Series
MS278XA
High Performance Signal Analyzer

Maintenance Manual

Notice

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

Anritsu

490 JARVIS DRIVE
MORGAN HILL, CA 95037-2809

P/N: 10410-00256
REVISION: A
PRINTED: DECEMBER

WARRANTY

The Anritsu product(s) listed on the title page is (are) warranted against defects in materials and workmanship for three years from the date of shipment.

Anritsu's obligation covers repairing or replacing products which prove to be defective during the warranty period. Buyers shall prepay transportation charges for equipment returned to Anritsu for warranty repairs. Obligation is limited to the original purchaser. Anritsu is not liable for consequential damages.

LIMITATION OF WARRANTY

The foregoing warranty does not apply to Anritsu connectors that have failed due to normal wear. Also, the warranty does not apply to defects resulting from improper or inadequate maintenance by the Buyer, unauthorized modification or misuse, or operation outside of the environmental specifications of the product. No other warranty is expressed or implied, and the remedies provided herein are the Buyer's sole and exclusive remedies.

END-USER LICENSE AGREEMENT FOR ANRITSU SIGNATURE SOFTWARE

IMPORTANT-READ CAREFULLY: This End-User License Agreement ("EULA") is a legal agreement between you (either an individual or a single entity) and Anritsu for the Signature software product identified above, which includes computer software and associated media and printed materials, and may include "online" or electronic documentation ("SOFTWARE PRODUCT" or "SOFTWARE"). By receiving or otherwise using the SOFTWARE PRODUCT, you agree to be bound by the terms of this EULA.

SOFTWARE PRODUCT LICENSE

The SOFTWARE PRODUCT is protected by copyright laws and international copyright treaties, as well as other intellectual property laws and treaties. The SOFTWARE PRODUCT is licensed, not sold.

1. GRANT OF LICENSE. This EULA grants you the following rights:

a. You may use ONE copy of the Software Product identified above only on the hardware product (Signature Signal Analyzer and its internal computer) which it was originally installed. The SOFTWARE is in "use" on a computer when it is loaded into temporary memory (for example, RAM) or installed into permanent memory (for example, hard disk, CD-ROM, or other storage device) of that computer. However, installation on a network server for the sole purpose of internal distribution to one or more other computer(s) shall not constitute "use."

b. Solely with respect to electronic documents included with the SOFTWARE, you may make an unlimited number of copies (either in hardcopy or electronic form), provided that such copies shall be used only for internal purposes and are not republished or distributed to any third party.

2. OWNERSHIP. Except as expressly licensed to you in this Agreement, Anritsu retains all right, title, and interest in and to the SOFTWARE PRODUCT; provided, however, that, subject to the license grant in Section 1.a and Anritsu's ownership of the underlying SOFTWARE PRODUCT, you shall own all right, title and interest in and to any Derivative Technology of the Product created by or for you.

3. COPYRIGHT. All title and copyrights in and to the SOFTWARE PRODUCT (including but not limited to any images, photographs, animations, video, audio, music, text, and "applets" incorporated into the SOFTWARE PRODUCT), the accompanying printed materials, and any copies of the SOFTWARE PRODUCT are owned by Anritsu or its suppliers. The SOFTWARE PRODUCT is protected by copyright laws and international treaty provisions. Therefore, you must treat the SOFTWARE PRODUCT like any other copyrighted material except that you may make one copy of the SOFTWARE PRODUCT solely for backup or archival purposes. You may not copy any printed materials accompanying the SOFTWARE PRODUCT.

4. DESCRIPTION OF OTHER RIGHTS AND LIMITATIONS.

a. Limitations on Reverse Engineering, Decompilation, and Disassembly. You may not reverse engineer, decompile, or disassemble the SOFTWARE, except and only to the extent that such activity is expressly permitted by applicable law notwithstanding this limitation.

b. Rental. You may not rent or lease the SOFTWARE PRODUCT.

c. Software Transfer. You may permanently transfer all of your rights under this EULA, provided that you retain no copies, you transfer all of the SOFTWARE PRODUCT (including the Signature Signal Analyzer, all component parts, the media and printed materials, any upgrades, this EULA, and, if applicable, the Certificate of Authenticity), and the recipient agrees to the terms of this EULA.

d. Termination. Without prejudice to any other rights, Anritsu may terminate this EULA if you fail to comply with the terms and conditions of this EULA. In such event, you must destroy all copies of the SOFTWARE PRODUCT.

5. U.S. GOVERNMENT RESTRICTED RIGHTS. THE SOFTWARE PRODUCT AND DOCUMENTATION ARE PROVIDED WITH RESTRICTED RIGHTS. USE, DUPLICATION, OR DISCLOSURE BY THE GOVERNMENT IS SUBJECT TO RESTRICTIONS AS SET FORTH IN SUBPARAGRAPH (C)(1)(II) OF THE RIGHTS IN TECHNICAL DATA AND COMPUTER SOFTWARE CLAUSE AT DFARS 252.227-7013 OR SUBPARAGRAPHS (C)(1) AND (2) OF THE COMMERCIAL COMPUTER SOFTWARE-RESTRICTED RIGHTS AT 48 CFR 52.227-19, AS APPLICABLE. MANUFACTURER IS ANRITSU COMPANY, 490 JARVIS DRIVE, MORGAN HILL, CALIFORNIA 95037-2809.

DISCLAIMER OF WARRANTY

DISCLAIMER OF WARRANTIES. TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, ANRITSU COMPANY AND ITS SUPPLIERS DISCLAIM ALL WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WITH REGARD TO THE SOFTWARE PRODUCT. THE USER ASSUMES THE ENTIRE RISK OF USING THE PROGRAM. ANY LIABILITY OF PROVIDER OR MANUFACTURER WILL BE LIMITED EXCLUSIVELY TO PRODUCT REPLACEMENT.

NO LIABILITY FOR CONSEQUENTIAL DAMAGES. TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, IN NO EVENT SHALL ANRITSU COMPANY OR ITS SUPPLIERS BE LIABLE FOR ANY SPECIAL, INCIDENTAL, INDIRECT, OR CONSEQUENTIAL DAMAGES WHATSOEVER (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION, LOSS OF BUSINESS INFORMATION, OR ANY OTHER PECUNIARY LOSS) ARISING OUT OF THE USE OF OR INABILITY TO USE THE SOFTWARE PRODUCTS, EVEN IF ANRITSU COMPANY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. BECAUSE SOME STATES AND JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES, THE ABOVE LIMITATION MAY NOT APPLY TO YOU.

TRADEMARK ACKNOWLEDGMENTS

Windows, Windows XP, Microsoft Paint, Microsoft Access, Microsoft Excel, Microsoft PowerPoint, and Visual Studio are all registered trademarks of Microsoft Corporation.
Acrobat Reader is a registered trademark of Adobe Corporation.
MATLAB is a a registered trademark of The MathWorks Corporation.
NI is a trademark of National Instruments Corporation.
Signature is a trademark of Anritsu Company.

NOTICE

Anritsu Company has prepared this manual for use by Anritsu Company personnel and customers as a guide for the proper installation, operation and maintenance of Anritsu Company equipment and computer programs. The drawings, specifications, and information contained herein are the property of Anritsu Company, and any unauthorized use or disclosure of these drawings, specifications, and information is prohibited; they shall not be reproduced, copied, or used in whole or in part as the basis for manufacture or sale of the equipment or software programs without the prior written consent of Anritsu Company.

UPDATES

Updates, if any, can be downloaded from the Documents area of the Anritsu web site at:
http://www.us.anritsu.com

DECLARATION OF CONFORMITY

Manufacturer's Name: ANRITSU COMPANY

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

declares that the product specified below:

Product Name: 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

Chapter 2— Installation

Chapter 3— Performance Verification

Chapter 4— System Calibration

Chapter 5— Troubleshooting Tools

Table of Contents (Continued)

Chapter 6— Exchange Assemblies and Replaceable Parts

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.

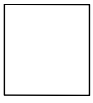
Safety Symbols Used on Equipment and in Manuals

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.

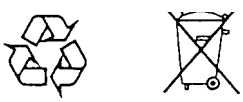
This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.

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

Table of Contents (Continued)

Figure 1-1. Signature Series MS278XA Signal Analyzer

Chapter 1
General Information

1-1 Scope of This Manual

This manual provides general calibration and maintenance 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 operation and programming manuals are installed on the analyzer's hard drive as an Adobe Acrobat™ (*.pdf) file. The files can be viewed on the analyzer's front panel display using Acrobat Reader™. The files are "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 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: 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.

1-6 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.

1-7 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

1-8 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

1-9 Performance Specifications

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

1-10 MS2781A Service Strategy

The MS2781A is comprised of the following major elements:

- **SBC:** Single Board Computer.
- **SPA:** Spectrum Analyzer.
- **VSA:** Vector Signal Analyzer.
- **SW:** Microsoft Windows XP Professional Operating System
  Signature GUI
  MATLAB

It is important to acquire the technical know-how in each of these distinguishing elements.

1-11 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 multitrace 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 commands through IEEE488.2 and Web Services
- Remote Control via a Local Area Network or TCP/IP
- Ability to run user applications and device drivers on its embedded Windows XP Professional environment

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

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

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. A trial version of MATLAB (from Mathworks) is installed in the system.

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.

Firmware

Each module has its own firmware requirements which may include:

- Flash Codes
- EEPROM Codes
- FPGA Codes

Signature GUI Software

Signature GUI Software is installed on the cPCI SBC as a Windows application. A Signature GUI shortcut is installed in the C:\Documents and Settings\All Users\Start Menu\Programs\Startup folder so the Signature GUI automatically starts when the instrument is powered on. A Signature GUI shortcut icon can also be found on the Windows desktop.

Motherboard

The motherboard provides complete electrical integration of all the instrument components. It implements a 64-bit cPCI (compact PCI) bus with five module slots that accommodate a mix of standard commercial 3U and 6U modules and larger 310 mm long custom boards. Standard 2 mm hard-metric, high-density connectors for cPCI are used.

The motherboard consists of two main sections:

- **RF/Analog Section:**
  The RF/analog section consists of six module slots.
- **Digital Section:**
  The digital section consists of five cPCI module slots and also accommodates two cPCI-based modular power supplies, rear transition connectors, a front panel connector area, and an AC power input distribution.

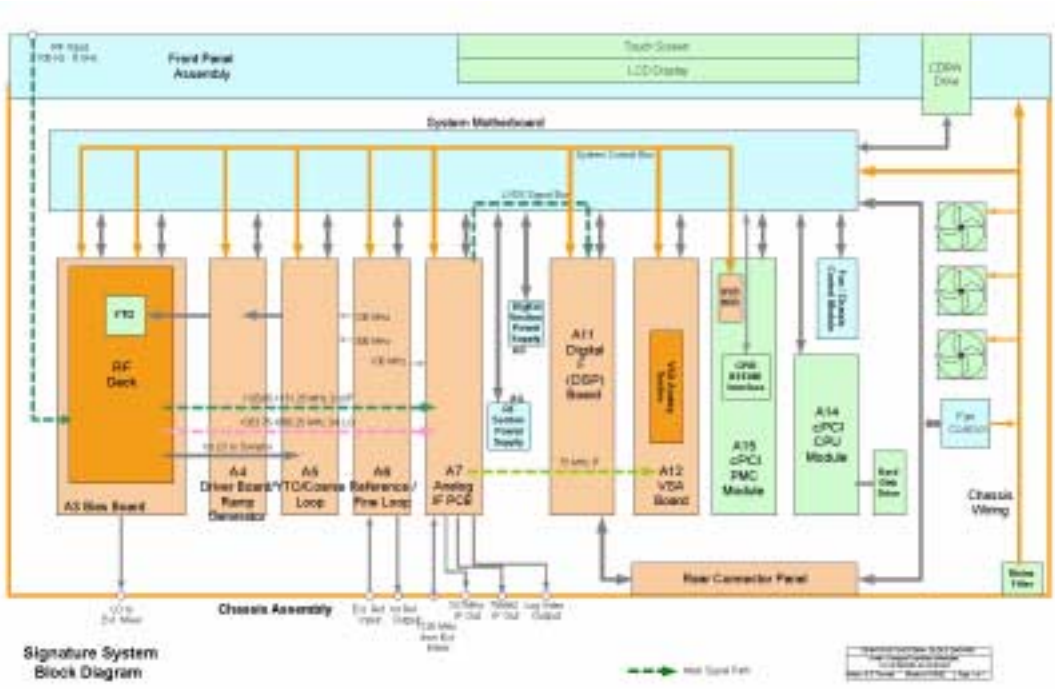


Figure 1-2. Motherboard Block Diagram

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 1-3, below:

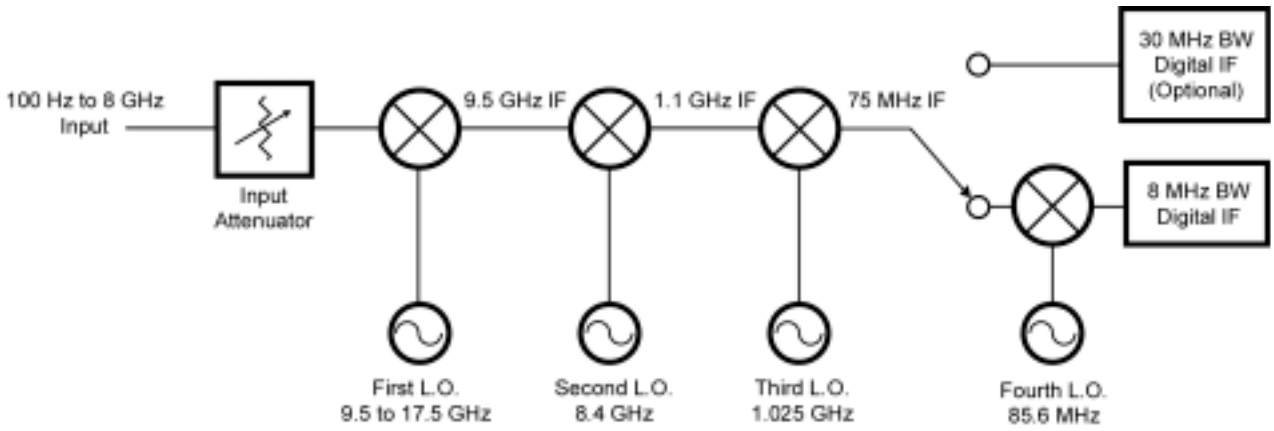


Figure 1-3. Basic Signature RF/Analog Block Diagram

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.

The RF/analog section is comprised of several plug-in modules and assemblies:

- RF Deck
- A4 YIG Tuned Oscillator (YTO) Driver/Ramp Generator
- A5 YIG Tuned Oscillator (YTO) Coarse Loop Module
- A6 Reference/Fine Loop Module
- A7 Analog IF Module

A4 YTO Driver/Ramp Generator Module

The YTO Driver works in conjunction with the reference/ fine loop module and YTO coarse loop module to precisely set the YTO current as needed to make the YTO output the required frequencies. This driver controls the YTO for both CW and frequency sweeps. This driver receives instructions via the USB port. 1st LO YTO Frequency Range is from 8.8 GHz to 17.7 GHz.

FM Coil Sweeps:

- Locked Sweeps:
  Sweep spans up to 30 MHz are locked sweeps. Where the 1st LO Fine Loop controls the frequency, the YTO main coil current is held constant and the FM coil current is controlled to lock at each frequency.
- Unlocked Sweeps:
  Sweep spans between 30 MHz and 100 MHz hold the main coil current constant and sweep the FM coil current.

Main Coil Sweeps:

- Sweep spans greater than 100 MHz hold the FM coil constant and sweep the main coil current.

The Ramp Generator consists of a 32-bit accumulator, driving a high speed DAC that results in a 0V to 5V digital ramp. The accumulator is driven by a 42.8 MHz clock. The clock is divided by either 1, 256, or 1024 to allow for sweep times from 5 milliseconds up to 1000 seconds. This ramp is then scaled using the Scaling DAC to give a variable width DAC that starts at 0V and can end anywhere from 0V to 5V. The ramp is then doubled in voltage and inverted by an inverting op-amp to give a 0V to –10V (maximum) ramp.

A5 YTO Coarse Loop Module

The YIG Coarse loop board contains the circuitry to phase lock the YIG Tuned Oscillator as well as the circuitry to generate the coarse frequency steps. The coarse loop portion of the board provides the LO drive signal to the microwave sampler, which is used to down convert the YIG frequency to an IF in the 15.625 to 62.5 MHz range.

The YIG loop portion of the board accepts the IF from the sampler and phase compares this to the fine loop signal generated on the Reference/Fine loop board. The error between the fine loop signal and the IF is used to lock the YIG oscillator. The driver circuitry to control the YIG oscillator is located on the YTO Driver/Ramp generator module.

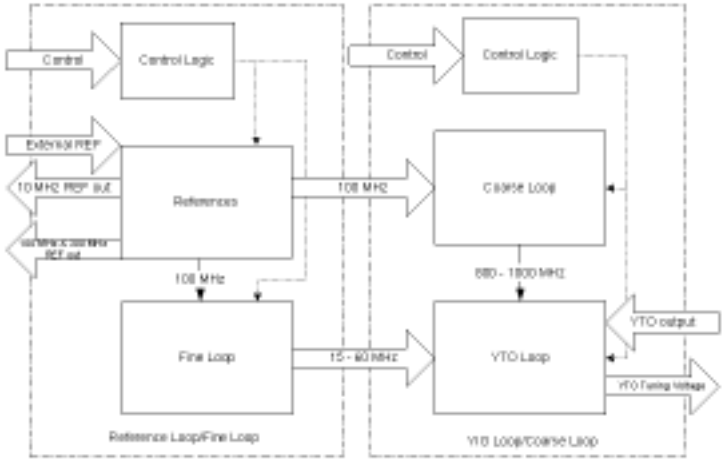


Figure 1-4. YTO Coarse Loop Module Block Diagram

A6 Reference/Fine Loop Module

The reference/fine loop module contains the circuitry to provide the reference frequencies for the instrument as well as the circuitry to generate narrow frequency sweeps. The reference loop portion provides the following:

- 100 MHz and 300 MHz signals to the rest of the instrument
- 50 MHz leveled calibration signal to the RF input of the instrument
- 900 MHz signal internally to the fine loop section

The fine loop section generates the swept IF of 15.625 to 62.5 MHz, which is used to phase lock the output of the sampler on the A5 YTO coarse loop module and to lock the YTO via the driven circuitry on the A4 YTO driver/ramp generator module.

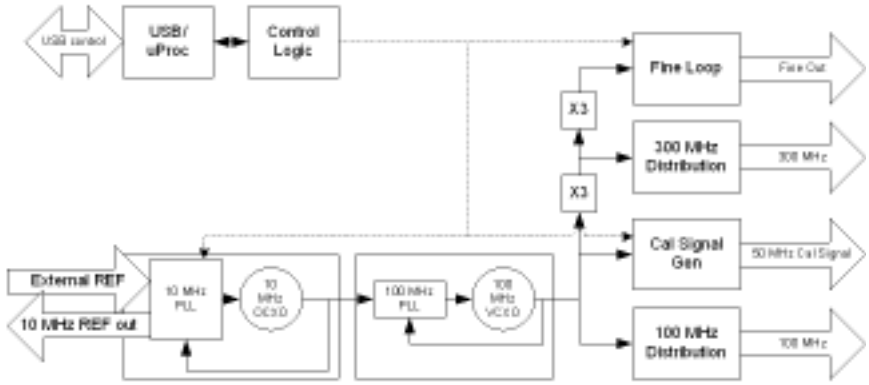


Figure 1-5. A6 Reference/Fine Loop Block Diagram

A7 Analog IF Module

The Analog IF module is a two stage down converter that contains the third and fourth mixers as a crucial part of the IF path for the spectrum analyzer. After the third mixer, the signal is sent to the VSA module for vector signal processing and to the SPA path for further down conversion in the fourth mixer.

The SPA path controls the gain and pre-filter bandwidths before the signal is applied to the A to D converter. The digitized signal from the A to D converter is sent to the DSP board for signal processing.

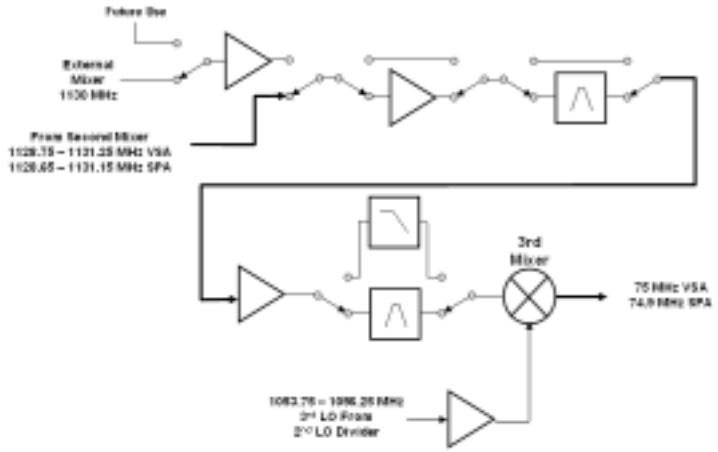


Figure 1-6. Input Section of A7 Analog IF Module

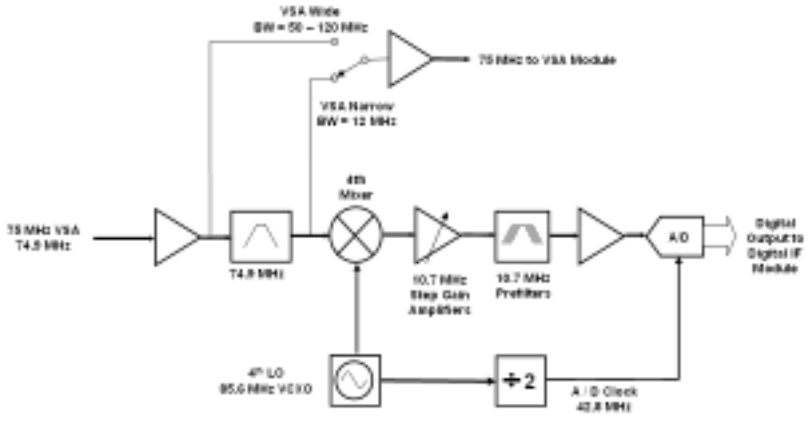


Figure 1-7. Output Section of A7 Analog IF Module

The Analog IF module receives a range of frequencies (for spur avoidance), either an 1128.75-1131.25 MHz (VSA Mode) or 1128.65-1131.15 MHz (SPA Mode) signal from the RF Deck. The VSA signal is converted to 75 MHz and passed on to the VSA module in the digital section for further signal processing. The SPA signal is converted to 74.9 MHz, filtered, gain adjusted, and applied to the fourth mixer for down conversion to the 10.7 MHz final IF frequency. Amplifiers are switched in or out of the 10.7 MHz path that establish the overall gain of the analyzer. Variable bandwidth filters are adjusted to provide the required pre-filtering before the signal is applied to the A to D Converter. The output of the A to D converter is routed to the Digital IF module via a high speed LVDS network.

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.

The digital section is comprised of three plug-in modules:

- A11 Digital IF Module
- A12 VSA Module
- A14 Single Board Computer

A11 Digital IF Module

The A11 Digital IF subsystem down-converts the input IF signal to baseband I and Q, performs resolution bandwidth (RBW) filtering, converts it to a video signal, and performs further display processing to generate trace data. For FFT measurements, the subsystem captures I and Q time domain data in memory and makes it available to the PC for further processing. The board plugs into a standard cPCI connector on the system motherboard. The board has other custom connectors that provide an interface to the instrument's control bus. A host PC can communicate with the board's DSP-BE through a PCI bus and a USB bus.

A12 VSA Module

The VSA Module consists of two boards:

- Mezzanine Board
- Main Board

The VSA mezzanine board receives the differential I and Q inputs and the IF signal input, then these signals are sampled by analog to digital converters and sent on to the VSA main board. The VSA mezzanine board can be broken down into four sections:

- I Input Switching and Filtering
- Q Input Switching and Filtering
- IF Input and Gain/Filter Switching
- Clock and Analog to Digital Control Circuit

The main board provides storage of the data from the VSA mezzanine board in designated memory locations. This allows the host PC (SBC) to read/write the data. The host PC can command the main board to filter and decimate the data, and then store it to a second designated memory location that can also be read by the host PC.

A14 CPU Module

The CPU Module is a cPCI Single Board Computer (SBC).

Original Release:

- 1.2 GHz Pentium 3 Processor-M, Ethernet via rear panel, 3.3V, V(I/O), 1 GB SDRAM, 20 GB Hard Drive minimum

Release 2.0:

- 2.2 GHz Pentium 4 Processor-M, Ethernet via rear panel, 3.3V, V(I/O), 1 GB SDRAM, 40 GB Hard Drive minimum

A15 cPCI PMC Module

The cPCI PMC module provides a bridged PCI bus to the PMC interface. This module can carry two PMC modules. In the MS2781A, up to two PMC modules are installed to the PMC carrier interface:

- PMC USB Hub Module (Standard)
- PMC-GPIB Module (Option 3)

A15A1 PMC USB Hub Module

This module will interface with the main CPU via the cPCI PMC Module. The cPCI PMC module provides a bridged PCI bus to this module via the P11 and P12 connectors. This module will provide to the CPU a USB 2.0 PCI Host with 15 USB ports. The USB Ports will be connected to the cPCI bus via the PMC general I/O port. Two of the USB ports will have power signals for routing to external USB plugs.

A15A2 PMC-GPIB Module

PMC-GPIB module provides IEEE 488.2 GPIB interface to the instrument.

USB Sub-system

Each section that plugs into the motherboard contains a USB controller chip for two way communication with the host CPU via a USB hub. The USB controller chips are inactive during data acquisition to eliminate the possibility of spurious signal generation that would result in erroneous signals being displayed. The USB control network is used for non-time critical events such as setting gain, pre-filter bandwidth, center frequency, frequency span, etc.

LVDS Sub-system

Dedicated lines to/from the Digital IF (DSP) Board handle time critical events relating to hardware control associated with data acquisition. An example of this is data acquisition vs. sweep timing. LVDS (Low Voltage Differential Signaling) high-speed chips are used to route the final digitized 14 bit words at a 42.8 MHz rate from the Analog IF Module to the Digital IF (DSP) Board.

RF Sub-system

The receiver path is broken into logical RF stages that are interconnected with coaxial cable.

Power Distribution

Two major power distributions are implemented with modular power supplies and ground and voltage planes. There is also a Standby Power Supply for temperature control of the master oscillator and to power the keypad controller in the front panel assembly.

Digital Section Power Supply, A9, of 200W with standard cPCI power distribution planes covering the digital hardware section. Voltages available are +3.3V, +5V, +12V, –12V, and a digital ground return.

RF/Analog Section Power Supply, A8, of 245W with power distribution planes covering the RF/Analog hardware section. Voltages available are +6V, +13.5V, -13.5V, +40V, and an analog ground return.

A17 Chassis Control Module

This module will provide a number of basic control requirements for the chassis. These functions include:

- Power Supply Shutdown/Enable Using Disable Signal from the Front Panel
- Analog Power Supply Shutdown Software Control
- Analog Supply Shutdown when Digital Supply Fails
- Power Supply Inhibit
- Voltage Output Trim Adjustment
- Power Supply Status Monitoring
- Voltage Monitoring
- Power Supply “In Spec” Led Indicator
- Fan Controller Thermistor

These functions also include:

- Local Temperature Monitoring
- RS-232 and In-circuit Serial Programming Interface to Fan Controller
- Fan Controller Status Monitoring
- Software Controlled Audio Switching for Audio Signals from the Digital IF, CD-RW, and SBC
- Amplifier for the Audio Signals
- Volume Control for the Audio Signals
- CD-RW Extra Signal Handling
- Noise Source Control
- Front Panel LCD Scan Control

A22 Fan Control Module

The fan control PCB controls the speed of the master fan versus the temperature at the exhaust side of the main power supplies. The two slave fans are then synchronized to the master fan to eliminate low frequency audible beat sounds. The fan control PCB operates from the standby 24-volt power supply. The fan control PCB is mounted in the front of the chassis behind the front panel where it is plugged into the main motherboard.

