

Service Guide

Agilent Technologies PNA Series RF Network Analyzers E8356A, E8357A, and E8358A



Agilent Technologies

Part Number E8356-90002

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The regulatory and warranty information is located in [Chapter 8](#), “[Safety and Regulatory Information](#).”

Assistance

Product maintenance agreements and other customer assistance agreements are available for Agilent Technologies, Inc. products. For any assistance, contact your nearest Agilent Technologies, Inc. sales or service office. See [Table 1-1 on page 1-10](#) for the nearest office.

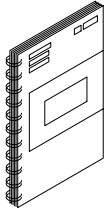
Safety Notes

The following safety notes are used throughout this manual. Familiarize yourself with each of the notes and its meaning before operating this instrument. All pertinent safety notes for using this product are located in [Chapter 8](#) , “[Safety and Regulatory Information](#).”

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

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

Documentation Map



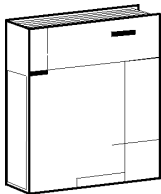
The *Installation and Quick Start Guide* provides procedures for installing, configuring, and verifying the operation of the analyzer. It also contains the basic operating instructions for the analyzer.



The **CD-ROM** provides the *Installation and Quick Start Guide*, the *Service Guide*, and the on-line network analyzer embedded help in PDF format for viewing or printing from a personal computer (PC). It also provides the network analyzer product overview multimedia presentation and the on-line network analyzer embedded help in formats that can be used on your PC.



The optional *Service Guide* provides information on troubleshooting and servicing your analyzer.



This optional printed version of the on-line network analyzer embedded help provides the help system in printed form.

How to Use This Guide

This guide uses the following text font conventions:

Front Panel Key

This text font represents a key physically located on the instrument.

Windows Interface

This text font represents window titles, menu items, or dialog box selections in the network analyzer or the Microsoft® Windows® 2000 Professional PC operating system and applications.

Screen Text

This text font represents text displayed on the instrument's screen.

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1 General Information, Analyzer Options, and Service Equipment

Information in This Chapter

Chapter One at-a-Glance

Section Title	Summary	Start Page
General Information	Information about cleaning, obtaining assistance with repairs, and shipping your analyzer to Agilent.	Page 1-3
Analyzer Options and Upgrades	List of the options available for the E8356A, E8357A, and the E8358A network analyzers.	Page 1-4
Service and Support Options	List of the service and support options available.	Page 1-6
Required Service Test Equipment	List of service equipment that is required to perform performance tests, adjustments and troubleshooting.	Page 1-8

General Information

This section includes information about:

- cleaning
- finding assistance with repairs
- shipping your network analyzer to Agilent Technologies for repair

Maintenance

Clean the cabinet, using a dry or damp cloth only.

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

Assistance

Product maintenance agreements and other customer assistance agreements are available for Agilent Technologies products.

For any assistance, contact your nearest Agilent Technologies sales and service office. A list of offices ([Table 1-1](#)) is included at the end of this chapter.

Shipment for Service

If you are sending the instrument to Agilent Technologies for service, ship the analyzer to the nearest Agilent Technologies service center for repair, including a description of any failed test and any error message. Ship the analyzer using the original or comparable antistatic packaging materials.

Analyzer Options and Upgrades

Option 010, Time Domain

An Option 010 analyzer can display the time domain response of a network or test device by calculating the inverse Fourier transform of the frequency domain response. This calculation allows the Option 010 analyzer to show the response of a test device as a function of time or distance. In time domain, the magnitude and location of a discontinuity and the characteristics of individual transmission paths of a network or test device can be determined. Time domain operation retains all accuracy inherent with the active error correction.

This option is also available as an upgrade: E835xAU-010.

Option 015, Configurable Test Set

An Option 015 analyzer can be configured to measure high-power devices and devices for high dynamic range.

For a high-power measurement, external amplifiers and high power attenuators or isolators can be added to complete the test setup. In this configuration, test port output power up to 1 Watt (+30 dBm) can be applied to the device under test (DUT). Additionally, there is an external reference input that allows the external amplifier's frequency response and drift to be ratioed out. There are also internal step attenuators between the coupler and the receivers to prevent receiver overload.

For high dynamic range measurements, front panel jumpers are moved to reverse the signal path through one of the couplers. This allows for a 15 dB improvement in transmitted signal sensitivity in one direction only. These jumpers are installed on both ports allowing the user to choose a high dynamic range measurement in either the forward or reverse direction.

Option 099, Firmware Upgrade

This upgrade provides the latest revision of firmware for the PNA series RF network analyzers on CD-ROM. This firmware is user installable. The installation requires a USB CD-ROM drive (see “[Option AM8, CD-RW Drive](#)” below) or an external computer connected to a Local Area Network (LAN). This firmware is also available on the Internet at the Agilent website: <http://www.agilent.com/find/pna>. (Select your analyzer's model number in this website to view available upgrades.)

This option is available as an upgrade only: E835xAU-099.

Option AM8, CD-RW Drive

This option includes an external read/write CD drive with a USB cable.

This option is also available as an upgrade: E835xAU-AM8.

Option B30, USB Hub

This option adds a 4-port USB hub for connecting additional USB peripheral devices.

This option is also available as an upgrade: E835xAU-B30.

Option AVK, Printed User's and Programmer's Guide

This option adds a printed copy of the user's and programmer's documentation that is embedded in the analyzer.

This option is not available as an upgrade. To order a printed copy of the user's and programmer's guide, refer to [Chapter 6](#), "Replaceable Parts."

Option OBW, Printed Service Guide

This option adds a printed copy of the assembly-level service guide (this manual).

This option is not available as an upgrade. To order an additional copy of this service guide, refer to [Chapter 6](#), "Replaceable Parts."

Option 1CP, Rack Mount Flange Kit for Instruments with Handles

Option 1CP is a rack mount kit that contains a pair of flanges (cut to adapt to handles), rack mount rails, and the necessary hardware to mount the analyzer in an equipment rack with 482.6 mm (19 inches) horizontal spacing.

Option 1CM, Rack Mount Flange Kit for Instruments without Handles

Option 1CM is a rack mount kit that contains a pair of flanges, rack mount rails, and the necessary hardware to mount the analyzer in an equipment rack with 482.6 mm (19 inches) horizontal spacing.

Service and Support Options

The analyzer's standard warranty is a *three-year return to Agilent Technologies* service warranty.

The following service and support options are available at the time you purchase a network analyzer. Contact your local sales or service office.

NOTE If the service and support options listed in this section were not purchased along with the analyzer, there are many other repair and calibration options available from the Agilent Technologies support organization. These options cover a range of on-site services and agreements with varying response times as well as return to Agilent Technologies agreements and per-incident pricing. Contact the nearest Agilent Technologies sales or service office for details. Refer to [Table 1-1 on page 1-10](#) for the nearest office.

Option W01

This option converts the standard three-year return to Agilent Technologies service warranty to a *one-year on-site* service warranty. This option may not be available in all areas.

Option W31

This option converts the standard three-year return to Agilent Technologies service warranty to a *three-year on-site* service warranty. This option may not be available in all areas.

Option W32

This option provides yearly return to Agilent Technologies for a commercial calibration for a period of three years. The calibration provided is traceable to national standards.

Option W34

This option provides yearly return to Agilent Technologies for a Standards Compliant Calibration for a period of three years. This type of calibration meets the ANSI/NCSL Z540-1-1994 standard.

Option W50

This option adds two years to the standard three-year return to Agilent Technologies warranty for a total of a *five-year return to Agilent Technologies* service warranty.

Option W51

This option converts the standard three-year return to Agilent Technologies service warranty to a *five-year on-site* service warranty. This option may not be available in all areas.

Option W52

This option provides yearly return to Agilent Technologies for a commercial calibration for a period of five years. The calibration provided is traceable to national standards.

Option W54

This option provides yearly return to Agilent Technologies for a Standards Compliant Calibration for a period of five years. This type of calibration meets the ANSI/NC SL Z540-1-1994 standard.

Required Service Test Equipment

Equipment	Critical Specifications	Recommended Model or Part Number	Alternate Model Number	Use ^a
Test Instruments				
Frequency counter	Freq: 300 kHz to 9.0 GHz Accuracy : ±0.5 ppm	53181A Opt 010,124	53131A Opt 010,124 53132A Opt 010,124	P,A,T
Spectrum analyzer	Max Freq:> 4 GHz RBW: 300 Hz	8561E	856xE Max freq: > 4 GHz	A,T
Power meter	Accuracy: 0.02 dB	E4419B	None	P,A,T
Power sensor	Freq: 300 kHz to 3.0 GHz Range: -30 to +20 dBm	8482A	None	P,A,T
Power sensor	Freq: 3.0 to 9.0 GHz Range: -30 to +20 dBm	E4412A	None	P,A,T
Dynamic accuracy module	N/A	Z5623A Opt H01	11713A 8496G 8492G	P
Digital voltmeter	Resolution: 10 mV	Any	Any	T
Oscilloscope	Bandwidth: 100 MHz	Any	Any	T
Printer	N/A	Any printer with Microsoft® Windows 2000® driver		P
Calibration and Verification Kits^b				
Type-N calibration kit	Refer to kit specifications	85032F	None	P,T
Type-N verification kit	Refer to kit specifications	85055A	None	P
3.5 mm calibration kit	Refer to kit specifications	85033E	None	P,T
3.5 mm verification kit	Refer to kit specifications	85053B	None	P

a. P = Performance tests, A = Adjustments, T = Troubleshooting

b. Only the type-N calibration kit and verification kit are used for performance tests. The 3.5 mm kits can be used for system verification and analyzing the error terms.

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Equipment	Critical Specifications	Recommended Model or Part Number	Alternate Model Number	Use ^a
Cables				
BNC cable	50Ω, 24 inch	8120-1839	None	A
Type-N RF cable	50Ω, 24 inch	N6314A	None	P,A
GPIB cable	N/A	10833A/B/C/D	None	P,A
Tools and Static Safety Parts				
Tool kit	N/A	E8356-60079	None	P,A,T
Adjustable antistatic wrist strap	N/A	9300-1367	None	P,A,T
Antistatic wrist strap grounding cord (5 foot)	N/A	9300-0980	None	P,A,T
Static control table mat and earth ground wire	N/A	9300-0797	None	P,A,T
Floppy disks	3.5 inch	Any	None	A
Adapters and Accessories				
Type-N (male to male)	N/A	1250-0778	None	P
BNC (male) to Type-N (female)	N/A	1250-1477	None	P,A
Type-N (female to female)	N/A	1250-0777	None	A
Type-N (female) to 3.5 mm (male)	N/A	1250-1750	None	A
Power splitter	N/A	11667B	Any	T

a. P = Performance tests, A = Adjustments, T = Troubleshooting

Table 1-1 Agilent Technologies Sales and Service Offices

UNITED STATES		
Instrument Support Center Agilent Technologies (800) 403-0801		
EUROPEAN FIELD OPERATIONS		
Headquarters Agilent Technologies S.A. 150, Route du Nant-d'Avril 1217 Meyrin 2/ Geneva Switzerland (41 22) 780.8111	France Agilent Technologies France 1 Avenue Du Canada Zone D'Activite De Courtaboeuf F-91947 Les Ulis Cedex France (33 1) 69 82 60 60	Germany Agilent Technologies GmbH Agilent Technologies Strasse 61352 Bad Homburg v.d.H Germany (49 6172) 16-0
Great Britain Agilent Technologies Ltd. Eskdale Road, Winnersh Triangle Wokingham, Berkshire RG41 5DZ England (44 118) 9696622		
INTERCON FIELD OPERATIONS		
Headquarters Agilent Technologies 3495 Deer Creek Rd. Palo Alto, CA 94304-1316 USA (415) 857-5027	Australia Agilent Technologies Australia Ltd. 31-41 Joseph Street Blackburn, Victoria 3130 (61 3) 895-2895	Canada Agilent Technologies (Canada) Ltd. 17500 South Service Road Trans-Canada Highway Kirkland, Quebec H9J 2X8 Canada (514) 697-4232
Japan Agilent Technologies Japan, Ltd. Measurement Assistance Center 9-1, Takakura-Cho, Hachioji-Shi, Tokyo 192-8510, Japan TEL (81) -426-56-7832 FAX (81) -426-56-7840	Singapore Agilent Technologies Singapore (Pte.) Ltd. 150 Beach Road #29-00 Gateway West Singapore 0718 (65) 291-9088	Taiwan Agilent Technologies Taiwan 8th Floor, H-P Building 337 Fu Hsing North Road Taipei, Taiwan (886 2) 712-0404
China China Agilent Technologies 38 Bei San Huan X1 Road Shuang Yu Shu Hai Dian District Beijing, China (86 1) 256-6888		

2 Checks and Adjustments, Firmware Upgrades, and Operating System Recovery

Information in This Chapter

This chapter contains procedures to help you:

- check, verify, and adjust your PNA series RF network analyzer.
 - The checks verify the operation of the assemblies in your analyzer.
 - The verification compares the operation of your analyzer to a gold standard.
 - The adjustments allow you to tune up your analyzer for maximum response.
- upgrade the firmware contained in your PNA series RF network analyzer.
- recover from a serious system malfunction such as would be caused by corrupted or inadvertently deleted files on the system's hard disk drive.

NOTE A description of the performance tests in the Agilent N2721A software package is included in this chapter. The Agilent N2721A software package must be purchased separately.

Chapter Two at-a-Glance

Section Title	Summary	Start Page
Before You Begin	This section contains descriptions of environmental conditions in which to test the analyzer and reviews the principles of connector care.	Page 2-5
Flow Chart of Test Sequences	This section describes the ANS/NCSL Z540-1-1994 and the non-ANS/NCSL Z540-1-1994 processes to verify your analyzer.	Page 2-6
Preliminary Checks	This section contains instructions for performing the operator's check and checking your test cables. Perform these checks before system verification.	Page 2-8
System Verification	This section describes: <ul style="list-style-type: none">• what the system verification does.• how to perform the verification test.• how to interpret the results.	Page 2-16

Section Title	Summary	Start Page
Performance Tests (Agilent N2721A Software Package)¹	<p>This section provides a brief summary for each performance test in the Agilent N2721A software package:</p> <ul style="list-style-type: none"> • Frequency Range and Accuracy Test • Test Port Output Power Accuracy • Test Port Output Power Range and Linearity Test • Test Port RMS Noise Level Test • Test Port Crosstalk Test • Calibration Coefficients Test • High Level Trace Noise CW Test • Test Port Receiver Dynamic Accuracy Test • Receiver Magnitude Compression Test 	Page 2-26
Adjustments	<p>This section provides setups and procedures for adjusting your analyzer:</p> <ul style="list-style-type: none"> • Source Calibration Adjustment • Receiver Calibration Adjustment • LO Power Adjustment • 10 MHz OCXO Frequency Adjustment • 3.8 GHz PMYO Frequency Adjustment 	Page 2-28
Serial Bus Test	<p>This section describes:</p> <ul style="list-style-type: none"> • what the serial bus test does. • how to perform the test. • where the serial test nodes are located. • the test nodes. 	Page 2-35
Option Enable Utility	<p>This section contains instructions for installing options and changing analyzer serial numbers.</p>	Page 2-41
Firmware Upgrades	<p>This section provides instructions for upgrading the firmware in your analyzer.</p>	Page 2-43
Operating System Recovery	<p>This section provides instructions for recovering from a serious operating system malfunction such as would be caused by corrupted or inadvertently deleted files on the system's hard disk drive.</p>	Page 2-46

1. The Agilent N27221A software package must be purchased separately.

Before You Begin

Before checking, verifying, and adjusting the analyzer, refer to the following paragraphs to:

- make sure the operating environment is within its requirements
- review the principles of connector care

Verify the Operating Environment

Due to their operating specifications, the verification and calibration kit devices determine your operating environment conditions. Open the calibration and verification kits and place all the devices on top of the foam inserts so they will reach room temperature. As the device dimensions change with temperature, their electrical characteristics change as well. It is necessary to keep the environmental levels within the following limits:

- Temperature: +20 °C to +26 °C

Once the measurement calibration has been done, the ambient temperature must be maintained to within ± 1 °C of the calibration temperature.

- Humidity: 0 to 80% at 26 °C maximum

CAUTION Use an antistatic work surface and wrist strap to reduce the chance of electrostatic discharge for all the procedures in this chapter.

NOTE To achieve the maximum system stability, allow the analyzer to warm up for at least 30 minutes.

Review the Principles of Connector Care

Proper connector care and connection technique are critical for accurate and repeatable measurements. Refer to [Table 2-1](#) for tips on connector care.

Prior to making connections to your analyzer, carefully review the information about inspecting, cleaning, and gaging connectors. Refer to the calibration kit documentation for detailed connector care information.

For course numbers about additional connector care instruction, contact your nearest Agilent Technologies sales or service office. Refer to [Table 1-1 on page 1-10](#) for the nearest office.

Table 2-1 Connector Care Quick Reference Guide

Handling and Storage	
Do <ul style="list-style-type: none"> • Keep connectors clean • Extend sleeve or connector nut • Use plastic end-caps during storage 	Do Not <ul style="list-style-type: none"> • Touch mating-plane surfaces • Set connectors contact-end down
Visual Inspection	
Do <ul style="list-style-type: none"> • Inspect all connectors carefully • Look for metal particles, scratches, and dents 	Do Not <ul style="list-style-type: none"> • Use a damaged connector - ever
Connector Cleaning	
Do <ul style="list-style-type: none"> • Try compressed air first • Use isopropyl alcohol • Clean connector threads 	Do Not <ul style="list-style-type: none"> • Use any abrasives • Get liquid into plastic support beads
Gaging Connectors	
Do <ul style="list-style-type: none"> • Clean and zero the gage before use • Use the correct gage type • Use correct end of calibration block • Gage all connectors before first use 	Do Not <ul style="list-style-type: none"> • Use an out-of-specification connector
Making Connections	
Do <ul style="list-style-type: none"> • Align connectors carefully • Make preliminary connection lightly • Turn only the connector nut • Use a torque wrench for final connect 	Do Not <ul style="list-style-type: none"> • Apply bending force to connection • Over tighten preliminary connection • Twist or screw any connection • Tighten past torque wrench “break” point

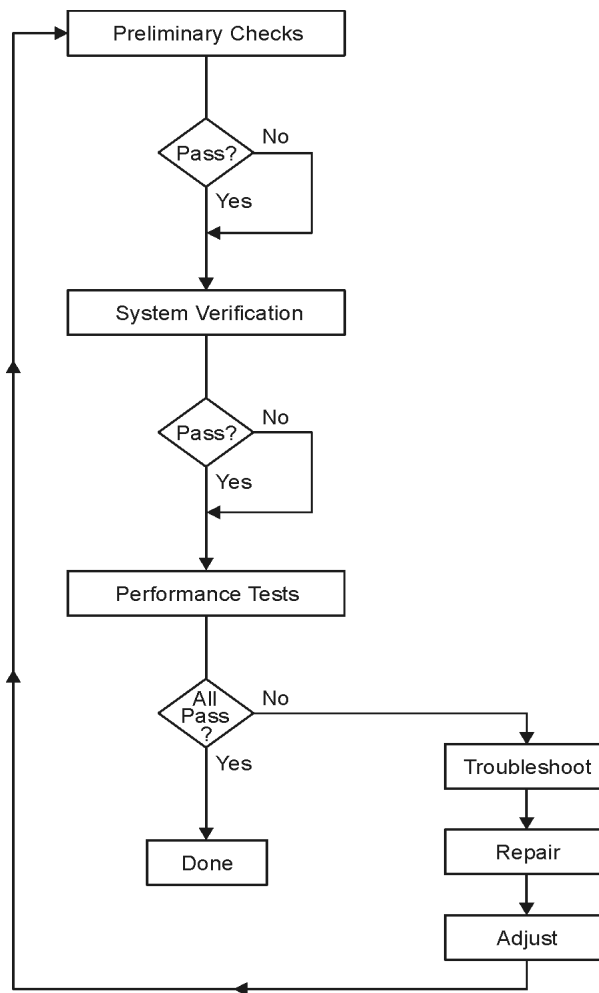
Flow Chart of Test Sequences

There are two different ways to verify the performance of your analyzer. One method meets ANSI/NCSL Z540-1-1994 standards, while the other method does not.

ANSI/NCSL Z540-1-1994 Verification

To meet the criteria for ANSI/NCSL Z54-1-1994, perform the preliminary checks, system verification, and performance tests *without stopping to troubleshoot*¹. Refer to [Figure 2-1](#) for test flow. Print data at completion of all the tests, even if you are aware that the analyzer will not pass. If there is a failure, complete the verification then troubleshoot, repair, and adjust. Repeat the entire system verification and performance tests and generate a new set of data.

Figure 2-1 ANSI/NCSL Z540-1-1994 Test Path Verification Flowchart



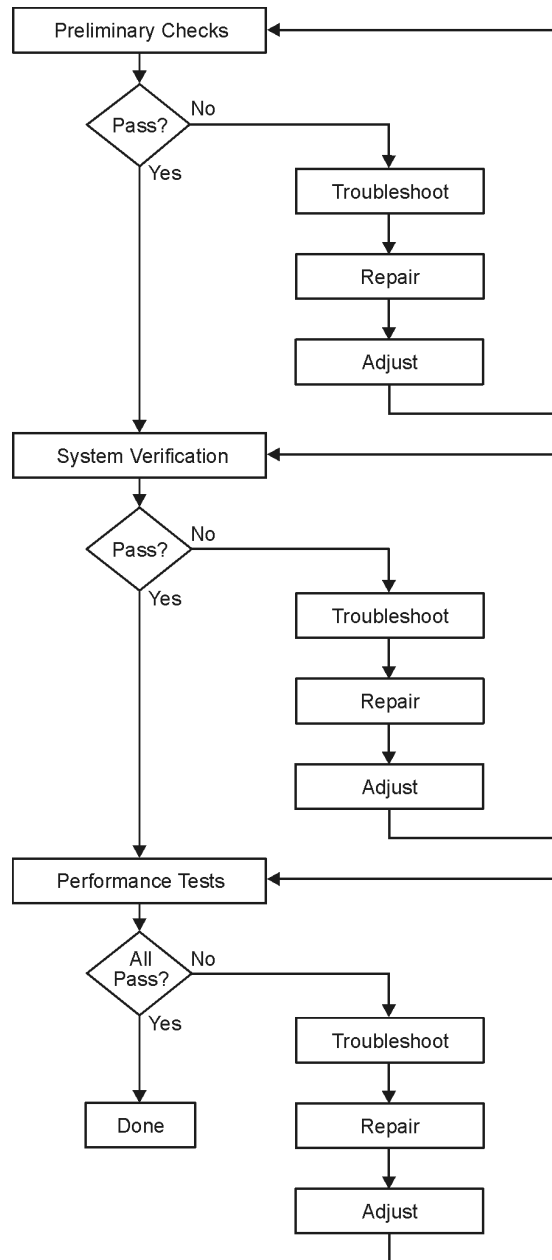
sb51e

1. Stop only in case of a catastrophic failure or cable connector damage

Non-ANSI/NCSL Z540-1-1994 Verification

For Non-ANSI/NCSL Z54-1-1994, perform the preliminary checks, system verification, and performance tests while *stopping to troubleshoot*. Refer to [Figure 2-2](#) for test flow. Troubleshoot and repair the first problem encountered without continuing to other tests. After you troubleshoot, repair, and adjust, repeat the *last failed* portion and generate a new set of data. Repeat the system verification and performance tests. Print out the system verification results and complete the performance test record as the analyzer passes each test.

Figure 2-2 Non-ANSI/NCSL Z540-1-1994 Test Path Verification Flowchart



sb532e

Preliminary Checks

Preliminary checks include the following:

- “Performing the Operator’s Check” on page 2-8

The operator’s check tests the network analyzer’s basic functionality of the source, switch, step attenuators, and receivers.

- “Performing the Test Port Cable Checks” on page 2-10

The test port cable checks are not required, but are recommended to verify the performance of the test port cables before performing the verification test.

Performing the Operator’s Check

The operator’s check is a software driven test that checks the basic operation of the assemblies in the Port 1 and Port 2 paths. By performing the operator’s check, the following is determined:

- the operation of the transfer switch (repeatability)
- the phase-lock capability of the source across the entire frequency band
- the function of the four receivers
- the operation of the attenuators (10 dB steps)
- the receivers’ linearity (rough check)

Information on Switch Repeatability

The operator’s check performs a reflection measurement of a short and stores this trace in memory. The software toggles the transfer switch to the opposite port and back again, and then another reflection measurement is made. The difference between the stored trace and the return trace is the switch repeatability. This test also checks the phase lock across the entire frequency band and operation of all four receivers.

Information on Attenuator Range Check

The operator’s check performs a reflection measurement of a short and stores this trace in memory. As the internal attenuator is switched in 10 dB steps over its 70 dB range, reflection measurements are made and compared with the stored trace. The resulting measurements must fall within a limit testing window to pass the test. The window size is based on source and receiver specifications. By performing the Port 1 and Port 2 tests, rough checks of the linearity for all four receivers (from 0 dB to 70 dB) are verified and both attenuators are verified.

Accessories Used in Operator's Check

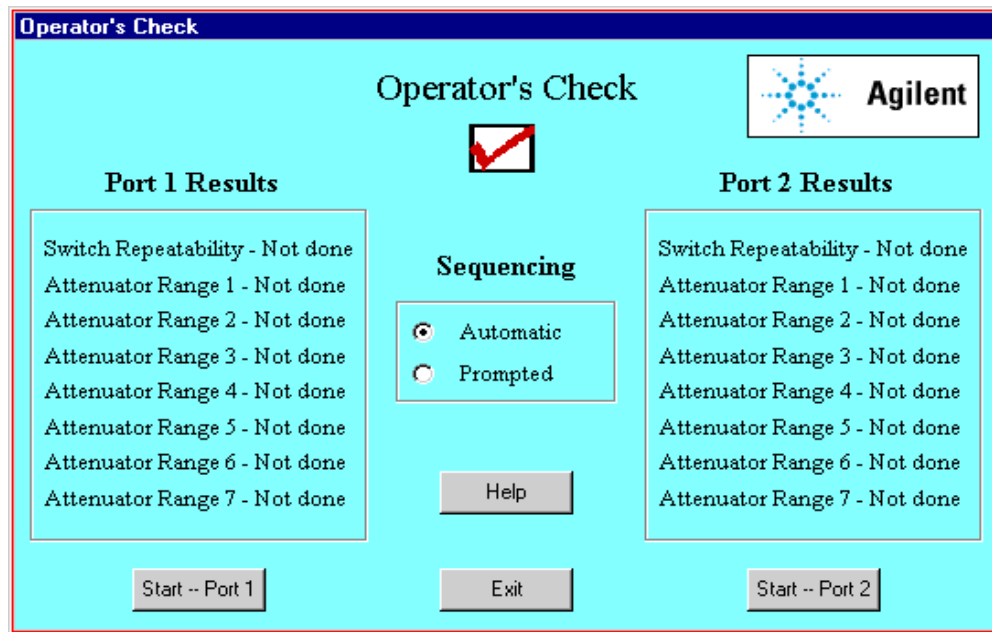
Equipment Type	Part Number
Type-N male short ¹	85032-60016 (from the 85032F calibration kit)

1. Alternate choice: 3.5 mm short from 3.5 mm 85033E calibration kit and type-N to 3.5 mm adapter.

Port 1 Check and Port 2 Check

1. From the **System** menu, point to **Service**, and then click **Operator's Check**.
2. In the **Operator's Check** dialog box (refer to [Figure 2-3](#)), under **Sequencing** select **Automatic** to run through the test without stopping or select **Prompted** to add test steps at each check.
3. To check Port 1, click the **Start--Port 1** or to check Port 2, click **Start--Port 2**.
4. The test will prompt you to connect the short.
5. The result of the operator's check will be shown as a PASS or FAIL next to the test.

Figure 2-3 Operator's Check Dialog Box



If the Operator's Check Fails

1. Clean the test ports, shorts, and adapters. Torque to specification. Repeat the check.
2. If the check still fails, suspect a faulty component:
 - A repeated failure in the switch repeatability for both the Port 1 and Port 2 checks indicates a faulty A22 switch splitter. Refer to [“Removing and Replacing the A22 Switch Splitter Assembly”](#) on page 7-32.

- A repeated failure in *any* of the ranges of the attenuator check indicates a faulty step attenuator.
 - If the Port 1 check fails, the A25 step attenuator may be faulty.
 - If the Port 2 check fails, the A26 step attenuator may be faulty.Refer to [“Removing and Replacing the A25 and A26 70 dB Step Attenuators” on page 7-36](#).
- If *all* ranges of the attenuator check fail, suspect a loose connection on the step attenuator control cable.
 - If the Port 1 check fails, check the A25 step attenuator cable.
 - If the Port 2 check fails, check the A26 step attenuator cable.

Performing the Test Port Cable Checks

A faulty test port cable can cause a failure in the verification test. The following checks are not required, but are recommended to verify the performance of the test port cable.

- [“Cable Return Loss Check”](#) below
- [“Cable Insertion Loss Check” on page 2-12](#)
- [“Cable Magnitude and Phase Stability Check” on page 2-12](#)
- [“Cable Connector Repeatability Check” on page 2-14](#)

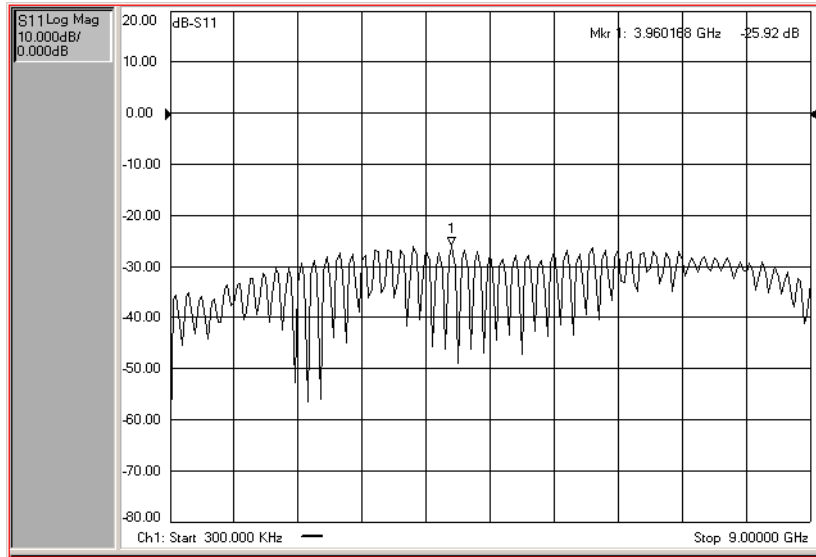
Accessories Used in Test Port Cable Checks

Equipment Type	Part Number
Type-N cable	N6314A
Calibration Kit	85032F

Cable Return Loss Check

1. Press **Preset**.
2. Perform a one-port calibration on Port 1. For detailed calibration procedures, refer to [“Performing Measurement Calibration” on page 4-4](#).
3. Connect the test port cable to Port 1. Connect a broadband load to the other end of the cable. Tighten to the specified torque for the connector type.
The analyzer now displays the return loss of the cable.
4. From the **Marker** menu, click **Marker Search**. In the **Marker Search** dialog box, in the **Search Type** box, make sure **Maximum** is selected. Click **Execute**, and then click **OK**.
5. The marker annotation on the screen indicates the worst case return loss. Refer to the cable manual to see if it meets the return loss specification. For an example of a typical return loss measurement, see [Figure 2-4](#).

Figure 2-4 Typical Cable Return Loss Response



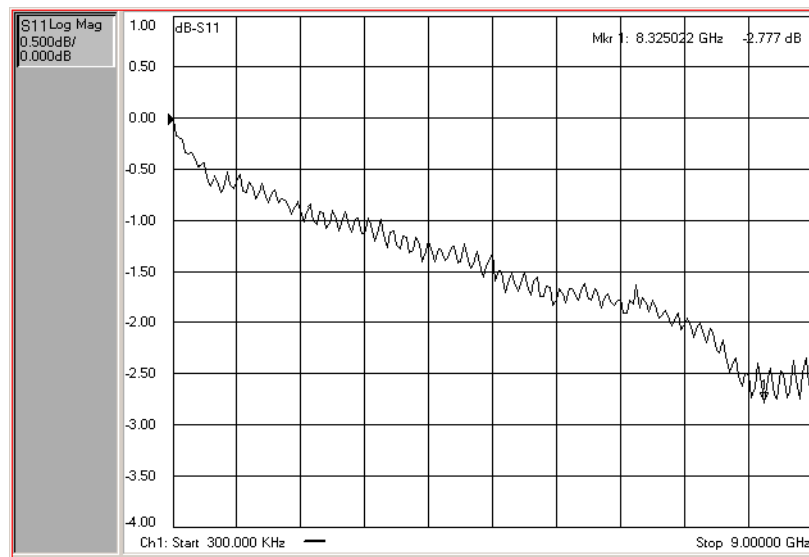
If the Cable Return Loss Check Fails

1. Clean the cable and devices and torque to specification. Repeat the check.
2. If the check still fails, the cable should be repaired or replaced.

Cable Insertion Loss Check

1. Keep the test port cable connected to Port 1.
2. Connect a short to the end of the cable.
3. From the **Marker** menu, click **Marker Search**. In the **Marker Search** dialog box, in the **Search Type** box, select **Minimum**. Click **Execute**, and then click **OK**.
4. The displayed response is twice the actual loss. To get the actual worst case insertion loss, divide the value at the marker annotation by two. Refer to the cable manual to see if it meets the insertion loss specification. For an example of a typical insertion loss measurement, see [Figure 2-5](#).

Figure 2-5 Typical Cable Insertion Loss Response



If the Cable Insertion Loss Check Fails

1. Clean the cable and devices and torque to specification. Repeat the check.
2. If the check still fails, the cable should be repaired or replaced.

Cable Magnitude and Phase Stability Check

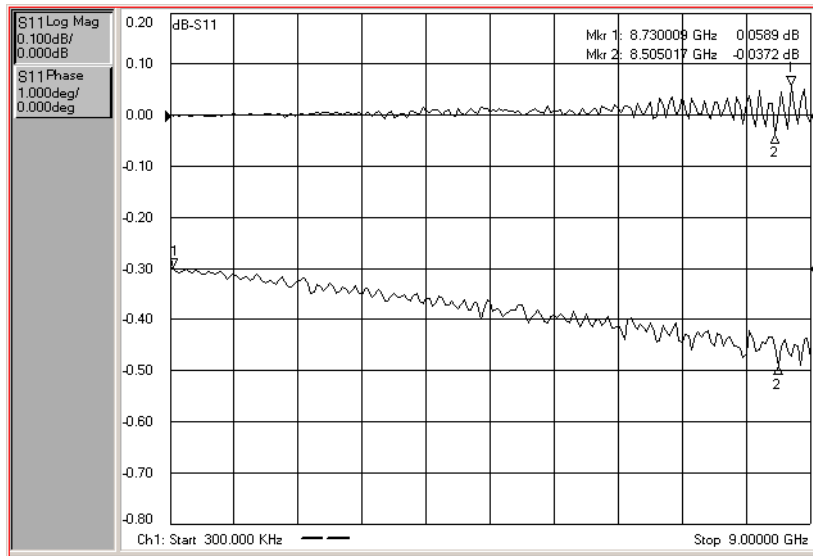
1. Keep the cable connected to Port 1, then connect a short to the end of the cable.
2. Press **Preset**.
3. On the **Trace** menu, click **New Trace**. In the **New Trace** dialog box, click the **S11** box, and then click **OK**.
4. On the **Trace** menu, click **Format**. In the **Format** dialog box, click **Phase**, and then click **OK**.
5. On the **Channel** menu, click **Average**. In the **Average** dialog box, click the **Average ON** check box. In the **Average Factor** box, type 50 or click the arrows to select 50, and then click **OK**.
6. To provide a good reference, hold the test cable in a straight line perpendicular to the

front panel of the network analyzer.

7. Wait for the analyzer to average the measurement 50 times (approximately two seconds).
8. On the **Trace** menu, click **Math/Memory**. In the **Math/Memory** dialog box, click the **Data->Memory** button. In the **Data Math** list, select **Data/Memory**. Under **Trace View Options**, make sure **Data Trace** is selected, and then click **OK**.
9. Slowly make a 180 degree bend in the middle of the cable and hold it in that position.
10. For each trace: On the **Scale** menu, click **AutoScale**.
11. Place a marker on the largest deflection that goes above the reference line and is within the cable's specified frequency range. For a typical response of cable magnitude and phase stability, see [Figure 2-6](#).
12. Place a marker on the largest deflection that goes below the reference line and is within the cable's specified frequency range.

In this S_{11} measurement, the displayed trace results from energy being propagated down the cable and reflected back from the short. Therefore, the measured deflection value must be divided in half to reach the correct value.

Figure 2-6 Typical Cable Magnitude and Phase Stability Response



If the Cable Magnitude and Phase Stability Check Fails

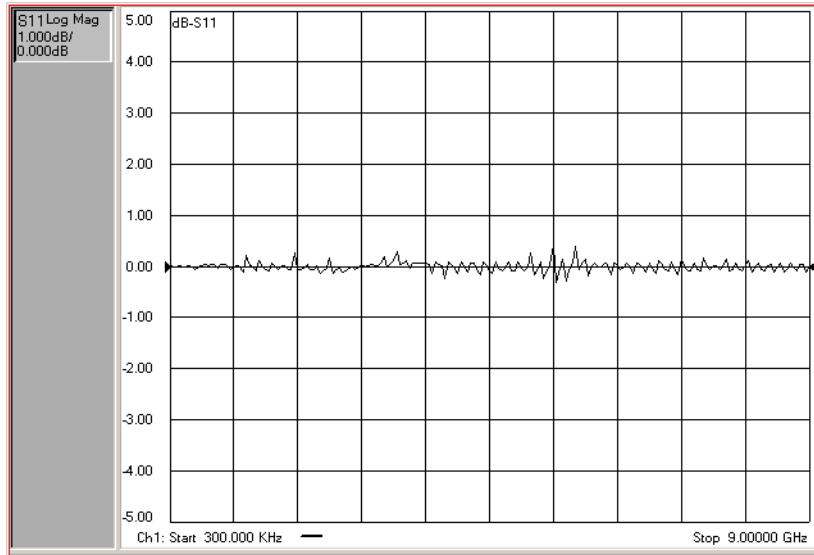
1. Clean the cable and devices and torque to specification. Repeat the check.
2. If the check still fails, the cable should be repaired or replaced.

Cable Connector Repeatability Check

NOTE The connector repeatability measurement should be done at the test port as well as at the end of the test port cable.

1. Keep the test port cable connected to Port 1.
2. Connect a broadband termination to the end of the cable.
3. Press **Preset**.
4. On the **Channel** menu, click **Average**. In the **Average** dialog box, click the **Average ON** check box. In the **Average Factor** box, type 100 or click the arrows to select 100. Click **OK**.
5. Wait for the analyzer to average the measurement 100 times (approximately five seconds).
6. To normalize the data trace:
On the **Trace** menu, click **Math/Memory**. In the **Math/Memory** dialog box, click the **Data->Memory** button. In the **Data Math** list, select **Data-Memory**. Under **Trace View Options**, make sure **Data Trace** is selected. Click **OK**.
7. On the **Scale** menu, click **Scale**. In the **Scale Per Division** box, click the arrow to select 10 dB. In the **Level** box under **Reference** click the arrow to select -50 dB. Click **OK**.
8. Disconnect and then reconnect the cable to the test port. Tighten the connection to the specified torque for the connector type. Look at the trace for spikes or modes.
9. To re-normalize the data trace of the reconnected cable: On the **Trace** menu, click **Math/Memory**. In the **Math/Memory** dialog box, click the **Data->Memory** button. Click **OK**.
10. Repeat step 9 at least three times to look for modes. (Modes appear when a harmonic of the source fundamental frequency is able to propagate through the cable or connector). It is helpful to print a plot of the trace each time to compare several connections. If any mode appears each time the cable is connected and reconnected, measurement integrity will be affected. For a typical response of cable connector repeatability, see [Figure 2-7](#).
11. For the Port 2 Check, connect the cable to Port 2 and repeat steps 2 through 10.

Figure 2-7 Typical Cable Connector Repeatability Response



If the Cable Connector Repeatability Check Fails

1. Clean the cable and devices, and torque to specification. Repeat the check.
2. If the check still fails, the cable should be repaired or replaced.

System Verification

System verification is used to verify system-level, error-corrected uncertainty limits for network analyzer measurements. The verification procedure is automated and is contained in the firmware of the analyzer.

The device data provided with the verification kit has a traceable path to a national standard. The difference between the supplied traceable data and the measured data must fall within the total uncertainty limits at all frequencies for the system verification to pass.

The total measurement uncertainty limits for the system verification are the sum of the factory measurement uncertainties for the verification devices and the uncertainties associated with the system being verified. You can determine your system measurement uncertainty limits by referring to the analyzer embedded on-line help.

IMPORTANT Passing this system verification does not guarantee that the analyzer meets all of its performance specifications. However, it does show that the network analyzer being verified measures the same devices with the same results as a factory system which has had all of its specifications verified and its total measurement uncertainty minimized.

What the System Verification Verifies

The system verification procedure verifies the:

- network analyzer
- calibration kit
- test port cables

NOTE Additional equipment or accessories used with the above system are not verified by system verification.

Measurement Uncertainty

Measurement uncertainty is defined as the sum of:

- the residual systematic (repeatable) errors, and
- the random (non-repeatable) errors

in the measurement system after calibration.

The systematic errors are:

- directivity,
- source match,
- load match,
- reflection and transmission frequency tracking, and
- isolation (crosstalk).

The random errors include:

- noise,
- drift,
- connector repeatability, and
- test cable stability.

A complete description of system errors and how they affect measurements is provided in the analyzer's on-line embedded help.

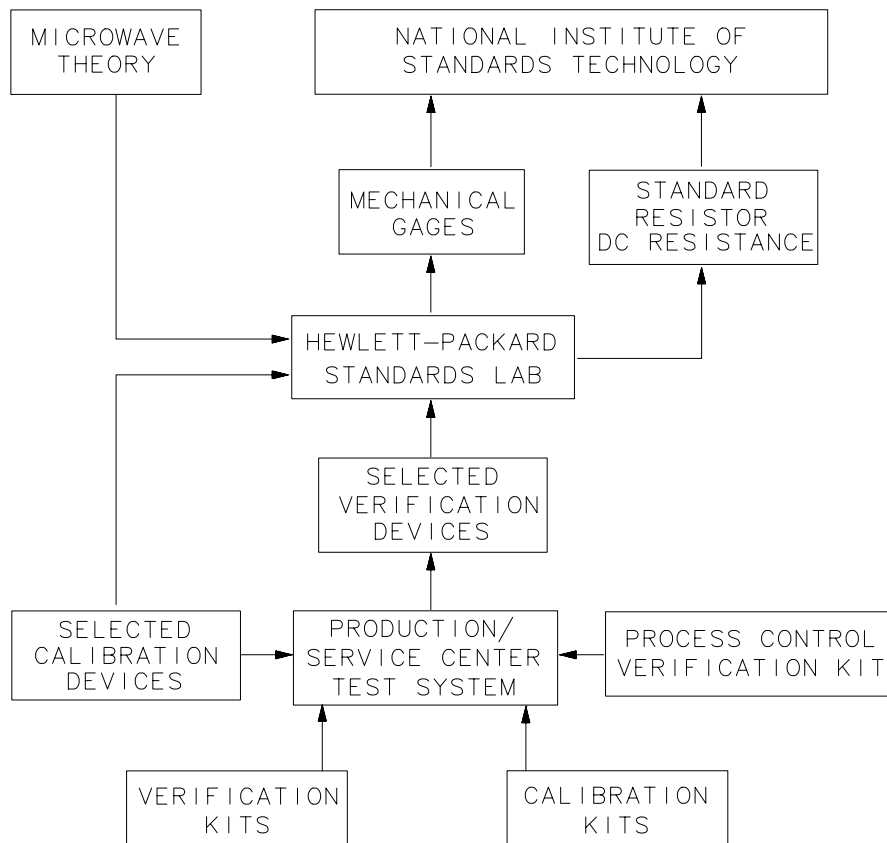
Any measurement result is the vector sum of the actual test device response plus all error terms. The precise effect of each error term depends on its magnitude and phase relationship to the actual test device response. When the phase of an error response is not known, phase is assumed to be worst-case (-180° to $+180^\circ$). Random errors such as noise and connector repeatability are generally combined in a root-sum-of-the-squares (RSS) manner.

Measurement Traceability

To establish a measurement traceability path to a national standard for a network analyzer system, the overall system performance is verified through the measurement of devices that have a traceable path. This is accomplished by measuring the devices in an Agilent verification kit.

The measurement of the devices in the verification kit has a traceable path because the factory system that measured the devices is calibrated and verified by measuring standards that have a traceable path to the National Institute of Standards and Technology (NIST) (see [Figure 2-8](#)). This chain of measurements defines how the verification process brings traceability to the network analyzer system.

Figure 2-8 NIST Traceability Path for Calibration and Verification Standard



sb66d

Performing System Verification

The following verification procedure is automated by the analyzer firmware. For each verification device, the analyzer reads a file from the verification disk and sequentially measures the magnitude and phase for all four S-parameters.

NOTE Although the performance for all four S-parameters are measured, the S_{11} and S_{22} phase uncertainties for the attenuators and airlines are less important for verifying system performance. Therefore, the limit lines will not appear on the printout.

Equipment Used in This Test

Equipment Type	Part Number	Alternate Part Number ¹
Calibration kit <i>or</i>	85032F (type-N)	85033E (3.5 mm)
ECal module	85902B (type-N)	85093B (3.5 mm)
Verification kit	85055A (type-N)	85053B (3.5 mm)
RF cable	N6314A (type-N)	

1. Use of these alternates may require the use of adapters.

Cable Substitution

The test port cables specified for the network analyzer system have been characterized for connector repeatability, magnitude and phase stability with flexing, return loss, insertion loss, and aging rate. Since test port cable performance is a significant contributor to the system performance, cables of lower performance will increase the uncertainty of your measurement. Refer to the plots in the cable tests (earlier in this chapter) that show the performance of good cables. It is highly recommended that the test port cables to be regularly tested.

If the system verification is performed with a non-Agilent cable, ensure that the cable meets or exceeds the specifications for the N6314A type-N cable. Refer to the N6314A user's guide for specifications.

Calibration Kit Substitution

Non-Agilent calibration kits are not recommended nor supported.

Precautions for Handling Airlines

The verification kit includes airlines. Follow the steps below to ensure good measurement techniques.

- Be very careful not to drop the airline's center or outer conductor. Irreparable damage will result if these devices are dropped.
- During this procedure, you will be touching the exposed center conductor of the test port and the center conductor of the airline.
 - Observe proper ESD procedures.
 - Clean your hands or wear gloves; skin oils will cause a change in electrical performance.
- Refer to [Figure 2-9](#) and [Figure 2-10](#) for connection procedures.

Figure 2-9 Aligning the Center Conductor

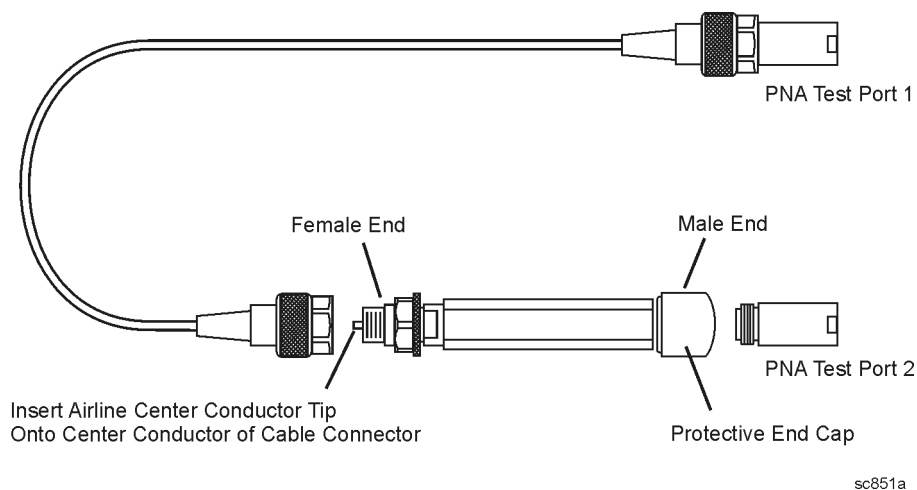
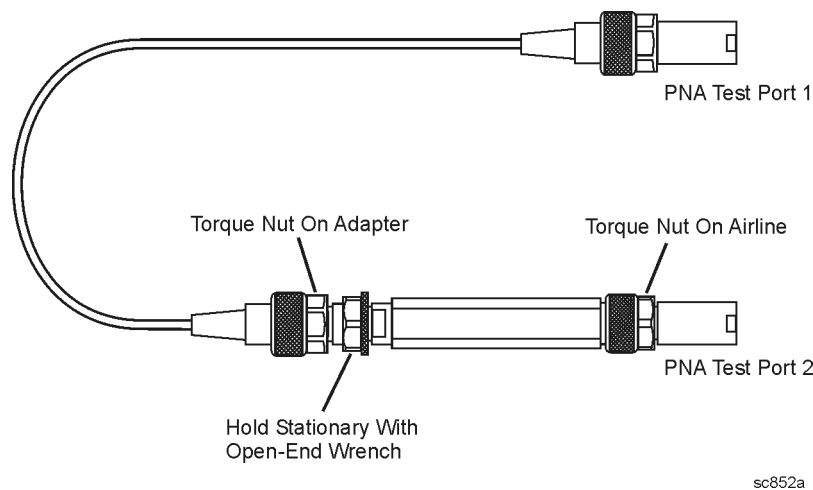


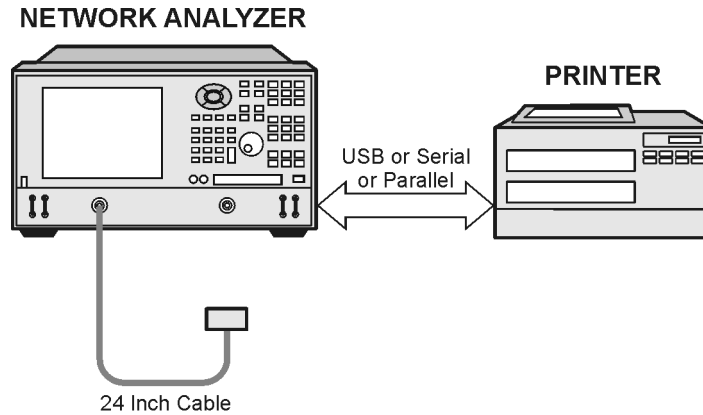
Figure 2-10 Torquing the Connection



Procedure for System Verification

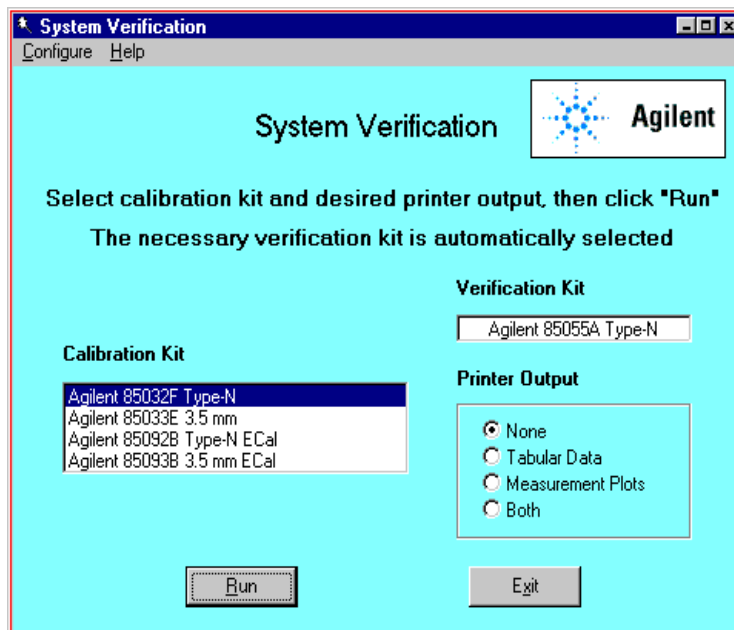
1. Connect a cable to Port 1 on the analyzer as shown in [Figure 2-11](#). If you desire printed test outputs, connect a printer to the analyzer. For the printer, ensure that the correct driver is loaded and the printer is defined as the default printer. Refer to the embedded help in the analyzer for printer setup. Let the analyzer warm up for at least 30 minutes.

Figure 2-11 System Verification Test Setup



2. Insert the verification kit disk into the analyzer disk drive.
3. On the **System** menu, point to **Service**, and then click **System Verification**. The **System Verification** dialog box is displayed; refer to [Figure 2-12](#).

Figure 2-12 System Verification Dialog Box



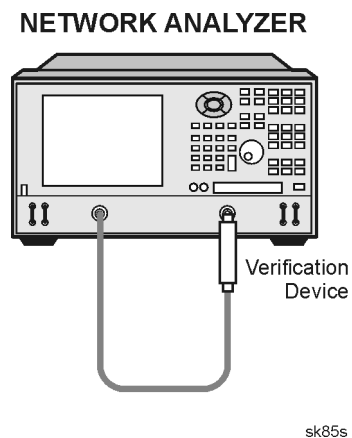
4. In the **Calibration Kit** box, select the calibration kit that is being used by clicking on it. The corresponding verification kit to use is selected for you and displayed in the **Verification Kit** box. Refer to [Figure 2-12](#).
5. Under **Printer Output**, click one of the following options. Refer to [Figure 2-12](#).
 - **None**: No printout of results.
 - **Tabular Data**: Prints the verification data in tabular form which includes measured data and uncertainty limits. For an example, refer to [Figure 2-15 on page 2-24](#).
 - **Measurement Plots**: Prints the verification data in graphical form. The graphical form includes the measured data trace, factory supplied data trace, and uncertainty limits. For an example, refer to [Figure 2-16 on page 2-25](#).
 - **Both**: Prints the verification data in both formats.

NOTE For printed output, it is assumed that the printer has been tested and the Windows 2000 driver is installed for the printer that is being used. The system verification test prints to the printer that has been designated as the default printer. (On the Windows Desktop display, click on **My Computer**, **Control Panel**, and then **Printers** to verify the printer setup.)

6. Click **Run**.
7. Follow the instructions on the analyzer for performing a full 2-port calibration.
8. After completion of the full 2-port calibration, follow the instructions on the analyzer for performing the system verification.

For the system verification, insert the devices as shown in [Figure 2-13](#).

