

Service Guide

Agilent Technologies
PNA Series
Microwave Network Analyzers
E8362A, E8363A, E8364A



Agilent Technologies

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Agilent Technologies, Inc. certifies that this product met its published specifications at the time of shipment from the factory. Agilent Technologies, Inc. further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology, to the extent allowed by the Institute’s calibration facility, and to the calibration facilities of other International Standards Organization members.

Safety and Regulatory Information

The safety and regulatory information pertaining to this product is located in [Chapter 1, “Safety and Regulatory Information.”](#)

Assistance

Product maintenance agreements and other customer assistance agreements are available for Agilent Technologies, Inc. products. For information about these agreements and for other assistance, contact Agilent. Refer to [“Contacting Agilent” on page 2-9.](#)

Safety Notes

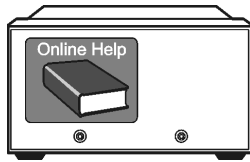
The following safety notes are used throughout this manual. Familiarize yourself with each of the notes and its meaning before operating this instrument. All pertinent safety notes for using this product are located in [Chapter 1, “Safety and Regulatory Information.”](#)

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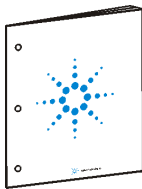
CAUTION	Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.
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Documentation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

Standard Documentation:



The online Help files are embedded in the analyzer, offering quick reference to programming and user documentation. From the Help drop-down menu, you can access the Help system in five different languages. Also, you can view the Analyzer Product Overview multimedia presentation and access the analyzer's Web page.



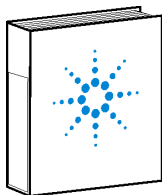
The *Installation and Quick Start Guide* contains procedures for installing, configuring, and verifying the operation of your analyzer.



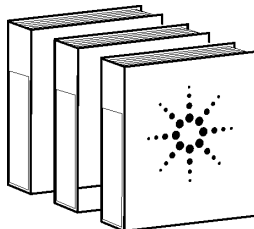
The **CD-ROM** provides the following:

- *Installation and Quick Start Guide*
- *Service Guide*
- Help system
- Help system in pdf format (for printing)
- Network Analyzer Product Overview multimedia presentation

Optional Documentation:



The optional printed version of the *Service Guide* provides information on troubleshooting and servicing your analyzer.



The optional printed version of the online Network Analyzer Help provides the Help system, programming information, and specifications in separate volumes.

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1 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.

Chapter One at-a-Glance

Section Title	Summary of Content	Start Page
Safety Symbols	Descriptions of CAUTION and WARNING symbols used throughout this manual.	Page 1-3
General Safety Considerations	A list of safety points to consider when servicing your network analyzer.	Page 1-3
Electrostatic Discharge Protection	A discussion of electrostatic discharge (ESD) and related recommendations and requirements for ESD protection.	Page 1-5
Regulatory Information	Definitions of instrument markings. Instructions for disposing of the analyzer's lithium battery. Information on compliance with Canadian EMC requirements. Information on compliance with German FTZ emissions requirements. Information on compliance with German noise requirements.	Page 1-6

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	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	Always use the three-prong AC power cord supplied with this product. Failure to ensure adequate grounding by not using this cord may cause product damage.
----------------	--

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 10 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).
----------------	---

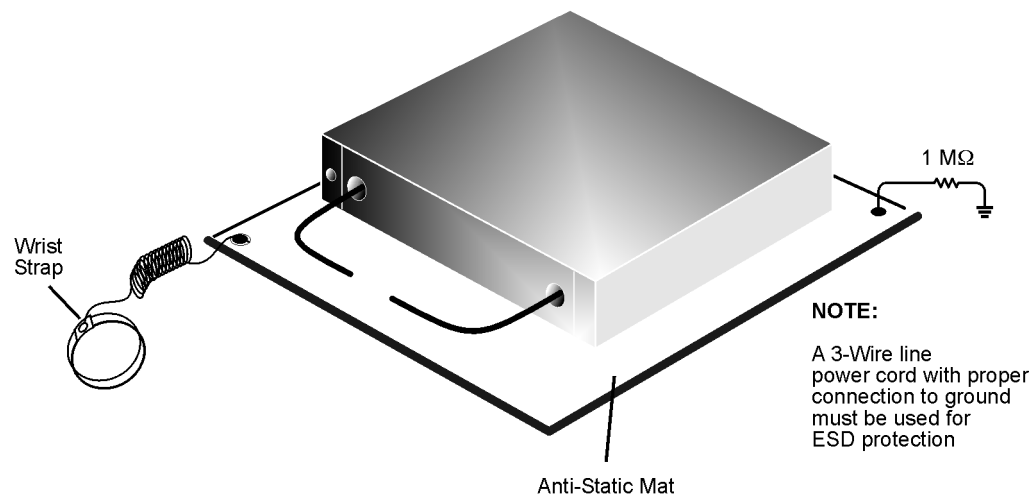
Electrostatic Discharge Protection

Protection against electrostatic discharge (ESD) is essential while removing assemblies from or connecting cables to the network analyzer. Static electricity can build up on your body and can easily damage sensitive internal circuit elements when discharged. Static discharges too small to be felt can cause permanent damage. To prevent damage to the instrument:

- *always* have a grounded, conductive table mat in front of your test equipment.
- *always* wear a grounded wrist strap, connected to a grounded conductive table mat, having a 1 M Ω resistor in series with it, when handling components and assemblies or when making connections.
- *always* wear a heel strap when working in an area with a conductive floor. If you are uncertain about the conductivity of your floor, wear a heel strap.
- *always* ground yourself before you clean, inspect, or make a connection to a static-sensitive device or test port. You can, for example, grasp the grounded outer shell of the test port or cable connector briefly.
- *always* ground the center conductor of a test cable before making a connection to the analyzer test port or other static-sensitive device. This can be done as follows:
 1. Connect a short (from your calibration kit) to one end of the cable to short the center conductor to the outer conductor.
 2. While wearing a grounded wrist strap, grasp the outer shell of the cable connector.
 3. Connect the other end of the cable to the test port and remove the short from the cable.

Figure 1-1 shows a typical ESD protection setup using a grounded mat and wrist strap. Refer to “ESD Supplies” on page 6-45 for part numbers.

Figure 1-1 ESD Protection Setup



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.

ICES/NMB-001

This is a marking to indicate product compliance with the Canadian Interference-Causing Equipment Standard (ICES-001).

ISM1-A

This is a symbol of an Industrial Scientific and Medical Group 1 Class A product.

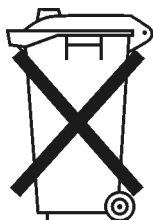


N10149

This is a required mark signifying compliance with an EMC requirement. The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency.

Lithium Battery Disposal

If the battery on the A15 CPU board assembly needs to be disposed of, dispose of it in accordance with your country's requirements. If required, you may return the battery to Agilent Technologies for disposal. Refer to [“Contacting Agilent” on page 2-9](#) for assistance.



DO NOT THROW BATTERIES AWAY BUT
COLLECT AS SMALL CHEMICAL WASTE.

Compliance with Canadian EMC Requirements

This ISM device complies with Canadian ICES-001.
Cet appareil ISM est conforme a la norme NMB du Canada.

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

2 General Product Information

Information in This Chapter

Chapter Two at-a-Glance

Section Title	Summary of Content	Start Page
Maintenance	Cleaning instructions for the external surfaces of your analyzer. Information about electrical maintenance of your analyzer.	Page 2-3
Analyzer Options, Upgrades, and Accessories	A list of the options and upgrades available for the microwave network analyzers.	Page 2-3
Required Service Test Equipment	A list of service equipment that is required to perform system verification, performance tests, adjustments, and troubleshooting.	Page 2-6
Agilent Support, Services, and Assistance	The Internet address (URL) for on-line assistance. Telephone and fax numbers for contacting Agilent for assistance. Service and support options available. Important information about shipping your analyzer to Agilent for service or repair.	Page 2-9

Maintenance

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.

Physical Maintenance

Clean the cabinet, including the front panel, using a dry or slightly damp cloth only.

Electrical Maintenance

Refer to [“Contacting Agilent” on page 2-9](#) and to [Chapter 3, “Tests and Adjustments.”](#)

Analyzer Options, Upgrades, and Accessories

How to Order an Upgrade

The options described in this section can be ordered as upgrades. To order an upgrade for your microwave PNA, order the analyzer’s model number, followed by a “U”, then indicate the option to be added:

- Your analyzer’s current model number followed by a “U”. For example, E8364AU.
- The desired option from the available list. For example, Time Domain.

Individual upgrade kits are also available and can be ordered by part number. Refer to [“Upgrade Kits” on page 6-45](#) for a complete list of available kits.

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 the accuracy of active error correction.

Option 014, Configurable Test Set

An Option 014 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. 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, allowing for a 15 dB improvement in transmitted signal sensitivity in one direction only. Jumpers are installed on both ports allowing the user to choose a measurement in either the forward or reverse direction.

Option 099, Firmware Upgrade

This upgrade provides the latest revision of firmware for the PNA series network analyzers on CD-ROM. This firmware is user installable. The installation requires a USB CD-ROM drive (see “CD-RW Drive” on page 2-4) 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.)

Option UNL, Source Attenuators and Bias Tees

This option adds a 60-dB step attenuator and a bias tee between the switch splitter and each of the ports. The step attenuators are used to adjust the power level to the device under test (DUT) without changing the power in the reference path. The bias tees provide a means of biasing active devices under test. DC bias for the bias tees is provided through two rear-panel BNC connectors. These inputs are fused for protection.

CD-RW Drive

This accessory is an external read/write CD drive with a USB cable.

This accessory can be ordered as model number N4688A.

USB Hub

This accessory is a 4-port USB hub for connecting additional USB peripheral devices.

This accessory can be ordered as model number N4689A.

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. It can be ordered as part number:

EnglishE8356-90028

Option 0BW, 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. It can be ordered as part number E8364-90001.

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.

Additional kits may be ordered from Agilent. Refer to [“Rack Mount Kits and Handle Kits” on page 6-45](#) for the part numbers.

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.

Additional kits may be ordered from Agilent. Refer to [“Rack Mount Kits and Handle Kits” on page 6-45](#) for the part numbers.

Required Service Test Equipment

Equipment ^a	Critical Specifications	Recommended Model or Part Number	Alternate Model or Part Number	Use ^b
Test Instruments and Software				
Frequency counter	Freq: 45 MHz to 20 GHz Accuracy : ± 0.5 ppm	53151A Opt 001	None	P, A, T
Spectrum analyzer	Min Freq: 1 MHz Max Freq: > 4 GHz Resolution BW: 300 Hz	8565E	856xE	A, T
Power meter	Accuracy: ± 0.0068 dB	E4418B/19B Opt G12 or H12 ^c	E4418A/19A ^d	P, A, T
Power sensor (All)	Freq: 45 MHz to 50 MHz Range: -30 to +20 dBm	8482A	None	P, A, T
Power sensor (E8362A)	Freq: 50 MHz to 20 GHz Range: -30 to +20 dBm	E4413A	None	P, A, T
Power sensor (E8363A, E8364A)	Freq: 50 MHz to 50 GHz Range: -30 to +20 dBm	8487A	None	P, A, T
Dynamic accuracy test set	None specified	Z5623A Opt H01	None	P
Compression test set	None specified	Z5623A Opt K01	None	P
Digital voltmeter	Resolution: 10 mV	Any	Any	T
Printer	N/A	Any printer with Microsoft® Windows® 2000 driver		P
Test software ^e	N/A	N2721A	None	P

- a. Unless specified otherwise, equipment listed is required for all analyzer models.
- b. P = Performance tests, A = Adjustments, T = Troubleshooting, V = System verification
- c. The accuracy of a standard E4418B or E4419B of ± 0.02 dB is adequate for all tests except “Dynamic Accuracy Test.” This test requires a power meter with Option G12 or H12 that has been certified to a higher accuracy specification. If an Option G12 or H12 power meter is not available, a test is provided on [page 3-43](#) to verify the accuracy of a standard power meter.
- d. If an accurate measurement of the dynamic accuracy specification is not required, the E4418A or E4419A can be used.
- e. The recommended model or part number for all equipment listed with a “P” in the **Use** column is required for proper operation of this test software.

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Equipment ^a	Critical Specifications	Recommended Model or Part Number	Alternate Model or Part Number	Use ^b
Calibration and Verification Kits				
3.5 mm calibration kit (E8362A)	Freq: 45 MHz to 20 GHz	85052B	85052D	P,T
3.5 mm verification kit (E8362A)	Freq: 45 MHz to 20 GHz	85053B	None	V
2.4 mm calibration kit (E8363A, E8364A)	Freq: 45 MHz to 50 GHz	85056A	85056D	P,T
2.4 mm verification kit (E8363A, E8364A)	Freq: 45 MHz to 50 GHz	85057B	None	V
Cables				
BNC cable (2 required)	50Ω, length ≥ 60 cm	8120-1839	None	A
3.5 mm RF cable (Qty 2) (E8362A)	50Ω, length ≥ 60 cm	85131C	85131E	P,A,V
2.4 mm RF cable (Qty 2) (E8363A, E8364A)	50Ω, length ≥ 60 cm	85133C	85133E	P,A,V
GPIO cable	N/A	10833A/B/C/D	None	P,A
Adapters				
3.5 mm (f) to 3.5 mm (f) (E8362A)	Return Loss: ≥ 32 dB	83059B	85052-60012 ^c	P,A,T
3.5 mm (f) to type-N (m) (E8362A)	Return Loss: ≥ 28 dB	1250-1743	None	P,A,T
2.4 mm (f) to 2.4 mm (f) (E8363A, E8364A)	Return Loss: ≥ 26 dB	11900B	85056-60007 ^d	P,A,T
2.4 mm (f) to type-N (m) (E8363A, E8364A)	Return Loss: ≥ 28 dB	11903D	None	P,A,T
Attenuators				
3.5 mm (m,f), 10-dB fixed attenuator (E8362A)	Accuracy: ± 0.5 dB Freq: 45 MHz to 20 GHz	8493C Option 010	None	P
3.5 mm (m,f), 20-dB fixed attenuator (E8362A)	Accuracy: ± 0.5 dB Freq: 45 MHz to 20 GHz	8493C Option 020	None	P
2.4 mm (m,f), 10-dB fixed attenuator (E8363A, E8364A)	Accuracy: ± 0.5 dB Freq: 45 MHz to 50 GHz	8490D Option 010	None	P
2.4 mm (m,f), 20-dB fixed attenuator (E8363A, E8364A)	Accuracy: ± 0.5 dB Freq: 45 MHz to 50 GHz	8490D Option 020	None	P

- a. Unless specified otherwise, equipment listed is required for all analyzer models.
b. P = Performance tests, A = Adjustments, T = Troubleshooting, R = Repair, V = System verification
c. Included in the 85052B/D calibration kits.
d. Included in the 85056A/D calibration kits.

Equipment ^a	Critical Specifications	Recommended Model or Part Number	Alternate Model Number	Use ^b
Tools				
Extender board	N/A	E8356-60021	None	T
T-8 TORX driver	0.6 N-m (5 in-lb) setting	N/A	N/A	R
T-10 TORX driver	0.5, 0.8, and 1.0 Nm (4, 7, and 9 in-lb) settings	N/A	N/A	T,R
T-20 TORX driver	2.4 N-m (21 in-lb) setting	N/A	N/A	T,R
1/4-inch and 5/16-inch open-end wrench	Thin profile	8710-0510	N/A	A,R
5/16-inch, open-end torque wrench (metric equivalent is 8 mm)	1.1 and 2.4 Nm (10 and 21 in-lb) settings (for semi-rigid cables)	N/A	N/A	T,R
1-inch, open-end torque wrench (metric equivalent is 26 mm)	8.1 N-m (72 in-lb) setting (for Port 1 and Port 2 connector nuts)	N/A	N/A	R
20-mm, open-end torque wrench	0.9 N-m (8 in-lb) setting (for Port 1 and Port 2 measurement connections)	8710-1764	N/A	P,A,T
Static Safety Parts				
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
Miscellaneous				
Floppy disks	3.5 inch	Any	None	A

a. Unless specified otherwise, equipment listed is required for all analyzer models.

b. P = Performance tests, A = Adjustments, T = Troubleshooting, R = Repair, V = System verification

Agilent Support, Services, and Assistance

Information on the following topics is included in this section.

- “Contacting Agilent”
- “Service and Support Options”
- “Shipping Your Analyzer to Agilent for Service or Repair”

Contacting Agilent

By internet, phone, or fax, get assistance with all your test and measurement needs.

Table 2-1 Contacting Agilent

Online assistance: www.agilent.com/find/assist		
United States (tel) 1 800 452 4844	Latin America (tel) (305) 269 7500 (fax) (305) 269 7599	Canada (tel) 1 877 894 4414 (fax) (905) 282-6495
Europe (tel) (+31) 20 547 2323 (fax) (+31) 20 547 2390	Australia (tel) 1 800 629 485 (fax) (+61) 3 9210 5947	New Zealand (tel) 0 800 738 378 (fax) (+64) 4 495 8950
Japan (tel) (+81) 426 56 7832 (fax) (+81) 426 56 7840	Singapore (tel) 1 800 375 8100 (fax) (65) 836 0252	Malaysia (tel) 1 800 828 848 (fax) 1 800 801 664
India (tel) 1 600 11 2929 (fax) 000 800 650 1101	Hong Kong (tel) 800 930 871 (fax) (852) 2506 9233	Taiwan (tel) 0800 047 866 (fax) (886) 2 25456723
Philippines (tel) (632) 8426802 (tel) (PLDT subscriber only) 1 800 16510170 (fax) (632) 8426809 (fax) (PLDT subscriber only) 1 800 16510288	Thailand (tel) (outside Bangkok) (088) 226 008 (tel) (within Bangkok) (662) 661 3999 (fax) (66) 1 661 3714	People's Republic of China (tel) (preferred) 800 810 0189 (tel) (alternate) 10800 650 0021 (fax) 10800 650 0121

Service and Support Options

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

NOTE	There are many other repair and calibration options available from the Agilent Technologies support organization. These options cover a range of service agreements with varying response times. Contact Agilent for additional information on available service agreements for this product. Refer to “Contacting Agilent” on page 2-9 .
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Calibration Options

Option R-50C-001, Commercial Calibration with Data

This option adds a calibration label, a calibration certificate, and the corresponding calibration data on a 3.5-in floppy disk. This calibration conforms to ISO 9001.

This certificate and data can be obtained by sending your analyzer to Agilent for calibration, along with an order for R-50C-001. Refer to [“Shipping Your Analyzer to Agilent for Service or Repair.”](#)

Option R-50C-002, Standards Compliant Calibration

This option adds a calibration label, an ISO 17025 calibration certificate, and the corresponding calibration data, measurement uncertainties, and guardbands on a CD-ROM.

This certificate and data can be obtained by sending your analyzer to Agilent for calibration, along with an order for R-50C-002. Refer to [“Shipping Your Analyzer to Agilent for Service or Repair.”](#)

Shipping Your Analyzer to Agilent for Service or Repair

IMPORTANT	Agilent Technologies reserves the right to reformat or replace the internal hard disk drive in your analyzer as part of its repair. This will erase all user information stored on the hard disk. It is imperative, therefore, that you make a backup copy of your critical test data located on the analyzer's hard disk before shipping it to Agilent for repair.
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If you wish to send your network analyzer to Agilent Technologies for service or repair:

- Include a complete description of the service requested or of the failure and a description of any failed test and any error message.
- Ship the analyzer using the original or comparable antistatic packaging materials.
- Contact Agilent for instructions on where to ship your analyzer. Refer to [“Contacting Agilent” on page 2-9](#).

3 Tests and Adjustments

Information in This Chapter

This chapter contains procedures to help you check, verify, and adjust your PNA series 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 your analyzer for maximum response.

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 Three at-a-Glance

Section Title	Summary of Content	Start Page
Before You Begin	Items to consider or procedures to perform before testing is begun: <ul style="list-style-type: none">• Verify the Operating Environment• Protect Against Electrostatic Discharge (ESD)• Allow the Analyzer to Warm Up• Review the Principles of Connector Care	Page 3-4
About System Verification and Performance Tests	Descriptions of: <ul style="list-style-type: none">• System Specifications• Instrument Specifications• System Verification Procedure• Performance Tests• Certificate of Calibration	Page 3-6
ANSI/NCSL Z540-1-1994 Verification	The ANSI/NCSL Z540-1-1994 process of verifying your analyzer.	Page 3-8
Non-ANSI/NCSL Z540-1-1994 Verification	The non-ANSI/NCSL Z540-1-1994 process of verifying your analyzer.	Page 3-9

Section Title	Summary of Content	Start Page
Preliminary Checks	Performing the operator's check. Checking your test cables. <i>Perform these checks before performing system verification.</i>	Page 3-10
System Verification	What the system verification does. How to perform the verification test. How to interpret the results.	Page 3-20
Performance Tests (Agilent N2721A Software Package) ^a	A brief summary of each performance test in the Agilent N2721A software package: <ul style="list-style-type: none"> • Source Power Accuracy Test • Source Power Linearity Test • Frequency Accuracy Test • Trace Noise Test • Receiver Compression Test • Noise Floor Test • Calibration Coefficient Test • System Crosstalk Test • Dynamic Accuracy Test 	Page 3-30
Adjustments	Setups and procedures for adjusting your analyzer: <ul style="list-style-type: none"> • Source Calibration Adjustment • Receiver Calibration Adjustment • LO Power Adjustment • 10 MHz Frequency Reference Adjustment • 3.8 GHz PMYO Frequency Adjustment 	Page 3-42

a. The Agilent N2721A software package must be purchased separately.

Before You Begin

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

- make sure the operating environment is within its requirements
- make sure that proper electrostatic discharge (ESD) protection is provided
- make sure the analyzer has warmed up properly to achieve system stability
- 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: $+23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ (Error-corrected temperature range)
Once the measurement calibration has been done, the ambient temperature must be maintained to within $\pm 1\text{ }^{\circ}\text{C}$ of the calibration temperature.
- Humidity: 5% to 95% at 40 $^{\circ}\text{C}$ maximum
- Altitude: 0 to 15,240 meters (50,000 feet.)

Protect Against Electrostatic Discharge (ESD)

This is important. If not properly protected against, electrostatic discharge can seriously damage your analyzer, resulting in costly repair.

CAUTION	To reduce the chance of electrostatic discharge, follow all of the recommendations outlined in “Electrostatic Discharge Protection” on page 1-5 , for all of the procedures in this chapter.
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Allow the Analyzer to Warm Up

NOTE	To achieve the maximum system stability, allow the analyzer to warm up for at least 90 minutes.
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Review the Principles of Connector Care

Proper connector care and connection techniques are critical for accurate and repeatable measurements. Refer to [Table 3-1](#) 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 Agilent Technologies. Refer to [“Contacting Agilent” on page 2-9](#).

Table 3-1 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 • Store connectors or adapters loose
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 contact lightly • Turn only the connector nut • Use a torque wrench for final connection 	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

About System Verification and Performance Tests

The performance of the network analyzer is specified in two ways: system specifications, and instrument specifications. Respectively, the analyzer's conformance to these specifications is verified in two ways: system verification, and performance tests.

System Specifications

System specifications specify warranted performance of the measurement system when making error-corrected measurements. The measurement system includes the analyzer, test cables, and calibration kit.

The analyzer's system specifications are described in the *Agilent PNA Series Network Analyzer Data Sheet* and also in the analyzer's on-line help system.

System specifications are included in section titled "Corrected System Performance."

System specifications are expressed in two ways:

- residual errors of the measurement system
- graphs of measurement uncertainty versus reflection and transmission coefficients

System specifications are applicable when the measurement system is used to make error-corrected measurements.

System specifications are verified in one of the following ways:

- Complete the system verification procedure using a certified verification kit, or
- Complete all of the performance tests and certify (or recertify) the calibration kit that will be used for future measurements. This alternative verifies both the system specifications and the instrument specifications for the analyzer.

Instrument Specifications

Instrument specifications specify the network analyzer's uncorrected measurement port characteristics and its output and input behavior.

The analyzer's instrument specifications are described in the *Agilent PNA Series Network Analyzer Data Sheet* and also in the analyzer's on-line help system. The sections that describe instrument specifications are titled:

- "Uncorrected System Performance"
- "Test Port Output"
- "Test Port Input"

These specifications apply when the analyzer is used to make measurements other than error-corrected measurements. An example would be the measurement of amplifier gain compression.

Performance tests are used to confirm that the analyzer meets the instrument specifications.

System Verification Procedure

The system verification procedure tests the network analyzer measurement system, as defined previously, against the system specifications. If confirmation is successful, the measurement system is capable of making measurements to the accuracy specified by the graphs of measurement uncertainty.

An illustrated outline of the system verification procedure:

- for ANSI/NCSL Z540-1-1994 verification, is shown in [Figure 3-1 on page 3-8](#).
- for non-ANSI/NCSL Z540-1-1994 verification, is shown in [Figure 3-2 on page 3-9](#).

NOTE	Calibration kits are different from verification kits. Calibration kits are used to determine the systematic errors of a network analyzer measurement system. Verification kits are used to confirm system specifications and are not used to generate error correction.
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Performance Tests

Performance tests are used to confirm analyzer performance against the instrument specifications. If confirmation is successful, the analyzer meets the instrument specifications.

If the calibration kit to be used for measurements is also certified, successful completion of the performance tests also ensures that the network analyzer measurement system meets the system specifications.

Certificate of Calibration

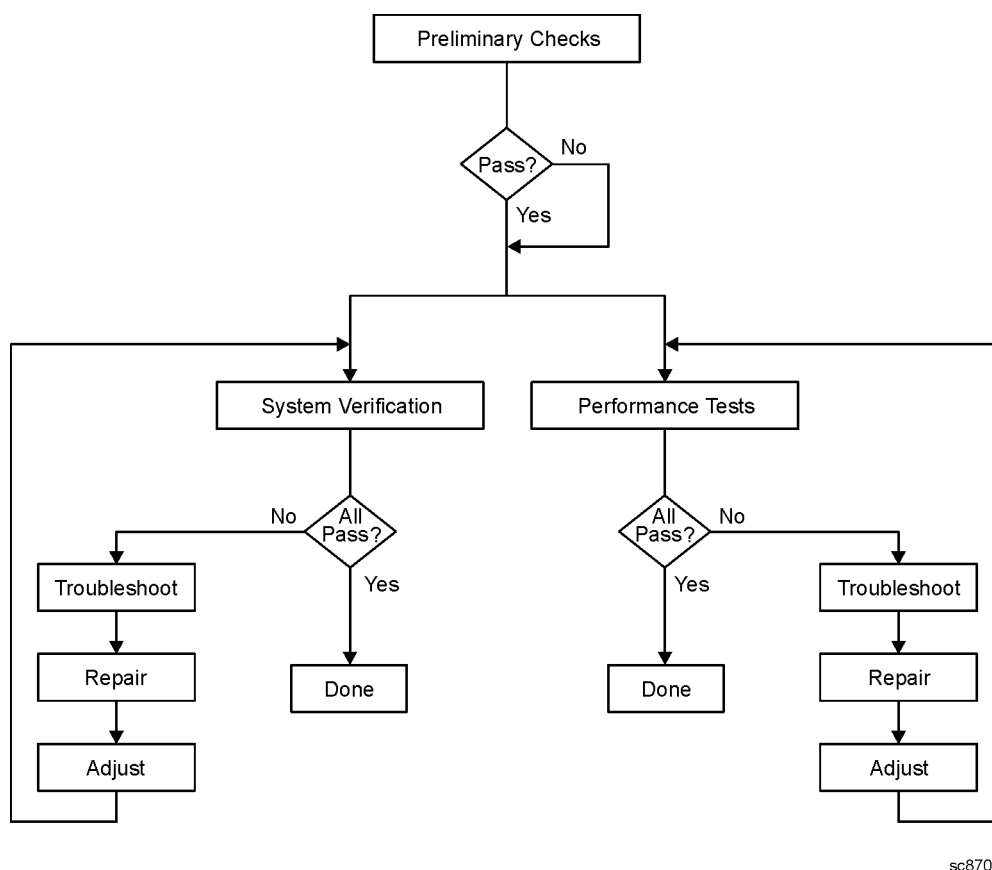
Agilent Technologies will issue a certificate of calibration for the product upon successful completion of system verification or completion of the performance tests. The certificate of calibration will include a “System Attachment” if the system verification procedure is used to confirm the system specifications. If the performance tests are used to confirm instrument specifications, the certificate of calibration will not include a system attachment. The equipment and measurement standards used for the tests must be certified and must be traceable to recognized standards.

NOTE	If you have a measurement application that does not use all of the measurement capabilities of the analyzer, you may ask your local Agilent Technologies service office to verify only a subset of the specifications. However, this creates the possibility of making inaccurate measurements if you then use the analyzer in an application requiring additional capabilities.
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ANSI/NCSL Z540-1-1994 Verification

To meet the criteria for ANSI/NCSL Z540-1-1994, perform the preliminary checks and either system verification or performance tests *without stopping to repair or adjust*¹. Refer to [Figure 3-1](#) for test flow. Print data at the completion of all the tests, even if you are aware that the analyzer did not pass. If there is a failure, complete the verification before you troubleshoot, repair, and adjust. After the failure has been corrected, repeat the entire system verification or performance tests and generate a new set of data.

Figure 3-1 ANSI/NCSL Z540-1-1994 Test Path Verification Flowchart

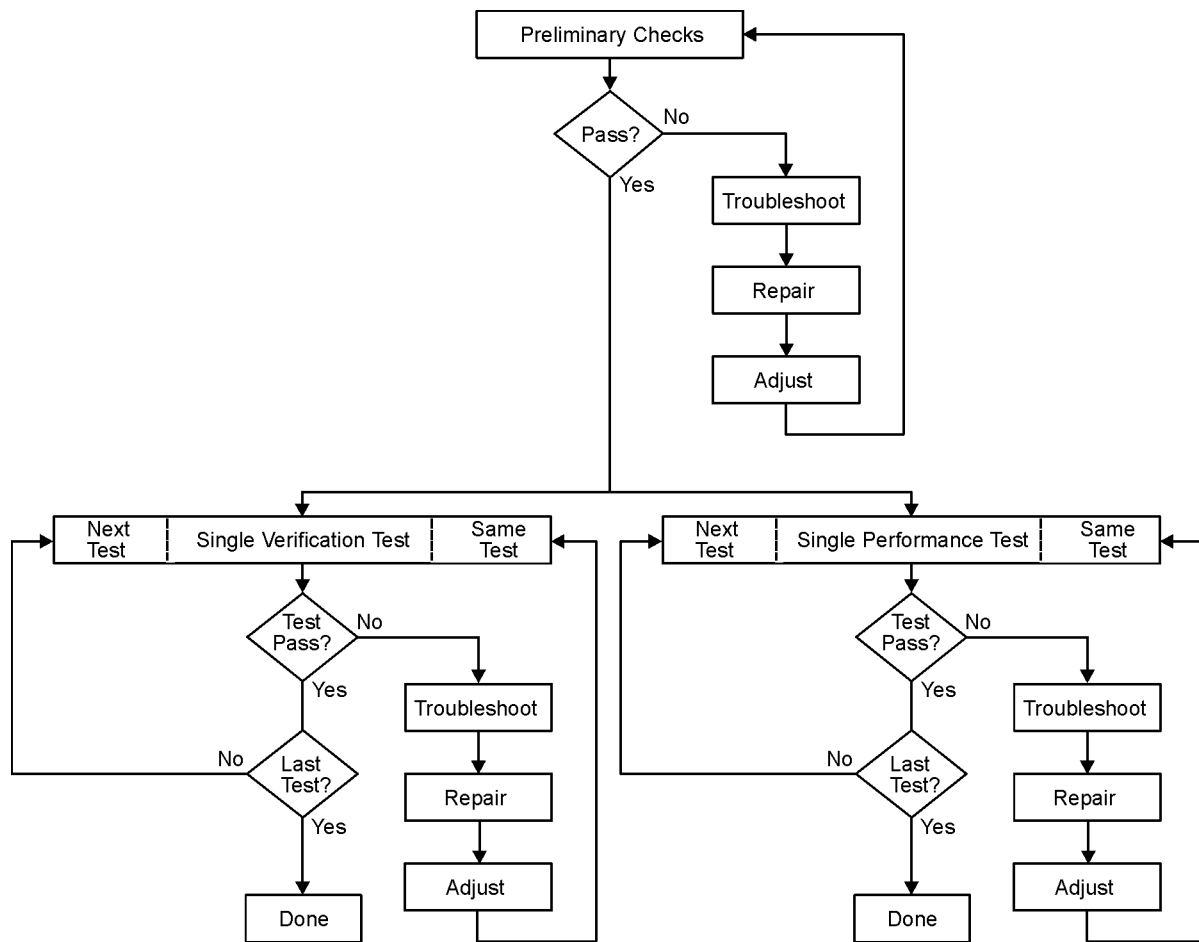


1. Stop only in case of a catastrophic failure or cable connector damage

Non-ANSI/NCSL Z540-1-1994 Verification

For non-ANSI/NCSL Z540-1-1994, perform the preliminary checks and either the system verification or performance tests while *stopping to troubleshoot*. Refer to [Figure 3-2](#) 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. Print out the system verification results or complete the performance test record as the analyzer passes each test.

Figure 3-2 Non-ANSI/NCSL Z540-1-1994 Test Path Verification Flowchart



sc869a

Preliminary Checks

Preliminary checks include the following:

- [“The Operator’s Check” on page 3-10](#)

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

- [“The Test Port Cable Checks” on page 3-13](#)

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.

The Operator’s Check

NOTE	To achieve the maximum system stability, allow the analyzer to warm up for at least 90 minutes before 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:

- operation of the transfer switch (switch repeatability check)
- phase-lock capability across the entire frequency band (switch repeatability check)
- function of the four receivers (switch repeatability check)
- operation of the step attenuators (attenuator range check—Option UNL only)
- receivers’ linearity (attenuator range check—Option UNL only)

Switch Repeatability Check

The check performs a reflection measurement of a short and stores the resulting trace in memory. The transfer switch is toggled to the opposite port and back, 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.

Attenuator Range Check—Option UNL Only

This check performs a reflection measurement of a short and stores the resulting trace in memory. As the internal attenuator is switched in 10 dB steps over its 60 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 60 dB) are verified and operation of the attenuator is verified.

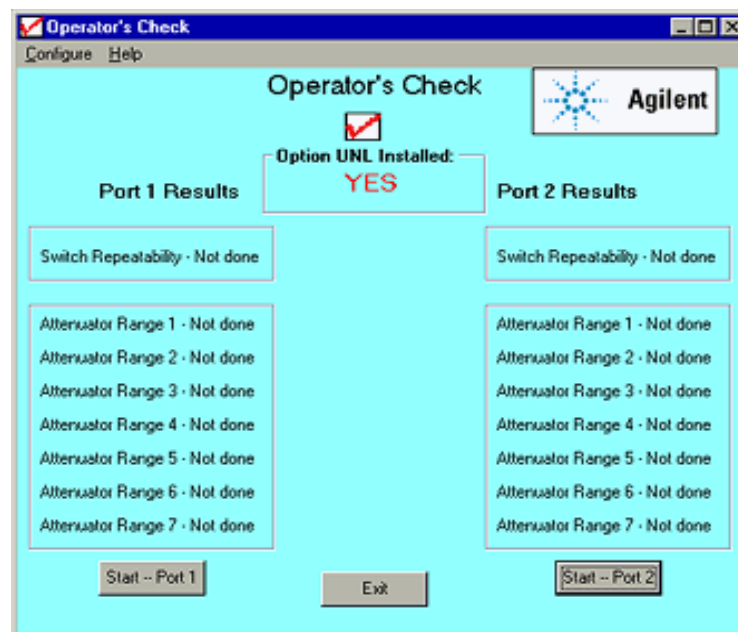
Accessories Used in the Operator's Check

Equipment Type	Models Used With	Part Number
Female short, 3.5 mm	E8362A	85052-60007 (from the 85052 calibration kit)
Female short, 2.4 mm	E8363A, E8364A	85056-60021 (from the 85056 calibration kit)

Performing the Operator's 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 3-3](#)), click **Configure**, and then select either **Automatic**, to run through the test without stopping, or **Prompted**, to pause at each step in the process.
3. To check Port 1, click **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 3-3 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”](#) on page 7-40.

- 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 A36 and A37 60-dB Step Attenuators \(Option UNL\)”](#) on page 7-54.
- 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.

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” on page 3-14
- “Cable Insertion Loss Check” on page 3-15
- “Cable Magnitude and Phase Stability Check” on page 3-16
- “Cable Connector Repeatability Check” on page 3-18

Accessories Used in the Test Port Cable Checks

Equipment Type	Models Used With	Model or Part Number	Alternate Model or Part Number
Calibration kit, 3.5 mm	E8362A	85052B	85052D
RF cable, 3.5 mm (f) to 3.5 mm (f)	E8362A	85131C	85131E
Calibration kit, 2.4 mm	E8363A, E8364A	85056A	85056D
RF cable, 2.4 mm (f) to 2.4 mm (f)	E8363A, E8364A	85133C	85133E

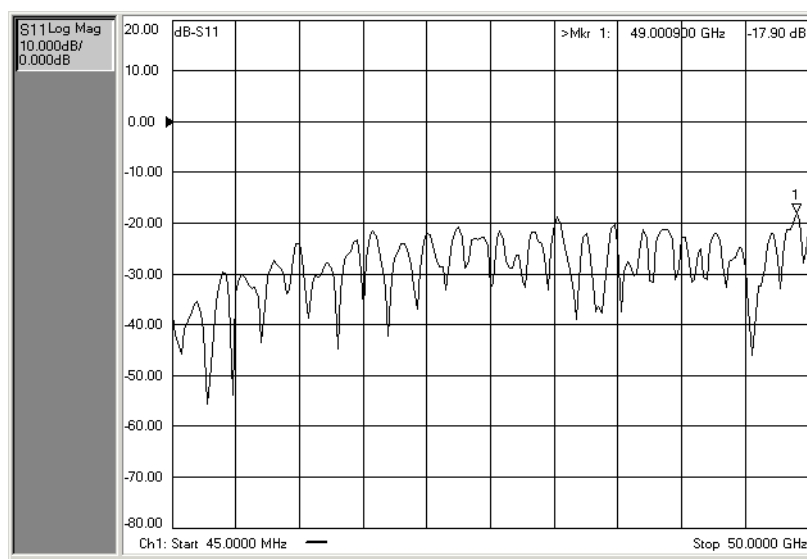
Cable Return Loss Check

1. Press **Preset**.
2. Perform a one-port calibration on Port 1, **1-Port Reflection**. Refer to the embedded help in the analyzer if necessary.
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 3-4](#).

Figure 3-4 Typical Cable Return Loss Response



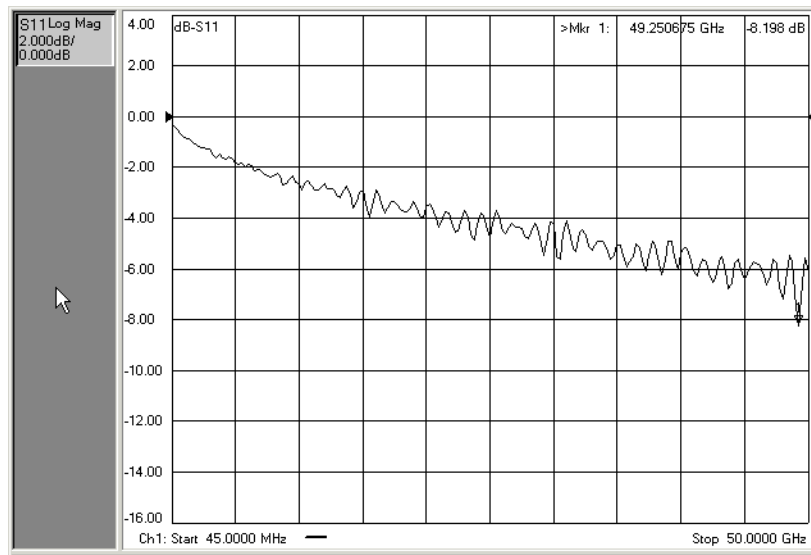
If the Cable Return Loss Check Fails

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. With the test port cable still connected to Port 1, connect a short to the other end of the cable.
2. 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**.
3. 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 3-5](#).

Figure 3-5 Typical Cable Insertion Loss Response



If the Cable Insertion Loss Check Fails

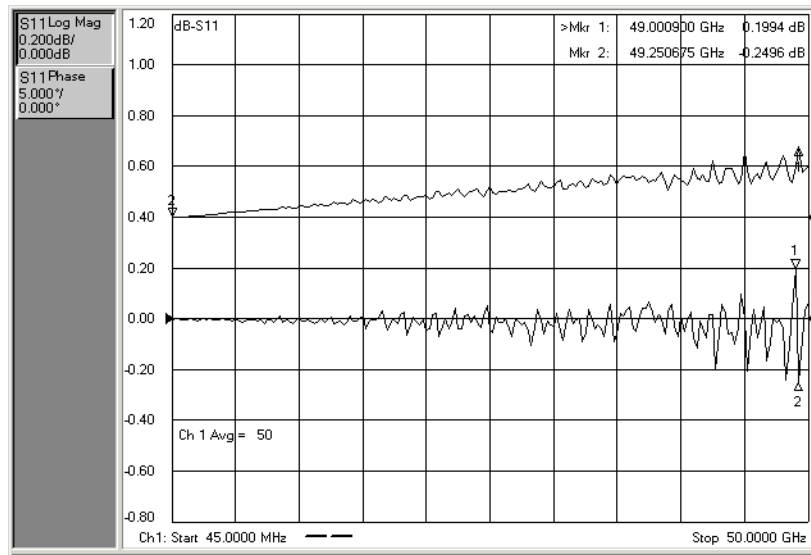
1. Clean the cable and devices and torque to specification. Repeat the check.
2. If the check still fails, the cable should be repaired or replaced.

Cable Magnitude and Phase Stability Check

1. With the test port cable still connected to Port 1, connect a short to the other 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. On the **Channel** menu, click **Restart Avg**.
8. Wait for the analyzer to average the measurement 50 times (approximately two seconds).
9. To normalize the data trace:
 - a. On the **Trace** menu, click **Math/Memory**.
 - b. In the **Math/Memory** dialog box, click the **Data->Memory** button.
 - c. In the **Data Math** list, select **Data/Memory**.
 - d. Under **Trace View Options**, make sure **Data Trace** is selected.
 - e. Click **OK**
10. Slowly make a 180 degree bend in the middle of the cable and hold it in that position.
11. For each trace: On the **Scale** menu, set the **Scale Per Division** for optimum viewing as shown in [Figure 3-6](#).
12. 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 3-6](#).
13. 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 3-6 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

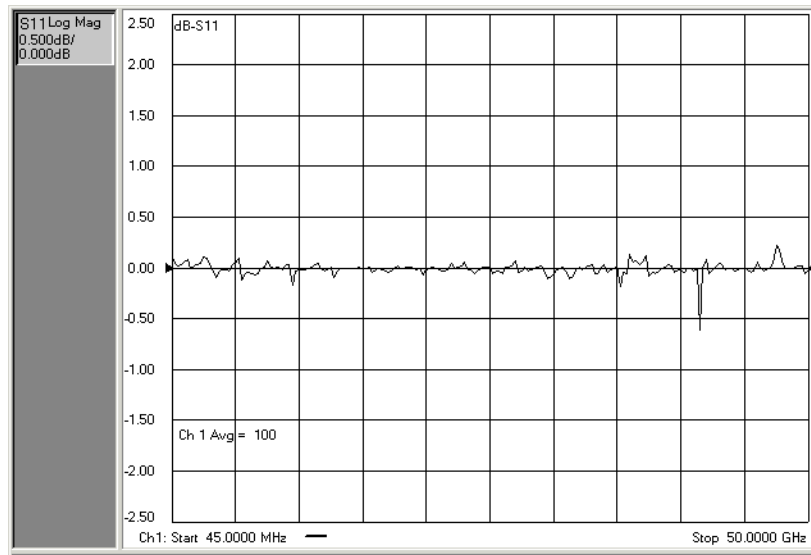
NOTE	The connector repeatability measurement should be done at the test port as well as at the end of the test port cable.
-------------	---

1. With the test port cable still connected to Port 1, connect a broadband load to the other end of the cable.
2. Press **Preset**.
3. 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**.
4. Wait for the analyzer to average the measurement 100 times (approximately five seconds).
5. To normalize the data trace:
 - a. On the **Trace** menu, click **Math/Memory**.
 - b. In the **Math/Memory** dialog box, click the **Data->Memory** button.
 - c. In the **Data Math** list, select **Data/Memory**.
 - d. Under **Trace View Options**, make sure **Data Trace** is selected.
 - e. Click **OK**
6. To adjust the display scale:
 - a. On the **Scale** menu, click **Scale**.
 - b. In the **Scale Per Division** box, click the arrow to select **0.5 dB**.
 - c. In the **Level** box under **Reference** click the arrow to select **0 dB**.
 - d. Click **OK**.
7. Disconnect and then reconnect the cable to the test port. Tighten the connection to the specified torque for the connector type.
8. On the **Channel** menu, click **Restart Avg**.
9. Look at the trace for spikes or modes.
10. To re-normalize the data trace of the reconnected cable:
 - a. On the **Trace** menu, click **Math/Memory**.
 - b. In the **Math/Memory** dialog box, click the **Data->Memory** button.
 - c. Click **OK**.
11. Repeat steps 7 through 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 3-7](#).

12. For the Port 2 Check, connect the cable (with the load attached) to Port 2 and repeat steps 2 through 11.

Figure 3-7 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 proper operation of 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.

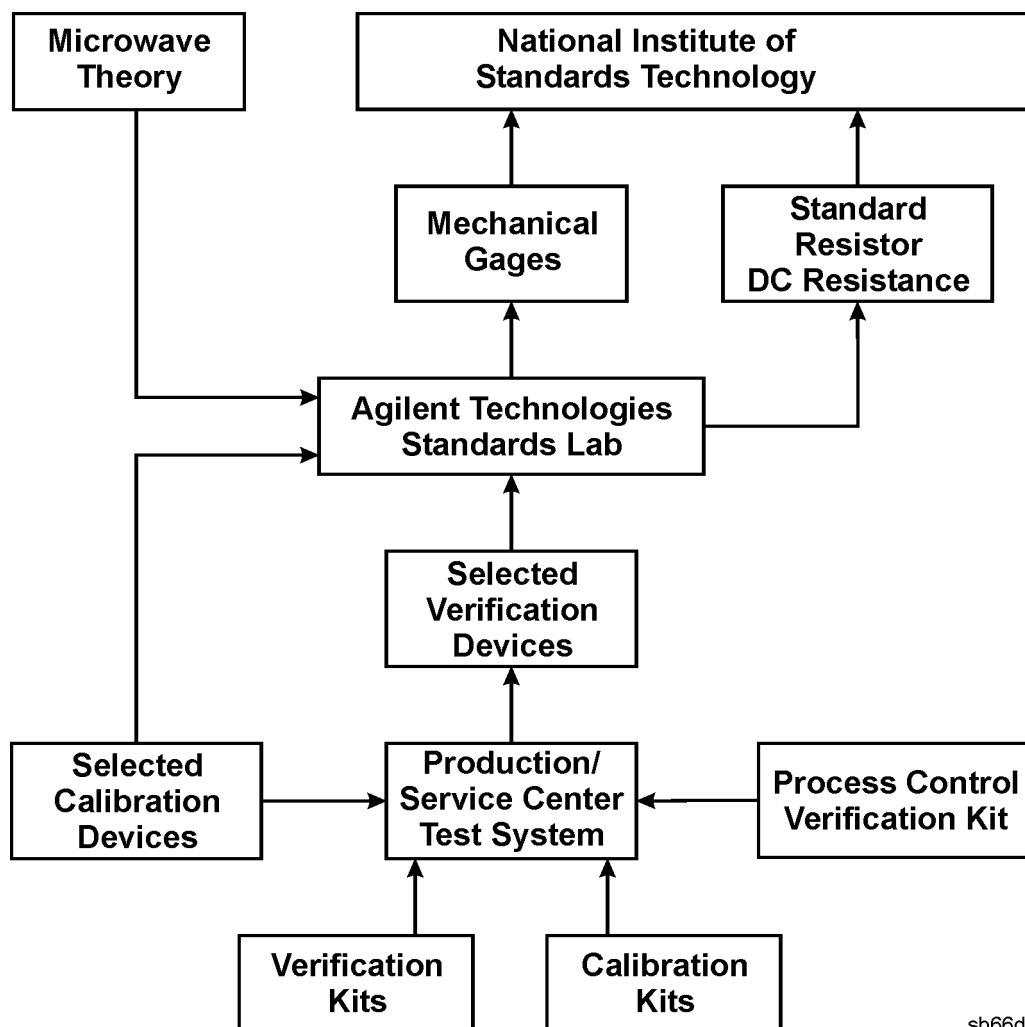
Any measurement result is the vector sum of the actual test device response plus all error terms. The precise effect of each error term depends on its magnitude and phase relationship to the actual test device response. When the phase of an error response is not known, phase is assumed to be worst-case (-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 3-8](#)). This chain of measurements defines how the verification process brings traceability to the network analyzer system.

Figure 3-8 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 the System Verification Procedure

Equipment Type	Models Used With	Model or Part Number	Alternate Model or Part Number
Calibration kit, 3.5 mm	E8362A	85052B	85052D
Verification kit, 3.5 mm	E8362A	85053B	None
RF cable, 3.5 mm (f) to 3.5 mm (f)	E8362A	85131C	85131E
Calibration kit, 2.4 mm	E8363A, E8364A	85056A	85056D
Verification kit, 2.4 mm	E8363A, E8364A	85057B	None
RF cable, 2.4 mm (f) to 2.4 mm (f)	E8363A, E8364A	85133C	85133E

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 RF cable specified in the above table, [“Equipment Used in the System Verification Procedure.”](#) Refer to the cable’s user’s guide for specifications.

Kit Substitution

Non-Agilent calibration kits and verification 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 3-9](#), [Figure 3-10](#), and to your calibration kit manual for connection procedures.

Figure 3-9 Aligning the Center Conductor

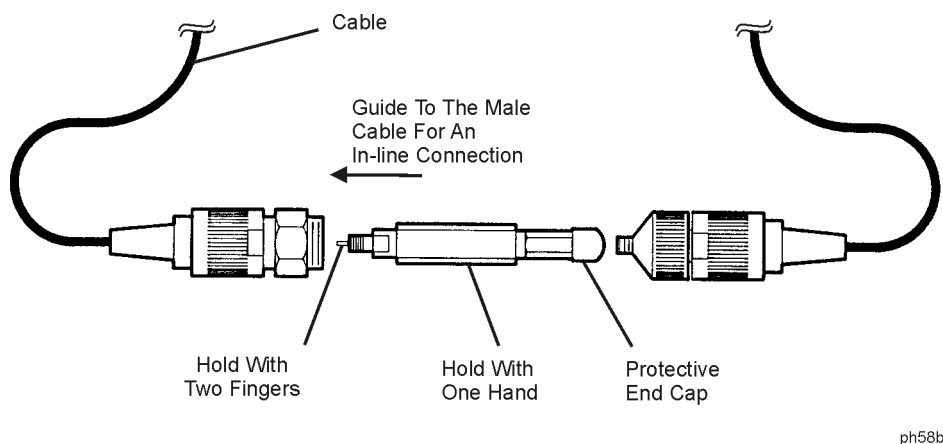
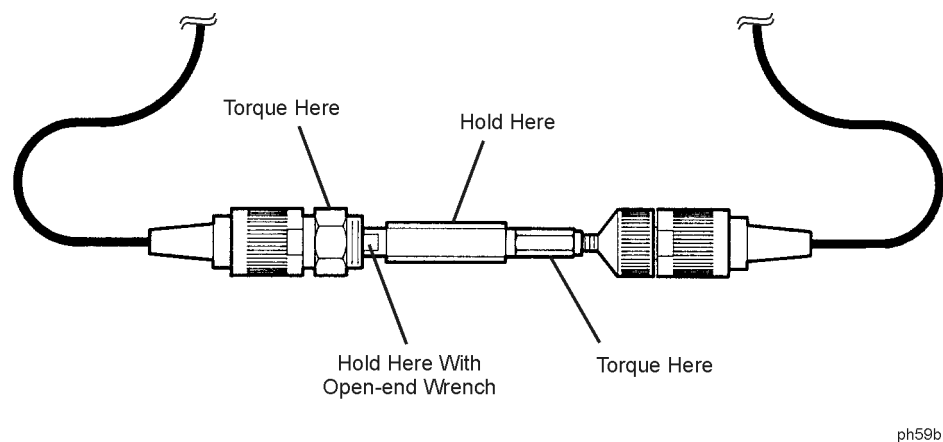


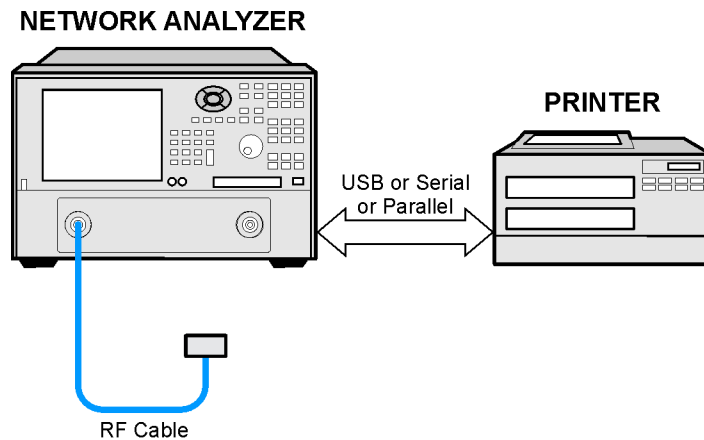
Figure 3-10 Torquing the Connection



System Verification Procedure

1. Connect a cable to Port 1 on the analyzer as shown in [Figure 3-11](#). 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 90 minutes.

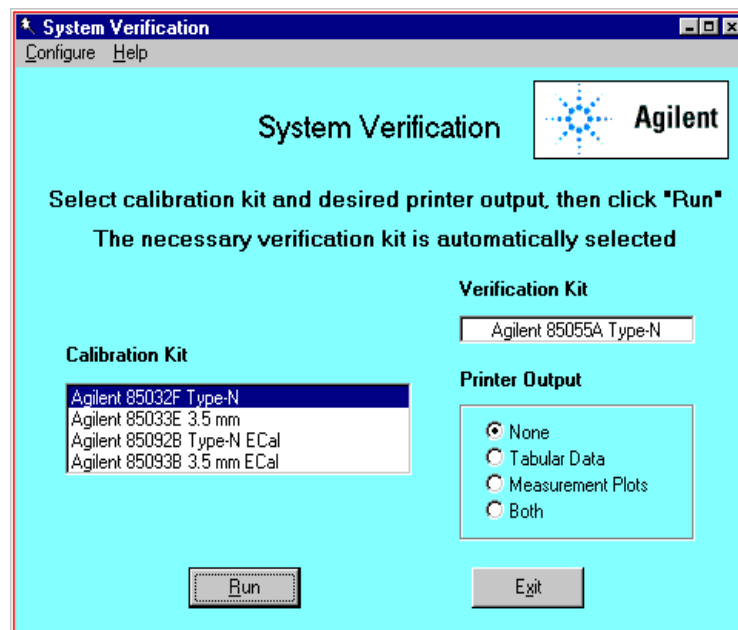
Figure 3-11 System Verification Test Setup



st505a

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 3-12](#).

Figure 3-12 System Verification Dialog Box



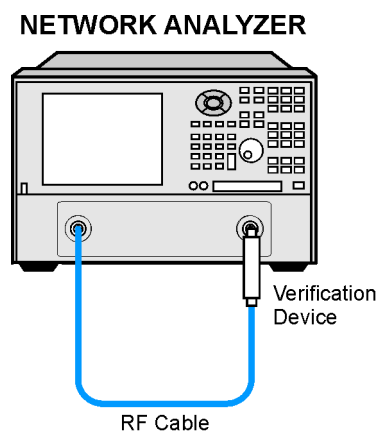
4. In the **Calibration Kit** box, select the calibration kit that is being used by clicking on it. The corresponding verification kit to use is selected for you and displayed in the **Verification Kit** box. Refer to [Figure 3-12](#).
5. Under **Printer Output**, click one of the following options. Refer to [Figure 3-12](#).
 - **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 3-15 on page 3-28](#).
 - **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 3-16 on page 3-29](#).
 - **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 3-13](#).

Figure 3-13 System Verification Device Connections



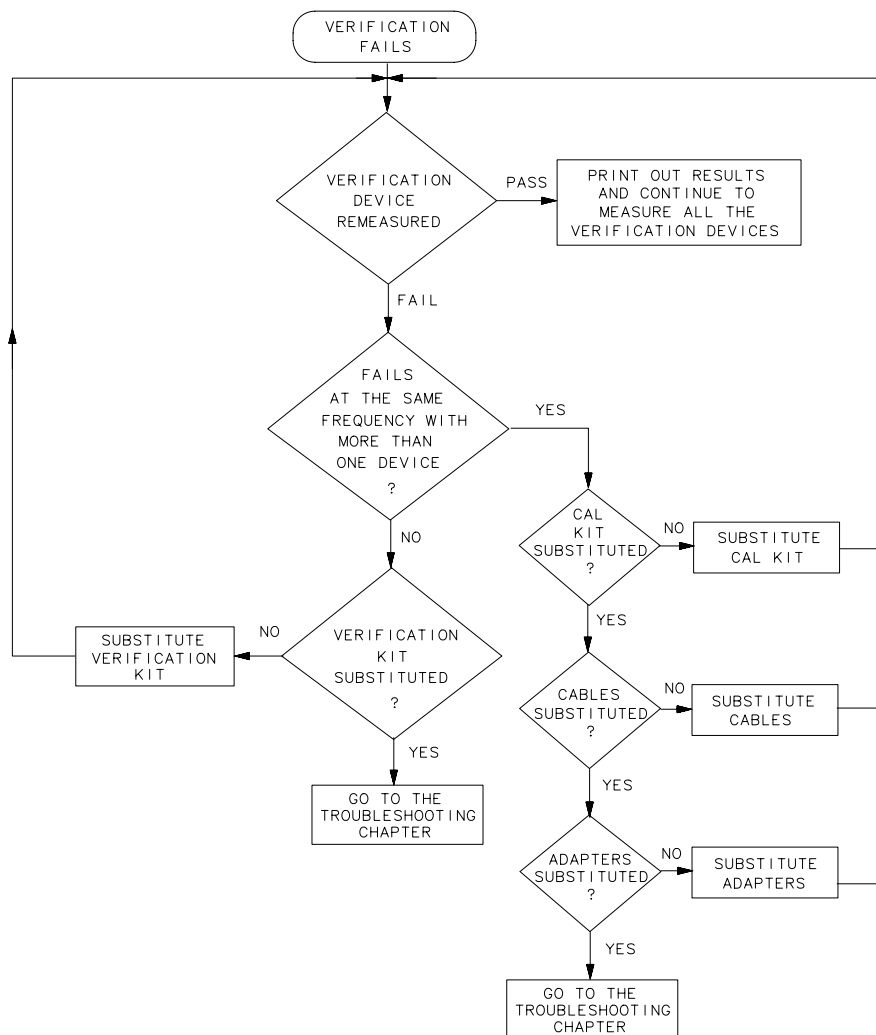
st506a

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 [“Accessing Error Terms” on page A-6](#).
5. Refer to [Figure 3-14](#) for additional troubleshooting steps.

