Series MS278XA High Performance Signal Analyzer

Operation Manual

Notice

This manual and the MS278XA Programming Manual, along with other product literature, are installed in the MS278XA as an Adobe Acrobat file.

490 JARVIS DRIVE
MORGAN HILL, CA 95037-2809

P/N: 10410-00252
REVISION: C
PRINTED: APRIL 2006

Series
MS278XA
High Performance Signal Analyzer

Addendum to Operation Manual

This addendum contains information about critical Windows XP settings that were not available during the initial publication of the Signature Operation Manual, 10410-00252, Revision C. Subsequent revisions of the Operation Manual will include this information, obsoleting this addendum.

This addendum describes various aspects of the instrument outside of the main Signature application software (Signature Graphical User Interface). It specifically addresses configurations and properties of the “open” Windows XP environment that are set at the factory, additional option descriptions, along with user sensitive data and applications.

Windows XP Configuration
Changing some of the default Windows XP settings may cause a loss of instrument control or undesired instrument behavior. Changing the Windows **Regional and Language Options** settings may cause unstable front panel operation. These settings must be maintained as **English (United States)** as is set at the factory by default.

User Installed Applications and Data
If Signature requires service or calibration, the system may be returned to factory specifications and reimaged with a standard software configuration. User installed applications and data may be lost and unable to be retrieved. It is advised that user data be backed up or copied and retained by the user. Applications will need to be reinstalled from their original installation disks. A complete system restore from a previous user backup is not advised after service or calibration as this will result in the new calibrations being overwritten, thus voiding the calibration accuracy.

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P/N: 10900-00339
REVISION: C
PRINTED: APRIL 2006

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DECLARATION OF CONFORMITY

Manufacturer's Name: ANRITSU COMPANY

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

declares that the product specified below:

Product Name: Spectrum Analyzer

Model Number: MS2781A

conforms to the requirement of:

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

Electromagnetic Interference:

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

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

Electrical Safety Requirement:

Product Safety: EN 61010-1:2001

Corporate Quality Director

Morgan Hill, CA

29 Sept 2004
Date

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

Table of Contents

Chapter 1— General Information

Table of Contents (Continued)

Chapter 2— Installation

Chapter 3— Front Panel Overview

Chapter 4— Front Panel Menus

Table of Contents (Continued)

Table of Contents (Continued)

Chapter 7— Software Peripherals

Chapter 8— Remote Operation

Appendix A— Performance Specifications

Subject Index

Safety Symbols

To prevent the risk of personal injury or loss related to equipment malfunction, Anritsu Company uses the following symbols to indicate safety-related information. For your own safety, please read the information carefully *before* operating the equipment.

Symbols Used in Manuals

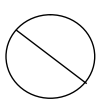
Danger: This indicates a very dangerous procedure that could result in serious injury or death, or loss related to equipment malfunction, if not performed properly.

Warning: This indicates a hazardous procedure that could result in light-to-severe injury or loss related to equipment malfunction, if proper precautions are not taken.

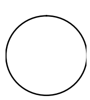
Caution: This indicates a hazardous procedure that could result in loss related to equipment malfunction if proper precautions are not taken.

Safety Symbols Used on Equipment and in Manuals

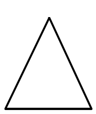
The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions *before* operating the equipment. Some or all of the following five symbols may or may not be used on all Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.



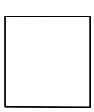
This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.



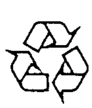
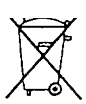
This indicates a compulsory safety precaution. The required operation is indicated symbolically in or near the circle.



This indicates a warning or caution. The contents are indicated symbolically in or near the triangle.



This indicates a note. The contents are described in the box.

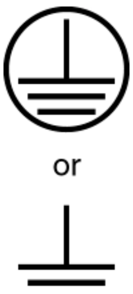



These indicate that the marked part should be recycled.

For Safety

Warning: Always refer to the operation manual when working near locations at which the alert mark, shown on the left, is attached. If the operation, etc., is performed without heeding the advice in the operation manual, there is a risk of personal injury. In addition, the equipment performance may be reduced.

Moreover, this alert mark is sometimes used with other marks and descriptions indicating other dangers.



Warning: When supplying power to this equipment, connect the accessory 3-pin power cord to a 3-pin grounded power outlet. If a grounded 3-pin outlet is not available, use a conversion adapter and ground the green wire, or connect the frame ground on the rear panel of the equipment to ground. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock.

Warning: This equipment can not be repaired by the operator. *Do not* attempt to remove the equipment covers or to disassemble internal components. Only qualified service technicians with a knowledge of electrical fire and shock hazards should service this equipment. There are high-voltage parts in this equipment presenting a risk of severe injury or fatal electric shock to untrained personnel. In addition, there is a risk of damage to precision components.

Warning: Use two or more people to lift and move this equipment, or use an equipment cart. There is a risk of back injury if this equipment is lifted by one person.

Caution: Electrostatic Discharge (ESD) can damage the highly sensitive circuits in the instrument. ESD is most likely to occur as test devices are being connected to, or disconnected from, the instrument's front and rear panel ports and connectors. You can protect the instrument and test devices by wearing a static-discharge wristband. Alternatively, you can ground yourself to discharge any static charge by touching the outer chassis of the grounded instrument before touching the instrument's front and rear panel ports and connectors. Avoid touching the test port center conductors unless you are properly grounded and have eliminated the possibility of static discharge.

Repair of damage that is found to be caused by electrostatic discharge is not covered under warranty.

Chapter 1
General Information

Table of Contents

Figure 1-1. Signature Series MS278XA Signal Analyzer

Chapter 1
General Information

1-1 Scope of This Manual

This manual provides general information, installation, and operating information for the model MS278XA High Performance Spectrum/Vector Signal Analyzer (SPA/VSA), Signature™. Manual organization is shown in the table of contents.

1-2 Introduction

This chapter provides general information about the MS278XA. It includes a general description of the analyzer and information on its identification number, related manuals, options, and performance specifications. This chapter also provides preventative maintenance and customer service information.

1-3 Related Manuals

This manual is one of a three part series containing the following:

- Operation Manual Part Number: 10410-00252
- Programming Manual Part Number: 10410-00253
- Maintenance Manual Part Number: 10410-00256

1-4 Online Information

The MS278XA manual set is installed on the analyzer's hard drive as an Adobe Acrobat™ (*.pdf) file. The file can be viewed on the analyzer's front panel display using Acrobat Reader™. The file is "linked" such that you can choose a topic to view from the displayed "bookmark" list and "jump" to the page on which the topic resides. The text can also be word-searched.

The MS2781A is also equipped with online Help called *Signature Help System*. The Help system is integrated into the product software making it context sensitive to front panel actions as well as providing full context search, advanced navigation controls, and custom bookmarking capabilities. The Signature Help System can also run independent of the product and is included on the Signature Manuals CD-ROM.

Updates to this document set can be downloaded from the Documents area of the Anritsu Internet site: http://www.us.anritsu.com.

1-5 Instrument Description

The Signature Signal Analyzer is a single instrument that integrates state-of-the-art spectrum, vector signal and digital modulation analysis into one easy to use instrument. It incorporates the following capabilities:

- Highly accurate spectrum measurements covering the range of 100 Hz to 8 GHz in a single band
- Vector measurements of modulated signals up to 30 MHz bandwidth
- Modulation and signal quality measurements of cellular and WLAN signals at the press of a button
- Multiple sweep and detector modes available in a single multi-trace setup
- Easy to use, customizable Microsoft Windows based User Interface
- Custom waveform and signal analysis using on board direct data linking to MATLAB® and Simulink® tools
- Control of external signal sources and other instruments via SCPI, IEEE488.2, and Web Services
- Remote Control via a Local Area Network or the Internet
- Ability to run user applications and device drivers on its embedded PC

The advanced design of the Anritsu Signature Signal Analyzer features the following innovations:

- RF/analog architecture optimized for maximum dynamic range, high accuracy, and operation to 8 GHz in a single band
- Exclusive low conversion loss mixer technology
- Exclusive 2 dB per step impedance-matched input attenuator
- Advanced design digital phase-lock loop local oscillator technology for maximum stability and sweep speed with lowest phase noise and spurious signals
- Upgradeable open architecture for lowest total cost of ownership
- Field replaceable, pre-calibrated functional modules
- Digital FPGA technology for maximum performance and ease of upgrade
- Industry standard, obsolescence-proof Compact PCI digital modules
- Improved reliability through an advanced, low ambient noise thermal management system

RF/Analog Architecture

The RF/analog architecture of the Signature Signal Analyzer is designed to maximize performance over a wide frequency and dynamic range. Signature's basic RF/analog block diagram is shown in Figure 1-2, below:

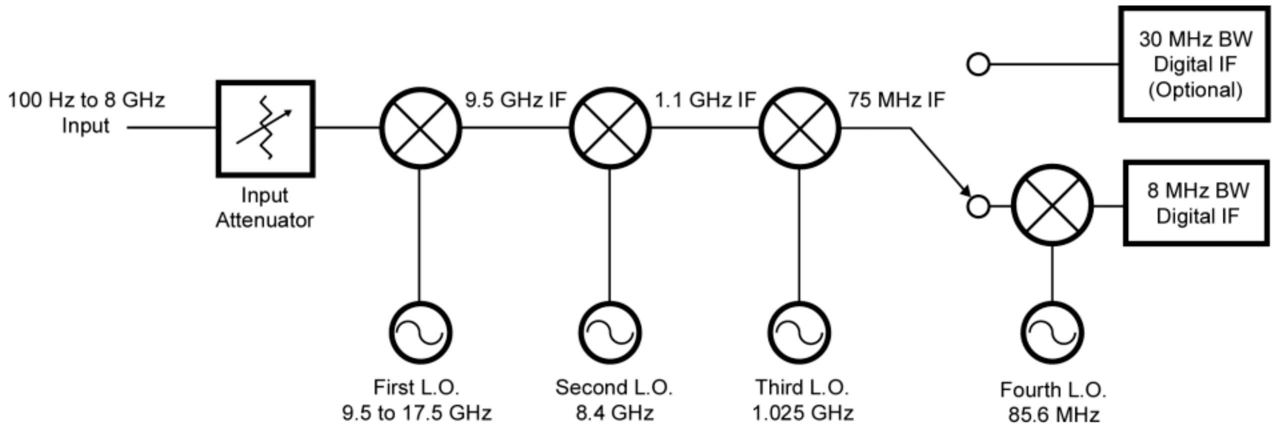


Figure 1-2. Basic Signature RF/Analog Block Diagram

The input signal, from either the internal 50 MHz calibrator or the test port input, is routed through the input attenuator and then to the first mixer where it is converted to the first IF frequency of 9.5 GHz. This allows the entire range of 100 Hz to 8 GHz to be covered in a single band without the need for prescaling. The signal is then down-converted in the second mixer to 1.1 GHz. The frequencies of both the first and second local oscillators can be adjusted to avoid any possible spurious response. In the third mixer, the signal is converted to 75 MHz. While the system's pass bandwidth up to this point has been maintained at greater than 100 MHz, the signal path is now routed to either a wideband 75 MHz IF section, used exclusively for vector signal analysis, or a lower bandwidth 10.7 MHz IF section, used for spectrum analysis and low bandwidth signal analysis. While there are prefilters in the RF/analog section, the task of shaping the IF bandwidth is left mainly to the digital section, where advanced DSP technology can be used.

Digital Architecture

The digital architecture of the Signature Signal Analyzer is built around an industry-standard Compact PCI based embedded PC. The PC section handles all control, data management, display, and user interface aspects of the instrument's operation. In addition to the embedded PC, two specialized modules play important roles in the instrument's operation:

- The Digital IF Module employs a state-of-the-art FPGA (Field Programmable Gate Array) to perform IF bandwidth filtering, detection, and data formatting, as well as providing the heartbeat for the real-time data acquisition circuitry.
- The optional 30 MHz Wideband IF Module employs an advanced design analog-to-digital conversion circuit working in conjunction with an LSI based digital signal processing section to capture large contiguous samples of wideband I/Q data for analysis.

These two modules pass data to the embedded PC for further processing, display, storage or transmission to external devices.

Software Architecture

The operating software of the Signature Signal Analyzer is based on the Microsoft® .Net platform and takes full advantage of the Windows® XP Professional operating system. All of the user interface constructs are based on the Windows model so that a new user who is familiar with Windows applications can learn to operate the instrument very quickly.

The fact that the Signature's main software is a Windows application also means that users can write their own programs in languages such as Visual Basic to run on the embedded PC and customize the operation of the instrument. Commercially available software, such as Microsoft Office and MATLAB from The MathWorks, can also interact with the instrument's programming and measurement data.

In order to maximize the responsiveness of the system, additional control programs run on dedicated microcomputers in most of the system's modules. These programs receive their instructions from the embedded PC through an internal network, but can operate autonomously to provide high speed hardware real-time control. This approach frees the instrument from the inherent response time limitations of the Windows-based PC while improving flexibility and measurement speed.

When used as a standalone instrument, the 8 GHz analyzer can perform the following measurements:

- All typical spectrum analysis, including channel power, carrier to noise ratio, conformance to spectral mask, peak signal frequency, and amplitude
- All typical vector signal measurements, such as constellation and vector plots, carrier leakage, I/Q imbalance, and quadrature error
- Smart one-button measurements such as ACPR, signal bandwidth, EVM (error vector magnitude), and BER (bit error rate)

When configured with one external source, the 8 GHz analyzer can perform the following network measurements:

- Frequency Response
- Return Loss
- Group Delay
- 1 dB Compression

When configured with two external sources, the 8 GHz analyzer can perform the same set of measurements, as well as perform the following network measurements:

- Conversion Loss
- Group Delay (frequency translating devices)
- Intermodulation Distortion
- 2^{nd} Order Intercept
- 3^{rd} Order Intercept

External Interfaces

In addition to the visible front panel interfaces, the MS278XA provides the following device interfaces:

- **IEEE488.2 GPIB:** Connects the MS278XA to an external controller for remote programming. This interface is detailed in the MS278XA Programming Manual, Part Number: 10410-00253.
- **Printer:** Provides a connection for printers with Parallel (Centronics) interfaces.
- **XGA Output:** Provides an Extended Graphics Array connector for an external monitor.
- **PS/2 Keyboard and Mouse:** Provides for the use of an external PS/2 keyboard and mouse.
- **Ethernet:** Provides network interface and control of the MS278XA. This interface is detailed in the MS278XA Programming Manual, Part Number: 10410-00253.
- **USB:** Provides Type A USB ports on the front and rear panel to connect most USB compatible devices.

Identification Number

All Anritsu instruments are assigned a unique six-digit ID number, such as “040101.” This number is affixed to a decal on the rear panel of each unit. In any correspondence with Anritsu customer service, please use this number.

1-6 Conventions

Throughout this manual, the terms *MS278XA* and *analyzer* will be used interchangeably to refer to the instrument. The term DUT is used in place of *device under test*.

Path names may be used to represent the keystrokes and button presses for a desired action or procedure. The path name generally begins with a front panel key, keyboard key, or main menu icon selection followed by additional sub-menu selections, each separated by a vertical line (|). Front panel key names and menu selections are presented in the manual as they are on the system, that is in initial caps, all uppercase letters, or with symbols as appropriate.

Note: In cases where a sub-menu is automatically expanded by accessing the main menu, the path still shows that sub-menu as part of the selection.

1-7 Environmental Specifications

The MS278XA environmental specifications are listed below:

Table 1-1. MS278XA Environmental Specifications

Storage Temperature Range:	–40 to +75 degrees Celsius
Operating Temperature Range:	0 to +50 degrees Celsius (per MIL-PRF-28800F)
Relative Humidity (operational):	5% to 95% (per MIL-PRF-28800F)
Altitude (operational):	4,600 meters, 43.9 cm Hg
Vibration:	Sinusoidal 5 Hz to 55 Hz on 3 axes (operational)
	Random 10 Hz to 500 Hz on 3 axes (non-operational)
Shock (non-operational):	30g for 11 msec on 3 axes
Bench Drop (operational):	4 inches on 4 surfaces and 4 edges
Shipment Protection (non-operational):	6 surfaces and 4 corners from 36 inches high to concrete floor

EMI Compatibility

The MS278XA meets the following EMI (emissions and immunity) requirements:

- EN61326:1998
- EN55011:1998/CISPR-11: 1997 Group 1 Class A
- EN61000-3-2:1995 +A14
- EN61000-3-3:1995
- EN 61000-4-2:1995—4kV CD, 8kV AD
- EN 61000-4-3:1997—3V/m
- EN 61000-4-4:1995—0.5kV SL, 1kV PL
- EN 61000-4-5:1995—0.5kV DM, 1kV CM
- EN 61000-4-6:1996—3V
- EN 61000-4-11:1994—100%/1 cycle

Safety

The MS278XA meets the following safety requirements for Low Voltage/Safety Standard: 72/73/EEC—EN61010-1: 2001.

1-8 Installed Options

Table 1-2 lists Signature's options with a brief description.

Table 1-2. Signature Options List

Option Number	Option Description
Option 1	Rack Mount Adapter
Option 1A	Slide Mount Adapter
Option 3	GPIB Interface
Option 22	30 MHz IF Bandwidth (includes baseband differential I & Q inputs)
Option 38	QAM/PSK modulation analysis (requires Option 22)
Option 40	MATLAB Connectivity
Option 98	Z540/ISO Guide 25 Calibration
Option 99	Premium Calibration
ES50MMD	Extends Warranty to 5 Years

1-9 Optional Accessories

Signature can be configured with the following optional accessories:

Table 1-3. Signature Optional Accessories

Part Number	Description
10410-00254	Signature Maintenance Manual (Hard Copy)
1N50B	Limiter/DC Block, N(m) to N(f), 50Ω, 1 MHz to 3 GHz
1N50C	Limiter, N(m) to N(f), 50Ω, 10 MHz to 18 GHz
42N50A-30	30 dB Attenuator, 50 Watt N(m) to N(f)
12N50-75B	75Ω Matching Pad, DC to 3 GHz, 50Ω, N(m) to 75Ω N(f)
11N50B	Power Divider, 1 MHz to 3 GHz, 50Ω, N(f) Input, N(f) Output
2100-1	GPIB Cable, 1M
2100-2	GPIB Cable, 2M
70-28	Headset

1-10 Performance Specifications

Performance specifications can be found in Appendix A, located at the back of the Signature operation manual. Updates can be downloaded from the Documents area of the Anritsu Internet site: http://www.us.anritsu.com.

1-11 Preventive Maintenance

Routine maintenance that can be performed by the operator consists of cleaning the data display and replacing a defective line fuse.

Cleaning the Touch Screen

The touch screen is protected by a plastic display filter. To clean the display filter, dampen a soft cloth with a mild soap and water solution, or a commercial window cleaner. Do not use abrasive cleaners, tissues, or paper towels that can scratch the plastic surface. Gently wipe the display filter to clean.

Replacing the Line Fuses

The line fuses used in the MS278XA are 6.3A, type T fuses. The line fuse values are printed on the rear panel next to the power connector. Always use a new fuse of the type and rating specified by the fuse markings on the rear panel of the instrument. To replace the line fuses, follow the procedure below.

> **Danger:** Before changing the fuse, always remove the power cord from the power outlet. There is the risk of receiving a fatal electric shock if the fuse is replaced with the power cord connected.

Step 1. Set the MS278XA to standby mode using the power button and disconnect the power cord from the rear panel power receptacle.

Step 2. Using a small flat-blade screwdriver, carefully pry under the tab next to the rear panel power receptacle to open the fuse block cover and gain access to the fuse holder, see Figure 1-3, below.

Figure 1-3. Replacing the Rear Panel Fuse

Refer to Figure 1-4, below, during the following steps:

Step 3. Slide out the fuse holder.

Step 4. Replace the fuse in the fuse holder.

Step 5. Install the fuse holder back into the rear panel fuse block.

Step 6. Close the cover to secure the fuse holder in place. The cover will close with an audible snap.

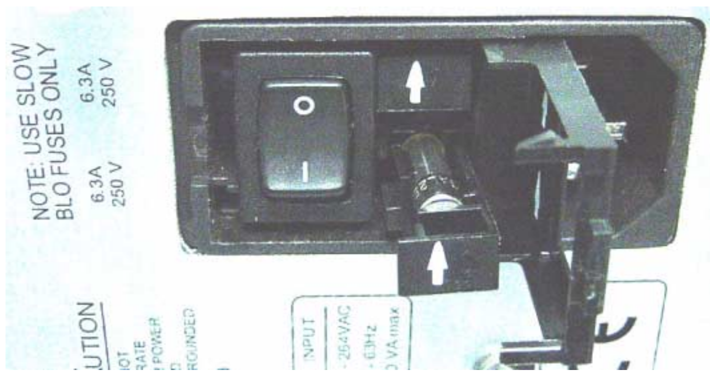


Figure 1-4. Replacing the Rear Panel Fuse

Step 7. Reconnect the analyzer to the power source and set the MS278XA to Operate using the front panel power button.

Internal Battery

The MS278XA has a Lithium battery installed on the CPU assembly. Battery replacement should be referred to an authorized Anritsu service center (refer to Table 1-4).

1-12 Preparation for Storage and Shipment

The following paragraphs give instructions for preparing the MS278XA for storage or shipment.

Preparation for Storage

Preparing the analyzer for storage consists of cleaning the unit, packing the inside of the storage container with moisture-absorbing desiccant crystals, and storing the unit in a temperature controlled environment that is maintained between –40°C and +75°C.

Preparation for Shipment

To provide maximum protection against damage in transit, the analyzer should be repackaged in the original shipping container. If this container is no longer available and the unit is being returned to Anritsu for repair, advise Anritsu Customer Service; they will send a new shipping container free of charge. In the event neither of these two options is possible, instructions for packaging and shipment are given below.

Use a Suitable Container

Obtain a corrugated cardboard carton with a 125 kg test strength. This carton should have inside dimensions of no less than 15 cm larger than the unit dimensions to allow for cushioning.

Protect the Instrument

Surround the unit with polyethylene sheeting to protect the finish.

Cushion the Instrument

Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the unit. Provide at least three inches of dunnage on all sides.

Seal the Container

Seal the carton by using either shipping tape or an industrial stapler.

Address the Container

If the instrument is being returned to Anritsu for service, mark the address of the appropriate Anritsu service center, see Table 1-4 on page 1-14, and your return address on the carton in one or more prominent locations.

1-13 Anritsu Customer Service Centers

Table 1-4, below, lists the contact information for Anritsu service centers around the world.

Table 1-4. Anritsu Customer Service Centers

UNITED STATES	FRANCE	JAPAN
ANRITSU COMPANY 490 Jarvis Drive Morgan Hill, CA 95037-2809 Telephone: 1-800-ANRITSU FAX: 408-776-1744	ANRITSU U.S.A. 9 Avenue du Quebec Zone de Courtaboeuf 91951 Les Ulis Cedex Telephone: 016-09-21-550 FAX: 016-44-61-065	ANRITSU CUSTOMER SERVICE LTD. 5-1-1 Onna Atsugi-shi Kanagawa-Prf. 243 Japan Telephone: 046-296-6688 FAX: 046-225-8379
	GERMANY	**SINGAPORE**
ANRITSU COMPANY 10 New Maple Ave., Unit 305 Pine Brook, NJ 07058 Telephone: 1-800-ANRITSU FAX: 201-575-0092	ANRITSU GmbH Konrad-Zuse-Platz 1 Muenchen 81829 Germany Telephone: 089-442308-0 FAX: 089-442308-55	ANRITSU (SINGAPORE) PTE LTD. 10, Hoe Chiang Road #07-01/02 Keppel Towers Singapore 089315 Telephone: 6-282-2400 FAX: 6-282-2533
	INDIA	**SOUTH AFRICA**
ANRITSU COMPANY 1155 E. Collins Blvd Richardson, TX 75081 Telephone: 1-800-ANRITSU FAX: 972-671-1877	MEERA AGENCIES (P) LTD. 23 Community Center Kailash Colony Extension New Delhi, India Telephone: 91-11-6442700 FAX: 91-11-6442500	ETECSA 12 Surrey Square Office Park 330 Surrey Avenue Ferndale, Randburg, 2194 South Africa Telephone: 27-11-787-7200 FAX: 27-11-787-0446
AUSTRALIA	**ISRAEL**	**SWEDEN**
ANRITSU PTY. LTD. Unit 3, 170 Foster Road Mt Waverley, VIC 3149 Australia Telephone: 03-9558-8177 FAX: 03-9558-8255	TECH-CENT, LTD. 4 Raul Valenberg St Tel-Aviv 69719 Telephone: 03-64-78-563 FAX: 03-64-78-334	ANRITSU AB Borgafjordsgatan 13 164 40 Kista Sweden Telephone: 46-8-53470700 FAX: 46-8-53470730
BRAZIL	**ITALY**	**TAIWAN**
ANRITSU ELECTRONICA LTDA. Praia de Botafogo, 440, Sala 2401 CEP22250-040, Rio de Janeiro, RJ, Brasil Telephone: 021-527-6922 FAX: 021-53-71-456	ANRITSU Sp.A Roma Office Via E. Vittorini, 129 00144 Roma EUR Telephone: 06-50-99-711 FAX: 06-50-22-4252	ANRITSU CO., INC. 7F, No. 316, Section 1 Nei Hu Road Taipei, Taiwan, R.O.C. Telephone: 886-2-8751-1816 FAX: 886-2-8751-2126
CANADA	**KOREA**	**UNITED KINGDOM**
ANRITSU INSTRUMENTS LTD. 700 Silver Seven Road, Suite 120 Kanata, Ontario K2V 1C3 Telephone: (613) 591-2003 FAX: (613) 591-1006	ANRITSU CORPORATION LTD. 8F Hyunjuk Building, 832-41 Yeoksam Dong, Kangnam-Ku Seoul, South Korea 135-080 Telephone: 02-553-6603 FAX: 02-553-6605	ANRITSU LTD. 200 Capability Green Luton, Bedfordshire LU1 3LU, England Telephone: 015-82-433200 FAX: 015-82-731303

Chapter 2
Installation

Table of Contents

Chapter 2
Installation

2-1 Introduction

This chapter provides information for the initial inspection, preparation for use, and installation instructions for the MS278XA signal analyzer. Information is included for interfacing the MS278XA through:

- IEEE-488.2 General Purpose Interface Bus
- Ethernet Port
- Universal Serial Bus

Detailed programming information can be found in the MS278XA programming manual (part number: 10410-00253) that came with the analyzer or in the online Help system.

2-2 Initial Inspection

Inspect the shipping container for damage. If the container or cushioning material is damaged, retain until the contents of the shipment have been checked against the packing list and the instrument has been checked for mechanical and electrical operation.

If the MS278XA is damaged mechanically, notify your local sales representative or Anritsu Customer Service. If either the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as Anritsu. Keep the shipping materials for the carrier's inspection.

> **Warning:** Use two or more people to lift and move this equipment, or use an equipment cart. There is a risk of back injury if this equipment is lifted by one person.

After removing the instrument from the shipping container, inspect the contents against the list found in the following section.

Shipping Contents

Signature comes with a standard set of accessories. In addition to the basic instrument, Table 2-1 lists the standard set of items that are commonly shipped with the base model.

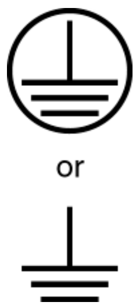
Table 2-1. Standard Shipment Contents

Part Number	Description
Accessories	
MS278XA	High Performance Signature SPA/VSA
800-XXX	Power Cord
10920-00047	Manuals CD-ROM
60004	Restore Software DVD-ROM
2000-1389	USB Optical Mouse
970-635	Blank CD R/W Disk
631-73	Spare Fuse
Standard Document Set (on CD-ROM and installed in the instrument)	
10410-00252	MS278XA Operation Manual
10410-00253	MS278XA Programming Manual
10450-00001	Signature Online Help System
Optional Documents	
10410-00256	MS278XA Maintenance Manual

2-3 Preparation for Use

No initial setup is required. After unpacking, the MS278XA is ready for use; however, it is strongly recommended that you connect an external keyboard and mouse to facilitate ease of use of the Windows operating system, particularly when installing third-party software (refer to Section 2-4).

The MS278XA is equipped with automatic line-power sensing and will operate with any of the following line voltages: 100V, 120V, 220V, 240V (+5%, –10%), 48–63 Hz, 350 VA. The MS278XA is intended for Installation Category (Over Voltage Category) II.



> **Warning:** When supplying power to this equipment, connect the accessory 3-pin power cord to a 3-pin grounded power outlet. If a grounded 3-pin outlet is not available, use a conversion adapter and ground the green wire, or connect the frame ground on the rear panel of the equipment to ground. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock.

After the above warning has been addressed, you may plug the instrument into an adequate mains supply and set the instrument to Operate by pressing the Standby/Operate front panel key.

> **Note:** Signature requires at least two minutes to initially power up, load the system software, and perform a series of internal calibrations. During this time, informational screens will be displayed.

After the instrument has completed its startup, the Signature application will be running. To access the PC functions and minimize the Signature application, access the View drop-down menu and select Desktop.

2-4 Connecting External Devices

Signature offers a variety of external device interfaces that facilitate ease of operation and enhance the usability of the instrument.

Connecting an External Keyboard or Mouse

The external keyboard and mouse interfaces use standard PS/2 type connectors. When connecting either a PS/2 keyboard or mouse, ensure that the instrument is set to standby mode before connecting them to the rear panel. When the MS278XA is set to Operate, the keyboard and mouse should be automatically detected by the operating system and be ready for use. To use any advanced features of your external keyboard and mouse, follow the manufacturers installation instructions.

Note: Advanced keyboard and mouse features may not be supported in the analyzer application, but should function as expected in the Windows environment.

Connecting an External Monitor

The external monitor interface is a standard 15-pin, D-type connector. When connecting an external monitor, ensure that the instrument is in standby mode and that the monitor is disconnected from its power source. When the MS278XA is set to Operate, the monitor should be automatically detected by the operating system and be ready for use.

Note: You may wish to install the monitor's hardware driver that was provided by the manufacturer to enhance performance; however, this is not typically necessary.

Connecting an External Printer

The external printer interface is a standard parallel connector. Install your printer driver according to the manufacturer's directions. Typically, the hardware connection will need to be made with the analyzer in the standby, or off, mode to allow for proper initialization of the hardware during boot-up of the operating system.

If you attempt to print while in the Signature application before a printer is installed, you will be prompted to install a printer as follows:

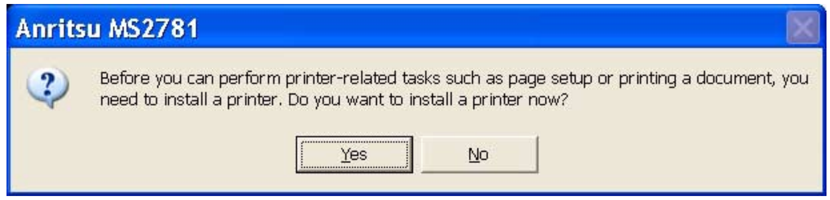


Figure 2-1. Anritsu MS2781 Add Printer Dialog

Pressing Yes will initiate the Windows Add Printer Wizard shown below.

Figure 2-2. Add Printer Wizard

If you are installing a network printer, continue with the Wizard as described below. Otherwise, it is recommended that you follow the manufacturer's installation instructions for your printer.

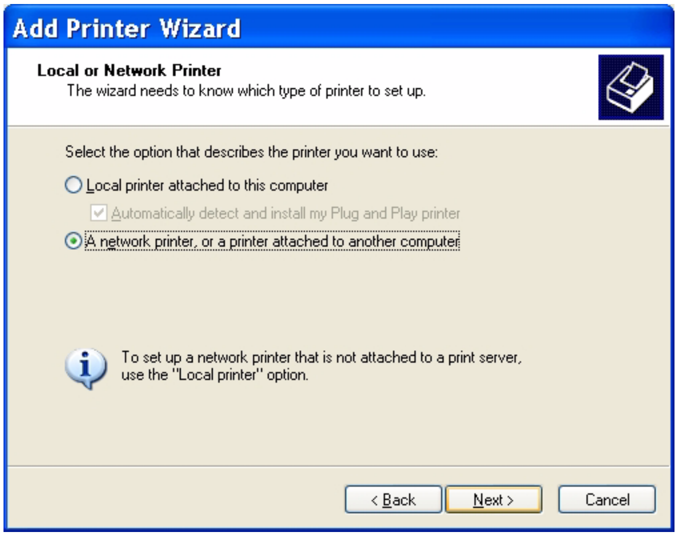


Figure 2-3. Add Printer Wizard

Step 1. Select the network radio button and press Next.

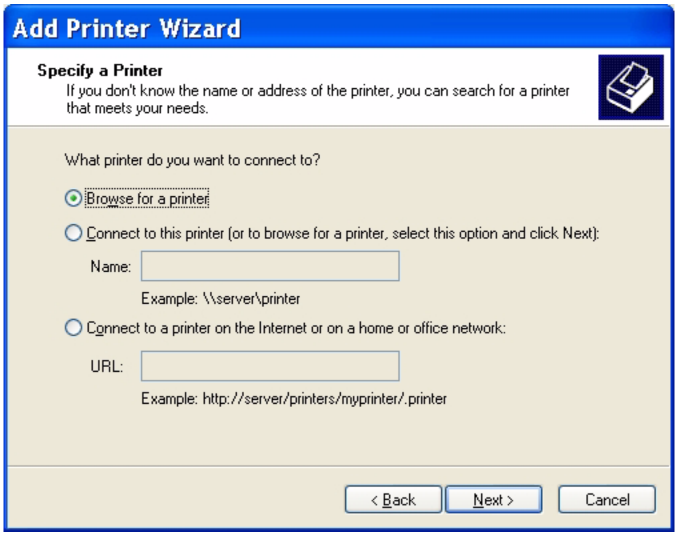


Figure 2-4. Add Printer Wizard

Step 2. Enter the location and name of your network printer, or select Browse for a printer, then press Next.

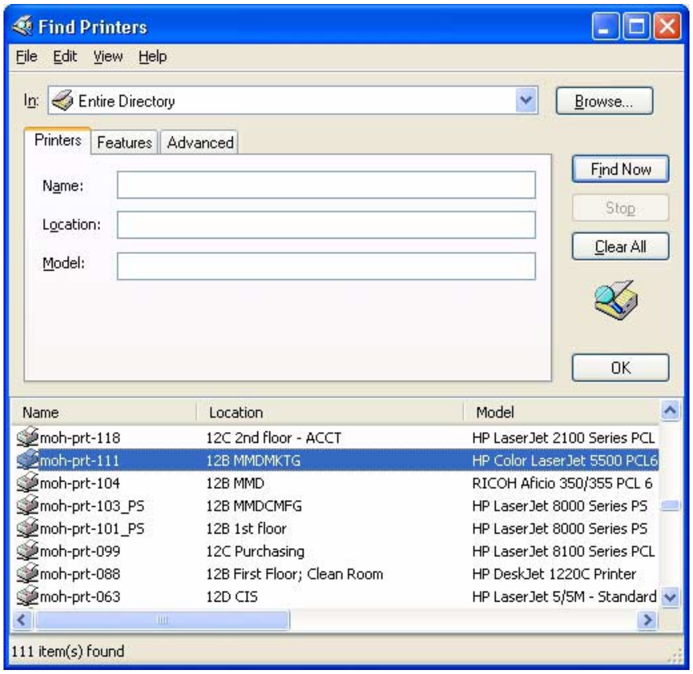


Figure 2-5. Find Printers Dialog

Step 3. Select the location of your network printer and press Find Now, then select your printer from the list and press OK.

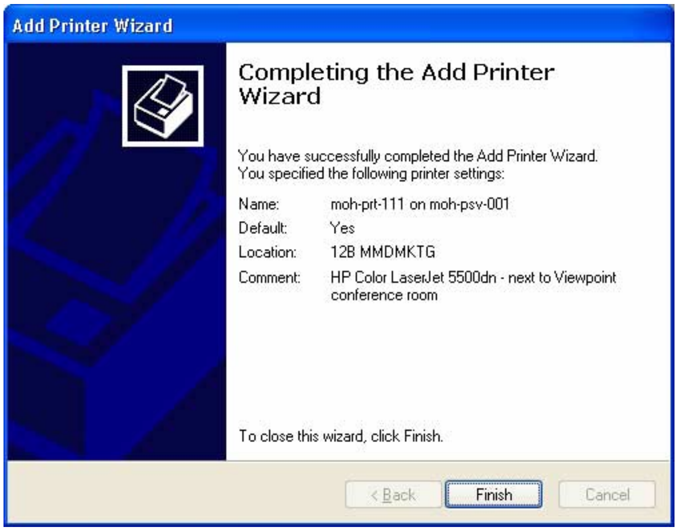


Figure 2-6. Add Printer Wizard

Step 4. Press Finish to complete the Add Printer Wizard.

Connecting an External USB Device

The external USB interface is a standard Type A, USB connector that supports the USB 2.0 standard. Signature can interface with a variety of external USB devices, such as a keyboard, mouse, printer, scanner, drive, or camera. The USB interface offers the same behavior that is typically experienced in the Windows environment. You may connect your USB devices as directed by the manufacturer's instructions.

Note: A USB mouse may require a hot connection while the instrument is in the Operate mode with the Signature software running. If a USB mouse fails to operate when the instrument is started with the mouse plugged into the USB port, reboot the instrument with the mouse disconnected and make the hot connection after the Signature software is running.

2-5 Rack Mount Installation

Instruments that are ordered from the factory with Option 1, Rack Mount, should have the rack mount pre-installed. Option 1 may be ordered at a later time. To install the Option 1 rack mount kit, refer to the procedure below:

Step 1. Disconnect the line cord and any other attachments from the instrument.

Step 2. Carefully place the instrument on a secure and stable work surface.

Step 3. Using a Phillips screwdriver, remove the two front panel handles and the four feet at the rear (see Figure 2-7). Save the screws for later use.

Note: The green-headed screws have a metric thread and must be reused in the same locations from which they were removed. Replacing these screws with different thread, such as SAE threaded screws, will damage the instrument chassis.

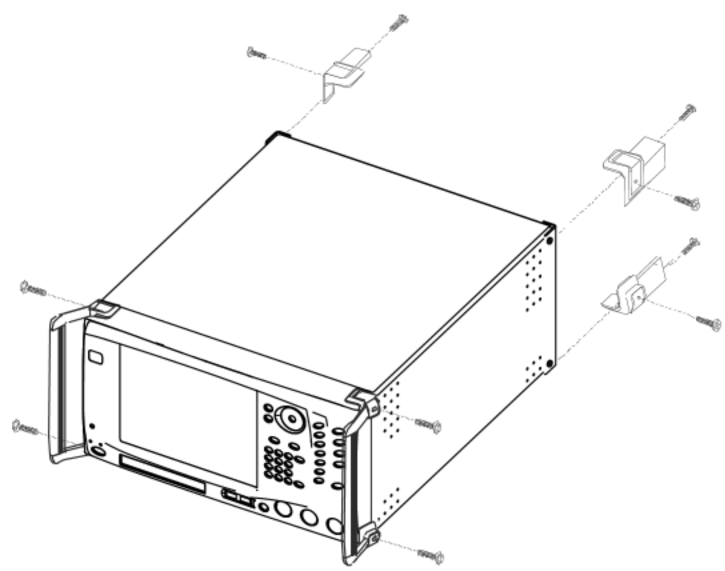


Figure 2-7. Instrument Handles and Feet Removal Diagram

Step 4. Install the rack mount slides over the threaded studs on the rack mount bracket and handle fixtures as shown in Figure 2-8, below, and secure them in place with the two fastening nuts. (Push button at 1 to release and extend slide.)

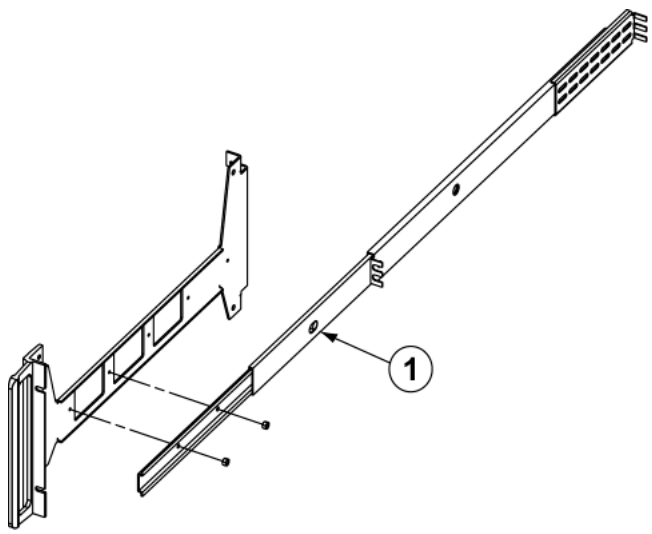


Figure 2-8. Rack Mount Slide Assembly Diagram

Step 5. Install the two rack mount bracket and slide assemblies onto the instrument sides using the green-headed screws removed earlier (Figure 2-9).

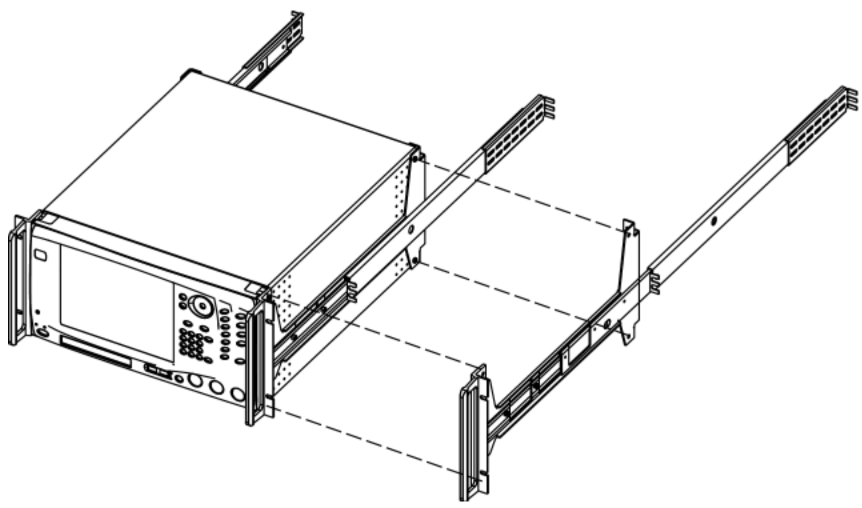


Figure 2-9. Rack Mount Assembly Installation Diagram

This completes the installation of the slide assembly.

2-6 Remote Interface Setup

Most of the MS278XA functions (except power on/off and initialization of the hard disk) can be controlled remotely by an external computer/controller via the IEEE-488.2 GPIB or a Local Area Network (LAN). The information in this section pertains to the interface connections and cable requirements for the GPIB Setup and LAN Setup. Refer to the Model MS278XA Programming Manual, Anritsu Part Number: 10410-00253, for detailed information about remote programming of the MS278XA using these remote interface options; refer to Chapter 8, Remote Operation for detailed information on operating the instrument remotely using Windows Remote Desktop or third party applications, such as WebEX or PCAnywhere™.

GPIB Setup

The MS278XA GPIB operates with any IBM® PC compatible computer/controller equipped with a National Instruments® GPIB-PCI I/IIA interface card and supporting software.

GPIB Interface Connection

Connect your external controller to the IEEE 488.2 GPIB interface connector on the rear panel as shown in Figure 2-10.

The GPIB system can accommodate up to 15 devices at any one time. To achieve maximum performance on the bus, proper timing and voltage level relationships must be maintained. If either the cable length between separate instruments or the accumulated cable length between all instruments is too long, the data and control lines cannot be driven properly and the system may fail to perform. The following guidelines should be observed:

- No more than 15 instruments may be installed on the bus (including the controller).
- Total accumulative cable length (in meters) may not exceed two times the number of bus instruments or 20 meters—whichever is less.
- Individual cable length should not exceed 4 meters.
- 2/3 of the devices must be powered on.
- Devices should not be powered on while the bus is in operation (that is; actively sending or receiving messages, data, etc.).
- Minimize cable lengths to achieve maximum data transfer rates.

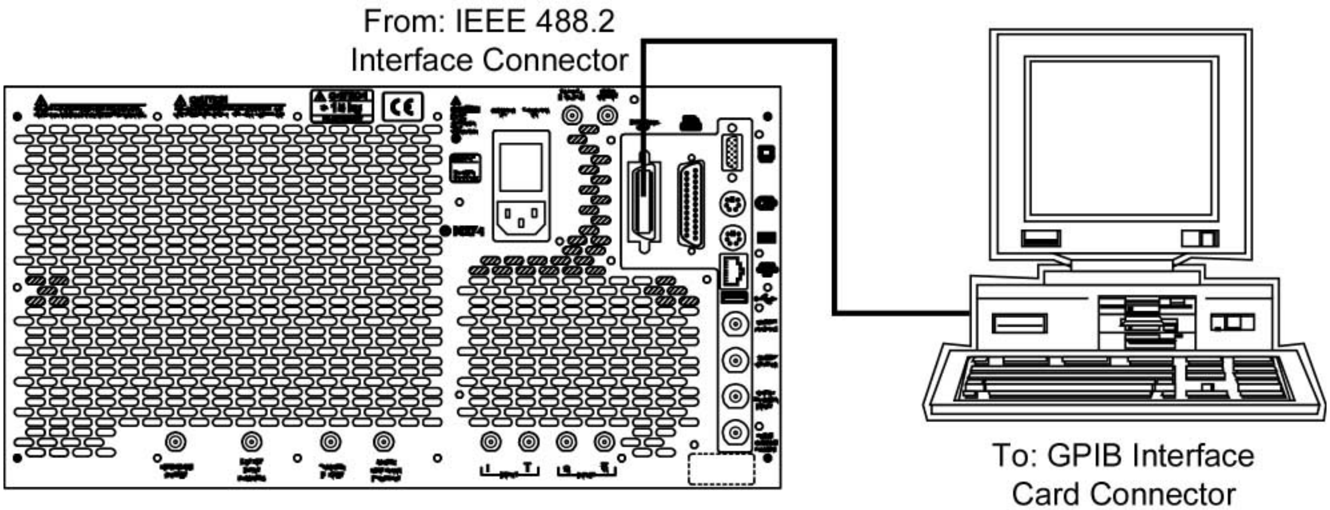


Figure 2-10. GPIB Setup

Configuration

Apply power to the MS278XA and allow the system to power up. Once the software has finished loading and start-up testing is complete, the MS278XA is ready to be remotely controlled via the GPIB. It is important to note that the MS278XA will not respond to GPIB commands until the system's software has been loaded.

The default GPIB address for the MS278XA is one (1). To change the default GPIB address, do the following on the MS2781A:

Step 1. Access the System main menu, expand the Configuration sub-menu, press the IO Config button, and then select GPIB.

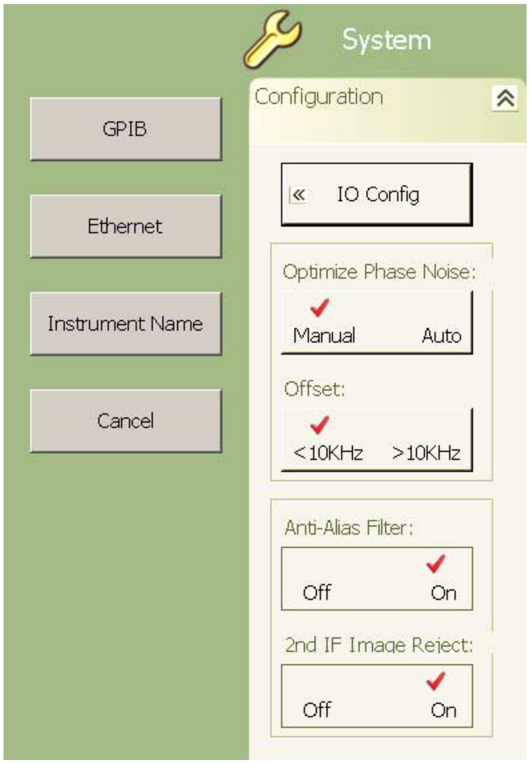


Figure 2-11. MS278XA Configuration Sub-menu

This brings up the Measurement and Automation Explorer window, below:

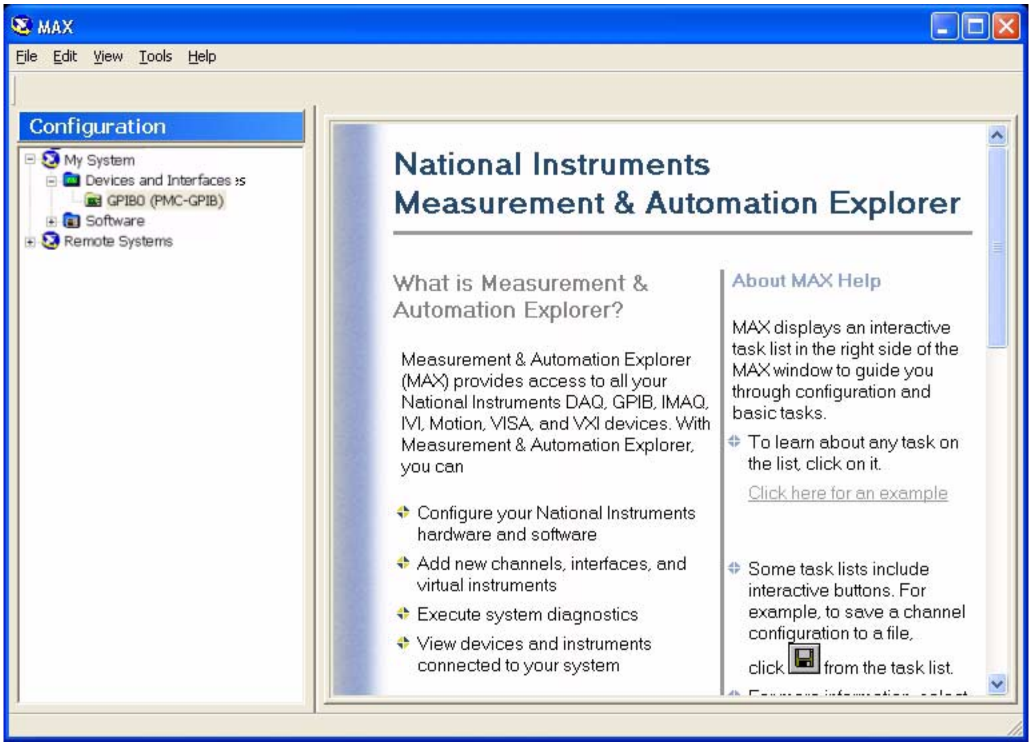


Figure 2-12. National Instruments Measurement and Automation Explorer

Step 2. On the left hand panel, go to My System | Devices and Interfaces | GPIB0 (PMC-GPIB), right click on GPIB0, and then select properties from the pop-up menu.

Step 3. In the GPIB Configuration dialog, change the Primary GPIB Address to the desired value.

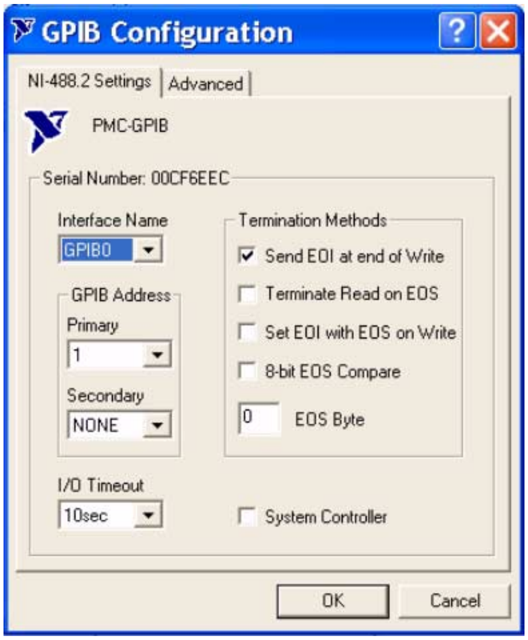


Figure 2-13. National Instruments GPIB Configuration Dialog

Step 4. Make similar changes on the Remote PC side by selecting the System Controller choice and changing the GPIB address as required.

When Signature is selected as the system controller, the message “System Controller” is displayed in Signature’s status bar.

Note: Signature cannot be remotely controlled through GPIB by another remote PC when it is selected as the system controller.

LAN Setup

The LAN can be set up via the RJ45 Ethernet port.

Network Connections

The MS278XA supports 10/100 BASE-T. You can connect the analyzer directly to your LAN via the RJ45 connector on the rear panel. Refer to Figure 2-14, below, for an illustration.

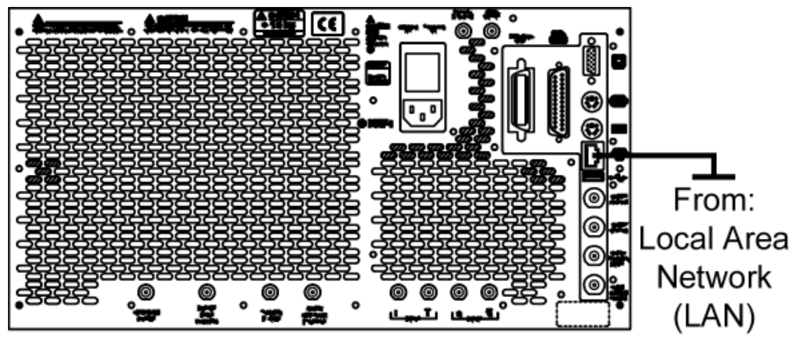


Figure 2-14. Ethernet Connection

Network Interface Setup

TCP/IP connectivity requires setting up the parameters described at the beginning of this section. You may need to contact your network administrator or refer to your network documentation for further assistance. The following is a brief overview of how to set up a general LAN connection on both the MS278XA and the remote machine:

Step 1. From the Start menu, select Control Panel.

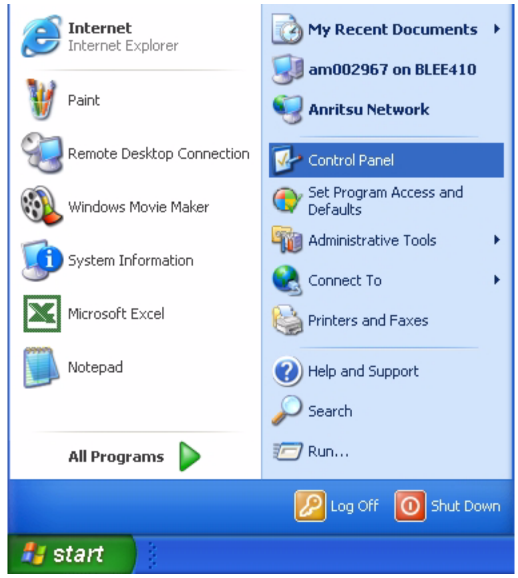


Figure 2-15. Start Menu

Step 2. From the Control Panel, select Network Connections.

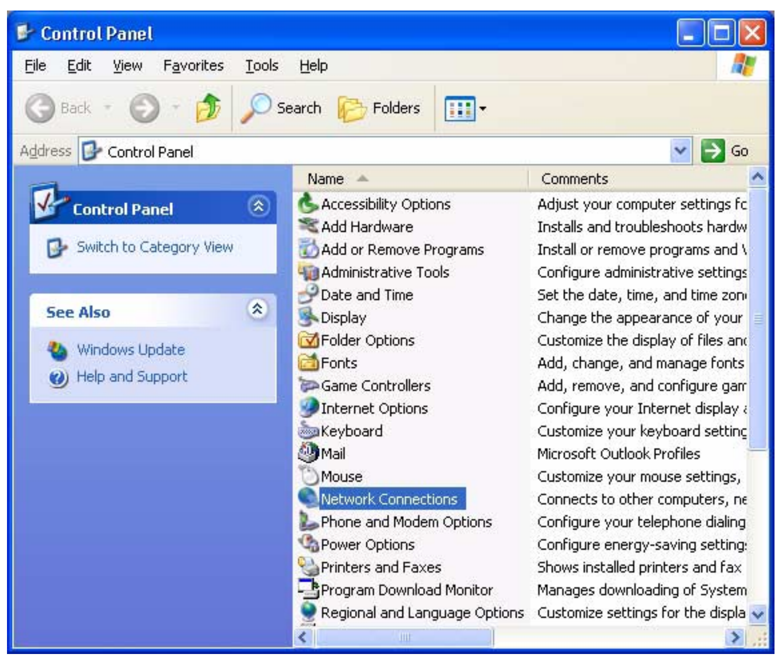


Figure 2-16. Control Panel

Note: If your connection already exists and just needs to be modified, skip the next step and proceed to Step 11.

Step 3. In the Network Connections window, under Network Tasks on the left pane, select *Create a new connection*.

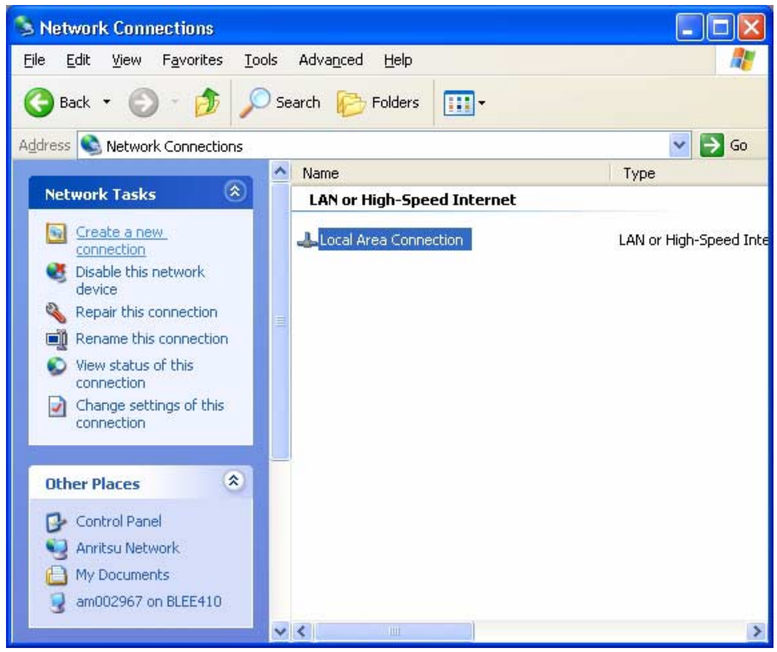


Figure 2-17. Network Connections

Step 4. The New Connection Wizard guides you through the new connection setup. Press Next to continue.

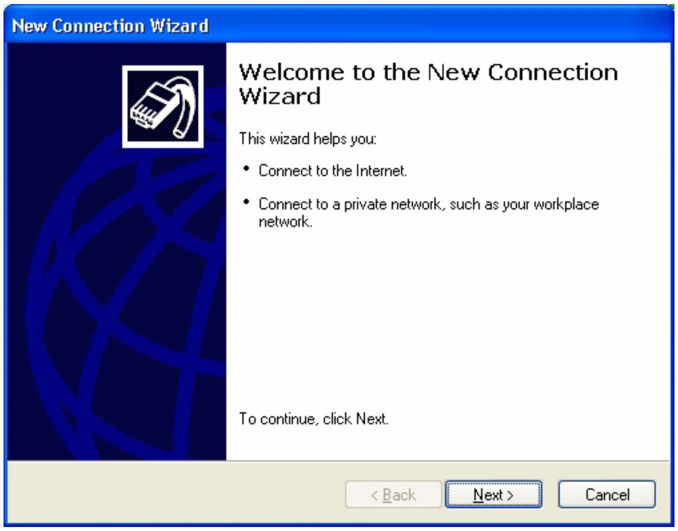


Figure 2-18. New Connection Wizard

Step 5. Select *Connect to the network at my workplace* and press Next.

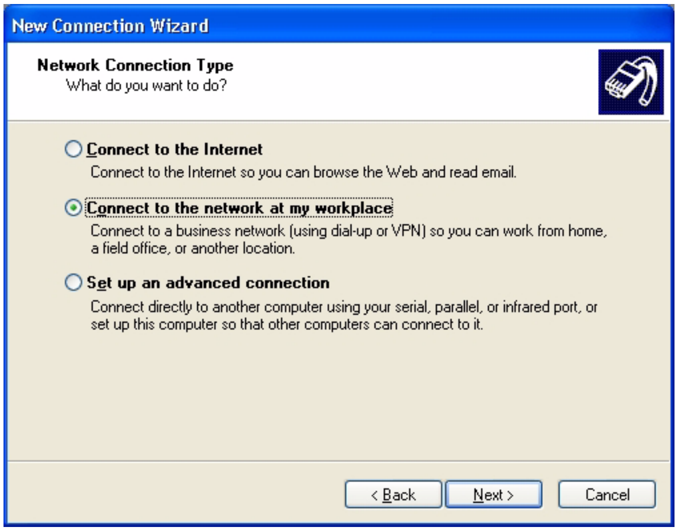


Figure 2-19. New Connection Wizard

Step 6. Select *Virtual Private Network connection* and press Next.

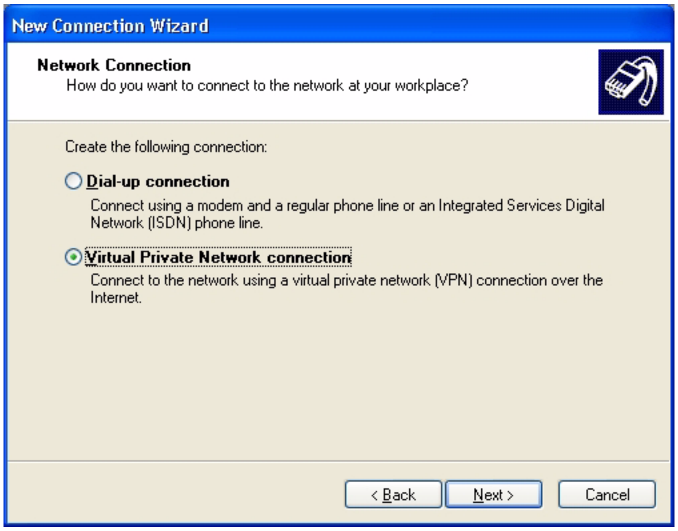


Figure 2-20. New Connection Wizard

Step 7. Enter the name of your new connection and press Next.

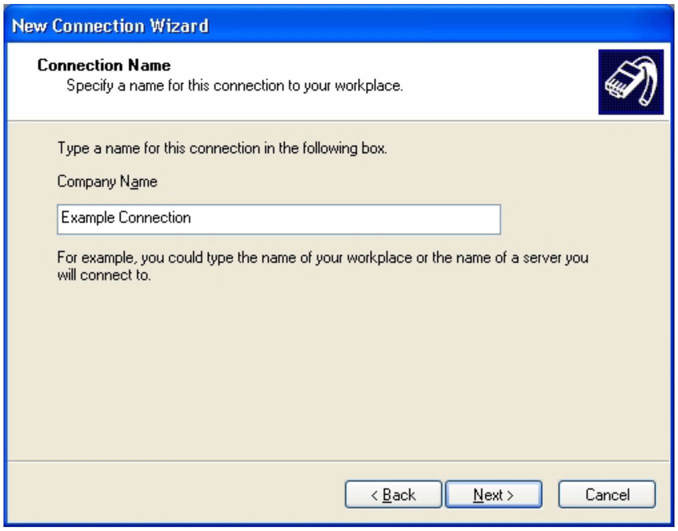


Figure 2-21. New Connection Wizard

Step 8. Enter the Host name or IP address for your network.

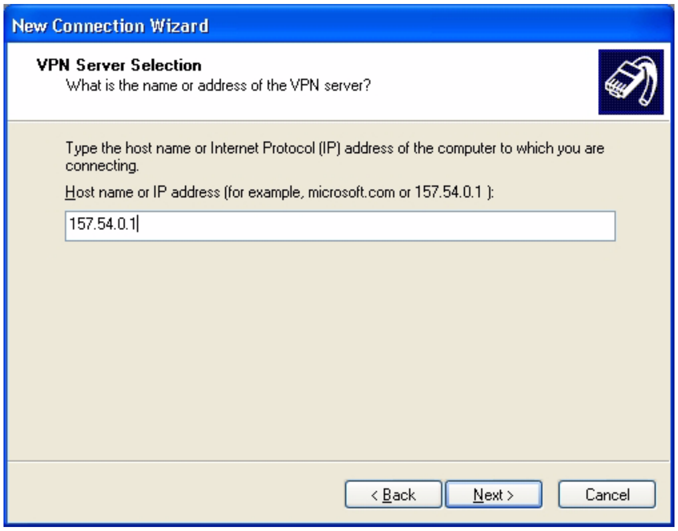


Figure 2-22. New Connection Wizard

Step 9. Select the connection availability of your choice and press Next.

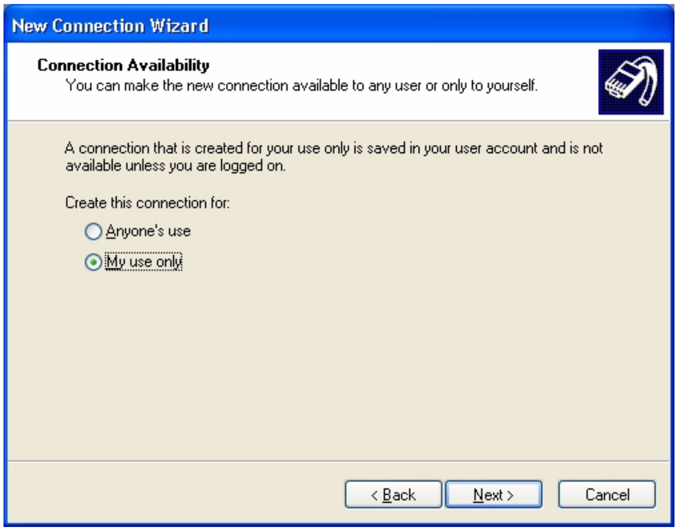


Figure 2-23. New Connection Wizard

Step 10. If you desire to have an Icon placed on the desktop, check the box and press Finish to create your new connection.

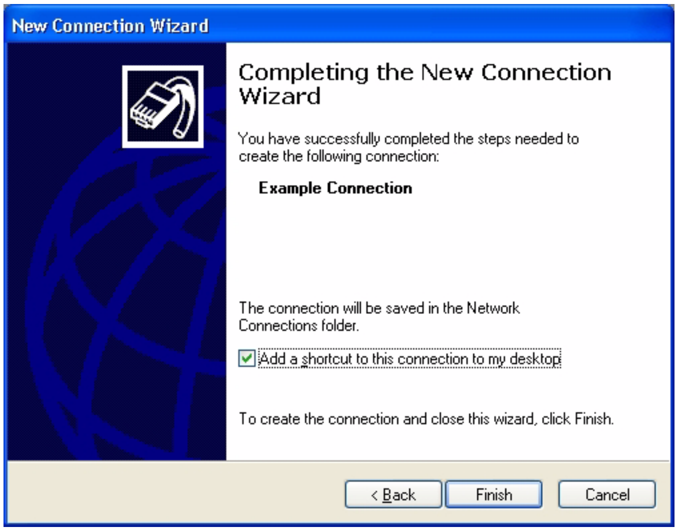


Figure 2-24. New Connection Wizard

Step 11. If a connection needs to be manually set up or modified, you can right click on the connection name in the Network Connections window (Figure 2-17) and select Properties from the pop-up dialog box.

