OBW Measurement**



Step 2. Set a GSM signal on the signal generator with a frequency of 950 MHz a nd the amplitude set to –10 dBm.

Step 3. Select the spectrum analyzer mode:

Press **Mode**, **Spectrum Analyzer**.

Step 4. Preset the analyzer:

Press **Mode Preset**.

Step 5. Set the center frequency and span:

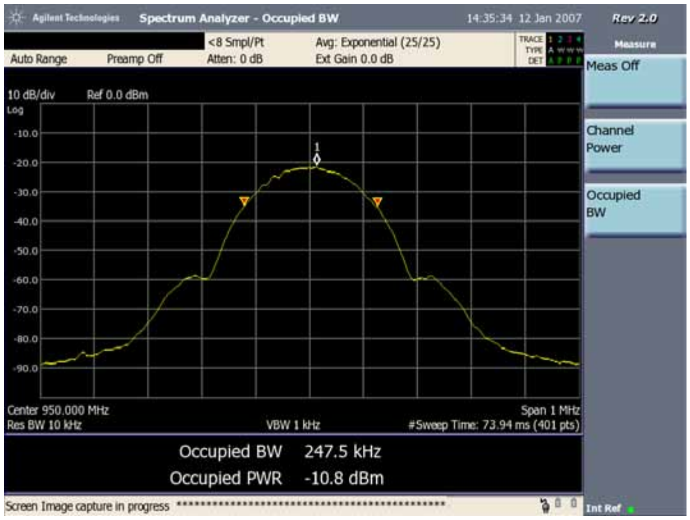
Press **FREQ Channel**, **Center Frequency**, 950, **MHz**.
Press **SPAN X Scale**, **Span**, 1, **MHz**

Step 6. Select Spectrum Analyzer Occupied BW measurement.

Press **Meas**, **Occupied BW**.

A marker pair will appear on the trace and the occupied bandwidth value and the integrated power in the OBW are displayed in the data window below the trace graticule. See Figure 5-30

Figure 5-30 OBW Measurement Results



Step 7. You can improve the repeatability of the measurements by setting the Average number to 100 or greater:

Press **Meas Setup**, **Avg Number**, 100, **Enter**, **Trace/Detector**, **Trace Average**.

Step 8. You can change the percentage of power used for calculating the Occupied BW. The default percentage is 99%.

Press **Meas Setup**, **Power**, 80, **%**.

NOTE If you are measuring a narrow signal such as TDMA or PDC, zoom in on the signal for a more accurate OBW results.

Press **SPAN X Scale**, **Span**, enter the frequency using the number keypad, and then press **Hz**, **kHz**, **MHz**, or **GHz**.

NOTE For an over the air measurement, connect an antenna and an external filter to the RF input.

The external filter is necessary to eliminate out-of-band signals that would otherwise reduce the dynamic range of measurements in the band of interest. The effect of the out-of-band signals is to raise the noise floor, possibly hiding some or all of the signal of interest. However, the external filter is optional in this set up:

If you want to limit your search to a specific band of interest, you should use the filter.
If you want to search beyond a specific band, then you can leave the filter off.

Using the Spectrogram View (Requires Option 271)

This section provides information on making a measurement using the Spectrogram View.

This section includes the following measurement:

"Spectrogram View Basics" on page 111

"A Spectrogram Measurement Using the OBW Measurement" on page 111

Spectrogram View Basics

The Spectrogram view is available in the Spectrum Analyzer mode only. You can use it with measurements turned off (basic spectrum analyzer) or with the available spectrum analyzer measurements listed in the measurement menu, such as the Occupied BW measurement.

Troubleshooting a transmitter system is often aided by examining the time evolution of the power distribution.This view provides a history of the spectrum. You can use it to:

- locate intermittent signals
- track signal levels over time.

You may set the following parameters for this view:

- **Update Interval**: Allows you to set the update interval to 1 or more seconds. Or, you may set it to automatically determine the capture interval that provides the maximum data collection speed.

  A data sample is taken every n^{th} trace for display on the spectrogram. Increasing the capture time allows data capturing over a longer period of time in the spectrogram. However, it is a sampling technique that allows intermittent events, which occur between samplings, to be lost. Therefore, if you are searching for intermittent signals, consider using Repeat Max Hold average type in conjunction with increasing the capture time.

- **Frame Skip**: Allows you to set the number of frames you would like to skip when capturing data. You may set this value from skip 0 to 2,147,483,647 frames. Increasing the frame skip value causes the display to redraw the spectrum every n^{th} trace and a block of lines are shown at once instead of a single line at a time. Higher frame skip values are for use with fast measurements.
- **Palette**: Allows you to set the display to full color or grayscale.

A Spectrogram Measurement Using the OBW Measurement

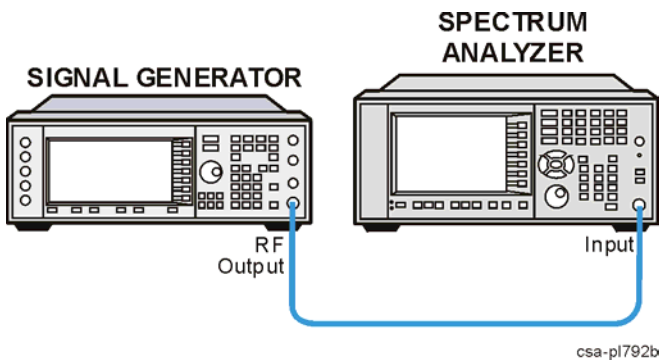
The following procedure is an example of a Spectrogram measurement using the

Spectrum Analyzer mode Occupied Bandwidth (OBW) measurement.

Performing a Spectrogram Measurement

Step 1. Connect the RF Output of the signal generator to the analyzer RF Input as shown in Figure 5-31.

Figure 5-31 Setup for OBW Measurement



Step 2. Set a GSM signal on the signal generator with a frequency of 950 MHz a nd the amplitude set to –10 dBm.

Step 3. Select the spectrum analyzer mode:

Press **Mode**, **Spectrum Analyzer**.

Step 4. Preset the analyzer:

Press **Mode Preset**.

Step 5. Set the center frequency and span:

Press **FREQ Channel**, **Center Frequency**, 950, **MHz**.
Press **SPAN X Scale**, **Span**, 1, **MHz**

Step 6. Set the number of averages to 25 and turn on averaging.:

Press **Meas Setup**, **Avg Number**, 25, **Enter**.
Press **Trace/Detector**, **Trace Average**

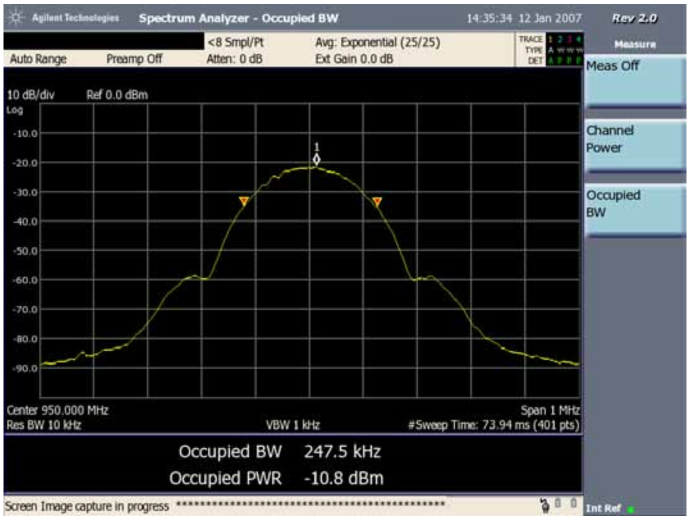
Step 7. Select Spectrum Analyzer Occupied BW measurement.

Press **Meas**, **Occupied BW**.

A marker pair will appear on the trace and the occupied bandwidth value and the integrated power in the OBW are displayed in the data window below the trace graticule. See Figure 5-32

Spectrum Analyzer

Figure 5-32 OBW Measurement Results – Normal View



Step 8. To switch to the Spectrogram view:

Press **Spectrogram**, **Spectrogram** (until ON is underlined), 100, **Enter**, **Trace/Detector**, **Trace Average**.

The OBW measurement results display will now be similar to Figure 5-33

Step 9. If you need to restart the data capture:

Press **Reset Spectrogram**.

Step 10. If desired set the capture interval:
Press **Update Interval**,
Enter the interval number using the number keypad.
Select **sec** or **Max Speed**.

Max Speed displays every trace captured.

Step 11. If you want to set the number of frames to skip:

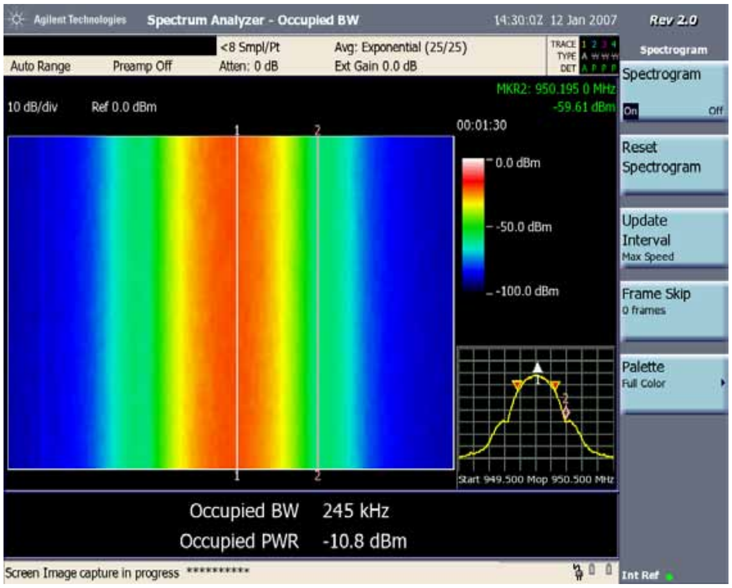
Press **Frame Skip**
Enter the interval number using the number keypad.
Select **frames**.

Step 12. If you want to set the display color:

Press **Palette**
Select **Full Color** or **Grayscale**.

The color/grayscale top and bottom mappings are determined by the Ref Level and Scale/Div settings. To change the mapping, go to **AMPTD Y Scale** and change **Ref Level** and **Scale/Div**.

Figure 5-33 OBW Measurement Results – Spectrogram View



NOTE In the picture, the elapsed time clock shows the amount of time shown on the graph and stops when the graph is full.

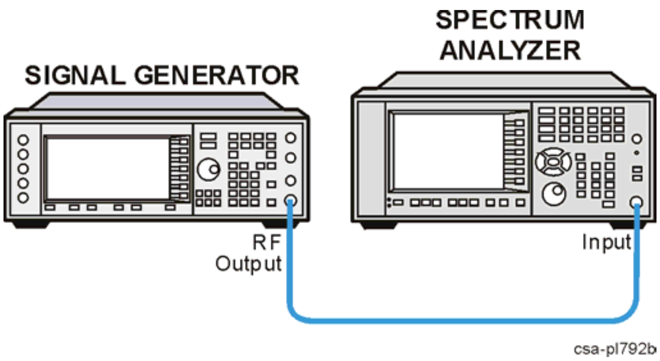
You can also place the markers (the two vertical lines) as shown to see the amplitude change of the specific frequency you care.

Pulse Measurement

In order to make better measurements of signals whose spectrum varies rapidly with time, such as pulsed signals, For firmware A.02.00 or greater, you can have sweep time control in non-zero spans. This example uses the analyzer to measure the pulsed signal at 100 MHz with period of 20 us and width of 4 us.

Step 1. Setup the pulsed signal using the signal generator Agilent ESG and connect the RF Output of the signal generator to the analyzer RF Input as shown in Figure 5-34.

Figure 5-34 **Setup for Pulse Measurement**



Step 2. Select the spectrum analyzer mode:

Press **Mode**, **Spectrum Analyzer**.

Step 3. Preset the analyzer:

Press **Mode Preset**.

Step 4. Set the center frequency:

Press **FREQ Channel**, **Center Freq**, **100**, **MHz**.

Step 5. Set the spectrum analyzer to zero span:

Press **SPAN X Scale**, **Zero Span**.

Step 6. Set the Resolution BW:

Press **BW** (Manual)**, 5, MHz**.

NOTE The larger the Resolution BW, the more power will pass through the Res BW filter, so the less distortion of the pulse signal there will be. Similarly, more noise will pass through the filter, so the displayed average noise floor will be higher. The setting of Res BW is therefore an important factor in determining your measurement results.

Step 7. Set the sweep time:

Press **Control/Sweep, Sweep Time, 50, us**.

Step 8. Set the vertical scale:

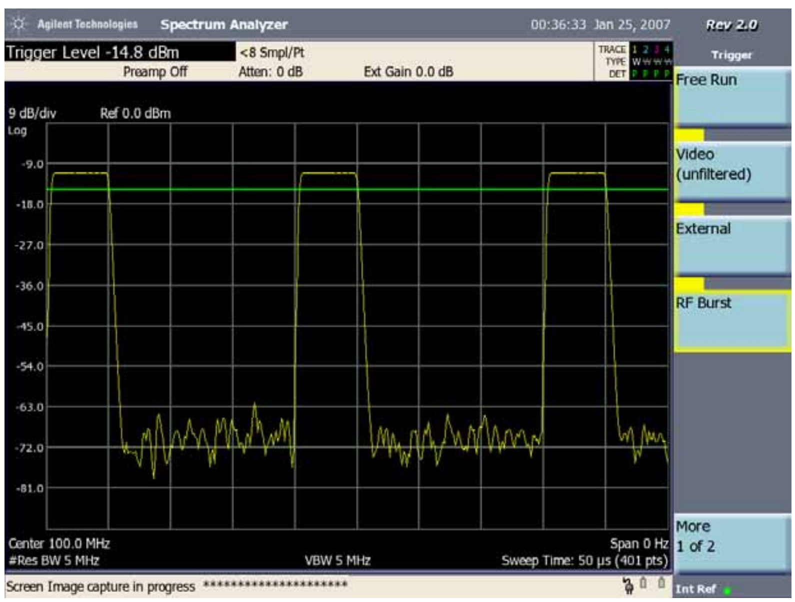
Press **AMPTD Y Scale**, **Autoscale**.

NOTE You can set Ref Level, Scale/Div to adjust the AMPTD Y Scale display. For more information on this front panel key, please see the User's and Programmer's Reference Manual.

Step 9. To adjust the trigger settings, press **Meas Setup**, **Trigger** and select the trigger mode **Free Run**, **Video** (unfiltered), **External** and **RF Burst**.

NOTE The primary difference between the trigger mode Video and RF Burst is trigger bandwidth. The RF Burst trigger has a bandwidth that is >50 MHz, while the Video has <5 MHz. For measuring pulses using Video Trigger, you may also have to enable Auto Trigger (press **Trigger**, **More 1 of 2**, **Auto Trig**) with a time greater than the pulse period.

Figure 5-35 Pulse Measurement



NOTE For more information of each soft key under Meas Setup menu, you can refer to spectrum analyzer section of User's and Programmer's Reference manual.

Tune and Listen (Requires Option AFM)

AM/FM Tune and Listen demodulates at the frequency of interest to permit audible detection of AM or FM modulated signals. This example uses the analyzer to listen to a FM radio signal at 97.4 MHz.

Step 1. Select the spectrum analyzer mode:

Press **Mode**, **Spectrum Analyzer**.

Step 2. Set the center frequency:

Press **FREQ Channel**, **Center Freq**, **97.4**, **MHz**.

Step 3. Set the span:

Press **SPAN X Scale**, **10**, **MHz**

Step 4. Set the demodulation type at marker place:

Press **Demod**, **Demod at Marker Type**, **FM**.

Step 5. Set the demodulation at marker:

Press **Demod**, **Demod at Marker, On**.

Step 6. Set the demodulation time:

Press **Demod**, **Demod Time**, **50**, **s**.

NOTE Set the demodulation time longer to listen to continuous voice material such as from a broadcast station. Set the demodulation time shorter (less than 5 seconds) to listen to two-way radio transmissions.

You can use the three keys below the screen in the front panel to mute, decrease the volume or increase the volume.

Spectrum Analyzer

6 Channel Analyzer Measurements

This chapter provides information on measuring signal power.

This chapter includes the following measurement:

"Making Adjacent Channel Power (ACP (I&M)) Measurements" on page 121

CAUTION Ensure that the total power of all signals at the analyzer input does *not* exceed +33 dBm (2 watts).

Basic Assumption

The material in this chapter is presented with the assumption that you understand the front and rear panel layout, and display annotations of your analyzer. If you do not, refer to the *Measurement Guide* "Front and Rear Panel Features".

Making Adjacent Channel Power (ACP (I&M)) Measurements

Adjacent Channel Power (ACP (I&M)) is a measure of the power that leaks into adjacent transmit channels. The ACP measurements, as currently implemented, are suitable for quick checks in installation and maintenance (I&M) applications. They are not necessarily suitable for ACP measurements in manufacturing or R & D applications.

The adjacent channel power (ACP (I&M)) measurement is also referred to as the adjacent channel power ratio (ACPR) and adjacent channel leakage ratio (ACLR). We use the term ACP to refer to this measurement.

ACP measures the total power (rms voltage) in the specified channel and up to three pairs of offset frequencies. The measurement result reports the ratios of the offset powers to the main channel power.

The measurement results can help you determine whether the power is set correctly and whether the transmitter filter is working properly. Once you have set the limits, you can easily see whether a test falls within those limits using the mask feature and the color-coded metrics. You can measure the adjacent channel power on one to three adjacent channels on each side of your center channel in the CDMA, TDMA, UMTS (W-CDMA), GSM EDGE and GPRS, AMPS, NMT-450, Tetra, and iDEN channel bands.

CAUTION When measuring multiple adjacent channels, the combined channel power must not exceed +33 dBm at the RF Input.

CAUTION The maximum power for the RF Input 50 Ω is 33 dBm (2 W). When directly coupled to a transmitter, the analyzer can be damaged by excessive power applied to any of these ports.

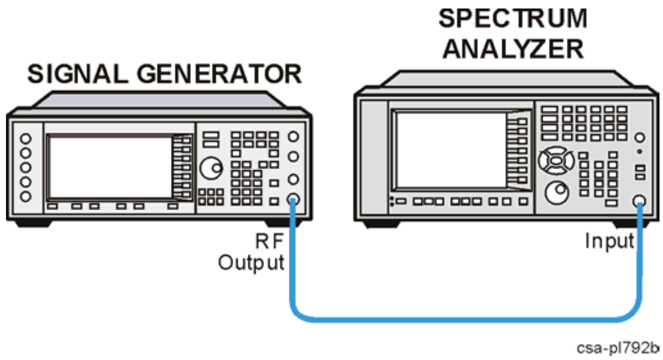
To prevent damage in most situations when you directly couple the analyzer to a transmitter, connect a high power attenuator between the analyzer RF Input 50 Ω and the transmitter.