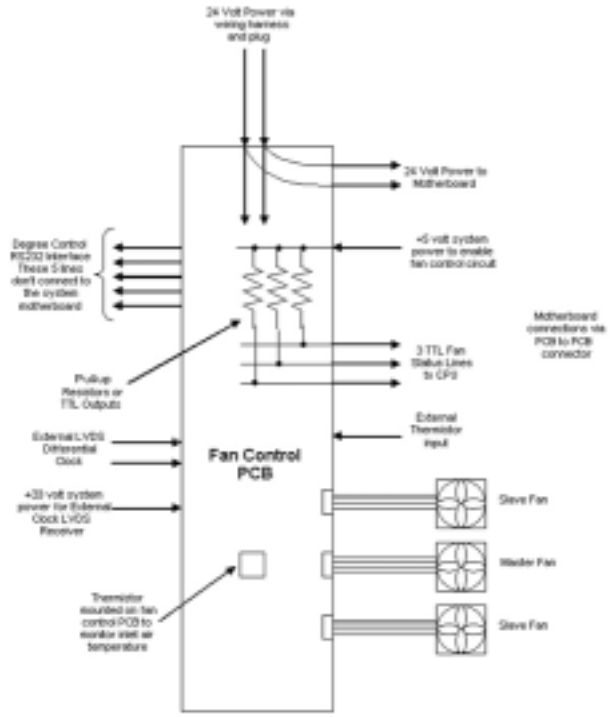


Figure 1-8. Fan Control Module Block Diagram

Front Panel Assembly

The front panel assembly provides various interface functions including a keypad, a knob, a LCD display with touchscreen capability, along with associated circuitry that comprise the human interface portion of the instrument.

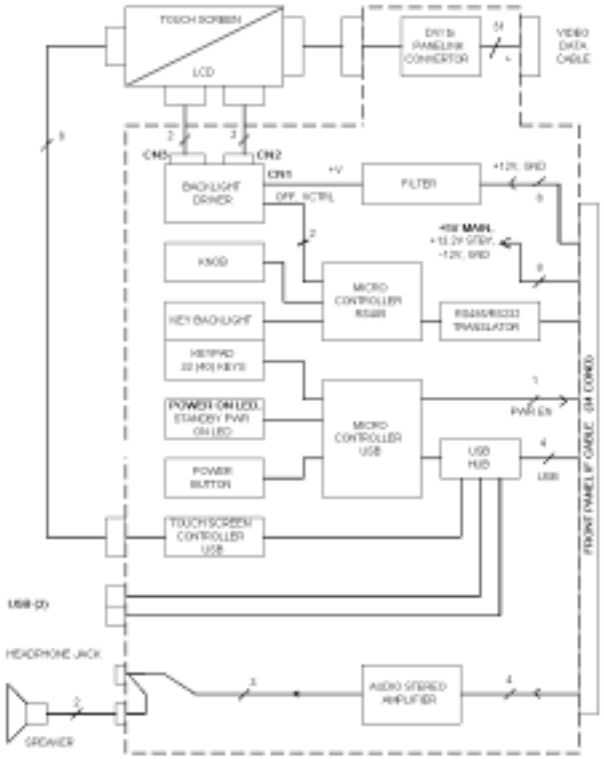


Figure 1-9. Front Panel Block Diagram

A18 Rear Panel I/O Assembly

The rear panel PCB supports signal interface traces between the system motherboard and I/O connectors accessible to the user at the rear of the instrument. The PCB also provides a breakaway A19 board for selective connection of signals routed to the motherboard. The rear panel connectors supported by this PCB provide access to the instrument CPU via USB, Ethernet, PS2, and GPIB style connectors. Output for the instrument CPU is provided via VGA and parallel printer style connectors. BNC style connectors provide interface with sweep functions and DC power supply for an external noise source module.

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.

1-12 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 on the rear panel power receptacle to open the fuse block cover and gain access to the fuse holder.

Figure 1-10. Opening the Rear Panel Fuse Cover

Step 3. Slide out the fuse holder.

Figure 1-11. Replacing the Rear Panel Fuses

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.

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.

Recovery Software

Norton Ghost software and a set of recovery CDs are also shipped with each instrument. Refer to the documention that accompanies this software for instructions on its use.

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.

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, always use a three-wire power cable connected to a grounded three-wire power line outlet. 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:

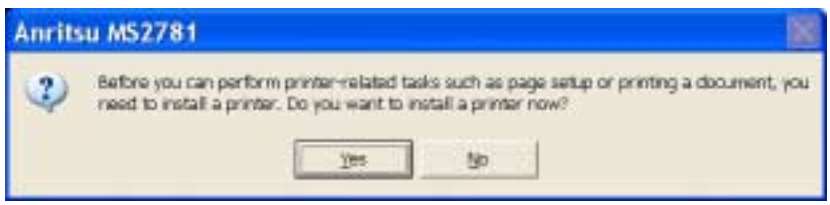


Figure 2-1. Anritsu MS2781 Add Printer Dialog

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

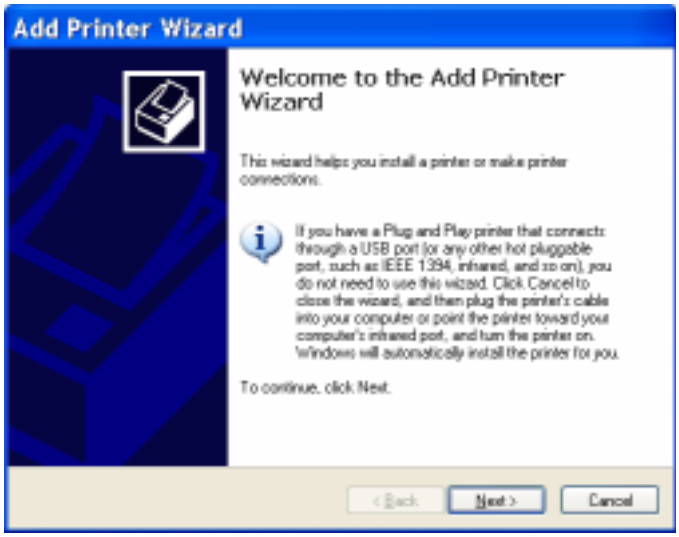


Figure 2-2. Add Printer Wizard

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.

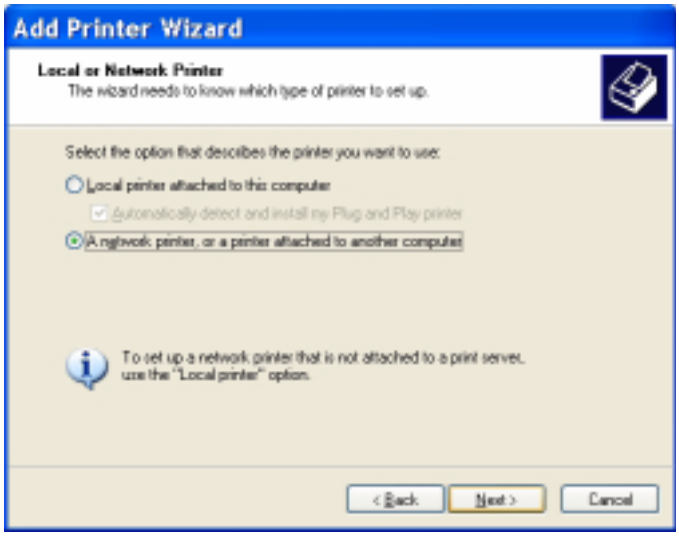


Figure 2-3. Add Printer Wizard

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

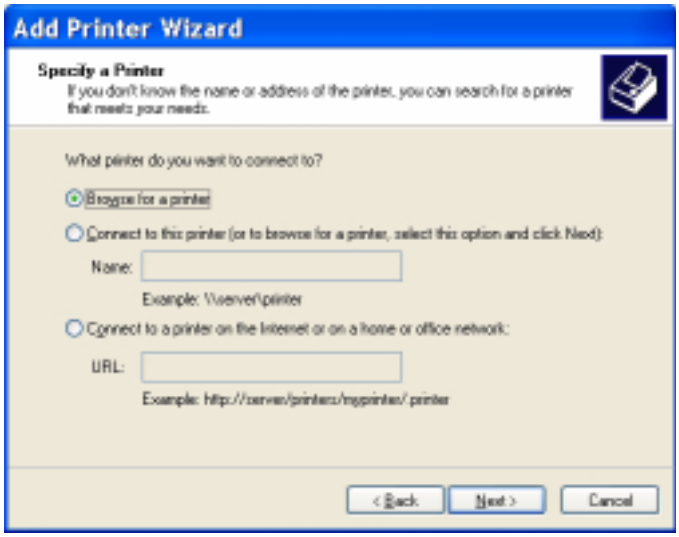


Figure 2-4. Add Printer Wizard

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.

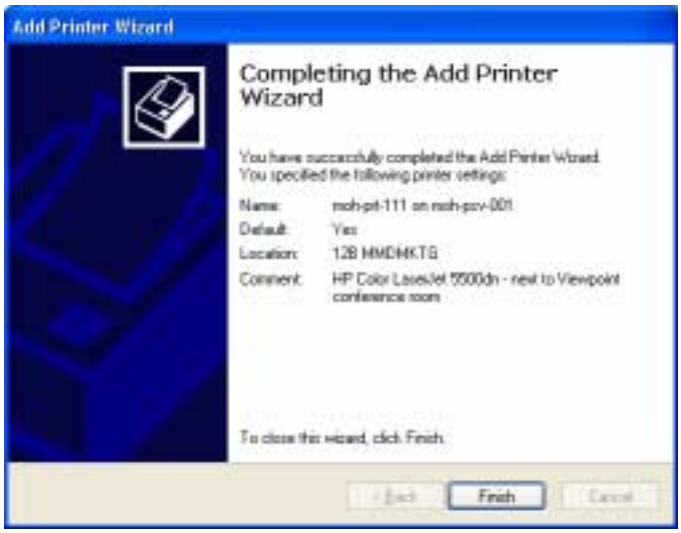


Figure 2-6. Add Printer Wizard

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 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:

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

SBC 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.

Power up the system. 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 loads the BIOS Setup Defaults. Pressing F4 saves the current settings (including any changes that were made) to BIOS and exits the BIOS setup utility.

Change the System Time and System Date to reflect current time and date. These options can be seen in the Main tab of the BIOS screens.

> **Note:** The system time is in 24 hour time format. (e.g. 1:00 PM should be entered as 13:00)

From the Boot screen, set the following boot order:

1. Hard Drive
2. CD-ROM
3. Removable Devices
4. Diskette Drive (if shown)

> **Note:** Instructions can be found on the right hand side and the bottom of the screen on how this can be done.

In the Advanced screen, Legacy USB Support must be disabled.

From Main | Boot Options | Boot Time Diagnostic Screen: Enabled.

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 14.

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 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:

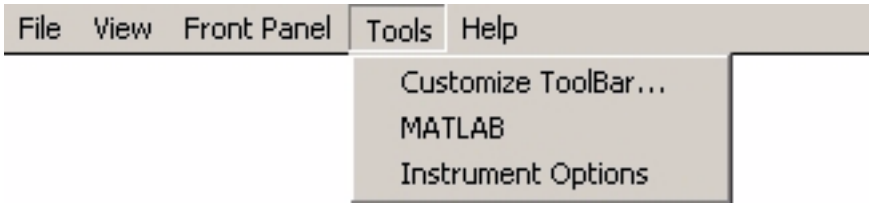


Figure 2-7. Tools Drop-down Menu

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

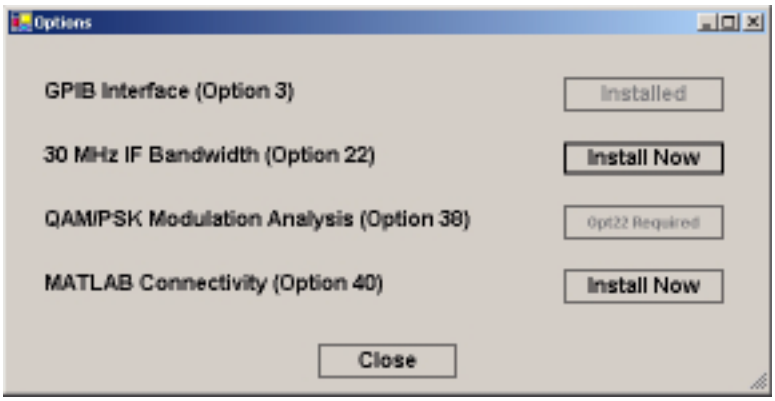


Figure 2-8. Options Dialog

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:

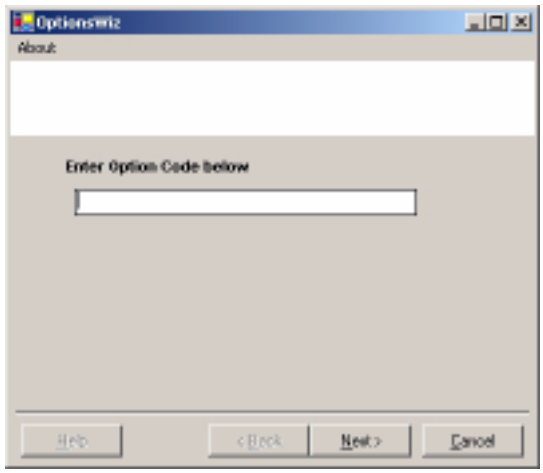


Figure 2-9. OptionsWiz Dialog

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:

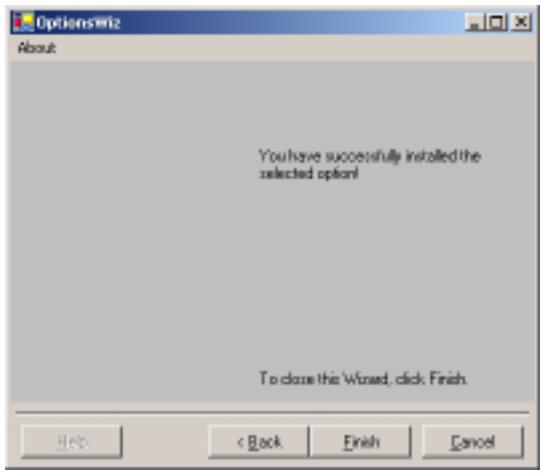


Figure 2-10. OptionsWiz Dialog

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:

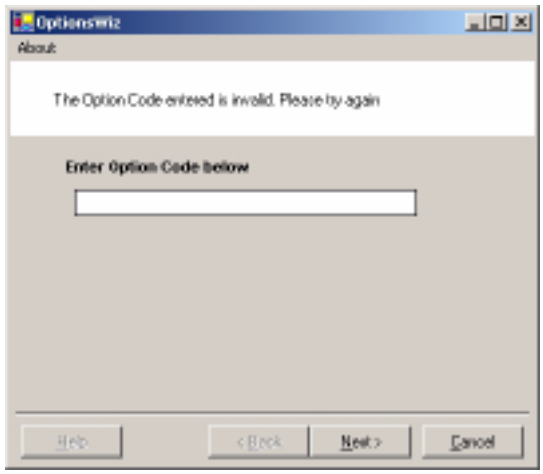


Figure 2-11. OptionsWiz Dialog

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 2-12, below.

Figure 2-12. 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.

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 2-13.

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.

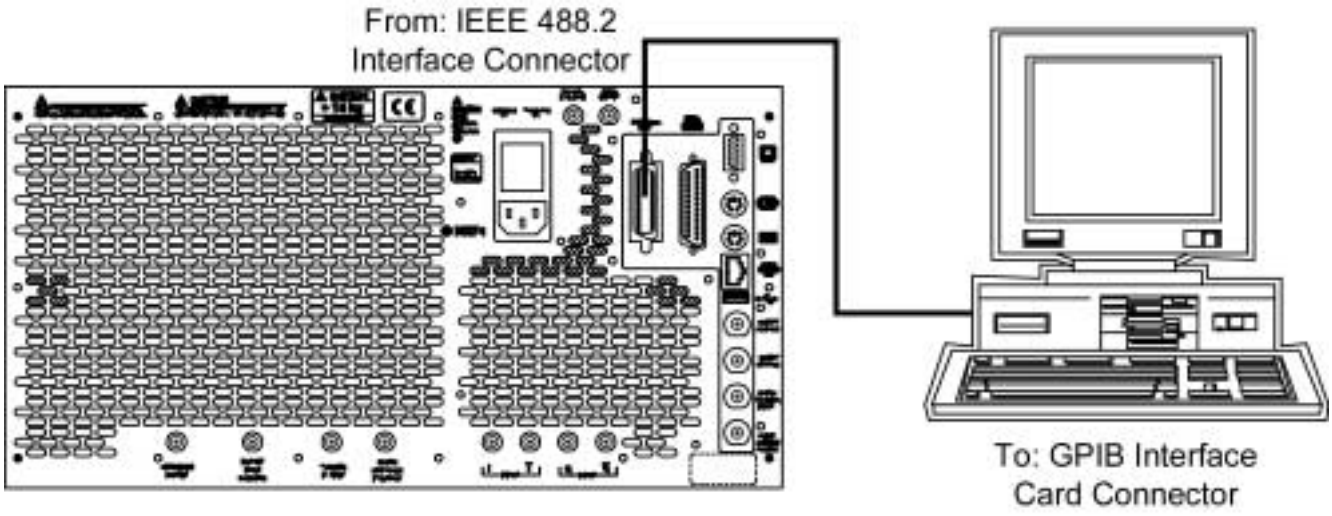


Figure 2-13. GPIB Setup

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.

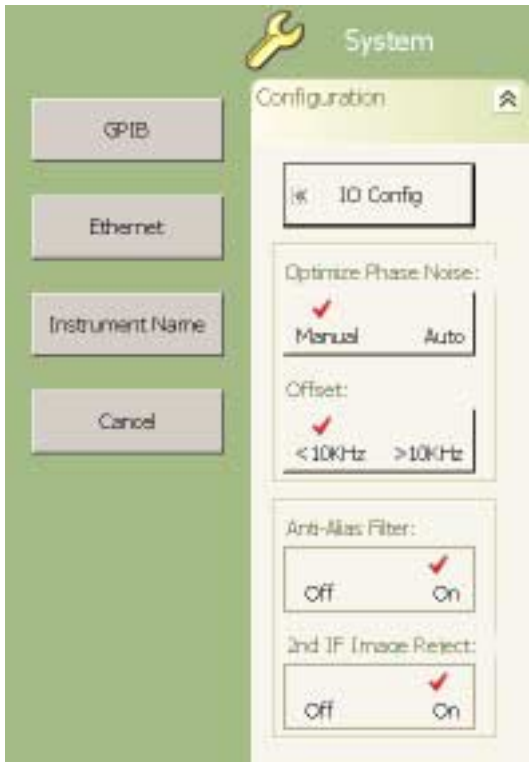


Figure 2-14. MS278XA Configuration Sub-menu

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

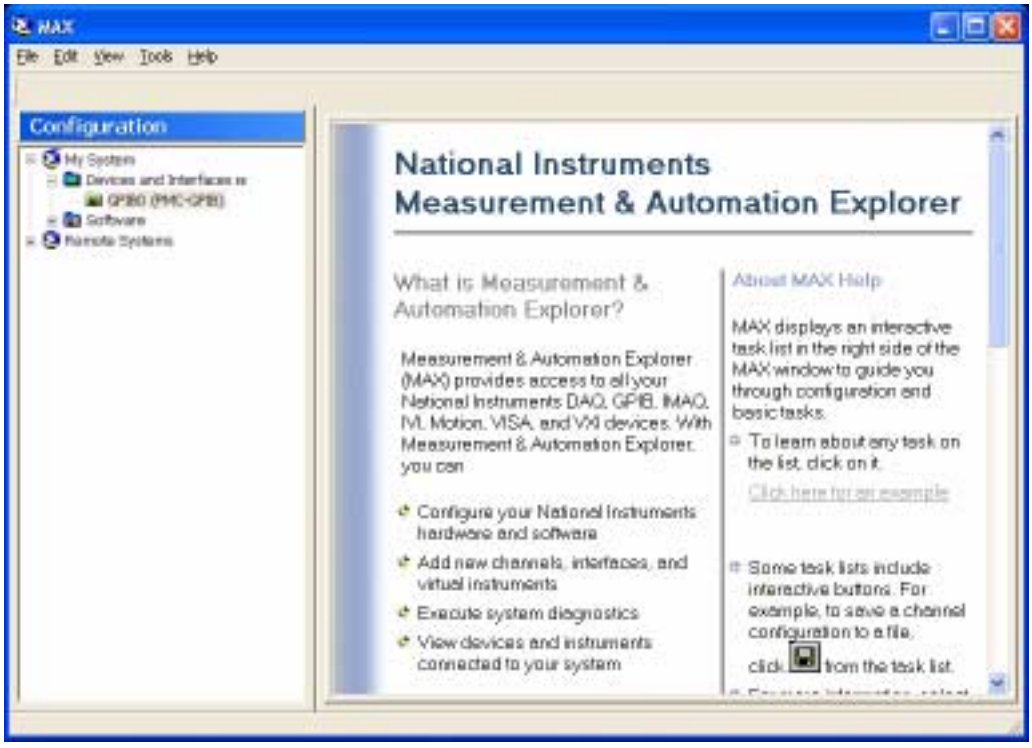


Figure 2-15. National Instruments Measurement and Automation Explorer

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.

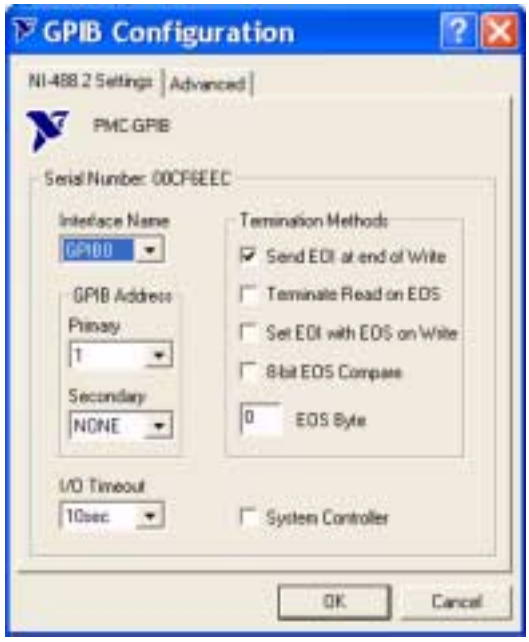


Figure 2-16. National Instruments GPIB Configuration Dialog

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 2-17, below, for an illustration.

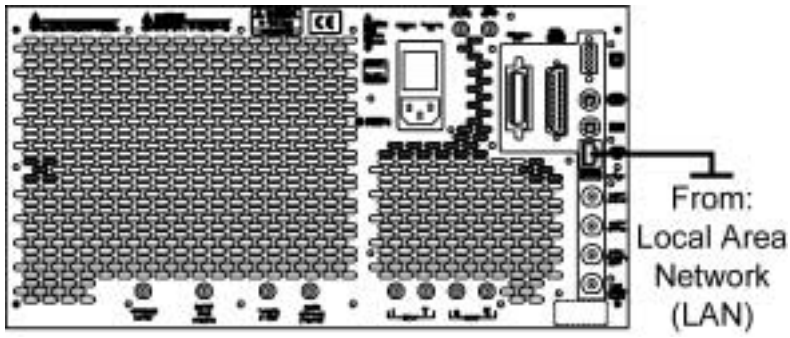


Figure 2-17. Ethernet Connection

Network Interface Setup

To a network, Signature is just a computer so it can be set up just like setting up a computer using the Control Panel in Windows. You must be logged on as an administrator or a member of the Administrators group in order to complete the network setup.

The default user account on Signature is a member of the Administrators group.

TCP/IP connectivity requires setting up the parameters described at the beginning of this section. If your computer is connected to a network, network policy settings may also prevent the network setup from completion. 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:

Joining Signature to a Domain

Step 1. Shut down the Signature GUI application.

Step 2. Right-click My Computer, and then click Properties.

Step 3. The System Properties dialog box is displayed.

Step 4. On the Computer Name tab, click Change.

Step 5. On the Computer Name Changes dialog box, select Domain and enter the name of the domain in the text box, as shown in Figure 2-18 below:

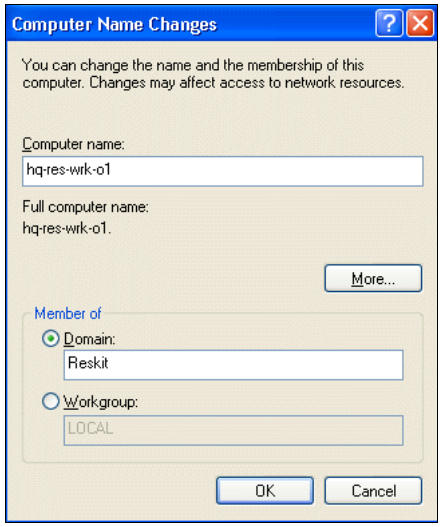


Figure 2-18. Computer Name Changes Dialog

In the example above, the computer currently named hq-res-wrk-o1 is joined to the Reskit domain.

Step 6. Provide user name and password credentials to show you have the appropriate permissions to join the desired domain.

Step 7. When the Welcome to the domain message appears, click OK.

Step 8. You will need to restart for the change to take effect.

Configuring the Domain Name Service (DNS)

DNS is an Internet service that translates domain names into IP addresses. On the Internet, whenever you use a domain name a DNS service needs to translate the name into the corresponding IP address.