Figure 3-14 System Verification Failure Flowchart



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Interpreting the Verification Results

Figure 3-15 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 3-15 Example of Printed Tabular Verification Results

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

S11 Results

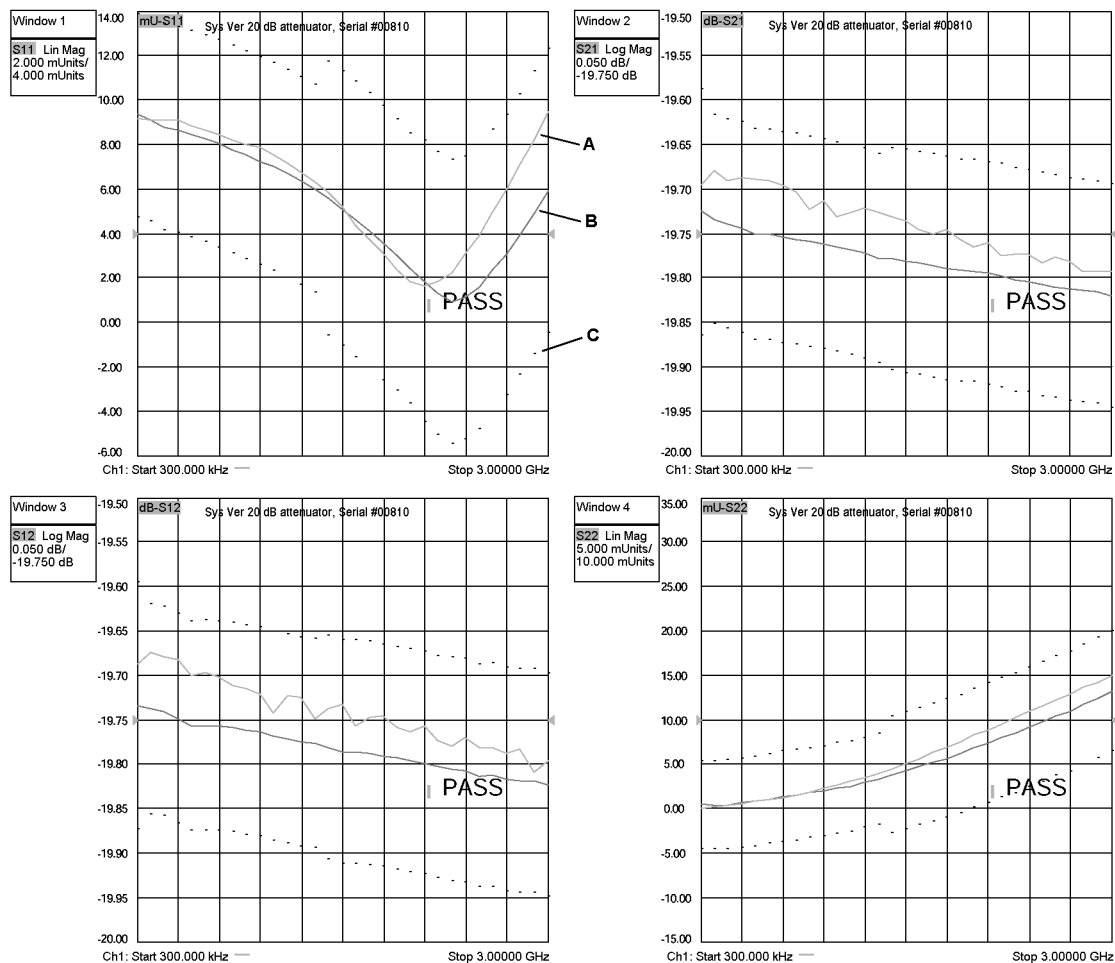
Frequency	Lower Limit	Measured Data	Upper Limit	Result
0.3 MHz	0.0048 Units	0.0090 Units	0.0139 Units	PASS
100	0.0046	0.0091	0.0137	PASS
200	0.0042	0.0092	0.0134	PASS
300	0.0040	0.0091	0.0133	PASS
400	0.0038	0.0089	0.0131	PASS
500	0.0036	0.0087	0.0129	PASS
600	0.0034	0.0085	0.0127	PASS
700	0.0031	0.0082	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 3-16 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 3-16.
- Data measured at the factory from the verification kit. Labeled as B in Figure 3-16.
- Upper and lower limit points as defined by the total system uncertainty system. Labeled as C in Figure 3-16.

Figure 3-16 Example of Printed Graphical Verification Results



Performance Tests (Agilent N2721A Software Package)

The Agilent N2721A software package verifies the electrical performance of your E8364A PNA series microwave network analyzer. 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 model numbers of the equipment used are specified under [“Required Service Test Equipment”](#) on page 2-6.

There are nine tests in the software package:

- [Source Power Accuracy Test](#)
- [Source Power Linearity Test](#)
- [Frequency Accuracy Test](#)
- [Trace Noise Test](#)
- [Receiver Compression Test](#)
- [Noise Floor Test](#)
- [Calibration Coefficient Test](#)
- [System Crosstalk Test](#)
- [Dynamic Accuracy Test](#)

Source Power Accuracy Test

Function of the Test: To confirm the accuracy of the source output power of your network analyzer over its full frequency range.

Specification Tested: Test Port Output–Power Level Accuracy

Equipment Used: A power meter, power sensors, and adapters.

Description of the Test:

1. The analyzer’s output power level is set to 0 dBm.
2. A power sensor is connected to Port 1.
3. The output power is measured at hundreds of CW frequencies across the analyzer’s frequency range and the values compared to the setting of 0 dBm.

If the Analyzer Fails this Test:

- Perform the [“Source Calibration Adjustment”](#) on page 3-43 and repeat this test.
- If the analyzer still fails this test, replace the source assembly and repeat this test. Refer to [“Removing and Replacing the A12 Source 20”](#) on page 7-22.

Source Power Linearity Test

Function of the Test: To verify that the power level is linear over the analyzer's frequency range and to check the linearity of the automatic leveling control (ALC).

Specification Tested: Power Sweep Range and Power Level Linearity

Equipment Used: A test cable. (And a 20 dB pad if the analyzer does not have an internal step attenuator.)

Description of the Test:

1. The Port 2 receiver is used to test Port 1. The receiver linearity is the standard against which the source linearity is checked.
2. A test cable is connected between Port 1 and Port 2 with 20 dB of attenuation in series with the cable. This can be done with an internal step attenuator or an external 20 dB pad. This attenuation ensures that the receiver remains in its linear range.
3. The analyzer is set to 25 different points across its frequency range.
4. At each frequency point, the output power level on Port 2 is set to 0.000 dBm and the power is measured to establish a reference, $P_{\text{reference}}$.
5. The source setting is then stepped from -15 to +10 dBm in 1 dB steps and the power is measured, P_{measured} , at each setting.
6. The non-linearity in dB at each frequency point is calculated as:
 $(P_{\text{measured}} - P_{\text{reference}}) - (\text{source setting})$

If the Analyzer Fails this Test:

- Perform the [“Source Calibration Adjustment” on page 3-43](#) and repeat this test.
- If the analyzer still fails this test, replace the source assembly and repeat this test. Refer to [“Removing and Replacing the A12 Source 20” on page 7-22](#).

Frequency Accuracy Test

Function of the Test: To verify the frequency accuracy and range of the analyzer's source output.

Specification Tested: Test Port Output–CW Accuracy

Equipment Used: A frequency counter, a test cable, and adapters.

Description of the Test:

1. Port 1 is connected to a frequency counter.
2. A series of frequencies across the band are checked.

If the Analyzer Fails this Test:

- Verify the accuracy of the 10 MHz OCXO by connecting a frequency counter to the rear-panel 10 MHz REF OUT.
- If the 10 MHz reference is off by more than 10 Hz, perform the [“10 MHz Frequency Reference Adjustment” on page 3-49](#) and also the [“3.8 GHz PMYO Frequency Adjustment” on page 3-50](#) and repeat this test.

Trace Noise Test

Function of the Test: To measure the stability of a signal in the internal source and receiver system of your analyzer.

Specification Tested: Test Port Input–Trace Noise Magnitude and Trace Noise Phase

Equipment Used: A test cable.

Description of the Test:

1. Port 1 and Port 2 are connected with a test cable.
2. The analyzer is set to a series of CW frequencies across its frequency range.
3. Magnitude and phase are measured at each frequency at both 1 kHz and 10 kHz IF bandwidths, in both directions.
4. All measurements are made at a nominal power level of 0 dBm and with 201 points per sweep.

If the Analyzer Fails this Test:

- Repeat this test. It is unlikely for the analyzer to fail this test without a complete failure of the network analyzer system.
- If the analyzer still fails this test, perform the [“Receiver Calibration Adjustment” on page 3-44](#) and repeat this test.

Receiver Compression Test

Function of the Test: To measure the compression at the analyzer’s specified maximum power level for the receivers.

Specification Tested: Test Port Input–Maximum Test Port Input Level

Equipment Used: The compression test set (Z5623A Option K01), a power meter, power sensors, two test cables, and a calibration kit. (And 10-dB and 20-dB pads if the analyzer does not have an internal step attenuator.)

Description of the Test:

1. All measurements are made with a 50 kHz IF bandwidth and 201 points per sweep.
2. The measurements are made separately on each port.
3. The analyzer is set to various CW frequencies across the range of the analyzer.
4. A power sensor is connected to the “signal source point” to be used to test the port. The “signal source point” may be either the port connector itself, when a short is used, or the end of the test cable, when the compression test set is used.
5. The analyzer source output level is adjusted to create the maximum power level specified for the receiver.
6. The power sensor is disconnected and the “signal source point” is connected to the port to be tested.
7. The absolute log magnitude value (dBm) for the reference channel on the source port is read.

8. The log magnitude ratioed measurement using the receiver under test is read: (P_a).
9. The source output level is adjusted to decrease the output by 15 dB.
10. The log magnitude ratioed measurement using the receiver under test is read: (P_b).
11. Attenuation of 20 dB is introduced between the source and receiver. This can be done with an internal step attenuator, an external 10 dB pad (if a short is being used to reflect the signal back into the port), or an external 20 dB pad (if the signal source is the compression test set).
12. The log magnitude ratioed measurement using the receiver under test is read: (P_c).
13. The source output level is adjusted to produce a reading of P_{ref} (within ± 0.03 dBm) for the reference channel on the source port.
14. The log magnitude ratioed measurement using the receiver under test is read: (P_d).
15. The compression in dB = $(P_a - P_b) - (P_d - P_c)$.

If the Analyzer Fails this Test:

- Repeat this test. There are no adjustments that can be made.
- Since all four receivers are identical, the suspect failed receiver can be swapped with one of the other receivers to verify that it is faulty. Swap the suspect receiver and repeat this test. Refer to [“Removing and Replacing the A31, A32, A33, and A34 Receiver Modules” on page 7-50](#).
- If the faulty channel “follows” the receiver, replace the receiver. If the same channel (now with a different receiver) is still faulty, suspect the associated cabling.

Noise Floor Test

Function of the Test: To measure the absolute power level of the noise floor for the analyzer’s receivers.

Specification Tested: Test Port Input–Test Port Noise Floor

Equipment Used: A power meter, power sensor, a calibration kit, and a test cable.

Description of the Test:

1. The analyzer is set to various CW frequencies across its frequency range at an IF bandwidth of 1 kHz and 801 points per sweep.
2. A test cable is connected to the driving port for the measurement and a power sensor is connected to the other end of the cable.
3. The power level at the end of the cable is set to -5.00 dBm.
4. The power sensor is disconnected and the cable is connected to the port to be tested.
5. The absolute power level in dBm (log magnitude) is read: (P_{log}).
6. The test cable is removed and loads are connected to both ports.
7. The analyzer’s trace is set to represent the absolute power level (linear magnitude) for the receiver under test and a sweep is taken.

8. The mean of the points on the trace, in watts, is read: (P_{lin}).
9. Average power in dBm is calculated: $P_{dBm} = 10 * \log_{10}(P_{lin} * 1000)$.
10. Corrected noise floor in dBm for a 10 Hz IF bandwidth = $P_{dBm} - 19.96 \text{ dB} - (5.00 - P_{log})$.

If the Analyzer Fails this Test:

- A failure of this test indicates a failure of one or more of the following assemblies.
 - A31 channel A receiver
 - A34 channel B receiver
 - A6 SPAM board
- Since all four receivers are identical, the channel A and channel B receivers can be swapped with the channel R1 and channel R2 receivers to determine if they are the cause of the failure. Refer to [“Removing and Replacing the A31, A32, A33, and A34 Receiver Modules” on page 7-50](#). After swapping the receivers, repeat this test.
- If the analyzer still fails this test, replace the A6 SPAM board and repeat this test. Refer to [“Removing and Replacing the A6, A8, and A10 Boards” on page 7-18](#).

Calibration Coefficient Test

Function of the Test: To verify the uncorrected calibration coefficients of your analyzer. The calibration coefficients are measured in forward and reverse direction. Refer to [Appendix A, “Error Terms,”](#) for error term information relating to the calibration coefficients measured.

Specification Tested: Uncorrected System Performance

Equipment Used: A calibration kit and a test cable.

Description of the Test:

1. A series of 2-port calibrations are performed. Two full SOLT 2-port calibrations are performed on each port. Isolation is turned off during each 2-port calibration.
2. A test cable is attached to the first port, and a calibration is performed at the end of the cable and at the second port. The cable is moved to the second port and another calibration is performed. Using two calibrations helps to eliminate the unknown characteristics of the through cable.
3. Each calibration produces 12 error terms.
4. The error terms are used to determine the following characteristics: directivity, source match, load match, reflection tracking, and transmission tracking.

If the Analyzer Fails this Test:

- If the analyzer fails tracking error terms only, perform [“Receiver Calibration Adjustment” on page 3-44](#) and repeat this test.
- Failure of any other error terms indicate a hardware failure. Refer to the appropriate error term discussion in [Appendix A, “Error Terms,”](#) for a typical cause of failure. Refer to [Chapter 7, “Repair and Replacement Procedures,”](#) for instructions on replacing the suspected faulty component or assembly.

System Crosstalk Test

Function of the Test: To measure the level of signal leakage between the analyzer's test ports.

Specification Tested: Test Port Input–Crosstalk

Equipment Used: A calibration kit and a test cable.

Description of the Test:

1. The analyzer is tested in both directions at various frequency segments.
2. The analyzer sweep is set for the desired frequency and number of points at a 10 Hz IF bandwidth. The power level is set to the lesser of either the maximum specified power level for the driving port or the maximum input power level for the receiving port.
3. A test cable is connected between the driving and receiving ports.
4. The analyzer is set for a ratioed through measurement (S21 for example) with log magnitude display and a sweep is taken and stored to memory (MEM).
5. The trace is set to data divided by memory (DATA/MEM).
6. The test cable is removed and shorts are placed on both ports.
7. The average of 16 sweeps is taken.
8. The resultant log magnitude trace represents the system crosstalk in dB for the frequency range or segment tested.

If the Analyzer Fails this Test:

- A failure of this test usually indicates one of the following:
 - a loose cable connection
 - degradation of signal isolation in the receivers
 - degradation of signal isolation on the A35 receiver motherboard
- Remove the covers from the analyzer and tighten all RF cable connections and tighten all screws on the receivers and repeat this test. Refer to [“Removing and Replacing the A31, A32, A33, and A34 Receiver Modules”](#) on page 7-50 for instructions on how to remove the covers and for illustrations of the cable and screw locations.
- If the analyzer still fails this test, replace the receiver associated with the port that is failing and repeat this test. Refer to [“Removing and Replacing the A31, A32, A33, and A34 Receiver Modules”](#) on page 7-50.
- If the analyzer still fails this test, replace the A35 receiver motherboard and repeat this test. Refer to [“Removing and Replacing the A35 Receiver Motherboard”](#) on page 7-52.

Dynamic Accuracy Test

Function of the Test: To measure the relative power linearity of the analyzer's receivers.

Specification Tested: Test Port Input–Dynamic Accuracy

Equipment Used: The dynamic accuracy test set (Z5623A Option H01), a power meter (E4418B or E4419B Option G12 or Option H12)¹, power sensors, and two test cables.

Description of the Test:

1. The analyzer's test ports are tested separately at a specific CW frequency and a reference power level of -20 dBm.
2. The analyzer's driving port is connected to the dynamic accuracy test set's source port and the analyzer's receiving port is connected to the dynamic accuracy test set's receiver port. A power sensor is connected to the dynamic accuracy test set's power meter port.
3. The dynamic accuracy test set is used to input a signal from the driving port on the analyzer. The input signal is routed through step attenuators to both the analyzer and a power sensor.
4. The analyzer source and the dynamic accuracy test set create power levels that are "deltas" from the reference power level of -20 dBm. Each delta is measured two ways: by the power sensor and by the analyzer's receiver under test.
5. The analyzer's power level into the port under test is set to the -20 dBm reference level.
6. The power level is measured with the power sensor: (P_{mr}).
7. The power level is measured using the analyzer's receiver under test: (P_{pr}).
8. The power level into the analyzer's port under test is stepped, in 5 dB steps, over the range of 0 to -120 dBm. Each power level represents a "delta" from the reference power level.
9. At each step, the power level is measured using the power meter: (P_{md}).
10. At each step, the power level is measured using the receiver under test: (P_{pd}).
11. The power error in dB = $(P_{mr} - P_{md}) - (P_{pr} - P_{pd})$.

If the Analyzer Fails this Test:

- A failure of this test indicates a failure of one or more of the following assemblies.
 - A31 channel A receiver
 - A34 channel B receiver
 - A6 SPAM board
- Since all four receivers are identical, the channel A and channel B receivers can be swapped with the channel R1 and channel R2 receivers to determine if they are the cause of the failure. Refer to ["Removing and Replacing the A31, A32, A33, and A34 Receiver Modules" on page 7-50](#). After swapping the receivers, repeat this test.
- If the analyzer still fails this test, replace the A6 SPAM board and repeat this test. Refer to ["Removing and Replacing the A6, A8, and A10 Boards" on page 7-18](#).

1. This test requires a higher accuracy power meter than standard. Refer to ["Required Service Test Equipment" on page 2-6](#) for specifications. If an Option G12 or H12 power meter is not available, refer to the ["Power Meter Accuracy Test" on page 3-37](#) to verify the accuracy of a standard power meter.

Power Meter Accuracy Test

This test is intended for power meters used in testing the PNA series network analyzers. The “[Dynamic Accuracy Test](#)” requires the use of a power meter that has been calibrated to a higher accuracy than the standard power meter.

Power meters with options G12 and H12 specify an improved instrumentation accuracy over a limited power range. (These power meters do not contain unique hardware.) A power meter may be returned to the factory to have one of these options added to an existing power meter or to renew the calibration for one of these options.

This test procedure is an alternative to returning the power meter to the factory. When a power meter passes this test, it is considered to be *calibrated* for the G12 or H12 option even though it has not been returned to the factory.

This test procedure is available on the Internet as a separate document, Agilent Part Number E8356-90051. The on-line document may have a more recent print date. Refer to “[Contacting Agilent](#)” on page 2-9 for the Internet address (URL).

EPM Series Power Meters That Can Be Tested Using This Procedure

This procedure assumes that the recommended model number power meter is being tested. The alternate model numbers can be tested but the necessary procedural steps may differ.

Recommended Model Number	Alternate Model Numbers
E4419B	E4418A/B, E4419A, EPM-441A, EPM-442A

NOTE It is recommended that the revision number for the power meter “Main Firmware” be Ax.03.00 or higher. This applies to all power meter model numbers listed above (both recommended and alternate).

Equipment Used for the Power Meter Accuracy Test

Equipment Type	Recommended Model or Part Number	Alternate Model or Part Number
Range calibrator	11683A	None
Precision digital voltmeter	3458A	Any with the required accuracy and resolution ^a
Power sensor cable	8120-8319, 11730A	Any equivalent
Cable, BNC, 50Ω	Any	Any
Adapter for connecting BNC cable to DVM inputs	Any	Any

- a. Required accuracy and resolution at the following voltage levels:
- | | | |
|----------------|------------------|-------------------|
| 14 mV input: | 0.0100% accuracy | 10 nV resolution |
| 0.140 V input: | 0.0050% accuracy | 100 nV resolution |
| 0.450 V input: | 0.003% accuracy | 100 nV resolution |

Description of the Test

The power meter accuracy is verified for various power inputs and the actual readings are recorded in a test record. A range calibrator is used to provide the reference inputs.

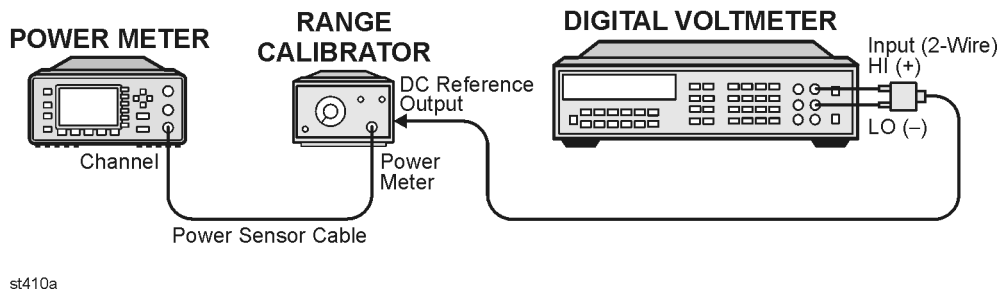
NOTE It is recommended that a copy of the test record on [page 3-41](#) be made, and the values be recorded on the copy, thus preserving the original for future use.

Test Procedure

NOTE This procedure assumes the use of the recommended equipment model numbers. The actual steps required, therefore, may differ for other model numbers of equipment used.

1. Setup the equipment as shown in [Figure 3-17](#):
 - a. Connect the DC REFERENCE OUTPUT connector on the rear panel of the range calibrator to the DVM voltage input.
 - b. Connect the POWER METER output of the range calibrator to the input of the power meter being tested.
 - c. Switch on the power to the power meter, the range calibrator, and the digital voltmeter.

Figure 3-17 Setup for the Power Meter Accuracy Test



2. Preset the power meter: Press **[Preset/Local]**, then **Confirm**.
3. Perform the following steps for each channel on the power meter:
 - a. Set to read in dBm: Press **[dBm/W]**, then **dBm**.
 - b. Set the ref cal factor to 100%: Press **[Zero/Cal]**, **Cal**, **A/B Ref CF**, then set to **100.0**, if necessary.
 - c. Set the cal factor to 100%: Press **[Frequency/Cal Fac]**, **A/B Cal Fac**, then set to **100.0**, if necessary.
 - d. Set readout to 0.001 dBm: Press **[Meas Setup]**, then **Resolution 1 2 3 4**, to highlight **4**.
 - e. Set filter step detect on and filter length to 512: Press **[System/Inputs]**, channel **A** or **B Input Settings**, **[More]**, **Ch A/B Filter**, **Step Det On**, **Filter On**, **Mode MAN**, **Length**, then set the filter length to **512**.

4. Setup the digital voltmeter (DVM) as follows:
 - a. Reset the DVM: Press the **blue key** followed by **Reset**.
 - b. Set the sample period to a value greater than one second: Press **NPLC, 5, 0**, then **Enter**.
5. Set the range calibrator controls as follows:
POLARITY NORMAL
RANGE 1 mW
FUNCTION CALIBRATE
6. Allow the equipment to warm up for approximately 30 minutes. Do not change any connections or control settings during this time.
7. Zero and calibrate the power meter channel to which the range calibrator is connected:
 - a. The range calibrator's RANGE switch should be set to 1 mW.
 - b. Set the range calibrator's FUNCTION switch to STANDBY.
 - c. Press **[Zero/Cal]**, then **Zero A** or **Zero B** (as appropriate). Wait for the operation to complete.
 - d. Set the range calibrator's FUNCTION switch to CALIBRATE.
 - e. Press **[Zero/Cal]**, **Cal**, then **Cal A** or **Cal B** (as appropriate). Wait for the operation to complete.
8. Monitor the drift rate of the power meter reading: Five minutes following calibration, the meter must read 0.001, 0.000, or -0.001 dBm. If the power meter reading is not one of these values, allow additional warm up time, then check the drift rate again. The range calibrator must remain connected to the power meter during this warm up time.
9. Zero and calibrate the power meter channel to which the range calibrator is connected:

NOTE	After a channel on the power meter is calibrated, do not allow more than 5 minutes to elapse before completing the remaining measurement steps for that channel.
-------------	--

- a. The range calibrator's RANGE switch should be set to 1 mW.
 - b. Set the range calibrator's FUNCTION switch to STANDBY.
 - c. Press **[Zero/Cal]**, then **Zero A** or **Zero B** (as appropriate). Wait for the operation to complete.
 - d. Set the range calibrator's FUNCTION switch to CALIBRATE.
 - e. Press **[Zero/Cal]**, **Cal**, then **Cal A** or **Cal B** (as appropriate). Wait for the operation to complete.
10. Record the DVM voltage reading as value A in the test record on [page 3-41](#).

NOTE	All DVM readings in this procedure should be recorded showing five significant digits.
-------------	--

11. The reading on the power meter should be 0.000 ±0.001 dBm.

12. Switch the range calibrator RANGE to 300 μ W.
13. Record the DVM voltage reading as value B in the test record.
14. Wait for the power meter reading to settle (no settling drift within 20 seconds).
15. Record the power meter reading as value C in the test record.
16. Switch the range calibrator RANGE to 100 μ W.
17. Record the DVM voltage reading as value D in the test record.
18. Wait for the power meter reading to settle (no settling drift within 20 seconds).
19. Record the power meter reading as value E in the test record.
20. If testing a dual-channel power meter, perform steps 7 through 19 for the other channel.
21. Perform the pass/fail calculations indicated on the test record.

NOTE	If a channel of the power meter does not pass this test, the power meter cannot be used in applications that require Option G12 or H12. There are no adjustments that can be performed to improve the performance of the power meter. Typically, replacing the A6 measurement assembly associated with the failed channel will correct the problem.
-------------	---

TEST RECORD FOR POWER METER ACCURACY TEST				
Power Meter Tested: Model No.: _____ Serial No.: _____				
Date: _____ Tested by: _____				
Test Equipment Used				
Range Calibrator: Model No.: 11683A Serial No.: _____				
Digital Voltmeter: Model No.: _____ Serial No.: _____				
Test Results				
Range Calibrator Setting	Channel A		Channel B	
	DVM Reading (Vdc)	Power Meter Reading (dBm)	DVM Reading (Vdc)	Power Meter Reading (dBm)
1 mW	A = _____	0.000 ±0.001	A = _____	0.000 ±0.001
300 µW	B = _____	C = _____	B = _____	C = _____
100 µW	D = _____	E = _____	D = _____	E = _____
Pass/Fail Calculations				
300 µW	R = B/A = _____ S = 10 ^(C/10) = _____ % ERROR = ((R-S)/R) × 100 = _____ % Limits: ±0.13% Pass <input type="checkbox"/> Fail <input type="checkbox"/>		R = B/A = _____ S = 10 ^(C/10) = _____ % ERROR = ((R-S)/R) × 100 = _____ % Limits: ±0.13% Pass <input type="checkbox"/> Fail <input type="checkbox"/>	
100 µW	T = D/A = _____ U = 10 ^(E/10) = _____ % ERROR = ((T-U)/T) × 100 = _____ % Limits: ±0.10% Pass <input type="checkbox"/> Fail <input type="checkbox"/>		T = D/A = _____ U = 10 ^(E/10) = _____ % ERROR = ((T-U)/T) × 100 = _____ % Limits: ±0.10% Pass <input type="checkbox"/> Fail <input type="checkbox"/>	

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 3-43
- “Receiver Calibration Adjustment” on page 3-44
- “LO Power Adjustment” on page 3-47
- “10 MHz Frequency Reference Adjustment” on page 3-49
- “3.8 GHz PMYO Frequency Adjustment” on page 3-50

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.

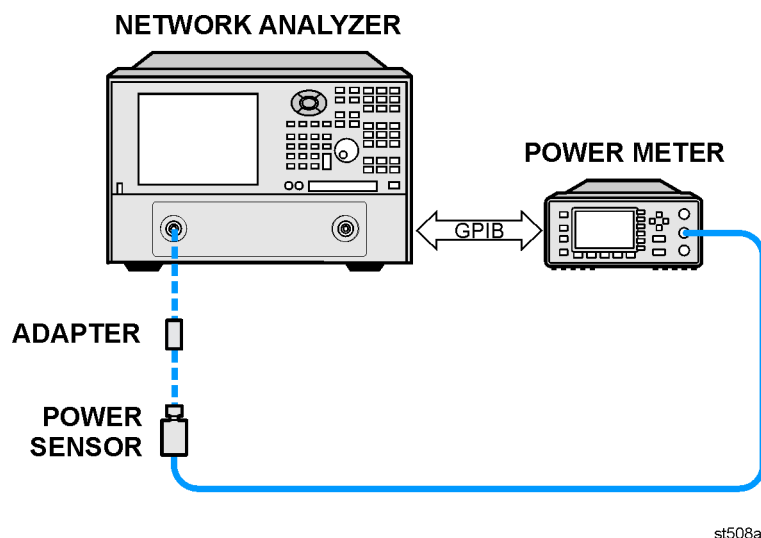
Equipment Used for the Source Calibration Adjustment

Equipment Type	Models Used With	Model or Part Number	Alternate Model or Part Number
Power meter	All	E4418B/E4419B	E4418A/E4419A
Power sensor, 3.5 mm	E8362A	E4413A	8485A
Adapter, 3.5 mm (f) to 3.5 mm (f)	E8362A	83059B	85052-60012
Power sensor, 2.4 mm	E8363A, E8364A	8487A	None
Adapter, 2.4 mm (f) to 2.4 mm (f)	E8363A, E8364A	11900B	85056-60007

Procedure

1. Connect the equipment as shown in [Figure 3-18](#). Connect a GPIB cable between the network analyzer and the power meter.

Figure 3-18 Setup for the Source Calibration Adjustment



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:

1. A power meter/sensor is connected to Port 1, as shown in [Figure 3-19](#), to establish a reference for flatness.
2. A cable is inserted between the power sensor and the test port, as shown in [Figure 3-20](#), to establish a reference for the cable.
3. The same cable is connected between the two test ports, as shown in [Figure 3-21](#), and a signal from Port 1 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.

Data obtained during this adjustment are stored in the mxcalfile_pxx files on the hard disk drive (where xx is a 1 or 2 digit number). The data are used in subsequent measurements.

If the hard disk drive is replaced, these mxcalfile_pxx files will be lost. Therefore, they should be backed up (saved on a floppy disk) so that they can be restored.

These files can be recreated by performing another receiver calibration adjustment.

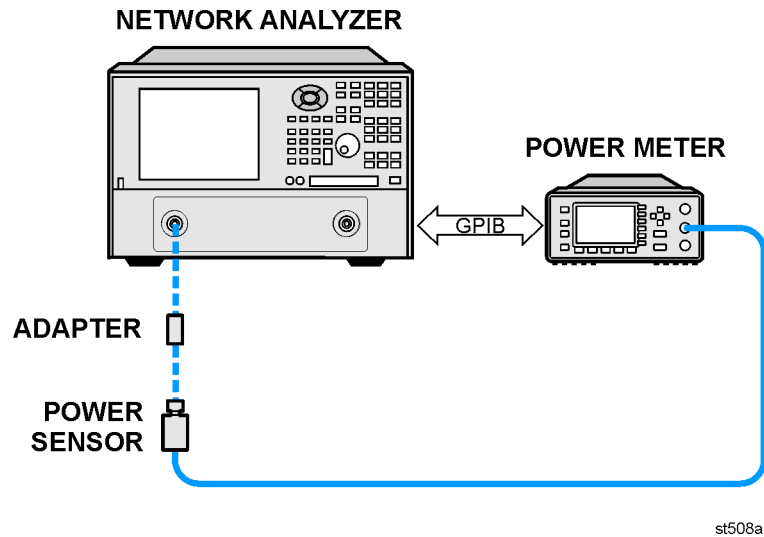
Equipment Used for the Receiver Calibration Adjustment

Equipment Type	Models Used With	Model or Part Number	Alternate Model Part Number
Power meter	All	E4418B/E4419B	E4418A/E4419A
Power sensor, 3.5 mm	E8362A	E4413A	8485A
Adapter, 3.5 mm (f) to 3.5 mm (f)	E8362A	83059B	85052-60012
RF Cable, 3.5 mm (f) to 3.5 mm (f)	E8362A	85131C	85131E
Power sensor, 2.4 mm	E8363A, E8364A	8487A	None
Adapter, 2.4 mm (f) to 2.4 mm (f)	E8363A, E8364A	11900B	85056-60007
RF Cable, 2.4 mm (f) to 2.4 mm (f)	E8363A, E8364A	85133C	85133E

Procedure

1. Connect the equipment as shown in [Figure 3-19](#). Connect a GPIB cable between the network analyzer and the power meter.

Figure 3-19 Setup 1 for the Receiver Calibration Adjustment



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.

Figure 3-20 Setup 2 for the Receiver Calibration Adjustment

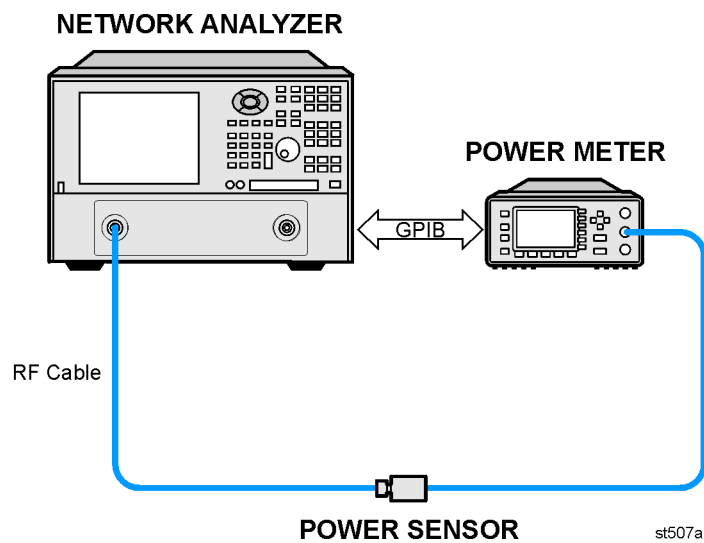
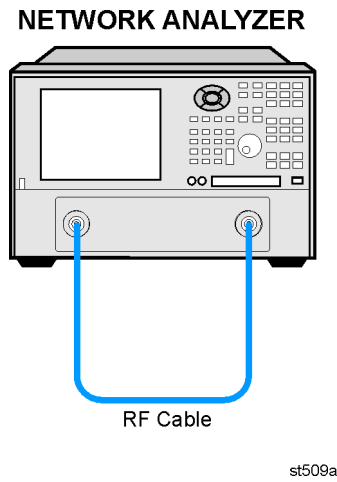


Figure 3-21 Setup 3 for the Receiver Calibration Adjustment



LO Power Adjustment

The LO power adjustment is used to adjust the power level of the LO signals from the A20 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 the LO Power Adjustment

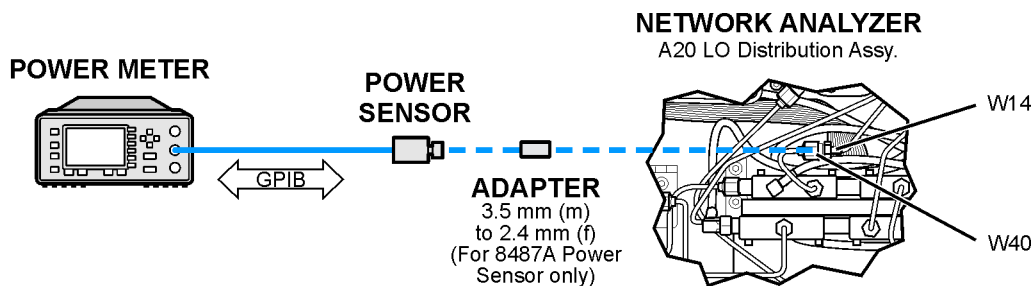
Equipment Type	Models Used With	Model or Part Number	Alternate Model or Part Number
Power meter	All	E4418B/E4419B	E4418A/E4419A
Power sensor, 3.5 mm	E8362A	E4413A	8485A
Power sensor, 2.4 mm	E8363A, E8364A	8487A	None
Adapter, 2.4 mm (f) to 3.5 mm (m) ^a	E8363A, E8364A	11901D	None
5/16-inch, open-end torque wrench (set to 10 in-lbs)	All	N/A	N/A
1/4-inch, open-end wrench	All	N/A	N/A

a. Required only if using the 8487A power sensor.

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 3-22](#). Connect a GPIB cable between the analyzer and the power meter.
5. With a 5/16-inch open-end wrench, loosen W40 at the first converter (mixer).
6. At the junction of W40 and W14, place a 5/16-inch wrench on the W40 connector and a 1/4-inch wrench on the W14 connector. While holding the 1/4-in wrench to prevent W14 from rotating, disconnect W40 from W14 and move W40 aside.
7. Connect the power sensor to the end of W14, as shown in [Figure 3-22](#).

Figure 3-22 Setup for the LO Power Adjustment



st510a

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

10 MHz Frequency Reference Adjustment

The 10 MHz frequency adjustment is used to adjust the frequency accuracy of the network analyzer’s 10 MHz frequency reference on the A10 frequency reference board assembly.

Equipment Used for the Frequency Adjustment at 10 MHz

Equipment Type	Models Used With	Model or Part Number	Alternate Model or Part Number
Cable, BNC, 50Ω, 24 inch	All	8120-1839	Any
Frequency counter	All	53151A Opt 001	Any ^a

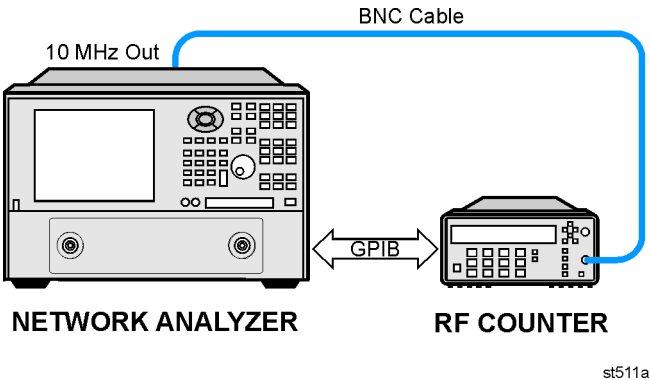
a. Must be capable of measuring a signal at 10 MHz.

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 3-23](#). Connect a GPIB cable between the network analyzer and the frequency counter.

Figure 3-23 Setup for Adjustment of the 10 MHz Frequency Reference



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 20.

Equipment used for the Frequency Adjustment at 3.8 GHz

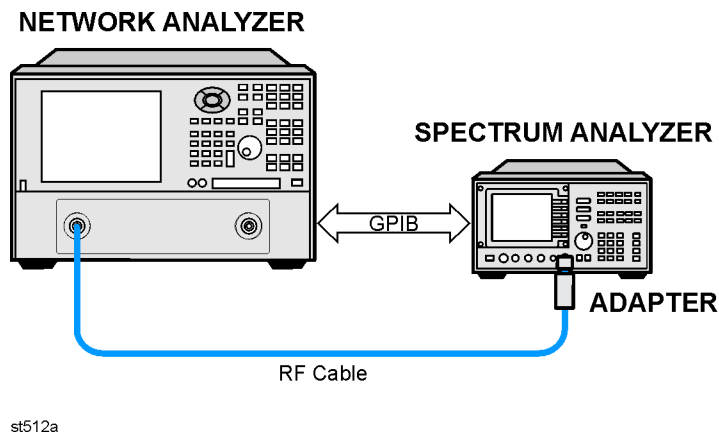
Equipment Type	Models Used With	Model or Part Number	Alternate Model or Part Number
Spectrum analyzer	All	8565E	856xE ^a
RF Cable, 3.5 mm (f) to 3.5 mm (f)	E8362A	85131C	85131E
Adapter, 3.5 mm (m) to type-N (m)	E8362A	1250-1743	None
RF Cable, 2.4 mm (f) to 2.4 mm (f)	E8363A, E8364A	85133C	85133E
Adapter, 2.4 mm (m) to type-N (m)	E8363A, E8364A	11903A	None

a. Must be capable of measuring a signal at 3.8 GHz.

Procedure

1. Connect the equipment as shown in [Figure 3-24](#). Connect a GPIB cable between the network analyzer and the spectrum analyzer.

Figure 3-24 Setup for Adjustment of the 3.8 GHz PMYO



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.

4 Troubleshooting

Information in This Chapter

The information in this chapter helps you:

- Identify the portion of the analyzer at fault.
- Locate the troubleshooting procedure to allow you to identify the specific 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 Four at-a-Glance

Section Title	Summary of Content	Start Page
Getting Started with Troubleshooting	A starting point to begin troubleshooting.	Page 4-4
Power Up Troubleshooting	Power-up problems: <ul style="list-style-type: none">• Power supply problems• LCD problems• Bootup for the network analyzer interface	Page 4-6
Front Panel Troubleshooting	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 4-17
Rear Panel Troubleshooting	Problems associated with the rear panel interconnects. <i>The data found at these rear panel interconnects can be used to troubleshoot the CPU board.</i>	Page 4-21
Measurement System Troubleshooting	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 group.• Checking the receiver group.• Checking the signal separation group.	Page 4-27
Instrument Block Diagrams	Block diagrams for the analyzer including Option UNL and Option 014.	Page 4-53

Protect Against Electrostatic Discharge (ESD)

This is important. If not properly protected against, electrostatic discharge can seriously damage your analyzer, resulting in costly repair.

CAUTION To reduce the chance of electrostatic discharge, follow all of the recommendations outlined in [“Electrostatic Discharge Protection” on page 1-5](#), for all of the procedures in this chapter.

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 [Table 7-2 on page 7-70](#).
- Step 3.** Perform the necessary adjustments in [Chapter 3, “Tests and Adjustments.”](#)
- Step 4.** Perform the necessary performance tests in [Chapter 3, “Tests and Adjustments.”](#)

Getting Started with Troubleshooting

Where you begin troubleshooting depends upon the symptoms of the failure. Start by checking the basics as outlined in the following section. Also review the flowchart in [Figure 4-1 on page 4-5](#). You should then be able to determine where to begin, in the troubleshooting procedure, to locate the failed assembly.

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 perform the following checks:

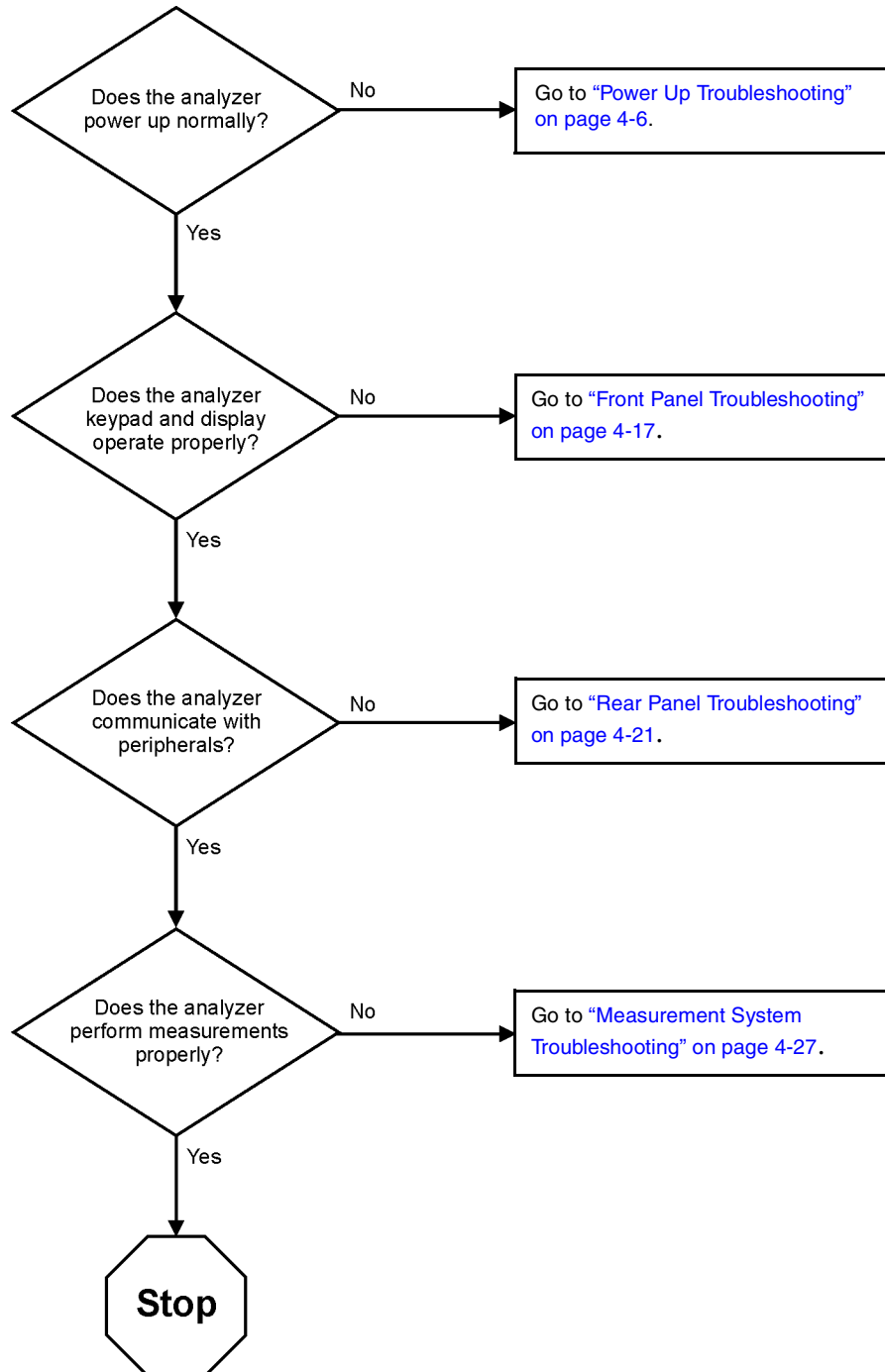
1. Is there power at the mains receptacle? If not, correct this situation and proceed.
2. Is the instrument turned on? Check to see if the front panel line switch glows. This indicates the power supply is on. If the front panel line switch is on but the power supply does not appear to be on, go to [“Power Up Troubleshooting” on page 4-6](#).
3. Is the Windows® operating system running? If not, refer to [Appendix D, “Operating System Recovery,”](#) for instructions.
4. If other equipment, cables, and connectors are being used with the instrument, make sure they are connected properly and operating correctly.
5. Review the procedure for the measurement being performed when the problem appeared. Are all the settings correct? If not, correct them.
6. If the instrument is not functioning as expected, return the unit to a known state by pressing the **Preset** key.
7. 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.
8. 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 [Appendix C, “Firmware Upgrades,”](#) for instructions.
9. If the necessary test equipment is available, perform the operator’s check and system verification in [Chapter 3, “Tests and Adjustments.”](#)

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Troubleshooting Organization

Follow the flowgraph in [Figure 4-1](#) to help direct you to the correct section for troubleshooting the analyzer.

Figure 4-1 Troubleshooting Organization Flowchart



sc867b

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 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. 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.

Step 3. If the analyzer powers up correctly, continue troubleshooting with [“Front Panel Troubleshooting” on page 4-17.](#)

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

- If the line switch does not glow or the fans are not operating (audible), go to [“Power Supply Check” on page 4-7.](#)
- If you cannot hear the fans operating, go to [“If the Fans Are Not Operating” on page 4-12.](#)
- If the line switch glows green and the fans are operating (audible), but the display remains dark, go to [“Troubleshooting LCD Display Problems” on page 4-13.](#)
- If the instrument appears to abort the network analyzer measurement interface process, contact Agilent. Refer to [“Contacting Agilent” on page 2-9.](#)

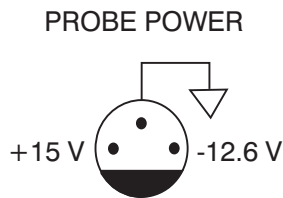
Power Supply Check

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 can be determined by observing the line switch, 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 on the instrument power and verify that the line switch glows. When the line switch glows, it is an indication that the power supply has received an “ON” command and that the +5.2 VDC supply can supply enough current to light, at least, 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 4-2](#) for a diagram of the probe power connector.

Figure 4-2 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, or another assembly is loading down the A4 power supply. Continue with [“If All Supply Voltages Are Missing” on page 4-10](#), to determine the cause of the problem.

If the line switch is lit correctly, and the probe power voltages measure within the specifications listed in [Table 4-1 on page 4-9](#), 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

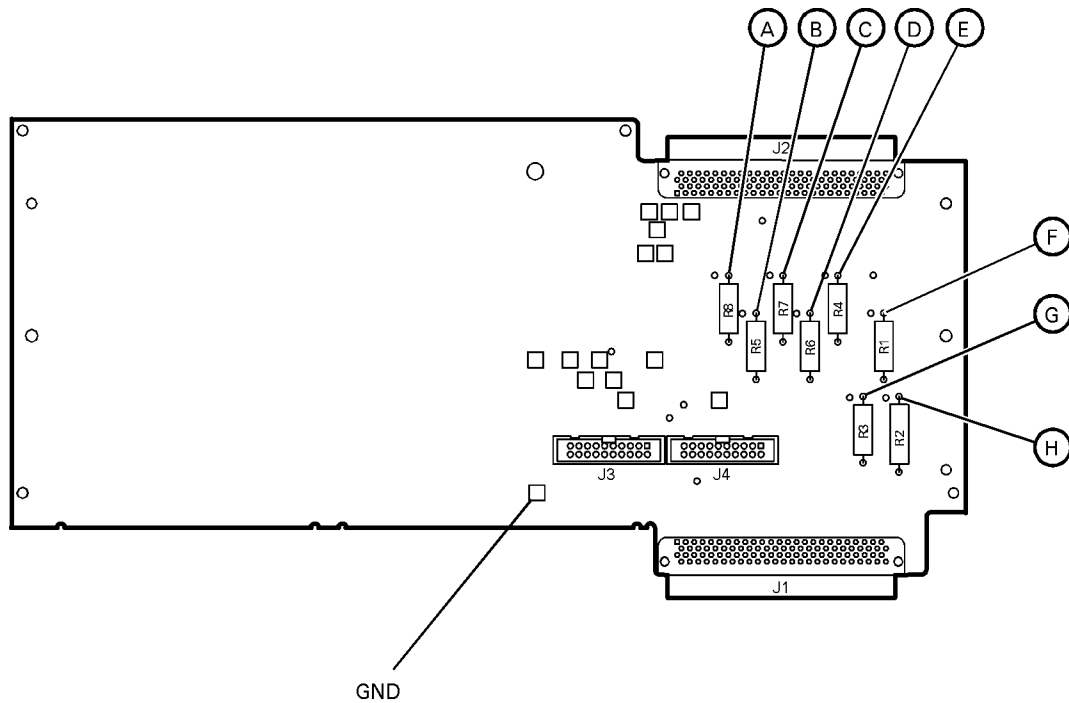
WARNING The instrument contains potentially hazardous voltages. Refer to the safety symbols provided on the instrument and in **“General Safety Considerations” on page 1-3** before operating the unit with the cover removed. Make sure that the safety instructions are strictly followed. Failure to do so 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. Refer to **Figure 6-3 on page 6-13** to determine this location.

NOTE If any one individual voltage supply from the A4 power supply 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 itself, or any assembly to which the A4 power supply 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 4-10**.

On the extender board, measure the power supply voltages using a digital voltmeter. Refer to **Figure 4-3** for the power supply test points on the extender board. Use the point marked as “GND” for the ground connection. **Table 4-1 on page 4-9** contains a list of the correct voltages.

Figure 4-3 E8356-60021 Synthesizer/Reference Extender Measurement Points



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Table 4-1 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 4-21](#).

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. Then, plug in the analyzer and measure the supply voltages after each assembly 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 cable from the A16 test set motherboard.
2. Unplug the front panel interface cable from the A3 front panel interface board.
3. Remove the A6 SPAM board.
4. Remove the A8 fractional-N synthesizer board.
5. Remove the A10 frequency reference board.
6. Remove the A11 phase lock board.
7. Unplug the A30 floppy disk drive from the A14 system motherboard.
8. Unplug the A31 hard disk drive from the A15 CPU board.

The minimum required assemblies to power up the analyzer are:

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

To further isolate the failure in the three remaining assemblies, measure the resistance on the extender board (with the power turned off and the power cord removed) from the power supply test points to “GND”. Refer to [Figure 4-3 on page 4-9](#). The resistance for each corresponding power supply voltage is shown in [Table 4-2](#).

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
- remove the A4 power supply
- This leaves only the A14 system motherboard installed. If the measurements are still incorrect, this is the suspected faulty assembly.

Table 4-2 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

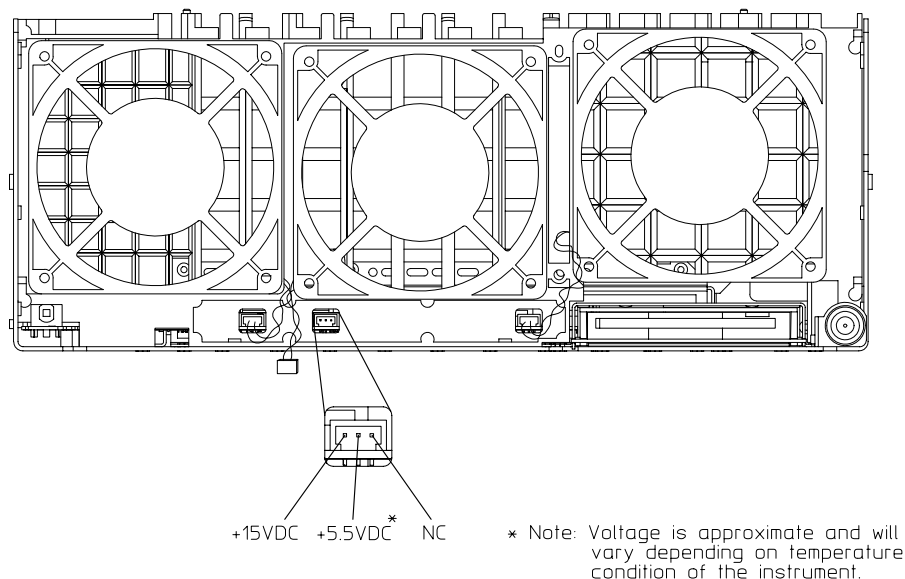
CAUTION The power supply may be in thermal shutdown if the instrument has been operating without the fans running. Allow the instrument to cool down before troubleshooting.

If all three fans are not operating, suspect a power supply problem or a defective A14 system motherboard. Refer to [“Power Supply Check” on page 4-7](#) to check the individual supplies. If the supplies are within specifications, the most probable cause is a defective A14 system motherboard. Refer to [“Removing and Replacing the A14 System Motherboard” on page 7-24](#).

If only one or two fans are not functioning, and the power supplies are within specifications, suspect the A14 system motherboard 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 7-10](#).
2. Refer to [Figure 4-4](#). Measure the fan voltages at J1, J3, and J4 on the A14 system motherboard.

Figure 4-4 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 7-67](#).
4. If the voltage is not present, suspect a defective A14 system motherboard. Refer to [“Removing and Replacing the A14 System Motherboard” on page 7-24](#).

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 4-19](#).

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 7-10](#).
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. Refer to [“Removing and Replacing the A15 CPU Board” on page 7-26](#).
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 7-10](#).
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 7-12](#). Put the A2 display assembly and its ribbon cables aside.
4. Remove the A3 board by referring to [“Removing the A3 Front Panel Interface Board” on page 7-12](#). 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 4-14](#) and [“Verifying the A3 Front Panel Interface Board” on page 4-16](#) 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.

1. 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 7-10](#).

Using [Figure 4-5](#) as a reference, measure the signals and voltages indicated in [Table 4-3 on page 4-14](#). If the signals and voltages measure good, the inverter board is functioning correctly.

Figure 4-5 Inverter Board Test Point Locations

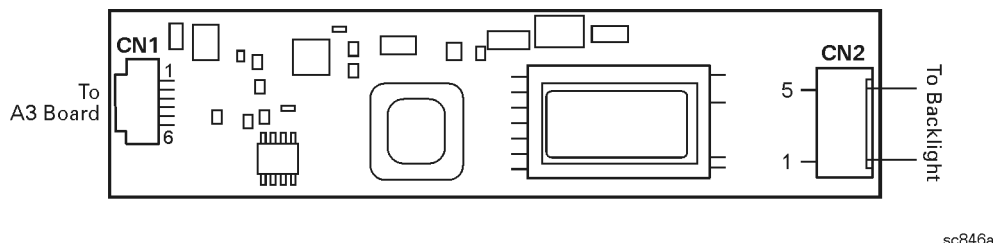


Table 4-3 Inverter Board, Voltages and Signals

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 4-4](#).

Table 4-4 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 7-14.
Good	Bad	Replace the inverter. Refer to “Removing and Replacing the Display Inverter Board and the Display Lamp” on page 7-14.
Bad	Bad	Refer to “Verifying the A3 Front Panel Interface Board” on page 4-16.

Verifying the A3 Front Panel Interface Board

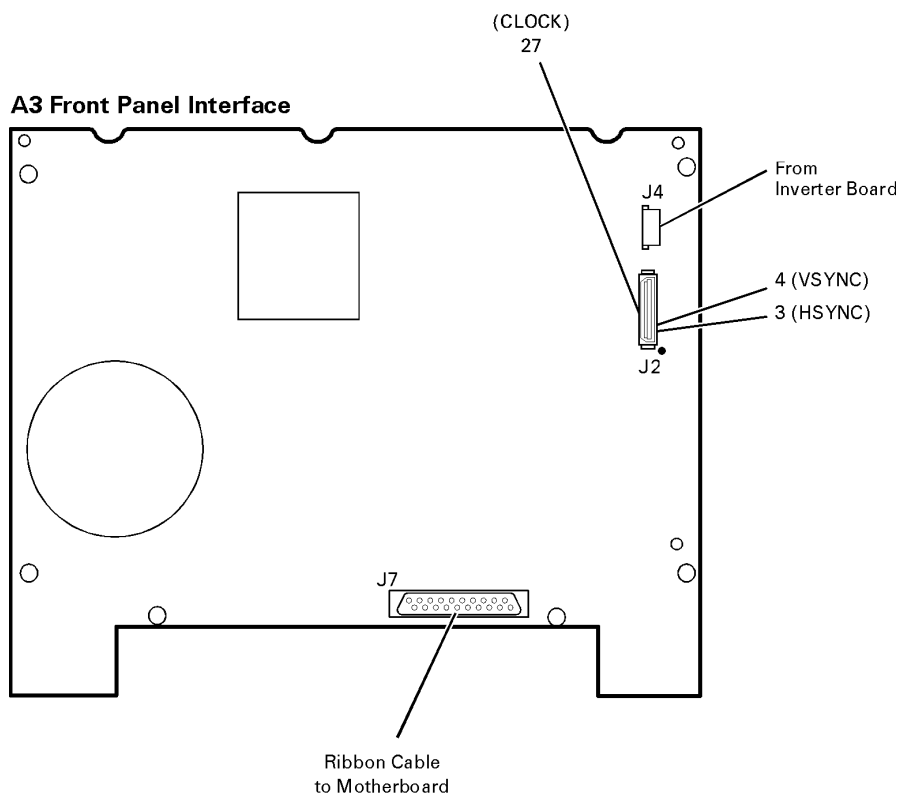
To verify that the HSYNC (horizontal sync), VSYNC (vertical sync), and LCD clock are functioning correctly, measure the signals listed in [Table 4-5](#) and illustrated in [Figure 4-6](#) on page 4-16. If all of these signals measure correctly, suspect a defective backlight or LCD. The backlight is the most probable cause.

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

Table 4-5 A3 Front Panel Interface Board, 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

Figure 4-6 Verifying HSYNC, VSYNC, and LCD Clock



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If any of the three signal types is incorrect, replace the A3 front panel interface board. Refer to [“Removing the A3 Front Panel Interface Board”](#) on page 7-12.