Figure 2-13 System Verification Device Connections

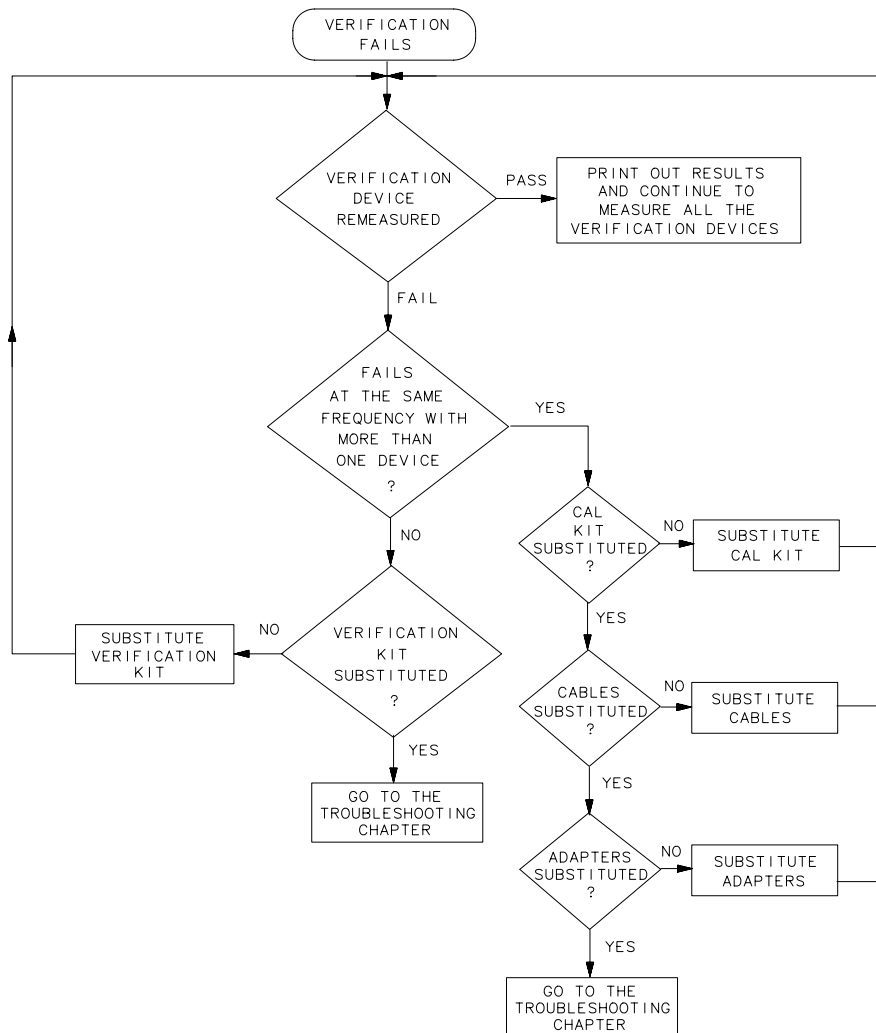


If the System Fails the Verification Test

IMPORTANT Inspect all connections. *Do not* remove the cable from the analyzer test port. This *will invalidate* the calibration that you performed earlier.

1. Disconnect and clean the device that failed the verification test.
2. Reconnect the device making sure that all connections are torqued to the proper specifications.
3. Measure the device again.
4. If the analyzer still fails the test, check the measurement calibration by viewing the error terms as described in “[Front Panel Access to Error Terms](#)” on page 4-7.
5. Refer to [Figure 2-14](#) for additional troubleshooting steps.

Figure 2-14 System Verification Failure Flowchart



sb69d

Interpreting the Verification Results

Figure 2-15 shows an example of typical verification results with **Tabular Data** selected in the **Printer Output** area of the **System Verification** dialog box.

At the top of the printed output is the name of the device, the serial number of the device, and the date tested.

Each S-parameter measurement result is printed with frequency tested, lower and upper limit lines, the measured data, and the result of the test.

Figure 2-15 Example of Printed Tabular Verification Results

```
Sys Ver -- 20 dB attenuator magnitude results, Serial #00810 -- 6 Sep 2000

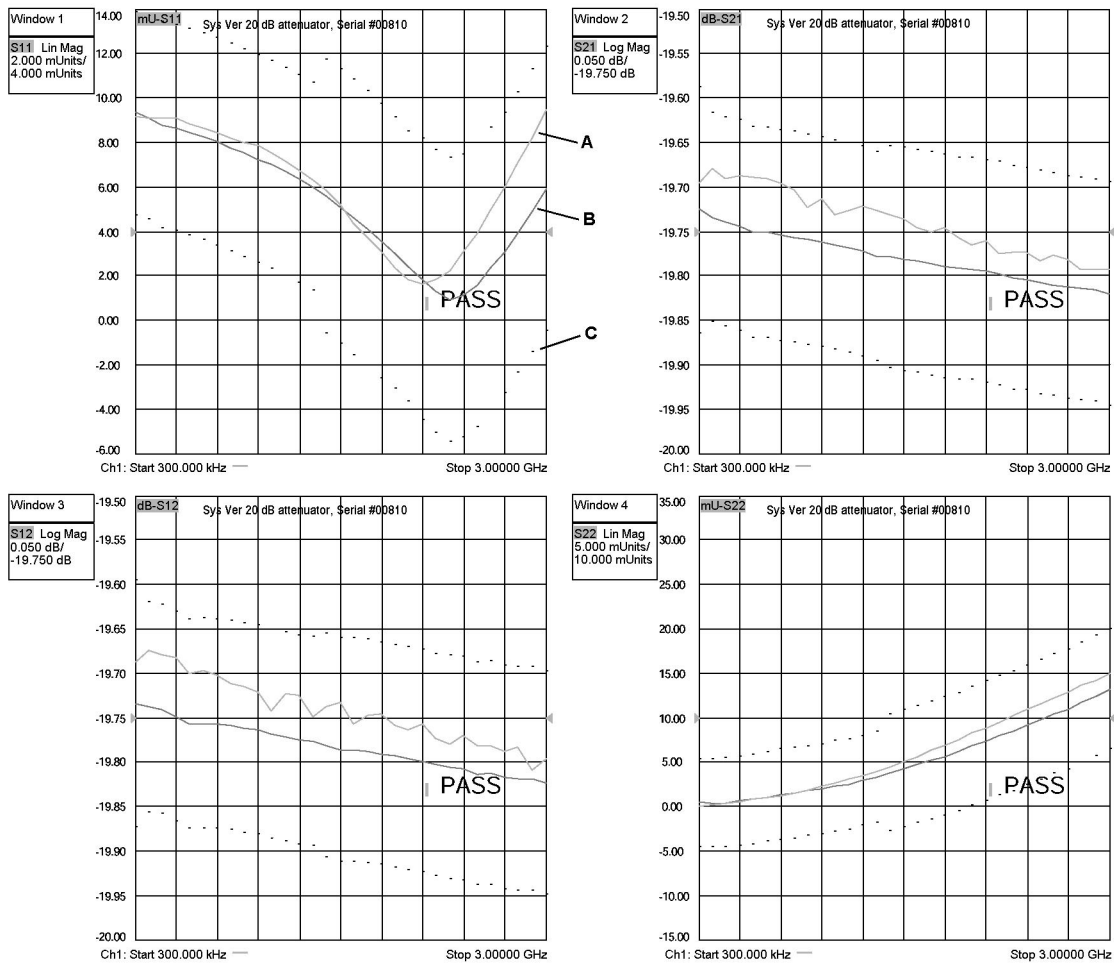
S11 Results
Frequency      Lower Limit      Measured Data      Upper Limit      Result
0.3 MHz        0.0048 Units    0.0090 Units       0.0139 Units    PASS
100            0.0046           0.0091             0.0137          PASS
200            0.0042           0.0092             0.0134          PASS
300            0.0040           0.0091             0.0133          PASS
400            0.0038           0.0089             0.0131          PASS
500            0.0036           0.0087             0.0129          PASS
600            0.0034           0.0085             0.0127          PASS
700            0.0031           0.0082             0.0125          PASS
800            0.0029           0.0080             0.0122          PASS
900            0.0026           0.0079             0.0119          PASS
1000           0.0023           0.0075             0.0117          PASS
1100           0.0020           0.0072             0.0114          PASS
1200           0.0017           0.0068             0.0111          PASS
1300           0.0013           0.0064             0.0107          PASS
1400           -0.0006          0.0059             0.0118          PASS
1500           -0.0011          0.0052             0.0113          PASS
1600           -0.0015          0.0044             0.0108          PASS
1700           -0.0020          0.0038             0.0103          PASS
1800           -0.0026          0.0032             0.0097          PASS
1900           -0.0031          0.0024             0.0091          PASS
2000           -0.0036          0.0019             0.0085          PASS
2100           -0.0045          0.0016             0.0082          PASS
2200           -0.0050          0.0018             0.0077          PASS
2300           -0.0054          0.0023             0.0073          PASS
2400           -0.0052          0.0031             0.0075          PASS
2500           -0.0048          0.0039             0.0080          PASS
2600           -0.0040          0.0050             0.0087          PASS
2700           -0.0032          0.0060             0.0094          PASS
2800           -0.0024          0.0071             0.0103          PASS
2900           -0.0014          0.0082             0.0113          PASS
3000           -0.0004          0.0095             0.0124          PASS
```

Overall PASS/FAIL result for entire frequency range = PASS

Figure 2-16 shows an example of typical verification results with **Measurement Plots** selected in the **Printer Output** area of the **System Verification** windows. The printed graphical results show the following:

- the name of the device measured
- the serial number of the device
- the parameters measured
- Results of the measurements. Labeled as A in Figure 2-16.
- Data measured at the factory from the verification kit. Labeled as B in Figure 2-16.
- Upper and lower limit points as defined by the total system uncertainty system. Labeled as C in Figure 2-16.

Figure 2-16 Example of Printed Graphical Verification Results



Performance Tests (Agilent N2721A Software Package)

The Agilent N2721A software package verifies the electrical performance of your PNA series RF network analyzer (E8536A, E8537A, and E8538A). The software automatically configures your analyzer to execute the performance tests. The N2721A software package is not included with the analyzer; it must be ordered separately.

The content of this section provides a summary of the tests and equipment used for each test. There are nine tests in the software package:

- [Frequency Range and Accuracy Test](#)
- [Test Port Output Power Accuracy](#)
- [Test Port Output Power Range and Linearity Test](#)
- [Test Port RMS Noise Level Test](#)
- [Test Port Crosstalk Test](#)
- [Calibration Coefficients Test](#)
- [High Level Trace Noise CW Test](#)
- [Test Port Receiver Dynamic Accuracy Test](#)
- [Receiver Magnitude Compression Test](#)

Frequency Range and Accuracy Test

This test is used to verify that any frequency point across the entire frequency range of your analyzer is accurate to ± 1 ppm. The output frequency is measured using an external frequency counter.

Specification Tested: Test Port Output Frequency Range and CW Accuracy

Test Port Output Power Accuracy

This test is used to confirm the accuracy of the test port output power of your PNA series RF network analyzer. The test software sets up the analyzer to test Port 1 at several CW (continuous wave) frequencies. The output power is measured using an external power meter and compared with the level set by the analyzer.

Specification Tested: Test Port Output Power Level Accuracy

Test Port Output Power Range and Linearity Test

This test is used to verify the output power ranges and the linearity over your analyzer's frequency range. This test uses an external power meter and power sensor.

Specification Tested: Test Port Output Power Level Linearity

Test Port RMS Noise Level Test

This test is used to verify your analyzer's test port input RMS noise level at a 1 kHz IF bandwidth across different frequency ranges. This test uses a 50Ω load from the calibration kit.

Specification Tested: Test Port Input Noise Floor

Test Port Crosstalk Test

This test is used to measure the maximum level of signal leakage between the analyzer's test ports. This test uses a calibration kit and test cable.

Specification Tested: Test Port Input Crosstalk

Calibration Coefficients Test

This test is used to verify the uncorrected calibration coefficients of your analyzer. The calibration coefficients are measured in forward and reverse direction. This test uses a calibration kit and test cable.

Specification Tested: Uncorrected System Performance

High Level Trace Noise CW Test

This test is used to measure the high level trace noise (magnitude and phase) of your analyzer at 1 kHz and 10 kHz bandwidths. The trace noise equates to the stability of the internal source and receiver assemblies of your analyzer. This test uses a calibration kit and a test cable.

Specification Tested: Test Port Output Source Stability

Test Port Receiver Dynamic Accuracy Test

This test is used to measure the receiver linearity against test port input power. This test uses the dynamic accuracy module (Z5623A Option H01), power meter, and power sensors.

Specification Tested: Test Port Input Dynamic Accuracy

Receiver Magnitude Compression Test

This test is used to measure the magnitude compression of the analyzer's test port. Power sweeps from low to high power are made at certain CW frequencies. This test uses a test cable.

Specification Tested: Test Port Input Dynamic Accuracy

Adjustments

These adjustments are firmware-driven tests that are used to fine-tune your analyzer for optimum response. The tests are as follows:

- “Source Calibration Adjustment” on page 2-29
- “Receiver Calibration Adjustment” on page 2-30
- “LO Power Adjustment” on page 2-32
- “10 MHz OCXO Frequency Adjustment” on page 2-33
- “3.8 GHz PMYO Frequency Adjustment” on page 2-34

Source Calibration Adjustment

The source calibration is used to adjust your network analyzer for a flat source power across its full frequency range. The differences between Port 1 and Port 2 are negligible; therefore, a Port 2 adjustment is not required.

Equipment Used for Source Calibration

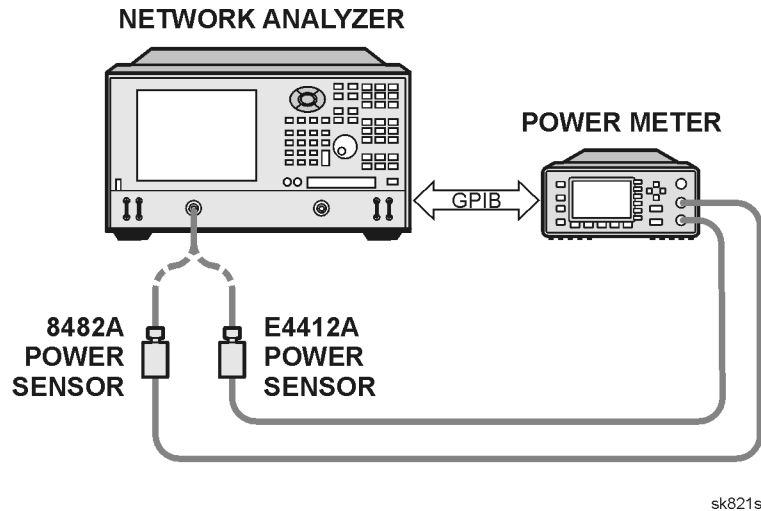
Equipment Type	Part Number
Power meter	E4419B
Power sensor	8482A (100 kHz–4.2 GHz)
Power sensor	E4412A ¹ (10 MHz–18 GHz)
RF Cable	N6314A

1. The E4412A is not needed with the E8356A.

Procedure

1. Connect the equipment as shown in [Figure 2-17](#). Connect a GPIB cable between the network analyzer and the power meter.

Figure 2-17 Source Calibration Setup



2. On the **System** menu, point to **Service, Adjustments**, and then click **Source Calibration**.
3. Ensure the GPIB settings are correct.
4. Click **Calibrate**, and then follow the instructions as they are displayed.

Receiver Calibration Adjustment

The receiver calibration is used to adjust the network analyzer receivers for a flat response across its full frequency range. A power meter is connected to Port 1, as shown in [Figure 2-18](#), to establish a reference for flatness. A signal from Port 1, as shown in [Figure 2-19](#), is used to adjust the “B” receiver at Port 2. The adjustment is repeated using a signal from Port 2 to adjust the “A” receiver at Port 1.

Equipment Used for Receiver Calibration

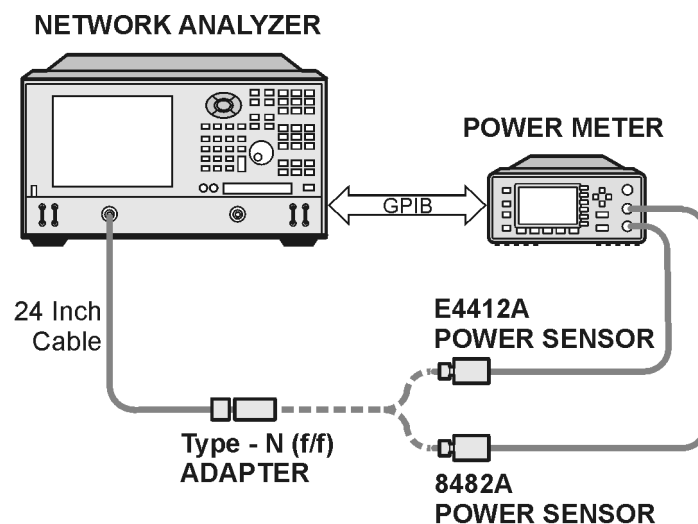
Equipment Type	Part Number
Power meter	E4419B
Power sensor	8482A (100 kHz–4.2 GHz)
Power sensor	E4412A ¹ (10 MHz–18 GHz)
Type-N (female to female)	1250-0777
RF Cable	N6314A

1. The E4412A is not needed with the E8356A.

Procedure

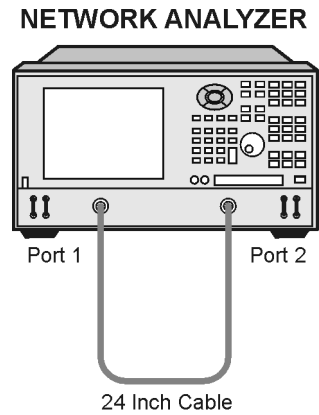
1. Connect the equipment as shown in [Figure 2-18](#). Connect a GPIB cable between the network analyzer and the power meter.

Figure 2-18 Receiver Calibration Setup



sk84s

Figure 2-19 Setup for Receiver Calibration of Port 2



sk820s

2. On the **System** menu, point to **Service, Adjustments**, and then click **Receiver Calibration**.
3. Ensure the GPIB settings are correct.
4. Click **Calibrate**, and then follow the instructions as they are displayed.

LO Power Adjustment

The LO power adjustment is used to adjust the power level of the LO signals from the A17 LO distribution assembly. This adjustment is done for only one LO output. The differences between each LO output is negligible; therefore, separate adjustments are not required.

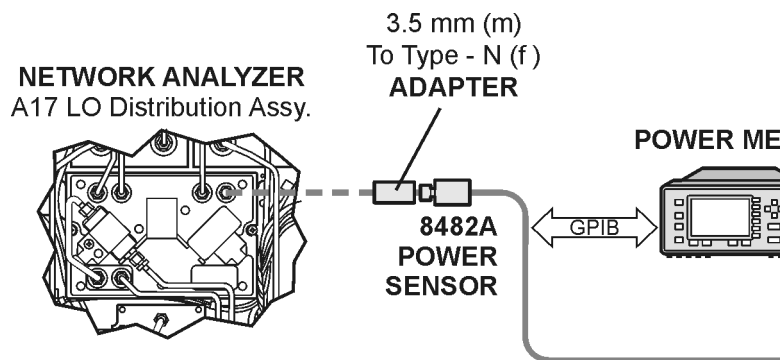
Equipment used for LO Power Adjustment

Equipment Type	Part Number
Power meter	E4419B
Power sensor	8482A
Type-N (female) to 3.5 (male)	1250-1750

Procedure

1. Turn off the network analyzer and remove the power cable and other external cables from the rear panel.
2. Remove the outer cover. Refer to [“Removing the Covers”](#) on page 7-6.
3. Place the analyzer on its side to allow access to the bottom of the analyzer.
4. Connect the equipment as shown in [Figure 2-20](#), making sure to support the power sensor to prevent excess pressure on the SMA connector. Connect a GPIB cable between the network analyzer and the power meter.

Figure 2-20 Setup for LO Power Adjustment



sk83s

5. Reconnect the power and USB cables. Turn on the analyzer.
6. On the **System** menu, point to **Service, Adjustments**, and then click **LO Power Adjust**.
7. Ensure the GPIB settings are correct.
8. Click **Begin Adj**, and then follow the instructions as they are displayed.
9. Turn off the analyzer, disconnect the power cable, and replace the covers.

10 MHz OCXO Frequency Adjustment

The 10 MHz frequency adjustment is used to adjust the frequency accuracy of the network analyzer's 10 MHz oven-controlled crystal oscillator (OCXO) on the A10 frequency reference board assembly.

Equipment Used for Frequency Adjustment at 10 MHz

Equipment Type	Part Number
BNC 50W, 24 inch	8120-1839
Frequency counter	53181A Opt 010,124 ¹

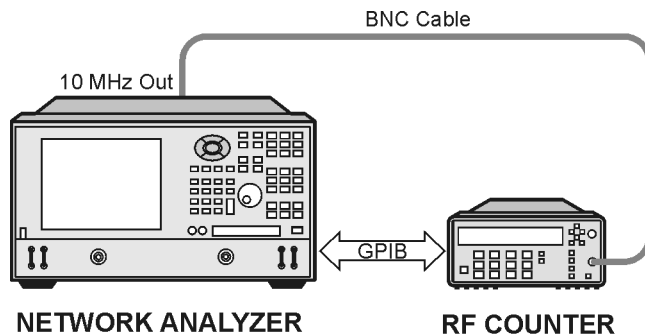
1. Alternate choices: 53131A and 53132A (both Opt 010,124)

Procedure

NOTE The specification of frequency accuracy is ± 1 ppm. However, this test typically adjusts to ± 0.01 ppm.

1. Connect the equipment as shown in [Figure 2-21](#). Connect a GPIB cable between the network analyzer and the frequency counter.

Figure 2-21 Setup for Frequency Adjustment at 10 MHz



sk

2. On the **System** menu, point to **Service, Adjustments**, and then click **10 MHz Freq Adjust**.
3. Ensure the GPIB settings are correct.
4. Click **Begin Adj**, and then follow the instructions as they are displayed.

3.8 GHz PMYO Frequency Adjustment

The 3.8 GHz adjustment is used to adjust the frequency accuracy of the network analyzer's 3.8 GHz permanent-magnet YIG oscillator (PMYO) on the A12 source assembly.

Equipment used for Frequency Adjustment at 3.8 GHz

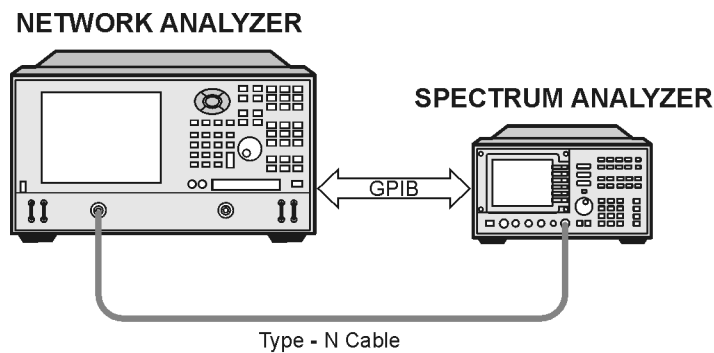
Equipment Type	Part Number
Spectrum analyzer	8561E ¹

1. or as alternate 856xE

Procedure

1. Connect the equipment as shown in [Figure 2-22](#). Connect a GPIB cable between the network analyzer and the spectrum analyzer.

Figure 2-22 Setup for Frequency Adjustment at 3.8 GHz



sk82s

2. On the **System** menu, point to **Service, Adjustments**, and then click **3.8 GHz Freq Adjust**.
3. Ensure the GPIB settings are correct.
4. Click **Begin Adj**, and then follow the instructions as they are displayed.

Serial Bus Test

NOTE This test is written for a PNA series RF network analyzers as it was originally shipped from the factory. Due to changes in board production, this test may not show accurate pass/fail results if the A8, A10, A11, or A12 board assemblies have been replaced with newer board assemblies.

Through the front panel, the serial bus test allows you to check signal and voltage levels at 32 points (nodes) distributed across four of the printed circuit board assemblies in the analyzer. With this test you can isolate problem board assemblies in the analyzer. The board assemblies tested and their associated node numbers are as follows:

Board Assembly	Node Numbers
A12 Source Assembly	111 to 118
A10 Frequency Reference	211 to 218
A11 Phase Lock	311 to 318
A8 Fractional-N Synthesizer	411 to 418

Descriptions of each board assembly and node is included in this section. Location of the nodes is indicated with the a ♦ symbol on the block diagrams located at the end of [Chapter 3 , “Troubleshooting.”](#)

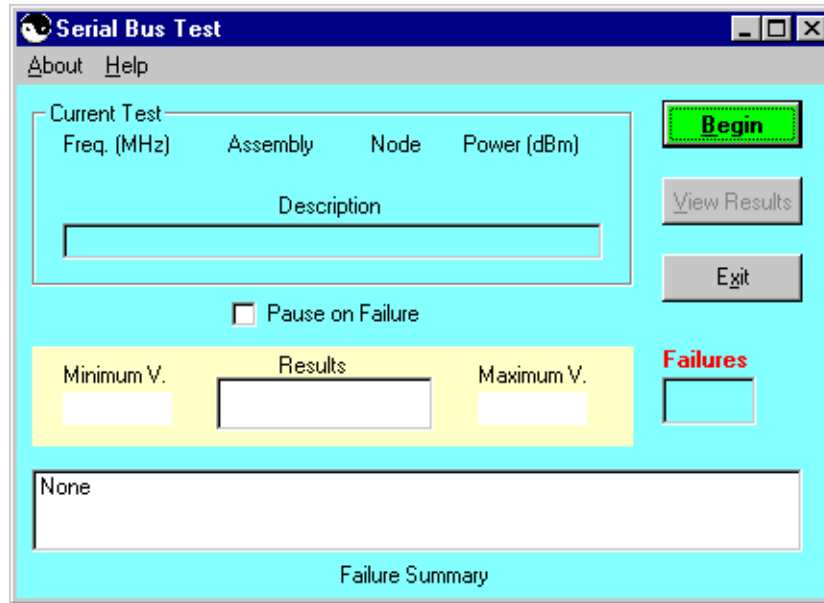
Performing the Serial Bus Test

First, this test sequentially checks all 32 nodes at 300 kHz. Next, the test checks all nodes that change values with frequency, at eleven different frequency points. For each node, measured values are copied to an ASCII text file in the service directory on the hard disk drive. Any measured values that exceed the tolerances are highlighted in the application and the data file.

To run the serial bus test:

- On the **System** menu, point to **Service**, and then click **Serial Bus Test**.
- The dialog box in [Figure 2-23 on page 2-36](#) is displayed. Click **Begin** to start the test.

Figure 2-23 Serial Bus Test Dialog Box



Node Descriptions, A12 Source Assembly

There are eight nodes located on the A12 source assembly. Nodes 111 through 116 are part of the ALC function. Nodes 117 and 118 are associated with leveling the output. The output of the A6 source assembly goes to the A22 switch splitter.

Node 111 *ALC integrator*

Node 111 senses the output of the ALC integrator. The output of the ALC integrator is the combined voltage output of all compensation circuits in the ALC. The voltage level varies with frequency and output power.

Node 112 *level output*

Node 112 senses the output of the detector log amp in the ALC.

Node 113 *Detector Level*

Node 113 senses the power level of the internal detector signal from the A22 switch splitter or the power level from the external detector from the rear panel.

Node 114 *-1V/GHz Compensation*

Node 114 senses the inverse of the -1V/GHz signal that comes from the A11 phase lock board. The -1V/GHz compensates for first-order power changes of the YIG oscillator with respect to frequency.

Node 115 *Temperature Compensation*

Node 115 senses the output of thermistor circuitry that compensates for changes in operating temperature of the YIG oscillator.

Node 116 *Power DAC*

Node 116 senses the output voltage of the power DAC. This output is summed with other compensation signals to control the source output level. The power DAC has the most influence of the compensation signals.

Node 117 *Power Amplifier Compensation*

Node 117 senses the voltage compensation for the source output power amplifiers. This compensation is set for each source band.

Node 118 *Permanent Magnet YIG Oscillator (PMYO) DAC*

Node 118 senses the output voltage of the DAC that sets the frequency of the 3.8 GHz PMYO.

Node Descriptions, A10 Frequency Reference Board Assembly

There are eight nodes located on the A10 frequency reference board assembly:

Node 211 *100 MHz Tune*

Node 211 senses the tune voltage that phase locks the 100 MHz VCO. The tune voltage is set by referencing the 100 MHz VCO to the internal 10 MHz OCXO or to the 10 MHz EXT REF.

Node 212 *100 MHz Level*

Node 212 senses the average voltage output level of the 100 MHz VCO phase locked reference signal.

Node 213 *100.167 MHz Tune*

Node 213 senses the tune voltage that phase locks the 100.167 MHz VCO. The tune voltage is set by referencing the 100 MHz VCO.

Node 214 *100.167 MHz level*

Node 214 senses the average voltage output level of the 100.167 MHz reference VCO.

Node 215 *External Reference Detect*

Node 215 senses a TTL signal which is used to set the reference frequency switch. The node registers a low TTL voltage when the internal 10 MHz OCXO signal is used or a high TTL voltage when the external 10 MHz EXT REF is used.

Node 216 *4 MHz 2nd LO Average Voltage*

Node 216 senses the average voltage of the 4 MHz 2nd LO signal that is routed to the A16 test set motherboard assembly. This voltage is constant through bands 1 and 6. There is no voltage present in band 0.

Node 217 *Phase Lock Average Voltage*

Node 217 senses the average voltage of the phase lock reference signal that is routed to the A11 phase lock board assembly. This voltage is constant through bands 1 and 6. There is no voltage present in band 0.

Node 218 *1 MHz Average Voltage*

Node 218 senses the average voltage of the 1 MHz reference signal for the 100.167 MHz reference signal. This voltage is constant in all bands.

Node Descriptions, A11 Phase Lock Board Assembly

There are eight nodes located on the A11 phase lock board assembly:

Node 311 *30 kHz Phase Detector*

Node 311 senses the average voltage of the band 0 phase comparator at the output of a 30 kHz low pass filter. This signal path is not used in Bands 1 through 6.

Node 312 *100 kHz Phase Detector*

Node 312 senses the average voltage of the Bands 1 through 6 phase comparator at the output of a 100 kHz low pass filter. This signal path is not used in Band 0.

Node 313 *30 kHz Phase Detector Integrator*

Node 313 senses the tune voltage that phase locks the source in band 0. The integrator that supplies this signal receives its input from the 30 kHz phase detector (Node 311).

Node 314 *100 kHz Phase Detector Integrator*

Node 314 senses the tune voltage that phase locks the source in Bands 1 through 6. The integrator that supplies this signal receives its input from the 100 kHz phase detector (Node 312).

Node 315 *1V/GHz YTO Drive Voltage*

Node 315 senses the YIG tuned oscillator drive voltage which sweeps at 1V/GHz.

Node 316 *YTO Drive Current*

Node 316 senses the YIG-tuned oscillator drive current.

Node 317 *YTO Tune Compensation*

Node 317 senses the voltage output of the YTO tune compensation summation node.

Node 318 *Ground*

Node 318 is connected to digital ground to serve as a measurement reference.

Node Descriptions, A8 Fractional-N Synthesizer Board Assembly

There are eight nodes located on the A8 fractional-N synthesizer board assembly.

Node 411 *+ 5V dc Supply Voltage*

Node 411 senses the 5V dc supply voltage which serves as a measurement reference.

Node 412 *1.5 to 3.0 GHz VCO Compensation*

Node 412 senses the average voltage output level of the 1.5 to 3.0 GHz VCO.

Node 413 *1.5 to 3.0 GHz VCO Tune Voltage*

Node 413 senses the average voltage input level of the 1.5 to 3.0 GHz VCO.

Node 414 *Heterodyne Band ALC Level*

Node 414 senses the ALC output voltage which is used to level the heterodyne circuit output for band 1.

Node 415 *2.250 GHz VCO Tune Voltage*

Node 415 senses the average voltage input level of the 2.250 GHz VCO.

Node 416 *Fundamental and Divide-by-2 Band ALC Level*

Node 416 senses the ALC output voltage which is used to level the heterodyne circuit output for bands 2 through 6.

Node 417 *2.250 GHz VCO Compensation*

Node 417 senses the average voltage output level of the 2.250 GHz VCO.

Node 418 *ALC Level Adjust*

Node 418 senses the voltage which is used to set the offset on the heterodyne band ALC.

Option Enable Utility

The option enable utility allows you to:

- install or remove software for analyzer options.
- recover option data if the A31 hard disk drive assembly or the A10 frequency reference board assembly is replaced.
- input or change the analyzer serial number.

NOTE For more in-depth information on option enable, refer to the embedded help in the analyzer.

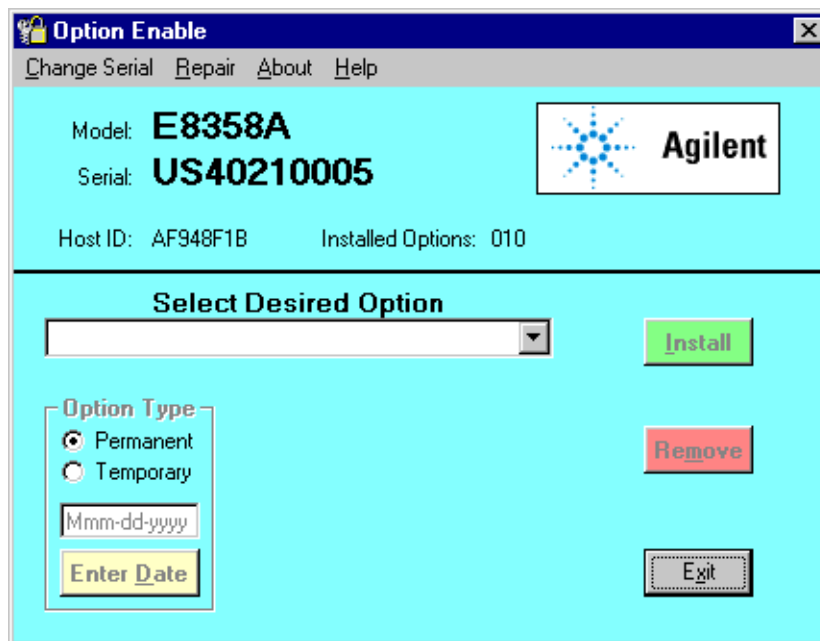
Accessing the Option Enable Utility

To start the option enable application:

- On the **System** menu, point to **Service**, and then click **Option Enable**.
- The dialog box illustrated in [Figure 2-24](#) is displayed.

NOTE Some applications require a keyword that is provided by Agilent. If you do not have the required keyword, contact Agilent for assistance. Refer to the nearest sale or service office, listed in [Table 1-1 on page 1-10](#).

Figure 2-24 Option Enable Dialog Box



Installing or Removing Options

There are two types of options:

- **Hardware option:** This option involves some physical change to the analyzer. The option enable utility allows you to load the software to drive the new changes.
- **Software option:** This option involves loading software to initialize your new option. The option enable utility is part of this process.

Use the **Select Desired Option** box to select an option to install or remove from your analyzer. If the option is not available in the list box, select **Enter Unlisted Option**. A dialog box will allow you to enter the option number. Enter the option and follow the instructions on the display.

Repairing and Recovering Option Data

If the hard disk drive is replaced or the A10 frequency reference board is replaced, use this option to recover data. This routine recovers option data lost during the repair. Select **Repair** from the **Option Enable** menu and follow the instructions on the display.

Installing or Changing a Serial Number

It may be necessary to install or change a serial number if certain assemblies are replaced.

IMPORTANT Use extreme care when entering the serial number, as only one attempt is allowed.

1. To change a serial number, select **Change Serial** from the **Option Enable** menu bar. The current serial number is displayed. If no serial number has previously been entered, the word "NONE" will be displayed.
2. Type the new serial number into the space provided, click **Serial**.

NOTE To change an incorrect serial number, a clear-code password is required. Contact your nearest Agilent sales or service office to obtain the clear-code. Refer to [Table 1-1 on page 1-10](#) for a list of offices.

Firmware Upgrades

This section provides instructions for installing firmware upgrades in your PNA series RF network analyzer. There are two ways in which you can upgrade the firmware in your network analyzer:

- [Downloading From the Internet](#)
- [Downloading Using Option 099, Firmware Upgrade](#)

Downloading From the Internet

If your network analyzer is connected to the Internet, there are two methods available for downloading new firmware:

- Download directly from: <http://www.agilent.com/find/pna>. (Select your analyzer's model number in this website to view available upgrades.)
- On the **System** menu, point to **Service**, and then click **AgileUpdate**. AgileUpdate compares the firmware revision currently installed in your network analyzer to the latest version available and assists you in downloading and installing the most recent version. This is available only on analyzers with firmware revision A .01.20 and higher.

Downloading Using Option 099, Firmware Upgrade

Option 099 provides a firmware upgrade kit containing a CD-ROM that contains firmware upgrades for your network analyzer. Refer to "[Option 099, Firmware Upgrade](#)" on page 1-4 for additional information.

Two procedures are provided for updating the analyzer firmware using the upgrade kit:

- [Downloading From a USB CD Drive Connected to the Analyzer](#)
- [Downloading From a Shared CD Drive Over the LAN](#)

Installation Requirements

- The network analyzer must be in proper working condition prior to installing this option. Any necessary repairs must be made before proceeding with this installation.
- This installation does not require removal of the analyzer's protective outer covers.
- The analyzer must be powered up and operating to perform this installation.

Downloading From a USB CD Drive Connected to the Analyzer

- A mouse and a keyboard must be connected to the network analyzer.
- A CD drive must be connected to the network analyzer. This procedure has been verified using the CD drive supplied with PNA Option AM8. It has not been verified using other USB CD drives.

Installation Procedure

1. Exit all applications; the analyzer display should show the PC desktop icons.

2. Insert the upgrade CD into your analyzer's CD drive.
3. Click **My Computer**, and then click your analyzer's CD drive.
4. On the CD drive menu, click on the program file listed to begin the installation.
5. Follow the instructions as they appear. Select your network analyzer's hard disk drive as the destination for the files being installed.

Downloading From a Shared CD Drive Over the LAN

- If your PC and your network analyzer are both connected to the same LAN, proceed to ["Downloading Over the LAN"](#).
- If your PC and your network analyzer are NOT connected to a LAN, you can connect them using a crossover cable. A crossover cable can be purchased or can be constructed from a standard LAN cable. Refer to ["Constructing a Crossover Cable" on page 3-26](#) for details.

Downloading Over the LAN

This procedure assumes that the network analyzer and the computer are both connected to the same LAN or are connected using a crossover cable.

From your PC:

1. Insert the upgrade CD in your PC's CD drive.
2. Right click on **Network Neighborhood**, and then click **Properties**. Record the **Computer Name** here: _____ . Click **Cancel**.
3. Double-click **My Computer**. Click on your PC's CD drive. On the **File** menu, click **Sharing**. Under the **Sharing** tab, click **Share as**. Type a **Share Name** and record it here: _____ . *Do not use the default letter that is displayed.* Click **Cancel** to close the dialog box.

From your network analyzer:

4. On the PC desktop, click **My Computer**, click **Tools**, and then click **Map Network Drive**.
5. The network analyzer will choose the next available drive letter. Record this drive letter here: _____ .
6. In the **Map Network Drive** window, click the **Folder** box (this is the **Path** box on the PC) and type the path of your PC's CD drive in the form \\computername\sharename. You recorded the computername in step 2 and the sharename in step 3.

NOTE If you are logged onto the analyzer using the same logon as for your PC, it is not necessary to select "Connect using a different user name". If, however, you are not logged onto your analyzer using the same logon or you prefer to connect under a different user name, click this hyperlink and type the user name and password. If the user name is in a different domain, use the format: domain\username.

7. To automatically connect to the shared drive each time you log on, check **Reconnect at logon**.

8. Click **Finish**.
9. Your PC's CD drive should now be visible on the display as the drive letter you recorded in step 5 with the share name you assigned in step 3.
10. A window listing the contents of the CD installed in your PC's CD drive is displayed.
11. On the CD drive menu, click on the program file listed to begin the installation.
12. Follow the instructions as they appear. Select your network analyzer's hard disk drive as the destination for the files being installed.

Operating System Recovery

This section provides instructions for recovering from a serious system malfunction such as would be caused by corrupted or inadvertently deleted files on the system's hard disk drive.

Windows 2000 has several methods to help recover from situations where the system will not start up properly. The scope of these methods is too extensive to cover in this document and is best left to system administrators or others that are well trained in the administration of Microsoft Windows.

This document describes a feature that exists on the hard drive and can be used to recover functionality without losing all previous settings. Of course, the success of any recovery will vary depending upon the type of damage done to the operating system or to the hard drive.

The hard drive in the PNA series RF network analyzer has two partitions:

- The first, the C: drive, has the main Windows 2000 operating system and is in the NTFS format. This is the normally used partition and it contains all the programs and other needed files.
- The second partition, the D: partition or D: drive, is the Disaster Recovery Partition and contains a separate, fully functional Windows 2000 operating system. The network analyzer application does not exist in this D: partition; it only resides on the C: drive.

The D: partition has all the files needed to re-install or repair the operating system. You can typically boot to the D: partition as a selection during the normal boot-up process. If, however, this boot-up selection process is not functioning, you must create a Windows 2000 boot disk, and then boot from that disk. To make this disk, you need a blank floppy disk and a computer (or another PNA series RF network analyzer) that is currently running Windows 2000.

A boot disk for Windows 2000 consists of a floppy disk with the following Windows 2000 files:

- Ntldr
- NTDETECT.COM
- boot.ini

The Ntldr and Ntdetect files are located in the root directory of both the C: and D: partitions. You may have to modify your file-view options so that Windows Explorer will show hidden and system files.

If a boot.ini file is copied from a source other than a PNA series RF network analyzer, it must be modified to match the listing shown below or you can simply enter this code into a text file and name it boot.ini.

```
[boot loader]
timeout=5
default=multi(0)disk(0)rdisk(0)partition(1)\WINNT
[operating systems]
multi(0)disk(0)rdisk(0)partition(1)\WINNT="Microsoft Windows 2000 Professional" /fastdetect
multi(0)disk(0)rdisk(0)partition(2)\WINNT="Disaster Recovery Partition" /fastdetect
C:\CMDCONS\BOOTSECT.DAT="Microsoft Windows 2000 Recovery Console" /cmdcons
```


To boot from this disk, insert it into the PNA series RF network analyzer and restart the system. The analyzer should detect this disk and ask you which system you wish to boot from. Since this recovery process assumes that the normal partition is not currently functional, select the **Disaster Recovery Partition**.

Bios Changes (If required)

NOTE If the system does not even attempt to boot from the floppy, you may have to change the bios settings to have it scan the floppy disk before scanning the hard drive.

To enter the bios menu, attach a keyboard and restart the analyzer. As soon as the Agilent logo appears (about 15 seconds) press the function key **F2** on the keyboard. The bios menu appears several seconds later. Use the keyboard arrow keys to highlight the **Boot Sequence** selection and then use the **+** and **-** keys to select **A: then C:**. Press function key **F10** to save and exit. Once the analyzer is functioning properly, don't forget to change this back to **C: then A:**. Failure to do so will result in error messages being generated if a floppy disk is left in the drive during power-up.

System Recovery Information

NOTE The following instructions assume that you have successfully booted to the D: partition.

NOTE If the instructions below are followed, your existing system settings should not change significantly.

There are two methods for recovery.

- The first method is much faster but, depending upon the amount of damage done, may be insufficient to fully recover the operating system.
- The second method performs a more complete restoration but takes at least an hour to complete and may change some system settings.

Neither method should affect installed programs or user account information.

You should try the first method before trying the second, unless you are certain that a large amount of damage has been done.

If recovery of the operating system is not successful, the only alternative is to replace the hard disk drive. Replacement hard disk drives have the full operating system already installed and configured.

Recovery Procedure (First Method, Fast)

The following instructions assume you are currently booted into the recovery partition (D: partition).

1. Remove all USB devices (including hubs) except for the keyboard and mouse; one connected to the front panel USB port, and the other connected to the rear panel USB port.
2. Remove any floppy disk from the floppy disk drive.
3. Select **Start**, and then **Run**. Enter the following command within the **Run** window, and then click **OK**: `D:\i386\winnt32.exe /tempdrive:C`
4. A message may or may not appear regarding the ability to upgrade; ignore any such message and click **OK**.
5. A Welcome window appears to ask if you want to **Upgrade Windows 2000** or perform a new installation (**Clean install**). Select **Clean Install**. (Selecting **Update** results in the installation of files on the wrong partition!) Click **Next**.
6. Accept the license agreement.
7. You are asked to enter the Microsoft Product Key. The product key label should be located on the right side of the analyzer, towards the front. Once entered, click **Next**.
8. The **Select Special Options** window appears. Select **Advanced Options**. Check the box that allows you to choose the installation partition. Do not change the other defaults listed. Select **OK**, and then **Next**.
9. You are asked if you want to upgrade your drive to NTFS file system. Select **No**. (The C: partition should already be in NTFS format, while the D: partition is in FAT32.)
10. Setup then begins copying files. This takes about 4 minutes, and then the analyzer restarts. Make sure there is no floppy disk installed.
11. Windows 2000 setup begins and starts loading files. You are asked if you want to **Setup** or **Repair** an installation. Choose **Repair** by entering the letter **R**.
12. You are asked if you want to repair by using the console or by using the emergency repair process. Choose emergency repair by entering the letter **R**.
13. Choose **Fast Repair** by entering the letter **F**.
14. If you have a recent emergency repair floppy disk, insert it now and press **Enter**. If you do not have a disk, enter the letter **L**.
15. At this point, both the C: and D: \WINNT partitions should be selectable. If the C:\WINNT partition is shown, highlight it and then press **Enter**.
If the C:\WINNT partition is not displayed, or if the repair process cannot locate any repair files, STOP! Do not select the D: partition. This repair method will not properly restore your system. You must use the [“Recovery Procedure \(2nd Method, Complete\)”](#) on page 2-50.
16. If a floppy disk was previously inserted, remove it now.
17. You can skip the drive examination by pressing the **ESC** key.

18. The repair process begins. This typically takes only a few minutes, after which the analyzer restarts.

The network analyzer system should now be fully functional. If not, use the following more complete repair process, [“Recovery Procedure \(2nd Method, Complete\)”](#).

Recovery Procedure (2nd Method, Complete)

In cases where extensive damage has occurred to the operating system, this repair method must be performed. This method takes at least one hour and resets some settings. The video driver also has to be re-installed. User account information and installed programs should remain intact, but exceptions can occur.

The following instructions assume you are currently in the recovery partition (D: partition). The first ten steps below, are identical to the previous procedure.

1. Remove any USB devices (including hubs) except for the keyboard and mouse; one connected to the front panel USB port, and the other connected to the rear panel USB port.
2. Remove any floppy disk from the floppy disk drive.
3. Select **Start**, and then **Run**. Enter the following command within the **Run** window, and then click **OK**: `D:\i386\winnt32.exe /tempdrive:C`
4. A message may or may not appear regarding the ability to upgrade; ignore any such message and click **OK**.
5. A Welcome window appears that asks if you want to **Upgrade** Windows 2000 or perform a new installation (**Clean install**). Select **Clean Install**. (Selecting **Update** results in the installation of files on the wrong partition!) Click **Next**.
6. Accept the license agreement.
7. You are asked to enter the Microsoft Product Key. The product key label should be located on the right side of the analyzer, towards the front. Once entered, click **Next**.
8. The **Select Special Options** window appears. Select **Advanced Options**. Check the box that allows you to choose the installation partition. Do not change the other defaults listed. Select **OK**, and then **Next**.
9. You are asked if you want to upgrade your drive to NTFS file system. Select **No**. (The C: partition should already be in NTFS format, while the D: partition is in FAT32.)
10. Setup begins copying files. This takes about 4 minutes, and then the analyzer restarts. Make sure there is no floppy disk installed.
11. Windows 2000 setup begins and starts loading files. You are asked if you want to **Setup** or **Repair** an installation. Choose **Setup** by pressing **Enter**.
12. At this point, both the C: and D: \WINNT partitions should be selectable. Make sure the C:\WINNT partition is shown, and highlight it. You are asked if you want to repair the highlighted installation, or install a fresh copy. Choose **Repair** by entering the letter **R**.
13. The repair process begins. This typically takes about an hour. During this process, you are asked several questions about your configuration and network settings.

When the repair process is finished, the network analyzer system restarts and the network analyzer application starts. However, the network analyzer application will fail due to a change in the video driver. *The video driver must be re-installed.*

Follow these instructions to re-load the video driver, which is located on the D: partition.

14. First, close the network analyzer application by selecting **File**, and then **Exit**.
15. Go to **Device Manager**, right-click on **My Computer**, select **Properties**, and then select the **Hardware** tab.
16. Select **Device Manager**. Look at the **Display adapter** listing; the **Chips and Technologies** entry should show as being disabled. Right-click on the **Chips and Technologies** entry to enable it, and then select **Properties**.
17. Select the **Driver** tab, and then select **Update Driver**. The **Update Device Driver Wizard** starts.
18. Click **Next** on the **Update Device Driver Wizard**. Leave the default selection of **Search** and click on **Next**. Check the box labeled **Specify a location**. Click **Next**.
19. You are asked for a location. **Enter**, or **browse** to: D:\69030. Click **OK**.
20. The video driver should be found. Ignore any message about an existing driver already being used. Click **Next**. Click **Yes** when asked if you want to continue.
21. The driver should start installing. If the installation process can't find a file, direct it back to the D:\69030 directory. Click **Finish**. Click **Close**. The **Chips and Technologies** entry should now be enabled. Close **Device Manager**.
22. You must restart the network analyzer system even if not prompted to do so. Select **Start, Shutdown**, and then **Restart**.
23. The network analyzer system should now be fully functional. If not, contact Agilent for further instructions. A list of Agilent Technologies offices is located on [Page 1-10](#).

NOTE If this second, more-complete recovery method is used, you may notice that, upon power up, the system pauses for 30 seconds to allow selection of the operating system. This time delay can be decreased to 5 seconds if desired. Using Notepad, open C:\boot.ini and change the listed timeout value to five seconds, and then save the file.

3 Troubleshooting

Information in This Chapter

The information in this chapter helps you:

- identify the portion of the analyzer that is at fault.
- locate the specific troubleshooting procedure to identify the assembly or peripheral at fault.

The sections in this chapter are arranged in a logical troubleshooting order. The following table lists the sections and a brief summary of what to look for in that section.

Chapter Three at-a-Glance

Section Title	Summary	Start Page
Check the Basics	This section provides a starting point to begin troubleshooting.	Page 3-4
Power Up Troubleshooting	This section addresses power-up problems: <ul style="list-style-type: none">• Power supply problems• LCD problems• Bootup for the network analyzer interface	Page 3-6
Front Panel Troubleshooting	This section addresses problems occurring after the network analyzer interface is loaded: <ul style="list-style-type: none">• Does the display color appear correct?• Do the front panel keys function properly?• Does the front panel USB connector function properly?	Page 3-18
Rear Panel Troubleshooting	This section addresses problems associated with the rear panel interconnects. The data found at these rear panel interconnects can be used to troubleshoot the CPU board.	Page 3-22
Measurement System Troubleshooting	This section addresses problems with the measurement portion of the analyzer. <ul style="list-style-type: none">• Checking the A, B, R1, and R2 signals• Checking the source assembly group• Checking the receiver assembly group• Checking the signal separation group	Page 3-28
Instrument Block Diagrams	This section contains block diagrams for both a standard analyzer and for an Option 015 analyzer.	Page 3-43

Assembly Replacement Sequence

After identifying the problem requiring an assembly to be replaced, follow these steps:

- Step 1.** Order a replacement assembly. Refer to [Chapter 6](#) , “[Replaceable Parts.](#)”
- Step 2.** Replace the faulty assembly and determine what adjustments are necessary. Refer to [Chapter 7](#) , “[Assembly Replacement and Post-Repair Procedures.](#)”
- Step 3.** Perform the necessary adjustments. Refer to [Chapter 2](#) , “[Checks and Adjustments, Firmware Upgrades, and Operating System Recovery.](#)”
- Step 4.** Perform the necessary performance tests. Refer to [Chapter 2](#) , “[Checks and Adjustments, Firmware Upgrades, and Operating System Recovery.](#)”

Check the Basics

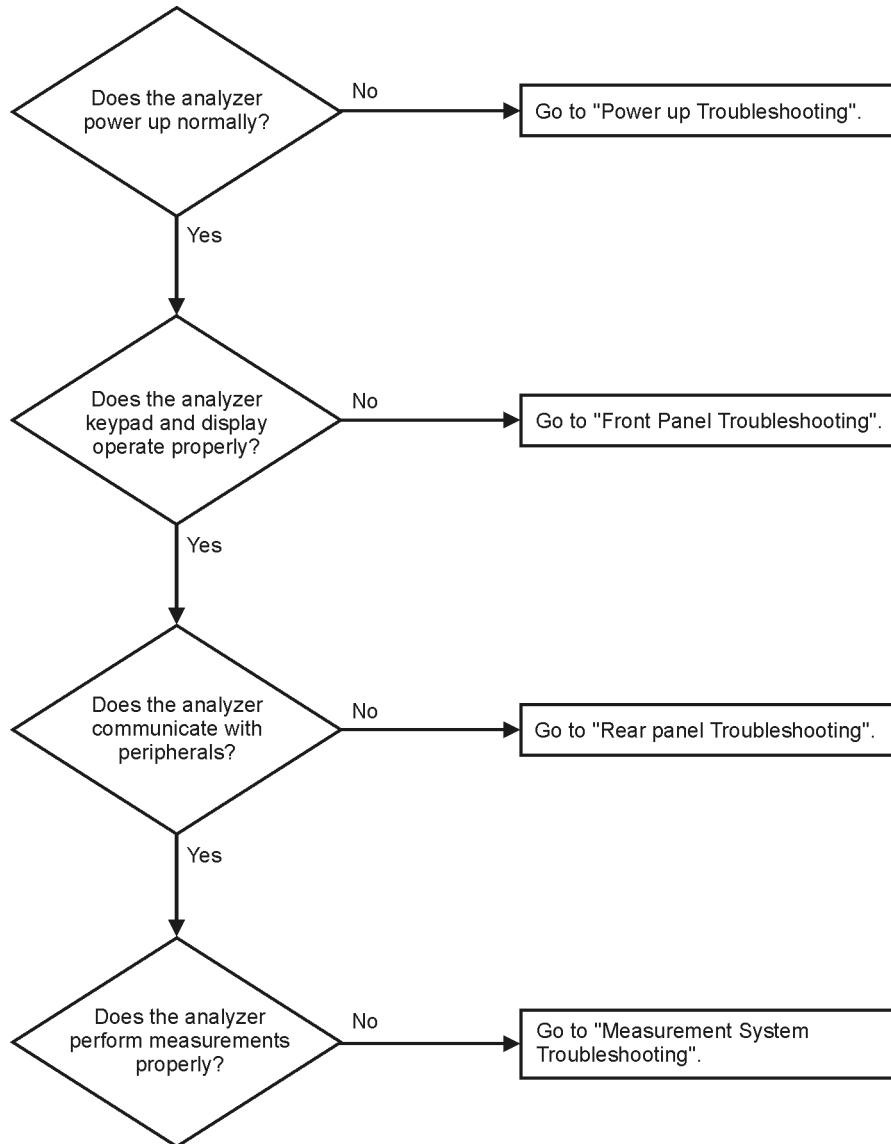
A problem can often be solved by repeating the procedure you were following when the problem occurred. Before calling Agilent Technologies or returning the instrument for service, please make the following checks:

1. Is there power at the mains receptacle?
2. Is the instrument turned on? Check to see if the front panel line switch and any of the LED rings around the ports glow. This indicates the power supply is on.
3. If other equipment, cables, and connectors are being used with the instrument, make sure they are connected properly and operating correctly.
4. Review the procedure for the measurement being performed when the problem appeared. Are all the settings correct?
5. If the instrument is not functioning as expected, return the unit to a known state by pressing the **Preset** key.
6. Is the measurement being performed, and the results that are expected, within the specifications and capabilities of the instrument? Refer to the embedded help in the analyzer for instrument specifications.
7. If the problem is thought to be due to firmware, check to see if the instrument has the latest firmware before starting the troubleshooting procedure. Refer to [“Firmware Upgrades” on page 2-43 in Chapter 2](#).
8. If the necessary test equipment is available, perform the operator's check and system verification in [Chapter 2](#), [“Checks and Adjustments, Firmware Upgrades, and Operating System Recovery.”](#)

Getting Started With Troubleshooting

Follow the flowgraph in [Figure 3-1](#). to help direct you to the correct section for troubleshooting the analyzer.