For example, the domain name www.reskit.com might translate to 178.145.135.6. In a corporate network, you can configure Windows XP to automatically detect the IP address of the domain controller. In addition, you can manually configure IP addresses. Both methods are explained as follows:

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

Figure 2-19. Start Menu

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

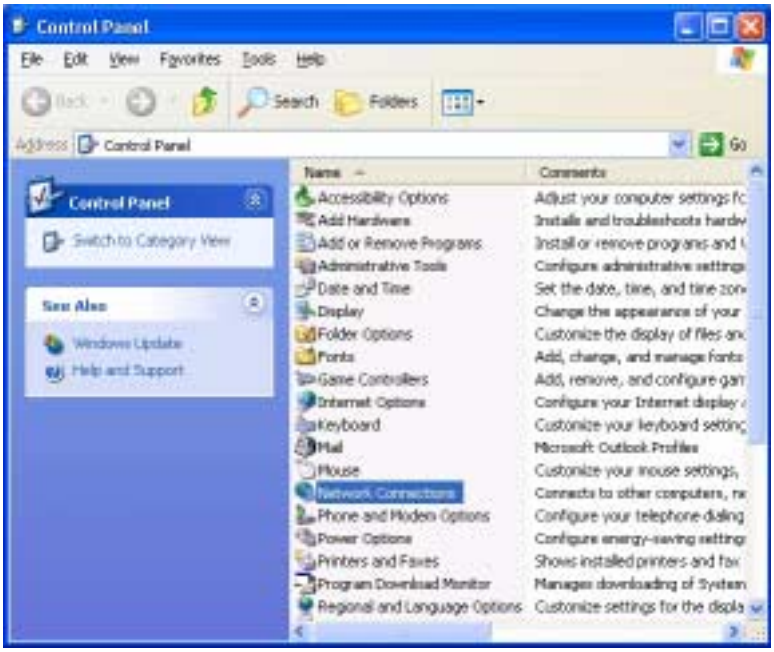


Figure 2-20. Control Panel

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

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

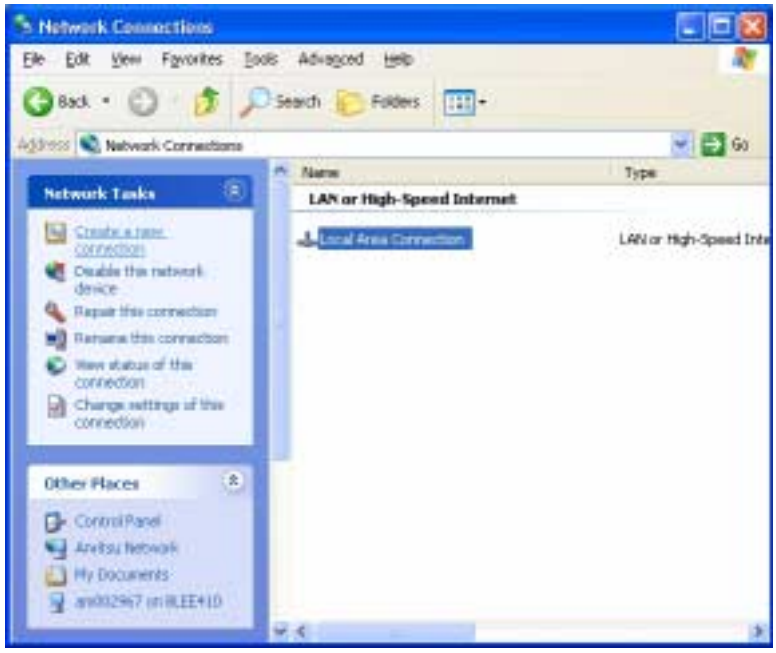


Figure 2-21. Network Connections

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

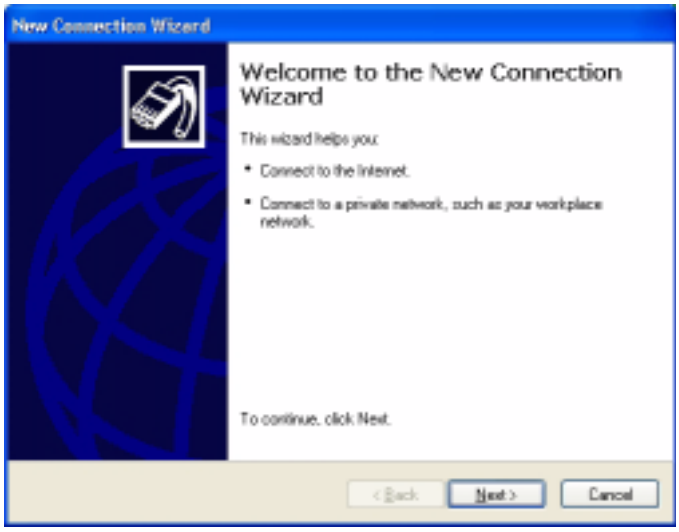


Figure 2-22. New Connection Wizard

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

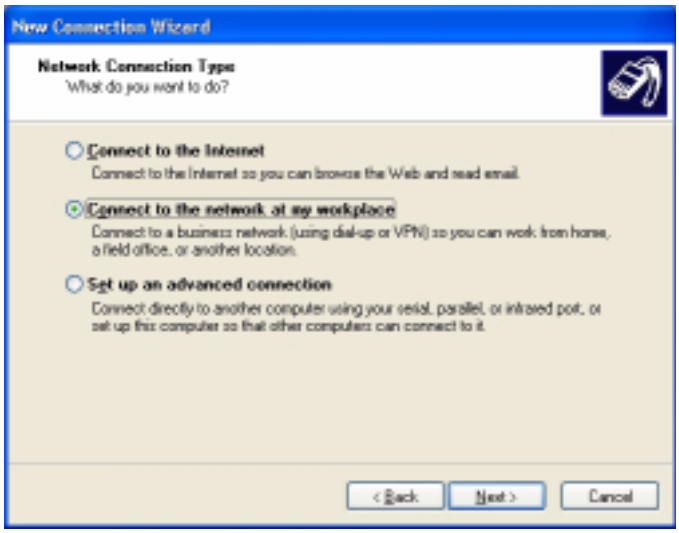


Figure 2-23. New Connection Wizard

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

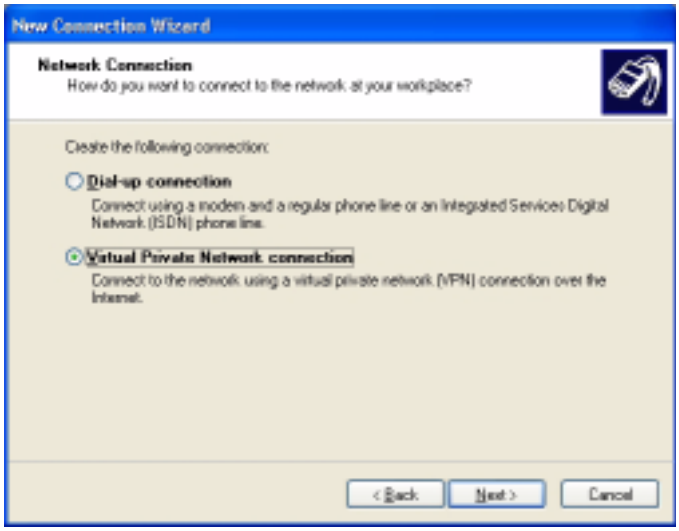


Figure 2-24. New Connection Wizard

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

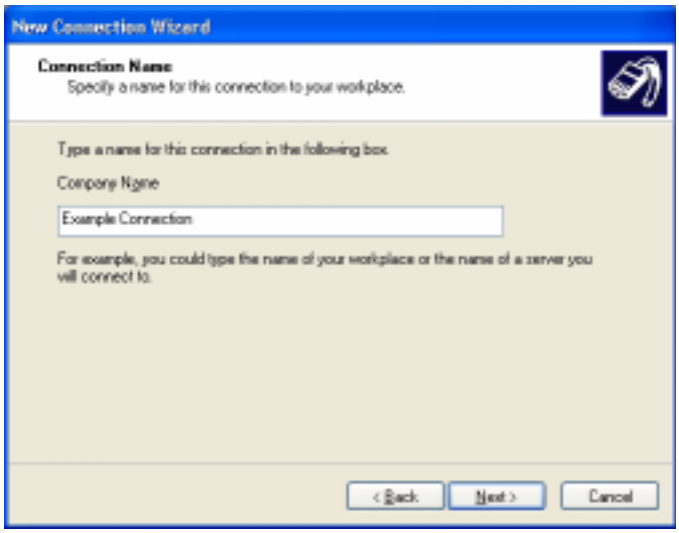


Figure 2-25. New Connection Wizard

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

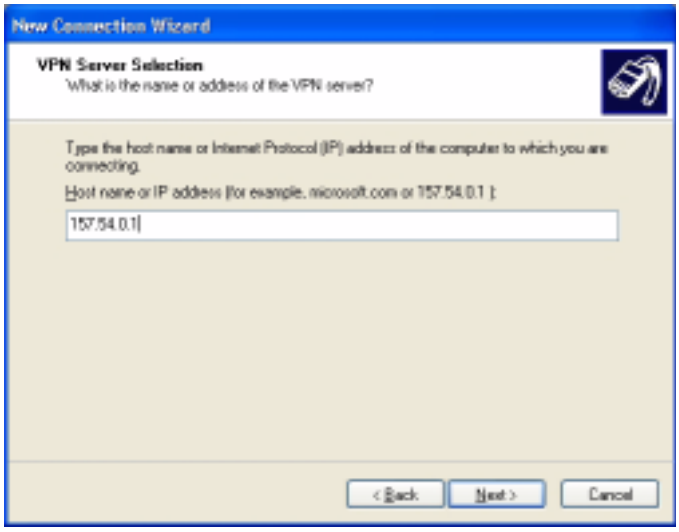


Figure 2-26. New Connection Wizard

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

Figure 2-27. 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.

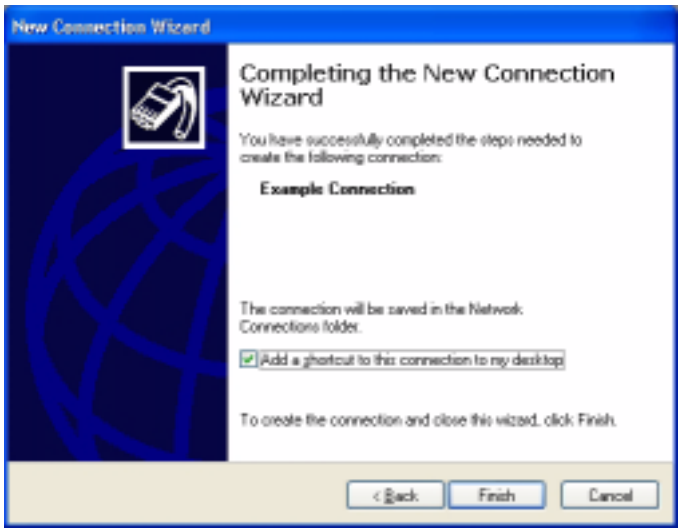


Figure 2-28. New Connection Wizard

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 2-21) and select Properties from the pop-up dialog box.

Configuring TCP/IP

Step 1. On the General tab (for a local area connection), or the Networking tab (for all other connections), click Internet Protocol (TCP/IP), and then click Properties.

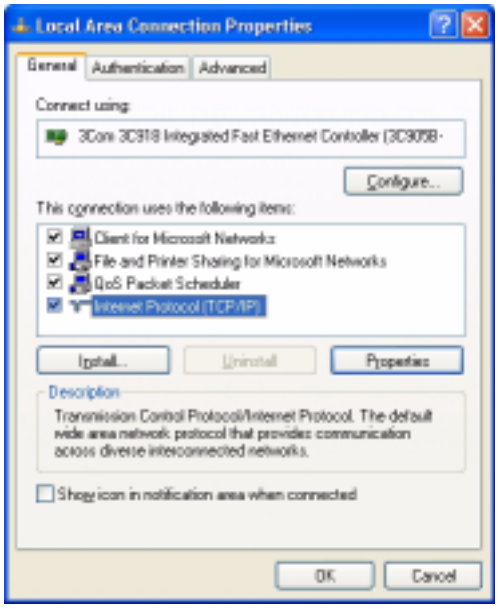


Figure 2-29. Local Area Connection Properties

Step 2. From here, you can select to dynamically obtain an IP address automatically or manually configure your network connection

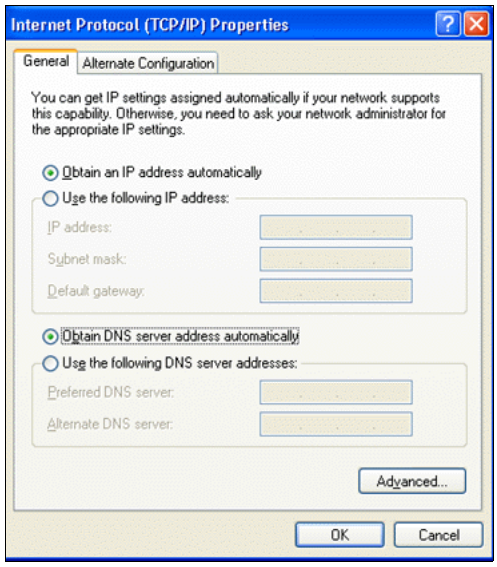


Figure 2-30. Internet Protocol (TCP/IP) Properties Dialog

Step 3. If you want to obtain DNS server addresses from a DHCP server, click Obtain DNS server address automatically, as shown in Figure 2-30 above.

If you want to manually configure DNS server addresses, click Use the following DNS server addresses, and in Preferred DNS server and Alternate DNS server, type the preferred DNS server and alternate DNS server IP addresses.

Configuring Advanced DNS Properties

Step 1. Click Advanced, and then click the DNS tab.

Step 2. In TCP/IP DNS server, type the IP address of the DNS server, and then click Add, as shown in Figure 2-31, below:

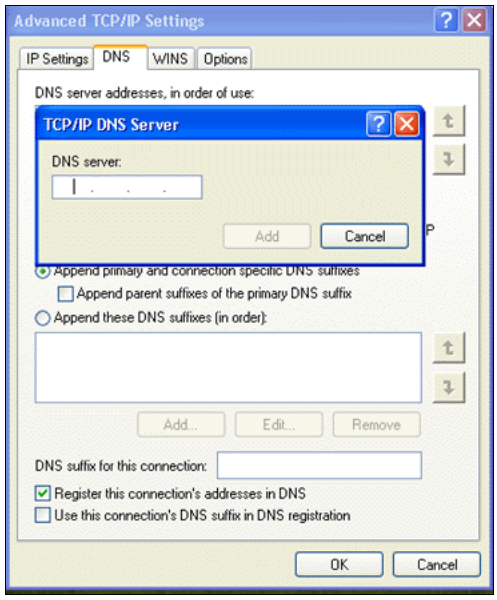


Figure 2-31. Advanced TCP/IP Settings

Configuring Additional DNS Server IP Addresses

Step 3. Under the DNS server addresses, in order of use, click Add.

Modifying the Resolution Behavior for Unqualified DNS Names

Step 4. To resolve an unqualified name by appending the primary DNS suffix and the DNS suffix of each connection (if configured), click Append primary and connection specific DNS suffixes.

Step 5. If you also want to search the parent suffixes of the primary DNS suffix up to the second-level domain, click to select the Append parent suffixes of the primary DNS suffix check box.

Step 6. To resolve an unqualified name by appending the suffixes from a list of configured suffixes, click Append these DNS suffixes (in order), and then click Add to add suffixes to the list.

Modifying DNS Dynamic Update Behavior

Step 1. To use a DNS dynamic update to register the IP addresses of this connection and the primary domain name of the computer, click to select the Register this connection's addresses in DNS check box.

This option is enabled by default. The primary domain name of the computer is the primary DNS suffix appended to the computer name and can be viewed as the full computer name on the Computer Name tab, which is available in the System properties in Control Panel.

Step 2. To use a DNS dynamic update to register the IP addresses and the connection-specific domain name of this connection, click to select the Use this connection's DNS suffix in DNS registration check box.

This option is disabled by default. The connection-specific domain name of this connection is the DNS suffix for this connection appended to the computer name.

Step 3. To completely disable DNS dynamic update for all names on the computer, click to clear the Register this connection's addresses in DNS and the Use this connection's DNS suffix in DNS registration check boxes for all connections in Network Connections.

2-7 Network Security

The Signature Signal Analyzer is one of the new generation of instruments based on the Microsoft Windows Operating System, which brings a tremendous set of benefits, including:

- Ease of Use
- Access to Peripherals and Networking
- Installing 3rd Party Applications such as MATLAB and Microsoft Office
- Running Your Own Applications on the Instrument

At the same time, the popularity of Windows has attracted a cadre of hackers developing viruses, Trojans, and worms.

In general, customer should follow the recommendations of his Information Technology (IT) department when connecting the Signature Signal Analyzer to a network.

Avoiding Viruses, Trojans and Worms

Just as with any computer, there are a variety of ways to avoid harmful infection of malware (malicious software), each with a different impact on the instrument and trade-offs.

It is best to start with the customer's company policy on anti-virus measures.

Anti-Virus Measure 1

Don't connect to network or peripherals with files (disks, CDs, memory keys, etc.).

Advantage: Eliminates all mechanisms for introducing viruses.

Disadvantage: Eliminates the benefits of these connections. Must control physical access to instrument to ensure that connections are never made.

Anti-Virus Measure 2

Don't load documents or programs from disks of unknown origin.

Advantage: Eliminates possible virus entry by piggy-backing on documents.

Disadvantage: Eliminates benefits of using your own code or editing documents with measurement results.

Anti-Virus Measure 3

Use a hardware firewall on your network.

Advantage: Reduces virus access to the network via one route.

Disadvantage: Doesn't eliminate virus attacks from all routes.

Anti-Virus Measure 4

Don't install virus-sensitive software, such as e-mail client.

Advantage: Reduces virus access to the instrument via that one route.

Disadvantage: Reduces benefits of communication capability from the instrument.

Anti-Virus Measure 5

Install Windows OS updates, as recommended by Anritsu.

Advantage: Reduces OS vulnerability to viruses.

Disadvantage: Be sure to check the Signature web site to ensure that the updates have been verified in the Signature environment.

Anti-Virus Measure 6

Install virus-checking software (as recommended by customer's IT group).

Advantage: Provides the most flexibility & protection.

Disadvantage: Some measurement speed reduction. Must be sure to keep virus definitions updated.

Performance Impact of Anti-virus Software

The best way to ensure that the Signature Analyzer remains virus-free is to use Anti-virus software. Anritsu has tested Signature with McAfee VirusScan Professional version 8.0. These tests show that there is minimal impact on the measurement speed of Signature and minimal impact on MATLAB applications running on Signature.

Note: Auto Scan feature can slow down the performance during file open and close operations.

Chapter 3
Performance Verification

Table of Contents

Chapter 3
Performance Verification

3-1 Introduction

This chapter provides information and instructions on verifying the performance of the Signature analyzer. The majority of the verification tests can be done manually if service centers own the test equipment that is required for these tests. These test procedures are also contained in the MS2781A operation manual.

Log Fidelity Test requires automated testing. The release of the automated test software is still pending.

VSA Functional Check also requires automated testing. This test requires very expensive test equipment.

The following sections 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

3-2 Required Equipment

Table 3-1 lists the equipment used throughout the verification procedures.

Table 3-1. 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
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

3-3 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.

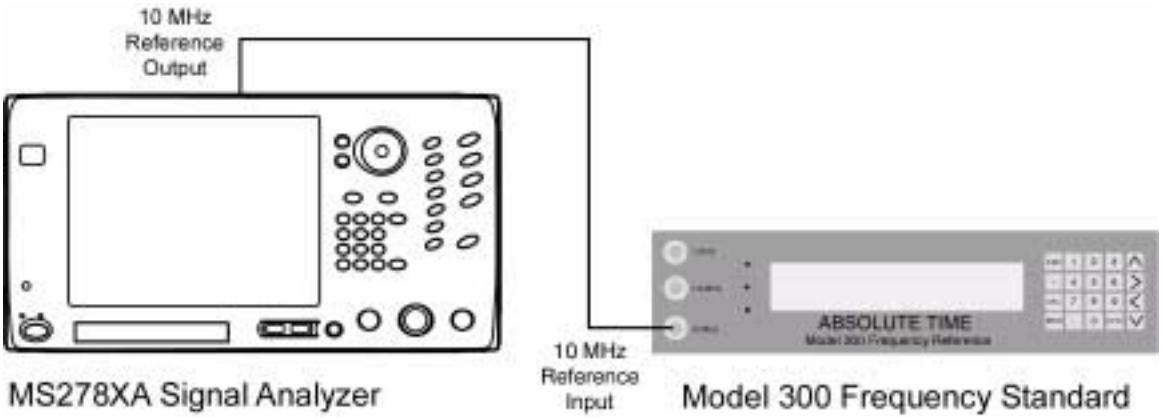


Figure 3-1. Equipment Setup for Internal Reference Oscillator Aging Rate Tests

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.

3-4 Frequency Readout Accuracy

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

Test Setup

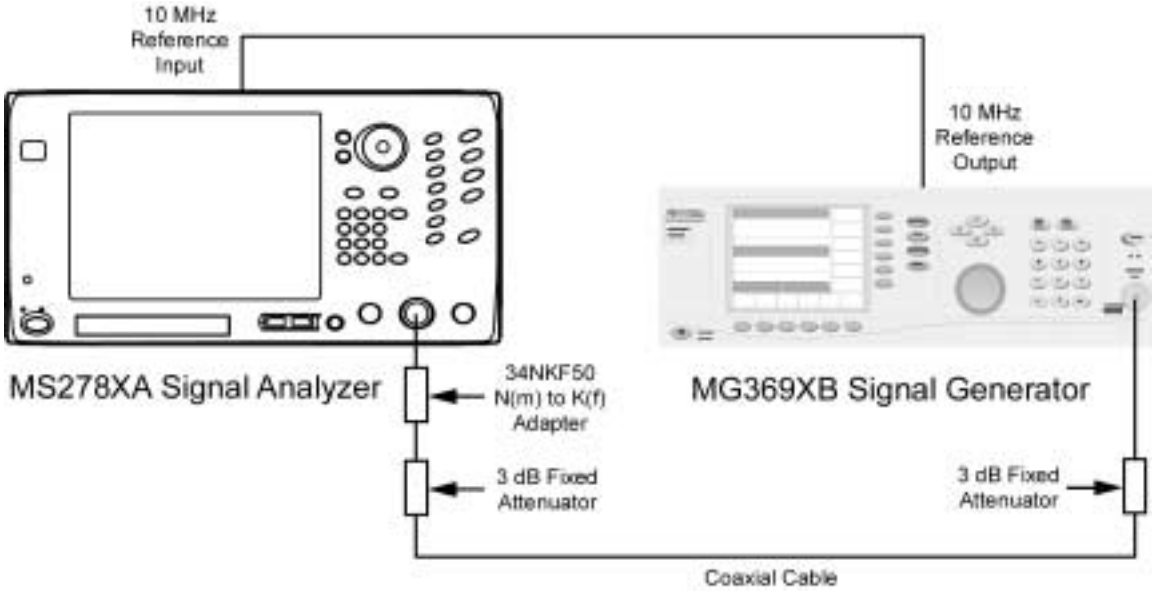


Figure 3-2. Equipment Setup for Frequency Readout Accuracy Test

Test Procedure

Step 1. Set up the instruments as shown in Figure 3-2.

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 3-2.

Step 8. Set the MS2781A to the first corresponding RBW and Span Frequency per Table 3-2.

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 Step 8 and Step 9 for other RBW/Span combinations listed in Table 3-2.

Step 11. Repeat Step 7 through Step 10 for 7900 MHz.

Table 3-2. 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		

3-5 Frequency Span Accuracy

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

Test Setup

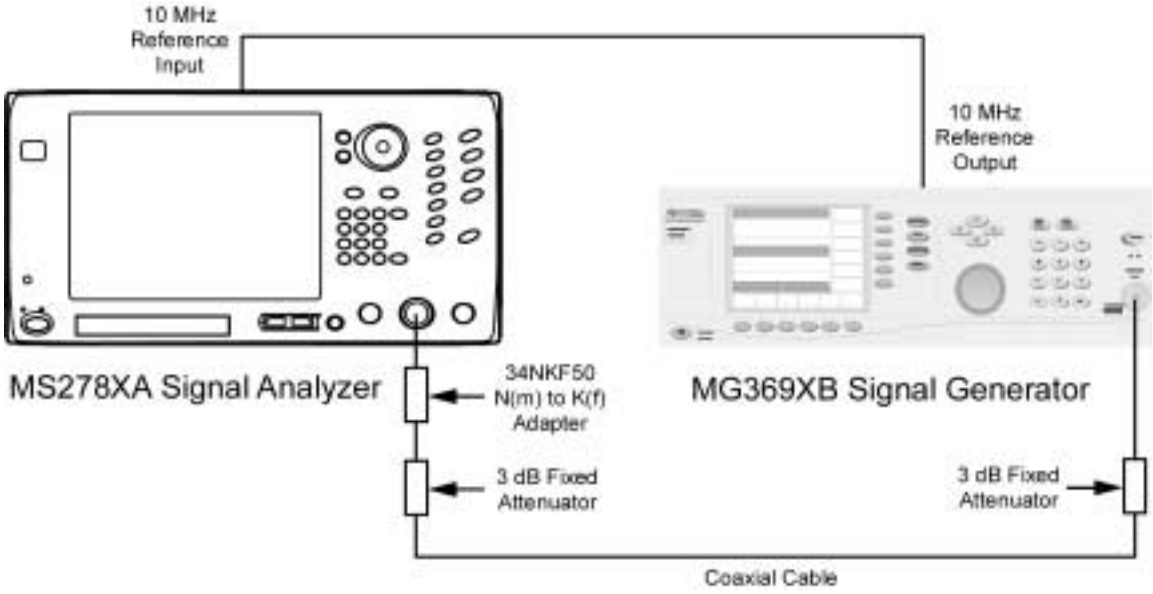


Figure 3-3. Equipment Setup for Frequency Span Accuracy Test

Test Procedure

Step 1. Set up the instruments as shown in Figure 3-3.

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 3-3.

Step 8. Set the output frequency of the MG369XB to the corresponding F1 value per Table 3-3.

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 3-3.

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 3-3.

Table 3-3. 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				

3-6 Swept Resolution Bandwidth

The following test can be used to verify that the MS2781A is within its Swept Resolution Bandwidth Accuracy specifications.

Test Setup

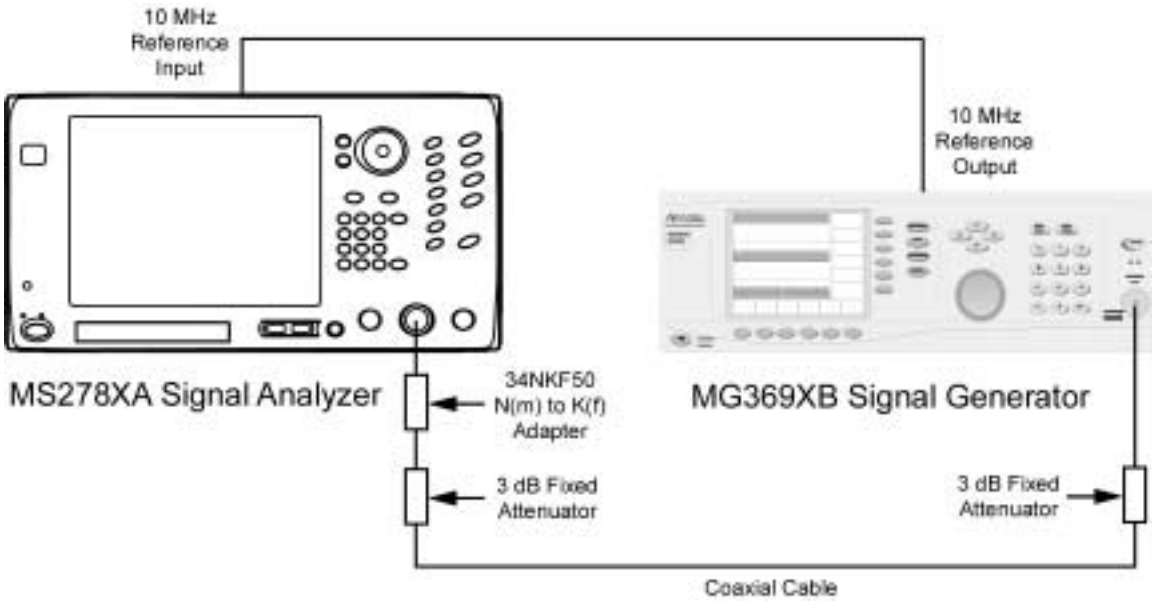


Figure 3-4. Equipment Setup for Swept Resolution Bandwidth Test

Test Procedure

Step 1. Set up the instruments as shown in Figure 3-4.

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 an 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 3-4.

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 3-4.

Step 13. Repeat steps 9 through 12 for the other combinations of RBW and Span settings.

Table 3-4. 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

3-7 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

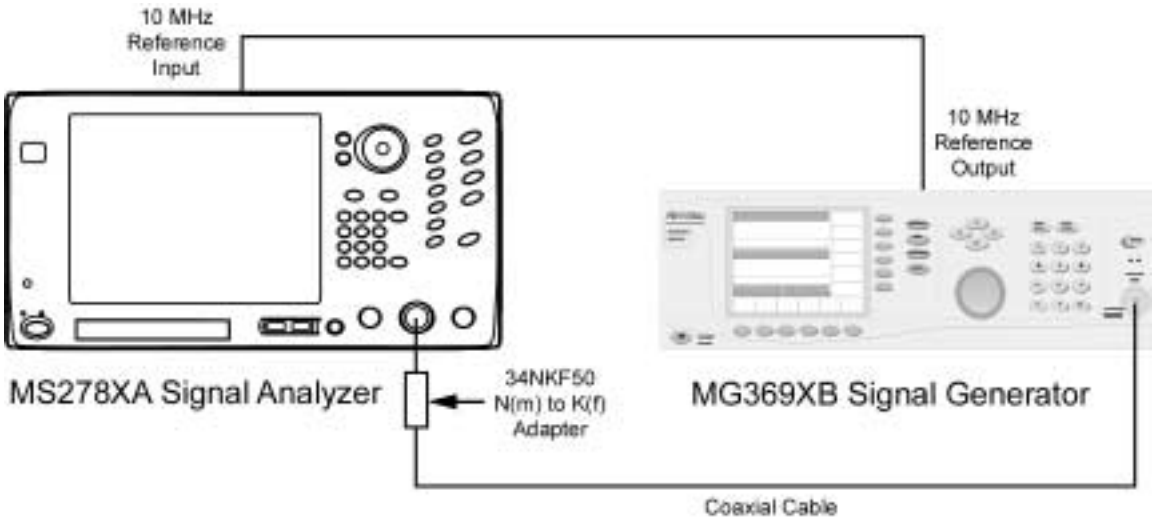


Figure 3-5. Equipment Setup for Single Sideband Phase Noise Test

Test Procedure

Step 1. Set up the instrument as shown in Figure 3-5.