If all of the signal types are correct, replace the A2 display assembly. Refer to [“Removing the A2 Display Assembly”](#) on page 7-12.

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 4-6](#).

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 4-19](#)
- [“A3 Front Panel Interface Board” on page 4-20](#)
 - USB
 - Speaker
 - Probe Power

If all assemblies are working correctly, continue troubleshooting with [“Rear Panel Troubleshooting” on page 4-21](#).

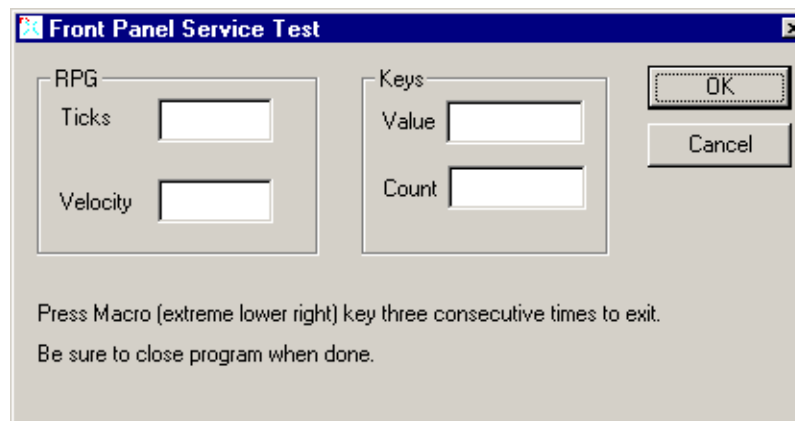
A1 Front Panel Keypad and RPG Test

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 4-7](#).

Figure 4-7 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 4-6](#).

- 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. To replace the A1 keypad, refer to [“Removing the A1 Keypad Assembly” on page 7-12](#).
- If none of the keys are working correctly, suspect a faulty A3 front panel interface board. To replace the A3 front panel interface board, refer to [“Removing the A3 Front Panel Interface Board” on page 7-12](#).

Table 4-6 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	Up ↑	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	Down ↓	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. Refer to [Figure 4-7 on page 4-17](#).

- 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. To replace the A3 front panel interface board, refer to [“Removing the A3 Front Panel Interface Board” on page 7-12](#).

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 4-13 .
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What Is a Damaged Pixel?

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

- A “stuck 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 “dark” 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** menu, 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

One or more of the following symptoms indicate a faulty A2 display assembly:

- a complete row or column of “stuck on” or “dark” pixels
- more than six “stuck on” pixels (but not more than three green)
- more than twelve “dark” pixels (but not more than seven of the same color)
- two or more consecutive “stuck on” pixels or three or more consecutive “dark” pixels (but no more than one set of two consecutive dark pixels)
- “stuck on” or “dark” pixels less than 6.5 mm apart (excluding consecutive pixels)

If any of these symptoms occur, replace the A2 display assembly. Refer to [“Removing the A2 Display Assembly” on page 7-12](#).

A3 Front Panel Interface Board

This assembly performs the following functions:

- It routes USB signals between the front-panel USB connector and the A15 CPU board.
- The speaker produces the audio output from signals supplied by the A15 CPU board.
- It supplies power to the two front-panel probe power connectors.
- It routes key pad commands from the A1 keypad to the A15 CPU board.
- It routes display signals from the A15 CPU board 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” on page 7-12](#).

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” on page 7-12](#).

Checking the Probe Power Connectors

To verify the probe power operation, refer to [“Power Supply Check” on page 4-7](#).

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 4-17](#).

Checking the Display

To verify the display functionality, refer to [“A2 Display Test” on page 4-19](#).

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 is faulty. Refer to [“Removing and Replacing the A15 CPU Board” on page 7-26](#).

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 is faulty. Refer to [“Removing and Replacing the A15 CPU Board” on page 7-26](#).

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**, and then click **SCPI/GPIB**. A **SCPI/GPIB** dialog box is displayed.
3. In the **GPIB** block, click **System Controller** to establish the analyzer as a controller. Wait for the analyzer to configure, and then click **OK**.
4. On the **System** menu, click **Windows Taskbar** to open the **Start Menu** window.
5. On the **Start Menu** window, point to **Programs, National Instruments NI-488.2**, and then click **Explore GPIB** to open the **Measurement & Automation** window.
6. 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.
7. On the submenu, click **Scan for Instruments** to run the test.
8. The state of all the peripherals found on the bus is returned.
9. 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.
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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 4-25](#).

1. Make sure the IP address on the analyzer is set properly and that it is unique. If unsure how to check the IP address, refer to the embedded help in the analyzer.
2. Make sure the subnet mask is 0.0.0.0. If not, note the current setting (to allow setting it back later) and then set it to 0.0.0.0. If unsure how to check the subnet mask, refer to the embedded help in the analyzer.
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. Refer to Step 5 for the results of a successful ping.

-
1. The letters x represent the IP address of the other device on the network.

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
7. If the subnet mask was changed in step 2, set it back at this time.

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 4-25](#).

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 4-23](#) 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.

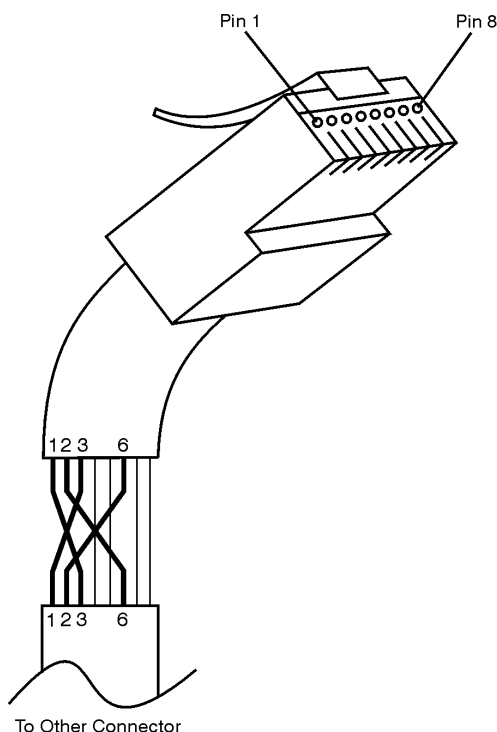
NOTE	Pins 1, 2, 3, and 6 of the connectors must be located to determine which wires to cut in the following steps. Most, but not all, LAN cables use the color coding listed in Table 4-7 . If your cable does not use this color scheme, you will have to determine the locations of the appropriate wires before proceeding with this procedure.
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Table 4-7 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 4-8 Construction of a Crossover Cable



sd623c

Measurement System Troubleshooting

This section provides troubleshooting procedures for the measurement portion of the PNA series 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.

Before you begin—consider: Where do you see a problem?

If you are seeing a problem at **Preset**, perform the standard S-parameter test set troubleshooting procedure, starting with: [“Verifying the A, B, R1, and R2 Traces” on page 4-28](#).

You should also consider the problem indications which are observed and whether the observed condition is a *soft* failure or a *hard* failure. With a *soft* failure, the network analyzer's performance has degraded to an unacceptable level, yet it continues to operate and displays no error messages. For this type of failure, performance tests must be conducted to isolate the problem. Begin with viewing the error terms as described in [Appendix A](#). This will help isolate most problems. If additional tests are required, refer to [“Performance Tests \(Agilent N2721A Software Package\)” on page 3-30](#).

With a *hard* failure, the PNA does not perform well and displays one or more error messages. To diagnose and repair a hard failure: Refer to [“Error Messages”](#) below and perform the procedures in those sections that are applicable for your particular error message.

Error Messages

PHASE LOCK LOST: The level of the signal from at least one of the reference receivers, and sensed by the phase lock board, is too low to be accurately captured. This could be due to a problem in the source group, signal separation group, or receiver group (refer to [“Checking the Source Group” on page 4-32](#), [“Checking the Signal Separation Group” on page 4-46](#), and [“Checking the Receiver Group” on page 4-50](#)).

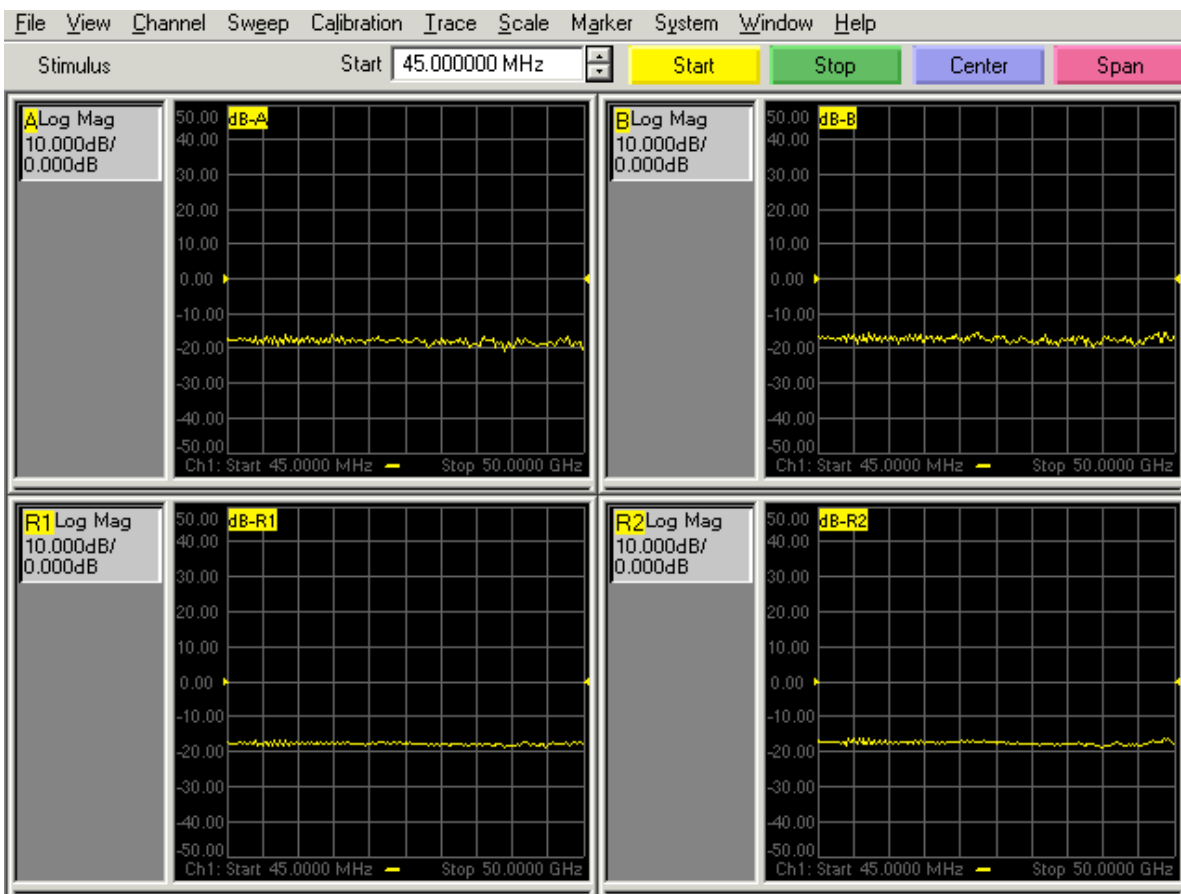
SOURCE UNLEVELED: The source ALC circuits on the A12 source or the A16 test set motherboard—E8363A and E8364A only—is running open-loop. For the E8362A, replacing the A12 source assembly can correct this. For the E8363A or E8364A, check the cable connections for W37 and W38 from the A23 and A24 detectors to the A16 test set motherboard, and for W39 from A16 to the A21 SOMA 50. If the problem is associated with one port and not the other, replace the detector associated with the problem port. If the problem affects both ports, replace the A16 test set motherboard.

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 **Receiver Display**.
- Traces A, B, R1, and R2 are displayed in four separate data windows as shown in [Figure 4-9](#). Identifying discrepancies of the traces in these windows can help you to isolate the faulty assembly.

Figure 4-9 Typical Four Channel Display



- If all traces are present and are similar to the traces in [Figure 4-9](#), 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 3](#), “[Tests and Adjustments](#),” and perform all the tests in that section.
- If a problem still exists, contact Agilent. Refer to “[Contacting Agilent](#)” on [page 2-9](#).

- 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 group**
 - A8 fractional-N synthesizer
 - A10 frequency reference
 - A11 phase lock
 - A12 source 20
 - A16 test set motherboard
 - A17 LOMA 10
 - A18 MA 20
 - A19 splitter
 - A20 LODA
 - A21 SOMA 50 (E8363A and E8364A only)
- **the signal separation group**
 - A22 switch splitter
 - A23 and A24 detectors (E8363A and E8364A only)
 - 30-dB fixed attenuators (E8362A only)
 - A25 and A26 test port couplers
 - A36 and A37 60-dB step attenuators (Option UNL only)
 - A38 and A38 bias tees (Option UNL only)
 - Port 1, Port 2, A, B, R1, and R2 ports
- **the receiver group**
 - A27, A28, A29, and A30 first converters
 - A31 receiver A
 - A32 receiver R1
 - A33 receiver R2
 - A34 receiver B
 - A35 receiver motherboard
 - A6 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 5-7](#) for a list of the frequencies associated with each of the network analyzer's 25 bands.

All Traces

- ***If all traces are missing in all bands***, the problem is most likely in the source 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 Group” on page 4-32](#).
- ***If the trace faults are band-related***, the problem is in the source group. Go to [“Checking the Source Group” on page 4-32](#) and check the A8 fractional-N synthesizer board outputs and the A10 frequency reference board outputs.

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, the A28 R1 first converter, the A32 R1 receiver, or the A22 switch splitter. To determine which is at fault:

1. Bypass the A22 switch splitter using a flexible RF cable connected between the input cable W2 and the R1 output cable W4.
2. If the R1 trace is now present, replace the A22 switch splitter. If the R1 trace is still missing, reconnect the cables to the A22 switch splitter.
3. Swap the A32 R1 receiver with the A33 R2 receiver. (Each of the four receivers is identical.)
4. If the missing trace is now R2 (still associated with the same A32 R1 receiver), replace the A32 R1 receiver. If the R1 trace is still missing, replace the A16 test set motherboard.

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, the A29 R2 first converter, the A33 R2 receiver, or the A22 switch splitter. To determine which is at fault:

1. Bypass the A22 switch splitter using a flexible RF cable connected between the input cable W2 and the R2 output cable W5.
2. If the R2 trace is now present, replace the A22 switch splitter. If the R2 trace is still missing, reconnect the cables to the A22 switch splitter.
3. Swap the A33 R2 receiver with the A32 R1 receiver. (Each of the four receivers is identical.)
4. If the missing trace is now R1 (still associated with the same A33 R2 receiver), replace the A33 channel R2 receiver. If the R2 trace is still missing, replace the A16 test set motherboard.

R1 Trace Only

A problem that affects only the R1 trace is isolated to the A28 R1 first converter, the A32 R1 receiver, or the A6 SPAM board. Go to [“Checking the Receiver Group” on page 4-50](#).

R2 Trace Only

A problem that affects only the R2 trace is isolated to the A29 R2 first converter, the A33 R2 receiver, or the A6 SPAM board. Go to [“Checking the Receiver Group” on page 4-50](#).

A Trace Only

If the trace is missing in all bands, go to [“Checking the Signal Separation Group” on page 4-46](#).

B Trace Only

If the trace is missing in all bands, go to [“Checking the Signal Separation Group” on page 4-46](#).

Checking the Source Group

Serial Bus Test

Before performing tests on specific assemblies in the source group, it is recommended that you perform the serial bus test. This may help to isolate the failure to a specific assembly.

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:

NOTE This test is written for a PNA series network analyzer 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, A12, or A16 board has been replaced with a newer board assembly.

Board Assembly	Node Numbers
A12 source 20	111 to 118
A10 frequency reference	211 to 218
A11 phase lock	311 to 318
A8 fractional-N synthesizer	411 to 418
A16 test set motherboard, MA 20	511 to 518
A16 test set motherboard, SOMA 50	611 to 618
A16 test set motherboard, AUX 1	711 to 718
A16 test set motherboard, AUX 2	811 to 818

Descriptions of each board assembly and nodes are included in this section. Location of the nodes is indicated with a ♦ symbol on the block diagrams located at the end of this chapter.

Performing the Serial Bus Test

First, this test sequentially checks all 48 nodes at 45 MHz. Next, the test checks all nodes that change values with frequency, at 49 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 4-10 on page 4-33](#) is displayed. Click **Begin** to start the test.

Figure 4-10 Serial Bus Test Dialog Box

The screenshot shows a Windows-style dialog box titled "Serial Bus Test". It has a menu bar with "About" and "Help". The main area is light blue and contains several sections:

- Current Test:** A section with four tabs: "Freq. (MHz)", "Assembly", "Node", and "Power (dBm)". Below these tabs is a text field labeled "Description".
- Buttons:** On the right side, there are three buttons: "Begin" (green), "View Results" (grey), and "Exit" (grey).
- Pause on Failure:** A checkbox labeled "Pause on Failure" is located below the "Description" field.
- Results Section:** A yellow-shaded area containing three text fields: "Minimum V.", "Results", and "Maximum V.". To the right of these fields is a red label "Failures" above a small empty box.
- Failure Summary:** A large text area at the bottom, currently displaying the word "None".

Node Descriptions, A12 Source 20

- 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 output of the A12 source 20.
- 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

- 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** **99.50 MHz Tune** Node 213 senses the tune voltage that phase locks the 99.50 MHz VCO. The tune voltage is set by referencing the 100 MHz VCO.
- Node 214** **99.50 MHz Level** Node 214 senses the average voltage output level of the 99.50 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** **Phase Lock Average Voltage** Node 216 senses the average voltage of the 8.333 MHz phase lock reference signal that is routed to the A11 phase lock board. This voltage is constant through all bands.
- Node 217** **500 kHz Level** Node 217 senses the average voltage of the 500 kHz phase lock reference signal.
- Node 218** **33.1667 MHz 2nd LO Average Voltage** Node 218 senses the average voltage of the 33.1667 MHz 2nd LO signal that is routed to the A35 receiver motherboard. This voltage is constant through all bands.

Node Descriptions, A11 Phase Lock Board

- Node 311** **NC** Node 311 is not used in this product.
- Node 312** **100 kHz Phase Detector** Node 312 senses the average voltage of the phase comparator at the output of a 700 kHz low-pass filter.
- Node 313** **NC** Node 313 is not used in this product.
- Node 314** **100 kHz Phase Detector Integrator** Node 314 senses the tune voltage that phase locks the source. The integrator that supplies this signal receives its input from the 700 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

- Node 411** **+5 Vdc Supply Voltage** Node 411 senses the 5 Vdc 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 2-25.
- 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.

Node Descriptions, A16 Test Set Motherboard, MA 20

- Node 511** **ALC Output** Node 511 senses the output of the ALC integrator. The output of the integrator is the combined voltage output of the compensation circuits in the ALC.
- Node 512** **Power DAC** Node 512 senses the output voltage of the power DAC. This output is summed with other compensation signals to control the SOMA 50 output level. The power DAC has the most influence of the compensation signals.
- Node 513** **ALC Output** Node 513 senses the output of the ALC summing junction. The output of the ALC summing junction is the combined voltage output of all compensation circuits in the ALC. The voltage level varies with frequency and output power.
- Node 514** **1V/GHz Compensation** Node 514 senses the output voltage of the 1V/GHz compensation amplifier for the LO ALC.
- Node 515** **Slope Compensation** Node 515 senses the slope compensation.
- Node 516** **-15 V Reference** Node 516 senses the -15 Vdc supply voltage which serves as a measurement reference.
- Node 517** **+9 V Reference** Node 517 senses the +9 Vdc supply voltage which serves as a measurement reference.
- Node 518** **+15 V Reference** Node 518 senses the +15 Vdc supply voltage which serves as a measurement reference.

Node Descriptions, A16 Test Set Motherboard, SOMA 50

- Node 611** ***Detector Level*** Node 611 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 612** ***Level Output*** Node 612 senses the output of the detector log amp in the ALC.
- Node 613** ***ALC Output*** Node 613 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 614** ***1V/GHz Compensation*** Node 614 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 615** ***Temperature Compensation*** Node 615 senses the input voltage applied to the temperature compensation amplifier for the source ALC.
- Node 616** ***Slope Compensation*** Node 616 senses the slope compensation.
- Node 617** ***Log Amp Collector Voltage*** Node 617 senses the collector voltage of the source ALC log amp.
- Node 618** ***Power DAC*** Node 618 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 Descriptions, A16 Test Set Motherboard, AUX 1

- Node 711** ***Log Amp Breakpoint 1 Voltage*** Node 711 senses the breakpoint voltage for stage 1 of the source ALC log amp.
- Node 712** ***Log Amp Breakpoint 2 Voltage*** Node 712 senses the breakpoint voltage for stage 2 of the source ALC log amp.
- Node 713** ***1V/GHz Compensation*** Node 713 senses the input voltage applied to the 1V/GHz compensation amplifier for the LO ALC.
- Node 714** ***Log Amp Offset Voltage*** Node 714 senses the offset voltage for the source ALC log amp.
- Node 715** ***+10 V Reference*** Node 715 senses the +10 V supply voltage which serves as a measurement reference.
- Node 716** ***Log Amp Emitter Voltage*** Node 716 senses the emitter voltage of the source ALC log amp.
- Node 717** ***Temperature Compensation*** Node 717 senses the output voltage of the temperature compensation amplifier for the source ALC.
- Node 718** ***SOMA 50 Prelevel DAC*** Node 718 senses the prelevel DAC voltage applied to the output of the source ALC circuitry upon analyzer startup to preset the output level of the SOMA 50.

Node Descriptions, A16 Test Set Motherboard, AUX 2

- Node 811** ***-10 V Reference*** Node 811 senses the -10 V supply voltage which serves as a measurement reference.
- Node 812** ***+1.78 V Bias Reference*** Node 812 senses the +1.78 V bias supply voltage which serves as a measurement reference.
- Node 813** ***Phase Lock IF Detector*** Node 813 senses the voltage input to the phase lock IF detector.
- Node 814** ***+10 V Reference*** Node 814 senses the +10 V supply voltage which serves as a measurement reference.
- Node 815** ***-1.25 V Bias Reference*** Node 815 senses the -1.25 V bias supply voltage which serves as a measurement reference.
- Node 816** ***+5 V Reference*** Node 816 senses the +5 V supply voltage which serves as a measurement reference.
- Node 817** ***Logger Drive Voltage Output*** Node 817 senses the drive voltage applied to the source ALC log amp.
- Node 818** ***Detector Voltage Output*** Node 818 senses the output voltage of the phase lock IF detector.

Source Group Tests

NOTE A defective A22 switch splitter can exhibit the same symptom as a faulty source. Therefore, if it is determined that the source is functioning properly, you are directed to [“Checking the Signal Separation Group” on page 4-46](#).

Equipment Used for These Tests

Equipment Type	Models Used With	Model or Part Number	Alternate Model or Part Number
Spectrum analyzer	All	8565E	None
Power meter	All	E4418B/19B	E4418A/19A
Power sensor, 3.5 mm	E8362A	8485A	None
RF cable, 3.5 mm (f) to 3.5 mm (f)	E8362A	85131C	Any
Power sensor, 2.4 mm	E8363A, E8364A	8487A	None
RF cable, 2.4 mm (f) to 2.4 mm (f)	E8363A, E8364A	85133C	Any

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.

Single vs. Broadband Failure

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

- broadband
- single band

Single band failures are indicated by all four channel traces having partial dropouts across the frequency range or intermittent phase lock problems. Troubleshooting information is provided under “If the traces faults are band-related,” under [“All Traces” on page 4-30](#).

Broadband failures are indicated by all four channel traces being in the noise floor. Most often this is due to problems in the phase lock signal path and will be characterized by a “PHASE LOCK LOST” error message on the display.

A phase lock problem is due to either:

- faulty RF signal generation (caused by the A12 source 20, A21 SOMA 50, A23 and A24 SOMA 70)
- faulty LO signal generation (caused by the A8, A10, A11, A17 or A18 board)

RF Signal Troubleshooting

To isolate a broadband RF signal generation failure, check the test port output power:

1. Connect a power meter and power sensor to Port 1 of the analyzer.
2. On the analyzer, press **Preset**, set the **Center Frequency** to **2 GHz**, and the **Frequency Span** to **0 Hz**. Note the power reading displayed on the power meter. The output power, as indicated on the power meter, should be approximately $-12\text{ dBm} \pm 5\text{ dB}$ for an analyzer with no hardware options or $-17\text{ dBm} \pm 5\text{ dB}$ for an analyzer with options.

NOTE	In the unlocked state, the analyzer will “search” for the reference signal.
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3. Connect the power sensor to Port 2 and set trace to measure S_{22} . Note the power reading displayed on the power meter. The power meter reading should be the same as was measured at Port 1.
 - If the power level is low at both test ports the problem is either the A12 source 20 or the A21 SOMA 50. Continue with [“Checking the A12 Output, All Bands”](#).
 - If the output power is high at both test ports the problem is LO signal related. Continue with [“LO Signal Troubleshooting”](#).

LO Signal Troubleshooting

To isolate a broadband LO signal, refer to the data obtained from the [“Serial Bus Test” on page 4-32](#):

- If the data obtained for the A10 frequency reference board is out of tolerance, continue testing at [“Checking the A10 5 MHz Reference Output” on page 4-40](#).
- If the data obtained for the A10 frequency reference board is correct but the data for the A8 fractional-N synthesizer board is out of tolerance, continue testing at [“Checking the A8 Fractional-N Synthesizer Band 1 Output” on page 4-41](#).
- If the data obtained for the A8 fractional-N synthesizer board is correct—and [“RF Signal Troubleshooting”](#) has been performed—but there is still a phase lock problem, continue testing at [“Checking the A17 LOMA 10 Output” on page 4-42](#).

Checking the A12 Output, All Bands

1. Disconnect W1 from the A12 source 20.
2. Connect a cable to the A12 connector and measure the output power. A power level of $-17\text{ dBm} \pm 5\text{ dB}$ indicates the A12 source 20 is functioning normally.
3. If the output power level is at or below the minimum power level for the power sensor, replace the A12 source 20.
4. If the signal is present, reconnect cable W1 and continue testing at [“Checking the A21 Output, All Bands” on page 4-40](#).

Checking the A21 Output, All Bands

1. Disconnect W2 from the A21 SOMA 50.
2. Connect a cable to the A21 connector and measure the output power. A power level of $-7 \text{ dBm} \pm 5 \text{ dB}$ indicates the A21 SOMA 50 is functioning normally.
3. If the output power level is at or below the minimum power level for the power sensor, replace the A21 SOMA 50.
4. If the signal is present, reconnect cable W2 and continue testing at [“Checking the Signal through the Signal Separation Path” on page 4-47](#).

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 6-24](#). Locate flexible cable W31, at the A10 frequency reference board.
2. Disconnect W31 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. Refer to [“Removing and Replacing the A6, A8, and A10 Boards” on page 7-18](#).
6. If the 5 MHz signal is present, reconnect cable W31, and continue testing at [“Checking the A10 Phase Lock Reference Output”](#).

Checking the A10 Phase Lock Reference Output

1. Refer to the block diagram at the end of this chapter and [“Top Cables” on page 6-24](#). Locate flexible cable W32 at the A10 frequency reference board.
2. Disconnect W32 from A10J5.
3. Connect the spectrum analyzer to A10J5.
4. Verify the presence of the 8.333 MHz phase lock reference output signal.
5. If the signal is not present, replace the A10 frequency reference board. Refer to [“Removing and Replacing the A6, A8, and A10 Boards” on page 7-18](#).
6. If the signal is present, reconnect cable W32, and continue testing at [“Checking the 2nd LO at the A10 Frequency Reference”](#).

Checking the 2nd LO at the A10 Frequency Reference

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 6-24](#). Locate the flexible cable W29 at the A10 frequency reference board.
2. Disconnect the flexible cable W29 at A10J4.
3. Connect the spectrum analyzer to A10J4.
4. Verify the presence of the 33.1667 MHz signal at A10J4.

5. If the signal is not present, replace the A10 frequency reference board. Refer to [“Removing and Replacing the A6, A8, and A10 Boards” on page 7-18.](#)
6. If the signal is present, reconnect cable W29, and continue testing at [“Checking the A31 through A34 Receiver Outputs” on page 4-50.](#)

Checking the A8 Fractional-N Synthesizer Band 1 Output

1. Refer to the block diagram at the end of this chapter and to [“Top Cables” on page 6-24.](#) Locate the flexible cable W20, at the A8 fractional-N synthesizer board.
2. Disconnect W20 from A8J101.
3. Connect the spectrum analyzer to A8J101.
4. Set the network analyzer for a 500 MHz CW frequency and observe the spectrum analyzer measurement.
 - The spectrum analyzer should measure a signal at 508.333 MHz.
5. If the 508.333 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. Refer to [“Removing and Replacing the A6, A8, and A10 Boards” on page 7-18.](#)
6. If the signal is present, reconnect cable W20, and continue testing at [“Checking the A8 Fractional-N Synthesizer Band 2 Output”.](#)

Checking the A8 Fractional-N Synthesizer Band 2 Output

Perform this procedure if you observe a problem in band 2 in all receivers.

1. Refer to the block diagram at the back of this chapter and to [“Top Cables” on page 6-24.](#) Locate semirigid cable W19, at the A8 fractional-N synthesizer board.

CAUTION	Be careful not to damage the center pins of the semirigid cable. Some flexing of the cable is necessary to measure the output. Do not over bend it.
----------------	---

2. Using a 5/16-inch torque wrench, disconnect W19 at A8J106.
3. Connect the spectrum analyzer to A8J106.
4. Set the network analyzer to a CW frequency of 1 GHz.
 - The spectrum analyzer should measure a signal at 1.008 MHz.
5. If this signal is not present, replace the A8 fractional-N synthesizer board. Refer to [“Removing and Replacing the A6, A8, and A10 Boards” on page 7-18.](#)
6. If the signal is present, leave the spectrum analyzer connected to A8J106 and continue testing at [“Checking the A8 Fractional-N Synthesizer Bands 3 through 25 Output”.](#)

Checking the A8 Fractional-N Synthesizer Bands 3 through 25 Output

Perform this procedure if you observe a problem in bands 3 through 25 in all receivers.

1. Set the network analyzer to a CW frequency of 2GHz.
 - The spectrum analyzer should measure a signal at 2.008GHz.

2. If the signal is not present, replace the A8 fractional-N synthesizer board. Refer to [“Removing and Replacing the A6, A8, and A10 Boards” on page 7-18](#).
3. If the signal is present, reconnect cable W19, and continue testing at [“Checking the A17 LOMA 10 Output”](#).

Checking the A17 LOMA 10 Output

Perform this procedure if you observe a problem in any band and all signals from the A8 fractional-N synthesizer are present.

1. Refer to the block diagram at the back of this chapter and to [“Top Cables” on page 6-24](#). Locate semirigid cable W18, at the A17 LOMA 10.

CAUTION	Be careful not to damage the center pins of the semirigid cable. Some flexing of the cable is necessary to measure the output. Do not over bend it.
----------------	---

2. Using a 5/16-inch torque wrench, disconnect W18 at the A17 LOMA 10.
3. Connect the spectrum analyzer to the open A17 connector.
4. For each frequency band in which problems were observed, set the network analyzer to the frequency indicated in [Table 4-8 on page 4-43](#).
5. Set the spectrum analyzer to measure each of the corresponding A17 output frequencies listed in [Table 4-8](#).
6. If the signals are <-30 dBm or not present, replace the A17 LOMA 10. Refer to [“Removing and Replacing the A17 LOMA 10” on page 7-30](#).
7. If the signals are present, reconnect cable W18, and continue testing at [“Checking the A18 MA 20 Output” on page 4-44](#).

Table 4-8 LO Path Frequencies

Model	Band	Network Analyzer Frequency Band of Problem (GHz)	Network Analyzer Source Frequency Setting (GHz)	Expected A17 Output Frequency (GHz)	Expected A18 Output Frequency (GHz)
E8362A, E8363A, E8364A	1	0.045 to 0.748	0.500	0.508	0.508
	2	0.748 to 1.500	1.000	1.008	1.008
	3	1.50 to 3.00	2.20	2.208	2.208
	4	3.00 to 3.80	3.400	3.408	3.408
	5	3.80 to 4.50	4.200	4.208	4.208
	6	4.50 to 4.80	4.600	4.608	4.608
	7	4.80 to 6.00	5.400	5.408	5.408
	8	6.00 to 6.40	6.200	6.208	6.208
	9	6.40 to 7.60	7.000	7.008	7.008
	10	7.60 to 10.00	8.800	8.808	8.808
	11	10.00 to 12.00	11.000	5.504	11.008
	12	12.00 to 12.80	12.400	6.204	12.408
	13	12.80 to 15.20	14.000	7.004	14.008
	14	15.20 to 16.00	15.600	7.804	15.608
	15	16.00 to 20.00	18.000	9.004	18.008
E8363A, E8364A	16	20.00 to 22.80	21.400	7.136	7.136
	17	22.80 to 25.60	24.200	8.069	8.069
	18	25.60 to 30.00	27.800	9.269	9.269
	19	30.00 to 32.00	31.000	5.168	10.336
	20	32.00 to 36.00	34.000	5.668	11.336
	21	36.00 to 38.40	37.200	6.201	12.403
	22	38.40 to 40.00	39.200	6.535	13.069
E8364A	23	40.00 to 45.60	42.800	7.135	14.269
	24	45.60 to 48.00	46.800	7.801	15.603
	25	48.00 to 50.00	49.000	8.168	16.336

Checking the A18 MA 20 Output

Perform this procedure if you observe a problem in any band and all signals from the A8 fractional-N synthesizer are present.

1. Refer to the block diagram at the back of this chapter and to [“Top Cables” on page 6-24](#). Locate semirigid cable W17, at the A18 MA 20.

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

2. Using a 5/16-inch torque wrench, disconnect W17 at the A18 MA20.
3. Connect the spectrum analyzer to the open A18 connector.
4. For each frequency band in which problems were observed, set the network analyzer to the frequency listed in [Table 4-8 on page 4-43](#).
5. Set the spectrum analyzer to measure each of the corresponding A18 output frequencies listed in [Table 4-8](#).
6. If the signals are <-30 dBm or not present, replace the A18 MA 20. Refer to [“Removing and Replacing the A18 MA 20” on page 7-32](#).
7. If the signals are present, reconnect cable W17, and continue testing at [“Checking the A19 Splitter Output”](#).

Checking the A19 Splitter Output

Perform this procedure if you observe a problem in any band and all signals from the A8 fractional-N synthesizer are present.

1. Refer to the block diagram at the back of this chapter and to [“Top Cables” on page 6-24](#). Locate semirigid cables W15 and W16, at the A19 splitter.

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

2. Using a 5/16-inch torque wrench, disconnect W15 and W16. one at a time at the A19 splitter and connect the spectrum analyzer to the A19 splitter connector.
3. Set the network analyzer to any one of the frequencies listed in [Table 4-8 on page 4-43](#).
4. Set the spectrum analyzer to measure the corresponding A18 output frequency listed in [Table 4-8](#).
5. If the signal is not present, replace the A19 splitter. Refer to [“Removing and Replacing the A19 Splitter” on page 7-34](#).
6. If the signal is present, reconnect cables W15 and W16, and continue testing at [“Checking the A20 LODA Output” on page 4-45](#).

Checking the A20 LODA Output

Perform this test if you observe a problem in all bands on a single channel.

1. Refer to the block diagram at the back of this chapter and to [“Top Cables” on page 6-24](#). Locate cables W11, W12, W13, and W14, at the A20 LODA.
2. Using a 5/16-inch torque wrench, disconnect the cable associated with the faulty channel (W11, W12, W13, or W14) and connect the spectrum analyzer to the A20 LODA connector.
3. Set the network analyzer to any one of the frequencies listed in [Table 4-8 on page 4-43](#).
4. Set the spectrum analyzer to measure the corresponding A18 output frequency listed in [Table 4-8](#).
5. If the signal is not present, replace the A20 LODA. Refer to [“Removing and Replacing the A20 LODA” on page 7-36](#).
6. If the signal is present, reconnect the cable, and go to [“Checking the Receiver Group” on page 4-50](#).

Checking the A11 Phase Lock YTO Tune Output

1. Perform the Serial Bus Test. Refer to [“Serial Bus Test” on page 4-32](#).
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 20 is faulty; replace it. Refer to [“Removing and Replacing the A12 Source 20” on page 7-22](#).
4. If the result at Node 315 fails the test, the A11 phase lock board is faulty; replace it. Refer to [“Removing and Replacing the A11 Phase Lock Board” on page 7-20](#).

Checking the Signal Separation Group

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

- “Getting Ready to Test” on page 4-38

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	Models Used With	Model or Part Number	Alternate Model or Part Number
Power meter	All	E4418B/E441B	E4418A/E4419A
Power sensor	E8362A	E8485A	None
Adapter, 3.5 mm (f) to 3.5 mm (f)	E8362A	83059B	85052-60012
Power sensor, 2.4 mm	E8363A, E8364A	8487A	None
Adapter, 2.4 mm (f) to 2.4 mm (f)	E8363A, E8364A	11900B	85056-60007

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 **Receiver Display** (Figure 4-9 on page 4-28) is not on the analyzer screen, perform the following: On the **System** menu, point to **Service, Utilities**, and then click **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. 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 $-12 \text{ dBm} \pm 4 \text{ dB}$, for an analyzer with no hardware options or $-17 \text{ dBm} \pm 4 \text{ dB}$ for an analyzer with options, over the entire frequency range.
 - If the measured power is correct, go to “Checking the Receiver Group” on page 4-50.
 - If the measured power is not correct, go to “Checking the Signal through the Signal Separation Path” on page 4-47.

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. 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 $-12 \text{ dBm} \pm 4 \text{ dB}$, for an analyzer with no hardware options or $-17 \text{ dBm} \pm 4 \text{ dB}$ for an analyzer with options, over the entire frequency range.

Checking the Signal through the Signal Separation Path

For all of the following checks, refer to the block diagrams at the end of this chapter and to:

- “Bottom Assemblies, Standard” on page 6-14
- “Bottom Assemblies, Option UNL” on page 6-16
- “Bottom Assemblies, Option 014” on page 6-18
- “Bottom Assemblies, Option UNL, 014” on page 6-20

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

- A22 switch splitter
- A25 test port 1 coupler
- A36 60-dB step attenuator (Option UNL)
- A38 bias tee (Option UNL)

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

- A22 switch splitter
- A26 test port 2 coupler
- A37 60-dB step attenuator (Option UNL)
- A38 bias tee (Option UNL)

Equipment Used for These Tests

Equipment Type	Models Used With	Model or Part Number	Alternate Model or Part Number
Spectrum analyzer	All	8565E	856xE ¹

1. Must be capable of measuring a signal at 1 GHz.

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

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

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

Perform the following checks in the order presented.

Checking the A22 Switch Splitter and A25 and A26 Test Port Couplers

1. Locate the following semirigid cable at the A22 switch splitter:
Standard W5 for Port 1 or W6 for Port 2
Option UNL W51 for Port 1 or W52 for Port 2
Option 014 W61 for Port 1 or W62 for Port 2
Option UNL/014 W51 for Port 1 or W52 for Port 2
2. Using a 5/16-inch torque wrench, disconnect the semirigid cable at the A22 switch splitter.
3. Connect the spectrum analyzer to the connector. Set the spectrum analyzer to measure a signal at 1 GHz.
4. If the 1 GHz signal is not present, replace the A22 switch splitter. Refer to [“Removing and Replacing the A22 Switch Splitter”](#) on page 7-40.
5. If the 1 GHz signal is present:
Standard replace the appropriate test port coupler. Refer to [“Removing and Replacing the A25 and A26 Test Port Couplers”](#) on page 7-46.
Option 014 replace the appropriate test port coupler. Refer to [“Removing and Replacing the A25 and A26 Test Port Couplers”](#) on page 7-46.
Option UNL reconnect the semirigid cable and go to [“Checking the A36 and A37 60-dB Step Attenuators \(Option UNL\)”](#) on page 4-48.
Option UNL/014 . . . reconnect the semirigid cable and go to [“Checking the A36 and A37 60-dB Step Attenuators \(Option UNL\)”](#) on page 4-48.

Checking the A36 and A37 60-dB Step Attenuators (Option UNL)

1. Locate the following semirigid cable at the appropriate step attenuator:
Option UNL W53 for Port 1 or W54 for Port 2
Option UNL/014 W81 for Port 1 or W82 for Port 2
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 60-dB step attenuator. Refer to [“Removing and Replacing the A36 and A37 60-dB Step Attenuators \(Option UNL\)”](#) on page 7-54.
5. If the 1 GHz signal is present, reconnect the semirigid cable and go to [“Checking the A38 and A39 Bias Tees \(Option UNL\)”](#) on page 4-49.

Checking the A38 and A39 Bias Tees (Option UNL)

1. Locate the following semirigid cable at the appropriate bias tee:
Options UNL and UNL/014 W55 for Port 1 or W56 for Port 2
2. Using a 5/16-inch torque wrench, disconnect the semirigid cable at the bias tee.
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 bias tee. Refer to [“Removing and Replacing the A38 and A39 Bias Tees \(Option UNL\)”](#) on page 7-56.
5. If the 1 GHz signal is present, replace the appropriate test port coupler. Refer to [“Removing and Replacing the A25 and A26 Test Port Couplers”](#) on page 7-46.

Checking the Receiver Group

Equipment Used for These Tests

Equipment Type	Models Used With	Model or Part Number	Alternate Model or Part Number
Spectrum analyzer	All	8565E	856xE ¹

1. Must be capable of measuring signals at 8.333 MHz and 41.667 MHz.

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 A27 through A30 First Converter Outputs

Perform this procedure if you observe a problem in all bands on a single channel.

1. Refer to the block diagram at the end of this chapter and to [“Bottom RF Cables, Standard” on page 6-26](#). Locate the cables W21, W22, W23, and W24 at the first converters, A27, A28, A29, and A30, respectively.
2. Using a 5/16-inch torque wrench, disconnect the semirigid cable associated with the faulty channel, from the first converter.
3. Connect the spectrum analyzer to the connector to which this cable was connected.
4. The measured signal on the spectrum analyzer should be at 8.333 MHz.
5. If the signal is not present, replace the faulty first converter. Refer to [“Removing and Replacing the A27, A28, A29, and A30 First Converters \(Mixers\) and Mixer Bias Board” on page 7-48](#).
6. If the signal is present, reconnect the cable and continue testing at [“Checking the A31 through A34 Receiver Outputs”](#).

Checking the A31 through A34 Receiver Outputs

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 RF Cables, Standard” on page 6-26](#). Locate the flexible cables W25, W26, W27 and W28 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.
 - If the measured signal is present, replace the A6 SPAM board. Refer to [“Removing and Replacing the A6, A8, and A10 Boards” on page 7-18](#).
5. 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 A35 receiver motherboard. Refer to [“Removing and Replacing the A35 Receiver Motherboard” on page 7-52](#).
 - c. If the analyzer functions properly with the replacement receiver, replace the suspect receiver. Refer to [“Removing and Replacing the A31, A32, A33, and A34 Receiver Modules” on page 7-50](#).

Instrument Block Diagrams

E8362A Overall Block Diagram, Includes Option UNL

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E8362A Overall Block Diagram, Includes Options UNL and 014

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E8363A and E8364A, Includes Option UNL

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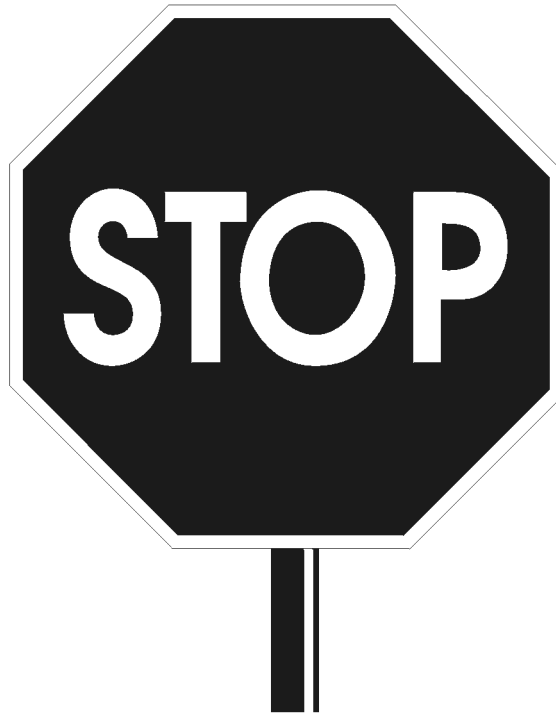


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E8363A and E8364A, Includes Options UNL and 014

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5 Theory of Operation

Information in This Chapter

This chapter provides a general description of the operating theory of the PNA series microwave network analyzers. 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 4](#), “Troubleshooting.”

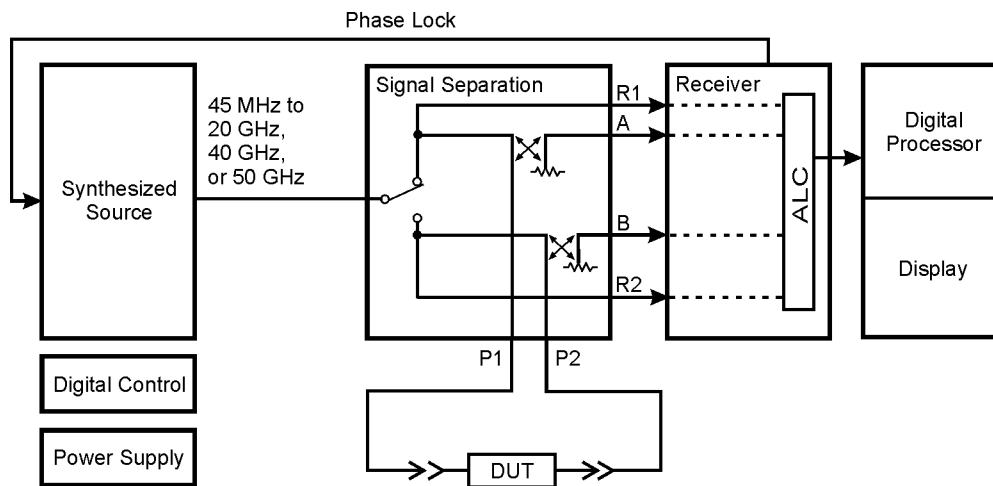
Chapter Five at-a-Glance

Section Title	Summary of Content	Start Page
Network Analyzer System Operation	A summary of the theory of operation for the analyzer. A summary of the operation of the five functional groups of the analyzer.	Page 5-3
Source Group Operation	Operation of the assemblies associated with the source group.	Page 5-5
Signal Separation Group Operation	Operation of the assemblies associated with signal separation, including the operation of Option 014.	Page 5-15
Receiver Group Operation	Operation of the assemblies associated with the receiver group.	Page 5-20
Digital Processing and Digital Control Group Operation	Operation of the assemblies associated with digital processing and control.	Page 5-23
Power Supply Group Operation	Operation of the power supply assembly group.	Page 5-29

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

Frequency Range	45 MHz to 500 MHz	500 MHz to 2GHz	2 GHz to 10 GHz	10 GHz to 20 GHz	20 GHz to 30 GHz	30 GHz to 40 GHz	40 GHz to 45 GHz	45 GHz to 50 GHz
Max. Pwr. Out								
Std & Opt. 014	+5 dBm	+6 dBm	+5 dBm	+2 dBm	-2 dBm	-6 dBm	-7 dBm	-12 dBm
Opt. UNL	+3 dBm	+4 dBm	+3 dBm	+1 dBm	-2 dBm	-6 dBm	-9 dBm	-15 dBm
Opt. UNL/014	+3 dBm	+4 dBm	+3 dBm	0 dBm	-4 dBm	-8 dBm	-11 dBm	-17 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 5-15](#).

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 5-20](#).

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 Processing and Digital Control Group Operation” on page 5-23](#).

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 5-29](#).

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 5-7](#) 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 on page 5-6](#).

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

- [Band Modes](#)
- [A8 Fractional-N Synthesizer Board](#)
- [A17 L.O. Multiplier/Amplifier 10 \(LOMA 10\)](#)
- [A18 Multiplier/Amplifier 20 \(MA 20\)](#)
- [A19 Splitter](#)
- [A20 L.O. Distribution Assembly \(LODA\)](#)
- [A10 Frequency Reference Board](#) (including rear-panel interconnects)
- [A11 Phase Lock Board](#)
- [A12 Source 20](#)
- [A21 Source Multiplier/Amplifier 50 \(SOMA 50\) \(E8363A and E8364A Only\)](#)
- [A16 Test Set Motherboard](#) (including rear-panel interconnects)

Band Modes

[Table 5-2](#) lists the L.O. harmonic number, the synthesizer frequency, the source frequency, and the frequencies at various other locations within the analyzer for each band.

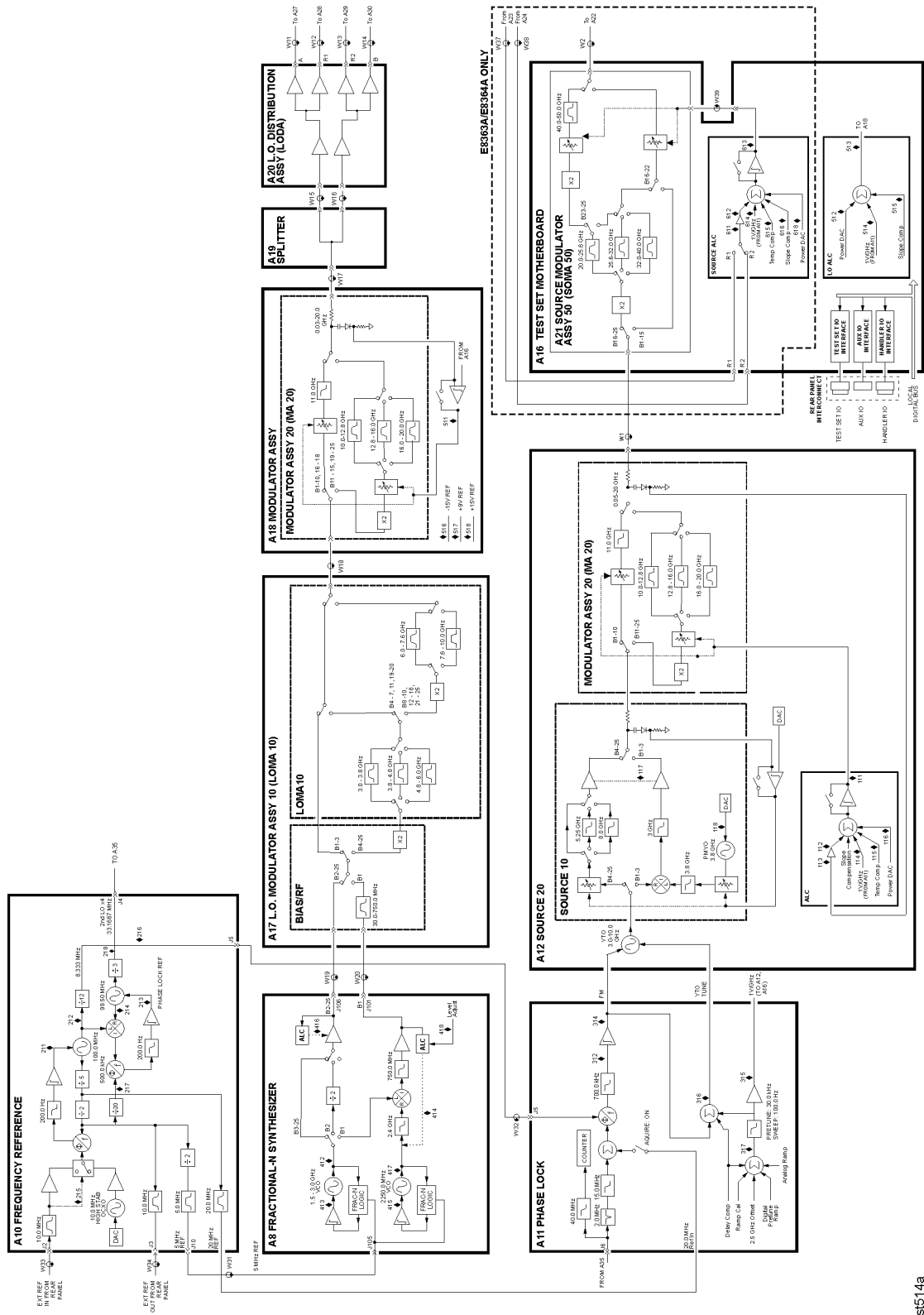
This table is referred to throughout this chapter and also appears on the overall block diagram at the end of [Chapter 4, “Troubleshooting.”](#)

The A10 frequency reference board produces a constant phase locked reference signal of 8.333 MHz which is sent to the A11 phase lock board.

The A8 fractional-N synthesizer board produces a fundamental LO signal which is sent through the A17–A20 LO distribution path to the A27–A30 first converters. The frequency is synthesized such that the mixing product of this LO signal with the main source output is a constant 8.333 MHz. A portion of the 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 A31–A34 receiver modules, 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 also produces a constant 33.1667 MHz signal which is passed to the A35 receiver motherboard where the frequency is divided by four to produce a constant 2nd LO signal of 8.29167 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.

Figure 5-2 Source Group



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Table 5-2 Subsweep Frequencies

Model	Band	L.O. Harmonic Number (N)	A8 Frac-N Synthesizer Frequency (GHz)	A17 LOMA 10 Frequency (GHz)	A20 LODA (L.O.) Frequency (GHz)	A12 Source 20 Frequency (GHz)	A21 SOMA 50 Frequency (GHz) ^a
E8362A, E8363A, E8364A	1	1	0.053 to 0.756	0.053 to 0.756	0.053 to 0.756	0.045 to 0.748	0.045 to 0.748
	2	1	0.756 to 1.508	0.756 to 1.508	0.756 to 1.508	0.748 to 1.500	0.748 to 1.500
	3	1	1.50 to 3.00	1.50 to 3.00	1.50 to 3.00	1.50 to 3.00	1.50 to 3.00
	4	1	1.50 to 1.90	3.00 to 3.80	3.00 to 3.80	3.00 to 3.80	3.00 to 3.80
	5	1	1.90 to 2.25	3.80 to 4.50	3.80 to 4.50	3.80 to 4.50	3.80 to 4.50
	6	1	2.25 to 2.40	4.50 to 4.80	4.50 to 4.80	4.50 to 4.80	4.50 to 4.80
	7	1	2.40 to 3.00	4.80 to 6.00	4.80 to 6.00	4.80 to 6.00	4.80 to 6.00
	8	1	1.50 to 1.60	6.00 to 6.40	6.00 to 6.40	6.00 to 6.40	6.00 to 6.40
	9	1	1.60 to 1.90	6.40 to 7.60	6.40 to 7.60	6.40 to 7.60	6.40 to 7.60
	10	1	1.90 to 2.50	7.60 to 10.00	7.60 to 10.00	7.60 to 10.00	7.60 to 10.00
	11	1	2.50 to 3.00	5.00 to 6.00	10.00 to 12.00	10.00 to 12.00	10.00 to 12.00
	12	1	1.50 to 1.60	6.00 to 6.40	12.00 to 12.80	12.00 to 12.80	12.00 to 12.80
	13	1	1.60 to 1.90	6.40 to 7.60	12.80 to 15.20	12.80 to 15.20	12.80 to 15.20
	14	1	1.90 to 2.00	7.60 to 8.00	15.20 to 16.00	15.20 to 16.00	15.20 to 16.00
	15	1	2.00 to 2.50	8.00 to 10.00	16.00 to 20.00	16.00 to 20.00	16.00 to 20.00
E8363A, E8364A	16	3	1.67 to 1.90	6.67 to 7.60	6.67 to 7.60	10.00 to 11.40	20.00 to 22.80
	17	3	1.90 to 2.13	7.60 to 8.53	7.60 to 8.53	11.40 to 12.80	22.80 to 25.60
	18	3	2.13 to 2.50	8.53 to 10.00	8.53 to 10.00	12.80 to 15.00	25.60 to 30.00
	19	3	2.50 to 2.67	5.00 to 5.33	10.00 to 10.67	15.00 to 16.00	30.00 to 32.00
	20	3	2.67 to 3.00	5.33 to 6.00	10.67 to 12.00	16.00 to 18.00	32.00 to 36.00
	21	3	1.50 to 1.60	6.00 to 6.40	12.00 to 12.80	18.00 to 19.20	36.00 to 38.40
	22	3	1.60 to 1.67	6.40 to 6.67	12.80 to 13.33	19.20 to 20.00	38.40 to 40.00
E8364A	23	3	1.67 to 1.90	6.67 to 7.60	13.33 to 15.20	10.00 to 11.40	40.00 to 45.60
	24	3	1.90 to 2.00	7.60 to 8.00	15.20 to 16.00	11.40 to 12.00	45.60 to 48.00
	25	3	2.00 to 2.08	8.00 to 8.33	16.00 to 16.67	12.00 to 12.50	48.00 to 50.00

a. Applies only to the E8363A and E8364A; this assembly is not included in the E8362A.

A8 Fractional-N Synthesizer Board

The A8 fractional-N synthesizer board uses the 5 MHz reference signal from the A10 frequency reference board 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 band 1, these two signals are heterodyned to produce the output frequencies listed in [Table 5-2 on page 5-7](#). In band 2, 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 all other bands, the swept VCO signal is sent directly to the synthesizer output.

At the output, an ALC circuit maintains the power level at $-5 \text{ dBm} \pm 2 \text{ dB}$ for bands 1–2 or $-1.5 \text{ dBm} \pm 2 \text{ dB}$ for bands 3–25. In all bands, the output is sent to the A17–A20 LO distribution path and on to the A27–A30 first converters, as the 1st LO signal.

A17 L.O. Multiplier/Amplifier 10 (LOMA 10)

In bands 1–3, the input signal from the A8 fractional-N synthesizer board is passed through the A17 LOMA 10 unchanged. For all other bands, the signals are doubled, filtered, and amplified. In bands 8–10, 12–19, and 21–25, the signals are again doubled, filtered, and amplified. Together, all of these signal paths create the full output frequency range of 53 MHz to 10 GHz.

A18 Multiplier/Amplifier 20 (MA 20)

In bands 1–10 and 16–18, the 53 MHz to 10 GHz input frequencies are filtered, amplified, and passed through the A18 MA 20. In bands 11–15, and 19–25, the signals are doubled, filtered, and amplified.

Together, these signal paths create the full output frequency range of 53 MHz to 20 GHz that is sent to the A19 splitter.

A19 Splitter

The A19 splitter receives the 53 MHz to 20 GHz LO signal from the A8, A17, and A18 LO generation chain and divides it into two signals which are routed to the A20 L.O. distribution assembly (LODA). This splitter configuration provides the highest level of balance and control of the LO signal.

A20 L.O. Distribution Assembly (LODA)

In the A20 LODA, the LO signal is amplified and split to provide balanced LO signals to each of the A27–A30 receiver first converters.

A10 Frequency Reference Board

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.

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 99.5 MHz. It is also used to provide the 10 MHz EXT REF OUT rear panel signal, reference for the A11 phase lock board, and a 5 MHz reference for the A6 signal processing ADC module (SPAM) board and the A8 fractional-N synthesizer board.

The 95.5 MHz reference signal is sent through a divide-by-3 circuit to produce the fourth multiple of the 8.29167 MHz 2nd LO signal which is sent to the A35 receiver motherboard. The 100 MHz reference signal is sent through a divide-by-12 circuit to produce the 8.3333 MHz phase lock reference signal which is sent to the A11 phase lock board.