Figure 3-1. Troubleshooting Organization



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Power Up Troubleshooting

WARNING **Immediately unplug the instrument from the ac power line if the unit shows any of the following symptoms:**

- **Smoke, arcing, or unusual noise from inside the analyzer.**
 - **A circuit breaker or fuse on the main ac power line opens.**
-

Check your network analyzer for evidence that it is powering up correctly. Perform the following steps and make sure that the analyzer is displaying correct behavior as noted in the following steps.

Step 1. Disconnect all peripherals and plug in the network analyzer. Before the analyzer is powered on, the line switch should glow yellow and no other lights should be on.

Step 2. Turn on the network analyzer.

- The line switch and the LED rings around each port should glow.
- The fans should be audible.
- The display should flash and then show the hardware boot-up sequence. This process checks the RAM and communication with the hard disk drive assembly. These checks return an error message if a problem is detected.
- The Windows 2000 operating system should start.
- The network analyzer measurement interface should open with an S₁₁ measurement displayed. The Port 1 LED ring should glow green and the Port 2 LED ring should be off.

Step 3. If the analyzer powers up correctly, continue troubleshooting with [“Front Panel Troubleshooting”](#) on page 3-18.

Step 4. If the analyzer does not power up correctly, follow these troubleshooting steps:

- If the line switch and the LED rings around each port do not glow green or the fans are not operating (audible), go to [“Power Supply Check”](#) on page 3-7.
- If you cannot hear the fans operating, go to [“If the Fans Are Not Operating”](#) on page 3-12.
- If the line switch and the LED rings around each port glow green and the fans are operating (audible), but the display remains dark, go to [“Troubleshooting LCD Display Problems”](#) on page 3-13.
- If the instrument appears to abort the network analyzer measurement interface process, contact your nearest Agilent sales or service office. Refer to [Table 1-1](#) on page 1-10 for the nearest office.

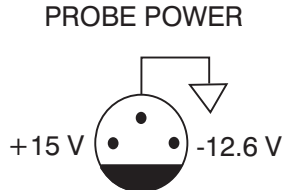
Power Supply Check

NOTE There are no fuses to replace within the power supply. If you determine that the power supply is the failed assembly, replace the power supply.

A catastrophic failure in the power supply assembly can be determined by observing that the line switch and the LED rings around each port glow, and by measuring the probe power at the front-panel Probe Power connectors.

1. Ensure that the instrument is plugged in with the power switch in the standby position (power not switched on). Verify that the line switch glows yellow. A line switch that glows yellow indicates that the +15 VDC line (P15 STB) is providing enough voltage to light the LED. (The actual voltage may not be +15 VDC.)
2. Turn the instrument power on and verify that the line switch glows bright green and the LED rings around each port glow a light green. When the line switch and the LED rings around each port glow, it is an indication that the power supply has received an “ON” command and that the +5.2 VDC supply can at least light these lamps.
3. The front-panel probe power-connector can be used to check the +15 VDC and –12.5 VDC (–15 VDC) supplies. The –12.5 VDC is produced by post regulating the –15 VDC supply. Refer to [Figure 3-2](#) for a diagram of the probe power connector.

Figure 3-2 Probe Power Connector



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If all of these supply voltages are missing, it is likely that the problem is either a defective A4 power supply assembly, or another assembly is loading down the A4 power supply assembly. Continue with [“If All Supply Voltages are Missing” on page 3-10](#), to determine the cause of the problem.

If the line switch and the LED rings around each port are lit correctly, and the probe power voltages measure within the specifications listed in [Table 3-1 on page 3-9](#), the power supply has not suffered a catastrophic failure; however, the power supply could still be at fault. Continue with the next section to measure the individual voltage supplies.

Measure the Individual Voltage Supplies

WARNING **The instrument contains potentially hazardous voltages. Refer to the safety symbols provided on the instrument and in “General Safety Considerations” on page 8-3 before operating the unit with the cover removed. Make sure that the safety instructions are strictly followed. Failure to do so can result in personal injury or loss of life.**

To measure the power supply voltages, it is necessary to remove the instrument’s outer and inner covers. Refer to “Removing the Covers” on page 7-6 for removal procedures. Use the E8356-60021 extender board to measure the individual power supply voltages. Insert the extender board into an empty slot next to the A6 signal processing ADC module (SPAM) Board.

NOTE If any one individual voltage supply from the A4 power supply assembly develops an over-voltage or over-current problem, all supplies are affected. The supply goes into a “burp” mode characterized by the supplies cycling on and off at a low voltage level. The cause of the over-voltage or over-current condition can be the A4 power supply assembly itself, or any assembly to which the A4 power supply assembly provides voltage. To isolate the cause of “burp” mode, continue to the assembly removal process as described in the section titled “If All Supply Voltages are Missing” on page 3-10.

On the extender board, measure the power supply voltages using a digital voltmeter. Refer to Figure 3-3 for the power supply test points on the extender board. Use the point marked as “GND” for the ground connection. Refer to Table 3-1 on page 3-9 for the correct voltages and tolerances.

Figure 3-3 E8356-60021 Synthesizer/Reference Extender Measurement Points

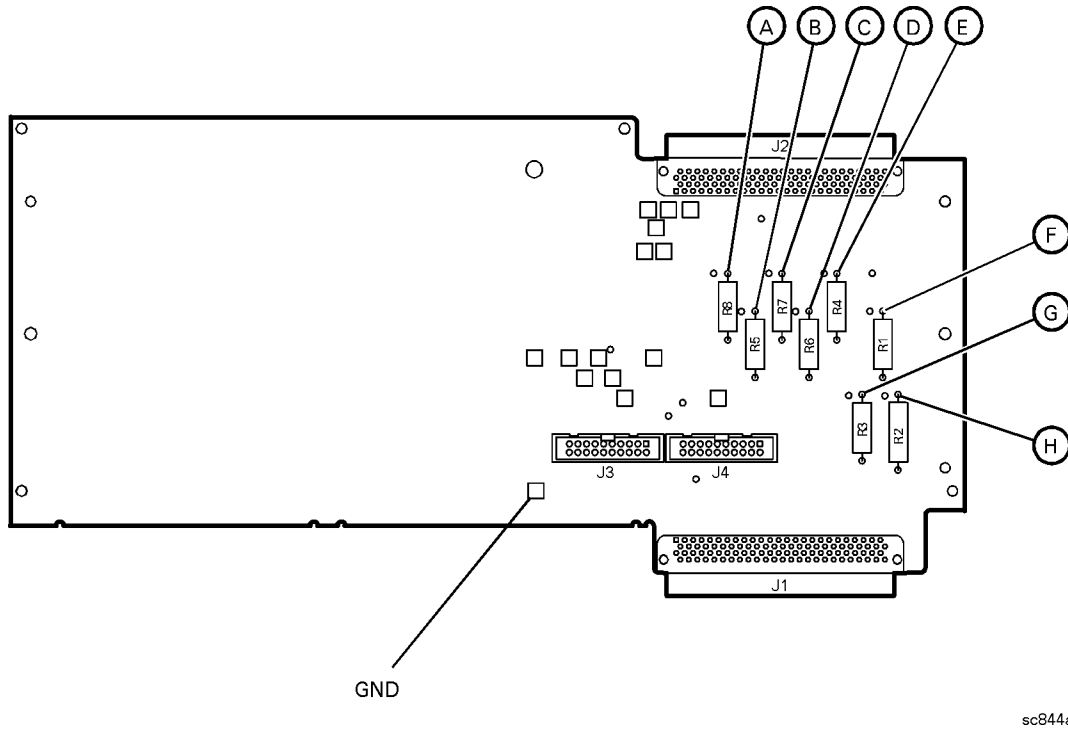


Table 3-1 Extender Board Measurement Points

Measurement Location	Signal Description	Test Equipment Used	Expected Level (Vdc)
A	power supply	DVM	+5.0
B	power supply	DVM	-15.0
C	power supply	DVM	-5.0
D	power supply	DVM	+9
E	power supply	DVM	+15
F	power supply	DVM	+15
G	power supply	DVM	+22
H	power supply	DVM	+32

If All Supply Voltages are Present

If all of the supplies have measured within tolerances, and the instrument still is not functioning properly, refer to [“Rear Panel Troubleshooting” on page 3-22.](#)

If All Supply Voltages are Missing

WARNING **Disconnect the line-power cord before removing any assembly. Procedures described in this document may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury or loss of life.**

It is necessary to sequentially remove all of the assemblies, taking care to disconnect the line-power cord before each removal, and then to measure the supply voltages after each removal.

If the missing supply voltages return to a “power on” condition after removal of an assembly, suspect that assembly as being defective.

Remove the network analyzer assemblies in the order specified in the following steps (refer to [Chapter 7](#) for removal instructions).

1. Unplug the test set motherboard assembly cable from the A16 test set motherboard assembly.
2. Unplug the front panel interface cable from the A3 front panel interface board.
3. Remove the A6 SPAM board assembly.
4. Remove the A8 fractional-N synthesizer board assembly.
5. Remove the A10 frequency reference board assembly.
6. Remove the A11 phase lock board assembly.
7. Unplug the A30 floppy disk drive from the A14 motherboard assembly.
8. Unplug the A31 hard disk drive assembly from the A15 CPU board assembly.

The minimum required assemblies to power up the analyzer are:

- A4 power supply assembly
- A14 motherboard assembly
- A15 CPU board assembly

To further isolate the failure in the three remaining assemblies, measure the resistance on the extender board (with the power turned off) from the power supply test points to “GND”. Refer to [Figure 3-3 on page 3-9](#). The voltages should be as shown in [Table 3-2](#).

NOTE **Make sure that the only assemblies plugged in are the three minimum required assemblies listed above.**

Check for shorts (zero Ω) or very low resistance (approximately 1 Ω). If a short or low resistance is measured, isolate each of the remaining three boards in the following order, and recheck the shorted test point after each board is removed. Note that the resistance may be different from that listed in the table, but you should be able to determine if the shorted condition has changed.

Isolate the remaining three assemblies:

- remove the A15 CPU board assembly
- remove the A4 power supply assembly

This leaves only the A14 motherboard assembly installed. If the measurements are still incorrect, this is the suspected faulty assembly.

Table 3-2 Power Supply Voltages and Resistances

Measurement Location	Supply (Vdc)	Approximate Resistance (Ω)
A	+5.0	285
B	-15.0	12.7 k
C	-5.0	7.2 k
D	+9	4.0 k
E	+15	3.0 k
F	+22	2.8 k
G	+22	890
H	+32	2.6 k

If the Fans Are Not Operating

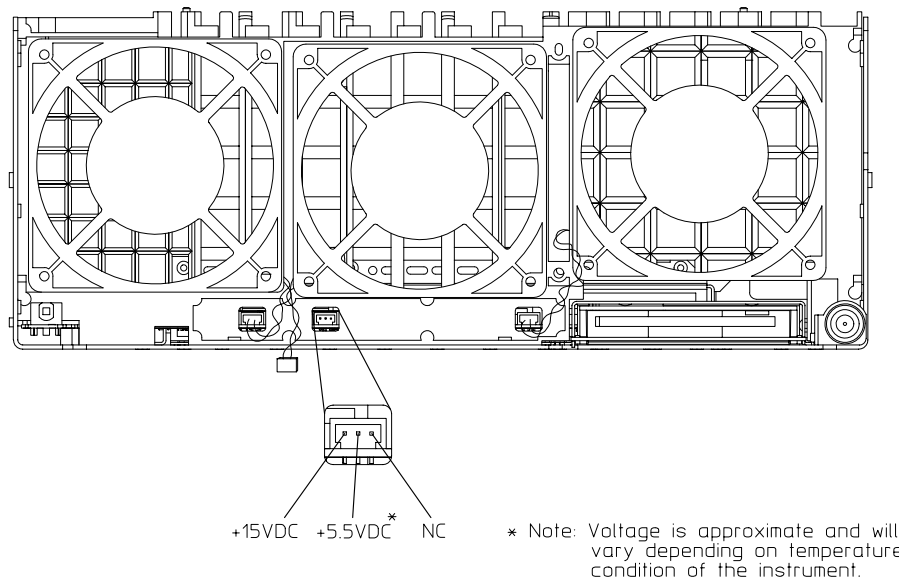
CAUTION The power supply may be in thermal shutdown if the instrument has been operating without the fans running. Allow the instrument to cool down before troubleshooting.

If all three fans are not operating, suspect a power supply problem or a defective A14 motherboard assembly. Refer to [“Power Supply Check” on page 3-7](#) to check the individual supplies. If the supplies are within specifications, the most probable cause is a defective A14 motherboard assembly. Refer to [“Removing and Replacing the A14 Motherboard Assembly” on page 7-22](#).

If only one or two fans are not functioning, and the power supplies are within specifications, suspect the A14 motherboard assembly or a defective fan. Perform the following procedure.

1. Remove the front panel assembly from the instrument. Refer to [“Removing and Replacing the Front Panel Assembly” on page 7-8](#).
2. Refer to [Figure 3-4](#). Measure the fan voltages at J1, J3, and J4 on the A14 motherboard assembly.

Figure 3-4 Fan Voltages



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3. If the correct voltage is present and the fan connector is in good mechanical condition, suspect a defective fan. Refer to [“Removing and Replacing the Midweb and the B1 Fan” on page 7-46](#).
4. If the voltage is not present, suspect a defective A14 motherboard. Refer to [“Removing and Replacing the A14 Motherboard Assembly” on page 7-22](#).

Troubleshooting LCD Display Problems

This procedure is intended to isolate the faulty assembly when the display is dark. If the display is lit, but the color mix is faulty, refer to [“A2 Display Test” on page 3-20](#).

NOTE There are no front panel adjustments for intensity and contrast of the LCD.

1. If the display is dim, the backlight assembly is defective. Refer to [“Removing and Replacing the Front Panel Assembly” on page 7-8](#).
2. If the display is dark (not visible), connect an external VGA monitor to the rear panel VGA output connector on the instrument. Be aware that some multisync monitors might not be able to lock to a 60 Hz sync pulse. If the video information is not present on the external VGA monitor, the most probable cause is the A15 CPU board assembly. Refer to [“Removing and Replacing the A15 CPU Board Assembly” on page 7-24](#).
3. If the external VGA monitor is functioning, verify that the front panel interface ribbon cable is properly plugged into the motherboard connector.
4. If the front panel interface ribbon cable is properly connected, suspect that one or more of the following is defective:
 - inverter board (mounted on the display assembly)
 - display lamp assembly
 - A3 front panel interface board
 - A2 display assembly

Refer to the following paragraphs to determine which of the above listed assemblies is defective.

Creating the Test Setup

For easy access to measure the voltages on the inverter board and on the A3 front panel interface board, it is best to disassemble the front panel and remove these two boards to set in front of you for testing. Use the ribbon cables that come with the boards and the analyzer as the supply source. Follow this procedure:

1. Turn off the analyzer.
2. Remove the front panel. Refer to [“Removing and Replacing the Front Panel Assembly” on page 7-8](#).
3. After the front panel is removed from the analyzer, isolate the inverter board by first removing the display assembly (refer to [“Removing the A2 Display Assembly” on page 7-10](#)). Put the A2 assembly and its ribbon cables aside.
4. Remove the A3 board by referring to [“Removing the A3 Front Panel Interface Board Assembly” on page 7-10](#). Put the A3 board aside.
5. Duplicate the board connections on your ESD safe test desk top by laying the A2 and A3 in front of the open-faced analyzer. Lay the A2 and A3 boards component-side down, the A2 to the left of the A3, with the top of the boards towards you.

6. Connect the display ribbon cable and display lamp cable from A2 to A3. Connect the front panel interface ribbon cable coming from the analyzer to the A3 board.
7. Turn the analyzer on and refer to [“Verifying the Inverter Board” on page 3-14](#) and [“Verifying the A3 Front Panel Interface Board Assembly” on page 3-16](#) to test and troubleshoot the boards.

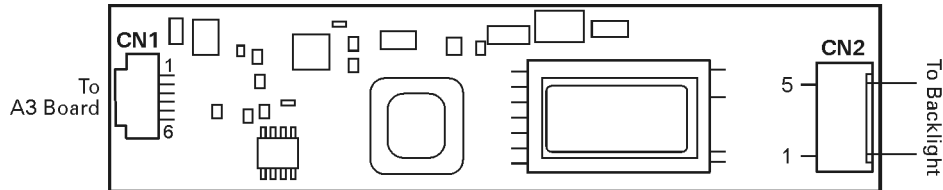
Verifying the Inverter Board

WARNING High voltage is present on the inverter board and the A3 front panel interface board. Be careful when measuring signals and voltages on these boards.

NOTE To access the front panel boards for measurements, it is necessary to remove the front panel assembly. Refer to [“Removing and Replacing the Front Panel Assembly” on page 7-8](#).

Using [Figure 3-5](#) as a reference, measure the signals and voltages indicated in [Table 3-3 on page 3-14](#). If the signals and voltages measure good, the inverter board is functioning correctly.

Figure 3-5 Inverter Board Test Point Locations



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Table 3-3 Inverter Board, Voltages and Signals

Test Point	Signal or Voltage	Test Point	Signal or Voltage
CN1 pin 1	+5.1 Vdc	CN1 pin 5	0 V (ground)
CN1 pin 2	+5.1 Vdc	CN1 pin 6	+2.54 V
CN1 pin 3	39 mV	CN2 pin 1	+400 V peak sinewave @ 38 kHz
CN1 pin 4	0 V (ground)	CN2 pin 5	ac neutral (referenced to pin 1)

After measuring the points CN1 and CN2, match the results and perform the rework as indicated in the action column in [Table 3-4](#).

Table 3-4 Inverter Board Troubleshooting Steps

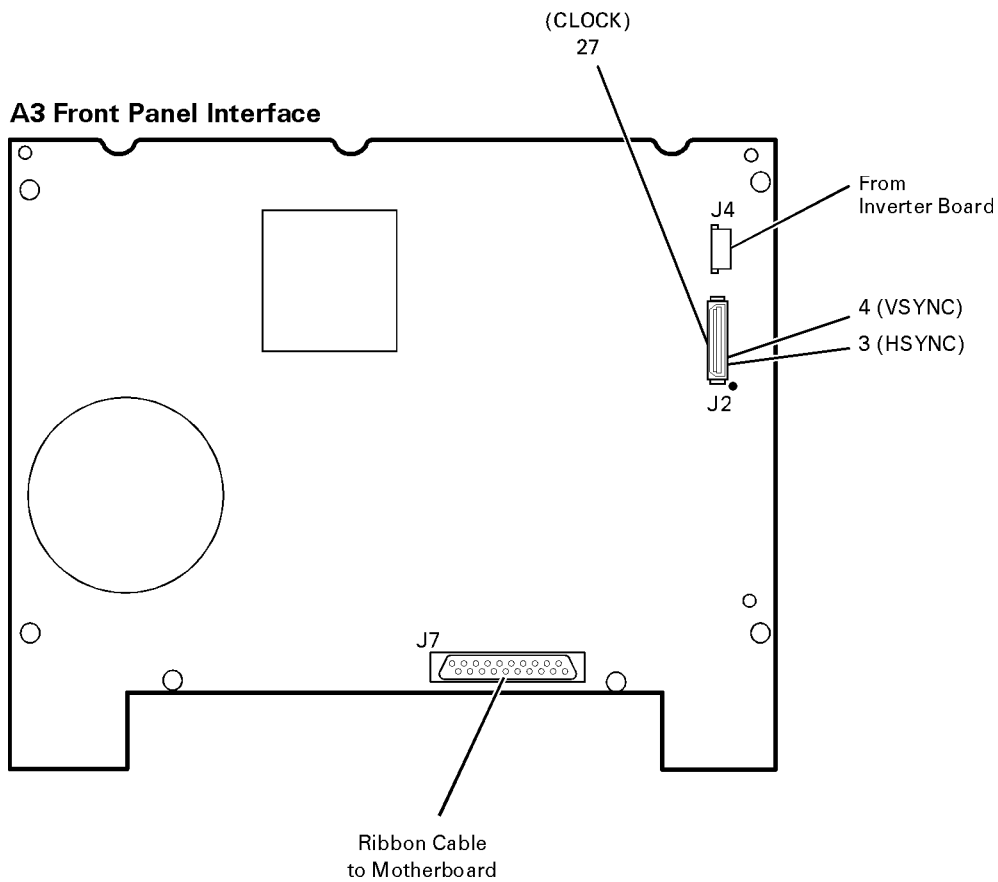
Input (CN1)	Output (CN2)	Action
Good	Good	Replace the display lamp (refer to “ Removing and Replacing the Display Inverter Board and the Display Lamp ” on page 7-12).
Good	Bad	Replace the inverter (refer to “ Removing and Replacing the Display Inverter Board and the Display Lamp ” on page 7-12).
Bad	Bad	Refer to “ Verifying the A3 Front Panel Interface Board Assembly ” on page 3-16.

Verifying the A3 Front Panel Interface Board Assembly

To verify that the HSYNC (horizontal sync), VSYNC (vertical sync), and LCD clock are functioning correctly, measure the following signals as indicated in [Figure 3-6](#). If all of these signals measure correctly, suspect a defective backlight or LCD. The backlight is the most probable cause.

CAUTION Be very careful not to short connector pins together when measuring these signals.

Figure 3-6 Verifying HSYNC, VSYNC, and LCD Clock



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Table 3-5 A3 Front Panel Interface Board Assembly, Voltages and Signals

Signal Type	Test Point	Voltage	Signal
HSYNC	J2 pin 3	0 to +3 V	30.8 kHz square wave
VSYNC	J2 pin 4	0 to +3 V	60 Hz square wave
CLOCK	J2 pin 27	0 to +3.4 V pk to pk	25 MHz sine wave

If any of the three signal types is incorrect, replace the A3 front panel interface board assembly. Refer to [“Removing the A3 Front Panel Interface Board Assembly”](#) on page 7-10.

If all of the signal types are correct, replace the A2 display assembly. Refer to [“Removing the A2 Display Assembly”](#) on page 7-10.

Front Panel Troubleshooting

The front panel assembly consists of the A1 keypad, A2 display, and the A3 front panel interface. The following tests verify the operation of the front panel assembly when the analyzer is in the measurement mode. If the instrument fails to power up correctly, or it is difficult to verify due to a faulty display, refer to [“Power Up Troubleshooting” on page 3-6](#).

Refer to the following sections to verify the operation of the noted assemblies.

- [“A1 Front Panel Keypad and RPG Test”](#) below
- [“A2 Display Test” on page 3-20](#)
- [“A3 Front Panel Interface Board Assembly” on page 3-21](#)
 - USB
 - Speaker
 - Probe Power

If all assemblies are working correctly, continue troubleshooting with [“Rear Panel Troubleshooting” on page 3-22](#).

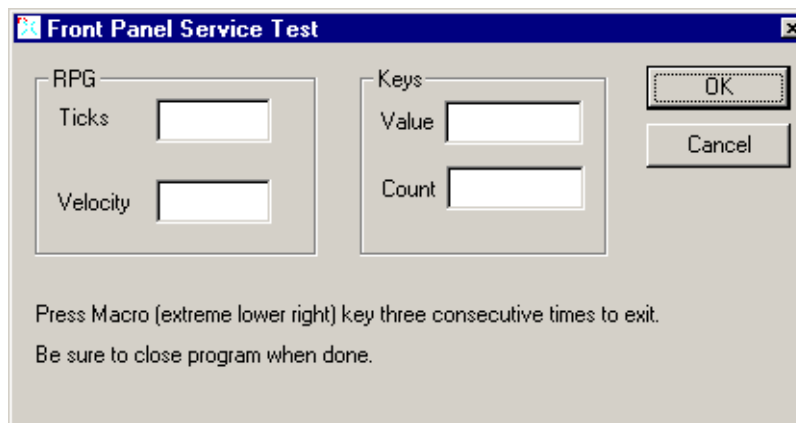
A1 Front Panel Keypad and RPG Test

Test the front panel keypad by running the front panel test. To run the front panel test, perform the following:

On the **System** menu, point to **Service** and click **Front Panel Test**.

A **Front Panel Test** dialog box will be displayed, as shown in [Figure 3-7](#).

Figure 3-7 Front Panel Service Test Dialog Box



Checking the Front Panel Keys

To check the front panel keys, push each key and compare the decimal value in the Value box under Keys to the key values in [Table 3-6](#).

- If all the key values are correct, then the A1 front panel keypad is working. If some of the keys are not working, suspect a faulty A1 keypad assembly. To replace the A1 keypad assembly, refer to [“Removing the A1 Keypad Assembly”](#) on page 7-10.
- If none of the keys are working correctly, suspect a faulty A3 front panel interface board assembly. To replace the A3 front panel interface board assembly, refer to [“Removing the A3 Front Panel Interface Board Assembly”](#) on page 7-10.

Table 3-6 Keyboard Key Numbers

Key Value	Front Panel Key	Key Value	Front Panel Key	Key Value	Front Panel Key	Key Value	Front Panel Key
50	Tab ←	66	Measure Setups	82	7	98	1
51	↑	67	F2	83	8	99	2
52	Tab →	68	F3	84	6	100	+/- ⇐
53	Window	69	F4	85	M/u	101	Not Applicable
54	OK	70	Help	86	Cancel	102	Not Applicable
55	Start/ Center	71	Trigger	87	Marker	103	Save
56	Stop/ Span	72	Average	88	Marker Table	104	Maximum Window Icon
57	Power	73	Calibrate	89	Limit Table	105	Preset
58	↓	74	F1	90	4	106	0
59	Click	75	Not Applicable	91	5	107	.
60	Trace	76	9	92	3	108	Not Applicable
61	Display Configure Icon	77	G/n	93	Enter	109	Not Applicable
62	Not Applicable	78	Menu Dialog	94	Not Applicable	110	Not Applicable
63	Sweep Setup	79	Measure	95	Marker Search	111	Recall
64	Channel	80	Format	96	Marker Function	112	Print Icon
65	Sweep Type	81	Scale	97	Math/ Memory	113	Macro

Checking the RPG (Front Panel Knob)

To check the RPG knob, rotate the knob and check for a fluid movement of numbers in the **Velocity** box.

- If the movement of numbers in the **Velocity** box is not smooth or no numbers appear at all, suspect a faulty A3 front panel interface board assembly. To replace the A3 front panel interface board assembly, refer to [“Removing the A3 Front Panel Interface Board Assembly” on page 7-10](#).

A2 Display Test

The display should be bright with all annotations and text readable. The display test allows you to check for non-functioning pixels and other problems.

NOTE If the display is dim or dark, refer to [“Troubleshooting LCD Display Problems” on page 3-13](#).

What is a Damaged Pixel?

A pixel is a picture element that combines to create the image on the display. They are about the size of a small pin point. Damaged pixels can be either “permanently on” or “permanently off.”

- A “permanently on” pixel is red, green, or blue and is always displayed regardless of the display setting. It will be visible on a dark background.
- A “permanently off” pixel is always dark and will be displayed against a background of its own color.

How to Run the Display Test

To run the display test, perform the following:

On the **System**, point to **Service**, and then click **Display Test**.

A multi-color screen is displayed. Be prepared to look for the symptoms described in [“How to Identify a Faulty Display”](#), and then click the **Start Test** button. To continue to the next test, click the moving **Next Test** button. The button moves to allow you to see all of the display. After the test is completed, the display defaults to the network analyzer screen.

How to Identify a Faulty Display

The display test has a sequence of red, green, blue, white, and black backgrounds. One or more of the following symptoms indicate a faulty A2 display assembly:

- complete rows or columns of “permanently on” or “permanently off” pixels
- more than five “permanently on” or “permanently off” pixels (not to exceed a maximum of two red or blue, and three green)
- two or more consecutive “permanently on” or “permanently off” pixels
- “permanently on” or “permanently off” pixels less than 6.5 mm apart

If any of these symptoms occur, replace the A2 display assembly. Refer to [“Removing the A2 Display Assembly” on page 7-10](#).

A3 Front Panel Interface Board Assembly

This assembly performs the following functions:

- It routes USB signals between the front-panel USB connector and the A15 CPU board assembly.
- The speaker produces the audio output from signals supplied by the A15 CPU board assembly.
- It supplies power to the two front-panel probe power connectors.
- It routes key pad commands from the A1 keypad assembly to the A15 CPU board assembly.
- It routes display signals from the A15 CPU board assembly to the A2 display assembly.

Checking the USB Port

To verify proper operation of the USB port:

- Connect a known good USB device, such as a USB mouse.
- Wait 15 seconds for the analyzer to verify the device connection, and then check the operation of the USB device.
- If the device performs correctly, the USB port is functioning properly.
- If the device does not perform correctly, the USB port is faulty. Refer to [“Removing the A3 Front Panel Interface Board Assembly” on page 7-10](#).

Checking the Speaker

If no audio is heard:

- Verify that the volume is set correctly and the proper sound driver is loaded; do the following:
 - On the **System** menu, point to **Configure**, and then click **Control Panel**.
 - Click the **Sounds and Multimedia** icon. Follow the normal Windows procedure to check the sound drivers and volume. If the audio is still not heard, suspect a faulty speaker. Refer to [“Removing the A3 Front Panel Interface Board Assembly” on page 7-10](#).

Checking the Probe Power Connectors

To verify the probe power operation, refer to [“Power Supply Check” on page 3-7](#).

Checking the Operation of the Key Pad Commands

To verify the key pad functionality, refer to [“A1 Front Panel Keypad and RPG Test” on page 3-18](#).

Checking the Display

To verify the display functionality, refer to [“A2 Display Test” on page 3-20](#).

Rear Panel Troubleshooting

Each rear panel connector is associated with a hardware group in the analyzer. You can use the data at these rear panel connectors to help troubleshoot these hardware groups in addition to testing the connectors.

The connectors discussed in this section are:

- USB
- SERIAL (RS-232)
- PARALLEL (1284-C)
- VGA
- GPIB
- LAN

Checking the USB Port

To verify proper operation of the USB port:

- Connect a known good USB device, such as a USB mouse.
- Wait 15 seconds for the analyzer to verify the device connection, and then check the operation of the USB device.
- If the device performs correctly, the USB port is functioning properly.
- If the device does not perform correctly, the A15 CPU board assembly is faulty. Refer to [“Removing and Replacing the A15 CPU Board Assembly” on page 7-24.](#)

Checking the SERIAL (RS-232), PARALLEL (1284-C) or VGA Port

To verify the proper operation of the SERIAL, PARALLEL, or VGA port:

- connect a known good serial, parallel, or VGA peripheral device.
- Wait 15 seconds for the analyzer to verify the device connection, and then check the operation of the peripheral device.
- If the peripheral device performs correctly, the port is functioning properly.
- If the peripheral device does not function properly, the A15 CPU board assembly is faulty. Refer to [“Removing and Replacing the A15 CPU Board Assembly” on page 7-24.](#)

Checking the GPIB Port

The network analyzer uses a National Instruments 488.2 GPIB controller and associated driver software. This software includes a test utility which scans the GPIB bus and returns the status of all the connected peripherals.

To run the test utility software and check the GPIB status:

1. Connect a known good peripheral to the analyzer using a known good GPIB cable.
2. On the **System** menu, point to **Configure, SCPI/GPIB**, click **System Controller** to activate, and then click **OK** to establish the analyzer as a controller.
3. On the **System** menu, click **Windows Taskbar** to open the **Start Menu** window.
4. On the **Start Menu** window, point to **Programs, National Instruments NI-488.2**, and then click **Explore GPIB** to open the **Measurement & Automation** window.
5. On the left side of the **Measurement & Automation** window under folders:
 - a. Click the plus sign to expand the **Measurement & Automation** folder.
 - b. Click the plus sign to expand the **Devices and Interfaces** folder.
 - c. Right click **GPIB0 (AT-GPIB/TNT)** to open a submenu.
6. On the submenu, click **Scan for Instruments** to run the test.
7. The state of all the peripherals found on the bus is returned.
8. If problems are detected, check the connections of all GPIB cables, and check all the GPIB addresses of the instruments on the bus.

NOTE Address Information

- Each device must have its own unique address.
- The network analyzer's default GPIB address in the controller mode is 21.
- The address set on each device must match the one recognized by the analyzer (and displayed).

Refer to the manual of the peripheral to read or change its address.

Troubleshooting Systems with Controllers

Passing the preceding test indicates that the analyzer's peripheral functions are operating normally. Therefore, if the analyzer has not been operating properly with an external controller, check the following:

- The GPIB interface hardware is incorrectly installed or not operational. (Refer to the embedded help in your analyzer.)
- The programming syntax is incorrect. (Refer to the embedded help in your analyzer.)

LAN Troubleshooting

Problems with the Local Area Network (LAN) can be difficult to solve. Software and protocol problems can make it difficult to determine whether the analyzer's hardware is working properly, or if there is a problem with the LAN or cabling.

The purpose of this section is to determine if the analyzer's hardware is functioning properly. While the turn-on self-test verifies some LAN hardware functionality, it is limited to internal testing only. Incorrect IP addresses will prevent proper operation. Improper subnet masks may allow only one-way communication, while improper gateway addresses may exclude outside LAN access.

Ping Command

The analyzer has the built-in capability of performing a “ping” operation. Ping will request the analyzer to send a few bytes of information to a specific LAN device. That device will then signal the analyzer that it has received the information. The analyzer computes the approximate round trip time of the communication cycle and displays it. For a full test of two-way communications, a ping test should be performed in two directions.

- **First:** you should ping from the analyzer to the local area network.
- **Second:** you should ping from the local area network to the analyzer.

NOTE In the second case, any other network device capable of sending a ping command could be used, assuming it is connected to the same network. This could be a computer or even another analyzer.

How to Ping from the Analyzer to the Local Area Network (LAN)

Follow the steps below to verify proper LAN operation (assuming you have a functioning LAN). If no network LAN is available, see [“Testing Between Two Analyzers” on page 3-26](#).

1. Make sure the IP address on the analyzer is set properly and that it is unique.
2. Make sure the subnet mask is 0.0.0.0. If not, note the current setting and then set it to 0.0.0.0.
3. Find and note the IP address of another working LAN device on the same network. Make sure this device is turned on, connected, and is functioning properly.
4. To ping the network device:
 - a. On the **System** menu, click **Windows Taskbar**.
 - b. On the **Windows Taskbar** menu, point to **Programs, Accessories**, and then click **Command Prompt**.
 - c. The command prompt window is displayed.
 - d. At the prompt, type `ping xxx.xxx.xxx.xxx`¹ and press **Enter** on the front panel or keyboard.
 - e. Refer to Step 5 for the results of a successful ping.