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 3-5.

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 3-5. 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

3-8 Average Noise Level

The following test can be used to verify that the MS2781A is within its Average Noise Level specifications.

Test Setup

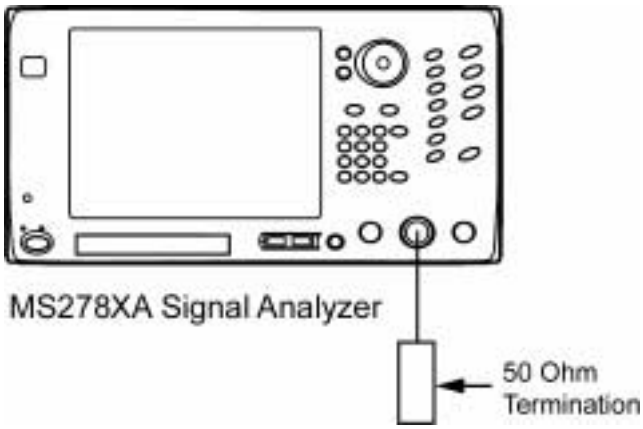


Figure 3-6. Equipment Setup for Average Noise Level Test

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:

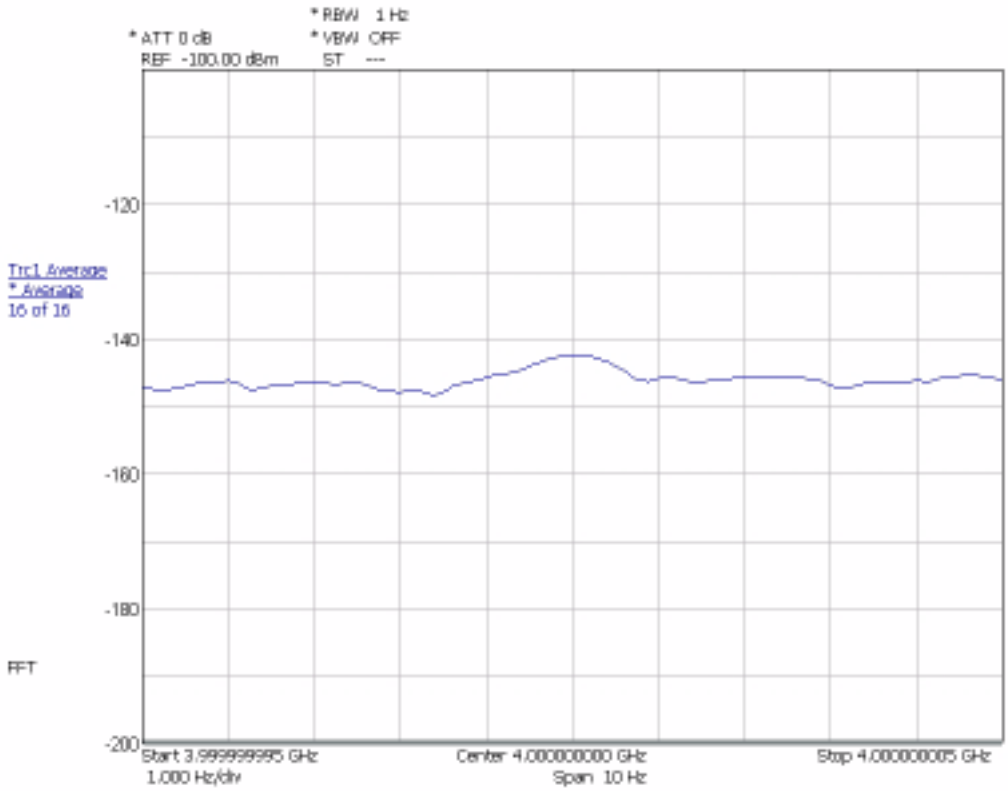


Figure 3-7. Displaying the Average Noise Level

Step 5. Set the Center Frequency on the MS2781A to the first Center Frequency listed in Table 3-6.

Step 6. Allow averaging to complete 16 of 16.

Step 7. Verify that the displayed noise level meets the specification.

Step 8. Repeat Step 5 through Step 7 for the rest of the center frequencies in Table 3-6.

Table 3-6. 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

3-9 Frequency Response

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

Test Setup

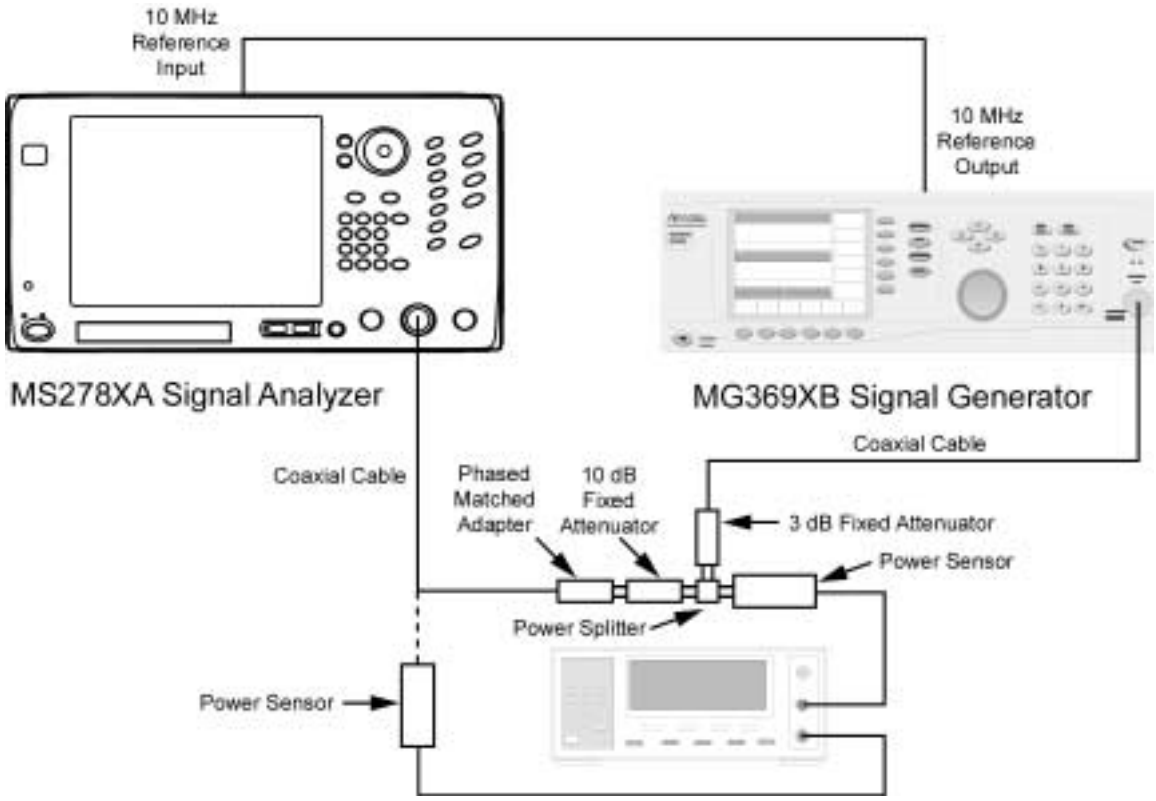


Figure 3-8. Equipment Setup for Frequency Response Test

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 3-8. 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 to Table 3-7.

Step 9. Repeat steps 7 and 8 for other frequencies listed in Table 3-7.

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 3-7.

Step 13. Set the Marker to Peak. Record the measured Marker value to Table 3-7.

Step 14. Repeat steps 11 and 12. Record the measured results to Table 3-7. Verify that the measured results are within specifications.

Table 3-7. 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

3-10 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

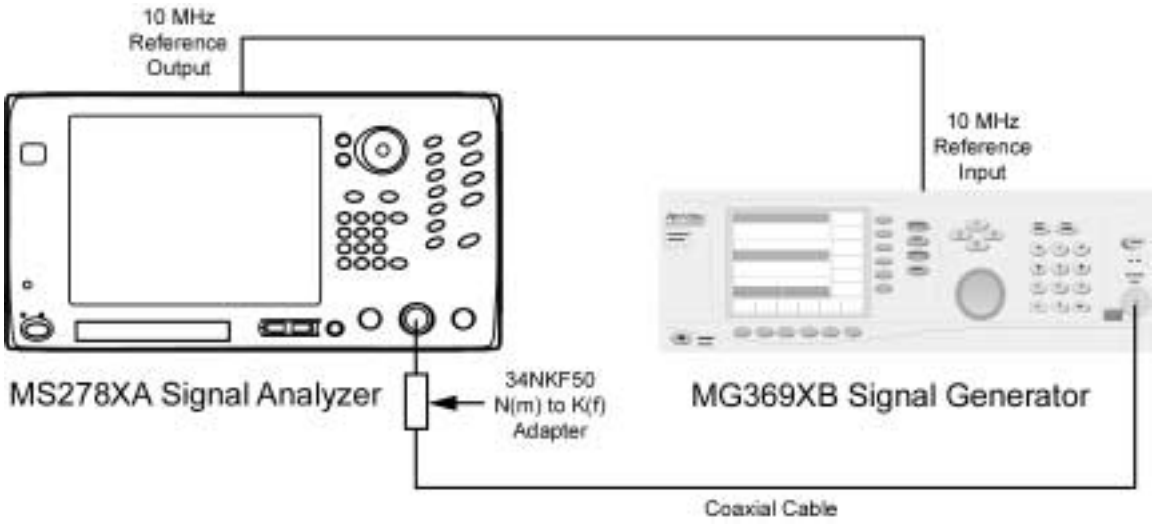


Figure 3-9. Equipment Setup for Reference Level Switching Uncertainty Test

Test Procedure

Step 1. Set up instruments as shown in Figure 3-9.

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 3-8.

Step 8. Set the Reference Level to –60 dBm.

Step 9. Record the new marker value to the MS2781A Marker Reading column of Table 3-8.

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 3-8.

Table 3-8. 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

3-11 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

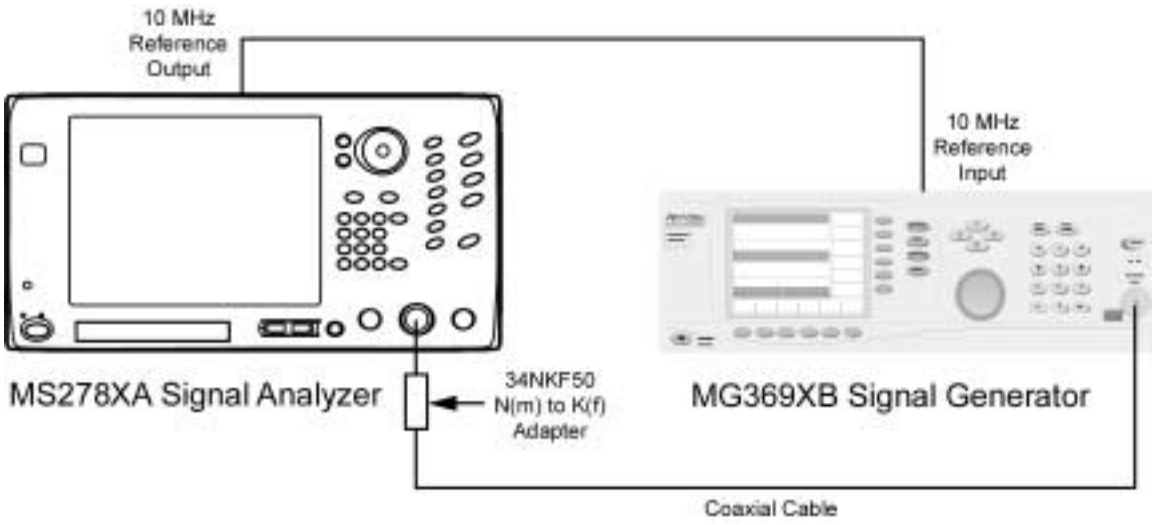


Figure 3-10. Equipment Setup for Resolution Bandwidth Switching Uncertainty Test

Test Procedure

Step 1. Set up the instruments as shown in Figure 3-10. 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 to Table 3-9.

Step 11. Set the RBW and frequency span on the MS2781A to the next settings in Table 3-9.

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 3-9.

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 3-9.

Table 3-9. 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

3-12 Residual Spurious Response

The following test can be used to verify that the MS2781A meets Residual Spurious Response specifications.

Test Setup

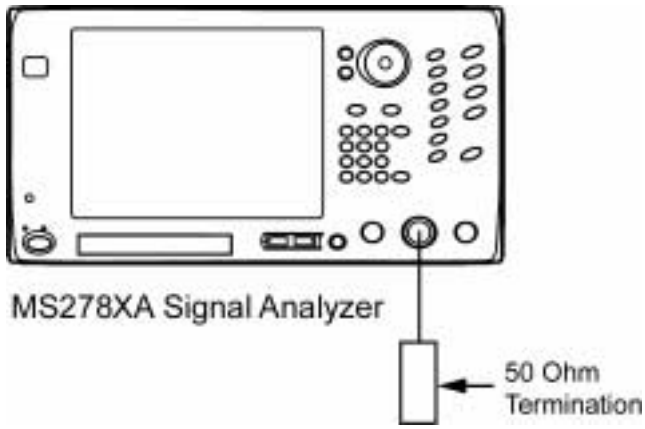


Figure 3-11. Equipment Setup for Residual Spurious Responses Test

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 3-11.

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 3-10. 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

3-13 Input-related Spurious Response

The following test can be used to verify that the MS2781A meets the Input-related Spurious Response specifications.

Test Setup

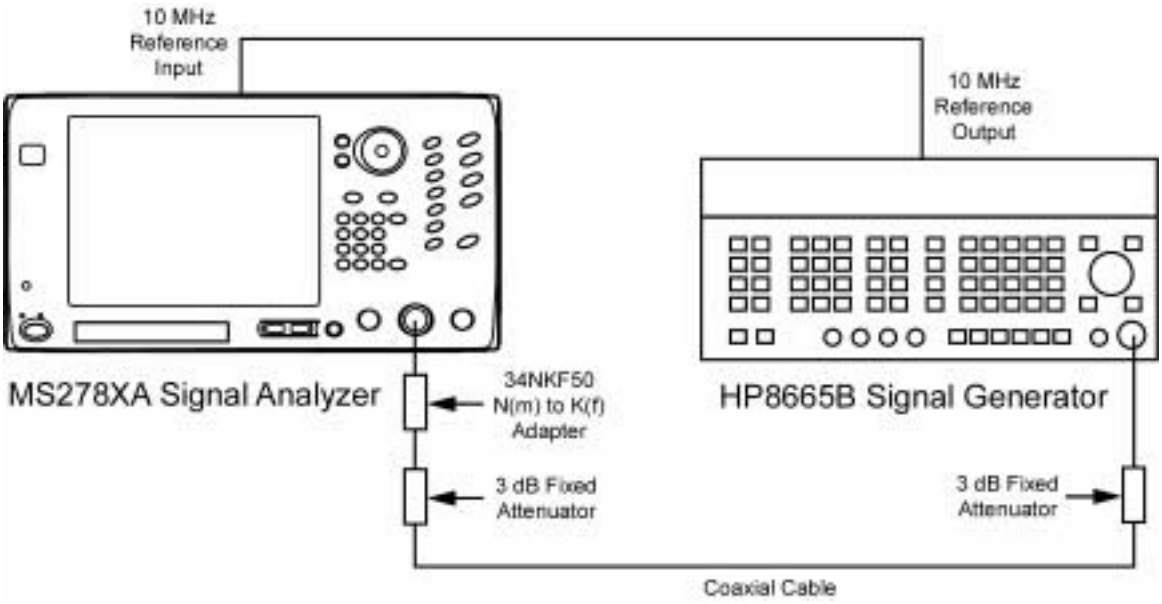


Figure 3-12. Equipment Setup for Input-related Spurious Response Test

Test Procedure

Step 1. Set up the instruments as shown in Figure 3-12.

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 3-11.

Step 7. Set the Center Frequency of the MS2781A to the corresponding center frequency setting listed in Table 3-11.

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 to Table 3-11.

Step 10. Change the Frequency Span to 3 MHz and repeat steps 5 through 7.

Step 11. Record the maximum Spurious amplitudes to Table 3-11.

Note: Any spurs found should be verified not to originate from the signal source.

Table 3-11. 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 4
System Calibration

Table of Contents

Chapter 4
System Calibration

4-1 Introduction

This chapter provides information on calibration and adjustment of the MS2781A analyzer.

4-2 Adjustment and Calibration

Test equipment required for the majority of adjustment or calibration procedures are:

- Frequency Counter
- Power Meter and Sensor
- Synthesized Signal Generator
- 10 MHz Reference Standard

Exception is the test equipment for VSA calibration. Instruments requiring VSA calibration MUST be returned to the factory.

A high level of measurement accuracy requirement necessitates the use of calibration references and correction tables stored in non-volatile memory, which are used to compensate for both static imperfections and drift in the hardware.

4-3 Levels of Calibrations

For Signature, there are three levels of calibrations:

- Assembly/Module Level
- System Level
- In-system Level

Assembly/Module Level

These calibrations are performed in the factory at the assembly/module level and can involve multiple pieces of test equipment. The results are stored in the non-volatile (flash) memory on the assembly/module. The calibration data is associated exclusively with one assembly/module.

System Level

These calibrations are performed in the factory on the integrated instrument. They are controlled by the instrument and can involve multiple pieces of test equipment. The results can be stored in the assembly/module or the hard disk of the instrument depending on the calibration. These calibrations can also be invoked by service personnel when certain modules in the instrument are replaced, provided that the external test equipment required for the calibration is also available.

In-System Level

These calibrations are performed and controlled by the instrument without any dependency on external test equipment. The results are stored on the hard disk of the instrument. They can also be invoked by service personnel when certain assemblies/modules in the instrument are replaced.

4-4 How Signature Uses Calibration Data

When the instrument is turned on the first time, the Signature GUI software will upload the calibration data from each module and store them on the hard disk. Calibration data files are found in the "C:\Signature\Dependencies" folder on the hard drive.

At subsequent power on, the Signature GUI software utilizes the calibration data on the hard disk instead of loading from each module. This improves the system initialization speed. After a module has been replaced, the associated cal data file must be deleted from the hard disk in some cases to force the instrument to upload the new calibration data (i.e. RF Deck, A5 Reference/Fine Loop Module and A7 Analog IF Module).

Calibration Data Files

The following assemblies and modules use the below listed calibration files:

- **RF Deck:**
  FreqResp.lvl
  RFBias.ini
- **A5 Reference/Fine Loop Module:**
  LoFineloop.ini
- **A7 Analog IF Module:**
  AIF.ini
- **A12 VSA Module:**
  EqualizerTap.csv
  IQDCOffsetWide.csv
  IQGainImbWide.csv
  WidePathCorrection.csv

Note: Do not delete any files with ".csv" extension as they are not uploaded from the VSA Module.

4-5 Calibration Required After Repair

This section describes the required calibrations after module or subassembly replacement. The following calibrations are used to make the listed adjustments:

Reference Oscillator Calibration (System Level)

Adjust the Reference Oscillator Frequency.

Cal Align (System Level)

Adjust the Internal 50 MHz Calibrator Level.

Factory Cal (In-system Level)

Adjust YTO Frequency and Ramp gain; IF Pre-Filter Center Frequency, Bandwidth and Symmetry; Center Frequency of Pre-Filter (based on temperature drift) and 2nd LO DAC.

Correct for Attenuator inaccuracies and drift in IF gain for all pre-filter paths.

Adjust VSA Magnitude and Phase and VSA IF Gains (if VSA module is installed).

Front Panel IF Gain Cal (In-system Level)

Correct for Drift in IF gain for all pre-filter paths.

VSA Calibration (System Level)

Creates the Equalizing Filters for the instrument that has the Vector Signal Analyzer (VSA) option installed. Equalizer Filters aid in improving Error Vector Magnitude (EVM) performance.

Reference Oscillator Calibration

Perform when A6 Reference/Fine Loop module is replaced.

Three methods can be used to calibrate the reference oscillator. The instrument must have been warmed up for at least 72 hours prior to performing this calibration.

Reference Oscillator Calibration Setup Method 1

Requires an RF frequency counter capable of "milli-Hertz" resolution and a known 10 MHz reference standard (i.e. GPS) as the reference to the frequency counter.

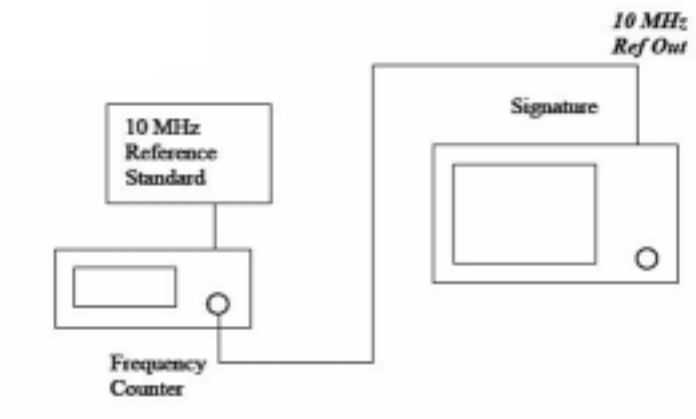


Figure 4-1. Reference Oscillator Calibration Setup, Method 1

Step 1. Set up the equipment as shown in Figure 4-1 above.

Step 2. Set the frequency counter to 1 mHz resolution.

Step 3. Set the frequency counter input impedance to 1 Mega-Ohm (use a 50 Ohm feed through to get 1 mHz resolution).

Step 4. Proceed to "Adjusting the Reference Oscillator" on page 10.

Note: Reference oscillator calibration setup method 1 has a sensitivity factor of –0.000875 Hz per DAC count.

Reference Oscillator Calibration Setup Method 2

Requires an RF frequency counter and a microwave synthesized signal generator. The frequency counter must be capable of 1 Hz resolution at 10 GHz or 0.1 Hz resolution at 1 GHz. Also requires a known 10 MHz reference standard as the reference to the frequency counter.

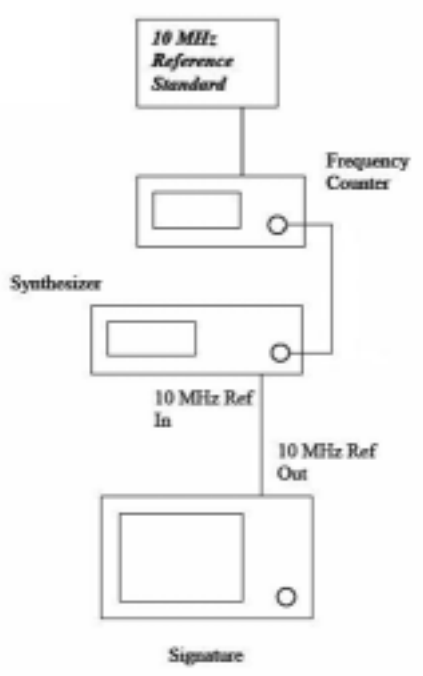


Figure 4-2. Reference Oscillator Calibration Setup, Method 2

Step 1. Set up the equipment as shown in Figure 4-2 above.

Step 2. Proceed to "Adjusting the Reference Oscillator" on page 10.

Note: Reference oscillator calibration setup method 2 has a sensitivity factor of –0.875 Hz per DAC count.

Reference Oscillator Calibration Setup Method 3

The reference oscillator calibration method 3 is an indirect method, but does not require a frequency counter.

Requires a microwave synthesized signal generator and a known 10 MHz reference standard to the signal generator.

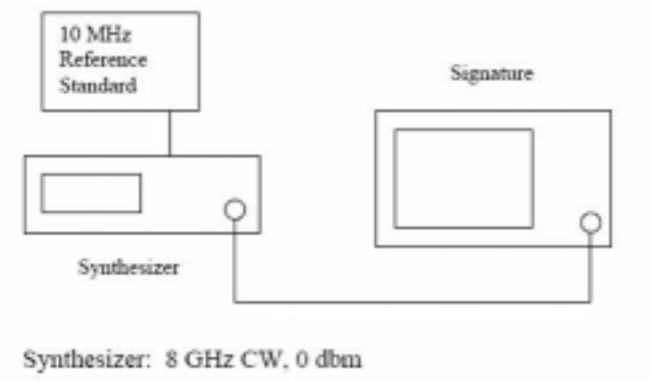


Figure 4-3. Reference Oscillator Calibration Setup, Method 3

Step 1. Set up the equipment as shown in Figure 4-3 above.

Step 2. Proceed to "Adjusting the Reference Oscillator" on page 10.

Note: Reference oscillator calibration setup method 3 has a sensitivity factor of –0.7 Hz per DAC count.

Adjusting the Reference Oscillator

Step 1. On the Signature analyzer, go to the Windows Explorer and open the "LOFineLoop.ini" file in C:\Signature\Dependencies folder.

Step 2. The Entry at the second line down in the file is labeled "RefFreqDAC". This is the DAC number which controls the internal reference Oscillator. Adjust this number up or down according to the error times the sensitivity factor with respect to which method you used.

Note: Reference oscillator calibration setup method 1 has a sensitivity factor of –0.000875 Hz per DAC count.

Reference oscillator calibration setup method 2 has a sensitivity factor of –0.875 Hz per DAC count.

Reference oscillator calibration setup method 3 has a sensitivity factor of –0.7 Hz per DAC count.

Step 3. Save the File.

Step 4. Exit the Signature GUI software.

Step 5. Restart the Signature GUI software. This causes the software to read the new value.

Step 6. Validate the Reference Oscillator frequency accuracy.

Step 7. Repeat as required to achieve the frequency tolerance.

Step 8. Once the frequency is in tolerance, save the result to flash.

Saving the Calibration Results to Flash

Step 1. Run the FlashLoader.exe utility on the instrument.

Step 2. Click on the "Reference/FineLoop" Radio button.

Step 3. Click on the "Add... button" and browse to the "LoFineLoop.ini" file in the "C:\Signature\Dependencies" folder.

Step 4. Click on the "LoFineLoop.ini" to close the File Dialog box.

The "LoFineLoop.ini" file is now listed in the Cal Files text box.

Step 5. Click on the "Load" button.

When the hourglass disappears, Flash loading is complete.

Cal Align

Perform when RF Deck or A6 Reference/Fine Loop Module is replaced.

Require a 50 MHz, 0 dBm traceable power reference, i.e., MA2418A reference oscillator.

Calibration Steps

Step 1. Run the Signature GUI software.

Step 2. Press the System key on the Front Panel.

Step 3. Select the “Service” tab.

Step 4. Click on the “Cal Align…” button and invoke the Cal Signal Alignment Wizard.

Step 5. Follow the instructions on the display.

Step 6. When the calibration is complete, perform a Front Panel IF Calibration.

Factory Calibration

Perform when any analog or digital modules are replaced.

No external test equipment is required.

Calibration Steps

Step 1. Shut down the Signature GUI software.

Step 2. If the instrument has the VSA module installed, copy the “setting_newVsa.ini” file from the “C:\Signature\bin\Simulation_Files” folder to the “C:\Signature\Dependencies” folder. If not, go to Step 4.