NOTE For complex modulation such as CDMA, W-CDMA, GSM, the frequency error measurement is not accurate.

The following example shows how to make an ACP measurement on a simulated W-CDMA base station signal broadcasting at 1.955 GHz.

Step 1. Connect the RF Output of the signal generator to the analyzer RF Input 50 Ω as shown in Figure 6-1.

Figure 6-1 **Setup for ACP Measurement**



Step 2. Using the signal generator to setup a W-CDMA signal transmitting at 1.955 GHz and –10 dBm.

Step 3. Select the channel analyzer mode and the adjacent channel power measurement:

Press **Mode**, **Channel Analyzer**.

Step 4. Preset the analyzer.

Press **Mode Preset**.

Step 5. Set the center frequency to 1.955 GHz:

Press **FREQ Channel**, **Center Freq**, 1.955, **GHz**.

Step 6. Set the analyzer radio mode to W-CDMA as a base station device:

Press **Meas Setup**, **Format/BW**, **Format Type** (List), **Format List**, select **W-CDMA** sing the up and down arrow buttons, press **Select**.

Figure 6-2 **ACP Measurement Results**

The frequency offsets, channel integration bandwidths, and span settings can all be modified when you select **Meas Setup**, **Format Type** (Cust).

Step 7. Turn the limit test on:

Press **Meas Setup**, **Limits**, **Power Limits**, **Power Limits** (On).

Figure 6-3 **ACP Results with Offset Limits**

Step 8. You may set different pass/fail limits for each offset:

Press **Meas Setup**, **Limits**, **Power Limits**, **Center Chan High Limit**, –10, **dBm**, **Center Chan Low Limit**, –30, **dBm**, **Adj Chan 1 High Limit**, –45, **dB**, and **Adj Chan 2 High Limit**, –60, **dB**.

In Figure 6-4 notice that ACP 2 Low and ACP 2 High have both failed, however all other channels have passed.

Figure 6-4 **Setting Offset Limits**

7 Stimulus Response Measurements (Requires N8995A)

This chapter provides information on measuring signal loss in cables and devices and making cable fault measurements.

This chapter is divided into the following sections:

CAUTION Ensure that the total power of all signals at the analyzer input does *not* exceed +33 dBm (2 watts).

Basic Assumption

The material in this chapter is presented with the assumption that you understand the front and rear panel layout, and display annotations of your analyzer. If you do not, refer to the *Measurement Guide* “Front and Rear Panel Features”.

Two Port Insertion Loss

This procedure measures the loss or gain of a filter, amplifier, cable, or other devices over a specified frequency range.

Insertion loss measurements are important in accurately quantifying the amount of loss or gain a signal will incur as it passes through a device. In S-parameter terms, insertion loss is referred to as an S_{21} measurement. “S” stands for scattering.

NOTE Before you perform a two port insertion loss measurement, you must first normalize the measured values for insertion loss by compensating for the loss associated with the devices (adapters, cables) that connect the analyzer to the device or assembly being tested. Otherwise, your measurement will be inaccurate.

CAUTION Note that in step 6 on page 127, excessive signal input may damage the DUT. Do not exceed the maximum power that the device under test can tolerate.

NOTE *DO NOT* make the connection at this time. You will be directed when to make the connections later in the procedure.

Step 1. To measure the rejection of a low pass filter, connect the RF Output of the analyzer to the RF Input.

This example uses a 50 MHz low pass filter as the DUT.

Step 2. Set the analyzer to the Two Port Insertion Loss measurement:

Press **Mode**, **Stimulus/Response**, **Meas**, **Two Port Insertion Loss**

Step 3. Preset the analyzer:

Press **Mode Preset**.

Step 4. Set the start and stop frequencies:

Press **FREQ Channel**, **Start Freq**, 10, **MHz**.
Press **FREQ Channel**, **Stop Freq**, 250, **MHz**.

Step 5. Turn averaging off:

Press **Meas Setup**, **Avg Mode, Off**.

Step 6. Set the signal source output power of analyzer to –15 dBm:

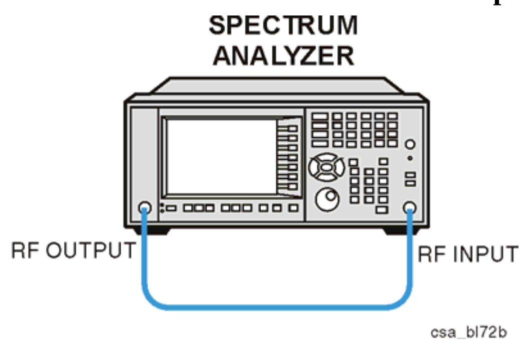
Press **Source**, **Source Level** (Manual), –15, **dBm**.

CAUTION Excessive signal input may damage the DUT. Do not exceed the maximum power that the device under test can tolerate.

NOTE In this step, the Source Level is set to Manual. In Manual mode, the output level can be set to any value between –15 dBm and –30 dBm and the output level will vary typically <+/-1 dB from the value selected. If Source Level is set to Auto, the output power level will be set to the maximum available at any given frequency. The output power may vary from 0 dBm to –15 dBm when set to Auto. The user cannot control the nominal output power when Source Level is set to Auto.

Step 7. Connect the cable (but not the DUT) from the analyzer RF Output to the RF Input as shown in Figure 7-1.

Figure 7-1 Two Port Insertion Loss Normalization Test Setup



Step 8. Normalize the frequency response:

Press **FREQ Channel**, **Normalize** and follow the instructions on the Normalize Wizard.

NOTE After normalization, the word “UnNormalized” on the top left of the screen will turn to “Normalized”.

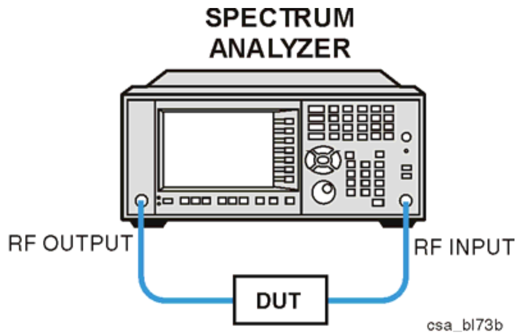
The normalization is needed each time you change the frequency setting.

Step 9. To measure the rejection of a low pass filter:

Connect the DUT between the RF Input and RF Output of the analyzer as shown in Figure 7-2.

Note that the units of the reference level are dB, indicating that this is a relative measurement.

Figure 7-2 Two Port Insertion Loss Measurement Test Setup



Step 10. Place the reference marker at the specified cutoff frequency:

Press **Marker**, **Normal**, 50, **MHz**.

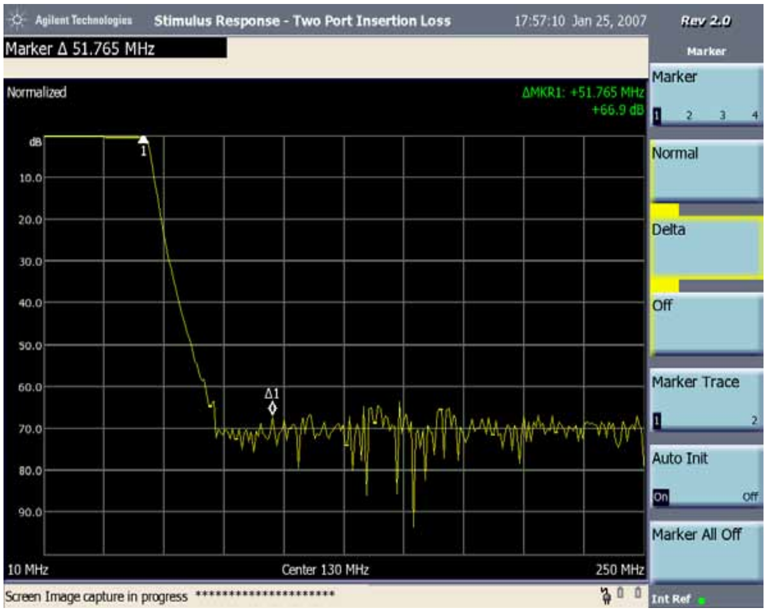
Step 11. Place the second marker at 100 MHz:

Press **Delta**, 50, **MHz**.

In this example, the attenuation over this frequency range is 66.9 dB/octave (one octave above the cutoff frequency).

Step 12. Use the front-panel knob to place the marker at the highest peak in the stop band to determine the minimum stop band attenuation. In this example, the peak occurs at 102.589 MHz. The attenuation is 63.2 dB.

Figure 7-3 Minimum Stop Band Attenuation



One Port Insertion Loss

The one port insertion loss measurement allows you to quantify signal loss in a cable or other device without connecting both ends of the cable or device to the analyzer. This measurement can be especially useful in measuring the loss of a feedline connected to the antenna on a tower. This method of measuring insertion loss is accurate for results up to 10 dB.

This measurement is less accurate than Two Port Insertion Loss. When it is practical to connect both ends of a device to the analyzer or for insertion loss measurements greater than 10 dB — for example when measuring a 40 dB attenuator — it is better to use Two Port Insertion Loss.

NOTE Test signals can cause interference. When testing cables attached to antennas, test signals are radiated. Verify that the signal used for the test cannot cause interference to another antenna.

Calibration - Minimizing your Workload

The *One-Port Insertion Loss* calibration is the same calibration as performed for the *Return Loss* and *Distance to Fault* (when it is performed with Frequency Range set to manual) measurements. If you have already calibrated for any of these three measurements, the calibration will apply to the other two measurements and “Calibrated”, together with the frequency range over which the calibration was performed, will be displayed on top left of the screen, indicating the user calibration data is used.

If you have not previously performed a calibration, the word “Factory Calibration” appears at the top left of the measurement screen, indicating the factory calibration data is used.

It is important that you keep the calibration frequency range as close as possible to the actual sweep frequencies you intend using for the measurement or measurements. Calibrating over a large frequency range (for example, 1 GHz) when you only intend measuring over a much smaller range (a few MHz, for example) will induce inaccuracies in your results. Furthermore, even if the measurement frequency range is a subset of the calibration frequency range, the calibration data can be disregarded if the calibration frequency step (calibration frequency range / 255) is greater than the factory calibration frequency step (2.926 MHz). In such cases, the factory calibration data will be used.

If you plan to perform a combination of *One-Port Insertion Loss* measurement, *Return Loss* measurement, and *Distance to Fault* measurements using a frequency range that you will set manually, you can perform one calibration for all three measurements as long as you calibrate over a frequency range that incorporates all three of your measurements, your cables do not change, and the calibration frequency step is not greater than that of the factory calibration. For this reason, if you are doing Distance to Fault measurements (using a frequency range that you have set manually) as well as any type of Insertion Loss measurement, Agilent recommends that you select your cable type before performing calibrations. Press **Mode**, **Stimulus/Response**, **Meas**, **Distance to Fault**, **Meas Setup**, **Cable Type** to set the cable type.

The calibration remains valid until you do any one of the following:

- set the Distance to Fault frequency range to Auto. Note that the calibration will become valid again as soon as you switch from Auto back to Manual Frequency Range
- power off the analyzer
- change the start frequency to a new value that lies below the start frequency of your previous calibration
- change the stop frequency to a new value that lies above the stop frequency of your previous calibration
- change the start or stop frequency when the calibration frequency step is greater than the factory calibration frequency step
- change any of the cables that you used for the calibration
- change any of the (optional) attenuators that might have been used for the calibration
- change the type of cable specified under the **Cable Type** menu key

Performing a One Port Insertion Loss Measurement

NOTE *DO NOT* make the connection at this time. You will be directed when to make the connections later in the procedure.

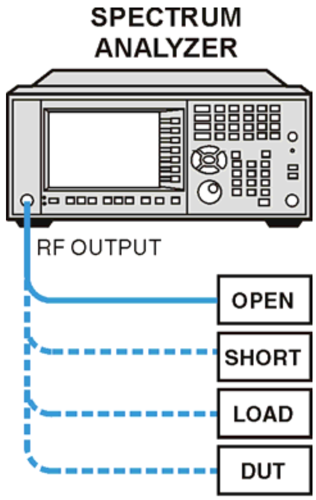
Step 1. Connect the calibrating devices to the analyzer RF Output when prompted in the procedure, as shown in Figure 7-4, or as shown in the calibration wizard.

To calibrate your spectrum analyzer, you will need the following calibration kit:

- Open/Short connector.
- Calibrated 50 ohm Load connector.

This example uses a 10 feet cable as the DUT.

Figure 7-4 **One Port Insertion Loss Measurement**



Step 2. Set the analyzer to the One Port Insertion Loss measurement:

Press **Mode**, **Stimulus/Response**, **Meas**, **One Port Insertion Loss**

Step 3. Preset the analyzer:

Press **Mode Preset**, **Meas**, **One Port Insertion Loss**.

Step 4. Set the start and stop frequencies:

Press **FREQ Channel**, **Start Freq**, 100, **MHz**.

Press **FREQ Channel**, **Stop Freq**, 500, **MHz**.

Step 5. Turn averaging off:

Press **Meas Setup**, **Avg Mode**, **Off**.

Step 6. Calibrate the measurement:

Press **FREQ Channel**, **Calibrate** and follow the instructions on the Calibration Wizard. The analyzer will calibrate over the desired frequency range.

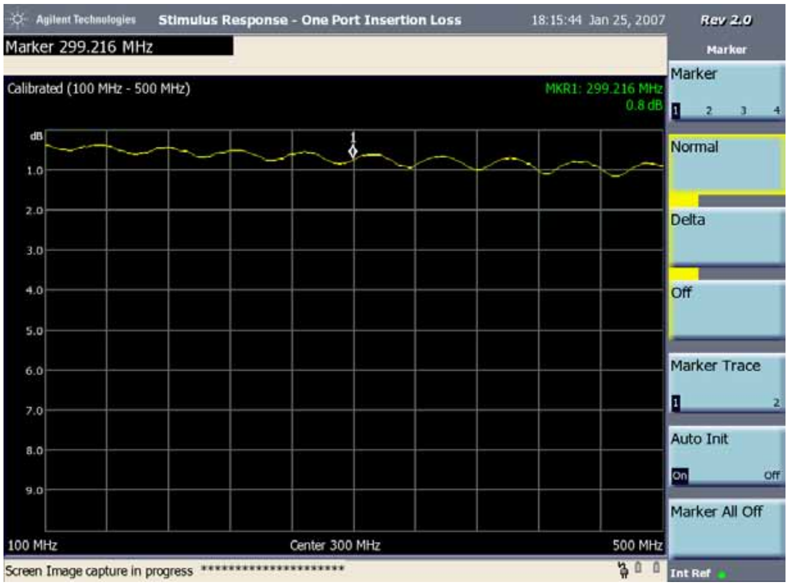
Step 7. Connect the DUT to the analyzer, as described in step 1. Note that the units of the reference level are dB, indicating that this is relative measurement.

Step 8. Change the amplitude scale to 1 dB per division:

Press **AMPTD Y Scale**, **Scale/Div**, 1, **dB**.

Step 9. Place a marker on the results at the frequency of interest. In this example, the marker is placed at 299.216 MHz. As you can see the loss is 0.8 dB.

Figure 7-5 One Port Insertion Loss Measurement Results, Normalized.



Return Loss

Return loss is a measure of reflection characteristics. One way you can use the return loss measurement is to detect problems in an antenna feedline system or the antenna itself. A portion of the incident power will be reflected back to the source from each transmission line fault as well as the antenna. The ratio of the reflected voltages to the incident voltage is called the reflection coefficient. The reflection coefficient is a complex number, meaning it has both magnitude and phase information. In S-parameter terms, Return Loss is referred to as an S_{11} measurement.

NOTE Test signals can cause interference. When testing cables attached to antennas, test signals are radiated. Verify that the signal used for the test cannot cause interference to another antenna.

Calibration - Minimizing your Workload

The *Return Loss* calibration is the same calibration as performed for the *Distance to Fault* and *One-Port Insertion Loss* (when it is performed with Frequency Range set to manual) measurements. If you have already calibrated for any of these three measurements, the calibration will apply to the other two measurements and “Calibrated”, together with the frequency range over which the calibration was performed, will be displayed on top left of the screen, indicating the user calibration data is used.

If you have not previously performed a calibration, the word “Factory Calibration” appears at the top left of the measurement screen, indicating the factory calibration data is used.

It is important that you keep the calibration frequency range as close as possible to the actual sweep frequencies you intend using for the measurement or measurements. Calibrating over a large frequency range (for example, 1 GHz) when you only intend measuring over a much smaller range (a few MHz, for example) will induce inaccuracies into your results. Furthermore, even if the measurement frequency range is a subset of the calibration frequency range, the calibration data can be disregarded if the calibration frequency step (calibration frequency range / 255) is greater than the factory calibration frequency step (2.926 MHz). In such cases, the factory calibration data will be used.

If you plan to perform a combination of *One-Port Insertion Loss* measurement, *Return Loss* measurement, and *Distance to Fault* measurements using a frequency range that you will set manually, you can perform one calibration for all three measurements as long as you calibrate over a frequency range that incorporates all three of your measurements, your cables do not change, and the calibration frequency step is not greater than that of the factory calibration. For this reason, if you are doing Distance to Fault measurements (using a frequency range that you have set manually) as well as any type of Insertion Loss measurement, Agilent recommends that you select your cable type before performing calibrations. Press

Mode, **Stimulus/Response**, **Meas**, **Distance to Fault**, **Meas Setup**, **Cable Type** to set the cable type.

The calibration remains valid until you do any one of the following:

- set the Distance to Fault frequency range to Auto. Note that the calibration will become valid again as soon as you switch from Auto back to Manual Frequency Range
- power off the analyzer
- change the start frequency to a new value that lies below the start frequency of your previous calibration
- change the stop frequency to a new value that lies above the stop frequency of your previous calibration
- change the start or stop frequency when the calibration frequency step is greater than the factory calibration frequency step
- change any of the cables that you used for the calibration
- change any of the (optional) attenuators that might have been used for the calibration
- change the type of cable specified under the **Cable Type** menu key

Performing a Return Loss Measurement

Step 1. Set the analyzer to the Stimulus/ Response Mode and the Return Loss measurement:

Press **Mode**, **Stimulus/Response, Meas, Return Loss**

Step 2. Preset the analyzer:

Press **Mode Preset, Meas, Return Loss**.