1. The letters x represent the IP address of the analyzer.

5. The analyzer attempts four cycles of communications with the indicated LAN device.
- It displays the time it took to complete each cycle.
 - Each cycle times-out after one second if no communication is established and the message, Request timed out, is displayed.
 - It is common for the first of the four cycles to time-out even though subsequent cycles pass.
 - See below for an example output of a successful ping.

```
C:>ping 141.121.69.162

Pinging 141.121.69.162 with 32 bytes of data:

Reply from 141.121.69.162: bytes=32 time<10ms TTL=127
Reply from 141.121.69.162: bytes=32 time<10ms TTL=127
Reply from 141.121.69.162: bytes=32 time<10ms TTL=127
Reply from 141.121.69.162: bytes=32 time<10ms TTL=127

Ping statistics for 141.121.69.162:

    Packets: Sent = 4, Received = 4, lost = 0 <0% loss>.

Approximate round trip times in milli-seconds:

    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

6. The above message verifies that one way communication from the analyzer to the network has been established

How to Ping from the Local Area Network (LAN) to the Analyzer

Reverse communication should also be verified. Determining this, though, is dependent upon your network setup and software. Generally, you need to issue a ping command using the IP address of the analyzer to be tested. For example, using Windows 95, 98, 2000 and while at a DOS prompt, type in `ping xxx.xxx.xxx.xxx`¹. Then press **Enter** on the front panel or keyboard. If full communication can be established, then the computer display shows the cycle time for each of four cycle attempts (similar to that in step 5). Other software may behave somewhat differently, but basically the same.

If the analyzer can talk to the network, but the network can not talk to the analyzer, then the computer or device used from the network may have a subnet mask that excludes communication with the IP address chosen for the analyzer. Any subnet mask other than 0.0.0.0 will exclude operation from some addresses. Changing the subnet mask of a computer or other device should only be attempted by a qualified network administrator. Failure to communicate due to a subnet mask incompatibility does not indicate any failure of the analyzer.

If the analyzer fails to ping in either direction, and assuming the subnet masks are set properly, then the fault must be isolated to the analyzer or to the network. Contact a qualified network administrator.

1. The letters x represent the IP address of the analyzer.

Testing Between Two Analyzers

The ability of the analyzer's LAN to function can be easily tested by connecting two analyzers together using a “crossover cable” (a short length of cable with an RJ-45 connector on each end).

Some network hubs have the capability to make a crossover connection using two normal, or straight-through, cables. If this capability is not available and a crossover cable is not available, a crossover cable can be made by following the directions in “[Constructing a Crossover Cable](#)” on page 3-26.

Set the IP addresses on two analyzers. The addresses can be set to anything, but they must be different. Make sure the subnet mask and gateway addresses are set to 0.0.0.0 and that the LAN is active on both analyzers. Connect the two analyzers together using either a crossover cable or a crossover hub.

Now follow the steps in “[How to Ping from the Analyzer to the Local Area Network \(LAN\)](#)” on page 3-24 to have the first analyzer ping the second analyzer. When done, repeat the procedure having the second analyzer ping the first. If both procedures function properly, the LAN circuitry on both analyzers is verified.

If neither function properly:

- One or both IP addresses could be wrong.
- One or both LAN states could be set to off.
- The crossover cable could be miswired.
- One or both analyzers could be defective.

If possible, eliminate the possibility of a defective analyzer by substitution of a known working unit. Once the analyzer has been proven to be working properly, concentration can be placed on the network itself to determine the cause of the failure.

Constructing a Crossover Cable

A crossover cable can be made from a standard LAN cable by connecting pin 1 from each connector to pin 3 of the other connector, and pin 2 from each connector to pin 6 of the other connector.

1. Strip away a few inches of the outside jacket insulation from the middle of a standard LAN cable that has an RJ-45 connector on each end.

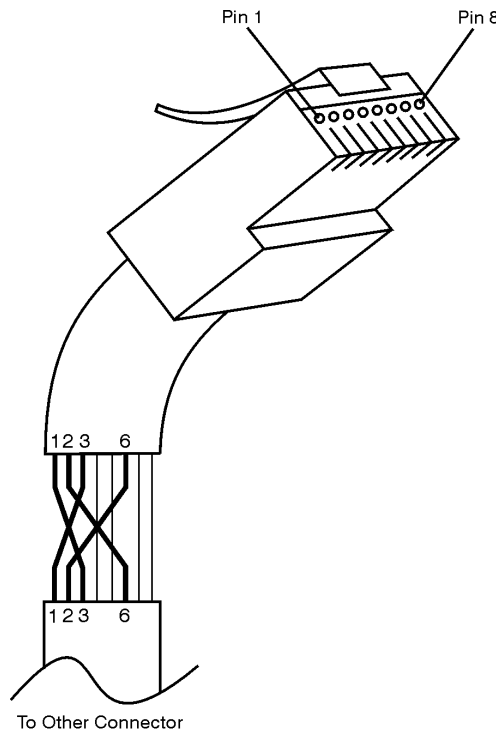
NOTE Pins 1, 2, 3, and 6 of the connectors must be located to determine which wires to cut in the following steps. Most, but not all, LAN cables use the color coding listed in [Table 3-7](#). If your cable does not use this color scheme, you will have to determine the locations of the appropriate wires before proceeding with this procedure.

Table 3-7 LAN Pin Definitions and Wire Color Codes

Pin Number	Color	Pin Number	Color
1 (transmit +)	White/orange	5	White/blue
2 (transmit -)	Orange	6 (receive -)	Green
3 (receive)	White/green	7	White/brown
4	Blue	8	Brown

2. Cut the wires going to pins 1, 2, 3, and 6. Strip away a small amount of insulation from each of the eight cut ends.
 - a. Connect the wire from pin 1 on one end of the cable to the wire from pin 3 on the other end of the cable.
 - b. Connect the wire from pin 3 on one end of the cable to the wire from pin 1 on the other end of the cable.
 - c. Connect the wire from pin 2 on one end of the cable to the wire from pin 6 on the other end of the cable.
 - d. Connect the wire from pin 6 on one end of the cable to the wire from pin 2 on the other end of the cable.
3. Insulate all exposed wires so that they cannot short together.
4. Label this as a crossover cable so that it cannot be confused with a standard cable.

Figure 3-8 Construction of a Crossover Cable



sd623c

Measurement System Troubleshooting

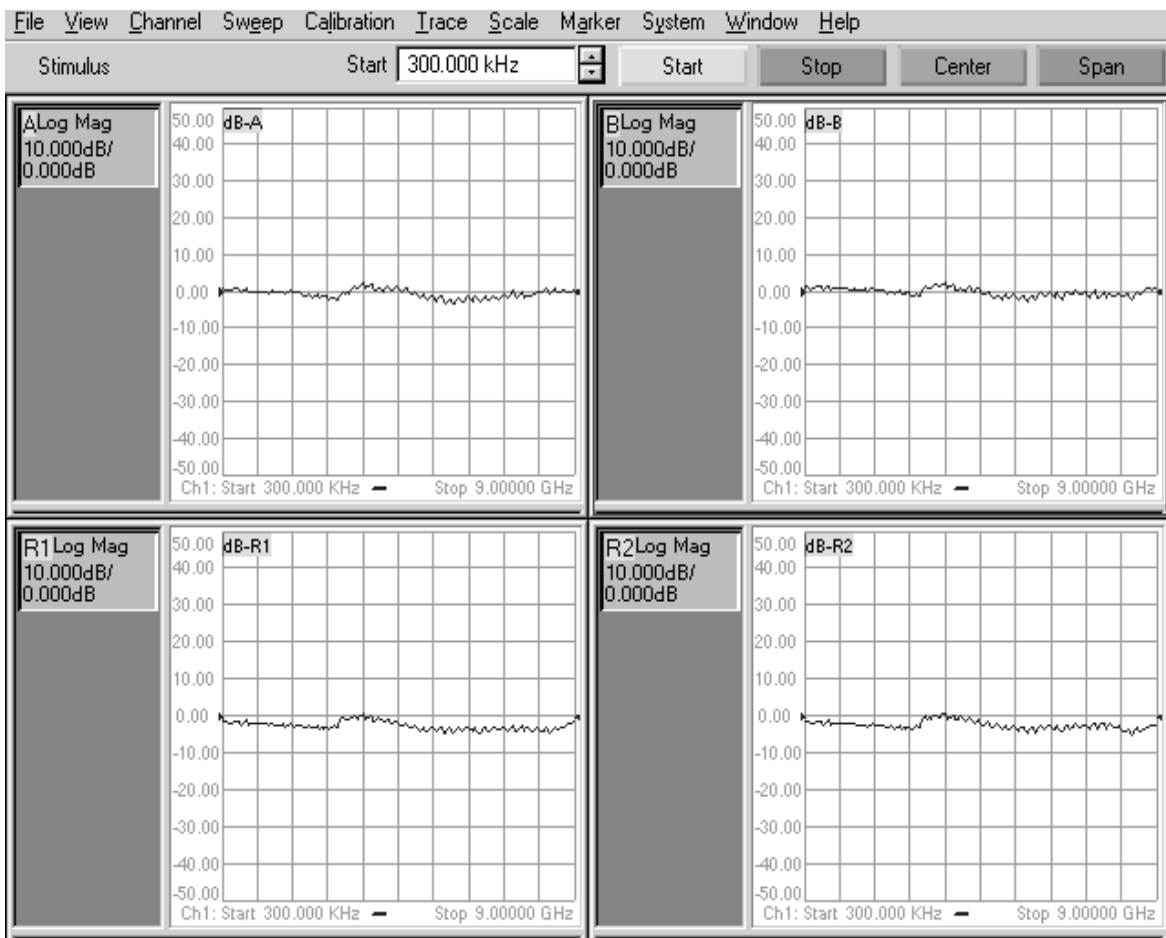
This section provides troubleshooting procedures for the measurement portion of the PNA series RF network analyzer. In this section, the analyzer is used as a tool to help isolate the suspected faulty functional group. Once the faulty functional group is determined, troubleshooting steps are provided to help you isolate the faulty assembly or part.

Verifying the A, B, R1, and R2 Traces

The first step is to verify that the A, B, R1, and R2 traces are present and that they are approximately level:

- On the **System** menu, point to **Service, Utilities**, and then click **Quad Receiver Display**.
- Traces A, B, R1, and R2 are displayed in four separate data windows as shown in [Figure 3-9](#). Identifying discrepancies of the traces in these windows can help you to isolate the faulty assembly.

Figure 3-9 Typical Four Channel Display



- If all traces are present and are similar to the traces in [Figure 3-9](#), then there are no major problems with the analyzer's measurement system. There may, however, be a minor failure in the analyzer.

To test further:

- Go to [Chapter 2](#), “Checks and Adjustments, Firmware Upgrades, and Operating System Recovery,” and perform all the tests in that section.
- If a problem still exists, contact the nearest Agilent Technologies sales or service office for assistance. Refer to [Table 1-1 on page 1-10](#) for a list of offices.
- If any of the traces are not present, are noisy or distorted, or are at an incorrect level, then there is a problem with the analyzer's measurement system. Proceed to “[Where to Begin Troubleshooting](#)”.

Where to Begin Troubleshooting

For the purposes of troubleshooting, the analyzer block diagram is divided into the following functional groups:

- **the source assembly group**
 - A8 fractional-N synthesizer
 - A10 frequency reference
 - A11 phase lock
 - A12 source
 - A16 test set motherboard (circuitry pertaining to the 2nd LO and the phase-lock signal multiplexer (MUX))
- **the signal separation group**
 - A22 switch splitter
 - A25 and A26 70dBstep attenuators
 - A27 and A28 35dBstep attenuators (Option 015 only)
 - A23 and A24 test port couplers
 - Port 1, Port 2, A, B, R1, and R2 ports
- **the receiver assembly group**
 - A17 local oscillator distribution assembly (LODA)
 - A16 test set motherboard
 - A18 receiver A
 - A19 receiver R1
 - A20 receiver R2
 - A21 receiver B
 - A6 signal processing ADC module (SPAM)

Use the list on the following pages to help you determine in which analyzer functional group to begin troubleshooting.

This is by no means an exhaustive list of possible symptoms nor possible failures. It is recommended that you view the system block diagram, located at the end of this chapter, as you review the entries in this list and while performing any of the troubleshooting procedures listed.

Good judgement and established logical troubleshooting techniques must be used to complement the procedures contained in this section.

Refer to [Table 5-2 on page 5-6](#) or to [Table 3-8 on page 3-32](#) for a list of the frequencies associated with each of the network analyzer's seven bands (bands 0–6).

All Traces

- If all traces are missing in all bands, the problem is most likely in the source assembly group. However, a missing or disabled DSP driver may exhibit the same or similar symptoms. To verify that this DSP driver is present and enabled:
 1. Click My Computer, **Properties, Hardware tab, Device Manager**. Expand **Network Adapters**. The following entry should be listed: **Agilent Technologies DSP Driver #2** and should be enabled.
 2. If the icon to the left of the name is a yellow box containing an exclamation mark (!), use Windows Explorer to verify the presence of the following file:
C:\WINNT\system32/drivers\spampnp.sys.
 3. If you have verified that the DSP driver is present and enabled, but all traces are still missing in all bands, go to [“Checking the Source Assembly Group” on page 3-32](#).
- If the trace faults are band-related, the problem is in either the source assembly group or the A17 LODA. Go to [“Checking the Source Assembly Group” on page 3-32](#) and check the A8 fractional-N synthesizer board assembly outputs and the A10 frequency reference board assembly outputs. If these are OK, go to [“Checking the A17 LODA Bands 1 through 6 Output” on page 3-41](#).

R1 and A Traces

If both traces are affected, the problem is in the R1 phase lock loop.

- If both traces are missing in all bands, the problem is in the A16 test set motherboard assembly, the A19 channel R1 receiver module assembly, or the A22 switch splitter assembly. To determine which is at fault:
 1. Bypass the A22 switch splitter assembly using a flexible RF cable connected between the input cable W1 and the R1 output cable W6.
 2. If the R1 trace is now present, replace the A22 switch splitter assembly. If the R1 trace is still missing, reconnect the cables to the A22 switch splitter assembly.
 3. Swap the A19 channel R1 receiver module assembly with the A20 channel R2 receiver module assembly. (Each of the four receivers is identical.)
 4. If the missing trace is now R2 (still associated with the same A19 channel R1 receiver), replace the A19 channel R1 receiver module assembly. If the R1 trace is still missing, replace the A16 test set motherboard assembly.

- If both traces are missing in bands 1 through 6, (but present in band 0), the problem is with the channel R1 1st LO output of the A17 LODA. Go to [“Checking the A17 LODA Bands 1 through 6 Output” on page 3-41.](#)

R2 and B Traces

If both traces are affected, the problem is in the R2 phase lock loop.

- If both traces are missing in all bands, the problem is in the A16 test set motherboard assembly, the A20 channel R2 receiver module assembly, or the A22 switch splitter assembly. To determine which is at fault:
 1. Bypass the A22 switch splitter assembly using a flexible RF cable connected between the input cable W1 and the R2 output cable W7.
 2. If the R2 trace is now present, replace the A22 switch splitter assembly. If the R2 trace is still missing, reconnect the cables to the A22 switch splitter assembly.
 3. Swap the A19 channel R1 receiver module assembly with the A20 channel R2 receiver module assembly. (Each of the four receivers is identical.)
 4. If the missing trace is now R1 (still associated with the same A20 channel R2 receiver), replace the A20 channel R2 receiver module assembly. If the R2 trace is still missing, replace the A16 test set motherboard assembly.
- If both traces are missing in bands 1 through 6, (but present in band 0), the problem is with the channel R2 1st LO output of the A17 LODA. Go to [“Checking the A17 LODA Bands 1 through 6 Output” on page 3-41.](#)

R1 Trace Only

A problem that affects only the R1 trace is isolated to the A19 channel R1 receiver module assembly or the A6 SPAM board assembly. Go to [“Checking the Receiver Assembly Group” on page 3-41.](#)

R2 Trace Only

A problem that affects only the R2 trace is isolated to the A20 channel R2 receiver module assembly or the A6 SPAM board assembly. Go to [“Checking the Receiver Assembly Group” on page 3-41.](#)

A Trace Only

- If the trace is missing in all bands, go to [“Checking the Signal Separation Group” on page 3-38.](#)
- If the trace is missing in bands 1 through 6, the problem is with the channel A 1st LO output of the A17 LODA. Go to [“Checking the A17 LODA Bands 1 through 6 Output” on page 3-41.](#)

B Trace Only

- If the trace is missing in all bands, go to [“Checking the Signal Separation Group” on page 3-38.](#)
- If the trace is missing in bands 1 through 6, the problem is with the channel B 1st LO output of the A17 LODA. Go to [“Checking the A17 LODA Bands 1 through 6 Output” on page 3-41.](#)

Checking the Source Assembly Group

In most cases, a defective source results in an incorrect reading in both of the above listed power checks.

However, a defective A22 switch splitter assembly can exhibit the same symptom as a faulty source. Therefore, if it is determined that the source is functioning properly in “[Checking the A12 Source Assembly Output](#)” on page 3-33, you are directed to “[Checking the Signal Separation Group](#)” on page 3-38.

There are two main types of failures that are related to the source group. The failures are classified as:

- broadband
- single band

Broadband failures are indicated by all four channel traces being in the noise floor.

Single band failures are indicated by all four channel traces having partial dropouts across the frequency range or intermittent phase lock problems. Use [Table 3-8](#) as a reference to correlate the band number and the source frequency.

Table 3-8 Settings to Use for Troubleshooting Band Related Problems

Band Number	Source Frequency Band Observed on the Network Analyzer	Network Analyzer CW Setting Used for Troubleshooting
0	0.3 MHz to 10 MHz	5 MHz
1	10 MHz to 748 MHz	500 MHz
2	748 MHz to 1.5 GHz	1.0 GHz
3	1.5 GHz to 3.0 GHz	2.0 GHz
4	3.0 GHz to 4.5 GHz	4.0 GHz
5	4.5 GHz to 6.5 GHz	6.0 GHz
6	6.5 GHz to 9.0 GHz	8.0 GHz

Equipment Used for These Tests

Use a spectrum analyzer to check the signals of the source assembly group.

Equipment Type	Part Number
Spectrum analyzer ¹	8561E
Power splitter	11667B
Short 3.5 mm RF cable	Any

1. Alternate: any 856xE spectrum analyzer.

Getting Ready to Test

Before checking the assemblies, you must open the analyzer.

CAUTION Use an antistatic work surface and wrist strap to reduce the chance of electrostatic discharge for all of the procedures in this chapter.

1. Turn off the analyzer power.
2. Unplug the power to the analyzer and disconnect all rear panel connections.
3. Remove the covers from the analyzer. Refer to [“Removing the Covers” on page 7-6](#).
4. With the covers off, plug in the analyzer and turn on the power.

Checking the A12 Source Assembly Output

Check the output of the A12 source assembly:

CAUTION Be careful not to damage the center pins of the semirigid cable. Some flexing of the cables is necessary to measure the output.

1. Refer to the block diagram at the end of this chapter and to [“Bottom Cables, Standard” on page 6-18](#). Locate the semirigid cable W1, at the A22 switch splitter assembly.
2. Using a 5/16-inch torque wrench, disconnect W1 from the A22 switch splitter assembly.
3. Connect W1 to the input port of a power splitter. Connect the other two ports of the power splitter to the spectrum analyzer and to the input of the A22 switch splitter assembly using a short 3.5 mm RF cable.
4. Refer to [Table 3-8 on page 3-32](#). Follow these steps.
 - a. Set the spectrum analyzer to the source frequency span.
 - b. Set the network analyzer to the corresponding CW frequency.
 - c. Verify that the CW frequency appears on the spectrum analyzer for each band.
5. If all signals are present on the spectrum analyzer for all bands, go to [“Checking the Signal Separation Group” on page 3-38](#).
6. If any of the signals are not present on the spectrum analyzer, continue with [“Checking the A10 5 MHz Reference Output” on page 3-34](#).

Checking the A10 5 MHz Reference Output

1. Refer to the block diagram at the end of this chapter and to [“Top Cables” on page 6-16](#). Locate flexible cable W41, at the A10 frequency reference board assembly.
2. Disconnect W41 from A10J10.
3. Connect the spectrum analyzer to A10J10.
4. The spectrum analyzer should measure a signal at 5 MHz.
5. If no 5 MHz signal is present, replace the A10 frequency reference board assembly. Refer to [“Removing and Replacing the A6, A8, and A10 Board Assemblies” on page 7-16](#).
6. If the 5 MHz signal is present, continue with [“Checking the A10 Phase Lock Reference Output” on page 3-34](#).

Checking the A10 Phase Lock Reference Output

1. Refer to the block diagram at the end of this chapter and [“Top Cables” on page 6-16](#). Locate flexible cable W39 at the A10 frequency reference board assembly.
2. Disconnect W39 from A10J5.
3. Connect the spectrum analyzer to A10J5.
4. Verify the phase lock reference output for band 0 and bands 1 through 6. For each network analyzer CW setting in [Table 3-9](#), verify the spectrum analyzer measurement result at A10J5.

Table 3-9 Network Analyzer Settings and Measurement Results

Band Number	Network Analyzer Setting (CW Frequency)	Spectrum Analyzer Measurement Result
Band 0	9.9 MHz	9.9 MHz
Band 1 through 6	1 GHz	1.04166 MHz

NOTE In band 0, the network analyzer attempts to lock to a higher band. Therefore, the spectrum analyzer shows a multitude of signals while it attempts to lock. The 9.9 MHz signal shows up as a strong signal for a short time before attempting to lock.

5. If the signals are not present for either band condition, replace the A10 frequency reference board assembly. Refer to [“Removing and Replacing the A6, A8, and A10 Board Assemblies” on page 7-16](#).
6. If the signals are present, continue with [“Checking the 2nd LO at the A10 Frequency Reference for Band 0” on page 3-35](#).

Checking the 2nd LO at the A10 Frequency Reference for Band 0

Perform this procedure if the problem is in one of the receiver channels and appears to be a band related problem.

1. Refer to the block diagram at the end of this chapter and to [“Top Cables” on page 6-16](#). Locate the flexible cable W36 at the A10 frequency reference board assembly.
2. Disconnect the flexible cable W36 at A10J7.
3. Connect the spectrum analyzer to A10J7.
4. Set the network analyzer to measure a CW signal at 20.167 MHz.
5. If the 20.167 MHz signal is not present, replace the A10 frequency reference board assembly. Refer to [“Removing and Replacing the A6, A8, and A10 Board Assemblies” on page 7-16](#).
6. If the signal is present, go to [“Checking the Receiver Output” on page 3-42](#).

Checking the 2nd LO at the A10 Frequency Reference for Bands 1 through 6

Perform this procedure if a problem is in one of the receiver channels and appears to be a band related problem.

1. Refer to the block diagram at the end of this chapter and to [“Top Cables” on page 6-16](#). Locate the flexible cable W35 at the A10 frequency reference board assembly.
2. Disconnect the flexible cable W35 at A10J4.
3. Connect the spectrum analyzer to A10J4.
4. For each network analyzer CW setting in [Table 3-10](#), verify the spectrum analyzer measurement result at A10J4.

Table 3-10 Network Analyzer Settings and Measurement Results

Band Number	Network Analyzer Setting (CW Frequency)	Spectrum Analyzer Measurement Result
Band 1	500 MHz	501.00 MHz
Band 2	1 GHz	1001.00 MHz
Band 3	2 GHz	2001.00 MHz
Band 4	4 GHz	1333.67 MHz
Band 5	6 GHz	2000.33 MHz
Band 6	8 GHz	2667.00 MHz

5. If the signal of the suspect band is not present, replace the A10 frequency reference board assembly. Refer to [“Removing and Replacing the A6, A8, and A10 Board Assemblies” on page 7-16](#).
6. If the signal is present, go to [“Checking the Receiver Output” on page 3-42](#).

Checking the A8 Fractional-N Synthesizer Band 0 Output

1. Refer to the block diagram at the end of this chapter and to [“Top Cables” on page 6-16](#). Locate the flexible cable W37, at the A8 fractional-N synthesizer board assembly.
2. Disconnect W37 from A8J102.
3. Connect the spectrum analyzer to A8J102.
4. Set the network analyzer for a 5 MHz CW frequency and observe the spectrum analyzer measurement.
 - The spectrum analyzer should measure a signal at 120.16 MHz.
5. If the 120.16 MHz signal is not present and the 5 MHz reference signal is present from [“Checking the A10 5 MHz Reference Output,”](#) replace the A8 fractional-N synthesizer board assembly. Refer to [“Removing and Replacing the A6, A8, and A10 Board Assemblies” on page 7-16](#).

Checking the A8 Fractional-N Synthesizer Band 1 Output

Perform this procedure if you observe a problem in band 1 in all receivers.

1. Refer to the block diagram at the back of this chapter and to [“Top Cables” on page 6-16](#). Locate semirigid cable W20, at the A8 fractional-N synthesizer board assembly.

CAUTION Be careful not to damage the center pins of the semirigid cable. Some flexing of the cables is necessary to measure the output.

2. Using a 5/16-inch torque wrench, disconnect W20 at A8J101.
3. Connect the spectrum analyzer to A8J101.
4. Set the network analyzer to a CW frequency of 500 MHz.
 - The spectrum analyzer should measure a signal at 501 MHz.
5. If this signal is not present, replace the A8 fractional-N synthesizer board assembly. Refer to [“Removing and Replacing the A6, A8, and A10 Board Assemblies” on page 7-16](#).
6. If the signal is present, continue with [“Checking the A8 Fractional-N Synthesizer Bands 2 through 6 Output” on page 3-37](#).

Checking the A8 Fractional-N Synthesizer Bands 2 through 6 Output

Perform this procedure if you observe a problem in bands 2 through 6 in all receivers.

1. Refer to the block diagram at the end of this chapter and to [“Top Cables” on page 6-16](#). Locate semirigid cable W19, at the A8 fractional-N synthesizer board assembly.

CAUTION Be careful not to damage the center pins of the semirigid cable. Some flexing of the cables is necessary to measure the output.

2. Using a 5/16-inch torque wrench, disconnect W19 at A8J106.
3. Connect the spectrum analyzer to A8J106.
4. For each network analyzer CW setting listed in [Table 3-11](#), verify the spectrum analyzer measurement result at A8J106.

Table 3-11 Network Analyzer Settings and Measurement Results

Band Number	Network Analyzer Setting (CW Frequency)	Spectrum Analyzer Measurement Result
Band 2	1 GHz	1001.00 MHz
Band 3	2 GHz	2001.00 MHz
Band 4	4 GHz	1333.67 MHz
Band 5	6 GHz	2000.33 MHz
Band 6	8 GHz	2667.00 MHz

5. If the signals are not present, replace the A8 fractional-N synthesizer board assembly. Refer to [“Removing and Replacing the A6, A8, and A10 Board Assemblies” on page 7-16](#).
6. If the signals are present, continue with [“Checking the A11 Phase Lock YTO Tune Output” on page 3-37](#).

Checking the A11 Phase Lock YTO Tune Output

1. Perform the Serial Bus Test. Refer to [“Performing the Serial Bus Test” on page 2-35](#).
2. Examine the “Phase Lock, Node 315” entry in the test results.
3. If the result at Node 315 passes the test, the A12 source assembly is faulty; replace it. Refer to [“Removing and Replacing the A12 Source Assembly” on page 7-20](#).
4. If the result at Node 315 fails the test, the A11 phase lock board assembly is faulty; replace it. Refer to [“Removing and Replacing the A11 Phase Lock Board Assembly” on page 7-18](#).

Checking the Signal Separation Group

Before checking the signal separation group, perform the following procedures:

- [“Getting Ready to Test” on page 3-33](#)
- [“Checking the A12 Source Assembly Output” on page 3-33](#)

Checking the Output Power of the A and B Signals

Using a power meter, you can measure the outputs of the A and B signals from the front panel. The measurement results will help you isolate a faulty assembly. The outputs of the R1 and R2 channels cannot be measured because it would necessitate breaking the phase lock loop, causing all of the signals to be lost.

Equipment Used for These Tests

Equipment Type	Part Number
Power meter	E4419B
Power sensor	E4412A
Adapter, type-N female to 3.5 mm male	1250-1750

Equipment Setup

1. Before starting these checks, zero and calibrate the power meter. (See the power meter user’s guide for instructions on setting the calibration factor.)
2. If the **Quad Receiver Display** ([Figure 3-9](#)) is not on the analyzer screen, perform the following: On the **System** Menu, point to **Service, Utilities**, and then click **Quad Receiver Display**.
3. Set the sweep speed for a 10 second sweep: On the **Sweep** menu, click **Sweep Time** and set the time to 10.000 seconds in the **Sweep Time** box.

Checking Port 1 Power (A Signal)

The object of this check is to verify the power of the A signal across the entire frequency range. Perform this test if there is an observed problem only with the channel A trace. The ten second sweep is slow enough to allow you to observe the output power on the power meter as the sweep occurs.

1. Connect the power sensor to Port 1.
2. When the Port 1 LED ring turns green, observe the power reading on the power meter as the sweep occurs on the analyzer.
3. The measured output power on the power meter should be within ± 1.0 dBm over the entire frequency range.
 - If the measured power is correct, go to [“Checking the Receiver Assembly Group” on page 3-41](#).
 - If the measured power is not correct, go to [“Checking the Signal through the Signal Separation Path” on page 3-39](#).

Checking Port 2 Power (B Signal)

The object of this check is to verify the power of the B signal across the entire frequency range. Perform this test if there is an observed problem only with the channel B trace. The ten second sweep is slow enough to allow you to observe the output power on the power meter as the sweep occurs.

1. Connect the power sensor to Port 2.
2. When the Port 2 LED ring turns green, observe the power reading on the power meter as the sweep occurs on the analyzer.
3. The measured output power on the power meter should be within ± 1.0 dBm over the entire frequency range.

Checking the Signal through the Signal Separation Path

Refer to the block diagram at the end of this chapter and to [“Bottom Assemblies and Hardware, Standard” on page 6-12](#) for these checks.

Port 1 trace loss in the signal separation group is due to one or more of the following assemblies being defective:

- A22 switch splitter assembly
- A25 70 dB step attenuator
- A23 test port 1 coupler

Port 2 trace loss in the signal separation group is due to one or more of the following assemblies being defective:

- A22 switch splitter assembly
- A26 70 dB step attenuator
- A24 test port 2 coupler

Equipment Used for These Tests

Use a spectrum analyzer to check the signals of the signal separation group.

Equipment Type	Part Number
Spectrum analyzer ¹	8561E

1. Alternate: any 856xE spectrum analyzer.

To determine which assembly is defective, check the signal at each available measurement point in the signal path from the A22 switch splitter assembly to the test port coupler.

For Port 1 measurements, set the network analyzer for an S_{11} measurement with a CW frequency of 1GHz.

For Port 2 measurements, set the network analyzer for an S_{22} measurement with a CW frequency of 1 GHz.

Perform [“Checking the A22 Switch Splitter Assembly”](#) and [“Checking the Step Attenuators and Test Port Couplers”](#) in the order presented.

Checking the A22 Switch Splitter Assembly

1. Locate the semirigid cable (W2 for Port 1 or W3 for Port 2) at the A22 switch splitter assembly.
2. Using a 5/16-inch torque wrench, disconnect the semirigid cable at the A22 switch splitter assembly.
3. Connect the spectrum analyzer to the connector. Set the spectrum analyzer to measure a signal at 1GHz.
4. If the 1 GHz signal is not present, replace the A22 switch splitter assembly. Refer to [“Removing and Replacing the A22 Switch Splitter Assembly” on page 7-32.](#)
5. If the 1 GHz signal is present, reconnect the semirigid cable and go to [“Checking the Step Attenuators and Test Port Couplers” on page 3-40.](#)

Checking the Step Attenuators and Test Port Couplers

1. Refer to the block diagram at the end of this chapter and to [“Bottom Assemblies and Hardware, Standard” on page 6-12.](#)

For Port 1 checks, locate the semirigid cable W4, at the A25 70 dB step attenuator.

For Port 2 checks, locate the semirigid cable W5, at the A26 70 dB step attenuator.

2. Using a 5/16-inch torque wrench, disconnect the semirigid cable at the step attenuator.
3. Connect the spectrum analyzer to the step attenuator connector. Set the spectrum analyzer to measure a signal at 1 GHz.
4. If the 1 GHz signal is not present, replace the appropriate 70 dB step attenuator. Refer to [“Removing and Replacing the A25 and A26 70 dB Step Attenuators” on page 7-36.](#)
5. If the 1 GHz signal is present, replace the appropriate test port coupler. Refer to [“Removing and Replacing the A23 and A24 Test Port Couplers” on page 7-34.](#)

Checking the Receiver Assembly Group

Equipment Used for These Tests

Use a spectrum analyzer to check the receiver assembly group.

Equipment Type	Part Number
Spectrum analyzer ¹	8561E

1. Alternate: any 856xE spectrum analyzer.

Getting Ready to Test

Before checking the assemblies, you must open the analyzer.

CAUTION Use an antistatic work surface and wrist strap to reduce the chance of electrostatic discharge for all of the procedures in this chapter.

1. Turn off the analyzer power.
2. Unplug the power to the analyzer and disconnect all rear panel connections.
3. Remove the covers from the analyzer. Refer to [“Removing the Covers” on page 7-6](#).
4. With the covers off, plug in the analyzer and turn on the power.

Checking the A17 LODA Bands 1 through 6 Output

Perform this procedure if you observe a problem in bands 1 through 6 but not band 0.

1. Refer to the block diagram at the end of this chapter and to [“Bottom Cables, Standard” on page 6-18](#). Locate the semirigid cables W15, W16, W17, and W18 at the A17 local oscillator distribution assembly (LODA).

CAUTION Be careful not to damage the center pins of the semirigid cable. Some flexing of the cables is necessary to measure the output.

2. Using a 5/16-inch torque wrench, disconnect the semirigid cable associated with the faulty channel, from the A17 LODA.
3. Connect the spectrum analyzer to the connector to which this cable was connected.
4. For each network analyzer CW setting listed in [Table 3-12](#), verify the spectrum analyzer measurement result at the A17 LODA.
5. If the signals are not present, replace the A17 LODA. Refer to [“Removing and Replacing the A17 Local Oscillator Distribution Assembly \(LODA\)” on page 7-28](#).
6. If the signals are present, check the A16 test set motherboard assembly and the A6 SPAM board assembly:
 - a. Refer to the block diagram at the end of this chapter and to [“Bottom Cables, Standard” on page 6-18](#). Locate the flexible cable W31 at the A18 channel A receiver module assembly, IF output.

- b. Disconnect W31 and connect the spectrum analyzer to the IF output connector.
- c. The measured signal on the spectrum analyzer should be at 41.667 kHz.
 - If the 41.667 kHz IF signal is present, replace the A6 SPAM board assembly. Refer to [“Removing and Replacing the A6, A8, and A10 Board Assemblies”](#) on page 7-16.
 - If the 41.667 kHz IF signal is not present, replace the A16 test set motherboard assembly. Refer to [“Removing and Replacing the A16 Test Set Motherboard Assembly”](#) on page 7-26.

Table 3-12 Network Analyzer Settings and Measurement Results

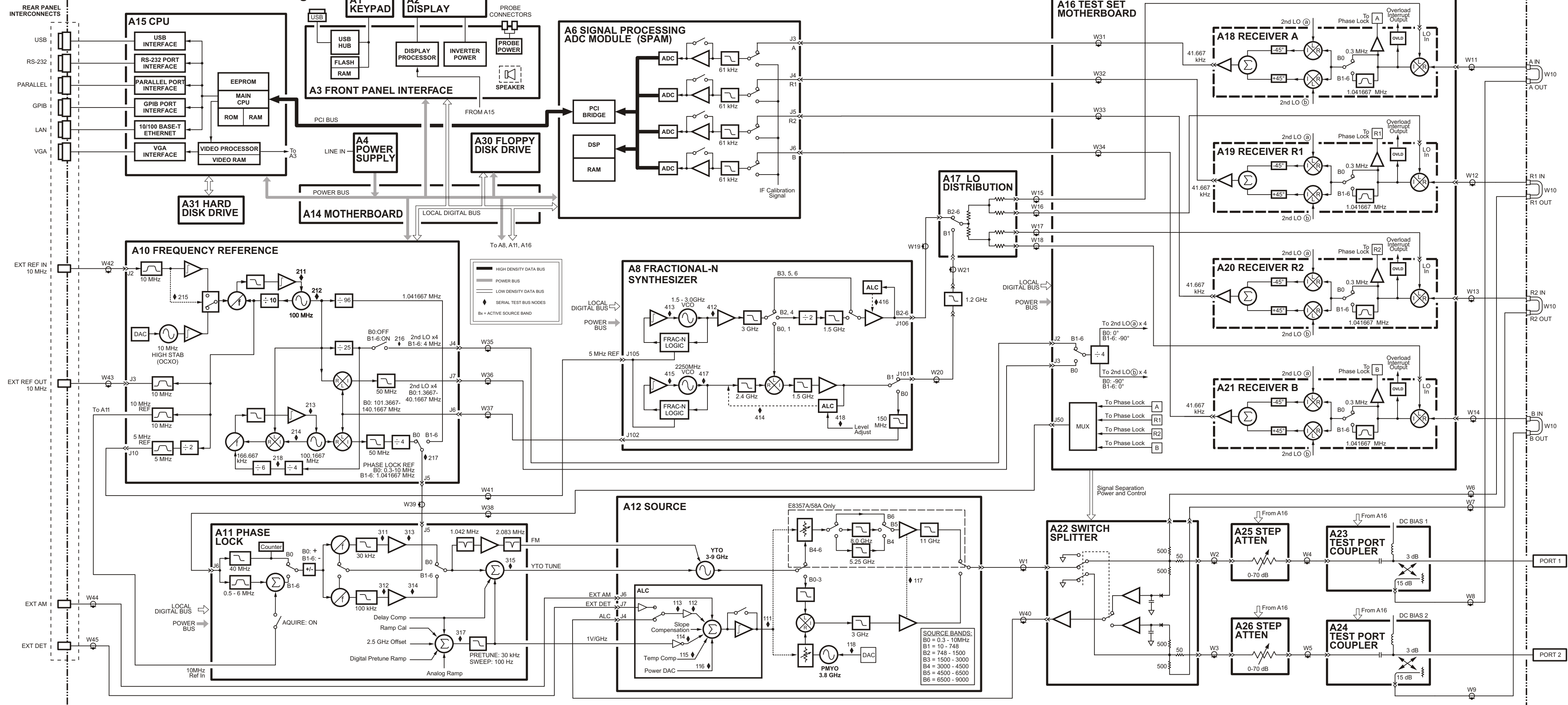
Band Number	Network Analyzer Setting (CW Frequency)	Spectrum Analyzer Measurement Result
Band 1	500MHz	501.00 MHz
Band 2	1 GHz	1001.00 MHz
Band 3	2 GHz	2001.00 MHz
Band 4	4 GHz	1333.67 MHz
Band 5	6 GHz	2000.33 MHz
Band 6	8 GHz	2667.00 MHz

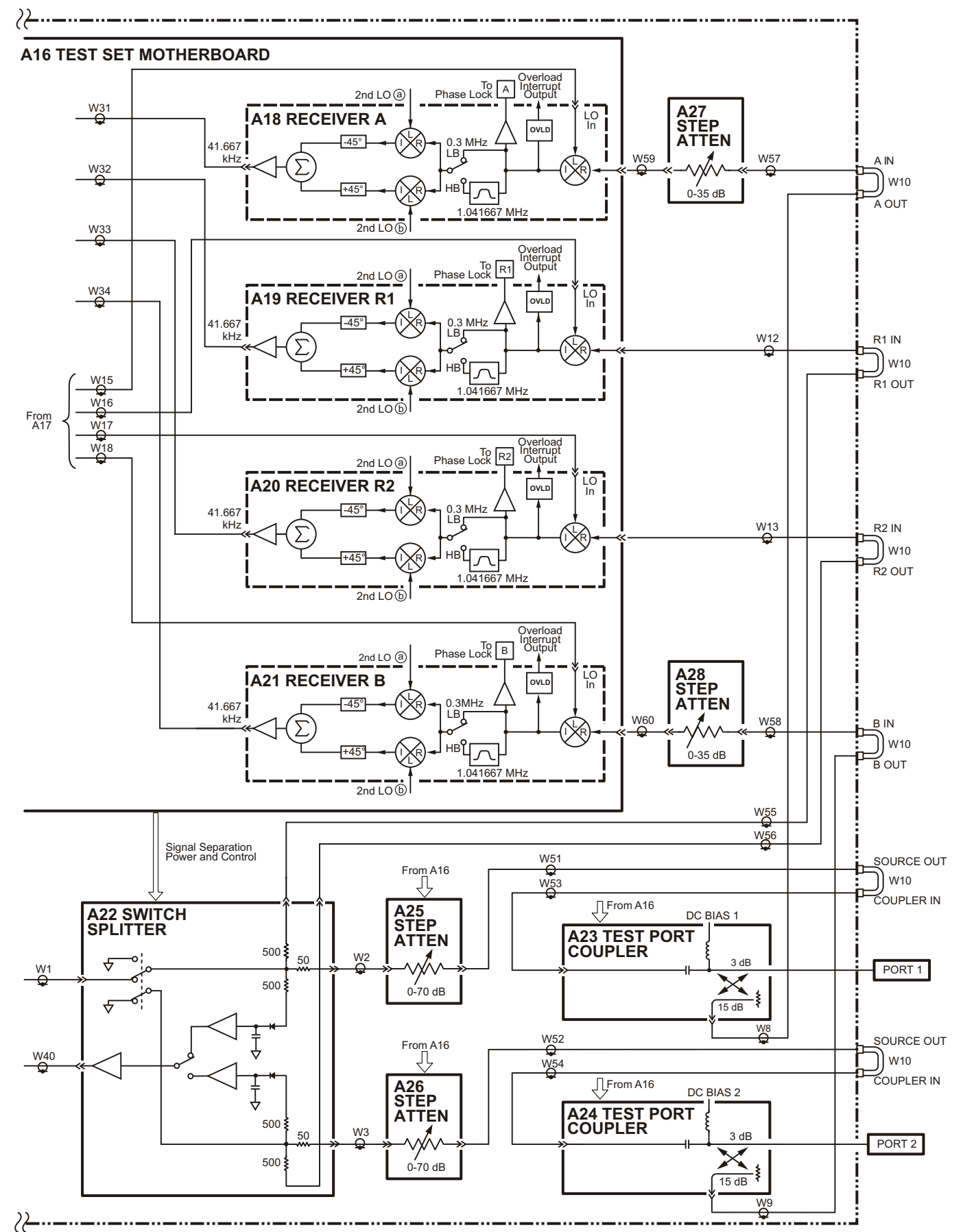
Checking the Receiver Output

Perform this procedure if a problem appears to be in one of the receiver channels.

1. Refer to the block diagram at the end of this chapter and to [“Bottom Cables, Standard”](#) on page 6-18. Locate the flexible cables W31, W32, W33 and W34 at each receiver IF output.
2. Disconnect the flexible cable at the suspect receiver.
3. Connect the spectrum analyzer to the suspect receiver connector.
4. The measured signal on the spectrum analyzer should be at 41.667 kHz.
5. If the measured signal is present, replace the A6 SPAM board assembly. Refer to [“Removing and Replacing the A6, A8, and A10 Board Assemblies”](#) on page 7-16.
6. If the measured signal is not present, verify the receiver operation:
 - a. Replace the suspect receiver with a known good receiver. You can use a known good receiver from the same analyzer.
 - b. If the error still occurs, replace the A16 test set motherboard assembly. Refer to [“Removing and Replacing the A16 Test Set Motherboard Assembly”](#) on page 7-26.
 - c. If the replacement receiver functions properly, replace the suspect receiver. Refer to [“Removing and Replacing the A18, A19, A20, and A21 Receiver Module Assemblies”](#) on page 7-30.

E8356A/57A/58A Overall Block Diagram





4 Error Terms

Information in This Chapter

Your PNA series RF network analyzer creates error terms (also called E-terms or measurement calibration coefficients) by measuring well-defined calibration devices over the frequency range of interest and comparing the measured data with an ideal model for the devices. The differences of the compared data represent systematic (repeatable) errors of the analyzer system. When a measurement error-correction or measurement calibration is performed, the analyzer generates and stores calibration factors in internal arrays.

NOTE For details on the various levels and theory of error-correction, refer to the embedded help in the analyzer.

Chapter Four at-a-Glance

Section Title	Summary	Start Page
Using Error Terms as a Diagnostic Tool	This section describes how to use error terms as a preventive maintenance and trouble-shooting tool.	page 4-3
Performing Measurement Calibration	This section describes the procedure for measurement calibration. Measurement calibration must be performed before you can use error terms as a tool.	page 4-4
Using Flowgraphs to Identify Error Terms	This section contains flowgraphs of the error terms for 1 port and 2 port calibrations.	page 4-5
Accessing Error Terms	This section describes how to access error terms by front panel interaction, SCPI commands by way of the GPIB connector, and COM commands by way of the LAN connector. Describes what type of error terms are returned.	page 4-7
Typical Error Term Data	This section describes the typical values of the error terms of your analyzer. Included are a table of typical values, typical response plots, and typical assembly failures.	page 4-12

Using Error Terms as a Diagnostic Tool

The magnitude and shape of the error terms are affected by:

- calibration kit devices
- cables
- adapters and accessories
- the assemblies from the signal separation group of the analyzer

Calibration kit devices, cables, and adapters and accessories are the most common cause of error term failures. Make sure of the following:

- Connectors must be clean, gaged, and within specification.
- Use proper connection technique during measurement and calibration. For information on connection technique and on cleaning and gaging connectors, refer to [“Review the Principles of Connector Care” on page 2-5](#) or to the calibration kit’s users’s and service guide.

By examining error terms, you can monitor system performance for preventive maintenance and troubleshooting purposes.

Preventive Maintenance

If you print or plot the error terms at set intervals (weekly, monthly and so forth), you can compare current error terms to these records. A stable system should generate repeatable error terms over long intervals, (for example, six months). Look for the following:

- A long-term trend often reflects drift, connector and cable wear, or gradual degradation, indicating the need for further investigation and preventive maintenance. Yet, the system may still conform to specifications. The cure is often as simple as cleaning and gaging connectors and cables.
- A sudden shift in error terms reflects a sudden shift in systematic errors, and may indicate the need for troubleshooting.

Troubleshooting

You can use the error terms as a tool to isolate faulty assemblies in the signal separation group of your analyzer. You can compare the current values to preventive maintenance records or to the typical values listed in [Table 4-3 on page 4-12](#), or data trace plots that start in [“Typical Error Term Data” on page 4-12](#).

To find assemblies related to error term failures, refer to plot descriptions in [“Typical Error Term Data” on page 4-12](#). Each plot description lists common assemblies related to each error term. Identify the assembly and refer to [Chapter 3 , “Troubleshooting.”](#)

NOTE Always suspect calibration devices, cables, or improper connector maintenance as the primary cause of an error term failure.

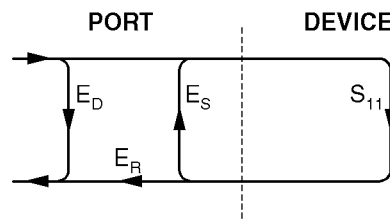
Performing Measurement Calibration

1. Connect a type-N cable to Port 2.
2. In the **Calibration** menu, click **Calibration Wizard**.
3. In the **Calibration Wizard** dialog box, click the **Cal Type** button.
4. In the **Select Calibration Type** dialog box, click **Full SOLT 2-Port** and if an isolation measurement *is* needed, clear the **Omit Isolation (2-Port types)** check box, and then click **OK**.
5. In the **Calibration Wizard** dialog box, click **Measure Stds**.
6. Perform each of the calibration steps when prompted, making sure to use male standards (open, short, load) on Port 1 and female standards (open, short, load) on the cable on Port 2.

Using Flowgraphs to Identify Error Terms

Flowgraphs are a graphical representation of signal flow through the measurement path. The flowgraphs in [Figure 4-1](#) and [Figure 4-2](#) illustrate the error terms associated with measurement calibration. Use the “Calibration Type” columns in [Table 4-1](#) and [Table 4-2](#) to cross-reference the associated error terms.

Figure 4-1 Flowgraph of One-Port Error Terms for Port 1



sc86a.cdr

where:

E = Error term

Subscript:

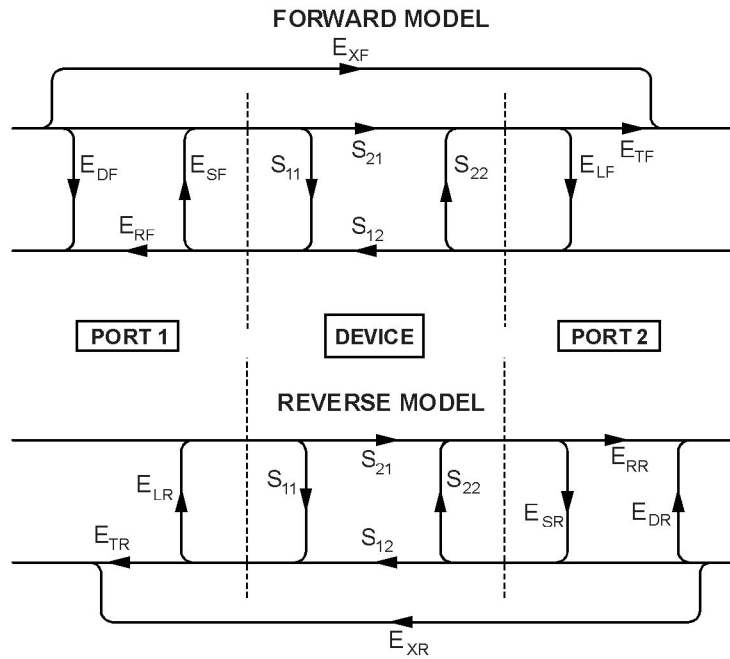
D = Directivity

S = Source Match

R = Reflection Tracking

The error terms are the same for a one port measurement on Port 2 (S_{22}).

Figure 4-2 Flowgraph of Two-Port Error Terms



sc87a.cdr

where:

E = error term

1st Subscript:

D = Directivity

S = Source Match

R = Reflection Tracking

X = Crosstalk (Isolation)

L = Load Match

T = Transmission Tracking

2nd Subscript:

F = forward measurement (Port 1 to Port 2)

R = reverse measurement (Port 2 to Port 1)

Accessing Error Terms

There are three methods to access error terms from your analyzer:

- “[Front Panel Access to Error Terms](#)” on page 4-7
- “[GPIB Access to Error Terms](#)” on page 4-8
- “[LAN Access to Error Terms](#)” on page 4-10

Front Panel Access to Error Terms

NOTE Ensure the calibration correction is active by making sure that **Correction ON/off** has a check-mark in the **Calibration** menu.

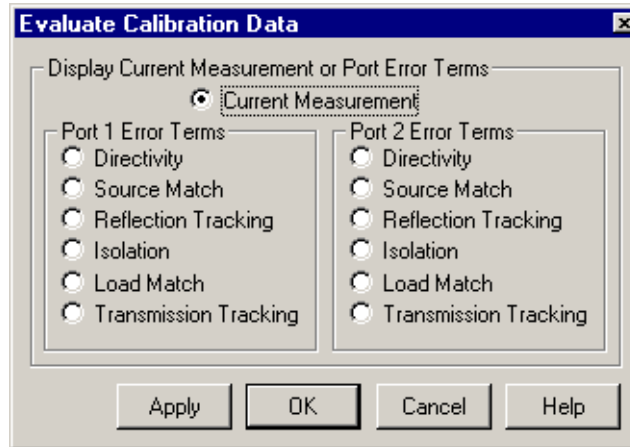
To access the error terms from the front panel, perform the following steps:

1. From the **System** menu:

Point to **Service, Utilities**, and then click **Evaluate Error Corr Data**.

2. In the **Evaluate Calibration Data** dialog box ([Figure 4-3](#)), click the desired error term under **Port 1 Error Terms** or **Port 2 Error Terms**. Click **OK** to display the error term trace and close the dialog box *or* click **Apply** to display the error term trace and keep the dialog box open to allow another error term selection

Figure 4-3 Dialog Box for Error Terms



3. On the **Scale** menu, click **Autoscale** to study the error term trace.
4. The network analyzer markers can be used to inspect the details of the error term trace.
5. Compare the displayed measurement trace to the equivalent data trace plots that start in “[Typical Error Term Data](#)” on page 4-12, to previously measured data, or to the uncorrected performance specifications listed in [Table 4-3](#) on page 4-12.
6. Print numerical data or print a plot of the measurement results.

GPIB Access to Error Terms

You can access error terms by way of GPIB with Standard Commands for Programmable Instruments (SCPI).

NOTE Ensure the calibration correction is active by making sure that **Correction ON/off** has a check-mark in the **Calibration** menu.

[Table 4-1](#) contains the error term that is returned with the SCPI command. Refer to [Figure 4-1](#) and [Figure 4-2](#) for an illustration of 1-port and 2-port flowgraph of error terms.

The SCPI command to access the error term is as follows:

```
SENS<num>:CORR:COEF <error num>,[<port num>]
```

where:

<num> designates the channel number of interest. If left blank, the default is channel one.

<error num> designates the error term type. The variables are:

- 0 = Return to current measurement
- 1 = Directivity
- 2 = Source Match
- 3 = Reflection Tracking
- 4 = Isolation
- 5 = Load Match
- 6 = Transmission Tracking

<port num> designates the source port. The variables are:

- 1 = Port 1
- 2 = Port 2

If the variable <port num> is not used, input the numbers 1 through 12 for the <error num>. Refer to [Table 4-1](#) for corresponding error terms and calibration types.

After the SCPI command is input, the analyzer can be used to inspect the data in the following ways:

1. The network analyzer markers can be used to inspect the details of the error term trace.
2. Compare the displayed measurement trace to the equivalent data trace plots that start in [“Typical Error Term Data” on page 4-12](#), to previously measured data, or to the uncorrected performance specifications listed in [Table 4-3 on page 4-12](#).
3. Print numerical data or print a plot of the measurement results.

NOTE For more information on GPIB and SCPI, refer to the embedded help in the analyzer.

NOTE The S-parameters in [Table 4-1](#) denote the active measurement when the calibration was performed.

Table 4-1 Error Terms, Associated Calibration Types, and SCPI Values

SCPI Parameters			Calibration Type			
<error num> when <portnum> not used	<error num>	<port num>	Response ^a	Thru Response and Isolation	1-Port	2-Port
1	1	1			$S_{11}\text{-}E_D$	E_{DF}
2	2	1			$S_{11}\text{-}E_S$	E_{SF}
3	3	1	$S_{11}\text{-}E_R$		$S_{11}\text{-}E_R$	E_{RF}
4	4	1		$S_{21}\text{-}E_X$		E_{XF}
5	5	1				E_{LF}
6	6	1	$S_{21}\text{-}E_T$	$S_{21}\text{-}E_T$		E_{TF}
7	1	2			$S_{22}\text{-}E_D$	E_{DR}
8	2	2			$S_{22}\text{-}E_S$	E_{SR}
9	3	2	$S_{22}\text{-}E_R$		$S_{22}\text{-}E_R$	E_{RR}
10	4	2		$S_{12}\text{-}E_X$		E_{XR}
11	5	2				E_{LR}
12	6	2	$S_{12}\text{-}E_T$	$S_{12}\text{-}E_T$		E_{TR}

Error term subscript meanings:

1st Subscript: D=directivity; S=source match; R=reflection tracking; X=crosstalk (isolation); L=load match; T=transmission tracking.

2nd Subscript: F=forward; R=reverse.

- a. The short response calibration and open response calibration each generate a reflection tracking error term. The thru response calibration generates a transmission tracking error term.

LAN Access to Error Terms

You can access error terms by way of LAN with Component Object Model (COM) or Distributed Component Object Model (DCOM) software architecture.

NOTE Ensure the calibration correction is active by making sure that **Correction ON/off** has a check-mark in the **Calibration** menu.

[Table 4-2](#) contains the error term that is returned with the COM or DCOM command. Refer to [Figure 4-1](#) and [Figure 4-2](#) for an illustration of 1-port and 2-port flowgraph of error terms.

The COM or DCOM command to access the error term is as follows:

```
cal.GetErrorTermComplex(rcv,src,term,pnumvalues,preal,pimag)
```

where:

cal designates a Calibrator object variable

rcv designates the receiver port

src designates the source port

term designates the error term type. The variables are:

```
naErrorterm_Directivity_Isolation  
naErrorterm_Match  
naErrorterm_Tracking
```

pnumvalues is a pointer to the number of points

preal is a pointer to an array to hold the real values

pimag is a pointer to an array to hold the imaginary values

After the COM or DCOM command is input, the values of the error terms are put into data arrays. Print or display the analyzer error terms using the technique from the program and controller you are using to access the analyzer. Compare the analyzer error terms with the typical error term data in [“Typical Error Term Data” on page 4-12](#).

NOTE For more information on LAN, COM, and DCOM, refer to the embedded help in the analyzer.

NOTE The S-parameters in [Table 4-2](#) denote the active measurement when the calibration was performed.

Table 4-2 Error Terms, Associated Calibration Type, and COM Values

COM Parameters			Calibration Type			
<term>	<rcv>	<src>	Response ^a	Thru Response and Isolation	1-Port	2-Port
naErrorTerm_Directivity_Isolation	1	1			$S_{11}\text{-}E_D$	E_{DF}
naErrorTerm_Match	1	1			$S_{11}\text{-}E_S$	E_{SF}
naErrorTerm_Tracking	1	1	$S_{11}\text{-}E_R$		$S_{11}\text{-}E_R$	E_{RF}
naErrorTerm_Directivity_Isolation	2	1		$S_{21}\text{-}E_X$		E_{XF}
naErrorTerm_Match	2	1				E_{LF}
naErrorTerm_Tracking	2	1	$S_{21}\text{-}E_T$	$S_{21}\text{-}E_T$		E_{TF}
naErrorTerm_Directivity_Isolation	2	2			$S_{22}\text{-}E_D$	E_{DR}
naErrorTerm_Match	2	2			$S_{22}\text{-}E_S$	E_{SR}
naErrorTerm_Tracking	2	2	$S_{22}\text{-}E_R$		$S_{22}\text{-}E_R$	E_{RR}
naErrorTerm_Directivity_Isolation	1	2		$S_{12}\text{-}E_X$		E_{XR}
naErrorTerm_Match	1	2				E_{LR}
naErrorTerm_Tracking	1	2	$S_{12}\text{-}E_T$	$S_{12}\text{-}E_T$		E_{TR}
Error term subscript meanings:						
1st Subscript:			D=directivity; S=source match; R=reflection tracking; X=crosstalk (isolation); L=load match; T=transmission tracking.			
2nd Subscript:			F=forward; R=reverse.			

a. The short response calibration and open response calibration each generate a reflection tracking error term. The thru response calibration generates a transmission tracking error term.

Typical Error Term Data

The error term descriptions in this section include the following information:

- a table of the typical error terms
- typical plots of results
- significance of each error term
- guidelines to interpret each error term

The same description applies to both the forward (F) and reverse (R) terms. The plots shown with each description are typical of a working system following a full 2-port calibration as performed in [“Performing Measurement Calibration” on page 4-4](#).

IMPORTANT Specifications listed are *typical* specifications that are listed here as a convenience to help you verify the network analyzer. More detailed instrument specifications are listed in the embedded help in the network analyzer.

Table 4-3 Typical Error Term Data

Parameter	Frequency Range			
	300 kHz to 1.3 GHz	1.3 GHz to 3 GHz	3 GHz to 6 GHz	6 GHz to 9 GHz
Directivity	> 33 dB	> 27 dB	> 20 dB	> 13 dB
Source Match	> 20 dB	> 17 dB	> 15 dB > 13 dB (Opt. 015)	> 14 dB > 12 dB (Opt. 015)
Load Match	> 20 dB	> 17 dB	> 15 dB	> 15 dB
Reflection Tracking	±1.5 dB	±1.5 dB	±2.5 dB	±3.0 dB
Transmission Tracking	±1.5 dB	±1.5 dB	±2.5 dB	±3.0 dB
Isolation ^a	> 128 dB	> 128 dB	> 118 dB	> 108 dB

a. Measurement conditions: Normalized to a thru, measured with two shorts, 10 Hz IF bandwidth, averaging factor of 8, alternate mode, source power set to the lesser of the maximum power output or the maximum receiver power. This value is only measured as part of an isolation measurement with a full 2-port calibration.

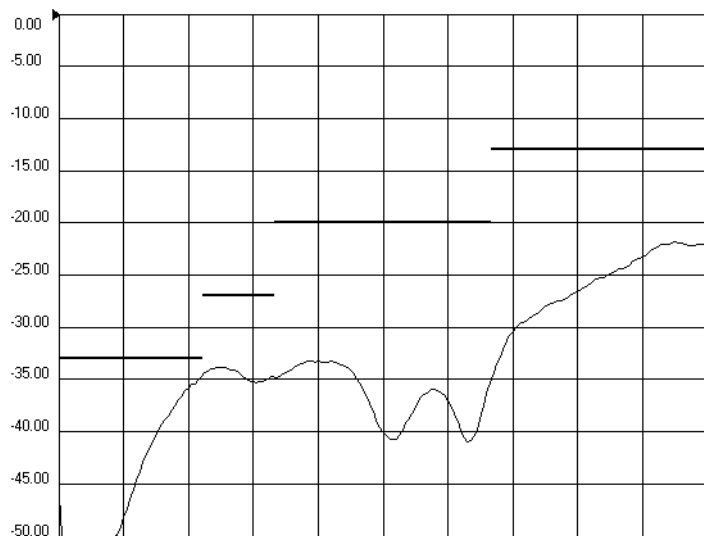
Directivity (E_{DF} and E_{DR})

E_{DF} and E_{DR} are the uncorrected forward and reverse directivity error terms of the system. The directivity error of the test port is determined by measuring the S_{11} and S_{22} reflection of the calibration kit load. The load has a much better return loss specification than does the uncorrected test port. Therefore, any power detected from this measurement is assumed to be from directivity error. The measurements most affected by directivity errors are measurements of low reflection devices.

Typical Cause of Failure

The calibration kit load is the most common cause of directivity specification failure. If the load has been gaged and its performance independently verified, suspect the analyzer test port coupler. To troubleshoot, refer to “[Checking the Signal Separation Group](#)” on page 3-38.

Figure 4-4 Typical E_{DF}/E_{DR} without Cables



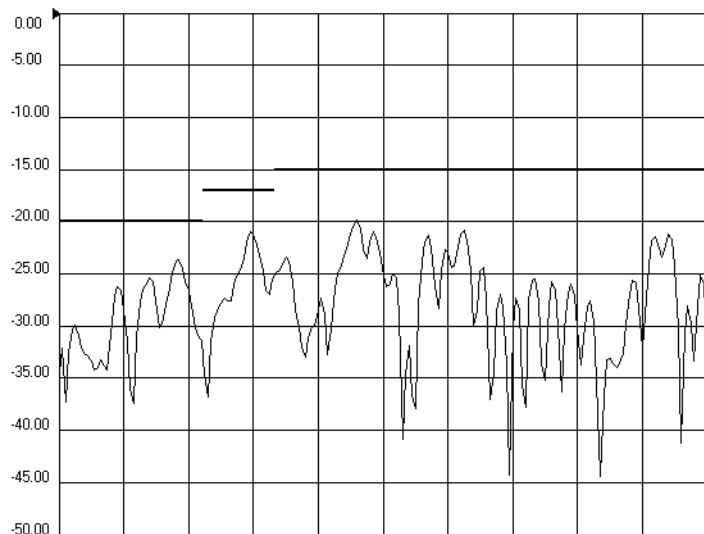
Source Match (E_{SF} and E_{SR})

E_{SF} and E_{SR} are the forward and reverse uncorrected source match terms of the driven port. They are obtained by measuring the reflection (S_{11} , S_{22}) of an open, and a short that are connected directly to the ports. Source match is a measure of the match of the coupler, as well as the match between all components from the source to the output port. The measurements most affected by source match errors are reflection and transmission measurements of highly reflective DUTs.

Typical Cause of Failure

The calibration kit open or short is the most common cause of source match specification failure. If the open or short performance has been independently verified, suspect the analyzer switch splitter, step attenuator, or coupler. To troubleshoot, refer to “[Checking the Signal Separation Group](#)” on page 3-38.

Figure 4-5 Typical E_{SF}/E_{SR} without Cables



Reflection Tracking (E_{RF} and E_{RR})

Reflection tracking is the difference between the frequency response of the reference path (R1 or R2path) and the frequency response of the reflection test path (A or B input path). These error terms are characterized by measuring the reflection (S_{11} , S_{22}) of the open and the short during the measurement calibration. All reflection measurements are affected by the reflection tracking errors.

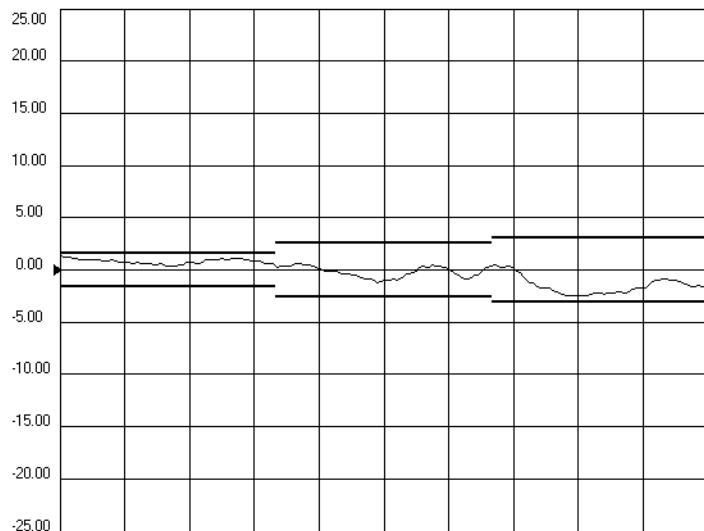
Typical Cause of Failure

The calibration kit open or short is the most common cause of reflection tracking specification failure. If the open or short performance has been independently verified, suspect the following:

- If both E_{RF} and E_{RR} fail
 - the analyzer switch splitter
- If one of the track term specification fails
 - coupler, step attenuator, or the test receiver of the failed port

To troubleshoot, refer to “[Checking the Receiver Assembly Group](#)” on page 3-41 or to “[Checking the Signal Separation Group](#)” on page 3-38.

Figure 4-6 Typical E_{RF}/E_{RR}



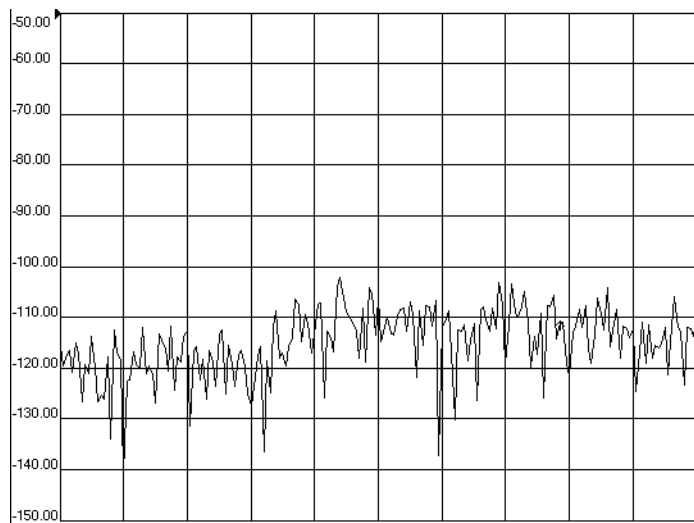
Isolation (E_{XF} and E_{XR})

Isolation is the uncorrected forward and reverse isolation error terms that represent leakage between the test ports and the signal paths. The isolation error terms are characterized by measuring transmission (S_{21} , S_{12}) with loads attached to both ports during the measurement calibration. Isolation errors affect transmission measurements primarily where the measured signal level is very low. The measurements most affected by isolation error terms are DUTs with large insertion loss. Since these terms are low in magnitude, they are usually noisy (not very repeatable).

Typical Cause of Failure

A loose cable connection or leakage between components in the test set are the most likely cause of isolation problems. After verifying the cable and its connections, suspect the analyzer switch splitter, step attenuator, coupler, or receivers. To troubleshoot, refer to “Checking the Receiver Assembly Group” on page 3-41 or to “Checking the Signal Separation Group” on page 3-38.

Figure 4-7 Typical E_{XF}/E_{XR} with 10 Hz Bandwidth



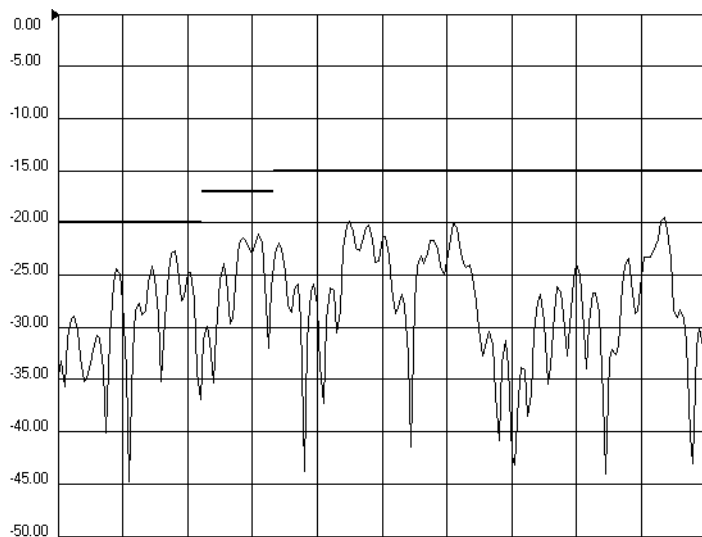
Load Match (E_{LF} and E_{LR})

Load match is a measure of the impedance match of the test port that terminates the output of a 2-port device. The match of test port cables is included in this response. Load match error terms are characterized by measuring the S_{11} and S_{22} responses of a “thru” configuration during the calibration procedure. The measurements most affected by load match errors are all transmission measurements, and reflection measurements of a low insertion loss two-port device, such as an airline.

Typical Cause of Failure

The calibration kit load or a bad “thru” cable is the most common cause of load match specification failure. If the load and cable performance are independently verified, suspect the analyzer test port coupler, step attenuator, or the test receiver at the bad port. To troubleshoot, refer to “[Checking the Receiver Assembly Group](#)” on page 3-41 or to “[Checking the Signal Separation Group](#)” on page 3-38.

Figure 4-8 Typical E_{LF}/E_{LR}



Transmission Tracking (E_{TF} and E_{TR})

Transmission tracking is the difference between the frequency response of the reference path (including the R input) and the frequency response of the transmission test path (including the A or B input) while measuring transmission. The response of the test port cables is included. These terms are characterized by measuring the transmission (S_{21} , S_{12}) of the “thru” configuration during the measurement calibration. All transmission measurements are affected by transmission tracking errors.

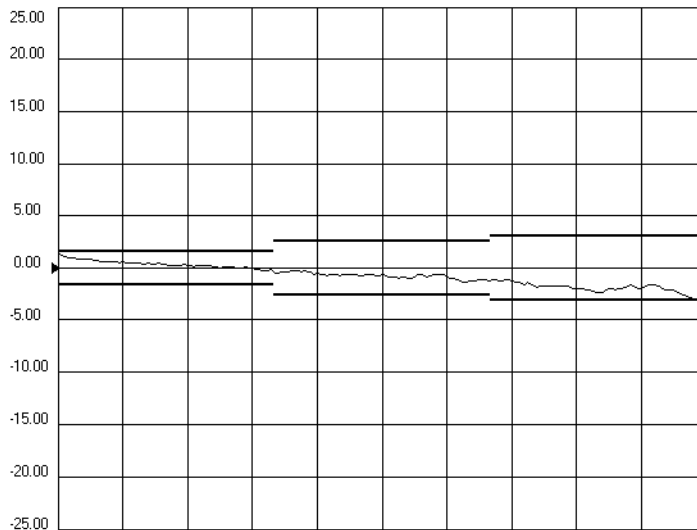
Typical Cause of Failure

The test port cable is the most common cause of transmission tracking specification failure. If the test port cable performance has been independently verified, suspect the following:

- If both E_{TF} and E_{TR} fail
 - the analyzer switch splitter
- If one of the track term specification fails
 - coupler, step attenuator, or the test receiver of the failed port

To troubleshoot, refer to “[Checking the Receiver Assembly Group](#)” on page 3-41 or to “[Checking the Signal Separation Group](#)” on page 3-38.

Figure 4-9 Typical E_{TF}/E_{TR}



If Error Terms Seem Worse than Typical Values

To verify that the system still conforms to specifications, perform a system verification. Refer to [Chapter 2](#), “[Checks and Adjustments, Firmware Upgrades, and Operating System Recovery](#).”

5 Theory of Operation

Information in This Chapter

This chapter provides a general description of the operating theory of the PNA series RF network analyzers (E8356A, E8357A, and E8358A). Theory of operation is explained to the assembly level only; component-level circuit theory is not provided. Simplified block diagrams are included for each functional group. More detailed block diagrams are located at the end of [Chapter 3](#), “Troubleshooting.”

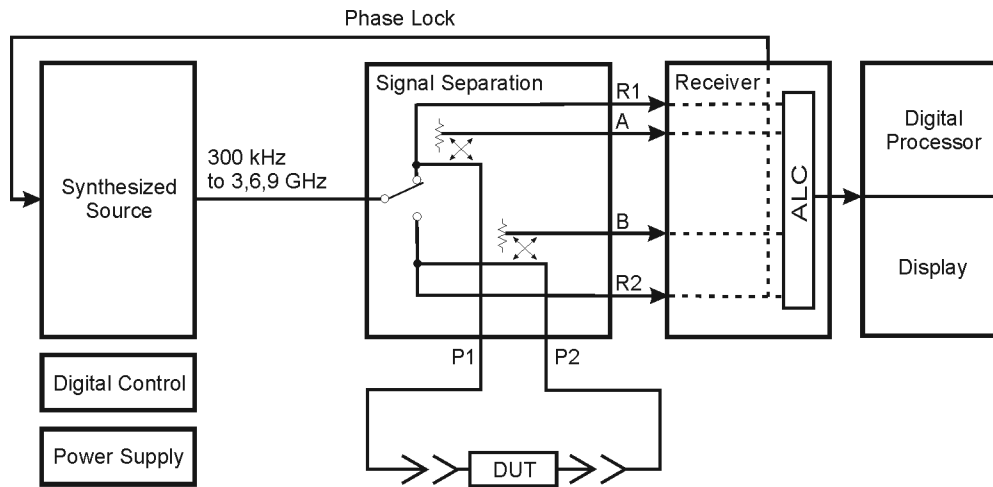
Chapter Five at-a-Glance

Section Title	Summary	Start Page
Network Analyzer System Operation	This section contains a summary of the theory of operation for the network analyzer and provides a summary of the operation of the five functional groups of the analyzer.	Page 5-3
Source Group Operation	This section describes the operation of the assemblies associated with the source group.	Page 5-5
Signal Separation Group Operation	This section describes the operation of the assemblies associated with signal separation, including the operation of Option 015.	Page 5-10
Receiver Group Operation	This section describes the operation of all assemblies associated with the receiver group.	Page 5-15
Digital Processor and Control Group Operation	This section describes the operation of the assemblies associated with digital processing and control.	Page 5-18
Power Supply Group Operation	This section describes the operation of the power supply assembly group.	Page 5-22

Network Analyzer System Operation

The PNA series network analyzer generates a phase-locked incident signal from the internal synthesized source. By means of signal separation, the incident signal is divided into a reference signal and a test signal. The reference signal is applied to the receiver group, while the test signal is applied to the device under test (DUT) and then to the receiver group. The signals are downconverted and are next sampled and digitally processed. Figure 5-1 is a simplified block diagram of the network analyzer system.

Figure 5-1 System Simplified Block Diagram



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Functional Groups of the Network Analyzer

The operation of the network analyzer can be separated into five functional groups. Each group consists of several major assemblies that perform a distinct function in the instrument. Some of the assemblies are related to more than one group, and all the groups, to some extent, are interrelated and affect each other's performance. The five major functional groups are:

- synthesized source group
- signal separation group
- receiver group
- digital processor and digital control group
- power supply group

Synthesized Source Group

The built-in synthesized source generates a swept, stepped, or continuous wave (CW) signal in the frequency ranges as listed in [Table 5-1](#). The source output power is leveled by an internal automatic leveling control (ALC) circuit. A portion of the source signal is routed to one of the reference receivers (R1 or R2), and fed back to the source for phase lock. The maximum output power level of the network analyzer at the test ports is shown in [Table 5-1](#). The operation of the source functional group is described in [“Source Group Operation” on page 5-5](#).

Table 5-1 Frequency Range and Maximum Output Power Level

Parameter	E8356A	E8357A	E8358A	
Frequency Range	300 kHz to 3.0 GHz	300 kHz to 6.0 GHz	300 kHz to 6.0 GHz	6.0 GHz to 9.0 GHz
Maximum Output Power	+10 dBm	+10 dBm	+10 dBm	+5 dBm

Signal Separation Group

The source signal is separated into a reference path and a test path. The reference signal is transmitted to the receiver group. The test signal is transmitted through—and reflected from—the DUT and then is transmitted to the receiver group. The signal separation group also provides attenuation for the test signals, RF path switching to allow forward and reverse measurements, and external connections for the DUT. The operation of the signal separation functional group is described in [“Signal Separation Group Operation” on page 5-10](#).

Receiver Group

The receiver converts the test signal to a 41 kHz intermediate frequency (IF) for signal processing, retaining both magnitude and phase characteristics. The IF is converted to digital signals by the digital processing group. The operation of the receiver functional group is described in [“Receiver Group Operation” on page 5-15](#).

Digital Processor and Digital Control Group

The digital processor and digital control group are divided into a front panel group and a data acquisition and processing group. The front panel group provides communication to the network analyzer. The data acquisition and processing group provides signal processing and analyzer control, and output to the display. The operation of the digital processing and control functional group is described in [“Digital Processor and Control Group Operation” on page 5-18](#).

Power Supply Group

The power supply functional group provides power for the other assemblies in the instrument. The operation of this functional group and its assemblies is described in [“Power Supply Group Operation” on page 5-22](#).

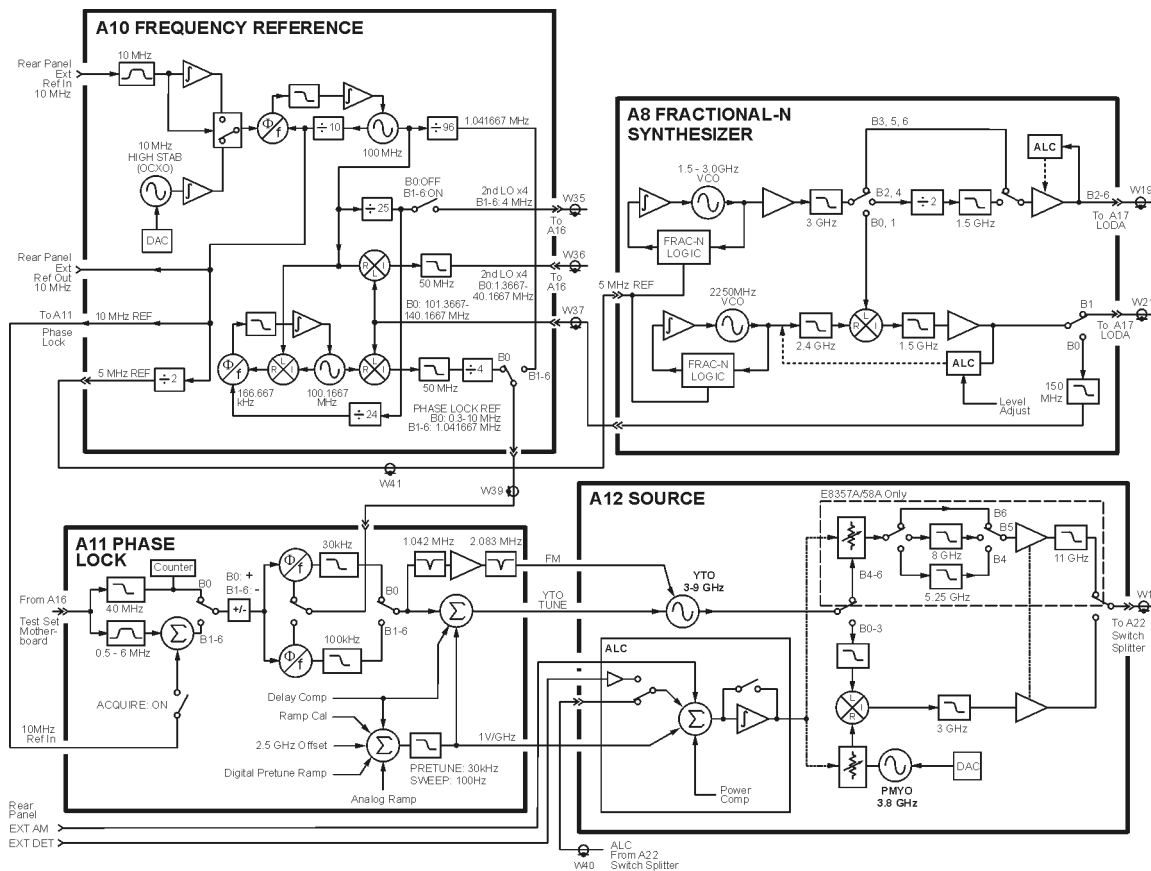
Source Group Operation

The source group produces a stable output signal by phase locking a yttrium-iron-garnet (YIG) oscillator to a synthesized voltage-controlled oscillator (VCO). Refer to [Table 5-2 on page 5-6](#) for the full frequency range of the source. The outputs at the front panel test ports are swept, stepped or CW signals. Maximum leveled output powers are listed in [Table 5-1 on page 5-4](#). For a simple block diagram of the source group, refer to [Figure 5-2](#).

In this section the following characteristics and assemblies of the source group are described:

- [Band Modes](#)
- [A8 Fractional-N Synthesizer Board Assembly](#)
- [A10 Frequency Reference Board Assembly](#)
- [A11 Phase Lock Board Assembly](#)
- [A12 Source Assembly](#)
- [Rear Panel Interconnects](#)

Figure 5-2 Source Group



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Band Modes

The source group operates in one of two different configurations during normal operation. These configurations are:

- Band 0
- Bands 1 through 6

Table 5-2 lists the synthesizer frequencies, harmonic number, and resulting source frequency. This table is referred to throughout this chapter.

Table 5-2 Subsweep Frequencies

Band	Synthesizer Frequency (MHz)	Harmonic Number (N)	Source Frequency (MHz)
0	101.3667 to 140.1667	1	0.3 to 10.0
1	11 to 749	1	10 to 748
2	749 to 1501	1	748 to 1500
3	1501 to 3001	1	1500 to 3000
4	1000.3 to 1500.3	3	3000 to 4500
5	1500.3 to 2167.0	3	4500 to 6500
6	2167.0 to 3000.3	3	6500 to 9000

Band 0

In Band 0, the output of the A8 fractional-N synthesizer board assembly is sent to the A10 frequency reference board assembly to generate the phase lock reference and 2nd local oscillator (LO) signals.

The A8 fractional-N synthesizer board assembly generates a signal sweep from 101.3667 MHz to 140.1667 MHz. This signal is switched into the A10 frequency reference board assembly where it is divided into two paths:

In the first path:

1. The synthesizer signal is mixed with the 100.1667 MHz reference signal and the resulting signal is divided by four to produce a swept phase lock reference signal from 0.3 MHz to 10.0 MHz.
2. The phase lock reference signal is routed to the A11 phase lock board assembly where it is used to tune the A12 source assembly for the same frequency range.
3. This 0.3 MHz to 10.0 MHz output signal from the A12 source assembly is sent to the active test and reference channels and then to the active receiver modules. There is no 1st LO to the receiver modules in band 0, so this signal passes through the first converter into the 1st IF path unchanged. A portion of this signal is then passed through the phase lock multiplexer back to the A11 phase lock board assembly to complete the phase lock loop. In the receiver module, this 1st IF signal is mixed with the 2nd LO to produce a constant 2nd IF signal at 41.667 kHz.

In the second path:

1. The synthesizer signal is mixed with a 100 MHz reference signal to produce a swept signal from 1.366668 MHz to 40.166668 MHz.
2. This resultant swept signal is passed to the A16 test set motherboard assembly where the frequency is divided by four to produce a swept 2nd LO signal from 0.341667 MHz to 10.041667 MHz.
3. This 2nd LO signal is then divided into two signals, the 2nd LO (a) and the 2nd LO (b). The 2nd LO (b) signal is phase shifted -90° relative to 2nd LO (a). Both of these signals are then distributed to each of the four receiver modules.

Bands 1 through 6

In bands 1 through 6 the A10 frequency reference board assembly produces a constant phase locked reference signal of 1.041667 MHz which is sent to the A11 phase lock board assembly.

The A8 fractional-N synthesizer board assembly produces an LO signal which is sent through the A17 LO distribution assembly (LODA) to the 1st converter for each of the four receiver modules. The frequency is synthesized such that the mixing product of this LO signal with the main source output is a constant 1.041667 MHz. A portion of this 1st IF signal is passed through the phase lock multiplexer on the A16 test set motherboard back to the A11 phase lock board to complete the phase lock loop. In the 2nd converter of the receiver module, this 1st IF signal is mixed with the 2nd LO signals to produce a constant 2nd IF signal at 41.667 kHz.

The A10 frequency reference board assembly also produces a constant 4 MHz signal which is passed to the A16 test set motherboard assembly where the frequency is divided by four to produce a constant 2nd LO signal of 1 MHz. It is then divided into two signals, the 2nd LO (a) and the 2nd LO (b). The 2nd LO (b) signal is phase shifted -90° relative to 2nd LO (a). Both of these signals are then distributed to each of the four receiver modules.

A8 Fractional-N Synthesizer Board Assembly

The A8 fractional-N synthesizer board assembly uses the 5 MHz reference signal from the A10 frequency reference board assembly to tune two VCO circuits: one that sweeps from 1500 to 3000 MHz and one that is set to a CW frequency of 2250 MHz. In bands 0 and 1, these two signals are heterodyned to produce the output frequencies listed in [Table 5-2 on page 5-6](#). In bands 2 and 4, the output of the swept VCO is passed through a divide-by-2 circuit to produce the output frequencies listed in [Table 5-2](#). In bands 3, 5, and 6, the swept VCO signal is sent directly to the synthesizer output.

At the output, an ALC circuit maintains the power level at a constant -3 dBm. In band 0, a switch at the output passes the signal to the A10 frequency reference board assembly to produce the 2nd LO and phase lock reference signals. In band 1, the output is sent through a 1.2 GHz low pass filter and then to the A17 LODA. In bands 2 through 6, the output is sent to the A17 LODA and on to the four receivers as the 1st LO signal.

A10 Frequency Reference Board Assembly

This assembly provides stable reference frequencies to the rest of the instrument. A high stability 10 MHz oven-controlled crystal oscillator (OCXO) normally provides the frequency standard. However, if a 10 MHz external reference signal is detected at the 10 MHz EXT REF IN port on the rear panel, it is used as the frequency reference instead of the internal OCXO.

The 10 MHz reference signal is used to phase lock a 100 MHz VCO. This VCO is then used to phase lock a second VCO at 100.1667 MHz. It is also used to provide the 10 MHz EXT REF OUT rear panel signal, reference for the A11 phase lock board assembly, and a 5 MHz reference for the A6 signal processing ADC module (SPAM) board assembly and the A8 fractional-N synthesizer board assembly.

In band 0, the swept signal from the A8 fractional-N synthesizer board assembly is mixed with the 100 MHz VCO signal to produce the fourth multiple of the 2nd LO signal which is sent to the A16 test set motherboard. It is also mixed with the 100.1667 MHz VCO signal to produce the fourth multiple of the phase lock reference signal which is sent to the A11 phase lock board assembly.

In bands 1 through 6, the 100 MHz reference signal is sent through a divide-by-25 circuit to produce the fourth multiple of the 1 MHz 2nd LO signal which is sent to the A16 test set motherboard. The 100 MHz reference signal is also sent through a divide-by-96 circuit to produce the 1.041667 phase lock reference signal which is sent to the A11 phase lock board assembly.

A11 Phase Lock Board Assembly

The A11 phase lock board assembly compares the phase lock IF signal from the A16 test set motherboard with the phase lock reference signal from the A10 frequency reference board assembly to generate the tuning voltage for the A12 source assembly YIG-tuned oscillator (YTO). In addition, various digital-to-analog converters (DACs) on this assembly are set by the A6 SPAM board assembly to inject offset and delay voltages for the various source bands and measurement sweep rates.

A12 Source Assembly

The A12 source assembly contains a 3–9 GHz YIG-tuned oscillator (YTO) and a fixed frequency 3.8 GHz permanent-magnet YIG oscillator (PMYO). The YTO has a main coil and an FM coil. These are analogous to the woofer and the tweeter in a stereo speaker: the woofer reproduces low frequencies and the tweeter reproduces high frequencies. Similarly in the YTO, the main coil allows large, slow changes in frequency but cannot respond to high frequency deviations, which are sent to the faster-acting FM coil.

The tune current from the A11 phase lock board assembly splits into two paths. One path is lowpass filtered, removing high frequency components, and goes to the YTO main coil; the other path is highpass filtered, removing low frequency components, and goes to the YTO FM coil. The filters are matched in stop-band response, such that one picks up where the other leaves off.

The frequency of the PMYO is set by a voltage received from a DAC set by the A6 SPAM board assembly.

In bands 0 through 3, the 3.8003 to 6.8 GHz output of the YTO and the 3.8 GHz output of the PMYO are mixed to produce the required output frequency. In bands 4 through 6, the output of the YTO is filtered and sent directly to the source output. A portion of this output signal is split off in the A22 switch splitter assembly and returned to the A12 source assembly. This signal is combined with other inputs in the automatic level control (ALC) circuitry to set the output power level. The other inputs include the temperature compensation and slope compensation circuits, the power level DAC, and the rear panel EXTERNAL AM input.

Rear Panel Interconnects

10 MHz REF. INPUT	<p>A BNC connector that allows an external frequency reference signal to be used to phase lock the analyzer for increased frequency accuracy.</p> <p>The analyzer automatically enables the external frequency reference feature when a signal is connected to this input. When the signal is removed, the analyzer automatically switches back to its internal frequency reference.</p>
10 MHz REF. OUTPUT	<p>A BNC connector that allows a 10 MHz reference signal, produced by the A10 frequency reference board assembly, to be output for use in phase locking external test equipment.</p>
EXT. AM INPUT	<p>A BNC connector that allows an external, analog input signal to be applied to the ALC circuitry of the analyzer's source. This analog input signal amplitude modulates the RF output signal.</p>
EXT. DETECTOR INPUT	<p>A BNC connector that allows an external, analog input signal to be applied to the ALC circuitry of the analyzer's source. This analog input signal amplitude modulates the RF output signal.</p>

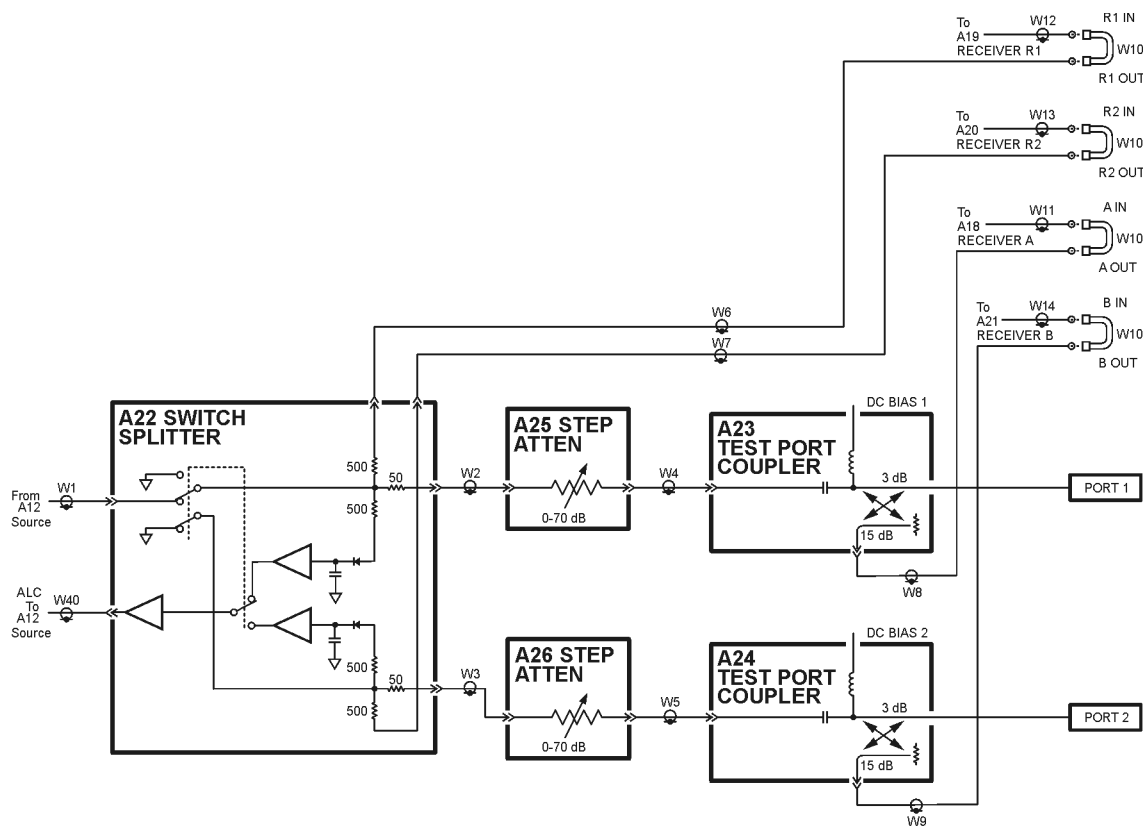
Signal Separation Group Operation

The signal separation group divides the source signal into a reference path and a test path. The reference signal is transmitted to the receiver group. The test signal is transmitted through—and reflected from—the device under test (DUT) and then is transmitted to the receiver group. Control lines to this group are routed from the A16 test set motherboard.

In this section, the following assemblies are described:

- [A22 Switch Splitter](#)
- [A23 and A24 Test Port Couplers](#)