Step 3. Rename the file as “setting.ini”.

Step 4. Run the “FactoryCal.exe” utility in the “C:\Signature\bin” folder.

Step 5. Choose option 1 in the menu, press “Y,” and then the “Enter” key to start the calibration.

Ignore the VSA calibration failure message if the instrument does not have a VSA module.

Step 6. After the Factory Calibration is complete, delete the “setting.ini” file from the “C:\Signature\Dependencies” folder.

Front Panel IF Gain Calibration

Usually perform after Cal Align but can also be invoked by user to improve level measurement accuracy. No external test equipment is required.

Calibration Steps

Step 1. Run the Signature GUI software.

Step 2. Press the System key on the Front Panel.

Step 3. Select the “Calibration” tab.

Step 4. Click on the “IF Cal…” button to start the calibration.

VSA Calibration

VSA calibration is done manually using expensive test equipment and MATLAB software. Is not presently supported to be performed in the field and MUST be returned to the factory for VSA calibration.

Chapter 5
Troubleshooting Tools

Table of Contents

Chapter 5
Troubleshooting Tools

5-1 Introduction

This chapter provides information about troubleshooting tools and techniques for identifying system failures.

5-2 Troubleshooting

On Signature, hardware and software are working together hand in hand. Any problem occurs in either hardware or software can affect the operation of the instrument.

The following tools can help isolating problems:

- Warning Messages (Internal)
- Information Log (Internal)
- Windows Control Panel (Internal)
- Windows Remote Access Tools (Internal)
- USB Flash Drive (External)

Examples of Possible Problems:

- Windows Driver Issues.
- Calibration Data files corrupted, missing or deleted.
- Hardware failures in the LO phase lock loop.
- Computer peripheral (i.e. DVD ROM/CD-RW Drive) failures.
- Malicious software Infection.

Warning Messages

The instrument will display an abbreviated red color warning message on the bottom of the display when it encounters a condition that affects proper operation.

Warning Message Example

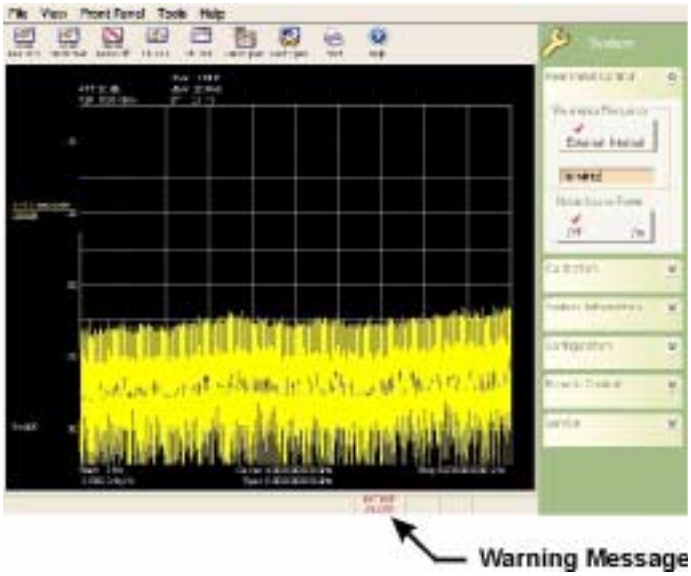


Figure 5-1. Warning Message Example

Windows Control Panel

Instrument modules are recognized by Windows as USB Devices.

By opening the Device Manager in Control Panel, you can examine whether the hardware and the Windows XP Professional OS are working properly together.

Control Panel – Device Manager

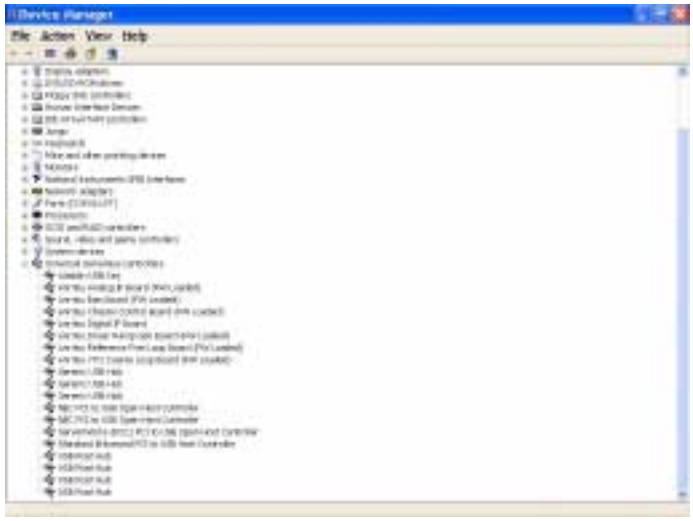


Figure 5-2. Windows Device Manager

Information Logs

There are two levels of information available via the:

- Message Log
- Windows Event Log

Message Log

Information displayed in the Message Log are filtered by the Signature GUI software and are easier to understand.

Use the following steps to display the information in Message Log:

Step 1. Press the “System” key on the Front Panel, and then select the “System Information” Tab.

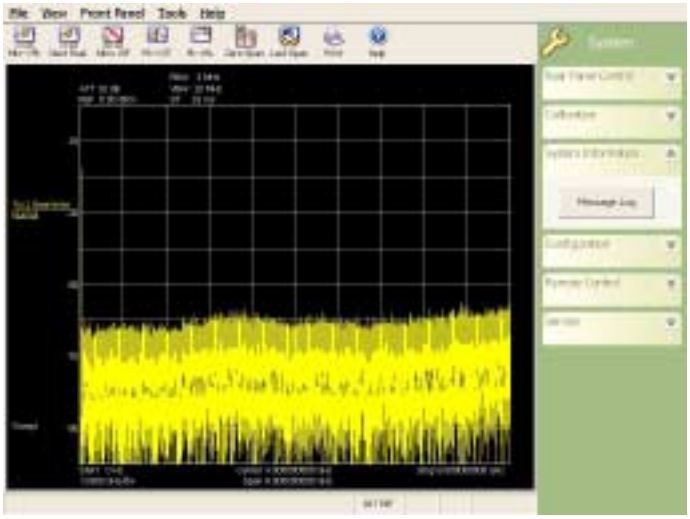


Figure 5-3. Signature System Information Menu

Step 2. Click on the “Message Log” button to display the System Messages dialog.

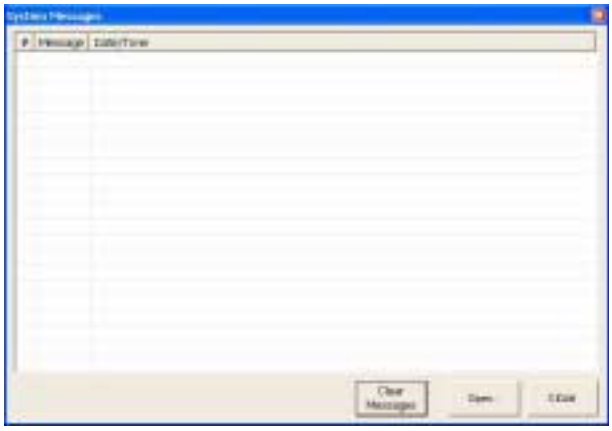


Figure 5-4. System Messages Log

Windows Event Log

Windows Event Log contains hardware operation errors as well as software debug data. Information may be in cryptic form. To view the data in the Windows Event Log:

Step 1. Click the “Start” button, and then select “Run…”

Step 2. Type “Eventvwr” in the Run Dialog box and click the “OK” button.

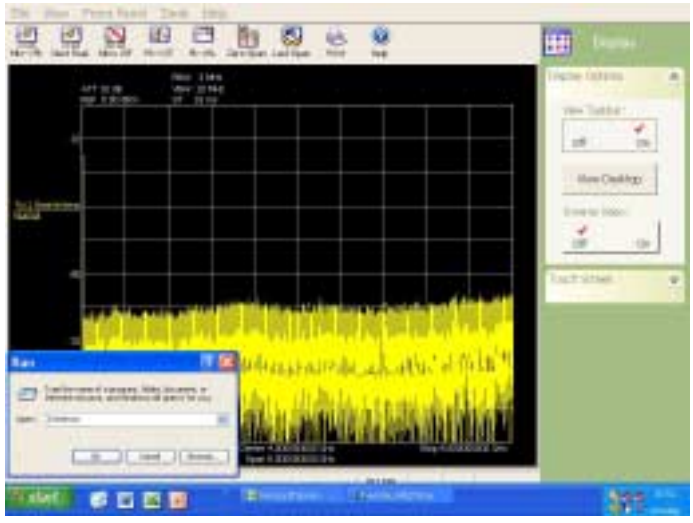


Figure 5-5. Windows Run Dialog

Step 3. Click on “SignatureLog” to display the information.

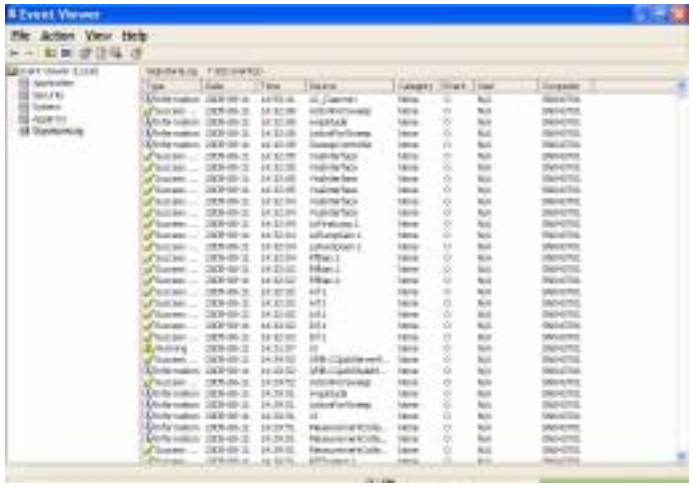


Figure 5-6. Windows Event Viewer (Signature Log)

USB Flash Drive

A USB flash drive is used to store software utilities that are required for updating firmware, calibration data, and other software applications.

Recommended memory size is 64 MB minimum.

5-3 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:

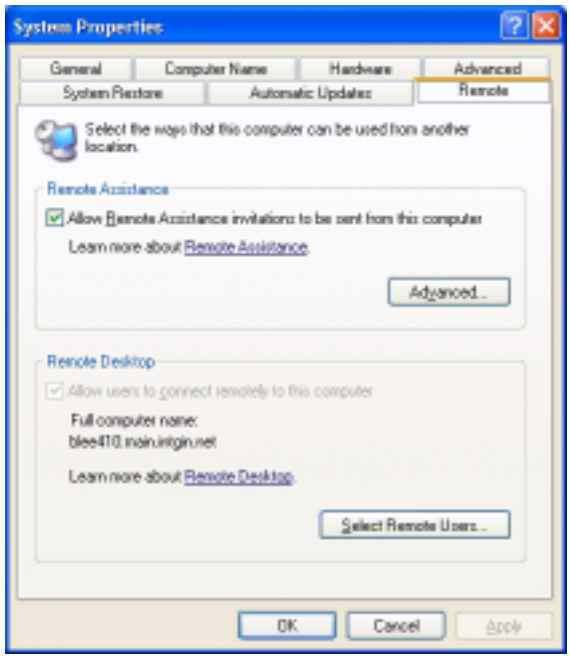


Figure 5-7. System Properties Dialog

Step 3. Also 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.

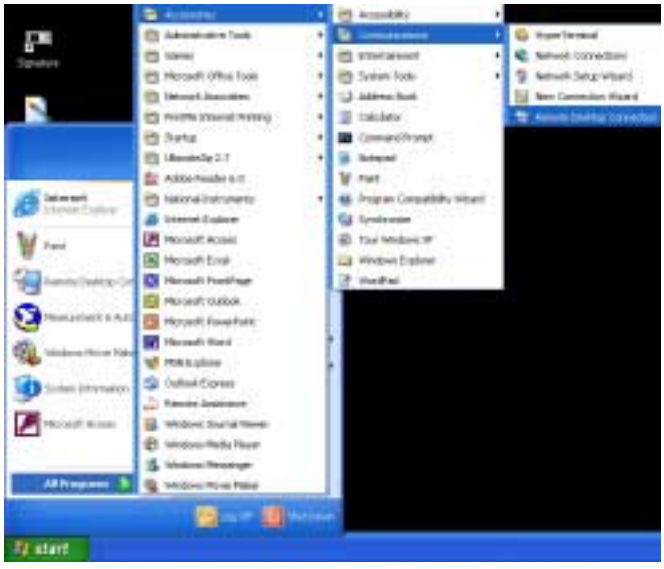


Figure 5-8. Starting a Remote Desktop Connection

This opens the Remote Desktop Connection dialog shown below:

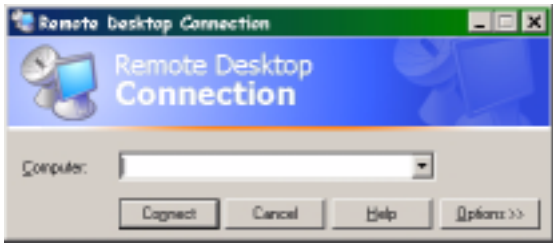


Figure 5-9. Remote Desktop Connection Dialog

Step 2. Type the computer name, noted in Step 3 of the previous procedure, for the Signature analyzer.

Step 3. Click Connect.

The Log On to Windows dialog box appears.

Step 4. Signature is shipped from the factory with the following user name and password:

User Name: SignatureUser
Password: 2780

Unless this was changed, you should be able to login using this user name and password.

Step 5. 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: 2780 (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.

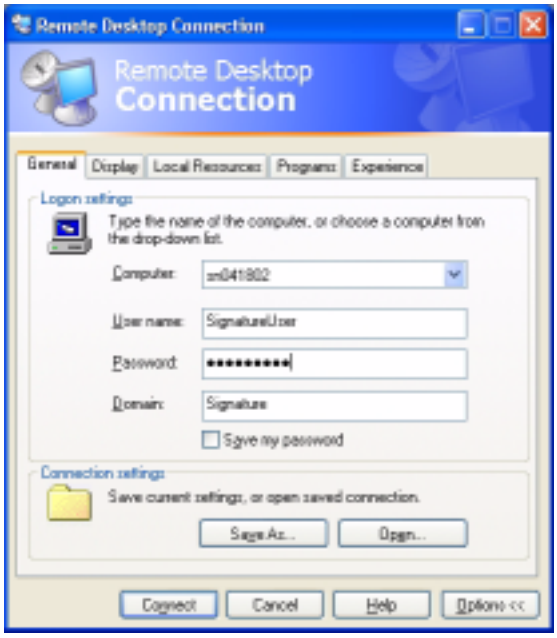


Figure 5-10. Advanced Remote Desktop Connection Dialog

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.

5-4 Hard Disk Recovery

Create a new hard disk image using Norton Ghost software if any service is done to the instrument.

Recovery Steps

Run Norton Ghost software with the Recovery CD set.

Run Signature GUI software and then exit.

Run the “AC_PC_Register_Ins.bat” file, which can be found in the “C:\Signature\bin” folder.

Chapter 6
Exchange Assemblies and Replaceable Parts

Table of Contents

Chapter 6
Exchange Assemblies and Replaceable Parts

6-1 Introduction

This chapter contains a list of exchange assemblies and replaceable parts that may be ordered for the Signature analyzer.

6-2 Assembly Level Repairs

The model MS2781A is designed to support assembly level repairs. Failed assemblies are not field repairable.

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: 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.

Caution: Proper Electro-static Discharge (ESD) precautions must be taken to avoid static damage to sensitive electronic devices and components found in this equipment. ESD damage is not covered under warranty.

Danger: Before attempting any repairs or disassembly of the instrument, ensure that the power cable is removed from the mains outlet. There is a risk of receiving a fatal electric shock if maintenance is performed with the power cord connected.

The following exchange assemblies are available from Anritsu MMD:

Table 6-1. Exchange Assembly List

Exchange Assembly	Description	Page
ND64400:	RF Deck	page 12
ND64401:	A4 YTO Driver/Ramp Generator Module	page 14
ND64402:	A5 YTO Coarse Loop Module	page 16
ND64403:	A6 Reference/Fine Loop Module	page 18
ND64404:	A7 Analog IF Module	page 20
ND64405:	A8 Analog Power Supply	page 22
ND64406:	A9 Digital Power Supply	page 22
ND64407:	A11 Digital IF Module	page 23
ND64408:	A12 VSA Module	page 24
ND64409:	A14 CPU Module	page 25
ND64410:	A15, A15A1 cPCI PMC Module and USB Hub	page 26
ND64411:	A17 Chassis Controller	page 28
ND64412:	A18/A19 Rear Panel I/O Assembly	page 29
ND64413:	A20 Front Panel Assembly	page 9
ND64414:	A22 Fan Control Module	page 33

The following replaceable parts are available from Anritsu MMD:

Table 6-2. Replaceable Part List

Replaceable Part	Description	Page
2000-1246:	GPIB-PMC Interface Module	page 26
ND64418:	USB Power Cable	page 26
ND66002:	Chassis Fan A/B Assembly	page 31
ND66003:	Chassis Fan C Assembly	page 31
40-161:	Chassis Standby Power Supply	page 34
2000-1230:	DVD/CDRW Drive	page 35
ND66005:	AC Input Module	page 37
ND66004:	Power Supply Cooling Fan Assembly	page 38
631-73:	6.3A, 250V Slow Blow Fuse	page 40

6-3 Remove and Replace Procedures

Signature uses a modular design offering ease of part replacement. The procedures in this chapter require the following equipment:

- Phillips Screwdrivers (eight inches or longer)
- Flat Blade Screwdrivers
- 5/16” Open End Wrench
- 5/16” Open End Torque Wrench, 8 in-lb

Note: Removing the chassis cover will break the calibration seals and void the instrument warranty.

Removing the Chassis Covers

Replacing assemblies and parts requires the removal of the chassis cover. The chassis cover is an integral unit that is held to the chassis with four phillips screws located on the rear panel.

Step 1. Remove the four rear panel mounting screws as shown in Figure 6-1, below.

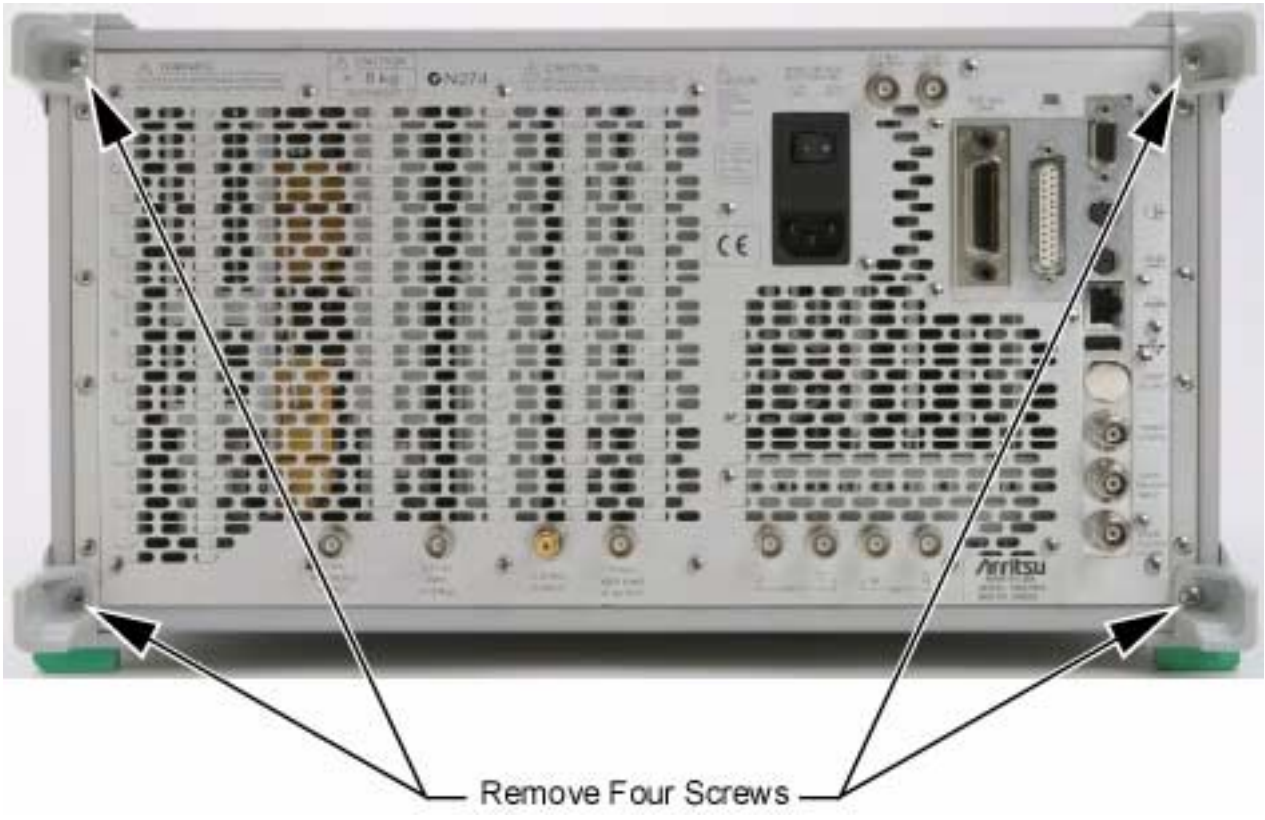


Figure 6-1. Chassis Cover Rear Panel Screws

Step 2. Place the instrument on it's front handles and slide the chassis cover off of the instrument (below left), then remove the inner cover screws (19) and remove the inner cover (below right).

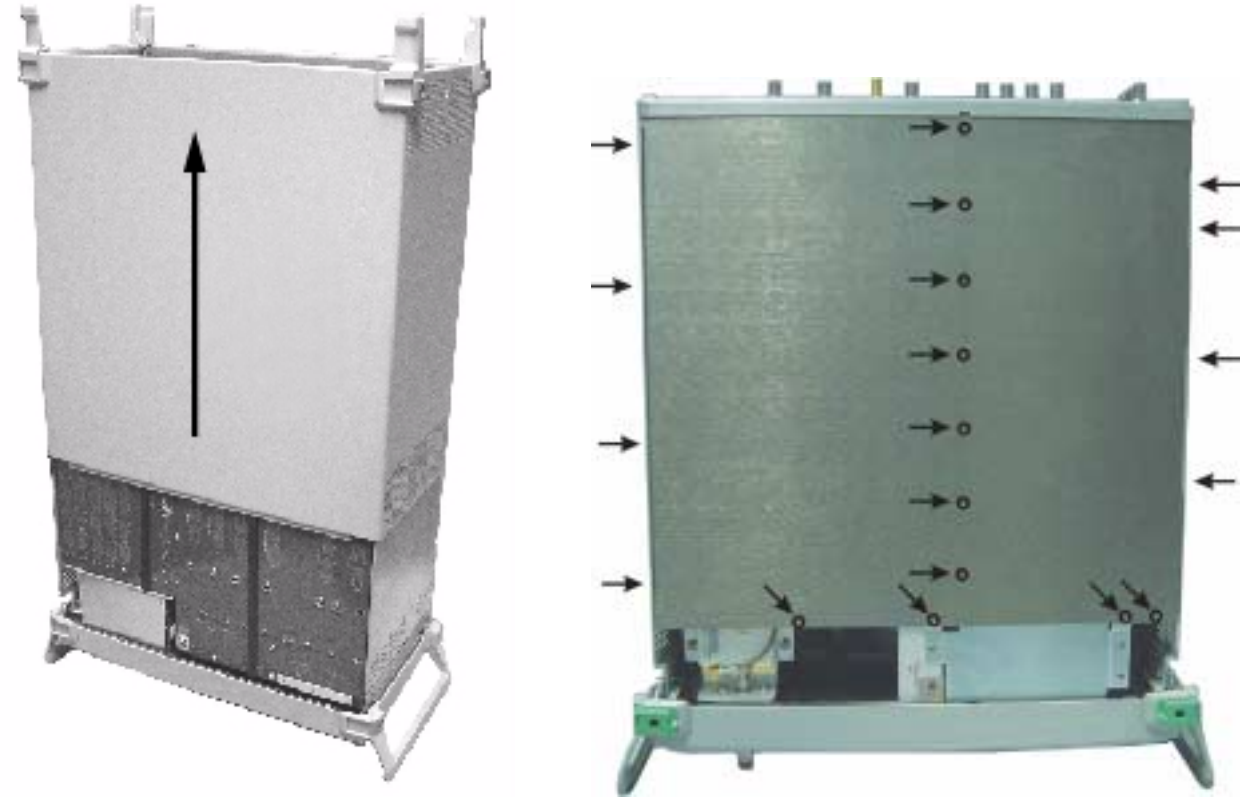


Figure 6-2. Chassis Cover Removal

Parts Layout Diagrams

Most of the modules and assemblies are accessed from the bottom of the instrument.