Step 3. Set the start and stop frequencies:

This example uses a 50 MHz low pass filter as the DUT.
Press **FREQ Channel**, **Start Freq**, 10, **MHz**.
Press **FREQ Channel**, **Stop Freq**, 250, **MHz**.

Step 4. Turn averaging off:

Press **Meas Setup**, **Avg Mode**, **Off**.

Step 5. Calibrate the measurement:

Press **FREQ Channel**, **Calibrate** and follow the instructions on the Calibration Wizard. The analyzer will calibrate over the desired frequency range.

To calibrate your spectrum analyzer, you will need the following calibration kit:

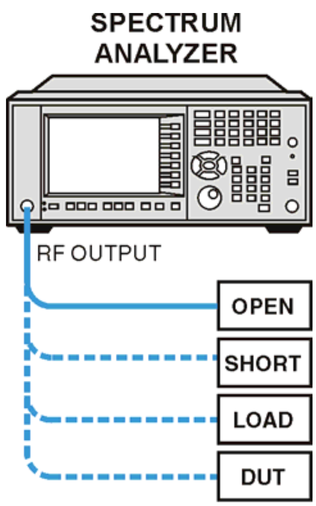
- Open/short connector.
- Calibrated 50 ohm Load connector.

Step 6. Connect the test cable (if used) and calibration devices to the analyzer RF Output, as shown in Figure 7-6, or in the calibration wizard. (If the DUT is a two-port device, be sure to terminate the unused port in the characteristic impedance of the device.)

This example uses a 50 MHz low pass filter as the DUT.

Note that the units of the reference level are dB, indicating that this is a relative measurement.

Figure 7-6 Return Loss Measurement



Step 7. Change the reference level.

Press **AMPTD Y Scale**, **Ref Level**, -5, **dB**.

Step 8. Use the markers to measure the return loss and SWR at any point.

Press **Marker**, **Normal**. Use the knob to place the marker at a frequency of interest.

Figure 7-7 Return Loss Measurement Results, Calibrated.

Stimulus Response Measurements (Requires N8995A)

Distance to Fault

A signal is transmitted from the RF Output connector of the analyzer to the cable-under-test. The signals reflected from faults in the cable are received by the analyzer.

In performing this measurement, the analyzer uses frequency domain reflectometry. The changing interference of the transmitted and reflected signals contains information about the distance to one or more faults. This information can be used to find the physical distance to the faults. The distance displayed on the analyzer is the physical distance to the probable faults, corrected for the cable loss and velocity factor of the cable.

Measured Distance - the Effects of Frequency and Points

It is not always obvious how frequency range affects measured distance and resolution, and it often appears to be counter-intuitive. If you are new to making Distance to Fault measurements, this section will help clarify what is happening.

In the following equations

- The Speed of Light (‘c’) is a constant value of 3 x 10^8 meters per second.
- Your test cable’s transmission speed (relative to light) is V_{Rel}

The **Measured Distance** (in meters) of the DTF (Distance to Fault) measurement is determined by the following equation:

$$\text{Measured Distance (in meters)} = \frac{\frac{1}{4} \times \text{Number of Points} \times c \times V_{Rel}}{\text{Frequency Span}}$$

You can see from this equation that:

- To **increase** the measured distance:
  — you can **increase** the **number of points**, or
  — you can **reduce** the **frequency span**.
- To **reduce** the measured distance:
  — you can **reduce** the **number of points**, or
  — you can **increase** the **frequency span**.

Resolution - the Effects of Frequency and Points

It is not always obvious how frequency range affects measured distance and resolution, and it often appears to be counter-intuitive. If you are new to making Distance to Fault measurements, this section will help clarify what is happening.

Resolution Distance (in meters) of the DTF (Distance to Fault) measurement, that is, the shortest distance between two faults that can still be resolved by the analyzer, is determined by the following equation:

$$\text{lution Distance (in meters)} = \frac{\text{Measured Distance (in met}}{\frac{1}{2} \times \text{Number of Points}}$$

NOTE Please be careful how you interpret this equation. Note that to *increase* the *resolution*, you need to *reduce* the *Resolution Distance*; to *reduce* the *resolution*, you need to *increase* the *Resolution Distance*.

You can see from this equation that:

- To **increase** the resolution, that is, to *reduce* the *Resolution Distance*:
  - — you can **increase** the **number of points**, or
  - — you can **reduce** the **measured distance**.
- To **reduce** the resolution, that is, to *increase* the *Resolution Distance*:
  - — you can **reduce** the **number of points**, or
  - — you can **increase** the measured distance.

NOTE Although you can set your number of points to 256, 512, or 1024, you will only ever be able to save 256 data points when you save trace data. This is because only 256 points are ever used to display the trace, regardless of how many points you have used to actually make the measurement. You will not, however, be losing any resolution, or reducing the quality of your data. The results will still reflect the true number of data points that you specified.

Automatic and Manual Distance to Fault Measurements

The analyzer provides two ways of measuring distance to fault:

- **Automatic Frequency Range**. You select the measurement distance and the analyzer automatically selects the **Start Frequency** and the **Stop Frequency**. The measurement distance is set using the **Start Distance** and the **Stop Distance** menu keys on the **Freq/Dist/Calibrate** menu. In this mode, the displayed and measured distances are the same. There are always 256 measurement points across the distance you set, so adjusting the distance settings allows you to display the maximum resolution for the portion of the cable you are testing. The disadvantage is that the start and stop frequencies are automatically set and may limit the analyzer's ability to sweep through filters or lightning protectors. This mode is best used for checking a cable that has no frequency limiting devices.

Example 1: If you set **Start Distance** to 0 m (0 ft) and the **Stop Distance** to 60 m (197 ft), and you specify 256 Data Points (**Meas Setup**, **FFT Size**, **256**), the instrument automatically selects a **Start Freq** of 10 MHz and a **Stop Freq** of 220.88 MHz.

Example 2: If you again set **Start Distance** to 0 m (0 ft) and the **Stop Distance** to 60 m (197 ft), but this time you specify 1024 Data Points (**Meas Setup**, **FFT Size**, **1024**) to give you greater resolution, the instrument automatically selects a **Start Freq** of 10 MHz and a **Stop Freq** of 853.52 MHz.

- **Manual Frequency Range**. When set to **Manual**, you must specify the **Start Frequency** and the **Stop Frequency**, and the measured distance is computed from these frequencies. Generally, the typical start and stop frequencies you use will result in a measured distance that will be larger than the distance over which you want to look for faults.

NOTE The **Measured Distance** and the **Displayed Distance** can be different. The distance over which the instrument has made its measurements, and which has been derived from the frequencies you specified, is called the **Measured Distance**. This is displayed at the top right corner of the measurement screen.

The **Displayed Distance** refers to that part of the entire **Measured Distance** that you choose to display on your measurement screen. You set the **Displayed Distance** manually by pressing the **Start Distance** and the **Stop Distance** menu keys on the **Freq/Dist/Calibrate** menu.

To help isolate faults over the length of interest, you can set a displayed distance less than the measured distance. The displayed distance is set using the **Start Distance** and the **Stop Distance** menu keys on the **Freq/Dist/Calibrate** menu.

Keep in mind that there are 256, 512, or 1024 measurement points across the measured distance. The exact number of measurement points is set using the **FFT Size** key on the **Meas Setup** menu. Therefore, the measurement points across the chosen displayed distance will be a ratio of displayed distance to measured distance times the number of points you have specified. The higher the number of data points, the greater the measurement resolution.

In most cases, the default resolution using 256 data points will be adequate to locate the faults, but if more resolution is needed you can increase the span between the start and stop frequencies (which will decrease the measured distance) or use the other approach, automatic frequency range. If the measurement distance is not long enough for the cable you are testing, reduce the span between the start and stop frequencies (which will increase the measurement distance) or use automatic frequency range.

NOTE When testing cables attached to antennas, test signals are radiated from the test antenna Verify that the signal used for the test, and therefore being radiated from the test antenna, cannot interfere with other radiated signals from other antennas.

Calibration - Minimizing your Workload

The *Distance to Fault* calibration is the same calibration as performed for the *Return Loss* and *One-Port Insertion Loss* (when it is performed with Frequency Range set to manual) measurements. If you have already calibrated for any of these three measurements, the calibration will apply to the other two measurements and “Calibrated”, together with the frequency range over which the calibration was performed, will be displayed on top left of the screen, indicating the user calibration data is used.

If you have not previously performed a calibration, the word “Factory Calibration” appears at the top left of the measurement screen, indicating the factory calibration data is used.

It is important that you keep the calibration frequency range as close as possible to the actual sweep frequencies you intend using for the measurement or measurements. Calibrating over a large frequency range (for example, 1 GHz) when you only intend measuring over a much smaller range (a few MHz, for example) will induce inaccuracies into your results. Furthermore, even if the measurement frequency range is a subset of the calibration frequency range, the calibration data can be disregarded if the calibration frequency step (calibration frequency range / 255) is greater than the factory calibration frequency step (2.926 MHz). In such cases, the factory calibration data will be used.

If you plan to perform a combination of *One-Port Insertion Loss* measurement, *Return Loss* measurement, and *Distance to Fault* measurements using a frequency range that you will set manually, you can perform one calibration for all three measurements as long as you calibrate over a frequency range that incorporates all three of your measurements, your cables do not change, and the calibration frequency step is not greater than that of the factory calibration. For this reason, if you are doing Distance to Fault measurements (using a frequency range that you have set manually) as well as any type of Insertion Loss measurement, Agilent recommends that you select your cable type before performing calibrations. Press **Mode**, **Stimulus/Response**, **Meas**, **Distance To Fault**, **Meas Setup**, **Cable Type** to set the cable type.

The calibration remains valid until you do any one of the following:

- set the Distance to Fault frequency range to Auto. Note that the calibration will become valid again as soon as you switch from Auto back to Manual Frequency Range
- power off the analyzer
- change the start frequency to a new value that lies below the start frequency of your previous calibration

- change the stop frequency to a new value that lies above the stop frequency of your previous calibration
- change the start or stop frequency when the calibration frequency step is greater than the factory calibration frequency step
- change any of the cables that you used for the calibration
- change any of the (optional) attenuators that might have been used for the calibration
- change the type of cable specified under the **Cable Type** menu key

NOTE The distance to fault calibration for the auto frequency range is unique, however. It is not applicable to return loss or one port insertion loss, or even to the manual frequency range method for distance to fault.

For distance to fault measurements, separate calibrations need to be performed for each frequency range mode.

Performing a Distance to Fault Measurement

Step 1. Set the analyzer to the Stimulus/Response mode.

Press **Mode**, **Stimulus/Response**.

Step 2. Preset the analyzer and select the Distance to Fault measurement.

Press **Mode Preset**.

Press **Meas**, **Distance to Fault**.

Step 3. Select the cable type:
Press **Meas Setup**, **Cable Type**.

If the cable being measured has an "RG" designation, such as RG-214, select: **Cable Type (RG)**. or select: **Cable Type (BTS)**. Press, **Select Cable**. You will then be given a list of cable types to select. Use the knob or the up/down arrow navigation keys to highlight the correct cable type and press **Select**. If the type of cable you are measuring is not listed, you need to select **Cust** (Custom Cable) as the cable type then setup **Cable Atten** (the attenuation per unit distance of the cable) and **Vel Factor** (the relative propagation velocity of the cable).

Step 4. Set the frequency range to auto.
Press **FREQ Channel**, **Freq Range** (Auto).

The start and stop frequencies are then automatically set by the start and stop distances.

Step 5. Set the distance units:

Press **FREQ Channel**, **Units** (Feet).

Each time you press this menu key, the selected option (Feet or Meters) changes.

The unit you choose here will be used as the unit of the start and stop distances.

Step 6. Set the start and stop distances for the cable you are measuring. In this example, the cable is approximately 23 feet.

Press **FREQ Channel**, **Start Distance**, 0, **ft** [feet], **Stop Distance**, 30, **ft** [feet].

You can also use meters as the unit in this step, the number you enter will be calculated to feet and shown.

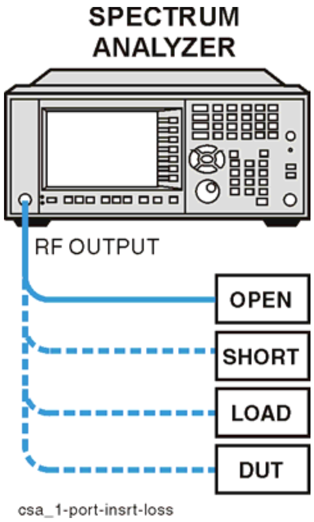
Step 7. Calibrate the measurement:

Press **FREQ Channel**, **Calibrate** and follow the instructions on the Calibration Wizard. The analyzer will calibrate over the desired frequency range.

To calibrate your spectrum analyzer, you will need the following calibration kit:

- Open/short connector.
- Calibrated 50 ohm Load connector.

Figure 7-8 Distant to Fault Measurement



Step 8. Connect the calibration devices and test cable to the analyzer RF Output, as shown in Figure 7-8, or in the calibration wizard.

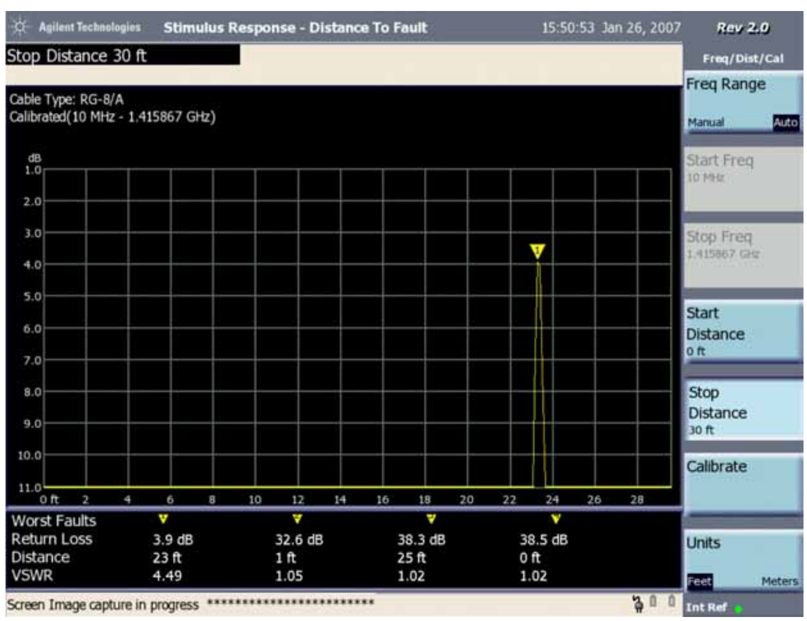
Figure 7-9 **Distance to Fault Measurement, Calibrated**

Step 9. Connect the DUT to the analyzer RF Output, as shown in Figure 7-8.

This example uses an RG8A type cable as the DUT.

Step 10. The triangles (up to 4) will indicate the worst faults. Below the graticule, the Return Loss, Distance, and VSWR of each fault is indicated. (This cable has a fault indicated at 23 feet.)

Figure 7-10 **Distance to Fault Measurement Results.**



8 Demodulating AM/FM Signals (Requires Option N8996A-1FP)

This Chapter provides information making the following measurements.

"Demodulating an AM Signal Using the CSA (Requires Option N8996A-1FP)" on page 147.

"Demodulating an FM Signal Using the CSA (Requires Option N8996A-1FP)" on page 153.

Demodulating an AM Signal Using the CSA (Requires Option N8996A-1FP)

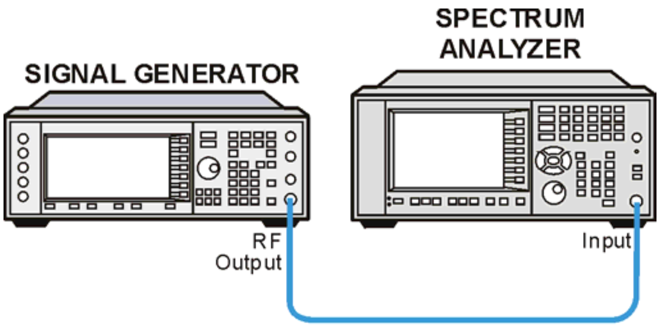
This section demonstrates how to demodulate an AM signal using the CSA built-in AM demodulator with Option N8996A-1FP.

Using the CSA built in AM demodulator you can tune to an AM signal and view the results displayed in the time domain or the frequency domain (refer to the concepts chapter in the *Measurement Guide* “AM Concepts” on page 200, “Modulation Distortion Measurement Concepts” on page 204 and “Modulation SINAD Measurement Concepts” on page 205 for more information).

CAUTION Ensure that the total power of all signals at the analyzer input does *not* exceed +33 dBm (2 watts).

Step 1. Connect an Agilent ESG RF signal source to the analyzer RF INPUT as shown in Figure 8-1. Set the ESG frequency to 300 MHz and the amplitude to -10 dBm. Set the AM depth to 80%, the AM rate to 1 kHz and turn AM on.

Figure 8-1 **Setup for AM Demodulation Measurement**



Step 2. Select the Modulation Analyzer mode and mode preset:

Press **Mode**, **Modulation Analyzer**, then press **Mode Preset**.

Step 3. Select AM measurement:

Press **Meas**, **AM**.

Step 4. Select the demodulation waveform view:

Press **View/Display**, **Demod Waveform**.

Demod Waveform is the default setting of View/Display.

Step 5. Set the center frequency to the center of the AM signal (in this case 300 MHz):

Press **FREQ Channel**, **Center Freq**, **300**, **MHz**.

NOTE There is a function called Global CF in **Mode**, **Mode Setup**, **Use Global CF** (On or Off). If you turn this On, the CF (center frequency) will use the same center frequency value as other modes which also have the Global CF switched On. This means when you want to switch between different modes, you can keep the same CF.

For example, if you set **Use Global CF** to On in Modulation Analyzer mode, and also set **Use Global CF** to On in Spectrum Analyzer mode, all measurements made in either mode will use the same center frequency. Any change you make to center frequency in one measurement or mode will be applied across all measurements in either mode.

Step 6. Set the IF bandwidth to Auto.

Press **Meas Setup**, **IFBW** (Auto).

For most measurements, you can use the Auto setting of IF bandwidth. If the AM depth is lower than 2%, you need to set the IF bandwidth manually. You should first calculate the minimum required bandwidth

$$IFBW = 2 \text{ x Modulation Rate}$$

Your IFBW must be greater than this minimum value. Use the IFBW menu key to select a suitable IFBW.