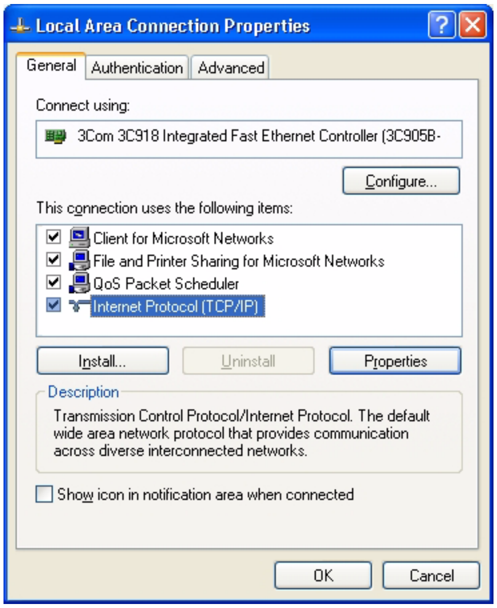


Figure 2-25. Local Area Connection Properties

Step 12. From the properties dialog above, select Internet Protocol (TCP/IP) and click on the Properties button. From here, you can select to dynamically obtain an IP address automatically, or manually configure your network connection.

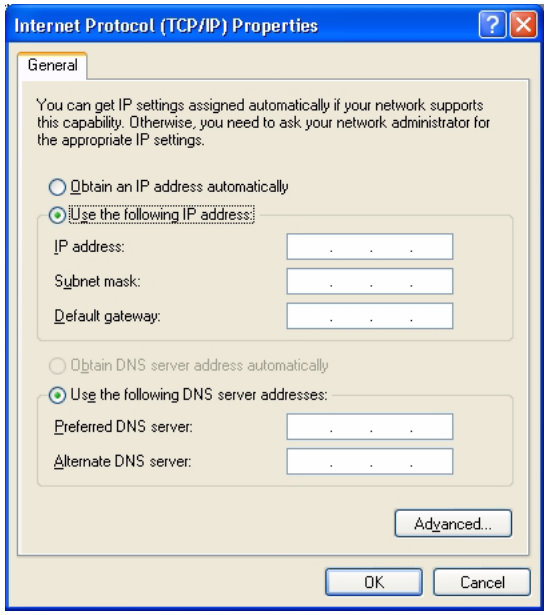


Figure 2-26. General Internet Protocol (TCP/IP) Properties

Step 13. For additional setup configurations, select Obtain an IP address automatically, then select the Alternate Configuration tab.

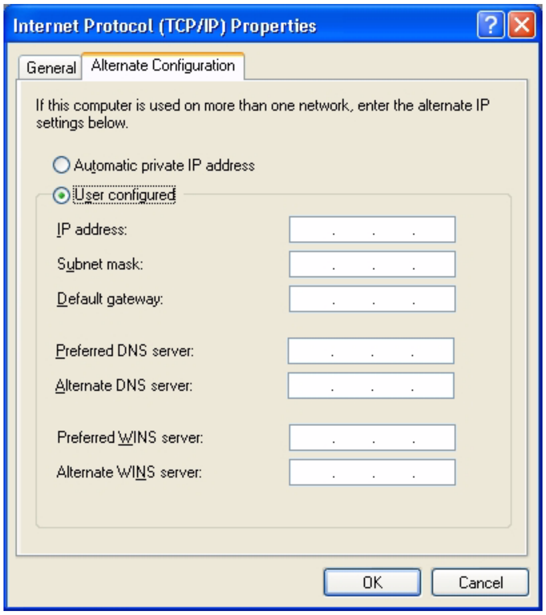


Figure 2-27. Alternate Internet Protocol (TCP/IP) Properties

Note: You may need to consult your network documentation or network administrator for assistance in manually configuring your network setup.

2-7 System Configuration

This section describes the various aspects of the instrument configurations both inside and outside of the main instrument software. The following system configurations are described below:

- BIOS Configuration
- Windows XP Configuration
- Analyzer Configuration
- Main Menu Tool Bar Configuration

BIOS Configuration

This section describes a few requirements of the BIOS setup.

Caution: It is strongly recommended that you do not enter or change the BIOS settings. The BIOS is configured at the factory for optimum system performance. Incorrect BIOS settings can render the system unusable.

Before entering the BIOS, you must install a PS2 keyboard. USB devices are not supported outside of the Windows operating environment.

The BIOS setup utility can be accessed by pressing F2 during the initial power up state when the Anritsu blue screen appears. If the system proceeds to the Windows XP startup screen, the BIOS will not be entered and the system will require a restart before BIOS entry can be attempted.

Note: After turning off the instrument, you must wait at least 10 to 15 seconds before turning the instrument back on again. This delay is required to allow the internal power supplies to discharge and to assure a reliable cold start.

Once the BIOS setup utility is entered, changes can be made in the usual manner. **USB BIOS Legacy Support** must remain disabled and the **USB Host Controller** must remain enabled. Failure to preserve these setting may result in display malfunction.

Pressing F3 will load the BIOS Setup Defaults. Pressing F4 will save the current settings (including any changes that were made) to BIOS and exit the BIOS setup utility.

Windows XP Configuration

This section describes the various aspects of the instrument outside of the main instrument software. It specifically addresses the various configurations and properties of the "open" Windows XP environment that are set at the Factory. Several of the Windows XP settings (primarily Desktop settings, Folder options, and Task Bar settings) can be saved and recalled using the File and Settings Transfer Wizard in Windows XP ("migwiz.exe" accessed from the command line).

> **Note:** The Quick Launch properties and Power Savings settings do not get saved using the "migwiz.exe" tool.

Desktop Properties

Background—Wallpaper set to None.

Screen Saver—Set to None.

Fonts—Size set to Large Fonts and the font properties for the Menu category set to Tahoma 14 with a size of 30.

Power Savings—In the "Home/Office Desk Power Scheme" group, the "Turn Off monitor" setting should be set to "Never."

User Accounts

There is one User Account setup by default:

SignatureUser—This account is password protected (the password is "2780"). A password is necessary for the Remote Desktop feature to work. This account is the default account and is set to Auto Logon.

Directory Structure

The following Directory Structure shall be used for installation of Signature related programs, files, etc.:

- **C:\Signature:** Root Directory
- **C:\Signature\SignatureHelpSystem:** Contains Help Files, Application Notes, Manuals, Examples, Data Sheets, etc.
- **C:\Signature\Bin:** Contains Instrument Binary Files
- **C:\Signature\Dependencies:** Contains Calibration Data, Initialization Files, etc.
- **C:\Signature\Setup:** Contains Instrument Setup Files

Security Settings

The following security related settings are configured in the instrument:

- Internet Explorer Security Settings set to High
- Fire wall set to On
- Encryption on File System set to Off
- Passwords are Enabled on all User Accounts

Remote Access

GPIB
The default GPIB properties that are set in the factory are:

- GPIB Address 1
- Mode Talker/Listener

> **Note:** You can access the National Instruments GPIB Configuration dialog box directly from the System Menu in the instrument software for any changes to the GPIB settings. See “GPIB Setup” on page 2-13.

TCP/IP
All default TCP/IP settings are used.

> **Note:** You can access the Windows XP TCP/IP dialog box directly from the System menu in the instrument software for any changes to the TCP/IP settings. See “LAN Setup” on page 2-18.

Computer Name
The computer name is set to SNXXXXXX (where XXXXXX is the Anritsu serial number for the instrument).

Third Party Software

The following third party software is loaded onto the instrument’s hard drive:

- **Adobe Acrobat Reader**
- **MATLAB** (A special demo version is copied onto the hard disk and requires installation.)

Hard Disk Configuration

One Primary Partition—This is the default booting partition.

One Recovery Partition—This contains a backup of the main partition that can be used to restore the main partition if the main partition becomes corrupted. This is set up to be as small as possible (about 5% extra space is allocated in addition to the space consumed by the Recovery utility).

Analyzer Configuration

This section describes how to determine which instrument options are installed or are available for installation. Start by selecting Options from the Tools drop-down menu shown below:

Figure 2-28. Tools Drop-down Menu

This displays the Options dialog box (below), which lists the installed options and their availability.

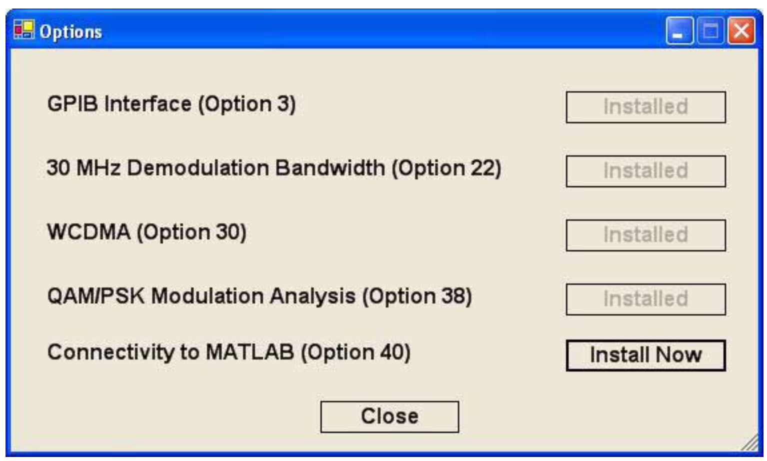


Figure 2-29. Options Dialog

If an option is installed, it will be listed as Installed. If the option is not installed, it will be listed as Install Now. If the option is not available or requires additional support, such as hardware, it will be indicated as such.

Installing Options

To install an Option, you will need to contact Anritsu customer service to obtain an installation key. Once the key has been obtained, you can install an option by pressing the Install Now button on the Options menu. Pressing the Install Now button will open the OptionsWiz dialog below:

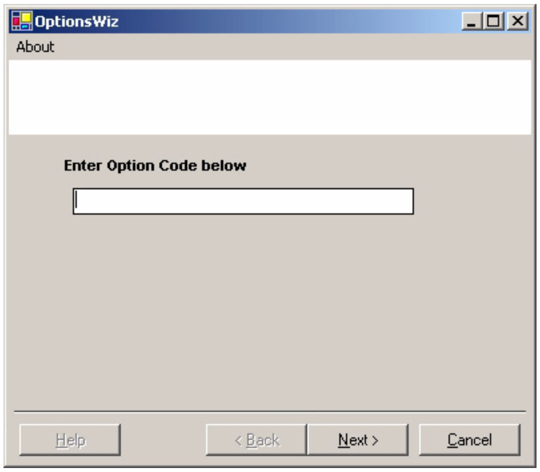


Figure 2-30. OptionsWiz Dialog

Enter your key in the Options Code parameter field and press Next. If the key you entered is validated, you will be informed of a successful installation in the dialog below:

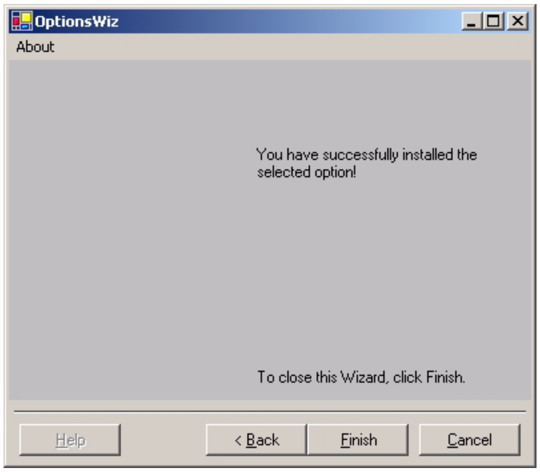


Figure 2-31. OptionsWiz Dialog

If the key is not validated, or there are additional requirements to install the option, you will be notified with a description of the additional requirements in a dialog similar to that shown below:

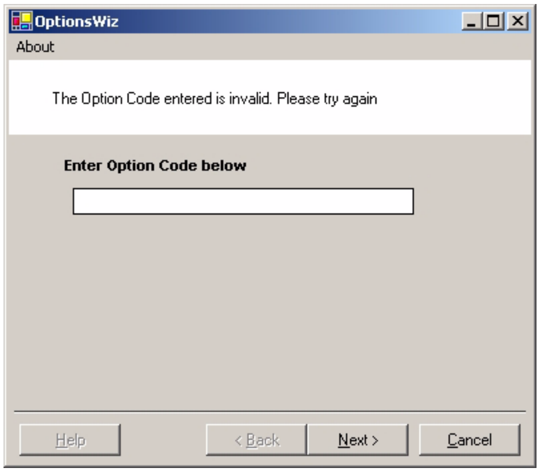


Figure 2-32. OptionsWiz Dialog

For further assistance with installing options, contact your nearest Anritsu customer service center found in Table 1-4.

Customizing the Tool Bar

Signature's tool bar can be customized by adding commonly used icons and eliminating those that are seldom used. To customize the tool bar, select Tools | Add/Remove Tool Bar Items | Customize... from the drop down menu bar. The Customize Toolbar dialog is displayed in Figure 2-33, below.

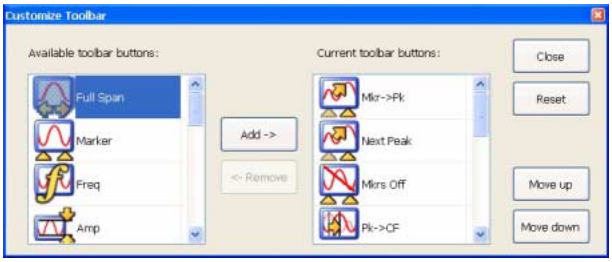


Figure 2-33. Customize Toolbar Dialog

To add icons to the tool bar, select an icon from the available tool bar buttons and press Add –>. To remove icons from the tool bar, select an icon from the current tool bar buttons and press <– Remove. Additional tool bar configurations include rearranging the icons and resetting the tool bar icon set to default.

Chapter 3
Front Panel Overview

Table of Contents

Table of Contents (Continued)

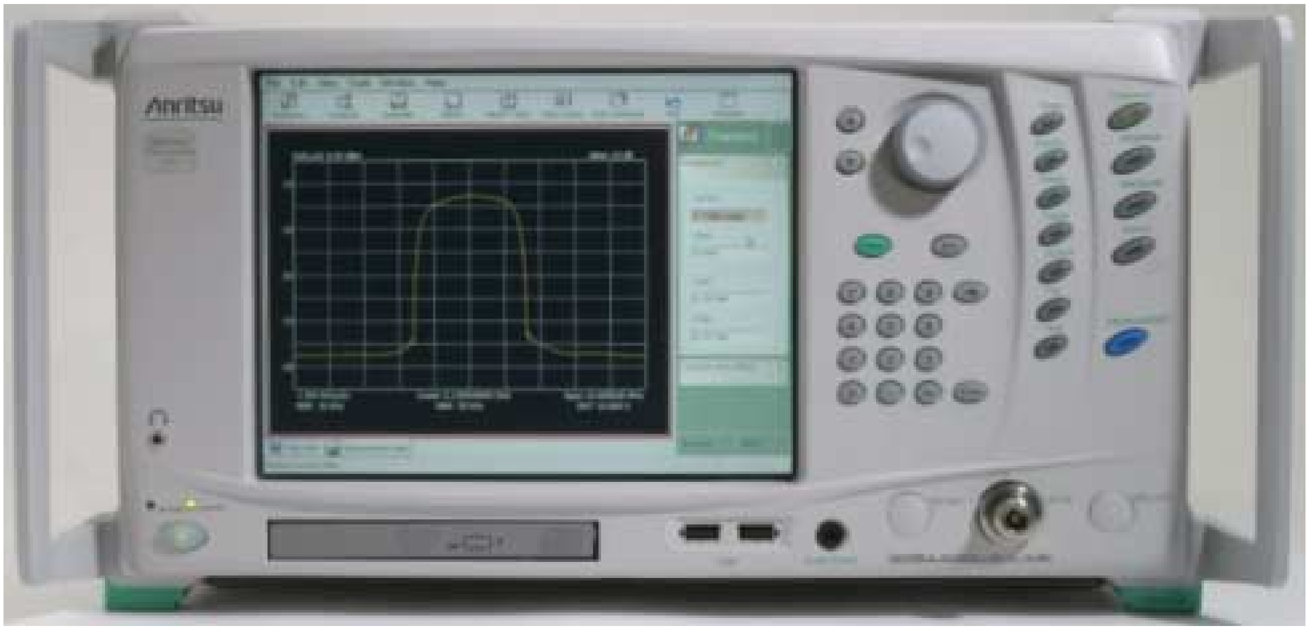


Figure 3-1. Signature Series MS278XA Signal Analyzer

Chapter 3
Front Panel Overview

3-1 Introduction

This chapter provides information and instructions on operating the series MS278XA signal analyzer using the front panel controls. It contains the following:

- Illustrations and diagrams of the front panel, data display area, and data entry area that identify and describe all front panel controls and interfaces.
- An annotated diagram of the menu display showing where the current setup information is located.
- Descriptions of measurement setups through the use of menus, property sheets, and wizards.
- An annotated diagram of the data displays showing where the current setup information and measurement data is displayed.
- Descriptions of instrument error messages and status indicators.

3-2 Front Panel Overview

The MS278XA front panel is divided into two main areas—the Graphical User Interface (GUI) and the key pad data entry area. The following paragraphs provide a brief description of the front panel controls, data display, and data entry areas shown in Figure 3-2. Detailed descriptions of the data display and data entry areas are contained in Section 3-4.

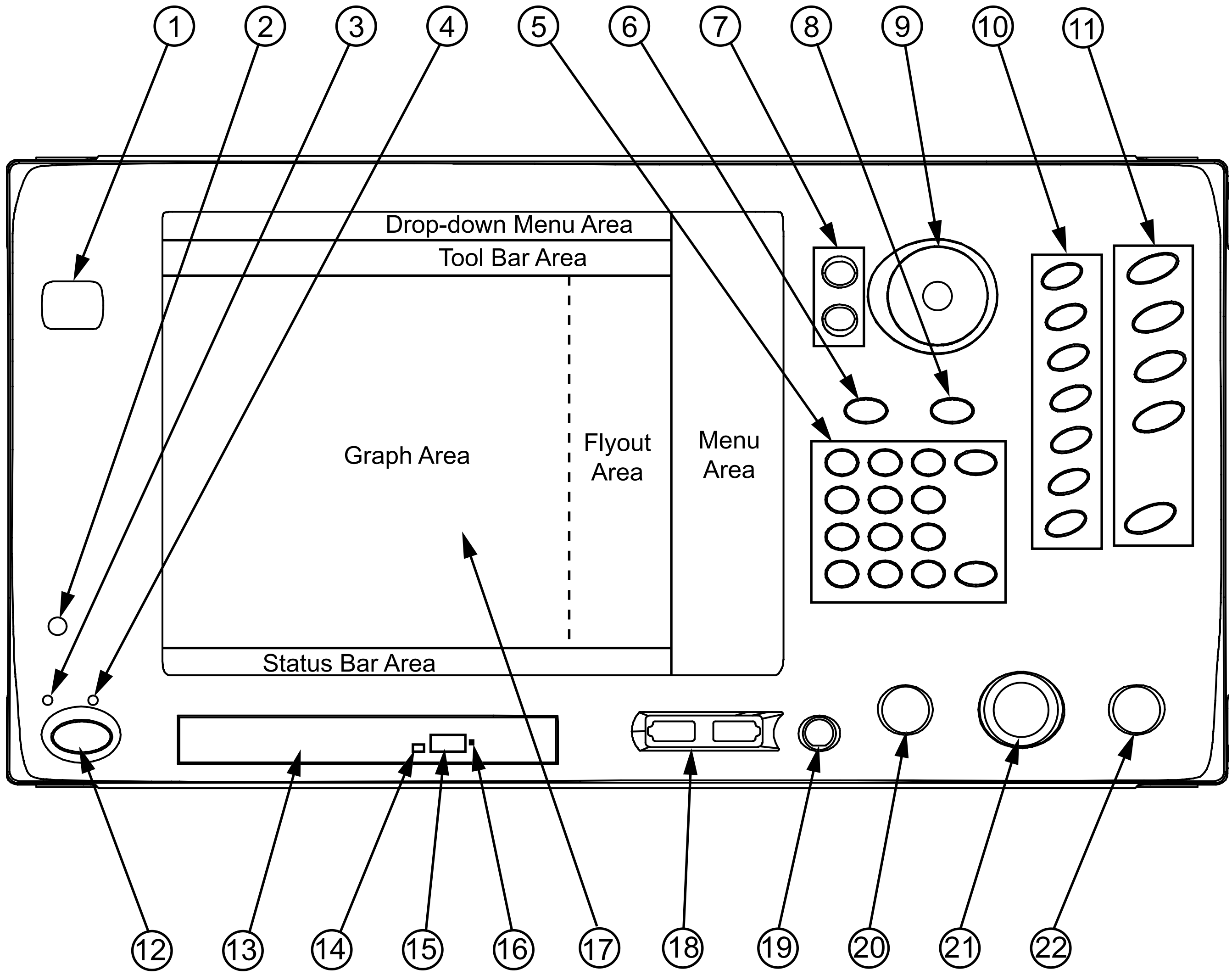


Figure 3-2. MS278XA Front Panel Drawing

Table 3-1. MS278XA Front Panel Legend

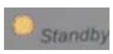
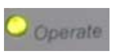
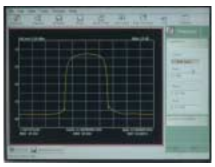
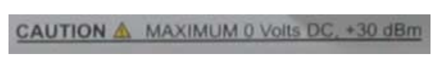
Index	Image	Description
1		**Instrument Name Tag:** The instrument name plate indicates the model number and upper frequency of the instrument.
2		**1/8 Inch Headphone Jack:** The headphone jack is used to output audio and can be used with a standard headphone speaker with a 1/8 inch type mono or stereo plug.
3		**Standby LED:** This LED illuminates orange when power is applied and the instrument is placed in standby mode.
4		**Operate LED:** This LED illuminates green when power is applied and the instrument is placed in operate mode.
5		**Numeric Keypad:** These keys are used for numerical entry and are listed as follows: 0,1,2,3,4,5,6,7,8,9, ., +/–, Enter, and Backspace.
6		**Preset Function Key:** This key sets all of the user settable parameters to their factory default values.
7		**Increment Keys:** The increment keys are used to increment a selected value up or down.
8		**Esc Key:** The Esc key is used to cancel an initiated function.

Table 3-1. MS278XA Front Panel Legend

Index	Image	Description
9		**Rotary Knob:** The rotary knob is used to increment a selected value up or down.
10		**Minor Function Keys:** The minor function keys are used to activate second-level menus.
11		**Major Function Keys:** The major function keys are used to activate basic functional parameter setups and second-level menus found on the GUI.
12		**Standby/Operate Key:** This key toggles the instrument between standby and operate mode.
13		**DVD-ROM/CD-RW Drive Tray:** This tray slides open and holds your CD media.
14		**DVD-ROM/CD-RW Drive Status LED:** This LED illuminates green when data is being read from the CD media and illuminates yellow when data is being written to the CD media.

Table 3-1. MS278XA Front Panel Legend

Index	Image	Description
15		**DVD-ROM/CD-RW Drive Tray Eject Button:** This button is pressed to open the CD media drive tray.
16		**DVD-ROM/CD-RW Drive Tray Manual Release:** The manual release is used when the drive tray fails to open and needs to be operated manually.
17		**Data Display and Touch Panel GUI:** The graphical user interface is used to display measurement data and interactive finger-touch menus.
18		**Front Panel USB Ports:** The two front panel USB ports offer a convenient interface access for USB compatible devices.
19		**Probe Power Port:** This port supplies power to your power probe.
20		**Tracking Generator Output Port:** This port provides for a Tracking Generator option. This is a future option and is not used at this time.
21		**RF Input Port:** The RF Input Port provides the connection to the Device Under Test. Input specification: +30 dBm @ 50Ω, MAXIMUM ZERO (0) Volts DC, 100 Hz to 8 GHz 
22		**Source Output Port:** This port provides for an Internal Modulated Source option. This is a future option and is not used at this time.

Data Display

The data display area is the large LCD touch screen. The touch screen is used to display measurements and function menus. The touch screen has the ability to receive input from the active soft-keys with a simple press of a finger. The majority of your interface with the analyzer is through the touch screen. Refer to Section 3-4 for more information about interfacing with the LCD touch screen.

Front Panel Keys

The front panel keypad is used to set the analyzer in and out of standby operation, enter numerical data, activate functions, and access menus on the GUI. The keypad is divided into groups consisting of the Major Function Keys, Minor Function Keys, and Numeric Keys.

Major Function Keys

Figure 3-3. Major Function Keys

The major function keys are located along the right edge of the front panel and are mapped to key functions of the instrument that are used most often. These keys activate basic functional parameter setups and second-level menus found on the GUI. Each of the major function keys have default parameters associated with them. The default parameter is available for adjustment via the increment keys or rotary knob after the function is activated. The key becomes illuminated when it's function is active. The following list describes each of the key's functionality:

- **Frequency:** Use this key for accessing the frequency menus. The frequency menus allow you to set the center, start, and stop frequencies, frequency span, frequency step size, and frequency offset. The default parameter is the center frequency.
- **Amplitude:** Use this key for accessing the amplitude menus. The amplitude menus allow you to set the reference level, attenuation parameters, graticule scaling and units parameters, and the level offset. The default parameter is the reference level.
- **Bandwidth:** Use this key for accessing the bandwidth menus. The bandwidth menus allow you to set the resolution and video bandwidths, sweep time, and bandwidth coupling factors. The default parameter is the resolution bandwidth.
- **Marker:** Use this key for accessing the marker menus. The marker menus allow you to select the active marker along with the marker mode and access the marker search functions. The default parameter is the active marker selection.
- **Measurement:** Use this key for accessing the advanced measurement menus. The advanced measure menus allow you to access the advanced measurement modes of the spectrum analyzer, such as RF and Modulation measurements.

Minor Function Keys

The minor function keys are located just left of the major function keys and activate second-level menu trees on the GUI. Each of the minor function keys have default parameters associated with them. The default parameter is available for adjustment via the increment keys or rotary knob after the function is activated. The key becomes illuminated when it's function is active. The following list describes each of the key's functionality:

Figure 3-4. Minor Function Keys

- **Trace:** Use this key for accessing the trace menus. The trace menus are used to set the active trace, select the trace state, set the number of averages for the trace display, and to select the detector type. The default parameter is the active trace selection.
- **Display:** Use this key for accessing the display menus. The display menus are used to activate and set display lines. The default parameter is the display line level parameter.
- **Sweep:** Use this key for accessing the sweep menus. The sweep menus are used to select between continuous and single sweep, trigger a new sweep, and to select the sweep mode. The default parameter is the continuous/ single sweep selection.
- **Trigger:** Use this key for accessing the trigger menus. The trigger menus are used to select the trigger source, set the trigger level, select the trigger slope, and to set the trigger delay. The default parameter is the trigger source selection.
- **System:** Use this key for accessing the system menus. The system menus are used to access calibration and alignment modes, set up external reference sources, configure phase noise performance, and to select the remote operating mode. The default parameter is the calibrator selection mode.
- **File:** Use this key for accessing the file menus. The file menus are used to save and recall instrument setups and to export trace and measurement data to a file. The default parameter is the Save selection.
- **Help:** Use this key for accessing the Signature Help system. When this key is pressed, context sensitive help is enabled and the topics are displayed in the graph area. Press the key again to toggle the display back to the measurement data.

Numeric and Cursor Keys

Figure 3-5. Numeric Keys

The numeric keys are located in a block next to the LCD display. These keys are used for entering and manipulating data while in a parameter setup function:

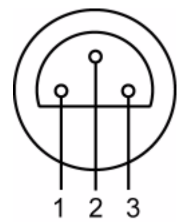
- **Increment Up/Down:** Use the increment up/down keys to increment an active parameter (up or down) and to move an active marker to the next step. The increment up/down keys allow you to increment or decrement the active parameter in coarse/discrete steps. These steps usually follow the 1, 2, 3, 5 convention. These keys are mapped to the Page Up/ Page Down keys on a standard keyboard.
- **Rotary Knob:** The rotary knob functions much like the increment keys and can be used to adjust active parameters and move active markers. The rotary knob allows you to increment or decrement the active parameters with a fine resolution. The rotary knob is mapped to the up/down arrow keys on a standard keyboard.
- **Preset:** Use this key to access the preset menu. The preset menu allows you to preset all of the instrument parameters to factory defaults.
- **Esc:** Use this key escape a function setup or parameter entry that has been initiated, but is not desired.
- **0,1,2...9:** Use these keys for entering numerical values.
- **+/-:** Use this key for changing a value's numerical sign.
- **.:** Use this key for entering a decimal point.
- **Back Space:** Use this key for clearing an active entry.
- **Enter:** Use this key for entering the data or executing a function.

Connectors

The front panel connectors consist of the following:

- **Probe Power Port:** This port supplies power to your power probe. Table 3-2 shows the probe power port pinout.

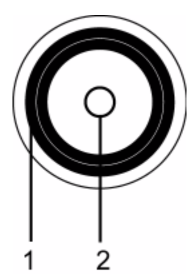
Table 3-2. Probe Power Port Pinout



Pin	Description
1	+15 Vdc at 130 mA
2	Ground
3	-12.6 Vdc at 45 mA

- **Tracking Generator Output Port:** Not used at this time.
- **RF Input Port:** Ruggedized N-style connector, +30 dBm @ 50Ω, MAXIMUM ZERO (0) Volts DC from 100 Hz to 8 GHz input.

Table 3-3. RF Input Port



Pin	Description
1	Outer Shield and Screw Fastener
2	Center Pin

- **Source Output Port:** Not used at this time.

DVD-ROM/CD-RW Drive

The DVD-ROM/CD-RW drive is capable of reading digitally stored data on a variety of CD media. The drive is also capable of writing digital data to CD-R and CD-RW media. You can use either 12 cm or 8 cm diameter media. The DVD-ROM/CD-RW drive supports ATA Packet Interface (ATAPI), revision 2.6. Performance specifications for the drive are listed in Table 3-4.

Table 3-4. DVD-ROM/CD-RW Performance Specifications

Function	Specification
Compatible Read Disk Types	CD-DA, CD+(E)G, CD-MIDI, CD-TEXT, CD-ROM, CD-ROM XA, MIXED MODE, CD-I, CD-I BRIDGE (PHOTO-CD, VIDEO-CD), CD-R, CD-RW, and MULTISESSION (PHOTO-CD, CD EXTRA, PORTFOLIO), DVD-ROM (DVD-5, DVD-9, DVD-10, DVD-18), DVD-R (VER 1.0 and 2.0), DVD-RW (VER 1.1), DVD-RAM (VER 2.1)
Compatible Write Disk Types	CD-R and CD-RW of types listed above
Compatible Write Format	Disk at Once Track at Once Session at Once Packet Write
Data Capacity (write)	Mode 1: 2048 Bytes/Block 656.5 Megabytes/Disk Mode 2: 2336 Bytes/Block 748.8 Megabytes/Disk
Access Time	DVD-ROM: 100 ms DVD-RAM: 170 ms CD-ROM: 90 ms
Maximum Read Speed	CD-ROM: 24 Times DVD-ROM: 8 Times
Maximum Sustained Data Transfer Rate (read)	CD-ROM Mode 1: 3600 Kilobytes/sec. CD-ROM Mode 2: 4104 Kilobytes/sec. DVD-ROM Single: 10,820 Kilobytes/sec.
Maximum Write Speed	CD-R: 24 Times CD-RW: 4 Times (10 times for high speed CD-RW media)
Maximum Rotational Speed	5100 RPM (CD-ROM, CD-R)
Data Buffer Capacity	2 Megabytes

Caution: Do not use storage media that is of the incorrect type, such as improperly formatted CDs.
Do not insert more than one disk at a time into the drive tray.
Do not use excessive force when loading or ejecting disks.
Failure to follow these cautions could result in loss of data or damage to the equipment.

Manually Ejecting the DVD-ROM/CD-RW Drive Tray

If the CD-RW drive tray fails to eject, a paper clip can be used to release the tray for manual ejection.

Before proceeding, power down the instrument and remove the power cord from the rear panel power receptacle.

Step 1. To release the drive tray, insert a 1.0 mm diameter paper clip into the manual release hole as shown in Figure 3-6.

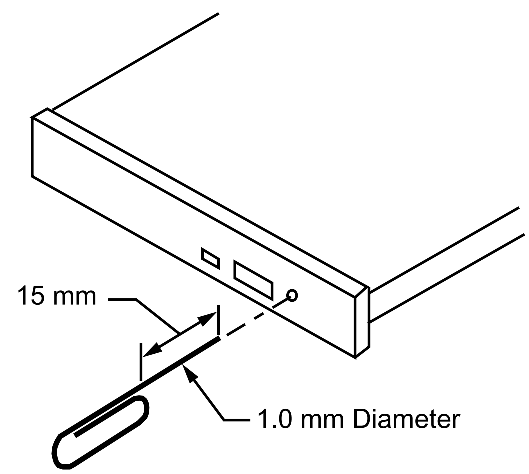


Figure 3-6. Manually Ejecting the CD-RW Drive Tray

Step 2. Gently slide the tray open and remove your disk from the drive tray.

Step 3. Remove the paper clip and carefully slide the drive tray completely closed.

If the drive tray does not slide smoothly, or there is excessive resistance, the mechanism may be damaged and in need of service from an authorized Anritsu service center.

3-3 Instrument Startup and Shutdown

During power-up, the system goes into a “startup” state in which a self-test checks all of the sub-systems for proper operation; the firmware is also downloaded into the various peripheral devices. During this time, an informational splash screen is shown as illustrated below:

Figure 3-7. Startup Splash Screen

Changing Setups

When a parameter is changed via the front panel, or a message is received containing new setup information, the system validates the requested change, and then goes into the “setup” state while the new setup information is assimilated. When the new setup information is processed, the system returns to the measure state. You may observe a momentary delay during this process, which is normal.

Calibration State

The system enters a calibration state when you request it or when the system determines that calibration is necessary. In this calibration state, the analog receiver and LO hardware is calibrated and the results saved for use in measurement corrections. Upon completion, the system returns to the measure state.

Instrument Preset

The instrument can be set to a known state by pressing the **Preset** key or by a command via the remote programming interface (GPIB or LAN). Pressing the front panel Preset key will open the Preset main menu. From this menu, the user selects the **Preset** menu item and the instrument will then go through a sequence similar to startup by loading the default measurement parameters to the hardware.

Instrument Shutdown

To shut down the instrument, press and hold the front panel Power key for longer than one second, or select “Shut Down” from the Start menu. Windows will begin the shutdown process and automatically close open applications. It is not advised to turn the power off at the rear panel or pull the power cord until Windows has been properly shut down.

Note: After turning off the instrument, you must wait at least 10 to 15 seconds before turning the instrument back on again. This delay is required to allow the internal power supplies to discharge and to assure a reliable cold start.

3-4 Graphical User Interface Overview

This section provides descriptions of the front panel graphical user interface, here forth referred to as the GUI. The GUI is the LCD touch screen that can be accessed through direct touch or with a pointing device such as a mouse. Figure 3-8 shows an annotated GUI.

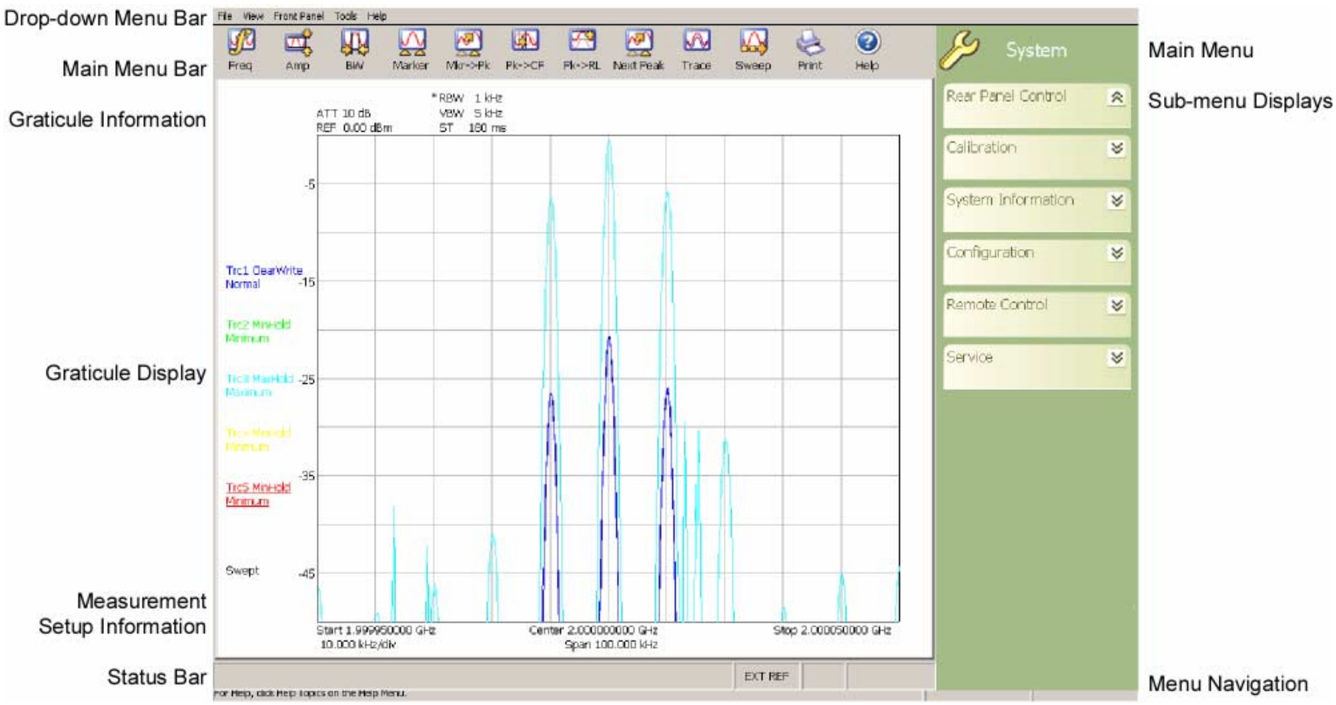


Figure 3-8. MS278XA Graphical User Interface

The major elements displayed on the LCD screen are the:

- MS-Windows style Drop-down Menu Bar
- Main Menu Bar
- Graticule and Measurement Setup Information
- Graticule and Data Display
- Main Menu Bar with Sub-menu Trees
- Instrument Messages and Status Bar

Warning: Do not use sharp objects, such as a pen or pencil, to touch the screen as damage may result.

Drop-down Menu Bar

The drop-down menus along the top of the screen conform to MS-Windows standards. They provide consistent application interfacing as that found in standard MS-Windows applications. In addition, there are menu selections that allow you to activate the major/minor functions found on the front panel assembly.

Figure 3-9. Drop-down Menu Bar

File

The File drop-down menu provides access to saving and recalling instrument setups, exporting trace data, opening Windows Explorer, printing trace data, or exiting the instrument application. The File drop-down menu can be quickly accessed using the Alt-F keyboard combination.

Figure 3-10. File Drop-down Menus

View

The View drop-down menu provides access to display control and facilitates access to the Windows Taskbar. The View drop-down menu can be quickly accessed using the Alt-V keyboard combination.

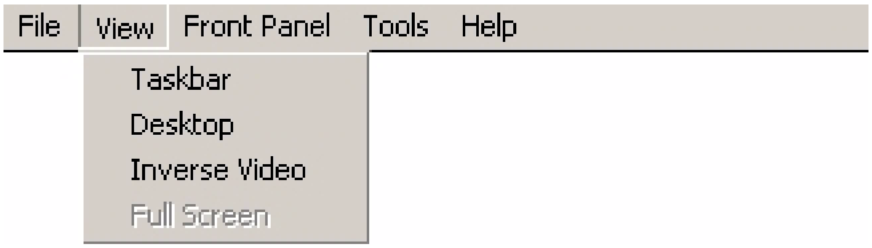


Figure 3-11. View Drop-down Menus

Taskbar
When you select Taskbar, the Windows Taskbar will be displayed allowing you to access the Windows operating system and other third party software applications.

Desktop
This menu selection minimizes all open windows and shows the desktop.

Inverse Video
The Inverse Video selection inverts the video colors of the graph area. This is useful to enhance the contrast between certain colors and for extracting graphical data to display in print format.

Full Screen
Enabling full screen will show the graph area in full screen with the absence of the menus and toolbar areas. To escape from Full Screen, press the Esc key on the keyboard. This feature is not available at this time and the selection is greyed out.

Front Panel

The Front Panel drop-down menu provides access to all of the instrument's main menus and sub-menus. This is useful when the instrument is being accessed via the remote desktop feature. The Front Panel drop-down menu can be quickly accessed using the Alt-P keyboard combination.

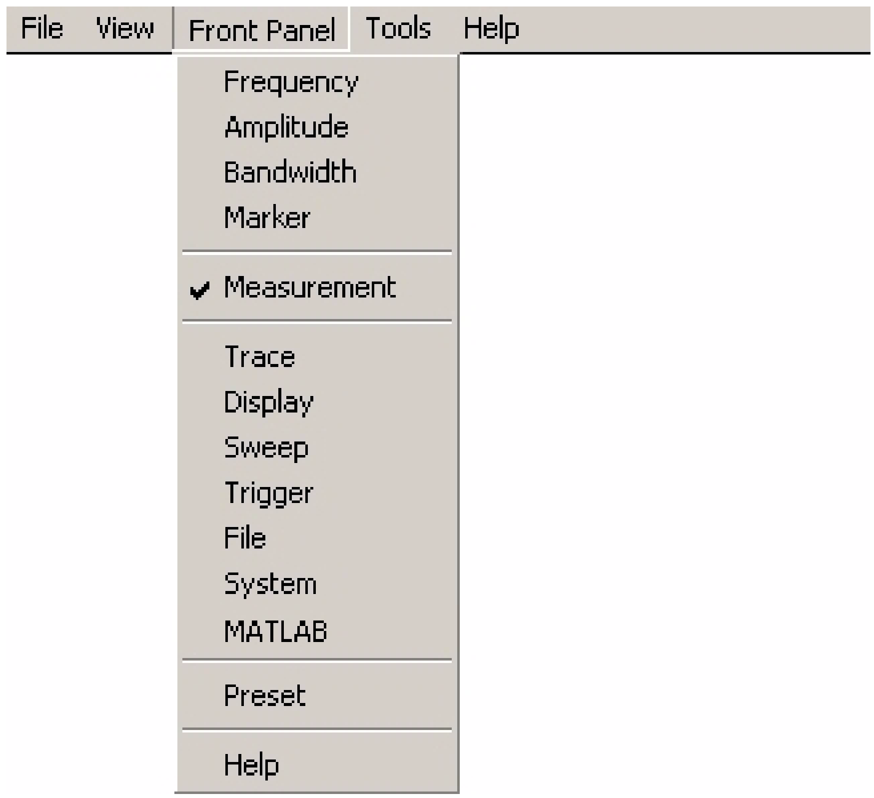


Figure 3-12. Front Panel Drop-down Menus

Refer to the following for more information:

- Frequency Main Menu on page 4-6
- Amplitude Main Menu on page 4-9
- Bandwidth Main Menu on page 4-12
- Marker Main Menu on page 4-15
- Measurement Main Menu on page 4-18
- Trace Main Menu on page 4-21
- Display Main Menu on page 4-23
- Sweep Main Menu on page 4-25
- Trigger Main Menu on page 4-27
- File Main Menu on page 4-33
- System Main Menu on page 4-29
- MATLAB Setup Dialog on page 4-51

Tools

The Tools drop-down menu provides access to the Customize Tool Bar dialog and MATLAB. The Tools drop-down menu can be quickly accessed using the Alt-T keyboard combination.

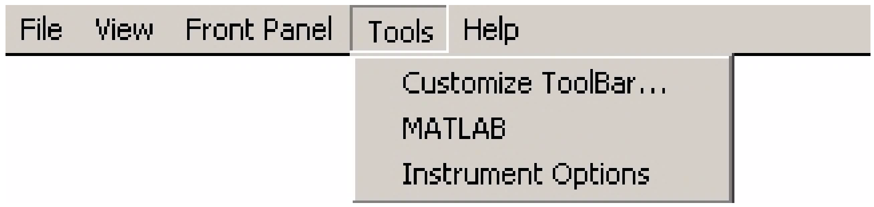


Figure 3-13. Tools Drop-down Menus

Customize ToolBar...
This menu selection opens the Configure Toolbar dialog. Refer to Customizing the Tool Bar on page 2-32 for information about configuring the tool bar.

MATLAB
This menu selection opens the MATLAB dialog. Refer to Signature–MathWorks Connectivity (Option 40 only) on page 7-3 for information about using MATLAB.

Instrument Options
This menu selection opens the Options dialog, which displays the options list and indicates which options are installed. Refer to Analyzer Configuration on page 2-30 for information about installing new options.

Help

The Help drop-down menu provides access to the Signature Help System, system updates, technical support, and the "About Anritsu Signature..." dialog. The Help drop-down menu can be quickly accessed using the Alt-H keyboard combination.

Figure 3-14. Help Drop-down Menus

Contents and Index
This menu selection provides quick access to the navigation pane of the Signature Help System. This navigation pane also provides a text based search feature to help you find information within the Help system.

Documentation
This menu selection opens Windows Explorer to the directory where product support documentation can be found.

Anritsu Web
This menu selection opens Internet Explorer to the Anritsu Web site, if an internet connection is available.

About Anritsu Signature
The About Anritsu Signature dialog contains information about the analyzer's software, provides a legal disclaimer, and offers a link to the Window's system information file.

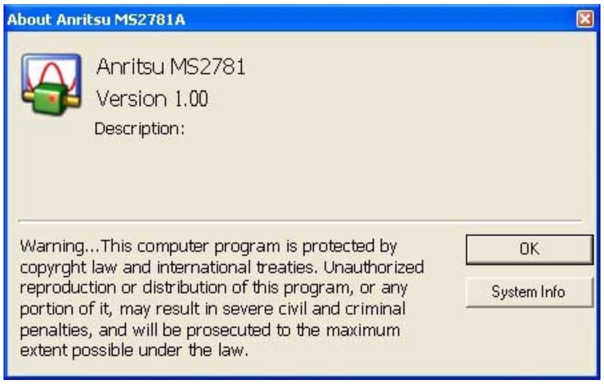


Figure 3-15. Help | About Dialog

Main Menu Bar

The Main Menu bar contains a set of icons that access the analyzer's measurement and setup configuration sub-menus. Pressing an icon will refresh the sub-menu tree with the related set of sub-menus. The Main Menu bar can also be customized to display the icons you use most often. Each available icon is detailed in Table 3-5, below:

Table 3-5. Main Menu Bar Icon List

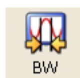
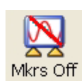
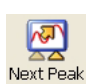
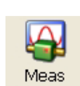
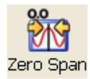
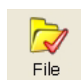
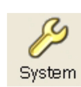
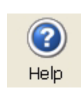
Icon	Description
	The Frequency icon opens the "Frequency Main Menu" on page 4-6.
	The Amplitude icon opens the "Amplitude Main Menu" on page 4-9.
	The Bandwidth icon opens the "Bandwidth Main Menu" on page 4-12.
	The Marker icon opens the "Marker Main Menu" on page 4-15.
	The Mkrs Off icon turns off all of the markers.
	The Mkr->Pk icon turns on the active marker (if no active markers are on) and sends the current active marker to the trace peak.
	The Pk->CF icon turns on the active marker (if no active markers are on), sends the current active marker to the trace peak, and changes the center frequency of the sweep to the trace peak frequency value.
	The Pk->RL icon turns on the active marker (if no active markers are on), sends the current active marker to the trace peak, and changes the reference level of the graticule to the trace's peak amplitude value.
	The Next Peak icon turns on the active marker (if no active markers are on) and sends the current active marker to the trace peak (or to the next trace peak if the active marker is already on).
	The Measurement icon opens the "Measurement Main Menu" on page 4-18.

Table 3-5. Main Menu Bar Icon List

Icon	Description
	The Trace icon opens the “Trace Main Menu” on page 4-21.
	The Sweep icon opens the “Sweep Main Menu” on page 4-25.
	The Zero Span icon sets the span to zero span.
	The Last Span icon recalls the previous span setting.
	The Trigger icon opens the “Trigger Main Menu” on page 4-27.
	Use the File icon to open and save instrument setups and configurations. See “File Main Menu” on page 4-33.
	Use the Print icon to send the graticule display, setup and configuration files, or measurement data to the printer.
	The Preset icon presets the instrument.
	The System icon opens the “System Main Menu” on page 4-29.
	The Help icon accesses the Signature Help system. Press this icon to enable context sensitive help and to display help topics in the graph area. Press the Help icon again to toggle the display back to the measurement data.
	The MATLAB icon accesses the “MATLAB Setup Dialog” on page 4-51.

Sub-menu Trees

After pressing one of the Main Menu icons, the main menu tree is updated with the related sub-menus. Each sub-menu and its related functions are documented in Chapter 4. A comprehensive list of menus is shown in Figure 3-16, below:

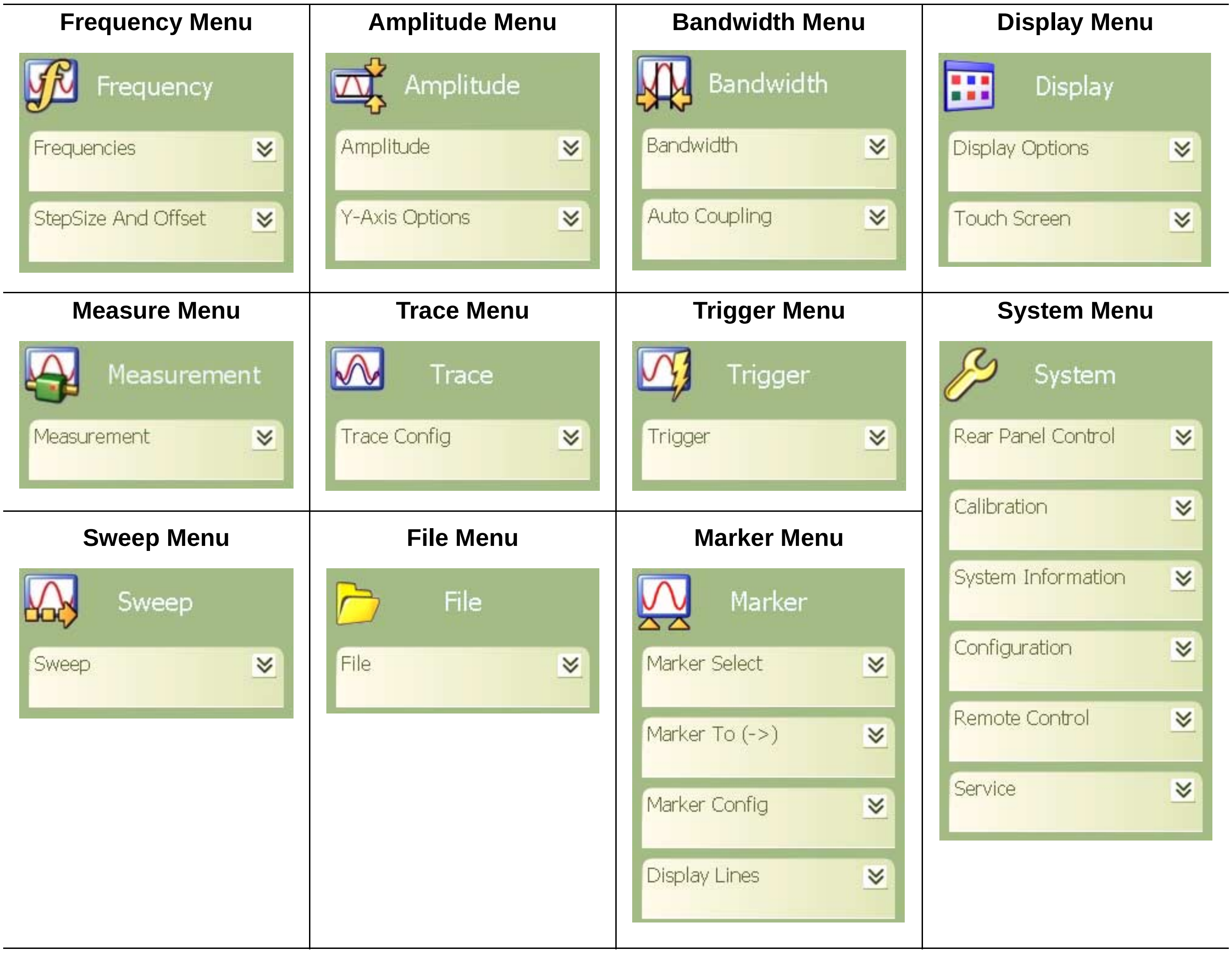


Figure 3-16. Graphical List of Menus

Only one sub-menu can be expanded as needed by pressing the sub-menu header. When a new sub-menu is expanded, the previous sub-menu automatically collapses. The sub-menus have a generalized behavior that is common throughout the system. This behavior is described in the following paragraphs for each type of menu control.

Entering Data and Fly-out Menus

Data parameter entry fields, such as center frequency or reference level, are accessed by pressing in the parameter field. Pressing in a parameter field makes it active and is indicated by a shaded background with a blinking cursor. When new menus are accessed, the default parameter field is automatically made active. The active parameter field's value can be incremented by using the rotary knob for fine steps or the increment keys for coarse steps that follow the 1, 2, 3, 5 convention. Numerical data can also be entered directly by using the keypad once the parameter field is made active.

When data is entered, a Fly-out menu flies out offering a variety of appropriate units, selections, or a terminator operation, such as Enter or Cancel. Fly-out menus work in conjunction with the main menu area and in some dialog boxes.

Figure 3-17 below illustrates the terminator fly-out menus that you may encounter when entering data:

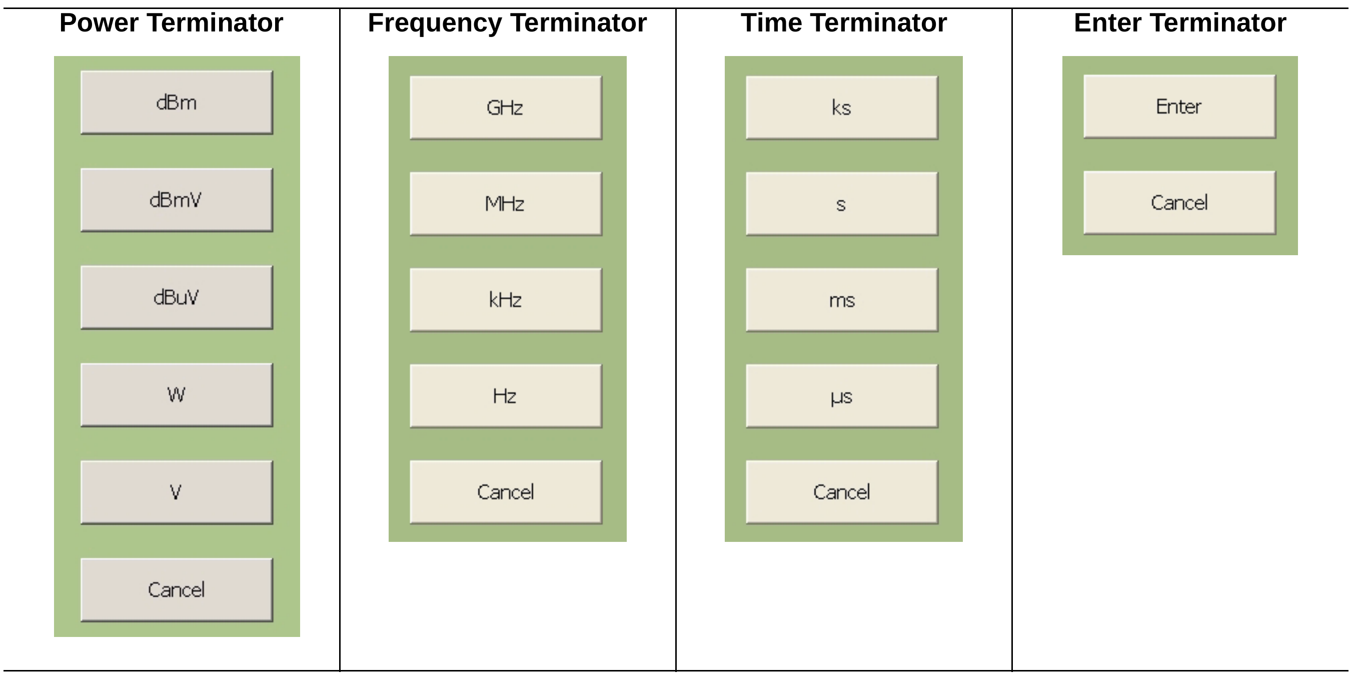


Figure 3-17. Terminator Fly-out Menus

Figure 3-18, below, illustrates most of the selection fly-out menus that you may encounter when entering data:

Figure 3-18. Selection Fly-out Menus

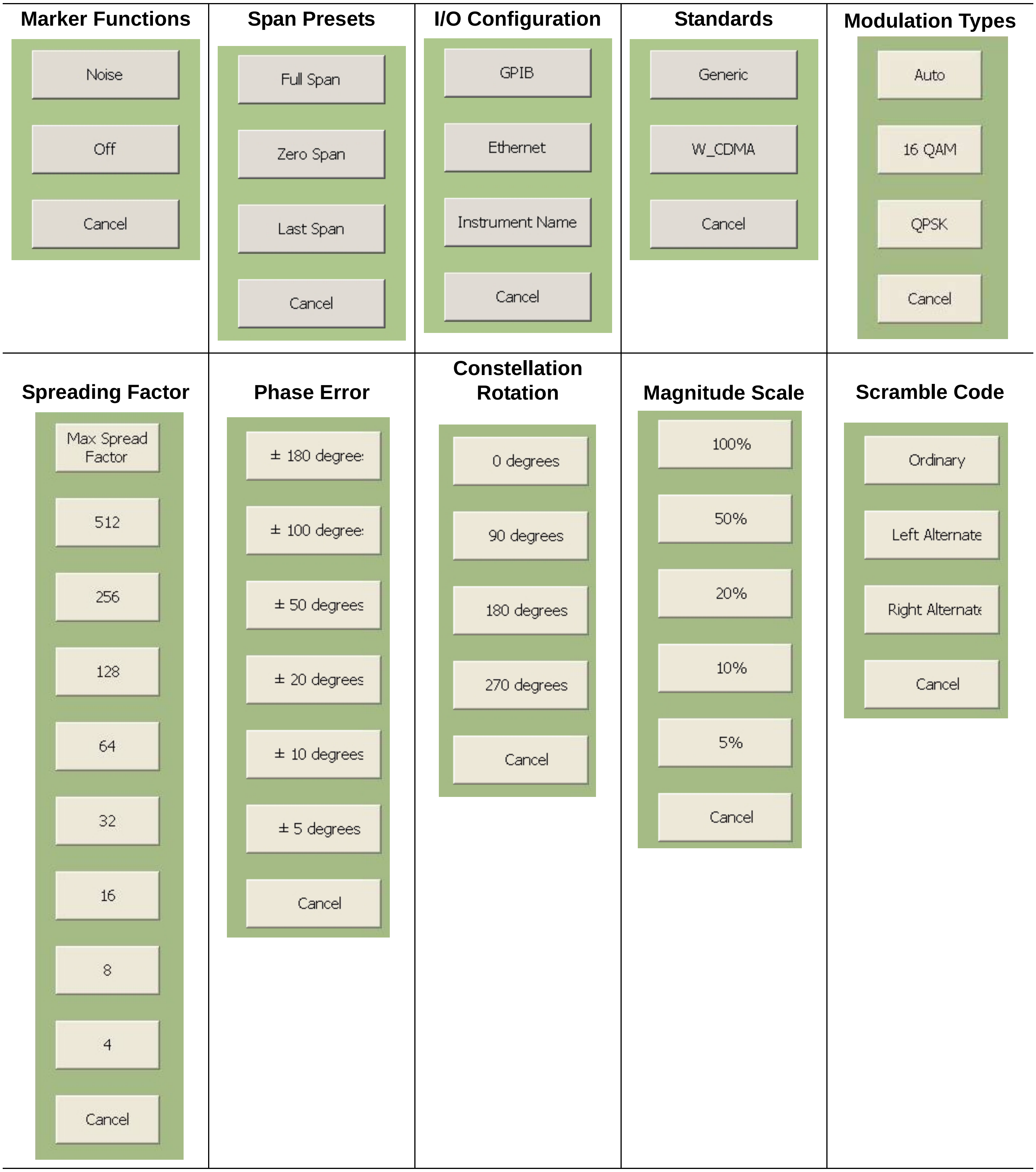


Figure 3-18. Selection Fly-out Menus

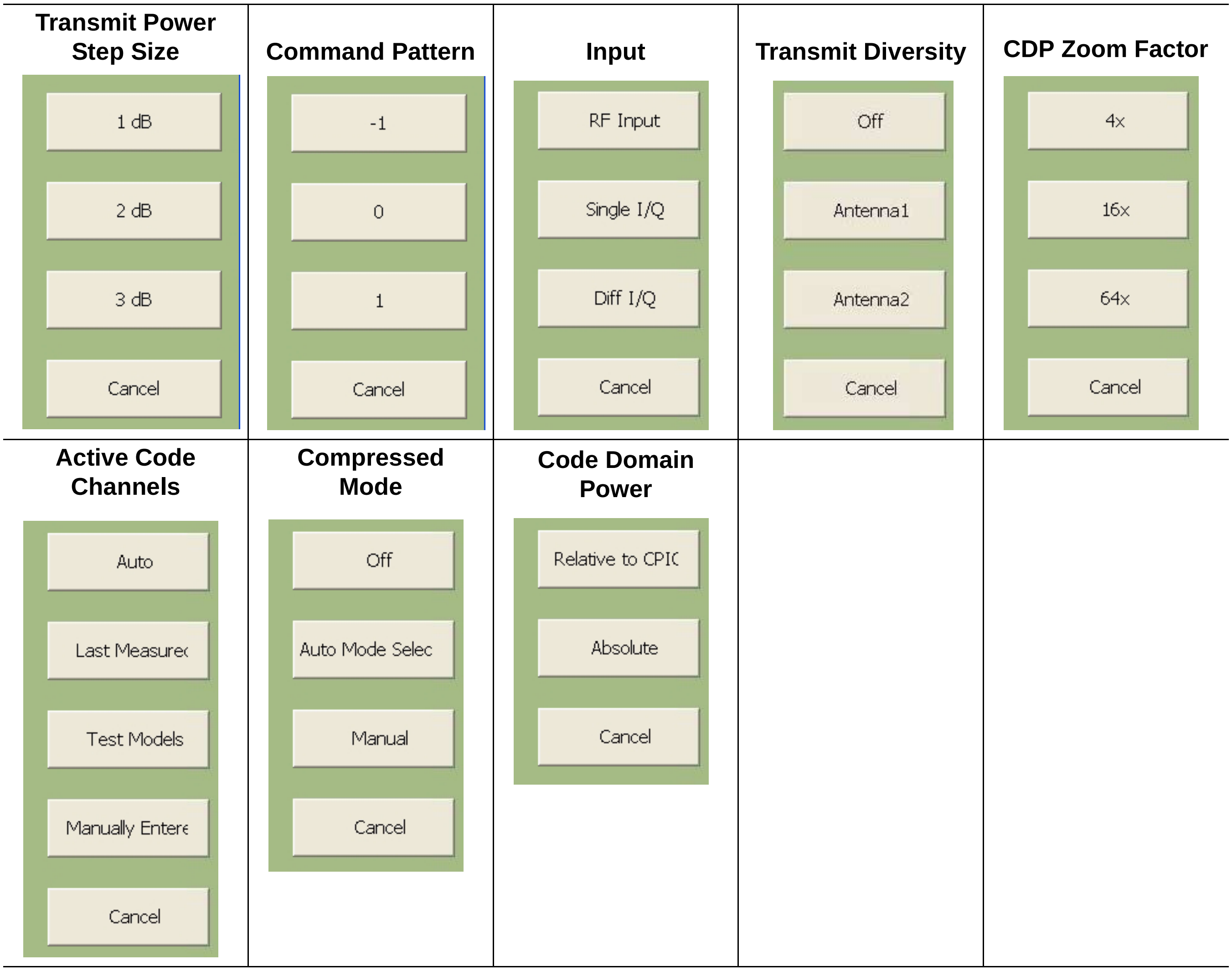


Figure 3-18. Selection Fly-out Menus

Toggle Buttons

Several menus offer a simple on/off type of mode selection. When these controls are present, there is a check mark indicating the current selection. To toggle the selection to the other mode, press on the control button. Figure 3-19 below illustrates the toggle buttons that you may encounter in menus:

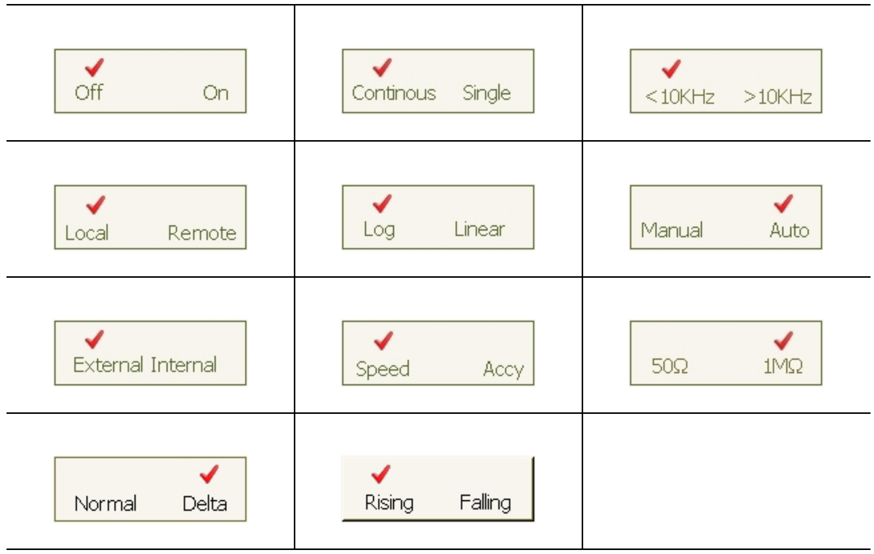


Figure 3-19. Toggle Buttons

Note: Control buttons that appear greyed out do not have functionality. This occurs when the function is not appropriate for the particular instrument setup or mode of operation.