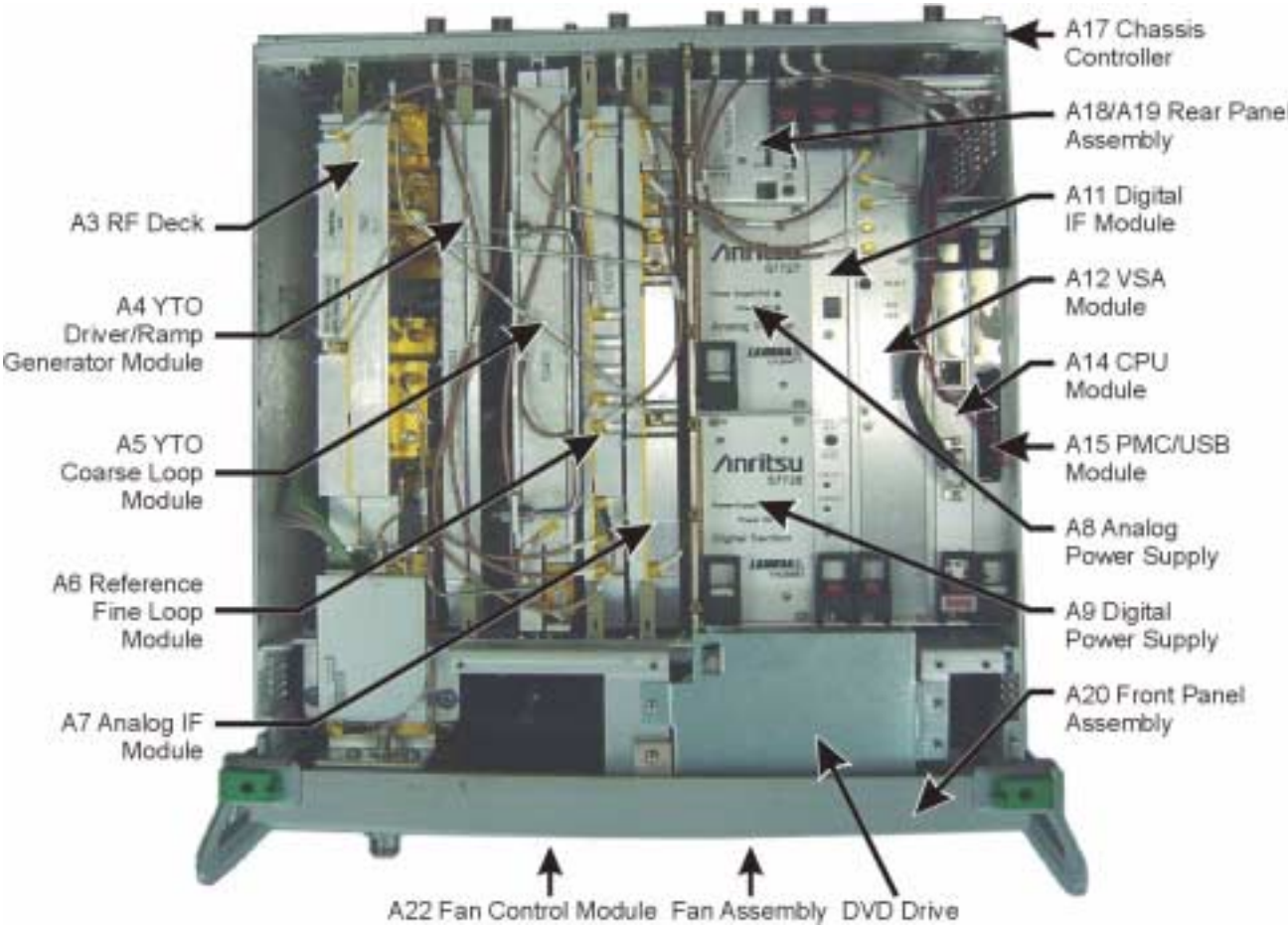


Figure 6-3. Parts Layout

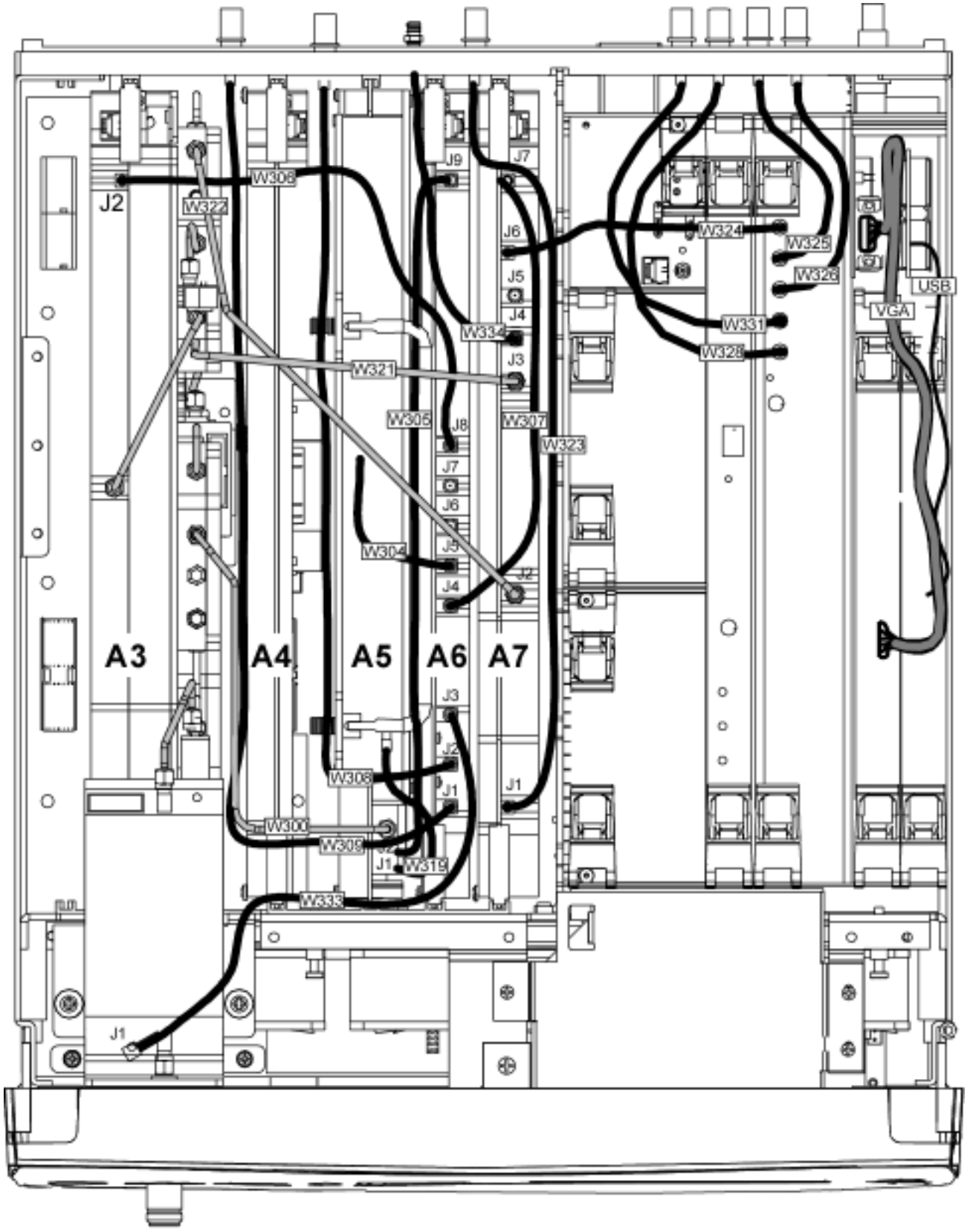


Figure 6-4. Parts Layout

Removing the A20 Front Panel

Step 1. Remove the RF Input connector nut.

Figure 6-5. RF Connector Nut

Step 2. Remove the front panel mounting screw from the bottom, middle of the chassis.

Figure 6-6. Front Panel Mounting

Step 3. Remove the three front panel mounting screws on each side of the chassis.

Figure 6-7. Front Panel Chassis Screws

Step 4. The front panel is mounted on slide rails. Pull the front panel away from the chassis as shown below.

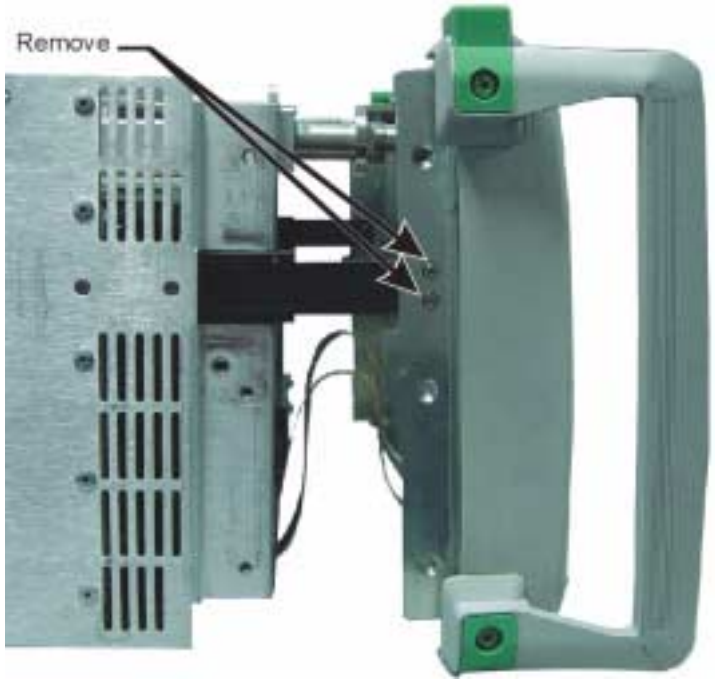


Figure 6-8. Front Panel Slide Rails

Warning: The front panel is interfaced through two fragile flex circuits. Take note of their location and ensure that they are not damaged or pulled during front panel removal.

Step 5. If the front panel is to be completely removed, remove the two screws that attach the front panel to the slide rails, Figure 6-8 above.

Step 6. With the front panel flat on the work surface, loosen the three finger nuts and remove the flex circuit strain relief.

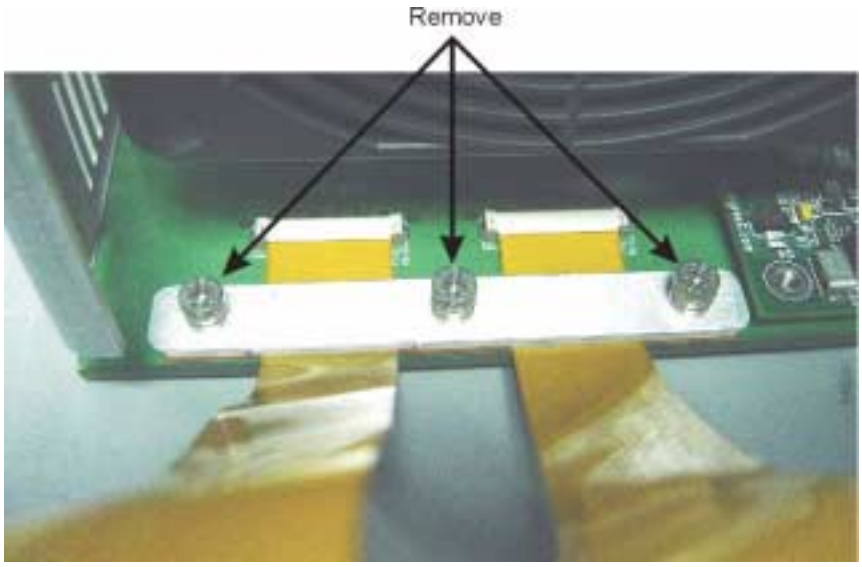


Figure 6-9. Front Panel Flex Circuit Strain Relief

Step 7. Gently pull back the flex circuit locking clamp, then gently pull the flex circuit out of the connector.

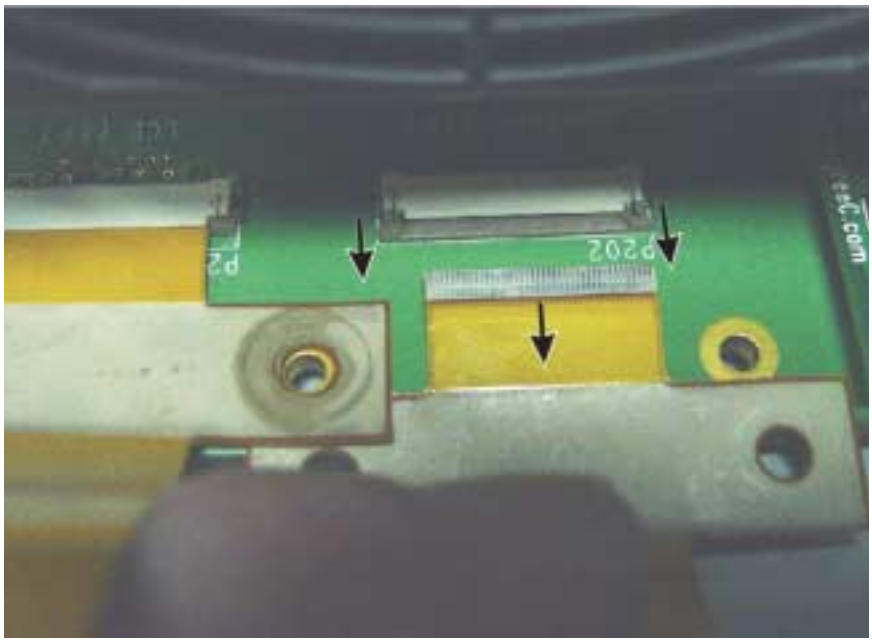


Figure 6-10. Front Panel Flex Circuit Removal

Step 8. Remove both of the flex circuits from the motherboard connectors and set the front panel aside.

Removing the A3 RF Deck

Step 1. Remove the A3 mounting screws (6) from the bottom of the motherboard.

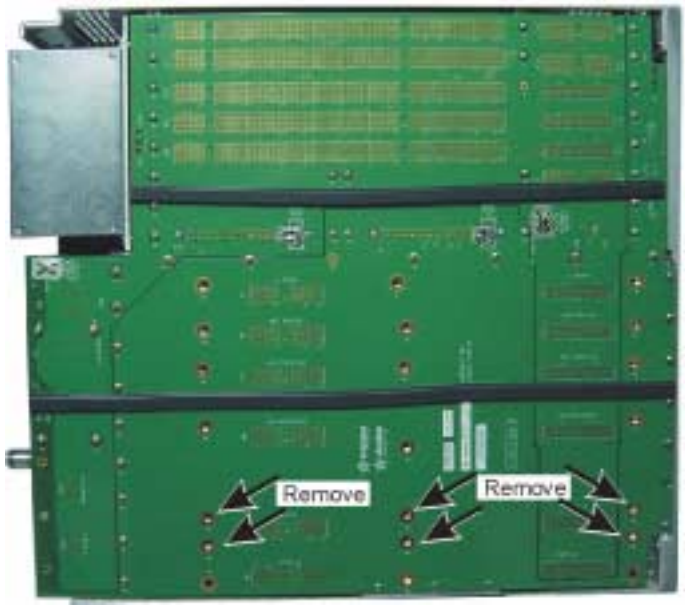


Figure 6-11. A3 Motherboard Screws

Step 2. Perform Step 1 through Step 4 of “Removing the A20 Front Panel” on page 9.

Step 3. Remove the two MCX cables from the front and back of the module, then remove the three RF cables at the A5 sampler and the A7. Also remove the two chassis mounting screws at the front of the module. (Refer to Figure 6-12 on the following page)

Warning: The RF cable at A7J3 must not be damaged or used with a replacement RF deck. The RF deck is calibrated with a specific cable that must be matched with the RF deck.

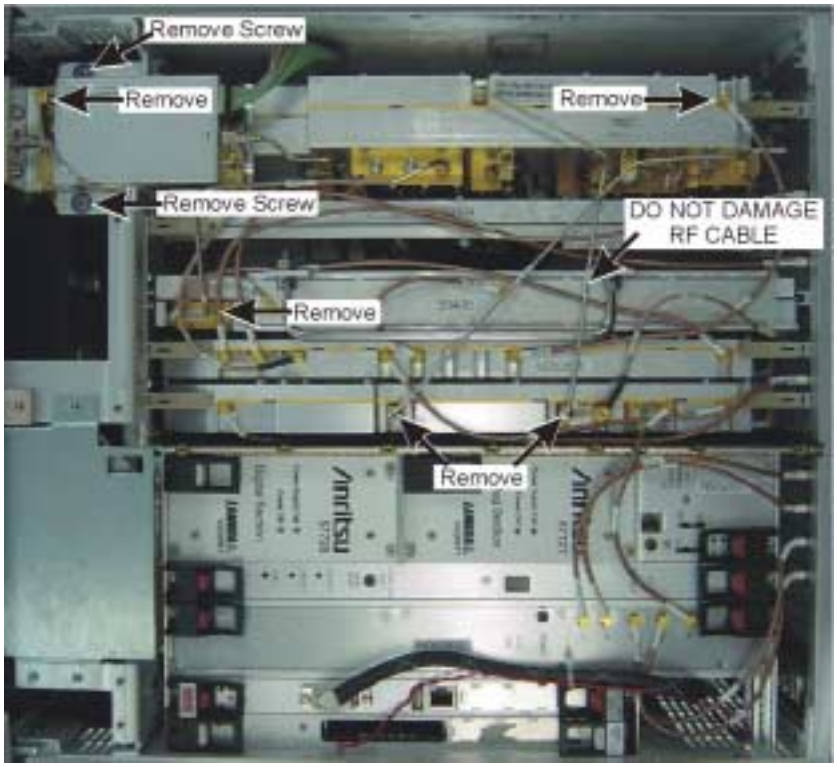


Figure 6-12. A3 Cables

Step 4. Lift the A3 RF deck with the lever and frame, and remove the ribbon cable.

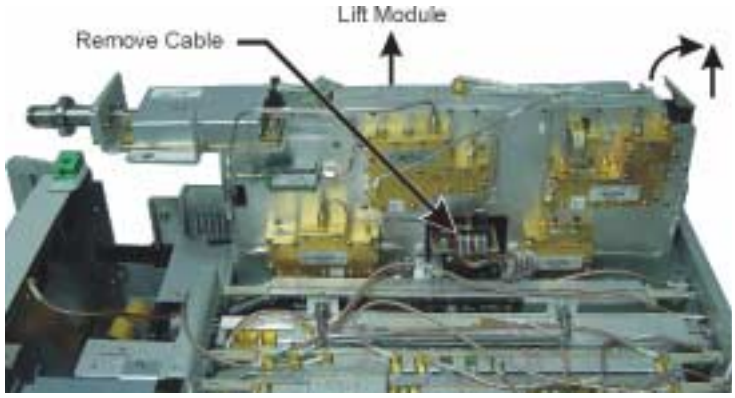


Figure 6-13. A3 Removal

Removing the A4 YTO Driver/Ramp Generator

Step 1. Remove the MCX cable from the A6J4 connector and move the cable aside.

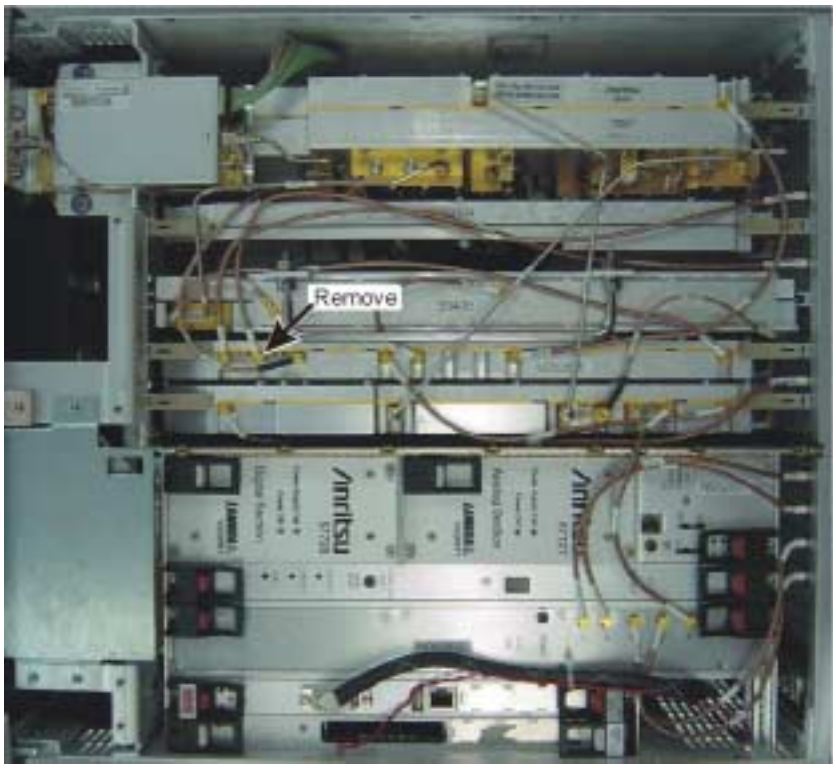


Figure 6-14. A4 Cables

Step 2. Remove the RF deck as described in “Removing the A3 RF Deck” on page 12.

Step 3. Remove the A4 mounting screws (3) from the bottom of the motherboard.

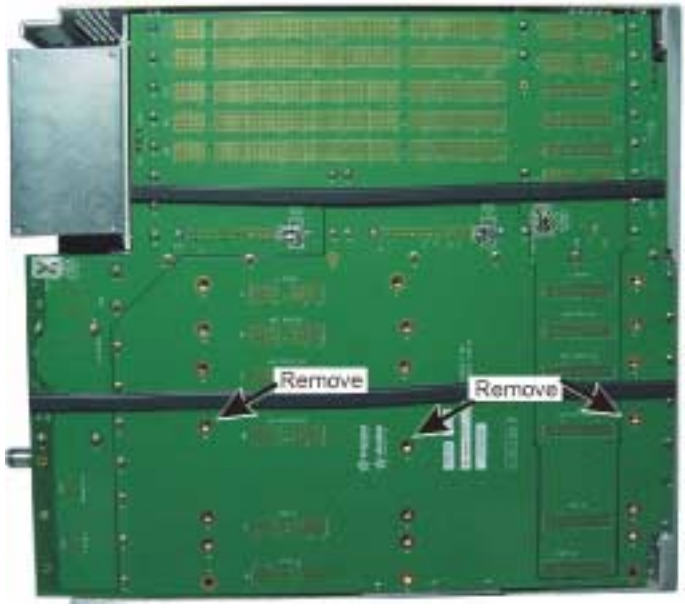


Figure 6-15. A4 Motherboard Screws

Step 4. Lift the A4 YTO driver/ramp generator module out from the chassis with the levers.

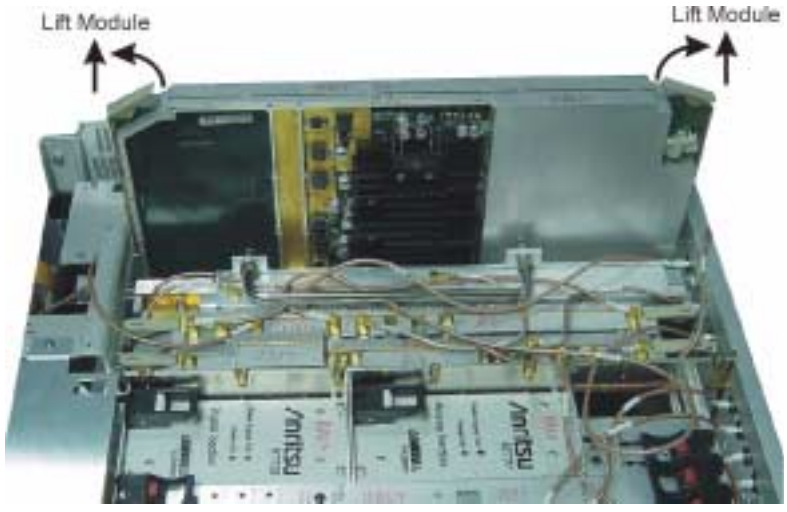


Figure 6-16. A4 Removal

Removing the A5 YTO Coarse Loop Module

Step 1. Remove the MCX cables at A6J1, A6J5, A6J8, A6J9 and move them aside.

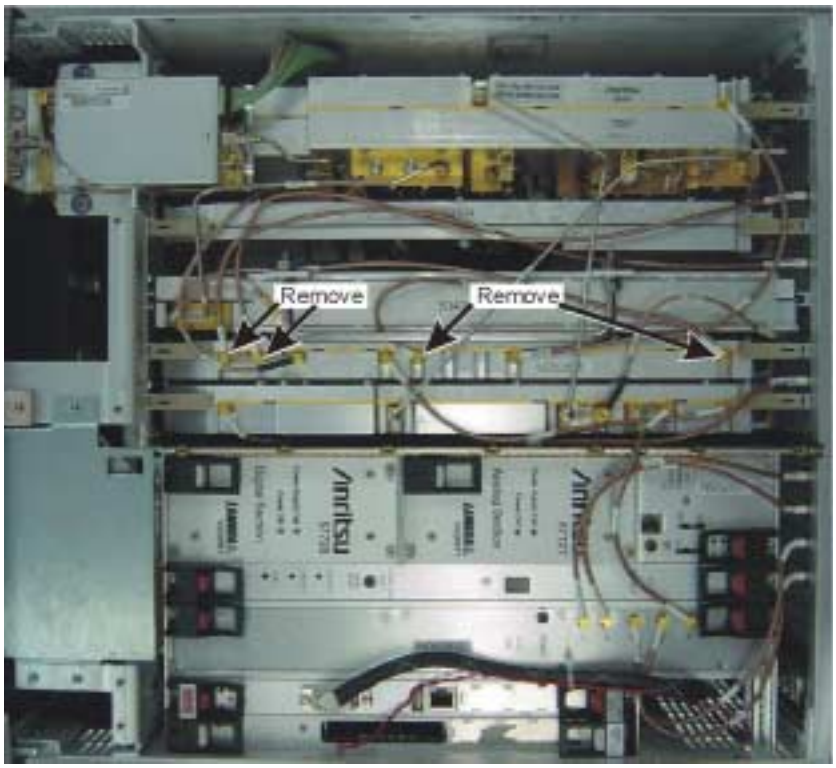


Figure 6-17. A5 Cables

Step 2. Remove the RF deck as shown in “Removing the A3 RF Deck” on page 12.

Step 3. Remove the mounting screws (2) from the bottom of the motherboard.

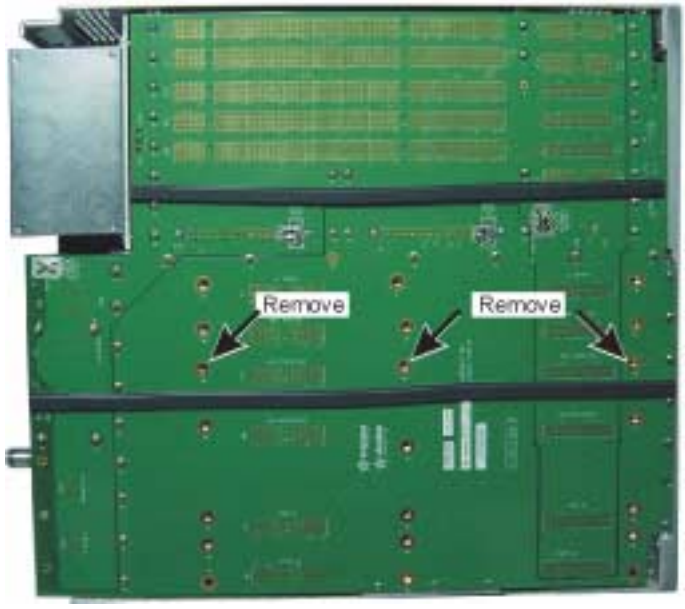


Figure 6-18. A5 Motherboard Screws

Step 4. Lift the A5 YTO coarse loop module out of the chassis using the handle.

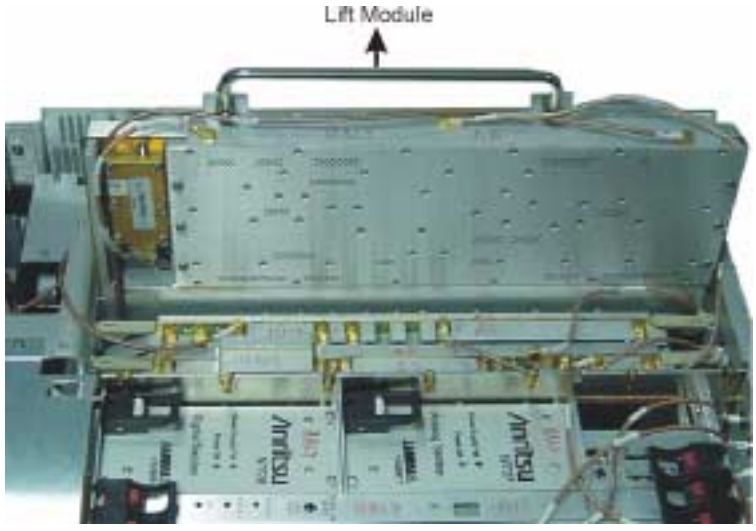


Figure 6-19. A5 Removal

Removing the A6 Reference/Fine Loop Module

Step 1. Remove all of the MCX cables from the A6 module and one RF/MCX cable from A7J4.

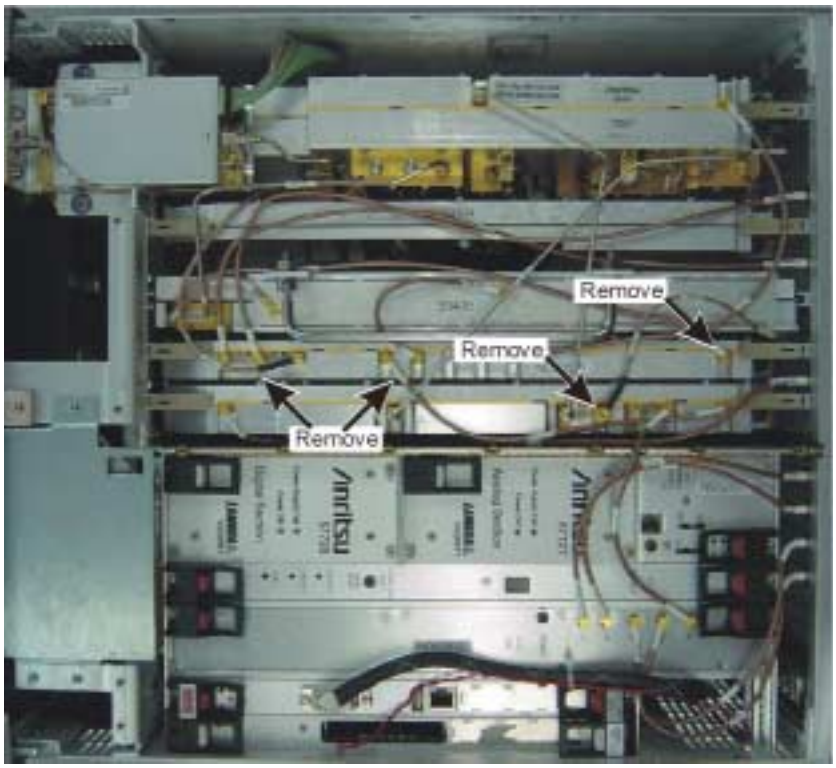


Figure 6-20. A6 Cables

Step 2. Remove the RF deck as shown in “Removing the A3 RF Deck” on page 12.