NOTE The IFBW can be set to the following values: 5 MHz, 3 MHz, 1.25 MHz, 1 MHz, 500 kHz, 300 kHz, 250 kHz, 100 kHz, 50 kHz, 30 kHz, 10 kHz, 5 kHz, 3 kHz.

Step 7. Set the horizontal scaling:

Press **SPAN X Scale**, **Scale/Div**, 500, **µs**.

Step 8. Set the vertical scaling:

Press **AMPTD Y Scale**, **Scale/Div**, 40, **%**.

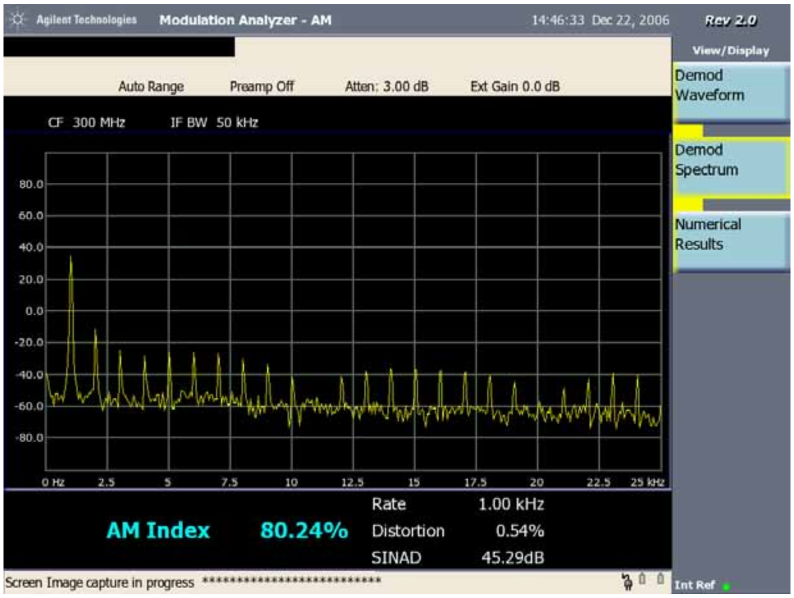
Step 9. Set your view to show the results in the best way for you. Press **View/Display**, and then select **Demod Waveform**, **Demod Spectrum**, or **Numerical Results**. Examples of these three views are shown below.

The Demod Waveform View of the measurement results is shown in Figure 8-2.

Figure 8-2 **AM Demod Waveform (ESG AM Signal with 80% Modulation Index)**

The Demod Spectrum View of the measurement results is shown in Figure 8-3.

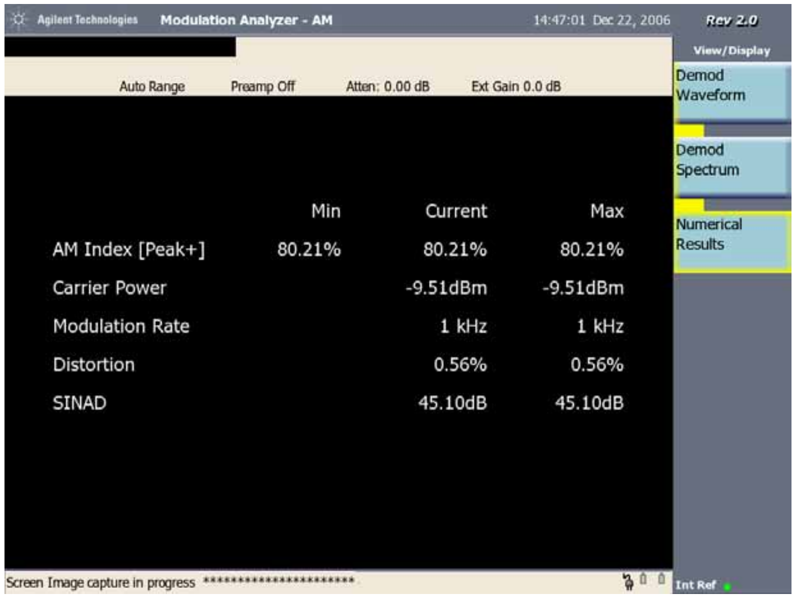
Figure 8-3 **AM Demod Spectrum (ESG AM Signal with 80% Modulation Index)**



The numeric results shown in the Demod Waveform view or the Demod Spectrum view are the current or the average measurement results in the Numerical Results view.

The Numerical Results view shown in Figure 8-4 gives the detailed measurement results for AM index, Carrier Power, Modulation Rate, Distortion and SINAD including the minimum value for AM Index and maximum value for all five parameters.

Figure 8-4 **AM Numerical Results (ESG AM Signal with 80% Modulation Index)**



Step 10. To adjust the measurement settings, press **Meas Setup**, then:

1. Avg Number: To set the averaging **On** or **Off**, switch the **Avg Number** key between **On** and **Off**. When averaging is **On**, enter the number of results used in the averaging calculations. The default average setting is **Off** and the default number is 10 when averaging is **On**. If your input signal changes during the average period, wait until the averaging has completed or the next averaging period has started.

   When the Avg Number is On, the column title “Current” in Numerical Results view will change to “Avg”.

2. Avg Mode: To change the average mode, press the **Avg Mode** key and select **Exponential** or **Repeat**. The default average mode is **Repeat**.

3. Demod: To change the demodulation settings, press the **Demod** menu key, then:

   To change detector, press **AM Detector** to select a detector **Peak+**, **Peak-**, **Peak+-/2**, or **RMS**.

   Peak+ is typically used when analyzing stationary signals like CW or sinusoids, but is not good for displaying noise, since it will not show the true randomness of the noise.

   Peak+-/2 is the average of Peak+ and Peak-.

   RMS is best for measuring the power of signals.

   To change the length of time over which your measurement is performed, press **Meas Time** and use the numeric keypad to enter the measurement time.

NOTE If a pulsed signal is being measured, the Meas Time should be set less than or equal to the Search Length.

When the AM Detector is Peak+ or Peak-, you can access **Peak Hold** to switch between **On** and **Off**. If Peak Hold is On, the measurement result of the AM Index is the maximum (when AM Detector is Peak+) or minimum (when AM Detector is Peak-) value of these peaks over the whole measurement time. If peak hold is Off, the measurement result of the AM Index (Peak+ or Peak- mode) is the average of these peaks over the whole measurement time.

Toggle the **Meas Filter** key to switch measurement filter between **On** and **Off**. If IFBW is greatly larger than the AM rate, a lot of noise will contaminate the normal signal. In order to decrease the interference of noise, you can select the Meas Filter to filter out the noise and improve the accuracy of measurement.

4. Burst Search: To change the settings of the burst search, press **Burst Search**, then:

   Press **Sync** to select **None** or **RF Amptd**. If RF Amptd is chosen, a burst search begins.

   Press **Burst Search Threshold** to enter the burst searching power threshold. The unit is dB because this threshold is defined as the logarithmic ratio of the power of idle data portion to the power of data portion.

   Press **Search Length** to enter the searching time for the pulsed signal. The setting of search length should be:

   `Search Length ≥ 2 x length of idle data portion + length of data portion`

5. Trigger: To change the settings of trigger, press **Trigger**, then:

   To select the trigger type, press **Free Run**, **External** or **RF Burst**.

   If External is chosen, the Trigger Slope and Trigger Delay are available. If RF Burst is chosen, the Trigger Level and Trigger Delay are available.

   To set the trigger level, press **Trigger Level,** then enter the numeric data to set the absolute trigger level for the RF burst envelope.

   Press **Trigger Slope** to control the trigger polarity.

   Press **Trigger Delay** to set the wait time of the analyzer before the analyzer starts a sweep.

6. Limits: To change the limit settings, press **More 1 of 2**, then press **Limits**:

   Toggle **Limits** between **On** and **Off** to activate or deactivate the limits display. When the setting is On, the green word “PASS” or the red word “FAIL” at the top left of the display indicates whether the measurement results have passed or failed the limits test. The mark “(P)” or “(F)” beside the measurement result means this value is passed or failed.

Press **Carrier Power Upper** to enter the maximum RF carrier power, the measured maximum value will be changed from green to red when it exceeds the limit set here.

Press **AM Index Upper** to enter the maximum AM index to warn you if the measured maximum value exceeds the limit specified here.

Press **AM Index Lower** to change the minimum AM index limit.

The measurement results are failed in the Figure 8-5 with the maximum AM Index exceeds the limit.

Figure 8-5 AM Numerical Results with Limits On

Demodulating an FM Signal Using the CSA (Requires Option N8996A-1FP)

This section demonstrates how to demodulate an FM signal using the CSA built-in FM demodulator with Option N8996A-1FP.

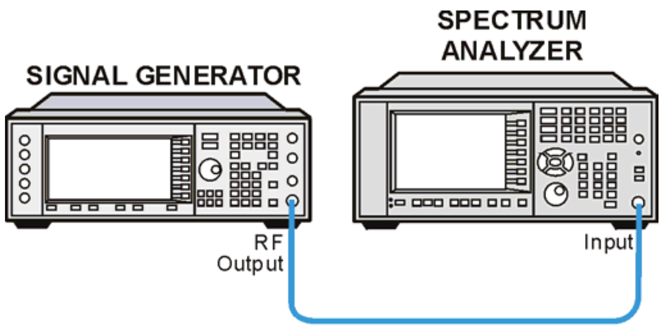
Using the CSA built in FM demodulator you can tune to an FM signal and view the results displayed in the time domain or the frequency domain (refer to the concepts chapter in the *Measurement Guide* “FM Concepts” on page 202, “Modulation Distortion Measurement Concepts” on page 204 and “Modulation SINAD Measurement Concepts” on page 205for more information).

CAUTION Ensure that the total power of all signals at the analyzer input does *not* exceed +33 dBm (2 watts).

Step 1. Use an Agilent ESG RF signal generator or an antenna to get an FM signal to analyze. In this example an ESG is used transmitting at 300 MHz with FM deviation of 10 kHz and FM rate of 1 kHz.

Step 2. Connect the RF OUTPUT of the Agilent ESG RF signal generator to the analyzer RF INPUT as shown in Figure 8-6.

Figure 8-6 Setup for FM Demodulation Measurement



Step 3. Select the Modulation Analyzer mode and mode preset:

Press **Mode**, **Modulation Analyzer**, then press **Mode Preset**.

Step 4. Select FM measurement:

Press **Meas**, **FM**.

Step 5. Select the demodulation waveform view:

Press **View/Display**, **Demod Waveform**.

Step 6. Set the center frequency to the center of the FM signal (in this case 300 MHz):

Press **FREQ Channel**, **Center Freq**, 300, **MHz**.

NOTE There is a function called Global CF in **Mode**, **Mode Setup**, **Use Global CF** (On or Off). If you turn this On, the CF (center frequency) will use the same center frequency value as other modes which also have the Global CF switched On. This means when you want to switch between different modes, you can keep the same CF.

For example, if you set **Use Global CF** to On in Modulation Analyzer mode, and also set **Use Global CF** to On in Spectrum Analyzer mode, all measurements made in either mode will use the same center frequency. Any change you make to center frequency in one measurement or mode will be applied across all measurements in either mode.

Step 7. Set the IF bandwidth to Auto.

Press **Meas Setup**, **IFBW** (Auto).

For measurements with β>1(β is the ratio of frequency deviation to modulation rate), you can use the automatic setting of IF Bandwidth. For measurements with β<1, you need to set IF bandwidth manually, you should first calculate the minimum required bandwidth, Then with CSA IFBW selections, choose a suitable

$$IFBW = ((2 \times \text{Frequency Deviation}) + (2 \times \text{Modulation Rate}))$$

IFBW:

NOTE The IFBW can be set as the following values: 5 MHz, 3 MHz, 1.25 MHz, 1 MHz, 500 kHz, 300 kHz, 250 kHz, 100 kHz, 50 kHz, 30 kHz, 10 kHz, 5 kHz, 3 kHz.

Step 8. Set the horizontal scaling:

Press **SPAN X Scale**, **Scale/Div**, 500, **μs**.

Step 9. Set the vertical scaling:

Press **AMPTD Y Scale**, **Scale/Div**, 5, **kHz**.

Step 10. Set your view to show the results in the best way for you. Press **View/Display**, and then select **Demod Waveform**, **Demod Spectrum**, or **Numerical Results**. Examples of these three views are shown below.

The Demod Waveform View of the measurement results is shown in Figure 8-7.

Figure 8-7 **FM Demod Waveform (ESG FM Signal with 10 kHz Deviation)**

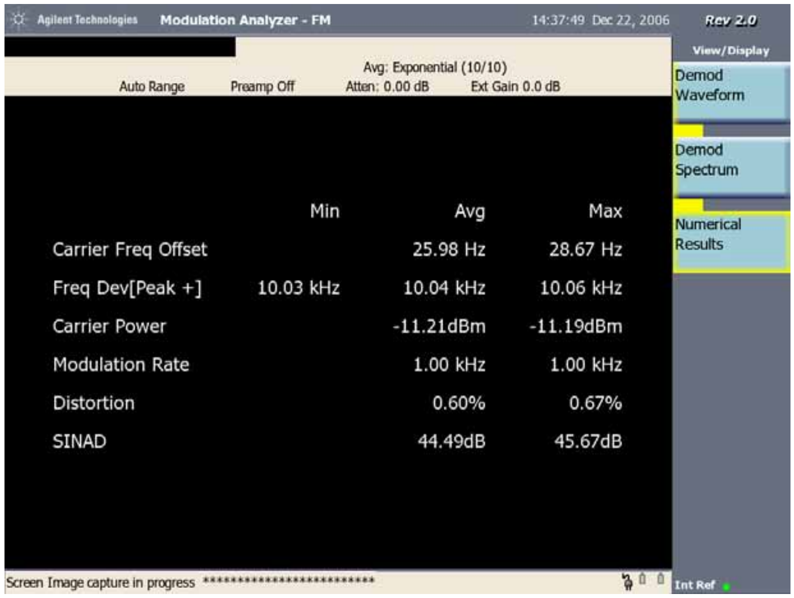
The Demod Spectrum View of the measurement results is shown in Figure 8-8.

Figure 8-8 **FM Demod Spectrum (ESG FM Signal with 10 kHz Deviation)**

The numeric results shown in the Demod Waveform view or the Demod Spectrum view are the current or the average measurement results in the Numerical Results view.

The Numerical Results view shown in Figure 8-9 gives the detailed measurement results for Carrier Frequency Offset, Frequency Deviation, Carrier Power, Modulation Rate, Distortion and SINAD including the minimum value for Frequency Deviation and maximum value for all the six parameters.

Figure 8-9 **FM Numerical Results (ESG FM Signal with 10 kHz Deviation)**



Step 11. To adjust the measurement settings, press **Meas Setup**, then:

1. Averaging: To set the averaging **On** or **Off**, switch the **Avg Number** key between **On** and **Off**. When averaging is **On**, enter the number of results used in the averaging calculations. The default average setting is **Off** and the default number is 10 when averaging is **On**. If your input signal changes during the average period, wait until the averaging has completed or the next averaging period has started.

   When the Avg Number is On, the column title “Current” in numerical results view will change to “Avg”.

2. Averaging Mode: To change the average mode, press the **Avg Mode** key and select **Exponential** or **Repeat**. The default average mode is **Repeat**.

3. Demod Settings: To change the demodulation settings, press the **Demod** menu key, then:

   To change the detector, press **FM Detector** to select a detector **Peak+**, **Peak-**, **Peak+-/2**, or **RMS**.

   Peak+ is typically used when analyzing stationary signals like CW or sinusoids, but is not good for displaying noise, since it will not show the true randomness of the noise.

   Peak+-/2 is the average of Peak+ and Peak-.

   RMS is best for measuring the power of signals.

   To change the length of time over which your measurement is performed, press **Meas Time** and use the numeric keypad to enter the measurement time.

NOTE If a pulsed signal is being measured, the Meas Time should be less than or equal to the Search Length.

When the FM Detector is Peak+ or Peak-, you can access **Peak Hold** to switch between **On** and **Off**. If Peak Hold is On, the measurement result of the frequency deviation is the maximum (when FM Detector is Peak+) or minimum (when FM Detector is Peak-) value of these peaks over the whole measurement time. If peak hold is Off, the measurement result of the frequency deviation (Peak+ or Peak- mode) is the average of these peaks over the whole measurement time.

Press **AutoCarrFreq** to switch between **On** and **Off**. When the setting is On, the analyzer will calculate the carrier frequency offset between the signal source and signal analyzer then correct this offset for the demodulated baseband signal. The frequency deviation can be measured more accurate using the setting On.

Press **Meas Filter** to switch between **On** and **Off**. Measurement Filter here is used to filter the FM demodulated signal. If IFBW is greatly larger than the modulation rate, a lot of noise will contaminate the normal signal. In order to decrease the interference of noise, you can select the Meas Filter On to filter out noise and improve the accuracy of measurement.

4. Burst Search: To change the settings of the burst search, press **Burst Search**, then:

   Press **Sync** to select **None** or **RF Amptd**. If RF Amptd is chosen, the burst searching begin.

   Press **Burst Search Threshold** to enter the burst searching power threshold. The unit is dB because this threshold is defined as the logarithmic ratio of the power of idle data portion to the power of data portion.

   Press **Search Length** to enter the searching time for the pulsed signal, the setting of search length should be:

   ```
   Search Length ≥ 2 x length of idle data portion + length of data portion
   ```

5. Trigger: To change the settings of trigger, press **Trigger**, then:

   To select the trigger type, press **Free Run**, **External** or **RF Burst**.

   If External is chosen, the Trigger Slope and Trigger Delay are available. If RF Burst is chosen, the Trigger Level and Trigger Delay are available.

   To set the trigger level, press **Trigger Level,** then enter the numeric data to set the absolute trigger level for the RF burst envelope.

   Press **Trigger Slope** to control the trigger polarity.

Press **Trigger Delay** to set the wait time of the analyzer before the analyzer starts a sweep.

6. Limits: To change limit settings, press **More 1 of 2**, then press **Limits**:

   Press **Limits** key between **On** and **Off** to activate or deactivate the limits display.

   Press **Carrier Power Upper** to enter the maximum RF carrier power. The color of the measured maximum value will be changed from green to red when the value exceeds the limit set here.

   Press **Freq Deviation Upper** to enter the maximum frequency deviation to warn you when the measured maximum value exceeds the limit specified here.

   Press **Freq Deviation Lower** to change the minimum frequency deviation limit.

   Press **Carrier Freq Offset Upper** to set the maximum carrier frequency offset limit.