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, to be output for use in phase locking external test equipment.</p>

A11 Phase Lock Board

The A11 phase lock board compares the phase lock IF signal from the A16 test set motherboard with the phase lock reference signal from the A10 frequency reference board to generate the tuning voltage for the A12 source 20 YIG-tuned oscillator (YTO). In addition, various digital-to-analog converters (DACs) on this assembly are set by the A6 SPAM board to inject offset and delay voltages for the various source bands and measurement sweep rates.

A12 Source 20

The A12 source 20 consists of:

- [Source 10](#)
- [Multiplier/Amplifier 20 \(MA 20\)](#)
- [ALC Circuitry](#)

Source 10

The A12 source 20 contains a 3–10 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 splits into two paths. One path is low-pass 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.

In bands 1–3, the 3.845 to 6.8 GHz output of the YTO and the 3.8 GHz output of the PMYO are mixed to produce the 45 MHz to 3.0 GHz output frequency that is sent to the multiplier/amplifier 20 (MA 20). In bands 4–25, the 3 to 10 GHz output of the YTO is filtered and sent directly to the MA 20.

Multiplier/Amplifier 20 (MA 20)

The MA 20 filters, amplifies, and passes through, the 45 MHz to 10 GHz output frequencies in bands 1–10. The signals for bands 11–25 are doubled, filtered, and amplified. Together, these two paths produce an output frequency range of 45 MHz to 20 GHz.

For the E8362A analyzer, this signal is sent directly to the A22 switch splitter in the signal separation group.

For the E8363A and E8364A analyzers, this signal is sent to the A21 source multiplier/amplifier 50 (SOMA 50).

A portion of this output signal is split off and combined with other inputs in the ALC circuitry to control the output power level.

ALC Circuitry

The following inputs are combined in the ALC circuitry to produce a signal that is sent to the MA20 to control its output power level:

- output of the MA 20
- temperature compensation
- slope compensation
- power level DAC
- 1V/GHz signal from the A11 phase lock board

A21 Source Multiplier/Amplifier 50 (SOMA 50) (E8363A and E8364A Only)

The A21 SOMA 50 consists of three signal paths:

- In the first path, the 45 MHz to 20 GHz source signals for bands 1–15 are amplified, leveled, and passed through to the A22 switch splitter.
- In the second path, the 10 to 20 GHz signals for bands 16–22 are doubled, filtered, and amplified to produce the 20 to 40 GHz output.
- In the third path, a portion of the second-path signal is doubled to produce the 40 to 50 GHz output.

The source ALC circuitry (located on the A16 test set motherboard) provides feedback to the SOMA 50 to control the output power level.

A16 Test Set Motherboard

The A16 test set motherboard serves these functions:

- to act as an interface between the A15 CPU board and the auxiliary rear panel interconnects.
- to provide ALC signals to the A21 SOMA 50 and to the A18 multiplier/amplifier.
- to route control signals to the signal separation group. Refer to [“Signal Separation Group Operation” on page 5-15](#) for more information.

Rear Panel Interconnects

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

TEST SET I/O	<p>A DB-25 female connector that is used to control external test sets. The external test set bus consists of 13 multiplexed address and data lines, three control lines, and an open-collector interrupt line. Pin assignments are listed in Table 5-3 on page 5-12.</p> <p>Up to 16 test sets may be “daisy-chained” on the bus at one time.</p> <p>The Test Set I/O is not compatible with 8753 network analyzer test sets.</p>
HANDLER I/O	<p>A rectangular 36-pin, female connector providing four independent parallel input/output ports, nine control signal lines, one ground, and a power supply line. This connector has Type 2 output pin assignments as listed in Table 5-4 on page 5-13.</p> <p>All signals are TTL-compatible. Data input/output ports consist of two 8-bit output ports (Port A and Port B) and two 4-bit bidirectional ports (Port C and Port D).</p> <p>Connector settings can be changed using SCPI and COM commands. The settings are not accessible from the front panel.</p>
AUX I/O	<p>A DB-25 male connector that provides a variety of both analog and digital input and output signals as described in Table 5-5 on page 5-14.</p>

Table 5-3 TEST SET I/O Connector Pin Assignments

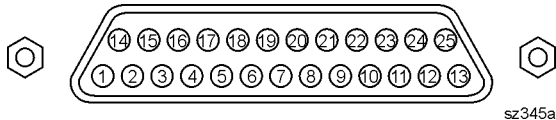
 <p style="text-align: center;">DB-25 Female Connector</p>		
Pin Numbers	Name	Function
1	SEL0	TTL out, test set select bit 0, tied to 0 V
2	Sweep Holdoff In	TTL in, low level holds off sweep
3–6	AD12–AD8	TTL I/O, address and latched data
7	GND	0 V, ground reference
8	LAS	TTL out, active low address strobe (1 μ s min)
9–11	AD4–AD2	TTL I/O, address and latched data
12	GND	0 V, ground reference
13	Interrupt In	TTL in, low level (10 μ s min) aborts sweep
14	+22 V	+22 Vdc, 100 mA max.
15–16	SEL1–2	TTL out, test set select bits 1-2, tied to 0 V
17	AD11	TTL I/O, address and latched data
18	SEL3	TTL out, test set select bit 3, tied to 0 V
19–21	AD7–5	TTL I/O, address and latched data
22–23	AD0–1	TTL I/O, address and latched data
24	LDS	TTL out, active low data strobe (1 μ s min)
25	RLW	TTL out, high = read, low = write

Table 5-4 HANDLER I/O Connector Key Pin Assignments

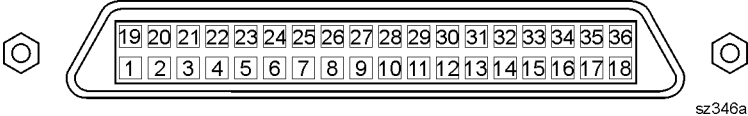
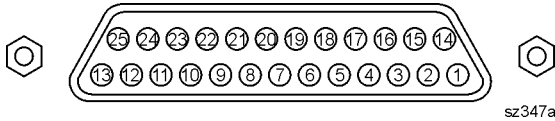
 <p style="text-align: center;">Rectangular 36-Pin Female Connector</p>		
Pin Numbers	Name	Function
1	GND	0 V, ground reference
2	INPUT1	TTL in, negative pulse (1 μ s min) latches OUTPUT1-2
3–4	OUTPUT1–2	TTL out, latched
5–12	Port A0–7 Out	TTL out, latched
13–20	Port B0–7 Out	TTL out, latched
21–24	Port C I/O	TTL I/O, latched
25–28	Port D I/O	TTL I/O, latched
29	Port C Status	TTL out, low = input mode, high = output mode
30	Port D Status	TTL out, low = input mode, high = output mode
31	Output Strobe Write Strobe	TTL out, active low data write strobe (1 μ s min)
32	No connect	Not used
33	Pass Fail	TTL out, latched, indicates pass fail (programmable polarity)
34	+5 V	+5 Vdc, 100 mA max.
35	Sweep End	TTL out, active low (10 μ s min) indicates sweep done
36	Pass/Fail Write Strobe	TTL out, active low pass/fail write strobe (1 μ s min)

Table 5-5 AUX I/O Connector Pin Assignments

 <p style="text-align: center;">DB-25 Male Connector</p>		
Pin Numbers	Name	Function
1	ACOM	0 V, ground reference for analog signals
2–3	Analog Out 2–1	–10 to +10 Vdc output, 10 mA max, $R_o = 100\ \Omega$
4	No connect	For future enhancements
5	DCOM	0 V, ground reference for digital signals
6–8	Pulse Out 3–1	TTL out, programmable pulse (for future use)
9	+5 V	+5 Vdc output, 100 mA max.
10	Pass/Fail Write Strobe	TTL out, active low (1 μ s min) indicates pass/fail line is valid
11	Sweep End	TTL out, active low (10 μ s min) indicates sweep is done
12	Pass/Fail	TTL out, latched, indicates pass or fail (programmable polarity)
13	Output Port Write Strobe	TTL out, active low (10 μ s min) writes I/O port data
14	Analog In	–10 to +10 Vdc input, $R_i = 100k\ \Omega$
15	ACOM	0 V, ground reference for analog signals
16	Power Button In	Open-collector input, active low replicates a power button press
17	DCOM	0 V, ground reference for digital signals
18	Ready for Trigger	TTL out, low indicates ready for external trigger
19	External Trigger In	TTL in, level trigger (width >1 μ s), programmable polarity
20	Footswitch In	TTL in, active low (width >1 μ s), triggers a programmable event
21	+22 V	+22 Vdc output, 100 mA max.
22–25	In/Out Port C0–3	TTL I/O, general purpose

Signal Separation Group Operation

The signal separation group divides the source signal into a reference path and a test path. Refer to [Figure 5-3 on page 5-16](#).

- 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](#)
- [A25 and A26 Test Port Couplers](#)
- [A23 and A24 Detectors \(E8363A and E8364A Only\)](#)
- [30-dB Fixed Attenuators \(E8362A Only\)](#)
- [A36 and A37 60-dB Step Attenuators \(Option UNL\)](#)
- [A38 and A39 Bias Tees \(Option UNL\)](#)
- [Front Panel Jumpers \(Option 014 Configurable Test Set\)](#)

A22 Switch Splitter

For the E8363A and E8364A, the output of the A21 SOMA 50 is routed to the A22 switch splitter. For the E8362A, this is the output of the A12 source 20 assembly. The A22 switch splitter 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 provides an internal termination for the measurement port that is inactive.

Each measurement path in the A22 switch splitter includes a two-way splitter; the signal is split into the test port signal and the receiver signal.

The test port signal is sent directly through the test port coupler, A25 or A26, and out through either PORT 1 or PORT 2 to the DUT, unless Option UNL is installed. In this case, the signal is routed through the step attenuator, A36 or A37, the bias tee, A38 or A39, then through the test port coupler and test port to the DUT.

The reference signal is routed to the appropriate R channel receiver module, A32 or A33, through a detector, A23 or A24 (for E8363A and E8364A), or a 30-dB fixed attenuator (for E8362A), and a receiver first converter, A28 or A29. If Option 014 is installed, the signal is routed through a front-panel channel R jumper to the receiver first converter.

A25 and A26 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 Option 014) for measurement. The coupling coefficient of the directional couplers is nominally 15 dB over the full frequency range.

A23 and A24 Detectors (E8363A and E8364A Only)

The A23 and A24 detectors are used to level the reference signals R1 and R2 that are routed to the channel R1 and R2 receivers.

30-dB Fixed Attenuators (E8362A Only)

The 30-dB fixed attenuators are placed in the reference signal paths to provide isolation.

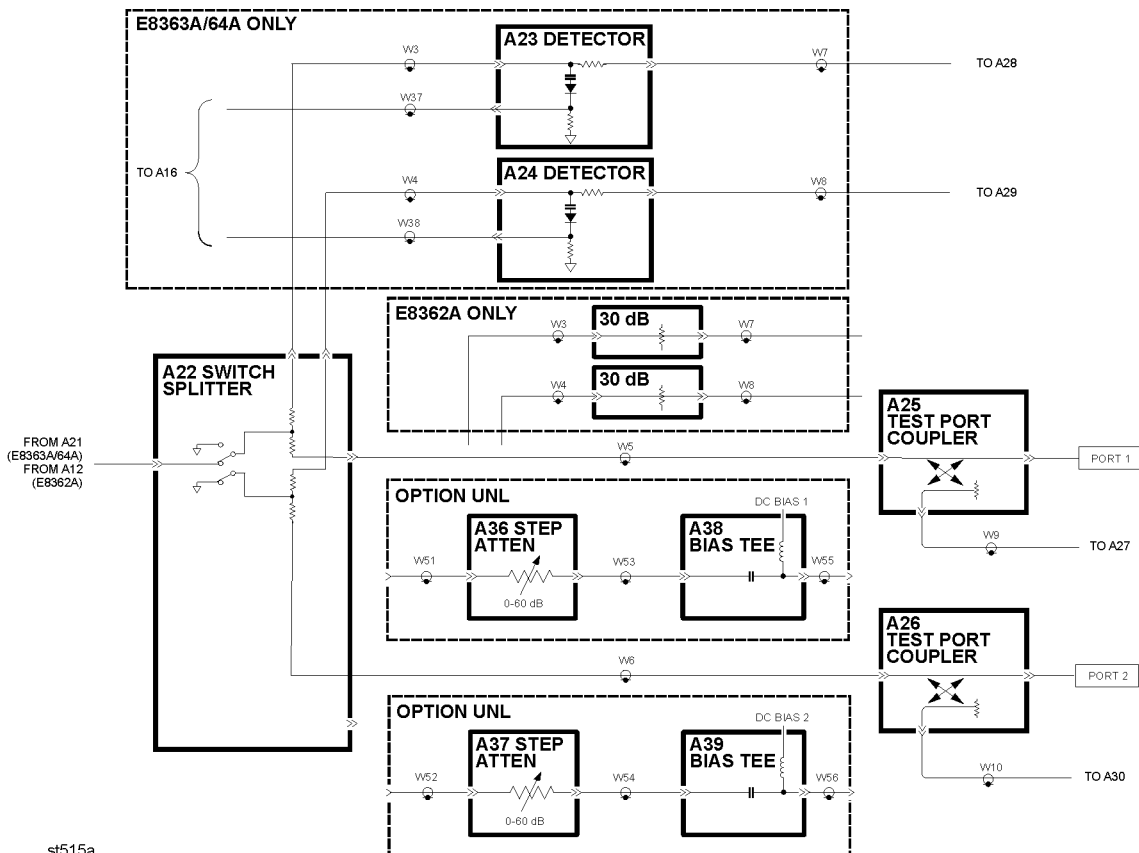
A36 and A37 60-dB Step Attenuators (Option UNL)

The 60 dB step attenuators provide coarse power control for the test port signals. They are electro-mechanical step attenuators, controlled by the A15 CPU board, that provide 0 to 60 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.

A38 and A39 Bias Tees (Option UNL)

The A38 and A39 bias tees provide 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 dc bias current goes only to the DUT, and not back into the source. Similarly, an inductor in the bias path prevents RF from being imposed on the external dc supply.

Figure 5-3 Signal Separation Group, Standard Analyzer



Option 014 Configurable Test Set

The Option 014 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 six front panel SMA jumpers.

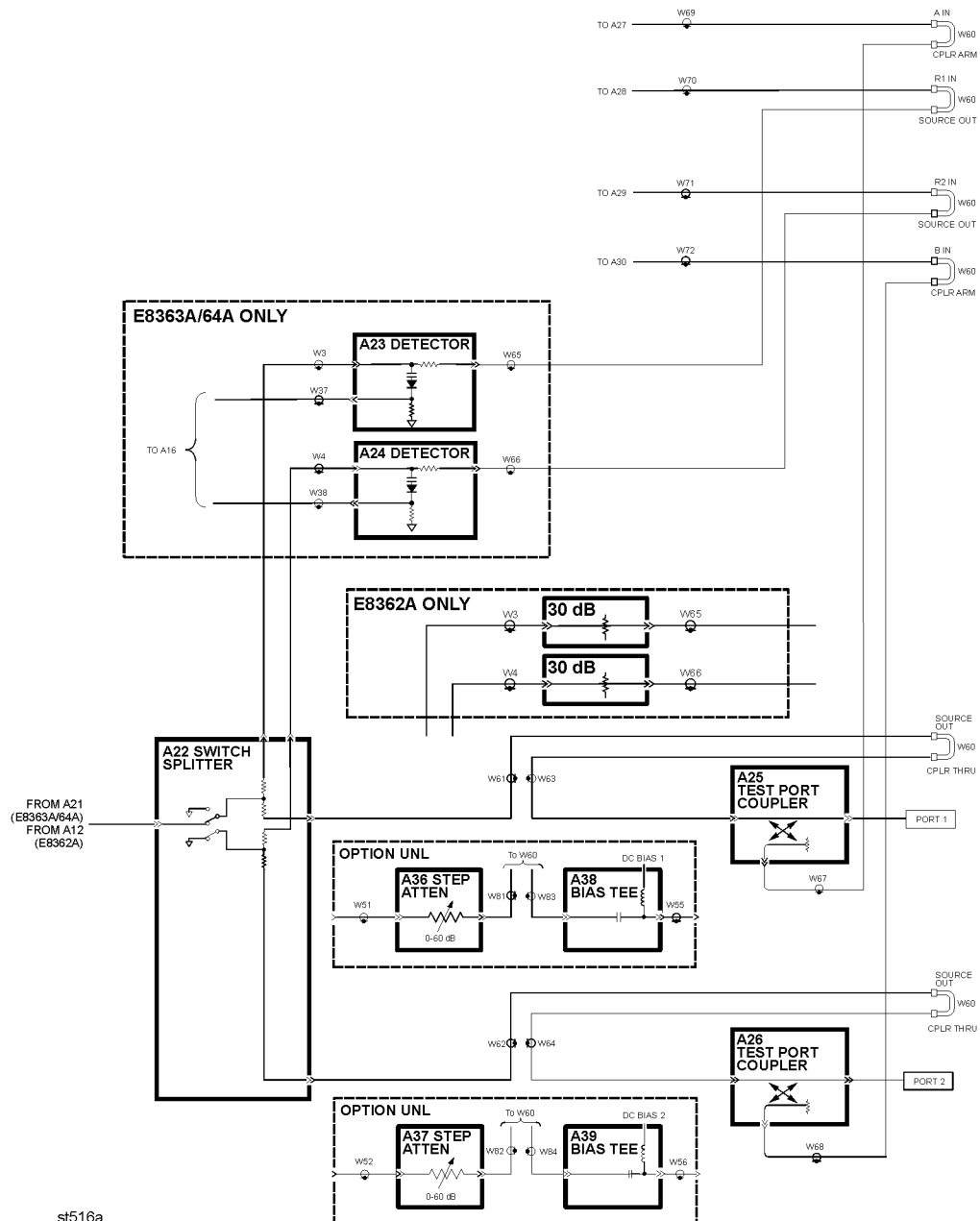
As shown in [Figure 5-4 on page 5-18](#), these jumpers allow access to the test port and reference signals between:

- the A22 switch splitter and the A25 test port 1 coupler. (For Option UNL, this is between the A36 step attenuator and the A38 bias tee.)
- the A22 switch splitter and the A26 test port 2 coupler. (For Option UNL, this is between the A37 step attenuator and the A39 bias tee.)
- the A25 test port 1 coupler and the A27 receiver A first converter
- the A26 test port 2 coupler and the A30 receiver B first converter
- the A23 detector (for E8363A and E8364A) or fixed attenuator (for E8362A) and the A28 receiver R1 first converter
- the A24 detector (for E8363A and E8364A) or fixed attenuator (for E8362A) and the A29 receiver R2 first converter

Normal Option 014 Configuration

The normal configuration for the Option 014 is shown in [Figure 5-4 on page 5-18](#). 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 014” in the embedded help index in the analyzer.

Figure 5-4 Signal Separation Group, Option 014 Analyzer



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High Dynamic Range Configuration

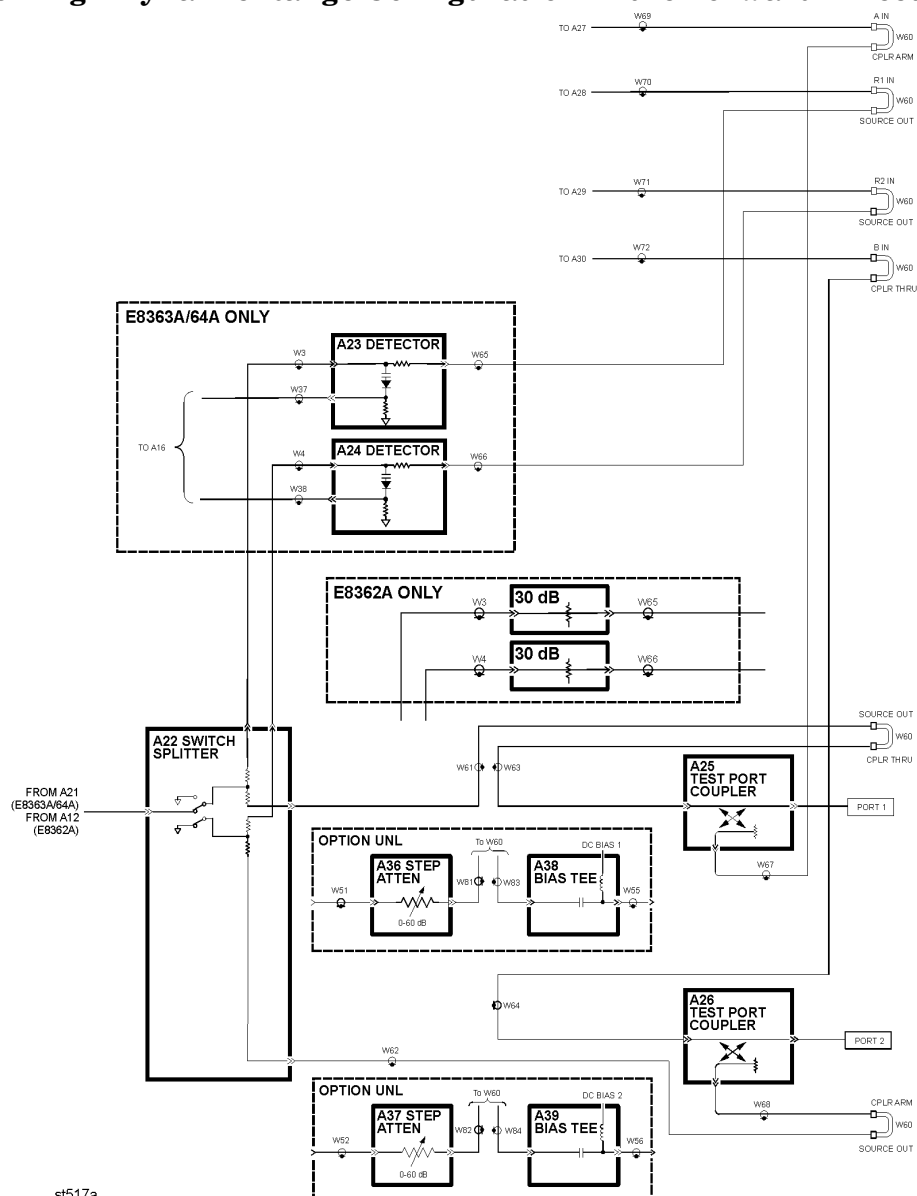
With a few jumper changes, you can configure the Option 014 for higher dynamic range measurements. By swapping the front panel jumpers for one port, signal flow through the corresponding coupler is reversed, increasing the test signal sensitivity by 15 dB.

In the forward direction, as shown in [Figure 5-5](#), the signal flow through the test port coupler (A26) is reversed by arranging the front panel jumpers such that RCVR B IN connects to CPLR THRU and CPLR ARM connects to SOURCE OUT.

In the reverse direction, not shown, the signal flow through the test port coupler (A25) is reversed by arranging the front panel jumpers such that RCVR A IN connects to CPLR THRU and CPLR ARM connects to SOURCE OUT.

For more information on high dynamic range measurements and configurations, search for “Option 014” 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 on page 5-21](#) is a simplified block diagram of the receiver functional group.

In this section the following assemblies are described:

- [A27, A28, A29, and A30 Receiver First Converters \(Mixers\)](#)
- [A31, A32, A33, and A34 Receiver Modules](#)
- [A6 SPAM Board \(Analog Description\)](#)
- [A35 Receiver Motherboard](#)
- [A16 Test Set Motherboard](#)

A27, A28, A29, and A30 Receiver First Converters (Mixers)

The four receiver first converters (mixers) function identically and are completely interchangeable.

Each first converter receives the RF reference or test signal and mixes it with the 1st LO signal from the A20 LODA to create the 1st IF signal at a constant 8.333 MHz. This 1st IF signal is sent to the A31, A32, A33, and A34 receiver modules.

A31, A32, A33, and A34 Receiver Modules

The four receiver modules function identically and are completely interchangeable.

A portion of the 8.333 MHz 1st IF signal is sent to a multiplexer on the A35 receiver motherboard, the output of which is routed to the A11 phase lock board to complete the phase lock loop. The 8.333 MHz 1st IF signal is also filtered, amplified, and routed to the 2nd converter.

The 2nd converter divides the 8.333 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 8.29167 MHz. 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.



A6 SPAM Board (Analog Description)

The A6 SPAM board contains digital and analog circuitry. For analog descriptions, refer to [“A6 SPAM Board \(Digital Description\)” on page 5-26](#).

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 Processing and Digital Control Group Operation” on page 5-23](#) for more information on signal processing.

A35 Receiver Motherboard

The A35 test set motherboard:

- supplies power and signal leveling control to the A31, A32, A33, and A34 receiver modules
- selects a phase lock signal and routes it to the A11 phase lock board
- receives the 2nd LO signal from the A10 frequency reference board

Power and Signal Leveling Control

Power and signal leveling control signals are received from the A16 test set motherboard and routed to each of the receiver modules.

Phase Lock Control

A portion of the 8.333 MHz 1st IF signal from each of the receiver modules is routed to a multiplexing circuit. With control from the A15 CPU board, one of these four signals is selected for routing to the A11 phase lock board to complete the phase lock loop.

2nd LO Control

The 33.1667 MHz signal from the A10 frequency reference board is divided by four, and then divided into two paths, designated 2nd LO (a) and 2nd LO (b). The 2nd LO (b) signal is phase shifted $+90^\circ$ relative to the 2nd LO (a) signal.

Digital Processing and Digital Control Group Operation

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

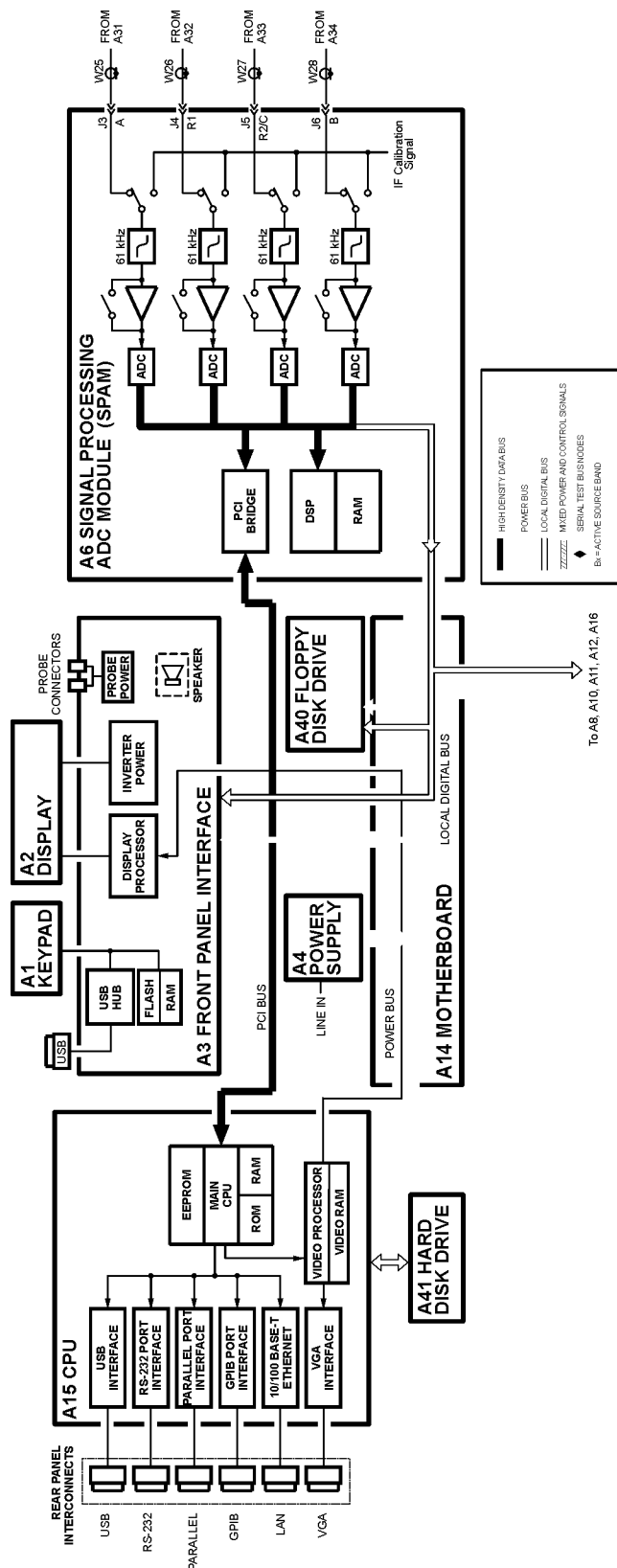
- front panel operation,
- output to the display,
- math processing functions, and
- communications between the analyzer and an external controller or peripherals.

A block diagram of the digital control functional group is shown in [Figure 5-7 on page 5-24](#).

The digital control functional group consists of two subgroups:

- [Front Panel Subgroup](#)
 - [A1 Keypad Assembly](#)
 - [A2 Display Assembly](#)
 - [A3 Front Panel Interface Board](#)
 - A14 system motherboard
- [Data Acquisition and Processing Subgroup](#)
 - [A6 SPAM Board \(Digital Description\)](#)
 - [A15 CPU Board](#)
 - [A40 Floppy Disk Drive](#)
 - [A41 Hard Disk Drive](#)

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](#)

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 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 and the necessary drive circuit power. The video data received from the A15 CPU board 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

The A3 front panel interface board detects and decodes user inputs from the A1 keypad assembly and front panel knob, and transmits them to the A15 CPU board by way of the A14 system motherboard. It also decodes video data from the video processor on the A15 CPU board and supplies this to the A2 display assembly. Power from the power bus on the A14 system motherboard 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 system motherboard.

The A3 front panel interface board 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.

Data Acquisition and Processing Subgroup

The data acquisition and processing subgroup contain the following assemblies. Refer to [Figure 5-7 on page 5-24](#).

- [A6 SPAM Board \(Digital Description\)](#)
- [A15 CPU Board](#) (including rear-panel interconnects)
- [A40 Floppy Disk Drive](#)
- [A41 Hard Disk Drive](#)
- [EPROMs](#) (on the A10 frequency reference board and the A16 test set motherboard)

A6 SPAM Board (Digital Description)

The A6 SPAM board contains digital and analog circuitry. For analog descriptions, refer to [“A6 SPAM Board \(Analog Description\)” on page 5-22](#).

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

A15 CPU Board

The A15 CPU board 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.

A40 Floppy Disk Drive

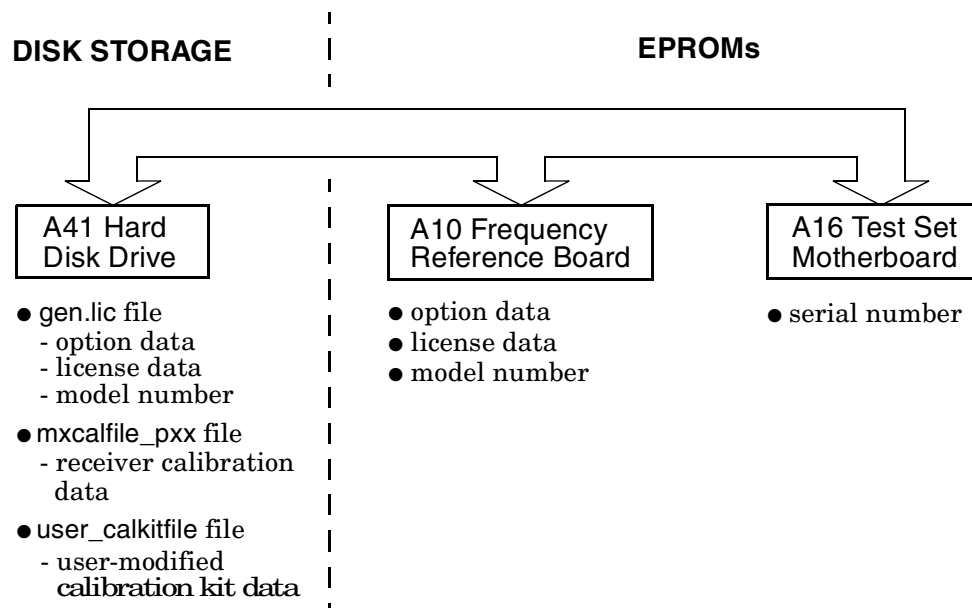
The A40 floppy disk drive allows you to store and recall instrument states and measurement results on a 3.5 inch, 1.44 MB floppy disk. This assembly is connected directly to the A14 system motherboard.

A41 Hard Disk Drive

The hard disk drive assembly (HDDA) is an integrated development environment (IDE) data storage device which is connected directly to the A15 CPU board.

Certain information used by the network analyzer, or about the network analyzer, is stored on the hard disk drive and in several EPROMs within the analyzer. [Figure 5-8](#) illustrates the interaction of the hard disk drive and the EPROMs.

Figure 5-8 Diagram of Hard Disk Drive and EPROM Interaction



The hard disk drive contains:

- the complete operating system
- the gen.lic file
- the mxcalfile_pxx files
- the user_calkitfile file

The operating system can be restored if it should become corrupt. Refer to [Appendix D, “Operating System Recovery.”](#)

The gen.lic file contains option data, license data, and the model number. This file is automatically created from data located in the EPROM on the A10 frequency reference board upon startup, if a file is not already present (if the hard disk drive has been replaced, for example). For the gen.lic file to be recreated from the data in EPROM, there must not be an existing file on the hard disk. Refer to [“Repairing and Recovering Option Data” on page B-5 in Appendix B.](#)

The mxcalfile_pxx files contain the receiver calibration data and can be recreated by performing a receiver calibration adjustment. Refer to [“Receiver Calibration Adjustment” on page 3-44.](#) This file should, however, be backed up so that it can be restored from the backup disk, eliminating the need to perform another receiver calibration. Refer to [“Copy Unique Files from the Hard Disk” on page 7-60.](#)

The user_calkitfile file contains user modified calibration kit data and must be restored from a backup disc. Refer to [“Copy Unique Files from the Hard Disk” on page 7-60.](#)

EPROMs

The following data is contained in EPROMs located on the specified printed circuit boards:

A10 frequency reference board

- option data
- license data
- model number

A16 test set motherboard

- serial number

Option data, license data, and model number can be restored into EPROM (if the A10 frequency reference board is replaced, for example) from the gen.lic file on the hard disk using the **Service, Option Enable Utility, Repair** function. Refer to [“Repairing and Recovering Option Data” on page B-5 in Appendix B.](#)

The serial number can be re-entered (if the A16 test set motherboard is replaced, for example) using the **Service, Option Enable Utility, Change Serial** function. Refer to [“Installing or Changing a Serial Number” on page B-6 in Appendix B.](#)

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)
- VDL (3.3 V to the A15 CPU board)

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 system 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 microwave network analyzers.
- includes several tables and illustrations to assist you in identifying the correct part for your analyzer.
- contains ordering information for new assemblies and rebuilt-exchange assemblies.

Chapter Six at-a-Glance

Section Title	Summary of Content	Start Page
Ordering Information	How to order a replaceable part from Agilent Technologies.	Page 6-3
Assembly Replacement Sequence	The correct sequence for replacing a defective assembly.	Page 6-4
Rebuilt-Exchange Assemblies	The definition of a rebuilt-exchange assembly. The procedure for replacing and returning a defective assembly to Agilent Technologies.	Page 6-5
Replaceable Parts Listings	A table that lists the assemblies by reference designator. Lists and illustrated locations of the replaceable parts in your analyzer: <ul style="list-style-type: none">• Assemblies (front panel, top, and bottom)• Cables (top and bottom)• Hardware (internal, hard disk drive, rear panel, and external)• Miscellaneous replaceable parts	Page 6-6

Ordering Information

To order a part listed in the replaceable parts lists:

- include the part number
- indicate the quantity required
- Contact Agilent Technologies for instructions on where to send the order. Refer to [“Contacting Agilent” on page 2-9](#).

To order a part that is not listed in the replaceable parts lists:

- include the instrument model number and complete instrument serial number
- include the description and function of the part
- indicate the quantity required
- Contact Agilent Technologies for instructions on where to send the order. Refer to [“Contacting Agilent” on page 2-9](#).

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 4, “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, “Repair and Replacement Procedures.”](#)
- Step 4.** Perform the necessary adjustments. Refer to [Chapter 3, “Tests and Adjustments.”](#)
- Step 5.** Perform the necessary performance tests. Refer to [Chapter 3, “Tests and Adjustments.”](#)

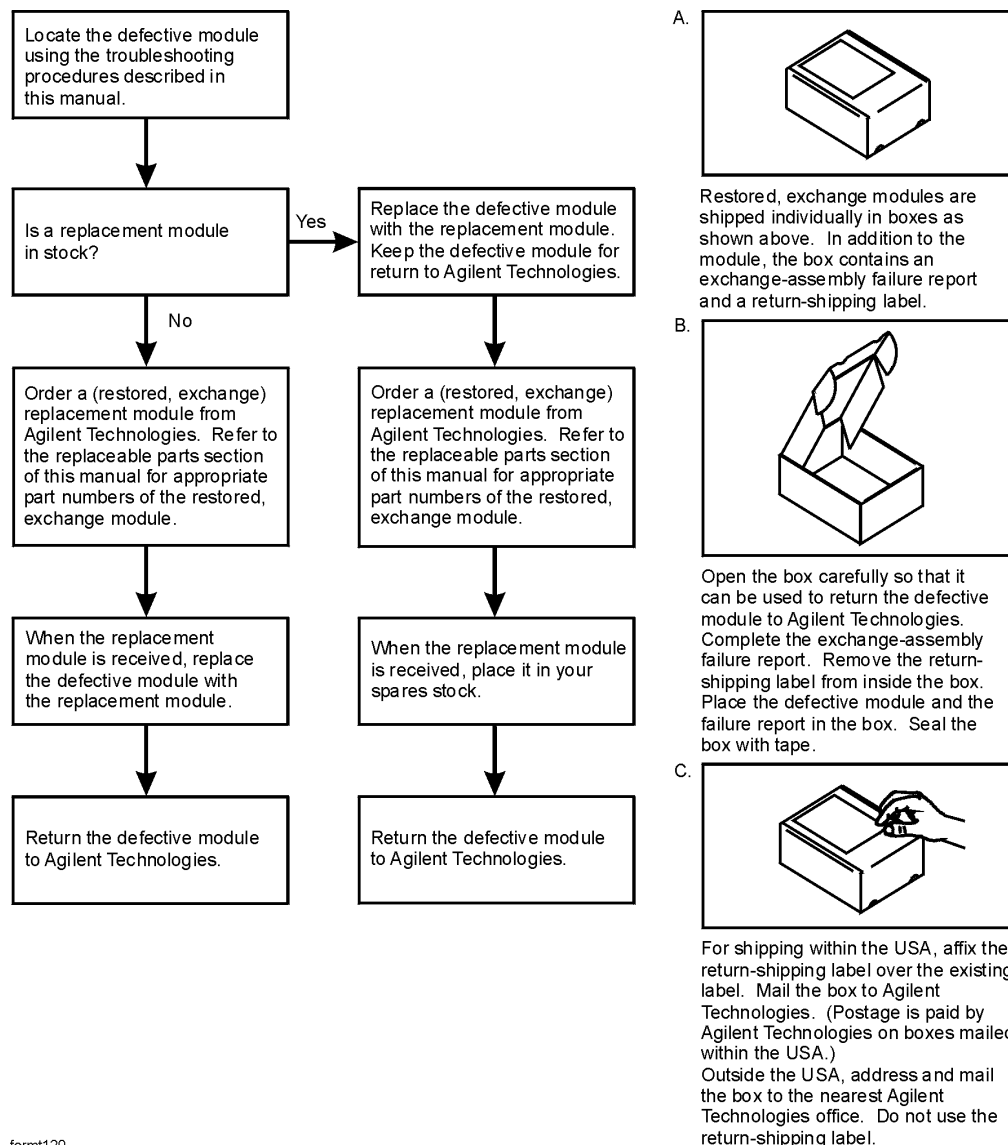
Rebuilt-Exchange Assemblies

Under the rebuilt-exchange assembly program:

- Certain factory-repaired and tested assemblies are available on a trade-in basis.
- Exchange 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.
- Spare assembly stock desired should be ordered using the new assembly part number.

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 microwave network analyzer. You can find the locations of replaceable parts in this section:

- listed by reference designator in [Table 6-1](#), or
- listed 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 6-10
A2	Display assembly	
A3	Front panel interface board	
A4	Power supply assembly	“Top Assemblies and Hardware” on page 6-12
A6	Signal processing ADC module (SPAM) board	
A8	Fractional-N synthesizer board	
A10	Frequency reference board	
A11	Phase lock board	
A12	Source 20	
A14	System motherboard	
A15	CPU board	
A16	Test set motherboard	“Bottom Assemblies, Standard” on page 6-14
A17	Local oscillator multiplier/amplifier 10 (LOMA 10)	
A18	Multiplier/Amplifier (MA 20)	
A19	Splitter	
A20	Local oscillator distribution assembly (LODA)	
A21	Source multiplier/amplifier 50 (SOMA 50) (E8363A, E8364A only)	
A22	Switch splitter	
	Channel R1 30-dB attenuator(E8362A only)	
	Channel R2 30-dB attenuator(E8362A only)	
A23	Channel R1 detector (E8363A, E8364A only)	
A24	Channel R2 detector (E8363A, E8364A only)	

Table 6-1 Location by Reference Designator (Continued)

Reference Designator	Description	Location
A25	Test port 1 coupler	"Bottom Assemblies, Standard" on page 6-14
A26	Test port 2 coupler	
A27	Channel A first converter (mixer)	
A28	Channel R1 first converter (mixer)	
A29	Channel R2 first converter (mixer)	
A30	Channel B first converter (mixer)	
A31	Channel A receiver module	
A32	Channel R1 receiver module	
A33	Channel R2 receiver module	
A34	Channel B receiver module	
A35	Receiver motherboard	
A36	Port 1 60-dB step attenuator (Option UNL)	"Bottom Assemblies, Option UNL" on page 6-16
A37	Port 2 60-dB step attenuator (Option UNL)	
A38	Port 1 bias tee (Option UNL)	
A39	Port 2 bias tee (Option UNL)	
A40	Floppy disk drive	"Internal Hardware and Parts" on page 6-38
A41	Hard disk drive assembly	"Hard Disk Drive Assembly" on page 6-40

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 6-10 • “Top Assemblies and Hardware” on page 6-12 • “Bottom Assemblies, Standard” on page 6-14 • “Bottom Assemblies, Option UNL” on page 6-16 • “Bottom Assemblies, Option 014” on page 6-18 • “Bottom Assemblies, Option UNL, 014” on page 6-20
Cables	<ul style="list-style-type: none"> • “Top Cables” on page 6-24 • “Bottom RF Cables, Standard” on page 6-26 • “Bottom RF Cables, Option UNL” on page 6-28 • “Bottom RF Cables, Option 014” on page 6-30 • “Bottom RF Cables, Option UNL, 014” on page 6-33 • “Bottom Cables, Ribbon and Wrapped-Wire” on page 6-36
Hardware	<ul style="list-style-type: none"> • “Bottom Hardware” on page 6-22 • “Internal Hardware and Parts” on page 6-38 • “Rear Panel Assembly” on page 6-41 • “Hard Disk Drive Assembly” on page 6-40 • “External Parts” on page 6-42

Table 6-2 Part Number Location by Type of Part (Continued)

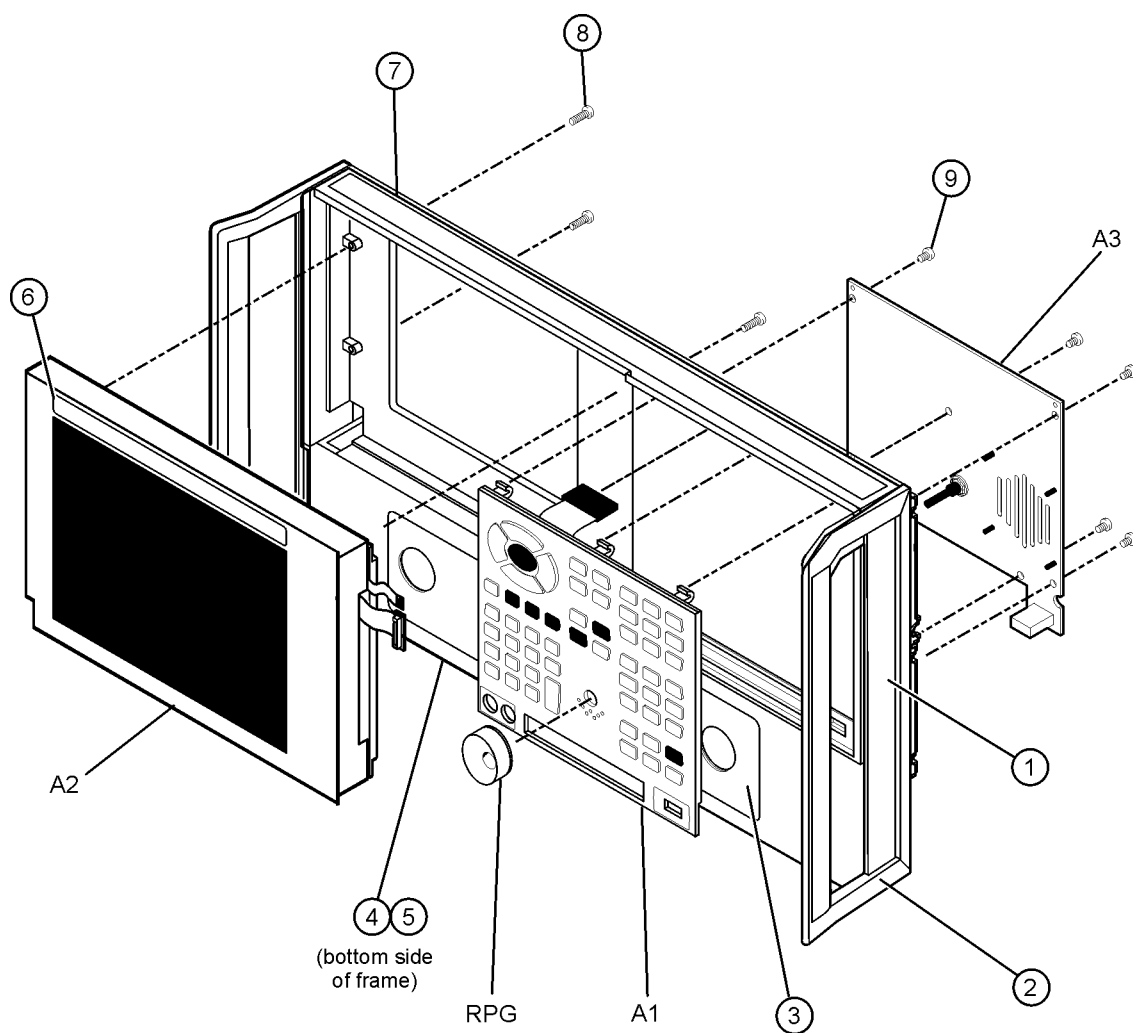
Type of Part	Location
Miscellaneous	<ul style="list-style-type: none">• Service Tools on page 6-44• Fuses on page 6-44• Documentation on page 6-44• Protective Caps for Connectors on page 6-44• GPIB Cables/GPIB Adapter on page 6-44• ESD Supplies on page 6-45• EMI/RFI Accessories on page 6-45• Upgrade Kits on page 6-45• Touch-up Paint on page 6-45• USB Accessories on page 6-45• Rack Mount Kits and Handle Kits on page 6-45

Front Panel Assembly

Reference Designator	Model	Part Number	Qty	Description
A1	All	E8356-60001	1	Keypad assembly
A2 ^a	All	E8356-60002	1	Display assembly
		0950-3379	1	Inverter board (included in A2 ^b)
		2090-0386	1	Display lamp for LCD (included in A2 ^b)
		1000-1161	1	Display glass (included in A2 ^b)
A3	All	E8356-60029	1	Front panel interface board
RPG	All	E8356-40006	1	Front knob
①	All	5041-9183	2	With handles—front handle side trim
	All	5041-9174	2	Without handles—trim strip, filler
② ^c	All	5063-9205	2	Front handle
③	All	E8364-80002	1	Front panel overlay, Standard and Option UNL
	All	E8364-80003	1	Front panel overlay, Option 014
	All	E8364-80011	1	Front panel overlay, Option UNL & 014 combined
④	All	E8356-00025	1	Trim strip, filler
⑤	All	0515-1227	2	Machine screw, M3.0 x 6, flat head (to attach item ④)
⑥	E8362A	E8362-80001	1	Nameplate
	E8363A	E8363-80001		
	E8364A	E8364-80001		
⑦ ^d	All	E8364-60015	1	Front frame assembly
⑧	All	0515-0375	4	Machine screw, M3.0 x 14, pan head
⑨	All	0515-0372	8	Machine screw, M3.0 x 8, pan head

- When ordering a replacement A2 display assembly, you must also order item ⑥.
- Although included in the A2 display assembly, each of these parts is also available separately. If one of these parts should have to be replaced, it is not necessary to replace the entire A2 display assembly. For any other parts failures within the display, replace the entire A2 display assembly.
- For part numbers of complete rack mount kits and handle kits, refer to [“Rack Mount Kits and Handle Kits” on page 6-45](#).
- When ordering a replacement front frame assembly, you must also order item ③.

Figure 6-2 Illustration of Front Panel Assembly



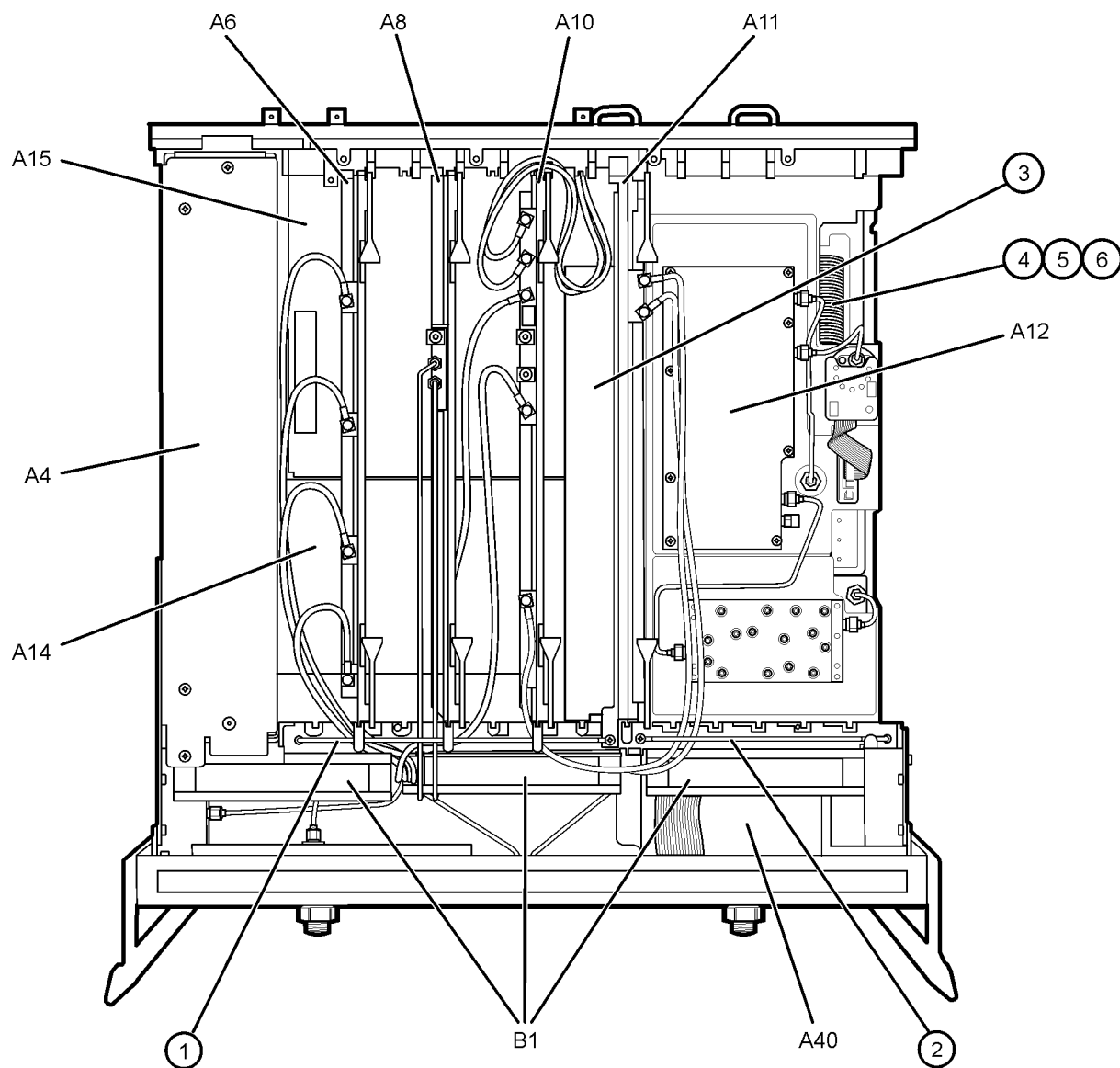
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Top Assemblies and Hardware

Reference Designator	Part Number ^a	Qty	Description
A4	0950-4219	1	Power supply assembly
A6	E8356-60006	1	Signal processing ADC module (SPAM) board
A8	E8356-60008	1	Fractional-N synthesizer board
A10	E8364-60004	1	Frequency reference board
A11	E8364-60005	1	Phase lock board
A12	E8362-60002 <i>E8362-69002</i>	1	Source 20
A14	E8364-60006	1	System motherboard
A15	E8801-60055	1	500 MHz CPU board
A40	Floppy disk drive	1	Refer to “ Internal Hardware and Parts ” on page 6-38.
B1	Fans		
①	5022-6134	1	Cable hold down
②	5022-6135	1	Cable hold down
③	E8356-40001	1	Air flow plenum
④	8121-0817	1	Ribbon cable, A41 hard disk drive to A15 CPU board
⑤	E8356-60024	1	Hard disk drive interface board
⑥	E8356-00014	1	Bracket, for hard disk drive interface board
⑦	0515-0430	1	Machine screw, M3.0 x 6, pan head

a. Part numbers in *italic* typeface are for rebuilt exchange assemblies. Refer to “[Rebuilt-Exchange Assemblies](#)” on page 6-5.