- [A25 and A26 70 dB Step Attenuators](#)
- [A27 and A28 35 dB Step Attenuators \(Option 015 Configurable Test Set\)](#)

Figure 5-3 Signal Separation Group, Standard Analyzer



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A22 Switch Splitter

The output of the A12 source assembly is routed to the A22 switch splitter assembly. This is a solid-state switch. It switches between the Port 1 and Port 2 measurement paths, automatically enabling alternate forward and reverse measurements. The A22 switch splitter assembly provides an internal termination for the measurement port that is inactive.

Both measurement paths in the A22 switch splitter assembly include a three-way splitter. The signal is split into the test port signal, the receiver signal, and the ALC signal.

The test port signal is routed through the step attenuator (A25 or A26), through the test port coupler (A23 or A24) and out through either PORT 1 or PORT 2 to the DUT.

The reference signal is routed through the front-panel channel R jumper to the appropriate R channel receiver module (A19 or A20).

The ALC signal is routed, through a log amplifier circuit, to the ALC circuitry in the A12 source assembly for source leveling.

A23 and A24 Test Port Couplers

The test port signal goes into the through-line arm of the couplers, and from there to the test ports and the DUT. The coupled arm of the couplers carries the signal reflected from or transmitted through the DUT to the receiver through a front panel jumper for measurement. The coupling coefficient of the directional couplers is nominally 15 dB over the full frequency range.

Each coupler includes a dc bias circuit which provides a means of biasing active devices with an external dc voltage connected to the rear panel DC BIAS CONNECT ports. The dc voltage is applied directly to the center conductor of the test port connectors. A blocking capacitor ensures that the bias current goes only to the DUT, and not back into the source. Likewise, an inductor in the bias path prevents RF from being imposed on the external dc supply.

A25 and A26 70 dB Step Attenuators

The 70 dB step attenuators provide coarse power control for the test port signals. They are electro-mechanical step attenuators, controlled by the A15 CPU board assembly, that provide 0 to 70 dB of attenuation in 10 dB steps. They adjust the power level to the DUT without changing the level of the incident power in the reference path.

Option 015 Configurable Test Set

The Option 015 analyzer allows you to measure devices with higher power and higher dynamic range limits than the standard analyzer. The theory of operation is the same as for the standard analyzer except that there are two additional front panel SMA jumpers and two 35 dB step attenuators (A27 and A28). As shown in [Figure 5-4](#), the additional jumpers allow access to the test port signal between the 70 dB step attenuators (A25 and A26) and the test port couplers (A23 and A24). The 35 dB step attenuators (A27 and A28) protect the test receivers (A18 and A21) from amplified input signals.

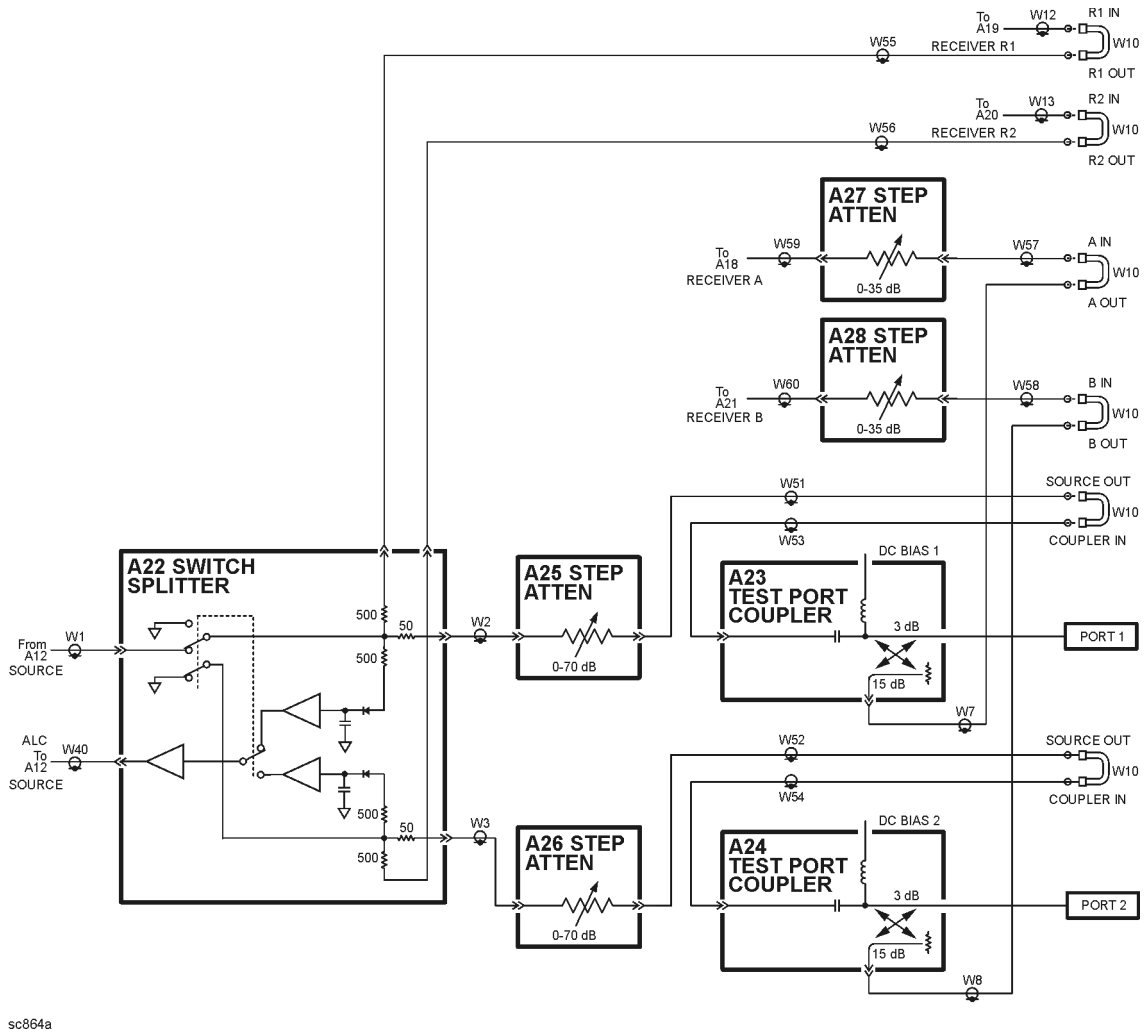
A27 and A28 35 dB Step Attenuators

The 35 dB step attenuators provide coarse power control for amplified input. They are electro-mechanical step attenuators, controlled by the A15 CPU board assembly, that provide 0 to 35 dB of attenuation in 5 dB steps.

Normal Option 015 Configuration

The normal configuration for the Option 015 is shown in [Figure 5-4](#). With this configuration and inclusion of an external amplifier and accessories, you can calibrate the analyzer and test devices at power levels up to +30 dBm. You can make measurements in the forward, reverse or both directions and still achieve these high power levels. For more information on higher power measurements, search for “Option 015” in the embedded help index in the analyzer.

Figure 5-4 Signal Separation Group, Option 015 Analyzer



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High Dynamic Range Configuration

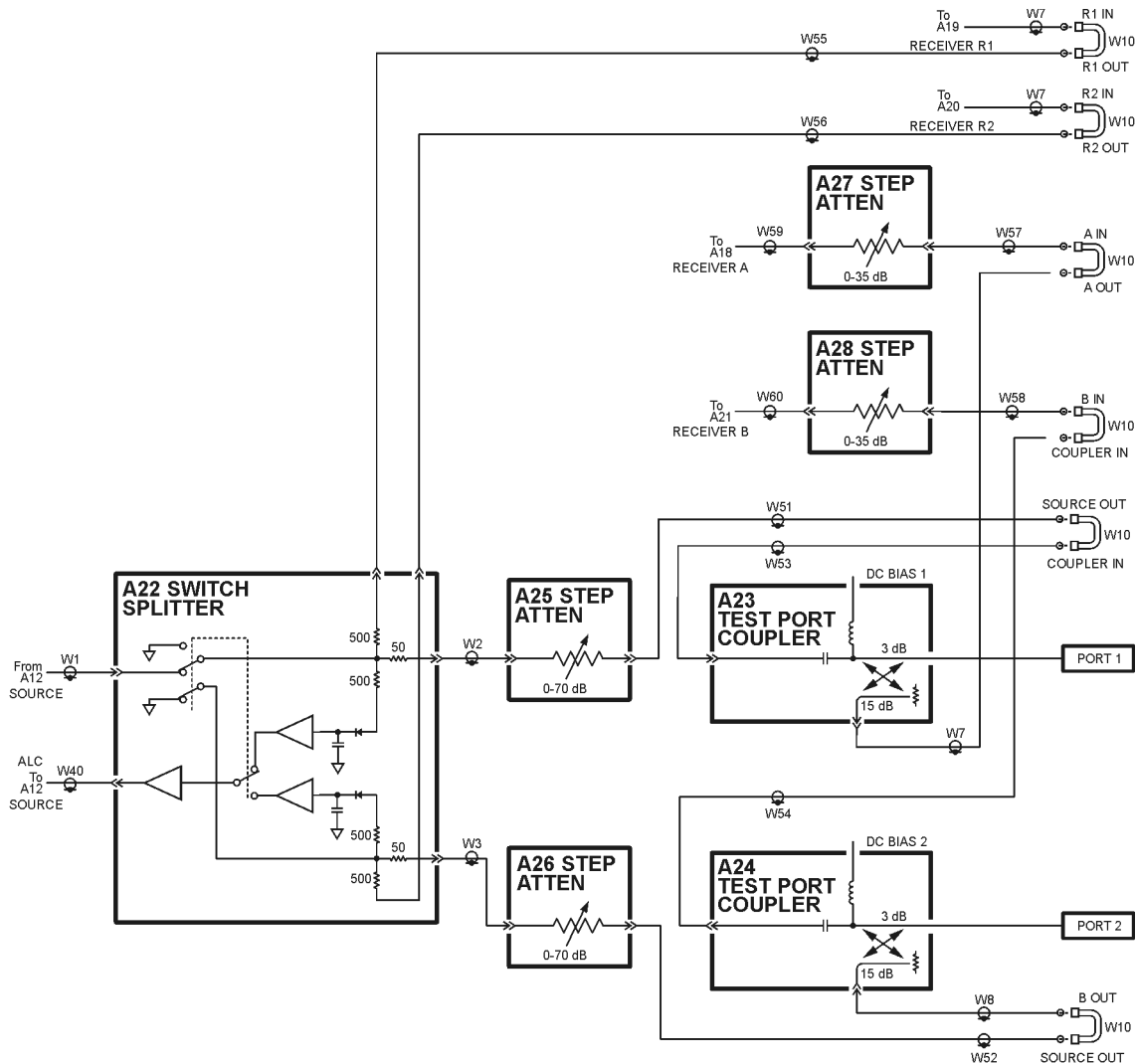
With a few jumper changes, you can configure the Option 015 for higher dynamic range measurements. By swapping the front panel jumpers for one port, signal flow through the corresponding coupler is reversed, increasing the test signal sensitivity by 15 dB.

In the forward direction, as shown in [Figure 5-5](#), the signal flow through the test port coupler (A24) is reversed by arranging the front panel jumpers such that B IN connects to COUPLER IN and B OUT connects to SOURCE OUT.

In the reverse direction, not shown, the signal flow through the test port coupler (A23) is reversed by arranging the front panel jumpers such that A IN connects to COUPLER IN and A OUT connects to SOURCE OUT.

For more information on high dynamic range measurements and configurations, search for “Option 015” in the embedded help index in the analyzer.

Figure 5-5 High Dynamic Range Configuration in the Forward Direction



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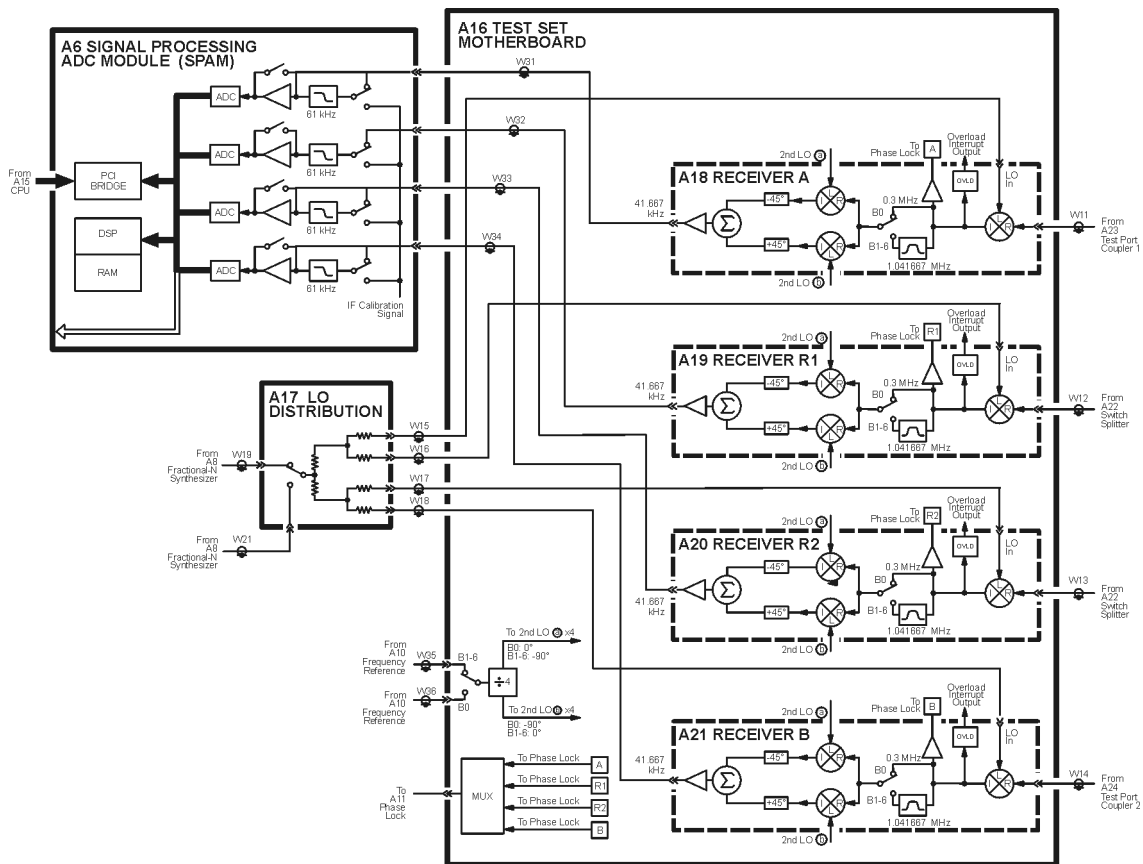
Receiver Group Operation

The receiver group measures and processes the input signals into digital information for processing and eventual display. **Figure 5-6** is a simplified block diagram of the receiver functional group.

In this section the following assemblies are described:

- A18, A19, A20, and A21 Receiver Modules
- A16 Test Set Motherboard Assembly
- A6 SPAM Board Assembly (Analog Description)

Figure 5-6 Receiver Group



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A18, A19, A20, and A21 Receiver Modules

The four receiver modules function identically and are completely interchangeable. Each of these receiver modules consists of two converter stages.

The 1st converter receives the RF reference or test signal and mixes it with the 1st LO signal from the A17 LODA (except in band 0 where the 1st LO is not used) to create the 1st IF signal at a constant 1.041667 MHz. The 1st IF signal is sensed by an overload circuit that shuts off the source if excessive power is encountered. A portion of the 1st IF signal is sent to a multiplexer on the A16 test set motherboard assembly, the output of which is routed to the A11 phase lock board assembly to complete the phase lock loop. The 1.041667 MHz 1st IF signal is also filtered (bands 1-6) and routed to the 2nd converter.

The 2nd converter divides the 1.041667 MHz signal into two paths and mixes each with a separate LO signal, designated 2nd LO (a) and 2nd LO (b). Both of these 2nd LO signals are 1.000 MHz. In the self-calibration mode, the 2nd LO (b) signal is phase shifted -90° relative to the 2nd LO (a) signal. In the normal measurement mode, the 2nd LO (b) signal is phase shifted $+90^\circ$ relative to the 2nd LO (a) signal. These two generated 2nd IF signals are a constant 41.667 kHz. These 2nd IF (a) and 2nd IF (b) signals are phase shifted -45 degrees and $+45$ degrees, respectively. These signals are summed together and routed to the A6 signal processing and ADC module (SPAM) board assembly.

A16 Test Set Motherboard Assembly

The A16 test set motherboard assembly serves three functions:

- to act as a controller for the four receiver modules and as a passage for the 2nd LO and phase lock signals.
- to act as an interface between the A15 CPU board assembly and the auxiliary rear panel interconnects.
- to route control signals to the signal separation group. Refer to [“Signal Separation Group Operation” on page 5-10](#) for more information.

Receiver Control

The A16 test set motherboard assembly supplies power and signal leveling control to the A18, A19, A20, and A21 receiver modules. It also receives the two 2nd LO signals from the A10 frequency reference board assembly.

- The first signal is used for Band 0 operation and ranges from 1.3667 MHz to 40.1667 MHz. The appropriate signal is selected, its frequency is divided by four, and it is divided into two paths, designated 2nd LO (a) and 2nd LO (b). In Band 0, the 2nd LO (b) signal is phase shifted -90° relative to the 2nd LO (a) signal.
- The second signal is used for Bands 1 to 6 and is a constant 4 MHz. In Bands 1 through 6, the 2nd LO (a) signal is phase shifted $+90^\circ$ relative to the 2nd LO (b) signal. Both of these signals are distributed to each of the receiver modules.

A portion of the 1.041667 MHz 1st IF signal from each of the receiver modules is routed through the A16 test set motherboard assembly to a multiplexing circuit. With control from the A15 CPU board assembly, one of these four signals is selected for routing to the A11 phase lock board assembly to complete the phase lock loop.

Rear Panel Interconnects

The A16 test set motherboard assembly includes the following rear panel interconnects.

EXT. TEST SET INTERFACE	<i>This connector is currently not used. A 25-pin connector for the control of external test sets allowing for a modular, expandable N-port test system.</i>
GPIO	<i>This connector is currently not used. A 36-pin, parallel I/O port consisting of four independent parallel input/output ports, control signal lines, and a power supply line.</i>
AUX I/O	<i>Only two pins on this connector are currently being used. A 25-pin connector that provides a variety of both analog and digital input and output signals.</i> The following pins are currently defined: pin 18: ready for trigger output pin 19: external trigger input

A6 SPAM Board Assembly (Analog Description)

In this assembly, the 2nd IF signals from the A, B, R1, and R2 second converters go through a gain stage where signals less than -40 dBm are amplified by 34 dB to ensure that they can be detected by the analog-to-digital converter (ADC).

All four signals are sampled simultaneously by the ADCs, where they are converted to digital form. The ADC conversions are triggered by timing signals from the digital signal processor (DSP) in response to commands from the central processing unit (CPU). The digitized data is processed into magnitude and phase data by the DSP and sent to the CPU random access memory (RAM) by way of the peripheral component interconnect (PCI) bus.

The processed and formatted data is finally routed to the display, and to the general-purpose interface bus (GPIB) for remote operation. Refer to [“Digital Processor and Control Group Operation” on page 5-18](#) for more information on signal processing.

Digital Processor and Control Group Operation

The digital processor and control group provides digital control for the entire analyzer. It provides:

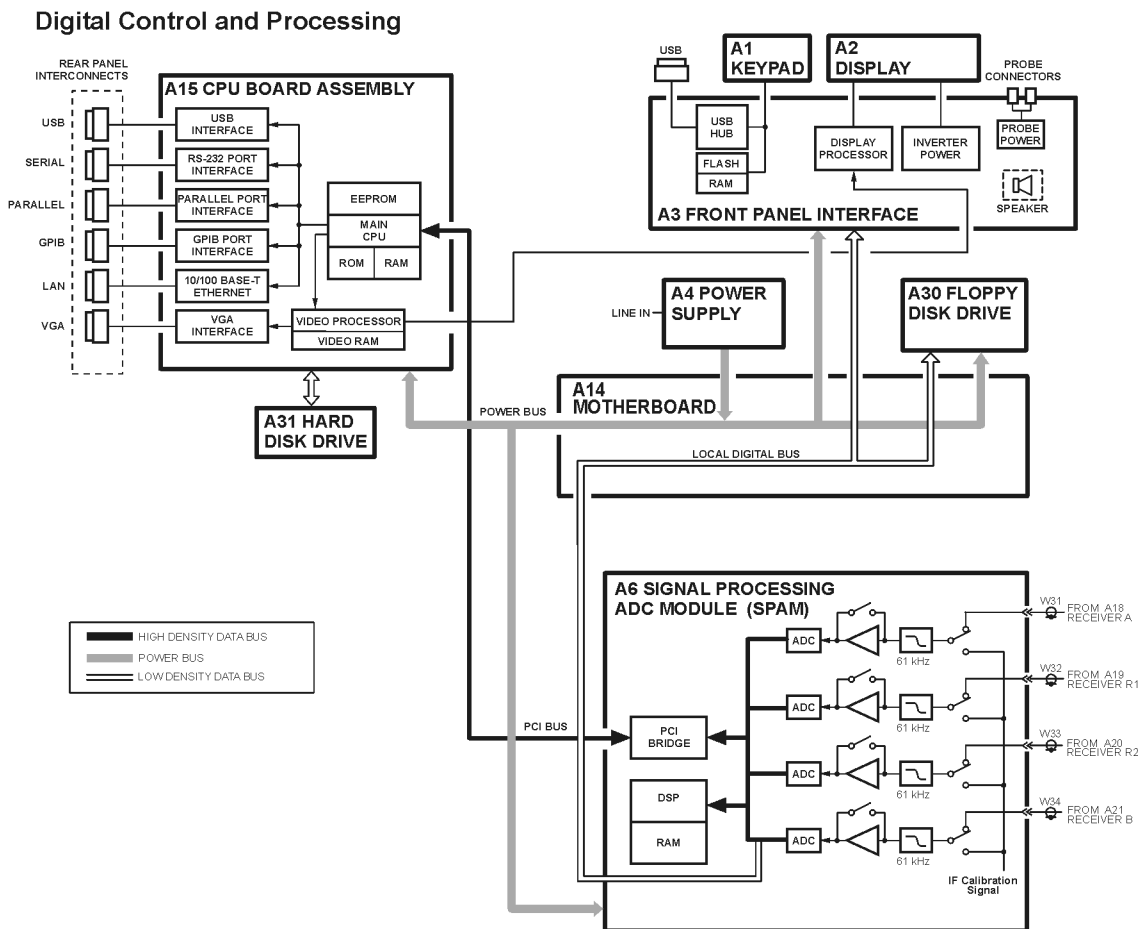
- front panel operation,
- output to the display,
- math processing functions, and
- communications between the analyzer and an external controller or peripherals.

A block diagram of the digital control functional group is shown in [Figure 5-7](#).

The digital control functional group consists of two subgroups:

- [Front Panel Subgroup](#)
- [Data Acquisition and Processing Subgroup](#)

Figure 5-7 Digital Processing and Digital Control Group



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Front Panel Subgroup

The front panel subgroup contains the following assemblies:

- [A1 Keypad Assembly](#)
- [A2 Display Assembly](#)
- [A3 Front Panel Interface Board Assembly](#)

A1 Keypad Assembly

The A1 keypad assembly provides user interface to the analyzer. The front panel rotary pulse generator (RPG) knob is not electrically connected to the keypad, but rather provides user inputs directly to the front panel processor.

A2 Display Assembly

The A2 display assembly contains an 8.4-inch LCD with associated drive circuitry and backlight inverter. Two cables between the A2 display assembly and the A3 front panel interface board assembly provide all necessary power and data for normal operation. The two cables are:

1. A cable to the inverter that supplies buffered power.
2. A cable to the display circuitry that supplies decoded data from the video processor on the A15 CPU board assembly and the necessary drive circuit power. The video data received from the A15 CPU board assembly includes the following:
 - digital TTL horizontal sync
 - digital TTL vertical sync
 - digital TTL red video
 - digital TTL green video
 - digital TTL blue video
 - blanking
 - data clock

A3 Front Panel Interface Board Assembly

The A3 front panel interface board assembly detects and decodes user inputs from the A1 keypad assembly and front panel knob, and transmits them to the A15 CPU board assembly by way of the A14 motherboard assembly. It also decodes video data from the video processor on the A15 CPU board assembly and supplies this to the A2 display assembly. Power from the power bus on the A14 motherboard assembly is buffered and routed to the A1 keypad assembly and the A2 display assembly. All data and power signals are routed through a single cable connector to the A14 motherboard assembly.

The A3 front panel interface board assembly also includes the following items:

USB	A universal serial bus (USB) jack (an industry standard 4-pin connector).
Probe Power	Two identical connectors (fused inside the instrument) that supply power to an active probe for in-circuit measurements of ac circuits.
Speaker	A speaker that emits the audio signals received from the A15 CPU board assembly.

Data Acquisition and Processing Subgroup

The data acquisition and processing subgroup contain the following assemblies. See [Figure 5-7 on page 5-18](#).

- [A6 SPAM Board Assembly \(Digital Description\)](#)
- [A15 CPU Board Assembly](#)
- [A30 Floppy Disk Drive](#)
- [A31 Hard Disk Drive Assembly](#)

A6 SPAM Board Assembly (Digital Description)

The A6 SPAM board assembly contains digital and analog circuitry. For analog descriptions, refer to [“A6 SPAM Board Assembly \(Analog Description\)” on page 5-17](#).

The digital signal processor (DSP) receives digitized data from the digital circuitry of the A6 SPAM board assembly. It computes discrete Fourier transforms to extract the complex phase and magnitude data from the 41.667 kHz IF signal. The resulting raw data is written into the main random access memory (RAM). The data taking sequence is triggered either externally from the rear panel or by firmware on the A15 CPU board assembly.

A15 CPU Board Assembly

The A15 CPU board assembly contains the circuitry to control the operation of the analyzer. Some of the components include the central processing unit (CPU), memory (EEPROM, ROM, RAM), bus lines to other board assemblies, and connections to the rear panel. Some of the main components are described next:

- [CPU](#)
- [Main RAM](#)
- [Rear Panel Interconnects](#)

CPU The central processing unit (CPU) is a microprocessor that maintains digital control over the entire instrument through the instrument bus. The CPU receives external control information from the keypad, any USB device, LAN or GPIB, and performs processing and formatting operations on the raw data in the main RAM. It controls the DSP, the video processor, and the interconnect port interfaces. In addition, when the analyzer is in the system controller mode, the CPU controls peripheral devices through the peripheral port interfaces.

Front panel settings are stored in SRAM, with a battery providing at least five years of backup storage when external power is off.

Main RAM The main random access memory (RAM) is shared memory for the CPU and the DSP. It stores the raw data received from the DSP while additional calculations are performed on it by the CPU. The CPU reads the resulting formatted data from the main RAM, converts it to a user-definable display format, and writes this to the video processor for display.

Rear Panel Interconnects The rear panel includes the following interfaces:

USB	A universal serial bus (USB) jack (an industry standard 4-pin connector).
GPIB	A 24-pin, female, type D-24 connector that meets IEEE-488 standards.
Serial	A 9-pin, male, RS-232 compatible, D-sub connector.
Parallel	A 36-pin, mini-D, 1284-C connector that provides connection to printers or any other parallel port peripheral.
LAN	A standard 8-pin, 10/100BaseT, Ethernet connection. It auto selects between the two data rates.
Display (VGA)	A 15-pin, female, D-sub connector that provides a video output of the analyzer display that can be viewed on an external VGA monitor.

A30 Floppy Disk Drive

The A30 floppy disk drive allows you to store and recall instrument states and measurement results on a 3.5 inch, 1.44 MB floppy disk. This assembly is connected directly to the A14 motherboard assembly.

A31 Hard Disk Drive Assembly

The A31 hard disk drive assembly (HDDA) is an integrated development environment (IDE) data storage device which is connected directly to the A15 CPU board assembly. The full operating system and firmware for the network analyzer is stored on this hard disk drive.

Power Supply Group Operation

The A4 power supply assembly is a switching power supply operating at 103 kHz switching frequency. The input power ranges for the power supply are 90 to 132 Vac or 195 to 250 Vac. The power supply automatically senses the input voltage and switches between these two ranges.

The dc output voltages are:

- +5.2 V
- -5.2 V
- +9 V
- +15 V
- +15 V standby (always on)
- -15 V
- +22 V
- VCC (5.2 V for the A15 CPU board assembly)
- VDL (3.3 V to the A15 CPU board assembly)

The +15 V standby line remains on continuously whenever the power supply is plugged in. This line is used to provide power to front panel LEDs and CPU components when the analyzer is turned off.

An additional +32 V supply line is generated on the A14 motherboard from the +22 V supply line.

NOTE	If the power supply senses an over-voltage or over-current condition on any of the supply lines, the power supply will cycle on and off at a low voltage level (burp mode).
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6 Replaceable Parts

Information in This Chapter

This chapter identifies the replaceable parts for the Agilent PNA series RF network analyzers (E8536A, E8537A, E8538A). Several tables and illustrations are provided to assist you in identifying the correct part for your analyzer. This chapter also contains ordering information for new assemblies and rebuilt-exchange assemblies.

Chapter Six at-a-Glance

Section Title	Summary	Start Page
Ordering Information	This section provides steps on how to order a replaceable part from Agilent Technologies.	Page 6-3
Assembly Replacement Sequence	This section provides the correct sequence for replacing a defective assembly.	Page 6-4
Rebuilt-Exchange Assemblies	This section defines a rebuilt-exchange assembly and provides the procedure for replacing and returning a defective assembly to Agilent Technologies.	Page 6-5
Replaceable Parts Listings	<p>This section provides lists and illustrated locations of the replaceable parts in your Agilent PNA Series RF network analyzers (E8356A, E8357A, and E8358A). This section is organized in the order below:</p> <ul style="list-style-type: none">• Assemblies (front panel, top, and bottom)• Cables (top and bottom)• Hardware (internal, hard disk drive, and bottom)• Miscellaneous <p>This section also includes a table that lists the assemblies by reference designator.</p>	Page 6-6

Ordering Information

To order a part listed in the replaceable parts lists:

- determine the part number
- indicate the quantity required
- address the order to the nearest Agilent Technologies sales and service office

A list of sales and service offices is located in [Table 1-1 on page 1-10](#). To order a part that is not listed in the replaceable parts lists, include the instrument model number, complete instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest sales or service office.

Assembly Replacement Sequence

The following steps outline the sequence to be performed to replace an assembly in the network analyzer.

- Step 1.** Identify the faulty group. Begin with [Chapter 3](#) , “[Troubleshooting](#).” Follow up with the appropriate troubleshooting chapter that identifies the faulty assembly.
- Step 2.** Order a replacement assembly. Refer to this chapter.
- Step 3.** Replace the faulty assembly and determine what adjustments are necessary. Refer to [Chapter 7](#) , “[Assembly Replacement and Post-Repair Procedures](#).”
- Step 4.** Perform the necessary adjustments. Refer to [Chapter 2](#) , “[Checks and Adjustments, Firmware Upgrades, and Operating System Recovery](#).”
- Step 5.** Perform the necessary performance tests. Refer to [Chapter 2](#) , “[Checks and Adjustments, Firmware Upgrades, and Operating System Recovery](#).”

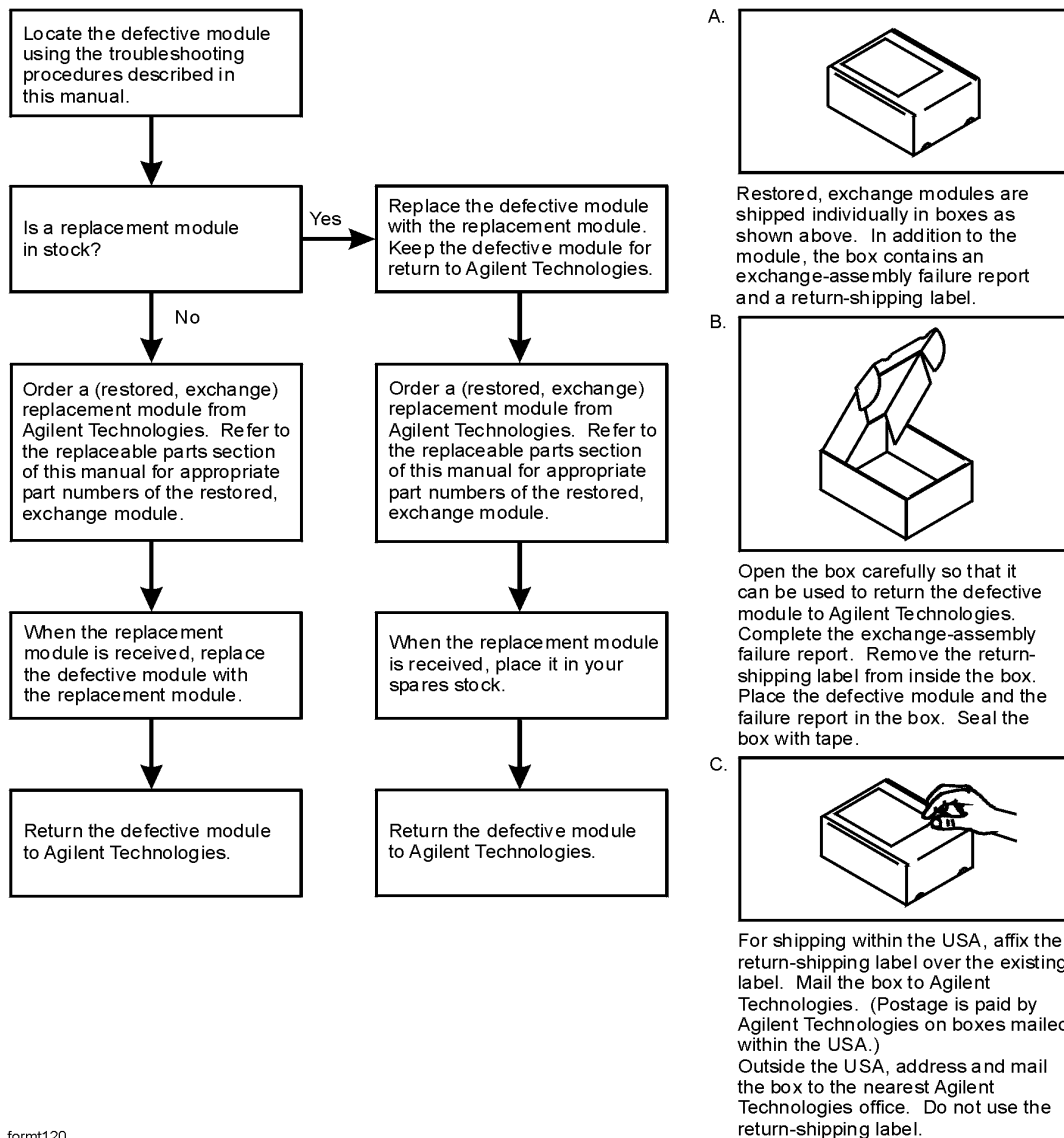
Rebuilt-Exchange Assemblies

Under the rebuilt-exchange assembly program, certain factory-repaired and tested modules (assemblies) are available on a trade-in basis. These assemblies are offered for lower cost than a new assembly, but meet all factory specifications required of a new assembly.

The defective assembly must be returned for credit under the terms of the rebuilt-exchange assembly program. Any spare assembly stock desired should be ordered using the new assembly part number. [Figure 6-1](#) illustrates the module exchange procedure.

Figure 6-1 Module Exchange Procedure

The module exchange program described here is a fast, efficient, economical method of keeping your instrument in service.



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Replaceable Parts Listings

This section contains the replacement part numbers and their descriptions for your Agilent PNA series network analyzer (E8356A, E8357A, and E8358A). You can find the replaceable parts in this section:

- by reference designator in [Table 6-1](#), or
- by the type of part in [Table 6-2](#).

Table 6-1 Location by Reference Designator

Reference Designator	Description	Location
A1	Keypad assembly	"Front Panel Assembly" on page 6-8
A2	Display assembly	
A3	Front panel interface board assembly	
A4	Power supply assembly	"Top Assemblies" on page 6-10
A6	Signal processing ADC module (SPAM) board assembly	
A8	Fractional-N synthesizer board assembly	
A10	Frequency reference board assembly	
A11	Phase lock board assembly	
A12	Source assembly	
A14	Motherboard assembly	
A15	CPU board assembly	
A16	Test set motherboard assembly	"Bottom Assemblies and Hardware, Standard" on page 6-12
A17	Local oscillator (LO) distribution assembly	
A18	Channel A receiver module assembly	
A19	Channel R1 receiver module assembly	
A20	Channel R2 receiver module assembly	
A21	Channel B receiver module assembly	
A22	Switch splitter assembly	
A23	Test port 1 coupler	
A24	Test port 2 coupler	
A25	70 dB step attenuator	
A26	70 dB step attenuator	
A27	35 dB step attenuator (Option 015 only)	"Bottom Assemblies and Hardware, Option 015" on page 6-14
A28	35 dB step attenuator (Option 015 only)	
A30	Floppy disk drive	"Internal Hardware and Parts" on page 6-22
A31	Hard disk drive assembly	"Hard Disk Drive Assembly" on page 6-25

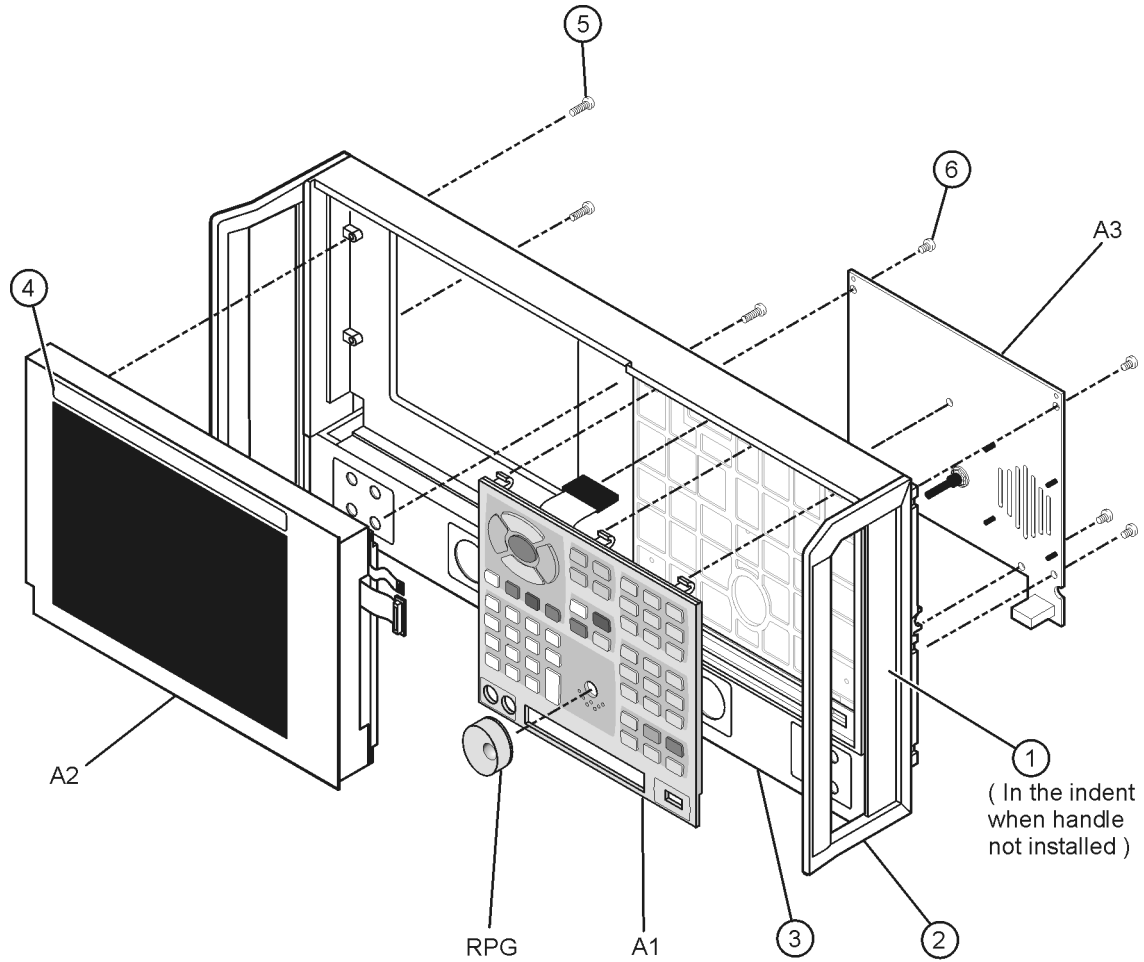
Table 6-2 Part Number Location by Type of Part

Type of Part	Location
Assemblies	<ul style="list-style-type: none"> • “Front Panel Assembly” on page 6-8 • “Top Assemblies” on page 6-10 • “Bottom Assemblies and Hardware, Standard” on page 6-12 • “Bottom Assemblies and Hardware, Option 015” on page 6-14
Cables	<ul style="list-style-type: none"> • “Top Cables” on page 6-16 • “Bottom Cables, Standard” on page 6-18 • “Bottom Cables, Option 015” on page 6-20
Hardware	<ul style="list-style-type: none"> • “Internal Hardware and Parts” on page 6-22 • “Rear Panel Assembly” on page 6-24 • “Hard Disk Drive Assembly” on page 6-25 • “External Parts” on page 6-26
Miscellaneous	<ul style="list-style-type: none"> • “Miscellaneous Part Numbers” on page 6-27 <ul style="list-style-type: none"> — Service Tools — Fuses — Front Panel Trim and Overlays — Documentation — Upgrade Kits — Protective Caps for Connectors — GPIB Cables — Touch-up Paint — ESD Supplies — USB Accessories — Rack Mount Kits and Handle Kits

Front Panel Assembly

Reference Designator	Model/Option	Part Number	Qty	Description
A1	All	E8356-60001	1	Keypad assembly
A2	All	E8356-60077	1	Display assembly
		0950-3379	1	Inverter board (included in A2)
		2090-0386	1	Backlight (included in A2)
		1000-1161	1	Display glass (included in A2)
A3	All	E8356-60003	1	Front panel interface board assembly
RPG	All	E8356-40006	1	Front knob
①	All	5041-9173	2	Front frame trim (without handles only)
②	All	5063-9204	2	Front handle
③	All	E8356-60074	1	Front frame assembly
④	E8356A	E8356-80005	1	Nameplate
④	E8357A	E8357-80001	1	Nameplate
④	E8358A	E8358-80001	1	Nameplate
⑤	All	0515-0375	4	Machine screw, M3.0 x 14 CW-PN-TX
⑥	All	0515-0372	8	Machine screw, M3.0 x 08 CW-PN-TX

Figure 6-2 Illustration of Front Panel Assembly

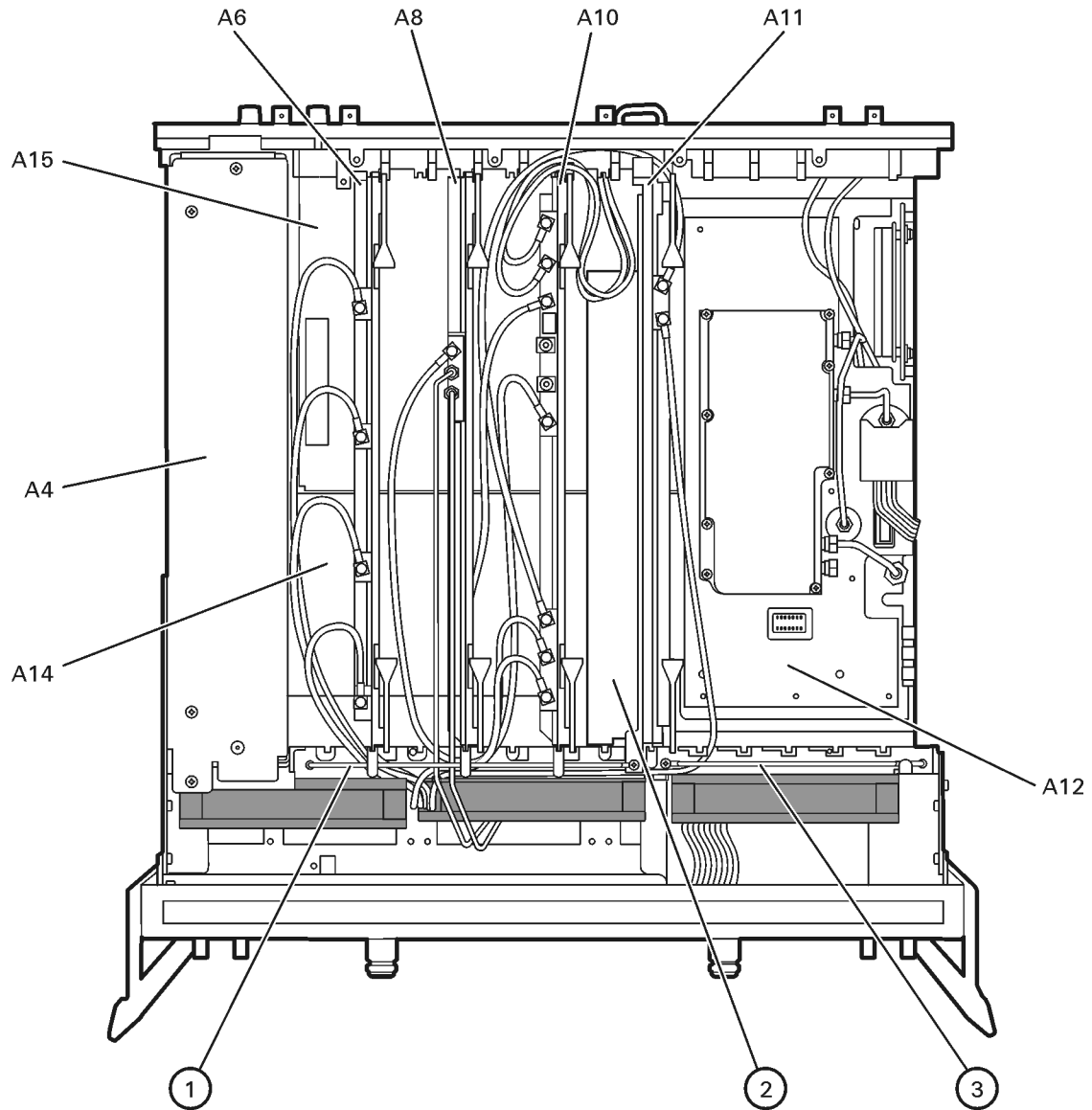


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Top Assemblies

Reference Designator	Model/Option	Part Number	Qty	Description
A4	All	0950-3384	1	Power supply assembly
A6	All	E8356-60006	1	Signal processing ADC module (SPAM) board assembly
A8	All	E8356-60008	1	Fractional-N synthesizer board assembly
A10	All	E8356-60010	1	Frequency reference board assembly
A11	All	E8356-60011	1	Phase lock board assembly
A12	E8356A	E8356-60031	1	Source assembly
A12	E8356A	E8356-69031	1	Source assembly (rebuilt-exchange)
A12	E8357A E8358A	E8356-60012	1	Source assembly
A12	E8357A E8358A	E8356-69012	1	Source assembly (rebuilt-exchange)
A14	All	E8356-60014	1	Motherboard assembly
A15	All	E8356-60030	1	CPU board assembly
A15	All	E8356-69030	1	CPU board assembly (rebuilt-exchange)
①	All	5022-6134	1	Cable hold down
②	All	E8356-40001	1	Air flow plenum
③	All	5022-6135	1	Cable hold down

Figure 6-3 Illustration of Top Assemblies

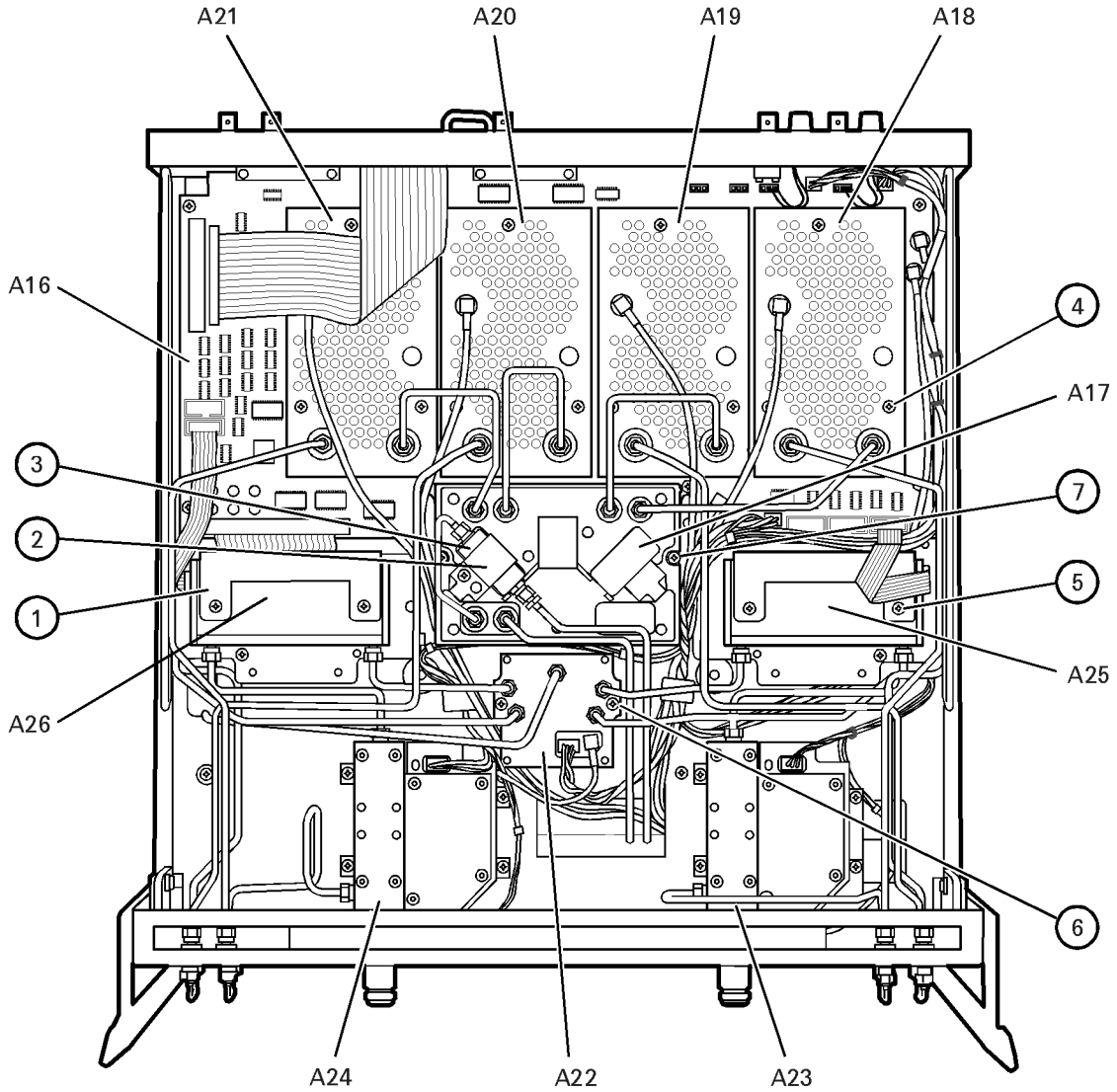


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Bottom Assemblies and Hardware, Standard

Reference Designator	Part Number	Qty	Description
A16	E8356-60049	1	Test set motherboard assembly
A17	E8356-60017	1	Local oscillator distribution assembly (LODA)
A18	E8356-60018	4	Channel A receiver module assembly
A19			Channel R1 receiver module assembly
A20			Channel R2 receiver module assembly
A21			Channel B receiver module assembly
A18	E8356-69018	4	Channel A receiver module assembly (rebuilt-exchange)
A19			Channel R1 receiver module assembly (rebuilt-exchange)
A20			Channel R2 receiver module assembly (rebuilt-exchange)
A21			Channel B receiver module assembly (rebuilt-exchange)
A22	5087-7019	1	Switch splitter assembly