   The Figure 8-10 show the failure result with the maximum carrier power exceeds the limit.

Figure 8-10 FM Numerical Results with Limits On

NOTE When Limits is set to On, the word “PASS” or “FAIL” in the left top corner of the display indicates the measurement results is passed or failed. The mark “(P)” or “(F)” beside the measurement result means this value has passed or failed the limit test.

9 Basic System Operations

This chapter contains information on the following Basic System Operations:

System Reference Introduction

The N1996A Agilent CSA spectrum analyzers provide a system utility that allows you to perform non-measurement activities and to configure the analyzer for:

- General operations
- System status updates
- Data manipulation
- Basic system functions testing

Setting System References

The Agilent CSA provides a utility to preconfigure the global settings for your analyzer.

Selecting a Frequency/Timing Reference

Perform this procedure to select a common frequency or timing reference to be used for all measurement tools (when applicable).

1. Press **System**, **Freq/Time Reference**
2. Using the knob or the up/down arrow navigation keys to highlight the frequency/timing reference you want.
3. Press **Select**.

NOTE A frequency/time reference indicator in the lower-right of the screen shows both the selected reference and its status.

Reference indicators include: Int Ref, Even Sec, Ext 1.0 MHz, Ext 2.048 MHz, Ext 4.95 MHz, Ext 10 MHz, Ext 13 MHz, Ext 15 MHz, or Ext 19.66 MHz.

Status indicators include:

- Green dot to indicate that the reference is locked
- Yellow triangle to indicate that the reference is acquiring lock
- Red X to indicate that the reference is not locked

Setting System Time/Date

The Agilent CSA provide a utility to preconfigure the Time/Date settings for your analyzer.

Setting Real Time Clock

Perform this procedure to set the system time and date.

1. Press **System**, **Time/Date/Location**, **Time/Date**.
2. Press **Set Time**, using the numeric keys or the up/down arrow navigation keys to enter the time as format hh:mm:ss.
3. Press **Set Date**, using the numeric keys or the up/down arrow navigation keys to enter the date as format mm/dd/yyyy.
4. Press **Data Format** to choose the data display is **MDY** (month-day-year) or **DMY** (day-month-year).
5. Press **Time/Date** between **On** and **Off**, when the setting is **On**, the real-time clock is shown on the right top of the display.

Printing a Screen To a File

The N1996A lets you save screen images to PNG files. You can save the image files to a USB mass storage device.

Printing Screens

1. Display data on a measurement screen.
2. Connect a USB mass storage device.
3. Select how you want to name the data file you're saving (see "File Naming Options" on page 167).

   This step must only be performed prior to the first time you save a file, or if you want to change the method you use.
4. Press (**Print**), there will be a status massage "Screen Image capture in progress" and "*" gives the progress of the saving process at the bottom of the display.
5. Enter a name for the file (or it is done automatically, depending on the file naming method you selected) and press OK.
6. When the screen capture is complete, press **Ok**.

Saving Data

Saving Data

You may save and manage data on an external storage device or the internal analyzer drive. You can save the current screen image, the current analyzer state, current trace data, and measurement results. To save data:

1. Display data on a measurement screen.
2. Press **Save**, **Type** and select the type of data you want to save.
3. If you have selected a data type of Trace, press **Source**, and select the trace for the data you want to save. Your choices are: Trace 1, Trace 2, Trace 3, Trace 4, or All.
4. Select how you want to name the data file you are saving (see "File Naming Options" on page 167).

   This step must only be performed prior to the first time you save a file, or if you want to change the method you use.
5. If you have previously saved a file of the same type or name, select how the new data will be saved. New data can be saved by action: overwriting an existing file, appending the new data to the existing file, prompting you to determine how each save will be handled, automatically increment the file name number, or timestamping the file to chronologically differentiate between files. (see "File Naming Options" on page 167).

   This step must only be performed prior to the first time you save a file, or if you want to change the method you use.
6. Enter a name for the file (or it is done automatically, depending on the file naming method you selected).
7. If you have set data type as State or Trace, select the location where you want to store the file by pressing **Save**, **Location** and press **Internal** or **USB**. For Screen or Measurement type of data, the choice of location can only be USB.

   This step must only be performed prior to the first time you save a file, or if you want to change the file storage location.
8. If you have selected USB as the storage location:
   a. Connect a USB mass storage device.
9. Press **Save Now**.
10. When the data save is complete, press **Ok**.

File Naming Options

You have three options for naming image files. You can:

- Name each file automatically using this format:

  For a screen image, the format is Screen_YYYYMMDD_HHMMSS.png. For measurement results, “Screen” is replaced by “Data”. For State, “Screen” is replaced by “State”. For Trace, “Screen” is replaced by “Trace”. In this example, the “.png” extension is only for Data Type set to Screen. Other Data Type have other extensions.

- Name each file individually, and enter the name you want. This is called User file naming.

- Have the analyzer ask you how you want to name each file for each file you save.

Setting Up Automatic File Naming

You can choose to have the analyzer automatically assign a file name that includes the file type and a three-digit number that the analyzer chooses to be the lowest number in the current sequence that does not conflict with an existing file name. The format of the file name will be DataType_YYYYMMDD_HHMMSS.xxx. the extension is different for different type of data.

1. Press **Save, Name**.

2. On **Filename** select *Auto*.

   Each time you press this softkey, the selected option changes.

Setting Up User File Naming

You can choose to have the analyzer use the file name you assign.

1. Press **Save**, **Name**.

2. On **Filename** select *User*.

   Each time you press this softkey, the selected option changes.

3. Setup file naming.

   a. Press **User Filename**

   b. If the filename does not exist, spell out the name using the knob or up and down arrow buttons to select a letter and the buttons on the left to change cursor position.

   c. For each character entered, press **Enter** or **Select**.

   d. Press **Ok**.

4. If you have previously saved a file of the same type or name, press **If File Exists**.
5. Press action: **Overwrite**, **Append**, **Prompt**, **Auto Incr**, or **Timestamp**
   - **Overwrite**—overwrites existing file data with new file data.
   - **Append**—appends the new data to the end of the existing file data. (Type = Measurement Results only)
   - **Prompt**—prompts you to input a new file name.
   - **Auto Incr**—automatically adds the numeric characters to the filename or increments the existing numeric character to the next higher number.
   - **Timestamp**—attaches a timestamp to the filename to distinguish it from the existing file.

Setting Up Asking For Filename

You can choose to have the analyzer ask you to name the file you wish to save or print. For every file you save, you enter the filename you want.

1. Press **Save**, **Name**.
2. On **Filename** select *Ask*.

   Each time you press this softkey, the selected option changes.

Configuring for Network Connectivity

The N1996A can operate as a device on any compatible network. Therefore, in order to be accessible on the network, certain information must be entered so the analyzer can communicate with other devices. Configuring the analyzer for network activity is performed by using the IP administrator located in the system utilities.

IP Administration Using DHCP

Perform this procedure to allow your analyzer to be integrated into an existing network that uses DHCP to dynamically assign IP addresses. This procedure requires that you have the Host Name (available from your network administrator).

1. Press **System**, **Controls**, **IP Admin**, **Host Name**.
2. Enter the name of the analyzer. This is assigned by the network administrator.
3. Press **Ok**
4. Press **IP Config**, **DHCP**. An IP address and other network information will automatically be assigned if the Host Name is recognized by the network.
5. Press **Save**, **Yes**. Saves the current configuration. DHCP will dynamically assign an IP address.
6. Cycle the power of the analyzer to access the network and have valid network information assigned.

IP Administration Without DHCP (Static IP Address)

Perform this procedure to allow your analyzer to be integrated into an existing network that uses a technique other than DHCP as its IP address assignments. This procedure requires the following specific data from the network administrator:

- Host name
- IP address
- Net mask
- Gateway

1. Press **System**, **Controls**, **IP Admin**, **Host Name**.
2. Enter the name of the analyzer. This is assigned by the network administrator.
3. Press **Ok**
4. Press **IP Config**, **Static**. Now you must specify relevant network information for the analyzer to be recognized. Contact your network administrator if you do not have this information.
5. Press **IP Address**.

6. Enter the IP address using the knob or the up and down arrows, and menu keys on the left.
7. Press **Ok**
8. Press **Net Mask**
9. Enter the Net Mask using the knob or the up and down arrows, and menu keys on the left.
10. Press **Ok**
11. Press **Gateway**
12. Enter the Gateway using the knob or the up and down arrows, and menu keys on the left.
13. Press **Save**, **Yes**. Saves the current configuration.
14. Cycle the power of the analyzer to access the network and have valid network information assigned.

NOTE If you are not using a LAN connection, you may want to set the IP Configuration to None to reduce the instrument power-on time.

Setting the Display

You can activate the screen save function and the time delay before the screen saver activates. Also you can set the brightness of the screen.

Setting the Screen Saver

Active the screen saver function to save the power, you can set the time delay to different values before the screen saver activates depending on the power source, battery or external DC power supply.

1. Press **System**, **Controls**, **Display Settings**.
2. If the power source is battery, press **Screen Save (Battery)**, using the up/down arrow navigation keys or the knob to highlight the delay time before the screen saver activates, press **Select**.
3. If the power source is eternal DC power supply, press **Screen Save (Ext DC)**, using the up/down arrow navigation keys or the knob to highlight the delay time before the screen saver activates, press **Select**.

The screen will turn to black after the time delay you set. Also a status massage at the bottom of the display “Back light turning off in 4 seconds...” will be shown when the residual time is 4 seconds. and after the screen saver activates, you can press any front panel key to turn on the back light.

Setting the Brightness

There are six brightness level to choose. 6 is the brightest level.

1. Press **System**, **Controls**, **Adjust Brightness**.
2. Select the desired brightness level.

Saving, Recalling, and Deleting Instrument States

You can save the current configuration and settings for recall at a later time. You can also save a customized power-up state, which the analyzer will use each subsequent time it is powered on. This enables you to configure common usage and power-on states to make measurements quickly.

Saving the State

1. Configure all measurement settings you want to save. Make sure you are viewing the screen you want to recall later.
2. Press **Save**, **Name**, **Filename** (Ask).
3. Press **Return** (the front panel key located below the screen window), **Location**, **Internal** or **USB**.
4. Press **Save**, **Type**, **State**, **Save Now**
5. Enter your preferred state name, for example, “Remote base station”.
6. Press **OK.** The message, “**`State was saved successfully: C:<filename>`**” is displayed. Press **OK** again to return to the **Save** key menu.

Saving the Power-Up State

1. Configure all measurement settings you want to save. Make sure you are viewing the screen you want to recall later.
2. Press **Save**, **Name**, **Filename** (Ask).
3. Press **Return** (the front panel key located below the screen window), **Location**, **Internal** or **USB**.
4. Press **Save**, **Type**, **State**, **Save Now**
5. Enter “Powerup” as the state name (the analyzer is case-sensitive, so be sure to capitalize the “P”). This is the name the analyzer uses to identify the power-up state. It is also the state loaded by User Preset.
6. Press **Ok**

NOTE This process is easier for firmware revision A.02.00 or greater. After configuring the measurement settings, press **User Preset**, **Save User Preset**.

Recalling the State

1. Press Recall, Type, State
2. Select the location from which you want to recall the file by pressing **Location** and press **Internal** or **USB**.

This step must only be performed prior to the first time you recall a file, or if you want to change the file recall location.

3. If you have selected USB as the recall location, connect the USB mass storage device.
4. If necessary, select how you want the state files sorted by pressing **Sort** and then press **By Date**, **By Name**, **By Extension**, **By Size**, or **Order**.
5. Press **Recall Now**.
6. Select from the file list the state file you want to recall using the knob or up and down arrow buttons.

   All states, in addition to two supplied in the analyzer (listed below), are displayed:

   - Powerup - The default power-up state shipped with the analyzer, or the power-up state last saved with the analyzer.
   - Factory Defaults - The default power-up state shipped with the analyzer. You can always revert to it by selecting it in this procedure.
7. Press **Select**

Returning the Power-Up State to Factory Defaults

1. Press Recall, Type, State
2. Select the location from which you want to recall the file by pressing **Location** and press **Internal**.

   This step must only be performed prior to the first time you recall a file, or if you want to change the file recall location.
3. If necessary, select how you want the state files sorted by pressing **Sort** and then press **By Date**, **By Name**, **By Extension**, **By Size**, or **Order**.
4. Press **Recall Now**. (Note that **Save**, **Name**, **Filename** (Auto) (User) (Ask) must be set to **Ask**.)
5. Select from the file list the “Factory Defaults” state file using the knob or up and down arrow buttons.
6. Press **Select**.
7. When the recall is complete, press **Save**, **Type**, **State**, **Save Now**. (Note that **Save**, **Name**, **Filename** (Auto) (User) (Ask) must be set to **Ask**.)
8. Enter as the state name, “Powerup” (the analyzer is case-sensitive, so be sure to capitalize the “P”). This is the name the analyzer uses to identify the power-up state.
9. Press **OK**, and then **OK** again to get back to the **Save** Menu.

Deleting States

If you have saved a state you will no longer use, you can delete it.

1. Press **Recall**, **Type**, **State**, **Location** (Internal), **Catalog**.
2. Select from the file list the state file you want to delete using the knob or up and down arrow buttons or **All** to delete all saved states.
3. Press **Delete**. You will then be asked, "`Are you sure you wish to delete the <filename> state?`" Press **Yes**.

NOTE Selecting **All** does not delete the Powerup or Factory Defaults states.

Viewing System Statistics

Viewing System Release Versions

Perform this procedure to view the current version of software and firmware for enabled features.

1. Press **System**, **System Stats**, **Rev Info**, and view version information for system firmware.
2. Press **Page Up** or **Page Down** to scroll to next screen.
3. Press **Return** to go back to the System Stats key menu.

Viewing System Memory

Perform this procedure to view current allocation and usage statistics of the memory available.

1. Press **System**, **System Stats**, **Memory**, and view status of total, used, and available memory.
2. Press **Return** to go back to the System Stats key menu.

Viewing Battery Statistics

Perform this procedure to view current status and battery usage.

1. Press **System**, **System Stats**, **Battery**, and view the status of battery conditions. For details, see “System Statistics—Battery Screen” on page 182.
2. Press **Return** to go back to the System Stats key menu.

Viewing System Copyrights

Perform this procedure to view current copyrights statistics.

1. Press **System**, **System Stats**, **Copyrights**, and view copyrights of Agilent Technologies, Inc. and the copyrights for software components from other manufactures used in the analyzer.
2. Press **Return** to the System Stats key menu.

Viewing System Identification

Perform this procedure to view current system identification.

1. Press **System**, **System Stats**, **Show System**, and view a list of instrument identification information.
2. Press **Return** to go back to the System Stats key menu.

Basic System Operations

Using the Option Manager

Viewing Installed Options

1. Press **System**, **Option Manager**, **Installed Options**. This provides a list of all installed options as well as their associated license keys.
2. Press **Page Up** or **Page Down** as necessary to scroll to next screen.

Viewing Installed Options

Perform this procedure to view a list of all options that you can install for the analyzer. Two lists are displayed: options you can install yourself and options that must be installed by Agilent.

1. Press **System**, **Option Manager**, **Installable Options**. This provides a list of options that can be installed.
2. Press **Page Up** or **Page Down** as necessary to scroll to next screen.
3. Press **Return** to go back to the Option Manager key menu.

Installing an Option

1. Press **System**, **Option Manager**, **Install an Option**.
2. If available, press **From List**. This key will not be available if all options have already been licensed.
3. Highlight the option to be installed from the list using knob or the up/down arrow navigation keys then press **Select**.
4. If you already have the license key for the option selected, press **Install Option** and follow the on-screen instructions. Otherwise, you need to order a license key for this option upgrade by contacting your Agilent sales representative.
5. If the option to be installed is not listed, there are two possible reasons:
    - The option to be installed requires a newer firmware revision than the revision that is currently installed. For example, Option AFM, AM/FM Tune and Listen, requires firmware revision A.02.00 or later. You have two alternatives in such a case. Either upgrade the firmware to the firmware necessary to support the option and then license the option, or use the **Type Option** feature (press **Cancel**, **Type Option**) to license the option now and upgrade the firmware later. Either way, the new option will be available when it is licensed and the minimum firmware revision is installed.
    - The option to be installed is no longer offered for sale with the current firmware revision. For example, N1996A Option TG3 and N1996A Option TG6 have been replaced by N8995A Option SR3 and N8995A Option SR6, respectively, beginning with firmware revision A.02.00 or later. You can

still install the TG3 or TG6 option using the **Type Option** feature (press **Cancel**, **Type Option**) to license the option.

6. If you want to cancel the installation process, press **Return** to go back to the Option Manager key menu.

Viewing Installation Information

Perform this procedure to view current manufacturing information about your analyzer that must be provided to Agilent to install a user-installable option.

1. Press **System**, **Option Manager**, **Install Info**.
2. When you call your Agilent sales representative to order an option, you will need to provide the information you see on this screen:
   - Model number
   - Serial number
   - Host ID
3. Press **Return** to go back to the Option Manager key menu.

Testing System Functions

The N1996A provides two simple tests you can perform to test the basic system functionality: a display test and a keyboard test.

Testing Your Display

Perform this procedure to verify the correct operation of your display.

1. Press **System**, **Service**, **Verification**, **Display Test**.
2. Follow the on-screen instructions.

Testing Your Keyboard

Perform this procedure to verify the correct operation of your keyboard device.

1. Press **System**, **Service**, **Verification**, **Keyboard Test**.
2. Press the available buttons and view the results on the screen.

10 Working with Batteries

This chapter contains the following topics on your Agilent CSA batteries:

Installing Batteries

1. Open the battery door by turning the latch counterclockwise several times until loose. Then pull the battery door open.
2. Insert two batteries. Both batteries must be installed for the instrument to operate properly.
3. Close the battery door and turn the latch clockwise until tight to secure the battery door.

WARNING **This instrument has a recharge circuit. Never install non-rechargeable cells or batteries of a different type.**

NOTE When operating the analyzer on battery power, batteries of different capacities will share current in proportion to individual battery capacity. Therefore, when purchasing and installing batteries, ensure that both batteries have equivalent capacities. Even batteries that appear physically identical, can have different capacities. It is recommended that batteries be purchased and installed in pairs.

Viewing Battery Status

You can view information about battery status in four ways:

- Two battery LEDs on the analyzer front panel (below the USB connectors, refer to "Front-Panel Connectors and Keys" on page 50)
- Icons in the lower right of the front panel screen
- System Statistics—Battery screen, available from the System menu
- LCD gauge built into each battery

Battery LEDs

LED	Charging Status
Green	When battery charging
Blinking green	Battery charging completes

NOTE The battery status LEDs will function only when the analyzer is in standby mode and connected to external power.