Figure 6-3 Illustration of Top Assemblies and Hardware



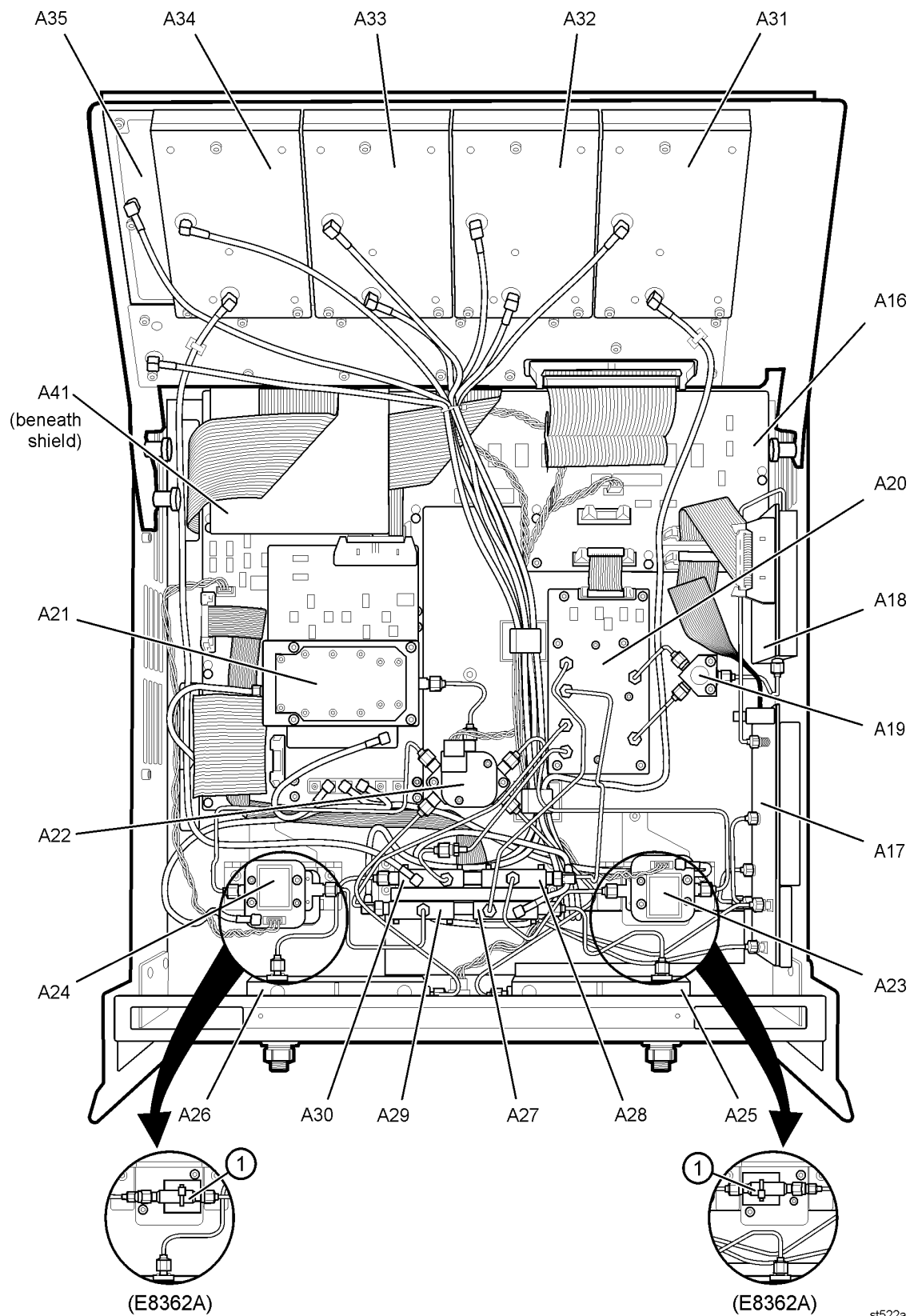
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Bottom Assemblies, Standard

Ref. Desig.	Models	Part Number ^a	Qty	Description
A16	All	E8364-60007	1	Test set motherboard
A17	All	5087-7127 <i>5087-6127</i>	1	LOMA 10
A18	All	5087-7128 <i>5087-6128</i>	1	MA 20
A19	All	5087-7139	1	Splitter
A20	All	5087-7129 <i>5087-6129</i>	1	LODA
A21	E8363A, E8364A	5087-7130 <i>5087-6130</i>	1	SOMA 50
A22	All	5087-7132 <i>5087-6132</i>	1	Switch splitter
A23 A24	E8363A, E8364A	5087-7133	2	Channel R1 detector Channel R2 detector
A25 A26	E8362A	5086-7968	2	Test port 1 coupler Test port 2 coupler
	E8363A, E8364A	5086-7518	2	Test port 1 coupler Test port 2 coupler
A27 A28 A29 A30	E8362A	5087-7145 <i>5087-6145</i>	4	Channel A first converter (mixer) Channel R1 first converter (mixer) Channel R2 first converter (mixer) Channel B first converter (mixer)
A27 A30	E8363A, E8364A	5087-7122 <i>5087-6122</i>	2	Channel A first converter (mixer) Channel B first converter (mixer)
A28 A29		5087-7145 <i>5087-6145</i>	2	Channel R1 first converter (mixer) Channel R2 first converter (mixer)
A31 A32 A33 A34	All	E8364-60003 <i>E8364-69003</i>	4	Channel A receiver module Channel R1 receiver module Channel R2 receiver module Channel B receiver module
A35	All	E8364-60010	1	Receiver motherboard
A41	All	Hard disk drive assembly. Refer to “Hard Disk Drive Assembly” on page 6-40.		
①	E8362A	08493-60017	2	30-dB fixed attenuator (pad)

a. Part numbers in *italic* typeface are for rebuilt exchange assemblies. Refer to [“Rebuilt-Exchange Assemblies” on page 6-5.](#)

Figure 6-4 Illustration of Bottom Assemblies, Standard

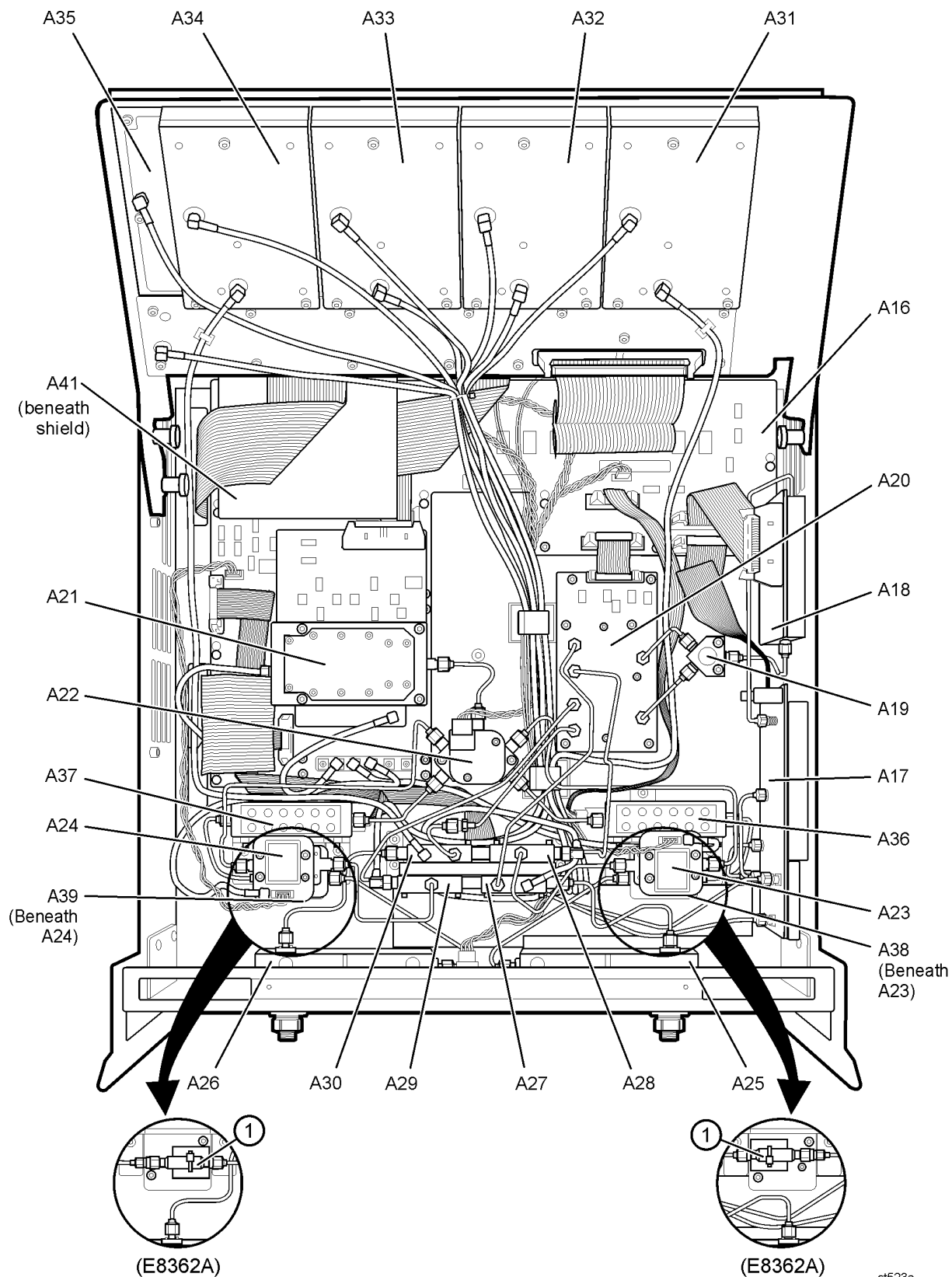


Bottom Assemblies, Option UNL

Ref. Desig.	Models	Part Number ^a	Qty	Description
A16	All	E8364-60007	1	Test set motherboard
A17	All	5087-7127 5087-6127	1	LOMA 10
A18	All	5087-7128 5087-6128	1	MA 20
A19	All	5087-7139	1	Splitter
A20	All	5087-7129 5087-6129	1	LODA
A21	E8363A, E8364A	5087-7130 5087-6130	1	SOMA 50
A22	All	5087-7132 5087-6132	1	Switch splitter
A23 A24	E8363A, E8364A	5087-7133	2	Channel R1 detector Channel R2 detector
A25 A26	E8362A	5086-7968	2	Test port 1 coupler Test port 2 coupler
	E8363A, E8364A	5086-7518	2	Test port 1 coupler Test port 2 coupler
A27 A28 A29 A30	E8362A	5087-7145 5087-6145	4	Channel A first converter (mixer) Channel R1 first converter (mixer) Channel R2 first converter (mixer) Channel B first converter (mixer)
A27 A30	E8363A, E8364A	5087-7122 5087-6122	2	Channel A first converter (mixer) Channel B first converter (mixer)
A28 A29		5087-7145 5087-6145	2	Channel R1 first converter (mixer) Channel R2 first converter (mixer)
A31 A32 A33 A34	All	E8364-60003 E8364-69003	4	Channel A receiver module Channel R1 receiver module Channel R2 receiver module Channel B receiver module
A35	All	E8364-60010	1	Receiver motherboard
A36 A37	All	33325-60004	2	Test port 1 60-dB step attenuator Test port 2 60-dB step attenuator
A38 A39	E8362A	5086-7239	2	Test port 1 bias tee (includes cable) Test port 2 bias tee (includes cable)
	E8363A, E8364A	5087-7233	2	Test port 1 bias tee (includes cable) Test port 2 bias tee (includes cable)
A41	All	Hard disk drive assembly. Refer to “Hard Disk Drive Assembly” on page 6-40.		
①	E8362A	08493-60017	2	30-dB fixed attenuator (pad)

a. Part numbers in *italic* typeface are for rebuilt exchange assemblies. Refer to [page 6-5](#).

Figure 6-5 Illustration of Bottom Assemblies, Option UNL

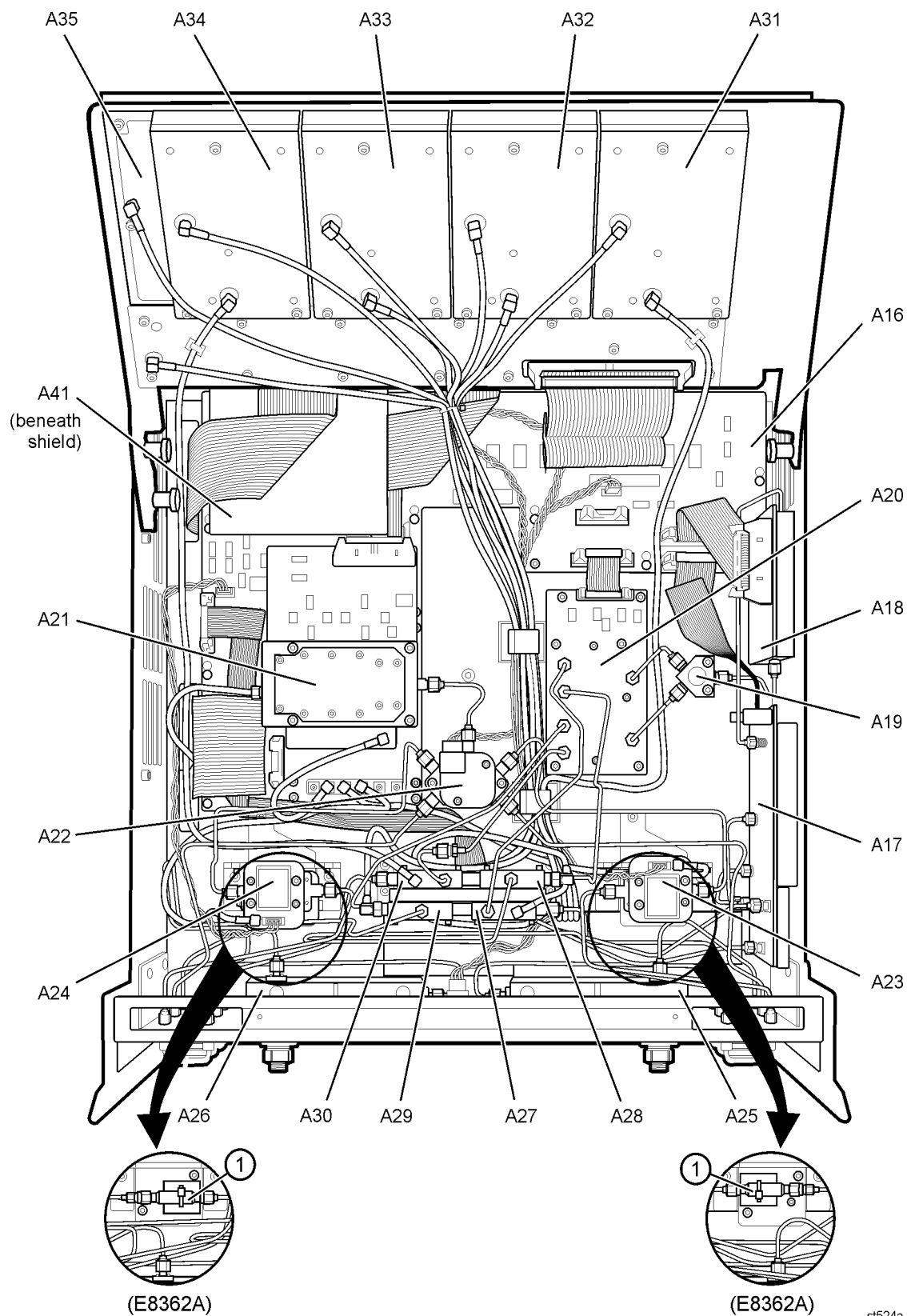


Bottom Assemblies, Option 014

Ref. Desig.	Models	Part Number ^a	Qty	Description
A16	All	E8364-60007	1	Test set motherboard
A17	All	5087-7127 5087-6127	1	LOMA 10
A18	All	5087-7128 5087-6128	1	MA 20
A19	All	5087-7139	1	Splitter
A20	All	5087-7129 5087-6129	1	LODA
A21	E8363A, E8364A	5087-7130 5087-6130	1	SOMA 50
A22	All	5087-7132 5087-6132	1	Switch splitter
A23 A24	E8363A, E8364A	5087-7133	2	Channel R1 detector Channel R2 detector
A25 A26	E8362A	5086-7968	2	Test port 1 coupler Test port 2 coupler
	E8363A, E8364A	5086-7518	2	Test port 1 coupler Test port 2 coupler
A27 A28 A29 A30	E8362A	5087-7145 5087-6145	4	Channel A first converter (mixer) Channel R1 first converter (mixer) Channel R2 first converter (mixer) Channel B first converter (mixer)
A27 A30	E8363A, E8364A	5087-7122 5087-6122	2	Channel A first converter (mixer) Channel B first converter (mixer)
A28 A29		5087-7145 5087-6145	2	Channel R1 first converter (mixer) Channel R2 first converter (mixer)
A31 A32 A33 A34	All	E8364-60003 E8364-69003	4	Channel A receiver module Channel R1 receiver module Channel R2 receiver module Channel B receiver module
A35	All	E8364-60010	1	Receiver motherboard
A41	All	Hard disk drive assembly. Refer to “ Hard Disk Drive Assembly ” on page 6-40.		
①	E8362A	08493-60017	2	30-dB fixed attenuator (pad)

a. Part numbers in *italic* typeface are for rebuilt exchange assemblies. Refer to “[Rebuilt-Exchange Assemblies](#)” on page 6-5.

Figure 6-6 Illustration of Bottom Assemblies, Option 014

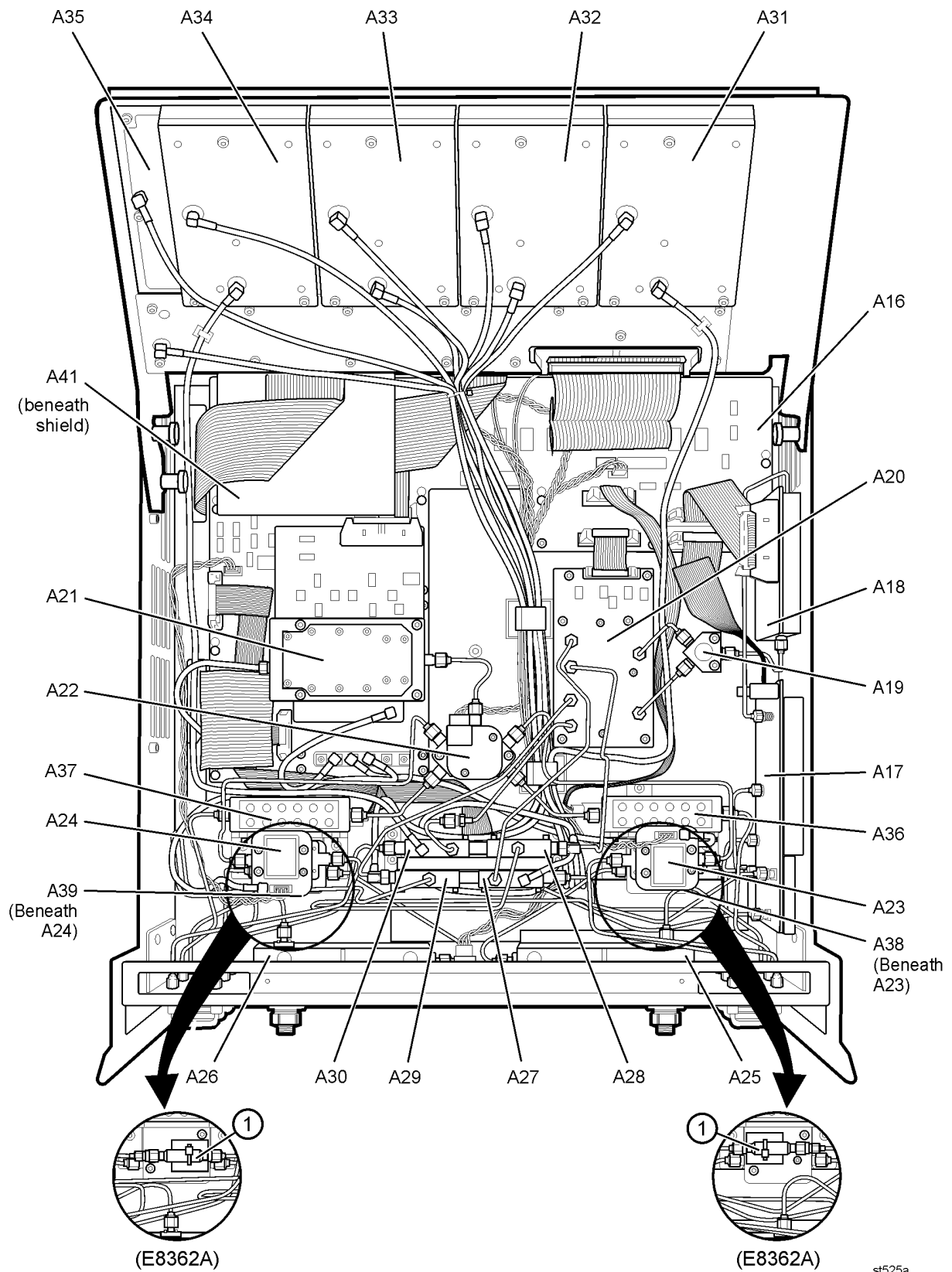


Bottom Assemblies, Option UNL, 014

Ref. Desig.	Models	Part Number ^a	Qty	Description
A16	All	E8364-60007	1	Test set motherboard
A17	All	5087-7127 5087-6127	1	LOMA 10
A18	All	5087-7128 5087-6128	1	MA 20
A19	All	5087-7139	1	Splitter
A20	All	5087-7129 5087-6129	1	LODA
A21	E8363A, E8364A	5087-7130 5087-6130	1	SOMA 50
A22	All	5087-7132 5087-6132	1	Switch splitter
A23 A24	E8363A, E8364A	5087-7133	2	Channel R1 detector Channel R2 detector
A25 A26	E8362A	5086-7968	2	Test port 1 coupler Test port 2 coupler
	E8363A, E8364A	5086-7518	2	Test port 1 coupler Test port 2 coupler
A27 A28 A29 A30	E8362A	5087-7145 5087-6145	4	Channel A first converter (mixer) Channel R1 first converter (mixer) Channel R2 first converter (mixer) Channel B first converter (mixer)
A27 A30	E8363A, E8364A	5087-7122 5087-6122	2	Channel A first converter (mixer) Channel B first converter (mixer)
A28 A29		5087-7145 5087-6145	2	Channel R1 first converter (mixer) Channel R2 first converter (mixer)
A31 A32 A33 A34	All	E8364-60003 E8364-69003	4	Channel A receiver module Channel R1 receiver module Channel R2 receiver module Channel B receiver module
A35	All	E8364-60010	1	Receiver motherboard
A36 A37	All	33325-60004	2	Test port 1 60-dB step attenuator Test port 2 60-dB step attenuator
A38 A39	E8362A	5086-7239	2	Test port 1 bias tee (includes cable) Test port 2 bias tee (includes cable)
	E8363A, E8364A	5087-7233	2	Test port 1 bias tee (includes cable) Test port 2 bias tee (includes cable)
A41	All	Hard disk drive assembly. Refer to “Hard Disk Drive Assembly” on page 6-40.		
①	E8362A	08493-60017	2	30-dB fixed attenuator (pad)

a. Part numbers in *italic* typeface are for rebuilt exchange assemblies. Refer to [Page 6-5](#).

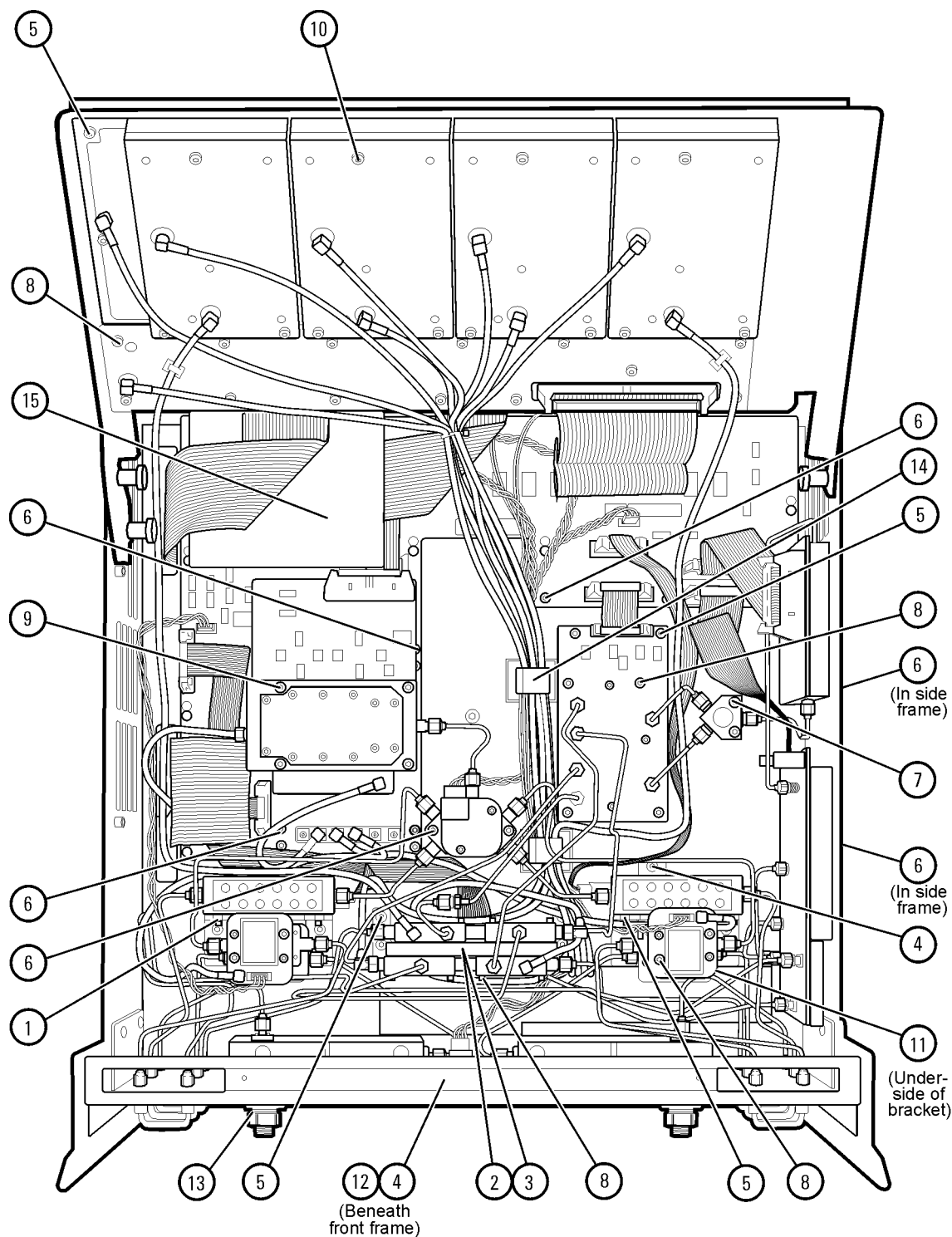
Figure 6-7 Illustration of Bottom Assemblies, Option UNL, 014



Bottom Hardware

Reference Designator	Part Number	Qty	Description
①	E8364-00002	2	Detector/attenuator/bias tee bracket (Used on standard instrument and all options.)
②	E8364-20115	1	mixer bracket
③	E8364-60008	1	mixer bias board
④	0515-0430	9	Machine screw M3.0 x 6, pan head (Detector brackets-3 ea; front-panel LED board-3)
⑤	0515-0372	12	Machine screw M3.0 x 8, pan head (A35-2; A20-2; A36/A37-2 ea; mixer bracket-4)
⑥	0515-0374	15	Machine screw M3.0 x 10, pan head (A17-4; A18-4; A16-5; A22-2)
⑦	0515-0664	2	Machine screw M3.0 x 12, pan head (A19-2)
⑧	0515-0666	37	Machine screw M3.0 x 18, pan head (A35 casting-13; A20-4; A27–A30-4 ea; A23/A24-2 ea: E8363A/E8364A only)
⑨	0515-0667	4	Machine screw M3.0 x 25, pan head (A21-4: E8363A/E8364A only)
⑩	0515-1349	12	Machine screw M3.0 x 30, pan head (A31–A34-3 ea)
⑪	0515-2141	4	Machine screw M2.5 x 14, pan head (A38/A39-2 ea)
⑫	08720-60182	1	Front-panel LED board
⑬	5022-1087	2	Test port coupler nut
⑭	1400-3014	2	Cable clamp
⑮	8364-0007	1	Shield, hard disk drive

Figure 6-8 Illustration of Bottom Hardware



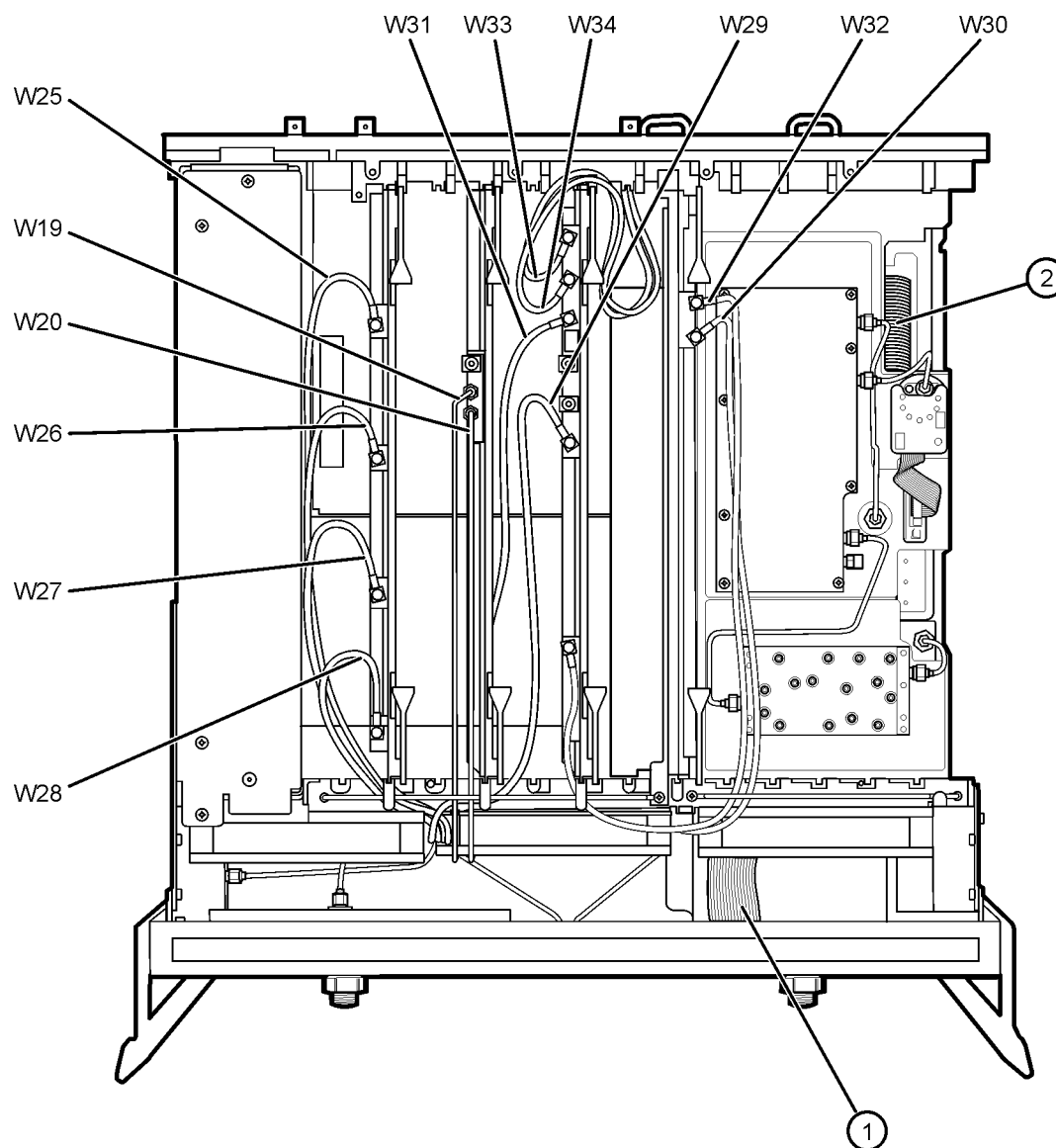
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Top Cables

Reference Designator	Type ^a	Part Number	Qty	Description
W19	SR	E8364-20027	1	A8 fractional-N synthesizer board J105 to A17 LOMA 10 J2
W20	SR	E8364-20057	1	A8 fractional-N synthesizer board J101 to A17 LOMA 10 J3
W25	F	E8364-60126	1	A31 receiver A J400 to A6 SPAM board J3
W26	F	E8364-60127	1	A32 receiver R1 J400 to A6 SPAM board J4
W27	F	E8364-60128	1	A33 receiver R2 J400 to A6 SPAM board J5
W28	F	E8364-60129	1	A34 receiver B J400 to A6 SPAM board J6
W29	F	E8364-60124	1	A10 frequency reference board J4 to A35 receiver motherboard J2
W30	F	E8364-60125	1	A35 receiver motherboard J50 to A11 phase lock board J6
W31	F	E8356-60052	1	A10 frequency reference board J10 to A8 fractional-N synthesizer board J105
W32	F	E8356-60043	1	A10 frequency reference board J5 to A11 phase lock board J5
W33 W34	F	8120-5055	2	A10 frequency reference board J2 to rear-panel 10 MHz REF. IN A10 frequency reference board J3 to rear-panel 10 MHz REF. OUT
①	40R	8121-0116	1	A3 front panel interface board to A14 system motherboard
②	50R	8121-0817	1	A41 hard disk drive assembly to A15 CPU board

a. SR = semi-rigid coaxial cable; F = flexible coaxial cable; nR = n wires in a ribbon (flat) cable

Figure 6-9 Illustration of Top Cables

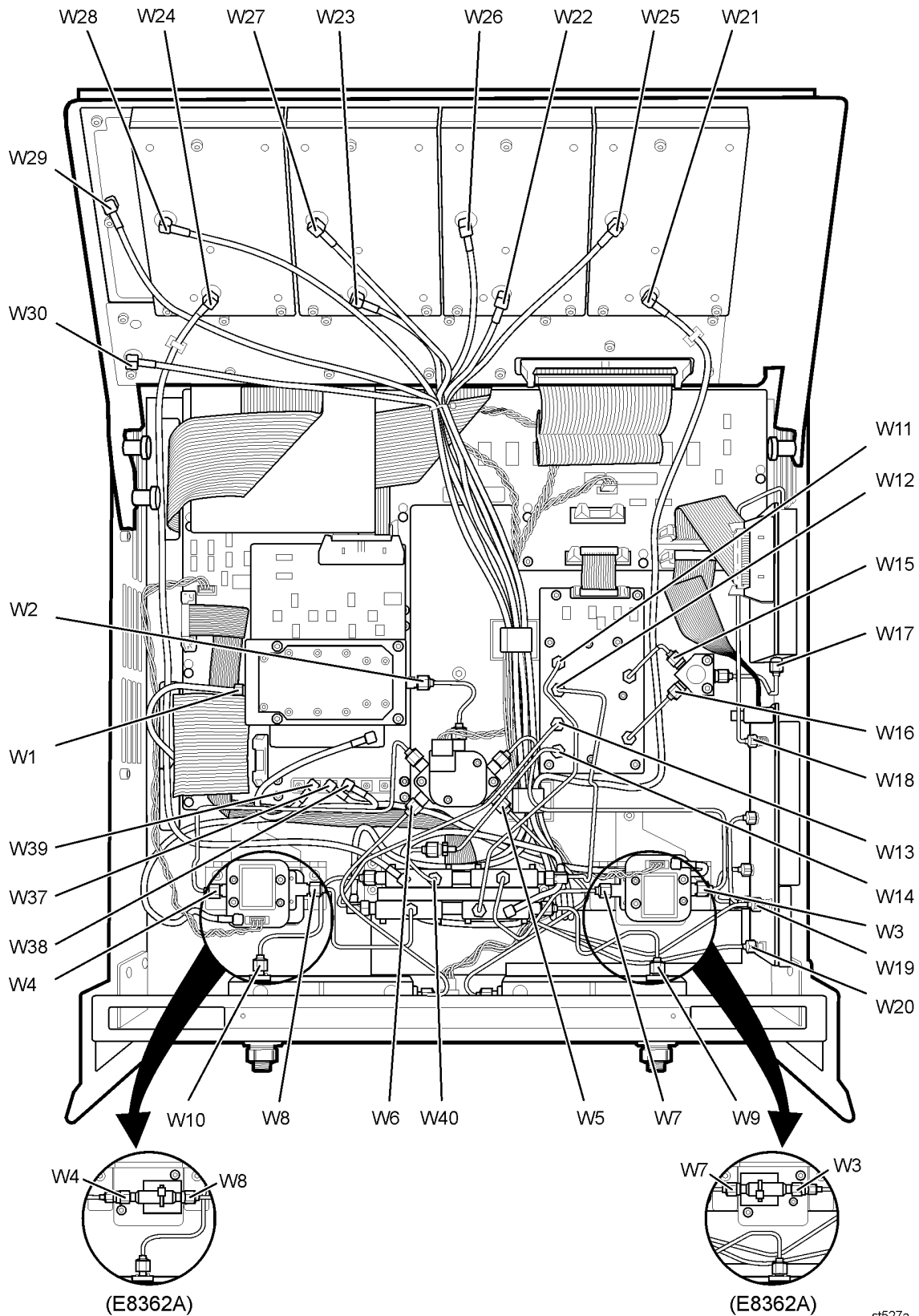


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Bottom RF Cables, Standard

Ref. Desig.	Models	Part Number	Qty	Description
W1	E8362A	E8362-20002	1	A12 source 20 to A22 switch splitter
	E8363A, E8364A	E8364-20036		A12 source 20 to A21 SOMA 50
W2	E8363A, E8364A	E8364-20034	1	A21 SOMA 50 to A22 switch splitter
W3	E8362A	E8362-20003	1	A22 switch splitter to channel R1 30-dB attenuator
	E8363A, E8364A	E8364-20023	1	A22 switch splitter to A23 detector
W4	E8362A	E8362-20004	1	A22 switch splitter to channel R2 30-dB attenuator
	E8363A, E8364A	E8364-20024	1	A22 switch splitter to A24 detector
W5	All	E8364-20021	1	A22 switch splitter to A25 test port 1 coupler
W6	All	E8364-20022	1	A22 switch splitter to A26 test port 2 coupler
W7	E8362A	E8362-20005	1	Channel R1 attenuator to A28 channel R1 mixer
	E8363A, E8364A	E8364-20025	1	A23 detector to A28 channel R1 mixer
W8	E8362A	E8362-20006	1	Channel R2 attenuator to A29 channel R2 mixer
	E8363A, E8364A	E8364-20026	1	A24 detector to A29 channel R2 mixer
W9	All	E8364-20019	1	A25 test port 1 coupler to A27 channel A mixer
W10	All	E8364-20020	1	A26 test port 2 coupler to A30 channel B mixer
W11	All	E8364-20030	1	A20 LODA to A27 channel A mixer
W12	All	E8364-20031	1	A20 LODA to A28 channel R1 mixer
W13	All	E8364-20033	1	A20 LODA to A29 channel R2 mixer
W14	All	E8364-20072	1	A20 LODA to W40 (to A30 channel B mixer)
W15	All	E8364-20041	1	A19 splitter to A20 LODA
W16	All	E8364-20042	1	A19 splitter to A20 LODA
W17	All	E8364-20029	1	A18 MA 20 to A19 splitter
W18	All	E8364-20028	1	A17 LOMA 10 to A18 MA 20
W19-W20	All	From “Top Cables” on page 6-24.		
W21	All	E8364-60130	1	A27 channel A mixer to A31 receiver A
W22	All	E8364-60131	1	A28 channel R1 mixer to A32 receiver R1
W23	All	E8364-60132	1	A29 channel R2 mixer to A33 receiver R2
W24	All	E8364-60133	1	A30 channel B mixer to A34 receiver B
W25-W30	All	From “Top Cables” on page 6-24.		
W37	E8363A, E8364A	E8364-60121	1	A16 test set motherboard to A23 detector
W38	E8363A, E8364A	E8364-60122	1	A16 test set motherboard to A24 detector
W39	E8363A, E8364A	E8364-60123	1	A16 test set motherboard to A21 SOMA 50
W40	All	E8364-20032	1	W14 (from A20 LODA) to A30 channel B mixer

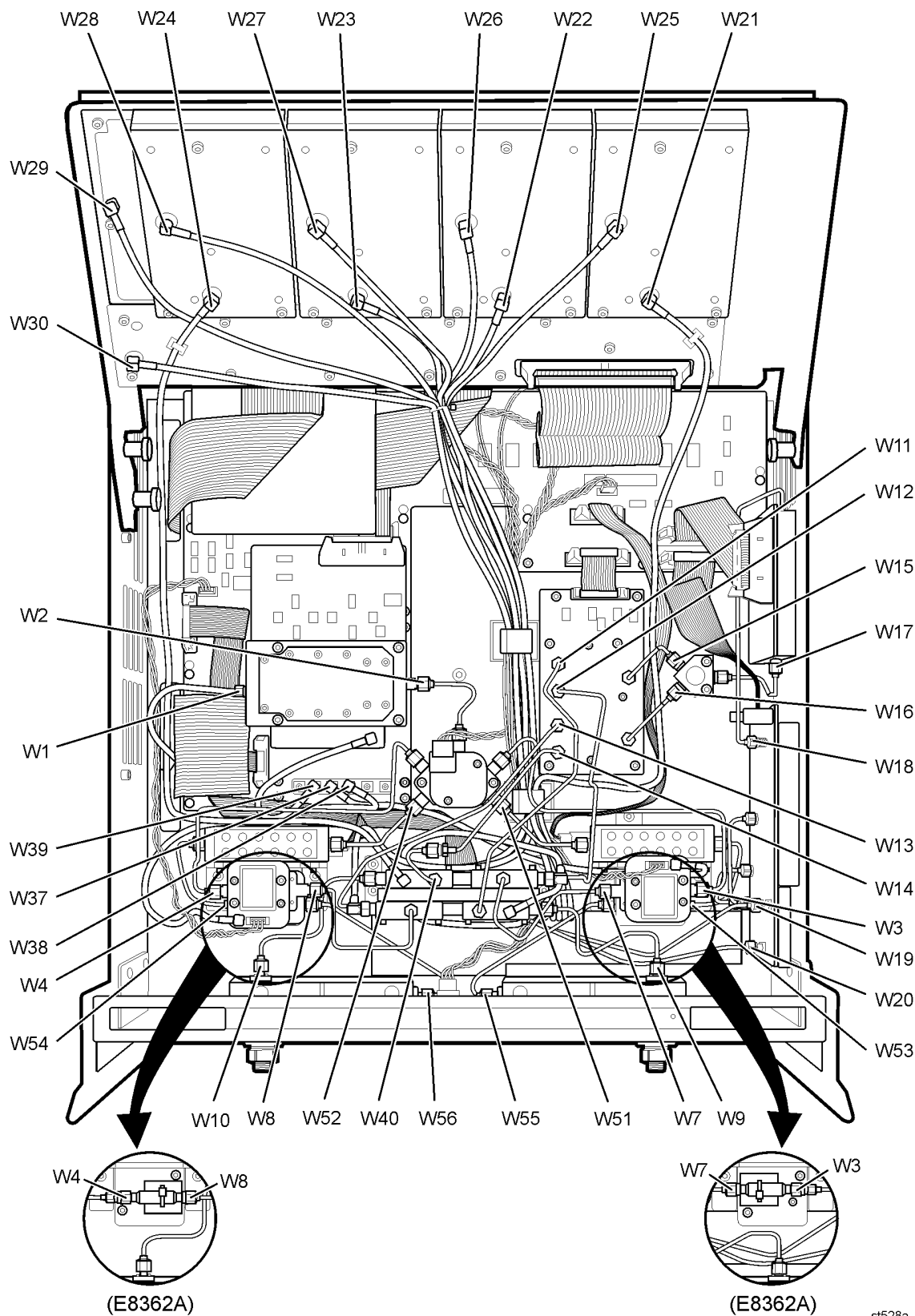
Figure 6-10 Illustration of Bottom RF Cables, Standard



Bottom RF Cables, Option UNL

Ref. Desig.	Models	Part Number	Qty	Description
W1	E8362A	E8362-20002	1	A12 source 20 to A22 switch splitter
	E8363A, E8364A	E8364-20036		A12 source 20 to A21 SOMA 50
W2	E8363A, E8364A	E8364-20034	1	A21 SOMA 50 to A22 switch splitter
W3	E8362A	E8362-20003	1	A22 switch splitter to channel R1 30-dB attenuator
	E8363A, E8364A	E8364-20023	1	A22 switch splitter to A23 detector
W4	E8362A	E8362-20004	1	A22 switch splitter to channel R2 30-dB attenuator
	E8363A, E8364A	E8364-20024	1	A22 switch splitter to A24 detector
W7	E8362A	E8362-20027	1	Channel R1 attenuator to A28 channel R1 mixer
	E8363A, E8364A	E8364-20079	1	A23 detector to A28 channel R1 mixer
W8	E8362A	E8362-20028	1	Channel R2 attenuator to A29 channel R2 mixer
	E8363A, E8364A	E8364-20080	1	A24 detector to A29 channel R2 mixer
W9	All	E8364-20019	1	A25 test port 1 coupler to A27 channel A mixer
W10	All	E8364-20020	1	A26 test port 2 coupler to A30 channel B mixer
W11	All	E8364-20030	1	A20 LODA to A27 channel A mixer
W12	All	E8364-20031	1	A20 LODA to A28 channel R1 mixer
W13	All	E8364-20033	1	A20 LODA to A29 channel R2 mixer
W14	All	E8364-20072	1	A20 LODA to W40 (to A30 channel B mixer)
W15	All	E8364-20041	1	A19 splitter to A20 LODA
W16	All	E8364-20042	1	A19 splitter to A20 LODA
W17	All	E8364-20029	1	A18 MA 20 to A19 splitter
W18	All	E8364-20028	1	A17 LOMA 10 to A18 MA 20
W19-W20	All	From “Top Cables” on page 6-24.		
W21	All	E8364-60130	1	A27 channel A mixer to A31 receiver A
W22	All	E8364-60131	1	A28 channel R1 mixer to A32 receiver R1
W23	All	E8364-60132	1	A29 channel R2 mixer to A33 receiver R2
W24	All	E8364-60133	1	A30 channel B mixer to A34 receiver B
W25-W30	All	From “Top Cables” on page 6-24.		
W37	E8363A, E8364A	E8364-60121	1	A16 test set motherboard to A23 detector
W38	E8363A, E8364A	E8364-60122	1	A16 test set motherboard to A24 detector
W39	E8363A, E8364A	E8364-60123	1	A16 test set motherboard to A21 SOMA 50
W40	All	E8364-20032	1	W14 (from A20 LODA) to A30 channel B mixer
W51	All	E8364-20055	1	A22 switch splitter to A36 step attenuator
W52	All	E8364-20056	1	A22 switch splitter to A37 step attenuator
W53	All	E8364-20077	2	A36 step attenuator to A38 bias tee
W54				A37 step attenuator to A39 bias tee
W55	All	E8364-20051	1	A38 bias tee to A25 test port 1 coupler
W56	All	E8364-20052	1	A39 bias tee to A26 test port 2 coupler

Figure 6-11 Illustration of Bottom RF Cables, Option UNL



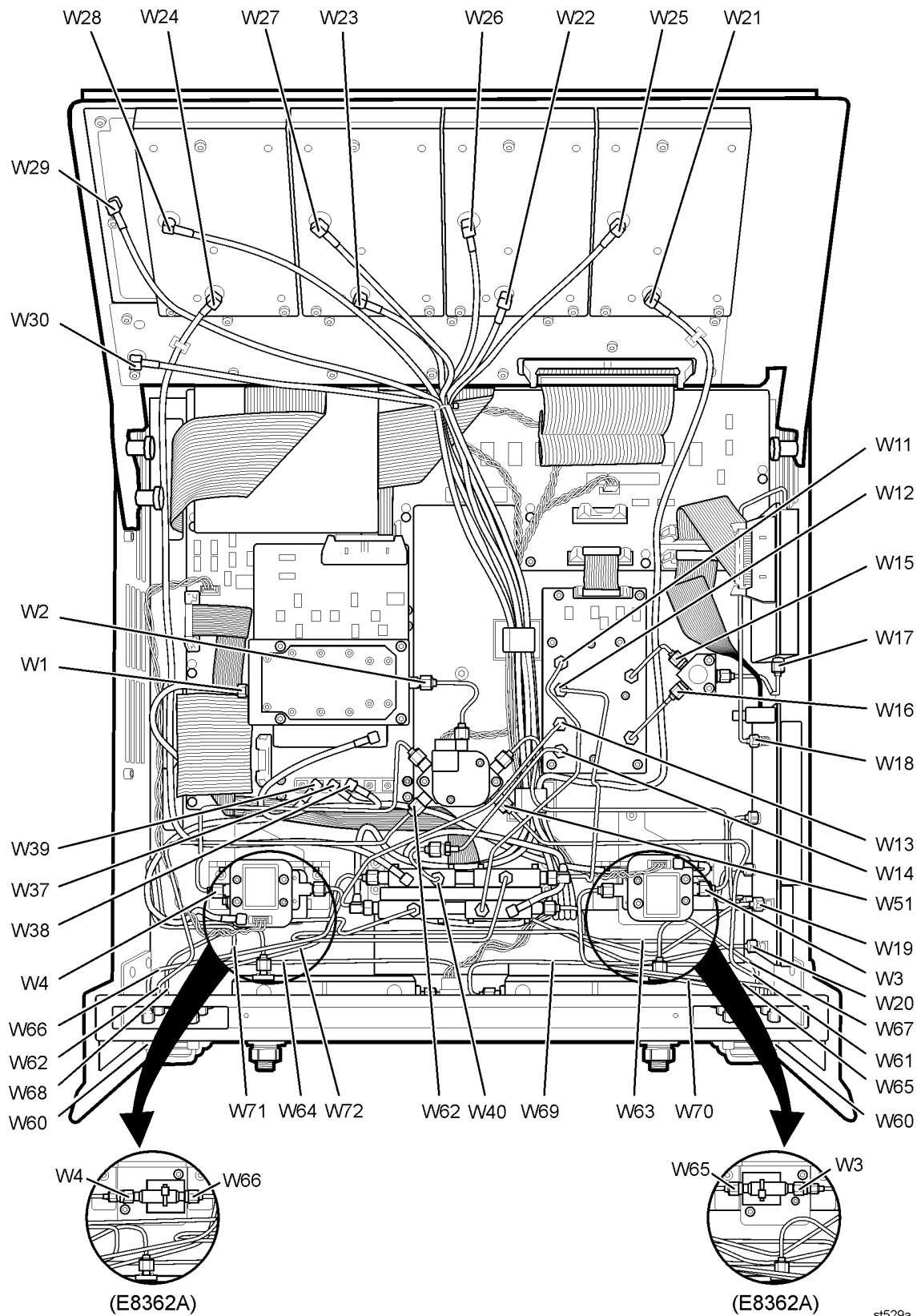
Bottom RF Cables, Option 014

Ref. Desig.	Models	Part Number	Qty	Description
W1	E8362A	E8362-20002	1	A12 source 20 to A22 switch splitter
	E8363A, E8364A	E8364-20036		A12 source 20 to A21 SOMA 50
W2	E8363A, E8364A	E8364-20034	1	A21 SOMA 50 to A22 switch splitter
W3	E8362A	E8362-20003	1	A22 switch splitter to channel R1 30-dB attenuator
	E8363A, E8364A	E8364-20023	1	A22 switch splitter to A23 detector
W4	E8362A	E8362-20004	1	A22 switch splitter to channel R2 30-dB attenuator
	E8363A, E8364A	E8364-20024	1	A22 switch splitter to A24 detector
W11	All	E8364-20030	1	A20 LODA to A27 channel A mixer
W12	All	E8364-20031	1	A20 LODA to A28 channel R1 mixer
W13	All	E8364-20033	1	A20 LODA to A29 channel R2 mixer
W14	All	E8364-20072	1	A20 LODA to W40 (to A30 channel B mixer)
W15	All	E8364-20041	1	A19 splitter to A20 LODA
W16	All	E8364-20042	1	A19 splitter to A20 LODA
W17	All	E8364-20029	1	A18 MA 20 to A19 splitter
W18	All	E8364-20028	1	A17 LOMA 10 to A18 MA 20
W19-W20	All	From “Top Cables” on page 6-24.		
W21	All	E8364-60130	1	A27 channel A mixer to A31 receiver A
W22	All	E8364-60131	1	A28 channel R1 mixer to A32 receiver R1
W23	All	E8364-60132	1	A29 channel R2 mixer to A33 receiver R2
W24	All	E8364-60133	1	A30 channel B mixer to A34 receiver B
W25-W30	All	From “Top Cables” on page 6-24.		
W37	E8363A, E8364A	E8364-60121	1	A16 test set motherboard to A23 detector
W38	E8363A, E8364A	E8364-60122	1	A16 test set motherboard to A24 detector
W39	E8363A, E8364A	E8364-60123	1	A16 test set motherboard to A21 SOMA 50
W40	All	E8364-20032	1	W14 (from A20 LODA) to A30 channel B mixer
W60	E8362A	08720-20098	6	Front-panel jumper
	E8363A, E8364A	E8364-20059	6	Front-panel jumper
W61	E8362A	E8362-20016	1	A22 switch splitter to port 1 SOURCE OUT
	E8363A, E8364A	E8364-20081	1	A22 switch splitter to port 1 SOURCE OUT
W62	E8362A	E8362-20017	1	A22 switch splitter to port 2 SOURCE OUT
	E8363A, E8364A	E8364-20082	1	A22 switch splitter to port 2 SOURCE OUT
W63	E8362A	E8362-20018	1	Port 1 CPLR THRU to A25 test port 1 coupler
	E8363A, E8364A	E8364-20073	1	Port 1 CPLR THRU to A25 test port 1 coupler
W64	E8362A	E8362-20019	1	Port 2 CPLR THRU to A26 test port 2 coupler
	E8363A, E8364A	E8364-20074	1	Port 2 CPLR THRU to A26 test port 2 coupler

Bottom RF Cables, Option 014 (Continued)

Ref. Design.	Models	Part Number	Qty	Description
W65	E8362A	E8362-20007	1	Channel R1 attenuator to channel R1 SOURCE OUT
	E8363A, E8364A	E8364-20047	1	A23 detector to channel R1 SOURCE OUT
W66	E8362A	E8362-20008	1	Channel R2 attenuator to channel R2 SOURCE OUT
	E8363A, E8364A	E8364-20048	1	A24 detector to channel R2 SOURCE OUT
W67	E8362A	E8362-20020	1	A25 test port 1 coupler to channel A CPLR ARM
	E8363A, E8364A	E8364-20043	1	A25 test port 1 coupler to channel A CPLR ARM
W68	E8362A	E8362-20021	1	A26 test port 2 coupler to channel B CPLR ARM
	E8363A, E8364A	E8364-20044	1	A26 test port 2 coupler to channel B CPLR ARM
W69	E8362A	E8362-20022	1	A IN to A27 channel A mixer
	E8363A, E8364A	E8364-20045	1	A IN to A27 channel A mixer
W70	E8362A	E8362-20029	1	R1 IN to A28 channel R1 mixer
	E8363A, E8364A	E8364-20075	1	R1 IN to A28 channel R1 mixer
W71	E8362A	E8362-20030	1	R2 IN to A29 channel R2 mixer
	E8363A, E8364A	E8364-20076	1	R2 IN to A29 channel R2 mixer
W72	E8362A	E8362-20023	1	B IN to A30 channel B mixer
	E8363A, E8364A	E8364-20046	1	B IN to A30 channel B mixer

Figure 6-12 Illustration of Bottom RF Cables, Option 014



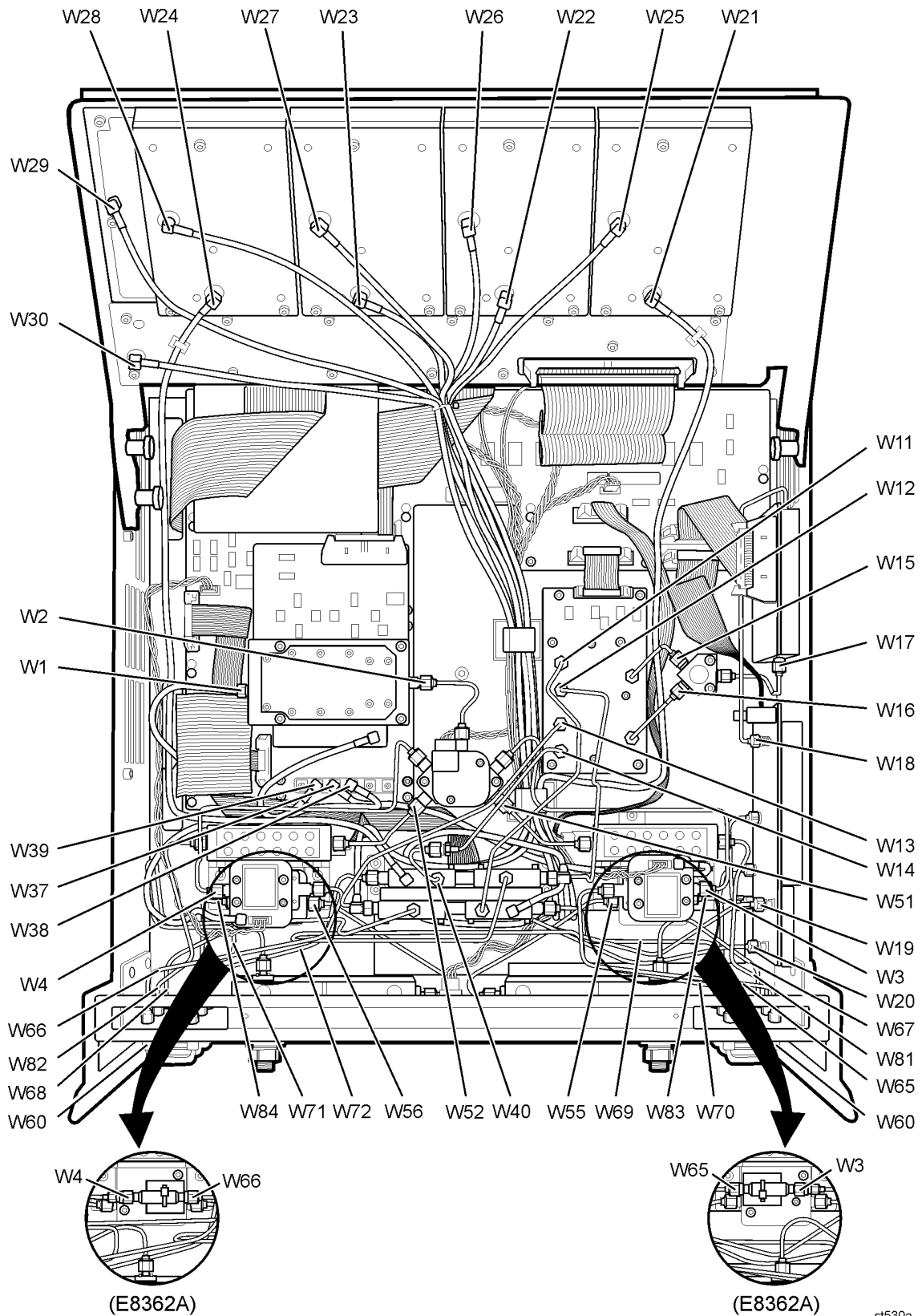
Bottom RF Cables, Option UNL, 014

Ref. Desig.	Models	Part Number	Qty	Description
W1	E8362A	E8362-20002	1	A12 source 20 to A22 switch splitter
	E8363A, E8364A	E8364-20036		A12 source 20 to A21 SOMA 50
W2	E8363A, E8364A	E8364-20034	1	A21 SOMA 50 to A22 switch splitter
W3	E8362A	E8362-20003	1	A22 switch splitter to channel R1 30-dB attenuator
	E8363A, E8364A	E8364-20023	1	A22 switch splitter to A23 detector
W4	E8362A	E8362-20004	1	A22 switch splitter to channel R2 30-dB attenuator
	E8363A, E8364A	E8364-20024	1	A22 switch splitter to A24 detector
W11	All	E8364-20030	1	A20 LODA to A27 channel A mixer
W12	All	E8364-20031	1	A20 LODA to A28 channel R1 mixer
W13	All	E8364-20033	1	A20 LODA to A29 channel R2 mixer
W14	All	E8364-20072	1	A20 LODA to W40 (to A30 channel B mixer)
W15	All	E8364-20041	1	A19 splitter to A20 LODA
W16	All	E8364-20042	1	A19 splitter to A20 LODA
W17	All	E8364-20029	1	A18 MA 20 to A19 splitter
W18	All	E8364-20028	1	A17 LOMA 10 to A18 MA 20
W19-W20	All	From "Top Cables" on page 6-24.		
W21	All	E8364-60130	1	A27 channel A mixer to A31 receiver A
W22	All	E8364-60131	1	A28 channel R1 mixer to A32 receiver R1
W23	All	E8364-60132	1	A29 channel R2 mixer to A33 receiver R2
W24	All	E8364-60133	1	A30 channel B mixer to A34 receiver B
W25-W30	All	From "Top Cables" on page 6-24.		
W37	E8363A, E8364A	E8364-60121	1	A16 test set motherboard to A23 detector
W38	E8363A, E8364A	E8364-60122	1	A16 test set motherboard to A24 detector
W39	E8363A, E8364A	E8364-60123	1	A16 test set motherboard to A21 SOMA 50
W40	All	E8364-20032	1	W14 (from A20 LODA) to A30 channel B mixer
W51	All	E8364-20055	1	A22 switch splitter to A36 step attenuator
W52	All	E8364-20056	1	A22 switch splitter to A37 step attenuator
W55	All	E8364-20051	1	A38 bias tee to A25 test port 1 coupler
W56	All	E8364-20052	1	A39 bias tee to A26 test port 2 coupler
W60	E8362A	08720-20098	6	Front-panel jumper
	E8363A, E8364A	E8364-20059	6	Front-panel jumper
W65	E8362A	E8362-20007	1	Channel R1 attenuator to channel R1 SOURCE OUT
	E8363A, E8364A	E8364-20047	1	A23 detector to channel R1 SOURCE OUT
W66	E8362A	E8362-20008	1	Channel R2 attenuator to channel R2 SOURCE OUT
	E8363A, E8364A	E8364-20048	1	A24 detector to channel R2 SOURCE OUT

Bottom RF Cables, Option UNL, 014 (Continued)

Ref. Desig.	Models	Part Number	Qty	Description
W67	E8362A	E8362-20020	1	A25 test port 1 coupler to channel A CPLR ARM
	E8363A, E8364A	E8364-20043	1	A25 test port 1 coupler to channel A CPLR ARM
W68	E8362A	E8362-20021	1	A26 test port 2 coupler to channel B CPLR ARM
	E8363A, E8364A	E8364-20044	1	A26 test port 2 coupler to channel B CPLR ARM
W69	E8362A	E8362-20022	1	A IN to A27 channel A mixer
	E8363A, E8364A	E8364-20045	1	A IN to A27 channel A mixer
W70	E8362A	E8362-20014	1	R1 IN to A28 channel R1 mixer
	E8363A, E8364A	E8364-20049	1	R1 IN to A28 channel R1 mixer
W71	E8362A	E8362-20015	1	R2 IN to A29 channel R2 mixer
	E8363A, E8364A	E8364-20050	1	R2 IN to A29 channel R2 mixer
W72	E8362A	E8362-20023	1	B IN to A30 channel B mixer
	E8363A, E8364A	E8364-20046	1	B IN to A30 channel B mixer
W81	E8362A	E8362-20024	1	A36 step attenuator to port 1 SOURCE OUT
	E8363A, E8364A	E8364-20053	1	A36 step attenuator to port 1 SOURCE OUT
W82	E8362A	E8362-20025	1	A37 step attenuator to port 2 SOURCE OUT
	E8363A, E8364A	E8364-20054	1	A37 step attenuator to port 2 SOURCE OUT
W83	E8362A	E8362-20012	1	Port 1 CPLR THRU to A38 bias tee
	E8363A, E8364A	E8364-20039	1	Port 1 CPLR THRU to A38 bias tee
W84	E8362A	E8362-20013	1	Port 2 CPLR THRU to A39 bias tee
	E8363A, E8364A	E8364-20040	1	Port 2 CPLR THRU to A39 bias tee