Step 3. Remove the mounting screws (2) from the bottom of the motherboard.

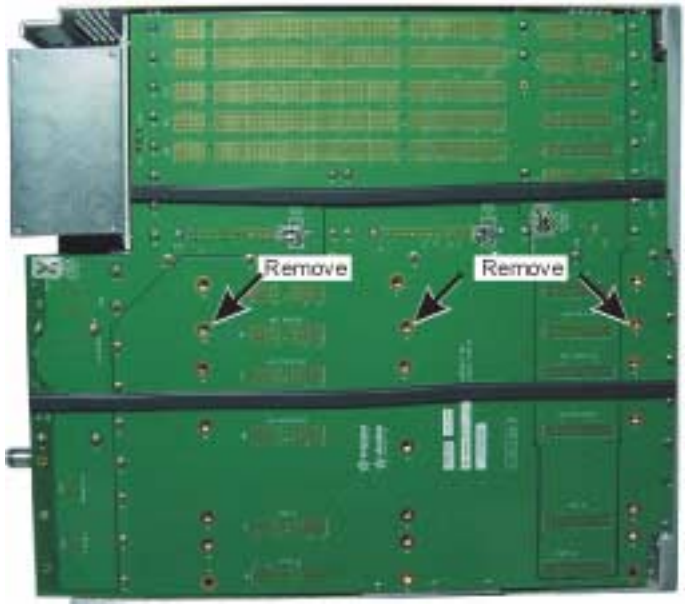


Figure 6-21. A6 Motherboard Screws

Step 4. Lift the A6 reference/fine loop module out from the chassis with the levers.

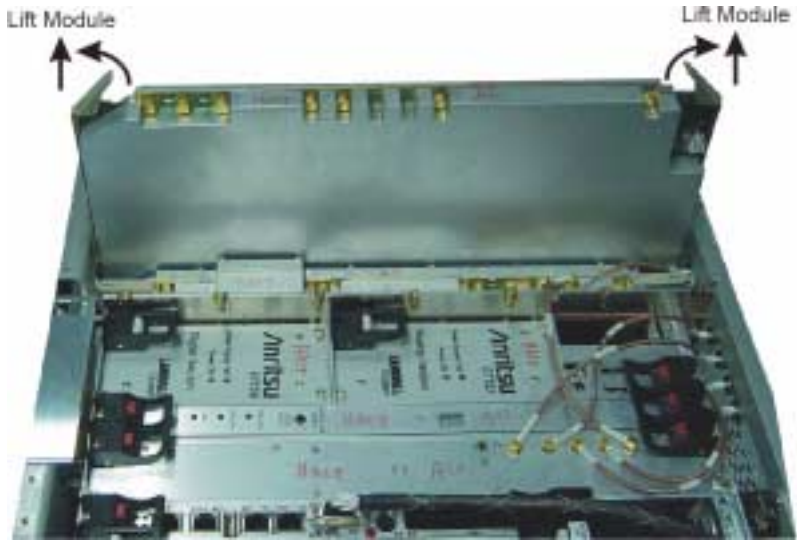


Figure 6-22. A6 Removal

Removing the A7 Analog IF Module

Step 1. Remove the MCX cables from the A7 module.

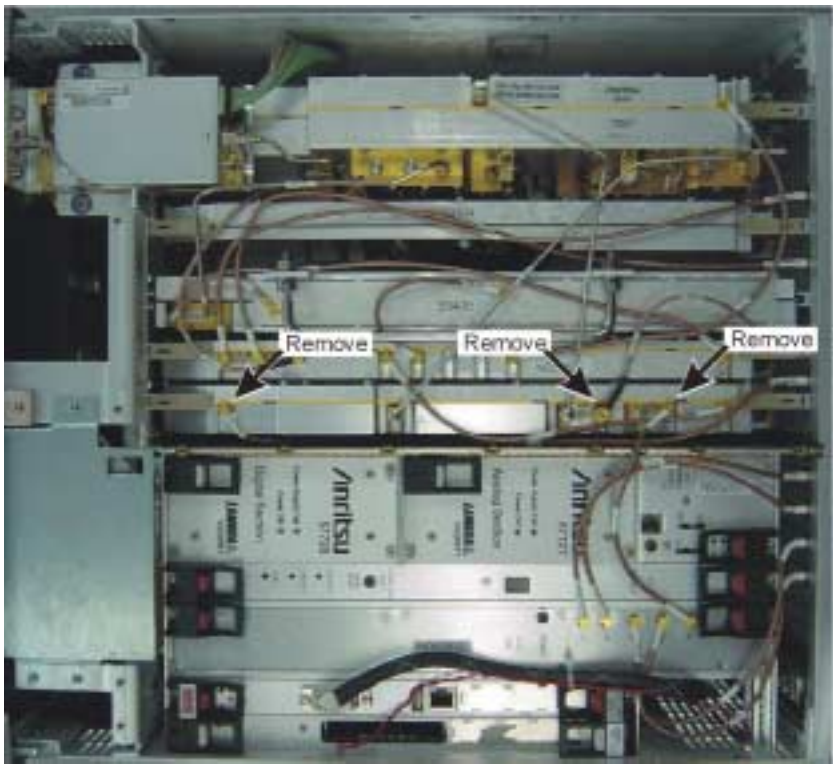


Figure 6-23. A7 Cables

Step 2. Remove the RF deck as shown in “Removing the A3 RF Deck” on page 12.

Step 3. Remove the mounting screws (2) from the bottom of the motherboard.

Figure 6-24. A7 Motherboard Screws

Step 4. Lift the A7 analog IF module out from the chassis with the levers.

Figure 6-25. A7 Removal

Removing the A8 Analog Supply

Step 1. Loosen the four mounting screws.

Step 2. Lift the supply module out of the chassis with the lever.

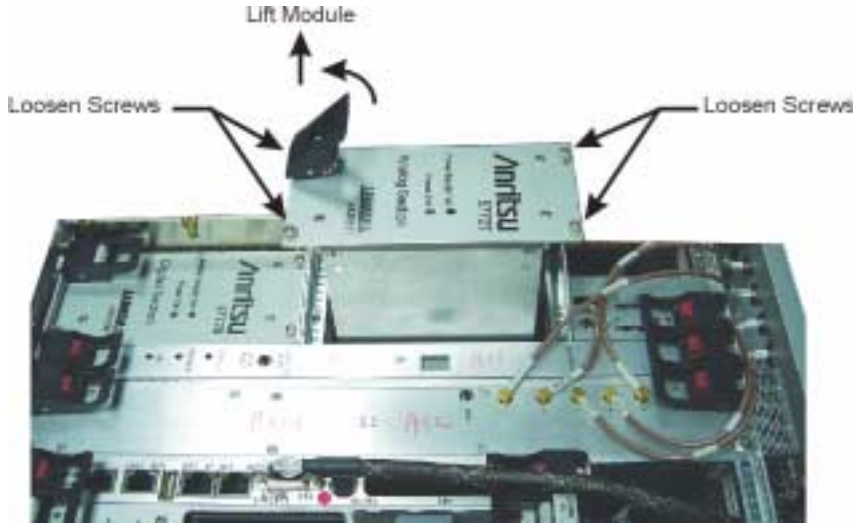


Figure 6-26. Analog Supply Removal

Removing the A9 Digital Supply

Step 1. Loosen the four mounting screws.

Step 2. Lift the supply module out of the chassis with the lever.

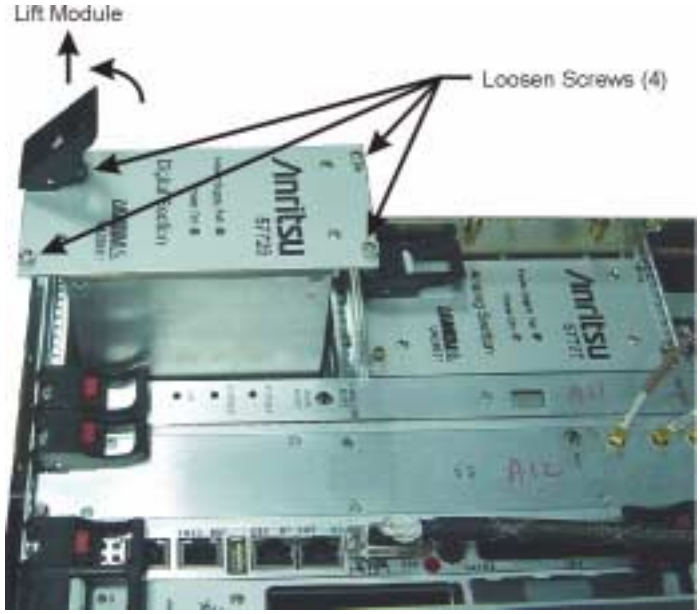


Figure 6-27. Digital Supply Removal

Removing the A11 Digital IF

Step 1. Remove the three MCX cables from the A12 marked **–1**, **+1**, and **IF** and move them aside.

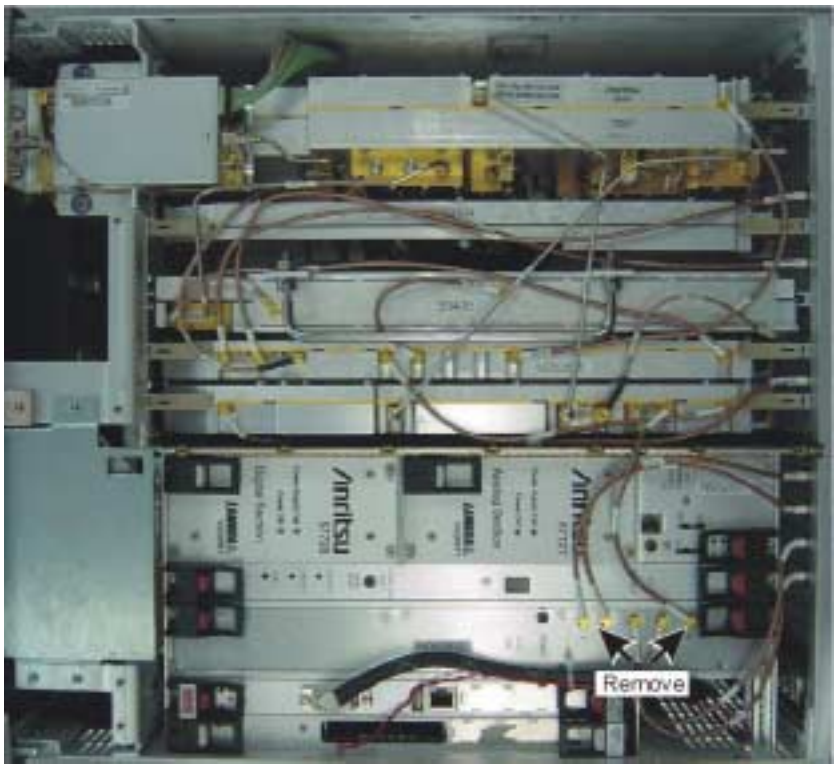


Figure 6-28. A11 Cables

Step 2. Loosen the two mounting screws and lift the A11 digital IF module out of the chassis with the levers.

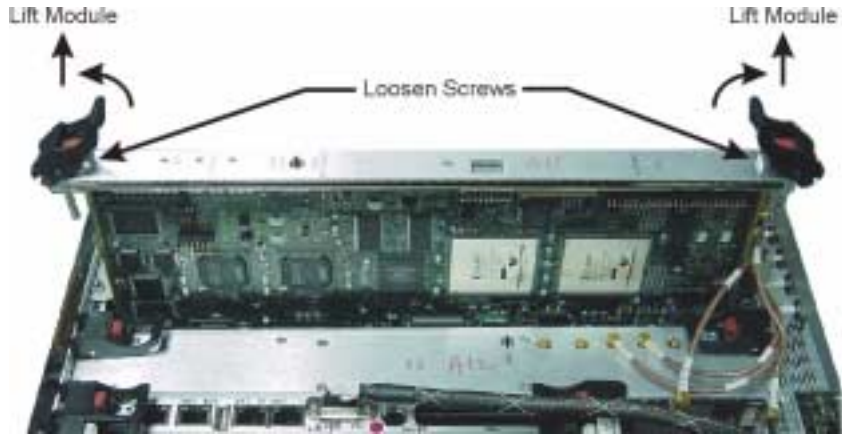


Figure 6-29. A11 Removal

Removing the A12 VSA

Step 1. Remove the five MCX cables from the A12 VSA module and move them aside.

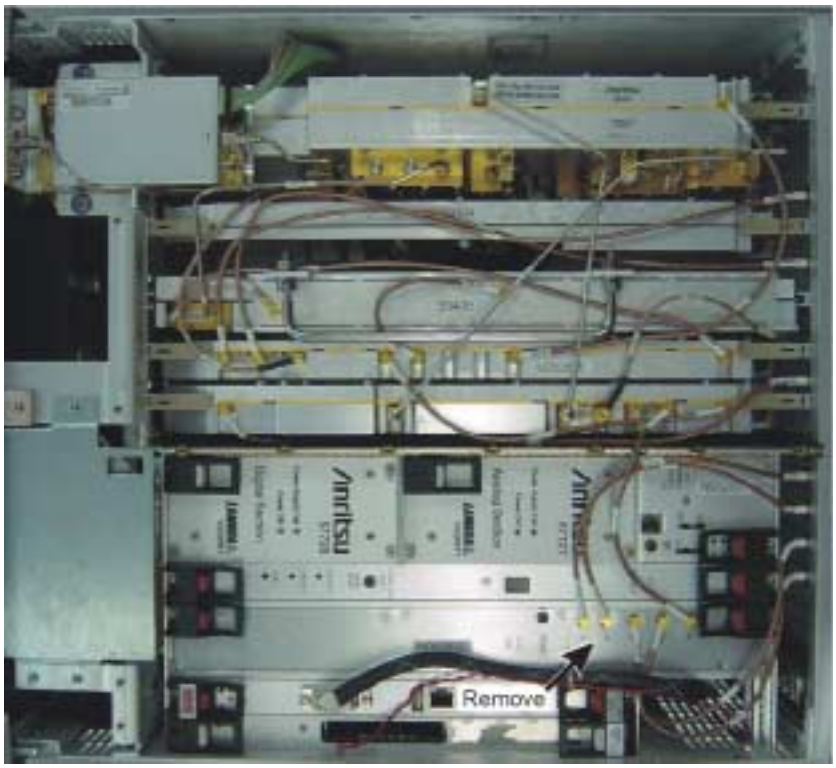


Figure 6-30. A12 Cables

Step 2. Loosen the two mounting screws and lift the A12 VSA module out of the chassis with the levers.

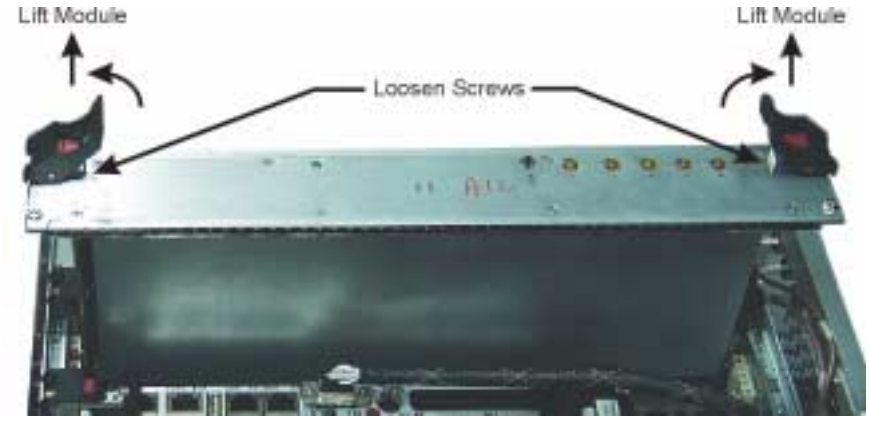


Figure 6-31. A12 Removal

Removing the A14 CPU Module

Step 1. Remove the VGA cable from the CPU module and move it aside.

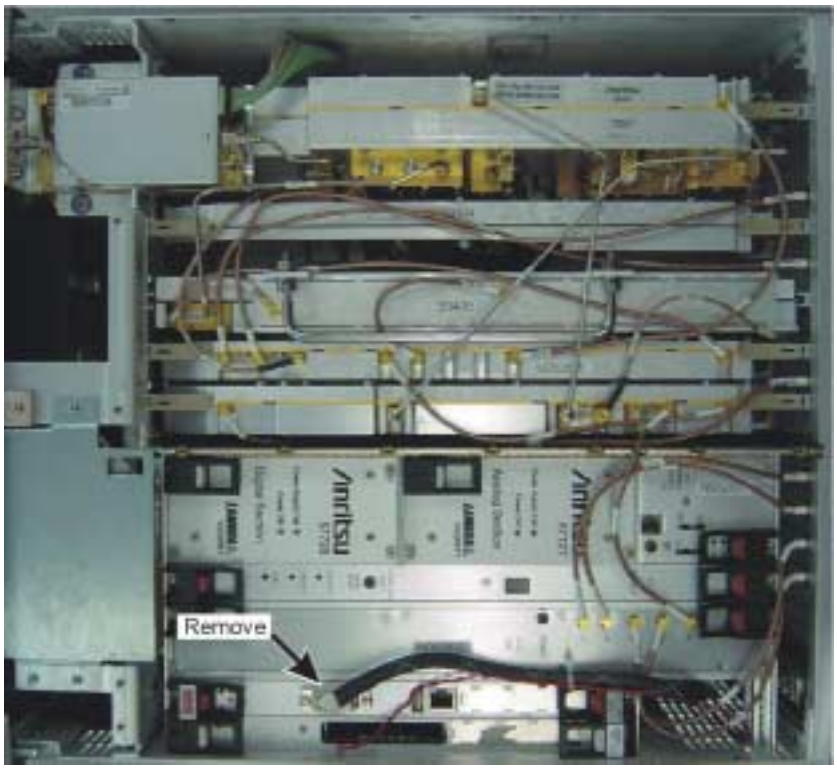


Figure 6-32. CPU VGA Cable

Step 2. Loosen the two mounting screws and lift the CPU module out of the chassis with the levers.

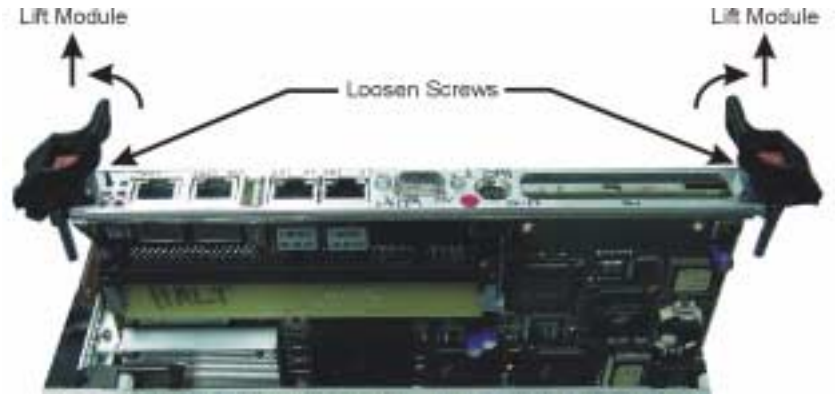


Figure 6-33. CPU Removal

Removing the A15 GPIB/USB Hub

Step 1. Remove the bias cable from the GPIB/USB hub.

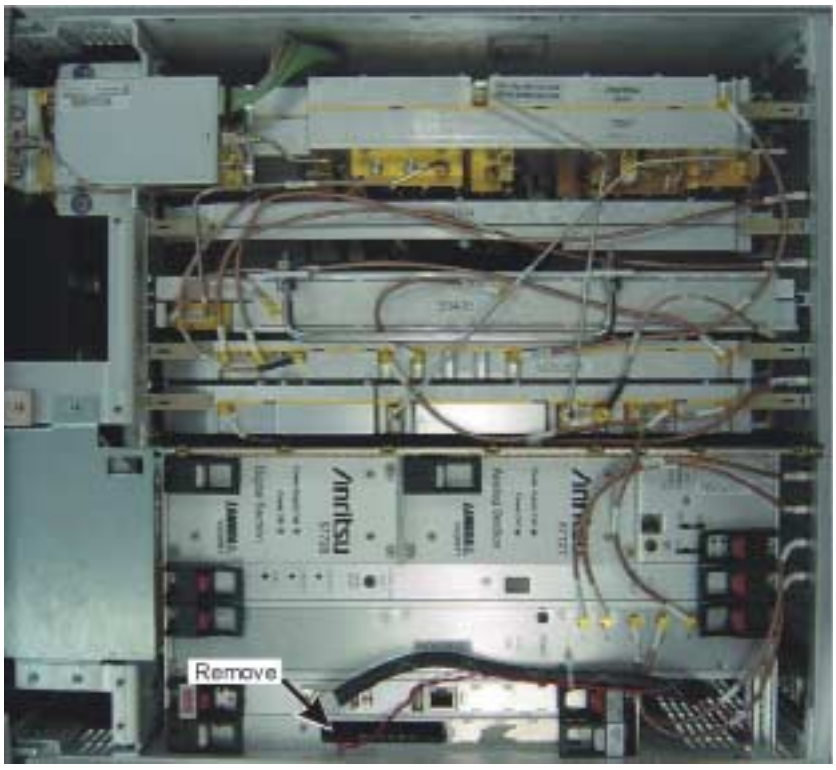


Figure 6-34. GPIB/USB Hub Cable

Step 2. Loosen the two mounting screws and lift the GPIB/USB hub module out of the chassis with the levers.

Figure 6-35. GPIB/USB Hub Removal

The A15 and USB Hub (A15A1) are an integral assembly that must be replaced as a single assembly. The GPIB-PMC interface module can be replaced as a seperate unit or must be reused when replacing the A15/A15A1 assembly.

Step 3. Remove the four screws from the GPIB-PMC module and pull the module straight off of the interface PCB.

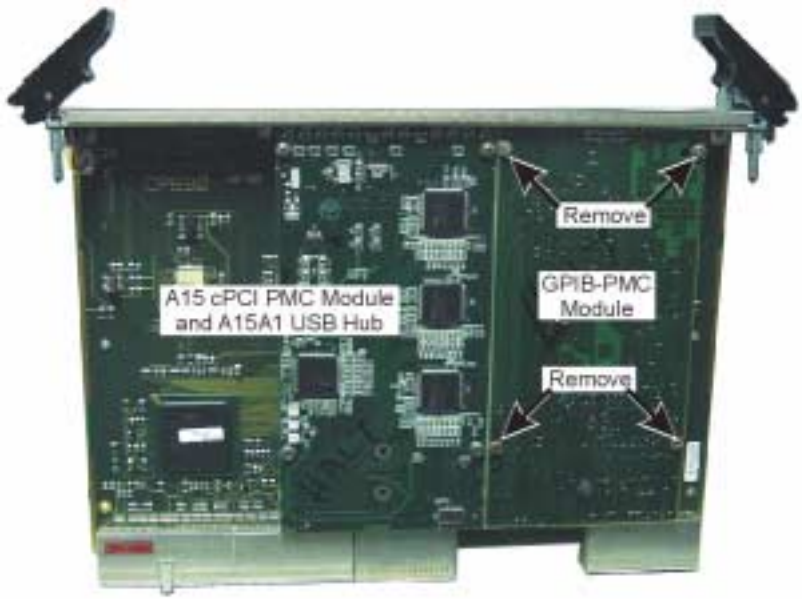


Figure 6-36. GPIB/USB Hub Module Removal

Removing the A17 Chassis Control Module

Step 1. Loosen the mounting screw.

Step 2. Lift the chassis control module out of the chassis with the lever.

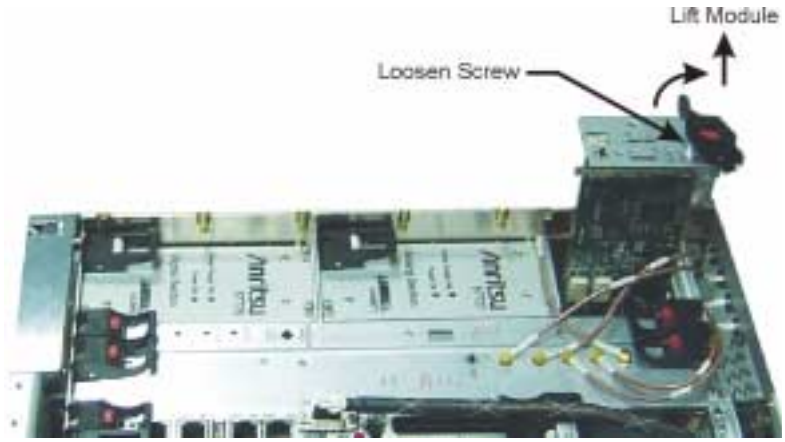


Figure 6-37. Chassis Control Module Removal

Removing the A18/ A19 Rear Panel I/O Assembly

Step 1. Remove the VGA cable from the rear panel I/O assembly.

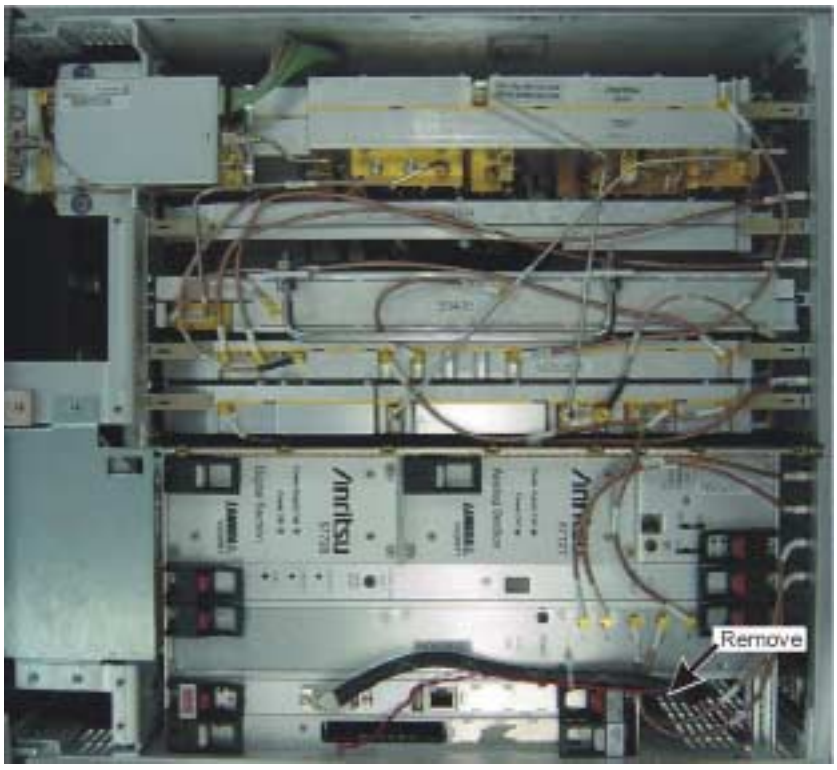


Figure 6-38. A18/19 VGA Cable

Step 2. Remove the rear panel grill screws (25).