Front Panel Icons

Icon	Status
Plug icon	Connected to external power through AC adapter converter
2 solid batteries	2 batteries installed
1 solid battery	1 battery installed
% displayed beneath battery	Amount of charge capacity remaining for battery

System Statistics—Battery Screen

To view the battery status, press **System**, **System Stats**, **Battery**. The Battery screen displays several kinds of information:

- **Temperature**—the internal temperature of each battery as measured by a sensor embedded in each battery
- **Voltage**—for each battery cell stack as measured by each battery's sensor

- **Run Time to Empty**—while using external power, External DC Power is displayed; while using battery power, the predicted remaining battery run time is displayed in minutes at the present rate of discharge. The instrument mode you select affects the discharge rate, which determines the run time to empty. Stimulus/Response uses the most power. The remaining modes use the least power.
- **Fuel Gauge Error**—the present accuracy of each battery’s fuel gauge or remaining charge capacity. If the error exceeds 10%, you should recalibrate the battery using the optional stand alone battery charger.
- **Percent Charged**—the predicted charge capacity of each battery in percent.
- **Battery Status**—For Battery 1 and Battery 2, Present or Missing tells you whether a battery is installed.

Built-In Battery Gauge

Each Lithium Ion battery has a five-segment LCD gauge that displays its charge status. Each segment represents 20% of the charge capacity. The gauge is active unless the battery is in shutdown mode. You can view the gauge with the door open.

Charging Batteries

You can charge batteries internally or using the external battery charger (Option BCG). The external charger provides much faster charging time.

CAUTION Charge batteries internally or with the appropriate charger, an SMBus charger of level II or higher.

Never use a non-SMBus charger because the battery issues commands over the SMBus to the charger to control the charge rate and voltage.

Never use a modified or damaged charger.

NOTE To ensure proper instrument function when operating the analyzer on battery power, both of the batteries must have equal charge levels.

NOTE For maximum runtime, it is best to have approximately equal charge levels on both batteries. The instrument will shut down if either battery becomes fully discharged during operation.

Internal Charging

You can use the N1996A to recharge the batteries while the analyzer is operating or shut down. For a fully depleted battery, charging time is approximately 4 hours if the analyzer is in standby, 8 hours if the analyzer is operating.

If two batteries are installed, the analyzer charges both batteries simultaneously.

To charge a battery internally, simply attach the external power supply and turn on external power.

NOTE Additional spurious responses may appear when operating the analyzer while charging a battery. These spurious responses are most noticeable when the battery is nearly depleted.

External Charging

The external battery charger (available as part of Option BCG) lets you charge two batteries simultaneously. If the batteries are fully depleted, it takes up to 4 hours to recharge them.

You have the option of charging batteries before they become fully depleted. Doing this does not shorten battery life. But repeatedly charging a battery before it's fully discharged will impair the accuracy of its internal charge-remaining indicator.

External Battery Charger LED	Charging Status
Green on	Charging complete
Green flashing	Charging
Blue flashing	Calibrating—the accuracy of the battery’s internal LCD charge gauge is being renewed. Refer to “Recalibrating Batteries” on page 186.
Blue	Calibration is complete
Red flashing	Battery fuel gauge recalibration recommended
Red on	Error

Recalibrating Batteries

Each battery contains a microchip that monitors battery usage and tracks how much capacity is available. This function can become less accurate because of temperature fluctuations, aging, self-discharge, repeated partial charging, and other factors. This inaccuracy is displayed on the System Statistics—Battery screen as Fuel Gauge Error.

To ensure the accuracy of the battery's internal capacity tracking system, occasionally you need to recalibrate the battery. Recalibrating is done by fully charging the battery, fully discharging it, recharging it again, and then verifying that the error has been corrected.

You can recalibrate a battery with the optional external charger. The charger makes the process simpler.

Determining if a Battery Needs Recalibration

To view the battery status, press **System**, **System Stats**, **Battery**.

NOTE After recalibrating, if the battery is not fully charged or still shows more than a 10% Fuel Gauge Error reading, repeat the recalibrating procedure. If the second recalibrating does not restore a full charge and an error reading of 10% or less, the battery needs replacement. This error will affect all of the displayed battery charge indicators.

Recalibrating with the External Battery Charger

1. Insert a battery into the external battery charger. Only one of the two battery bays is capable of recalibrating the battery.
2. If fuel gauge recalibration is recommended by the charger (LED flashing red), press the button on the front of the external battery charger to initiate a recalibration cycle.

   The charger will charge the battery fully, discharge it completely, then recharge it fully again. The entire process can take up to 10 hours.
3. Install the battery into the analyzer.
4. On the System Statistics—Battery screen, verify that the battery is fully charged and recalibrated.

Battery Care

WARNING

Lithium Ion and lithium polymer cells and battery packs may get hot, explode, or ignite and cause serious injury if exposed to abuse conditions. Be sure to follow these safety warnings:

- **Do not install the battery backward, so the polarity is reversed.**
- **Do not connect the positive terminal and negative terminal of the battery to each other with any metal object (such as wire).**
- **Do not carry or store the battery with necklaces, hairpins, or other metal objects.**
- **Do not pierce the battery with nails, strike the battery with a hammer, step on the battery, or otherwise subject it to strong impacts or shocks.**
- **Do not solder directly onto the battery.**
- **Do not expose the battery to water or salt water, or allow the battery to get wet.**
- **Do not disassemble or modify the battery. The battery contains safety and protection devices, which, if damaged, may cause the battery to generate heat, explode, or ignite.**
- **Do not place the battery in or near fire, on stoves, or in other high temperature locations. Do not place the battery in direct sunlight, or use or store the battery inside cars in hot weather. Doing so may cause the battery to generate heat, explode, or ignite. Using the battery in this manner may also result in a loss of performance and a shortened life expectancy.**
- **Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended. Discard used batteries according to manufacturer's instructions.**
- 

  Do not throw batteries away but collect as small chemical waste

WARNING **Do not discharge the battery using any device except the specified device. When the battery is used in devices other than the specified device, it may damage the battery or reduce its life expectancy. If the device causes an abnormal current to flow, it may cause the battery to become hot, explode, or ignite and cause serious injury.**

Maximizing Battery Life

The Lithium Ion battery used in the N1996A has a life span of approximately 300 charge cycles at room temperature, with normal charge and discharge rates. You can maximize the number of charge cycles with reasonable battery care:

- Clean the battery contacts occasionally, using a pencil eraser or alcohol and a cotton swab. Make sure no residue from the eraser or cotton swab is left on the contact points.
- Cycle each battery through a full charge and full discharge on a regular basis, preferably monthly. Even if you use external power most of the time, you will lengthen battery life by occasionally cycling through a full discharge/recharge cycle.
- Do not leave a battery unused and fully charged for an extended period. Batteries that sit idle eventually lose their ability to hold a charge.
- Store batteries in a cool, dry location, away from metal objects and corrosive gases. To extend battery life during long-term battery storage, store the batteries with a 50% charge level. Storage limits are –20 °C to 60 °C 80% RH.
- Extended exposure to high humidity or temperatures above 45 degrees Celsius (113 degrees Fahrenheit) can impair battery performance and shorten battery life.
- Allow a battery to warm to room temperature before charging it. Temperature shock can damage the battery chemistry and in some cases cause a short circuit.
- Always charge batteries at temperatures between 0 and 45 degrees Celsius (32 to 113 degrees Fahrenheit).
- Operate the analyzer on battery power between the temperatures of 0 and 50 degrees Celsius (32 to 122 degrees Fahrenheit). Using the batteries at lower or higher temperatures can damage the batteries and reduce operating life. Cold temperatures affect battery chemistry, reducing charge capacity, especially below 0 degrees Celsius (32 degrees Fahrenheit).
- Batteries are shipped with a minimum of 20% charge capacity to provide at least a 6-month shelf life at room temperature, before the battery electronics go into shutdown mode. When a battery has discharged down to 7.1 volts, it goes into shutdown mode. When this occurs, the battery electronics self-disconnect, removing their electronic load from the cells. This provides approximately 1 year of room temperature storage before the cells self-discharge to the point beyond which they should not be recharged. Once a battery has reached shutdown mode the battery will undergo a self-test immediately upon being put

into charge. The charger will then attempt to pre-charge the battery at a very low initial charge rate. If the voltage does not recover, the battery pack has been allowed to discharge beyond the point of safe recovery. The charge cycle will be terminated, and the battery pack needs to be replaced.

If the battery does recover from a shutdown mode, the fuel gauge accuracy will be reduced. Complete a battery recalibration as soon as possible to calibrate the fuel gauge.

Initial Charge Cycle

New batteries must be rapid-charged (typically to 80%), then trickle-charged (slowly charged to 100%) for 24 hours, before their first use and for the first two or three uses.

Because the batteries you receive for use with the N1996A are new, they have a minimal charge when you receive them. All batteries require a “break-in” period, so do not be alarmed if a battery doesn't hold a full charge right away. A new battery commonly will show a false full charge (voltage) as indicated on the analyzer or charger, and may not power up the analyzer upon first use. Before using a new battery, leave it charging for 24 hours.

NOTE Batteries are not standard on the N1996A, but they can be ordered with a new analyzer or later as an upgrade kit.

Lithium Ion Battery Disposal

When you notice a large decrease in charge capacity after proper recharging, it is probably time to replace the battery.

Li-Ion batteries need to be disposed of properly. Contact your local waste management facility for information regarding environmentally sound collection, recycling, and disposal of the batteries. Regulations vary for different countries. Dispose of in accordance with local regulations.

Battery Specifications

The N1996A Agilent CSA Series Spectrum Analyzer uses the Inspired Energy NF2040HD24 Smart Battery, which produces 10.8 volts DC at approximately 6 A. The NF2040HD24 is a Lithium Ion battery pack, which uses the System Management Bus (SMBus) interface to communicate with the analyzer and charger. To charge the batteries, use only the Agilent approved SMBus charger of Level II or higher or the N1996A.

- The battery is designed for approximately 300 full charge/discharge cycles at room temperature and under normal rates of discharge.
- The NF2040HD24 uses electronically programmable read-only memory (EPROM) to store key data regarding the battery cells and charge capacity.

Protection Electronics

The NF2040HD24 SMBus battery uses several protection devices to prevent damage to the battery and analyzer. The battery is internally protected against excessive current draws and reduced loads (shorts), excessive voltage and temperatures.

During charging and discharging, the battery will monitor and report its voltage, current, and temperature. If any of these monitored conditions exceeded their safety limits, the battery will terminate any further charge or discharge until the error condition is corrected.

Analyzer Operation: Battery Current Drain in the Off Mode

When the analyzer is operating from battery power, it continues to draw current in the off mode. When in off mode, the analyzer draws <10 mA per hour, or approximately 38 days to discharge. Agilent recommends that if the analyzer is not going to be used for an extended period of time, remove the batteries from your analyzer. This will ensure you have sufficient battery capacity if you intend to operate the analyzer from battery power.

Battery and Charger Part Numbers

Option BAT

Description	Part Number
NF2040HD24 Battery (quantity 2)	1420-0891

Option BCG

Description	Part Number
Dual Battery Charger	0950-4776

NOTE Replace only with NF2040HD24 or equivalent, Agilent-approved battery.

Additional batteries are also available directly from Inspired Energy, Inc. To purchase additional or replacement batteries, visit www.inspired-energy.com, or call toll free USA 1-888-5-INSPIRE (546-7747).

NOTE When operating the analyzer on battery power, batteries of different capacities will share current in proportion to individual battery capacity. Therefore, when purchasing and installing batteries, ensure that both batteries have equivalent capacities. Even batteries that appear physically identical, can have different capacities. It is recommended that batteries be purchased and installed in pairs.

11 Concepts

Resolving Closely Spaced Signals

Resolving Signals of Equal Amplitude

Two equal-amplitude input signals that are close in frequency can appear as a single signal trace on the analyzer display. Responding to a single-frequency signal, a swept-tuned analyzer traces out the shape of the selected internal IF (intermediate frequency) filter (typically referred to as the resolution bandwidth or RBW filter). As you change the filter bandwidth, you change the width of the displayed response. If a wide filter is used and two equal-amplitude input signals are close enough in frequency, then the two signals will appear as one signal. If a narrow enough filter is used, the two input signals can be discriminated and appear as separate peaks. Thus, signal resolution is determined by the IF filters inside the analyzer.

The bandwidth of the IF filter tells us how close together equal amplitude signals can be and still be distinguished from each other. The resolution bandwidth function selects an IF filter setting for a measurement. Typically, resolution bandwidth is defined as the 3 dB bandwidth of the filter. However, resolution bandwidth may also be defined as the 6 dB or impulse bandwidth of the filter.

Generally, to resolve two signals of equal amplitude, the resolution bandwidth must be less than or equal to the frequency separation of the two signals. If the bandwidth is equal to the separation and the video bandwidth is less than the resolution bandwidth, a dip of approximately 3 dB is seen between the peaks of the two equal signals, and it is clear that more than one signal is present.

When the Agilent CSA spectrum analyzer span is > 0 Hz, the sweep time is set automatically to keep the analyzer measurement calibrated. When the resolution bandwidth is < 1 kHz, there will be large increases in the sweep time as you decrease the RBW in a 1, 3, 10 sequence. Fortunately, the Agilent CSA allows you to also set the RBW to discrete values, thereby allowing you greater flexibility in trading off sweep time and resolution.

For the shortest measurement times, use the widest resolution bandwidth that still permits discrimination of all desired signals.

For example, in a 10 MHz span, the sweep time with a 300 Hz RBW is 1.23 s, and the sweep time with a 100 Hz RBW is 9.01 s. If the 300 Hz RBW does not provide sufficient resolution, and the sweep time with a 100 Hz RBW is too long, you could try the 200 Hz RBW. The sweep time with a 200 Hz RBW is 2.52 s, over 3 times faster than the sweep time with a 100 Hz RBW.

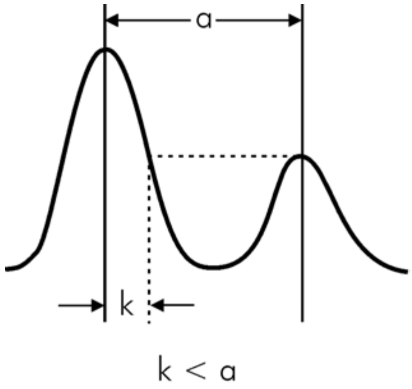
Resolving Small Signals Hidden by Large Signals

When dealing with the resolution of signals that are close together and not equal in amplitude, you must consider the shape of the IF filter of the analyzer, as well as its 3 dB bandwidth. (See "Resolving Signals of Equal Amplitude" on page 194 for more information.) The shape of a filter is defined by the selectivity, which is the ratio of the 60 dB bandwidth to the 3 dB bandwidth. If a small signal is too close to a larger signal, the smaller signal can be hidden by the skirt of the larger signal.

To view the smaller signal, select a resolution bandwidth such that *k* is less than *a* (see Figure 11-1). The separation between the two signals (*a*) must be greater than half the filter width of the larger signal (*k*), measured at the amplitude level of the smaller signal.

The digital filters in the Agilent CSA have filter widths about one-half to one-third as wide as typical analog RBW filters. This enables you to resolve close signals with a wider RBW (for a faster sweep time).

Figure 11-1 RBW Requirements for Resolving Small Signals



Trigger Concepts

With firmware versions prior to A.02.00, the trigger functions are only available when the Agilent CSA is in zero span. With firmware version A.02.00 and later, the trigger functions are available in both zero span and non-zero span.

Selecting a Trigger

1. **Video Triggering**

   Video triggering controls the sweep time based on the detected envelope signal to steady the signal on the display. Video triggering triggers the measurement at the point at which the rising signal crosses the trigger level horizontal green line on the display:

   Press **Meas Setup**, **Trigger**, **Video**, **–30**, **dBm**.

2. **External Triggering**

   In the event that you have an external trigger available that can be used to synchronize with the signal of interest, connect the trigger signal to the rear of the Agilent CSA using the EXT TRIGGER IN connector. You can change the slope of the external trigger signal on which you want the analyzer to trigger using the Trigger Slope feature.

   Press **Meas Setup**, **Trigger, External**.

3. **RF Burst Triggering**

   RF burst triggering occurs in the IF circuitry chain, as opposed to after the video detection circuitry with video triggering. In the event video triggering is used, the detection filters are limited to the maximum width of the resolution bandwidth filters. The RF burst signal level can be set using the Trigger Level feature.

   Press **Meas Setup**, **Trigger**, **RF Burst**.

Trigger Delay

Trigger delay can be used to move the sweep trigger point arbitrarily to allow closer examination of waveform patterns (Press **Trigger**, **Trigger Delay**, and enter a delay time).

AM and FM Demodulation Concepts

Demodulating an AM Signal Using the Analyzer as a Fixed Tuned Receiver (Time-Domain)

The zero span mode can be used to recover amplitude modulation on a carrier signal.

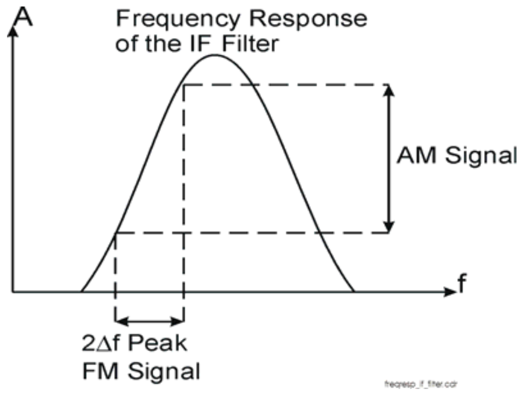
The following functions establish a clear display of the waveform:

- Triggering stabilizes the waveform trace by triggering on the modulation envelope. If the modulation of the signal is stable, video trigger synchronizes the sweep with the demodulated waveform.
- Linear display mode should be used in amplitude modulation (AM) measurements to avoid distortion caused by the logarithmic amplifier when demodulating signals.
- Sweep time to view the rate of the AM signal.
- RBW is selected according to the signal bandwidth.

Demodulating an FM Signal Using the Analyzer as a Fixed Tuned Receiver (Time-Domain)

To recover the frequency modulated signal, a spectrum analyzer can be used as a manually tuned receiver (zero span). However, in contrast to AM, the signal is not tuned into the passband center, but to one slope of the filter curve as Figure 11-2.