Figure 6-13 Illustration of Bottom RF Cables, Option UNL, 014

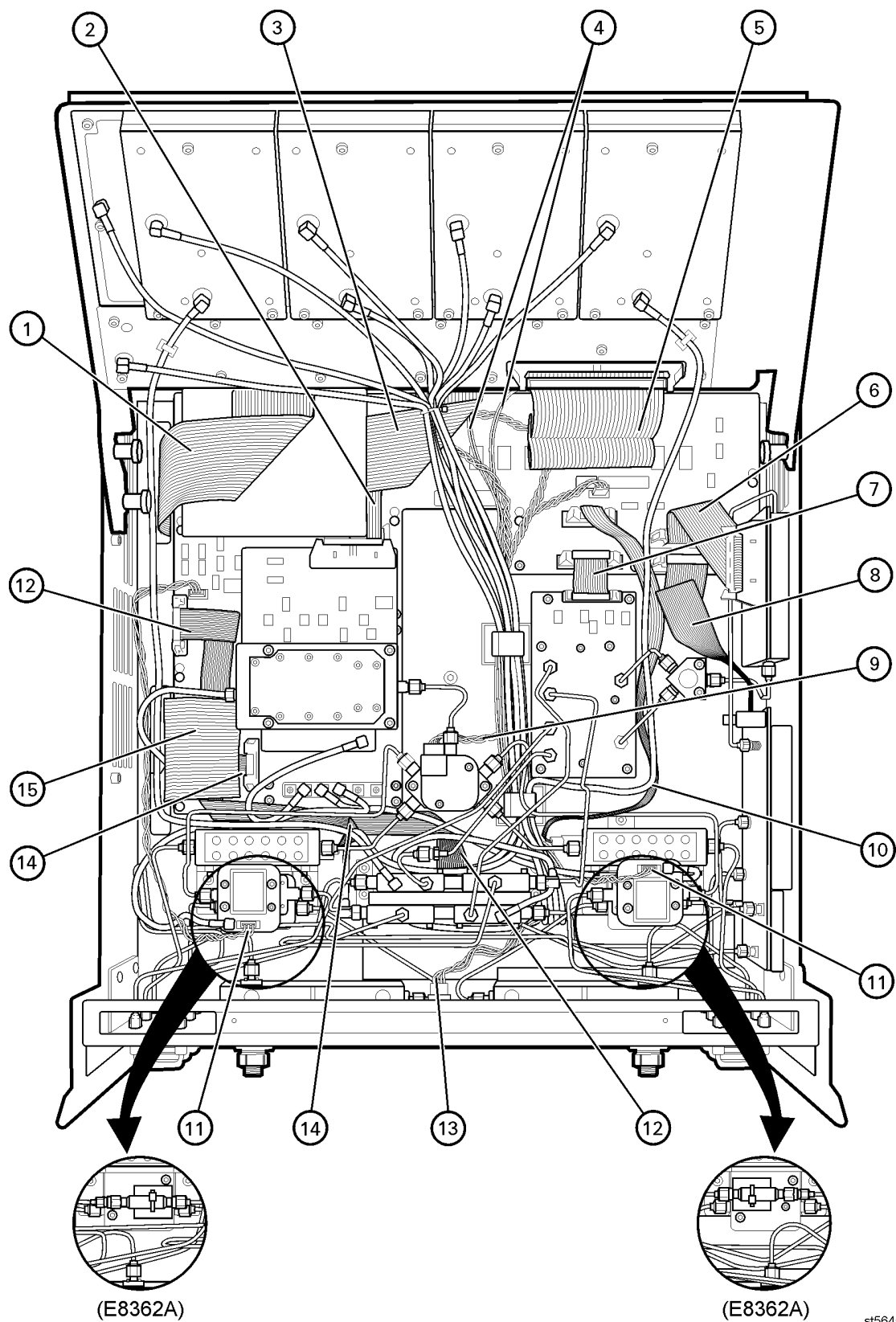


Bottom Cables, Ribbon and Wrapped-Wire

Reference Designator	Type ^a	Part Number	Description
①	50R	8121-0817	A41 hard disk drive assembly to A15 CPU board
②	26R	8121-0818	A16 test set motherboard A21 SOMA 50
③	40R	8121-0834	A16 test set motherboard to rear-panel connector
④	2W	8121-0836	A16 test set motherboard to A38 or A39 bias tee
⑤	60R	8121-0813	A16 test set motherboard to A35 receiver motherboard
⑥	24R	8121-0815	A16 test set motherboard to A18 MA 20
⑦	16R	8121-0816	A16 test set motherboard to A20 LODA
⑧	20R	8121-0846	A16 test set motherboard A17 LOMA 10
⑨	5W	8121-0803	A16 test set motherboard to A22 switch splitter
⑩	10R	8121-0819	A16 test set motherboard to A36 step attenuator
⑪	3W	E7340-60075	A16 test set motherboard to A23 or A24 detector (E8363A/E8364A only)
⑫	14R	8121-0814	A16 test set motherboard to mixer bias board
⑬	4W	8121-0802	A16 test set motherboard to front-panel LED board
⑭	10R	8121-0119	A16 test set motherboard to A37 step attenuator
⑮	100R	8121-0118	A14 system motherboard to A16 test set motherboard

a. nW = n wires in a wrapped cable; nR = n wires in a ribbon (flat) cable

Figure 6-14 Illustration of Bottom Cables, Ribbon and Wrapped Wire

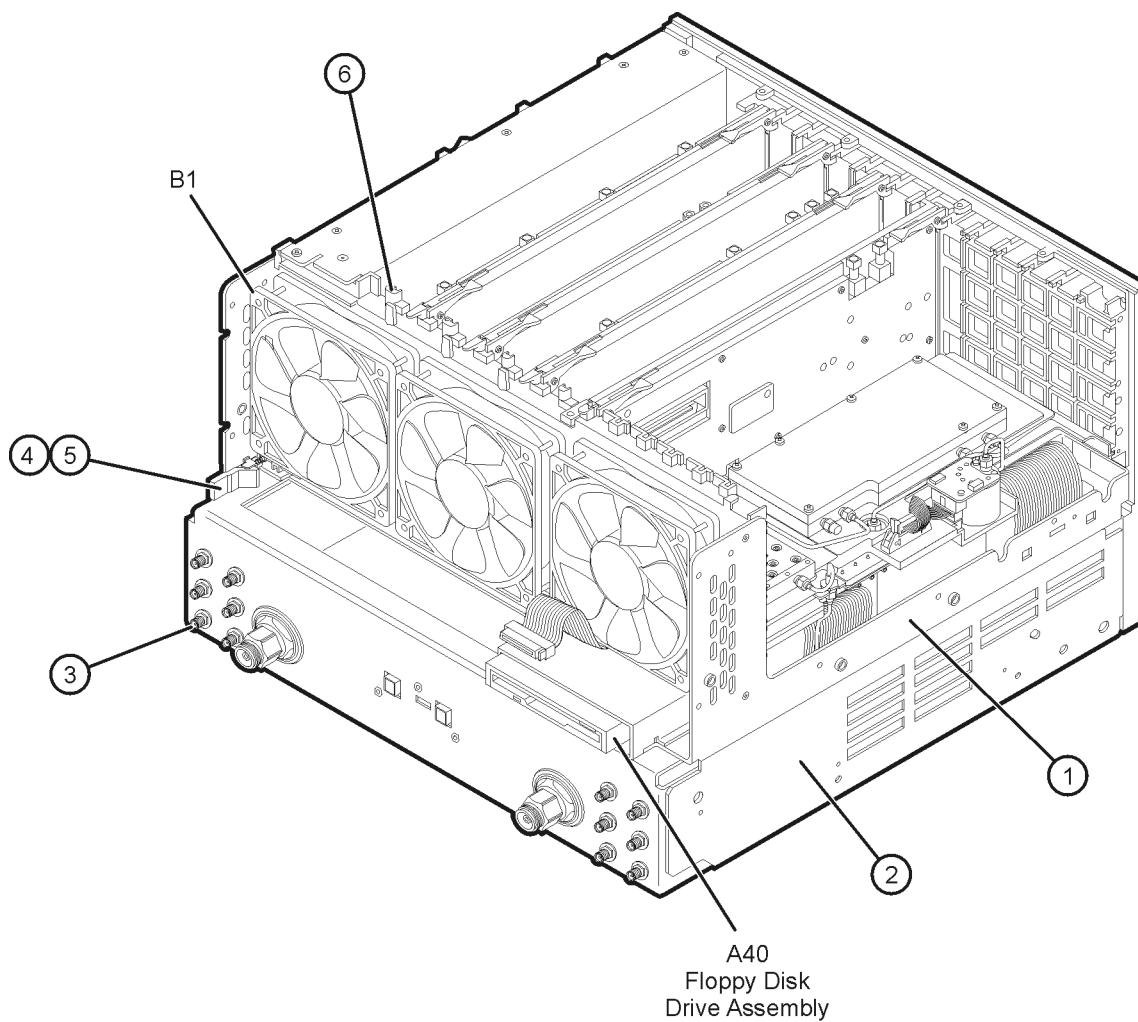


st564a

Internal Hardware and Parts

Reference Designator	Part Number	Qty	Description
A40	0950-2782	1	Floppy disk drive
	8121-0120	1	Cable
	E4406-60014	1	Floppy disk drive board
	E4406-40006	1	Floppy disk drive mount
	E8356-00007	1	Floppy disk drive enclosure
B1	3160-1085	3	Fan
①	E8356-00027	1	Chassis assembly
②	E8364-00015	1	Test set deck
③	These feed-through connectors, including the nuts and washers, are part of the individual cables. Refer to Figure 6-12 on page 6-32 or Figure 6-13 on page 6-35 to determine the part number of the cable assembly.		
④	E8356-40004	1	Line switch button
⑤	1460-2632	1	Line switch spring
⑥	E4406-60109	1	Midweb assembly (includes three fans)

Figure 6-15 Illustration of Internal Hardware and Parts

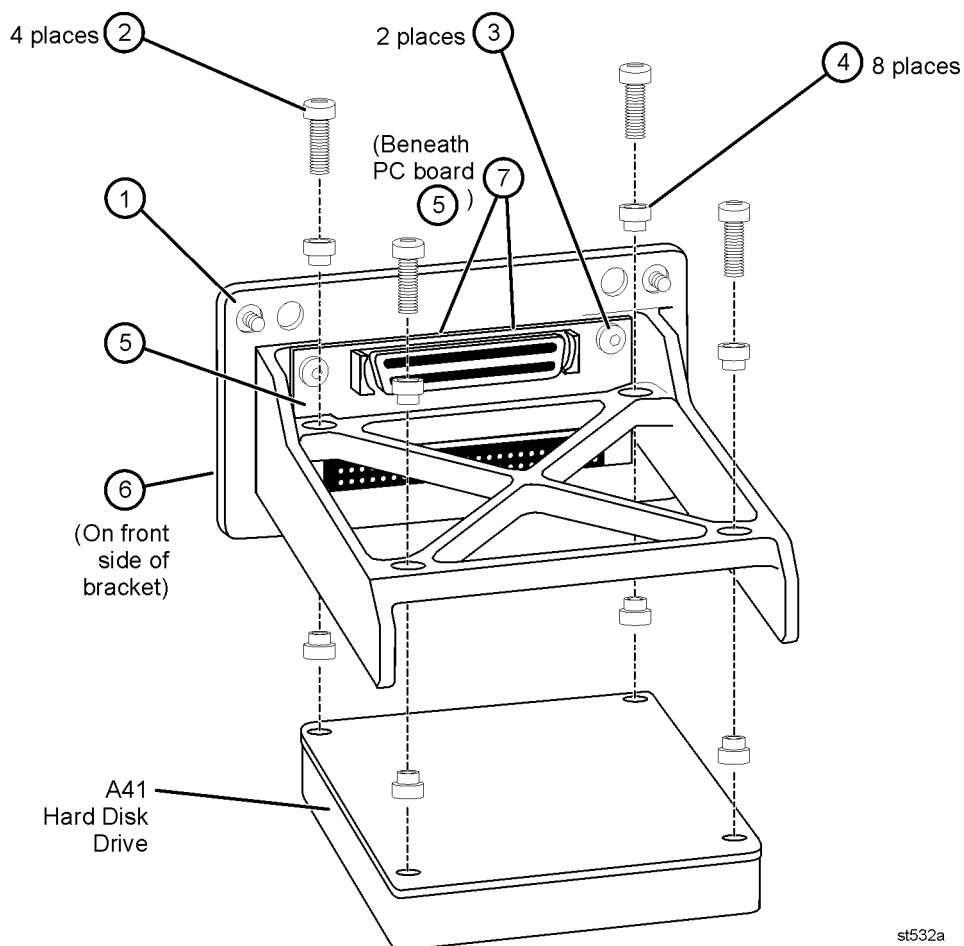


st531a

Hard Disk Drive Assembly

Reference Designator	Part Number	Qty	Description
A41	E8801-60063	1	Programmed hard disk drive
①	E8364-20118	1	Hard disk drive bracket
②	0515-0664	4	Machine screw, M3.0 x 12, pan head
③	0515-0372	2	Machine screw, M3.0 x 8, pan head
④	0340-1525	8	Bushing
⑤	E8364-60094	1	Hard disk drive board
⑥	1440-0421	1	U-handle, finger grip
⑦	0515-1227	2	Machine screw, M3.0 x 6, flat head (for U-handle)

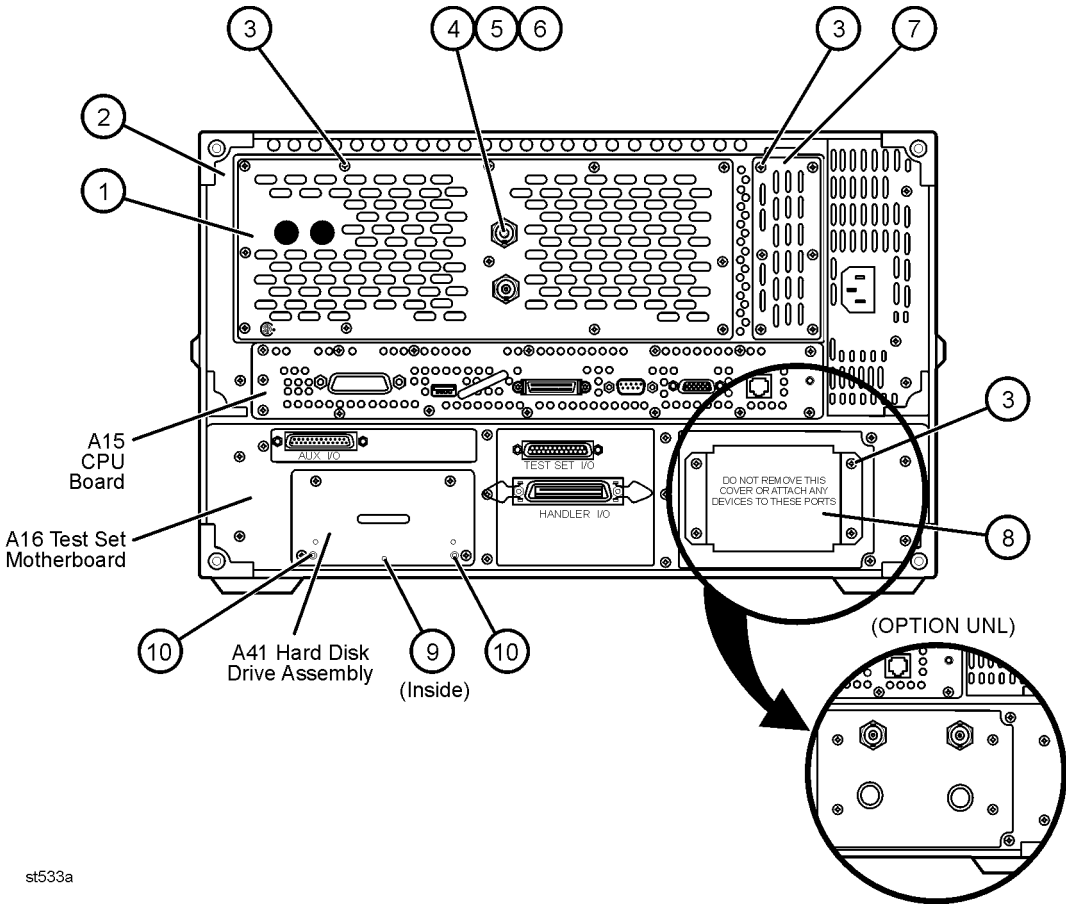
Figure 6-16 Illustration of the Hard Disk Drive Assembly



Rear Panel Assembly

Item Number	Part Number	Qty	Description
①	E8356-00023	1	Cover plate, large
②	E8364-60023	1	Rear frame assembly (includes items ①, ③, ④, ⑤, and ⑥)
③	0515-0372	23	Machine screw, M3.0 x 8, pan head
④	8120-5055	2	BNC cable assembly
⑤	2950-0035	2	Hex nut for BNC connector
⑥	2190-0102	2	Lock washer for BNC connector
⑦	E8356-00022	1	Cover plate, digital section
⑧	E8364-00009	1	Cover, bias connectors and fuse holders
⑨	E8364-60095	1	Hard disk drive stationary board
⑩	0515-1410	1	Machine screw, M3.0 x 20, pan head (for attaching item ⑨)

Figure 6-17 Illustration of the Rear Panel Assembly

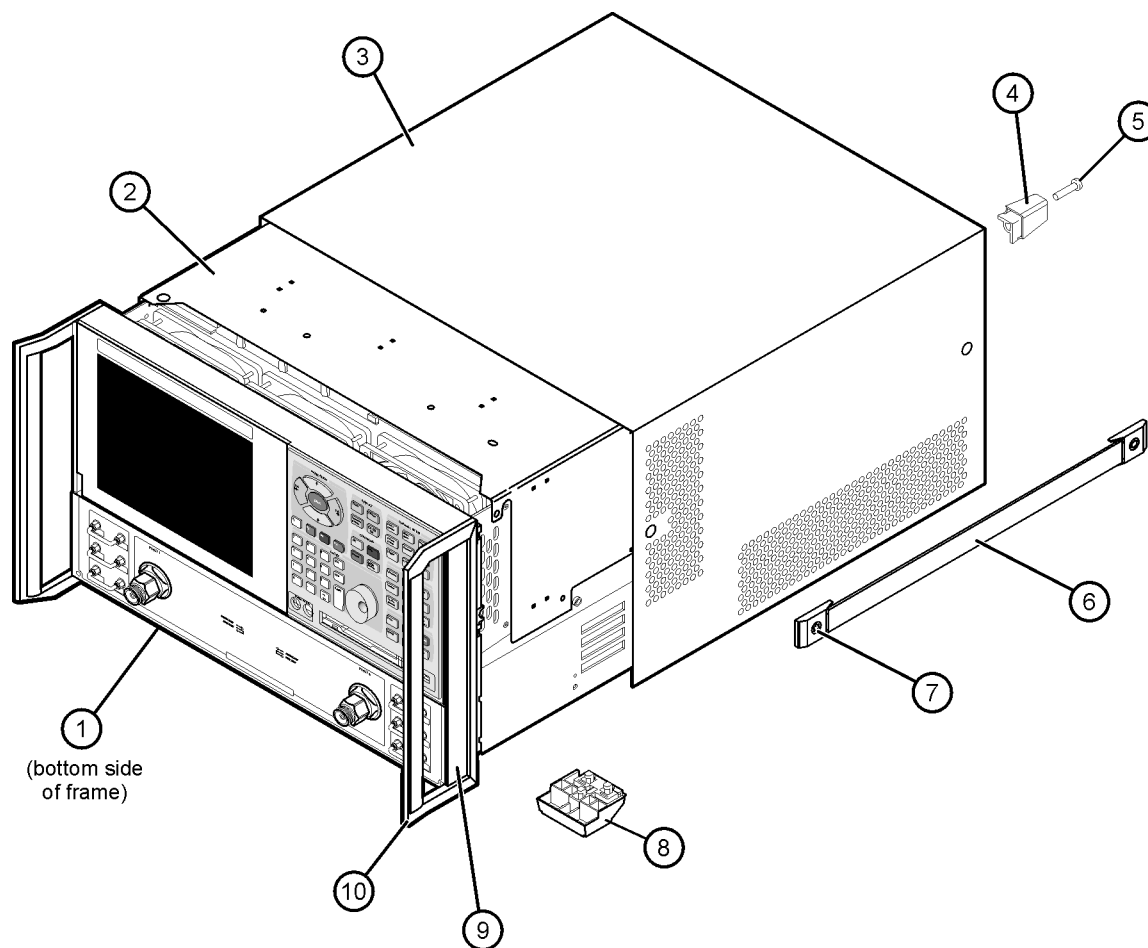


st533a

External Parts

Reference Designator	Part Number	Qty	Description
①	E8356-00025	1	Trim strip, filler
②	E8356-00011	1	Inner cover
③	E8364-00003	1	Outer cover
④	5041-9611	4	Rear feet
⑤	0515-1619	4	Machine screw M4.0 x 25, pan head
⑥	E4400-60026	2	Strap handle assembly (includes item ⑦)
⑦	0515-0710	4	Machine screw M5.0 x 18, flat head
⑧	5041-9167	4	Bottom feet
⑨	5041-9183	2	With handles—front handle side trim
	5041-9174	2	Without handles—trim strip, filler
⑩	5063-9205	2	Front handle

Figure 6-18 Illustration of External Parts



st534a

Miscellaneous Part Numbers

Description	Model or Part Number
Service Tools	
Extender board, synthesizer/reference	E8356-60021
1/4-inch and 5/16-inch open-end wrench, thin profile	8710-0510
5/16-inch (8 mm), open-end torque wrench; 0.9 N-m (8 in-lb)	8710-1765
20-mm open-end torque wrench; 0.9 N-m (8 in-lb)	8710-1764
Spanner wrench	08513-20014
Fuses	
Rear-panel Bias Input fuse Port 1, Port 2 (0.5 A, 125 V) (Option UNL)	2110-0046
Documentation	
Installation and Quick Start Guide (for all PNA series analyzers)	E8356-90001
Service Guide (this manual)	E8364-90001
Printed version of online Help, user's and programmer's guide (English)	E8356-90028
CD-ROM (Includes the following): <i>Installation and Quick Start Guide in PDF format, Service Guide in PDF format, Online Help in PDF format, Online Help program to run on a PC</i>	E8356-10001
Protective Caps for Connectors	
Protective cap for GPIB connector	1252-5007
Protective cap for Test Set I/O connector	1252-4690
Protective cap for Aux I/O connector	1252-4691
Protective cap for Handler I/O connector	1253-5320
Protective cap for Display (VGA) connector	1252-4696
Protective cap for Serial (RS-232) connector	1252-4697
Protective cap for Parallel (1284-C) connector	1252-4690
Protective cap for test port (Port 1, Port 2) connector (E8362A)	1401-0249
Protective cap for test port (Port 1, Port 2) connector (E8363A, E8364A)	1401-0247
GPIB Cables/GPIB Adapter	
GPIB cable, 0.5 meter (1.6 feet)	10833D
GPIB cable, 1 meter (3.3 feet)	10833A
GPIB cable, 2 meter (6.6 feet)	10833B
GPIB cable, 4 meter (13.2 feet)	10833C
GPIB cable to GPIB cable adapter	10834A

Miscellaneous Part Numbers (Continued)

Description	Model or Part Number
EMI/RFI Accessories	
5-mm ferrite bead (for probe power cable)	9170-2047
7-mm ferrite bead (for serial bus cable)	9170-1793
9-mm ferrite bead (for parallel port cable)	9170-1702
ESD Supplies	
Adjustable antistatic wrist strap	9300-1367
Antistatic wrist strap grounding cord (5 foot length)	9300-0980
Static control table mat and earth ground wire	9300-0797
Upgrade Kits	
Time domain (Option 010)	E8356-60101
Configurable test set (Option 014)	E8364-60101
Firmware upgrade on CD-ROM (Option 099)	E8356-60103
60-dB step attenuators and bias tees (Option UNL)	E8364-60102
Touch-up Paint	
Dove gray (for use on frame around front panel and painted portion of handles)	6010-1146
French gray (for use on cover)	6010-1147
Parchment white (for use on rack mount flanges, rack support flanges, and front panels)	6010-1148
USB Accessories	
Mouse	1150-7799
Keyboard	1150-7896
Read/write CD-ROM	N4688A
Hub	N4689A
Rack Mount Kits and Handle Kits	
Rack mount kit for instruments with handles (Option 1CP)	5063-9237
Rack mount flange for use with handles (two included in 5063-9237)	5022-2809
Rack mount kit for instruments without handles (Option 1CM)	5063-9217
Rack mount flange for use without handles (two included in 5063-9217)	5022-2802
Front handle kit (two handles and hardware)	5063-9230
Front handle (two included in 5063-9230)	5063-9205
Rack mount rail set	E3663AC

7 Repair and Replacement Procedures

Information in This Chapter

This chapter contains procedures for removing and replacing the major assemblies of your Agilent Technologies PNA series microwave network analyzer.

Chapter Seven at-a-Glance

Section Title	Summary of Content	Start Page
Before Starting the Removal and Replacement Procedures	Warnings and cautions pertaining to personal safety and ESD protection. The proper assembly replacement sequence for your analyzer.	Page 7-3
Removal and Replacement Procedures	A table of removal and replacement procedures and the corresponding page numbers where they are located. The actual procedures for removing and replacing the major assemblies in your analyzer. <i>The procedures occur in numerical order of assembly reference designator.</i>	Page 7-4 See Table 7-1 on page 7-4 for specific procedures.
Post-Repair Procedures	A table for the proper tests, verifications, and adjustments to perform on your analyzer after repair.	Page 7-70

Before Starting the Removal and Replacement Procedures

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

Personal Safety Warnings

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.
----------------	--

Electrostatic Discharge (ESD) Protection

CAUTION	<p>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 grounded wrist strap.</p> <p>This is important. If not properly protected against, electrostatic discharge can seriously damage your analyzer, resulting in costly repair.</p> <p>To reduce the chance of electrostatic discharge, follow all of the recommendations outlined in “Electrostatic Discharge Protection” on page 1-5, for each of the procedures in this chapter.</p>
----------------	--

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 4, “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 [Table 7-2 on page 7-70](#) in this chapter.
- Step 4.** Perform the necessary adjustments in [Chapter 3, “Tests and Adjustments.”](#)
- Step 5.** Perform the necessary performance tests in [Chapter 3, “Tests and Adjustments.”](#)

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	Receiver deck	Page 7-8
N/A	Midweb and fans	Page 7-67
N/A	Front panel assembly	Page 7-10
N/A	30-dB fixed attenuators (E8362A only)	Page 7-42
A1	Keypad assembly	Page 7-12
A2	Display assembly	
A3	Front panel interface board	
A4	Power supply assembly	Page 7-16
A6	SPAM board	Page 7-18
A8	Fractional-N synthesizer board	
A10	Frequency reference board	
A11	Phase lock board	Page 7-20
A12	Source 20	Page 7-22
A14	System motherboard	Page 7-24
A15	CPU board	Page 7-26
A16	Test set motherboard	Page 7-28
A17	LOMA 10	Page 7-30
A18	MA 20	Page 7-32
A19	Splitter	Page 7-34
A20	LODA	Page 7-36
A21	SOMA 50 (E8363A and E8364A only)	Page 7-38

Table 7-1 List of Procedures

Reference Designator	Assembly Type	Location
A22	Switch splitter	Page 7-40
A23	Detector (E8363A and E8364A only)	Page 7-44
A24	Detector (E8363A and E8364A only)	
A25	Test port 1 coupler	Page 7-46
A26	Test port 2 coupler	
A27	Channel A first converter	Page 7-48
A28	Channel R1 first converter	
A29	Channel R2 first converter	
A30	Channel B first converter	
A31	Channel A receiver module	Page 7-50
A32	Channel R1 receiver module	
A33	Channel R2 receiver module	
A34	Channel B receiver module	
A35	Receiver motherboard	Page 7-52
A36	Port 1 60-dB step attenuator (Option UNL)	Page 7-54
A37	Port 2 60-dB step attenuator (Option UNL)	
A38	Port 1 bias tee (Option UNL)	Page 7-56
A39	Port 2 bias tee (Option UNL)	
A40	Floppy disk drive	Page 7-58
A41	Hard disk drive	Page 7-60

Removing the Covers

Tools Required

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

Removing the Outer Cover

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

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 of the frame.

Removing the Inner Cover

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

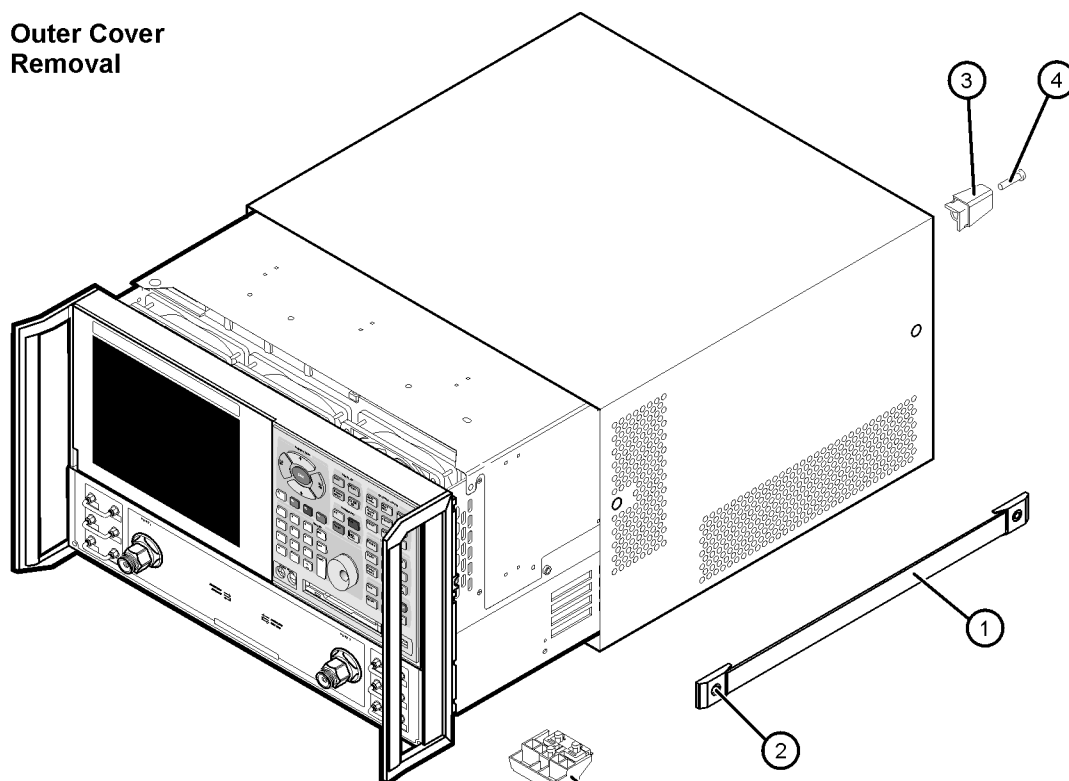
1. With a T-10 TORX driver, remove the 11 screws (item ⑥).
2. Lift off the cover.

Replacement Procedure

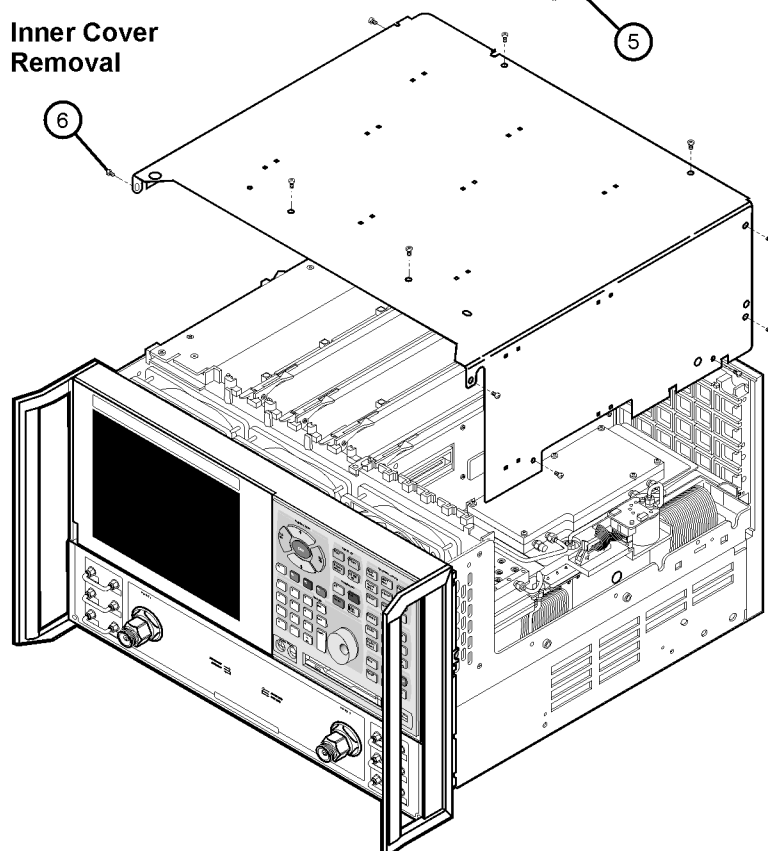
Reverse the order of the removal procedures.

Figure 7-1 Outer and Inner Cover Removal

**Outer Cover
Removal**



**Inner Cover
Removal**



st535a

Raising and Removing the Receiver Deck

Tools Required

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

Raising the Receiver Deck

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. Place the analyzer bottom-side up on a flat surface.
4. With a T-10 TORX driver, remove the four screws (item ①), that secure the receiver deck.
5. Pull the latch pin (item ②) towards the center of the analyzer to release the receiver deck.
6. Lift the receiver deck to partially raise it, then release the latch pin (item ②). Lift the receiver deck to its fully raised position and ensure that the latch pin latches in the raised position.

Lowering the Receiver Deck

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

1. Pull the latch pin (item ②) toward the center of the analyzer to release the receiver deck.
2. Lift the receiver deck to partially lower it, then release the latch pin (item ②). Lower the receiver deck to its fully lowered position and ensure that the latch pin latches in the lowered position.
3. With a T-10 TORX driver, install the four screws (item ①), to secure the receiver deck.

Removing the Receiver Deck

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

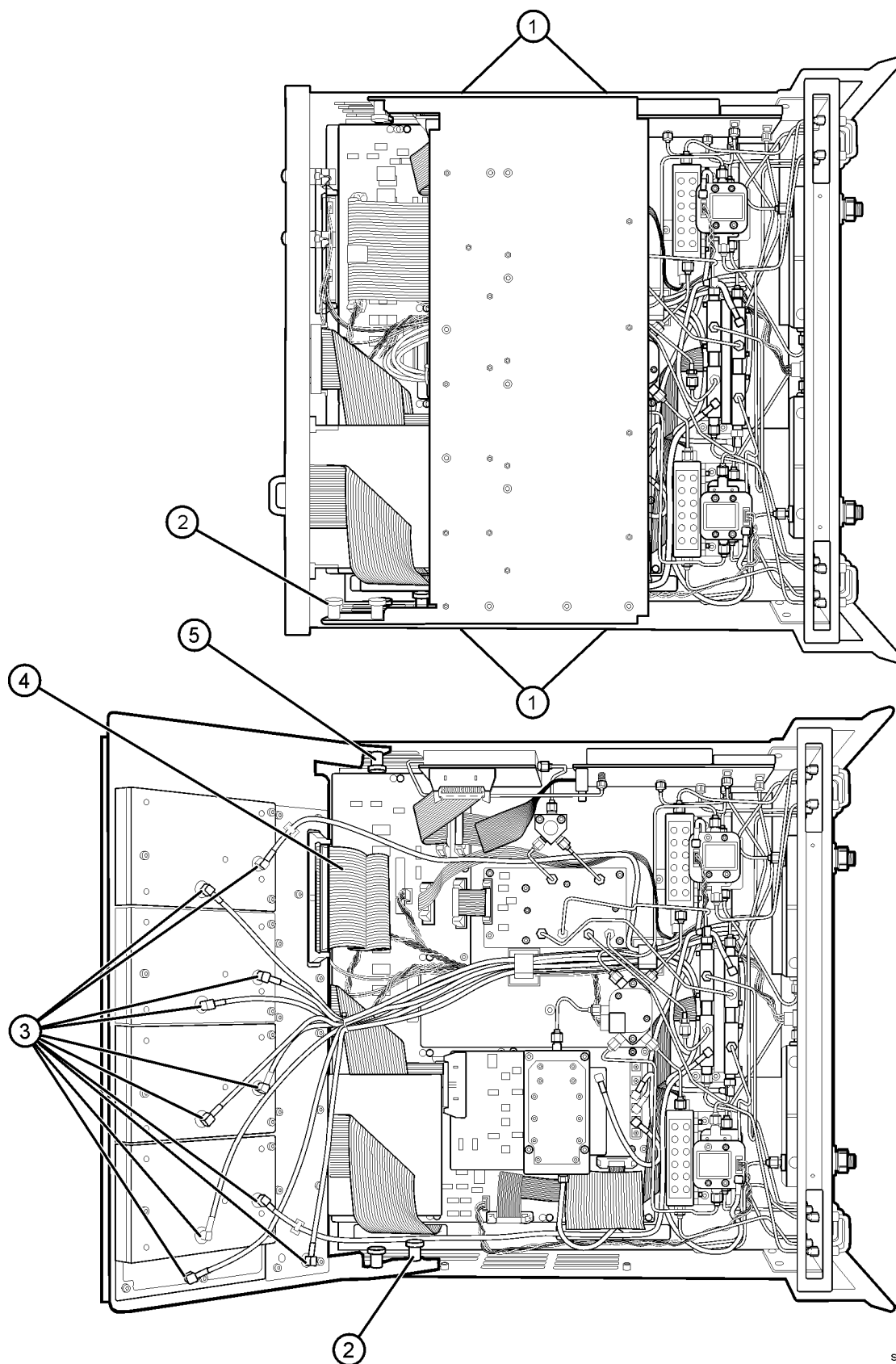
1. Raise the receiver deck as outlined in [“Raising the Receiver Deck,”](#) above.
2. Disconnect the ten flexible cables (item ③), and the ribbon cable (item ④).
3. Pull the latch pin (item ⑤) to release one side of the receiver deck.
4. Lift the side of the receiver deck that was just released, above the side of the analyzer, and then lift the entire receiver deck out of the analyzer.

Replacing the Receiver Deck

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

1. Reverse the procedure for [“Removing the Receiver Deck,”](#) above.

Figure 7-2 Receiver Deck, Raising and Removal



st565a

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 7-3](#) 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-inch torque wrench, remove all the semirigid jumpers (item ①) from the front panel (Option 014 only).
4. With a T-10 TORX driver, remove the eight 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.

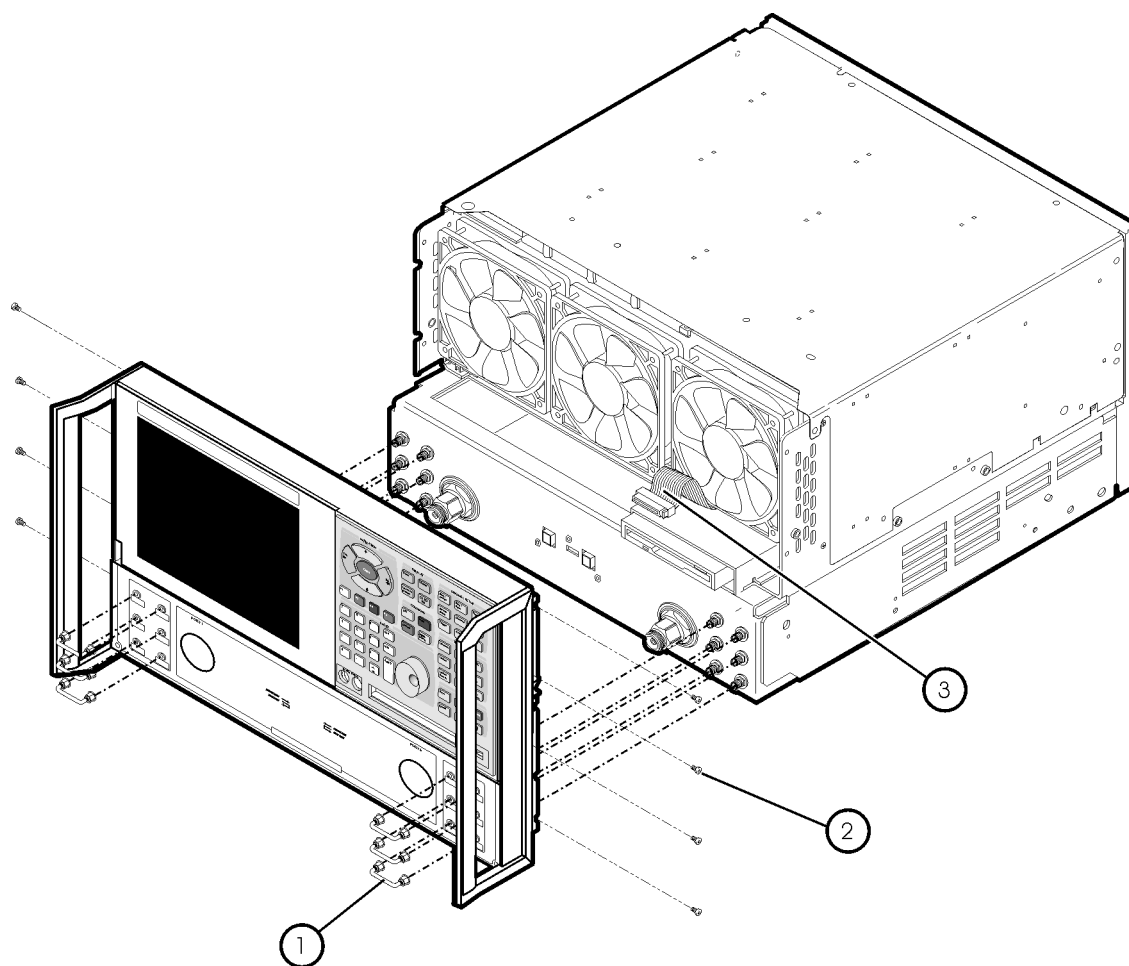
Replacement Procedure

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 7-70](#).

Figure 7-3 Front Panel Assembly Removal



st536a

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

Refer to [Figure 7-4](#) for the following procedures.

Pre-removal Procedure

1. Disconnect the power cord.
2. Remove the front panel assembly. Refer to [“Removing and Replacing the Front Panel Assembly” on page 7-10](#).
3. Disconnect the display ribbon cable (item ①) and the display lamp cable (item ②) from the A3 front panel interface board.

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

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 up at an angle until the board clears the frame. Disconnect the keypad ribbon cable (item ⑤) from the A3 front panel interface board and lift out the board.

Removing the A1 Keypad Assembly

1. Remove the A3 front panel interface board as instructed above.
2. From the rear of the front panel assembly, remove the center retaining screw (item ⑥). Bend the bottom keypad assembly tabs away from the frame and push the A1 keypad assembly out of the frame.

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

- ### Figure 7-4 Front Panel Subassemblies Removal



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

Pre-removal Procedure

1. Disconnect the power cord.
2. Remove the front panel assembly. Refer to [“Removing and Replacing the Front Panel Assembly” on page 7-10](#).
3. Remove the display assembly. Refer to [“Removing the A2 Display Assembly” on page 7-12](#).

Removing the Display Inverter Board

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

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

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

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 outward slightly.

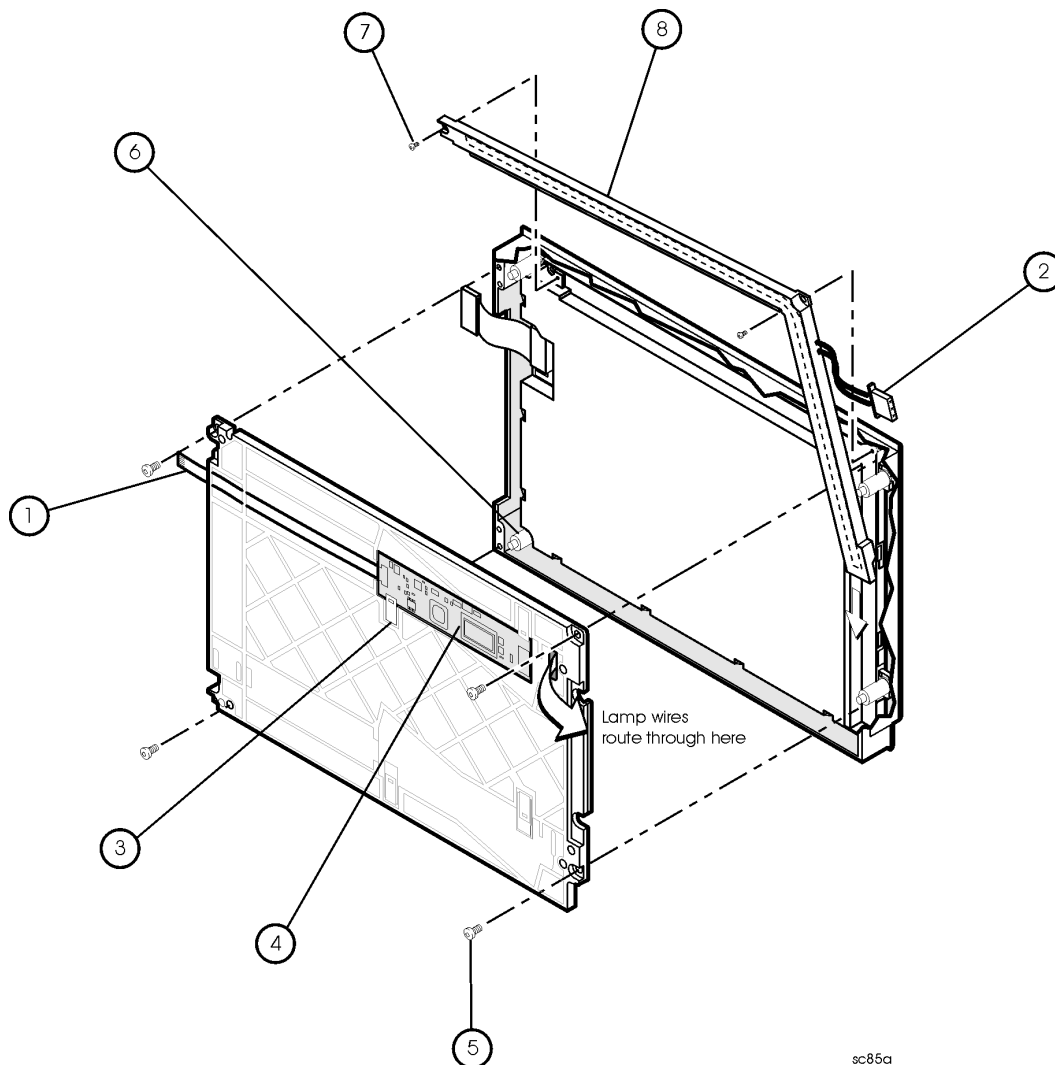
NOTE To avoid dust or dirt particles from getting in between the display glass and the display, do not completely take out the display.

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 7-70](#).

Figure 7-5 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

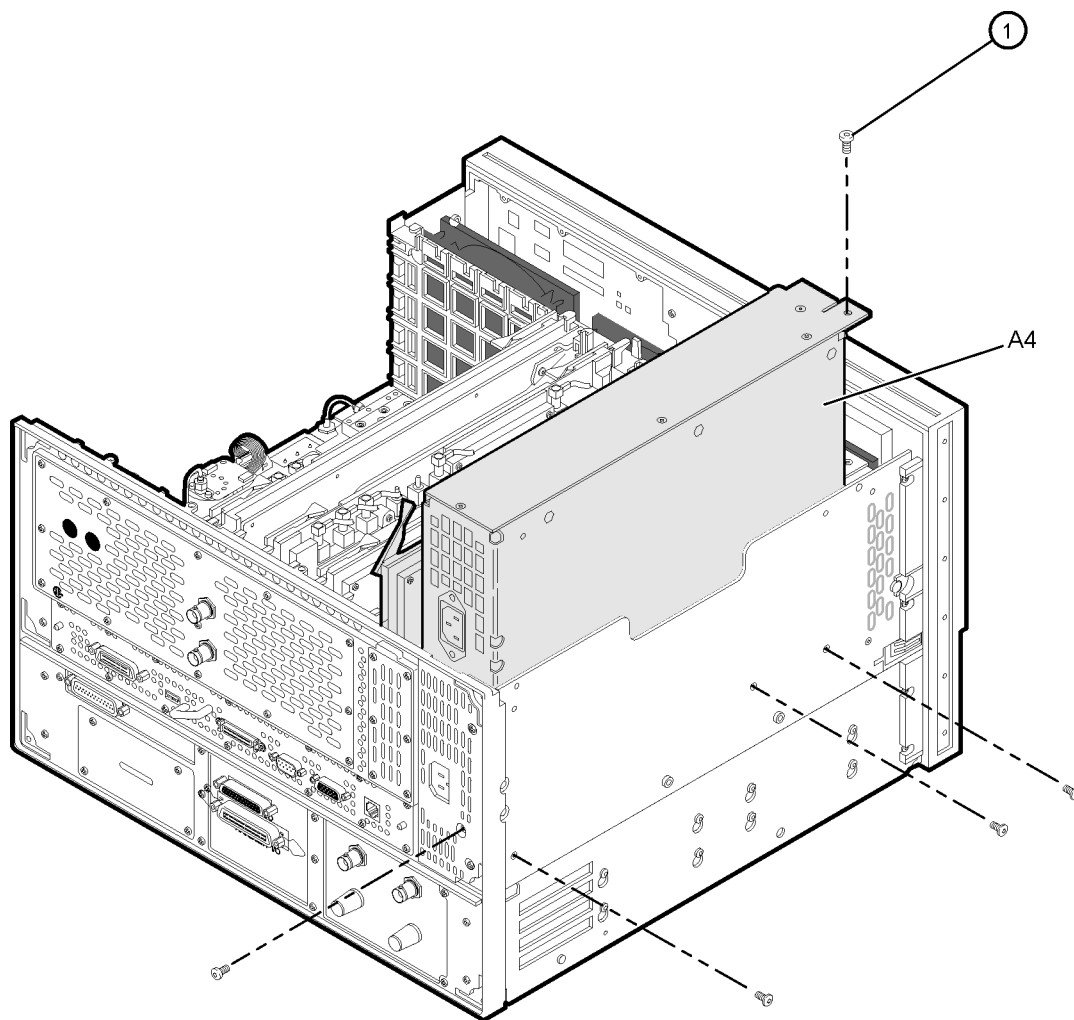
Refer to [Figure 7-6](#) for this procedure.

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 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 7-70](#).

Figure 7-6 A4 Power Supply Assembly Removal



st538a

Removing and Replacing the A6, A8, and A10 Boards

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. 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.

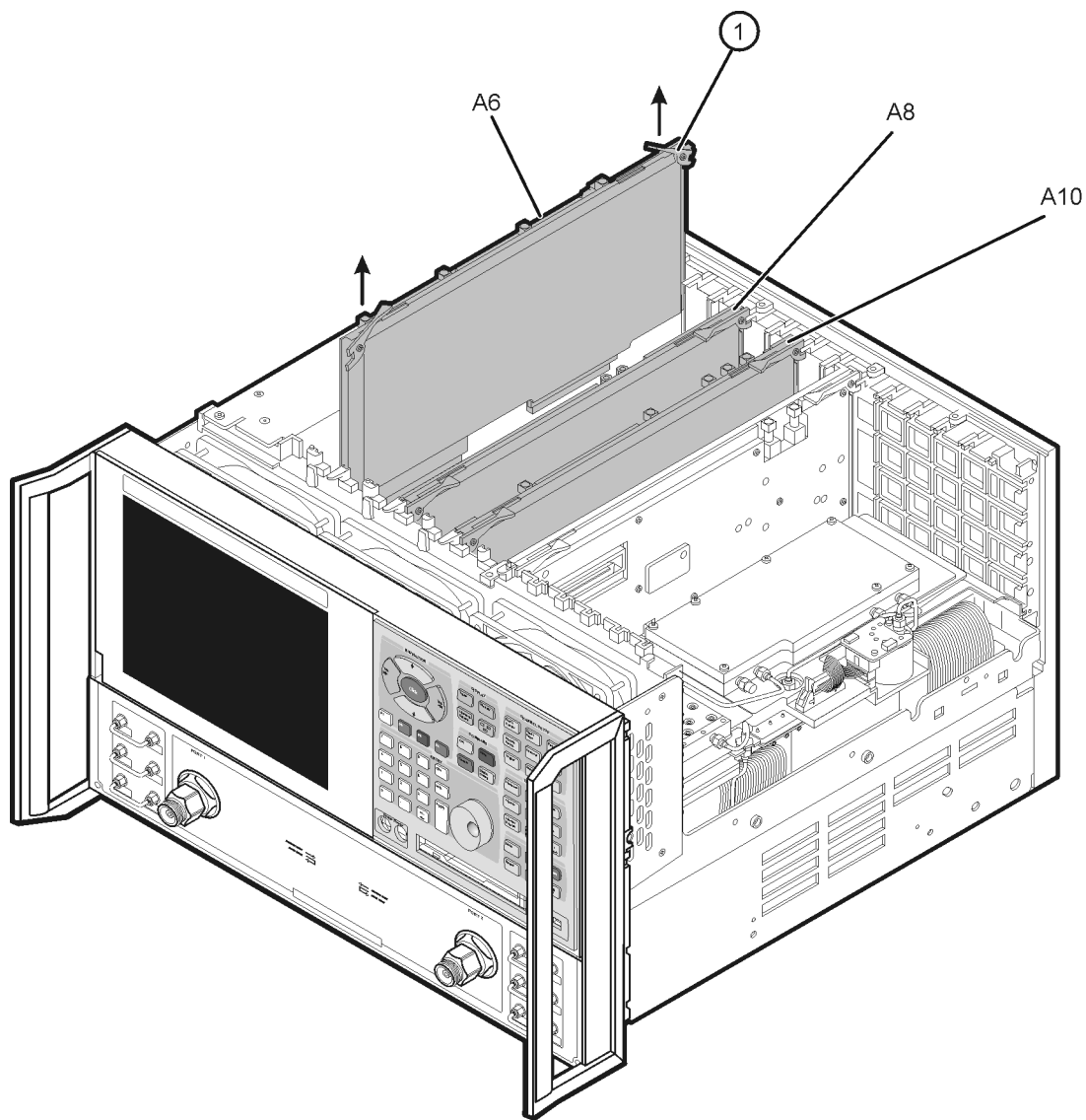
NOTE	Before removing the board completely, check the bottom of the board for any attached cables.
-------------	--

6. While holding on to the extractors, slide the board out of the slot and 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 7-70](#).

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



st539a

Removing and Replacing the A11 Phase Lock Board

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

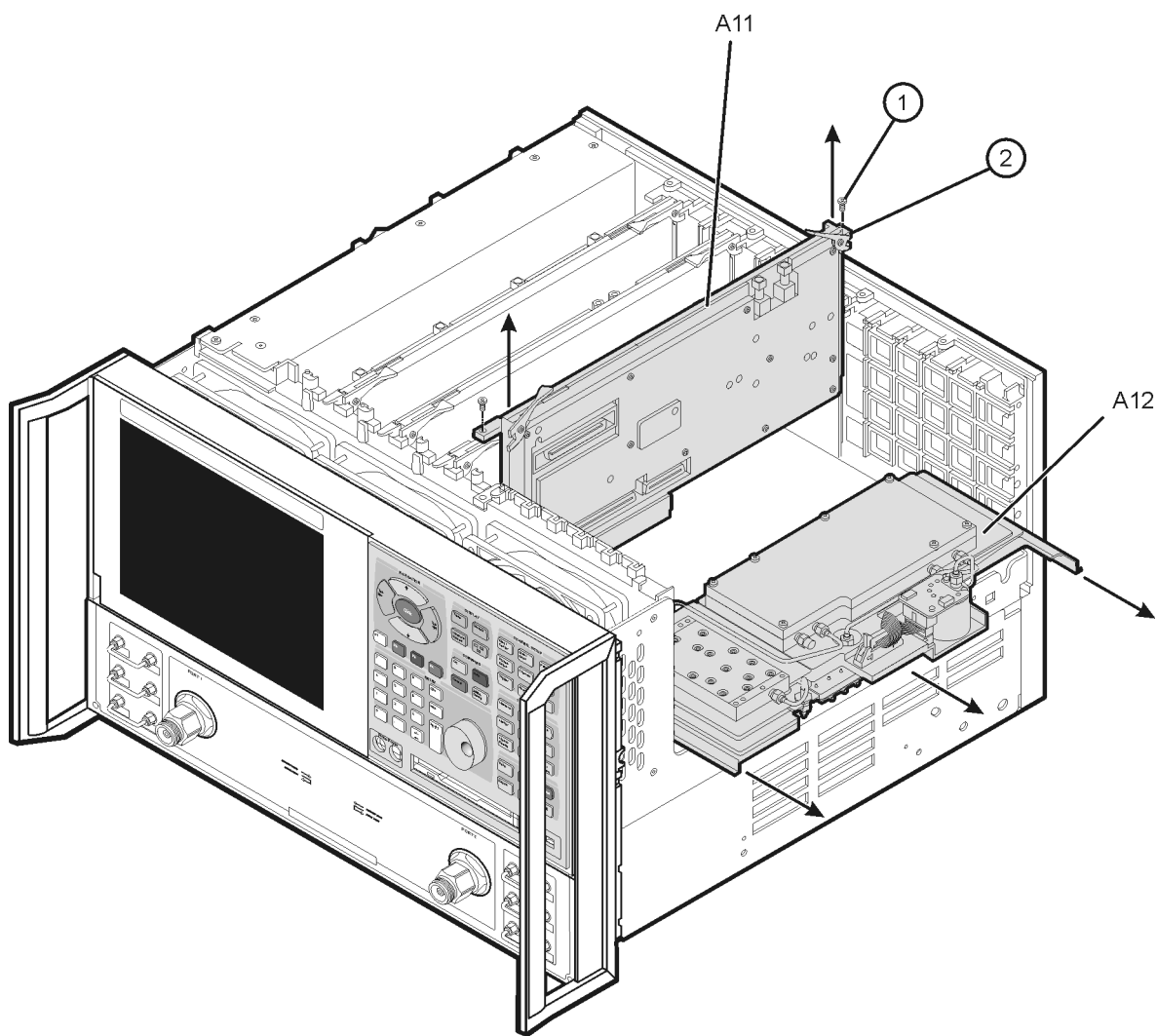
Refer to [Figure 7-8](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to [“Removing the Covers” on page 7-6](#).
3. With a T-10 TORX driver, remove the two brackets that secure cables to the top of the midweb.
4. With a T-10 TORX driver, remove the two screws (item ①) from the top of the A11 phase lock board.
5. Disengage the A12 source 20 from the A11 connector and slide the A12 partially out of the analyzer. Refer to [“Removing and Replacing the A12 Source 20” on page 7-22](#).
6. Disconnect any flexible cables that are attached to the A11 phase lock board.
7. Lift the two extractors (item ②) located at each end of the board.
8. While holding on to the extractors, lift the A11 phase lock board 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 7-70](#).

Figure 7-8 A11 Phase Lock Board Removal



st540a

Removing and Replacing the A12 Source 20

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. With a 5/16-inch torque wrench, disconnect the semirigid cable (item ①) from the bottom of the A12 source 20.