Drop-down Selection Menus

Many menus offer drop-down selections that contain a variety of choices. To access a drop-down selection menu, press on the down arrow for the parameter you would like to change and the drop-down selections will expand. To make a selection, press on one of the choices, then press Done. The current selection is highlighted at the top of the drop-down selection menu. Figure 3-20 below illustrates a drop-down selection menu:

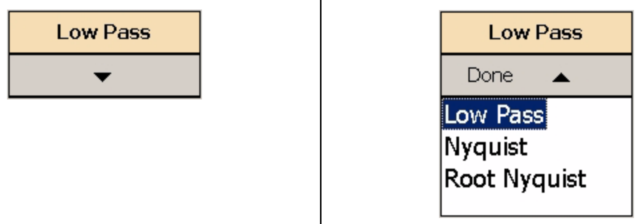


Figure 3-20. Drop-down Selection Menu

> **Note:** A selection may also be entered with a rapid double press of the selection or by highlighting the selection, then pressing the Enter key on the front panel or keyboard.

Parameter Entry and Measurement Setup Dialogs

Parameter entry and measurement setup dialogs are used throughout the system to provide direct access to related parameters for a given context. These dialogs will generally look like the one shown in Figure 3-21, below.

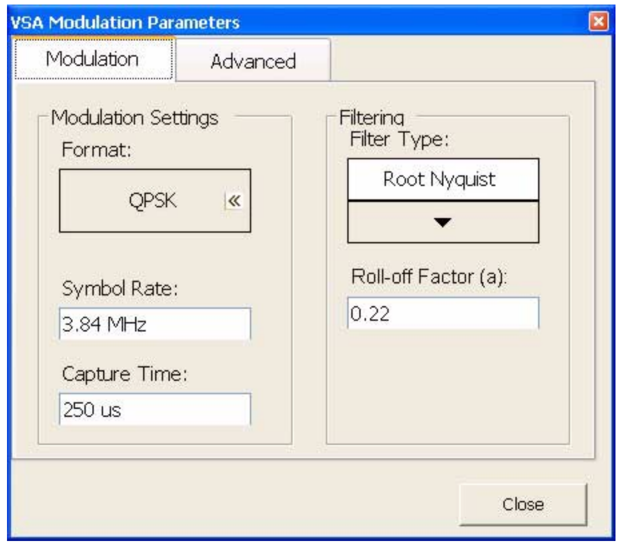


Figure 3-21. Parameter Entry and Measurement Setup Dialog

Not all parameters are set by using dialogs. Only those functions that have a complex set of parameters to set use dialogs. Most SPA functions use parameter entry fields and buttons in the sub-menu display to set their measurement parameters. Many VSA functions use dialogs to set their measurement parameters. Refer to Parameter Entry and Measurement Setup Dialog Archive on page 4-35.

Wizards

"Wizards" have a common appearance and behavior defined within the paradigm of MS-Windows. Figure 3-22 shows an example of what a hardware troubleshooting wizard looks like. Most Wizards are easy to follow and provide enough direction for you to complete the procedures.

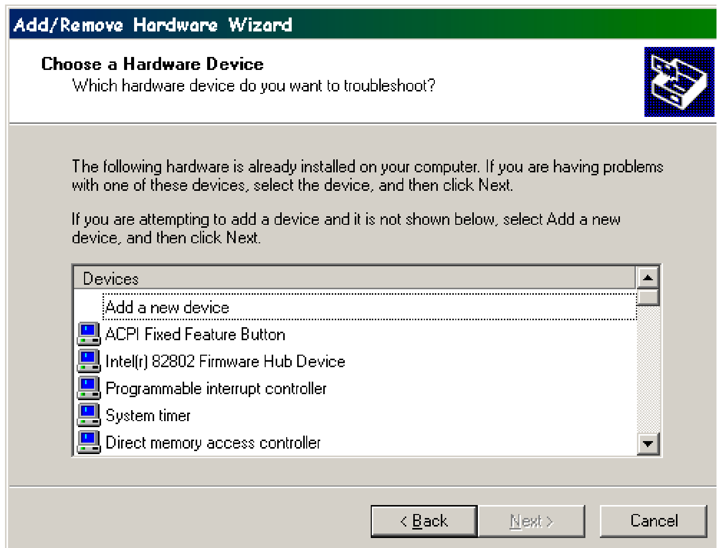


Figure 3-22. MS278XA Setup Wizard

Alpha-Numeric Entry

Alphanumeric entry can be accomplished through an external physical keyboard or through the on-screen software keyboard. Figure 3-23 shows the on-screen keyboard interface.

Figure 3-23. MS278XA On-Screen Keyboard

The on-screen keyboard functions the same as most common keyboards. You simply press the key that you want to enter. Additional settings are available through the drop-down menus on the keyboard interface window. The on-screen keyboard is accessed through the Windows Taskbar (View | Taskbar) by pressing:

Start | Programs | Accessories | Accessibility | On-Screen Keyboard

Graticule

The Graph area is the main container for all of the measurement displays. The primary element in this area is the trace data on a graticule display. Annotations provide feedback on the instrument's hardware setup for the measurement as well as measurement related warnings and status messages outside of the graticule area.

Spectral Analysis Graticule Displays

Figure 3-24 shows a typical display while in the spectral analysis mode. Most of the informational annotations are indicated. Table 3-6 provides a detailed description of each of the display elements.

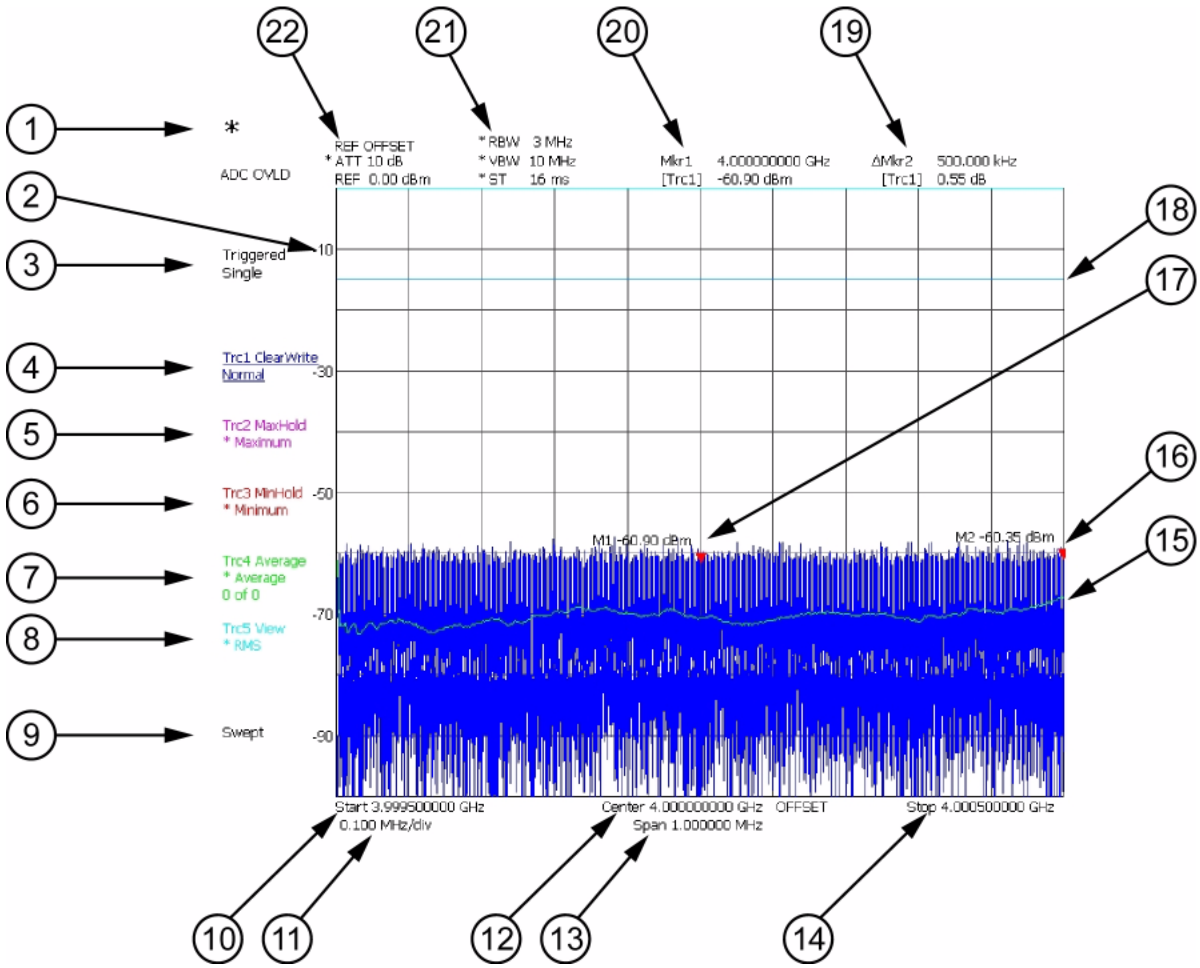


Figure 3-24. Spectral Analysis Graticule

Table 3-6. Spectral Analysis Graticule Legend

Index	Description
1	**Status Indicator:** This indicator (asterisk) is displayed when the current instrument setup does not correspond to the one which was applied when a trace is displayed. This happens when: The instrument setup is modified when the Sweep mode is set to Single and a new sweep has not yet been triggered. The instrument setup is modified in the middle of a measurement. The measurement is re-started with the new setup and this indicator is shown until the entire trace is re-written.
2	**Y-axis Scale:** The Y-axis scale is labeled every other major grid line.
3	**Sweep Status:** Displays the sweep status of Triggered and Single sweep modes.
4 to 8	**Trace Information:** Trace information is displayed in the following format (the current active trace has the text underlined): Trc<n> <Trace State> <Detector Mode> <Trace Math> Where: **n:** Trace Number (1 to 5) **Mode:** Trace Mode (Clear Write, Max Hold, Min Hold, View, or Average) **Detector:** Detector Type (Auto, Normal, Max Peak, Min Peak, Sample, RMS, or Average) **Trace Math:** Trace Math indicator.
9	**Sweep Mode:** This field is used to display the sweep modes of Swept, FFT (Fast Fourier Transform), or FFT-WB (Wideband).
10	**Start Frequency:** Indicates the start frequency of the sweep.
11	**Frequency/Division:** This field indicates the horizontal scaling per division.
12	**Center Frequency:** Indicates the center frequency of the sweep. If a frequency offset is set, OFFSET is also displayed.
13	**Span Frequency:** Indicates the total span of the frequency sweep.
14	**Stop Frequency:** Indicates the stop frequency of the sweep.
15	**Trace Display:** Up to five traces can be displayed using the following colors: Trace 1--Yellow, Trace 2--Green, Trace 3--Cyan, Trace 4--Magenta, Trace 5--Red
16	**Marker Display:** Markers are annotated with the absolute power level next to the marker location.
17	**Marker Display:** Markers are annotated with the absolute power level next to the marker location.
18	**Display Line:** A display line may be displayed at any desired level. Display lines are shown in Red color.
19	**Active Marker Field:** The active marker number, frequency, and amplitude values are displayed in this field. The trace that has received the marker is indicated in brackets. If the Marker is a Delta Marker, the delta symbol (Δ) precedes the Mkr number and the values displayed are relative to the reference marker.
20	**Reference Marker Field:** The reference marker number, frequency, and amplitude values are displayed in this field. The displayed values are absolute in magnitude.
21	**Bandwidth Setup:** The bandwidth setup field displays the current Resolution Bandwidth, Video Bandwidth, and Sweep Time settings. If the settings are manually entered, an asterisk is displayed.
22	**Amplitude Setup:** The amplitude setup field displays the current attenuation level, reference level, and reference level offset. If the attenuation is set manually, an asterisk is displayed.

Data Displays

The following figures (Figure 3-26 to Figure 3-29) show the measurement tables that are displayed for the one-button RF measurements.

Marker Table

Marker	Frequency	Amplitude	Delta Ref
Mkr1(Trc1)	4 GHz	-77.60 dBm	
Mkr2(Trc1)	2 GHz	-74.00 dBm	
Mkr3(Trc1)	6 GHz	-66.80 dBm	
Mkr4(Trc1)	3 GHz	9.00 dB	Mkr1
Mkr5(Trc1)	4 GHz	-142.40 dBm/Hz	

Figure 3-25. Marker Table with Delta and Noise Marker

Occupied Bandwidth

OBW	4.2 MHz	% Power	99 %
26 dB BW	4.64 MHz		

Figure 3-26. Occupied Bandwidth Measurement Table

Third Order Intercept

Marker	Frequency	Amplitude	TOI
Mkr1	2.0005 GHz	1.72 dBm	31.99 dBm
Mkr2	1.9995 GHz	1.72 dBm	
Mkr3	1.9985 GHz	-58.82 dBm	
Mkr4	2.0015 GHz	-70.15 dBm	

Figure 3-27. Third Order Intercept Measurement Table

Channel Power

Power	-12.287 dBm	Channel Bandwidth	5 MHz

Figure 3-28. Channel Power Measurement Table

Adjacent Channel Power

Tx Channel				
	Power	-5.868 dBm	Bandwidth	5 MHz
Adj Channel				
	Upper	-60.300 dBm	Bandwidth	5 MHz
	Lower	-60.875 dBm	Spacing	5 MHz

Figure 3-29. Adjacent Channel Power Measurement Table

Multicarrier Power

Channel #	Power	Adjacent Channel		
1	-9.090 dBm		Upper	-53.900 dB
2	-9.200 dBm		Lower	-54.160 dB
3	-9.190 dBm	Alt1 Channel		
4	-9.290 dBm		Upper	-55.940 dB
			Lower	-56.130 dB

Figure 3-30. Multi-Carrier Power Table

Vector Signal Analysis Graticule Displays

Figure 3-31 shows trace data while using the various modulation graph types indicated below:

- Vector Graph Type
- EVM/Time Graph Type
- Constellation Graph Type
- Power/Time Graph Type
- Eye(I) Graph Type
- Eye(Q) Graph Type

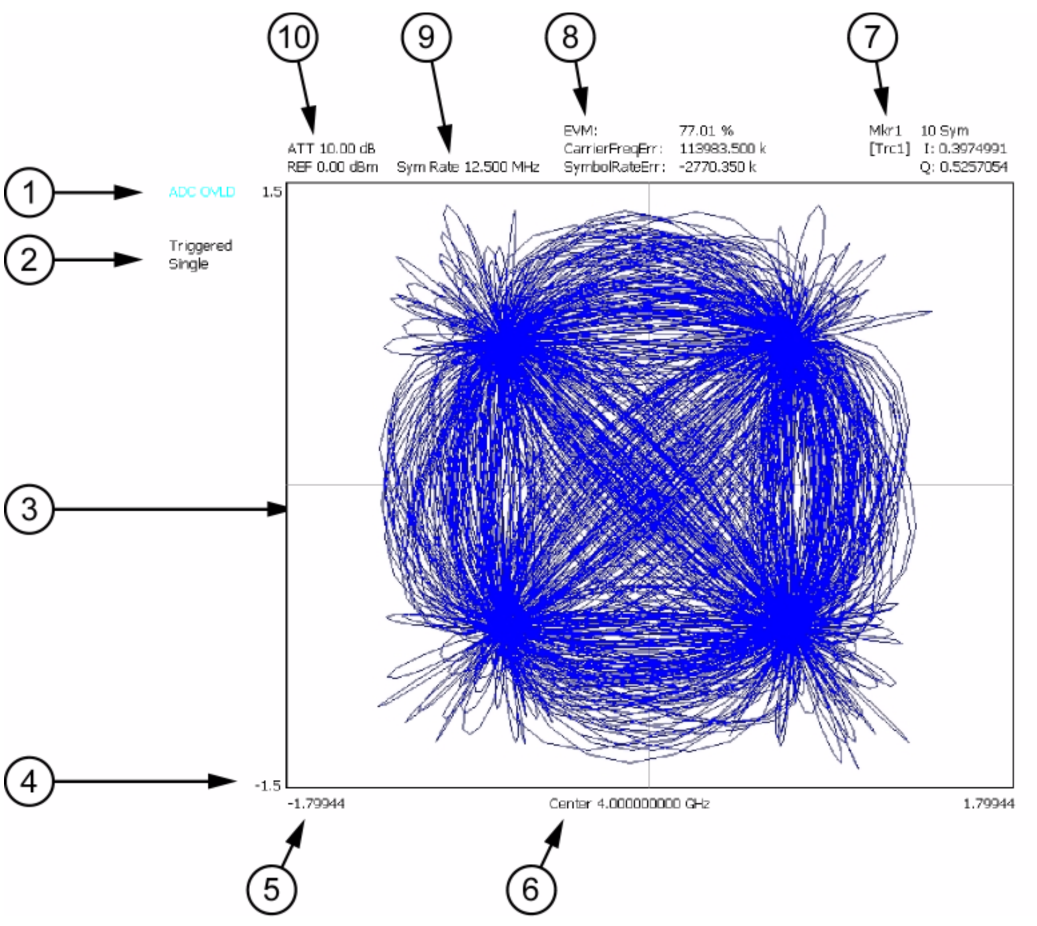


Figure 3-31. Vector Signal Analysis Graticule

Table 3-7. Vector Signal Analysis Graticule Legend

Index	Description
1	**Input Status:** Indicates ADC overload and L.O. unlock.
2	**Sweep Status:** Displays the sweep status of Triggered and Single sweep modes.
3	**Trace Display:** Vector trace data is displayed in Yellow.
4	**Y-axis Scale:** This scale shows the normalized I and Q range when in the Vector, Constellation, Power vs. Time, and Eye graph types; it shows percentage error (%) when in the EVM graph type.
5	**X-axis Scale:** This field shows the Symbols or Time.
6	**Center Frequency:** Indicates the center frequency of the sweep. If a frequency offset is set, OFFSET is also displayed.
7	**Marker Information:** Displays the Symbol and I and Q magnitude.
8	**Error Data:** Displays the error vector magnitude, carrier frequency error, and symbol rate error.
9	**Symbol Rate:** Displays the current symbol rate
10	**Amplitude Setup:** The amplitude setup field displays the current attenuation level and reference level. If the attenuation is set manually, an asterisk is displayed.

The Summary graph type displays the position and value (bits) of the demodulated signal.

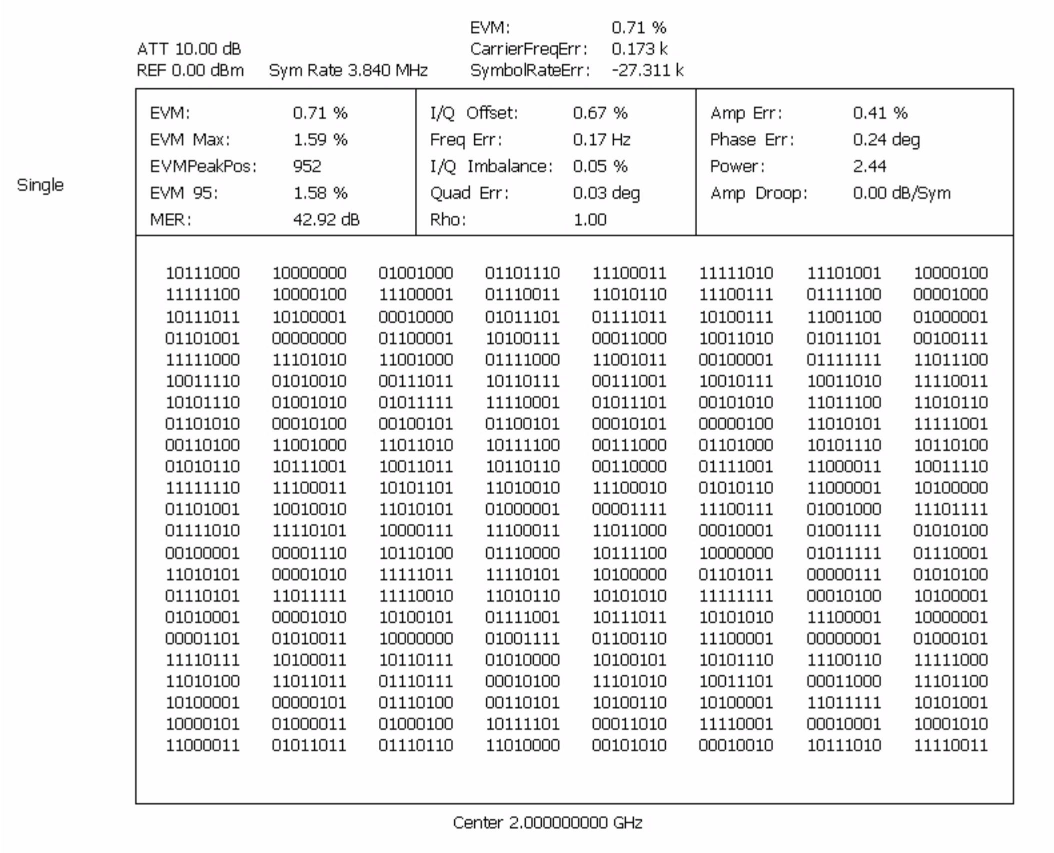


Figure 3-32. QPSK Summary Display

Figure 3-33 is a summary table showing the key modulation quality measurements and the bit stream for one of the codes.

Note that the bit stream can be very long in some cases. If you have captured the full 8 slots and have a High-Speed (HSDPA) signal, there can be many pages of the bit stream. The scroll buttons at the right facilitate viewing all of this information.

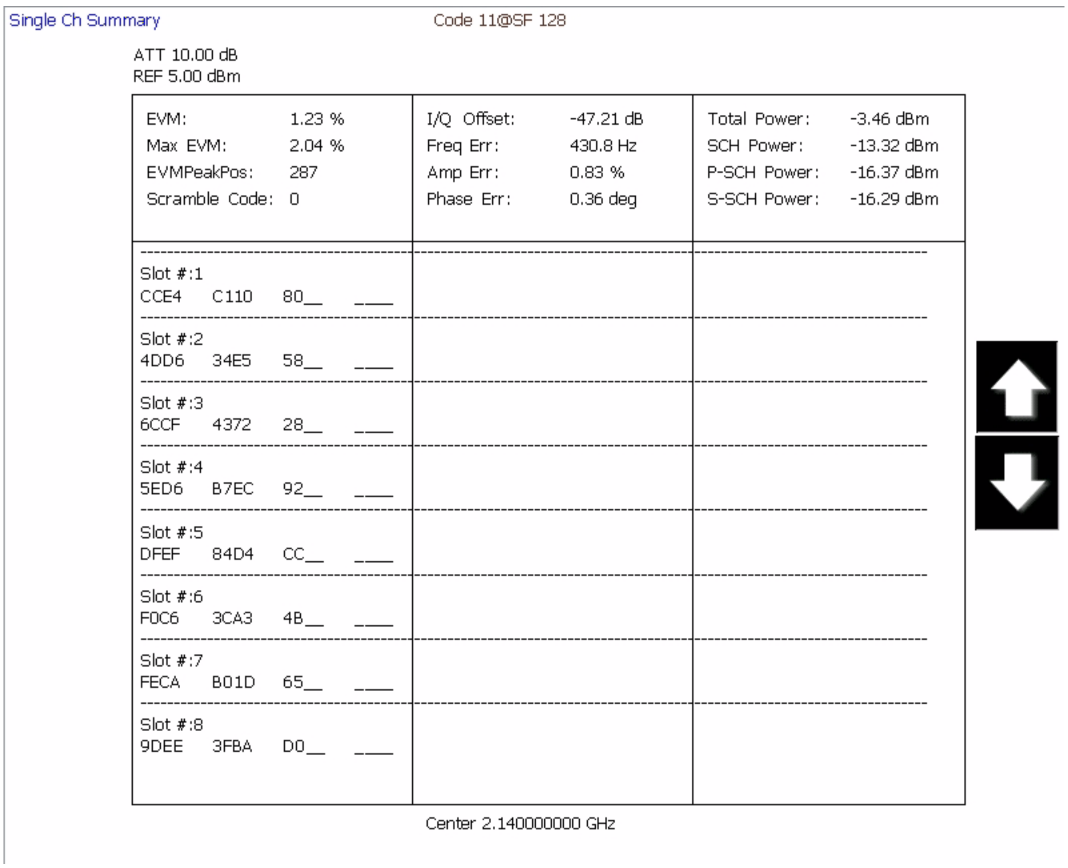
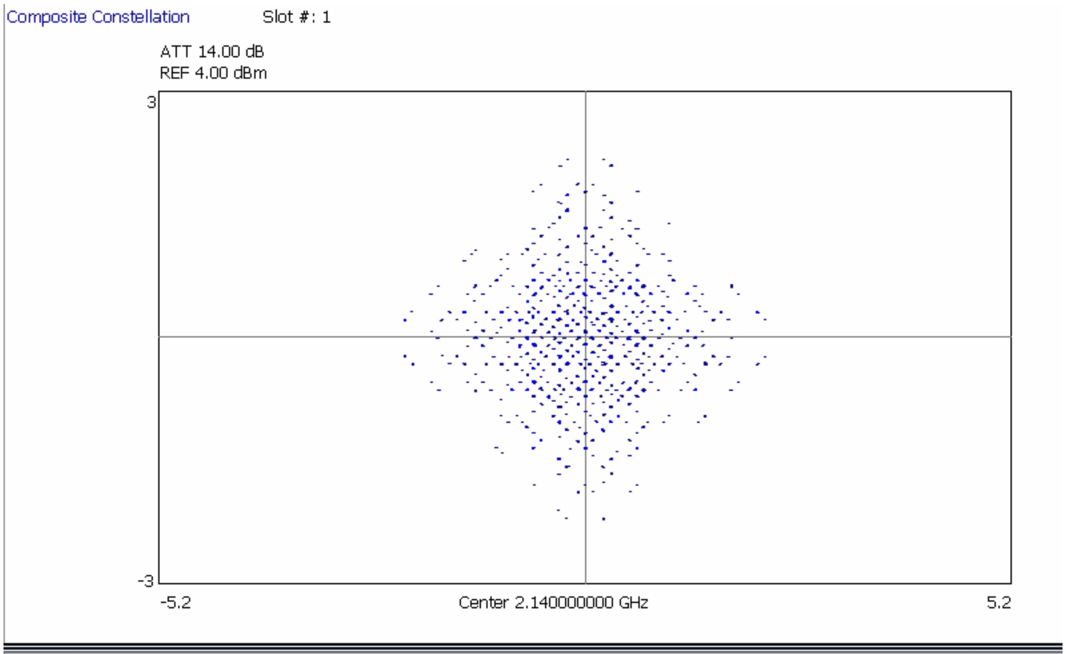


Figure 3-33. Single Code Summary Table

Signature can also display a variety of data combinations as shown in the following figures.



EVM:	0.76 %	I/Q Offset:	-57.96 dB	Total Power:	-5.28 dBm
Max Composite EVM:	2.00 %	Freq Err:	441.80 Hz	SCH Power:	-15.24 dBm
Peak CodeDomain Error:	-56.75 dB	Amp Err:	0.53 %	P-SCH Power:	-18.22 dBm
EVMPeakPos:	875	Phase Err:	0.31 deg	S-SCH Power:	-18.29 dBm
Scramble Code:	0	Rho:	0.999930		

Figure 3-34. Composite Constellation with Summary Table of Test Model 2

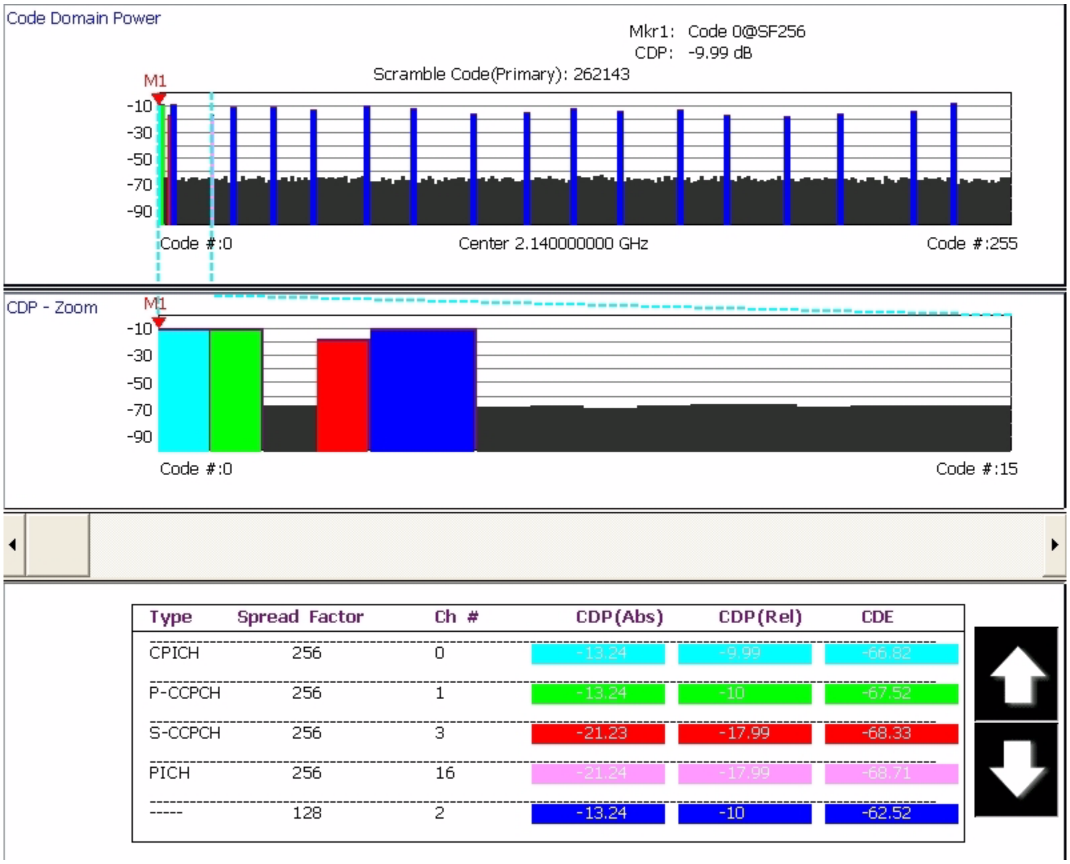


Figure 3-35. Code Domain Power for Test Model 1 with Zoom and Summary Table

For more detail about making modulation measurements and setting up the displays, refer to the appropriate sections in Chapter 6.

Instrument Messages and Status Bar

The Status Bar Area is used for instrument wide messages to show Status, Warnings, Errors, etc. Typically, any warning messages displayed in this area will be shown until you perform some action on the interface. Error indicators are persistent until you have viewed (and cleared) the error log.

Figure 3-36. Instrument Status Bar

General Status Messages

The status bar indicates the status of items, such as calibration in progress, FFT is in acquisition or computation, startup, self test, etc. General status messages are displayed in the left field of the status bar, for example, EXT REF.

Warning Messages

Warning messages are displayed in the center field of the status bar. These messages indicate that there is an internal error, such as, ERR!

Calibration Messages

If the instrument detects that a calibration needs to be performed, an UNCAL indicator appears in the status bar. If the you click on the message, you are given the option to perform the calibration now or defer action until a later time. If the calibration is performed, the message is cleared.

Note: UNCAL messages may be automatically cleared if the software determines that the instrument is within tolerance again.

External Keyboard Hot-key Functions

When the MS278XA is equipped with an external keyboard, additional input is available through various keyboard combinations (hot keys). Table 3-8 lists the hot keys and their function.

Table 3-8. Keyboard Hot-key Reference

Key Reference	Signature Usage	AT-101 Usage
1	Frequency Main Menu	Ctrl-Shift-Q
2	Amplitude Main Menu	Ctrl-Shift-W
3	Bandwidth Main Menu	Ctrl-Shift-E
4	Marker Main Menu	Ctrl-Shift-R
5	Measure Main Menu	Ctrl-Shift-T
6	Trace Main Menu	Ctrl-Shift-A
7	Display Main Menu	Ctrl-Shift-S
8	Sweep Main Menu	Ctrl-Shift-D
9	Trigger Main Menu	Ctrl-Shift-F
10	System Main Menu	Ctrl-Shift-G
11	File Main Menu	Ctrl-Shift-H
12	Preset Main Menu	Ctrl-Shift-P
13	Signature Help System View Toggle	Ctrl-Shift-J
14	File Drop Down Menu	Alt-F
15	View Drop Down Menu	Alt-V
16	Front Panel Drop Down Menu	Alt-P
17	Tools Drop Down Menu	Alt-T
18	Help Drop Down Menu	Alt-H
19	Increment Parameter Up (Coarse)	Page Up
20	Increment Parameter Down (Coarse)	Page Down
21	Increment Parameter Up (Fine)	Up Arrow
22	Increment Parameter Down (Fine)	Down Arrow
23	Numeric Keys	Numeric Keys
24	Backspace	Backspace
25	Escape	Esc
26	Enter	Enter

Chapter 4
Front Panel Menus

Table of Contents

Chapter 4
Front Panel Menus

4-1 Introduction

This chapter provides a comprehensive collection of annotated front panel menus and displays. Each illustration is accompanied with a description that includes information on how to use the functions available in that particular display. Additional navigation options and techniques may also be provided; however, this chapter does not provide measurement concepts. For details on making measurements, refer to Chapter 6.

4-2 Quick Reference

This section contains a comprehensive list of menus with references to the page where a full description can be found. Table 4-1 contains a list of main and sub-menus; Table 4-2 contains a list of property sheets and dialog menus.

Table 4-1. List of Menus

Main Menu	Submenu	Page
Frequency Main Menu	Frequencies Menu	4-7
	Step Size and Offset Menu	4-8
Amplitude Main Menu	Amplitude Menu	4-10
	Y-Axis Options Menu	4-11
Bandwidth Main Menu	Bandwidth Menu	4-13
	Auto Coupling Menu	4-14
Marker Main Menu	Marker Select Menu	4-16
	Marker to (–>) Menu	4-16
	Marker Config Menu	4-17
	Display Lines Menu	4-17
Measurement Main Menu	Measurement Menu	4-19
Trace Main Menu	Trace Config Menu	4-22
Display Main Menu	Display Options Menu	4-24
	Touch Screen Menu	4-24
Sweep Main Menu	Sweep Menu	4-26
Trigger Main Menu	Trigger Menu	4-28
System Main Menu	Rear Panel Control Menu	4-30
	Calibration Menu	4-30
	System Information Menu	4-30
	Configuration Menu	4-31
	Remote Control Menu	4-31
	Service Menu	4-32
File Main Menu	File Menu	4-34

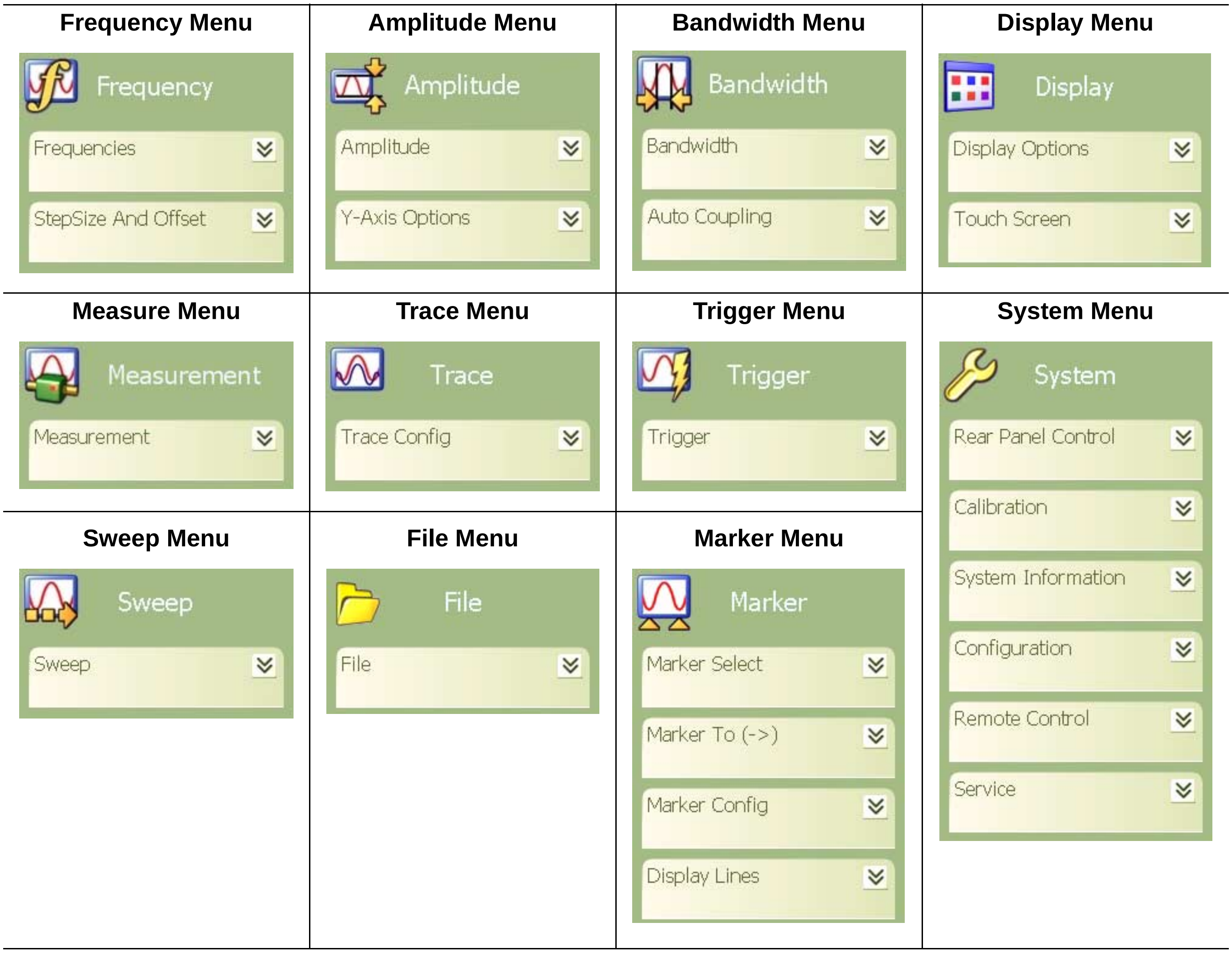


Figure 4-1. Graphical List of Menus

Table 4-2. List of Dialogs

4-3 Menu Archive

This menu archive illustrates a comprehensive set of the main menus and sub-menus contained in the MS278XA GUI. The structure follows that of what one would encounter when normally interfacing with the analyzer. Refer to Table 4-1, Table 4-2, and Figure 4-1 for a quick reference to the menu archive.

Frequency Main Menu

The Frequency Main Menu allows you to set the:

- Center Frequency
- Frequency Span
- Start Frequency
- Stop Frequency
- Frequency Step Size
- Frequency Offset

The Frequency main menu can be quickly accessed by using the Ctrl-Shift-Q keyboard combination.

Figure 4-2. Frequency Main Menu

Frequencies Menu

The Frequencies Menu lets you set the following frequency parameters:

Table 4-3. Frequencies Menu

 	**Center:** To set the center frequency, press in the Center parameter field and enter a new value using the numeric keys. When a new value is entered, the terminator fly-out menu will appear with the available units. Press on the desired units to terminate the entry. Range: (MinStart + MinSpan ÷ 2) to (MaxStop – MinSpan ÷ 2) Resolution: 1 Hz Default: 4 GHz Terminators: GHz, MHz, kHz, Hz, Cancel **Span:** To set the frequency span, press in the Span parameter field and enter a new value using the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. Range: 10 Hz to 8 GHz Resolution: 1 Hz Default: 8 GHz Ranges: 10 Hz to 100 Hz, 100 Hz to 1 kHz, 1 kHz to 10 kHz, etc. Terminators: GHz, MHz, kHz, Hz, Cancel **Span Presets:** To select a span preset, press the Span Presets button and select the desired span preset from the fly-out menu. Range: Full Span, Zero Span, Last Span Default: Full Span **Start:** To set the start frequency, press in the Start parameter field and enter a new value using the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. Range: 0 Hz to (Stop – MinSpan) Resolution: 1 Hz Default: 0 Hz Terminators: GHz, MHz, kHz, Hz, Cancel **Stop:** To set the stop frequency, press in the Stop parameter field and enter a new value using the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. Range: (Start+MinSpan) to 8.08 GHz Resolution: 1 Hz Default: 8 GHz Terminators: GHz, MHz, kHz, Hz, Cancel

Step Size and Offset Menu

The Step Size and Offset Menu lets you set the center frequency step size and frequency offset parameters.

Table 4-4. Step Size and Offset Menu

	**CF Step Size:** To set the center frequency step size, press the CF Step Size button and select the desired step size from the fly-out menu. To set the span step size manually, select Manual in the fly-out menu, then press in the CF Step Size parameter field and enter a value using the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. Range: 1/10 Span, ½ Span, %Span, =Center, =Marker, =Span, Manual Resolution: 1 Hz (for Manual), 0.01 or 1 Hz (for %Span) Default: 1/10 Span Terminators: GHz, MHz, kHz, Hz, Cancel (Applies only to choices where a numeric value is entered) **Frequency Offset:** To set the frequency offset, press in the Frequency Offset parameter field and enter a new value using the numeric keys. When a new value is entered, the terminator fly-out menu will appear with the available units. Press on the desired units to terminate the entry. Range: –100 GHz to +100 GHz Resolution: 1 Hz Default: 0 Hz Terminators: GHz, MHz, kHz, Hz, Cancel

Amplitude Main Menu

Figure 4-3. Amplitude Main Menu

The Amplitude main menu allows you to set the following:

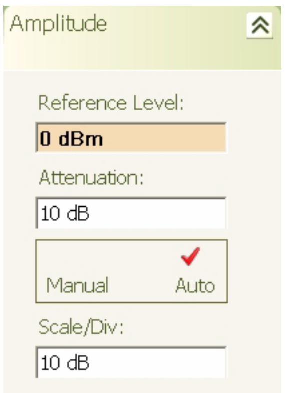
- Reference Level Parameter
- Input Attenuation Level Parameter
- Attenuation Mode
- Vertical Scale-per-division Parameter
- Level Offset Parameter
- Scale Type (Log or Linear)
- Scale Units
- Level Offset
- Mixer Level

The Amplitude main menu can be quickly accessed by using the Ctrl-Shift-W keyboard combination.

Amplitude Menu

The Amplitude menu lets you set the reference level, attenuation level, attenuation mode, and scale-per-division of the graticule's Y-axis.

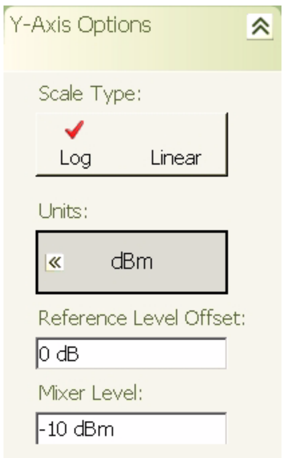
Table 4-5. Amplitude Menu

 	**Reference Level:** The reference level is set at the top line of the graticule. To change the value, press in the Reference Level parameter field and enter a new value using the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. Range: 30 dBm to –150 dBm (does not include Reference Offset) Resolution: 0.01 dB Default: 0 dBm The following unit terminators are supported when the appropriate amplitude units are selected: dBm, dBmV, dBuV, W, mW, uW, nW, pW, fW, aW, V, mV, uV, nV, pV **Attenuation Level and Mode:** To change the manual attenuation level, press in the Attenuation Level parameter field and enter a new value using the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. Range: 0 to 62 dB Resolution: 2 dB Default: Auto Terminators: dB or Cancel To toggle the internal RF attenuation mode between Manual or Auto, press the Manual/Auto button. **Scale/Div:** The Scale/Div parameter sets the number of units indicated for each major graticule division. This parameter only applies if the Scale Type is set to Log, otherwise the selection is grayed out. To change the value, press in the Vertical Scale parameter field and enter a new value using the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. Range: 1 to 20 dB Resolution: 1 dB 1 dB (for 1 to 20 dB range) Default: 10 dB/division Terminators: dB or Cancel

Y-Axis Options Menu

The Y-Axis Options menu lets you set the following parameters:

Table 4-6. Y-Axis Options Menu

 	**Scale Type:** The Scale Type button is used to toggle the vertical scale type between Logarithmic or Linear scales. The selected scale type is indicated with a check mark. This option is not currently available and the Scale Type is fixed to Log. **Units:** The Units menu lets you select the amplitude units of: dBm, dBmV, dBµV, V, or W To change the amplitude units, press the Units button and select the new amplitude units on the fly-out menu. **Reference Level Offset:** Level Offset is used to offset the reference level by the indicated amount. To change the value, press in the Level Offset parameter field and enter a new value with the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. Toggle the Level Offset On or Off by pressing the Off/On button below the parameter field. Range: +300 dB to –300 dB Resolution: 0.01 dB Default: 0 dB Terminators: dB, –dB, Cancel **Mixer Level:** The Mixer Level is used to calculate the attenuation value when the attenuation mode is set to Auto as follows: Attenuation Level = Reference Level – Mixer Level +5 dBm is used as a limiting factor for the reference level when the attenuation mode is set to Manual. The auto attenuation value is constrained to 10 dB to –62 dB. The mixer level is disabled in the wideband FFT and the VSA modes. Range: +5 dBm to –50 dBm Resolution: 1 dB Default: –10 dBm The following unit terminators are supported when the appropriate amplitude units are selected: dBm, dBmV, dBuV, W, mW, uW, nW, pW, fW, aW, V, mV, uV, nV, pV

Bandwidth Main Menu

Figure 4-4. Bandwidth Main Menu

The Bandwidth main menu lets you adjust the following:

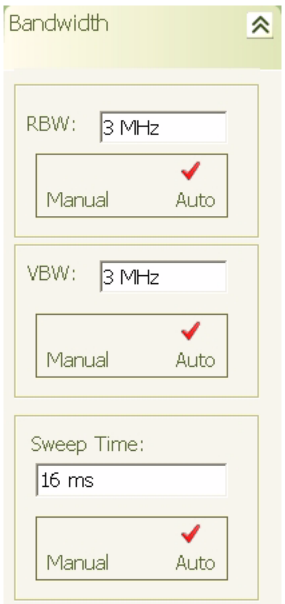
- Resolution Bandwidth and Mode
- Video Bandwidth and Mode
- Sweep Time and Mode
- Bandwidth Coupling Parameters

The Bandwidth main menu can be quickly accessed by using the Ctrl-Shift-E keyboard combination.

Bandwidth Menu

The Bandwidth menu lets you select between automatic or manual resolution bandwidth and set the resolution and video bandwidths when in the manual mode.

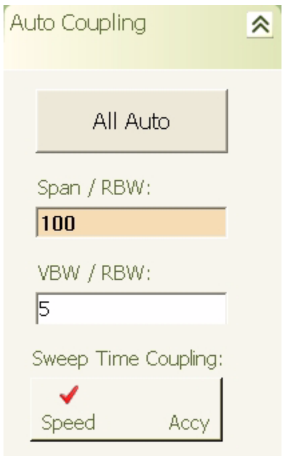
Table 4-7. Bandwidth Menu

 	**RBW:** To change the resolution bandwidth when in the manual mode, press in the RBW parameter field and enter a new value using the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. Range: 10 Hz to 8 MHz Resolution: 1,2,3,5 steps (10 Hz, 20 Hz, 30 Hz, 50 Hz, 100 Hz…) Default: Auto (see Span/RBW) Terminators: MHz, kHz, Hz, Cancel To toggle between resolution bandwidth modes, press the Manual/Auto button. **VBW:** To set the video bandwidth when in the manual mode, press in the VBW parameter field and enter a value using the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. Range: 1 Hz to 10 MHz Resolution: 1,2,3,5 steps (10 Hz, 20 Hz, 30 Hz, 50 Hz, 100 Hz, etc.) Default: Auto (see VBW/RBW) Terminators: MHz, kHz, Hz, Cancel **Sweep Time:** To set the sweep time when in the manual mode, press in the Sweep Time parameter field and enter a value using the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. Range: 5 ms to 10 ks (0.1 ms to 10 ks in zero span) Resolution: 1 ms or 1% of upper bound of range (100 µs in zero span) Default: Auto = k*Span/(RBW)^2 - if VBW is >= RBW or Auto = k*Span/(VBW*RBW) if VBW < RBW where: k (k-factor) = 1.8 for Auto-speed mode k (k-factor) = 5 for Auto-Accy mode Terminators: ks, s, ms, Cancel To toggle between manual or automatic sweep time modes, press the Manual /Auto button.

Auto Coupling Menu

The Auto Coupling menu lets you select the coupling modes and set the coupling parameters.

Table 4-8. Auto Coupling Menu

	To select the fully coupled mode, press the All Auto button. This couples all of the bandwidth coupling factors automatically. **Span/RBW:** To set this coupling parameter, press in the Span/RBW parameter field and enter a value using the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. Range: 2 to 10,000 Resolution: 1 Default: 50 Terminators: Enter or Cancel **VBW/RBW:** To set this coupling parameter, press in the VBW/RBW parameter field and enter a value using the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. Range: 0.001 to 1000 Resolution: 0.001 Default: 5 Terminators: Enter or Cancel This parameter is not available in FFT sweep modes. **Sweep Time Coupling:** To set the sweep time coupling parameter, press the Speed Accy button to toggle the selection. The Speed setting yields the fastest sweep times, but sacrifices amplitude accuracy. The Accy setting yields the most accurate amplitude measurement.

Marker Main Menu

Figure 4-5. Marker Main Menu

The Marker main menu lets you set the:

- Active Marker and Marker Status
- Marker to Next Options
- Marker Configuration Parameters
- Display Line Setup Parameters

The Marker main menu can be quickly accessed by using the Ctrl-Shift-R keyboard combination.

Marker Select Menu

The Marker Select menu lets you toggle the markers on or off, set the active marker frequency, and select between normal or delta markers.

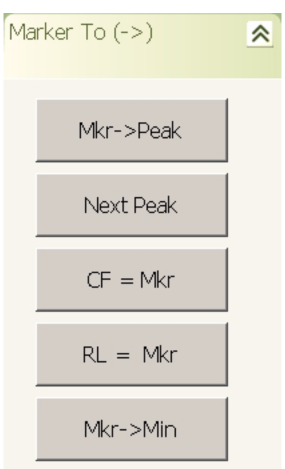
Table 4-9. Marker Select Menu

	**Active Marker:** To select the active marker, press on the Active Marker field and select a marker from the fly-out menu. To turn the active marker on or off, press the Off/On button. To set the active marker as a delta marker, press the Normal/Delta button. Note that Marker 1 is used at the reference and must be turned on before any subsequent marker can be set as a delta marker. **Marker n:** To set the active marker's frequency, press in the Marker n (where n is the active marker's number) parameter field and enter a value using the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. The marker's value is displayed in the field below Marker n and on the graticule display. **All Markers Off:** Press the All Markers Off button to deactivate all of the markers.

Marker to (–>) Menu

The Marker To (–>) menu lets you perform the following actions:

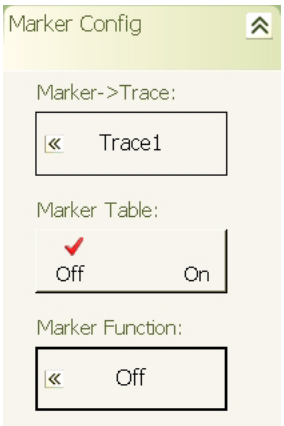
Table 4-10. Marker To (–>) Menu

	**Mkr->Peak:** To send the marker to the trace peak, press on the Mkr->Peak button. The peak is on the active trace when this menu is accessed and the enter key may be used to quickly send the active marker to the trace peak. **Next Peak:** To send the marker to the next trace peak, press on the Next Peak button. **CF = Mkr:** To change the center frequency to the current marker frequency value, press on the CF = Mkr button. **RL = Mkr:** To change the reference level to the current marker value, press on the RL = Mkr button. **Mkr->Min:** To send the marker to the trace minimum, press on the Mkr->Min button.

Marker Config Menu

The Marker Config menu lets you select the following:

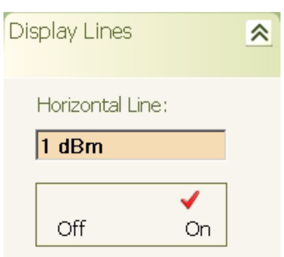
Table 4-11. Marker Config Menu

	**Marker -> Trace:** To select the trace that receives the marker, press on the Marker On Trace field and select the trace from the fly-out menu. **Marker Table:** A marker table can be displayed at the bottom of the graticule. To toggle the table on or off, press on the Off/On Marker Table button. **Marker Function:** The Marker Function activates Noise Markers (refer to Measuring Phase Noise on page 6-33 for information on phase noise measurements).

Display Lines Menu

The Display Lines menu lets you display limit lines.

Table 4-12. Display Lines Menu

	**Horizontal Line:** To set the level for a limit line, press in the Horizontal Line parameter field and enter a value using the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. The following unit terminators are supported when the appropriate amplitude units are selected: dBm, dBmV, dBuV, W, mW, uW, nW, pW, fW, aW, V, mV, uV, nV, pV Press on the desired units to terminate the entry, then toggle the limit line on by pressing on the Off/On toggle button.

Measurement Main Menu

The Measurement main menu lets you set the:

- Spectrum Measurement Type
- RF Measurement Type
- QAM/PSK Measurement Type
- WCDMA Measurement Type

The Measurement main menu can be quickly accessed by using the Ctrl-Shift-T keyboard combination.

Figure 4-6. Measure Main Menu

Measurement Menu

The Measurement menu gives you access to setup various measurement types, such as Spectrum, RF, and a variety of modulation measurements.

Table 4-13. Measurement Menu

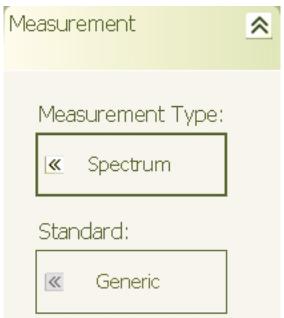
Spectrum Measurement Type 	**Spectrum Measurement Type:** To change the measurement type, press on the Measurement Type button and select one of the following measurement types from the fly-out menu: **Spectrum:** Selects the spectrum analysis mode (frequency domain) **RF:** Selects the RF measurement mode (see below) **QAM/PSK:** Selects the modulation measurement mode (see below) **WCDMA:** Selects the modulation measurement mode (see below) **Standard:** This selection allows you to select a measurement standard that automatically configures all of the measurement parameters. To select a measurement standard, press on the Standard button and select the desired standard from the fly-out menu.
RF Measurement Type 	**RF Measurement Type:** To change the measurement type, press on the Measurement Type button and select one of the following measurement types from the fly-out menu: **Spectrum:** Selects the spectrum analysis mode (see above) **RF:** Selects the RF measurement mode **QAM/PSK:** Selects the modulation measurement mode (see below) **WCDMA:** Selects the modulation measurement mode (see below) **Standard:** This selection allows you to select a measurement standard that automatically configures all of the measurement parameters. To select a measurement standard, press on the Standard button and select the desired standard from the fly-out menu. **Setup:** Opens the RF Parameters Setup dialogs listed below: Occupied Bandwidth Setup Dialog on page 4-35 Channel Power Setup Dialog on page 4-36 Adjacent Channel Power (ACP) Setup Dialog on page 4-37 Multicarrier Channel Power Setup Dialog on page 4-39 **RF Measurement Types:** **OBW:** Measures the occupied bandwidth of the signal **TOI:** Measures the third order intercept of the signal **Channel Power:** Measures the channel power of the signal **ACP:** Measures the adjacent channel power of the signal **Multicarrier Channel Power:** Measures the channel power of up to 12 carriers along with the adjacent and two alternate channel powers. **CCDF:** Not available.

Table 4-13. Measurement Menu

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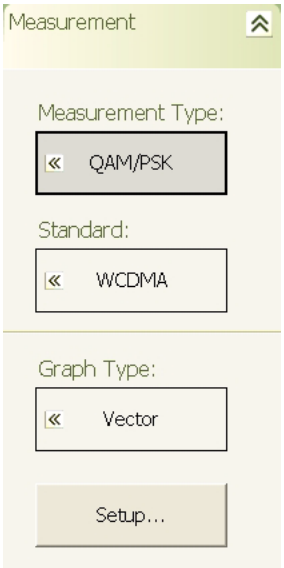
QAM/PSK Measurement Type



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QAM/PSK Measurement Type: To change the measurement type, press on the Measurement Type button and select one of the following measurement types from the fly-out menu:

Spectrum: Selects the spectrum analysis mode (see above)
RF: Selects the RF measurement mode (see above)
QAM/PSK: Selects the modulation measurement mode
WCDMA: Selects the modulation measurement mode (see below)

Standard: This selection allows you to select a measurement standard that automatically configures all of the measurement parameters. To select a measurement standard, press on the Standard button and select the desired standard from the fly-out menu.

Graph Types:

Vector
EVM/Time
Constellation
Power/Time
Summary
Eye(I)
Eye(Q)

Setup: Opens the VSA Modulation Parameters Setup Dialog on page 4-42.

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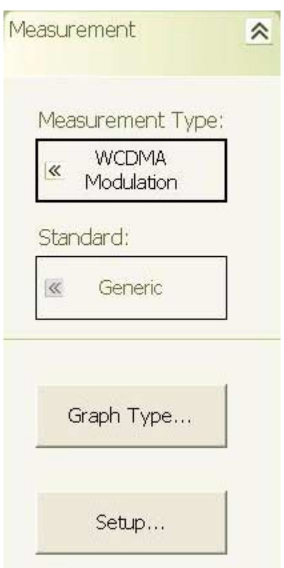
WCDMA Measurement Type



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WCDMA Measurement Type: To change the measurement type, press on the Measurement Type button and select one of the following measurement types from the fly-out menu:

Spectrum: Selects the spectrum analysis mode (see above)
RF: Selects the RF measurement mode (see above)
QAM/PSK: Selects the modulation measurement mode (see above)
WCDMA: Selects the modulation measurement mode

Standard: This selection allows you to select a measurement standard that automatically configures all of the measurement parameters. To select a measurement standard, press on the Standard button and select the desired standard from the fly-out menu.

Graph Type...: Opens the WCDMA Graph Type Dialog on page 4-44.

Setup: Opens the WCDMA Setup Dialog on page 4-46.

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Trace Main Menu

Figure 4-7. Trace Main Menu

The Trace main menu lets you configure and set up the:

- Active Trace Display
- Trace Mode
- Trace Averaging
- Detectors

The Trace main menu can be quickly accessed by using the Ctrl-Shift-A keyboard combination.

Trace Config Menu

The Trace Config menu lets you select the active trace, trace state, detector type, and set various trace options.

Table 4-14. Trace Config Menu

Trace Select: To set the active trace, press on the Trace Select button and select the active trace from the fly-out menu. When a trace is selected, the current trace mode is Off unless it was previously defined.

Trace Mode: To change the trace mode, press on the Trace Mode button and select one of the following trace states from the fly-out menu:

Clear-Write: This mode clears the trace as it writes new data.
Max-Hold: This mode writes new data that is greater than the previous sweeps.
Min-Hold: This mode writes new data that is less than the previous sweeps.
Average: This mode averages the data for each display point.
View: This mode displays the current trace value and does no further updating
Off (Blank): This mode turns the trace display off.

Default: Clear-Write for Trace1, Blank for all others

Averaging: Averaging provides two methods of averaging depending on the detector that is selected. For Sample & RMS detectors, the averaging is done on the linear power data before the log values are calculated for the display. For Maximum, Minimum, and Average detectors, the averaging is done on the log power data. To change the number of averages, press in the Averaging field and enter a new value.

Range: 1 to 10000
Resolution: 1
Default: 10

Restart: To restart the averaging count, press on the Restart button.

Detector: To change the detector type, press on the Detector Type field and select one of the following detector types from the fly-out menu:

Auto: Auto is the default detector type and uses the Normal detector type except as follows:
RMS when Trace Mode is set to Average or Noise Markers are active
Maximum when Trace Mode is set to Max-Hold
Minimum when Trace Mode is set to Min-Hold
Previous detector setting when Trace Mode is set to View
Normal: Combines maximum and minimum data values for the display point. (simulates an analog display)
Maximum: Uses the maximum data value for the display point.
Minimum: Uses the minimum data value for the display point.
Sample: Uses the center data value for the display point.
Average: Averages the log(Power) data for the display point.
RMS: Averages the power data for the display point.

Inactive Traces Off: To turn off the inactive traces, press on the Inactive Traces Off button. All of the traces **not** shown in the Trace Select field will be turned off.

Display Main Menu

Figure 4-8. Display Main Menu

The Display main menu lets you select the:

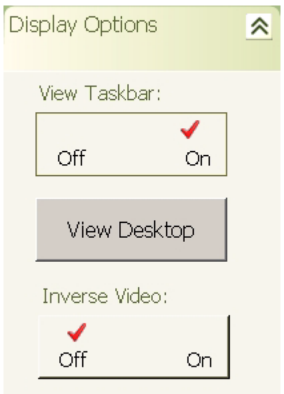
- Taskbar View
- Desktop View
- Video Inversion
- Touch Screen Calibration

The Display main menu can be quickly accessed by using the Ctrl-Shift-S keyboard combination.

Display Options Menu

The Display Options menu lets you set up limit lines on the graticule for display and measurement purposes.

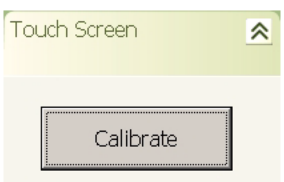
Table 4-15. Display Options Menu

	**View Taskbar:** To display the Windows taskbar, press the View Taskbar toggle button. **View Desktop:** To display the Windows desktop, press the View Desktop button to On. All open applications and windows will be minimized. **Inverse Video:** To inverse the video display of the graticule, press the Inverse Video toggle button to On.

Touch Screen Menu

The Touch Screen menu lets you calibrate the touch screen.

Table 4-16. Touch Screen Menu

	**Calibrate:** To calibrate the touch screen, press the Calibrate button and follow the on-screen instructions.

Sweep Main Menu

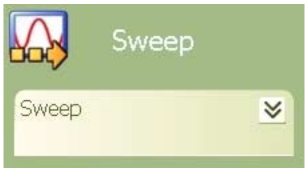


Figure 4-9. Sweep Main Menu

The Sweep Main Menu lets you:

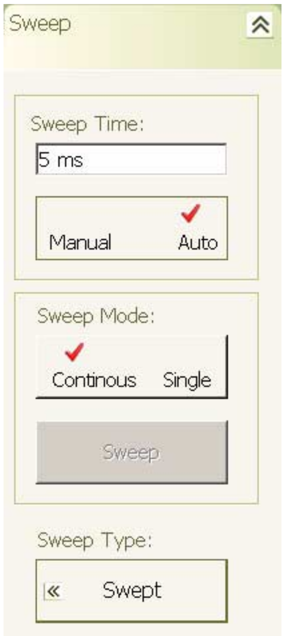
- Set the Sweep Time Parameter
- Select the Sweep Mode
- Start a Single Sweep
- Select the Sweep Type

The Sweep main menu can be quickly accessed by using the Ctrl-Shift-D keyboard combination.

Sweep Menu

The Sweep menu lets you lets you select between continuous or single sweep modes, and to start a single sweep.

Table 4-17. Sweep Menu

	**Sweep Time:** To set the sweep time, press in the Sweep Time parameter field and enter the desired sweep time value. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. To change between manual or auto sweep time, press on the Manual/Auto toggle button. **Sweep Mode:** To toggle the sweep mode between continuous and single sweep, press the Continuous/Single toggle button. When in the Single Sweep mode, press the Sweep button to trigger a new sweep. **Sweep Type:** To change the sweep type, press the Sweep Type button and select the desired sweep mode from the following fly-out menu selections: **Swept:** Selects a normal sweep. **FFT:** Selects a Fast Fourier Transform sweep (maximum span limited to 1 MHz) **FFT WideBand:** Selects a Wideband Fast Fourier Transform sweep with spans up to 30 MHz (requires Option 22).

Trigger Main Menu

Figure 4-10. Trigger Main Menu

The Trigger main menu lets you:

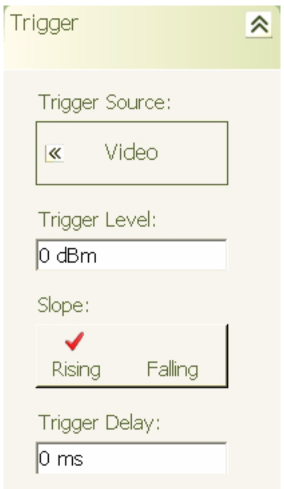
- Select the Trigger Source
- Set the Trigger Level
- Set the Trigger Edge
- Set the Trigger Delay

The Trigger main menu can be quickly accessed by using the Ctrl-Shift-F keyboard combination.

Trigger Menu

The Trigger menu lets you configure the following:

Table 4-18. Trigger Menu

	**Trigger Source:** To change the trigger source, press on the Trigger Source button and select the trigger source from the fly-out menu selections listed under Trigger Level below. **Trigger Level:** To set the trigger level, press in the Trigger Level parameter field and enter a value using the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. **Free Run:** No Settings **Video:** Range: Reference Level to (Reference Level – 10 * Scale/Div) Resolution: 0.1 dB Default: Reference Level – 0.5 * (10 * Scale/Div) The following unit terminators are supported when the appropriate amplitude units are selected: dBm, dBmV, dBuV, W, mW, uW, nW, pW, f W , aW, V, mV, uV, nV, pV **IF Power (Wide BW):** Range: (–10 dBm to –50 dBm) + Attenuator Value Resolution: 1 dB Default: –10 dBm + Attenuator Value The following unit terminators are supported when the appropriate amplitude units are selected: dBm, dBmV, dBuV, W, mW, uW, nW, pW, f W , aW, V, mV, uV, nV, pV **External TTL:** Level = 1.4 V (cannot be changed) **External:** Range: –10V to 10V (External) Resolution: 100 mV Default: TTL (1.4V) Terminators: V, mV, Cancel **Line:** Settings are not available. **Slope:** To change the trigger slope, press on the Slope button to toggle between Rising edge or Falling edge. Rising edge is the default setting. **Trigger Delay:** To set the trigger delay, press in the Trigger Delay parameter field and enter a value using the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. **SPA Mode:** Range: 0 ms to 65.5 ms (current sweep time to 65 ms for zero span) Resolution: 0.1 ms (100 ns for zero span) Default: 0 ms **FFT, FFT-WB Modes:** Range: 0 ms to 65 ms Resolution: 100 ns Default: 0 ms **VSA Mode:** Range: –65.5 ms to 65.5 ms Resolution: 10 ns Default: 0 ms

System Main Menu

Figure 4-11. System Main Menu

The System main menu lets you:

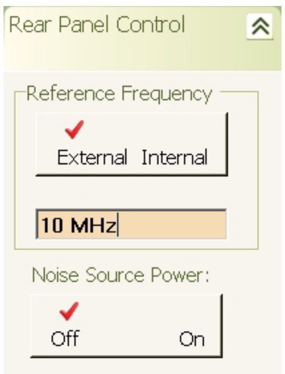
- Set Up the Rear Panel I/O
- Start an IF Calibration
- View the System Information
- Configure the System Hardware
- Toggle Between Local and Remote Operation
- Select Instrument Services

The System main menu can be quickly accessed by using the Ctrl-Shift-G keyboard combination.