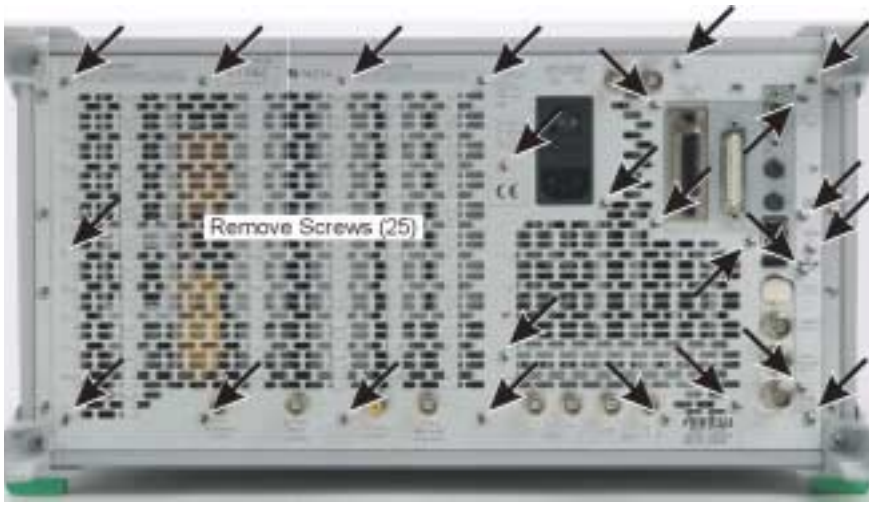


Figure 6-39. Rear Panel Grill Screws

Step 3. Pull the grill away from the chassis (remove MCX cables as required).

Figure 6-40. Rear Panel Grill

Step 4. Pull the A18/A19 rear panel assembly off of the mother-board connector and remove the assembly from the chassis.

Figure 6-41. A18/A19 Removal

Removing the Fan Assembly

Step 1. Remove the front panel as described in "Removing the A20 Front Panel" on page 9.

Step 2. Remove the DVD as described in "Removing the DVD Drive" on page 35.

Step 3. Remove the three supply leads, then loosen the six fan assembly mounting screws.

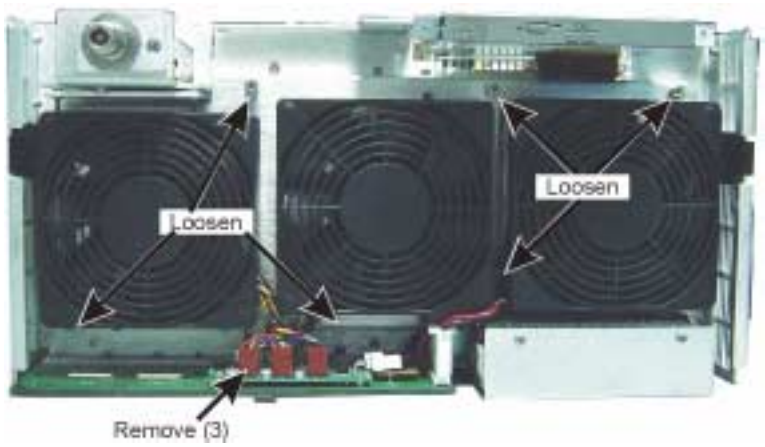


Figure 6-42. Fan Assembly Screws and Supply Leads

Warning: When removing the fan assembly, ensure that the DVD flex circuit is not damaged as it is routed between two fans within the fan assembly.

Step 4. Remove the fan assembly.

Figure 6-43. Fan Assembly Removal

The fan assembly consists of two part numbers:

- Chassis Fan A/B Assembly, ND66002
- Chassis Fan C Assembly, ND66003

Step 5. Remove the failed fan assembly by removing the fan retaining nuts from the fan mounting bracket and replace the fans.

Figure 6-44. Fan Assembly Removal

Removing the A20 Fan Control Module

Step 1. Remove the fan assembly as described in "Removing the Fan Assembly" on page 31.

Step 2. Remove the four mounting screws from the bottom of the motherboard.

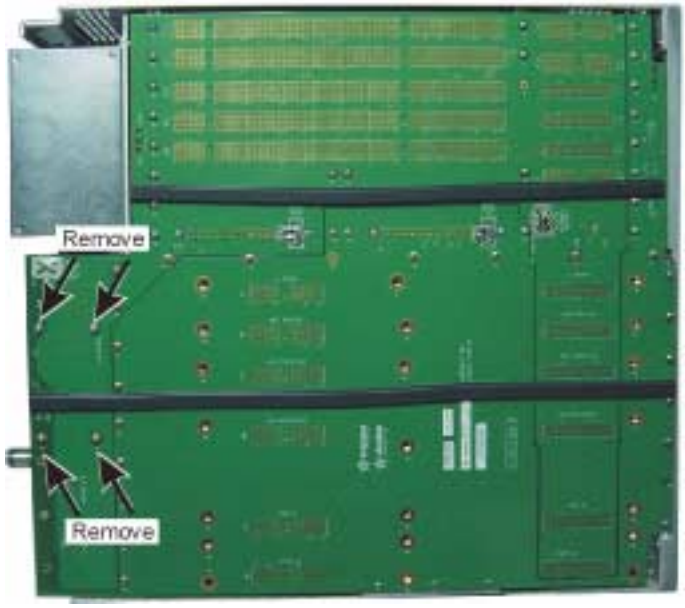


Figure 6-45. Fan Control Module Motherboard Screws

Step 3. Unplug the fan control and lift the module straight off of the motherboard connector.

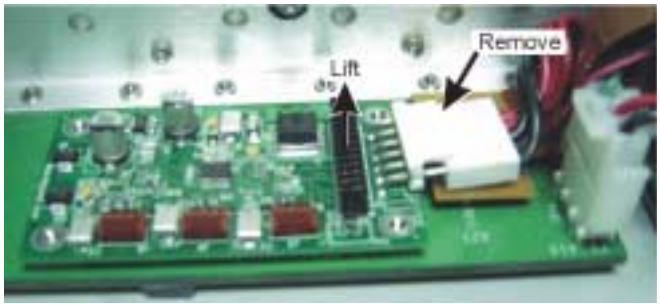


Figure 6-46. Fan Control Module Removal

Removing the Standby Supply

Step 1. Remove the front panel as described in "Removing the A20 Front Panel" on page 9.

Step 2. Remove the four mounting screws from the standby supply.

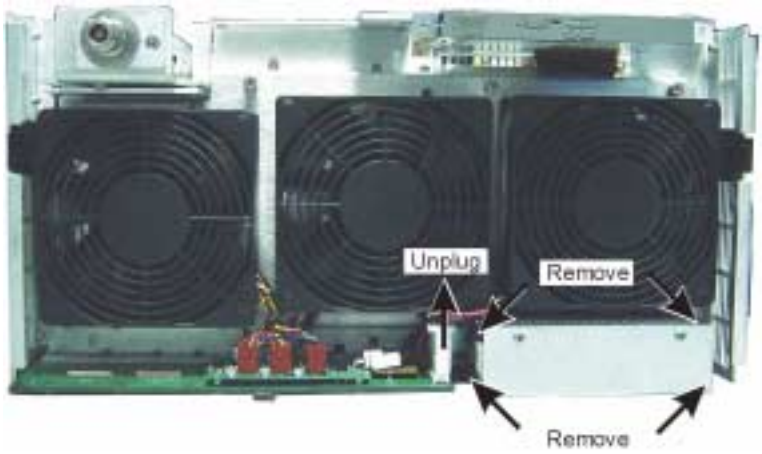


Figure 6-47. Standby Supply Removal

Step 3. Unplug the supply input, output, and ground connectors and remove the supply from the chassis.

Step 4. Remove the supply top cover.

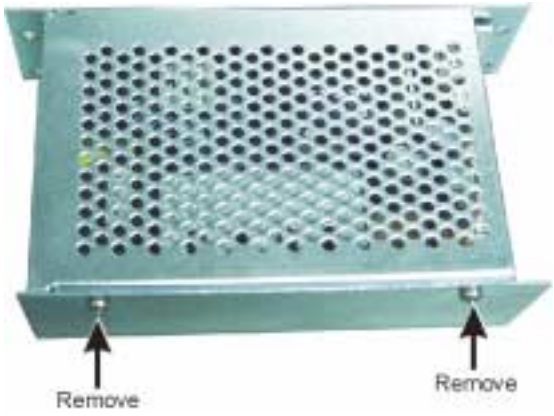


Figure 6-48. Standby Supply Cover Removal

Step 5. Remove the four mounting screws and remove the power supply from its housing.

Figure 6-49. Standby Supply Removal

Removing the DVD Drive

Step 1. Perform Step 1 through Step 4 of "Removing the A20 Front Panel" on page 9 to slide the front panel away from the chassis.

Step 2. Remove the three DVD mounting screws.

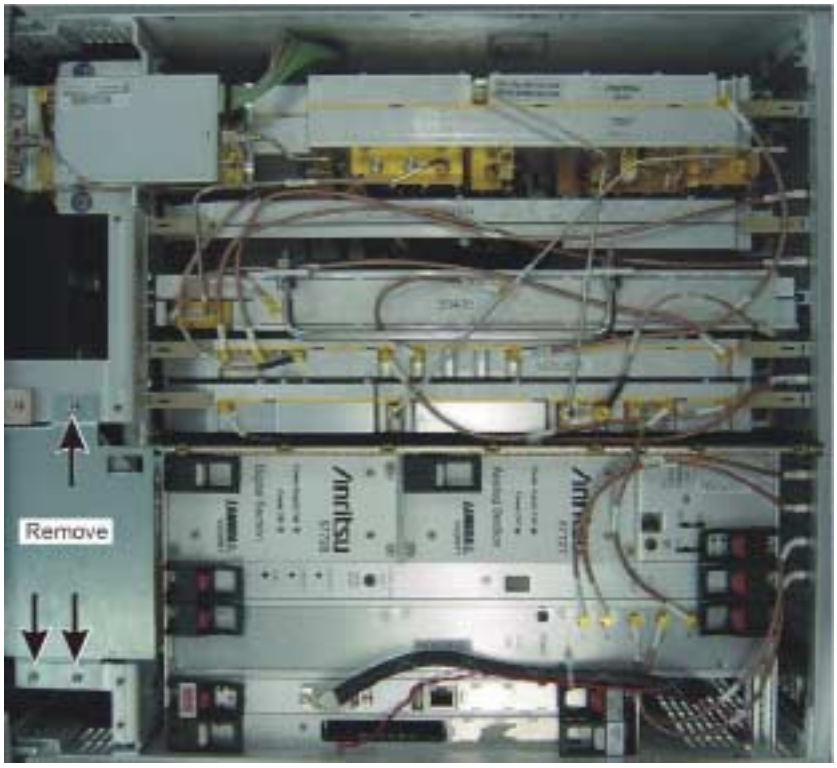


Figure 6-50. DVD Drive Removal

Step 3. Remove the two flex circuit mounting screws.

Figure 6-51. DVD Drive Flex Circuit Screws

Step 4. Carefully pull the flex circuit from the DVD connector and remove the DVD drive.

Figure 6-52. DVD Drive Flex Circuit Removal

EMI Filter Removal

Step 1. Perform Step 2 and Step 3 of the "Removing the A18/A19 Rear Panel I/O Assembly" on page 29.

Step 2. Remove the EMI filter mounting screws.

Figure 6-53.

Step 3. Unplug the EMI filter from the motherboard and remove the filter from the chassis.

Power Supply Fan Removal

Step 1. Remove the analog power supply as described in “Removing the A8 Analog Supply” on page 22.

Step 2. Remove the rear panel grill screws (25).

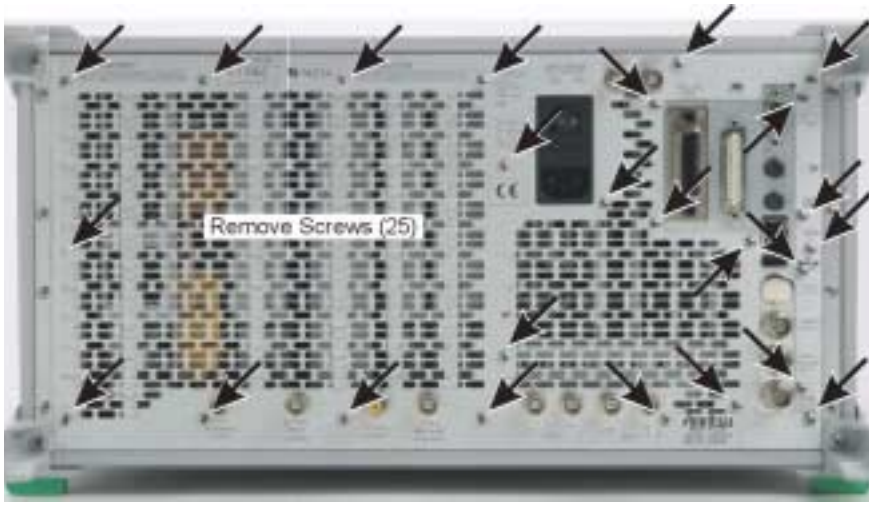


Figure 6-54. Rear Panel Grill Screws

Step 3. Pull the grill away from the chassis (remove MCX cables as required).

Figure 6-55. Rear Panel Grill

Step 4. Using a long Phillips screwdriver, remove the eight fan mounting screws (refer to the detail below).

Figure 6-56. Power Supply Fan Removal

Figure 6-57. Removing Fan Screws

Step 5. Unplug the fans from the chassis control module and remove the fans from the chassis.

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.

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 on the rear panel power receptacle to open the fuse block cover and gain access to the fuse holder.

Figure 6-58. Opening the Rear Panel Fuse Cover

Step 3. Slide out the fuse holder.

Figure 6-59. Replacing the Rear Panel Fuses

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.

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

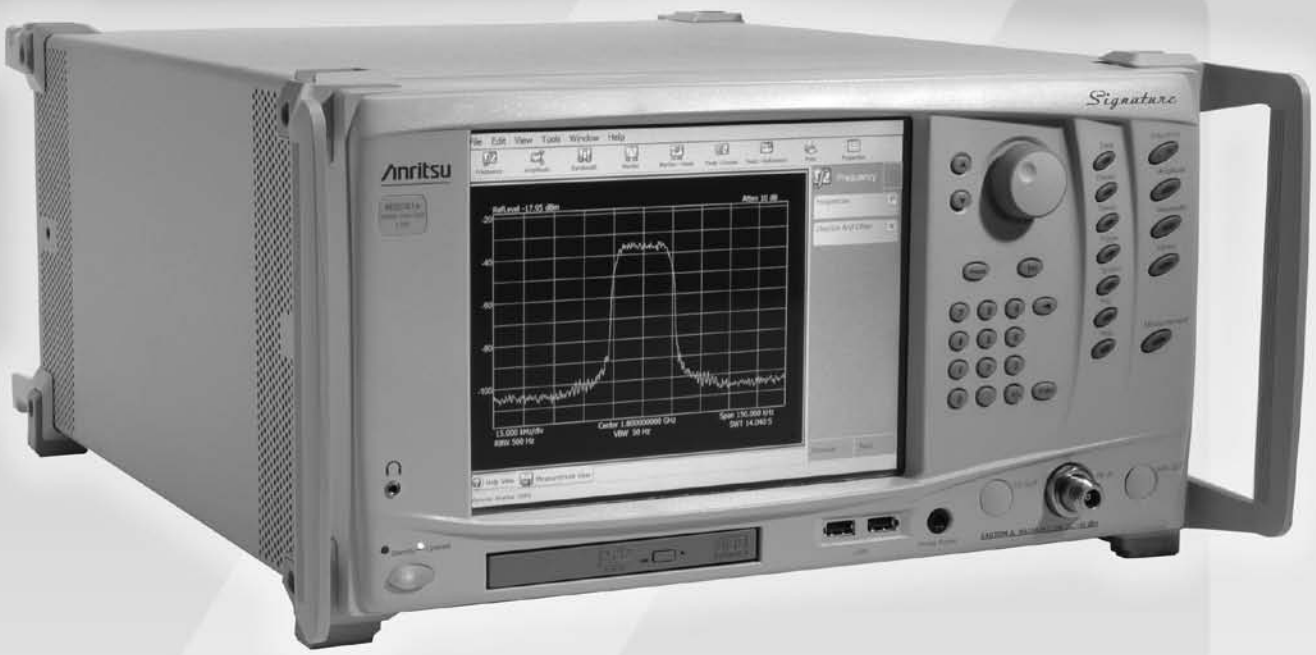
Technical Datasheet

Anritsu

Signature™

High Performance Signal Analyzer

100 Hz to 8 GHz



Version 2.0

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.

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.

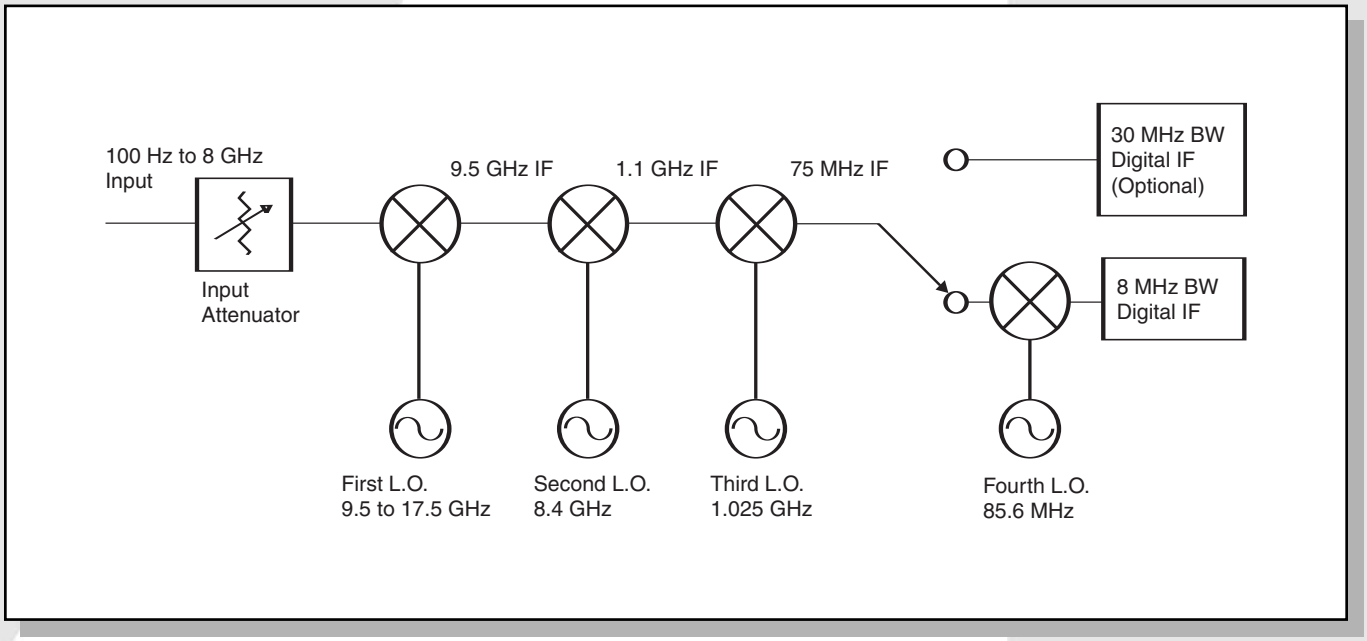


Figure 1, Signature RF block diagram (L.O. frequencies are nominal values)

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 (with Option 22):
30 MHz (50 MHz with anti-alias filter off)

FFT

FFT RBWs: 0.1 Hz to 100 kHz (1,2,3,5)

Maximum Span for FFT:

Standard: 1 MHz
With Option 22: 30 MHz

FFT Span/RBW: ≤10,000

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: <–147 dBm
2.5 GHz to 7 GHz: <–145 dBm
7 GHz to 8 GHz: <–143 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

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

Adjacent Channel Power Ratio (ACPR):

Standards Measured: WCDMA (UMTS), user defined

Offsets Measured: Up to 6

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

GPIB Interface (Option 3)

SH1, AH1, T6, SR1, RL1, PP0, DC1, C0 or C1

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

QAM/PSK Modulation Analysis (Option 38, Requires Option 22)

Modulation Analysis BW: 30 MHz, 50 MHz with anti-alias filter turned off

Symbol Rate Range: 10 kHz to 20 MHz, 30 MHz with anti-alias filter turned off

Modulation Formats: BPSK, QPSK, π/4 DQPSK, 8 PSK, 3π/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, superimposed on the Signature measurement display. MATLAB 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
- IQ vectors

IQ vector parameters:

- Sample rate: 25k to 50M samples/sec (14 settings)
- Capture Length: 100 to 10M samples, 1.28 sec max
- Bandwidth: Varies with sample rate; 30 MHz max, 50 MHz with anti-alias filter turned off

Handshake: On/Off

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 = 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

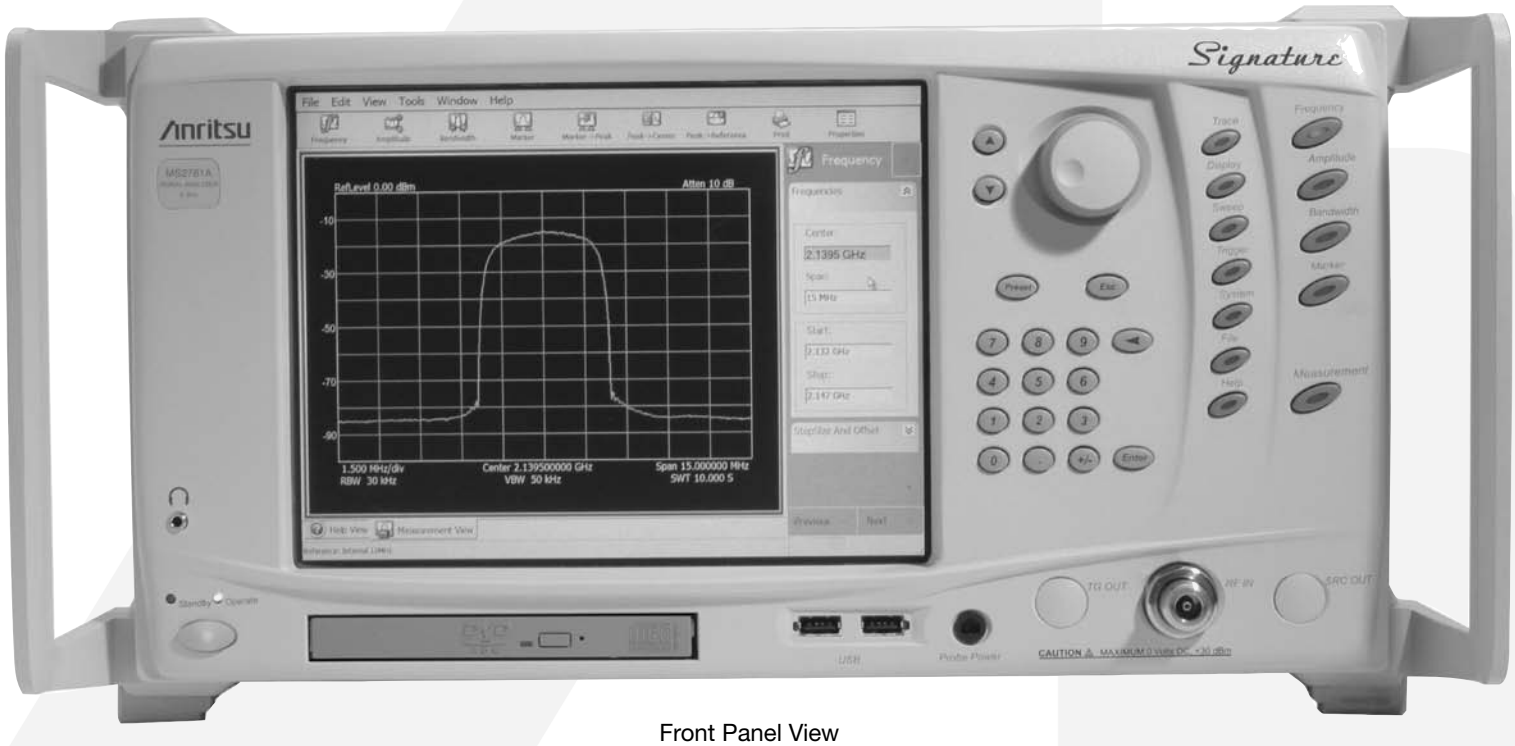
Note 9

Spurious performance for 30 MHz FFT span may be degraded when attenuation is set manually

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.

Front Panel Inputs and Outputs

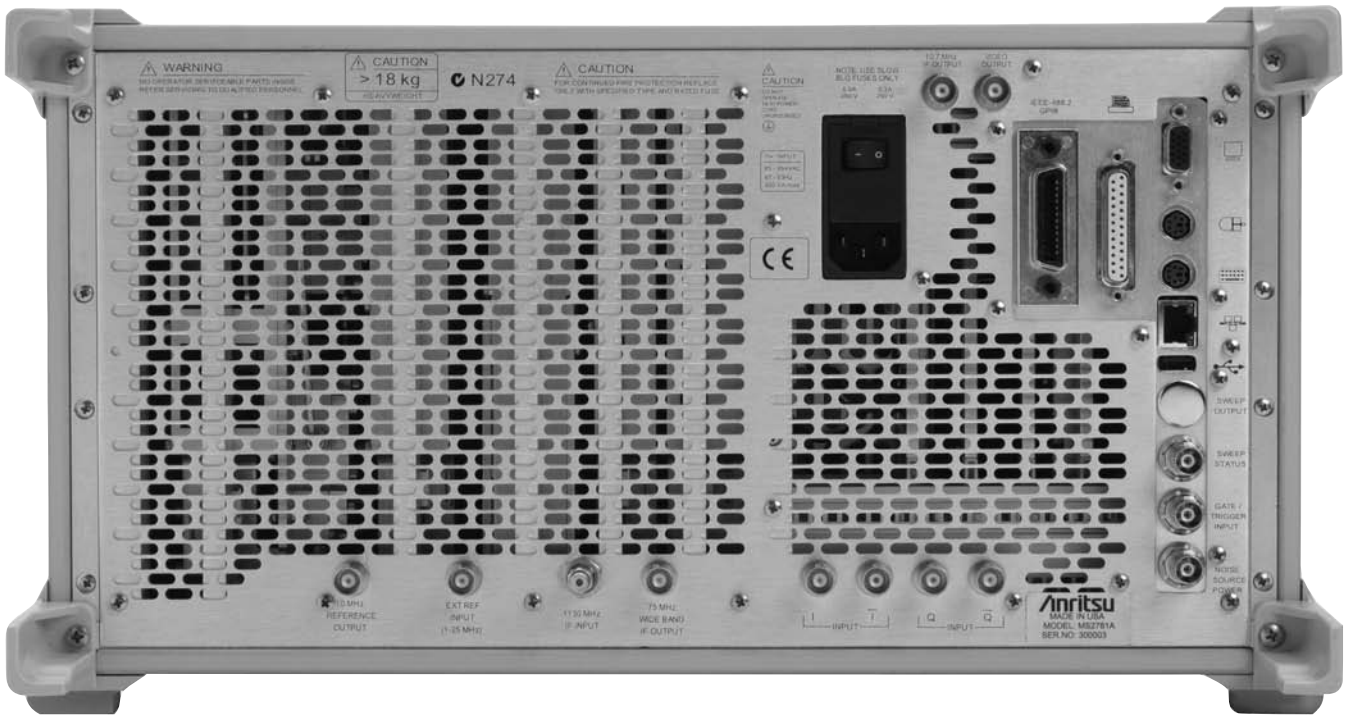


Front Panel View

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



Rear Panel View

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
MS2780/22	30 MHz Demodulation Bandwidth (includes baseband differential I & Q inputs)
MS2780/38	QAM/PSK Modulation Analysis (requires Option 22)
MS2780/40	Connectivity to MATLAB
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

SALES CENTERS:
United States (800) ANRITSU
Canada (800) ANRITSU
South America 55 (21) 2527-6922
Europe 44 (0) 1582-433433
Japan 81 (46) 223-1111
Asia-Pacific (852) 2301-4980
Microwave Measurements Division
490 Jarvis Drive, Morgan Hill, CA 95037-2809
http://www.us.anritsu.com

Anritsu

Discover What's Possible®

11410-00333 Rev. E

Subject Index

N

O

P

R

S

T

U

V

W