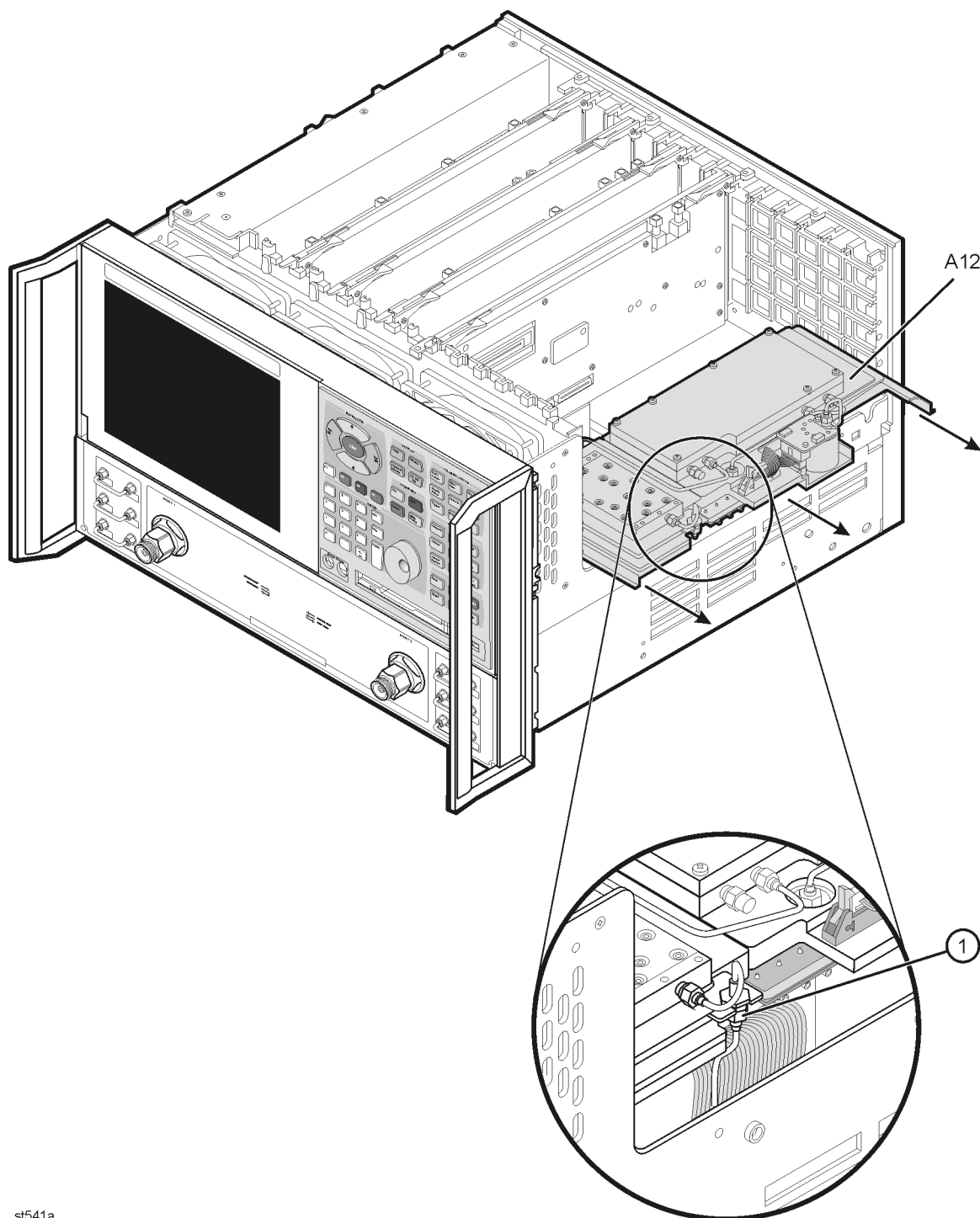
CAUTION	To avoid damage to the semirigid cable (item ①), pull down on the cable from the bottom of the analyzer to move it away while sliding out the A12 source 20. The cable has some spring to it and the RF pin could be damaged by the A12 source 20.
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4. Slide the A12 source 20 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 7-70](#).

Figure 7-9 A12 Source 20 Removal



st541a

Removing and Replacing the A14 System Motherboard

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

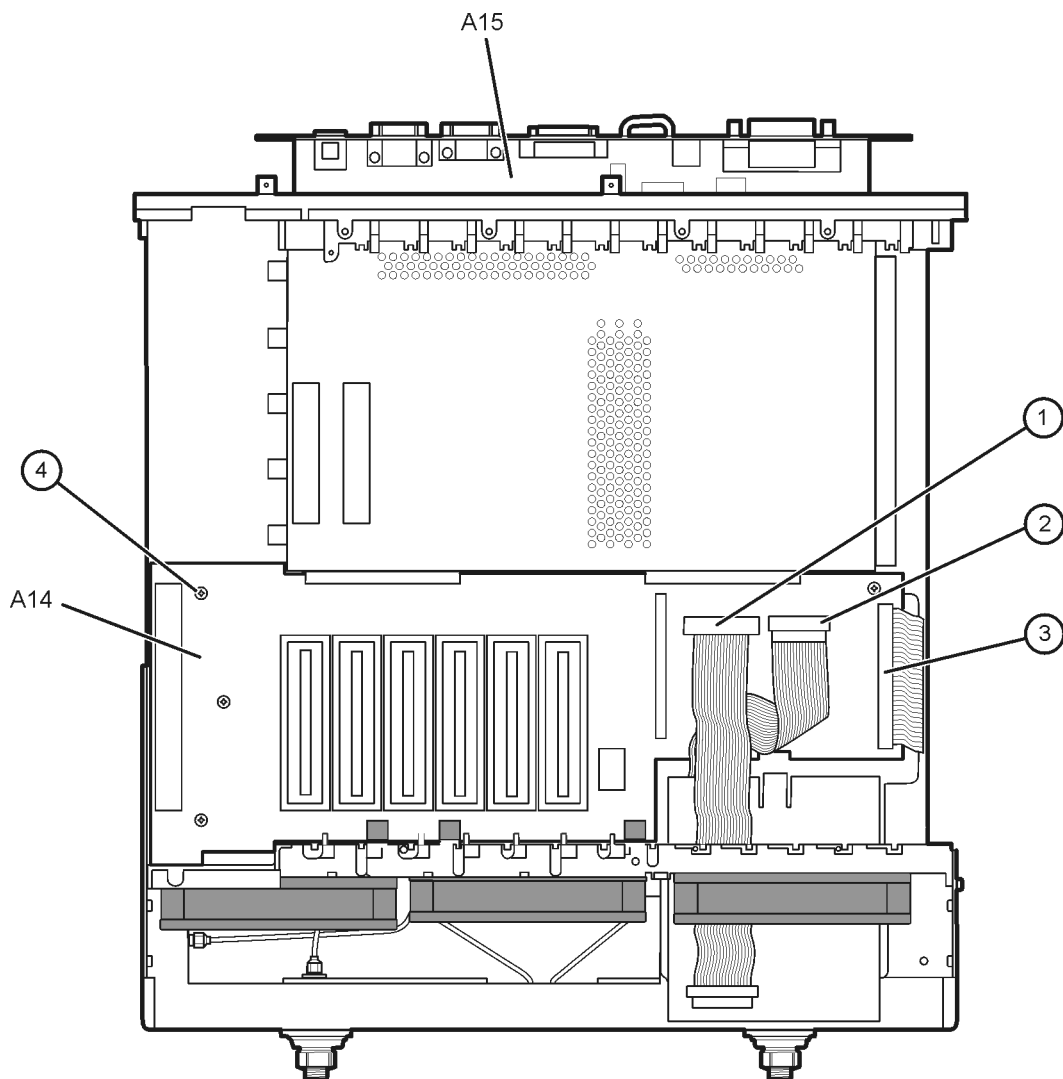
Refer to [Figure 7-10](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to [“Removing the Covers”](#) on page 7-6.
3. Remove the front panel assembly. Refer to [“Removing and Replacing the Front Panel Assembly”](#) on page 7-10.
4. Remove the A12 source 20. Refer to [“Removing and Replacing the A12 Source 20”](#) on page 7-22.
5. Remove the A11 phase lock board. Refer to [“Removing and Replacing the A11 Phase Lock Board”](#) on page 7-20.
6. Remove the A4 power supply assembly. Refer to [“Removing and Replacing the A4 Power Supply Assembly”](#) on page 7-16.
7. Remove the card cage boards (A6, A8, and A10). Refer to [“Removing and Replacing the A6, A8, and A10 Boards”](#) on page 7-18.
8. Remove the A15 CPU board. Refer to [“Removing and Replacing the A15 CPU Board”](#) on page 7-26.
9. Remove the Midweb. Refer to [“Removing and Replacing the Midweb and the B1 Fan”](#) on page 7-67.
10. Disconnect the A1 front panel ribbon cable (item ①), the A40 floppy disk drive ribbon cable (item ②), and the A16 test set motherboard ribbon cable (item ③) from the A14 system motherboard.
11. Lift the tab at the rear of the A40 floppy disk drive enclosure and remove the rear enclosure cover.
12. Remove the four screws (item ④) that secure the A14 system motherboard.
13. Lift the A14 system motherboard 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 7-70.

Figure 7-10 A14 System Motherboard Removal



st542a

Removing and Replacing the A15 CPU Board

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

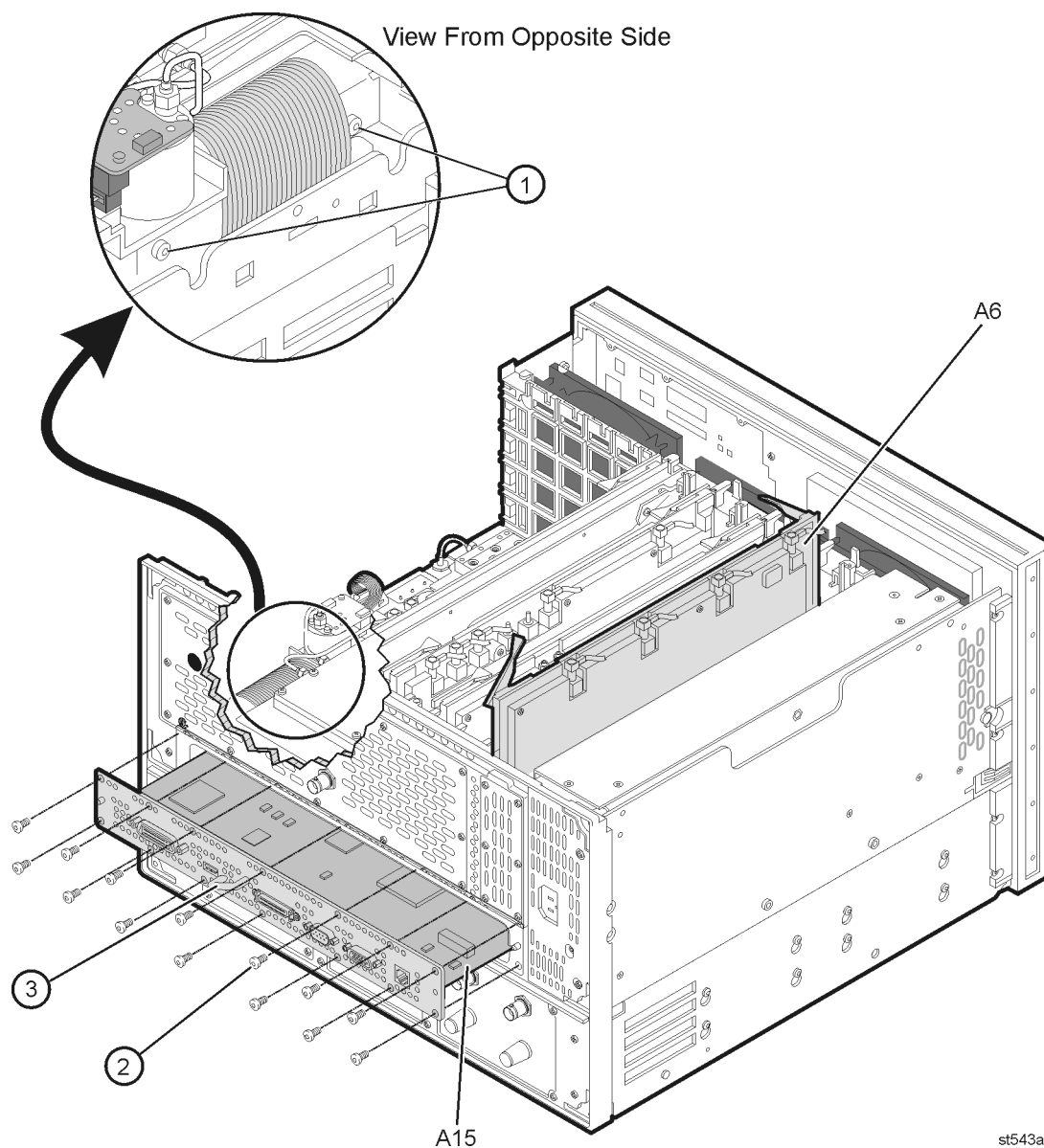
Refer to [Figure 7-11](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to [“Removing the Covers” on page 7-6](#).
3. Disconnect the hard disk drive assembly (HDDA) ribbon cable and interface board from the A15 CPU board by removing the two screws (item ①).
4. Disengage the A6 SPAM board from the A15 CPU board 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. Lower the board 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 ②) from the rear panel of the A15 CPU board.
6. Gently pull on the finger grip (item ③) to disengage the A15 CPU board from the analyzer.
7. Slide the A15 CPU board 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 7-70](#).

Figure 7-11 A15 CPU Board Removal



Removing and Replacing the A16 Test Set Motherboard

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

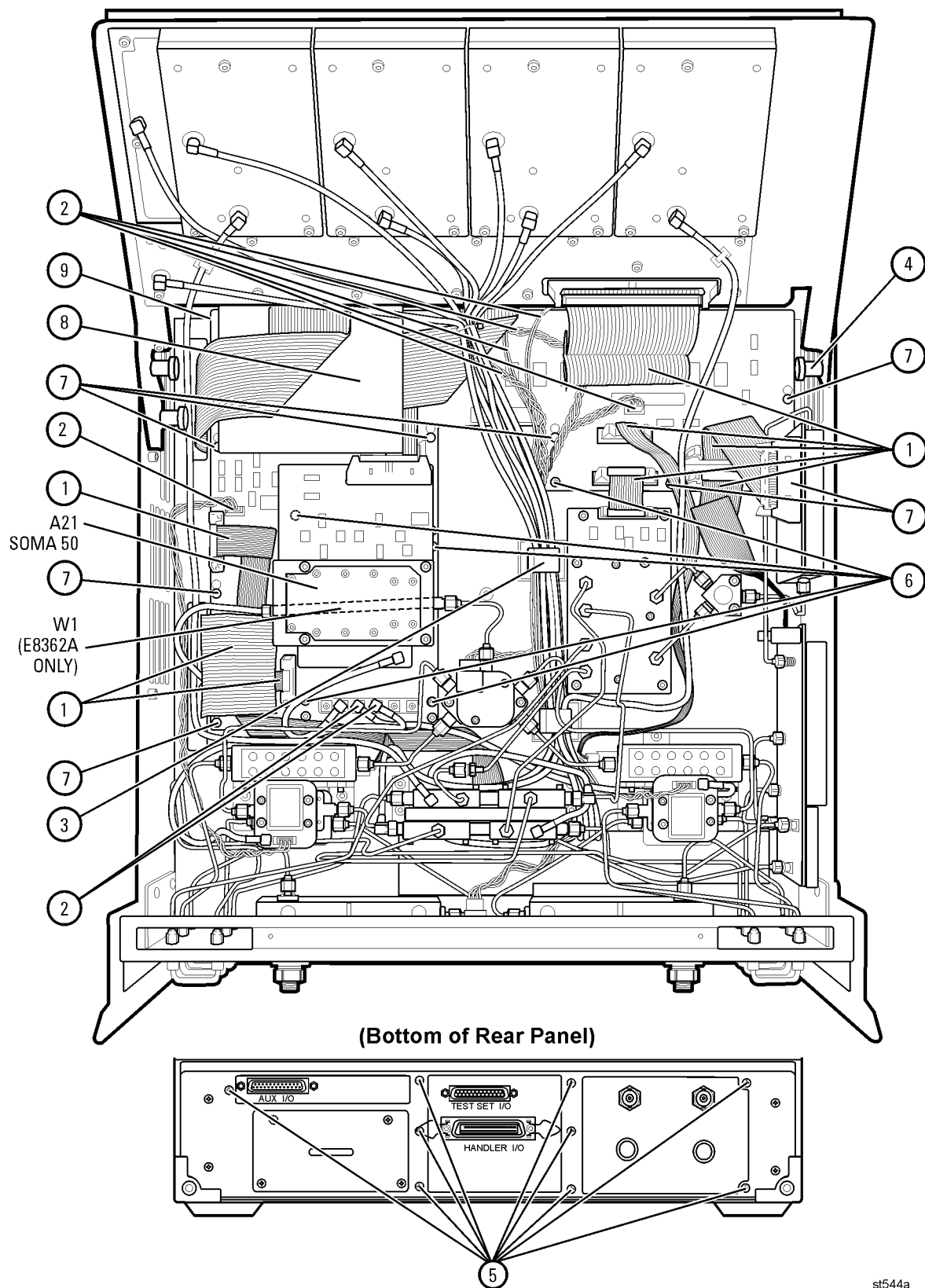
Refer to [Figure 7-12](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer covers. Refer to [“Removing the Covers” on page 7-6](#). Position the analyzer bottom side up and raise the receiver deck as shown. Refer to [“Raising and Removing the Receiver Deck” on page 7-8](#) if necessary.
3. Remove the A21 SOMA 50 (E8363A and E8364A) or RF cable W1 (E8362A). Refer to [“Removing and Replacing the A21 SOMA 50 \(E8363A and E8364A Only\)” on page 7-38](#).
4. Remove the A41 hard disk drive. Refer to [“Removing and Replacing the A41 Hard Disk Drive” on page 7-60](#).
5. Remove the hard disk drive shield (item ⑧) by loosening two attachment screws (item ⑨), using a T-10 TORX driver. These screws are accessible through holes in the side of the chassis.
6. Disconnect the ribbon cables (item ①) from the A16 test set motherboard:
7. Disconnect the wrapped-wire cables and flexible RF cables (item ②) from the A16 test set motherboard:
8. Release the flexible RF cables from the cable clamp (item ③). Release the receiver deck by pulling the latch pin (item ④), and move the entire receiver deck out of the way, with the cables attached.
9. With a T-10 TORX driver, remove the following screws:
 - Nine screws (item ⑤) from the rear panel.
 - Four screws (item ⑥) from the A16 test set motherboard.
10. Slide the A16 test set motherboard toward the front of the instrument to release the locking pins (item ⑦), then lift the motherboard and 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 7-70](#).

Figure 7-12 A16 Test Set Motherboard Removal



st544a

Removing and Replacing the A17 LOMA 10

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](#). Position the analyzer bottom side up and raise the receiver deck as shown. Refer to [“Raising and Removing the Receiver Deck” on page 7-8](#) if necessary.
3. With a 5/16-inch torque wrench, disconnect the three semirigid cables (item ①) from the A17 LOMA 10.
4. Disconnect the ribbon cable (item ②) at the A17 LOMA 10.
5. With a T-10 TORX driver, remove the four mounting screws (item ③) from the side of the analyzer.

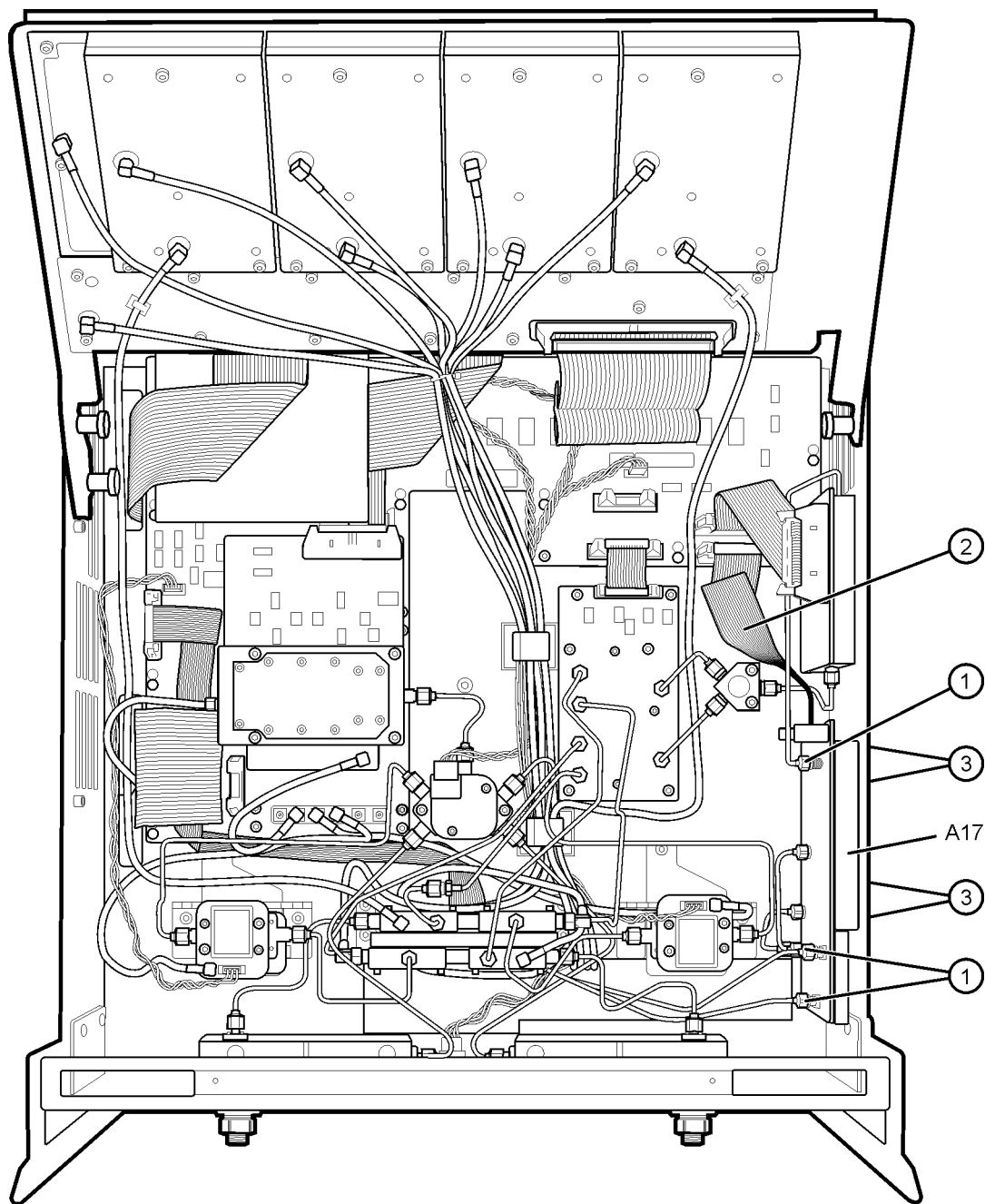
CAUTION	Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend the semirigid cables.
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6. Remove the A17 LOMA 10 from the analyzer. Observe the **CAUTION** above.

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 7-70](#).

Figure 7-13 A17 LOMA 10 Removal



st545a

Removing and Replacing the A18 MA 20

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](#). Position the analyzer bottom side up and raise the receiver deck as shown. Refer to [“Raising and Removing the Receiver Deck” on page 7-8](#) if necessary.
3. With a 5/16-inch torque wrench, disconnect the two semirigid cables (item ①) from the A18 MA 20. It may be necessary to remove these cables completely to allow the A18 MA 20 to be removed from the analyzer.
4. Disconnect the ribbon cable (item ②) at the A18 MA 20.
5. With a T-10 TORX driver, remove the four mounting screws (item ③) from the side of the analyzer.

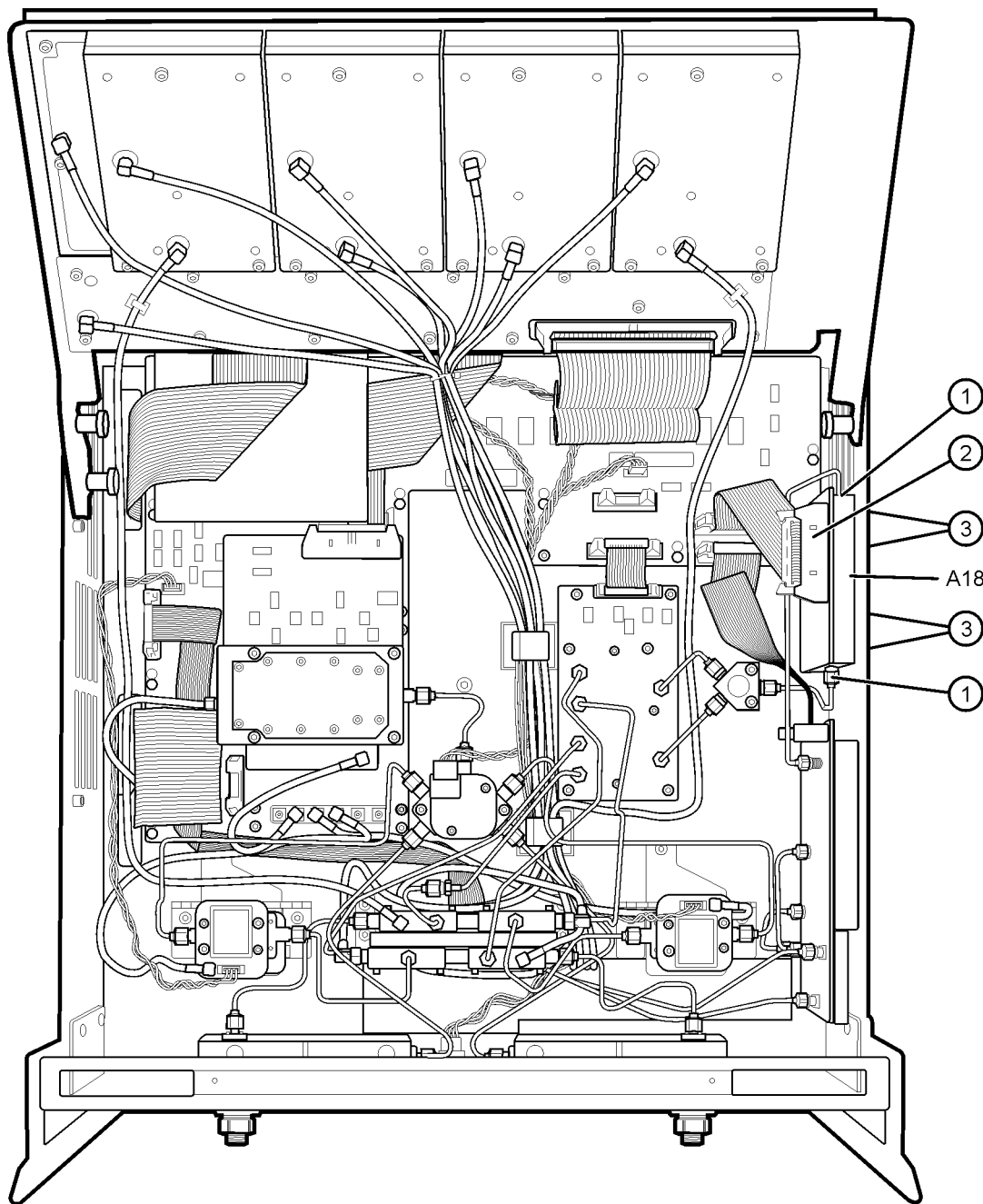
CAUTION	Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend the semirigid cables.
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6. Remove the A18 MA 20 from the analyzer. Observe the **CAUTION** above.

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 7-70](#).

Figure 7-14 A18 MA 20 Removal



st546a

Removing and Replacing the A19 Splitter

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](#). Position the analyzer bottom side up and raise the receiver deck as shown. Refer to [“Raising and Removing the Receiver Deck” on page 7-8](#) if necessary.
3. With a 5/16-inch torque wrench, disconnect the three semirigid cables (item ①) from the A19 splitter.
4. With a T-10 TORX driver, remove the two mounting screws (item ②).

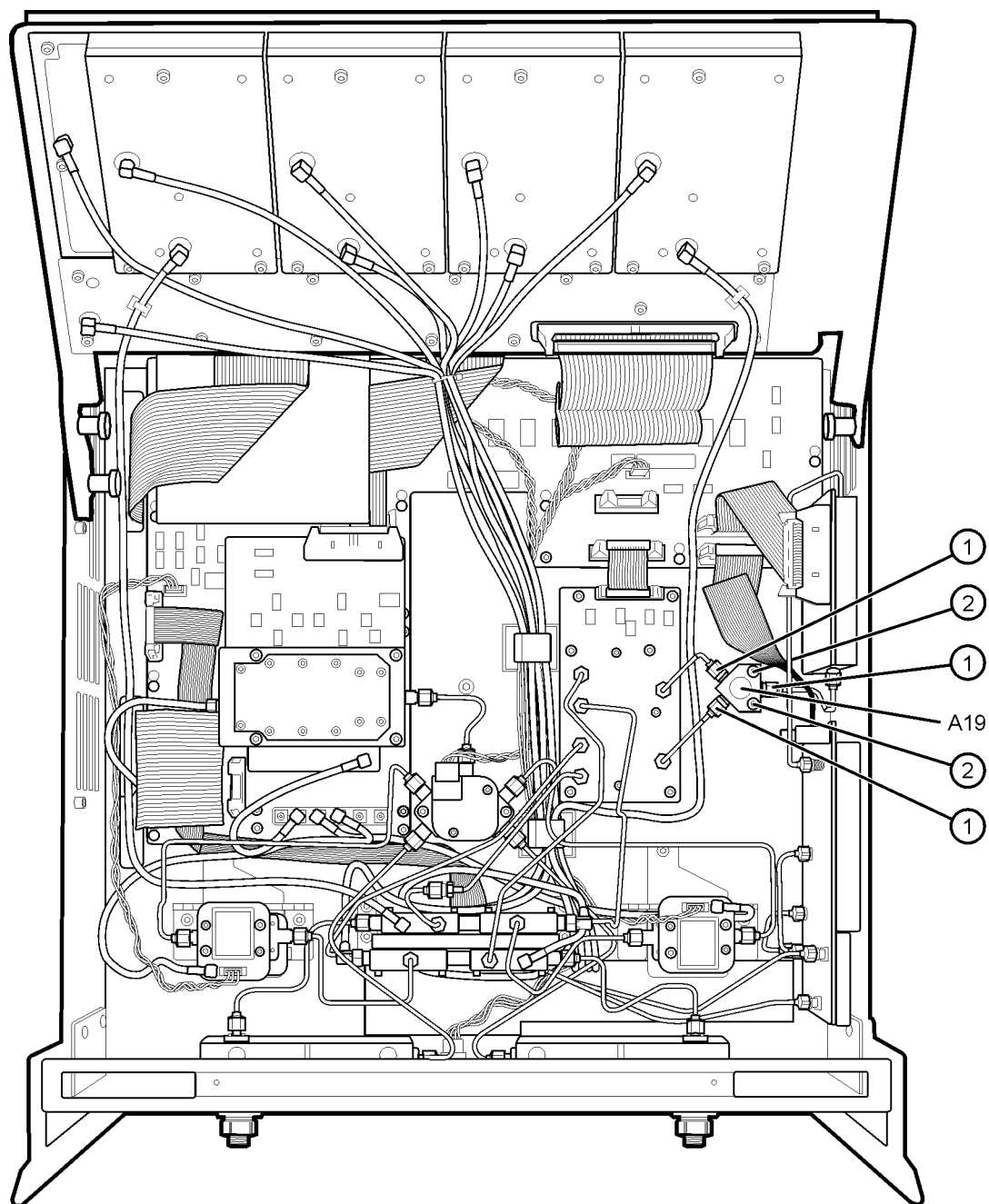
CAUTION	Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend the semirigid cables.
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5. Remove the A19 splitter from the analyzer. Observe the **CAUTION** above.

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 7-70](#).

Figure 7-15 A19 Splitter Removal



st547a

Removing and Replacing the A20 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 7-13](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to [“Removing the Covers” on page 7-6](#). Position the analyzer bottom side up and raise the receiver deck as shown. Refer to [“Raising and Removing the Receiver Deck” on page 7-8](#) if necessary.
3. With a 5/16-inch torque wrench, disconnect the six semirigid cables (item ①) from the A20 LODA.
4. Disconnect the ribbon cable (item ②) at the A20 LODA.
5. With a T-10 TORX driver, remove the six mounting screws (item ③). There are two different sizes of screws on the assembly. Remove all six of the same size even though only three are identified in [Figure 7-16](#).

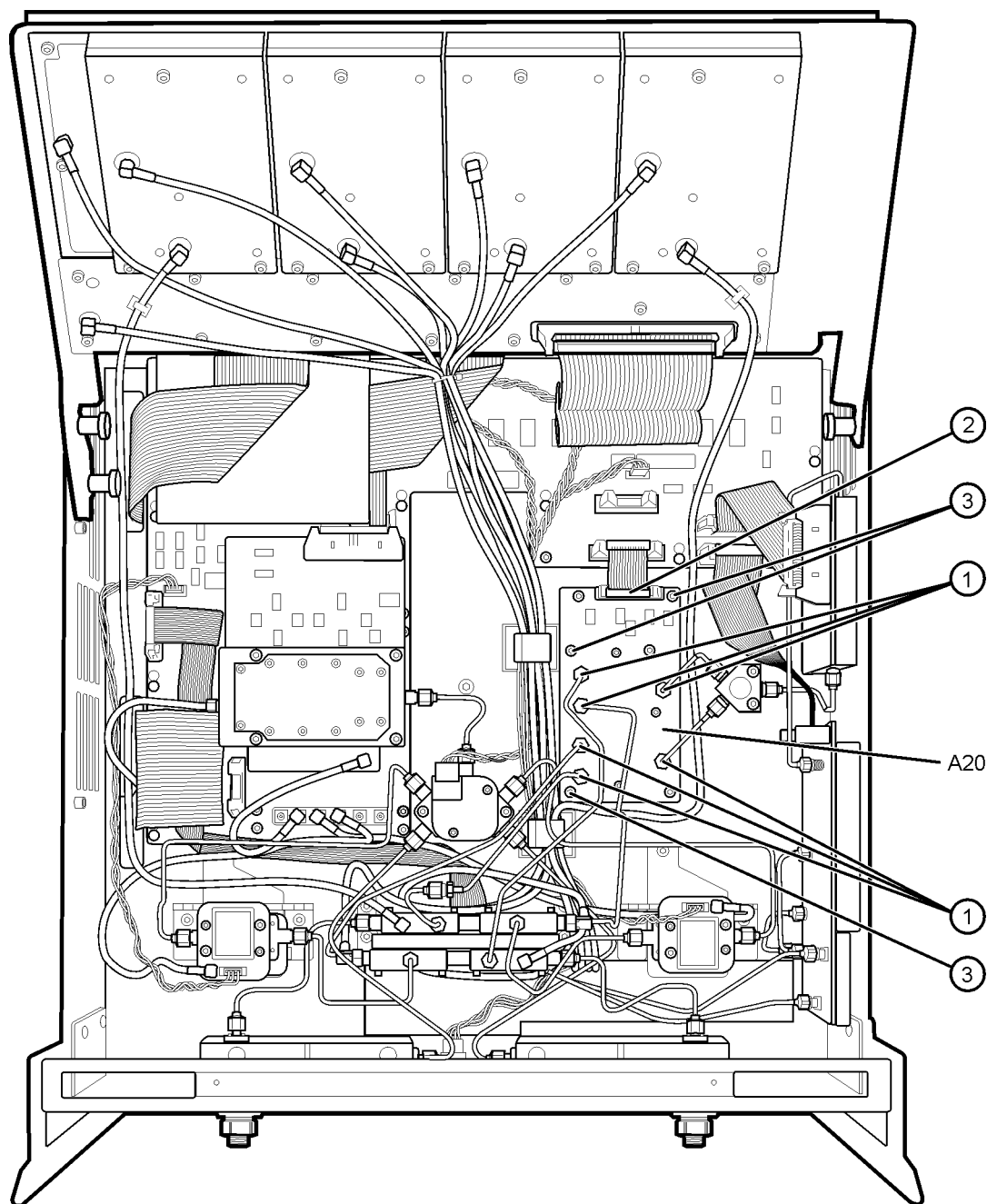
CAUTION	Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend the semirigid cables.
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6. Remove the A20 LODA from the analyzer. Observe the **CAUTION** above.

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 7-70](#).

Figure 7-16 A20 LODA Removal



st548a

Removing and Replacing the A21 SOMA 50 (E8363A and E8364A Only)

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](#). Position the analyzer bottom side up and raise the receiver deck as shown. Refer to [“Raising and Removing the Receiver Deck” on page 7-8](#) if necessary.
3. With a 5/16-inch torque wrench, disconnect the two semirigid cables (item ①) from the A21 SOMA 50.
4. Disconnect the flexible cable (item ②) from the A21 SOMA 50.
5. Disconnect the ribbon cable (item ③) at the A21 SOMA 50.
6. With a T-10 TORX driver, remove the four mounting screws (item ④).

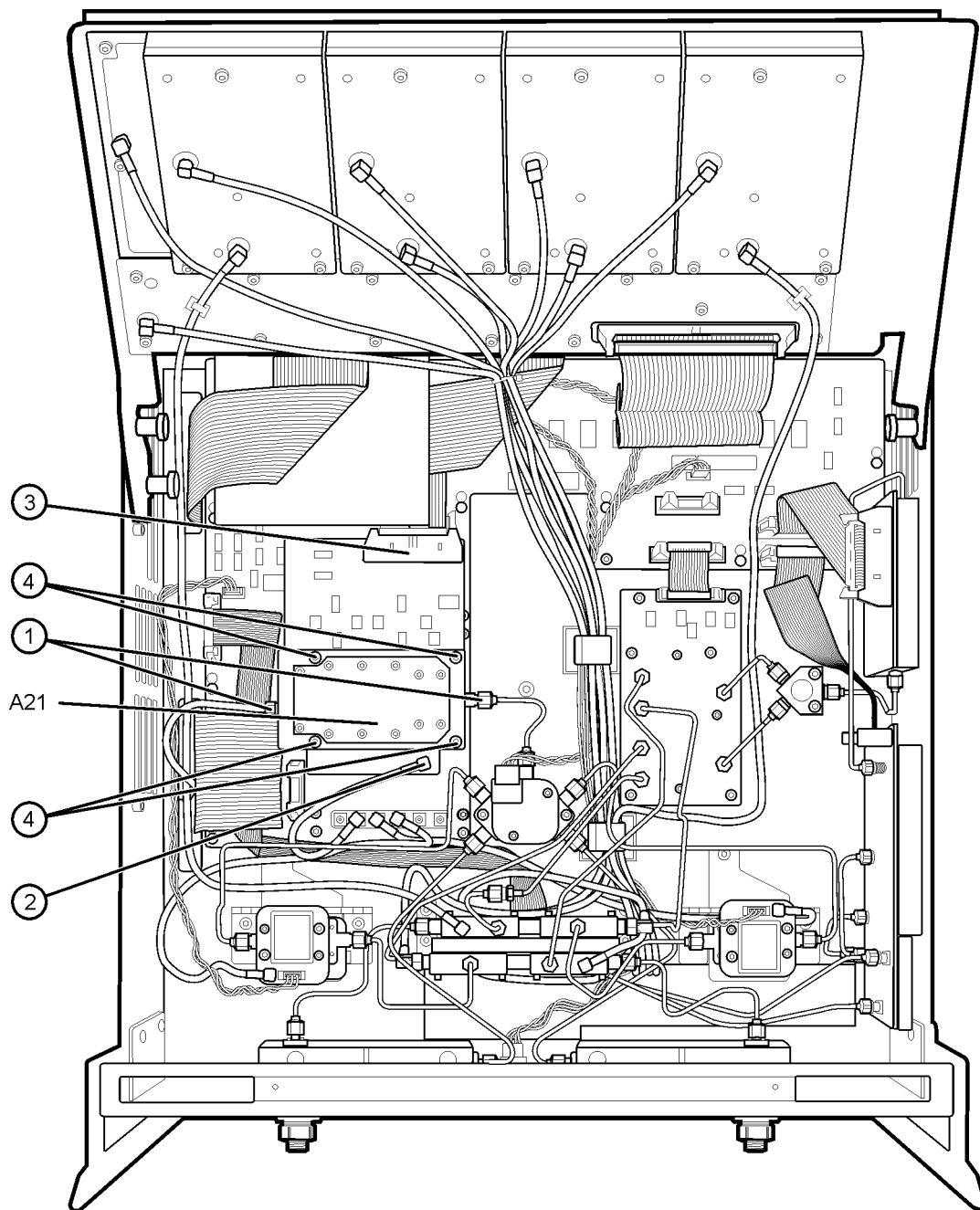
CAUTION	Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend the semirigid cables.
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7. Remove the A21 SOMA 50 from the analyzer. Observe the **CAUTION** above.

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 7-70](#).

Figure 7-17 A21 SOMA 50 Removal (E8363A and E8364A Only)



st549a

Removing and Replacing the A22 Switch Splitter

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](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to [“Removing the Covers” on page 7-6](#). Position the analyzer bottom side up and raise the receiver deck as shown. Refer to [“Raising and Removing the Receiver Deck” on page 7-8](#) if necessary.
3. Disconnect the stranded switch control cable (item ①) from the A22 switch splitter.
4. With a 5/16-inch torque wrench, disconnect the five semirigid cables (item ②).
5. With a T-10 TORX driver, remove the two mounting screws (item ③).

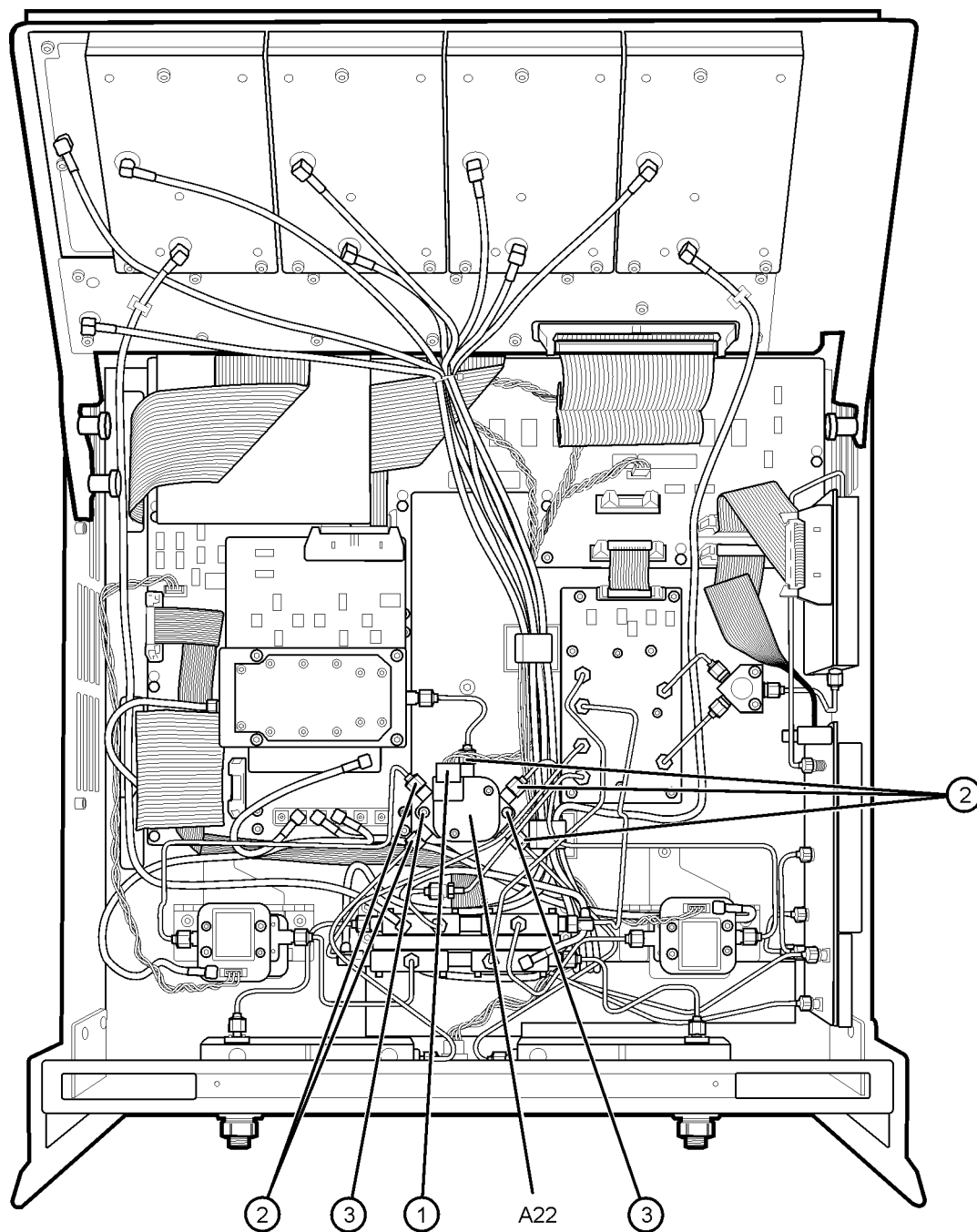
CAUTION	Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend the semirigid cables.
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6. Remove the A22 switch splitter from the analyzer. Observe the **CAUTION** above.

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 7-70](#).

Figure 7-18 A22 Switch Splitter Removal



Removing and Replacing the 30-dB Fixed Attenuators (E8362A only)

Tools Required

- T-10 TORX driver (set to 9 in-lb)
- T-20 TORX driver (set to 21 in-lb)
- 1/4-inch open-end wrench
- 5/16-inch open-end torque wrench (set to 10 in-lb)
- ESD grounding wrist strap

Removal Procedure

Refer to [Figure 7-19](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to [“Removing the Covers” on page 7-6](#). Position the analyzer bottom side up as shown. It may be convenient to raise the receiver deck to provide better access. If necessary, refer to [“Raising and Removing the Receiver Deck” on page 7-8](#).
3. Identify the fixed attenuator to be removed.
4. Disconnect the two semirigid cables (item ①) from the attenuator:
 - Use a 1/4-inch open-end wrench, adjacent to the connector to be removed, to hold the attenuator in a fixed position.
 - Use a 5/16-inch torque wrench to loosen the cable connector.
 - Repeat for the cable connector at the other end of the attenuator.

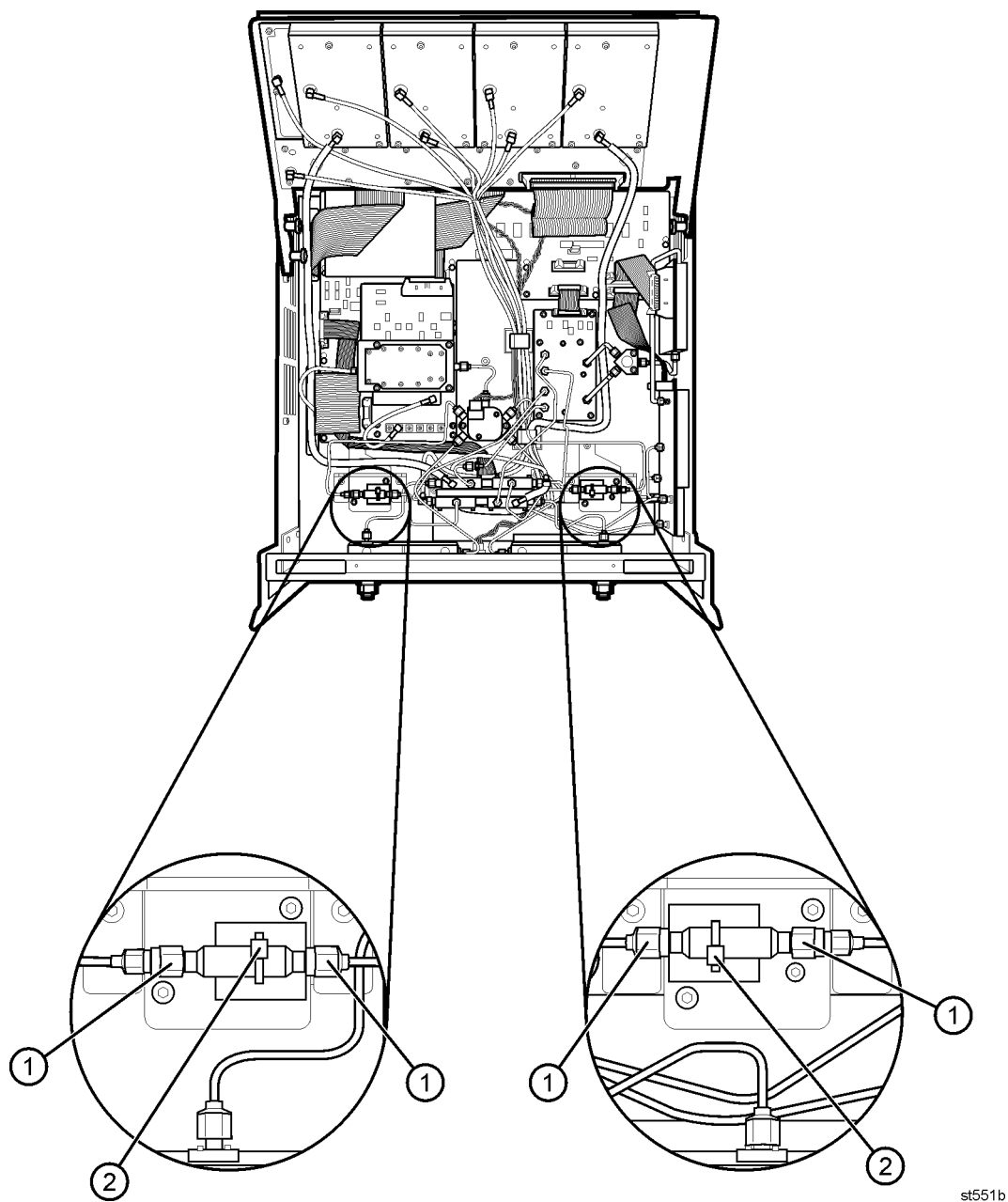
CAUTION	Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the attenuator. Do not over-bend the semirigid cables.
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5. Cut the cable tie (item ②), used to secure the attenuator, and remove the attenuator from its holder. Observe the **CAUTION** above.

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 7-70](#).

Figure 7-19 Fixed Attenuator Removal (E8362A Only)



Removing and Replacing the A23 and A24 Detectors (E8363A and E8364A only)

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 7-20](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to [“Removing the Covers” on page 7-6](#). Position the analyzer bottom side up as shown. It may be convenient to raise the receiver deck to provide better access. If necessary, refer to [“Raising and Removing the Receiver Deck” on page 7-8](#).
3. Identify the detector to be removed.
4. Disconnect the stranded control cable (item ①) from the appropriate detector.
5. With a 5/16-inch torque wrench, disconnect the two semirigid cables (item ②) from the detector.
6. Remove the flexible cable (item ③) from the detector.
7. With a T-10 TORX driver, remove the two mounting screws (item ④).

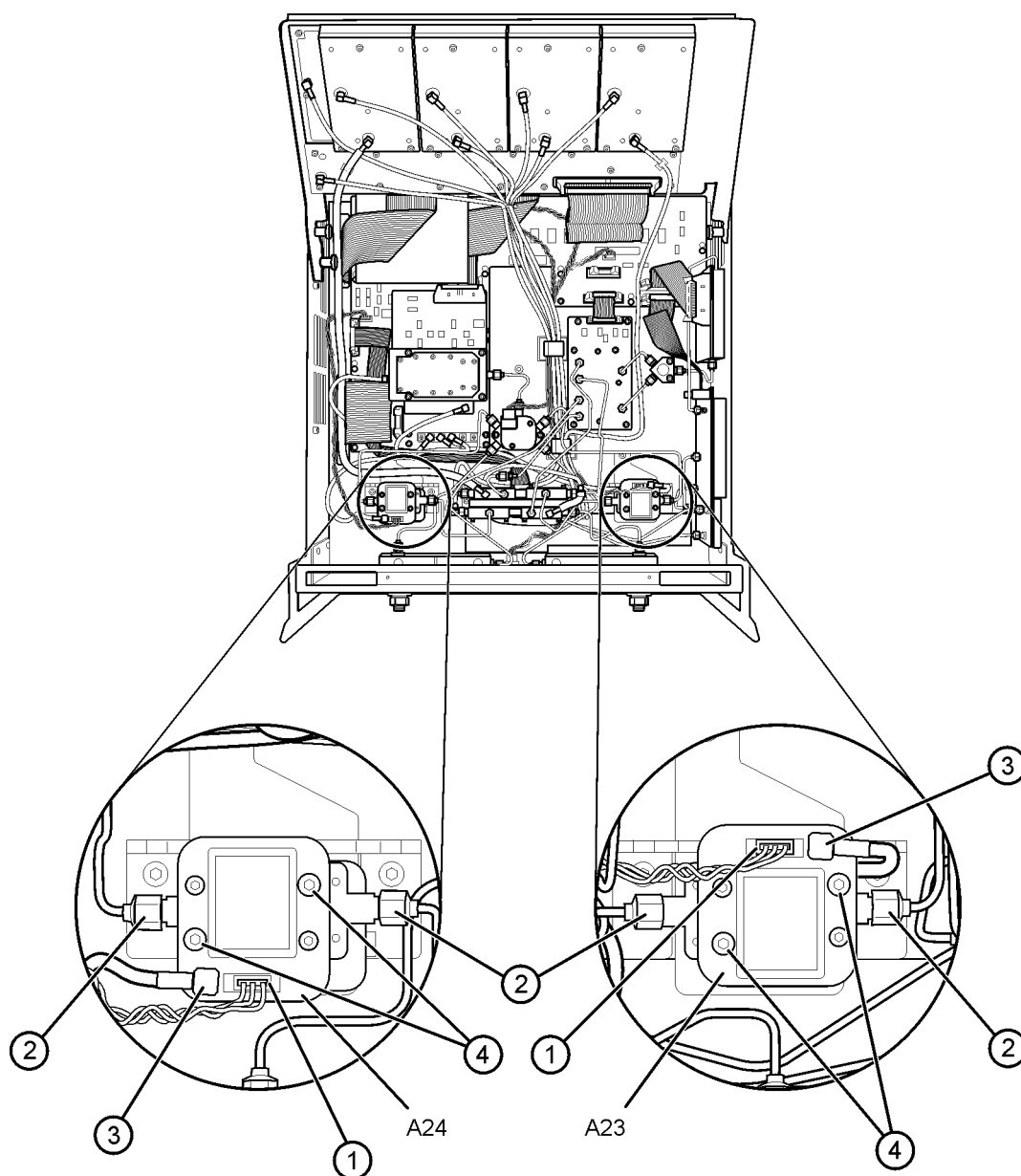
CAUTION	Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend the semirigid cables.
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8. Remove the detector from the analyzer. Observe the **CAUTION** above.

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 7-70](#).

Figure 7-20 A23 and A24 Detectors Removal (E8363A and E8364A Only)



st551a

Removing and Replacing the A25 and A26 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)
- 1-inch open-end torque wrench (set to 72 in-lb)
- ESD grounding wrist strap

Removal Procedure

Refer to [Figure 7-21](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to [“Removing the Covers” on page 7-6](#). Position the analyzer bottom side up and raise the receiver deck as shown. Refer to [“Raising and Removing the Receiver Deck” on page 7-8](#) if necessary.
3. Identify the test port coupler to be removed.
4. With a 5/16-inch torque wrench, disconnect the two semirigid cables (item ①) from the test port coupler.
5. With a 1-inch torque wrench, remove the test port coupler nut (item ②) from the front panel.

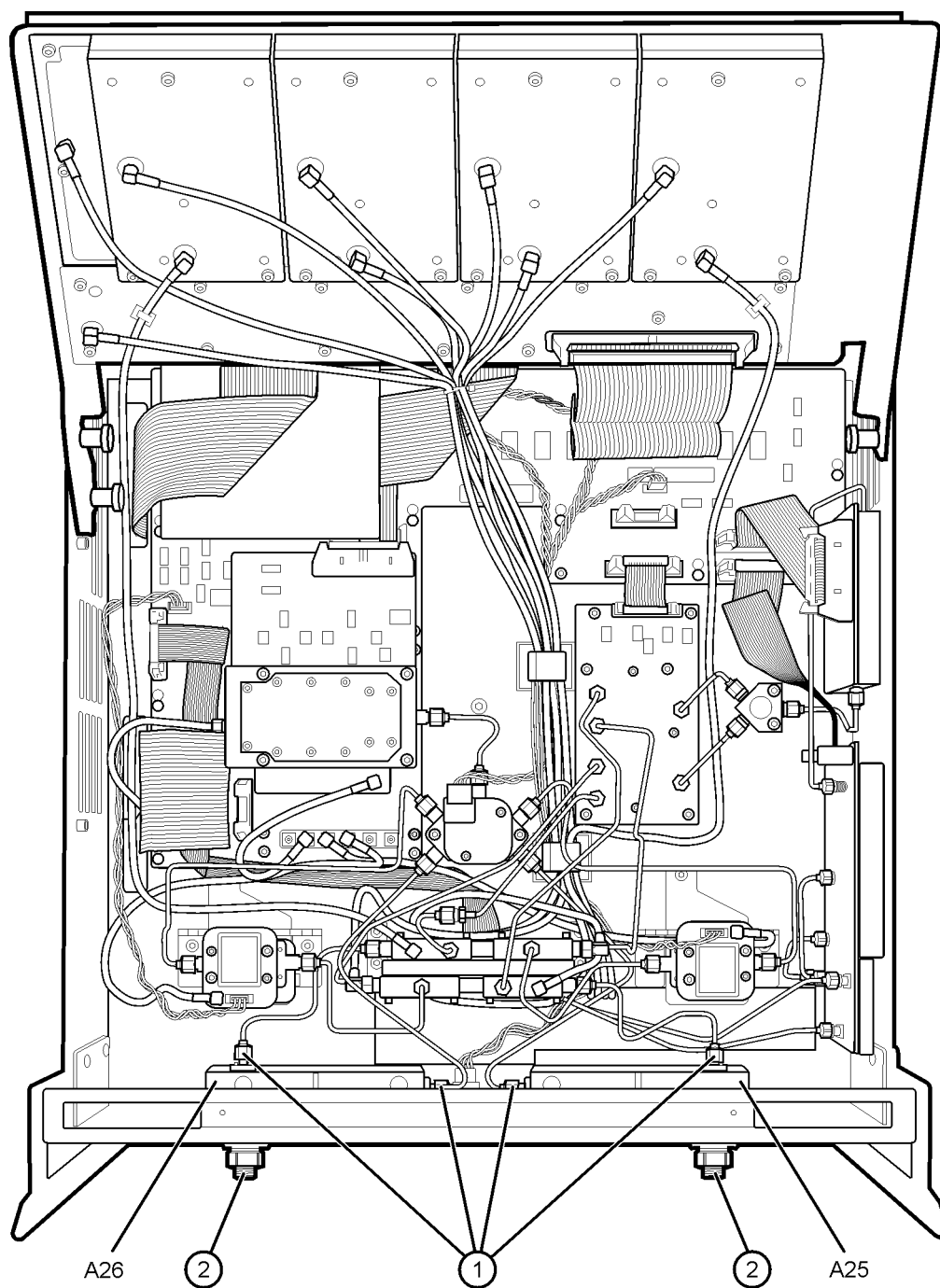
CAUTION	Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend the semirigid cables.
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6. Remove the test port coupler from the analyzer. Observe the **CAUTION** above.

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 7-70](#).

Figure 7-21 A25 and A26 Test Port Couplers Removal



st552a

Removing and Replacing the A27, A28, A29, and A30 First Converters (Mixers) and Mixer Bias Board

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 7-21](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to [“Removing the Covers” on page 7-6](#). Position the analyzer bottom side up and raise the receiver deck as shown. Refer to [“Raising and Removing the Receiver Deck” on page 7-8](#) if necessary.
3. With a 5/16-inch torque wrench, disconnect the eight semirigid cables (item ①) and the four flexible cables (item ②) from the first converters.