Figure 11-2 **Determining FM Parameters using FM to AM Conversion**



Here the frequency variations of the FM signal are converted into amplitude variations (FM to AM conversion). The reason we want to measure the AM component is that the envelope detector responds only to AM variations. There are no changes in amplitude if the frequency changes of the FM signal are limited to the flat part of the RBW (IF filter). The resultant AM signal is then detected with the envelope detector and displayed in the time domain.

Stimulus Response Measurement Concepts

NOTE Stimulus response measurements require the N8995A Stimulus Response Measurement Suite and either option SR3 or SR6.

Stimulus Response Overview

Stimulus response measurements require a source to stimulate a device under test (DUT), a receiver to analyze the frequency response characteristics of the DUT, and, for return loss measurements, a directional coupler or bridge. The Agilent CSA signal source options include a built-in RF bridge. Characterization of a DUT can be made in terms of its transmission or reflection parameters. Examples of transmission measurements include flatness and rejection. Return loss is an example of a reflection measurement.

A spectrum analyzer combined with a signal source forms a stimulus response measurement system. With the signal source as the swept source and the analyzer as the receiver, operation is the same as a single channel scalar network analyzer. The signal source output frequency must be made to precisely track the analyzer input frequency for good narrow band operation. A narrow band system has a wide dynamic measurement range. This wide dynamic range will be illustrated in the following example.

There are three basic steps in performing a stimulus response measurement, whether it is a transmission or a reflection measurement. The first step is to set up the analyzer, the second is to normalize, and the last step is to perform the measurement.

Normalization Concepts

To make a transmission measurement accurately, the frequency response of the test system must be known. Normalization is used to eliminate this error from the measurement. To measure the frequency response of the test system, connect the cable (but not the DUT) from the signal source output to the analyzer input.

Press **Mode, Stimulus/Response**, **Two Port Insertion Loss**. Set the desired start and stop frequencies. Press **Normalize**, **Continue**.

The frequency response of the test system is automatically stored and a normalization is performed. This means that the active displayed trace is now the ratio of the input data to the data stored in memory.

When normalization is on, trace math is performed on the active trace, with the result placed into the selected trace.

Reconnect the DUT to the analyzer. Note that the units of the reference level are dB, indicating that this is a relative measurement.

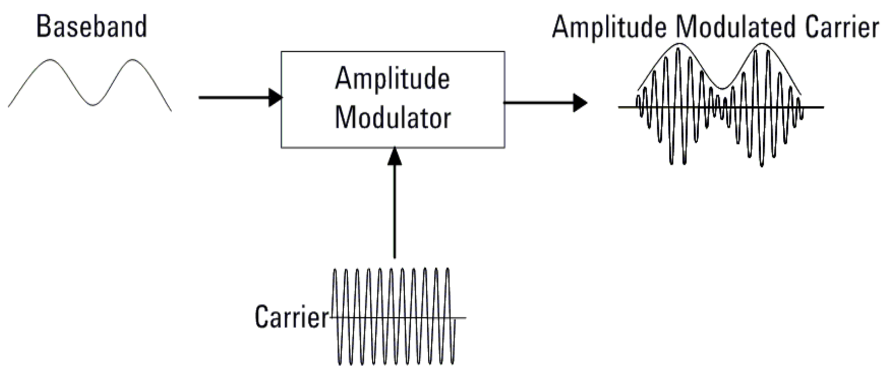
To make a reflection measurement accurately, it is necessary to perform an open/short/load calibration. An open, short, and load are included in the Stimulus Response Calibration Kit, Option SRK.

Press **Mode, Stimulus/Response, Return Loss.** Set the desired start and stop frequencies. Press **Calibrate** and follow the instructions.

After the calibration is complete, connect the DUT to the RF OUTPUT connector to make your return loss measurement. The marker readout returns the amplitude values in both return loss and VSWR.

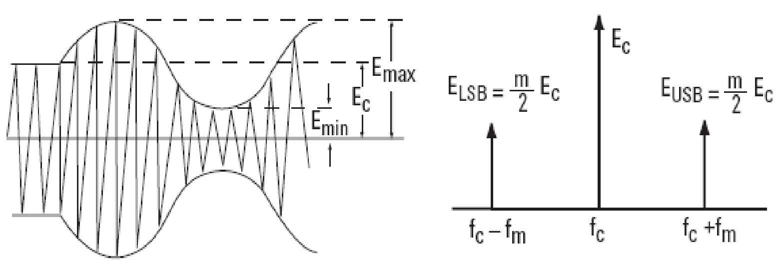
AM Concepts

Figure 11-3 **AM waveform**



In AM (Amplitude Modulation), the instantaneous amplitude of the modulated carrier signal changed in proportion to the instantaneous amplitude of the information signal.

Figure 11-4 **Calculation AM index in time and frequency domain**



The modulation index m represents the amount of the modulation or the degree to which the information signal modulates the carrier signal.The index for an AM signal can be calculated from the amplitudes of the carrier and either of the sidebands by the equation:

Equation 11-1

$$m = \frac{E_{max} - E_c}{E_c} = \frac{E_{max} - E_{min}}{E_{max} + E_{min}} = \frac{E_{USB} + E_{LSB}}{E_c} = \frac{2E_{SB}}{E_c}$$

For 100% modulation, the modulation index is 1.0, and the amplitude of each sideband will be one-half of the carrier amplitude expressed in voltage. On a decibel power scale, each sideband will thus be 6 dB less than the carrier, or one-fourth the power of the carrier. Since the carrier power does not change with amplitude modulation, the total power in the 100% modulated wave is 50% higher

Concepts

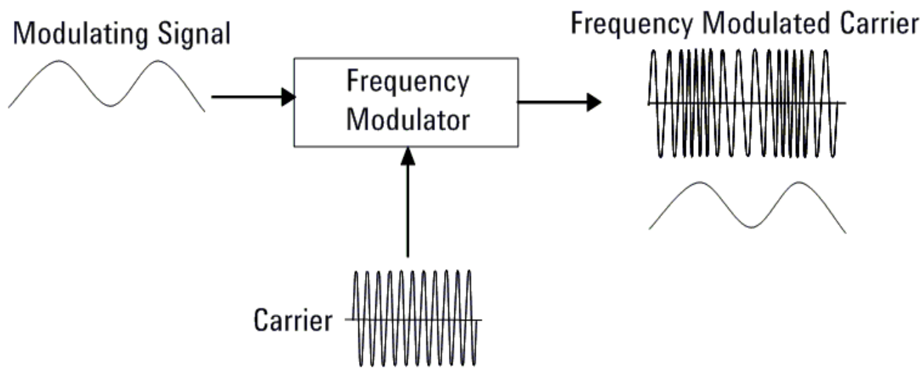
than in the unmodulated carrier. The relationship between m and the logarithmic display can be expressed as:

Equation 11-2

$$(E_{SB}/E_c)dB + 6dB = 20\log m$$

FM Concepts

Figure 11-5 **FM waveform**



FM (Frequency Modulation) and PM (Phase modulation) belong to angle modulation. In FM, the instantaneous frequency deviation of the modulated carrier signal changed in proportion to the instantaneous amplitude of the modulating signal. And in PM, the instantaneous phase deviation of the modulated carrier with respect to the phase of the unmodulated carrier is directly proportional to the instantaneous amplitude of the modulating signal.

The modulation index for angle modulation, β, is expressed by this equation:

Equation 11-3

$$\beta = \Delta f_p / f_m = \Delta\phi_p$$

Where Δfp is the peak frequency deviation, fm is the frequency of the modulating signal, and $\Delta\phi$p is the peak phase deviation.

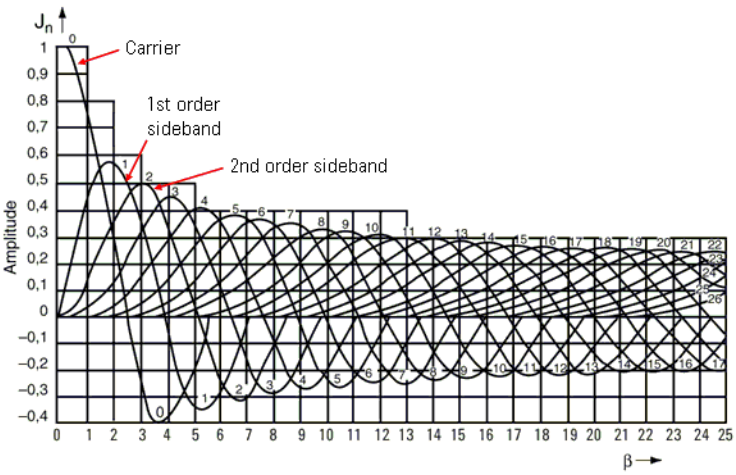
This expression tells us that the angle modulation index is really a function of phase deviation, even in the FM case. Also, note that the definitions for frequency and phase modulation do not include the modulating frequency. In each case, the modulated property of the carrier, frequency or phase, deviates in proportion to the instantaneous amplitude of the modulating signal, regardless of the rate at which the amplitude changes. However, the frequency of the modulating signal is important in FM and is included in the expression for the modulating index because it is the ratio of peak frequency deviation to modulation frequency that equates to peak phase.

Unlike the modulation index for AM, there is no specific limit to the value of β, since there is no theoretical limit to the phase deviation; thus there is no equivalent of 100% AM. However, in real world systems there are practical limits.

Unlike AM, which is a linear process, angle modulation is nonlinear. This means that a single sine wave modulating signal, instead of producing only two sidebands, yields an infinite number of sidebands spaced by the modulating frequency.

The Bessel function graph shows the amplitudes of the carrier and the sidebands as a function of modulation index, β. The spectral components, including the carrier, change their amplitudes as the modulation index varies.

Figure 11-6 Carrier and sideband amplitude for angle-modulated signals



In theory, for distortion-free detection of the modulating signal, all the sidebands must be transmitted. However, in practice, the sideband amplitudes become negligibly small beyond a certain frequency offset from the carrier, so the spectrum of a real-world FM signal is not infinite.

Modulation Distortion Measurement Concepts

Purpose

This measurement is used to measure the amount of modulation distortion contained in the Modulated signal by determining the ratio of harmonic and noise power to fundamental power. This measurement verifies the modulation quality of the signal from the UUT.

Measurement Technique

Modulation Distortion is defined as:

Equation 11-4

$$\%_{ModulationDistortion} = \sqrt{\frac{P_{total} - P_{signal}}{P_{total}}} \times 100\%$$

where: P_{total} = the power of the total signal,

P_{signal} = the power of the wanted modulating signal, and

P_{total} - P_{signal} = total unwanted signal which includes harmonic distortion and noise.

First, the received signal is demodulated and filtered to remove DC. Then the filtered signal is transformed by an FFT into frequency domain. Next, total power in the total filter band is measured as P_{total}, the peak power of the modulated signal is computed as P_{signal}, the square root of the ratio of P_{total} - P_{signal} to P_{total} is calculated. The result is signal’s modulation distortion. It can be expressed as dB or %.

Modulation SINAD Measurement Concepts

Purpose

Modulation SINAD (SIgnal to Noise And Distortion) measures the amount of Modulation SINAD contained in the modulated signal by determining the ratio of fundamental power to harmonic and noise power. Modulation SINAD is reciprocal of modulation distortion provided by Modulation Distortion measurement. This is another way to quantify the quality of the modulation process

Measurement Technique

Modulation SINAD is defined as:

Equation 11-5

$$dB_{ModulationSINAD} = 20 \times \log \sqrt{\frac{P_{total}}{P_{total} - P_{signal}}}$$

where: P_{total} = the power of the total signal,

P_{signal} = the power of the wanted modulating signal, and

P_{total} - P_{signal} = the total unwanted signals which include harmonic distortion and noise.

First, the received signal is demodulated and filtered to remove DC, then the filtered signal is transformed by an FFT into frequency domain. Next, total power in the total filter band is measured as P_{total}, the peak power of the modulated signal is computed as P_{signal}, the square root of the ratio of P_{total} to P_{total} - P_{signal} is calculated. The result is signal’s Modulation SINAD. It can be expressed as dB or %.

12 Programming Examples

Finding Examples and More Information

The latest version of programming examples are available from the following URL:

http://www.agilent.com/find/saprogramming

Interchangeable Virtual Instruments COM (IVI-COM) drivers: Develop system automation software easily and quickly. IVI-COM drivers take full advantage of application development environments such as Visual Studio using Visual Basic, C# or Visual C++ as well as Agilent's Test and Measurement Toolkit. You can now develop application programs that are portable across computer platforms and I/O interfaces. With IVI-COM drivers you do not need to have in depth test instrument knowledge to develop sophisticated measurement software. IVI-COM drivers provide a compatible interface to all. COM environments. The IVI-COM software drivers can be found at the URL
http://www.agilent.com/find/ivi-com

Programming Examples Information and Requirements

- The programming examples were written for use on an IBM compatible PC.
- The programming examples use C, Visual Basic and VEE programming languages.
- The programming examples use the LAN interface.
- Most of the examples are written in C using the Agilent VISA library.

  The VISA transition library must be installed. The Agilent I/O libraries contain the latest VISA library and is available at:

  `www.agilent.com/find/iolib`

Programming in C Using the VISA

The C programming examples that are provided are written using the C programming language and the Agilent (VISA library). This section includes some basic information about programming in the C language. Note that some of this information may not be relevant to your particular application. (For example, if you are not using VXI instruments, the VXI references will not be relevant).

Refer to your C programming language documentation for more details. The following topics are included:

Typical Example Program Contents

The following is a summary of the VISA function calls used in the example programs.

`visa.h` This file is included at the beginning of the file to provide the function prototypes and constants defined by VISA.

`ViSession` The `ViSession` is a VISA data type. Each object that will establish a communication channel must be defined as `ViSession`.

`viOpenDefaultRM` You must first open a session with the default resource manager with the `viOpenDefaultRM` function. This function will initialize the default resource manager and return a pointer to that resource manager session.

`viOpen` This function establishes a communication channel with the device specified. A session identifier that can be used with other VISA functions is returned. This call must be made for each device you will be using.

`viPrintf`
`viScanf` These are the VISA formatted I/O functions that are patterned after those used in the C programming language. For example, the `viPrintf` call sends the IEEE 488.2 `*RST` command to the instrument to put it in a known state. The `viPrintf` call is used again to query for the device identification (`*IDN?`). The `viScanf` call is then used to read the results.

`viClose` This function must be used to close each session. When you close a device session, all data structures that had been allocated for the session will be de-allocated. When you close the default manager session, all sessions opened using the default manager session will be closed.

Linking to VISA Libraries

Your application must link to one of the VISA import libraries:

32-bit Version:

`C:\VXIPNP\WIN95\LIB\MSC\VISA32.LIB` for Microsoft compilers

`C:\VXIPNP\WIN95\LIB\BC\VISA32.LIB` for Borland compilers

16-bit Version:

`C:\VXIPNP\WIN\LIB\MSC\VISA.LIB` for Microsoft compilers

`C:\VXIPNP\WIN\LIB\BC\VISA.LIB` for Borland compilers

See the following section, "Compiling and Linking a VISA Program" for information on how to use the VISA run-time libraries.

Compiling and Linking a VISA Program

32-bit Applications

The following is a summary of important compiler-specific considerations for several C/C++ compiler products when developing WIN32 applications.

For Microsoft Visual C++ version 2.0 compilers:

- Select `Project | Update All Dependencies` from the menu.
- Select `Project | Settings` from the menu. Click on the `C/C++` button. Select `Code Generation` from the `Use Run-Time Libraries` list box. VISA requires these definitions for WIN32. Click on `OK` to close the dialog boxes.
- Select `Project | Settings` from the menu. Click on the `Link` button and add `visa32.lib` to the `Object / Library Modules` list box. Optionally, you may add the library directly to your project file. Click on `OK` to close the dialog boxes.
- You may wish to add the include file and library file search paths. They are set by doing the following:
  1. Select `Tools | Options` from the menu.
  2. Click on the `Directories` button to set the include file path.
  3. Select `Include Files` from the `Show Directories For` list box.
  4. Click on the `Add` button and type in the following: `C:\VXIPNP\WIN95\INCLUDE`
  5. Select `Library Files` from the `Show Directories For` list box.
  6. Click on the `Add` button and type in the following: `C:\VXIPNP\WIN95\LIB\MSC`

For Borland C++ version 4.0 compilers:

- You may wish to add the include file and library file search paths. They are set under the `Options | Project` menu selection. Double click on `Directories` from the `Topics` list box and add the following:

  ```
  C:\VXIPNP\WIN95\INCLUDE
  C:\VXIPNP\WIN95\LIB\BC
  ```

16-bit Applications

The following is a summary of important compiler-specific considerations for the Windows compiler.

For Microsoft Visual C++ version 1.5:

- To set the memory model, do the following:
  1. Select `Options | Project`.
  2. Click on the `Compiler` button, then select `Memory Model` from the `Category` list.
  3. Click on the `Model` list arrow to display the model options, and select `Large`.
  4. Click on `OK` to close the `Compiler` dialog box.
- You may wish to add the include file and library file search paths. They are set under the `Options | Directories` menu selection:

  ```
  C:\VXIPNP\WIN\INCLUDE
  C:\VXIPNP\WIN\LIB\MSC
  ```

  Otherwise, the library and include files should be explicitly specified in the project file.

Example Program

This example program queries a LAN device for an identification string and prints the results. Note that you must change the address.

```
/*idn.c - program filename */

#include "visa.h"
#include <stdio.h>

void main ()
{
     /*Open session to LAN device at IP address 192.168.0.2
*/
     ViOpenDefaultRM (&defaultRM);
     ViOpen (defaultRM, "TCPIP0::192.168.0.2::inst0::INSTR",
VI_NULL,
       VI_NULL, &vi);

     /*Initialize device */
     viPrintf (vi, "*RST\n");

     /*Send an *IDN? string to the device */
     printf (vi, "*IDN?\n");

     /*Read results */
     viScanf (vi, "%t", &buf);

     /*Print results */
     printf ("Instrument identification string: %s\n", buf);

     /* Close sessions */
     viClose (vi);
     viClose (defaultRM);
}
```

Including the VISA Declarations File

For C and C++ programs, you must include the `visa.h` header file at the beginning of every file that contains VISA function calls:

```
#include “visa.h”
```

This header file contains the VISA function prototypes and the definitions for all VISA constants and error codes. The `visa.h` header file includes the `visatype.h` header file.

The `visatype.h` header file defines most of the VISA types. The VISA types are used throughout VISA to specify data types used in the functions. For example, the `viOpenDefaultRM` function requires a pointer to a parameter of type `ViSession`. If you find `ViSession` in the `visatype.h` header file, you will find that `ViSession` is eventually typed as an unsigned long.