Rear Panel Control Menu

The Rear Panel Control menu lets you configure the rear panel input/output ports and toggle the noise source power On or Off.

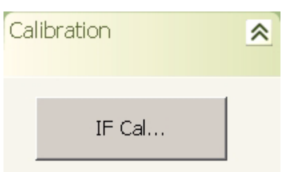
Table 4-19. Rear Panel Control Menu

	**Reference Frequency:** To toggle between an internal or external reference input, press on the External/Internal toggle button. To set the external reference input frequency, press in the Reference Frequency field and enter a value using the numeric keys. When a new value is entered, the terminator fly-out will appear with the available units. Press on the desired units to terminate the entry. **Noise Source Power:** To toggle the noise source power on or off, press on the Noise Source Power Off/On toggle button.

Calibration Menu

The Calibration menu lets you select and apply a calibration routine for specific hardware systems.

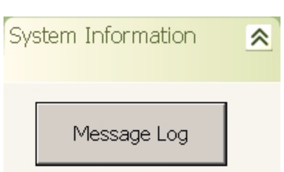
Table 4-20. Calibration Menu

	**IF Cal**: The IF Cal button initiates an amplitude calibration of all possible IF paths to improve the amplitude accuracy.

System Information Menu

The System Information menu lets you view the message log.

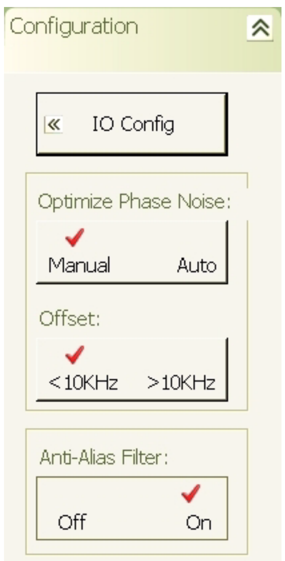
Table 4-21. Calibration Menu

	**Message Log**: The Message Log button opens the System Messages dialog box.

Configuration Menu

The Configuration menu lets you configure the IO, optimize phase noise, and select filtering.

Table 4-22. Configuration Menu

<table>
<tr>
<td>


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IO Config: The IO Config button lets you select the National Instruments GPIB configuration utility (refer to GPIB Setup on page 2-13 for more information), view the instrument IP address (Ethernet), or view the instrument name.

Optimize Phase Noise: To optimize phase noise, toggle the button to Auto.

Offset: When in Manual phase noise optimization, the bandwidth can be toggled between <10 kHz or >10 kHz.

Anti-Alias Filter: To toggle the anti-alias filter on or off, press on the Anti-Alias Filter Off/On toggle button. The Anti-alias filter is only available with Option 38 and when measuring QAM/PSK signals.

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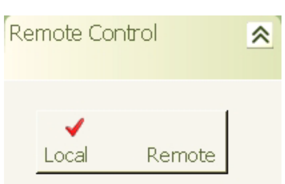
Remote Control Menu

The Remote Control menu lets you return local control from remote operations, such as GPIB remote control.

Table 4-23. Remote Control Menu

<table>
<tr>
<td>


</td>
<td>To return the instrument to local control, press on the Local/Remote toggle button.</td>
</tr>
</table>

Service Menu

The Service menu lets you toggle the internal 50 MHz calibrator Off and On and initiate a calibration alignment.

Table 4-24. Calibrator Menu

	**Calibrator:** To toggle the internal 50 MHz calibrator Off or On, press on the calibrator Off/On toggle button. To initiate a calibration alignment, press on the Cal Align... button. **Warning:** This changes the level of the internal calibrator and should only be performed by qualified service personnel.

File Main Menu

Figure 4-12. Preset Main Menu

The File main menu lets you:

- Save and Recall Instrument Setups
- Export Trace Data to a .csv file
- Open Windows File Explorer
- Print the Current Measurement Display

The File main menu can be quickly accessed by using the Ctrl-Shift-H keyboard combination.

File Menu

The File menu lets you save and recall measurement setup information and send the measurement display to a printer.

Table 4-25. File Menu

<table>
<tr>
<td>
</td>
<td> To save the current instrument setup, press on the Save... button to open a Windows Save As dialog. You can enter a name for your current setup and save the file as an Anritsu Setup File (.asr). The current default folder is C:\Signature\Setup\.
To recall a previously saved instrument setup, press on the Recall... button to open a Windows Open dialog. You can then browse for the Anritsu Setup File (.asr). The current default folder is C:\Signature\Setup\.
To export the current measurement data to a .csv file, press on the Export... button to open a Windows Export dialog. You can enter a name for your data file and save the file as a comma separated value file (.csv). The current default folder is C:\Signature\.
To send the current measurement data to a printer, press on the Print button to open a Windows Print dialog. You can configure the printer options based on the selected printer and its capabilities. </td>
</tr>
</table>

4-4 Parameter Entry and Measurement Setup Dialog Archive

This property and dialog menu archive illustrates the following set of property sheets and other dialog menus contained in the MS278XA GUI:

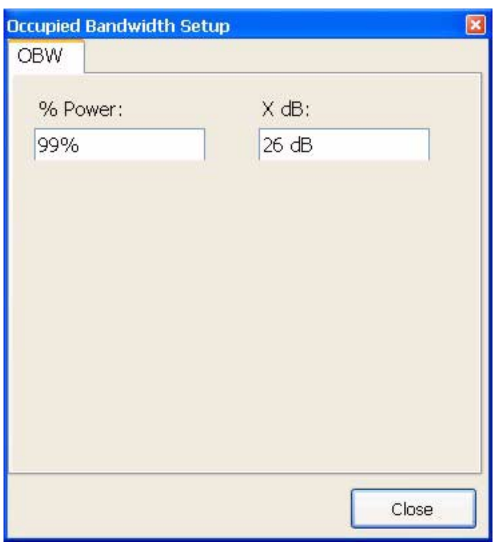
- Occupied Bandwidth Setup Dialog
- Channel Power Setup Dialog
- Adjacent Channel Power (ACP) Setup Dialog
- VSA Modulation Parameters Setup Dialog
- Customize Tool Bar Dialog
- Options Dialog
- MATLAB Setup Dialog

The structure follows that of what one would encounter when normally interfacing with the analyzer.

Occupied Bandwidth Setup Dialog

Occupied Bandwidth integrates the power of the displayed spectrum and puts markers at the bandwidth limits as specified in the measurement setup fields. The measurement defaults to 99% of the occupied bandwidth.

OBW Tab



% Power: Sets the limits for the occupied bandwidth measurement by specifying the percentage of power included in the measured bandwidth.

Range: 10% to 100% in steps of 1%
Default: 99%

X dB: Sets the limits down from the carrier peak for which occupied bandwidth is measured.

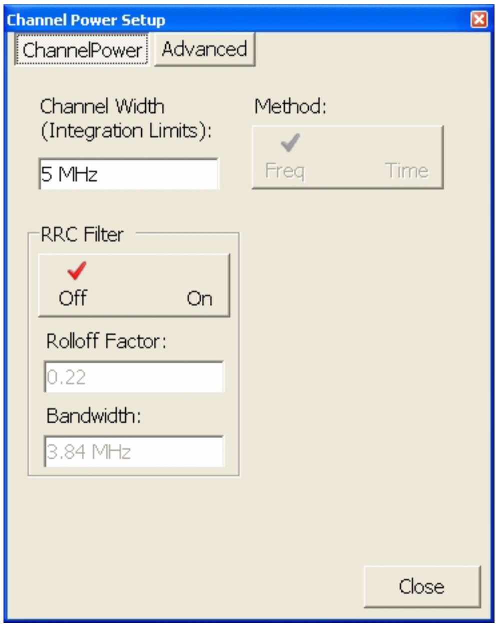
Range: 0.1 dB to 100 dB in steps of 0.1 dB
Default: 26 dB

Figure 4-13. Occupied Bandwidth Setup Dialog

Channel Power Setup Dialog

Channel Power measures the power and power spectral density in the channel bandwidth that you specify in the following dialogs:

Channel Power Tab



Channel BW: Sets the bandwidth over which the measurement is made. This is typically larger than the actual signal bandwidth.

Range: 1 Hz to 8 GHz in steps of 1 Hz
Default: 5 MHz

Method: Currently not available.

RRC Filter: This is used to turn the root-raised-cosine filter (RRC) On or Off.

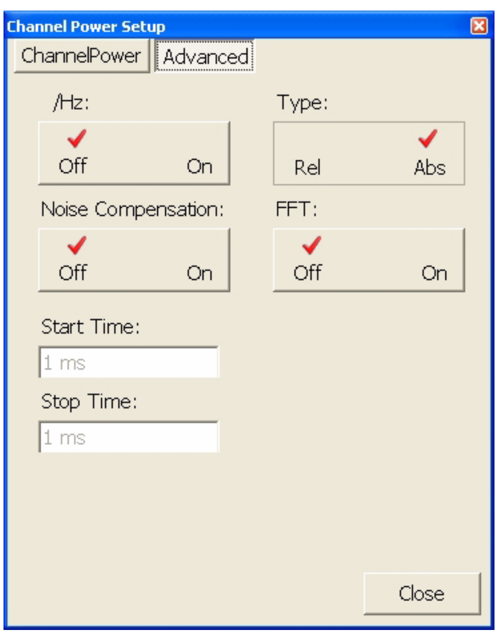
Rolloff Factor: Sets the roll-off factor for the measurement (RRC filter must be on).

Range: 0.1 to 1.0 in steps of 0.01
Default: 0.22.

Symbol Rate: Sets the symbol rate for the measurement (RRC filter must be on).

Range: 1 Hz to 8 GHz in steps of 1 Hz
Default: 3.84 MHz.

Advanced Tab



/Hz: Toggles the result display between dBm or dBm/Hz. The measurement type must be set to Abs before the /Hz can be toggled on.

Type: Toggles between an absolute or relative measurement.

Noise Compensation: When noise compensation is toggled on, a noise floor measurement is subtracted from the channel power.

FFT: Toggles between FFT or Swept modes.

Start Time: Sets the start of the measurement relative to a triggered event (currently not available).

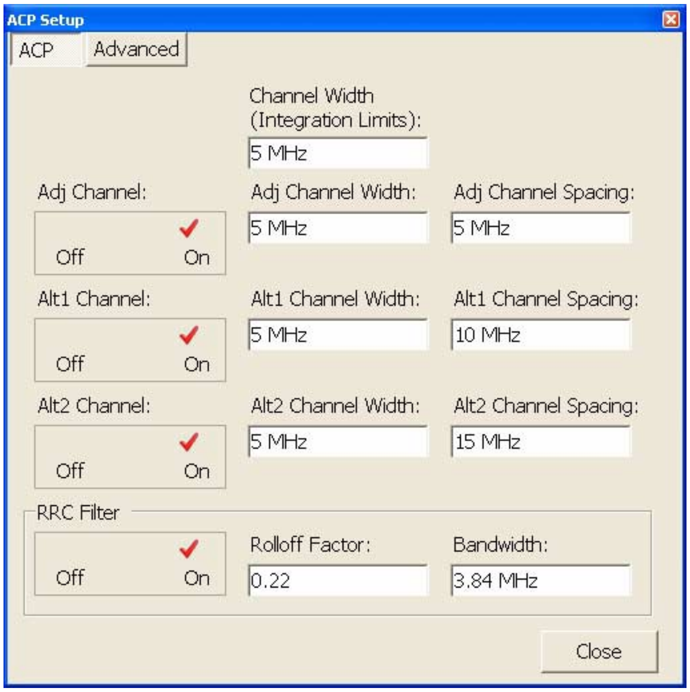
Stop Time: Sets the stop time of the measurement relative to a triggered event (currently not available).

Figure 4-14. Channel Power Setup Dialog

Adjacent Channel Power (ACP) Setup Dialog

Adjacent Channel Power (ACP) is a measure of the power that leaks into adjacent transmit channels. ACP measures the power present in the adjacent transmit channels and can be set up as follows:

ACP Tab (1 of 2)



Channel Width: Sets the channel bandwidth.

Range: 1 Hz to 8 GHz in steps of 1 Hz
Default: 5 MHz

Adjacent Channel: Toggles the adjacent channel measurement off or on.

Adj Channel Width: Sets the bandwidth of the adjacent channel.

Range: 1 Hz to 8 GHz in steps of 1 Hz
Default: 5 MHz

Adj Channel Spacing: Sets the spacing between the main and adjacent channel.

Range: 1 Hz to 8 GHz in steps of 1 Hz
Default: 5 MHz

Alt1 Channel: Toggles the Alt1 channel measurement off or on.

Alt1 Channel Width: Sets the bandwidth of the Alt1 channel.

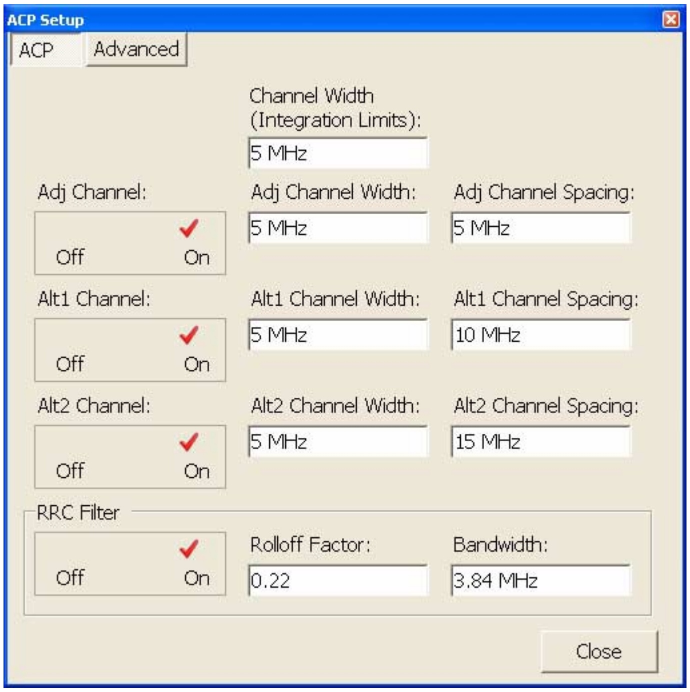
Range: 1 Hz to 8 GHz in steps of 1 Hz
Default: 5 MHz

Alt1 Channel Spacing: Sets the spacing between the main and Alt1channel.

1 Hz to 8 GHz in steps of 1 Hz
Default: 10 MHz

Figure 4-15. Adjacent Channel Power Setup Dialog

ACP Tab (2 of 2)



Alt2 Channel: Toggles the Alt2 channel measurement off or on.

Alt2 Channel Width: Sets the bandwidth of the Alt2 channel.

Range: 1 Hz to 8 GHz in steps of 1 Hz
Default: 5 MHz

Alt2 Channel Spacing: Sets the spacing between the main and Al2 channel.

Range: 1 Hz to 8 GHz in steps of 1 Hz
Default: 15 MHz

RRC Filter: This is used to turn the root-raised-cosine filter (RRC) On or Off.

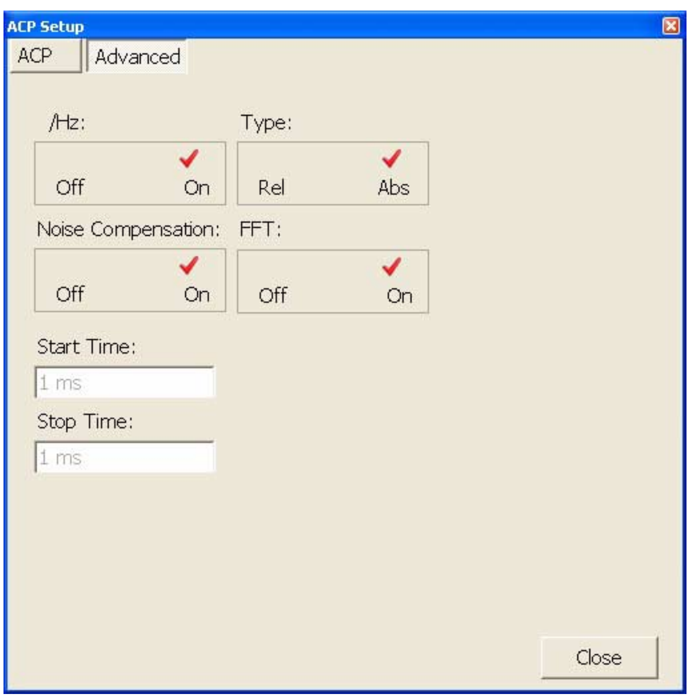
Rolloff Factor: Sets the roll-off factor for the measurement (RRC filter must be on).

Range: 0.1 to 1.0 in steps of 0.01
Default: 0.22.

Bandwidth: Sets the bandwidth for the measurement (RRC filter must be on).

Range: 1 Hz to 8 GHz in steps of 1 Hz
Default: 3.84 MHz.

Advanced Tab



/Hz: Toggles the result display between dBm or dBm/Hz. The measurement type must be set to Abs before /Hz can be toggled on.

Type: Toggles between an absolute or relative measurement.

Noise Compensation: When noise compensation is toggled on, a noise floor measurement is subtracted from the channel power.

FFT: Toggles between FFT or Swept modes.

Start Time: Sets the start of the measurement relative to a triggered event (currently not available).

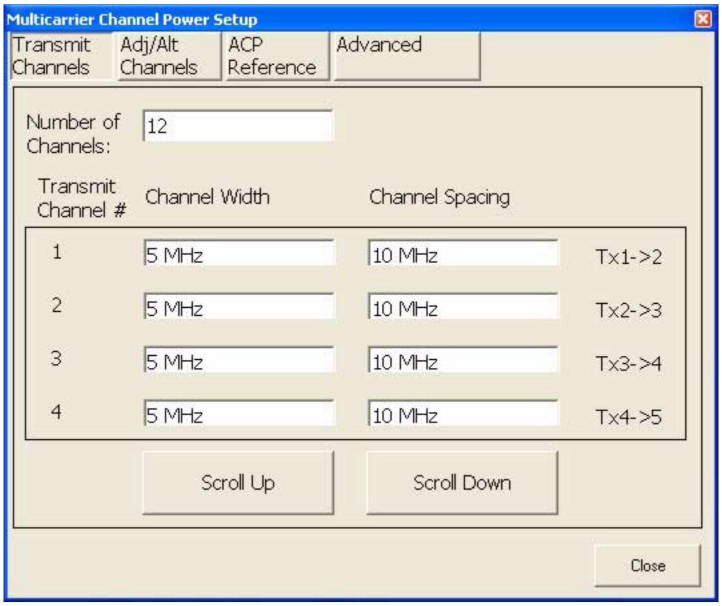
Stop Time: Sets the stop time of the measurement relative to a triggered event (currently not available).

Figure 4-15. Adjacent Channel Power Setup Dialog

Multicarrier Channel Power Setup Dialog

Multicarrier Channel Power is similar to the ACP measurement and can be set up as follows:

Transmit Channels Tab



Number of Channels: Sets the number of channels.

Range: 1 to 12 channels.
Default: 4 channels

Channel Width: Sets the channel width for each of the channels.

Range: 1 Hz to 8 GHz in steps of 1 Hz
Default: 5 MHz

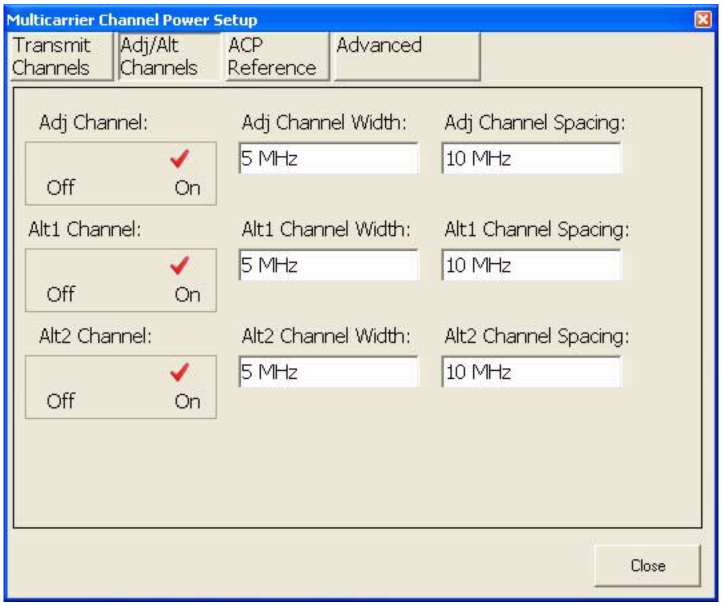
Channel Spacing: Sets the channel spacing for each of the channels.

Range: -8 GHz $\leq$ Channel Spacing $\leq$ 8 GHz in steps of 1 Hz
Default: 10 MHz

Scroll Buttons: Scrolls up or down the channel list.

Figure 4-16. Multicarrier Channel Power Setup Dialog

Adj/Alt Channels Tab



Adj Channel: Toggles the adjacent channel On or Off.

Adj Channel Width: Sets the adjacent channel width.

Range: 1 Hz to 8 GHz in steps of 1 Hz
Default: 5 MHz

Adj Channel Spacing: Sets the adjacent channel spacing.

Range: 1 Hz to 8 GHz in steps of 1 Hz
Default: 10 MHz

Alt1 Channel: Toggles the first alternate channel On or Off.

Alt1 Channel Width: Sets the first alternate channel width.

Range: 1 Hz to 8 GHz in steps of 1 Hz
Default: 5 MHz

Alt1 Channel Spacing: Sets the first alternate channel spacing.

Range: 1 Hz to 8 GHz in steps of 1 Hz
Default: 10 MHz

Alt2 Channel: Toggles the second alternate channel On or Off.

Alt2 Channel Width: Sets the second alternate channel width.

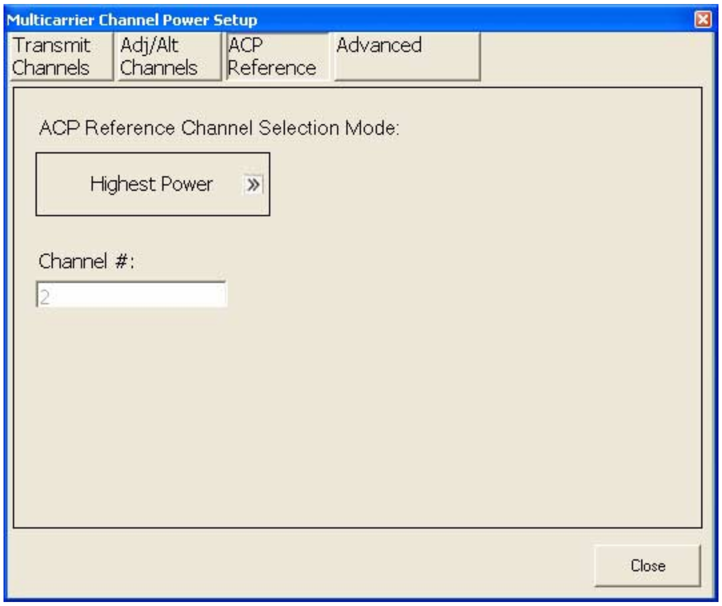
Range: 1 Hz to 8 GHz in steps of 1 Hz
Default: 5 MHz

Alt2 Channel Spacing: Sets the second alternate channel spacing.

Range: 1 Hz to 8 GHz in steps of 1 Hz
Default: 10 MHz

Figure 4-16. Multicarrier Channel Power Setup Dialog

ACP Reference Tab

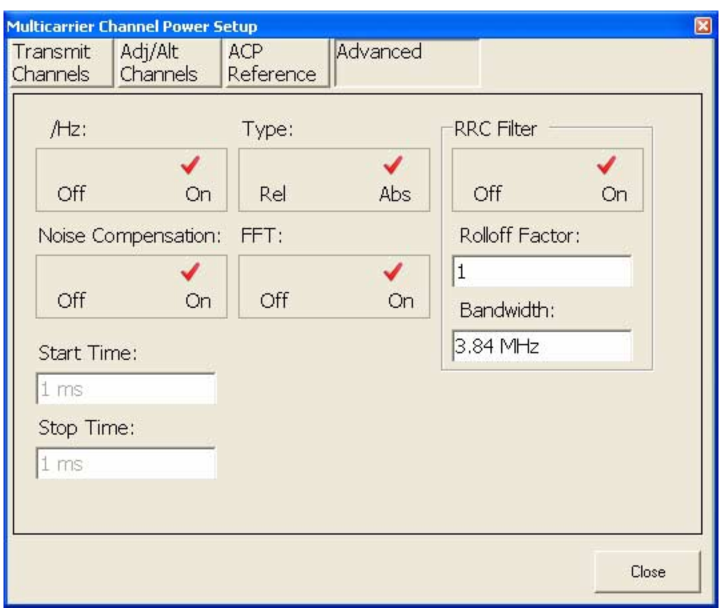


ACP Reference Channel Selection Mode: Selects the adjacent channel power reference mode of:

- Select Channel
- Highest Power Channel
- Lowest Power Channel
- Closest Channel (Left)
- Closest Channel (Right)
- Highest and Lowest Frequency Channel

Channel #: Enter the channel number for the reference (channel 1 through 12).

Advanced Tab



/Hz: Toggles the result display between dBm or dBm/Hz. The measurement type must be set to Abs before /Hz can be toggled on.

Type: Toggles between an absolute or relative measurement.

Noise Compensation: When noise compensation is toggled on, a noise floor measurement is subtracted from the channel power.

FFT: Toggles between FFT or Swept modes.

Start Time: Sets the start of the measurement relative to a triggered event (currently not available).

Stop Time: Sets the stop time of the measurement relative to a triggered event (currently not available).

RRC Filter: This is used to turn the root-raised-cosine filter (RRC) On or Off.

Rolloff Factor: Sets the roll-off factor for the measurement (RRC filter must be on).

Range: 0.1 to 1.0 in steps of 0.01
Default: 1

Bandwidth: Sets the bandwidth for the measurement (RRC filter must be on).

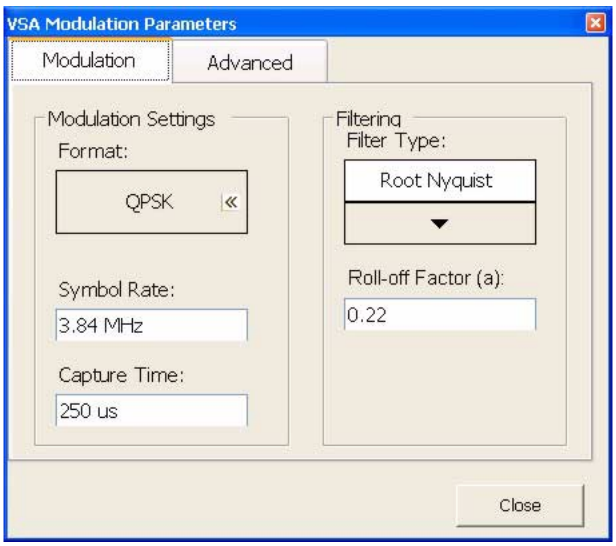
Range: 1 Hz to 8 GHz in steps of 1 Hz
Default: 3.84 MHz

Figure 4-16. Multicarrier Channel Power Setup Dialog

VSA Modulation Parameters Setup Dialog

The VSA Modulation Parameters dialog allows you to specify the modulation setting for your measurement.

Modulation Tab



Modulation Settings:
Format:

BPSK: Binary Phase Shift Keying
QPSK: Quadrature Phase Shift Keying (default)
Pi4QPSK: Pi/4 Quadrature Phase Shift Keying
8PSK: Octet Phase Shift Keying
3Pi8PSK: 3Pi/8 Phase Shift Keying
16QAM: 16 Value Quadrature Amplitude Modulation
32QAM: 32 Value Quadrature Amplitude Modulation
64QAM: 64 Value Quadrature Amplitude Modulation
128QAM: 128 Value Quadrature Amplitude Modulation
256QAM: 256 Value Quadrature Amplitude Modulation

Symbol Rate: Sets the symbol rate for the measurement.

Range: 10 kHz to 20 MHz in steps of 1 Hz
Default: 3.84 MHz.

Capture Time: Sets the length of the time during which samples are captured.

Range: 1s to 5 µs*
Terminators: us, ms, s, ks, Cancel

* Constrained by the following:
10,000 ≥ (Symbol Rate x Capture Time ≥ 100

Filtering:
Filter Type: Selects from the following receiver filters:

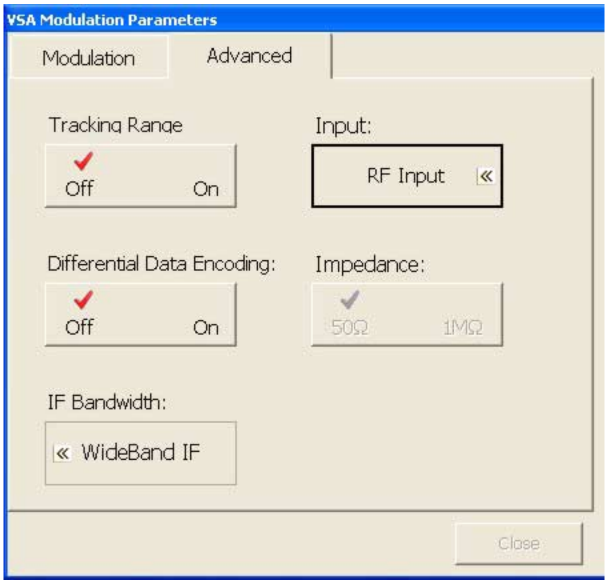
Low Pass
Nyquist
Root Nyquist (default)

Rolloff Factor: Sets the roll-off factor for the measurement.

Range: 0.1 to 1.0 in steps of 0.01
Default: 0.22.

Figure 4-17. VSA Modulation Parameters Dialog

Advanced Tab



Tracking Range: Toggles the tracking range on or off.

Input: This button opens a fly-out menu with the following input sources:

RF Input
Diff I/Q Input
Single I/Q Input
Cancel

Differential Data Encoding: Toggles differential encoding off or on.

Impedance: Toggles the input impedance between 50Ω or 1 MΩ. The input must be changed to Single or Diff I/Q before the input impedance can be changed.

IF Bandwidth: This button opens a fly-out menu with the following input sources:

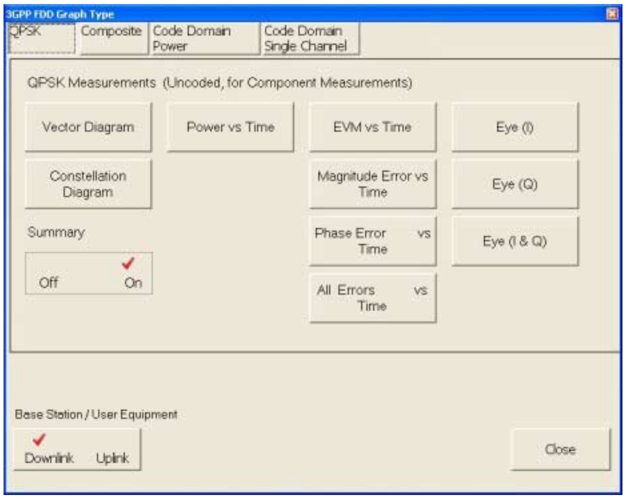
WideBand IF
NarrowBand IF
Cancel

Figure 4-17. VSA Modulation Parameters Dialog

WCDMA Graph Type Dialog

The Channel Table Editor dialog lets you manually enter the active code channel setup.

QPSK Tab

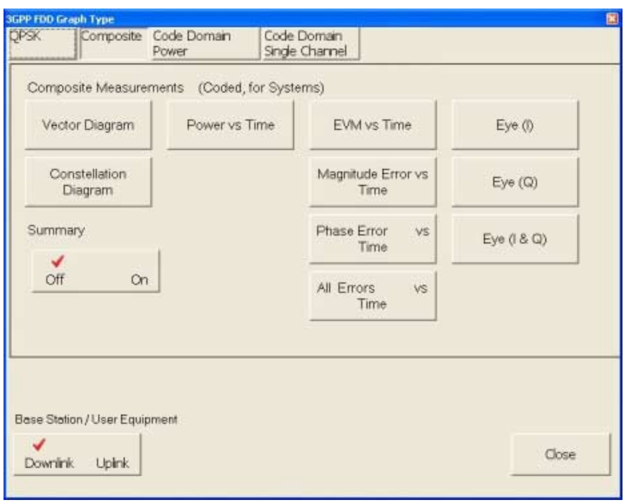


For QPSK measurements, the following graph types can be selected:

Vector Diagram
Constellation Diagram
Power vs. Time
EVM vs. Time
Magnitude Error vs. Time
Phase Error vs. Time
All Errors vs. Time
Eye (I)
Eye (Q)
Eye (I & Q)
Summary Display

Base Station/User Equipment: Uplink is not available.

Composite Tab



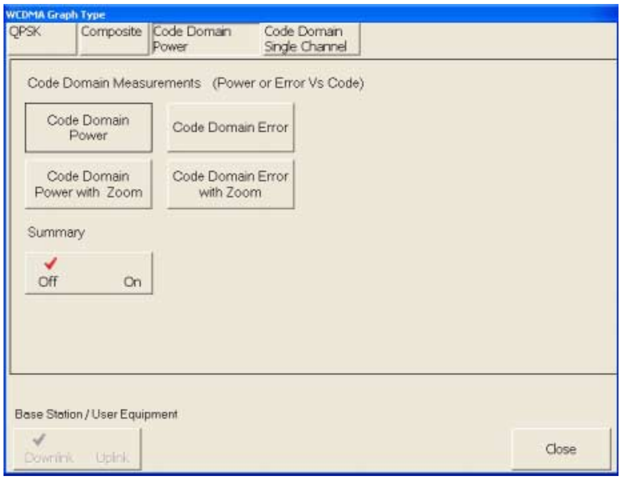
For Composite measurements, the following graph types can be selected:

Vector Diagram
Constellation Diagram
Power vs. Time
EVM vs. Time
Magnitude Error vs. Time
Phase Error vs. Time
All Errors vs. Time
Eye (I)
Eye (Q)
Eye (I & Q)
Summary Display

Base Station/User Equipment: Uplink is not available.

Figure 4-18. 3GPP FDD Graph Type Dialog

Code Domain Power Tab

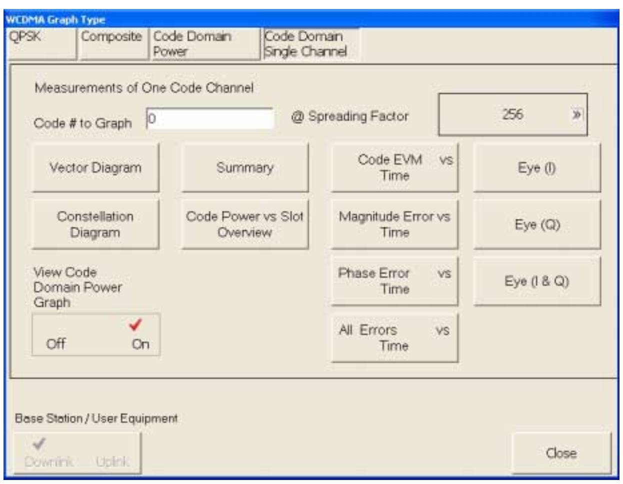


For Code Domain Power measurements, the following graph types can be selected:

Code Domain Power
Code Domain Power with Zoom
Code Domain Error
Code Domain Error with Zoom
Summary Display

Base Station/User Equipment: Uplink is not available.

Code Domain Single Channel Tab



For Code Domain Single Channel measurements, select the Code number to graph and a spreading factor of 4, 8, 16, 32, 64, 128, or 256.

The following graph types can be selected:

Vector Diagram
Constellation Diagram
View Code Domain Power Graph
Summary Display
Code Power vs. Slot Overview
Code EVM vs. Time
Magnitude Error vs. Time
Phase Error vs. Time
All Errors vs. Time
Eye (I)
Eye (Q)
Eye (I & Q)

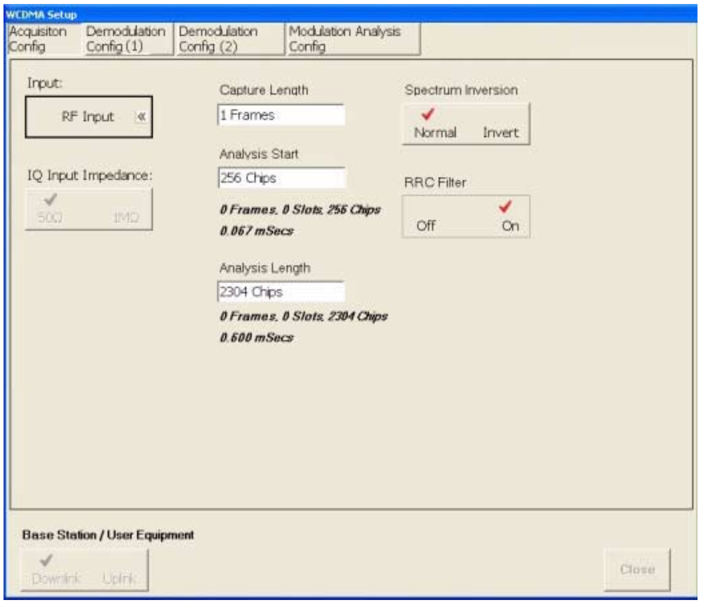
Base Station/User Equipment: Uplink is not available.

Figure 4-18. 3GPP FDD Graph Type Dialog

WCDMA Setup Dialog

The WCDMA Config dialog allows you to specify the WCDMA settings for your measurement.

Acquisition Config Tab



Input: Select Wideband RF Input, Narrowband RF Input, Wideband Single I/Q, Wideband Diff, I/Q.

IQ Input Impedance: Select between 50Ω or 1MΩ.

Capture Length: Enter the number of frames to capture.

Analysis Start: Enter the number of chips

Analysis Length: Enter the number of chips

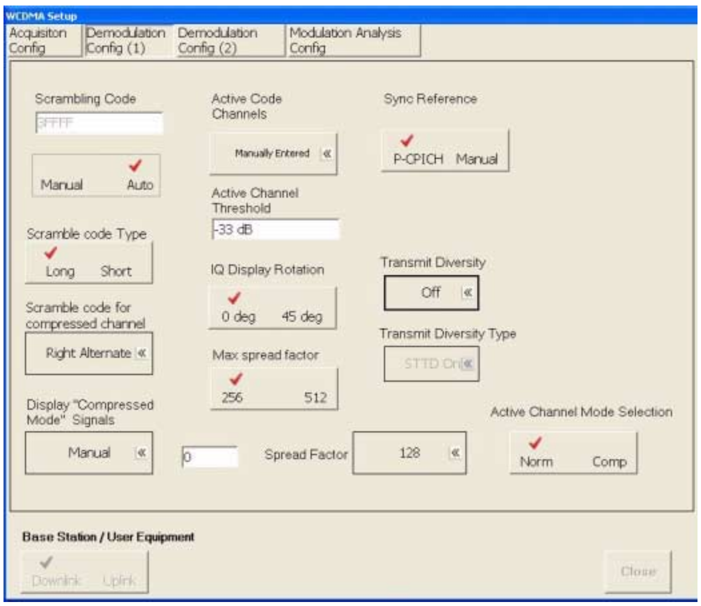
Spectrum Inversion: Select either Normal or Invert.

RRC Filter: Select the root raised cosine filter On or Off.

Base Station/User Equipment: Uplink is not available.

Figure 4-19. WCDMA Setup Dialog

Demodulation Config (1) Tab



Scrambling Code: Manually sets the modulation scrambling code or selects Auto.

Scramble Code Type: Selects between long and short.

Scramble Code for Compressed Channel: Select between Ordinary, Left Alternate, or Right Alternate.

Display "Compressed Mode" Signals: Select the compressed mode of Auto Mode Selection or Manual.

Spread Factor: Select the spreading factor of 4, 8, 16, 32, 64, 128, or Max Spread Factor.

Active Code Channels: Select between Auto, Test Models, or Manually Entered (refer to the Channel Table Dialogs on page 4-49).

Active Channel Threshold: Enter the active channel threshold in dB.

Range: –50 dB to –10 dB
Resolution: 1 dB
Default: –33 dB

IQ Display Rotation: Select the IQ display rotation of 0 degrees or 45 degrees.

Max Spread Factor: Select the maximum spreading factor of 256 or 512.

Sync Reference: Select the synchronizing reference of P-CPICH or Manual.

Transmit Diversity: Select Off, Antenna1 or Antenna2.

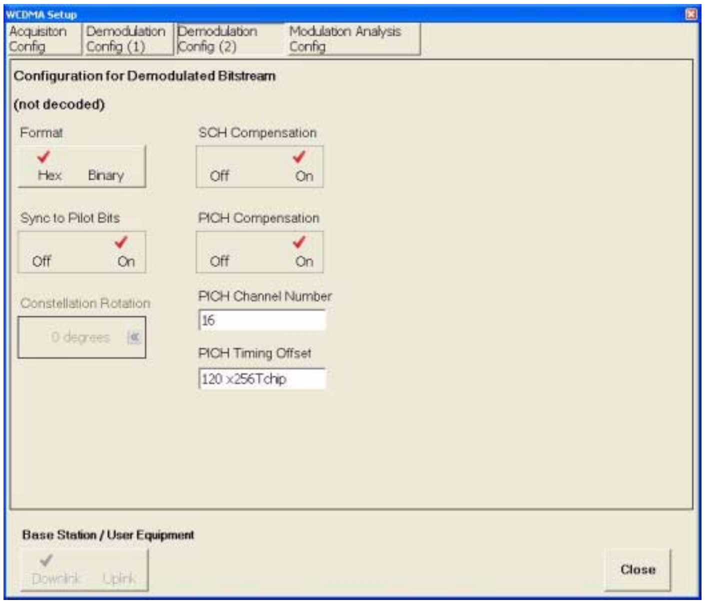
Transmit Diversity Type: Select between STTD On or STTD Off.

Active Channel Mode Selection: Select between compressed or normal mode.

Base Station/User Equipment: Uplink is not available.

Figure 4-19. WCDMA Setup Dialog

Demodulation Config (2) Tab



Format: Select either Hex or Binary.

Sync to Pilot Bits: Select synchronization On or Off.

Constellation Rotation: Select 0 degrees or 45 degrees.

SCH Compensation: Select the synchronizing channel compensation either On or Off.

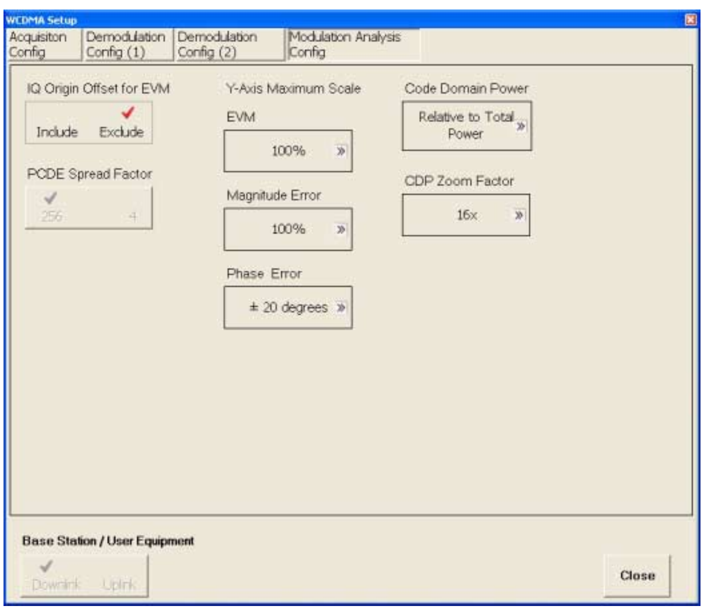
PICH Compensation: Select the pilot channel compensation either On or Off.

PICH Channel Number: Enter the pilot channel number.

PICH Timing Offset: Enter the pilot channel timing offset.

Base Station/User Equipment: Uplink is not available.

Modulation Analysis Config Tab



IQ Origin Offset or EVM: Select to include or exclude the IQ origin offset for the error vector magnitude.

PCDE Spread Factor: Select either 4 or 256 for the peak code domain error spreading factor.

EVM: Select the Y-axis scale for the error vector magnitude of 5%, 10%, 20%, 50%, or 100%.

Magnitude Error: Select the magnitude error of 5%, 10%, 20%, 50%, or 100%.

Phase Error: Select the phase error of ±5 degrees, ±10 degrees, ±20 degrees, ±50 degrees, ±100 degrees, ±180 degrees.

Code Domain Power: Select between Relative to Total Power or Absolute.

CDP Zoom Factor: Select the code domain zoom factor of 4x, 16x, or 64x.

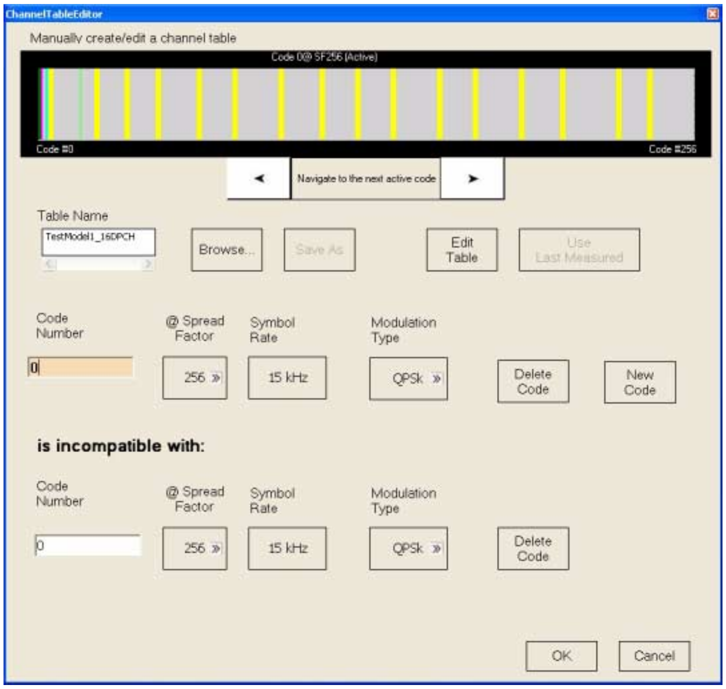
Base Station/User Equipment: Uplink is not available.

Figure 4-19. WCDMA Setup Dialog

Channel Table Editor Dialog

The Channel Table Editor dialog lets you manually enter the active code channel setup.

Channel Table Editor



The Channel Table Editor is used to create or edit channel tables.

Scroll Bar: Use the scroll bar to scroll through the channel codes.

Table Name: Enter the table name, select a table to Open, or use the last measured table.

When the Edit table is selected, the table parameters below become available.

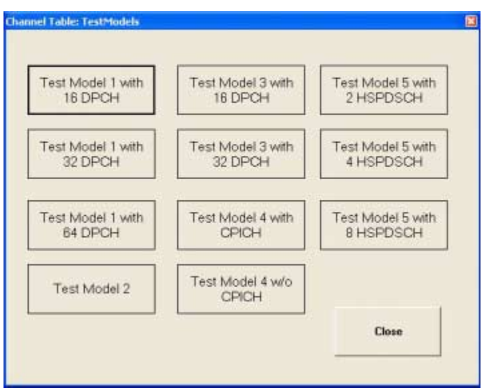
Enter the Code Number, select the Spreading Factor and note the Symbol Rate.

Choose the Modulation Type of Auto, 16QAM, or QPSK.

When the New Code button is selected, the incompatible code parameters become available.

Configure the code parameters as described above or select to delete a code.

Channel Table Test Models



The Channel Table Test Models dialog allows selection of one of eleven common WCDMA test models.

Figure 4-20. Channel Table Dialogs

Customize Tool Bar Dialog

The Customize Tool Bar Dialog allows you to add and remove icons to suit your needs.

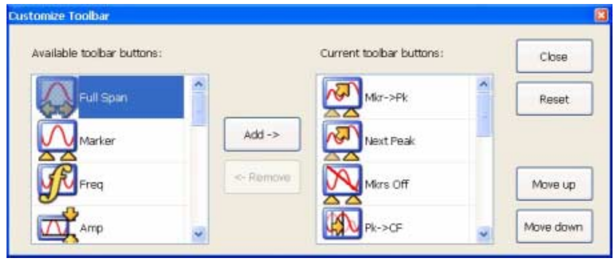


Figure 4-21. Customize Tool Bar Dialog

Refer to Customizing the Tool Bar on page 2-32 for more information.

Options Dialog

The Options dialog allows you to view the options list. Here you can determine which options are installed and install new options.

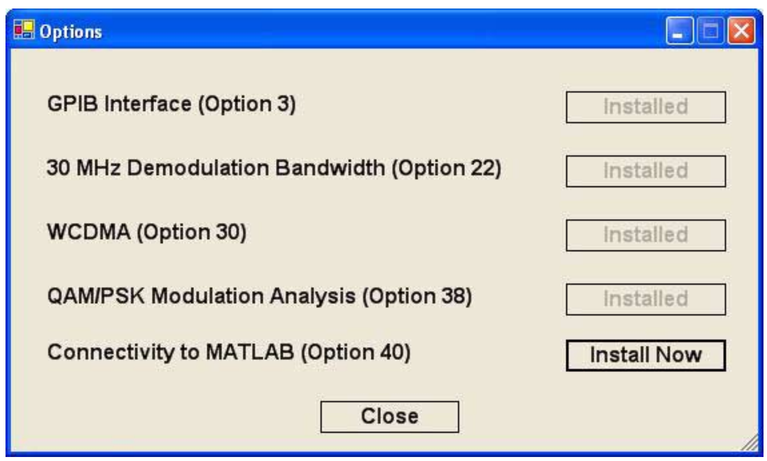


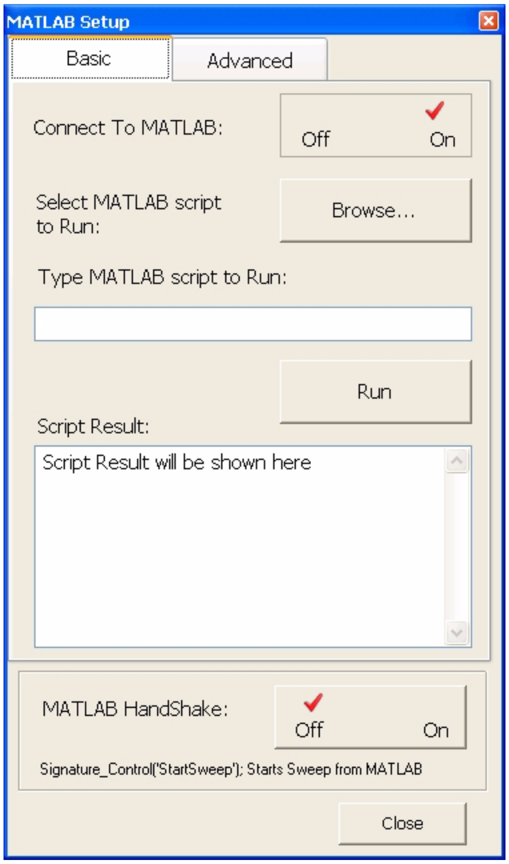
Figure 4-22. Options Dialog

Refer to Installing Options on page 2-31 for more information.

MATLAB Setup Dialog

The MATLAB Setup dialog allows you to launch The MathWorks MATLAB application. In this dialog, you can toggle the MATLAB connection On and Off, and select which information to send (Active Traces and I/O Vectors). For more information about using MATLAB, refer to Signature–MathWorks Connectivity (Option 40 only) on page 7-3.

Basic Tab



Connect to MATLAB: Toggles the MATLAB connectivity on or off.

Select MATLAB Script to Run: Opens a dialog to select a MATLAB script.

Type MATLAB Script: Sends the MATLAB script to run.

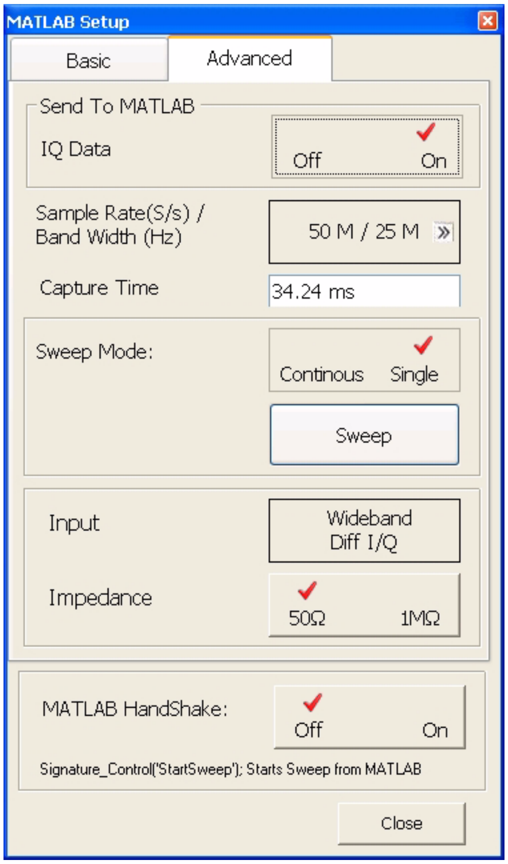
Run: Runs the MATLAB scripts above.

Script Results: Returns the results from the executed MATLAB scripts.

MATLAB Handshake: Toggles the MATLAB handshaking on or off. Handshaking allows you to know when Signature is finished making a measurement and can be useful for such things as storing or averaging multiple traces, where you need to know when the trace data is new.

Figure 4-23. MATLAB Setup Dialog

Advanced Tab



Send To MATLAB:

IQ Data: Toggles the IQ Data (vectors) on or off and enables the transfer configurations below. The IQ vectors from Signature give you the most freedom to make complex measurements, such as FFTs or demodulation, and allow larger data sets. When IQ Data is selected, Signature does not display trace data and the MATLAB Setup dialog must be left open.

Sample Rate (S/s)/BandWidth (Hz): Selects the following Sample Rate and Bandwidth, (S/s)/(Hz):

Without Option 22:
50M/25M, 50M/20M, 25M/10M, 12.5M/5M, 6.25M/2M, 3.125M/1M, 2M/800K, 1M/400K, 500K/200K, 400K/150K, 200K/80K, 100K/40K

With Option 22:
21.4M/10M, 21.4M/5M, 12.8M/3M, 8.56M/2M, 4.28M/1M, 2.14M/500K, 1.284M/300K, 856K/200K, 428K/100K

Capture Time: Sets the capture time. Ranges from 2 µs to 1.28 s, depending on the sample rate/ bandwidth selection.

Sweep Mode: Toggles between continuous or single sweep modes and starts a single sweep. Sweep mode is disabled when handshaking is enabled.

Input: Toggles between Single I/Q or Diff I/Q.

Impedance: Toggles between 50Ω or 1MΩ.

MATLAB Handshake: Toggles the MATLAB handshaking on or off. Handshaking allows you to know when Signature is finished making a measurement and can be useful for such things as storing or averaging multiple traces, where you need to know when the trace data is new. When handshaking is selected, sweep mode is disabled.

In the MATLAB application, the following script:

```
Signature_Control('StartSweep')
```

is used to initiate a sweep when handshaking is toggled On.

Figure 4-23. MATLAB Setup Dialog

Note: The connection to MATLAB can only be made when Option 40 is installed. Option 40 comes with a trial version of MATLAB, from The MathWorks, that may need to be activated. The full MATLAB software is not supplied with Signature and must be purchased separately.
Install MATLAB with any of its configurations and licensing option onto the "C:" drive in Signature. It is best to install MATLAB into the default directory.

Chapter 5
Rear Panel Layout

Table of Contents

Figure 5-1. MS278XA Rear Panel View

Chapter 5
Rear Panel Layout

5-1 Introduction

This chapter provides detailed information about all of the MS278XA rear panel interfaces and connectors.

5-2 Rear Panel and Connector Diagrams

Figure 5-2, below, illustrates the MS278XA's rear panel features and connectors. Table 5-1, on the following pages, describes the indices shown, lists Input/Output specifications for each connector, and lists the connector type. The connector pinout diagrams are illustrated in Table 5-2 through Table 5-8.

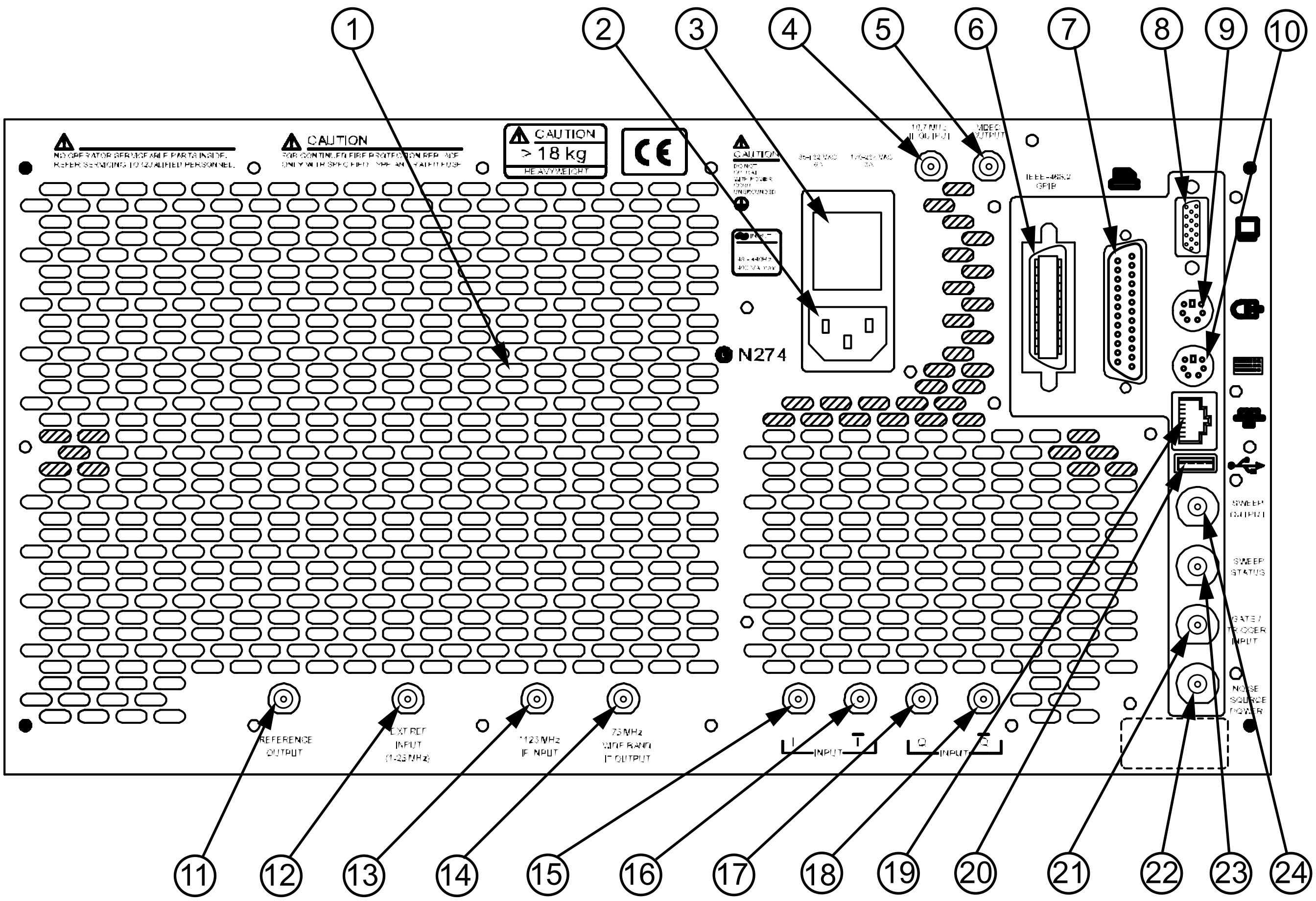


Figure 5-2. MS278XA Rear Panel Overlay Drawing

Table 5-1. MS278XA Rear Panel Index Legend

Index	Name/Image	Description	Connector
1	**Air Exhaust Grill** 	The rear panel exhaust grill provides for cooling of the instruments internal components. Ensure that the exhaust grill is not blocked.	N/A
2	**AC Power Input** 	The ac power input accepts an ac power supply in the range of 85 to 240 Vac, 48 to 63 Hz, and 350 VA. The receptacle accepts a 3-pronged power cord, which must be properly grounded to avoid the risk of an electric shock.	N/A
3	**Fuse Block** 	The MS278XA has two, SLOW BLO fuses with a rating of: 250V, 6.3A.	N/A
4	**10.7 MHz Output** 	Outputs a 10.7 MHz IF Level: –9 dBm ± 3 dB BW: varies with RBW (3 kHz minimum to 8 MHz maximum)	BNC Female
5	**Log Video Out** 	Outputs “Y” data value 2.5V nominal output into 50Ω with full scale signal level displayed	BNC Female

Table 5-1. MS278XA Rear Panel Index Legend

Index	Name/Image	Description	Connector
6	**GPIB Interface** 	IEEE 488 standard 24-pin connector that provides for remotely controlling the MS278XA from an external computer/controller via the IEEE-488 bus (GPIB). Table 5-2 describes the signal lines and shows the connector pinout.	IEEE 488.2
7	**Parallel Interface** 	25-pin connector that provides a parallel interface to an external printer. Table 5-3 describes the signal lines and shows the connector pinout.	25-pin D-Sub
8	**Monitor Interface** 	15-pin XGA connector allows the MS278XA to send the front panel touch screen display to an external VGA/XGA monitor. Table 5-4 describes the signal lines and shows the connector pinout.	15-pin D-Sub
9	**PS/2 Mouse Interface** 	Provides connection to an external PS/2 mouse.	6-pin DIN

Table 5-1. MS278XA Rear Panel Index Legend

Index	Name/Image	Description	Connector
10	**PS/2 Keyboard Interface** 	Provides connection to an external PS/2 keyboard.	6-pin DIN
11	**Reference Output** 	Provides a reference frequency output Using the Internal 10 MHz Reference: Level: 8 dBm ± 3 dB Frequency: 10 MHz Using an External Frequency Reference: Level: –19 to –14 dBm Frequency: Same as external frequency	BNC Female
12	**Reference Input** 	Provides a reference frequency input Level: –6 dBm < Input signal < +10 dBm Frequency: Any frequency from 1 to 25 MHz with 1 MHz resolution and 1.544 or 2.048 MHz	BNC Female
13	**External IF Input** 	1128.65 MHz Input for VSA, Mixer, etc.	SMA Female
14	**IF Output** 	Outputs 75 MHz IF Level: –5 dBm ± 5 dB BW: > 40 MHz (>120 MHz without image rejection filter)	BNC Female
15	**I Input** 	Differential input for Baseband I/Q 50Ω or 1MΩ Switchable unbalanced or differential 1 Volt max	BNC Female
16	**$\bar{\text{I}}$ Input** 	VSA $\bar{\text{I}}$ differential input for Baseband I/Q 50Ω or 1 MΩ Switchable unbalanced or differential 1 Volt max	BNC Female

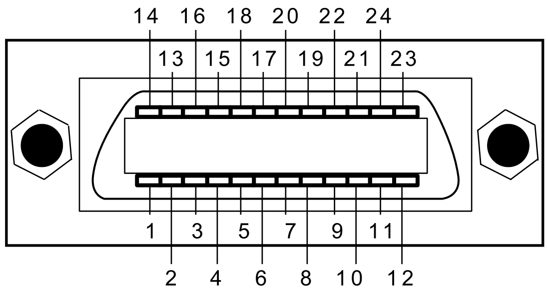
Table 5-1. MS278XA Rear Panel Index Legend

Index	Name/Image	Description	Connector
17	**Q Input** 	VSA Q differential input for Baseband I/Q 50Ω or 1 MΩ Switchable unbalanced or differential 1 Volt max	BNC Female
18	**$\overline{Q}$ Input** 	VSA $\overline{Q}$ differential input for Baseband I/Q 50Ω or 1 MΩ Switchable unbalanced or differential 1 Volt max	BNC Female
19	**Ethernet** 	10BASE-T, 100BASE-TX with LED indicators Amber LED indicates power Green LED indicates communication	8-pin RJ45
20	**USB** 	USB serial bus interface Version 2.0	USB 4-pin Type A
21	**Trig/Gate Input** 	Logic input for sweep control +10V to –10V 10 kΩ	BNC Female
22	**Noise Source Power** 	Provides power for an external noise source +28V ±2V 100 mA Software enabled	BNC Female
23	**Sweep Status Output** 	Logic output for sweep control TTL active LOW when sweeping	BNC Female

Table 5-1. MS278XA Rear Panel Index Legend

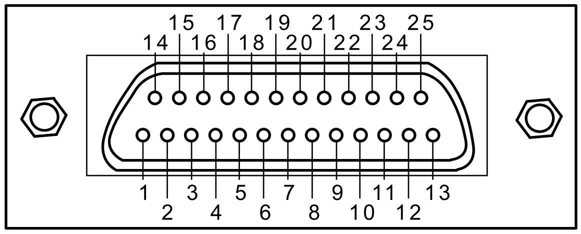
Index	Name/Image	Description	Connector
24	**Sweep Output** 	Output is currently **not used**	BNC Female

Table 5-2. **Index 6:** IEEE 488.2 GPIB Connector Pinout Diagram



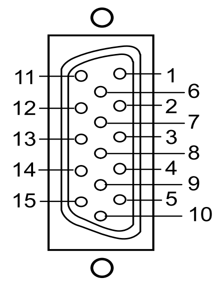
Pin	Name	Description
1-4	DIO 1 through DIO 4	Data Input/Output. Bits are HIGH when the data is logical 0 and LOW when the data is logical 1.
5	EOI	End or Identify. A low-true state indicates that the last byte of a multi byte message has been placed on the line.
6	DAV	Data Valid. A low-true state indicates that the talker has (1) sensed that NRFD is LOW, (2) placed a byte of data on the bus, and (3) waited an appropriate length of time for the data to settle.
7	NRFD	Not Ready For Data. A high-true state indicates that valid data has not yet been accepted by a listener.
8	NDAC	Not Data Accepted. A low-true state indicates that the current data byte has been accepted for internal processing by a listener.
9	IFC	Interface Clear. A low-true state places all bus instruments in a known state—such as, unaddressed to talk, unaddressed to listen, and service request idle.
10	SRQ	Service Request. A low-true state indicates that a bus instrument needs service from the controller.
11	ATN	Attention. A low-true state enables the controller to respond to both its own listen/talk address and to appropriate interface messages—such as, device clear and serial poll.
12	Shield	Ground Point.
13-16	DIO 5 through DIO 8	Data Input/Output. Bits are high with the data is logical 0 and LOW when the data is logical 1.
17	REN	Remote Enable. A low-true state enables bus instruments to be operated remotely, when addressed.
18 to 24	GND	Logic ground.