A22	5087-6019	1	Switch splitter assembly (rebuilt-exchange)
A23	5087-7020	2	Test port 1 coupler
A24			Test port 2 coupler
A23	5087-6020	2	Test port 1 coupler (rebuilt-exchange)
A24			Test port 2 coupler (rebuilt-exchange)
A25	33321-60056	2	70 dB step attenuator
A26			70 dB step attenuator
①	E8356-00019	2	Attenuator bracket
②	E8356-00021	1	Cable / filter clamp
③	9135-5305	1	1.2 GHz lowpass filter
④	0515-1349	12	Machine screw M3.0 x 30 CW-PN-TX
⑤	0515-0372	39	Machine screw M3.0 x 8 CW-PN-TX
⑥	0515-0375	2	Machine screw M3.0 x 16 CW-PN-TX
⑦	0515-0374	4	Machine screw M3.0 x 10 CW-PN-TX

Figure 6-4 Illustration of Bottom Assemblies and Hardware, Standard

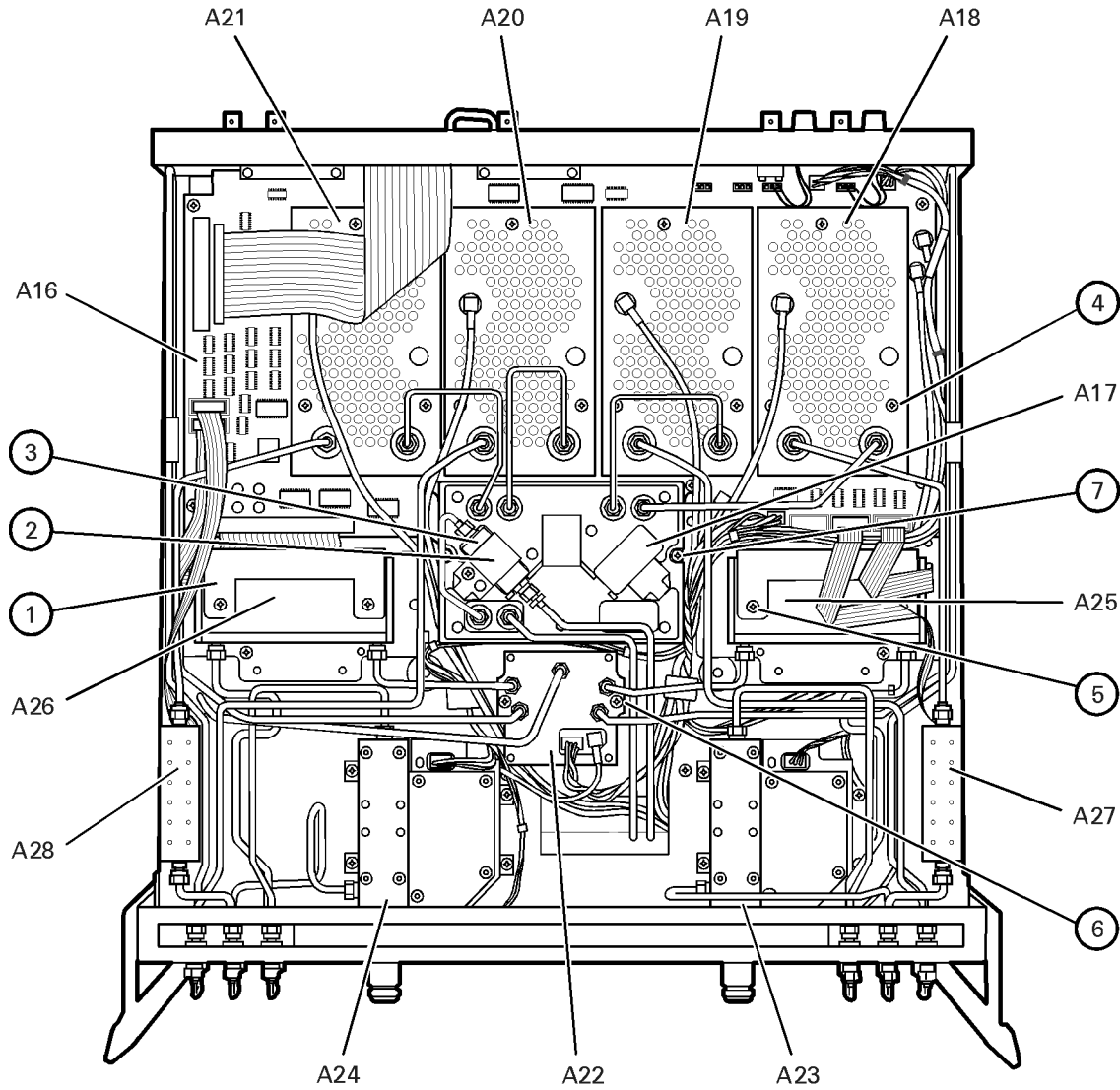


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Bottom Assemblies and Hardware, Option 015

Reference Designator	Part Number	Qty	Description
A16	E8356-60049	1	Test set motherboard assembly
A17	E8356-60017	1	Local oscillator distribution assembly (LODA)
A18	E8356-60018	4	Channel A receiver module assembly
A19			Channel R1 receiver module assembly
A20			Channel R2 receiver module assembly
A21			Channel B receiver module assembly
A18	E8356-69018	4	Channel A receiver module assembly (rebuilt-exchange)
A19			Channel R1 receiver module assembly (rebuilt-exchange)
A20			Channel R2 receiver module assembly (rebuilt-exchange)
A21			Channel B receiver module assembly (rebuilt-exchange)
A22	5087-7019	1	Switch splitter assembly
A22	5087-6019	1	Switch splitter assembly (rebuilt-exchange)
A23	5087-7020	2	Test port 1 coupler
A24			Test port 2 coupler
A23	5087-6020	2	Test port 1 coupler (rebuilt-exchange)
A24			Test port 2 coupler (rebuilt-exchange)
A25	33321-60056	2	70 dB step attenuator
A26			70 dB step attenuator
A27	33325-60008	2	35 dB step attenuator
A28			35 dB step attenuator
①	E8356-00019	2	Attenuator bracket
②	E8356-00021	3	Cable / filter clamp
③	9135-5305	1	1.2 GHz low pass filter
④	0515-1349	12	Machine screw M3.0 x 30 CW-PN-TX
⑤	0515-0372	39	Machine screw M3.0 x 8 CW-PN-TX
⑥	0515-0375	2	Machine screw M3.0 x 16 CW-PN-TX
⑦	0515-0374	4	Machine screw M3.0 x 10 CW-PN-TX

Figure 6-5 Illustration of Bottom Assemblies and Hardware, Option 015



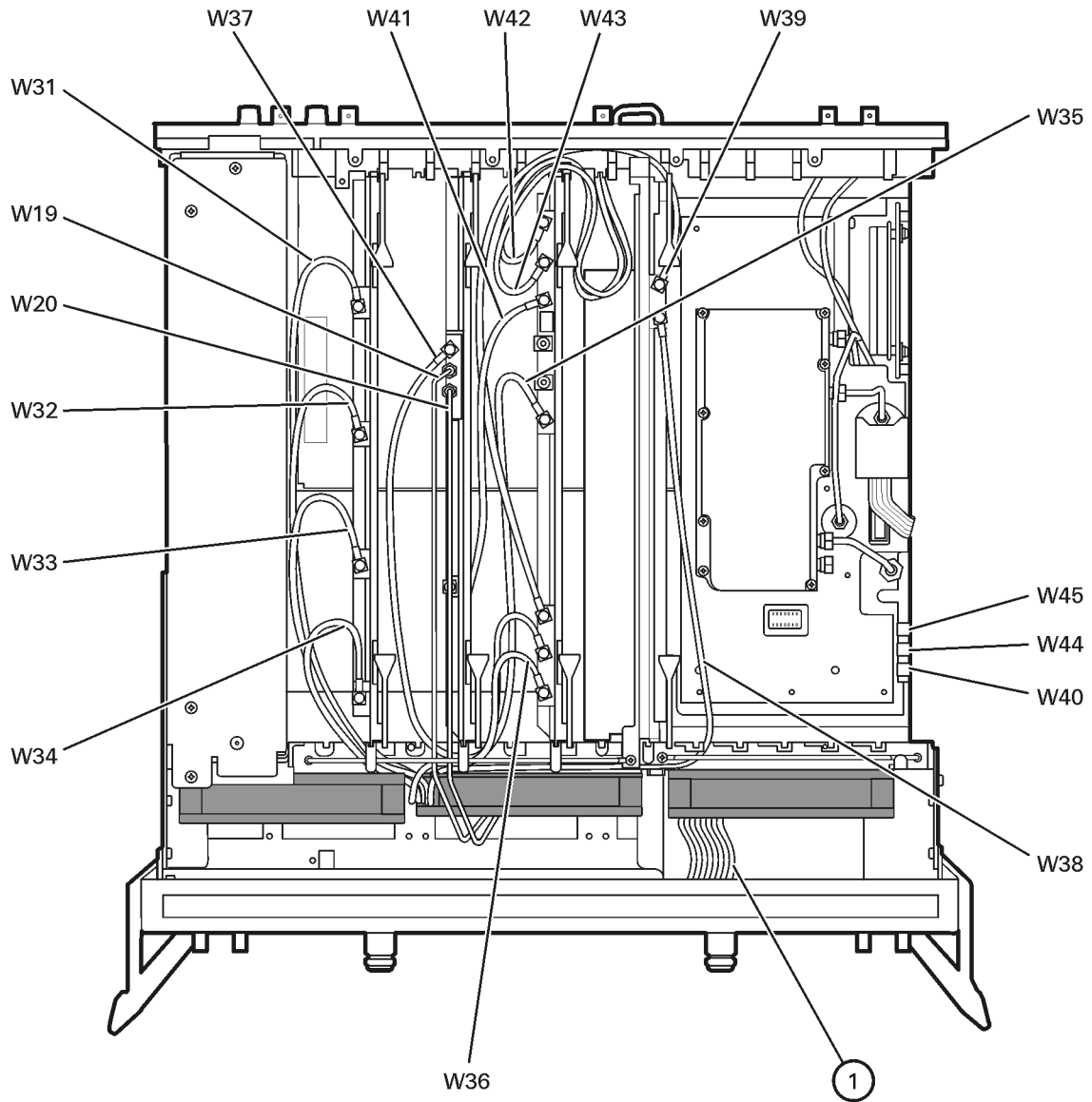
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Top Cables

Reference Designator	Type ^a	Part Number	Qty	Description
W31	F	E8356-60037	1	A18 channel A receiver module assembly (A18J400) to A6 SPAM board assembly (A6J3)
W32	F	E8356-60038	1	A19 channel R1 receiver module assembly (A19J400) to A6 SPAM board assembly (A6J4)
W33	F	E8356-60039	1	A20 channel R2 receiver module assembly (A20J400) to A6 SPAM board assembly (A6J5)
W34	F	E8356-60040	1	A21 channel B receiver module assembly (A21J400) to A6 SPAM board assembly (A6J6)
W35	F	E8356-60042	1	A10 frequency reference board assembly (A10J4) to A16 test set motherboard assembly (A16J2)
W36	F	E8356-60044	1	A10 frequency reference board assembly (A10J7) to A16 test set motherboard assembly (A16J3)
W37	F	E8356-60041	1	A8 fractional-N synthesizer board assembly (A8J102) to A10 frequency reference board assembly (A10J6)
W38	F	E8356-60045	1	A11 phase lock board assembly (A11J6) to A16 test set motherboard assembly(A16J50)
W39	F	E8356-60043	1	A10 frequency reference board assembly (A10J5) to A11 phase lock board assembly (A11J5)
W40	F	E8356-60046	1	A22 switch splitter (A22J1) to A12 source assembly(A12J4)
W41	F	E8356-60052	1	A8 fractional-N synthesizer board assembly (A8J105) to A10 frequency reference board assembly (A10J10)
W42	F	8120-5055	4	A10 frequency reference board assembly to rear-panel 10 MHz REF. IN (A10J2)
W43	A10 frequency reference board assembly to rear-panel 10 MHz REF. OUT (A10J3)			
W44	Rear-panel EXT. AM INPUT to A12 source assembly (A12J6)			
W45	Rear-panel EXT. DETECTOR INPUT to A12 source assembly (A12J7)			
①	40R	8121-0116	1	A3 front panel interface board assembly to A14 motherboard assembly

a. F = coaxial flexible cable; nR = n wires in a flat cable

Figure 6-6 Illustration of Top Cables



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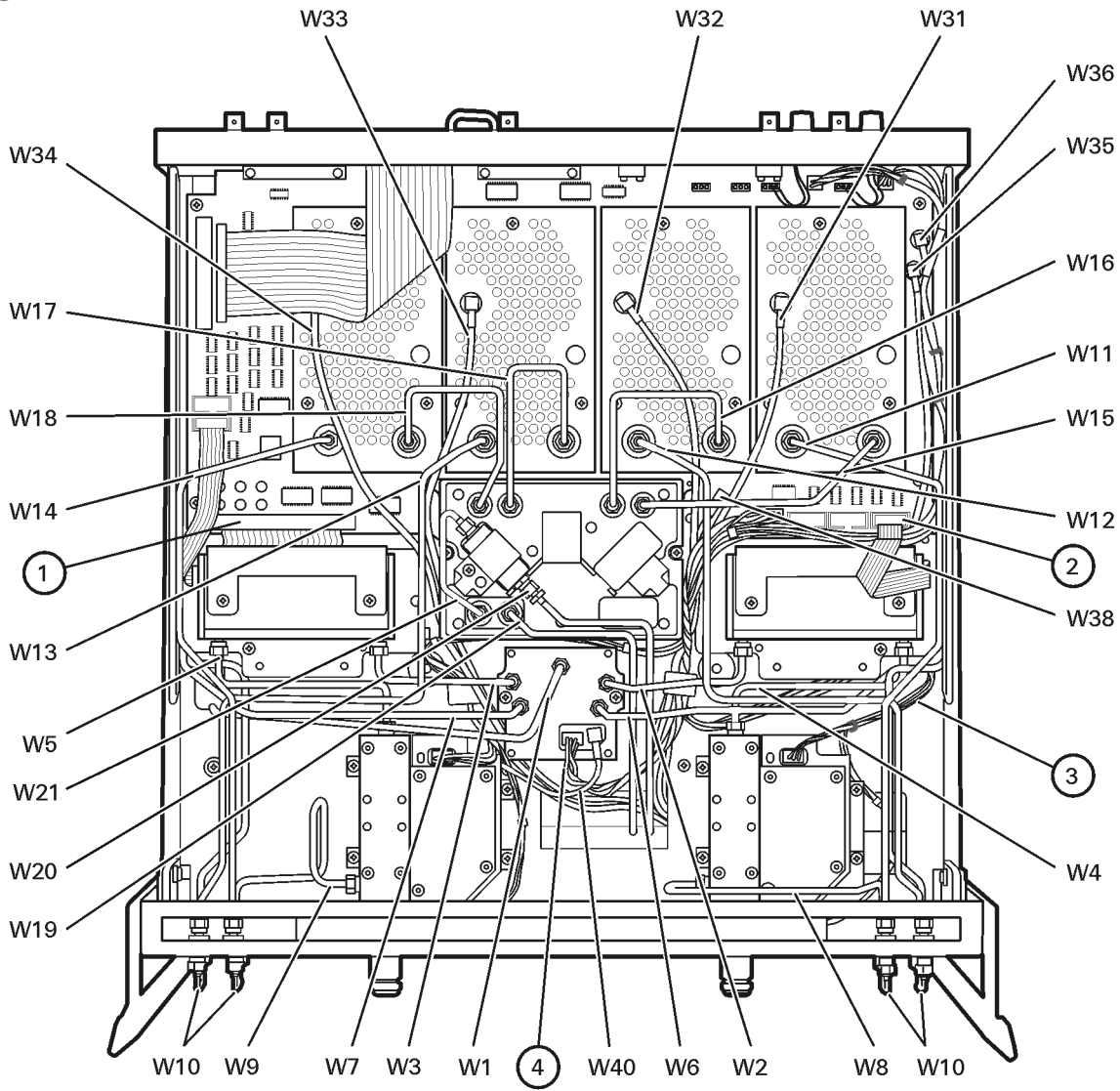
Bottom Cables, Standard

Reference Designator	Type ^a	Part Number	Qty	Description
W1	SR	E8356-20058	1	A12 source assembly (A12J6) to A22 switch splitter assembly (A22J1)
W2	SR	E8356-20056	1	A22 switch splitter assembly to A25 70 dB step attenuator
W3	SR	E8356-20057	1	A22 switch splitter assembly to A26 70 dB step attenuator
W4 W5	SR	E8356-20054	2	A25 70 dB step attenuator to A23 test port coupler A26 70 dB step attenuator to A24 test port coupler
W6	SR	E8356-20050	1	A22 switch splitter assembly to front panel R1 OUT
W7	SR	E8356-20052	1	A22 switch splitter assembly to front panel R2 OUT
W8	SR	E8356-20048	1	A23 test port 1 coupler to front panel A OUT
W9	SR	E8356-20055	1	A24 test port 2 coupler to front panel B OUT
W10	SR	E8356-20072	4	Front-panel jumper
W11	SR	E8356-20066	1	Front-panel A IN to A18 channel A receiver module assembly
W12	SR	E8356-20051	1	Front-panel R1 IN to A19 channel R1 receiver module assembly
W13	SR	E8356-20073	1	Front-panel R2 IN to A20 channel R2 receiver module assembly
W14	SR	E8356-20049	1	Front-panel B IN to A21 channel B receive module assembly
W15	SR	E8356-20082	1	A17 LODA (A17J70) to A18 channel A receiver module assembly
W16	SR	E8356-20085	1	A17 LODA (A17J80) to A19 channel R1 receiver module assembly
W17	SR	E8356-20086	1	A17 LODA (A17J50) to A20 channel R2 receiver module assembly
W18	SR	E8356-20084	1	A17 LODA (A17J60) to A20 channel B receiver module assembly
W19	SR	E8356-20053	1	A8 fractional -N synthesizer board assembly(A8J106) to A17 LODA (A17J101)
W20	SR	E8356-20091	1	A8 fractional-N synthesizer board assembly (A8J101) to filter
W21	SR	E8356-20092	1	Filter to A17 LODA
W31 to W35, and W38	F	See page 6-16	7	Various flexible cables routed from the top of the analyzer and listed under "Top Cables".

Reference Designator	Type ^a	Part Number	Qty	Description
①	100R	8121-0118	1	A14 motherboard assembly to A16 test set motherboard assembly
②	10W	8120-5537	2	Attenuator control cable
③	6W	8121-0122	2	A16 test set motherboard assembly to A23 or A24 test port coupler
④	6W	83437-60013	1	A22 switch splitter assembly to A16 test set motherboard assembly

a. F = coaxial flexible cable; SR = semirigid cable
nW = n wires in a wrapped cable; nR = n wires in a flat cable

Figure 6-7 Illustration of Bottom Cables, Standard



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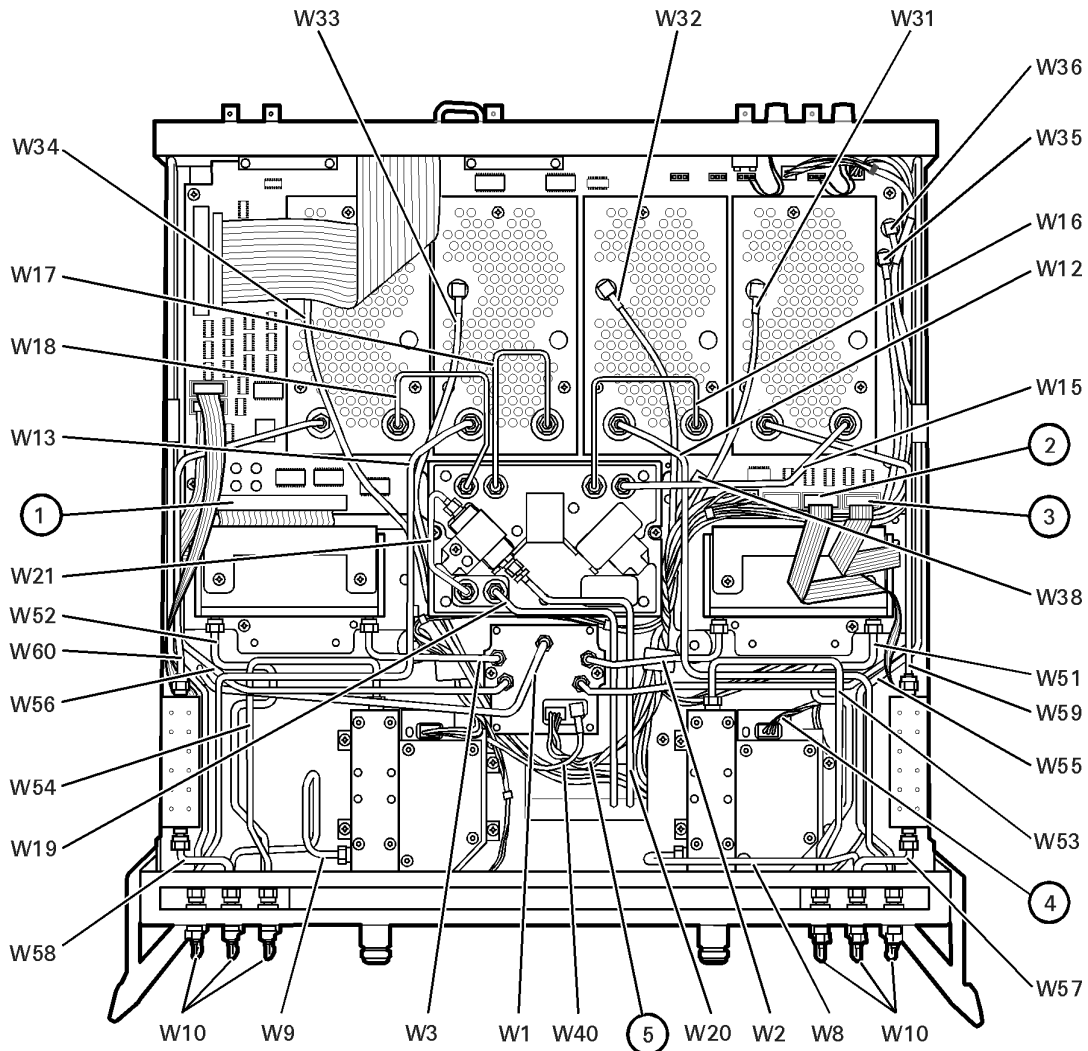
Bottom Cables, Option 015

Reference Designator	Type ^a	Part Number	Qty	Description
W1	SR	E8356-20058	1	A12 source assembly (A12J6) to A22 switch splitter assembly (A22J1)
W2	SR	E8356-20056	1	A22 switch splitter assembly to A25 70 dB step attenuator
W3	SR	E8356-20057	1	A22 switch splitter assembly to A26 70 dB step attenuator
W8	SR	E8356-20048	1	A23 test port 1 coupler to front-panel A OUT
W9	SR	E8356-20055	1	A24 test port 2 coupler to front-panel B OUT
W10	SR	E8356-20072	6	Front-panel jumper
W12	SR	E8356-20051	1	Front-panel R1 IN to A19 channel R1 receiver module assembly
W13	SR	E8356-20073	1	Front-panel R2 IN to A20 R2 receiver module assembly
W15	SR	E8356-20082	1	A17 LODA to A18 channel A receiver module assembly
W16	SR	E8356-20085	1	A17 LODA to A19 channel R1 receiver module assembly
W17	SR	E8356-20086	1	A17 LODA to A20 channel R2 receiver module assembly
W18	SR	E8356-20084	1	A17 LODA to A20 channel R2 receiver module assembly
W19	SR	E8356-20053	1	A8 fractional-N synthesizer board assembly (A8J106) to A17 LODA (A17J101)
W20	SR	E8356-20091	1	A8 fractional -N synthesizer board assembly (A8J101) to filter
W21	SR	E8356-20092	1	Filter to A17 LODA
W31 to W35, and W38	F	See page 6-16	7	Various flexible cables routed from the top of the analyzer and listed under "Top Cables".
W51	SR	E8356-20067	1	A25 70 dB step attenuator to front-panel SOURCE OUT
W52	SR	E8356-20068	1	A26 70 dB step attenuator to front-panel SOURCE OUT
W53	SR	E8356-20069	1	Front-panel COUPLER IN to A23 test port 1 coupler
W54	SR	E8356-20070	1	Front-panel COUPLER IN to A24 test port 2 coupler
W55	SR	E8356-20094	1	A22 switch splitter assembly to front-panel R1 OUT
W56	SR	E8356-20095	1	A22 switch splitter assembly to front panel R2 OUT
W57	SR	E8356-20078	1	Front-panel A IN to A27 35 dB step attenuator
W58	SR	E8356-20076	1	Front-panel B IN to A28 35 dB step attenuator
W59	SR	E8356-20077	1	A27 35 dB step attenuator to A18 channel A receiver module assembly
W60	SR	E8356-20075	1	A28 35 dB step attenuator to A21 channel B receiver module assembly

Reference Designator	Type ^a	Part Number	Qty	Description
①	100R	8121-0118	1	A14 motherboard assembly to A16 test set motherboard assembly
②	10R	8121-0119	2	35 dB step attenuator control cable
③	10R	8120-5537	2	Attenuator control cable
④	6W	8121-0122	2	A16 test set motherboard assembly to A23 or A24 test port coupler
⑤	6W	83437-60013	1	A22 switch splitter assembly to A16 test set motherboard assembly

a. F = coaxial flexible cable; SR = semirigid cable; nW = n wires in a wrapped cable; nR = n wires in a flat cable

Figure 6-8 Illustration of Bottom Cables, Option 015

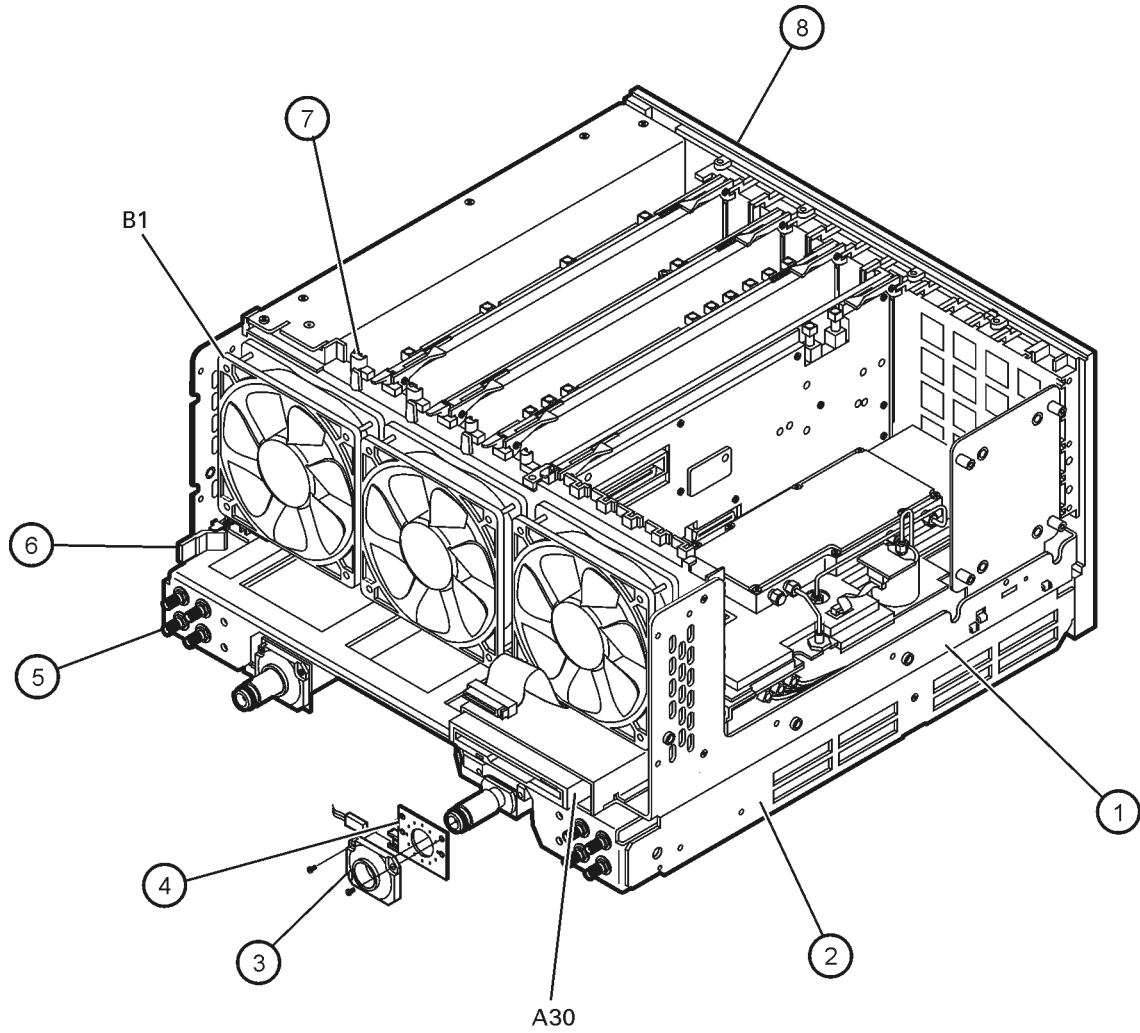


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Internal Hardware and Parts

Reference Designator	Model/Option	Part Number	Qty	Description
A30	All	0950-2782	1	Floppy disk drive
	All	8121-0120	1	Cable
	All	E4406-60014	1	Floppy disk drive board
	All	E4406-40006	1	Floppy disk drive mount
	All	E8356-00007	1	Floppy disk drive enclosure
B1	All	3160-1085	3	Fan
①	All	E8356-00027	1	Chassis assembly
②	All	E8356-00008	1	Test set deck
③	All	5041-9626	2	Coupler LED ring
④	All	5064-3959	2	Coupler LED board
⑤	All except Option 015	1250-1251	8	SMA (f) to SMA (f), bulkhead connector
⑤	Option 015	1250-1251	12	SMA (f) to SMA (f), bulkhead connector
⑥	All	E8356-40004	1	Line switch button
	All	1460-2632	1	Line switch spring
⑦	All	E4406-60109	1	Midweb assembly (includes three fans)

Figure 6-9 Illustration of Internal Hardware and Parts

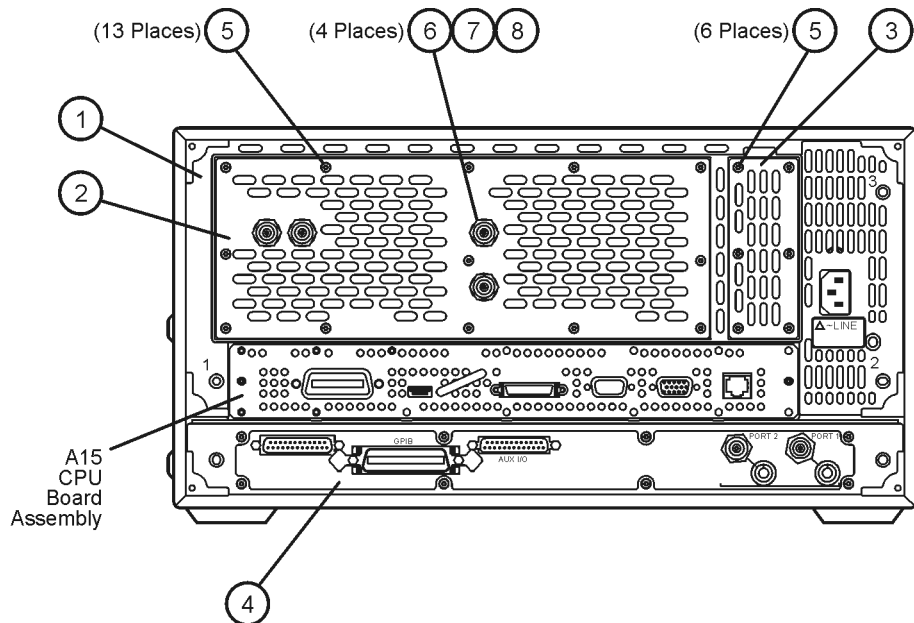


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Rear Panel Assembly

Item Number	Part Number	Qty	Description
①	E8356-20132	1	Rear frame
②	E8356-00023	1	Cover plate, large
③	E8356-00022	1	Cover plate, digital section
④	E8356-00028	1	Cover plate, test set section
⑤	0515-0372	19	Machine screw, M3.0 x 8, CW-PN-TX
⑥	8120-5055	4	BNC cable assembly
⑦	2950-0035	4	Hex nut for BNC connector, 15/32-32
⑧	2190-0102	4	Lock washer for BNC connector, 0.472 ID

Figure 6-10 Illustration of the Rear Panel Assembly

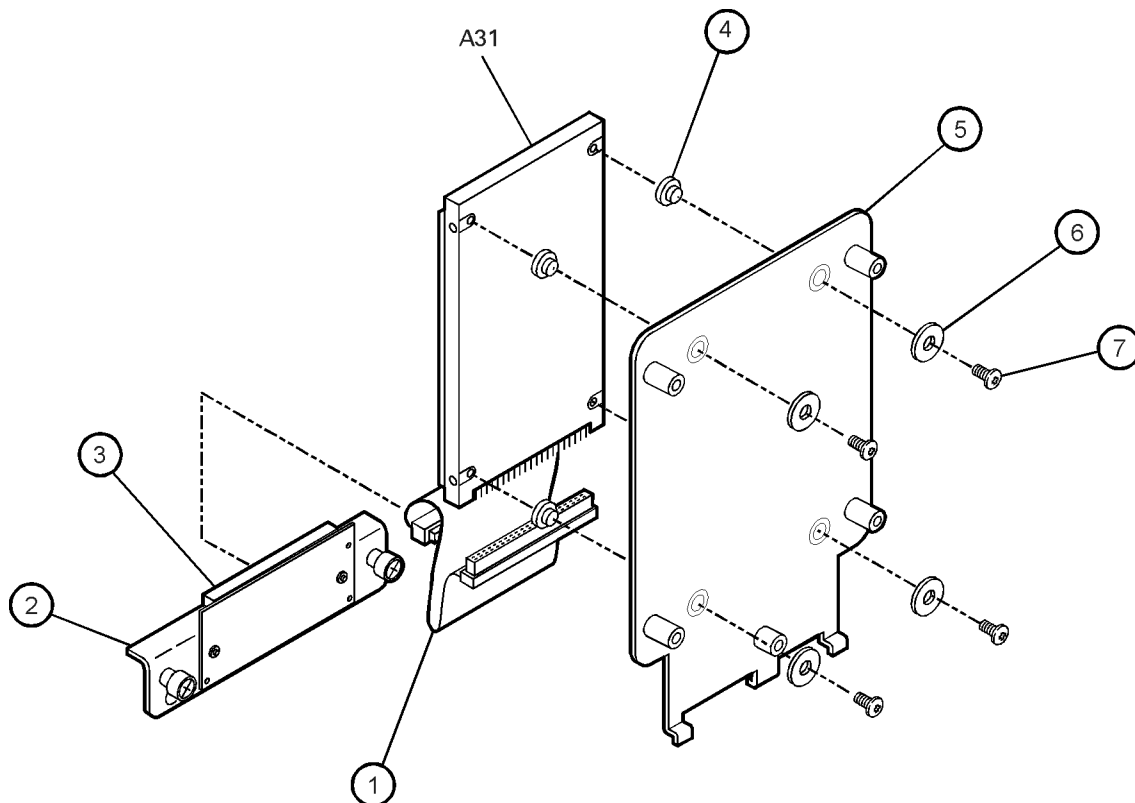


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Hard Disk Drive Assembly

Reference Designator	Part Number	Qty	Description
A31	E8356-10002	1	Programmed hard disk drive
①	8121-0114	1	Interface cable
②	E8356-00014	1	Hard disk drive interface board bracket
③	E8356-60024	1	Hard disk drive interface board assembly
④	1200-0147	4	Bushing
⑤	E8356-00010	1	Hard disk drive shock mount assembly
⑥	2190-0401	4	Flat washer
⑦	0515-0664	4	Machine screw, M3.0 x 6 CW-PN-TX

Figure 6-11 Illustration of the Hard Disk Drive Assembly

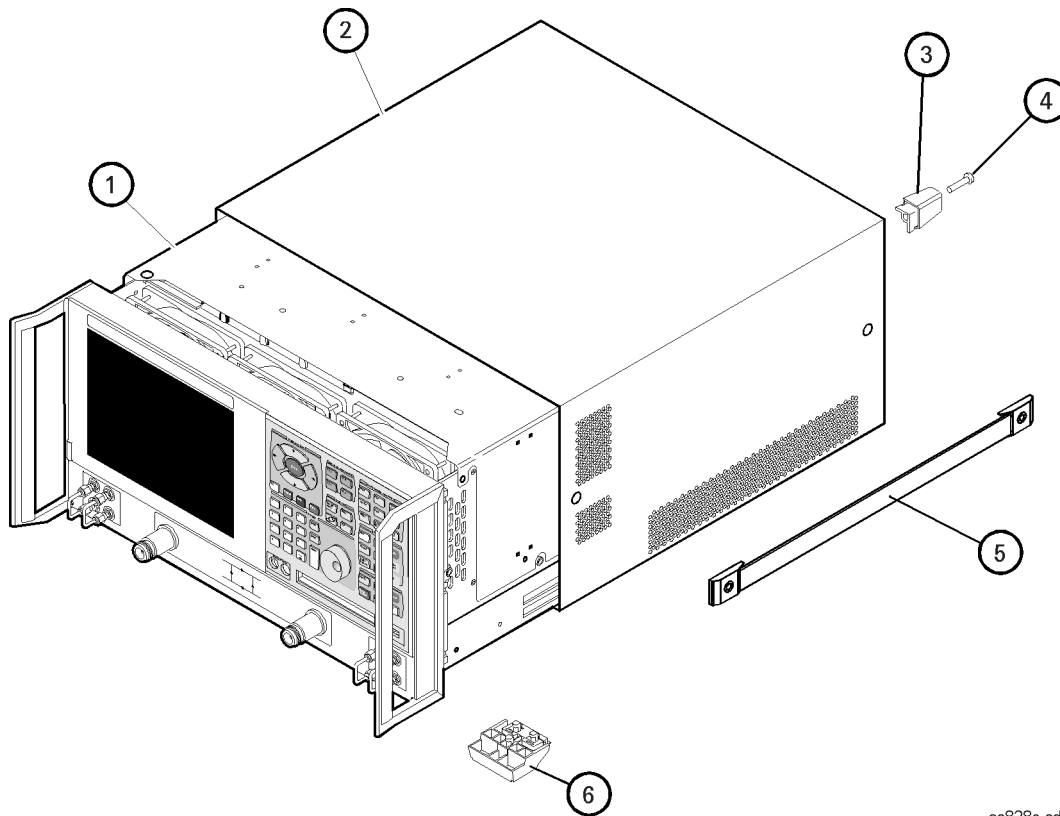


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External Parts

Reference Designator	Part Number	Qty	Description
①	E8356-00011	1	Inner cover
②	E8356-00009	1	Outer cover
③	5041-9167	4	Rear feet
④	0515-0710	4	Machine screw M5.0 x 18 CW-FL-TX
⑤	E4400-60026	2	Strap handle assembly
⑥	5041-9611	4	Bottom feet

Figure 6-12 Illustration of External Parts



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Miscellaneous Part Numbers

Description	Model or Part Number
Service Tools	
Extender board, synthesizer/reference	E8356-60021
T-10 TORX driver (set to 9 in-lb)	N/A
T-20 TORX driver (set to 21 in-lb)	N/A
5/16 in open-end torque wrench (set to 10 in-lb)	N/A
Fuses	
Rear Panel Bias Input Fuse Port 1 (1 A, 125 V)	2110-0047
Rear Panel Bias Input Fuse Port 2 (1 A, 125 V)	2110-0047
Front Panel Trim and Overlays	
Front frame trim (for instruments without handles)	5041-9173
Front frame trim (for instruments with handles)	5041-9182
Front panel overlay (standard)	E8356-80002
Front panel overlay (Option 015)	E8356-80003
Documentation	
Installation and Quick Start Guide	E8356-90001
Service Guide (this manual)	E8356-90002
CD-ROM Includes: <i>Installation and Quick Start Guide in PDF format</i> <i>Service Guide in PDF format</i> <i>Embedded Help in PDF format</i> <i>Embedded Help program to run on PC</i>	E8356-10001
Upgrade Kits	
Time domain	E8356-60101
Configurable test set	E8356-60102
Firmware upgrade on CD-ROM	E8356-60103
Protective Caps for Connectors	
Female GPIB connector	1252-5007
Female parallel port	1252-4690
RS-232 connector	1252-4697
Type-N connector	1401-0247
GPIB Cables	
GPIB cable, 1M (3.3 feet)	10833A
GPIB cable, 2M (6.6 feet)	10833B
GPIB cable, 4M (13.2 feet)	10833C
GPIB cable, 0.5M (1.6 feet)	10833D
GPIB cable to GPIB cable adapter	10834A

Description	Model or Part Number
Touch-up Paint	
Dove gray <i>(for use on frame around front panel and painted portion of handles)</i>	6010-1146
French gray <i>(for use on cover)</i>	6010-1147
Parchment white <i>(for use on rack mount flanges, rack support flanges, and front panels)</i>	6010-1148
ESD Supplies	
Adjustable antistatic wrist strap	9300-1367
Antistatic wrist strap grounding cord <i>(5 foot length)</i>	9300-0980
Static control table mat and earth ground wire	9300-0797
USB Accessories	
Mouse	1150-7799
Keyboard	1150-7788
Read, write CD-ROM (available as upgrade Option AM8)	1150-7787
Hub (available as upgrade Option B30)	1150-7789
Rack Mount Kits and Handle Kits	
Rack mount kit for instruments with handles	5063-9236
Rack mount kit for instruments without handles	5063-9216
Rack mount rails	E3663AC
Front handle kit (two handles and hardware)	5063-9229

7 Assembly Replacement and Post-Repair Procedures

Information in This Chapter

This chapter contains procedures for removing and replacing the major assemblies of your Agilent Technologies PNA series RF network analyzers (E8356A, E8357A, E8358A).

Chapter Seven at-a-Glance

Section Title	Summary	Start Page
Before Starting the Removal and Replacement Procedures	This section provides warnings and cautions, and an assembly sequence before removing or replacing an assembly in your analyzer.	Page 7-3
Removal and Replacement Procedures	This section contains a table of removal and replacement procedures and the corresponding page number.	Page 7-4
Removal and Replacement Procedures	This sections contains the procedures for removing and replacing the major assemblies in your analyzer. The procedures occur in the order of reference designator.	Page 7-6 to Page 7-46
Post-Repair Procedures	After you have removed and replaced an assembly, refer to this table for the proper tests, verifications, and adjustments to perform on your analyzer.	Page 7-49

Before Starting the Removal and Replacement Procedures

Before starting the removal and replacement procedures, review these warnings, cautions, and the assembly replacement sequence.

Warnings and Cautions

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

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

WARNING **The power cord is connected to internal capacitors that may remain live for 10 seconds after disconnecting the plug from its power supply assembly. Wait at least 10 seconds, after disconnecting the plug, before removing the covers.**

CAUTION Many of the assemblies in this instrument are very susceptible to damage from electrostatic discharge (ESD). Perform the following procedures only at a static-safe workstation and wear a grounding strap.

Assembly Replacement Sequence

The following steps show the sequence that you should follow to replace an assembly in the network analyzer.

- Step 1.** Identify the faulty group. Begin with [Chapter 3](#) , “[Troubleshooting](#).”
- Step 2.** Order a replacement assembly. Refer to [Chapter 6](#) , “[Replaceable Parts](#).”
- Step 3.** Replace the faulty assembly and determine what adjustments are necessary. Refer to this chapter.
- Step 4.** Perform the necessary adjustments. Refer to [Chapter 2](#) , “[Checks and Adjustments, Firmware Upgrades, and Operating System Recovery](#).”
- Step 5.** Perform the necessary performance tests. Refer to [Chapter 2](#) , “[Checks and Adjustments, Firmware Upgrades, and Operating System Recovery](#).”

Removal and Replacement Procedures

Table 7-1 List of Procedures

Reference Designator	Assembly Type	Location
N/A	Covers, outer and inner	Page 7-6
N/A	Midweb and fans	Page 7-46
N/A	Front panel assembly	Page 7-8
A1	Keypad assembly	Page 7-10
A2	Display assembly	
A3	Front panel interface board assembly	
A4	Power supply assembly	Page 7-14
A6	Signal processing ADC module (SPAM) board assembly	Page 7-16
A8	Fractional-N synthesizer board assembly	
A10	Frequency reference board assembly	
A11	Phase lock board assembly	Page 7-18
A12	Source assembly	Page 7-20
A14	Motherboard assembly	Page 7-22
A15	CPU board assembly	Page 7-24
A16	Test set motherboard assembly	Page 7-26
A17	Local oscillator distribution assembly (LODA)	Page 7-28
A18	Channel A receiver module assembly	Page 7-30
A19	Channel R1 receiver module assembly	
A20	Channel R2 receiver module assembly	
A21	Channel B receiver module assembly	
A22	Switch splitter assembly	Page 7-32

Table 7-1 List of Procedures

Reference Designator	Assembly Type	Location
A23	Test port 1 coupler	
A24	Test port 2 coupler	Page 7-34
A25	70 dB step attenuator	
A26	70 dB step attenuator	Page 7-36
A27	35 dB step attenuator (Option 015 only)	
A28	35 dB step attenuator (Option 015 only)	Page 7-38
A30	Floppy disk drive	Page 7-40
A31	Hard disk drive assembly (HDDA)	Page 7-42

Removing the Covers

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)

Removal Procedure

CAUTION This procedure is best performed with the analyzer resting on its front handles in the vertical position. *Do not place the analyzer on its front panel without the handles.* This will damage the front panel assemblies.

Removing the Outer Cover

Refer to [Figure 7-1](#) for this procedure.

1. Disconnect the power cord.
2. With a T-20 TORX driver, remove the strap handles (item ①) by loosening the screws (item ②) on both ends until the handle is free of the analyzer.
3. With a T-20 TORX driver, remove the four rear panel feet (item ③) by removing the center screws (item ④).
4. Slide the four bottom feet (item ⑤) off the cover.
5. Slide the cover off the frame.

Removing the Inner Cover

Refer to [Figure 7-1](#) for this procedure.

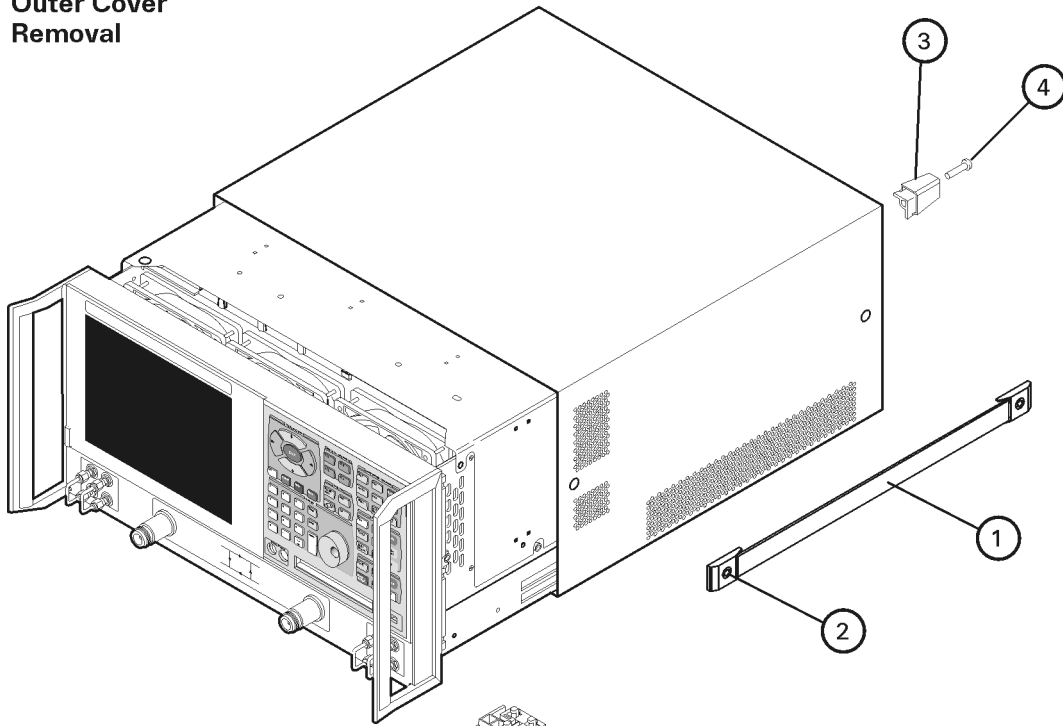
1. With a T-10 TORX driver, remove the 15 screws (item ⑥).
2. Lift the cover off.

Replacement Procedure

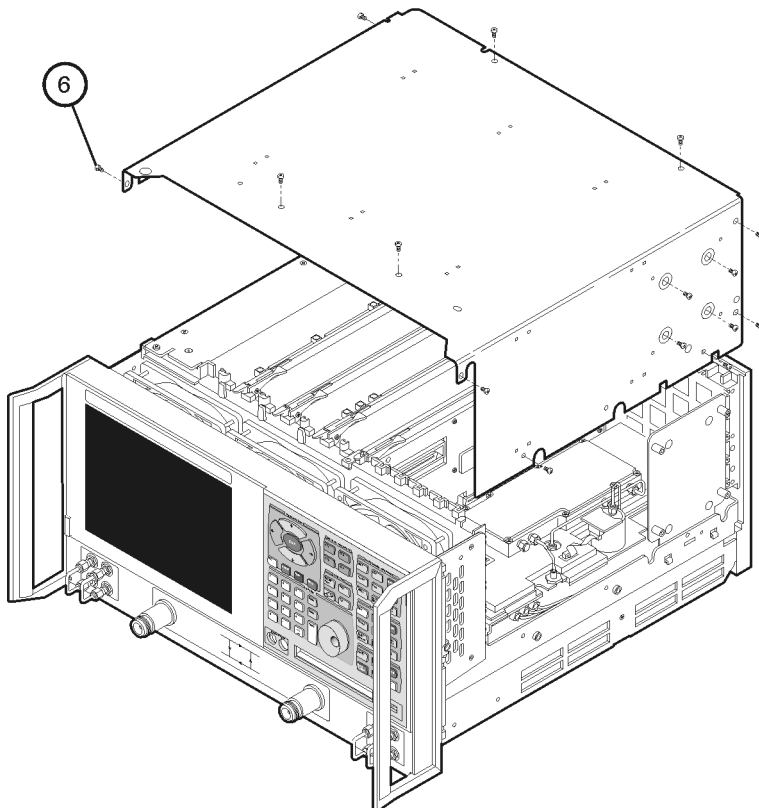
Reverse the order of the removal procedures.

Figure 7-1 Outer and Inner Cover Removal

**Outer Cover
Removal**



**Inner Cover
Removal**



sc857a

Removing and Replacing the Front Panel Assembly

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- 5/16-inch open-end torque wrench (set to 10 in-lb)
- ESD grounding wrist strap

Removal Procedure

Refer to [Figure 7-2](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to [“Removing the Covers” on page 7-6](#).
3. With a 5/16 in torque wrench, remove all the semirigid jumpers (item ①) from the front panel.
4. With a T-10 TORX driver, remove the six screws (item ②) from the sides of the frame.

CAUTION Before removing the front panel from the analyzer, lift and support the front of the analyzer frame.

5. Slide the front panel over the test port connectors.
 6. Disconnect the front panel interface ribbon cable (item ③).
- The front panel is now free from the analyzer.

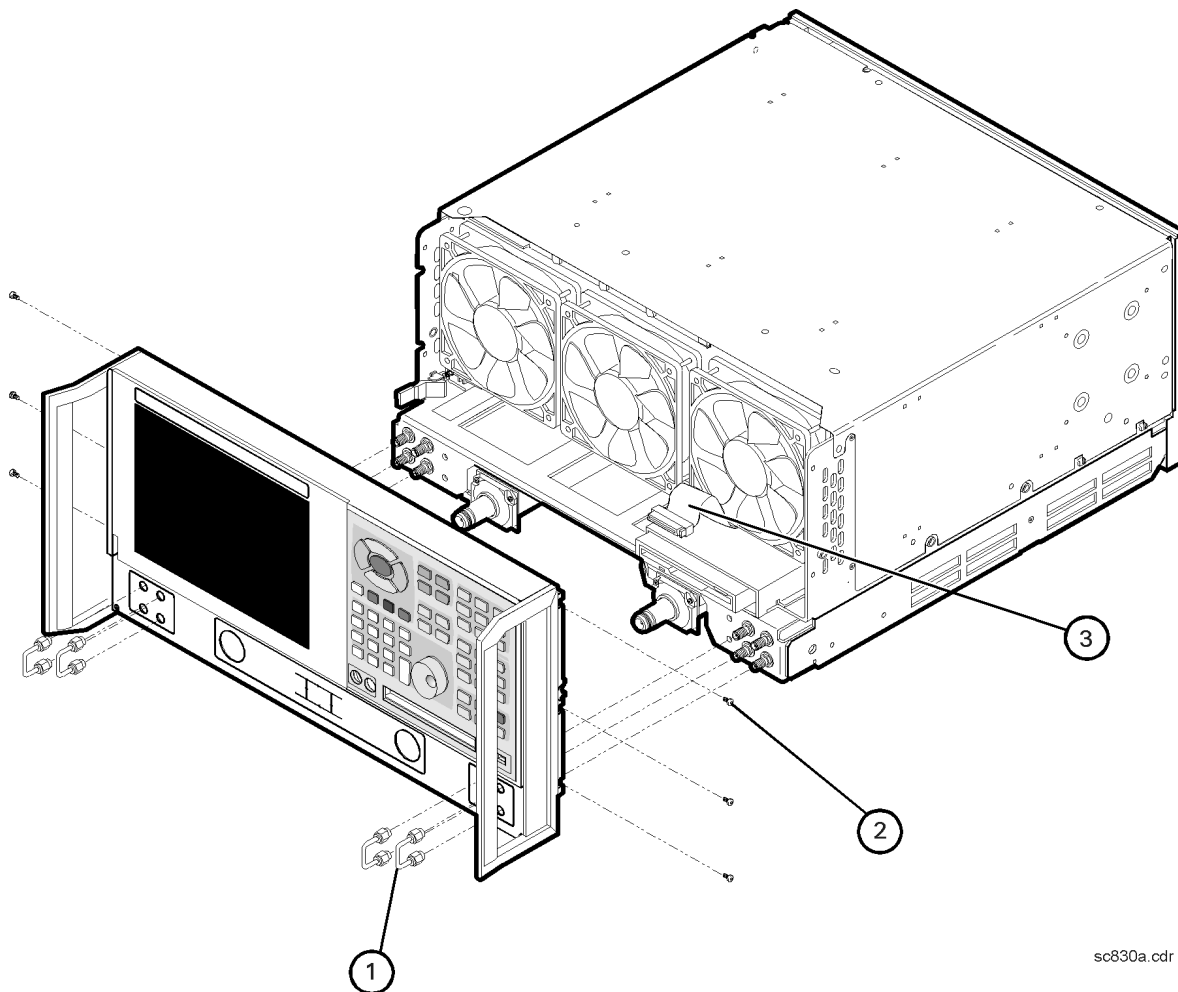
Replacement Procedure

CAUTION When replacing the front panel, align the power switch and the floppy disk drive to their corresponding front panel cutouts.

IMPORTANT When reconnecting semirigid cables, torque the cable connectors to 10 in-lb.

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Figure 7-2 Front Panel Assembly Removal



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Removing and Replacing Front Panel Subassemblies

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- 5/16-inch open-end torque wrench (set to 10 in-lb)
- ESD grounding wrist strap

Removal Procedure

Refer to [Figure 7-3](#) for this procedure.

1. Disconnect the power cord.
2. Remove the front panel assembly. Refer to [“Removing and Replacing the Front Panel Assembly” on page 7-8](#).
3. Disconnect the display ribbon cable (item ①) and the display lamp cable (item ②) from the A3 front panel interface board assembly.

Removing the A2 Display Assembly

1. With a T-10 TORX driver, remove the four retaining screws (item ③) from the display assembly.
2. Remove the display assembly from the front panel.

Removing the A3 Front Panel Interface Board Assembly

1. Remove the round knob (RPG) from the front panel by gently pulling the knob forward.
2. With a T-10 TORX driver, remove the seven screws (item ④) from the front panel interface board.
3. From the bottom of the frame, lift the A3 front panel interface board assembly up at an angle until the board clears the frame. Disconnect the keypad ribbon cable (item ⑤) from the A3 front panel interface board assembly and lift out the board.

Removing the A1 Keypad Assembly

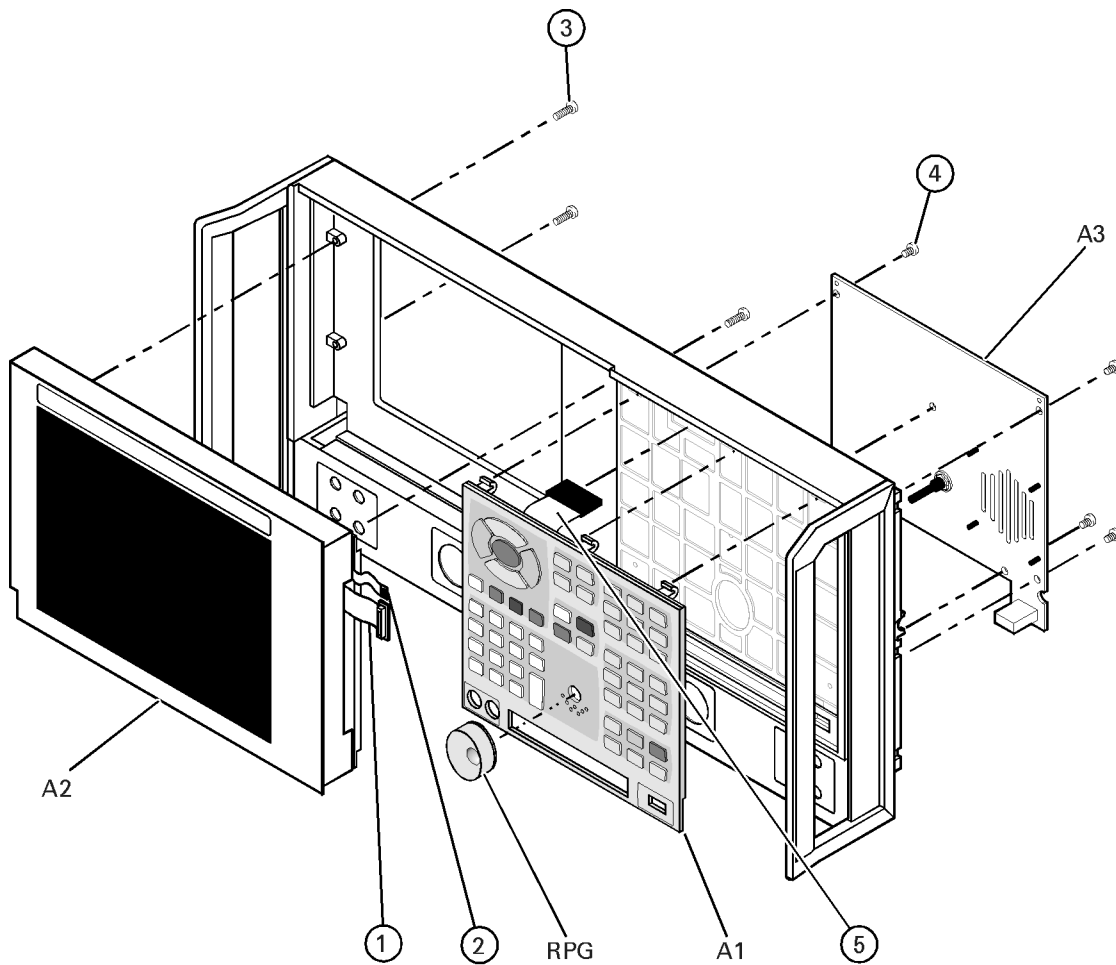
1. Remove the A3 front panel interface board assembly as instructed above.
2. From the rear of the front panel assembly, remove the center retaining screw. Bend the bottom keypad assembly tabs away from the frame and push the A1 keypad assembly out of the frame.

Replacement Procedure

NOTE When replacing the assemblies, ensure that the ribbon cables are not under the assemblies.

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Figure 7-3 Front Panel Assembly Removal



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Removing and Replacing the Display Inverter Board and the Display Lamp

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- Small jeweler's screwdriver
- 5/16-inch open-end torque wrench (set to 10 in-lb)
- ESD grounding wrist strap

Removal Procedure

Refer to [Figure 7-4](#) for this procedure.

1. Disconnect the power cord.
2. Remove the front panel assembly. Refer to [“Removing and Replacing the Front Panel Assembly” on page 7-8](#).
3. Remove the display assembly. Refer to [“Removing the A2 Display Assembly” on page 7-10](#).

Removing the Display Inverter Board

1. Disconnect the ribbon cable (item ①) and the display lamp cable (item ②) from the display inverter board.
2. Lift the inverter retention tabs (item ③) with slight pressure and rotate the display inverter board (item ④).
3. Lift the display inverter board (item ④) out of the slot.

NOTE Stop now if you are only removing the display inverter board. Replace the board and reverse the removal procedure.

Removing the Display Lamp

1. Remove the display lamp cable (item ②) from the display inverter board (item ④).
2. With a T-10 TORX driver, remove the four screws (item ⑤) on the display back panel and then lift the panel off.
3. Remove the four display bumpers (item ⑥).
4. To gain access to the display lamp, rotate the top of the display slightly out of the display frame.

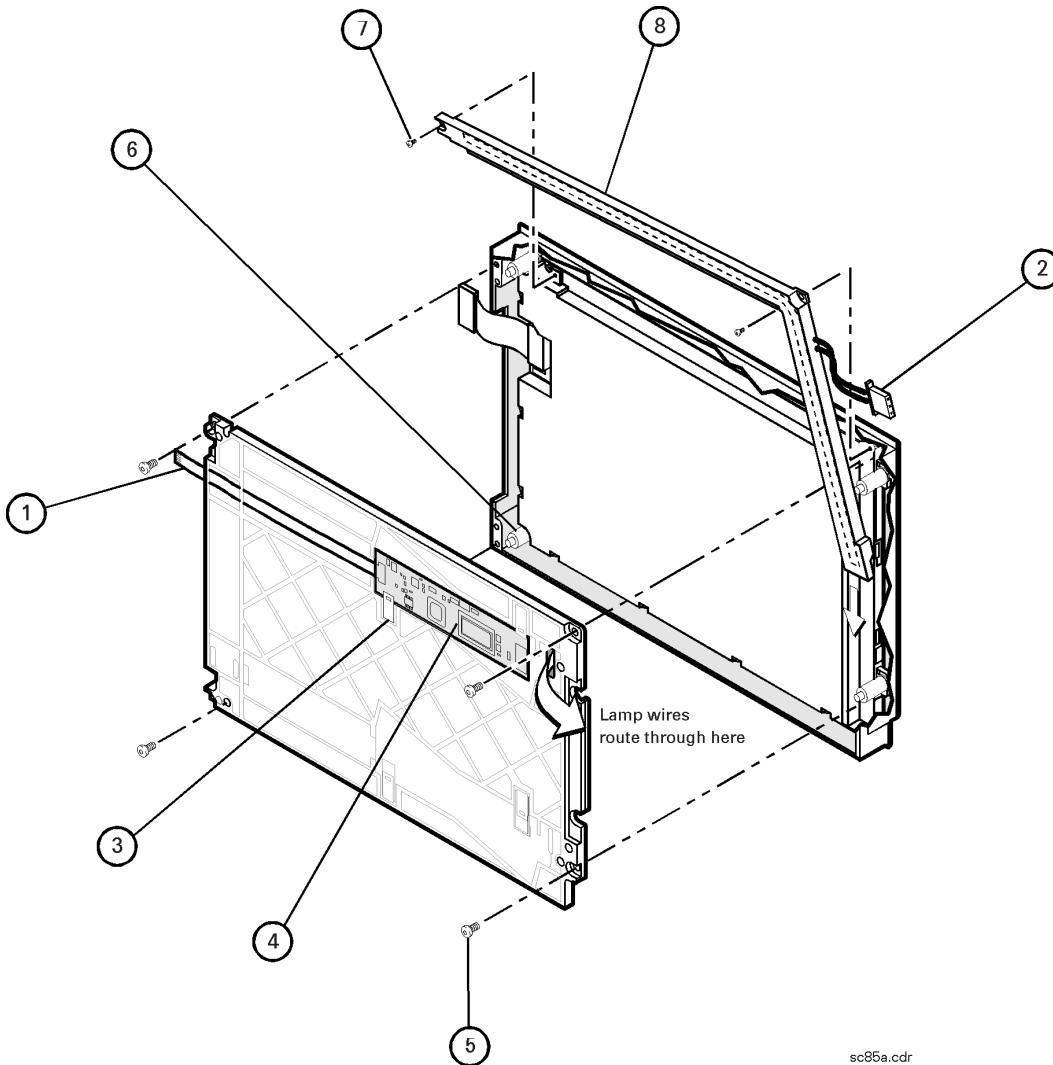
NOTE To avoid dust or dirt particles from getting in between the display glass and the display, do not completely take out the display.

5. Remove the two screws (item ⑦) from the display with the jeweler's screwdriver. Slide the lamp enclosure up to remove it.
6. Remove the display lamp (item ⑧).

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Figure 7-4 Display Inverter Board and Display Lamp Removal



Removing and Replacing the A4 Power Supply Assembly

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- ESD grounding wrist strap

Removal Procedure

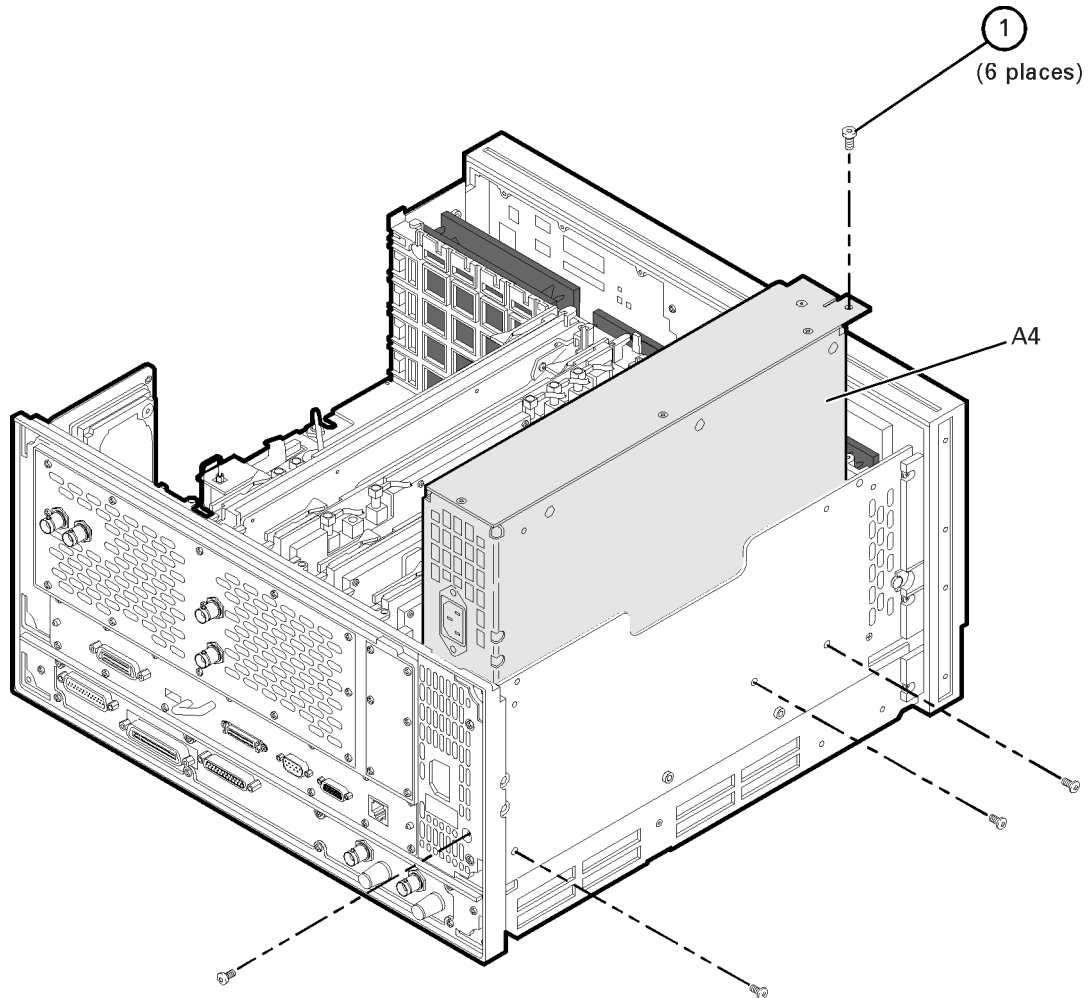
Refer to [Figure 7-5](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to [“Removing the Covers” on page 7-6](#).
3. With a T-10 TORX driver, remove the five screws (item ①) from the power supply assembly.
4. Lift out and remove the A4 power supply assembly.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Figure 7-5 A4 Power Supply Assembly Removal



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Removing and Replacing the A6, A8, and A10 Board Assemblies

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- ESD grounding wrist strap

Removal Procedure

Refer to [Figure 7-6](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to [“Removing the Covers” on page 7-6](#).
3. With a T-10 TORX driver, remove the two brackets that secure cables to the top of the midweb.
4. Identify the board you want to remove and disconnect any cables that are attached to it.
5. Lift the two extractors (item ①), located at each end of the board.

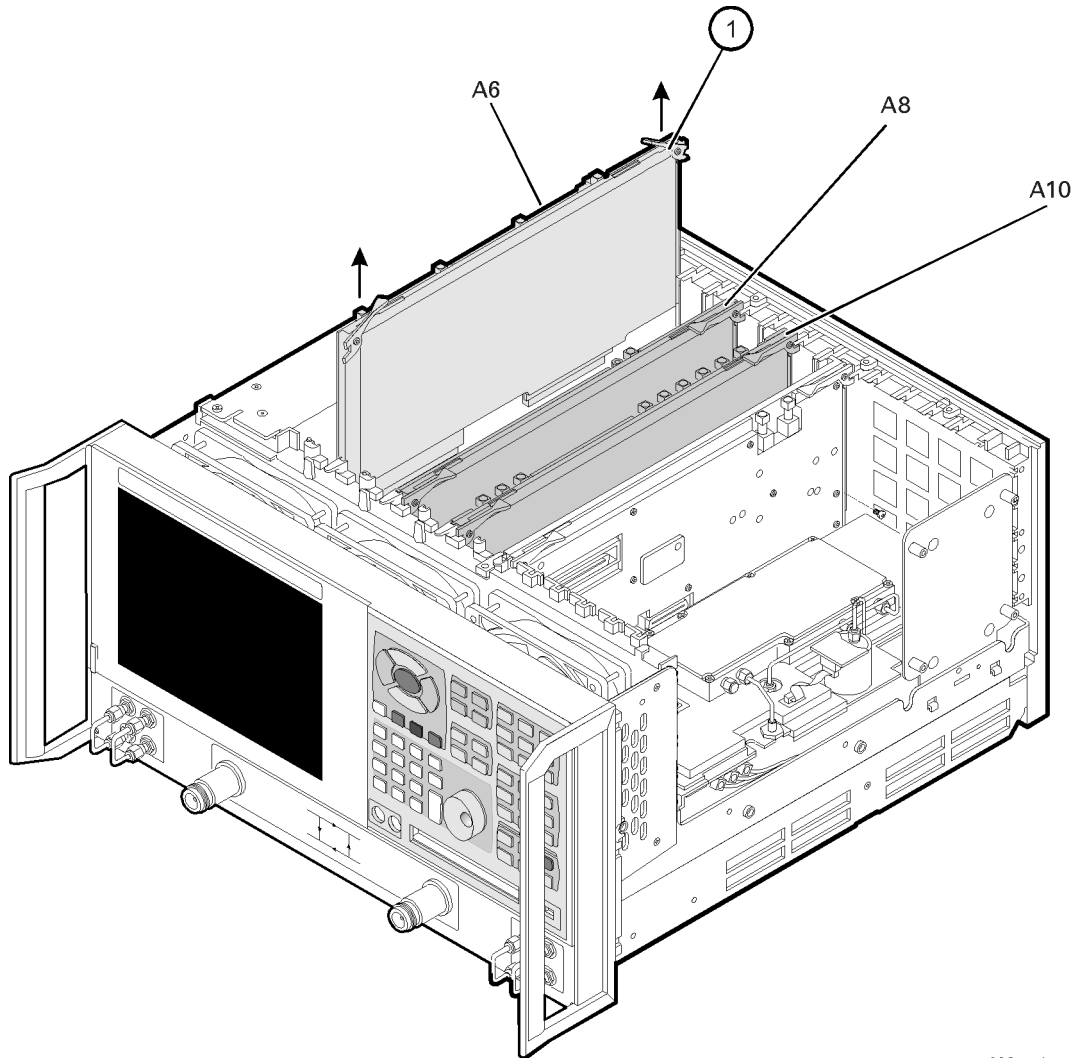
NOTE Before removing the board, check the bottom of the boards for any attached cables.

6. While holding on to the extractors, slide the board out of the slot and remove from the analyzer.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Figure 7-6 A6, A8, and A10 Board Assemblies Removal



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Removing and Replacing the A11 Phase Lock Board Assembly

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- ESD grounding wrist strap

Removal Procedure

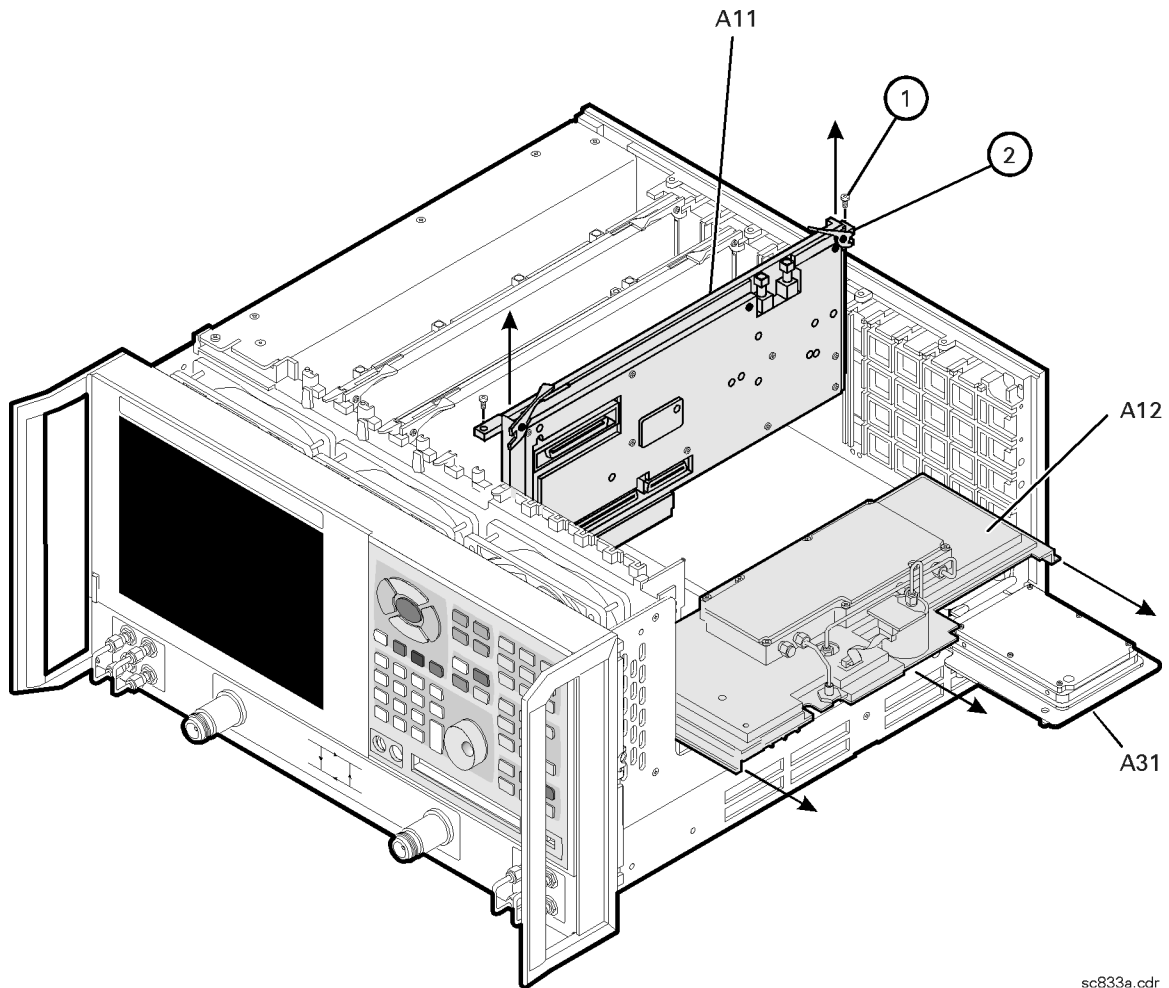
Refer to [Figure 7-7](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to [“Removing the Covers” on page 7-6](#).
3. With a T-10 TORX driver, remove the two brackets that secure cables to the top of the midweb.
4. Place the A31 hard disk drive assembly into the service position. Refer to [“Placing the HDDA in the Service Position” on page 7-43](#).
5. With a T-10 TORX driver, remove the two screws (item ①) from the top of the A11 phase lock board assembly.
6. Disengage the A12 source assembly from the A11 connector and slide the A12 partially out of the analyzer. Refer to [“Removing and Replacing the A12 Source Assembly” on page 7-20](#).
7. Disconnect any flexible cables that are attached to the A11 phase lock board assembly.
8. Lift the two extractors (item ②) located at each end of the board.
9. While holding on to the extractors, lift the A11 phase lock board assembly out of the analyzer.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Figure 7-7 A11 Phase Lock Board Assembly Removal



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Removing and Replacing the A12 Source Assembly