Opening a Session

A session is a channel of communication. Sessions must first be opened on the default resource manager, and then for each device you will be using. The following is a summary of sessions that can be opened:

- A **resource manager session** is used to initialize the VISA system. It is a parent session that knows about all the opened sessions. A resource manager session must be opened before any other session can be opened.
- A **device session** is used to communicate with a device on an interface. A device session must be opened for each device you will be using. When you use a device session you can communicate without worrying about the type of interface to which it is connected. This insulation makes applications more robust and portable across interfaces. Typically a device is an instrument, but could be a computer, a plotter, or a printer.

NOTE All devices that you will be using need to be connected and in working condition prior to the first VISA function call (`viOpenDefaultRM`). The system is configured only on the *first* `viOpenDefaultRM` per process. Therefore, if `viOpenDefaultRM` is called without devices connected and then called again when devices are connected, the devices will not be recognized. You must close **ALL** resource manager sessions and re-open with all devices connected and in working condition.

Device Sessions

There are two parts to opening a communications session with a specific device. First you must open a session to the default resource manager with the `viOpenDefaultRM` function. The first call to this function initializes the default resource manager and returns a session to that resource manager session. You only need to open the default manager session once. However, subsequent calls to `viOpenDefaultRM` returns a session to a unique session to the same default resource manager resource.

Next, you open a session with a specific device with the `viOpen` function. This function uses the session returned from `viOpenDefaultRM` and returns its own session to identify the device session. The following shows the function syntax:

viOpenDefaultRM (*sesn*);

viOpen (*sesn*, *rsrcName*, *accessMode*, *timeout*, *vi*);

The session returned from `viOpenDefaultRM` must be used in the *sesn* parameter of the `viOpen` function. The `viOpen` function then uses that session and the device address specified in the *rsrcName* parameter to open a device session. The *vi* parameter in `viOpen` returns a session identifier that can be used with other VISA functions.

Your program may have several sessions open at the same time by creating multiple session identifiers by calling the `viOpen` function multiple times.

The following summarizes the parameters in the previous function calls:

sesn	This is a session returned from the `viOpenDefaultRM` function that identifies the resource manager session.
rsrcName	This is a unique symbolic name of the device (device address).
accessMode	This parameter is not used for VISA. Use VI_NULL.
timeout	This parameter is not used for VISA. Use VI_NULL.
vi	This is a pointer to the session identifier for this particular device session. This pointer will be used to identify this device session when using other VISA functions.

The following is an example of opening sessions with a GPIB multimeter and a spectrum analyzer on LAN:

```
ViSession defaultRM, dmm, sa;
.
.
viOpenDefaultRM(&defaultRM);
viOpen (defaultRM, "GPIB0::22::INSTR", VI_NULL,
    VI_NULL, &dmm);
viOpen (defaultRM, "TCPIP0::192.168.0.2::inst0::INSTR",
VI_NULL,
    VI_NULL, &sa);
.
.
viClose (sa);
viClose (dmm);
viClose(defaultRM);
```

The above function first opens a session with the default resource manager. The session returned from the resource manager and a device address is then used to open a session with the GPIB device at address 22. That session will now be identified as **dmm** when using other VISA functions. The session returned from the resource manager is then used to open a session with the LAN device at IP Address 192.168.0.2. That session will now be identified as **sa** when using other VISA functions. See the following section for information on addressing particular devices.

Addressing a Session

As seen in the previous section, the *rsrcName* parameter in the `viOpen` function is used to identify a specific device. This parameter is made up of the VISA interface name and the device address. The interface name is determined when you run the VISA Configuration Utility. This name is usually the interface type followed by a number. The following table illustrates the format of the *rsrcName* for the different interface types:

Interface	**Syntax**
VXI	VXI [*board*]::*VXI logical address*[::INSTR]
GPIB-VXI	GPIB-VXI [*board*]::*VXI logical address*[::INSTR]
GPIB	GPIB [*board*]::*primary address*[::*secondary address*][::INSTR]
TCPIP	TCPIP [*board*]::*host address*[::*LAN device name*]::INSTR

The following describes the parameters used above:

board — This optional parameter is used if you have more than one interface of the same type. The default value for *board* is 0.

VSI logical address — This is the logical address of the VXI instrument.

primary address — This is the primary address of the GPIB device.

secondary address — This optional parameter is the secondary address of the GPIB device. If no secondary address is specified, none is assumed.

host address — The IP address (in dotted decimal notation) or the name of the host computer/gateway.

LAN device name — The assigned name for a LAN device. The default is inst().

INSTR — This is an optional parameter that indicates that you are communicating with a resource that is of type **INSTR**, meaning instrument.

NOTE If you want to be compatible with future releases of VISA and VISA, you must include the INSTR parameter in the syntax.

The following are examples of valid symbolic names:

XI0::24::INSTR — Device at VXI logical address 24 that is of VISA type INSTR.

VXI2::128 — Device at VXI logical address 128, in the third VXI system (VXI2).

GPIB-VXI0::24 — A VXI device at logical address 24. This VXI device is connected via a GPIB-VXI command module.

GPIB0::7::0 A GPIB device at primary address 7 and secondary address 0 on the GPIB interface.

TCPIP::devicename@company.com::INSTR
A TCPIP device using VXI-11 located at the specified address. This uses the default LAN Device Name of inst0.

The following is an example of opening a device session with the GPIB device at primary address23.

```
ViSession defaultRM, vi;

.
.

viOpenDefaultRM (&defaultRM);

viOpen (defaultRM, "GPIB0::23::INSTR", VI_NULL,VI_NULL,&vi);

.
.

viClose(vi);

viClose (defaultRM);
```

Closing a Session

The `viClose` function must be used to close each session. You can close the specific device session, which will free all data structures that had been allocated for the session. If you close the default resource manager session, all sessions opened using that resource manager will be closed.

Since system resources are also used when searching for resources (`viFindRsrc`) or waiting for events (`viWaitOnEvent`), the `viClose` function needs to be called to free up find lists and event contexts.

13 Connector Care

This chapter contains the following topics on care of your Agilent CSA connectors:

Using, Inspecting, and Cleaning RF Connectors

Taking proper care of cables and connectors will protect the ability of your analyzer to make accurate measurements. Inaccurate measurements often result from improperly made connections or dirty or damaged connectors. Worn, out-of-tolerance, or dirty connectors degrade the accuracy and repeatability of measurements.

Repeatability

If you make two identical measurements with your analyzer, the differences should be so small that they do not affect the value of the measurement. Repeatability (the amount of similarity from one measurement to another of the same type) can be affected by:

- Dirty or damaged connectors
- Connections that have been made without using proper torque techniques (this applies primarily when connectors in the analyzer have been disconnected, then reconnected)

CAUTION This analyzer contains devices that are static-sensitive. Always take proper electrostatic precautions before touching the center conductor of any connector, or the center conductor of any cable that is connected to the analyzer.

RF Cable and Connector Care

Connectors are the most critical link in a precision measurement. These devices are manufactured to extremely precise tolerances and must be used and maintained with care to protect the measurement accuracy and repeatability of your analyzer.

To Extend the Life of Your Cables or Connectors:

- Avoid repeated bending of cables—a single sharp bend can ruin a cable instantly.
- Avoid repeated connection and disconnection of cable connectors.
- Inspect the connectors before connection; look for dirt, nicks, and other signs of damage or wear. A bad connector can ruin the good connector instantly.
- Clean dirty connectors. Dirt and foreign matter can cause poor electrical connections and may damage the connector.
- Minimize the number of times you bend cables.
- Never bend a cable at a sharp angle.
- Do not bend cables near the connectors.
- If any of the cables will be flexed repeatedly, buy a back-up cable. This will

allow immediate replacement and will minimize your analyzer’s down time.

Before Connecting the Cables to Any Device:

- Check all connectors for wear or dirt.
- When making the connection, torque the connector to the proper value.

Proper Connector Torque

- Provides more accurate measurements
- Keeps moisture out the connectors
- Eliminates radio frequency interference (RFI) from affecting your measurements

The torque required depends on the type of connector. Refer to Table 13-1. Do not overtighten the connector.

CAUTION Never exceed the recommended torque when attaching cables.

Table 13-1 Proper Connector Torque

Connector	Torque cm-kg	Torque N-cm	Torque in-lbs	Wrench part number
Type-N	52	508	45	8710-1935
3.5 mm	9.2	90	8	8710-1765
SMA	5.7	56	5	8710-1582

Connector Wear and Damage

Look for metal particles from the connector threads and other signs of wear (such as discoloration or roughness). Visible wear can affect measurement accuracy and repeatability. Discard or repair any device with a damaged connector. A bad connector can ruin a good connector on the first mating. A magnifying glass or jeweler’s loupe is useful during inspection.

Cleaning Procedure

1. Blow particulate matter from connectors using an environmentally-safe aerosol such as Ultrajet. This product is recommended by the United States Environmental Protection Agency and contains chlorodifluoromethane.
2. Use an alcohol wipe to wipe connector surfaces. Wet a small swab with alcohol (from the alcohol wipe) and clean the connector with the swab.

WARNING **Use alcohol in a well ventilated area and allow adequate time for fumes to**

disperse and moist alcohol to evaporate.

3. Allow the alcohol to evaporate off the connector before making connections

CAUTION Do not allow excessive alcohol to run into the connector. Excessive alcohol entering the connector collects in pockets in the connector's internal parts. The liquid will cause random changes in the connector's electrical performance. If excessive alcohol gets into a connector, lay it aside to allow the alcohol to evaporate. This may take up to three days. If you attach that connector to another device it can take much longer for trapped alcohol to evaporate.

14 In Case of Difficulty

This chapter includes information on how to check for a problem with your Agilent Technologies spectrum analyzer, and how to return it for service.

If you experience a problem or would like additional information about your analyzer, Agilent Technologies' worldwide organization is ready to provide the support you need. Before calling Agilent Technologies, however (or returning an analyzer for service), perform the quick checks listed in "Check the Basics" on page 228. This check may eliminate the problem.

If a problem persists, you may choose to:

- Repair the analyzer yourself. See "Service Options" on page 229.
- Return the analyzer to Agilent Technologies for repair. See "Returning an Analyzer for Service" on page 231, for more information.

WARNING **No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock, do not remove covers.**

NOTE If the analyzer is still under warranty or is covered by a maintenance contract, it will be repaired under the terms of the warranty or plan (the warranty is located in the Specifications Guide).

If the analyzer is no longer under warranty or is not covered by an Agilent Technologies maintenance plan, Agilent Technologies will notify you of the cost of the repair after examining the analyzer.

Types of Spectrum Analyzer Messages

The analyzer can generate various messages that appear on the display during operation.

For a complete list of spectrum analyzer messages, see the Instrument Messages and Functional Tests manual. The following table describes the three types of spectrum analyzer messages.

Table 14-1 **Types of Messages**

Type of Message	Location	Notes
Informational messages typically provide verification that an action has occurred. In general, no user intervention is required.	Bottom of the display in the status line.	Messages will remain until the message is cleared by pressing **Esc** or it is overwritten by another message.
Status messages indicate a condition that may result in erroneous data being displayed. Multiple status messages may be displayed at the same time.	Bottom of the display in the status line and/or in the SCPI Status Register system.	Messages in the display status line will remain until the message is cleared by pressing **Esc** or it is overwritten by another message.
User Error messages appear when an attempt has been made to set a parameter incorrectly or an operation has failed (such as saving a file).	Bottom of the display in the status line and in the SCPI Error Queue.	Messages in the display status line will remain until you clear the error or another message is displayed in the status line. Pressing the **Esc** key will clear error messages from the display, but the messages will remain in the error queue.

Before Calling Agilent Technologies

Check the Basics

- Is there power at the receptacle?
- Is the analyzer turned on? Check to see if the green LED above the power switch is on. Also, listen for internal fan noise to determine if the analyzer cooling fan is running.
- If other equipment, cables, and connectors are being used with your spectrum analyzer, make sure they are connected properly and operating correctly.
- Review the measurement procedures being performed when the problem first appeared. Are all of the settings correct?
- If the analyzer is not functioning as expected, return the analyzer to a known state by pressing **Mode Preset**.
- Is the measurement being performed, and the results that are expected, within the specifications and capabilities of the analyzer? Refer to the Specifications guide for your analyzer.

NOTE The analyzer must be powered on with the LAN already connected in order to recognize the LAN port.

- Is the analyzer displaying an error message? If so, refer to the Instrument Messages and Functional Tests guide.
- If the necessary equipment is available, perform the functional tests in the Instrument Messages and Functional Tests guide for your analyzer.

TIP You can get automatic electronic notification of new firmware releases and other product updates/information by subscribing to the *Agilent Technologies Test & Measurement E-Mail Notification Service* for the Agilent CSA Series analyzers at: http://www.agilent.com/find/emailupdates

Read the Warranty

The warranty for your analyzer is in the front of your Specifications Guide. Please read it and become familiar with its terms.

If your analyzer is covered by a separate maintenance agreement, please be familiar with its terms.

Service Options

Agilent Technologies offers several optional maintenance plans to service your analyzer after the warranty has expired. Call your Agilent Technologies office for full details.

If you want to service the analyzer yourself after the warranty expires, you can purchase the service documentation that provides all necessary test and maintenance information.

You can order the service documentation, *Option 0BW* (assembly level troubleshooting) through your Agilent Technologies office.

You can order calibration software N7813A. This provides performance verification and calibration software. In addition, you will need to purchase a license for each Agilent CSA with which you will use the software.

Calling Agilent Technologies

Agilent Technologies has offices around the world to provide you with complete support for your analyzer.

For help with product selection and configuration, technical and application assistance, consulting and integration services, rental and leasing options, refurbished equipment, product purchases, education and training, and obtaining servicing information (including order replacement parts repair, or calibration), contact the nearest Agilent Technologies office by going to http://www.agilent.com/find/assist or refer to the numbers listed in Table 14-2 on page 230.

In any correspondence or telephone conversations, refer to your analyzer by its product number, full serial number, and firmware revision. To obtain the serial number, firmware revision, Host identification information, and IP address press **Mode** and view the information displayed on the screen. (A serial number label is also attached to the rear panel of the analyzer.)

Table 14-2 **Contacting Agilent Technologies**

Online assistance: http://www.agilent.com/find/assist

Americas (tel) 1 800 829 4444 (fax) 1 800 829 4433		**New Zealand** (tel) 64 4 939 0636 (fax) 64 4 972 5364
Canada (tel) 1 877 894 4414 (fax) 1 800 746 4866	**Japan** (tel) 0120 421 345 (fax) 0120 421 678	
Europe (tel) 31 (0) 20 547 2111 (fax) 31 (0) 20 547 2190	**Australia** (tel) 1 800 629 485 (fax) 1 800 142 134	**Africa, Middle East** (tel) 32 (0) 2 404 9340 (fax) 32 (0) 2 404 9395

Returning an Analyzer for Service

NOTE Please notify Agilent Technologies before returning your system for service. Any special arrangements for the system can be discussed at this time. This will help Agilent Technologies repair and return your system as quickly as possible.

NOTE For specific analyzer packing instructions, refer to "Preparing the Analyzer for Shipping" on page 232.

Adjustment, Maintenance, or Repair of the Analyzer

Any adjustment, maintenance, or repair of the N1996A Series Analyzer must be performed by qualified personnel. Contact your customer engineer through your local Agilent Technologies Service Center. You may contact Agilent through the Internet or by telephone. For contact information refer to "Calling Agilent Technologies" on page 229.

Service Tag

When you are returning an analyzer to Agilent Technologies for service, fill out and attach one of the blue service tags provided at the end of this chapter. Please be as specific as possible about the nature of the problem. If you have recorded any error messages that appeared on the display, have completed a functional test, or have any other specific data on the performance of your analyzer, please include a copy of this information.

Write a complete description of the failure and attach it to the system. Include any specific performance details related to the problem. The following information should be returned with the system:

- Type of service required
- Date system was returned for repair
- Description of the problem:
  - Whether problem is constant or intermittent
  - Whether system is temperature-sensitive
  - Whether system is vibration sensitive
  - System settings required to reproduce the problem
  - Error Code
  - Performance data
- Company Name and return address
- Name and phone number of technical contact person
- Model number of returned system
- Full serial number of returned system
- List of any accessories returned with the system

Packaging

CAUTION Cover electrical connectors to protect sensitive components from electrostatic damage.

Spectrum analyzer damage can result from using packaging materials other than the original materials.

Never use styrene pellets in any shape as packaging materials. They do not adequately cushion the equipment or prevent it from shifting in the carton. They cause equipment damage by generating static electricity and by lodging in the analyzer louvers, blocking airflow.

Original Packaging

When an analyzer is returned to Agilent Technologies for servicing, it must be adequately packaged (see “Preparing the Analyzer for Shipping” on page 232) and have a complete description of the failure symptoms attached.

Before shipping, pack the unit in the original factory packaging materials if they are available. If the original materials were not retained, see “Other Packaging” (below).

Other Packaging

You can repackage the analyzer with commercially available materials. If using alternative packing material, observe the following material requirements and follow the shipping procedure given in “Preparing the Analyzer for Shipping” on page 232.

- Use a strong shipping container. The carton must be both large enough and strong enough to accommodate the analyzer. A double-walled, corrugated cardboard carton with 159 kg (350 lb) bursting strength is adequate. Allow at least 3 to 4 inches on all sides of the analyzer for packing material.
- Surround the equipment with three to four inches of packing material and prevent the equipment from moving in the carton. If packing foam is not available, the best alternative is S.D.-240 Air Cap™ from Sealed Air Corporation (Hayward, California, 94545). Air Cap looks like a plastic sheet filled with 1-1/4 inch air bubbles. Use the pink-colored Air Cap to reduce static electricity. Wrapping the equipment several times in this material should both protect the equipment and prevent it from moving in the carton.

Preparing the Analyzer for Shipping

1. Attach a completed service tag to the analyzer. Refer to “Service Tag” on page 231.
2. Pack the system in the original shipping containers. Original materials are available through Agilent Technologies office.

3. Wrap the system in anti-static plastic to reduce the possibility of damage caused by electrostatic discharge.
4. Seal the carton with strong nylon adhesive tape.
5. Mark the shipping container "**FRAGILE, HANDLE WITH CARE**" to ensure careful handling
6. Retain copies of all shipping papers.

15 Copyright Information

Where to Find Additional Copyright Information

Additional Copyright information is available on the Documentation CD-ROM and in the front matter of this manual.

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