Table 5-3. Index 7: 25-pin Parallel Printer Connector Pinout Diagram



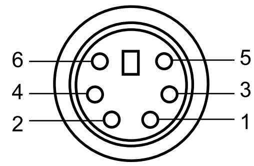
Pin	Name	Description
1	Strobe	Strobe signal drops TTL low when data is being sent to printer
2	Data0	Data signal to printer
3	Data1	Data signal to printer
4	Data2	Data signal to printer
5	Data3	Data signal to printer
6	Data4	Data signal to printer
7	Data5	Data signal to printer
8	Data6	Data signal to printer
9	Data7	Data signal to printer
10	Acknowledge	Acknowledge signal drops TTL low when data is received by printer
11	Busy	TTL high when printer is busy
12	Paper End	TTL high when printer is out of paper
13	Select	TTL high signals that the printer is online
14	Auto Feed	TTL high signals an auto feed
15	Error	TTL low signals a printer error
16	Init	TTL low initializes the printer
17	Select In	TTL high sets printer offline
18 to 25	Ground	Electrical reference ground

Table 5-4. **Index 8:** 15-pin XGA Connector Pinout Diagram



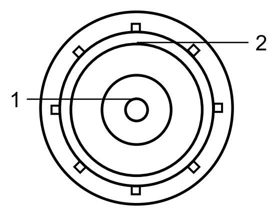
Pin	Name	Description
1	Red	Red Video (75Ω, 0.7 V_{p-p})
2	Green	Green Video (75Ω, 0.7 V_{p-p})
3	Blue	Blue Video (75Ω, 0.7 V_{p-p})
4	ID2	Monitor ID Bit 2
5	GND	Ground
6	RGND	Red Ground
7	GGND	Green Ground
8	BGND	Blue Ground
9	Key	Connector Orientation Key
10	SGND	Sync Ground
11	ID0	Monitor ID Bit 0
12	ID1	Monitor ID Bit 1
13	Hsync	Horizontal Sync
14	Vsync	Vertical Sync
15	ID3	Monitor ID Bit 3

Table 5-5. Index 9 and 10: 6-pin PS2 Mouse and Keyboard Connector Pinout Diagram



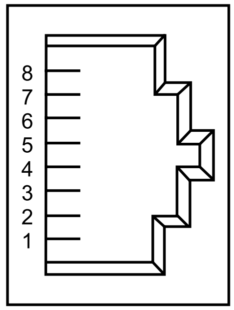
Pin	Name	Description
1	Data	Data signals from mouse or keyboard
2	–	Not used
3	GND	Ground
4	VCC	+5 volts, 500 mA
5	Clock	Sent data clock
6	–	Not used

Table 5-6. Indexes 4,5, 11 to 18, and 21 to 24: BNC Connector Pinout Diagram



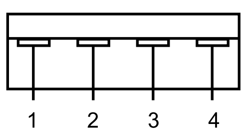
Pin	Name	Description
1	Center Pin	Carries data or signal
2	Shield	Ground return or shield

Table 5-7. **Index 19:** 8-pin Ethernet RJ45 Connector Pinout Diagram



Pin	Name	Description
1	TX+	Transmit data (> +3 volts)
2	TX–	Transmit data (< –3 volts)
3	RX+	Receive data (< –3 volts)
4	–	Not used (common mode termination)
5	–	Not used (common mode termination)
6	RX–	Receive data (< –3 volts)
7	–	Not used (common mode termination)
8	–	Not used (common mode termination)

Table 5-8. **Index 20:** 4-pin USB Type A Connector Pinout Diagram



PIN	Name	Description
1	VCC	+5 volts, 500 mA
2	–Data	Data input
3	+Data	Data output
4	GND	Ground

Chapter 6
Measurements

Table of Contents

Table of Contents (Continued)

Table of Contents (Continued)

Chapter 6
Measurements

6-1 Introduction

This chapter provides procedures on how to make several common spectrum analyzer measurements. It is assumed that you have a basic understanding of spectrum analyzer measurements and that the MS278XA front panel and menu structure is familiar to you. Refer to Chapter 3 for a description of the instrument's front panel operation and to Chapter 4 for a description of the instrument's menus and their structure. Once you are familiar with the instrument, you should be able to easily follow the procedures found in the following sections of this chapter:

- Basic Measurement Setups on page 6-6
- Measurement Examples on page 6-25
- RF Measurements on page 6-34
- Modulation Measurements on page 6-41

6-2 Basic Measurement Setups

This section describes the basic manual operation of the signal analyzer. In the following procedures, the receiver is tuned over a swept range of frequencies and the power is computed at each of the displayed data points. The range of frequencies, resolution bandwidth, video bandwidth, trace processing, reference power level, scale factor (dB/division), and type of signal detection must all be selected to determine a valid setup for the measurement. Alternately, many of these parameters may be auto coupled to enable a valid measurement. The most common steps to achieve this are illustrated throughout the procedures in this chapter.

The procedures in this section assume that the analyzer will not be equipped with an external keyboard and mouse, and that you will be using the touch screen and front panel keys. The same operations may be performed in a similar fashion by making use of an external keyboard and mouse. The following measurement setups are illustrated in this section:

- Setting the Center Frequency
- Setting the Frequency Span
- Setting the Start and Stop Frequencies
- Setting the Reference Level
- Setting the Input Attenuation
- Setting the Scale/Div
- Setting the Resolution Bandwidth
- Setting the Video Bandwidth
- Setting the Sweep Time
- Setting the Bandwidth Coupling Modes
- Setting Markers
- Setting Trace Modes
- Configuring the Triggering

Setting the Center Frequency

The center frequency is set at the center of the graticule display.

Step 1. Press the Freq icon on the main menu bar, or press the Frequency key on the instrument front panel, to display the Frequency menu below:

Step 2. Press in the Center parameter field and use the keypad to enter the desired center frequency, then select the appropriate frequency terminator from the fly-out menu.

Setting the Frequency Span

The frequency span is set such that the graticule display shows the entire span from the left edge of the graticule to the right edge of the graticule.

Step 1. Press the Freq icon on the main menu bar, or press the Frequency key on the instrument front panel, to display the Frequency menu below:

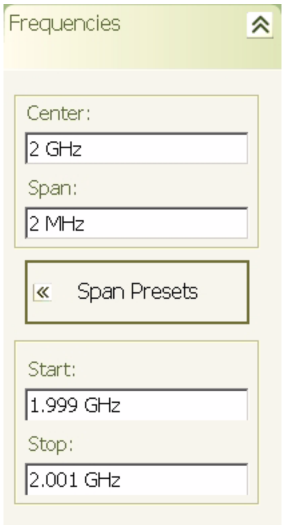
Step 2. Press in the Span parameter field and use the keypad to enter the desired frequency span, then select the appropriate frequency terminator from the fly-out menu.

> **Note:** When the Center frequency and frequency Span are entered, the Start and Stop frequencies are automatically determined.

Setting the Start and Stop Frequencies

The start frequency is set at the left side of the graticule display and the stop frequency is set at the right side of the graticule display.

Step 1. Press the Freq icon on the main menu bar, or press the Frequency key on the instrument front panel, to display the Frequency menu below:



Step 2. Press in the Start parameter field and use the keypad to enter the desired start frequency, then select the appropriate frequency terminator from the fly-out menu.

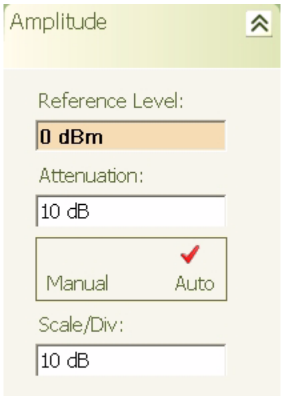
Step 3. Repeat the previous step for the Stop frequency.

> **Note:** When the Start and Stop frequencies are entered, the Center frequency and frequency Span are automatically determined.

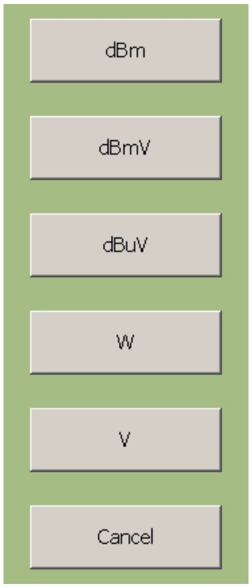
Setting the Reference Level

The reference level is set at the top of the graticule display. Measurements can only be made on signal peaks that are below the reference level, so it is important to determine the approximate level of the signal peak and appropriately set the reference level higher than the signals being measured.

Step 1. Press the Amp icon on the main menu bar, or press the Amplitude key on the instrument front panel, to display the Amplitude menu below:



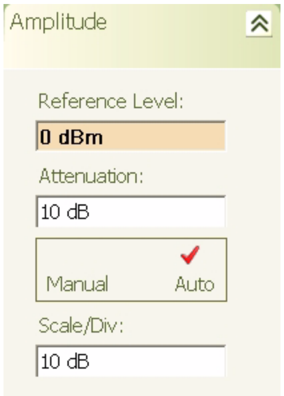
Step 2. Press in the Reference Level parameter field and use the keypad to enter the desired reference level, then select the appropriate amplitude terminator from the fly-out menu.



Setting the Input Attenuation

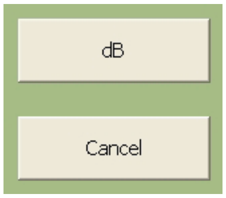
The input attenuation is set to bring the input signal down to an optimum level range below +30 dBm and to protect the input stage of the analyzer from damage. The input attenuation can be selected between Manual or Auto. The Auto attenuation settings are based on the internal mixer and reference levels currently set on the analyzer. The Manual attenuation level must be appropriately set based on the input signal level.

Step 1. Press the Amp icon on the main menu bar, or press the Amplitude key on the instrument front panel, to display the Amplitude menu below:



Step 2. Select Manual or Auto from the Manual/Auto toggle button.

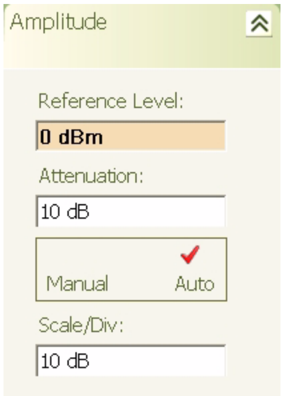
Step 3. If manual attenuation is selected, press in the Attenuation parameter field and use the keypad to enter the desired attenuation level, then select the appropriate amplitude terminator from the fly-out menu.



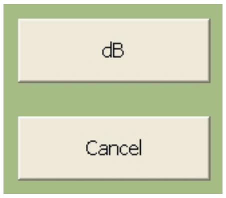
Setting the Scale/Div

The Scale/Div selection is only available when the instrument is set to Log mode. The Scale/Div setting adjusts the number of units per vertical division of the graticule display.

Step 1. Press the Amp icon on the main menu bar, or press the Amplitude key on the instrument front panel, to display the Amplitude menu below:



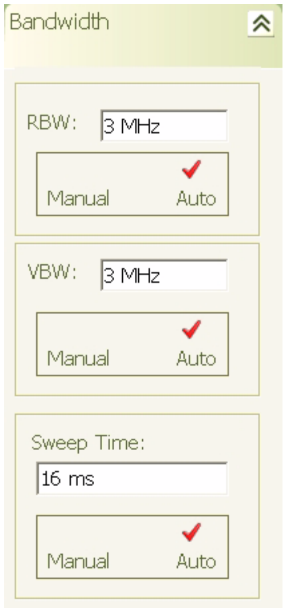
Step 2. Press in the Scale/Div parameter field and use the keypad to enter the desired scaling value, then select the appropriate terminator from the fly-out menu.



Setting the Resolution Bandwidth

The Resolution Bandwidth (RBW) sets the filter response of the analyzer's IF stages. This is defined as the width of the filter response at its 3 dB (50%) point from maximum. Increasing the RBW allows faster sweep times while decreasing the RBW allows you to view lower noise levels.

Step 1. Press the BW icon on the main menu bar, or press the Bandwidth key on the instrument front panel, to display the Bandwidth menu below:

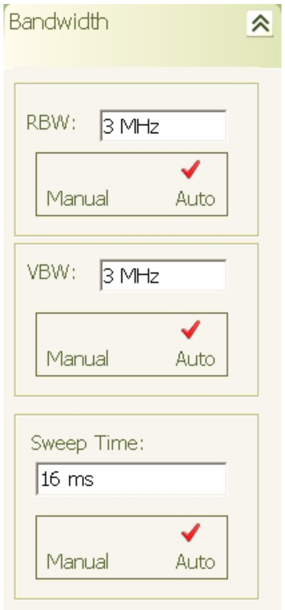


Step 2. Select Auto RBW mode or press in the RBW parameter field and use the keypad to enter the desired bandwidth, then select the appropriate terminator from the fly-out menu.

Setting the Video Bandwidth

The Video Bandwidth (VBW) sets the filter response of the analyzer's Video processor.

Step 1. Press the BW icon on the main menu bar, or press the Bandwidth key on the instrument front panel, to display the Bandwidth menu below:

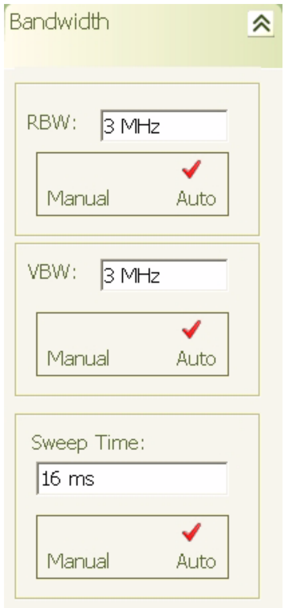


Step 2. Select Auto VBW mode or press in the VBW parameter field and use the keypad to enter the desired bandwidth, then select the appropriate terminator from the fly-out menu.

Setting the Sweep Time

The Sweep Time sets the duration of a full span sweep. When the sweep time is set to Manual mode, the RBW and VBW settings need to be set to Auto to allow for their automatic determination.

Step 1. Press the BW icon on the main menu bar, or press the Bandwidth key on the instrument front panel, to display the Bandwidth menu below:

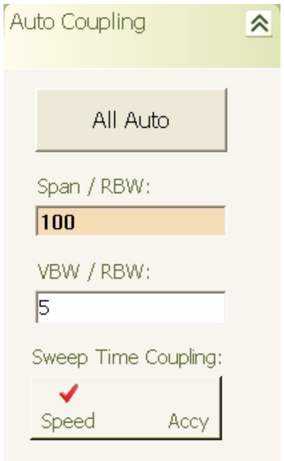


Step 2. Select Auto Sweep Time mode or press in the Sweep Time parameter field and use the keypad to enter the desired sweep time, then select the appropriate terminator from the fly-out menu.

Setting the Bandwidth Coupling Modes

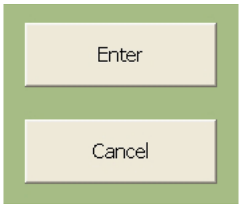
The Bandwidth Auto Coupling modes (Span/RBW and VBW/RBW) sets the coupling ratios of the span, RBW, and VBW. These ratios can be set automatically or manually as follows:

Step 1. Press the BW icon on the main menu bar, or press the Bandwidth key on the instrument front panel, then expand the Auto Coupling menu by selecting it to display the menu below:



Step 2. Select the All Auto mode.

Step 3. If All Auto is not selected, press in the Span/RBW or VBW/RBW parameter field and use the keypad to enter the desired ratio, then select the appropriate terminator from the fly-out menu.



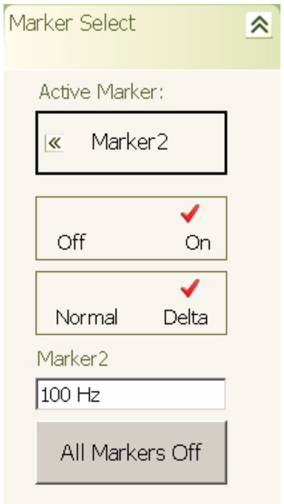
Step 4. Toggle the sweep time coupling mode between speed or amplitude accuracy.

Note: When the sweep time coupling mode is set to Speed, the amplitude measurement accuracy is slightly degraded. Amplitude accuracy specifications only apply to the Accy sweep time coupling mode.

Setting Markers

Markers can be used to measure the frequency and peak power values as follows:

Step 1. Press the Marker icon on the main menu bar, or press the Marker key on the instrument front panel, to display the Marker Select menu below:



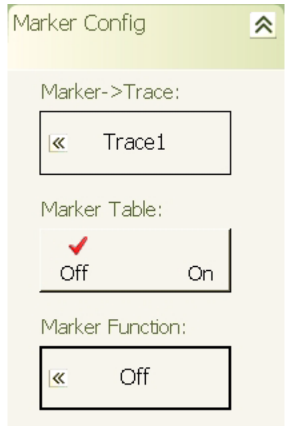
Step 2. Press the Active Marker button and select the marker you wish to make active from the fly-out menu.

Step 3. Press the Off On button to turn the marker on.

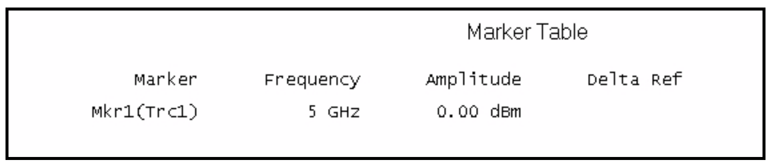
Step 4. To activate a delta marker, you must first turn on Marker 1 as a reference, then turn on any other marker and press the Normal/Delta button.

The marker's value is displayed on the Marker Select menu, at the top of the graticule display, and near the actual marker on the trace.

Step 5. To activate the marker table, select the Marker Config menu and press the Marker Table Off/On toggle button.



The marker table is displayed under the graticule as shown below:


Marker Table

Marker	Frequency	Amplitude	Delta Ref
Mkr1(Trc1)	5 GHz	0.00 dBm	

Setting Trace Modes

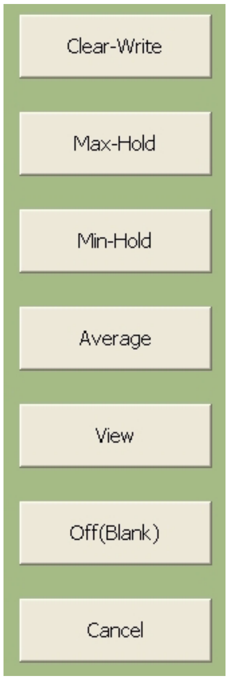
Signature can display up to five traces, each using different trace modes and detectors. Set up the various trace modes and detectors as follows:

Step 1. Press the Trace icon on the main menu bar, or press the Trace key on the instrument front panel, to display the Trace Config menu below:

Step 2. Press the Trace Select button and select the trace you wish to make active from the fly-out menu.

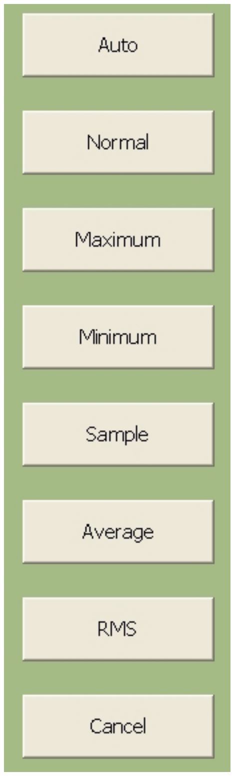
> **Note:** By default, Trace 1 is set to the active trace in the Clear-Write state. When a new trace is selected as the active trace, its mode is set to Off (Blank) by default and is not displayed until a new mode is also selected.

Step 3. Press the Trace Mode button and select a trace mode from the fly-out menu below to turn the trace on.



Note: Refer to Displaying Trace Modes on page 6-32 for a detailed description of the trace modes.

Step 4. To change the detector for the currently active trace, press the Detector button and select a new detector from the fly-out menu below:

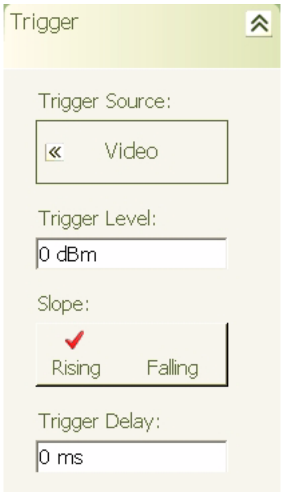


Note: Refer to Displaying Detectors on page 6-31 for a more detailed description of the different detectors.

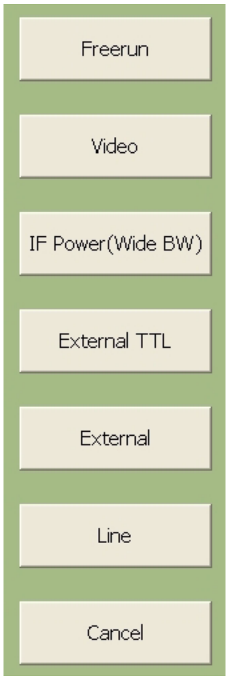
Configuring the Triggering

Signature has a variety of trigger modes and configurations you can setup to help you display signals. Configure the instrument triggering as follows:

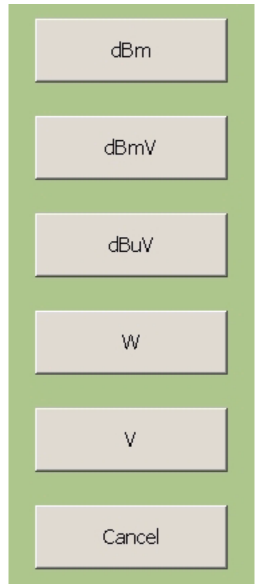
Step 1. Press the Trig icon on the main menu bar, or press the Trigger key on the instrument front panel, to display the Trigger menu below:



Step 2. To change the trigger source, press the Trigger Source button and select the trigger source from the fly-out menu below:

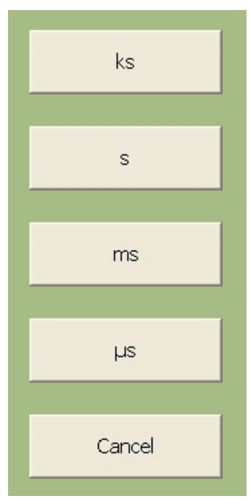


Step 3. Press in the Trigger Level parameter field and enter the trigger level using the keypad, then select the appropriate terminator from the fly-out menu below:



Step 4. Select the trigger slope by pressing the Rising/Falling toggle button.

Step 5. To enter a trigger delay, press in the Trigger Delay parameter field and enter a value using the keypad, then select the appropriate terminator from the fly-out menu below:



6-3 Measurement Examples

The examples in this section give a simple step-by-step instruction on how to set up the MS278XA to perform the measurement and show a final screen shot of the measurement result.

The following example measurements are shown:

- Measuring a CW Carrier
- Measuring Harmonics
- Displaying Wide Band FFT Mode
- Displaying Narrow Band FFT Mode
- Measuring a Pulse in the Time Domain
- Displaying Trace Modes
- Displaying Detectors
- Measuring Phase Noise

It is assumed that you have read the previous section, Basic Measurement Setups, and are familiar with the instrument's menus and measurement setup procedures.

Measuring a CW Carrier

The following example shows a basic measurement of a 0 dBm, 5 GHz carrier using markers:

Step 1. Preset the analyzer using the Preset All button.

Step 2. On the analyzer, set up the following:
Center Frequency: 5 GHz
Span: 20 kHz
RBW: 200 Hz

Step 3. In the Auto Coupling menu, toggle the Sweep Time Coupling to Accy.

Step 4. Select Marker 1 as the active marker and toggle it on, then toggle the Marker Table on.

Step 5. Press the Mkr–>Pk icon to send the marker to the signal peak.

Step 6. Read the frequency and amplitude value from the marker table at the bottom of the graticule.

The display should look like the one in the figure below:

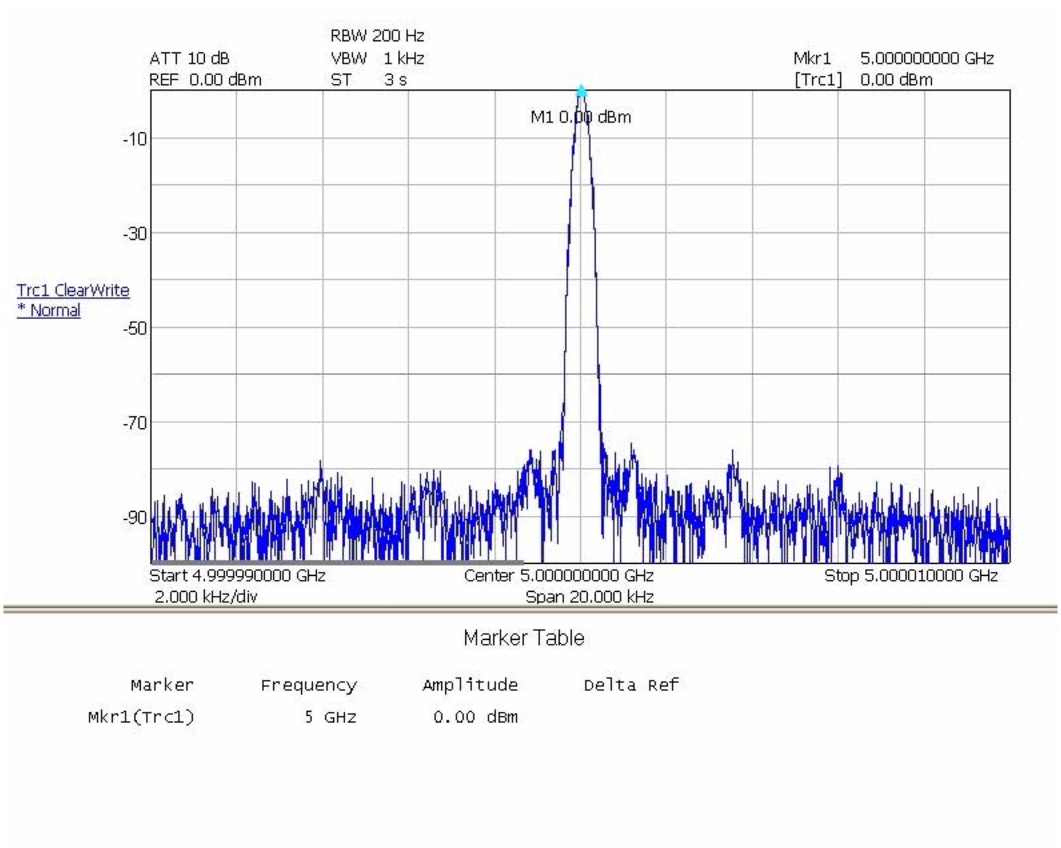


Figure 6-1. Measuring a CW Carrier

Measuring Harmonics

The following example shows a basic measurement of the second and third harmonic of a + 10 dBm, 1 GHz carrier using delta markers:

Step 1. Preset the analyzer using the Preset All button.

Step 2. On the analyzer, set up the following:
Center Frequency: 2 GHz
Span: 3 GHz
Reference Level: 10 dBm
RBW: 30 kHz

Step 3. Turn on Marker 1 and press the Mkr–>Pk icon, then turn on the Marker Table.

Step 4. Turn on Marker 2, set it as a Delta Marker, then press the Next Peak icon until the marker lands on the second harmonic.

Step 5. Turn on Marker 3, set it as a Delta Marker, then press the Next Peak icon until the marker lands on the third harmonic.

The display should look like the one in the figure below:

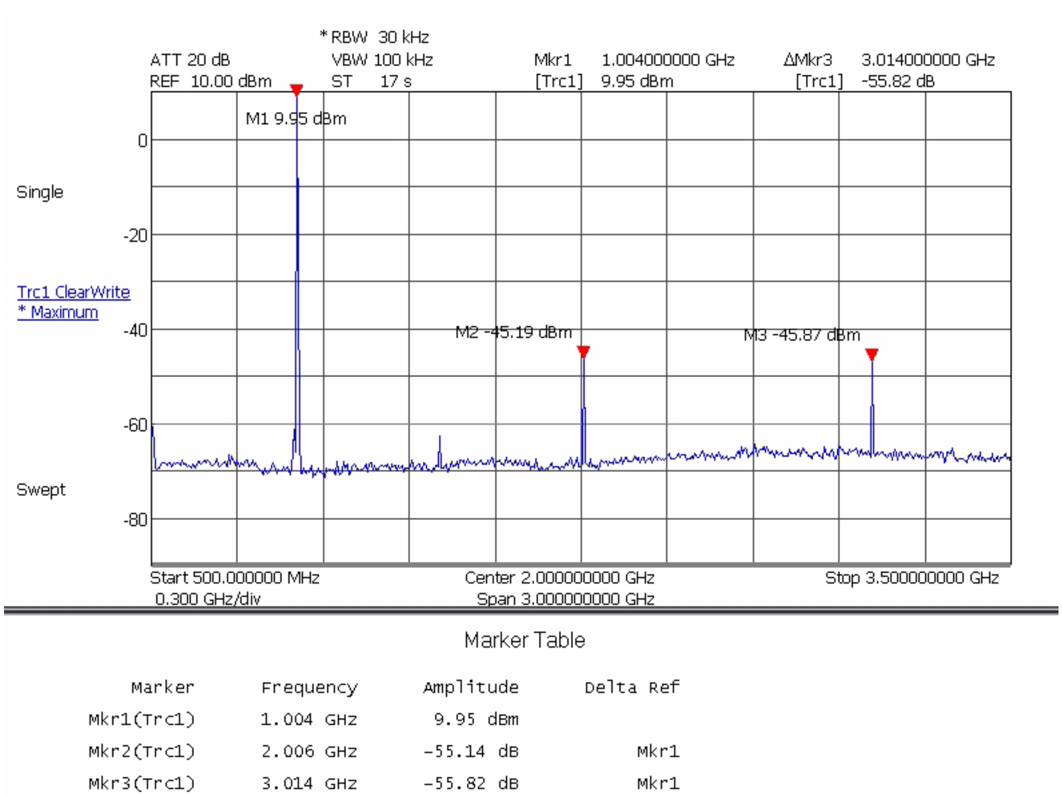


Figure 6-2. Measuring Harmonics

Displaying Wide Band FFT Mode

The following example shows a modulated, 1 GHz signal in the wide band FFT mode:

Step 1. Preset the analyzer using the Preset All button.

Step 2. On the analyzer, set the center frequency to 1 GHz.

Step 3. From the Sweep menu, set the Sweep Mode to FFT Wide Band.

The display should look like the one in the figure below:

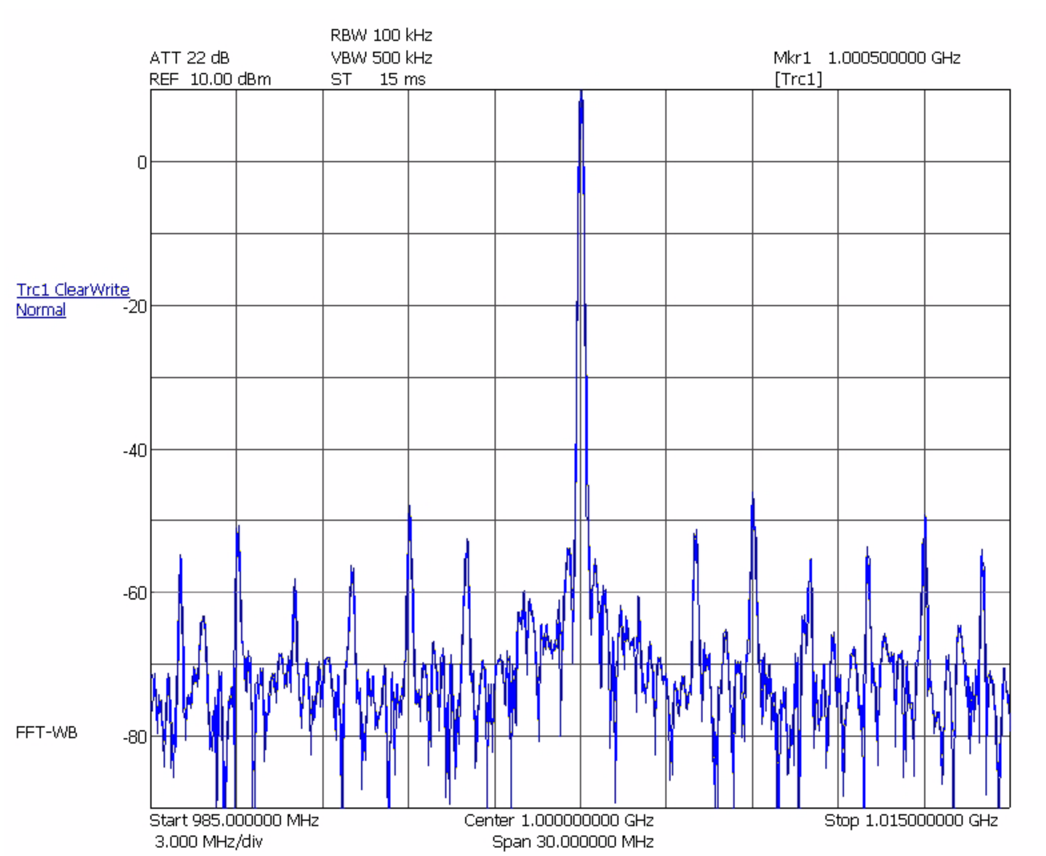


Figure 6-3. Displaying Wide Band FFT Mode

Displaying Narrow Band FFT Mode

The following example shows a modulated, 1 GHz signal in the narrow band FFT mode:

Step 1. Preset the analyzer using the Preset All button.

Step 2. On the analyzer, set the center frequency to 1 GHz.

Step 3. From the Sweep menu, set the Sweep Mode to FFT.

The display should look like the one in the figure below:

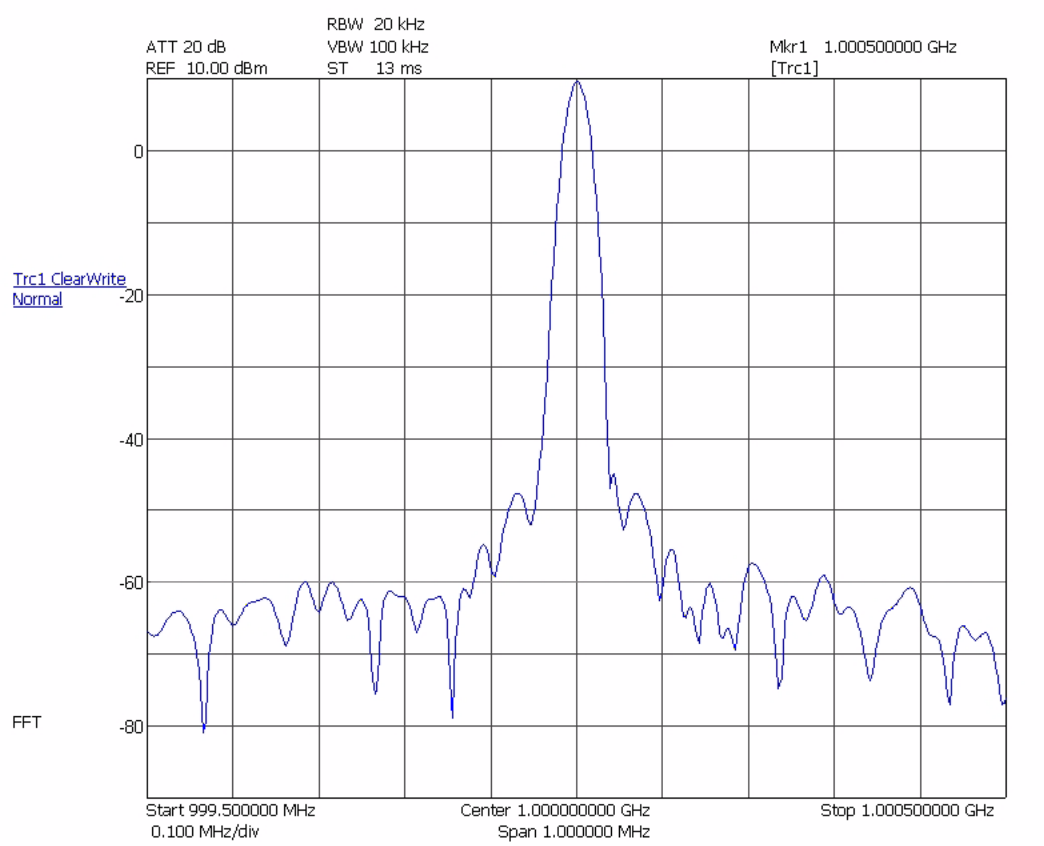


Figure 6-4. Displaying Narrow Band FFT Mode

Measuring a Pulse in the Time Domain

The following example shows a triggered measurement of a pulsed 1 GHz signal in zero-span mode:

Step 1. Preset the analyzer using the Preset All button.

Step 2. On the analyzer, set up the following:
Center Frequency: 1 GHz
Span: 0 Hz
Reference Level: 10 dBm

Step 3. On the Bandwidth menu, set the sweep time to be twice the pulse width of the signal. In this case, it is set to 0.2 ms to measure a 0.1 ms pulse width.

Step 4. On the Trigger menu, set the trigger source to Video, enter a trigger level of –20 dBm, and ensure that Rising edge triggering is selected.

The display should look like the one in the figure below:

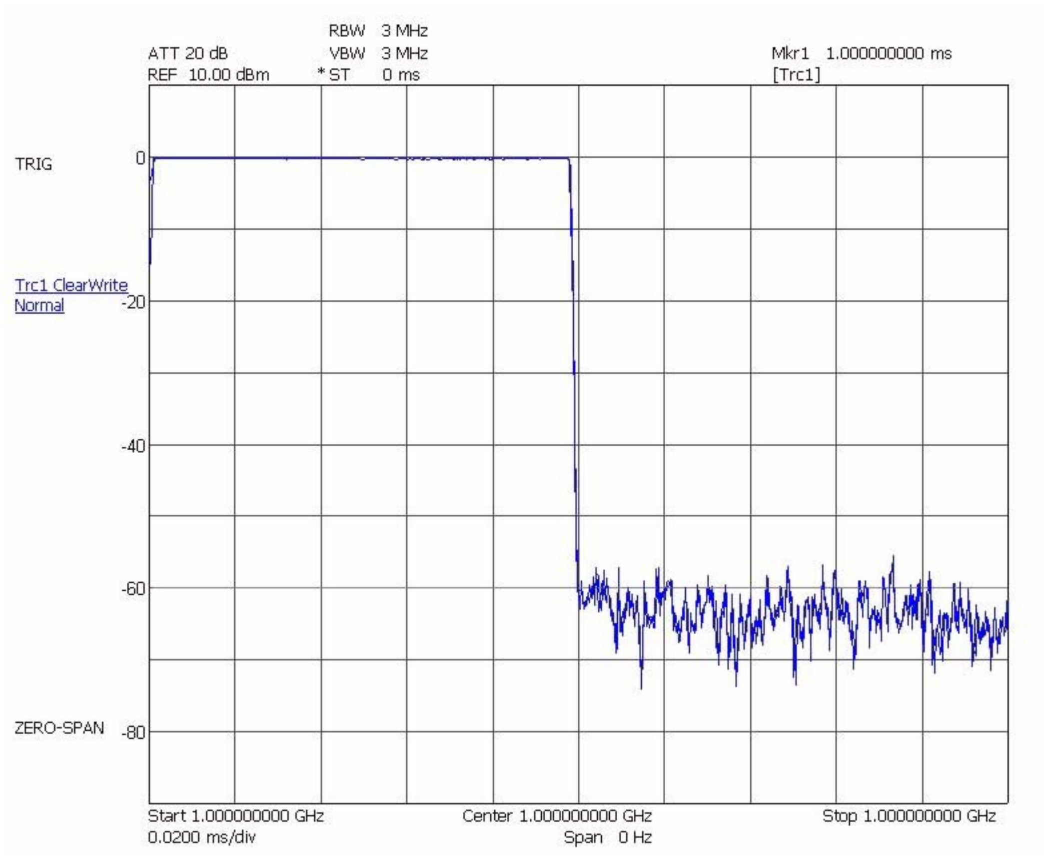


Figure 6-5. Measuring a Pulse in the Time Domain

Displaying Detectors

The following example shows an example of a 1 GHz carrier using the Average, RMS, Minimum, and Maximum detectors:

Step 1. Preset the analyzer using the Preset All button.

Step 2. Set the center frequency to 1 GHz and the span to 300 kHz.

Step 3. On the Trace Config menu, set the Trace 1 detector to Average.

Step 4. Select Trace 2 as the active trace and set it's detector to RMS.

Step 5. Select Trace 3 as the active trace and set it's detector to Minimum.

Step 6. Select Trace 4 as the active trace and set it's detector to Maximum.

The display should look like the one in the figure below:

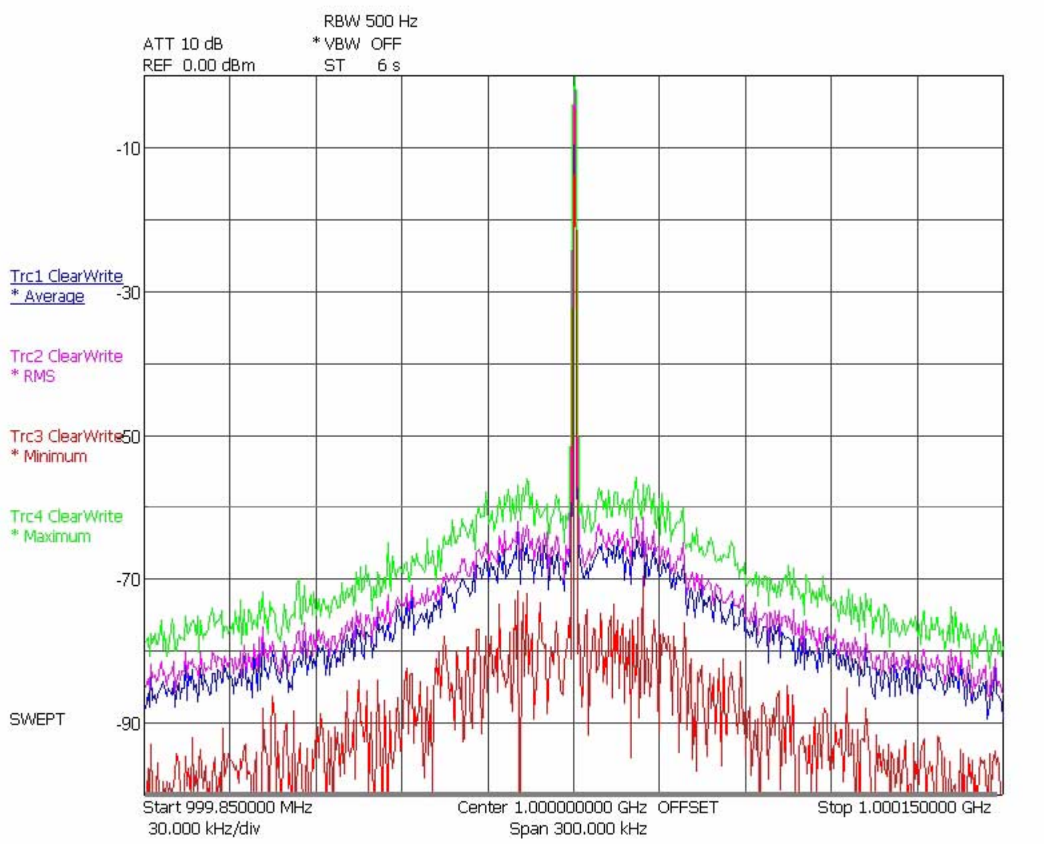


Figure 6-6. Displaying Detector Modes

Displaying Trace Modes

The following example shows the display of a 1 GHz carrier using the MaxHold, Average, and MinHold trace states:

Step 1. Preset the analyzer using the Preset All button.

Step 2. Set the center frequency to 1 GHz and the span to 300 kHz.

Step 3. On the Trace Config menu, set Trace 1 to the MaxHold state.

Step 4. Select Trace 2 as the active trace and set it to the Average state with 5 averages.

Step 5. Select Trace 3 as the active trace and set it to the MinHold state.

The display should look like the one in the figure below:

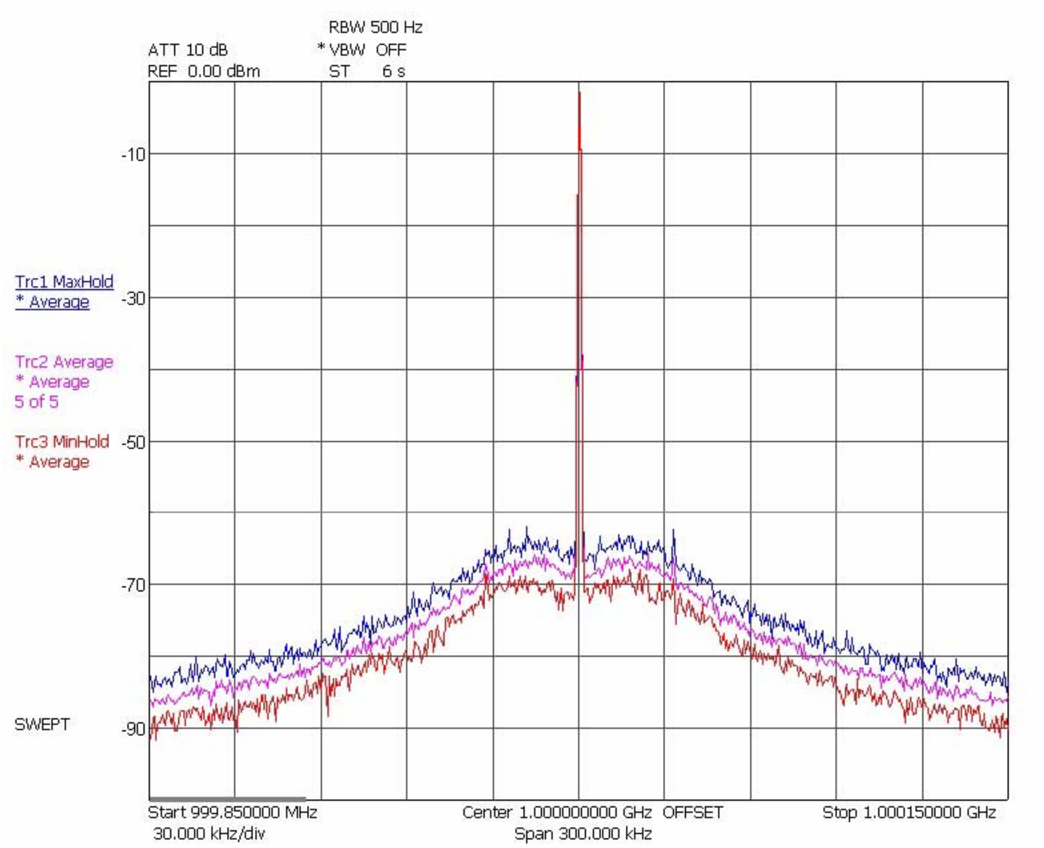


Figure 6-7. Displaying Trace Modes

Measuring Phase Noise

The following example shows a basic measurement of a 1 GHz carrier's 100 kHz phase noise using markers:

Step 1. Preset the analyzer using the Preset All button.

Step 2. On the analyzer, set up the following:
Center Frequency: 1 GHz
Span: 1 MHz
RBW: 1 kHz

Step 3. On the Trace Config menu, set the Trace 1 detector to Maximum, then press the Mkr–>PK icon.

Step 4. On the Trace Config menu, select Trace 2 as the active trace and set it's detector to RMS.

Step 5. On the Marker menu, select Marker 2 as the active marker, set it as a Delta Marker on Trace 2, then set its frequency to 100 kHz.

Step 6. Read the delta marker value from the top of the graticule.

The display should look like the one in the figure below:

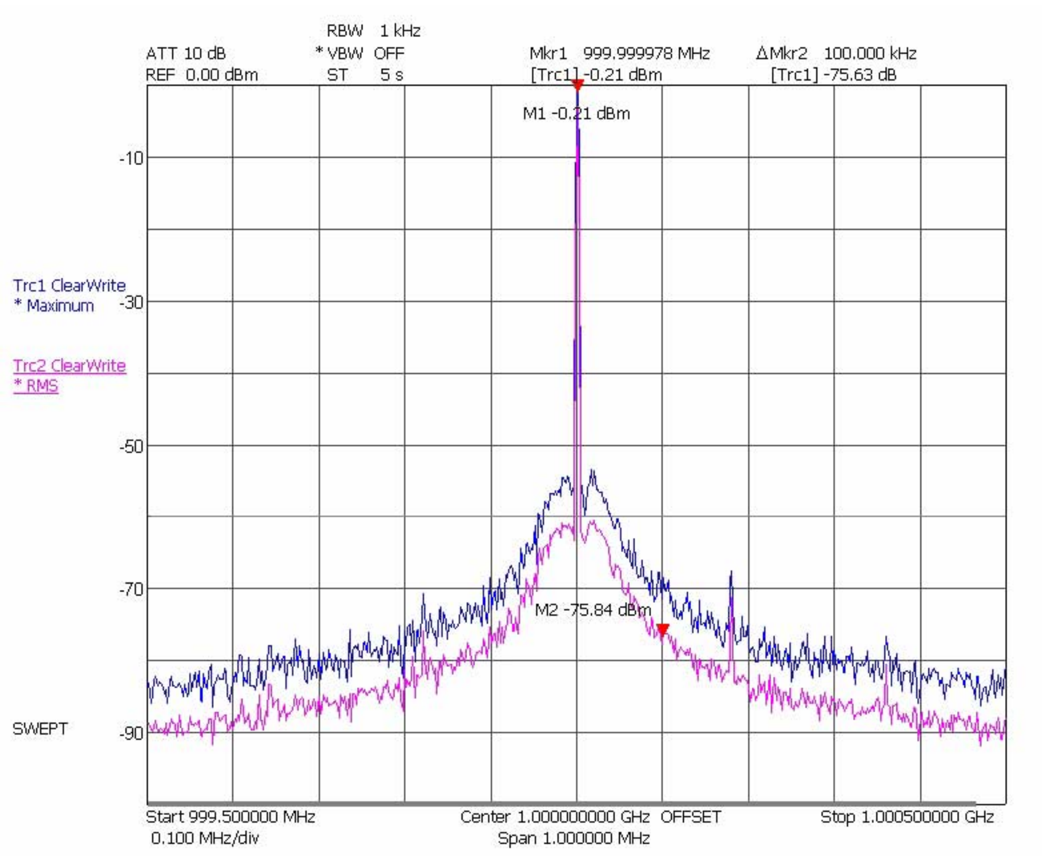


Figure 6-8. Measuring Phase Noise

6-4 RF Measurements

This section describes the one-button Spectrum RF measurements that are available. In the RF measurement mode (refer to the Measurement Main Menu on page 4-18), you can make power measurements, such as:

- Occupied Bandwidth Measurement
- Third Order Intercept Measurement
- Channel Power Measurement
- Adjacent Channel Power Measurement
- Multicarrier Channel Power Measurement

Occupied Bandwidth Measurement

The Occupied Bandwidth (OBW) measurement shows the bandwidth that includes most of the channel energy. This is usually 99%, but can be adjusted. It also shows the bandwidth that is occupied down to X dB below the signal level, which can also be adjusted.

When in the OBW measurement, the frequency, sweep and bandwidth parameters are used according to basic instrument setup. The RBW must be sufficiently small to not affect the OBW reading. The attenuator and reference level must be set correctly and the signal must be significantly above the analyzer's noise floor to get a reasonable measurement. The detector is automatically set to RMS detector.

During the measurement, the instrument integrates power over the entire span, then starts integrating out from the center until the selected percentage is reached. The corresponding bandwidth is reported as OBW. The Center of the measurement is the point where the integrated power is one half of the total span. The instrument then starts at the center and move outward until the X dB value is crossed, then reports the X dB bandwidth value.

The following measurement is made on a 2 GHz, 3.8 MHz QPSK modulated test signal. The analyzer is set up with a 20 MHz span using all other default setups.

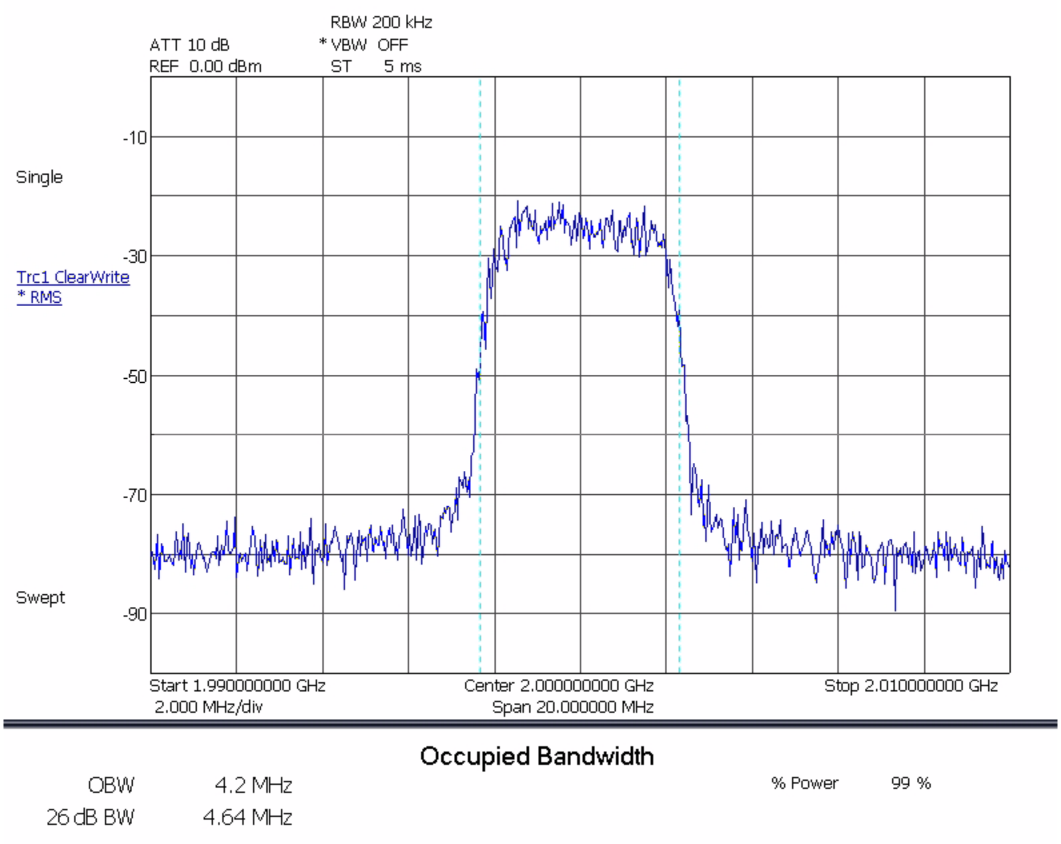


Figure 6-9. Occupied Bandwidth Measurement

Third Order Intercept Measurement

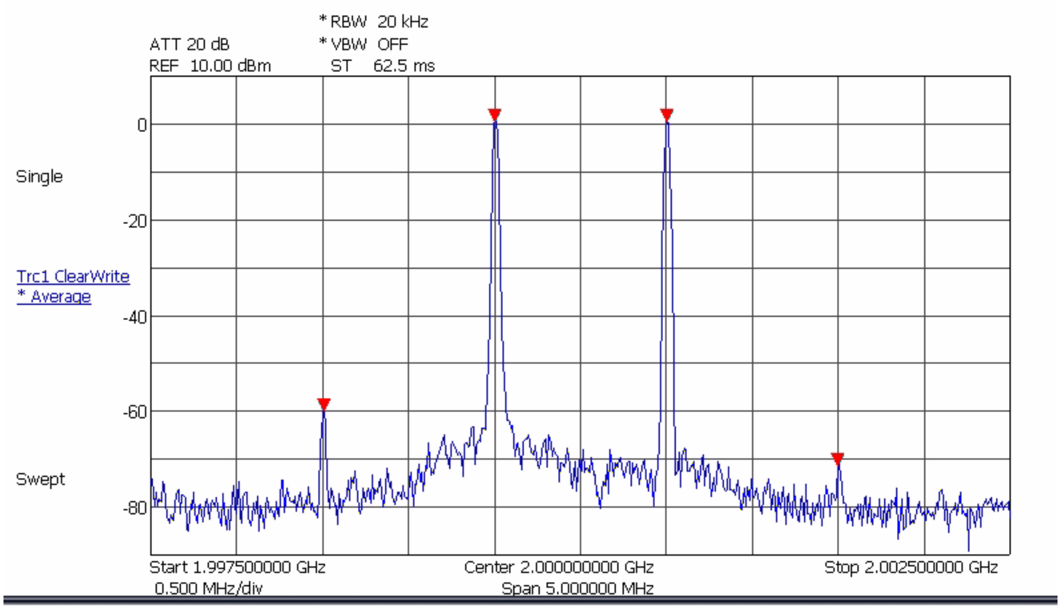
The Third Order Intercept (TOI) measurement computes and displays the output intercept point and places markers on the trace to indicate the measured signals and their third-order products.

For odd orders, the measurement is done by:

Step 1. Applying 2 tones with a small separation (usually < 1 MHz) and identical amplitudes to the DUT. Note that the signal generator must generate very low levels of interfering signals at the expected location of the distortion components.

Step 2. Measuring the amplitude difference between the applied tones and the distortion components. The distortion components will be at known frequencies, based on the separation of the 2 tones and the order of the distortion.

Step 3. Computing the intercept point. This is the theoretical level where the distortion component would be the same level as the input signal. Since the distortion changes by a known amount with signal level, based on the order, this is a simple computation.



Third Order Intercept

Marker	Frequency	Amplitude	TOI
Mkr1	2.0005 GHz	1.72 dBm	31.99 dBm
Mkr2	1.9995 GHz	1.72 dBm	
Mkr3	1.9985 GHz	-58.82 dBm	
Mkr4	2.0015 GHz	-70.15 dBm	

Figure 6-10. Third Order Intercept Measurement

Channel Power Measurement

The Channel Power measurement is similar to a power meter. It shows the total power from a transmitter, but the measurement is more accurate than a power meter as it is frequency selective and can be made on lower amplitude signals.

The channel power measurement is made by integrating the power reading from multiple pixels on the display and making various corrections to this result.

The measurement is made by setting the span to be somewhat larger than the channel width of interest. Markers are used to indicate the channel width and the power from all of the display points within the markers are integrated to obtain the channel power. RMS detection is used to ensure accurate readings for digital modulation with any amplitude statistics. A correction is then applied to account for the noise bandwidth of the RBW filter, along with the channel bandwidth and the number of data points.

The following is the equation used to calculate the Channel Power:

$$CP = 10 * \log\left[\frac{CHBW}{RBW * k_n} * \frac{1}{N} * \sum_{1}^{N} 10^{\frac{P_i}{10}}\right]$$

Where:

CP = Channel Power in dBm

CHBW = Channel bandwidth in kHz

RBW = Resolution bandwidth used for measurement in kHz

kn = RBW filter noise bandwidth correction factor
kn = NBW/RBW

N = Number of data points within the channel

Pi = Level represented by data point i of the trace in dBm

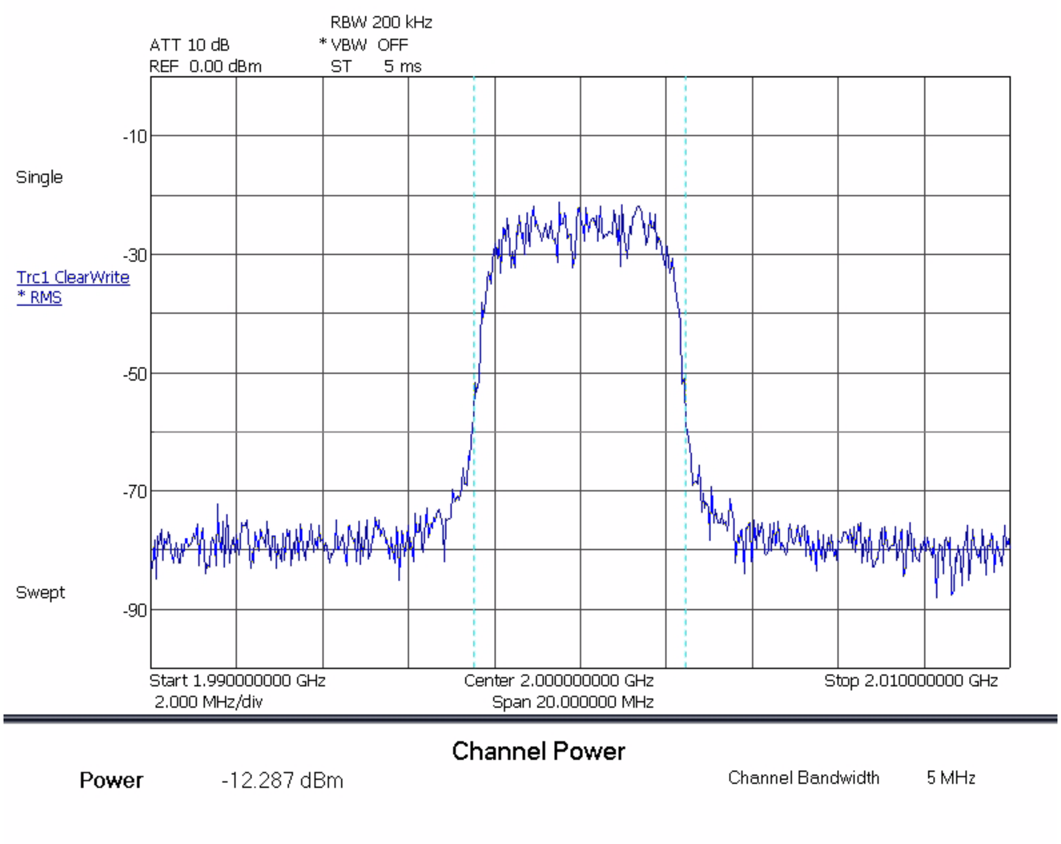


Figure 6-11. Channel Power Measurement

Adjacent Channel Power Measurement

Adjacent Channel Power (ACP) is a measure of the power that leaks into adjacent transmit channels. The ACP measurement measures the power present in the transmit channel (refer to Channel Power Measurement on page 6-37) along with the adjacent transmit channels that have been configured in the setup menu. In this example display, the channel bandwidth and channel spacing are set to 5 MHz.

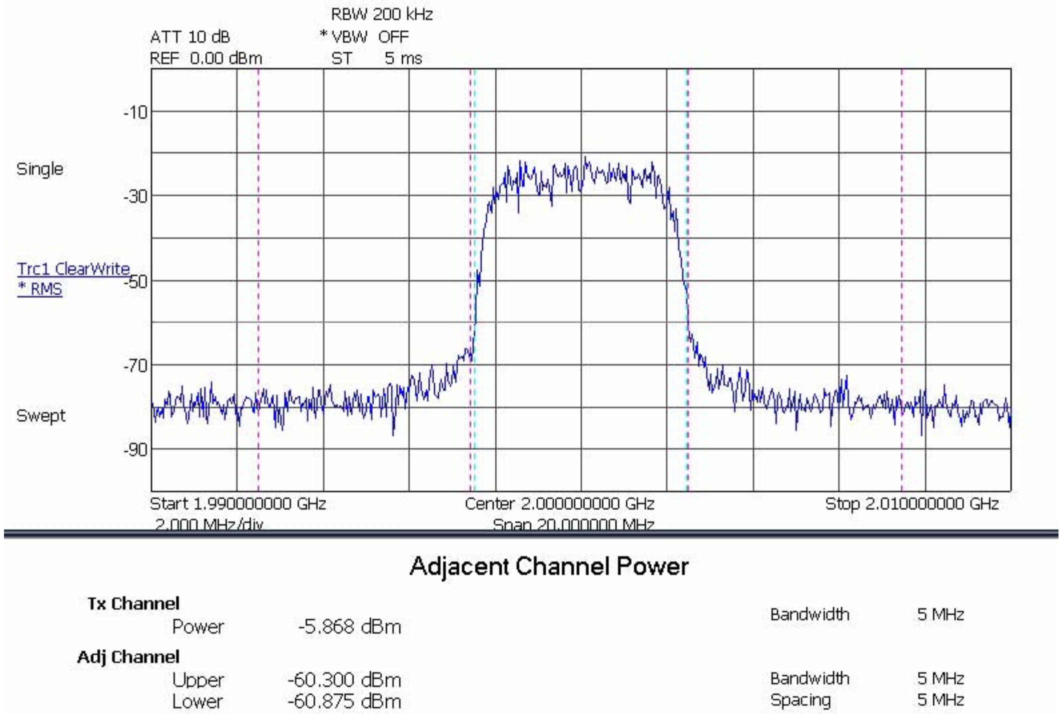


Figure 6-12. Adjacent Channel Power Measurement

Multicarrier Channel Power Measurement

The Multicarrier Channel Power measurement is similar to the Channel Power measurement (refer to Channel Power Measurement on page 6-37). It shows the total power from a transmitter, but the measurement is more accurate than a power meter as it is frequency selective and can be made on lower amplitude signals. The Multicarrier Channel Power measurement is similar in this regard, only it is capable of measuring up to 12 carriers at the same time, along with measuring the adjacent channel and two alternate channel powers.

Below is an example display measuring four carriers as well as the upper and lower adjacent and upper and lower alternate channels.