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- 5/16-inch open-end torque wrench (set to 10 in-lb)
- ESD grounding wrist strap

Removal Procedure

Refer to [Figure 7-8](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to [“Removing the Covers”](#) on page 7-6.
3. Place the A31 hard disk drive assembly into the service position. Refer to [“Placing the HDDA in the Service Position”](#) on page 7-43.
4. Disconnect the three flexible cables (item ①) from the A12 source assembly.

CAUTION Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend the semirigid cables.

5. With a 5/16 in torque wrench, disconnect the semirigid cable (item ②) from the bottom of the A12 source assembly.

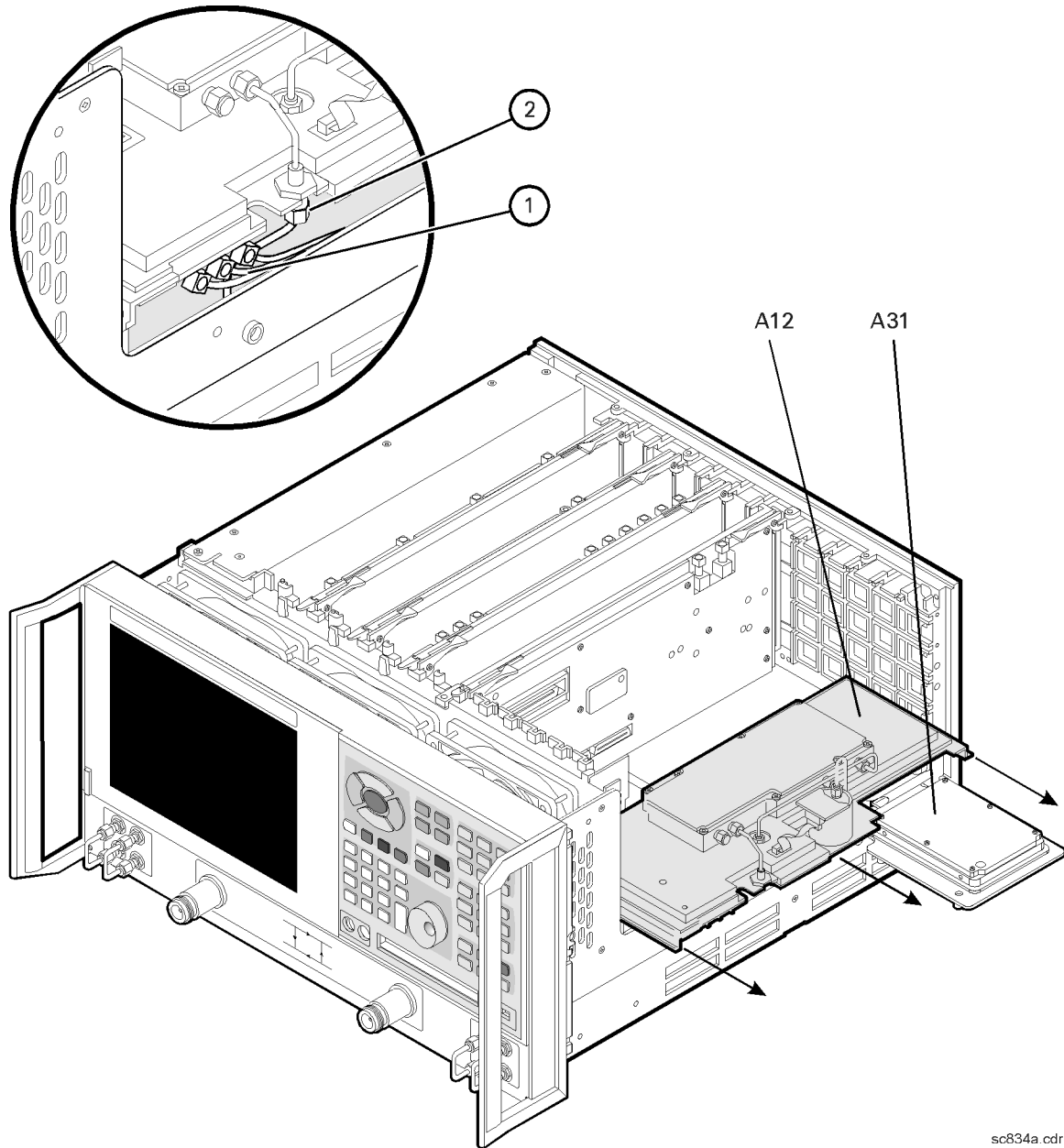
CAUTION To avoid damage to the semirigid cable (item ②), pull down on the cable from the bottom of the analyzer to move it away while sliding out the A12 source assembly. The cable has some spring to it and the RF pin could be damaged by the A12 source assembly.

6. Slide the A12 source assembly out of the analyzer.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Figure 7-8 A12 Source Assembly Removal



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Removing and Replacing the A14 Motherboard Assembly

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- 5/16-inch open-end torque wrench (set to 10 in-lb)
- ESD grounding wrist strap

Removal Procedure

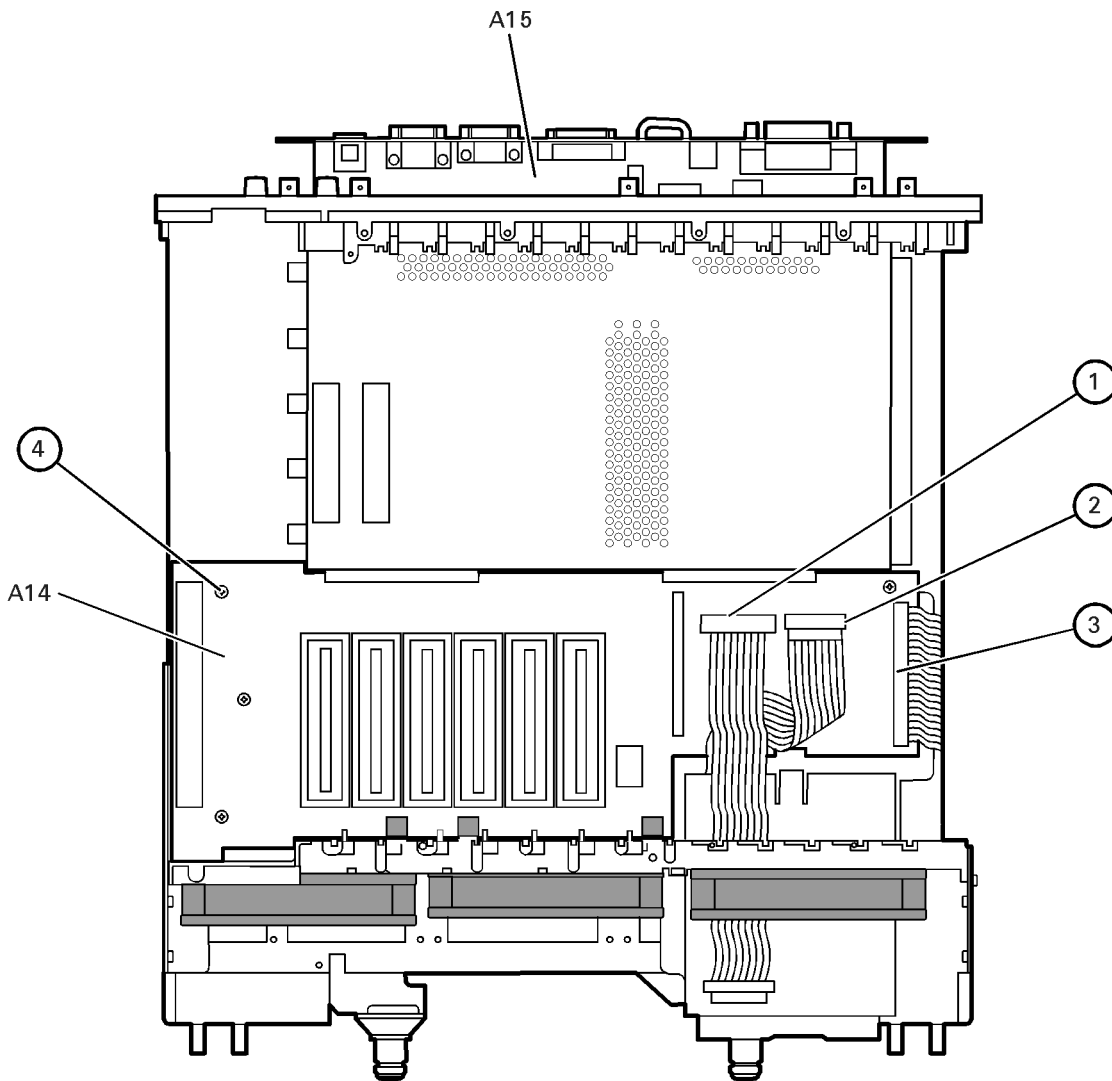
Refer to [Figure 7-9](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to [“Removing the Covers”](#) on page 7-6.
3. Remove the front panel assembly. Refer to [“Removing and Replacing the Front Panel Assembly”](#) on page 7-8.
4. Remove the A31 hard disk drive assembly. Refer to [“Removing the HDDA”](#) on page 7-43.
5. Remove the A12 source assembly. Refer to [“Removing and Replacing the A12 Source Assembly”](#) on page 7-20.
6. Remove the A11 phase lock board assembly. Refer to [“Removing and Replacing the A11 Phase Lock Board Assembly”](#) on page 7-18.
7. Remove the A4 power supply assembly. Refer to [“Removing and Replacing the A4 Power Supply Assembly”](#) on page 7-14.
8. Remove the card cage boards (A6, A8, and A10). Refer to [“Removing and Replacing the A6, A8, and A10 Board Assemblies”](#) on page 7-16.
9. Remove the A15 CPU board assembly. Refer to [“Removing and Replacing the A15 CPU Board Assembly”](#) on page 7-24.
10. Remove the Midweb. Refer to [“Removing and Replacing the Midweb and the B1 Fan”](#) on page 7-46.
11. Disconnect the A1 front panel ribbon cable (item ①), the A30 floppy disk drive ribbon cable (item ②), and the A16 test set motherboard assembly ribbon cable (item ③) from the A14 motherboard assembly.
12. Lift the tab at the rear of the A30 floppy disk drive enclosure and remove the rear enclosure cover.
13. Remove the four screws (item ④) that secure the A14 motherboard assembly.
14. Lift the A14 motherboard assembly out of the analyzer.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Figure 7-9 A14 Motherboard Assembly Removal



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Removing and Replacing the A15 CPU Board Assembly

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- ESD grounding wrist strap

Removal Procedure

Refer to [Figure 7-10](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to [“Removing the Covers”](#) on page 7-6.
3. Remove the A31 hard disk drive assembly. Refer to [“Removing and Replacing the A31 Hard Disk Drive Assembly \(HDDA\)”](#) on page 7-42.
4. Disengage the A6 SPAM board assembly from the A15 CPU board assembly by performing the following steps.
 - a. Lift the two extractors located at each end of the board.
 - b. While holding onto the extractors, lift the board halfway out of the slot.
 - c. Let the extractors drop to their normal position.
 - d. Let the board drop into the slot.

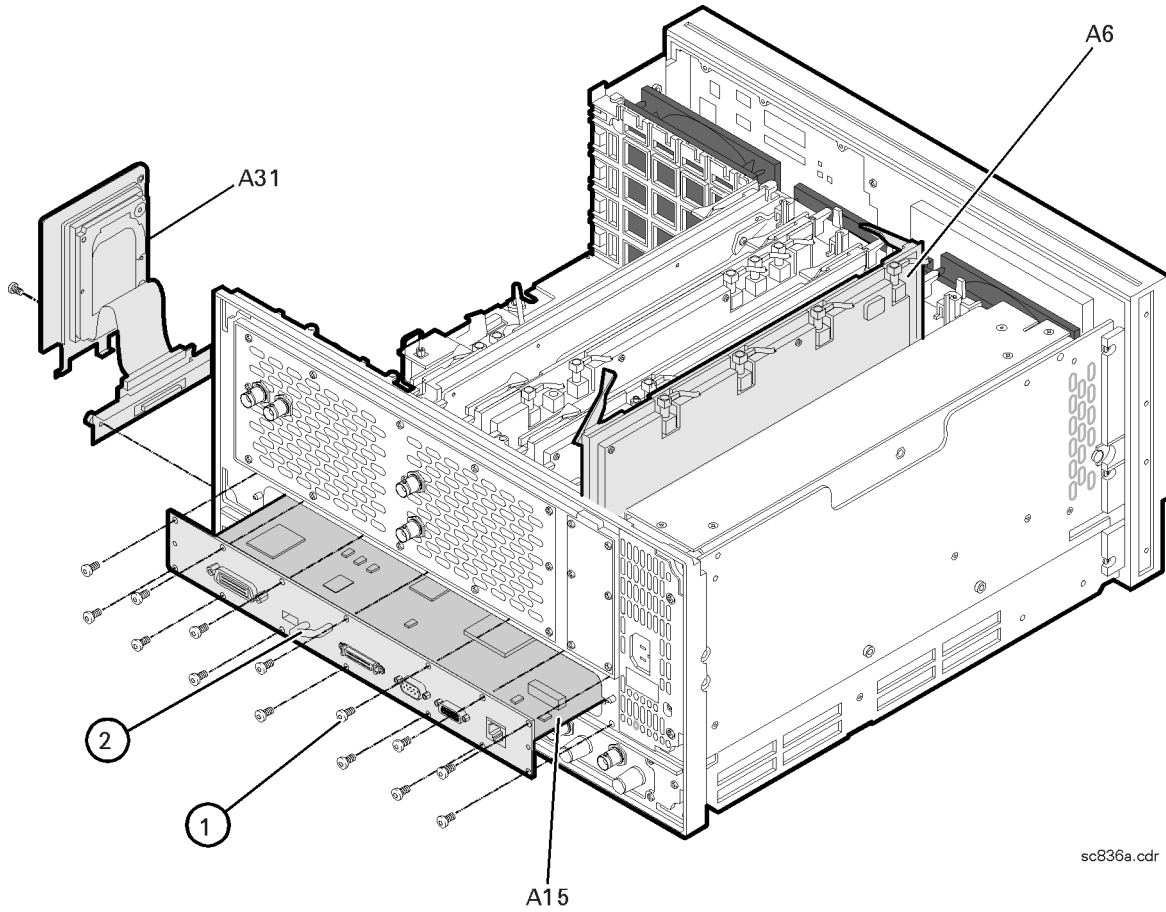
The board should now rest above its normal seated position.

5. With a T-10 TORX driver, remove the 14 screws (item ①) from the rear panel of the A15 CPU board assembly.
6. Gently pull on the finger grip (item ②) to disengage the A15 CPU board assembly from the analyzer.
7. Slide the A15 CPU board assembly out of the analyzer.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2](#) on page 7-49.

Figure 7-10 A15 CPU Board Assembly Removal



sc836a.cdr

Removing and Replacing the A16 Test Set Motherboard Assembly

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- 5/16-inch open-end torque wrench (set to 10 in-lb)
- ESD grounding wrist strap

Removal Procedure

Refer to [Figure 7-11](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer covers. Refer to [“Removing the Covers” on page 7-6](#).
3. Remove the A17 local oscillator (LO) distribution assembly (LODA). Refer to [“Removing and Replacing the A17 Local Oscillator Distribution Assembly \(LODA\)” on page 7-28](#).
4. Disconnect the step attenuator ribbon cables (item ①) from the A16 test set motherboard assembly.
5. Disconnect the coupler stranded power cables (item ②).
6. Disconnect the stranded switch control cable (item ③).
7. Disconnect the A14 motherboard ribbon cable (item ④).
8. Disconnect the flexible cables (item ⑤) from the A18, A19, A20, and A21 receiver module assemblies and the A16 test set motherboard assembly. Move the flexible cables out of the way.

CAUTION Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend the semirigid cables.

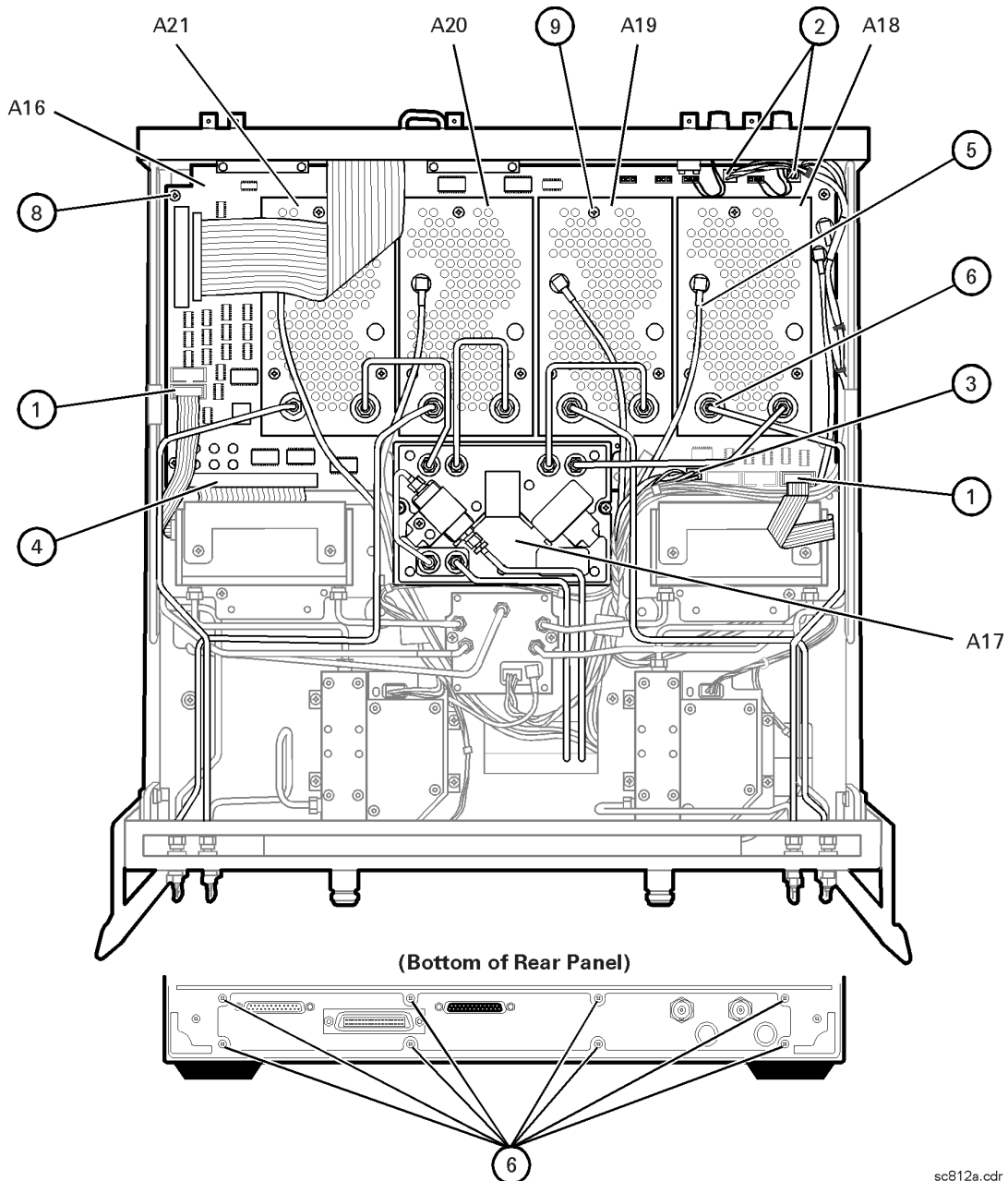
9. With a 5/16 in torque wrench, disconnect all the semirigid cables from the A18, A19, A20, and A21 receiver module assemblies (item ⑥).
10. With a T-10 TORX driver, remove the eight screws (item ⑦) from the rear panel from the and the six screws (item ⑧) from the edges of the A16 test set motherboard assembly.
11. Remove the A16 test set motherboard assembly, taking care not to bend or damage the semirigid cables.

12. With the A16 test set motherboard assembly out of the analyzer, remove the four receiver module assemblies (A18, A19, A20, and A21) by removing the screws (item 9) and lifting them off of the board.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Figure 7-11 A16 Test Set Motherboard Assembly Removal



sc812a.cdr

Removing and Replacing the A17 Local Oscillator Distribution Assembly (LODA)

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- 5/16-inch open-end torque wrench (set to 10 in-lb)
- ESD grounding wrist strap

Removal Procedure

Refer to [Figure 7-12](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to [“Removing the Covers” on page 7-6](#).

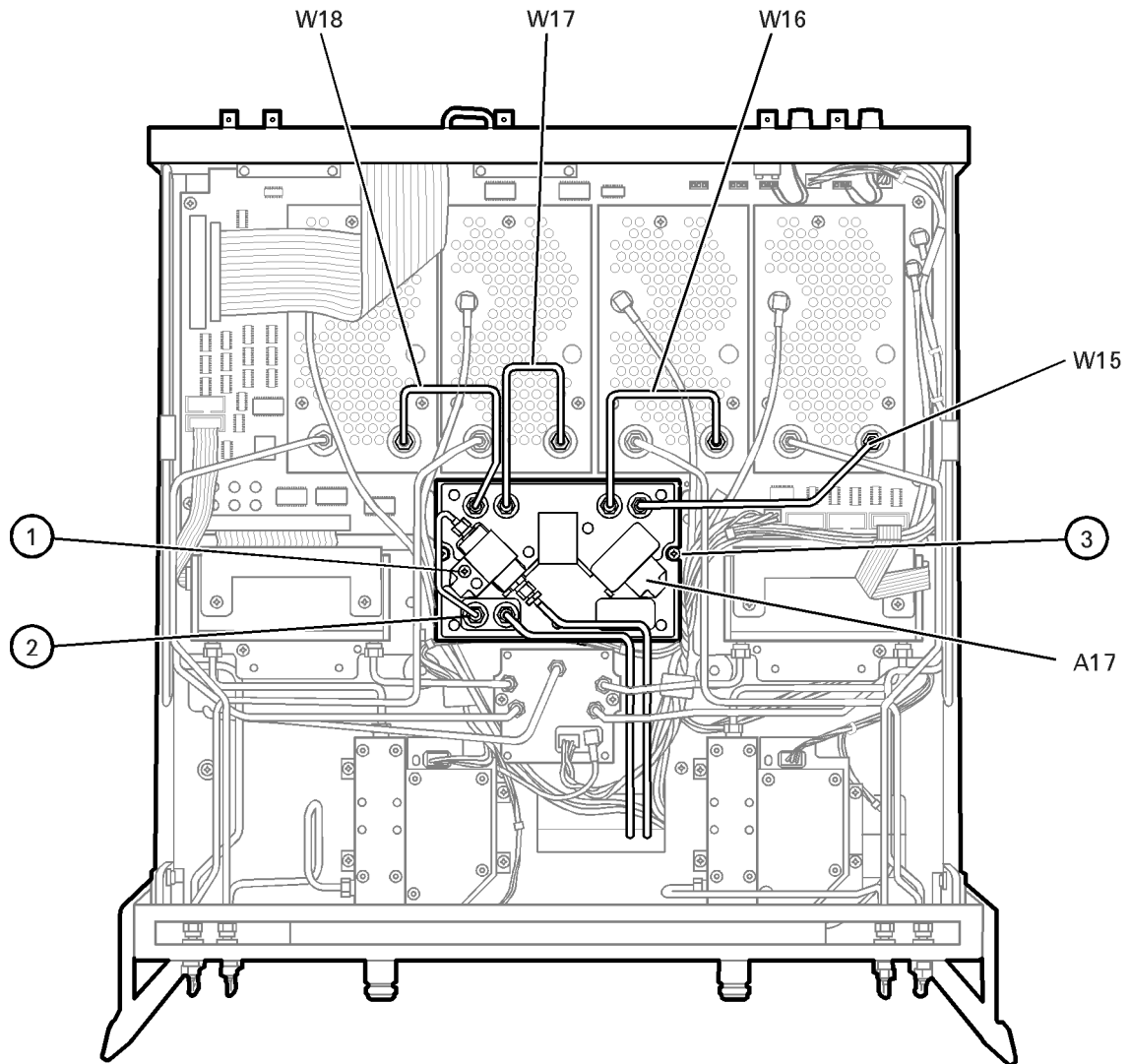
CAUTION Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend the semirigid cables.

3. Remove W15, W16, W17, and W18 semirigid cables from the analyzer.
4. Remove the filter retaining bracket by removing the screw (item ①).
5. With a 5/16-inch torque wrench, disconnect two semirigid cables (item ②) from the A17 LO distribution assembly (LODA).
6. With a T-10 TORX driver, remove the four mounting screws (item ③).
7. Support the filter and semirigid cables and remove the A17 LO distribution assembly (LODA).

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Figure 7-12 A17 LO Distribution Assembly Removal



sc813a.cdr

Removing and Replacing the A18, A19, A20, and A21 Receiver Module Assemblies

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- 5/16-inch open-end torque wrench (set to 10 in-lb)
- ESD grounding wrist strap

Removal Procedure

Refer to [Figure 7-13](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to [“Removing the Covers” on page 7-6](#).

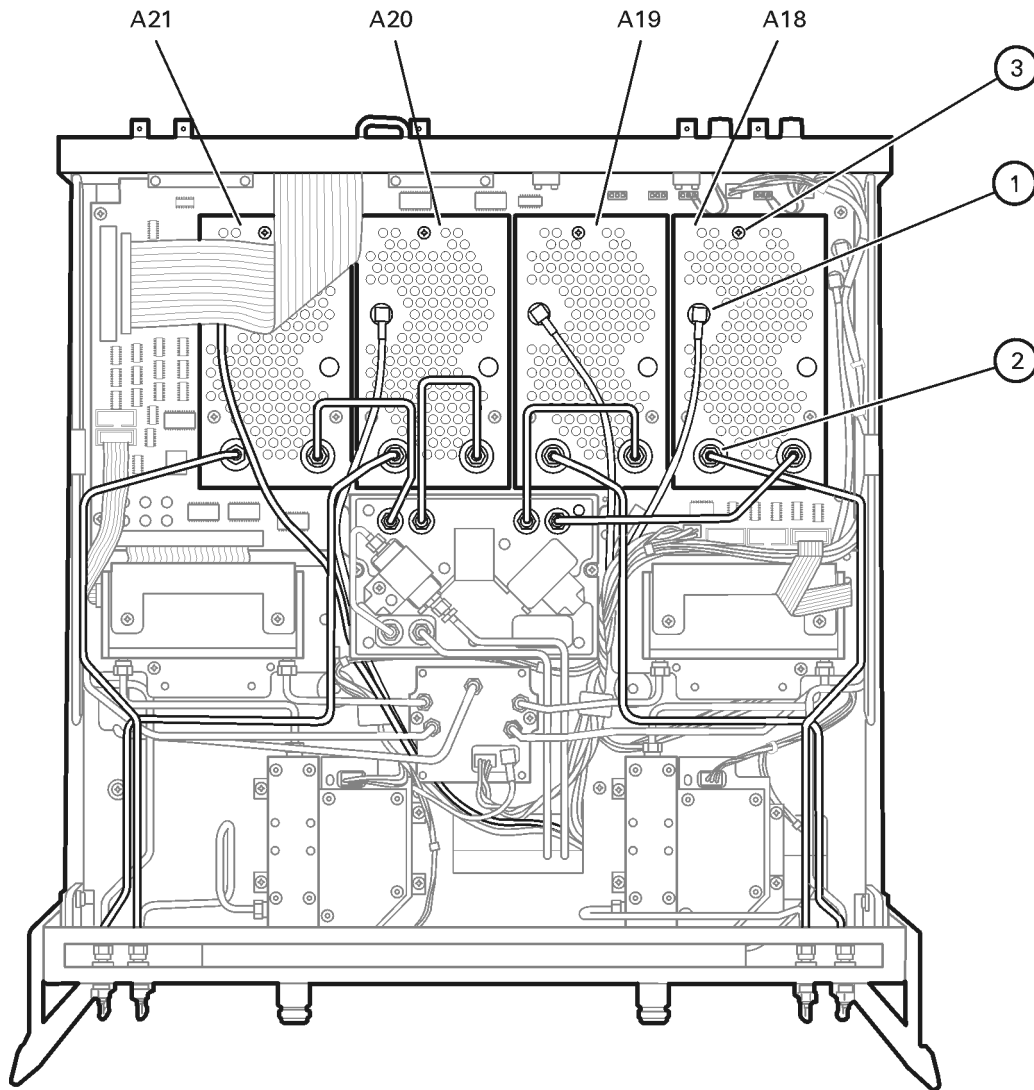
CAUTION Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend the semirigid cables.

3. Identify the receiver module to be removed.
4. Disconnect the appropriate flexible cable (item ①) and, with a 5/16 in torque wrench, disconnect the semirigid cables (item ②) from the appropriate receiver module assembly.
5. With a T-10 TORX driver, remove the three mounting screws (item ③) from the appropriate receiver module assembly.
6. Remove the receiver module assembly.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Figure 7-13 A18, A19, A20, and A21 Receiver Assembly Removal



sc814a.cdr

Removing and Replacing the A22 Switch Splitter Assembly

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- 5/16-inch open-end torque wrench (set to 10 in-lb)
- ESD grounding wrist strap

Removal Procedure

Refer to [Figure 7-14](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to [“Removing the Covers” on page 7-6](#).

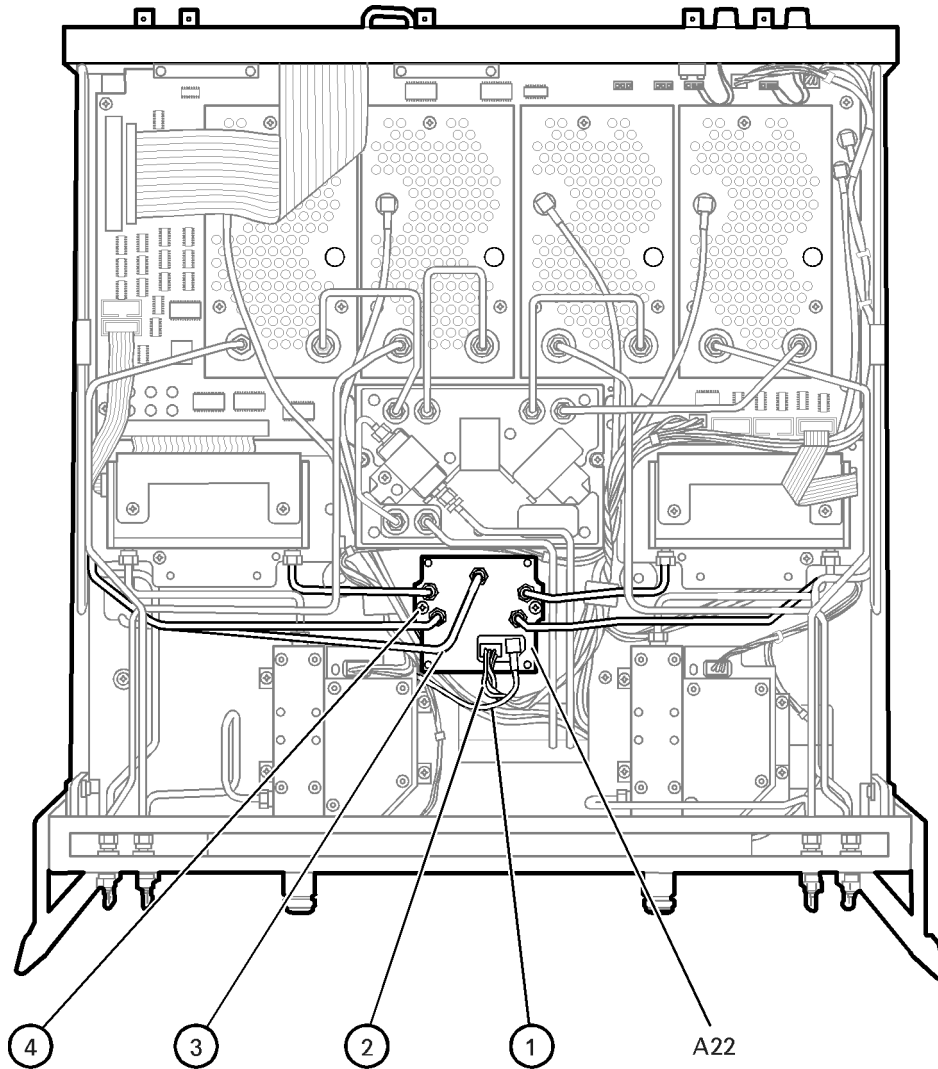
CAUTION Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend the semirigid cables.

3. Disconnect the flexible cable (item ①) and the stranded switch control cable (item ②) from the A22 switch splitter assembly.
4. With a 5/16 in torque wrench, disconnect the semirigid cables (item ③).
5. With a T-10 TORX driver, remove the two mounting screws (item ④).
6. Remove the A22 switch splitter assembly.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Figure 7-14 A22 Switch Splitter Assembly Removal



sc815a.cdr

Removing and Replacing the A23 and A24 Test Port Couplers

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- 5/16-inch open-end torque wrench (set to 10 in-lb)
- ESD grounding wrist strap

Removal Procedure

Refer to [Figure 7-15](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to [“Removing the Covers” on page 7-6](#).

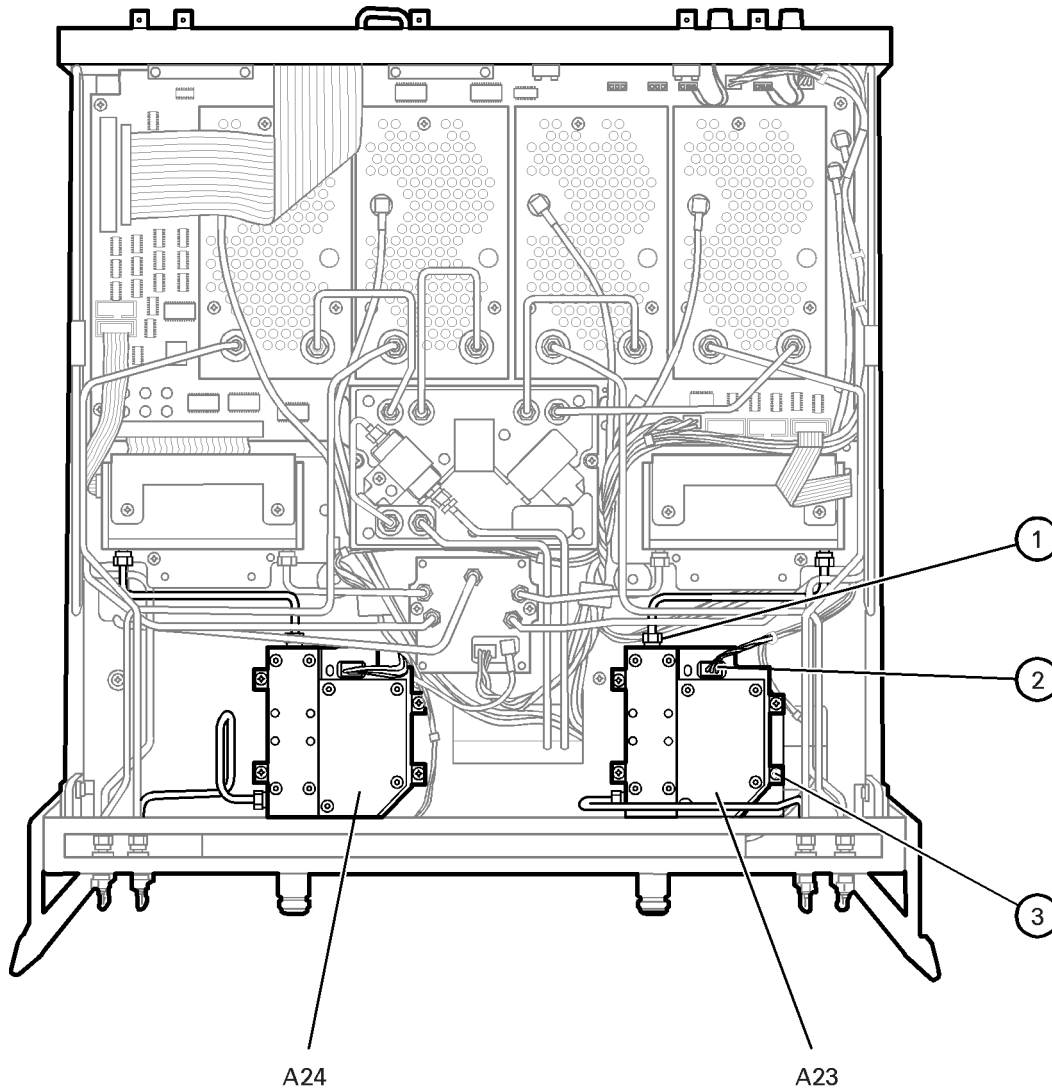
CAUTION Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend the semirigid cables.

3. Identify the test port coupler to be removed.
4. With a 5/16 in torque wrench, disconnect the two semirigid cables (item ①) and the stranded wire assembly (item ②) from the appropriate test port coupler.
5. With a T-10 TORX driver, remove the four mounting screws (item ③).
6. Remove the test port coupler.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Figure 7-15 A23 and A24 Test Port Coupler Removal



sc816a.cdr

Removing and Replacing the A25 and A26 70 dB Step Attenuators

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- 5/16-inch open-end torque wrench (set to 10 in-lb)
- ESD grounding wrist strap

Removal Procedure

Refer to [Figure 7-16](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to [“Removing the Covers” on page 7-6](#).

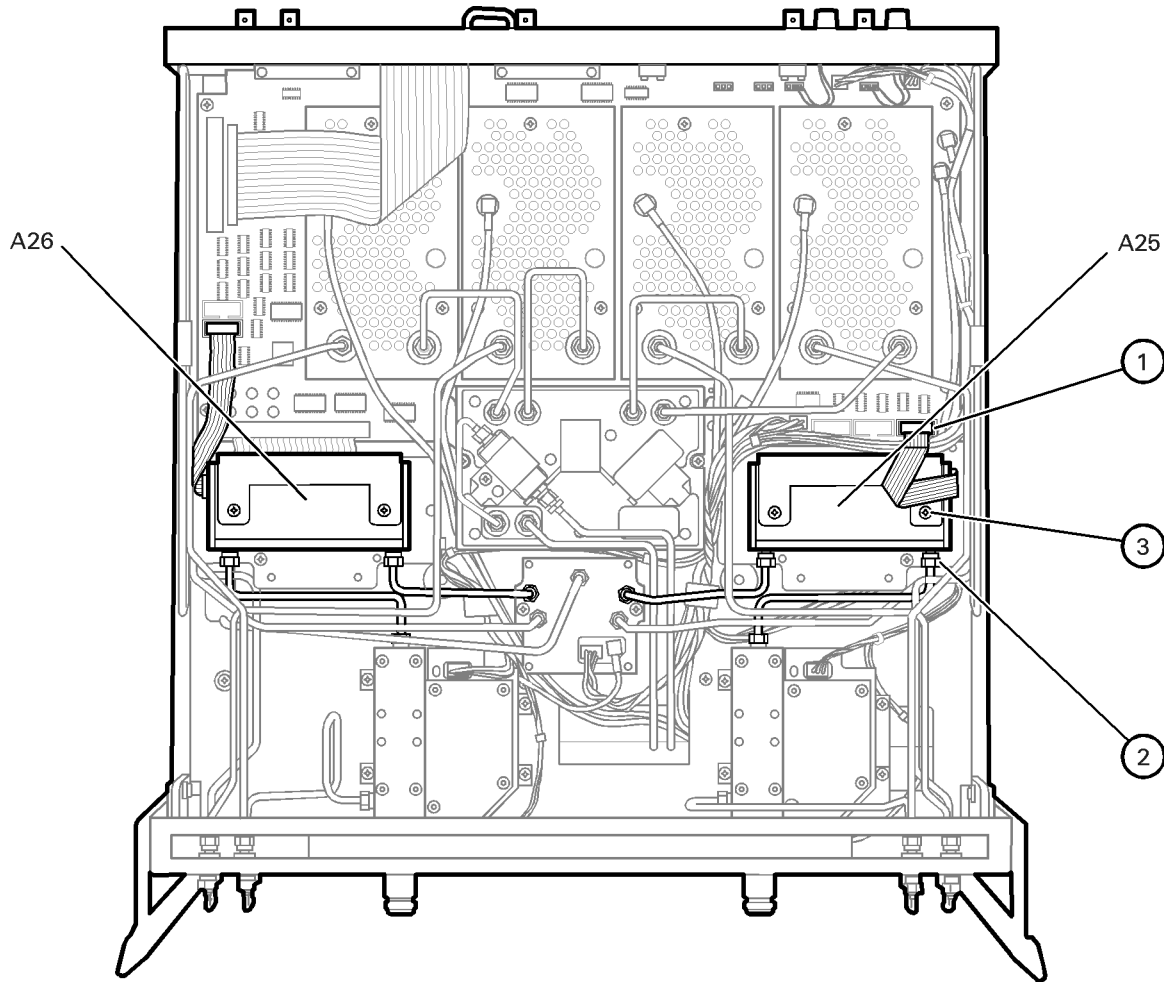
CAUTION Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend the semirigid cables.

3. Identify the step attenuator to be removed.
4. Disconnect the appropriate ribbon cable (item ①) from the A16 test set motherboard assembly.
5. With a 5/16 in torque wrench, disconnect the two semirigid cables (item ②) from the appropriate step attenuator.
6. With a T-10 TORX driver, remove the two mounting screws (item ③).
7. Remove the step attenuator.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Figure 7-16 A25 and A26 70 dB Step Attenuator Removal



sc817a.cdr

Option 015, Removing and Replacing the A27 and A28 35 dB Step Attenuators

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- 5/16-inch open-end torque wrench (set to 10 in-lb)
- ESD grounding wrist strap

Removal Procedure

Refer to [Figure 7-17](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to [“Removing the Covers” on page 7-6](#).

CAUTION Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend the semirigid cables.

3. Identify the step attenuator to be removed.
4. Disconnect the appropriate ribbon cable (item ①) from the A16 test set motherboard assembly.
5. With a 5/16 in torque wrench, disconnect the appropriate semirigid cable (item ②) at the step attenuator end of the cable.

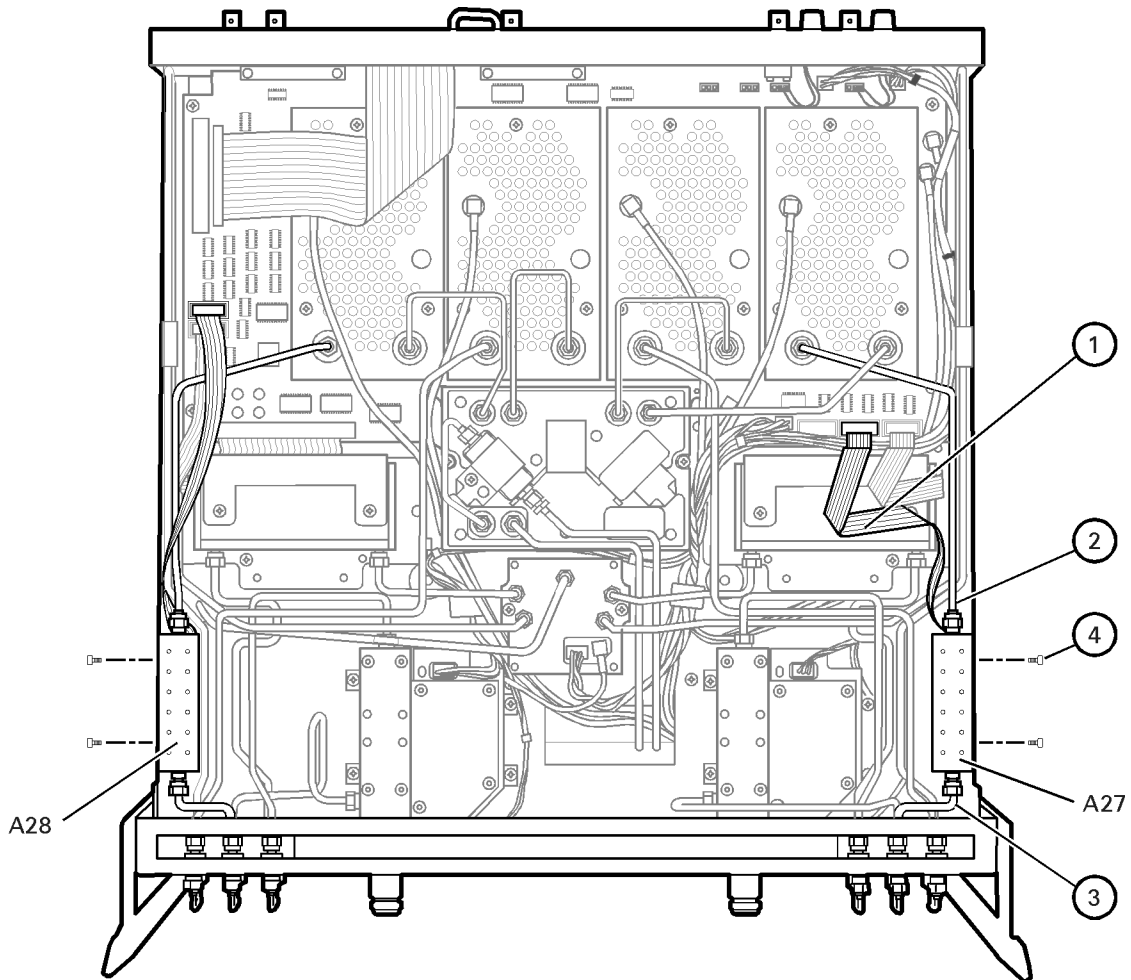
CAUTION The semirigid cable (item ③) can break easily at the cable bends. Use extreme caution when disconnecting this cable.

6. With a 5/16 in torque wrench, disconnect the appropriate semirigid cable (item ③) at the step attenuator end of the cable.
7. With a T-10 TORX driver, remove the two mounting screws (item ④).
8. Remove the step attenuator.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Figure 7-17 Option 015, A27 and A28 35 dB Step Attenuator Removal



sc837a.cdr

Removing and Replacing the A30 Floppy Disk Drive

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- 5/16-inch open-end torque wrench (set to 10 in-lb)
- ESD grounding wrist strap

Removal Procedure

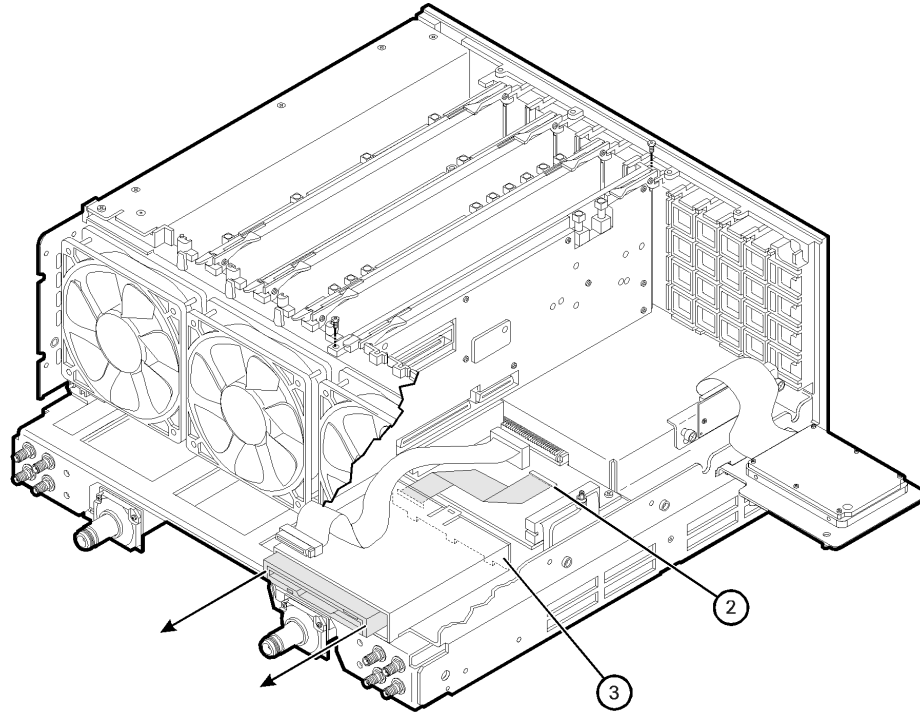
Refer to [Figure 7-18](#) and [Figure 7-19](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to [“Removing the Covers”](#) on page 7-6.
3. Remove the front panel assembly. Refer to [“Removing and Replacing the Front Panel Assembly”](#) on page 7-8.
4. Place the A31 hard disk drive assembly into the service position. Refer to [“Placing the HDDA in the Service Position”](#) on page 7-43.
5. Remove the A12 source assembly. Refer to [“Removing and Replacing the A12 Source Assembly”](#) on page 7-20.
6. Disconnect the ribbon cable (item ②) from the A14 motherboard assembly.
7. Lift the tab at the rear of the A30 floppy disk drive enclosure and remove the rear enclosure cover (item ③).
8. Slide the A30 floppy disk drive out of the front of the enclosure. The A30 floppy disk drive fits snugly. You may have to push the drive from the back to remove it from the analyzer.

Replacement Procedure

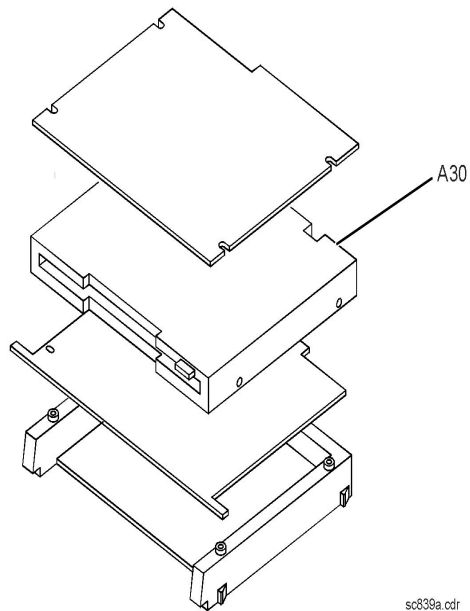
1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Figure 7-18 A30 Floppy Disk Drive Removal



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Figure 7-19 A30 Floppy Disk Drive (Exploded View)



sc839a.cdr

Removing and Replacing the A31 Hard Disk Drive Assembly (HDDA)

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- ESD grounding wrist strap

Three Levels of Procedures

There are procedures related to removing and replacement of the A31 hard disk drive assembly (HDDA):

Placing the HDDA in the Service Position

Place the HDDA in the service position where the hard disk drive is still electrically connected, but is mounted on the outer frame so that the following assemblies may be serviced.

- A11 phase lock board assembly
- A12 source assembly
- A30 floppy disk drive

Removing the HDDA

Disconnect and remove the HDDA from the analyzer so that the following assemblies may be serviced.

- A14 motherboard assembly
- A15 CPU board assembly
- A31 hard disk drive assembly

Disassembly of the HDDA

This procedure outlines how to disassemble the HDDA once it has been removed from the analyzer.

Removal Procedure

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to “[Removing the Covers](#)” on page 7-6.

Placing the HDDA in the Service Position

Refer to [Figure 7-20](#) for this procedure.

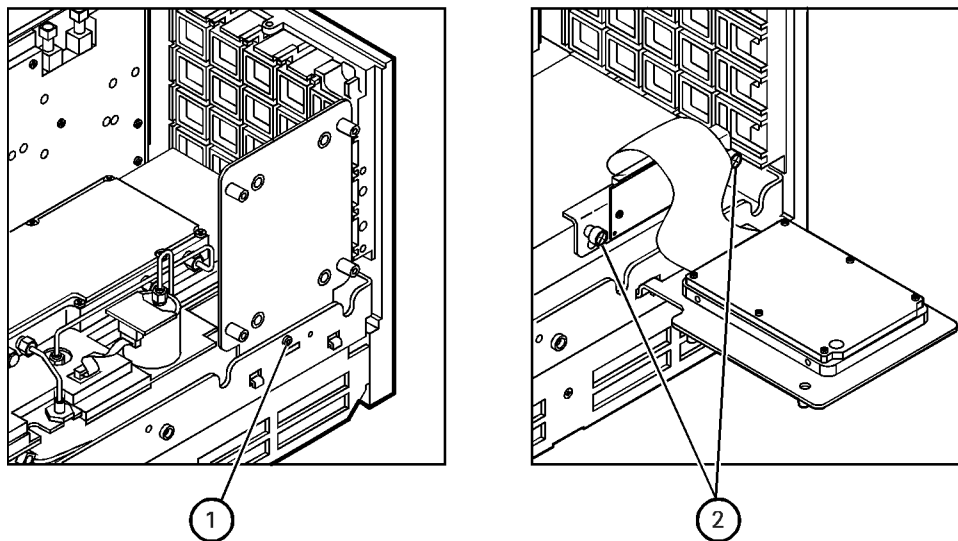
1. With a T-10 TORX driver, remove the mounting screw (item ①).
2. Move the HDDA to the outside of the analyzer and slide the HDDA bracket feet into the slots on the frame to the horizontal position. This is the service position.

Removing the HDDA

Refer to [Figure 7-20](#).

1. Put the HDDA in the service position. Refer to “[Placing the HDDA in the Service Position](#)” on page 7-43.
2. With a T-10 TORX driver, loosen the mounting screws (item ②) and disconnect the interface board from the A15 CPU board assembly.
3. Remove the A31 hard disk drive assembly from the analyzer.

Figure 7-20 A31 Hard Disk Drive Assembly Removal and Service Position



sc840a.cdr

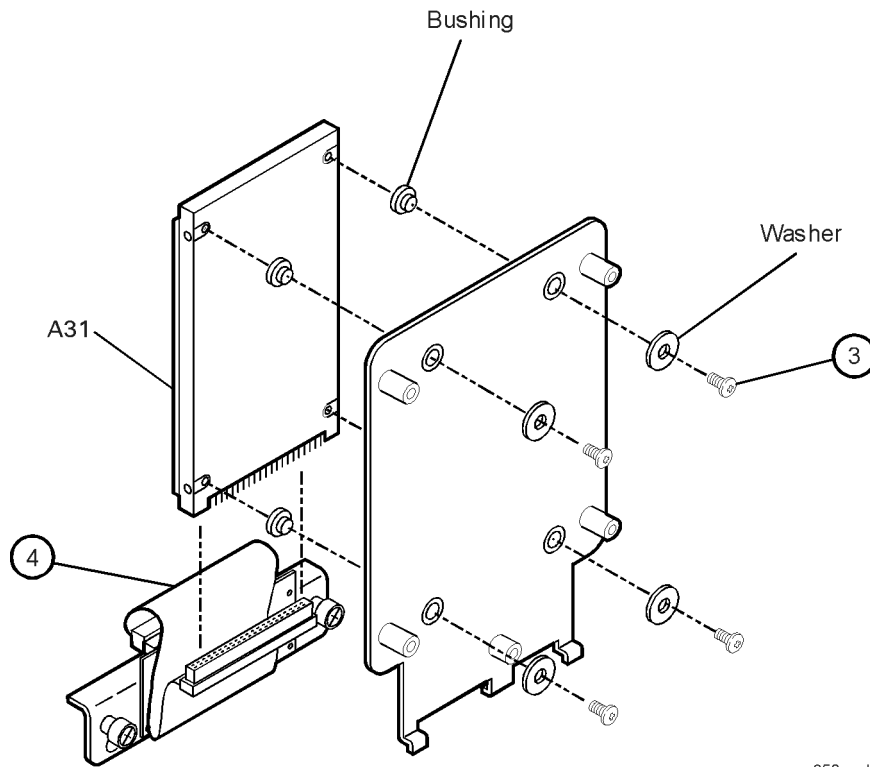
Disassembling the HDDA

IMPORTANT When replacing the HDDA, first torque all four screws (item ③) to 4 in-lb with a T-10 TORX driver. Then secure each screw to 7 in-lb with a T-10 TORX driver.

Refer to [Figure 7-21](#).

1. Remove the A31 hard disk drive assembly from the analyzer. Refer to [“Removing the HDDA”](#) on page 7-43.
2. With a T-10 TORX driver, remove the four screws (item ③), flat washer, and bushing that mount the hard disk drive assembly to the bracket.
3. Disconnect the ribbon cable (item ④) from the hard disk drive.

Figure 7-21 A31 Hard Disk Drive Assembly (Exploded View)



Replacement Procedure

WARNING **When connecting the ribbon cable (item ④ on Figure 7-21) to the hard disk drive, take special care to align the connector pins. Applying power to a misaligned connection can permanently damage the hard disk drive.**

IMPORTANT When replacing the HDDA, first torque all four screws (item ③) to 4 in-lb with a T-10 TORX driver. Then secure each screw to 7 in-lb with a T-10 TORX driver.

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Removing and Replacing the Midweb and the B1 Fan

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- Pozidriv screw driver
- 5/16-inch open-end torque wrench (set to 10 in-lb)
- ESD grounding wrist strap

Removal Procedure

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to [“Removing the Covers” on page 7-6](#).
3. Put the A31 hard disk drive assembly in the service position. Refer to [“Placing the HDDA in the Service Position” on page 7-42](#).
4. Remove the A12 source assembly. Refer to [“Removing and Replacing the A12 Source Assembly” on page 7-20](#).
5. Remove the A11 phase lock board assembly. Refer to [“Removing and Replacing the A11 Phase Lock Board Assembly” on page 7-18](#).
6. Remove the A4 power supply assembly. Refer to [“Removing and Replacing the A4 Power Supply Assembly” on page 7-14](#).
7. Remove the card cage boards (A6, A8, and A10). Refer to [“Removing and Replacing the A6, A8, and A10 Board Assemblies” on page 7-16](#).

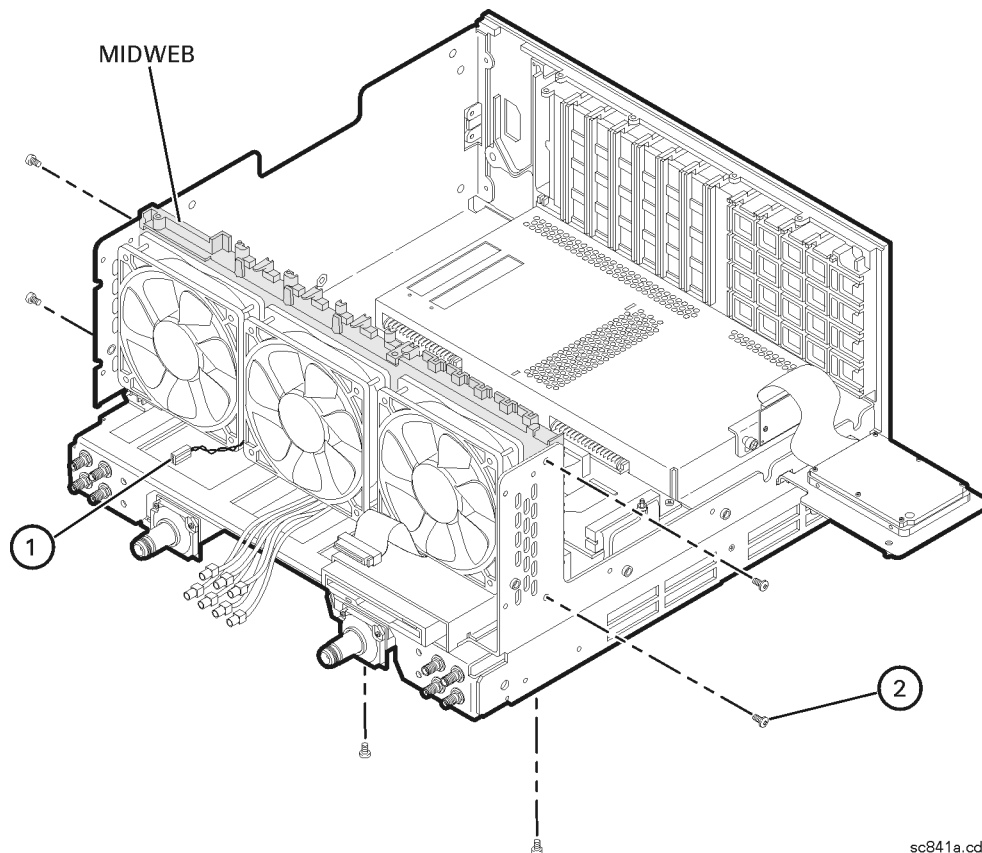
NOTE This procedure has two parts: removing the midweb and removing the fan from the midweb. You must remove the midweb before removing the fan.

Removing the Midweb

Refer to [Figure 7-22](#).

1. Disconnect the power cable (item ①) for the three fans from the A14 motherboard assembly. Remove the midweb.
2. With a T-10 TORX driver, remove the six midweb mounting screws (item ②). Partially lift out the midweb.

Figure 7-22 Midweb Removal



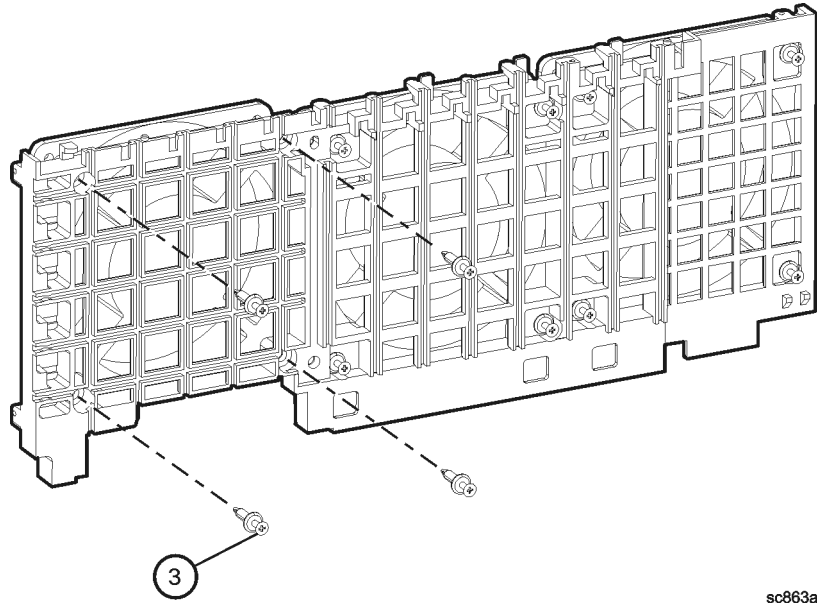
sc841a.cdr

Removing the Fan

Refer to [Figure 7-23](#).

1. To remove the fan, it is necessary to remove the four nylon rivets that attach it to the midweb. To do this, use the Pozidriv screwdriver on the nylon screw (item ③) and a small blade screwdriver to stabilize the rivet. Turn and push the rivet out of the rivet hole. Once the four rivets are out, remove the fan.

Figure 7-23 B1 Fan Removal



Replacement Procedure

1. Reverse the order of the removal procedure.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-49](#).

Post-Repair Procedures

After the replacement of an assembly, you must perform the service procedures in the order listed in [Table 7-2](#). Refer to [Chapter 2](#), “[Checks and Adjustments, Firmware Upgrades, and Operating System Recovery](#)” for information on how to perform the service procedures.

Table 7-2 Related Service Procedures

Replaced Assembly	Adjustments / Correction Constants	Verification and Performance Tests
A1 keypad assembly	No adjustment needed	Keypad test
A2 display assembly	No adjustment needed	Display test
A3 front panel interface board assembly	No adjustment needed	Keypad and display test
A4 power supply assembly	No adjustment needed	None needed
A6 SPAM board assembly	No adjustment needed	RMS noise level Crosstalk System trace noise
A8 fractional-N synthesizer board assembly	LO power adjust	Frequency range and accuracy test Operation check
A10 frequency reference board assembly	10 MHz frequency adjust Option enable utility	Frequency range and accuracy test
A11 phase lock board assembly	No adjustment needed	Frequency range and accuracy test
A12 source assembly	3.8 GHz frequency adjust Source calibration	Frequency range and accuracy test Output power accuracy Output power range and linearity
A14 motherboard assembly	No adjustment needed	Keypad test Display test Operation check
A15 CPU board assembly	No adjustment needed	Operation check
A16 test set motherboard assembly	Restore correction constants	Operation check Crosstalk
A17 LO distribution assembly (LODA)	LO power adjust	Operation check

Table 7-2 Related Service Procedures (Continued)

Replaced Assembly	Adjustments / Correction Constants	Verification and Performance Tests
A18, A19, A20, and A21 receiver module assemblies	Receiver calibration	RMS noise level Crosstalk Receiver magnitude dynamic Accuracy Calibration coefficients Receiver magnitude compression
A22 switch splitter assembly	Source calibration	Output power accuracy Output power range and linearity Receiver magnitude compression Calibration coefficients
A23 and A24 test port couplers	Source calibration	Output power accuracy Output power range and linearity Receiver magnitude compression Calibration coefficients
A25 and A26 70 dB step attenuators	Source calibration	Output power accuracy Output power range and linearity Receiver magnitude compression Calibration coefficients
A27 and A28 35 dB step attenuators	Receiver calibration	Calibration coefficients Receiver magnitude dynamic Accuracy Receiver magnitude compression RMS noise level
A30 floppy disk drive	No adjustment needed	Read and write to the drive
A31 hard disk drive assembly (HDDA)	Firmware upgrade Restore correction constants Option enable utility	Read and write to the drive
B1 fan	No adjustment needed	Check for fan operation

8 Safety and Regulatory Information

Information in This Chapter

This chapter provides safety information that will help protect you and your network analyzer. It also contains information that is required by various government regulatory agencies.

Safety Symbols

The following safety symbols are used throughout this manual. Familiarize yourself with each of the symbols and its meaning before operating this instrument.

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

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

General Safety Considerations

Safety Earth Ground

WARNING This is a Safety Class I product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor, inside or outside of the instrument, will make the instrument dangerous. Intentional interruption is prohibited.

Before Applying Power

CAUTION The front panel LINE switch disconnects the mains circuits from the mains supply after the EMC filters and before other parts of the instrument.

CAUTION This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and 664 respectively.

CAUTION Make sure that the analyzer line voltage selector switch is set to the voltage of the power supply and the correct fuse is installed.

CAUTION If this product is to be energized via an autotransformer make sure the common terminal is connected to the neutral (grounded side of the mains supply).

Servicing

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

WARNING The opening of covers or removal of parts may expose dangerous voltages. Disconnect the instrument from all voltage sources while it is opened.

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

WARNING **Procedures described in this document may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.**

WARNING **The power cord is connected to internal capacitors that may remain live for 5 seconds after disconnecting the plug from its power supply.**

WARNING **For continued protection against fire hazard, replace line fuse only with same type and rating. The use of other fuses or material is prohibited.**

WARNING **The detachable power cord is the instrument disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the instrument. The front panel switch is only a standby switch and is not a LINE switch (disconnecting device).**

Regulatory Information

This section contains information that is required by various government regulatory agencies.

Instrument Markings



The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the documentation.



The CE mark is a registered trademark of the European Community. (If accompanied by a year, it is when the design was proven.)



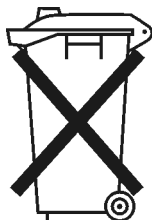
The CSA mark is a registered trademark of the Canadian Standards Association.



This is a symbol of an Industrial Scientific and Medical Group 1 Class A product.

Lithium Battery Disposal

If the battery on the A15 CPU board assembly needs to be disposed of, dispose of it according to your country's requirements. If required, you may return the battery to the nearest Agilent Technologies sales or service office for disposal. A list of sales and service offices is located on [Page 1-10](#).



DO NOT THROW BATTERIES AWAY. DISPOSE
OF THEM IN ACCORDANCE WITH SMALL
CHEMICAL WASTE DISPOSAL REGULATIONS.

sc866a

Compliance with German FTZ Emissions Requirements

This network analyzer complies with German FTZ 526/527 Radiated Emissions and Conducted Emission requirements.

Compliance with German Noise Requirements

This is to declare that this instrument is in conformance with the German Regulation on Noise Declaration for Machines (Laermangabe nach der Maschinenlaermrrerordnung –3. GSGV Deutschland).

Acoustic Noise Emission/Geraeuschemission	
LpA<70 dB	Lpa<70 dB
Operator Position	am Arbeitsplatz
Normal Operation	normaler Betrieb
per ISO 7779	nach DIN 45635 t. 19

Declaration of Conformity

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014

Manufacturer's Name: Agilent Technologies, Inc.

Manufacturer's Address: 1400 Fountaingrove Parkway
Santa Rosa, CA 95403-1799
USA

Declares that the products

Product Name: PNA Series RF Network Analyzer

Model Number: E8356A, E8357A, E8358A

Product Options: This declaration covers all options of the above products.

Conform to the following product specifications:

EMC: IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998

<u>Standard</u>	<u>Limit</u>
CISPR 11:1990 / EN 55011-1991	Group 1, Class A
IEC 61000-4-2:1995+A1998 / EN 61000-4-2:1995	4 kV CD, 8 kV AD
IEC 61000-4-3:1995 / EN 61000-4-3:1995	3 V/m, 80 - 1000 MHz
IEC 61000-4-4:1995 / EN 61000-4-4:1995	0.5 kV sig., 1 kV power
IEC 61000-4-5:1995 / EN 61000-4-5:1996	0.5 kV L-L, 1 kV L-G
IEC 61000-4-6:1996 / EN 61000-4-6:1998	3 V, 0.15 – 80 MHz
IEC 61000-4-11:1994 / EN 61000-4-11:1998	1 cycle, 100%

Safety: IEC 61010-1:1990 + A1:1992 + A2:1995 / EN 61010-1:1993 +A2:1995
CAN/CSA-C22.2 No. 1010.1-92

Supplementary Information:

The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.



Santa Rosa, CA, USA 18 August 2000

Greg Pfeiffer/Quality Engineering Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor.

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