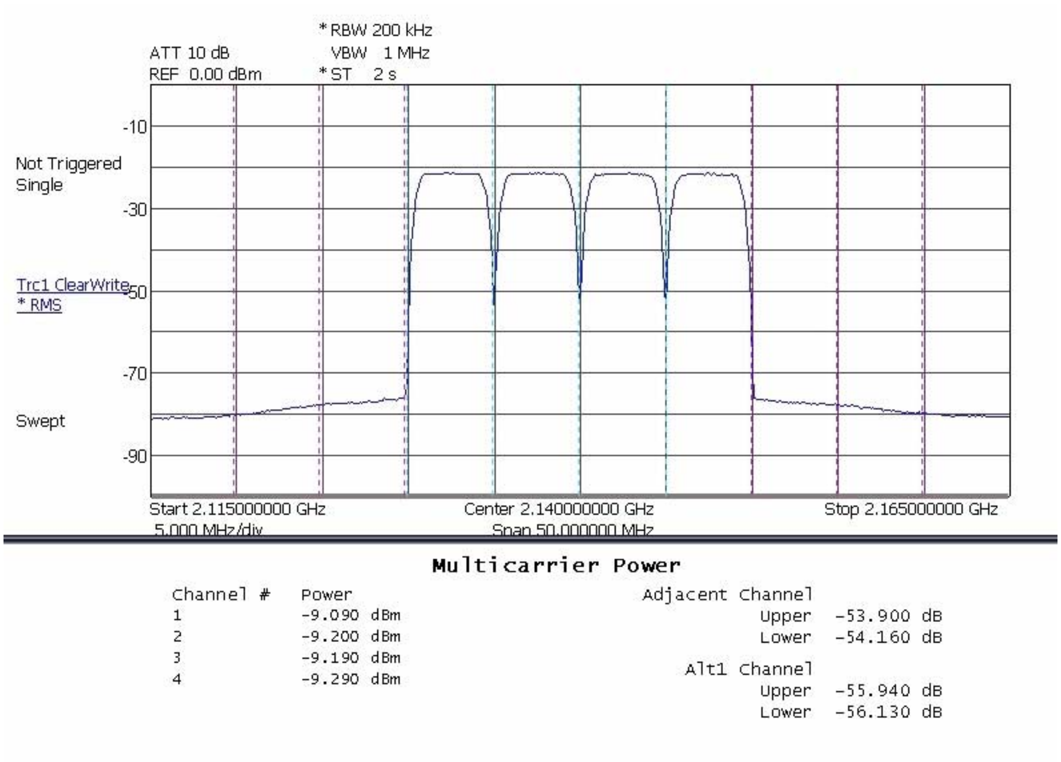


Figure 6-13. Multi-Carrier Channel Power with ACPR Measurement

6-5 Modulation Measurements

This section outlines a few common modulation measurements performed by Signature. These measurements include:

- QPSK Measurement
- QAM Measurement
- WCDMA Measurements
    - Code Domain Power Measurement
    - Code Domain Error Measurement
    - Composite Measurement
    - Single Code Measurement
    - Single Code with Compressed Mode Measurement

QPSK Measurement

The following modulation measurements use a 2 GHz test signal at 5 dBm with the analyzer set up as follows:

- **Modulation Format:** QPSK
- **Filter Type:** vNyquist
- **Roll-off Factor (a):** 0.22
- **Symbol Rate:** 3.84 MHz

Vector Graph of QPSK Modulated Test Signal

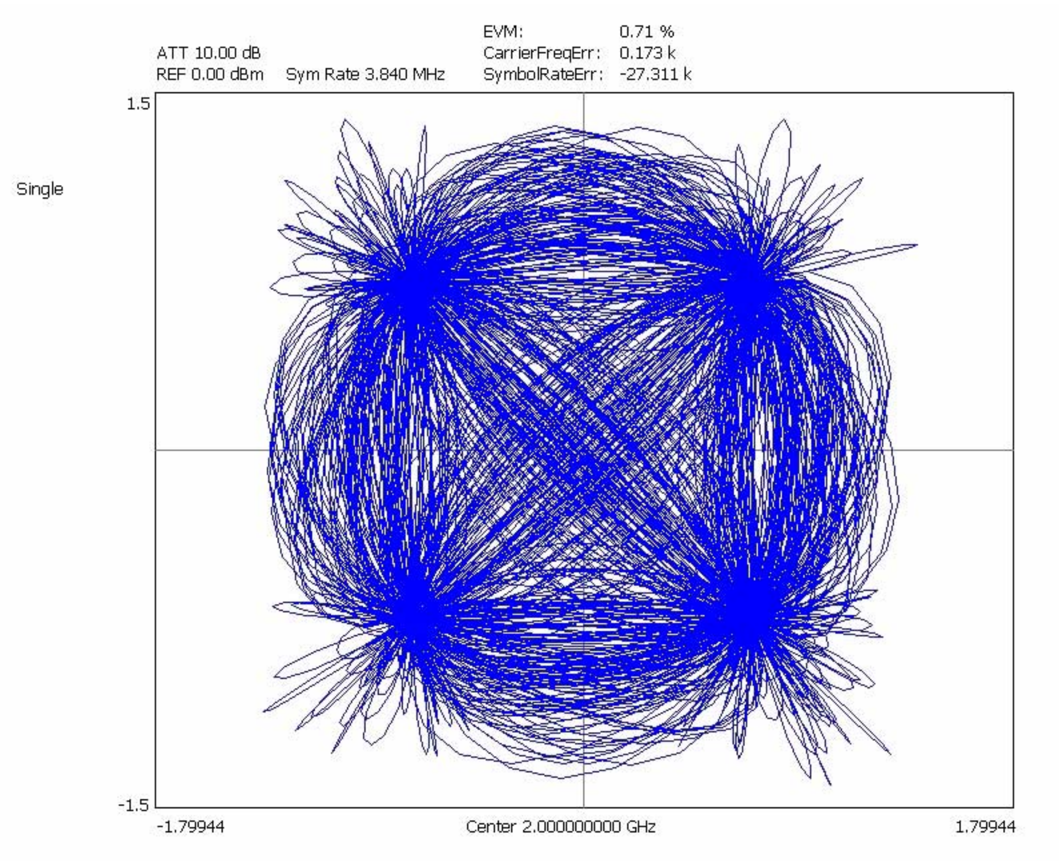


Figure 6-14. Vector Graph of QPSK Modulated Test Signal

EVM vs. Time Graph of QPSK Modulated Test Signal

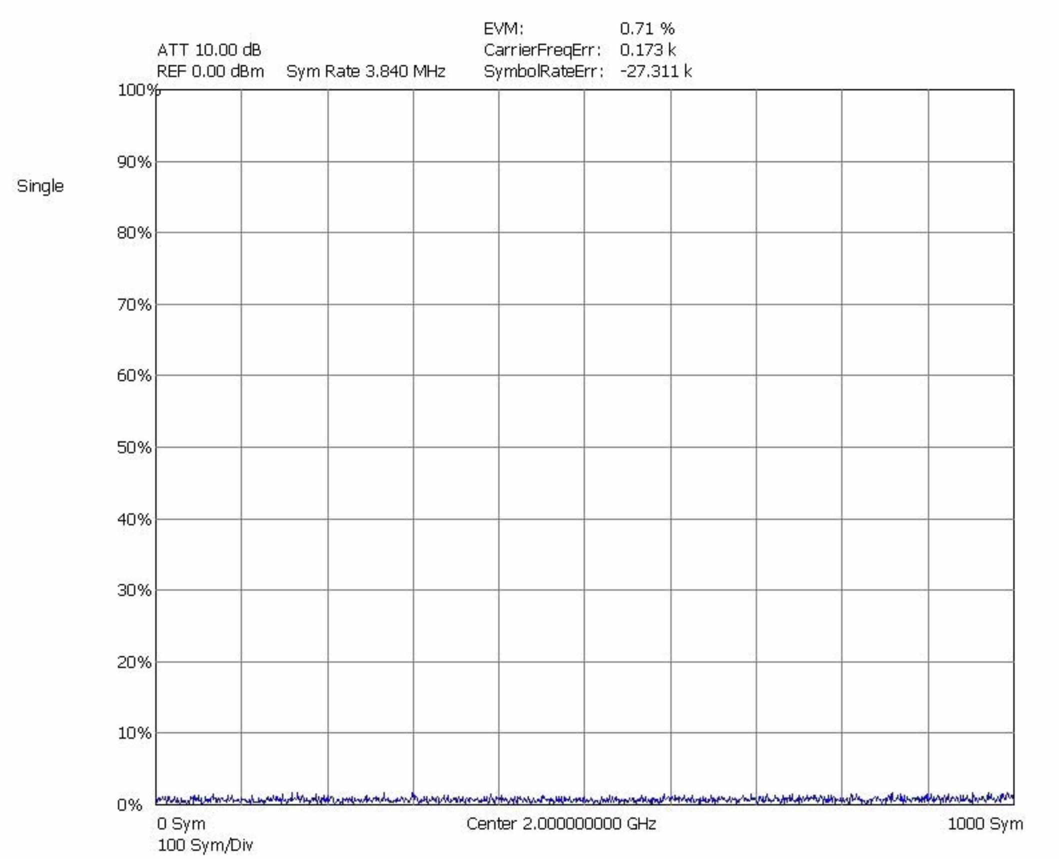


Figure 6-15. EVM/Time Graph of QPSK Modulated Test Signal

Summary Table of QPSK Modulated Test Signal

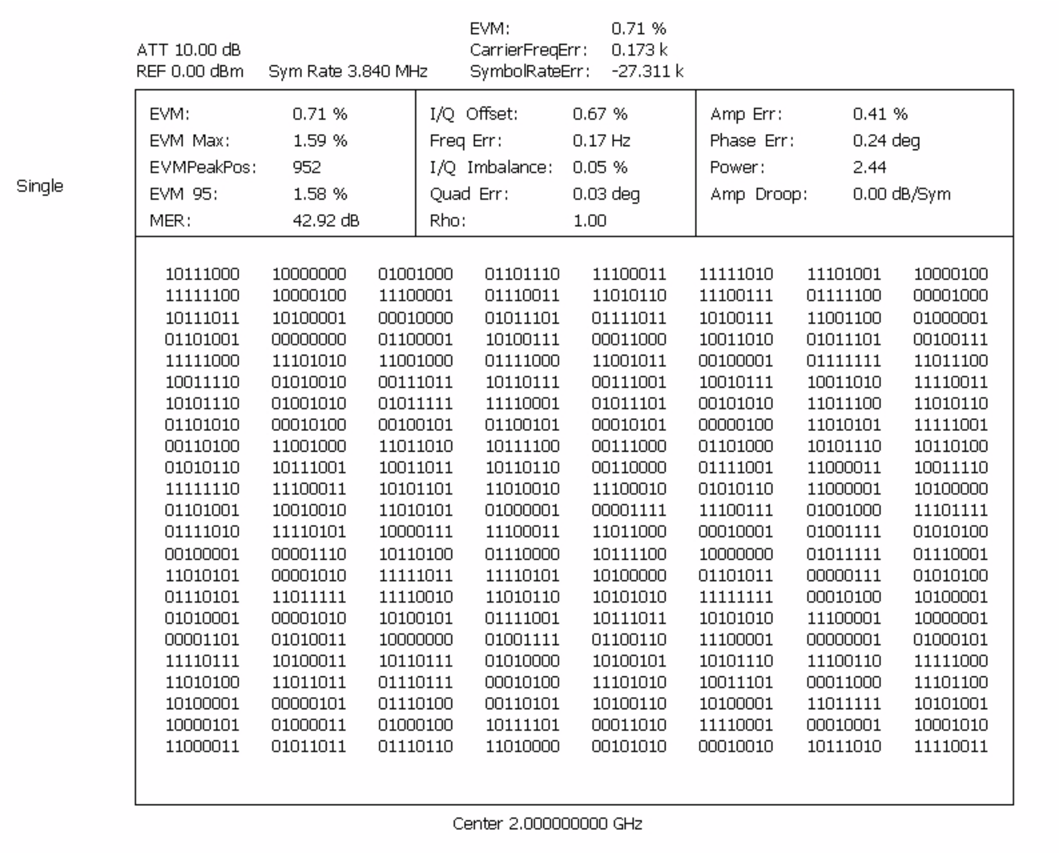


Figure 6-16. Summary Table of QPSK Modulated Test Signal

Eye (I or Q) Graph of QPSK Modulated Test Signal

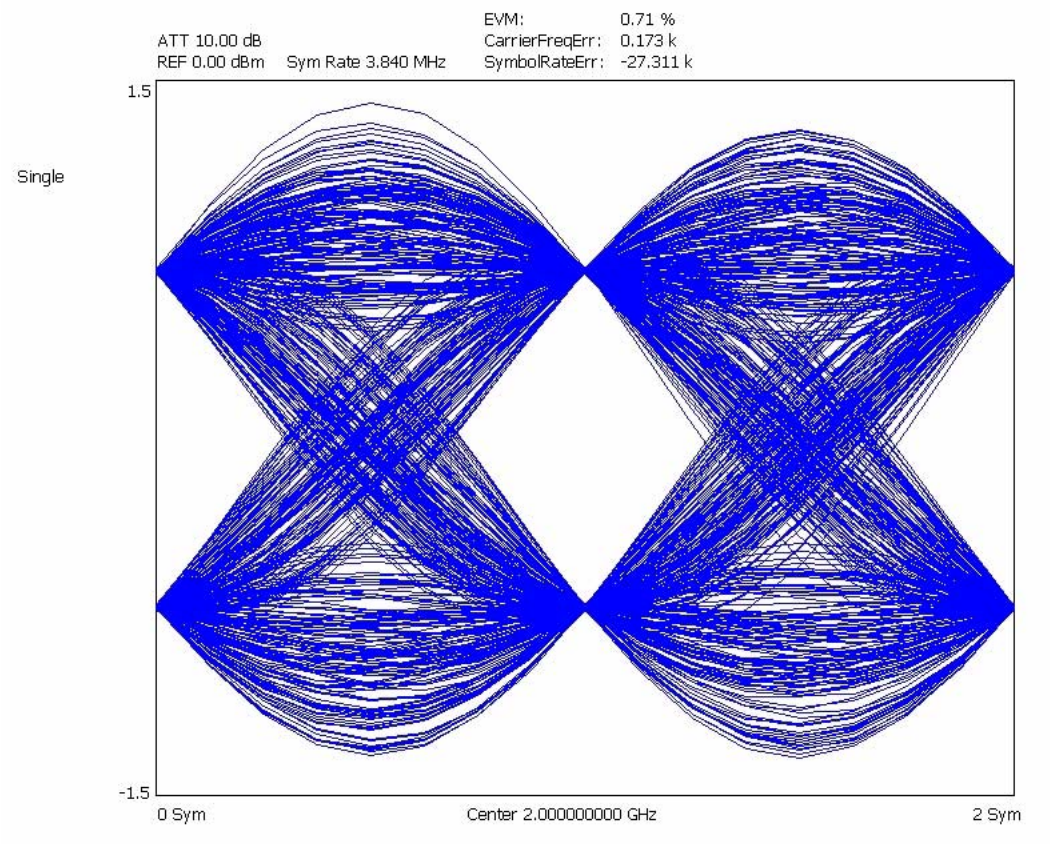


Figure 6-17. Eye Graph of QPSK Modulated Test Signal

QAM Measurement

The following modulation measurements use a 2 GHz, 64QAM modulated test signal at 5 dBm with the analyzer set up as follows:

- Modulation Format: 64QAM
- Roll-off Factor (a): 0.22
- Symbol Rate: 5 MHz

Constellation Graph of 64QAM Modulated Test Signal

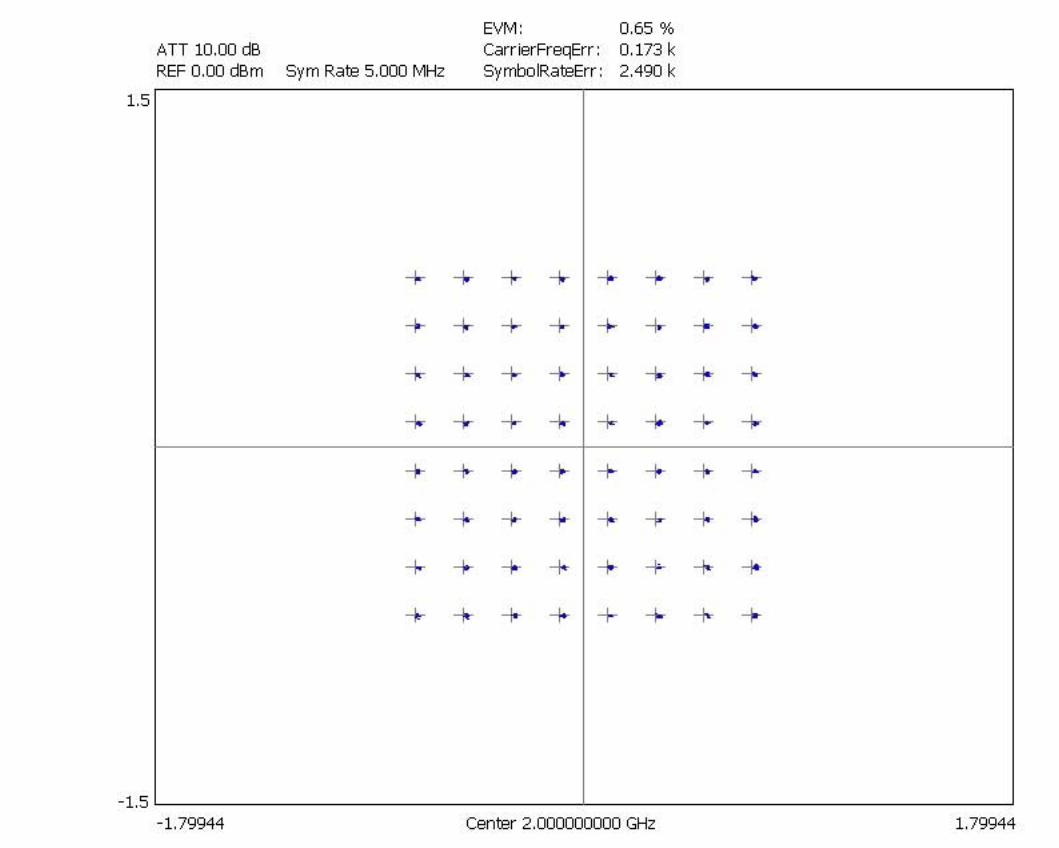


Figure 6-18. Constellation Graph of 64QAM Modulated Test Signal

Power vs. Time Graph of 64QAM Modulated Test Signal

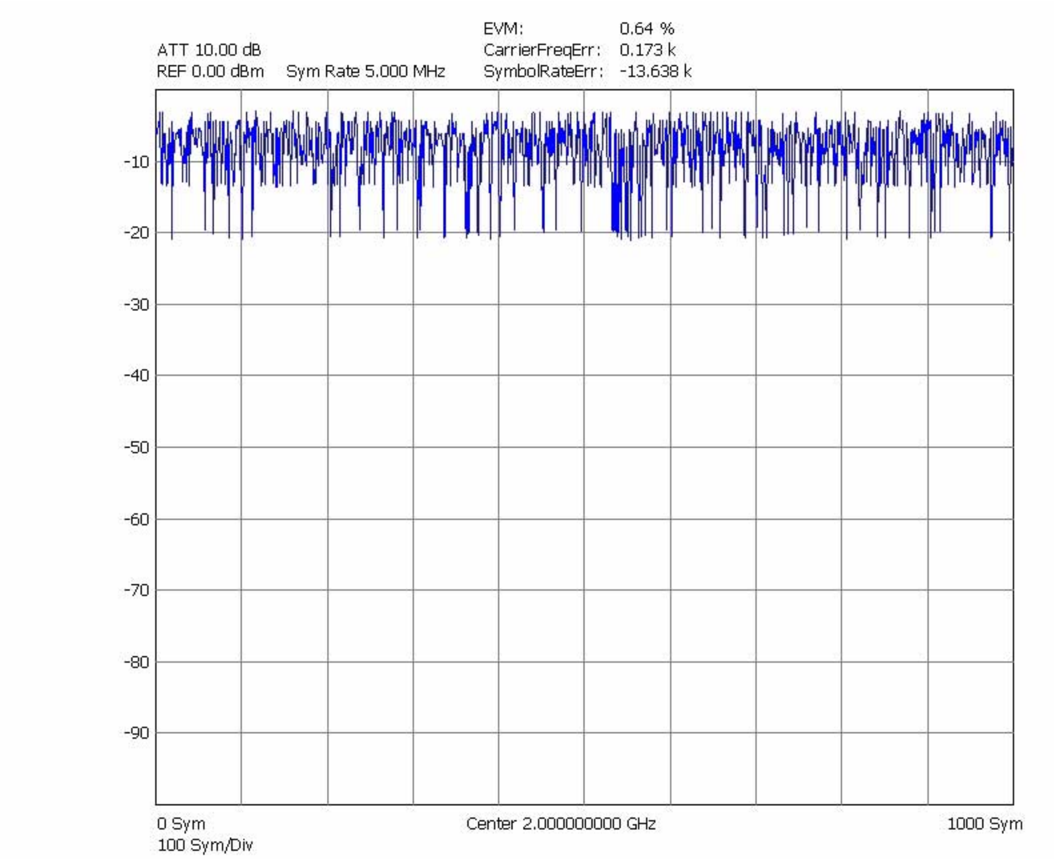


Figure 6-19. Power/Time Graph of 64QAM Modulated Test Signal

WCDMA Measurements

All of the common modulation quality measurements are available, similar to the Signature Option 38 (QAM/PSK Modulation Analysis); however, since this is focused on WCDMA, the symbol (chip) rate is fixed at 3.84 MHz. A few additional displays (compared to Option 38) are available as well, including Magnitude Error vs. Time and Phase Error vs. Time.

One of the strongest features of the WCDMA measurement user interface is that you are rarely required to use the Setup menu. In most cases when you connect a signal, set the center frequency and amplitude correctly, and select the WCDMA measurement you want, Signature will provide a measurement result.

The rare exceptions include:

- When making QPSK measurements, the signal must be QPSK—it can not have multiple codes
- If the signal does not have a pilot (P-CPICH), the channel requires manual synchronization
- If the signal does not have the synchronizing channel (SCH), the scrambling code needs to be manually entered
- In addition, there are a number of advanced measurements that are accessed from the Setup menu, such as Compressed Mode displays, Transmit Diversity, and measuring other than the first slot (or longer than one frame in the Single-Channel Code Power vs. Slot Overview)

Refer to the “WCDMA Setup Dialog” on page 4-46 for information about setting up a WCDMA measurement.

Two key measurements for CDMA are the Code Domain Power (CDP) and Code Domain Error (CDE).

Code Domain Power Measurement

Signature can display the Code Domain Power with an optional zoom window or an optional summary table, or both. In each case, the absolute power in each active code is shown.

The graph types are set up using the Graph Type setup dialog shown below by pressing the button for the measurement you want. Each tab also has a check box that is usually in the lower left corner that is an option to the measurement. In the dialog shown, the option is to include a Summary table (showing the Code Domain Power and Error of the active codes) to each of the selected graphs. The buttons immediately switch to the graph type selected. The check boxes are options for CPD overview.

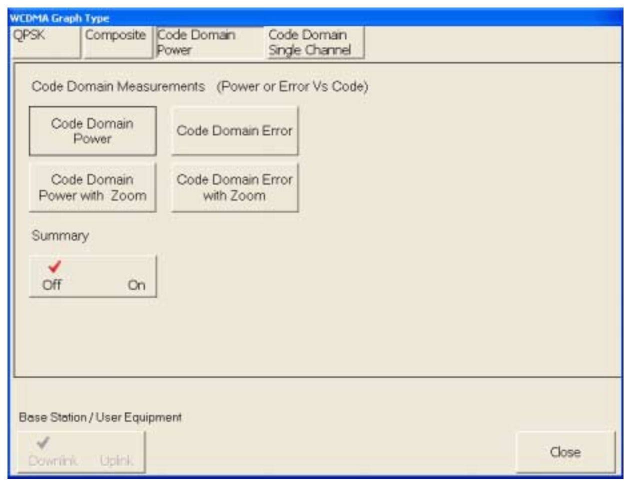


Figure 6-20. Code Domain Power Graph Selection Dialog

One of the key measurements of the WCDMA signal is the power level of the pilot signal (P-CPICH). This is the left most signal on the display in the following figures. The table view makes the power level of any code very easy to see and markers allow for picking out individual codes from the graph.

The Code Domain Power graph shows the power in each code and allows a comparison to the total signal power in terms of absolute power.

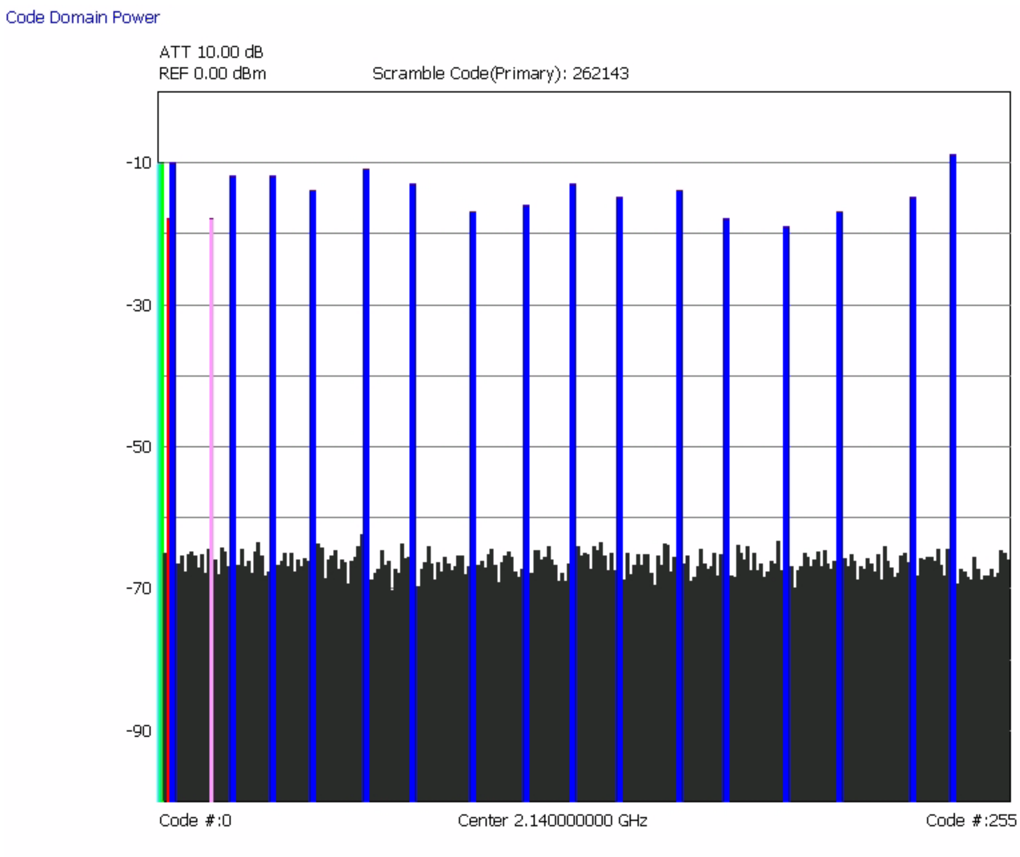


Figure 6-21. Code Domain Power for Test Model

The following CDP display is with the summary table view active. The table can be scrolled by using the scroll buttons on the right side of the table.

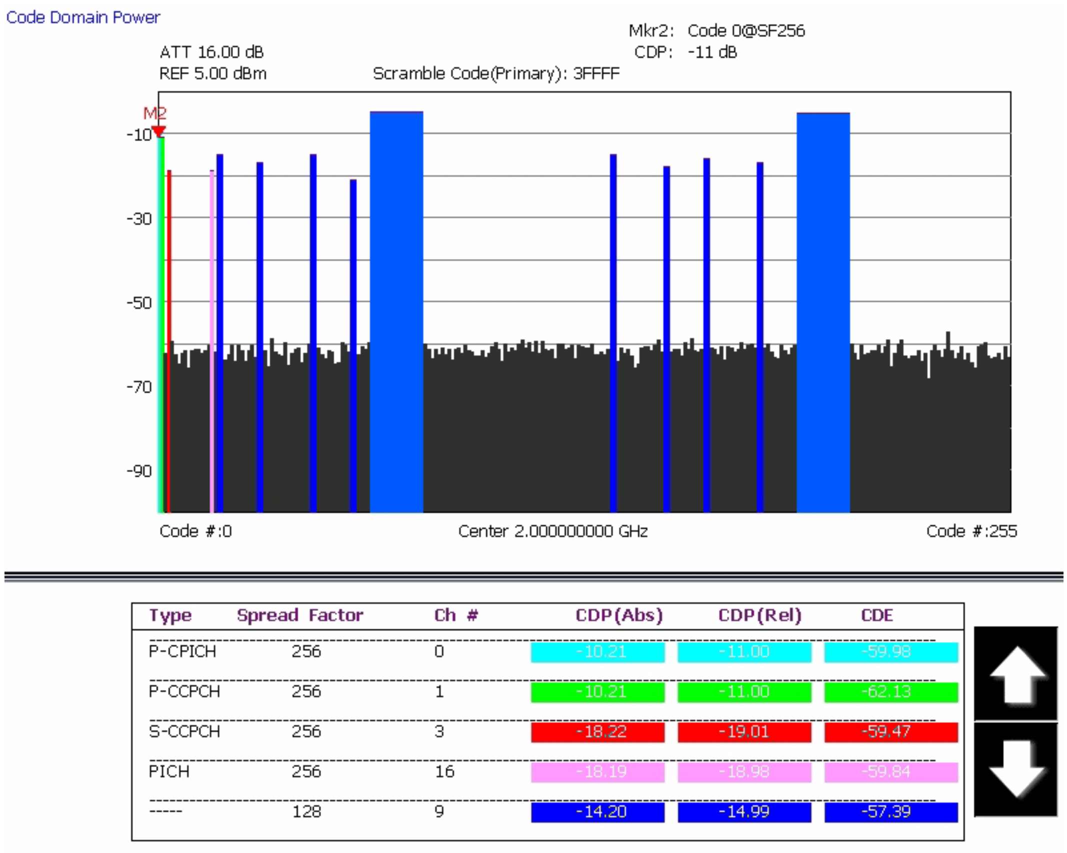


Figure 6-22. Code Domain Power for Test Model 5 with Summary Table

The following CDP display is with the zoom view active. The zoom view can be scrolled by using the scroll buttons on the bottom of the graph.

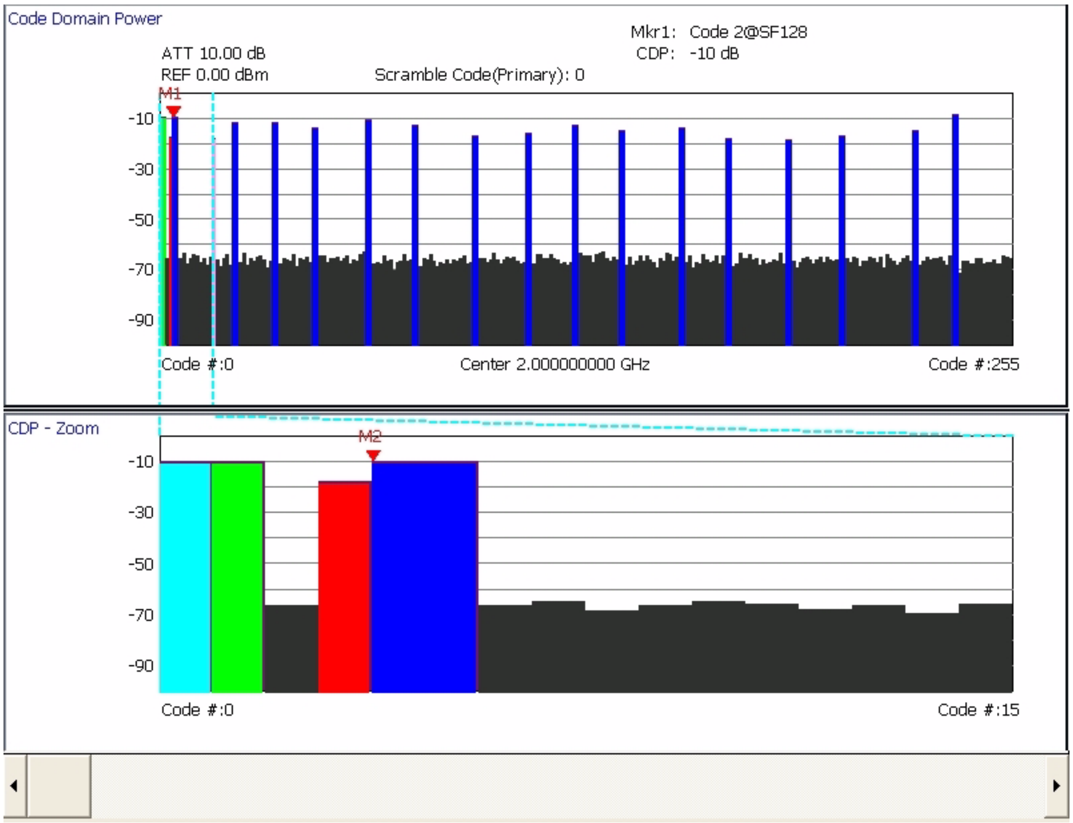


Figure 6-23. Code Domain Power for a Test Model with Zoom

The following CDP display is with both the zoom and summary table views active. The views can be scrolled by using the scroll buttons next to each of the graphs.

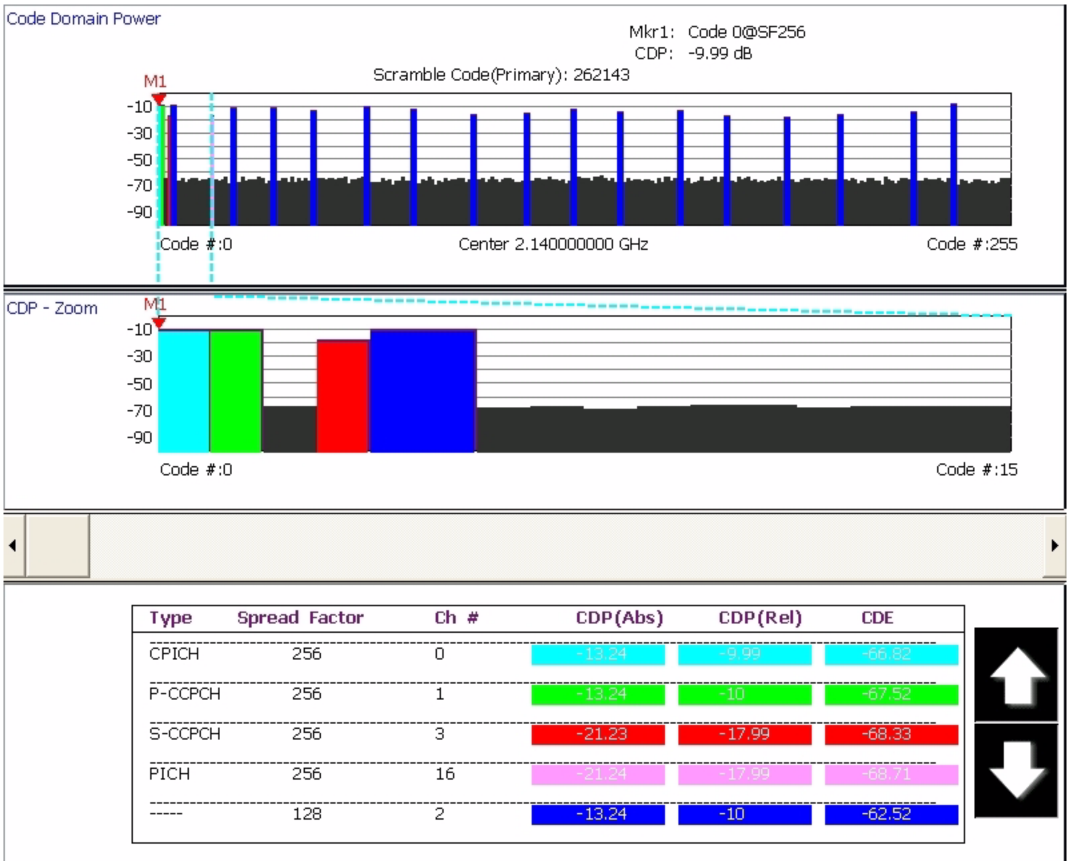


Figure 6-24. Code Domain Power for Test Model 1 with Zoom and Summary Table

Code Domain Error Measurement

Signature can display the Code Domain Error with an optional zoom window or an optional summary table, or both. In each case, the absolute power in each active code is shown.

Below is the graph type selection dialog:

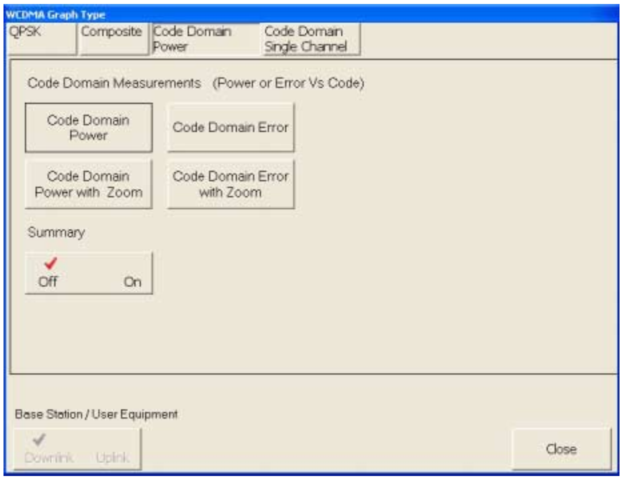


Figure 6-25. Code Domain Power Graph Selection Dialog

The CDE graphs shows the error of each code and is similar to the EVM of each code, but it is in dB.

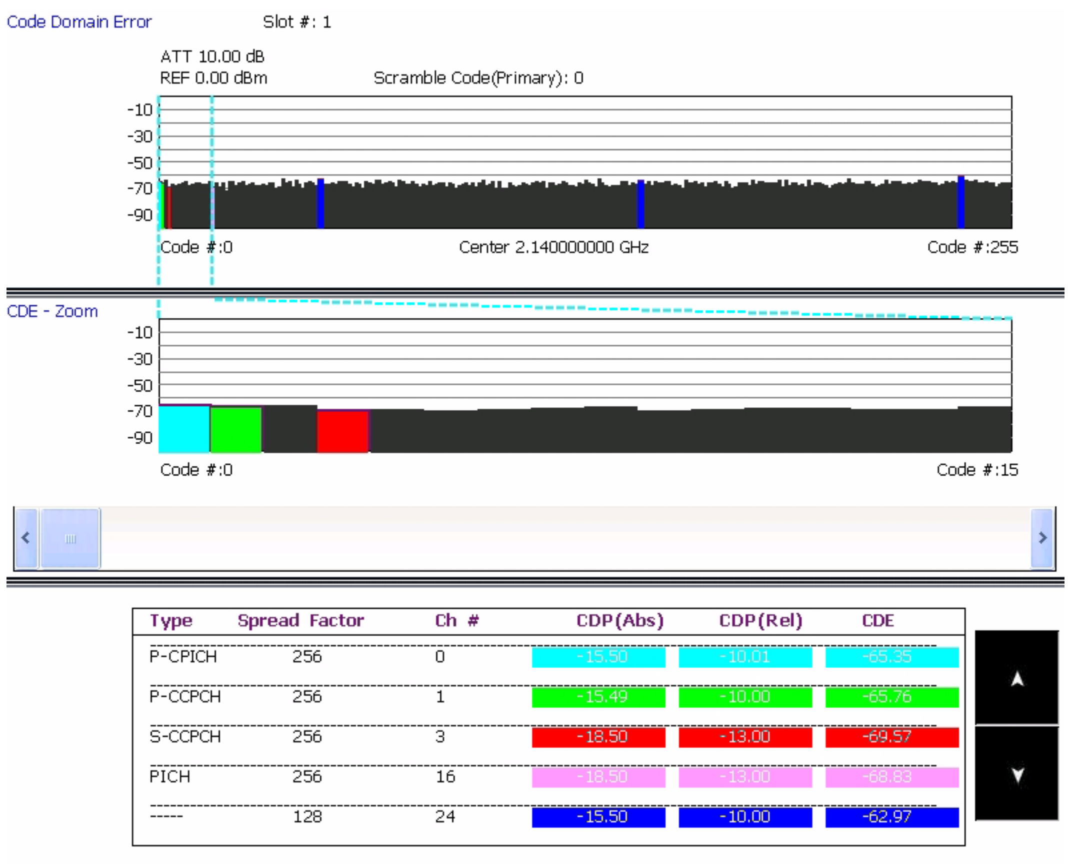


Figure 6-26. Code Domain Error of Test Model 2

QPSK Measurement

The next class of modulation quality measurements is when you don't have a full WCDMA transmitter, but you want to measure the modulation quality anyway. This is a common test for RF components, for example. These are called QPSK measurements, as you would use a QPSK-modulated signal generator as a source.

Component measurements are similar to QAM/PSK measurements, except they are at a WCDMA chip rate of 3.84 MHz. Signature is capable of displaying:

- Vector Diagram & Constellation
- Power vs. Time
- EVM, Magnitude Error, Phase Error, or all 3 vs. Time
- Eye Diagrams (I, Q, or both)
- Optional Summary table with any diagram
- EVM (RMS, Peak, Peak Location)
- Magnitude & Phase Error
- IQ Offset
- Frequency Error

The graph types are set up using the Graph Type setup dialog shown below by pressing the button for the measurement you want. Each tab also has a check box that is usually in the lower left corner. This is an option to the measurement. In the dialog shown below, the option is to include a Summary table to each of the selected graphs.

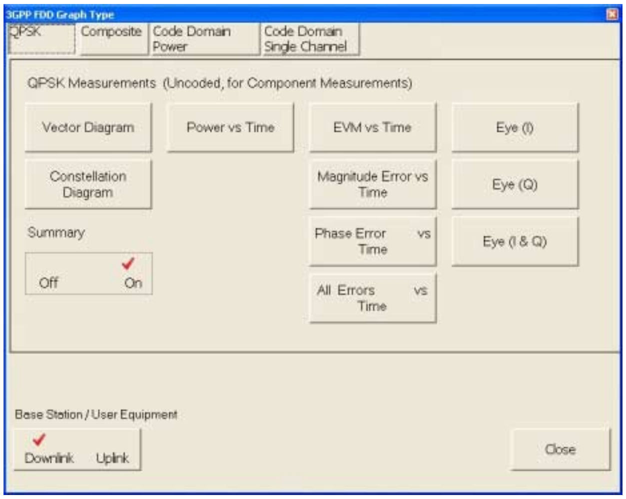
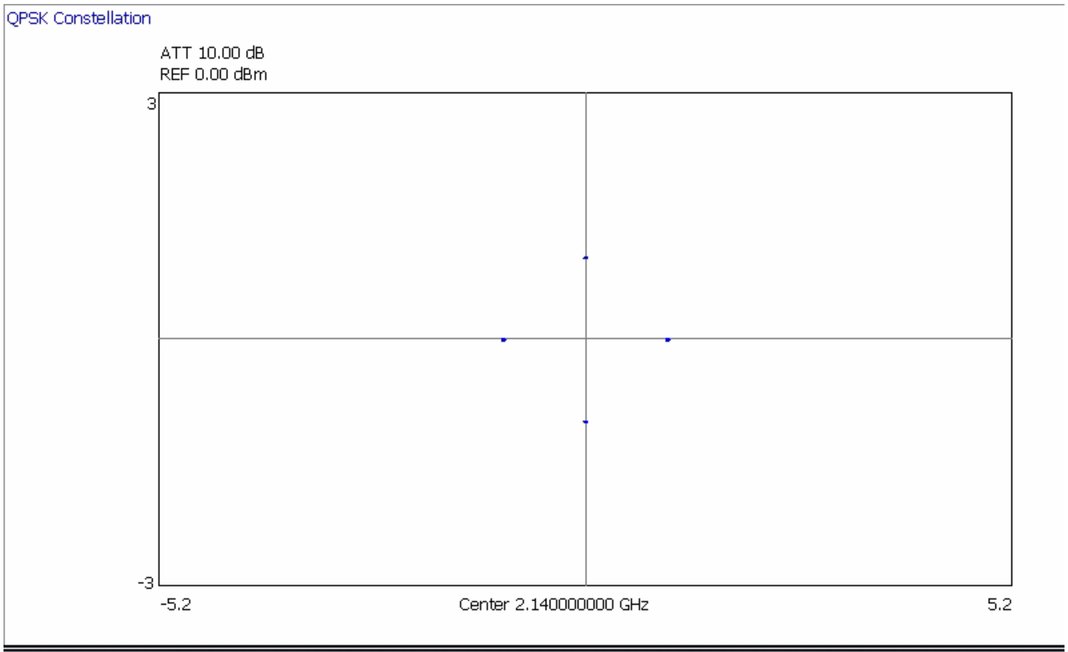


Figure 6-27. QPSK Graph Type Setup Dialog

The following display is a constellation measurement along with the key summary measurements (EVM, IQ Offset, Frequency Error, Magnitude Error and Phase Error).



EVM:	0.69 %	I/Q Offset:	-59.13 dB	Amp Err:	0.47 %
Max EVM:	1.9 %	Freq Err:	430.5 Hz	Phase Err:	0.29 deg
EVMPeakPos:	62				

Figure 6-28. QPSK Constellation with Summary Table

Signature can also show displays of multiple measurements at once, such as this All Errors vs. Time display. This display simultaneously shows EVM, Magnitude Error and Phase Error, all versus time.

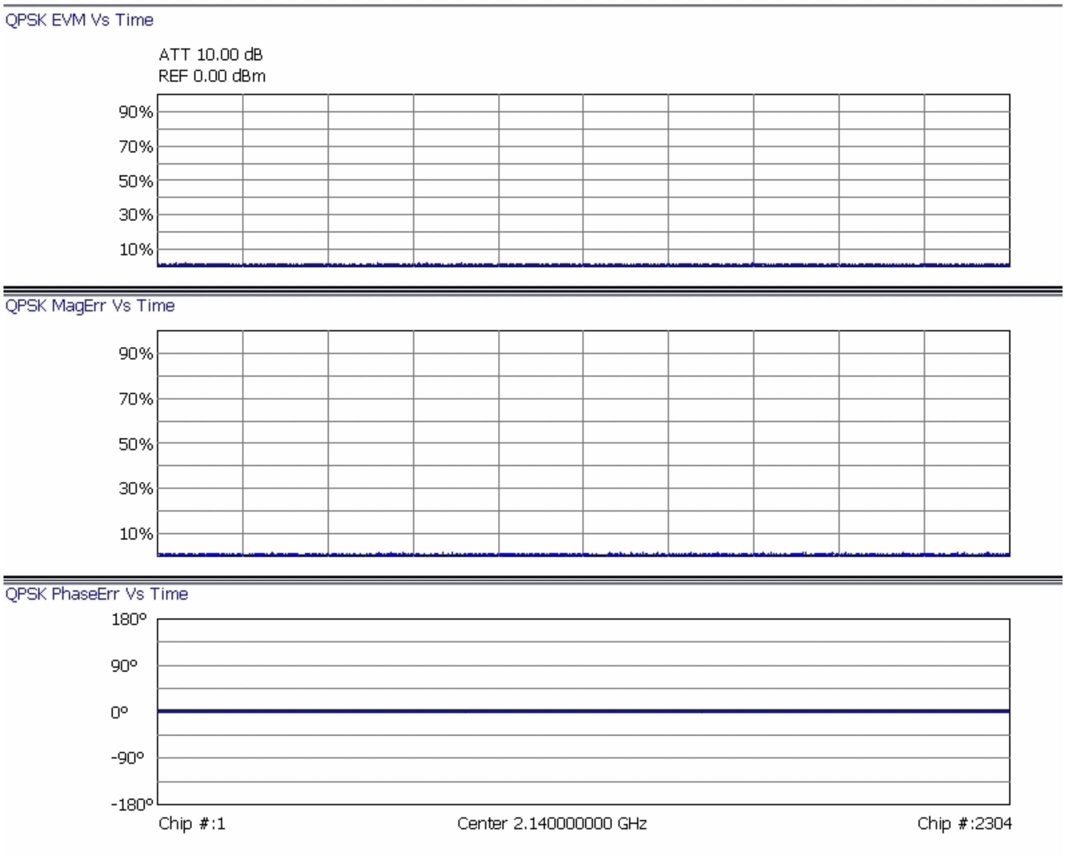


Figure 6-29. All Errors Vs. Time Display

Eye diagrams are also available. These can be of the I channel, the Q channel, or both at once as show here.

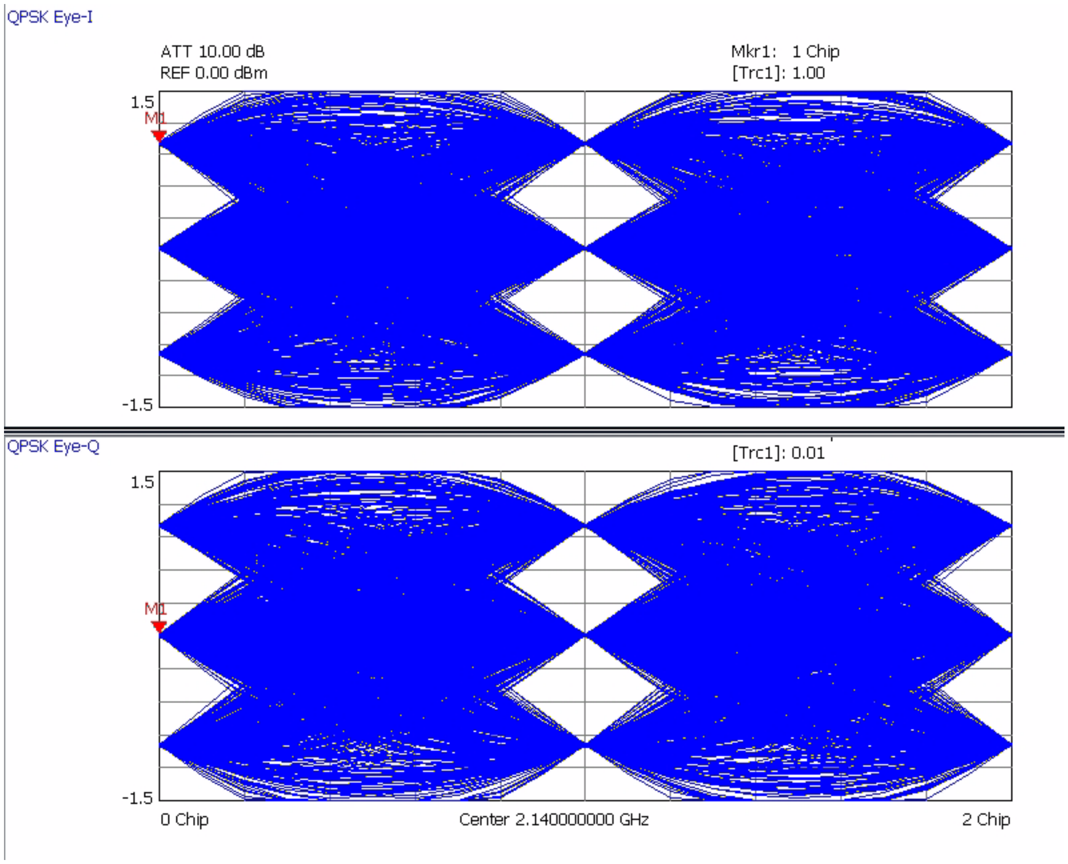


Figure 6-30. QPSK Eye-I and Eye-Q Diagram

Composite Measurement

The next class of measurements are of the Composite signal. This measures the entire coded WCDMA signal and provides metrics for the entire signal. A standard measurement of the transmitter is the Composite EVM (shown in the summary table). This is the EVM of a signal that has all of the active codes combined together for the entire transmitter.

3GPP has “Composite EVM” conformance specifications similar to QPSK, but they look very different due to the different signals. Each code is demodulated, then combined to get a composite waveform. The composite measurement also supports HSDPA signals along with several additional measurements such as:

- Scramble Code
- Peak Code Domain Error
- Power in the Synchronizing Channel (SCH)

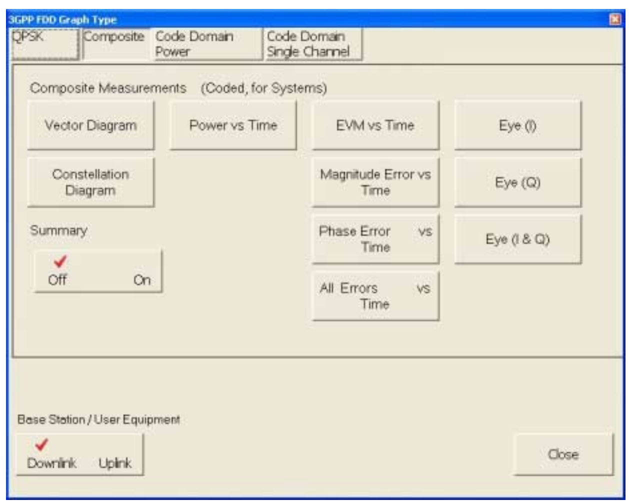
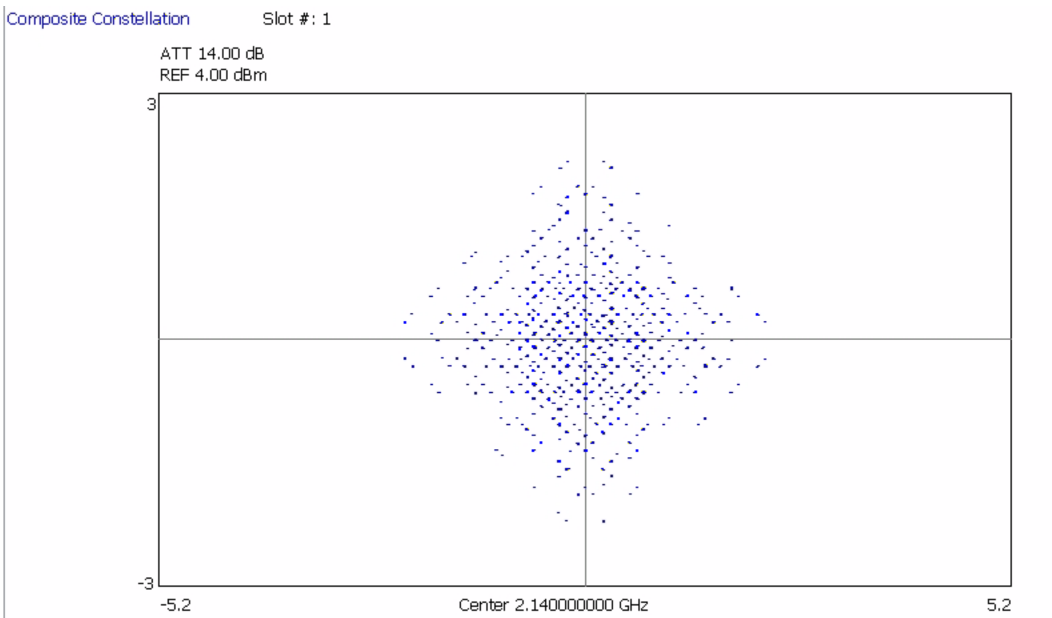


Figure 6-31. Composite Graph Type Selection Dialog

Below is a composite constellation along with the summary table. The composite constellation includes the effects of all active codes as well as noise. If there was only one active code, the constellation would be very simple—it would look like QPSK. As additional codes are added, the constellation gets more complex. This constellation is of Test Model 2, which is a fairly simple signal where only 7 codes are being transmitted out of a total possible of 256 (or even 512) codes.



EVM:	0.76 %	I/Q Offset:	-57.96 dB	Total Power:	-5.28 dBm
Max Composite EVM:	2.00 %	Freq Err:	441.80 Hz	SCH Power:	-15.24 dBm
Peak CodeDomain Error:	-56.75 dB	Amp Err:	0.53 %	P-SCH Power:	-18.22 dBm
EVMPeakPos:	875	Phase Err:	0.31 deg	S-SCH Power:	-18.29 dBm
Scramble Code:	0	Rho:	0.999930		

Figure 6-32. Composite Constellation with Summary Table of a Test Model

All of the summary measurements shown for QPSK are available as well as a few additional ones, such as Peak Code Domain Error (a required measurement) and Rho. A variety of power measurements, such as total power and the power in the Synchronizing channel (SCH).

Single Code Measurement

The next class of modulation quality measurements focuses on a single WCDMA code. This is again very similar to the QPSK and Composite measurement selections, but with a few significant differences. Instead of an optional summary table with each measurement, there is an optional Code Domain Power graph; this helps the user visualize which code is being measured. The summary table is still available, but in this case it is a separate display (rather than an option to the other displays). One other difference is the Power vs. Time display; in this case, instead of focusing on the detail of 1 slot, the display shows the power level over a longer time frame—up to 8 frames (120 slots) total.

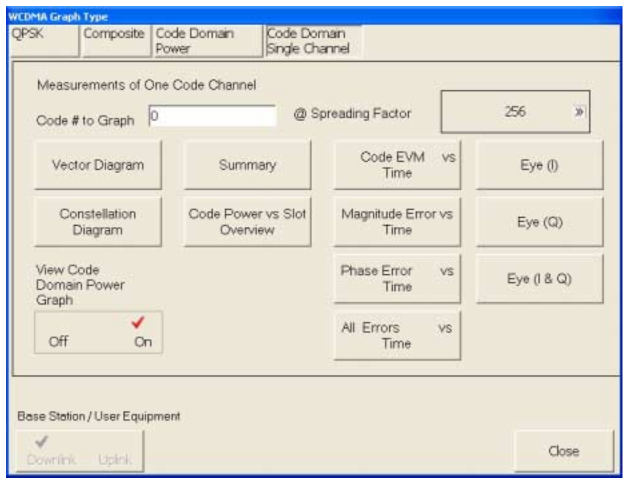


Figure 6-33. Code Domain Single Channel Graph Type Selection Dialog

The following figure is an example of the single-code measurements. This is the Code Power vs. Slot overview looking at 1 Frame (15 slots). The optional Code Domain Power graph shows that the chosen code (#65 at spreading factor 256) is an active code since it is highlighted in blue. Two additional codes at the left are the pilot signal (P-CPICH) and the control channels (SCH & P-CCPCH), which is necessary for automatic measurements.

The top graph shows that the power level of this code varies with time. This is a simple example where the power varies in linear 5 dB steps from 0 dB (relative to the maximum) to –40 dB. Note that the markers read out either relative to the total power (shown here) or in absolute values (in dBm).

Note that the 2 key measurements of EVM (for this code) and Carrier Frequency Offset are shown at the top of the graph and that the scramble code is shown at the top of the CDP overview.

Note also that the CDP overview shows the power for the selected slot (in the Setup dialog); the default for this is slot #1, so the CDP for the selected code in the CDP overview is the same as the power in slot #1 of the upper graph.

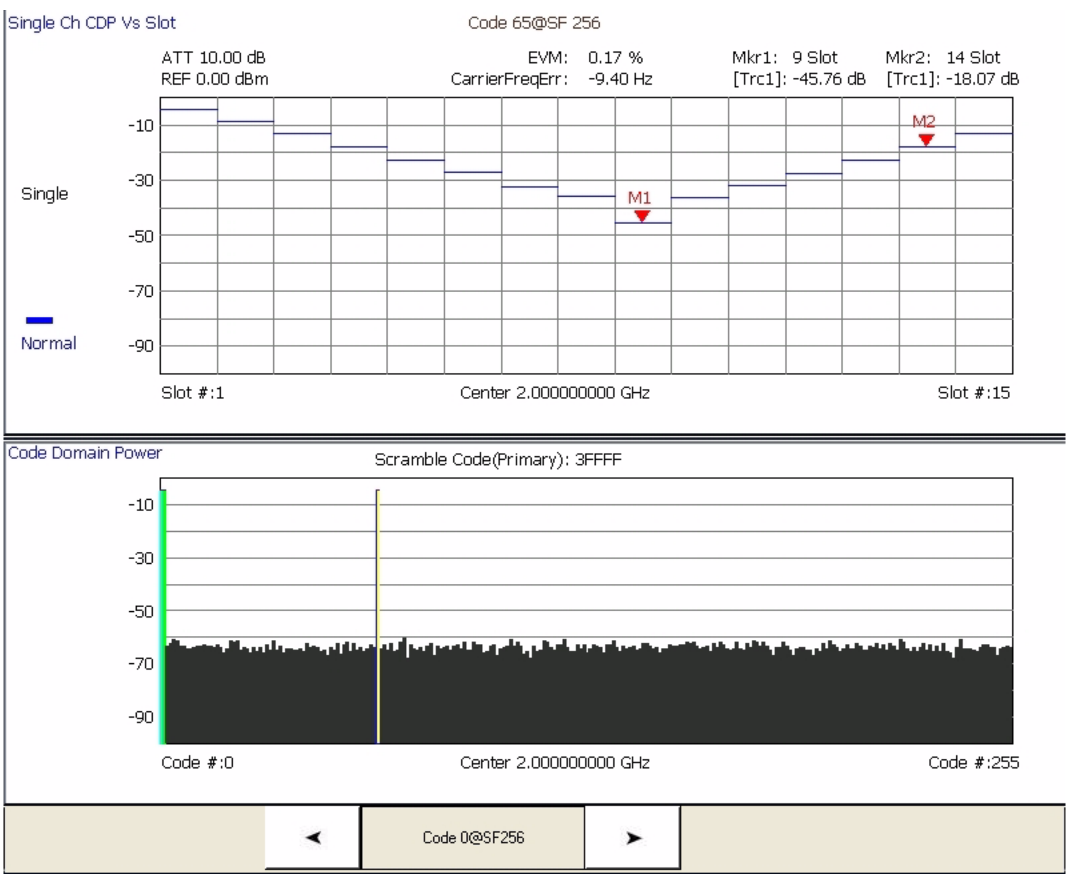


Figure 6-34. Single Channel Code Power vs. Slot Overview with Code Domain Power Display

This single-code example shows the 16QAM constellation of an HSDPA signal. This is Test Model 5 with two high speed data channels. The selected code (#4 at Spreading Factor 16) is shown highlighted. Note the buttons at the bottom of the screen that make it easy to move among the active codes.

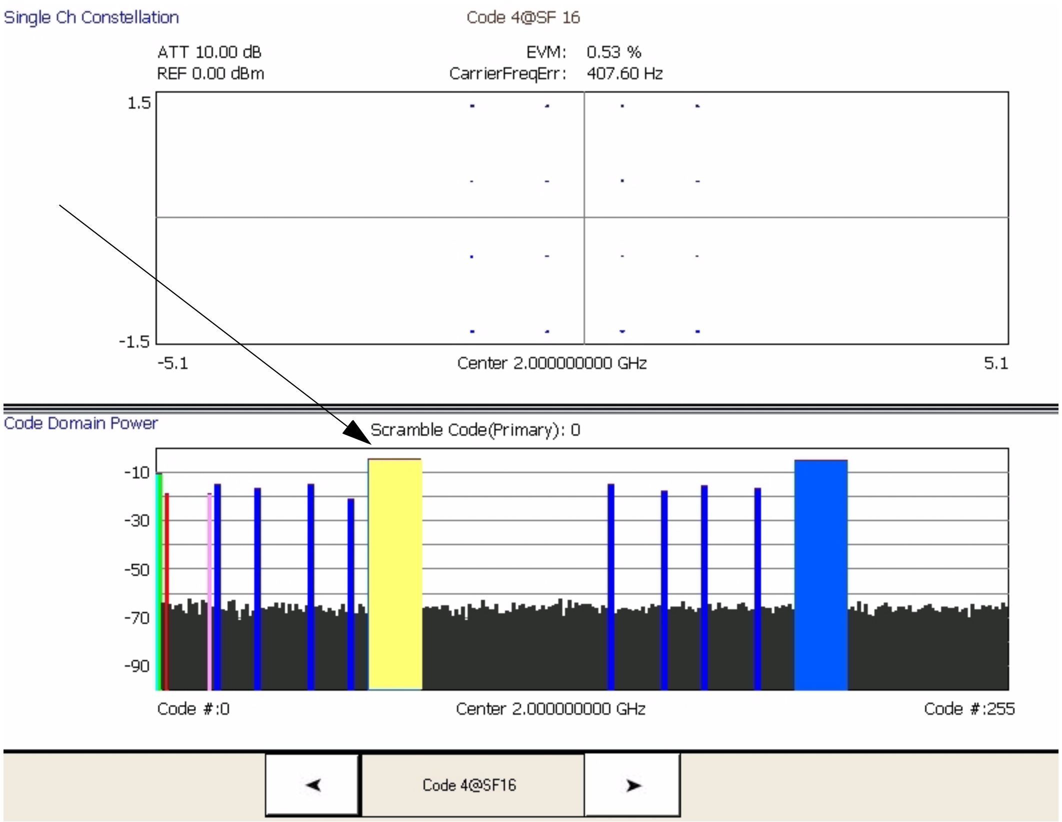


Figure 6-35. Single Channel Constellation of HSDPA Code with Code Domain Power Overview

Below is the Summary table showing the key modulation quality measurements and the bit stream for one of the codes. In this case, it is code #11 at spreading factor 128. The modulation quality measurements are again very similar to the Composite & QPSK measurements with minor differences. For example, PCDE and Rho don't make sense for a single code.

Note that the bit stream can be very long in some cases. If you have captured the full 8 frames and have a high speed (HSDPA) signal, there can be many pages of the bit stream. The scroll buttons at the right facilitate viewing all of this information.

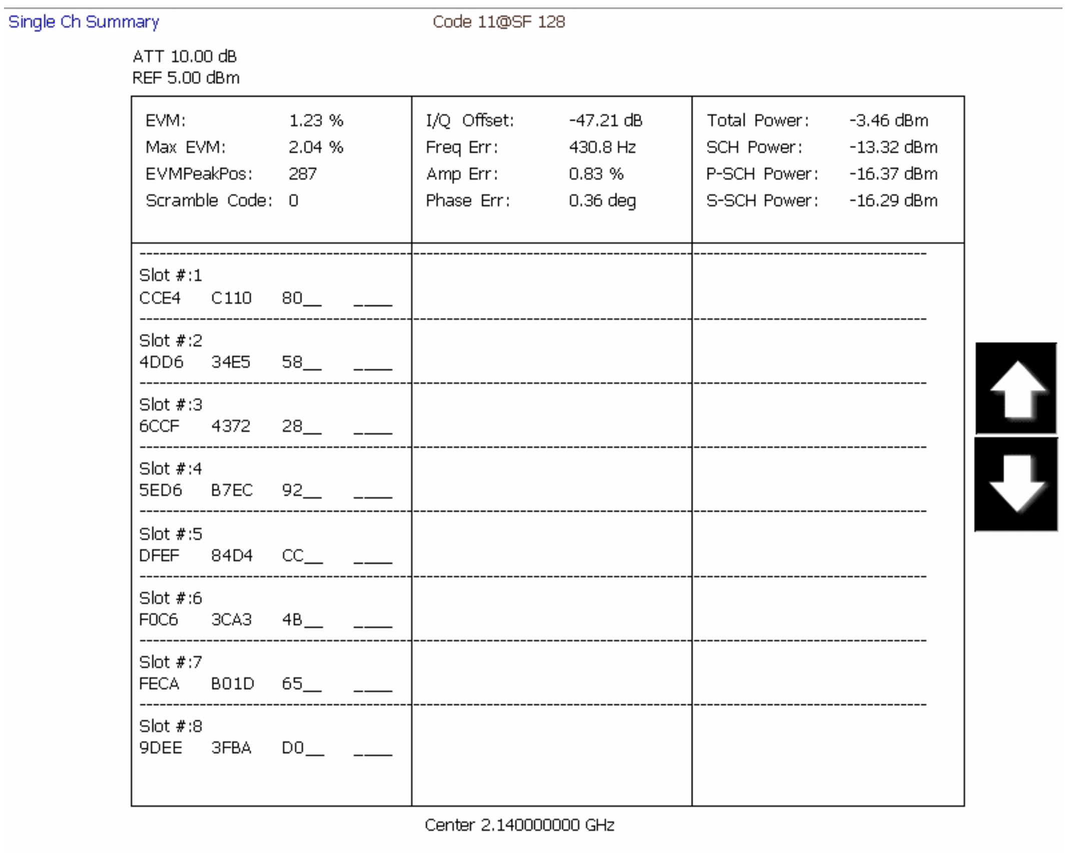
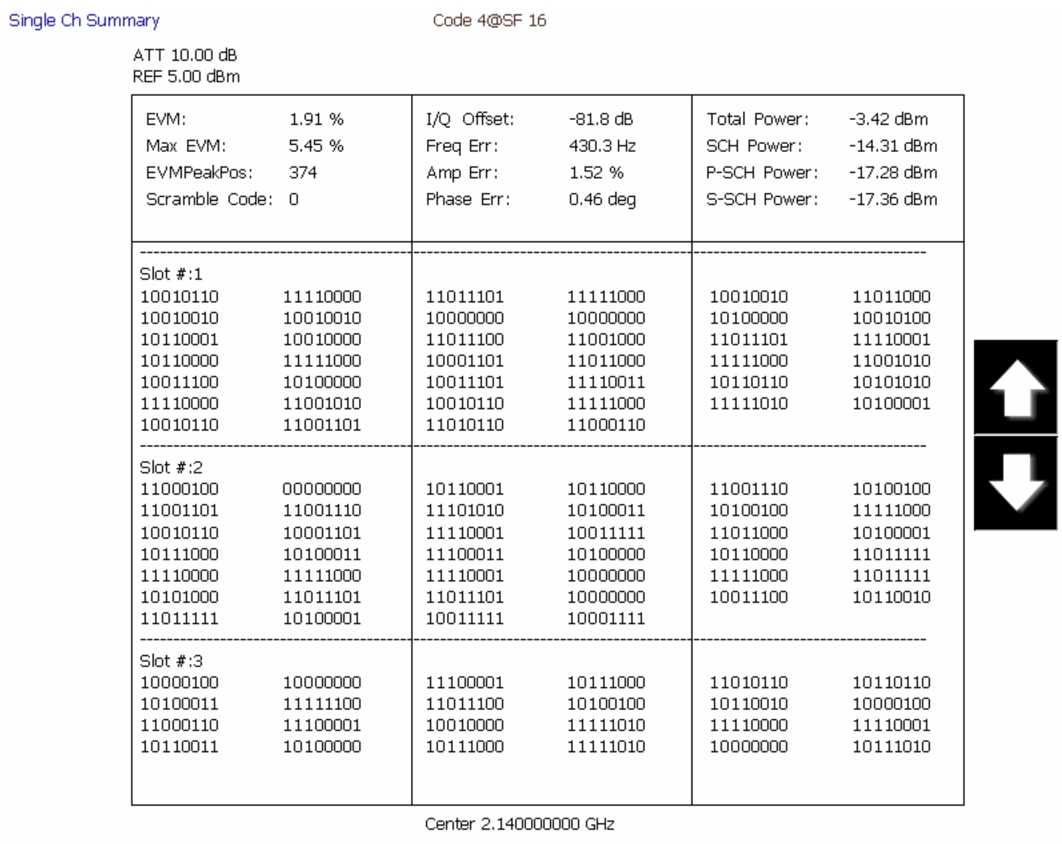


Figure 6-36. Single-Code Summary Table with Bit Stream Display

Below is an example of the summary table showing the bit stream of a high-speed channel in binary. In this case, you can see about 2.5 slots on the display.



EVM:	1.91 %	I/Q Offset:	-81.8 dB	Total Power:	-3.42 dBm
Max EVM:	5.45 %	Freq Err:	430.3 Hz	SCH Power:	-14.31 dBm
EVMPeakPos:	374	Amp Err:	1.52 %	P-SCH Power:	-17.28 dBm
Scramble Code:	0	Phase Err:	0.46 deg	S-SCH Power:	-17.36 dBm

Slot #:1					
10010110	11110000	11011101	11111000	10010010	11011000
10010010	10010010	10000000	10000000	10100000	10010100
10110001	10010000	11011100	11001000	11011101	11110001
10110000	11111000	10001101	11011000	11111000	11001010
10011100	10100000	10011101	11110011	10110110	10101010
11110000	11001010	10010110	11111000	11111010	10100001
10010110	11001101	11010110	11000110		
Slot #:2					
11000100	00000000	10110001	10110000	11001110	10100100
11001101	11001110	11101010	10100011	10100100	11111000
10010110	10001101	11110001	10011111	11011000	10100001
10111000	10100011	11100011	10100000	10110000	11011111
11110000	11111000	11110001	10000000	11111000	11011111
10101000	11011101	11011101	10000000	10011100	10110010
11011111	10100001	10011111	10001111		
Slot #:3					
10000100	10000000	11100001	10111000	11010110	10110110
10100011	11111100	11011100	10100100	10110010	10000100
11000110	11100001	10010000	11111010	11110000	11110001
10110011	10100000	10111000	11111010	10000000	10111010

Figure 6-37. Single-Code Summary Table of HSDPA Bit Stream in Binary

Single Code with Compressed Mode Measurement

The final class of measurements is of Single Codes in Compressed Mode. We are calling this a separate “class” as there are a number of significant distinctions from the usual single-code measurements.

This example is of the Code Power vs. Slot overview, but with the maximum capture time selected (eight frames or 120 slots). The signal being measured is periodically compressed as can be seen near the marker.

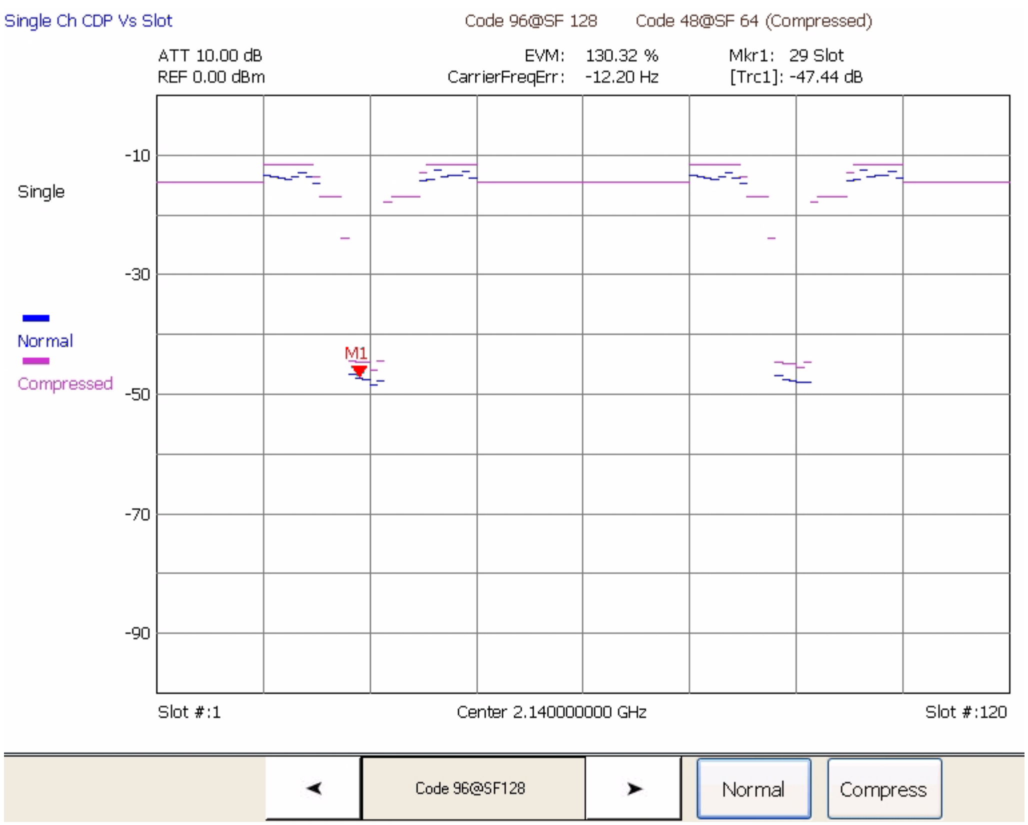


Figure 6-38. Single Channel Code Power vs. Slot

For all other Single Channel measurements (other than the Code Power vs. Slot Overview), you can choose either the Normal or Compressed display. The measurement results will then be for the signal assuming that it is in the mode of the chosen Analysis Start and Length.

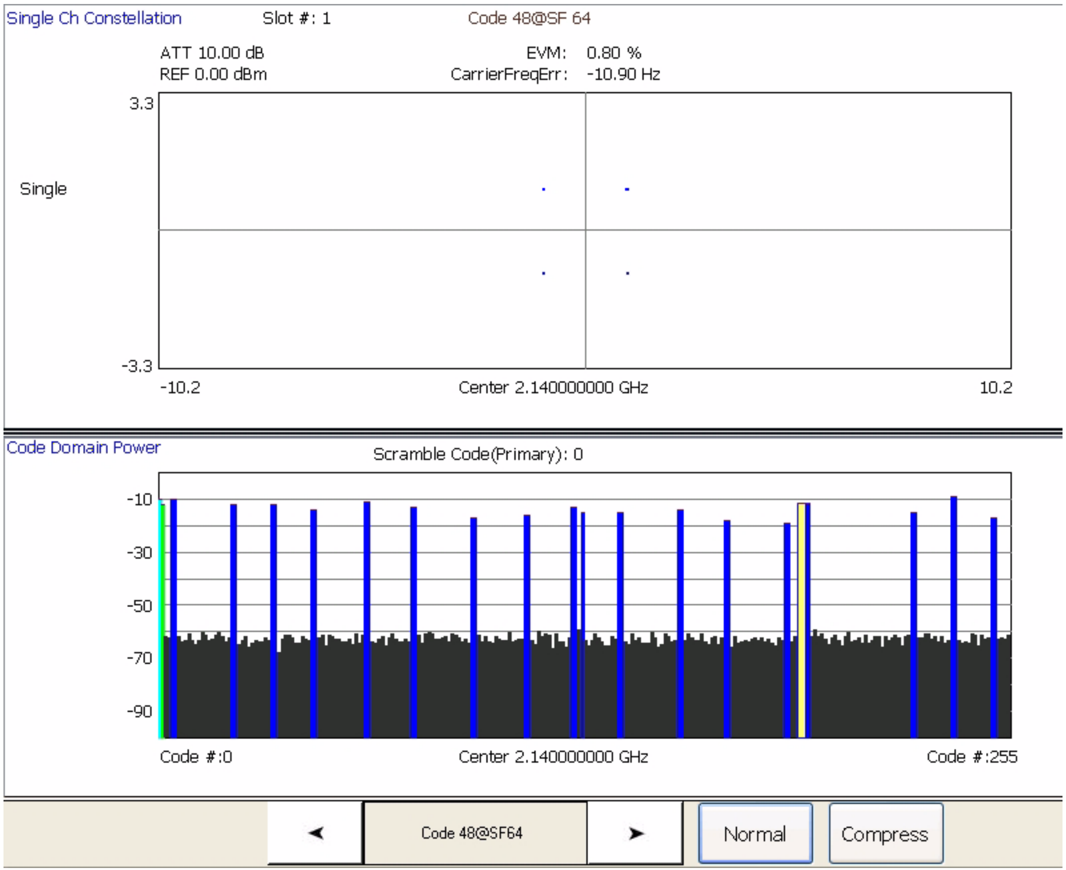


Figure 6-39. Single Channel Compressed Mode Constellation with CDP Overview

6-6 Operation Verification

This section provides procedures that you can use to verify the signal analyzer is operating properly and meets some of its specifications. You may perform the following verifications:

- Reference Oscillator Aging Rate (Optional)
- Frequency Readout Accuracy
- Frequency Span Accuracy
- Swept Resolution Bandwidth
- Single Sideband Phase Noise
- Average Noise Level
- Frequency Response
- Reference Level Switching Uncertainty
- Resolution Bandwidth (RBW) Switching Uncertainty
- Residual Spurious Response
- Input-related Spurious Response

Refer to the Required Equipment list before beginning these verification procedures.

Note: Specifications listed in this section are for reference only and should be verified with the Signature Datasheet, part number: 11410-00333. The most current revision can be downloaded from the Documents area of the Anritsu Internet site:
http//:www.us.anritsu.com

Required Equipment

Table 6-1 lists the equipment used throughout the verification procedures.

Table 6-1. Required Equipment

Instrument	Critical Specification	Recommended Manufacturer/Model
Frequency Standard	Frequency: 10 MHz Accuracy: 5×10^{-12} parts/day	Absolute Time Corp., Model 300
Synthesized Signal Generator	Frequency Range: 10 MHz to 8 GHz Ultra Low Phase Noise	Anritsu Model MG3691B with Options 2A, 3, 4, 16
Synthesized Signal Generator	Frequency Range: 10 MHz to 6 GHz Spurious Performance <–85 dBc	HP 8665B
Adapter	N(m) to K(f)	Anritsu Model 34NKF50
Adapter	Ruggedized K(m) to N(f)	Anritsu Model 34RKNF50
Attenuator	K(m) to K(f) Frequency Range: DC to 8 GHz Attenuation: 3 dB	Anritsu Model 43KB-3
Attenuator	N(m) to N(f) Frequency Range: DC to 8 GHz Attenuation: 3 dB	Weinschel Model 1-3

Table 6-1. Required Equipment

Instrument	Critical Specification	Recommended Manufacturer/Model
Attenuator	N(m) to N(f) Frequency Range: DC to 8 GHz Attenuation: 10 dB	Weinschel Model 4410
Cable	N(m) to N(m) Frequency Range: DC to 8 GHz Impedance: 50Ω	Any
Cable	N(m) to N(f) Frequency: 50 MHz Impedance: 50Ω	Anritsu Model 15NNF50-1.5C
Cable	K(m) to K(m) Frequency Range: DC to 8 GHz Impedance: 50Ω	Any
Cable	BNC(m) to BNC(m) Frequency: 10 MHz Impedance: 50Ω	Any
Phase Matched Adapter	N(m) to N(m)	Maury Model 8828B
Phase Matched Adapter	N(m) to N(f)	Maury Model 8828C
Power Splitter		Weinschel Model 1870A
Power Meter	Dual Channel	Anritsu Model ML2438A
Power Sensor	Frequency Range: 10 MHz to 8 GHz High Accuracy Diode Sensor (two units required)	Anritsu Model MA2442B
Programmable Attenuator	Attenuation: 0 to 90 dB (capable of both 1 dB and 10 dB increments) Frequency Range: DC to 2 GHz Impedance: 50Ω	Anritsu Model MN63A
Termination	Frequency Range: DC to 8 GHz Return Loss: 40 dB	Anritsu Model 28N50-2

Reference Oscillator Aging Rate (Optional)

The following test can be used to verify that the MS2781A 10 MHz Reference Oscillator is within its aging specification. The instrument derives its frequency accuracy from an internal 10 MHz crystal oscillator standard. An inherent characteristic of crystal oscillators is the effect of crystal aging within the first few days to weeks of operation. Typically, the frequency of the crystal oscillator increases slightly at first, then settles to a relatively constant value for the rest of its life.

> **Note:** Do not confuse crystal aging with other short term frequency instabilities, for example, noise and temperature. The internal time base of the instrument may not achieve its specified aging rate before the specified warm-up time of 7 to 30 days has elapsed; therefore, this performance test is optional.

For the greatest absolute frequency accuracy, allow the MS2781A to warm up until its output frequency has stabilized (usually 7 to 30 days). Once stabilized, the change in reference oscillator frequency should remain within the aging rate if (1) the reference oscillator oven is not allowed to cool, (2) the instrument orientation with respect to the earth's magnetic field is maintained, (3) the instrument does not sustain any mechanical shock, and (4) ambient temperature is held constant. This test should be performed upon receipt of the instrument and again after a period of several days to weeks to fully qualify the aging rate.

Test Setup

Connect the MS2781A rear panel 10 MHz REFERENCE OUT to the frequency reference front panel input connector labeled 10 MHz when directed to do so during the test procedure.

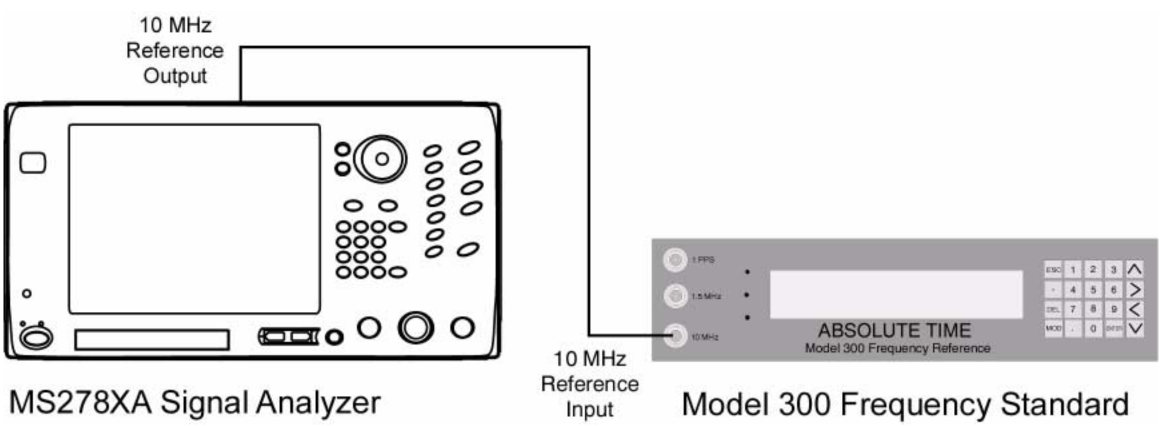


Figure 6-40. Equipment Setup for Internal Reference Oscillator Aging Rate Tests

Test Procedure

The frequency error is measured at the start and finish of the test time period of 24 hours. The aging rate is the difference between the two error readings. Both the Frequency Reference and the MS2781A must be warmed up at least seven days.

Step 1. Set up the frequency reference as follows:

- **a.** Press the ESC key until the MAIN MENU is displayed.
- **b.** At the MAIN MENU display, press 1 to select the CONFIGURATION MENU.
- **c.** At the CONFIGURATION MENU display, press 8 to select MEAS.
- **d.** Press the MOD key and use the Up/Down arrow keys to get to the menu display: MEASUREMENT = FREQ.
- **e.** Press the ENTER key.
- **f.** Press the ESC key until the MAIN MENU is displayed.
- **g.** At the MAIN MENU display, press 3 to select the REVIEW MENU.
- **h.** At the REVIEW MENU display, press 8 to select TFM.

Step 2. Connect the MS2781A rear panel 10 MHz REFERENCE OUT signal to the frequency reference front panel 10 MHz input. Ensure that the MS2781A is set to use the internal reference oscillator on the System | Rear Panel Control menu.

Step 3. Wait approximately 90 minutes (default setting) until the FMFOM on the frequency reference display decreases from 9 to 1. (The default setting is recommended to achieve optimum measurements.)

Step 4. The frequency error of the signal under test is displayed in ps/s (picoseconds/second). For example, an error of –644681 ps/s is -644681×10^{-12} or -6.44681×10^{-7} away from the 10 MHz internal reference on the frequency reference.

Step 5. The frequency error display is continuously updated as a running 5000 second average. The averaging smooths out the short-term instability of the oscillator.

Step 6. Record the frequency error value displayed on the frequency reference in the test record.

Step 7. Wait for 24 hours, then record the frequency error value in the test record.

Step 8. The aging rate is the difference between the two frequency error values.

Step 9. Record the computed result in the test record. To meet the specification, the computed aging rate must be: $\leq 5 \times 10^{-10}$ per day.

Frequency Readout Accuracy

The following test can be used to verify that the MS2781A is within its Frequency Readout Accuracy specifications.

Test Setup

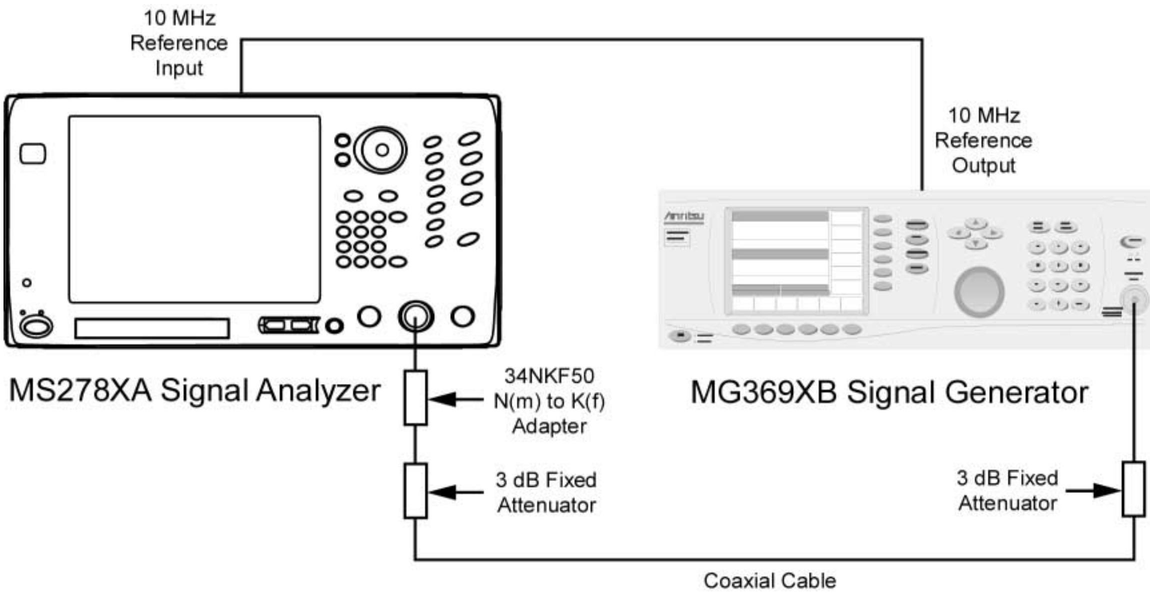


Figure 6-41. Equipment Setup for Frequency Readout Accuracy Test

Test Procedure

Step 1. Set up the instruments as shown in Figure 6-41.

Step 2. Turn on both the MS2781A Signal Analyzer and the MG369XB Signal Generator and allow them to warm up for one hour.

Step 3. Press the Preset key on the MS2781A to reset the instrument to factory default state.

Step 4. Set the MS2781A to use External Reference signal.

Step 5. Set the output level of the MG369XB to 6 dBm.

Step 6. Set up the MS2781A as follows:

a. Reference Level: 0 dBm

b. VBW: Auto

c. Attenuation: 10 dB

Step 7. Set the output frequency of the MG369XB and the center frequency of MS2781A to the first freq listed in Table 6-2.

Step 8. Set the MS2781A to the first corresponding RBW and Span Frequency per Table 6-2.

Step 9. Turn on Marker and perform Marker Peak search. Read the marker frequency and verify that the value is within specifications using the formula below:

± ((marker freq x reference accuracy) + span accuracy + (0.05 x RBW) + (0.5 x last digit))

For technical specifications, refer to the Signature Technical Data Sheet, part number: 11410-00333, located in Appendix A of the Signature operation manual.

Step 10. Repeat steps 8 through 9 for other RBW/Span combinations listed in Table 6-2.

Step 11. Repeat steps 7 through 10 for 7900 MHz.

Table 6-2. Frequency Readout Accuracy Test

FREQ (MHz)	RBW (Hz)	Span (Hz)	Specification (Hz)	Marker Readout Frequency
100	100	100		
	100	1000		
	100	10,000		
	1000	1,000		
	1000	10,000		
	1000	100,000		
	10,000	10,000		
	10,000	100,000		
	10,000	1,000,000		
7900	100	100		
	100	1,000		
	100	10,000		
	1000	1000		
	1000	10,000		
	1000	100,000		
	10,000	10,000		
	10,000	100,000		
	10,000	1,000,000		

Frequency Span Accuracy

The following test can be used to verify that the MS2781A is within its Frequency Span Accuracy specifications.

Test Setup

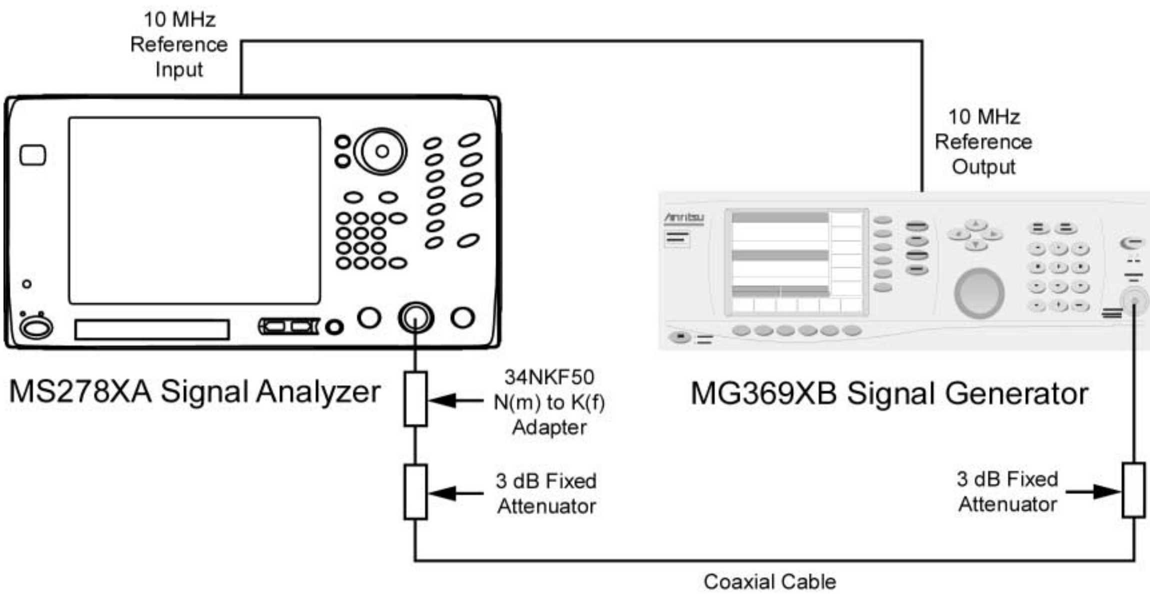


Figure 6-42. Equipment Setup for Frequency Span Accuracy Test

Test Procedure

Step 1. Set up the instruments as shown in Figure 6-42.

Step 2. Turn on both the MS2781A Signal Analyzer and the MG369XB Signal Generator and allow them to warm up for one hour.

Step 3. Press the Preset key on the MS2781A to reset the instrument to the factory default state.

Step 4. Set the MS2781A to use External Reference signal.

Step 5. Set the output level of the MG369XB to 6 dBm.

Step 6. Set up the MS2781A as follows:

a. Reference Level: 0 dBm

b. VBW: Auto

c. Attenuation: 10 dB

d. Center Frequency: 4000 MHz

Step 7. Set Span Frequency and RBW on the MS2781A to the values listed in the first row of Table 6-3.

Step 8. Set the output frequency of the MG369XB to the corresponding F1 value per Table 6-3.

Step 9. Turn on Marker and perform Mark Peak Search. Record the marker readout value as F1'.

Step 10. Set the output frequency of the MG369XB to the corresponding F2 value per Table 6-3.

Step 11. Perform Marker Peak Search. Record the marker readout value as F2'.

Step 12. Use the formula below to verify whether the measured result is within specifications:

F2' – F1' $\leq \pm$Frequency Span Accuracy Specification x 0.8

Step 13. Repeat steps 7 through 12 for the other combinations of Span and RBW settings listed in Table 6-3.

Table 6-3. Frequency Span Accuracy Test

Span (Hz)	RBW (Hz)	F1 (MHz)	F2 (MHz)	F1'	F2'	Specification (Hz)	Measured Result (F2' – F1')/0.8
10k	100	3999.996	4000.004				
100k	1k	3999.96	4000.04				
100k	10k	3999.96	4000.04				
1M	50k	3999.6	4000.4				
10M	100k	3996	4004				
33M	100k	3986.8	4013.2				
34M	100k	3986.4	4013.6				
81M	100k	3967.6	4032.4				
500M	20k	3800	4200				
500M	1M	3800	4200				
1000M	20k	3600	4400				
1000M	1M	3600	4400				
2000M	50k	3200	4800				
2000M	1M	3200	4800				
4000M	100k	2400	5600				
4000M	1M	2400	5600				
8000M	100k	800	7200				
8000M	1M	800	7200				

Swept Resolution Bandwidth

The following test can be used to verify that the MS2781A is within its Swept Resolution Bandwidth Accuracy specifications.

Test Setup

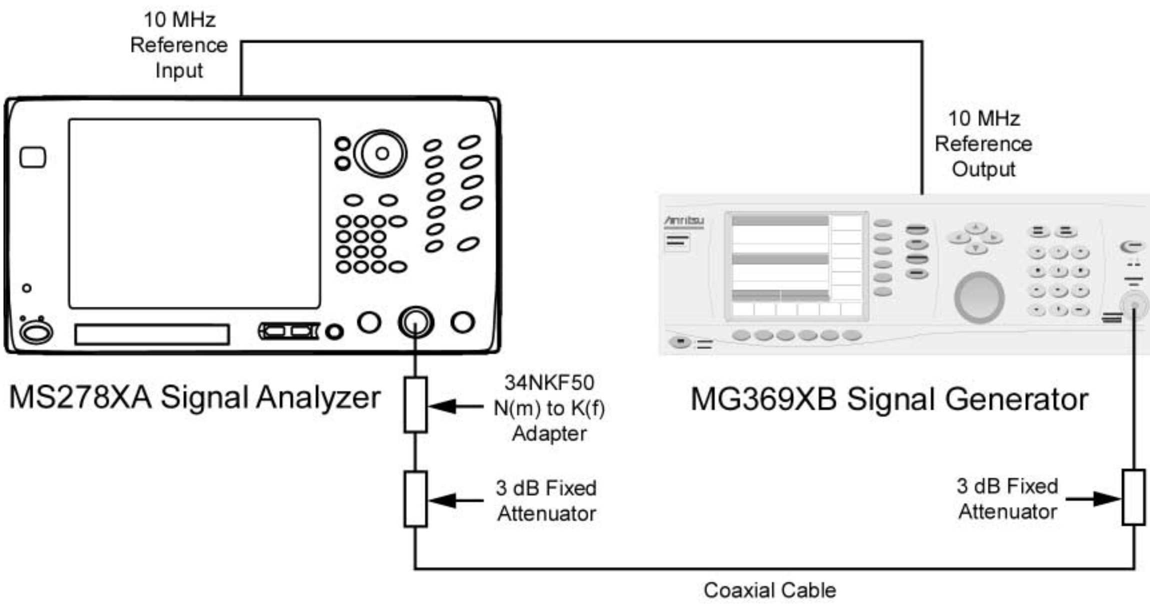


Figure 6-43. Equipment Setup for Swept Resolution Bandwidth Test

Test Procedure

Step 1. Set up the instruments as shown in Figure 6-43.

Step 2. Turn on both the MS2781A Signal Analyzer and the MG369XB Signal Generator and allow them to warm up for one hour.

Step 3. Press the Preset key on the MS2781A to reset the instrument to factory default state.

Step 4. Set the MS2781A to use External Reference signal.

Step 5. Set the output level of the MG369XB to 6 dBm.

Step 6. Set the output frequency of the MG369XB to 100 MHz CW.

Step 7. Set up the MS2781A as follows:

a. Reference Level: 0 dBm

b. VBW: Auto

c. Attenuation: Auto

Step 8. Set the center frequency on the MS2781A to 100 MHz

Step 9. Set the Span Frequency and the RBW on the MS2781A to the values listed in the first row of Table 6-4.

Step 10. On the MS2781A, set Peak to CF.

Step 11. Set the MS2781A to measure 3 dB OBW.

Step 12. Verify that the measured OBW is within specifications listed in Table 6-4.

Step 13. Repeat steps 9 through 12 for the other combinations of RBW and Span settings.

Table 6-4. Swept Resolution Bandwidth Test

Frequency	RBW	Span	Specification	
			Minimum	Maximum
100 MHz	10 Hz	30 Hz	9.8 Hz	10.2 Hz
	20 Hz	50 Hz	19.6 Hz	20.4 Hz
	30 Hz	100 Hz	29.4 Hz	30.6 Hz
	50 Hz	200 Hz	49 Hz	51 Hz
	100 Hz	300 Hz	98 Hz	102 Hz
	200 Hz	500 Hz	196 Hz	204 Hz
	300 Hz	1 kHz	294 Hz	306 Hz
	500 Hz	2 kHz	498 Hz	510 Hz
	1 kHz	3 kHz	980 Hz	1.02 kHz
	2 kHz	5 kHz	1.96 kHz	2.04 kHz
	3 kHz	10 kHz	2.94 kHz	3.06 kHz
	5 kHz	20 kHz	4.9 kHz	5.1 kHz
	10 kHz	30 kHz	9.8 kHz	10.2 kHz
	20 kHz	50 kHz	19.6 kHz	20.4 kHz
	30 kHz	100 kHz	29.4 kHz	30.6 kHz
	50 kHz	200 kHz	49 kHz	51 kHz
	100 kHz	300 kHz	98 kHz	102 kHz
	200 kHz	500 kHz	196 kHz	204 kHz
	300 kHz	1 MHz	294 kHz	306 kHz
	500 kHz	2 MHz	490 kHz	510 kHz
	1 MHz	3 MHz	980 kHz	1.02 MHz
	2 MHz	5 MHz	1.96 MHz	2.04 MHz
	3 MHz	10 MHz	2.7 MHz	3.3 MHz
	5 MHz	20 MHz	4.5 MHz	5.5 MHz

Single Sideband Phase Noise

The following test can be used to verify that the MS2781A is within its Single Sideband Phase Noise specifications.

Test Setup

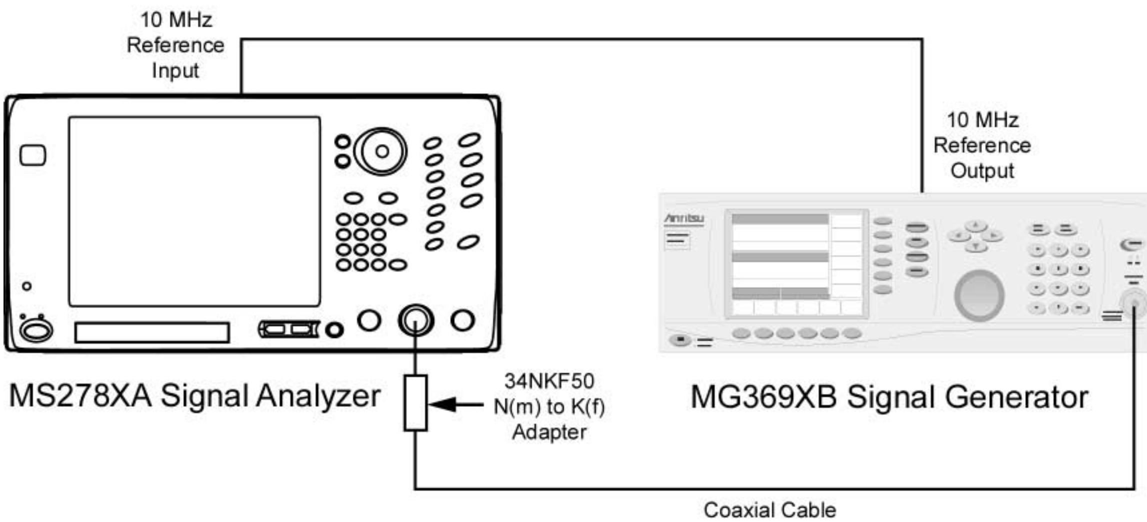


Figure 6-44. Equipment Setup for Single Sideband Phase Noise Test

Test Procedure

Step 1. Set up the instrument as shown in Figure 6-44.

Step 2. Turn on both the MS2781A Signal Analyzer and the MG369XB Signal Generator and allow them to warm up for one hour.

Step 3. Press the Preset key on the MS2781A to reset the instrument to factory default state.

Step 4. Set the MS2781A to use External Reference signal.

Step 5. Set the output level of the MG369XB to 0 dBm.

Step 6. Set the output frequency of the MG369XB to 1 GHz CW.

Step 7. Set up the MS2781A as follows:

- **a.** Center Frequency: 1 GHz
- **b.** Reference Level: 0 dBm
- **c.** VBW: Auto
- **d.** SWT: Auto
- **e.** Attenuation: 10 dB
- **f.** Detection Mode: RMS
- **g.** Average Mode: On
- **h.** Number of Average: 16

Step 8. Connect the output of the MG369XB to the input of the MS2781A with a coaxial cable and an adapter.

Step 9. On the MS2781A, set Peak to CF and then set Peak to Reference Level.

Step 10. Set Span to 250 Hz and RBW to 10 Hz.

Step 11. Set the MS2781A to Single Sweep mode and trigger a new sweep.

Step 12. Turn on Marker 1 and Marker 2. Make Marker 2 as delta marker referenced to Marker 1.

Step 13. Move Marker 2 to the first offset frequency from the carrier frequency. Record the marker reading in the measured dBc column.

Step 14. Calculate the normalized phase noise using the formula in the Calculated Phase Noise column. Verify that the calculated value is within specification.

Step 15. On the MS2781A, set Span and RBW to the next set of values in Table 6-5.

Step 16. Trigger a new sweep.

Step 17. Move Marker 2 to the next offset frequency. Record the marker reading in the Measured Carrier to Noise Ratio column.

Step 18. Calculate the phase noise and verify that the value is within specification.

Step 19. Repeat steps 15 through 18 for the rest of the offset frequencies.

Table 6-5. Single Sideband Phase Noise Test

Offset	Span	RBW	Measured Carrier to Noise Ratio, C/N (dBc)	Calculated Phase Noise (dBc/Hz)	Specification (dBc/Hz)
100 Hz	250 Hz	10 Hz		C/N–10 dB=	< –80
1 kHz	2.5 kHz	100 Hz		C/N–20 dB=	< –106
10 kHz	25 kHz	1 kHz		C/N–30 dB=	< –114
100 kHz	250 kHz	10 kHz		C/N–40 dB=	< –115
1 MHz	2.5 MHz	100 kHz		C/N–50 dB=	< –136
5 MHz	12.5 MHz	300 kHz		C/N–54.77 dB=	< –140

Average Noise Level

The following test can be used to verify that the MS2781A is within its Average Noise Level specifications.

Test Setup

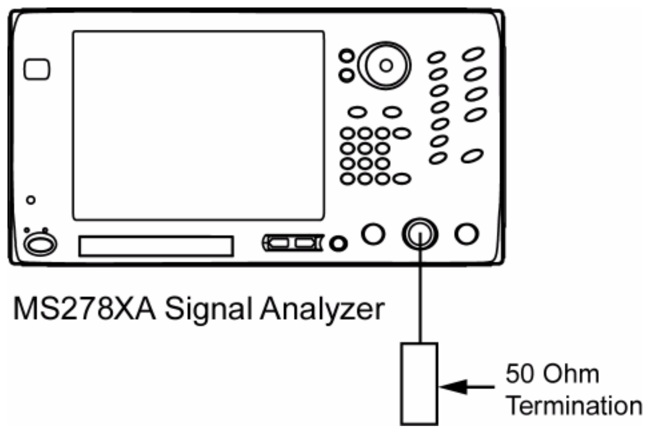


Figure 6-45. Equipment Setup for Average Noise Level Test

Test Procedure

Step 1. Turn on the MS2781A Signal Analyzer and allow the instrument to warm up for one hour.

Step 2. Connect a 50Ω termination to the RF Input connector.

Step 3. Press the Preset key on the MS2781A to reset the instrument to factory default state.

Step 4. Set up the MS2781A as follows:

- **a.** Mode: FFT
- **b.** Frequency Span: 10 Hz
- **c.** RBW: 1 Hz
- **d.** VBW: 3 MHz
- **e.** Attenuation: 0 dB
- **f.** Detector Mode: Average
- **g.** Reference Level: –100 dBm
- **h.** Average Mode: On
- **i.** Number of Average: 16

The display should look similar to that below:

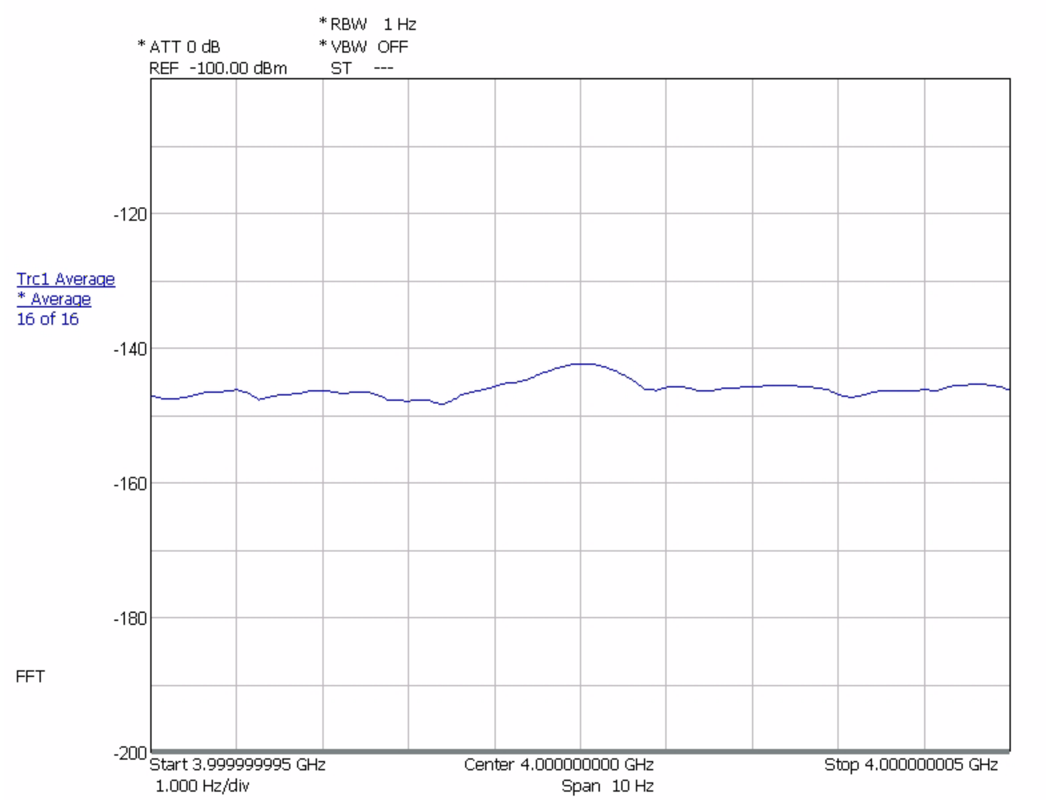


Figure 6-46. Displaying the Average Noise Level

Step 5. Set Center frequency on the MS2781A to the first Center Frequency listed in Table 6-6.

Step 6. Allow averaging to complete 16 of 16.

Step 7. Verify that the displayed noise level meets the specification.

Step 8. Repeat steps 5 through 6 for the rest of the center frequencies in Table 6-6.

Table 6-6. Average Noise Level Test

Center Frequency	Measured Result	Specifications
10 MHz		< –147 dBm
98 MHz		< –147 dBm
499 MHz		< –147 dBm
999 MHz		< –147 dBm
1499 MHz		< –147 dBm
2099 MHz		< –147 dBm
2499 MHz		< –147 dBm
2899 MHz		< –145 dBm
3499 MHz		< –145 dBm
3999 MHz		< –145 dBm
4499 MHz		< –145 dBm
5299 MHz		< –145 dBm
6099 MHz		< –145 dBm
6699 MHz		< –145 dBm
7099 MHz		< –145 dBm
7699 MHz		< –145 dBm
7.999999995 MHz		< –145 dBm

Frequency Response

The following test can be used to verify that the MS2781A is within its Frequency Response specifications.

Test Setup

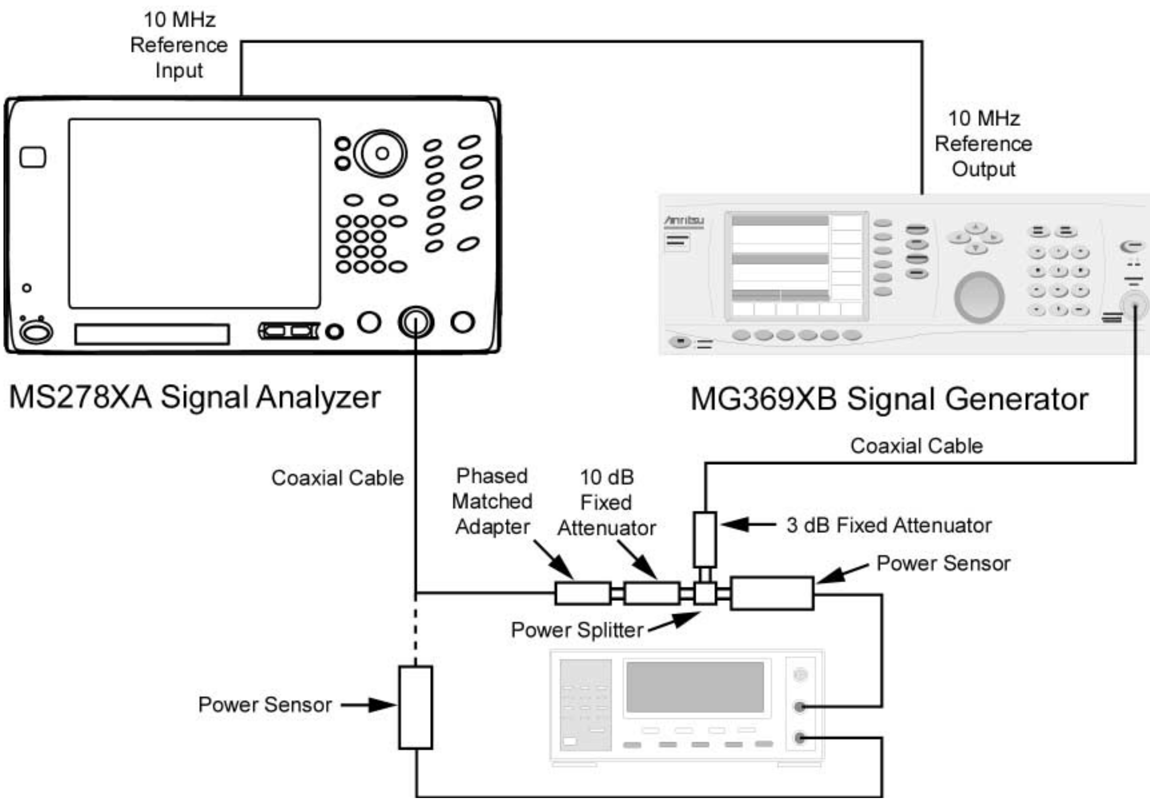


Figure 6-47. Equipment Setup for Frequency Response Test

Test Procedure

Step 1. Turn on both the MS2781A Signal Analyzer and the MG369XB Signal Generator and allow them to warm up for one hour.

Step 2. Press the Preset key on the MS2781A to reset the instrument to factory default state.

Step 3. Set the MS2781A to use External Reference signal.

Step 4. Set the output frequency of the MG369XB to 50 MHz CW.

Step 5. Set the output level of the MG369XB to 9 dBm.

Step 6. Connect the attenuators to the power splitter as shown in Figure 6-47. Use a cable to link the MG369XB RF output to the 3 dB attenuator. Connect a N male to N female adapter to the 10 dB attenuator.

Step 7. Connect a power sensor (Input A) to the power splitter and a power sensor (Input B) to the female end of the adapter.

Step 8. Adjust the MG369XB RF output so that the power meter input B reading is –10 dBm. Record the corresponding power meter input A reading in Table 6-7.

Step 9. Repeat steps 7 and 8 for other frequencies listed in Table 6-7.

> **Note:** Set the Cal Factor on the power meter to match the frequency being measured.

Step 10. Disconnect the power sensor from the adapter. Then replace the adapter with the N male to N male Phase Matched adapter and then connect to the MS2781A RF Input.

Step 11. Set up the MS2781A as follows:

a. Center Frequency: 50 MHz

b. Span: 300 kHz

c. RBW:50 kHz

d. VBW: 500 Hz

e. Sweep Time: 100 ms

f. Attenuation: 10 dB

g. Reference Level: 0 dBm

Step 12. Set the frequency on the MG369XB to 50 MHz, then set the output power level so that the sensor A reading matches the corresponding value as recorded in column 2 of Table 6-7.

Step 13. Set the Marker to Peak. Record the measured Marker value in Table 6-7.

Step 14. Repeat steps 11 and 12. Record the measured results in Table 6-7. Verify that the measured results are within specifications.

Table 6-7. Frequency Response Test

Frequency	Sensor A Power Reading for –10 dBm Output at Adapter	MS2781A Marker Reading	Specifications –10 dBm
50 MHz			±0.4 dB
500 MHz			±0.4 dB
1000 MHz			±0.4 dB
1500 MHz			±0.4 dB
2000 MHz			±0.4 dB
3000 MHz			±0.4 dB
4000 MHz			±0.4 dB
5000 MHz			±0.4 dB
6000 MHz			±0.4 dB
7000 MHz			±0.4 dB
7800 MHz			±0.4 dB

Reference Level Switching Uncertainty

The following test can be used to verify that the MS2781A is within its Reference Level Switching Uncertainty specifications.

Test Setup

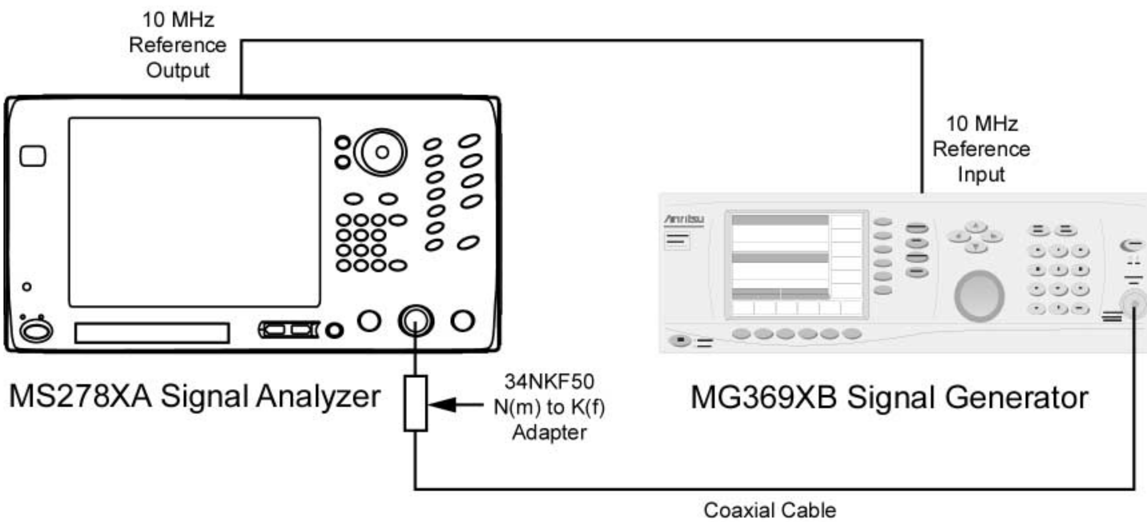


Figure 6-48. Equipment Setup for Reference Level Switching Uncertainty Test

Test Procedure

Step 1. Set up instruments as shown in Figure 6-48.

Step 2. Turn on both the MS2781A Signal Analyzer and the MG369XB Signal Generator and allow them to warm up for one hour.

Step 3. Press the Preset key on the MS2781A to reset the instrument to factory default state.

Step 4. Set the output frequency of the MG369XB to 50 MHz CW and output power to –70 dBm.

Step 5. Set up the MS2781A as follows:

- **a.** Center Frequency: 50 MHz
- **b.** Span: 300 kHz
- **c.** RBW:50 kHz
- **d.** VBW: 500 Hz
- **e.** Sweep Time: 100 ms
- **f.** Attenuation: 10 dB
- **g.** Average: 16
- **h.** Reference Level: –70 dBm

Step 6. Turn on Marker 1 on the MS2781A and set Marker to Peak.

Step 7. Record the amplitude readout value to the MS2781A Marker Reading column of Table 6-8.

Step 8. Set the Reference Level to –60 dBm.

Step 9. Record the new marker value in the MS2781A Marker Reading column of Table 6-8.

Step 10. Subtract the new reading from the marker reading at –70 dBm Reference Level setting.

Step 11. Verify that the deviation is within specifications.

Step 12. Repeat steps 8 to 12 for other Reference Level settings listed in Table 6-8.

Table 6-8. Reference Level Switching Uncertainty Test

MS2781A Reference Level Setting	MS2781A Marker Reading	Deviation from –70 dBm Reference Level (dB)	Specifications
–70 dBm		0	N/A
–60 dBm			0.1 dB
–50 dBm			0.1 dB
–40 dBm			0.1 dB
–30 dBm			0.1 dB
–20 dBm			0.1 dB
–10 dBm			0.1 dB
0 dBm			0.1 dB

Resolution Bandwidth (RBW) Switching Uncertainty

The following test can be used to verify that the MS2781A is within its RBW Switching uncertainty specifications.

Test Setup

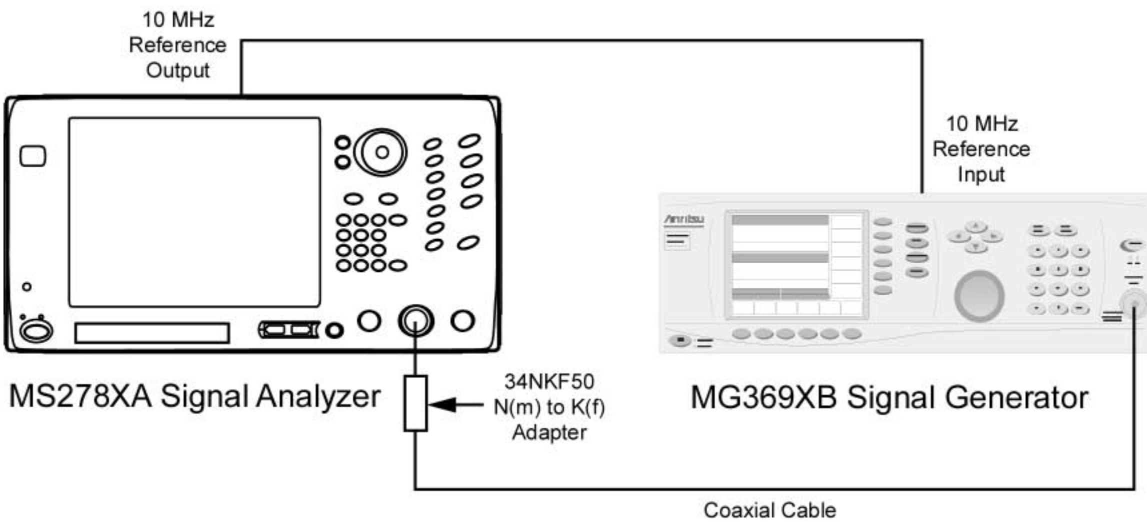


Figure 6-49. Equipment Setup for Resolution Bandwidth Switching Uncertainty Test

Test Procedure

Step 1. Set up the instruments as shown in Figure 6-49. Turn on both the MS2781A Signal Analyzer and the MG369XB Signal Generator and allow them to warm up for one hour.

Step 2. Press the Preset key on the MS2781A to reset the instrument to factory default state.

Step 3. Set the output level of the MG369XB to 0 dBm.

Step 4. Set the output frequency of the MG369XB to 100 MHz CW.

Step 5. Set up the MS2781A as follows:

a. Reference Level: 0 dBm

b. VBW: Auto

c. SWT: Auto

d. Attenuation: Auto

e. Sweep Time Coupling: Accy

Step 6. Set the center frequency on the MS2781A to 100 MHz.

Step 7. Set the RBW to 30 kHz and the frequency Span to 10 kHz on the MS2781A.

Step 8. Set the MS2781A to Single Sweep mode and trigger a new sweep.

Step 9. Turn on Marker 1 and set Marker to Peak.

Step 10. Record the marker level readout value on the display in Table 6-9.

Step 11. Set the RBW and frequency span on the MS2781A to the next settings in Table 6-9.

Step 12. Trigger a new sweep on the MS2781A.

Step 13. Set Marker to Peak

Step 14. Record the new marker level readout value on the display to the corresponding cell in Table 6-9.

Step 15. Calculate the amplitude deviation by subtracting the new marker value from the 30 kHz RBW marker reading.

Step 16. Verify that the amplitude deviation is < 0.1 dB.

Step 17. Repeat steps 11 through 16 for the rest of RBW and SPAN combinations in Table 6-9.

Table 6-9. Resolution Bandwidth Switch Uncertainty Test

RBW	SPAN	MS2781A Marker Reading	Amplitude Deviation from 30 kHz RBW (dB)	Specifications
1 Hz	10 kHz			0.15 dB
100 Hz	1 kHz			0.15 dB
300 Hz	5 kHz			0.15 dB
3 kHz	30 kHz			0.15 dB
10 kHz	100 kHz			0.15 dB
30 kHz	500 kHz			0.15 dB
100 kHz	1 MHz			0.15 dB
300 kHz	5 MHz			0.15 dB
1 MHz	10 MHz			0.15 dB
3 MHz	50 MHz			0.15 dB

Residual Spurious Response

The following test can be used to verify that the MS2781A meets Residual Spurious Response specifications.

Test Setup

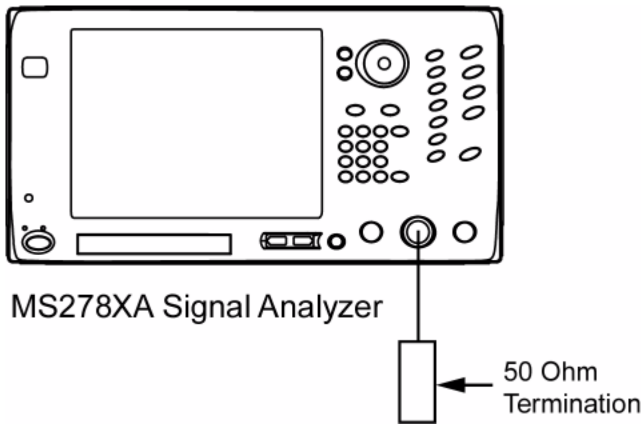


Figure 6-50. Equipment Setup for Residual Spurious Responses Test

Test Procedure

Step 1. Turn on both the MS2781A Signal Analyzer and warm up for one hour.

Step 2. Press the Preset key on the MS2781A to reset the instrument to factory default state.

Step 3. Set up instruments as shown in Figure 6-50.

Step 4. Set up the MS2781A as follows:

a. Sweep Mode: Swept

b. RBW: 5 kHz

c. VBW: 200 Hz

d. Attenuation: 0 dB

e. Frequency Span: 1 MHz

f. Reference Level: –60 dBm

g. Detector Mode: Maximum

Table 6-10. Residual Spurious Response Test

Center Frequency (MHz)	Measured Residual (dBm)	Specifications (dBm)
10		–95
100		–95
300		–95
600		–95
900		–95
1000		–95
2000		–95
3000		–95
4000		–95
5000		–95
6000		–95
7000		–95
8000		–95

Input-related Spurious Response

The following test can be used to verify that the MS2781A meets the Input-related Spurious Response specifications.

Test Setup

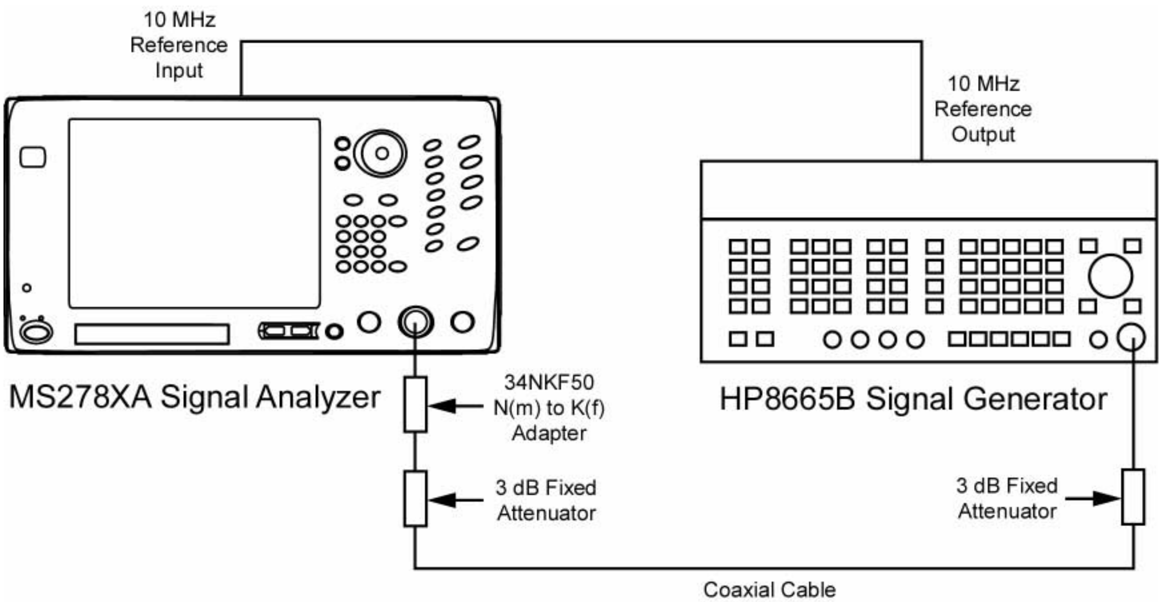


Figure 6-51. Equipment Setup for Input-related Spurious Response Test

Test Procedure

Step 1. Set up the instruments as shown in Figure 6-51.

Step 2. Turn on both the MS2781A Signal Analyzer and the HP 8665B Signal Generator and allow them to warm up for one hour.

Step 3. Press the Preset key on the MS2781A to reset the instrument to factory default state.

Step 4. Ensure that the MS2781A is set to use an External Reference.

Step 5. Set up the MS2781A as follows:

- **a.** Mode: Normal
- **b.** RBW: 100 Hz
- **c.** VBW: Auto
- **d.** Attenuation: 0 dB
- **e.** Frequency Span: 610 kHz
- **f.** Reference Level: –10 dBm
- **g.** Detector Mode: Maximum

Step 6. Set the frequency of the 8665B to the source frequency setting listed in Table 6-11.

Step 7. Set the Center Frequency of the MS2781A to the corresponding center frequency setting listed in Table 6-11.

Step 8. Adjust the output power of 8665B so that the MS2781A marker to peak reads close to –10 dBm.

Step 9. Record the maximum Spurious amplitudes in Table 6-11.

Step 10. Change the Frequency Span to 3 MHz and repeat steps 5 through 7.

Step 11. Record the maximum Spurious amplitudes in Table 6-11.

Note: Any spurs found should be verified not to originate from the signal source.

Table 6-11. Input-related Spurious Responses Test

Center Frequency (MHz)	Source Frequency (MHz)	Spur Amplitude, f<300 kHz from Carrier	Specification (dBc)	Spur Amplitude, f≥300 kHz from Carrier	Specification (dBc)
10	10		–73		–80
12.5	12.5		–73		–80
16	16		–73		–80
21.5	21.5		–73		–80
32	32		–73		–80
142.5	142.5		–73		–80
500	500		–73		–80
650	650		–73		–80
820	820		–73		–80
950	950		–73		–80
999	999		–73		–80
1020	1020		–73		–80
2640	2640		–73		–80
3000	3000		–73		–80
3500	3500		–73		–80
4000	4000		–73		–80
4500	4500		–73		–80
5000	5000		–73		–80
5500	5500		–73		–80
6000	6000		–73		–80

Chapter 7
Software Peripherals

Table of Contents

Chapter 7
Software Peripherals

7-1 Introduction

This chapter describes a few of the software peripherals that may be used in conjunction with Signature to enhance data analysis and presentation. These peripherals are centered around the advanced features of MathWorks MATLAB and the popular Microsoft Office tools. Here, we will briefly describe the uses of, and demonstrate how to export the measurement data that Signature acquires into the following powerful applications:

- MathWorks MATLAB
- Microsoft Paint
- Microsoft Word
- Microsoft Excel
- Microsoft Access
- Microsoft PowerPoint

7-2 Signature–MathWorks Connectivity (Option 40 only)

This section describes the general connection and use of the capabilities of Anritsu's MS2781A Signal Analyzer (Signature) and The MathWorks MATLAB software products provided with Option 40. Anritsu has published an application note, *Custom Measurements and Analysis using MATLAB® on Signature*™, which offers an in-depth discussion on using Signature and MATLAB for advanced measurement analysis.

Signature MathWorks Connectivity Description

Signature can output setup data, active trace data of any measurement, and I/Q vectors to MathWork's MATLAB to enable you to do your own measurements and data analysis.

To control the interaction between Signature and MATLAB, in the Signature GUI, you can choose a MATLAB script to run, control the synchronization between the two environments, and hold all of the instrument settings so they do not change during a MATLAB processing session.

Integrated MathWorks Computational Components

The MathWorks computational components and MathWorks application software, along with the Signature System Software, define a complete system. The Signature system interfaces with the MathWorks application tools to provide measurement and parameter data. Given that the computational components are user definable, it follows that there is a pre-defined protocol used to exchange data between the Signature System Software and the MathWorks application environments.

Integrated MathWorks Computational Components–Flow of Events

The flow of events begins with the a Signature based measurement followed by the integration of a MathWorks based computational component.

Once the measurement is created, you select a MathWorks based computational component to integrate, then select the target data sets for computation, and finally select the desired graphical measurement results.

Step 1. Selecting the Computational Component:

In this step, you are presented with a list of computational components installed in the system. Each computational component provides a name, brief description, file name, along with a visual cue relating to its computational environment.

Step 2. Selecting the Target Parameters for Computation:

To facilitate usage of external computational tools, Signature provides a list of measurement related parameters as well as acquisition data. For Spectrum type measurements, you may choose from the following parameters to export into the MATLAB environment:

- Center Frequency
- Span Frequency
- Resolution Bandwidth
- Video Bandwidth
- Reference Level
- Attenuation
- Sweep Time and Time Span

For Vector Signal Analysis measurements, you may choose from the following parameters to export to the MATLAB environment:

- Center Frequency
- Sampling Frequency

Step 3. Selecting the Target Data-sets for Computation:

In addition to target parameters, there are system generated data from the hardware receiver. The system generated data appears in the system as a series of floating point arrays, or traces. You may choose to export one or more of these traces into the MATLAB environment; therefore, the system presents you with a list of data sources to output.

For Spectrum type measurements, you may choose to export up to five traces (each of which can be configured differently based on the various trace states and detection options).

For the Vector Signal Analysis measurements, the system exports only Trace 1, which represents I/Q vs. Time.

Pre-Conditions

The pre-conditions for operational interfacing of all of the above uses assume that the system is running at steady state. It also assumes that no other applications or applets are being executed in the foreground during these uses.

Outputs to MATLAB

To launch and start sending data to MATLAB, proceed as follows:

Step 1. Select MATLAB from the Tools drop-down menu. This will bring up a dialog for configuring what is sent to MATLAB as shown below:

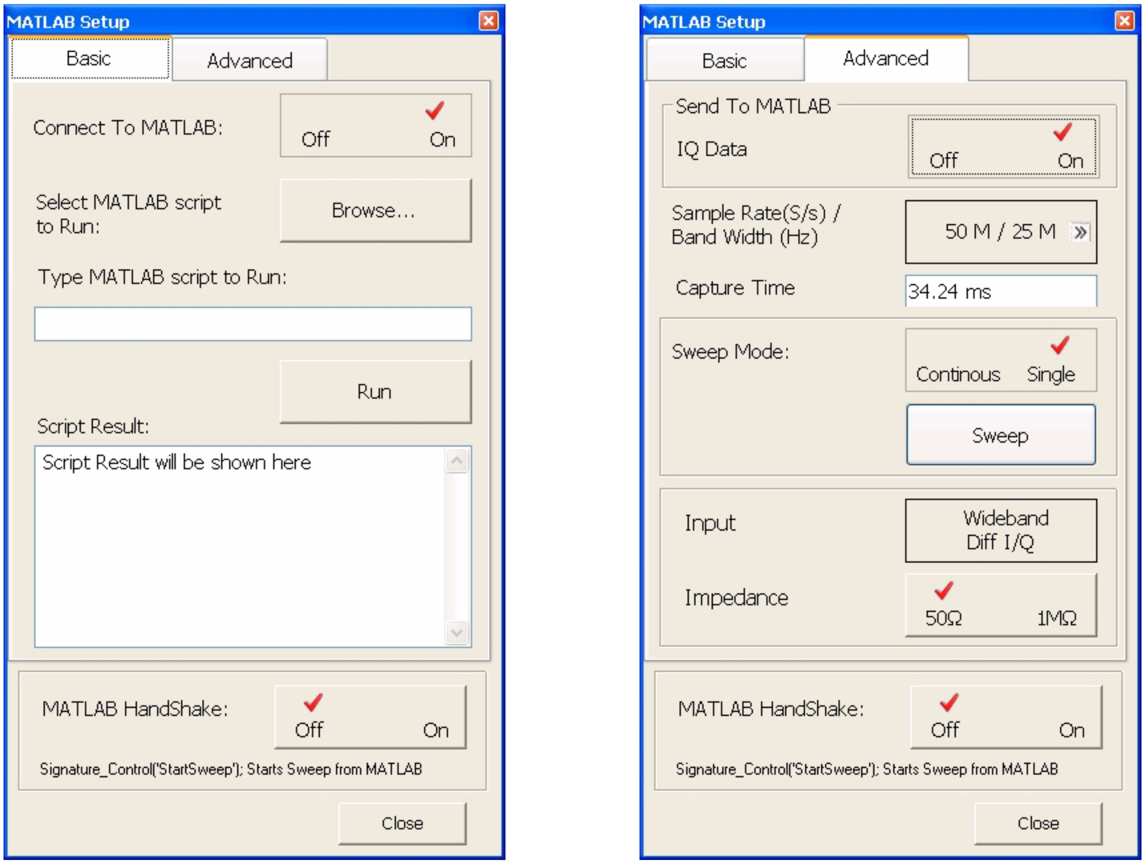


Figure 7-1. MATLAB Setup Dialog

Step 2. Choose the I/Q vectors (the setup information is always sent when you select "Connect to MATLAB" and close the dialog).

The active traces can come from any measurement including spectrum (swept or FFT), zero-span, constellation, or vector diagram. For the I/Q vector output, you need to have some way of configuring the sample rate, record length, IF bandwidth, whether the input comes from the RF or I/Q (if available), and the Wideband IF anti-aliasing filter. Since these are obscure in other instrument settings, the suggestion is to allow direct control from this dialog.

Note: Other hardware settings will be done elsewhere. These settings include:

- Center Frequency (Span=0)
- Reference Level and Attenuation
- Trigger Source, Level, and Position
- Sweep (Single or Continuous)

Step 3. To easily see that MATLAB is turned on, click on the View drop-down menu and select Taskbar. After a few moments, you will see a MATLAB window. Click on the MATLAB window or use Alt-Tab to make it the active window.

> **Note:** When sending IQ Data to MATLAB, the MATLAB Setup dialog must be left open.

If the 30 MHz Wideband IF (Option 22) is installed, for all inputs:

Input: RF, I/Q, I/Q Differential (the VSA input names)

If the 30 MHz Wideband IF (Option 22) is installed, for RF inputs:

Sample Rate:

- Range: Same as Digital IF sample rates, approximately 40 S/s to 21.4 MS/s plus 50 MS/s, 25 MS/s
- Resolution: Same as Digital IF sample rates, plus two additional sample rates through the wideband IF
- Default: 50 MS/s
- Terminators: MS/s, kS/s, S/s

Record Length:

- If Digital IF sample rates are selected, same as for no wideband IF
- If Wideband IF sample rates are selected:
    - Range: 1 to 128 MS
    - Resolution: 1
    - Default: 1000
- Terminators: MS, kS, S

IF Bandwidth:

- Range: Same as for spectrum analyzer RBW, 10 Hz to 8 MHz, plus:
    - If the AA filter is on: 30 MHz
    - If the AA filter is off: 50 MHz
- Resolution: same as for spectrum analyzer RBW, 1/2/3/5 sequence up to 5 MHz, plus 8 MHz, plus either 30 or 50 MHz
- Default: Maximum, = 30 or 50 MHz
- Terminators: MHz, kHz, Hz

Wideband AA filter:

- Range: On or Off
- Default: On

If the 30 MHz Wideband IF (Option 22) is installed, for IQ inputs:

Sample Rate:

- Range: 25k, 50k, 100k, 200k, 400k, 500k, 1M, 2M, 3.125M, 6.25M, 12.5M, 25M, 50 MS/s
- Resolution: from above set
- Default: Maximum Available, 50 MS/s
- Terminators: MS/s, kS/s

Record Length:

- Range: 1 to 128 MS
- Resolution: 1
- Default: 1000
- Terminators: ms, ks, s

The formats are:

- For a spectrum or zero-span trace, a vector of doubles using the current units, for example: AnritsuSignatureTrace1(1:501)
- For constellation or vector diagrams, a vector of complex numbers describing the I/Q positions of the data points
- For the markers, a structure, for example:

  AnritsuSignatureMarkers.Marker1.Value

  AnritsuSignatureMarkers.Marker1.Trace

  AnritsuSignatureMarkers.Marker1.Active
- For measurement results, a structure, for example:

  AnritsuSignatureMeasurements.ChannelPower

  All measurements should always exist in the structure, but the measurements that are not being made return a null value, such as an empty set.
- For the setup information, a structure, for example:

  AnritsuSignatureSetup.CenterFrequency
- For I/Q vectors, a vector of complex doubles, for example:

  AnritsuSignatureIQ(1:1e6)

MATLAB Control

Once the connection to MATLAB is established, a Desktop Window is launched as shown below:

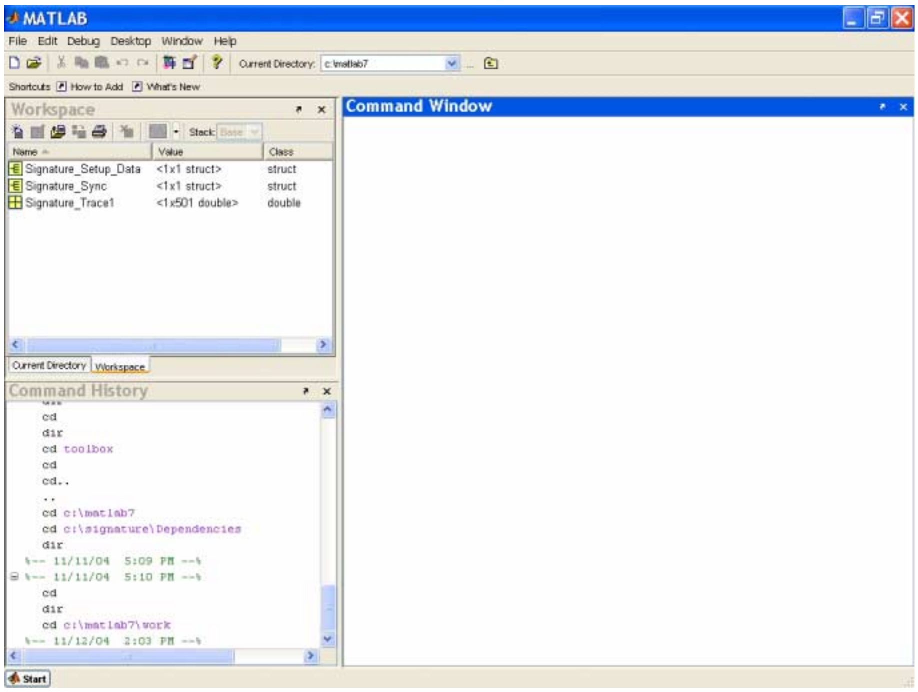


Figure 7-2. MATLAB Main Interface

The Main MATLAB Interface has three sub-windows:

Workspace: This shows information about MATLAB variables. Note the tab selection to show either the Workspace or the current directory.

Command History: This shows the command history. You can double-click on a command to execute it or single-click to copy and then paste in the command window for editing.

Command Window: This is where you type commands. You can do math, plot graphs, or start programs.

> **Note:** If you do not see the normal desktop, you can restore it by clicking on: Desktop | Desktop Layout | Default

The Workspace contains variables/data from the Signature software. Signature can output a variety of data to MATLAB to enable users to do their own measurements or analysis. These outputs are active traces (of any measurement), active markers, measurement results, setup information, and I/Q vectors.

To control the interaction between Signature and MATLAB in the Signature GUI, the you can choose a MATLAB script to run, control the synchronization between the two environments, and hold all of the instrument settings so they do not change during a MATLAB processing session.

For in depth descriptions and procedures on how to use the advanced power MATLAB brings to Signature's measurement analysis capabilities, refer to the Anritsu application note, “Custom Measurements and Analysis using MATLAB® on Signature™.”

Advanced MATLAB Functions

MATLAB provides advanced data analysis capabilities. The scope of these capabilities is limitless and beyond the intent of this manual to describe; however, Signature ships with a number of sets of demonstration code to help get you up and running quickly with MATLAB.

These include several plotting routines that correctly label the X-axis (based on Signature_Setup_Data) as well as automatically update the plot as the Signature measurement trace changes. One of these functions is called timerplot. This plot is shown side-by-side with an actual screen shot of the same signal taken from the analyzer's measurement screen.

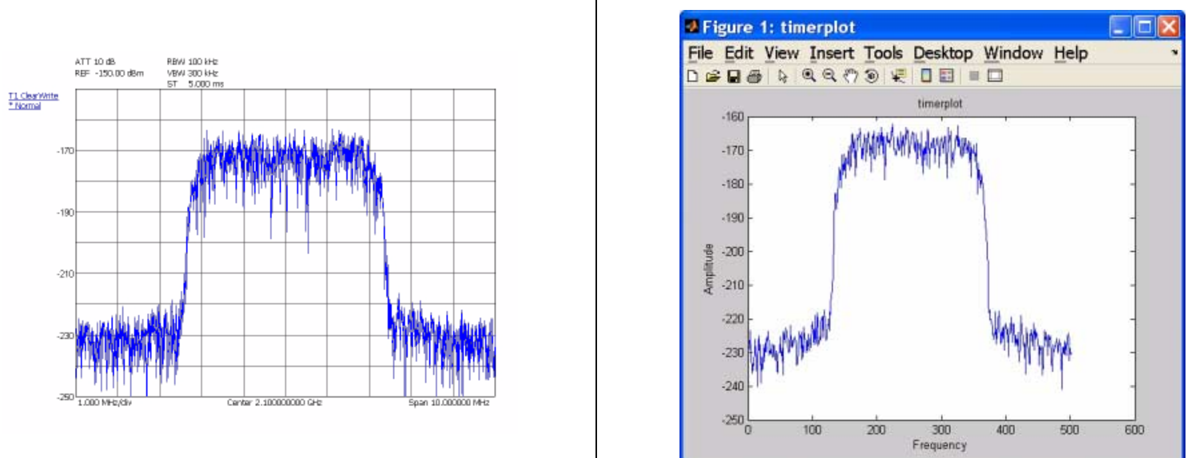


Figure 7-3. Signature Measurement Trace vs. MATLAB Timerplot

The timerplot function executes a continuously updated, data acquisition routine and creates a plot of the data in real time within a MATLAB plot window.

You can also invoke measurement functions from the MATLAB command line. For example, another one of the measurement functions that will come with Option 40 is channel power. To see the structure of the channel power command, you can use the help function. This is available for all of the MATLAB functions, as well as all of the Option 40 functions. To use this help feature, type:

```
>> help command name
```

MATLAB also has a Windows-style help system, which you can get to by using F1, the drop-down help menu, or document file:

Figure 7-4. MATLAB Online Help System

7-3 Microsoft Applications

Microsoft has many popular tools that are used for generating reports. Signature allows you to export data to a variety of these tools, such as:

- Microsoft Paint
- Microsoft Word
- Microsoft Excel
- Microsoft Access
- Microsoft PowerPoint

Copying Graphical Screen Images

The easiest way to import graphical data into most of these tools is to use the features already built into the Microsoft operating system, namely, the copy/paste feature. You can easily copy the current screen display to the clipboard, then paste the image as a bitmap by doing the following:

> **Note:** You may acquire a better image and reduce the use of black ink on hard copy printouts if the display is first presented in Inverse Video. Access this feature from the View drop-down menu and select Inverse Video.
>
> The following procedures only work with Microsoft compatible applications that let you paste images from the clipboard, such as Paint. The same capabilities may be offered by third party software, but are not demonstrated here.

Copying Screen Shots to Image Editors

Step 1. With the analyzer displaying the image of interest, press and hold the Alt key on the keyboard, then press the Print Screen key. This copies the screen display to the clipboard.

Step 2. Open the application to which you wish to paste the image.

Step 3. Press and hold the Ctrl key on the keyboard, then press the V key to paste the image.

> **Note:** Microsoft Paint may ask you to resize the bitmap. Select Yes to this question.

Step 4. You may now use the image editing tools provided by the application to make any desired edits, such as cropping, resizing, and annotating the image.

Copying Screen Shots to Office Tools

Step 1. With the analyzer displaying the image of interest, press and hold the Alt key on the keyboard, then press the Print Screen key. This copies the screen display to the clipboard.

Step 2. Open the application to which you wish to paste the image.

Step 3. In Microsoft Word, place the cursor where you want to paste the image.

In Microsoft PowerPoint, navigate to the slide where you want to paste the image.

Step 4. Press and hold the Ctrl key on the keyboard, then press the V key to paste the image.

Step 5. Resize and position the image by dragging the image and by using the image handles.

Exporting Trace Data

Signature allows you to export numerical trace data for further analysis and processing by applications such as Excel and Access.You can easily export trace data by doing the following:

Note: You must first ensure that the trace you want to export is the active trace.

Step 1. Press the File key on Signature's front panel, then press the Export button.

Step 2. When the Save As dialog box is displayed, navigate to the directory where you want to store the trace data and enter a file name.

Step 3. Press the Save button to save the trace data.

Importing the Trace Data to Excel

Step 1. Open Excel and select File | Open.

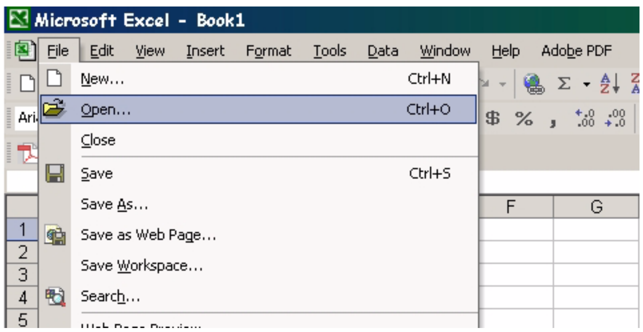


Figure 7-5. Opening a File in Excel

Step 2. Navigate to the directory where you exported the trace data and select:
Files of type: Text Files (*.prn, *.txt, *.csv)

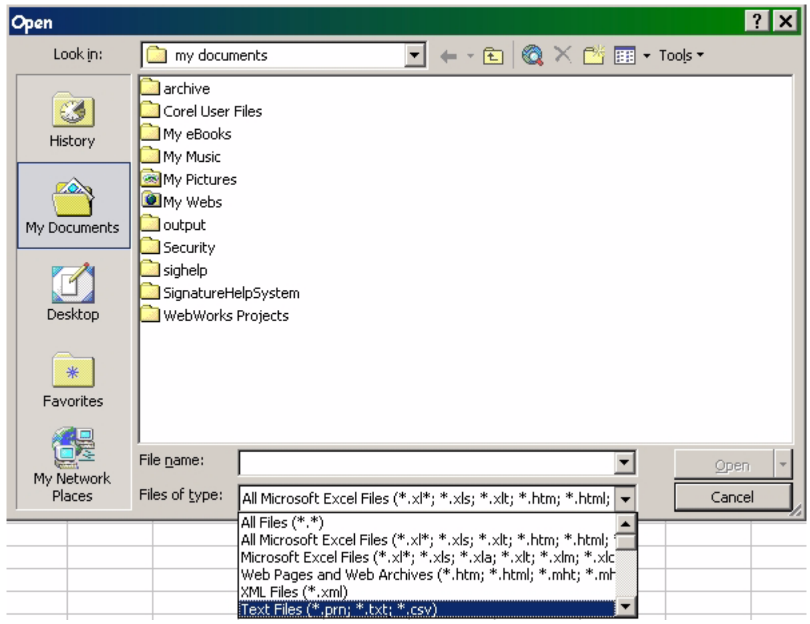
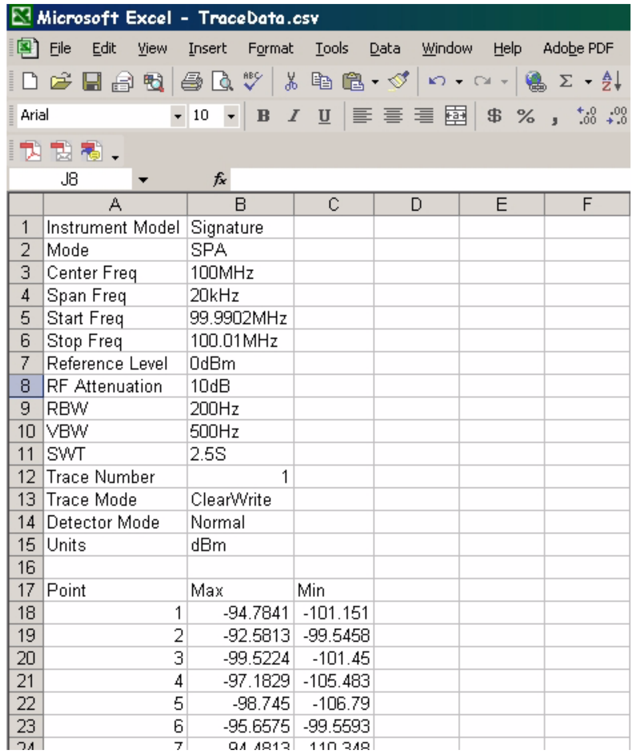


Figure 7-6. Selecting the File Type in Excel

Step 3. The data is imported into Excel as shown below:



	A	B	C	D	E	F
1	Instrument Model	Signature				
2	Mode	SPA				
3	Center Freq	100MHz				
4	Span Freq	20kHz				
5	Start Freq	99.9902MHz				
6	Stop Freq	100.01MHz				
7	Reference Level	0dBm				
8	RF Attenuation	10dB				
9	RBW	200Hz				
10	VBW	500Hz				
11	SWT	2.5S				
12	Trace Number	1				
13	Trace Mode	ClearWrite				
14	Detector Mode	Normal				
15	Units	dBm				
16						
17	Point	Max	Min			
18	1	-94.7841	-101.151			
19	2	-92.5813	-99.5458			
20	3	-99.5224	-101.45			
21	4	-97.1829	-105.483			
22	5	-98.745	-106.79			
23	6	-95.6575	-99.5593			

Figure 7-7. Signature Data Imported Into Excel

> **Note:** Frequency information must be calculated by using the center frequency and frequency span information, along with the number of samples (501).

Importing the Trace Data to Access

Step 1. Open Access and create a new database.

Step 2. Select File | Get External Data | Import...

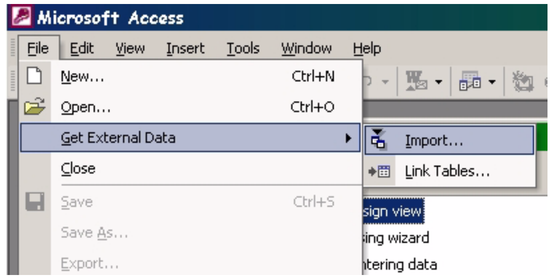


Figure 7-8. Importing Data Into Access

Step 3. Navigate to the directory where you exported the trace data and select:
Files of type: Text Files (*.txt, *.csv, *.tab, *.asc).

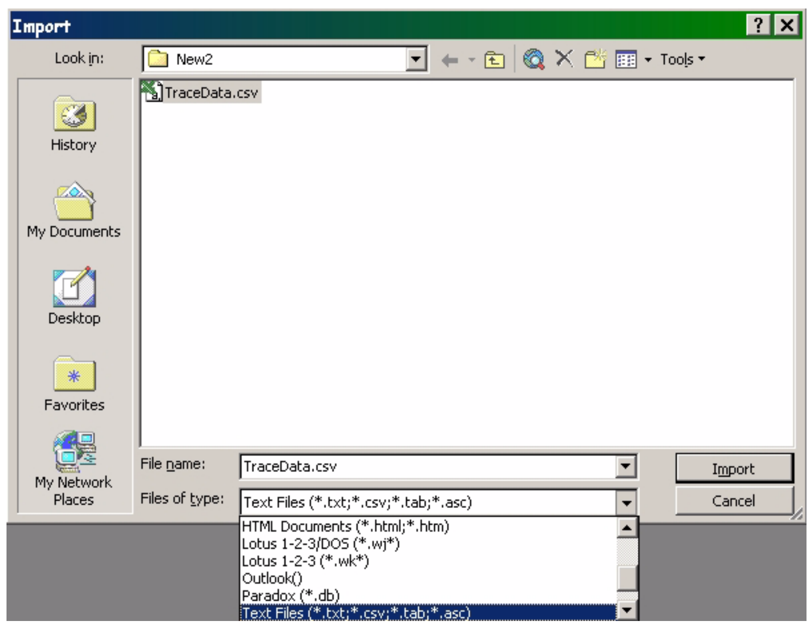
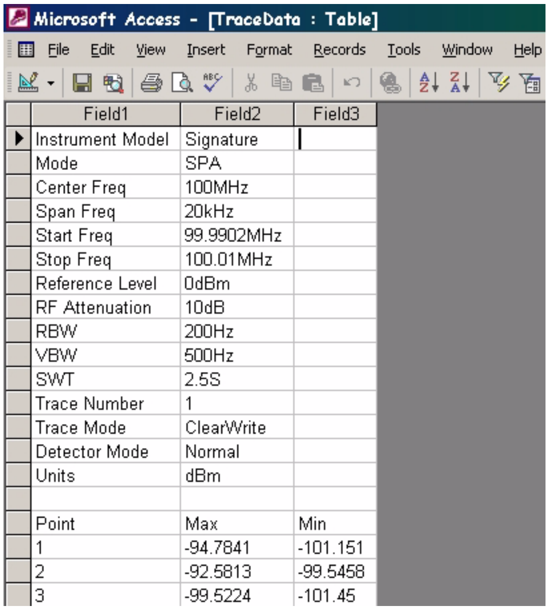


Figure 7-9. Selecting the File Type in Access

Step 4. Follow the Import Text Wizard by choosing the Comma Delimited format and continuing to set the remaining options to your preference.



Field1	Field2	Field3
Instrument Model	Signature	
Mode	SPA	
Center Freq	100MHz	
Span Freq	20kHz	
Start Freq	99.9902MHz	
Stop Freq	100.01MHz	
Reference Level	0dBm	
RF Attenuation	10dB	
RBW	200Hz	
VBW	500Hz	
SWT	2.5S	
Trace Number	1	
Trace Mode	ClearWrite	
Detector Mode	Normal	
Units	dBm	
Point	Max	Min
1	-94.7841	-101.151
2	-92.5813	-99.5458
3	-99.5224	-101.45

Figure 7-10. Signature Data Imported Into Access

Note: Frequency information must be calculated by using the center frequency and frequency span information, along with the number of samples (501).

Chapter 8
Remote Operation

Table of Contents

Chapter 8
Remote Operation

8-1 Introduction

Remote Operation is comprised of one of three methods:

- GPIB Control
- Web Services Control
- Remote Desktop

The primary functions of GPIB and Web Services are documented in the MS2781A programming manual (part number: 10410-00253). Refer to Chapter 2 for information about the GPIB Setup and LAN Setup. The remainder of this chapter will focus on configuring and using the Remote Desktop client provided by Microsoft. Other applications, such as PCAnywhere, can be used in similar fashion, but are not covered by this document. Refer to that product's documentation for details on its installation and use.

8-2 Remote Desktop

With the Remote Desktop feature in Windows XP Professional, you can remotely control the Anritsu Signature Analyzer from another computer. This allows you to use the data, applications, and network resources that are available to your analyzer, without being at the lab.

To use Remote Desktop, you need the following:

- Signature SPA/VSA with Windows XP Professional installed. This computer is known as the host.
- A remote computer running Windows 95 or above version of Windows. This computer is known as the client and it must have the Remote Desktop Connection client software installed. Windows XP comes with the Remote Desktop software, or it can be downloaded from Microsoft.
- A connection to the Internet or network to which the analyzer is connected.

> **Note:** A broadband Internet connection improves performance, but it is not required because Remote Desktop transfers only the minimal amount of data (such as display and keyboard data) to remotely control your analyzer.

When the instrument is controlled remotely, the display is switched to the operating system's login menu, usually presenting two icons. One icon represents the remote user and the second icon represents the local user. Logging in as either user will disconnect the remote Desktop.

Setting Up Your Analyzer

This procedure assumes that your analyzer is part of a corporate network in which Remote Desktop connections are permitted. You may need to consult your system administrator for more detailed setup and access permissions.

Enabling the Analyzer as the Host

Note: Signature is preset at the factory as the Host, so this step may not be necessary.

You must first enable the Remote Desktop feature on the analyzer so that you can control it remotely from another computer. You must be logged on as an administrator or the Local User, which is part of the Administrators group, to enable Remote Desktop.

Step 1. Open the System folder in Control Panel by clicking:
Start | Control Panel | then double-click the System icon to open the System Properties dialog.

Step 2. On the Remote tab, select the “Allow users to connect remotely to this computer” check box, as shown below:

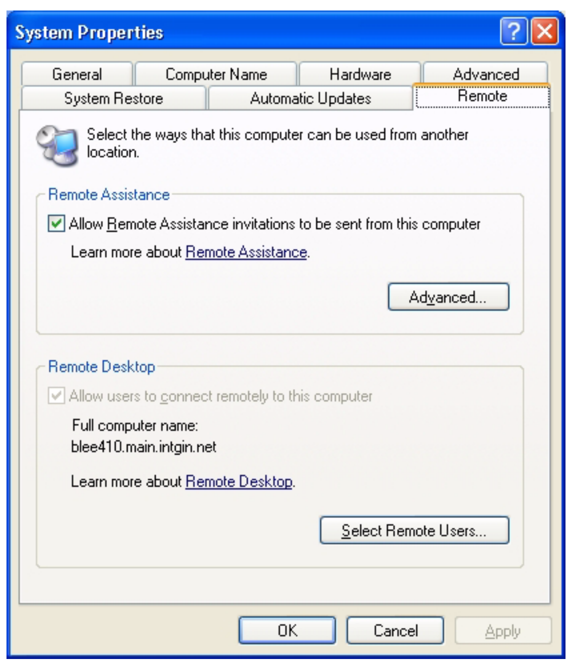


Figure 8-1. System Properties Dialog

Step 3. Note the analyzer's full computer name shown in the dialog box above for use when making the remote connection.

> **Note:** Signature is configured with one remote user at the factory. Additional remote users can be added by selecting the "Add Remote Users..." button in the dialog above. Refer to your Microsoft documentation for more information about adding remote users.

Step 4. Leave the analyzer running and connected to the network.

Installing the Client Software

The Remote Desktop Connection client software allows a computer running Windows 95, Windows 98, Windows 98 Second Edition, Windows Me, Windows NT 4.0 or Windows 2000 to control your Windows XP Professional computer remotely. The client software is available from the Microsoft Web Site. The client software is installed by default on computers running Windows XP Professional and Windows XP Home Edition, and is available to install on computers from these disks.

Step 1. Insert the Windows XP compact disc into your CD-ROM drive.

Step 2. When the Welcome page appears, click Perform additional tasks, then click Setup Remote Desktop Connection.

Step 3. When the installation wizard starts, follow the directions that appear on your screen.

> **Note:** The remote machine should have a Terminal Services client installed on it. If you have a Windows XP machine, the remote monitoring capability is automatically installed with the operating system. For other operating systems, please review your supplier's documentation to see how to install and configure a Terminal Services client on your machine.

Starting a Remote Desktop Session

Once you have enabled your analyzer to allow remote connections and have installed the client software on a Windows-based client computer, you are ready to start a remote desktop session. You must first establish a virtual private network connection or remote access service connection from your client computer to your office network, or host computer.

To start a new connection:

Step 1. Open Remote Desktop Connection by clicking: Start | Programs (or All Programs) | Accessories | Communications | Remote Desktop Connection.

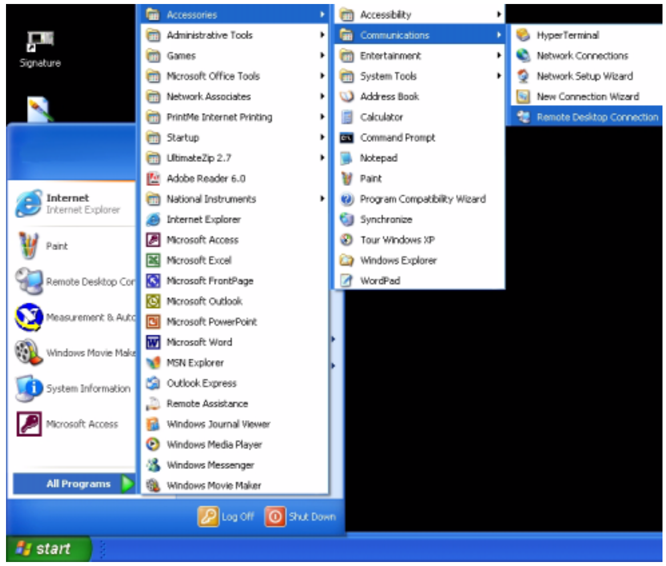


Figure 8-2. Starting a Remote Desktop Connection

Step 2. This opens the Remote Desktop Connection dialog shown below:

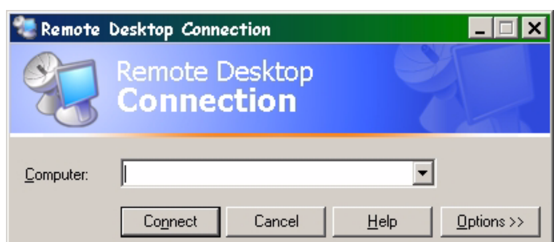


Figure 8-3. Remote Desktop Connection Dialog

Step 3. Type the computer name, noted in Step 3 of the previous procedure, for the Signature analyzer.

Step 4. Click Connect.

The Log On to Windows dialog box appears.

Step 5. Signature is shipped from the factory with the following user name and password:

UserName: SignatureUser
Password: 2780

Unless this was changed, you should be able to login using this user name and password.

Step 6. After a successful login, you will see the desktop of Signature and you can remotely perform all of the tasks on the analyzer that you could normally perform locally.

Note: While Signature is being remotely controlled, the local screen will blank out and local controls will cease to be effective. Local control can be taken back by logging back into the machine with the password: signature (unless you have changed the password setting).

Advanced Connection Options

Connection settings such as screen size, automatic logon information, and performance options can be configured before you start your remote Connection. You can expand the Remote Desktop Connection dialog by clicking on the Options >> button.

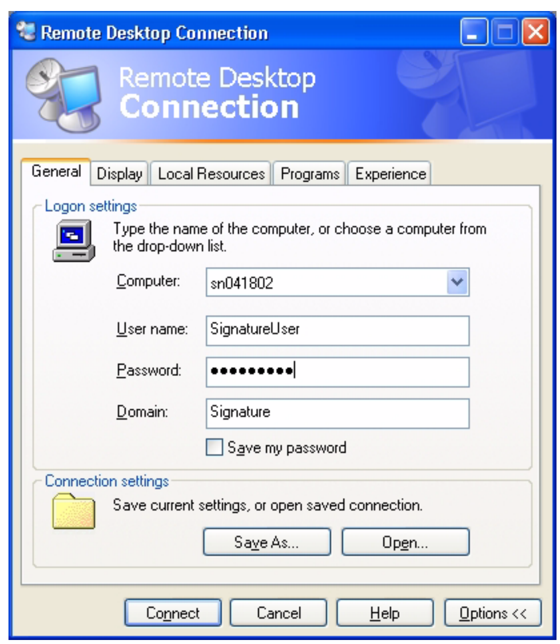


Figure 8-4. Advanced Remote Desktop Connection Dialog

Connection setting may also be saved and recalled by using the Save As and Open buttons.

> **Note:** A Remote Desktop file (.rdp) file contains all of the information for a connection to a remote computer, including the Options settings that were configured when the file was saved. You can customize any number of .rdp files, including files for connecting to the same computer with different settings. For example, you can save a file that connects to MyComputer in full screen mode and another file that connects to the same computer in 800x600 screen size. By default, .rdp files are saved in the My Documents | Remote Desktops folder. To edit an .rdp file and change the connections settings it contains, right-click the file, then click Edit.

Logging Off and Ending a Remote Desktop Session

Step 1. In the Remote Desktop Connection window, click Start, then click Shut Down. The Shut Down Windows dialog box appears.

Step 2. In the drop-down menu, select Log Off <username>, then click OK.

Appendix A
Performance Specifications

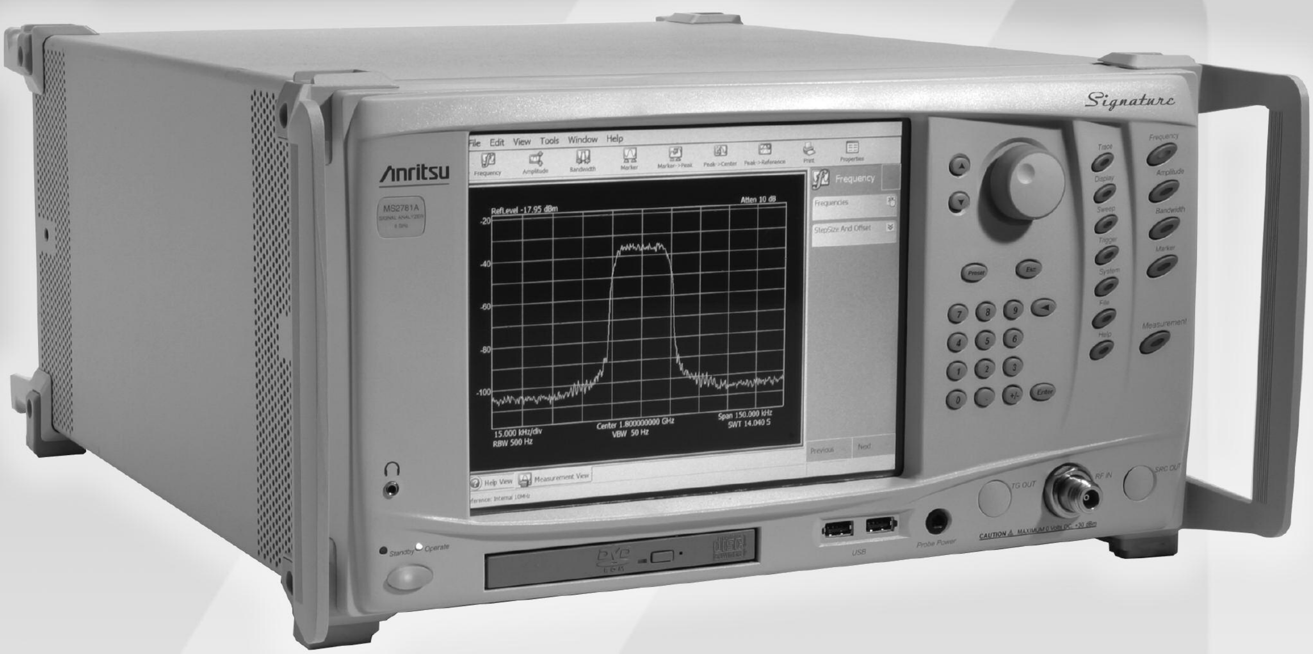
Technical Datasheet

Anritsu

Signature™

High Performance Signal Analyzer

100 Hz to 8 GHz



Version 3.0

MS2781A Spectrum Analysis and Vector Signal Analysis with Bandwidths to 50 MHz

System Description

The Anritsu Signature High Performance Signal Analyzer is designed to provide exceptional spectrum analyzer performance and integrated vector signal analysis over the 100 Hz to 8 GHz frequency range.

Exceptional Performance to 8 GHz Without the Need for a Preselector or Bandswitching

The Signature RF block diagram illustrates how a Signature uses a 9.5 to 17.5 GHz synthesized first local oscillator and 9.5 GHz first IF (see Figure 1). This fundamental mixing approach allows the 100 Hz to 8 GHz range to be covered without bandswitching. Also, a preselector is not needed to eliminate image responses of the first LO. Preselectors can degrade the overall amplitude accuracy as well as the modulation analysis bandwidth and accuracy. Fundamental mixing to 8 GHz improves the sensitivity, high signal level performance (TOI) and dynamic range.

8 MHz Spectrum Analyzer Resolution Bandwidths

Signature offers standard resolution bandwidths from 0.1 Hz to 8 MHz. Four conversions are used to achieve a typical displayed dynamic range of 120 dB.

30 MHz Demodulation Bandwidth (Option 22)

Option 22, 30 MHz IF Bandwidth, extends single FFT spectrum and I-Q vector measurements to 30 MHz and enables vector signal analysis capability (Option 38). Baseband differential I & Q inputs are also added. The ability to turn off the anti-alias filter extends the capture bandwidth to 50 MHz.

Comprehensive WCDMA/HSDPA Measurements (Option 30)

Option 30, WCDMA/HSDPA Measurements, allows a wide variety of Modulation Quality measurements on Base Station (Node B) transmitters and related components. Combined with the standard RF measurements in Signature, these provide a complete suite of measurements for Engineering use, both in R&D and Manufacturing.

Fully Integrated Vector Signal Analysis (Option 38)

Option 38, QAM/PSK Modulation Analysis, allows you to select the symbol rate, modulation type, and filtering to demodulate captured signals. Measurements include EVM, carrier leakage, and I-Q imbalance. Symbol table, constellation and vector diagrams enhance viewing of measurement results.

Advanced Connectivity

Signature can be remotely controlled via GPIB and Ethernet interfaces with SCPI commands that provide familiar spectrum analyzer function calls. Signature supports Web Services, greatly simplifying the task of programming.

Open Windows® XP Operating System

Signature's Windows XP Professional environment and built-in PC provide a new level of connectivity, ease-of-use, and remote operation.

Integrated Compatibility with MATLAB (Option 40)

Signature expands the ability to analyze RF signals with simulation and analysis tools from the industry leader, The MathWorks. Signature provides an interface to easily transfer captured trace data and I-Q Vectors into MATLAB® and Simulink® for further analysis. DSP demodulator models created in MATLAB and Simulink can be applied to Signature data to evaluate new or proprietary modulation formats.

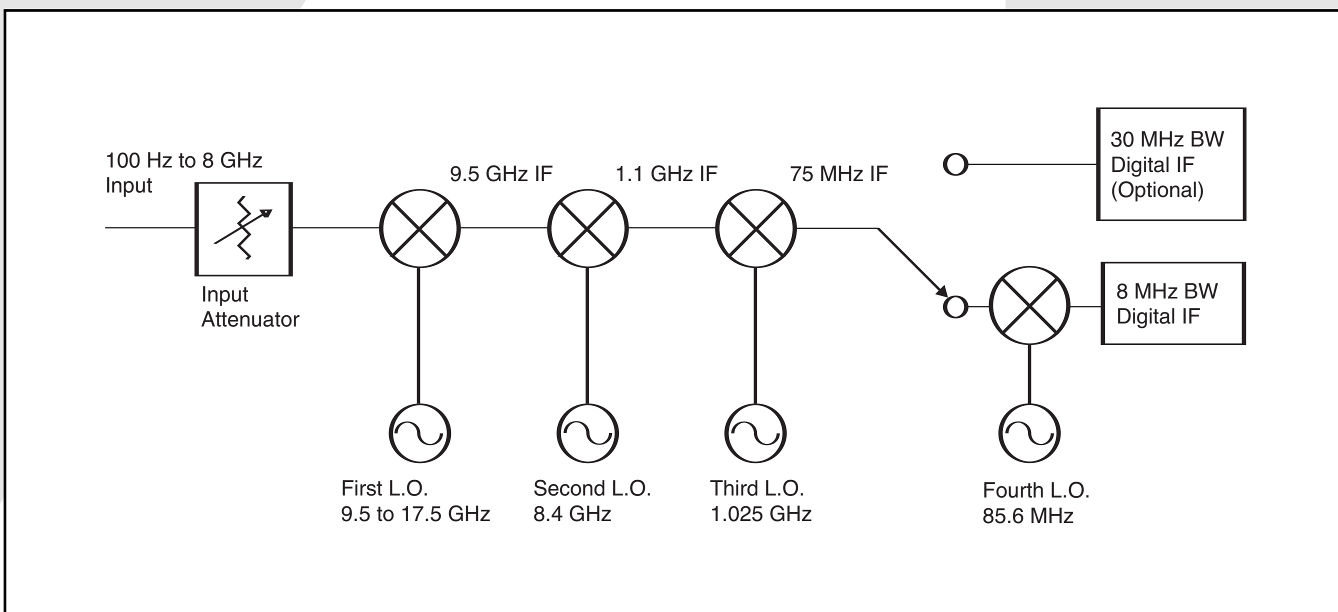


Figure 1, Signature RF block diagram (L.O. frequencies are nominal values)

Frequency Related Specifications

Frequency Range: 100 Hz to 8 GHz

Bands (Architecture): Single-band, fundamentally mixed, image free

Frequency Resolution: 1 Hz

Frequency Span Range: 10 Hz to 8 GHz, 0 Hz

Frequency Span Accuracy:
0.3% of span
1.4% for 33 MHz <f ≤80 MHz
1.0 % for >80 MHz

Frequency Readout Accuracy: ± marker freq * reference accuracy + span accuracy + RBW accuracy * RBW + 0.5 * last digit

Swept Resolution Bandwidth (RBW):
RBW Range: 10 Hz to 8 MHz (1/2/3/5)
RBW Shape Factor (60 dB/3 dB), nominal: 4.6
RBW Accuracy: 10 Hz to 2 MHz: 5%
3 MHz and 5 MHz: 10%

Modulation Analysis Bandwidth:
Standard: 8 MHz
With Option 22: 30 MHz
With Option 22 and anti-alias filter turned off: 50 MHz

FFT

FFT RBWs: 0.1 Hz to 100 kHz (1,2,3,5)
Wideband FFT (requires Option 22): 100 Hz to 3 MHz (1, 2, 3, 5)

FFT Span:
Standard: 10 Hz to 1 MHz
Wideband FFT (requires Option 22): 1 MHz to 30 MHz

FFT Span/RBW: ≤30,000
Wideband FFT (requires Option 22): No restriction

Video Bandwidth (VBW): 1 Hz to 10 MHz (1/2/3/5)

SSB Phase Noise (dBc/Hz @ 1 GHz):
100 Hz Offset: <–80, –86 typical
1 kHz Offset: <–106
10 kHz Offset: <–114
100 kHz Offset: <–115
1 MHz Offset: <–136
5 MHz Offset: <–140

Residual FM: <1 Hz in 1 second, nominal

Reference Oscillator Aging Rate: $5x10^{-10}$/day; $1x10^{-7}$/year

Reference Oscillator Temperature Drift: $5x10^{-9}$ over 0 to 50ºC

Amplitude Related Specifications

Intermodulation Distortion

Third-Order Intercept (TOI):
<100 MHz: >19 dBm
≥100 MHz: >23 dBm, >27 dBm typical

Second Harmonic Intercept: >38 dBm

1 dB Compression Point: >10 dBm

Noise

Displayed Average Noise Level (DANL) (note 5):
10 MHz to 2.5 GHz: <–157 dBm
2.5 GHz to 7 GHz: <–155 dBm
7 GHz to 8 GHz: <–153 dBm

Noise Figure: <29 dB typical @ 1 GHz

Amplitude Uncertainty (20° to 30°C)

Amplitude Uncertainty at 50 MHz (note 2): <0.1 dB

Frequency Response at 10 dB Attenuation: <0.4 dB

Frequency Response from Attenuator Switching: <0.2 dB (note 8)

Additional Frequency Response in FFT Mode: <0.1 dB

Reference Level Switching Uncertainty:
Without Attenuator Changes: 0.2 dB
With Attenuator Changes: 0.25 dB

RBW Switching Uncertainty (RBW ≤3 MHz): <0.15 dB

Log Fidelity (<–10 dBm mixer level [note 4], 0 to 80 dB below reference level, signal to noise >25 dB): <0.07 dB

Power Bandwidth Uncertainty (RBW 10 Hz to 1 MHz): 0.1 dB

VSWR (≥10 dB attenuation):
≤3 GHz: <1.3
>3 GHz: <1.5

Combined Amplitude Accuracy (95% confidence, note 3): <0.65 dB

Ranges

Reference Level Range:

–150 to +30 dBm in 0.01 dB steps

Scale Type: Log or Linear

Log Scale per Division: 0.1 to 20 dB

Max Average Power (10 dB attn.) w/o Damage: +30 dBm

Input Attenuator Range: 0 to 62 dB, 2 dB steps nominal

Displayed Dynamic Range: 120 dB typical

Spurious

Spurious Responses (–10 dBm mixer level, span ≤3 MHz [note 6]):
f <300 kHz from carrier, –70 dBc
f ≥300 kHz from carrier, –80 dBc

Residual Responses (≥10 MHz): <–95 dBm

Image Rejection: <–90 dBc, <–105 dBc typical

IF Rejection: <–80 dBc, <–100 dBc typical

Other Amplitude Related

Calibrator Frequency: 50 MHz, internal connection

Amplitude Axis Units: dBm, dBmV, dBμV, W, and A

Sweep Related Characteristics

Trigger Source(s): Free Run, Line, External (±10V @ 10 kΩ), Video, IF Power (Wide BW)

Frequency Domain Sweep Time:

Span ≤4 GHz: 5 ms to 10000 seconds
Span >4 GHz: 16 ms to 10000 seconds

Time Domain (Zero Span) Sweep Time: 200 µsec to 10000 seconds

Sweep Time Accuracy:

Span = 0 Hz: 0.1%
Span >0 Hz (Swept): 1%
Pre/Post Trigger: –Sweep Time to 65 ms

Display Related Characteristics

Detector Modes: Auto, Normal, Max Peak, Min Peak, RMS, Average, Sample (available simultaneously)

Trace Functions: Normal, View, Max Hold, Min Hold, Average, Blank

Traces per Graph: Up to 5

Waveform Math: User can export trace data in CSV format for external processing. Additional math available using MATLAB from The Mathworks. See **Connectivity to MATLAB (Option 40)** for more details.

Marker Related Characteristics

Markers: Normal, Delta, Display Line, Noise, Phase Noise (Delta CW to Noise)

Marker Frequency Resolution: 0.2% of span

Marker Amplitude Resolution: 0.01 dB

Marker Functions: Marker to peak, marker to next peak, marker to min., marker to reference level, marker to center frequency

Peak Functions: Peak to center, peak to reference level

“Smart” Signal Analyzer Measurements

Channel Power:

Standards Measured: WCDMA (UMTS), user defined
Channel Power Uncertainty: 0.67 dB (Note 10)

Adjacent Channel Power Ratio (ACPR):

Standards Measured: WCDMA (UMTS), user defined
Offsets Measured: Up to 6
ACPR Uncertainty: 0.5 dB (Note 11)

Multi-Carrier Channel Power:

Standards Measured: WCDMA (UMTS), user defined
Number of Carriers: 1 to 10, plus adjacent and 2 alternate channels
Channel Power Uncertainty: 0.67 dB (Note 10)

Occupied Bandwidth:

Frequency Accuracy: ±Span/500 Nominal

Third-Order Intercept (TOI): Measure third order products and intercept from two tones

Internal PC Functionality

Interfaces: USB, Ethernet, VGA, Parallel printer

USB Functionality: USB access to printers, CDs, disks, cameras, memory devices

Internal Hard Disk Drive: ≥40 GB
“Restore” partition on internal Hard Disk Drive

Removable Media Drive: CD R/W + DVD-ROM

Processor: Pentium 4 or greater

Options

GPIB Interface (Option 3)

SH1, AH1, T6, SR1, RL1, PP0, DC1, C0 or C1

External Hard Disk Drive (Option 4)

Internal disk drive removed, rear panel Serial-ATA connector replaces rear panel parallel printer port. Includes two external disk drives with complete Signature™ software.

30 MHz Demodulation Bandwidth (Option 22)

Complex modulated signals with up to 50 MHz bandwidth can be captured and analyzed. Also includes baseband differential I & Q inputs. Option 22 must be factory installed and calibrated.

Max Single-FFT Span: 30 MHz (Note 9)

Modulation Analysis BW: 30 MHz, 50 MHz with anti-alias filter turned off

I-Q Inputs: 30 MHz combined BW

Additional Frequency Response Error in Wideband FFT mode: 1 dB (nominal)

WCDMA & HSDPA Modulation Analysis (Option 30)

Link Direction: Downlink

Inputs: RF

Measurements Functions: See next page

Specifications: See next page

QAM/PSK Modulation Analysis (Option 38)

Modulation Analysis BW: 8 MHz

With Option 22: 30 MHz, 50 MHz with anti-alias filter turned off

Symbol Rate Range: 10 kHz to 4 MHz

With Option 22: 10 kHz to 20 MHz, 30 MHz with anti-alias filter turned off

Modulation Formats: BPSK, QPSK, $\pi/4$ DQPSK, 8 PSK, $3\pi/8$ - 8PSK, 16 QAM, 32 QAM, 64 QAM, 128 QAM, 256 QAM

Filtering: Root-raised-cosine, α=0.1 to 1

Analysis Length: 100 to 10k symbols

EVM: (20º to 30ºC) Test Conditions >–20 dBm, QPSK and 64 QAM modulation, alpha = 0.22

For Carrier Frequency <3 GHz (Note 7): 1.25% 0.1 to 6 MHz, 2% 6 to 15 MHz, 2.5% 15 to 20 MHz

For Carrier Frequency from 3 GHz to 6 GHz: error due to frequency response = 1%

Connectivity to MATLAB (Option 40)

Allows seamless transfer of Signature measurements and setup information into the MATLAB workspace. Supports MATLAB 7 (revision 14). Simulink can access this information via the “To Workspace” and “From Workspace” blocks.

Allows viewing of MATLAB computed results, superimposed on the Signature measurement display. MATLAB computed results may be set to automatically update with current measurements. Handshake between Signature and MATLAB ensures synchronization, such as for averaging. MATLAB must be purchased from The MathWorks (www.mathworks.com).

Signature Measurements Transfered to MATLAB:

Traces (in dBm)
IQ vectors (in Volts)

IQ Vector Parameters:

Sample rate: 428 kHz to 21.4 MHz (9 settings)
With Option 22: 100 kHz to 50 MHz (21 settings)

Capture Length: 1 Msample (>4.5 seconds)
With Option 22: 10 Msamples (1.28 sec max for some sample rates)

Bandwidth: Varies with sample rate; 8 MHz max
With Option 22: 30 MHz max, 50 MHz with anti-alias filter off

Handshake: On/Off

Phase Noise Measurements (Option 52)

Plot of Single-Sideband Phase Noise versus Offset

Sweep Mode: FFT and Swept, controllable by decade

Averaging: Trace averaging for FFT, specifiable by decade. VBW for swept; VBW/RBW ratio adjustable and RBW specifiable by decade

Minimum Offset: 10 Hz

Maximum Offset: 100 MHz

Comprehensive WCDMA and HSDPA Measurements

	QPSK	Composite	Single-Code	Single-Code Compressed Mode
Modulation Measurements				
EVM (RMS, Peak, and Peak Position)	✓	✓	✓	✓
Magnitude & Phase Error	✓	✓	✓	✓
IQ Offset	✓	✓	✓	✓
Frequency Error	✓	✓	✓	✓
Scramble Code (automatically determined)	N/A	✓	✓	✓
Channel Power (with or without RRC filtering)	✓	✓	✓	✓
Primary, Secondary, and Total Sync Channel (SCH) Power	N/A	✓	✓	✓
Peak Code-Domain Error (PCDE)	N/A	✓	✓	✓
Bitstream	N/A	N/A	✓	✓
Modulation Graphs				
Constellation	✓	✓	✓	✓
Vector Diagrams	✓	✓	✓	✓
Power vs. Time	✓	✓	✓	✓
EVM versus Time	✓	✓	✓	✓
Magnitude Error versus Time	✓	✓	✓	✓
Phase Error versus Time	✓	✓	✓	✓
Eye Diagrams	✓	✓	✓	✓

Code-Domain Graphs	Graph	Zoom	Table
Code-Domain Power	✓	✓	✓
Code-Domain Error	✓	✓	✓

N/A: Not Applicable
✓: Included

RF Measurements

Channel Power
ACLR
Multi-Carrier Power
Occupied Bandwidth

Specifications	3GPP TS 25.141 Clause	Instrument Tolerance Interval	3GPP Required Test Intrument Tolerance[1]	Conditions 95% confidence, 20-30ºC, Frequency 500 MHz to 3 GHz, Mixer Level –10 to –25 dBm, sufficient averaging.
Power Uncertainty	6.2.1	0.67	<0.7 dB	Note 3
CPICH Power Uncertainty	6.2.2	0.65	<0.8 dB	
Frequency Error	6.3	10 Hz	<12 Hz	Frequency References Locked
Power Control Step Uncertainty	6.4.2	0.1	<0.1 dB	
Power Control Dynamic Range Uncertainty	6.4.3	0.3	<1.1 dB	
Total Power Dynamic Range Uncertainty	6.4.4	0.2	<0.3 dB	
Occupied Bandwidth Uncertainty	6.5.1	38 kHz	100 kHz	
Code Domain Power Floor	–	–50 dB	–	
ACLR	6.5.2.2			Nominal, optimum mixer level and reference level
Floor (1 Carrier)		75 dB	–	
Uncertainty		0.5	<0.8 dB	ACLR= 45 to 55 dB
EVM	6.7.1			Composite, Single-Code, or QPSK
Floor		1%	–	Optimal Reference Level and Attenuation
Uncertainty		1%	2.5%	EVM 15 to 20%
Peak Code-Domain Error (PCDE)	6.7.2			
Floor		–50 dB	–	
Uncertainty		1 dB	<1.0 dB	PCDE –30 to –36 dB
Transmitted Code Power Absolute Uncertainty	H.3	0.64	<0.9 dB	Note 3
Transmitted Code Power Relative Uncertainty	H.3	0.2	<0.2 dB	
Transmitted Carrier Power Uncertainty	H.4	0.07	<0.3 dB	

1: 3GPP TS 25.141 version 6.12.0 December 2005, subclause 4.1 and Annex G

General Specifications

Power Requirements

AC: 85-264 VAC, 47-63 Hz

Power Consumption:
Operating: 400 VA
Standby: 30 VA

Display: 26.6 cm (10.4 inches) XGA Color with touch screen

Weight: <32 kg (70 lbs)

Dimensions: 242 H x 432 W x 508 D mm
(9.5 H x 17 W x 20 D in.)

Warranty: 3 years

Calibration Interval: 1 year

Temperature Range:
Operating Temperature Range: 0 to +50°C
Storage Temperature Range: –40 to +75°C

EMI Compatibility: Meets the emission and immunity requirements of:

EN61326: 1998
EN55011: 1998 / CISPR 11: 1997 Group 1 Class A
EN61000-3-2: 1995 + A14
EN61000-3-3: 1995
EN61000-4-2: 1995 – 4 kV CD, 8 kV AD
EN61000-4-3: 1997 – 3 V/m
EN61000-4-4: 1995 – 0.5 kV SL, 1 kV PL
EN61000-4-5: 1995 – 0.5 kV DM, 1 kV CM
EN61000-4-6: 1996 – 3V
EN61000-4-11: 1994 – 100%/1 cycle

Safety: Meets safety requirements of Low Voltage/Safety Standard 72/73/EEC – EN61010-1: 2001

Notes to Specifications

Note 1

For swept spectrum measurements

Note 2

50 MHz, 0 dBm input, Source VSWR <1.1, 10 dB input attenuation, 500 kHz RBW, +0 dBm reference level

Note 3

95% Confidence Amplitude Error Calculation, (CW Signals, 20 to 30°C) 95% confidence level is determined by RSS combination of the individual standard errors. Uniform distribution is used for all contributors except VSWR error. U-shaped distribution is used for VSWR error.

	Error Specification (dB)	σ
Amplitude Uncertainty at 50 MHz [dB]	0.1	0.06
Frequency Response at 10 dB Attenuation [dB]	0.4	0.23
Frequency Response from Attenuator Switching [dB]	0.2	0.12
Reference Level Switching Uncertainty with Attenuator Changes [dB]	0.25	0.14
RBW Switching Uncertainty [dB]	0.15	0.09
Log Fidelity [dB]	0.07	0.04
VSWR 1.5 Error (DUT VSWR 1.2)	0.15	0.11
RSS Combined Errors		0.33
95% Confidence Level for Combined Errors (Combined Errors * 1.96)		0.65

Note 4

Mixer level = signal level minus attenuation

Note 5

RBW = 0.1 Hz, FFT mode, 0 dB attenuation, average detector, Reference Level ≤–50 dBm

Note 6

Specifications apply to mixer level ≤–30 dBm for signals near 3186 MHz and ≤–50 dBm for signals near 4780 MHz

Note 7

For symbol rates ≥10 MHz, the carrier frequency must be >500 MHz

Note 8

Compared to 10 dB attenuator setting, for 20, 30, and 40 dB attenuator settings. For other attenuator settings:

≤3 GHz: <0.4 dB
>3 GHz: <0.65 dB

Note 9

Spurious performance for 30 MHz FFT span may be degraded when attenuation is set manually

Note 10

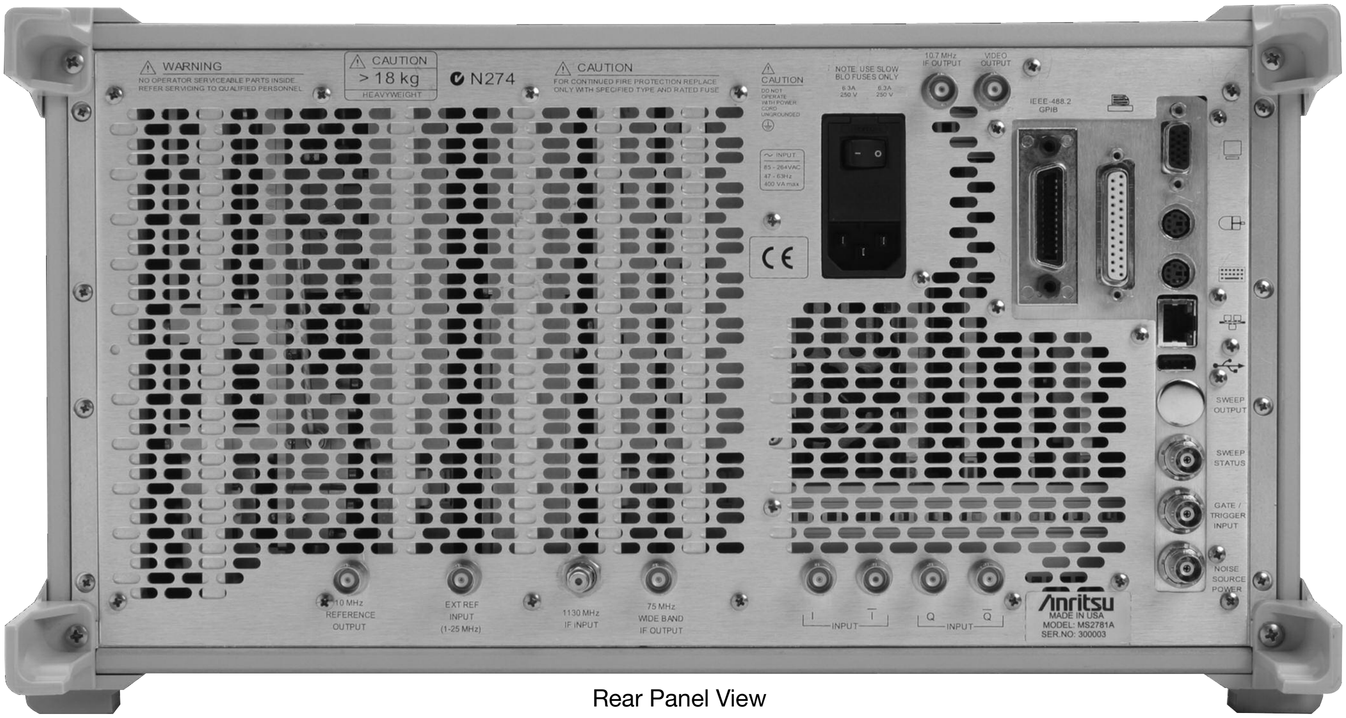
95% Confidence Amplitude Error Calculation, similar to note 3. However Power Bandwidth Uncertainty is included. Uses RMS detection and sufficient averaging to reduce the measurement variance.

Note 11

The most significant contribution to ACPR uncertainty is the instruments measurement floor.

Specification Conditions

The specifications presented are covered by the product warranty unless indicated as typical or nominal. Specifications apply over the 0° to 50°C operating range, and after a 60 minute warm up at ambient temperature, unless otherwise noted. Typical specifications describe expected performance beyond the warranted values. Characteristics or nominal specifications describe expected product performance as designed or performance that may not be measured in the manufacturing process.



Rear Panel View

Front Panel Inputs and Outputs

RF Input: Type-N Female, 50Ω

Probe Power: +15V ±7%/130 mA, –12.6V ±10%/45 mA

Touch Screen Display: Contact sensitive

Front Panel Keypad: Preset, Menu keys, Help key, Measurement key, Numerical entry pad, Entry/Knob, Increment/Decrement keys

Operate/Standby

CD R/W + DVD-ROM

USB: 2 ports Type A, Version 1.1

Headphone Jack: CD audio

Rear Panel Inputs and Outputs

Power Supply Input Voltage: 85-264 VAC; 47 to 63 Hz

AC Power Switch: Mains power switch

Wide Bandwidth Log Video Output:
2.5V nominal, full scale into 50Ω

IF Output #1:

Frequency: 75 MHz nominal

Level (–10 dBm @ 1st mixer): –8 dBm ±3 dB

BW: >40 MHz

IF Output #2:

Frequency: 10.7 MHz

Level (–10 dBm @ 1st mixer): –8 dBm ±3 dB

BW: varies with RBW, 3 kHz min, 8 MHz max

IF Input: Not used

Reference Frequency Input:

Input Level: –6 dBm <Input signal <+10 dBm

Frequency: Any frequency from 1 to 25 MHz with 1 MHz resolution and 1.544 or 2.048 MHz. (Derate SSB Phase Noise by 3 dB w/Ext Ref of 1.544 MHz)

Reference Frequency Output:

Output Level: 8 dBm ±3 dB

Frequency:

If external reference not used: 10 MHz
If external reference used: Same as external reference frequency

Sweep Output: Not used

Sweep Status Output: TTL, active low when sweeping

GPIB: See option description

Ethernet: 10BASE-T, 100BASE-TX, 1000BASE-T

External Trigger Input: BNC (±10 V nominal, into 10 kΩ)

VGA Monitor Output: Matches instrument front panel display resolution

I and Q Inputs (Option 22): 50Ω or 1 MΩ, switchable unbalanced or differential, ±2.5V max (signal to ground or between differential inputs)

USB: Type A Port, Version 2.0

Keyboard: PS/2

Mouse: PS/2

Parallel Printer Port: ECP

Ordering Information

Models

MS2781A High Performance Signal Analyzer (100 Hz to 8 GHz)

Options

MS2780/1	Rack Mount Adapter, with slides
MS2780/1A	Rack Mount Adapter, no slides
MS2780/3	GPIB Interface
MS2780/4	External Hard Disk Drive
MS2780/22	30 MHz Demodulation Bandwidth (includes baseband differential I & Q inputs)
MS2780/30	WCDMA and HSDPA Modulation Analysis (Options 22 and 38 are not required)
MS2780/38	QAM/PSK Modulation Analysis (Option 22 is no longer required)
MS2780/40	Connectivity to MATLAB
MS2780/52	Phase Noise Measurements
Es50MMD	Extends warranty to 5 years
MS2780/98	Z540/ISO Guide 25 Calibration
MS2780/99	Premium Calibration

Included Accessories

Power Cord, Operating and Programming Manual (printed and CD-ROM), Restore software CD set, USB Optical Mouse, Blank CD R/W disc, Spare Fuse

Optional Accessories

10410-00252	Additional printed Operation Manual
10410-00253	Additional printed Programming Manual
10410-00256	Signature Maintenance Manual
1N50B	Limiter/DC Block, N(m), to N(f), 50Ω, 1 MHz to 3 GHz.
1N50C	Limiter, N(m) to N(f), 50Ω, 10 MHz to 18 GHz
42N50A-30	30 dB Attenuator, 50 Watt N(m) to N(f)
12N50-75B	75Ω Matching Pad, DC to 3 GHz, 50Ω N(m) to 75Ω N(f)
11N50B	Power Divider, 1 MHz to 3 GHz, 50Ω, N(f) input, N(f) output
2100-1	GPIB Cable 1M
2100-2	GPIB Cable 2M

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11410-00333 Rev. J

Subject Index

Symbols

Numerics

A

B

C

D

E

F

G

H

I

N

O

P

Q

R

U

V

W

X

Y