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 them.
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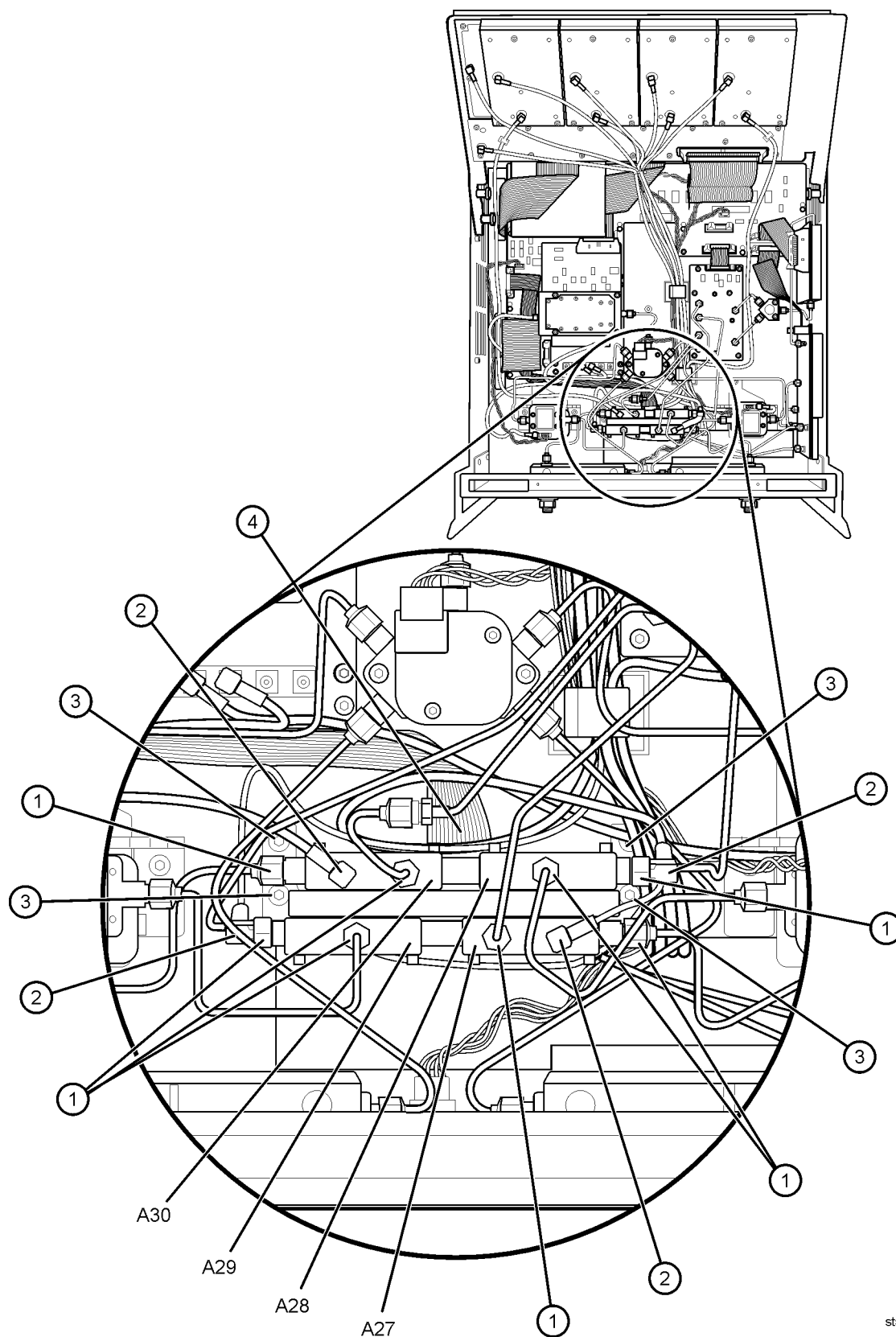
4. With a T-10 TORX driver, remove the four mounting screws (item ③).
5. Remove the mixer bracket and disconnect the ribbon cable (item ④).
6. *If replacing a first converter (mixer):*
 - a. Remove the defective mixer from the bracket by removing the attachment screws.
 - b. Install the new mixer onto the bracket using the attachment screws from the mixer that was removed. Be careful to properly align the DC connection pins.

If replacing the mixer bias board:

 - a. Remove all four mixers from the bracket by removing the attachment screws.
 - b. Remove the mixer bias board by removing the attachment screw.
 - c. Install the new mixer bias board onto the bracket by installing the attachment screw from the old mixer bias board.
 - d. Reinstall the four mixers using their original attachment screws. Be careful to properly align the DC connection pins.

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 7-70](#).

Figure 7-22 A27, A28, A29, and A30 First Converters (Mixers) Removal

st553a

Removing and Replacing the A31, A32, A33, and A34 Receiver Modules

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

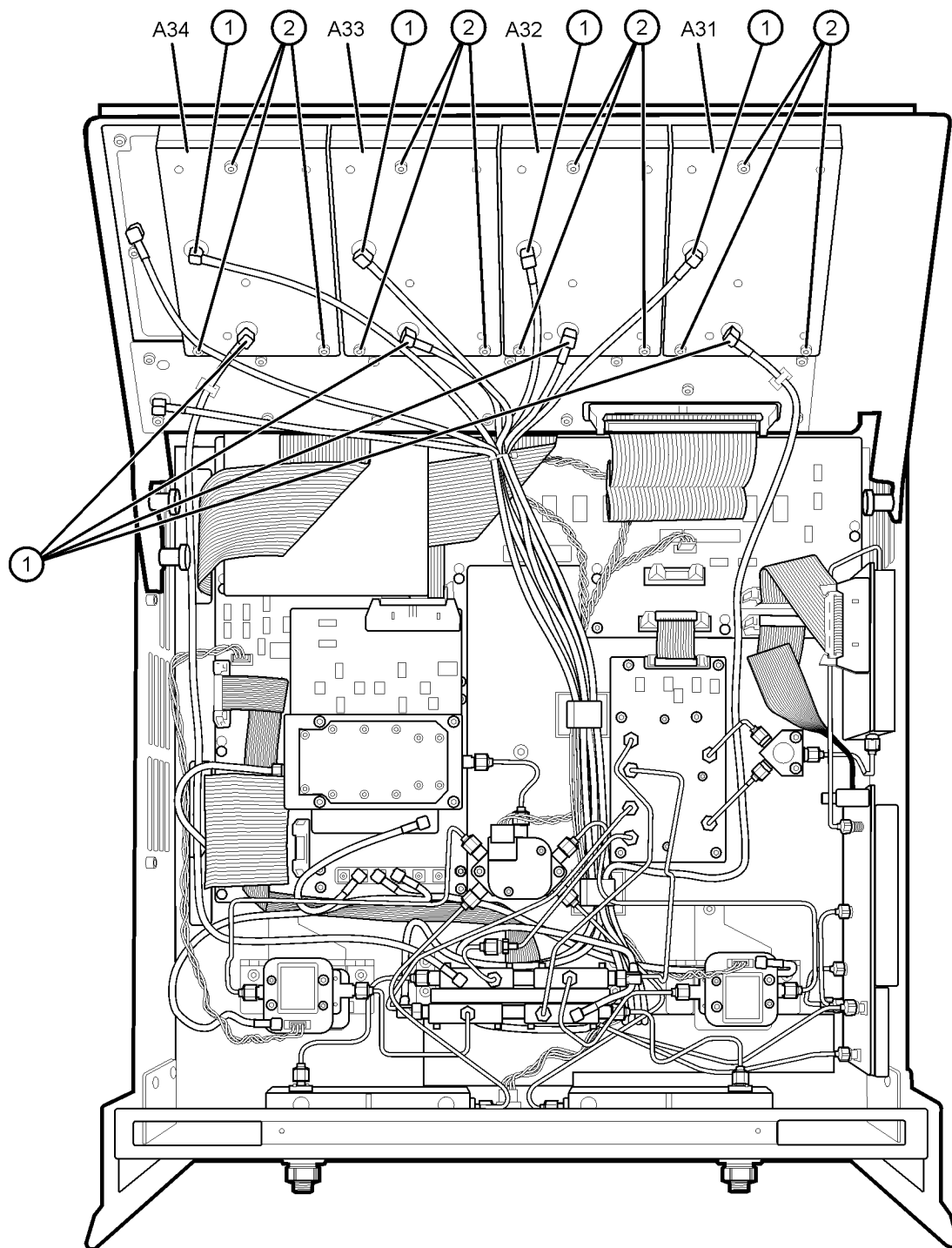
Refer to [Figure 7-23](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to [“Removing the Covers” on page 7-6](#). Position the analyzer bottom side up and raise the receiver deck as shown. Refer to [“Raising the Receiver Deck” on page 7-8](#) if necessary.
3. Identify the receiver module to be removed.
4. Disconnect the two flexible cables (item ①) from the appropriate receiver module.
5. With a T-10 TORX driver, remove the three mounting screws (item ②) from the appropriate receiver module.
6. Remove the receiver module 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 7-70](#).

Figure 7-23 A31, A32, A33, and A34 Receiver Modules Removal



st554a

Removing and Replacing the A35 Receiver Motherboard

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

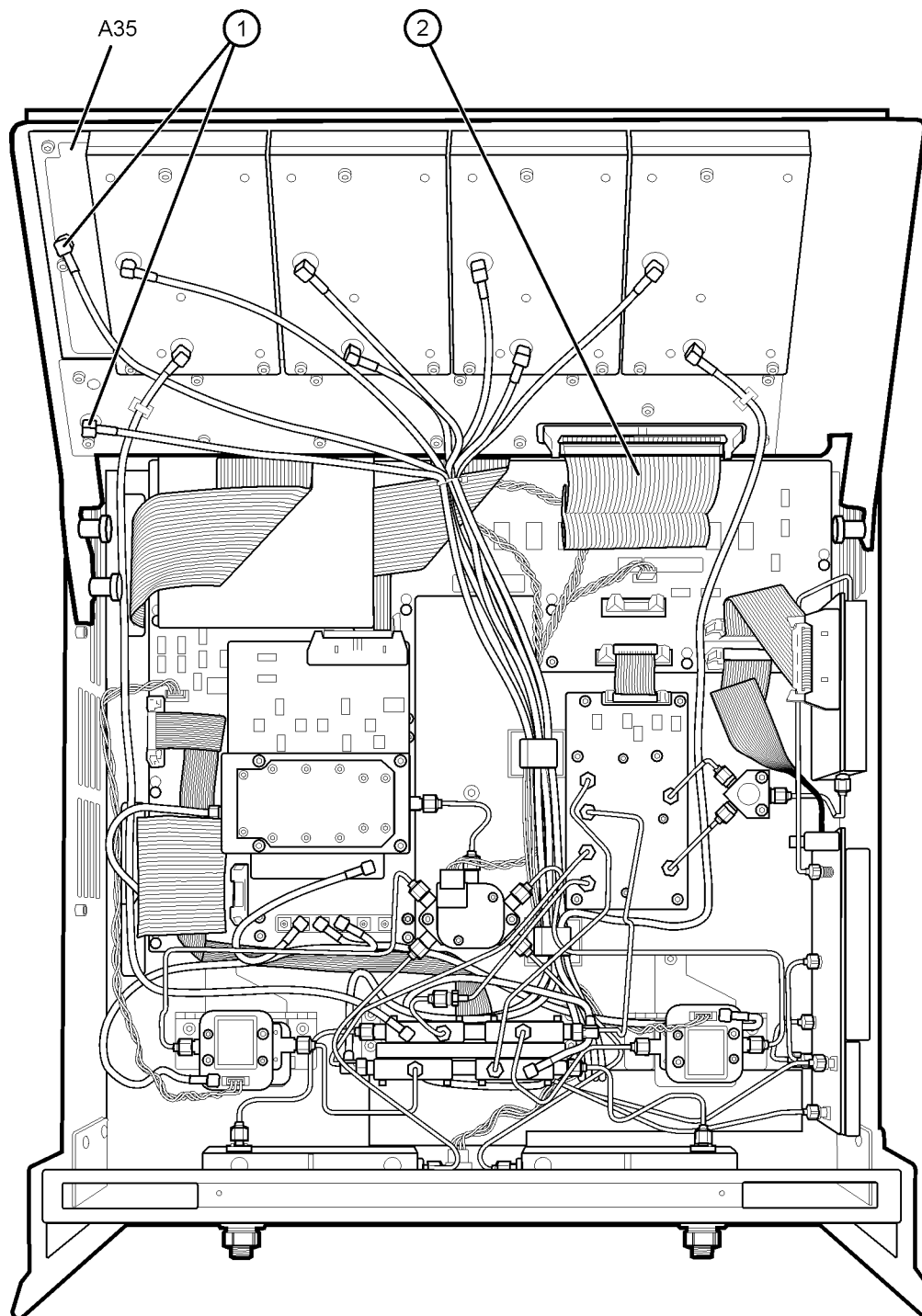
Refer to [Figure 7-12](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer covers. Refer to [“Removing the Covers” on page 7-6](#). Position the analyzer bottom side up and raise the receiver deck as shown. Refer to [“Raising the Receiver Deck” on page 7-8](#) if necessary.
3. Remove all four receiver modules. Refer to [“Removing and Replacing the A31, A32, A33, and A34 Receiver Modules” on page 7-50](#).
4. Disconnect the two flexible cables (item ①) from the receiver motherboard.
5. Disconnect the ribbon cable (item ②) from the receiver motherboard.
6. Remove the receiver deck from the analyzer with the receiver motherboard attached. Refer to [“Removing the Receiver Deck” on page 7-8](#), if necessary. The receiver motherboard and receiver deck are replaced as one unit.

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 7-70](#).

Figure 7-24 A35 Receiver Motherboard Removal



st555a

Removing and Replacing the A36 and A37 60-dB Step Attenuators (Option UNL)

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 7-25](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to [“Removing the Covers” on page 7-6](#). Position the analyzer bottom side up and raise the receiver deck as shown. Refer to [“Raising the Receiver Deck” on page 7-8](#) if necessary.
3. Identify the step attenuator to be removed. To replace the attenuator, the bracket holding the attenuator, detector (E8363A/E8364A) or fixed pad (E8362A)), and bias tee must be removed.
4. Disconnect the ribbon cable (item ①) from the appropriate attenuator.
5. With a 5/16-inch torque wrench, disconnect the two semirigid cables (item ②) from the appropriate step attenuator, two semirigid cables (item ③) from the detector (or fixed pad), and two semirigid cables (item ④) from the bias tee.
6. Disconnect the stranded control cable (item ⑤) and the flexible cable (item ⑥) from the appropriate detector (E8363A/E8364A only) and the stranded bias tee cable (item ⑦) from A16 test set motherboard. (Release the bias tee cable such that it can be removed with the bias tee.)
7. With a T-10 TORX driver, remove the three mounting screws (item ⑧) from the bracket holding the attenuator, detector (or fixed pad), and bias tee.

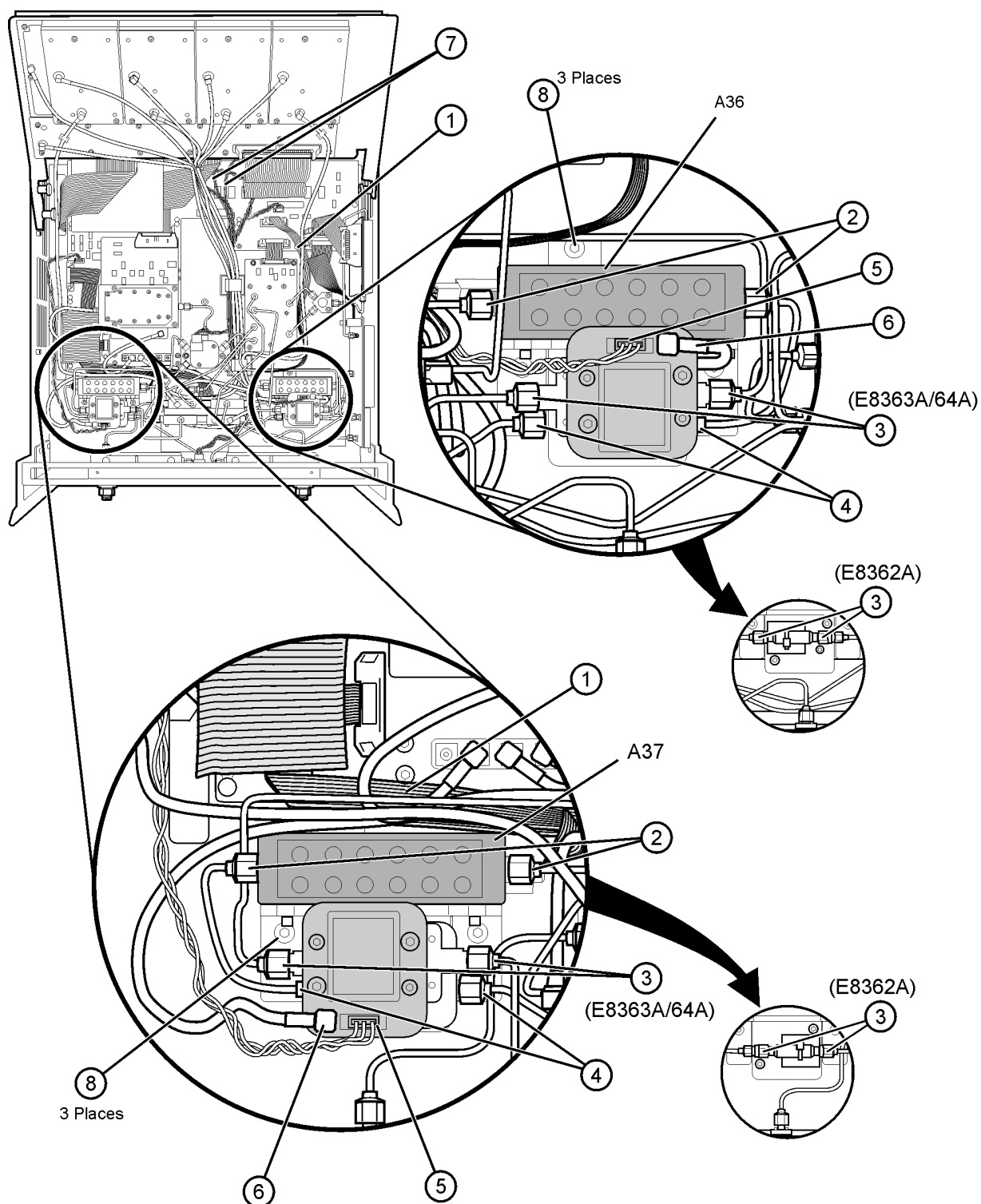
CAUTION	Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend the semirigid cables.
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8. Remove the bracket from the analyzer with the attenuator, detector (or fixed pad), and bias tee attached. Observe the **CAUTION** above.
9. Remove the attenuator from the bracket and install the new attenuator.

Replacement Procedure

1. Reverse the order of the removal procedure using the existing attenuator ribbon cable.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-70](#).

Figure 7-25 A36 and A37 60-dB Step Attenuators Removal (Option UNL)



st556a

Removing and Replacing the A38 and A39 Bias Tees (Option UNL)

Tools Required

- T-8 TORX driver (set to 5 in-lb)
- 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 7-25](#) for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to [“Removing the Covers” on page 7-6](#). Position the analyzer bottom side up and raise the receiver deck as shown. Refer to [“Raising the Receiver Deck” on page 7-8](#) if necessary.
3. Identify the bias tee to be removed. To replace the bias tee, the bracket holding the attenuator, detector (E8363A/E8364A) or fixed pad (E8362A), and bias tee must be removed.
4. Disconnect the ribbon cable (item ①) from the appropriate attenuator.
5. With a 5/16-inch torque wrench, disconnect the two semirigid cables (item ②) from the appropriate step attenuator, two semirigid cables (item ③) from the detector (or fixed pad), and two semirigid cables (item ④) from the bias tee.
6. Disconnect the stranded control cable (item ⑤) and the flexible cable (item ⑥) from the appropriate detector (E8363A/E8364A only) and the stranded bias tee cable (item ⑦) from A16 test set motherboard. (Release the bias tee cable such that it can be removed with the bias tee.)
7. With a T-10 TORX driver, remove the three mounting screws (item ⑧) from the bracket holding the attenuator, detector (or fixed pad), and bias tee.

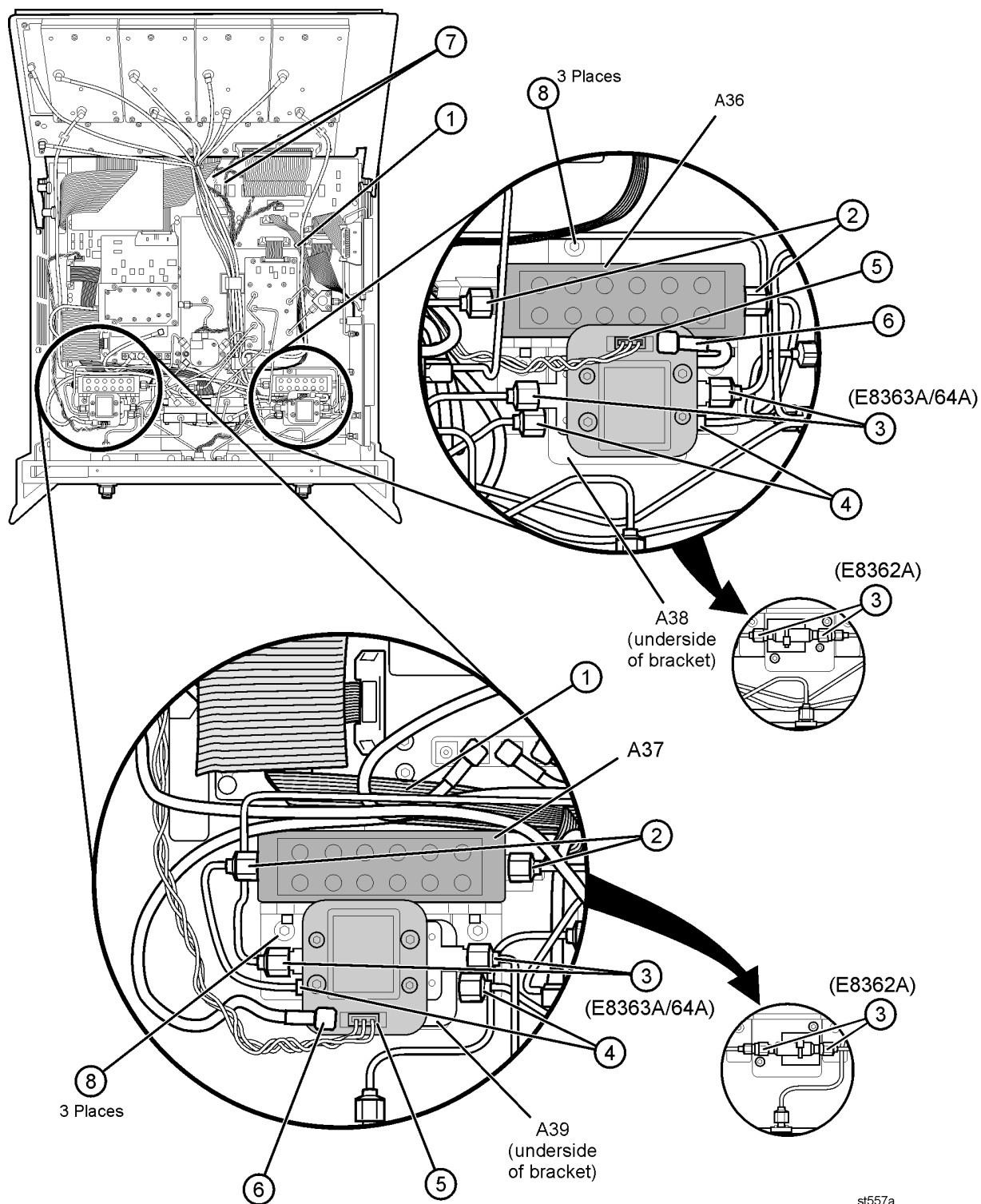
CAUTION Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove the assembly. Do not over-bend them.

8. Remove the bracket from the analyzer with the attenuator, detector (or fixed pad), and bias tee attached. Observe the **CAUTION** above.
9. Remove the old bias tee from the bracket and, using a T-8 TORX driver, install the new bias tee with cable.

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 7-70](#).

Figure 7-26 A38 and A39 Bias Tees Removal (Option UNL)



st557a

Removing and Replacing the A40 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

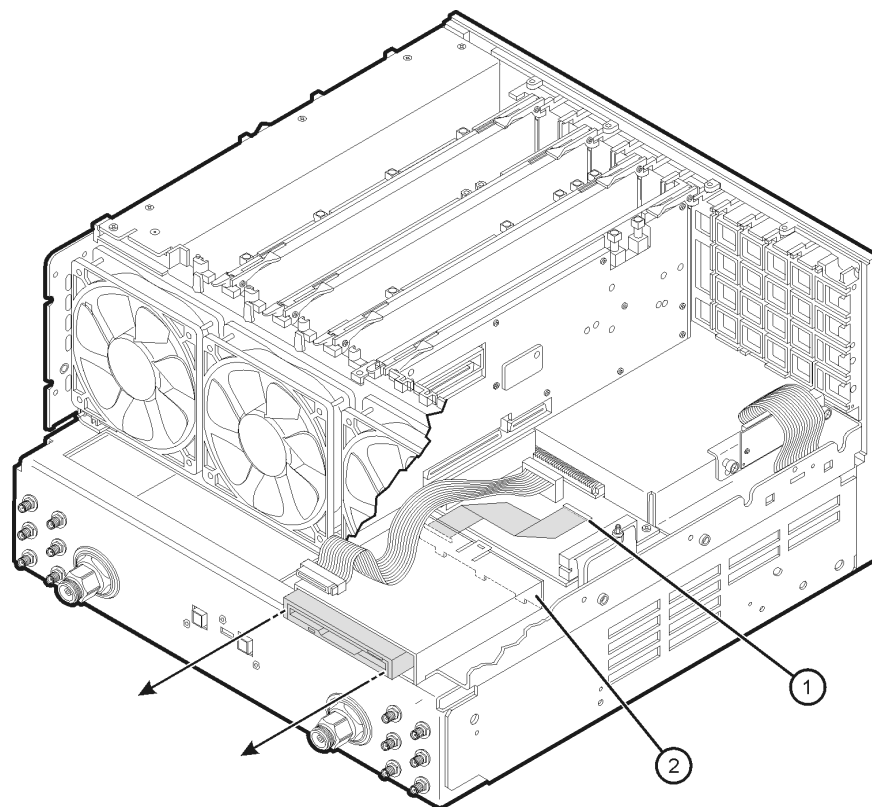
Refer to [Figure 7-27](#) and [Figure 7-28](#) for this procedure.

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 7-10](#).
4. Remove the A12 source 20. Refer to [“Removing and Replacing the A12 Source 20” on page 7-22](#).
5. Disconnect the ribbon cable (item ①) from the A14 system motherboard.
6. Lift the tab at the rear of the A40 floppy disk drive enclosure and remove the rear enclosure cover (item ②).
7. Slide the A40 floppy disk drive out of the front of the enclosure. The A40 floppy disk drive fits snugly. You may have to push the drive from the back to remove it from the analyzer.

Replacement Procedure

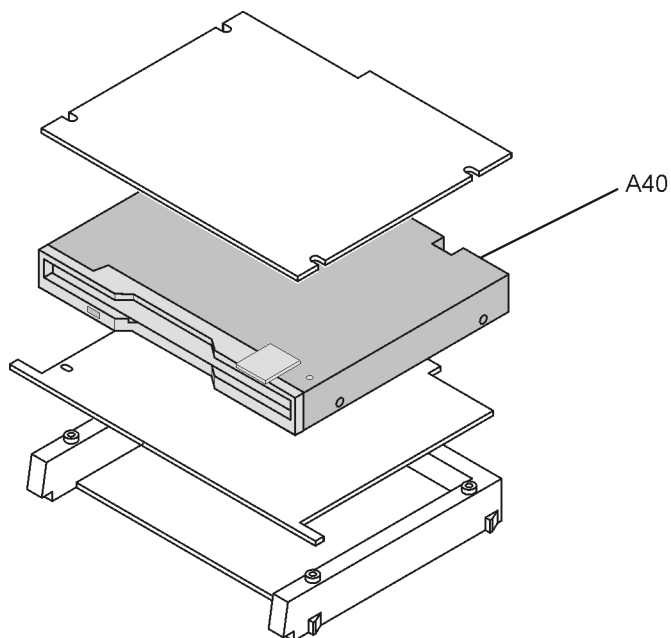
1. Reverse the order of the removal procedure using the existing ribbon cable (item ①).
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table 7-2 on page 7-70](#).

Figure 7-27 A40 Floppy Disk Drive Removal



st558a

Figure 7-28 A40 Floppy Disk Drive (Exploded View)



st559a

Removing and Replacing the A41 Hard Disk Drive

Certain unique files exist on the hard disk drive that are necessary for proper operation of your analyzer. These files must be copied to another location to allow them to be installed onto the new hard disk drive after it has been installed.

If you are replacing the hard disk, not just removing the hard disk drive assembly (HDDA) to allow access to other assemblies, the following procedure must be performed first.

If you are not replacing the actual hard disk, proceed to [“Tools Required” on page 7-61](#).

Copy Unique Files from the Hard Disk

The files to be copied include:

- license file (gen.lic)
- mixer calibration files (mxcalfiles_pxx)
- user calibration kit file (user_calkitfile)
- any user data files or program files that need to be preserved

The network analyzer must be powered up and operating for this procedure.

1. Insert a writable floppy disk into the floppy disk drive.
2. Open two copies of **Windows Explorer**:
 - a. Click on **START**. (It may be necessary to exit the **Network Analyzer** application.)
 - b. Point to **Programs, Accessories**, and then click on **Windows Explorer**.
 - c. Adjust the horizontal width of the **Windows Explorer** window to approximately one-half the width of the display and position it to either the left or right side of the display.
 - d. Repeat this procedure to create another copy of the **Windows Explorer** window and position it to the opposite side of the display so that the two copies are displayed side-by-side.
3. Set one copy of **Windows Explorer** to the **A:** drive and the other to the **C:** drive:
 - a. In one copy of **Windows Explorer**, double-click on **My Computer**, and then double-click on **3 1/2 Floppy (A:)**. A listing of the files on the floppy disk will appear in the right-hand side of the window.
 - b. In the other copy of **Windows Explorer**, double-click on **My Computer**, and then double-click on **Hard Disk (C:)**.
 - c. Navigate to C:\Program Files\Agilent\Network Analyzer by double-clicking on each of the names in this path name, in turn. A listing of the files in this directory on the hard disk will appear in the right-hand side of the window.
4. Copy each of the following files from the hard disk drive to the floppy disk drive:
 - a. Files to copy:
gen.lic user_calkitfile mxcalfile_pxx (where xx is a 1 or 2 digit number)
Any personal user files that you wish to preserve.

- b. Click and drag each of the files on the C: drive from the C:\Program Files\Agilent\Network Analyzer directory by clicking and holding on the file name in the directory and, while holding the mouse button down, drag the file name to the A: drive. If you need help with this “dragging” process, refer to Windows Help. (Click **START, HELP**. Click on the **Index** tab and type **dragging** in the dialog box.)
5. After all files have been copied, remove the floppy disk from the analyzer’s disk drive and exit both copies of **Windows Explorer**.

Tools Required

- T-10 TORX driver (set to 4 in-lb; for hard disk drive replacement)
- T-10 TORX driver (set to 7 in-lb; for hard disk drive replacement)
- T-10 TORX driver (set to 9 in-lb; for all other T-10 applications)
- T-20 TORX driver (set to 21 in-lb)
- ESD grounding wrist strap

Overview of Procedures

There are two procedures related to removing and replacing the hard disk drive assembly (HDDA):

Removing the HDDA

Disconnect and remove the HDDA from the analyzer so that the following assemblies may be serviced.

- A14 system motherboard
- A16 test set motherboard
- A41 hard disk drive

Disassembling the HDDA

This procedure outlines how to disassemble the HDDA, once it has been removed from the analyzer, to replace the A41 hard disk drive.

Removal Procedure

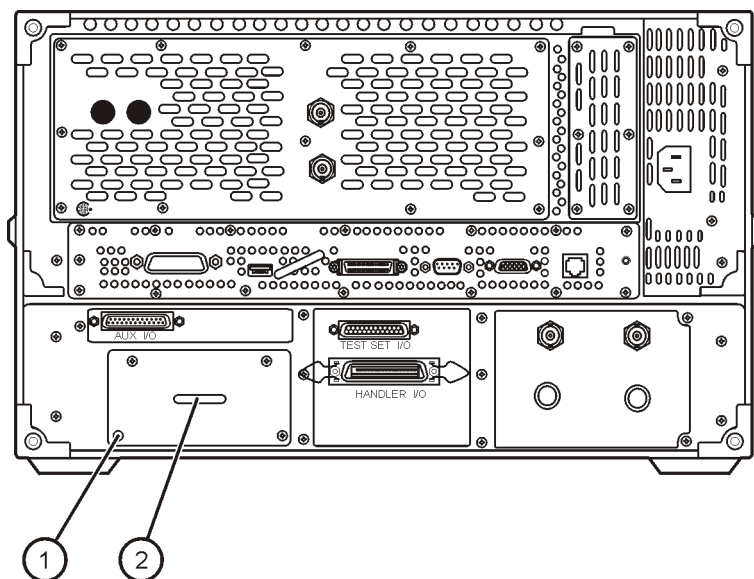
1. Disconnect the power cord.

Removing the HDDA

Refer to [Figure 7-29](#) for this procedure.

1. With a T-10 TORX driver, loosen the four HDDA mounting screws (item ①) on the rear panel.
2. Remove the HDDA from the analyzer by pulling on the finger grip (item ②). The HDDA interconnects with a connector inside the analyzer rear panel so moderate force may be necessary to disengage this connector.

Figure 7-29 Hard Disk Drive Assembly Removal



st560a

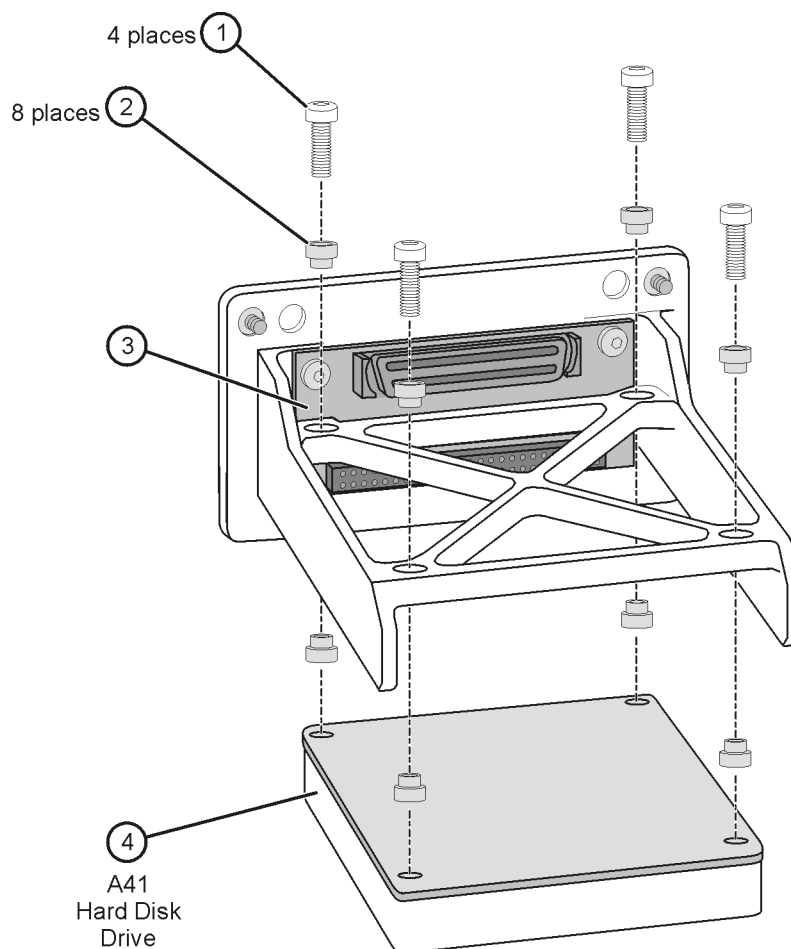
Disassembling the HDDA

IMPORTANT When replacing the hard disk, first torque all four screws (item ③) to 4 in-lb, then secure each to 7 in-lb with a T-10 TORX driver.

Refer to [Figure 7-30](#).

1. Remove the hard disk drive assembly from the analyzer. Refer to [“Removing the HDDA” on page 7-62](#).
2. With a T-10 TORX driver, remove the four screws (item ①), and the eight bushings (item ②), that mount the hard disk (item ④), to the bracket.
3. Disconnect the hard disk (item ④) from the interface board (item ③).

Figure 7-30 Hard Disk Drive Assembly (Exploded View)



st561a

Replacement Procedure

WARNING When connecting the hard disk (item ③ in [Figure 7-30](#)) to the interface board, take special care to align the connector pins. Applying power to a misaligned connection can permanently damage the hard disk drive.

IMPORTANT When installing the hard disk, first torque all four mounting screws (item ① in [Figure 7-30](#)) to 4 in-lb with a T-10 TORX driver. Then secure each screw to 7 in-lb with a T-10 TORX driver.

Installing the New A41 Hard Disk Drive

Refer to [Figure 7-30 on page 7-63](#).

1. With the disk drive bracket right-side up (it is shown upside down in [Figure 7-30 on page 7-63](#)), insert four bushings (item ②) into the four holes in the bracket.
2. Connect the new hard disk drive (item ④) to the interface board (item ③) by pushing it firmly into the connector on the interface board. Refer to the **WARNING** above.
3. While holding the disk drive in place, turn the bracket over and insert the other four bushings (item ②), into the other side of the same four holes specified in step 1.
4. Install the four screws (item ①), finger tight, through the eight bushings (item ②), to attach the hard disk drive to the bracket.

With a T-10 TORX driver, torque the four screws, in a Z-pattern, to 4 in-lb, and then torque them again, in the same pattern, to 7 in-lb. Refer to the **IMPORTANT** note above.

Reinstalling the HDDA

Refer to [Figure 7-29 on page 7-62](#).

1. Slide the hard disk drive assembly into the slot in the rear panel and push it firmly into place to engage the connector.
2. With a T-10 TORX driver, tighten the four HDDA mounting screws (item ①).

Install Backup Files onto the New Hard Disk Drive

The files that were saved onto a floppy disk in Step 1 must now be installed onto the new hard disk drive for the analyzer to operate properly.

The network analyzer must be powered up and operating for this procedure.

1. Insert the floppy disk containing the backup files into the floppy disk drive.
2. Open two copies of **Windows Explorer**:
 - a. Click on **START**. (It may be necessary to exit the **Network Analyzer** application.)
 - b. Point to **Programs, Accessories**, and then click on **Windows Explorer**.

- c. Adjust the horizontal width of the **Windows Explorer** window to approximately one-half the width of the display and position it to either the left or right side of the display.
 - d. Repeat this procedure to create another copy of the **Windows Explorer** window and position it to the opposite side of the display so that the two copies are displayed side-by-side.
3. Set one copy of **Windows Explorer** to the **A:** drive and the other to the **C:** drive:
 - a. In one copy of **Windows Explorer**, double-click on **My Computer**, and then double-click on **3 1/2 Floppy (A:)**. A listing of the files on the floppy disk will appear in the right-hand side of the window.
 - b. In the other copy of **Windows Explorer**, double-click on **My Computer**, and then double-click on **Hard Disk (C:)**.
 - c. Navigate to C:\Program Files\Agilent\Network Analyzer by double-clicking on each of the names in this path name, in turn. A listing of the files in this directory on the hard disk will appear in the right-hand side of the window.
4. Copy each of the backup files from the floppy disk to the hard disk drive:
 - a. Click and drag each of the files from the **A:** drive to the C:\Program Files\Agilent \Network Analyzer directory by clicking and holding on the file name in the **A:** directory and, while holding the mouse button down, drag the file name to the Network Analyzer directory on the **C:** drive. If you need help with this “dragging” process, refer to Windows Help. (Click **START**, **HELP**. Click on the **Index** tab and type **dragging** in the dialog box.)
5. After all files have been copied, remove the floppy disk from the analyzer’s disk drive and exit both copies of **Windows Explorer**.

Set Up the Agilent Administrator Password

If the hard disk has been replaced, it is necessary to set up the Agilent administrator password for the analyzer. This requires obtaining a password from Agilent:

Obtaining a Password

- If this procedure is being performed by Agilent personnel, go to the following Internet site and follow the instructions under “Agilent Administrator Password.”
<http://mktwww.soco.agilent.com/field/service/network/pna/support.htm>
- If this procedure is being performed by non-Agilent personnel, contact Agilent for a password before beginning this procedure. Refer to “[Contacting Agilent](#)” on page 2-9.

Entering Your Agilent Administrator Password

The network analyzer must be powered up and operating for this procedure.

1. Exit the Network Analyzer program, if it is running.
2. On the **Windows Desktop**, right-click on **My Computer**, and then click **Manage**.
3. In the **Computer Management** window, navigate to **System Tools, Local Users and Groups, Users**.

4. Right-click on **Agilent**, and then click on **Set Password**.
 - a. Type the password obtained from Agilent as the **Password**. Refer to [“Obtaining a Password” on page 7-65](#) for information if you have not yet obtained this password.
 - b. Type the password again in the **Confirm password** block.
 - c. Click **OK**.
5. Right-click on **Agilent**, and then click on **Properties**.
 - a. Unselect **User must change password at next logon** (if not already unselected).
 - b. Unselect **User cannot change password** (if not already unselected).
 - c. Select **Password never expires** (if not already selected).
 - d. Click **OK**.
6. Close the **Computer Management** window.

Post-Repair Procedures

Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to [Table on page 7-70](#).

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 front panel assembly. Refer to [“Removing and Replacing the Front Panel Assembly” on page 7-10](#).
3. Remove the outer and inner covers. Refer to [“Removing the Covers” on page 7-6](#).
4. On the bottom side of the analyzer, remove the A27–A30 first converters (mixers). This is necessary to gain access to one of the midweb mounting screws. Refer to [“Removing and Replacing the A27, A28, A29, and A30 First Converters \(Mixers\) and Mixer Bias Board” on page 7-48](#).
5. Remove the A12 source 20. Refer to [“Removing and Replacing the A12 Source 20” on page 7-22](#).
6. Remove the A11 phase lock board. Refer to [“Removing and Replacing the A11 Phase Lock Board” on page 7-20](#).
7. Remove the A4 power supply assembly. Refer to [“Removing and Replacing the A4 Power Supply Assembly” on page 7-16](#).
8. Remove the card cage boards (A6, A8, and A10). Refer to [“Removing and Replacing the A6, A8, and A10 Boards” on page 7-18](#).

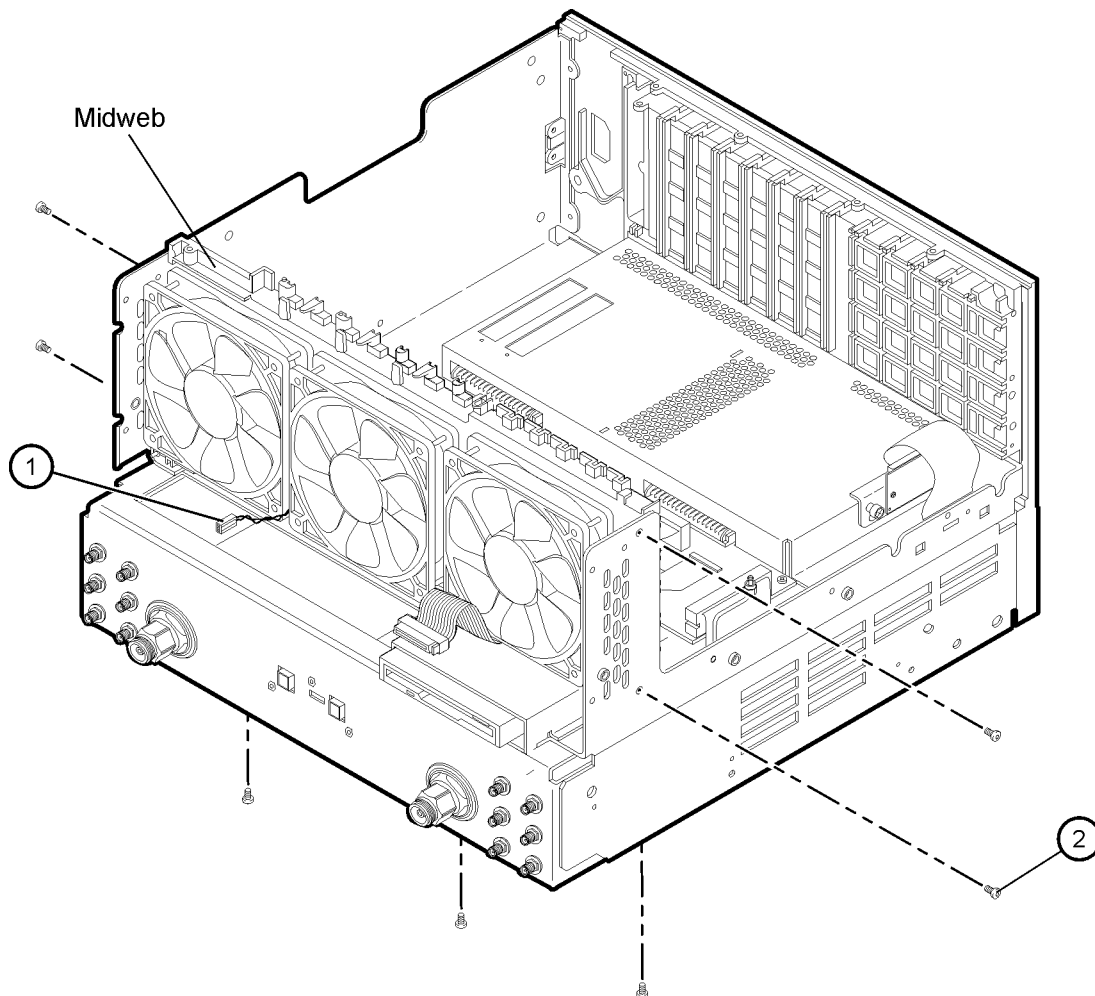
NOTE	This procedure has two parts: removing the midweb and removing the fan from the midweb. You must remove the midweb before removing the fan.
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Removing the Midweb

Refer to [Figure 7-31](#).

1. Disconnect the power cable (item ①) for the three fans from the A14 system motherboard.
2. With a T-10 TORX driver, remove the seven midweb mounting screws (item ②). Lift out the midweb.

Figure 7-31 Midweb Removal



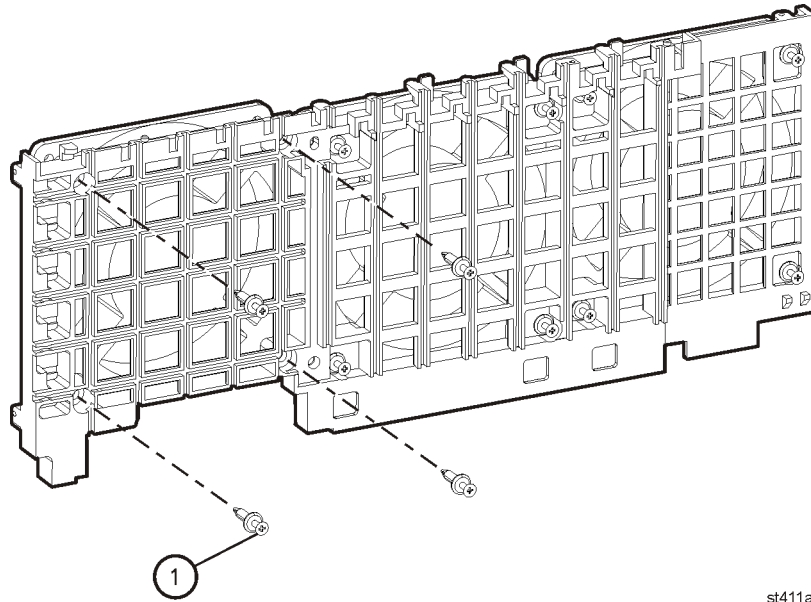
st562a

Removing the Fan

Refer to [Figure 7-32](#).

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 ①) 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 7-32 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 7-70](#).

Post-Repair Procedures

After the replacement of an assembly, you must perform the service procedures in the order listed in [Table 7-2](#).

Procedures referenced in this table are located in Chapter 3, “Tests and Adjustments,” unless specified otherwise.

Table 7-2 Related Service Procedures

Replaced Assembly	Adjustments and Other Procedures	Verification, Performance, and Other Tests and Procedures
A1 keypad assembly	No adjustment needed	A1 Front Panel Keypad and RPG Test in Chapter 4
A2 display assembly	No adjustment needed	A2 Display Test in Chapter 4
A3 front panel interface board	No adjustment needed	A1 Front Panel Keypad and RPG Test and A2 Display Test in Chapter 4
A4 power supply assembly	No adjustment needed	None needed
A6 SPAM board	No adjustment needed	Noise Floor Test Trace Noise Test System Crosstalk Test
A8 fractional-N synthesizer board	LO Power Adjustment	Frequency Accuracy Test The Operator’s Check
A10 frequency reference board	10 MHz Frequency Reference Adjustment Restore option data (Refer to “ Repairing and Recovering Option Data ” in Appendix B .)	Frequency Accuracy Test
A11 phase lock board	No adjustment needed	Frequency Accuracy Test
A12 source 20	3.8 GHz PMYO Frequency Adjustment Source Calibration Adjustment	Source Power Accuracy Test Source Power Linearity Test Frequency Accuracy Test
A14 system motherboard	No adjustment needed	A1 Front Panel Keypad and RPG Test and A2 Display Test in Chapter 4 The Operator’s Check
A15 CPU board	No adjustment needed	The Operator’s Check

Table 7-2 Related Service Procedures (Continued)

Replaced Assembly	Adjustments and Other Procedures	Verification, Performance, and Other Tests and Procedures
A16 test set motherboard	Reinstall the serial number. (Refer to “Installing or Changing a Serial Number” in Appendix B.) Reinstall hardware options. (Refer to “Installing or Removing Options” in Appendix B.)	The Operator’s Check System Crosstalk Test
A17 LOMA 10	LO Power Adjustment	Frequency Accuracy Test The Operator’s Check
A18 MA 20	LO Power Adjustment	Frequency Accuracy Test The Operator’s Check
A19 splitter	LO Power Adjustment	The Operator’s Check
A20 LODA	LO Power Adjustment	The Operator’s Check
A21 SOMA 50 (E8363A/E8364A only)	Source Calibration Adjustment	Source Power Accuracy Test Source Power Linearity Test Frequency Accuracy Test
A22 switch splitter	Source Calibration Adjustment	Source Power Accuracy Test Source Power Linearity Test Receiver Compression Test Calibration Coefficient Test
A23 and A24 detectors (E8363A/E8364A only) or 30-dB fixed attenuators (E8362A only)	Source Calibration Adjustment	Source Power Accuracy Test Source Power Linearity Test Receiver Compression Test Calibration Coefficient Test
A25 and A26 test port couplers	Source Calibration Adjustment	Source Power Accuracy Test Source Power Linearity Test Receiver Compression Test Calibration Coefficient Test
A27, A28, A29, and A30 first converters (mixers)	Receiver Calibration Adjustment	Receiver Compression Test Noise Floor Test Calibration Coefficient Test System Crosstalk Test Dynamic Accuracy Test

Table 7-2 Related Service Procedures (Continued)

Replaced Assembly	Adjustments and Other Procedures	Verification, Performance, and Other Tests and Procedures
A31, A32, A33, and A34 receiver modules	Receiver Calibration Adjustment	Receiver Compression Test Noise Floor Test Calibration Coefficient Test System Crosstalk Test Dynamic Accuracy Test
A35 receiver motherboard	Receiver Calibration Adjustment	The Operator's Check
A36 and A37 60-dB step attenuators	Source Calibration Adjustment	Source Power Accuracy Test Source Power Linearity Test Receiver Compression Test Calibration Coefficient Test
A38 and A39 bias tees	Source Calibration Adjustment	Source Power Accuracy Test Source Power Linearity Test Receiver Compression Test Calibration Coefficient Test
A40 floppy disk drive	No adjustment needed	Read and write to the drive
A41 hard disk drive	Restore previously saved receiver calibration data ^a (or perform Receiver Calibration Adjustment)	Read and write to the drive
B1 fan	No adjustment needed	Check for fan operation

- a. If a backup copy of receiver calibration data from the faulty disk drive is available, it can be copied to the new disk drive. If not, new data must be generated by performing the "Receiver Calibration Adjustment."

If the replacement procedure in this chapter has been followed, then this has already been done.

A Error Terms

Information in This Appendix

Your PNA series network analyzer calculates error terms 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. The analyzer calculates and stores these differences as error terms. These error terms are then removed from subsequent measurements when error correction is on.

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

Appendix A at-a-Glance

Section Title	Summary of Content	Start Page
Using Error Terms as a Diagnostic Tool	How to use error terms as a preventive maintenance and troubleshooting tool.	Page A-3
Performing Measurement Calibration	Procedure for measurement calibration. <i>Measurement calibration must be performed before you can use error terms as a tool.</i>	Page A-4
Using Flowgraphs to Identify Error Terms	Flowgraphs of the error terms for 1 port and 2 port calibrations.	Page A-4
Accessing Error Terms	How to access error terms either manually or programmatically using the analyzer front panel or SCPI and COM/DCOM commands.	Page A-6
Error Term Data	Typical values of the error terms of your analyzer. Included are: <ul style="list-style-type: none">• a table of typical values• typical response plots• typical assembly failures	Page A-8

Using Error Terms as a Diagnostic Tool

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

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 anomalies. 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 3-5](#) or to the calibration kit’s user’s and service guide.

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 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 A-1 on page A-9](#), or data trace plots that start in [“Error Term Data” on page A-8](#).

To find assemblies related to error term failures, refer to plot descriptions in [“Error Term Data” on page A-8](#). Each plot description lists common assemblies related to each error term. Identify the assembly and refer to [Chapter 4, “Troubleshooting.”](#)

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

Performing Measurement Calibration

A calibration must be performed to allow the analyzer to calculate the error terms before they can be used as a tool:

CAUTION Perform the following procedure only at a static-safe workstation, and wear a grounded wrist strap.

This is important. If not properly protected against, electrostatic discharge can seriously damage your analyzer, resulting in costly repair.

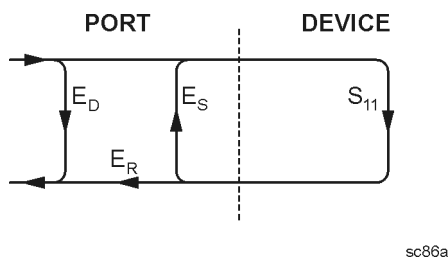
To reduce the chance of electrostatic discharge, follow all of the recommendations outlined in [“Electrostatic Discharge Protection” on page 1-5](#), when performing the following calibration.

1. Connect a type-N cable to Port 2.
2. Perform a full 2-port calibration, **FULL SOLT 2-Port**. Refer to embedded help in the analyzer if necessary.

Using Flowgraphs to Identify Error Terms

Flowgraphs are a graphical representation of signal flow through the measurement path. The flowgraphs in [Figure A-1](#) and [Figure A-2](#) illustrate the error terms associated with measurement calibration.

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



where:

E = Error term

Subscript:

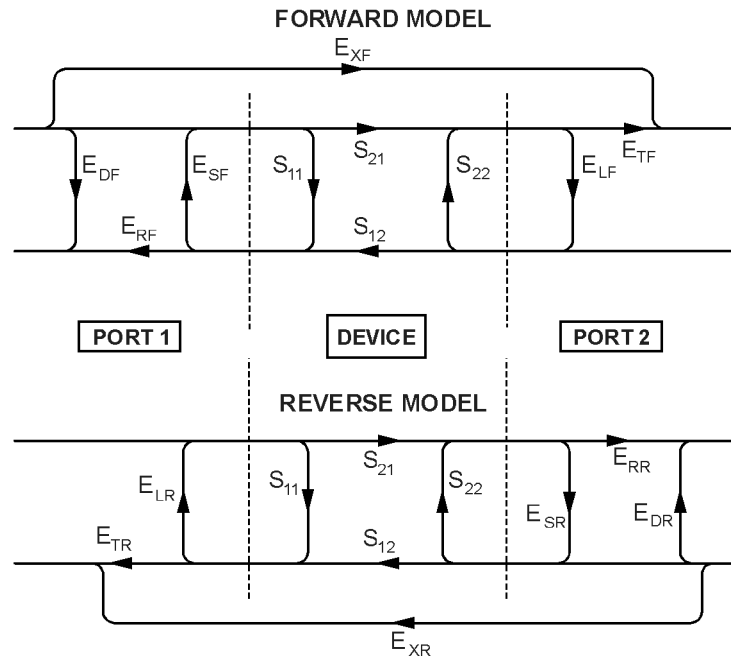
D = Directivity

S = Source Match

R = Reflection Tracking

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

Figure A-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

Error terms can be accessed either manually or programmatically:

Manually

- “Front Panel Access to Error Terms” on page A-6

Programmatically

- “GPIB Access to Error Terms” on page A-7
- “COM/DCOM Access to Error Terms” on page A-7

Manual Access to Error Terms

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. In the **System** menu, point to **Service, Utilities**, and then click **Cal Set Viewer**.
The **Cal Set Viewer** toolbar appears directly above the trace window.
2. In the **Cal Set** list, select the desired cal set.
3. Click the **Standards/ETerms** button to toggle between viewing the raw measurement data from the standard or the corrected error term data. Note that the title of the center box in the toolbar will toggle between **Standard** and **Error Term**.
4. In the **Standard** or **Error Term** list, select the standard or error term to view. Click the **View** check box.
5. Compare the displayed measurement trace to the equivalent data trace plots that start in “**Error Term Data**” on page A-8, to previously measured data, or to the uncorrected performance specifications listed in Table A-1 on page A-9.
6. Print numerical data or print a plot of the measurement results.

Programmatic Access to Error Terms

GPIB Access to Error Terms

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

For more information on GPIB and SCPI, refer to the embedded help in the analyzer. Type in keyword “errors, systematic” in the index.

COM/DCOM Access to Error Terms

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

For more information on COM and DCOM, refer to the embedded help in the analyzer. Type in keyword “errors, systematic” in the index.

Error Term Data

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

- a table of the 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 A-4](#).

IMPORTANT Data are listed here as a convenience. Detailed instrument specifications are listed in the embedded help in the network analyzer.

Table A-1 Error Term Data^a

Parameter	Frequency Range					
	45 MHz to 2 GHz	2 GHz to 10 GHz	10 GHz to 20 GHz	20 GHz to 40 GHz	40 GHz to 45 GHz	45 GHz to 50 GHz
Directivity	>24 dB	>22 dB	>16 dB	>16 dB	>15 dB	>13 dB
Source Match						
Standard	>23 dB	>16 dB	>14 dB	>10 dB	>9 dB	>5.5 dB
Option UNL, 014, or UNL & 014	>18 dB	>14 dB	>12 dB	>8 dB	>7 dB	>4 dB
Load Match						
Standard	>23 dB	>14 dB	>10 dB	>9 dB	>9 dB	>7 dB
Option UNL, 014, or UNL & 014	>17 dB	>13 dB	>10 dB	>9 dB	>8 dB	>6 dB
Reflection Tracking ^b	±1.5 dB	±1.5 dB	±1.5 dB	±1.5 dB	±2.0 dB	±2.0 dB
Transmission Tracking ^{b,c}	±1.5 dB	±2.0 dB	±2.5 dB	±3.5 dB	±4.0 dB	±4.5 dB
Crosstalk (Isolation)						
Standard	−100 dB ^d	−110 dB	−110 dB	−108 dB	−105 dB	−100 dB
Option UNL or 014	−100 dB ^d	−109 dB	−109 dB	−106 dB	−103 dB	−98 dB
Option UNL & 014	−98 dB ^d	−108 dB	−107 dB	−104 dB	−100 dB	−95 dB

a. Uncorrected system performance. The values in the table apply over an environmental temperature of 23 °C ±3 °C, with less than 1 °C deviation from the calibration temperature.

b. Typical performance.

c. Transmission tracking performance is strongly dependent upon the cable used. These typical specifications are set based on the use of Agilent through cable, part number 85133-60016.

d. The value is −85 dB for frequencies below 1 GHz.

If Error Terms Seem Worse than Expected

To verify that the system still conforms to specifications, perform a system verification. Refer to [Chapter 3, “Tests and Adjustments”](#).

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.

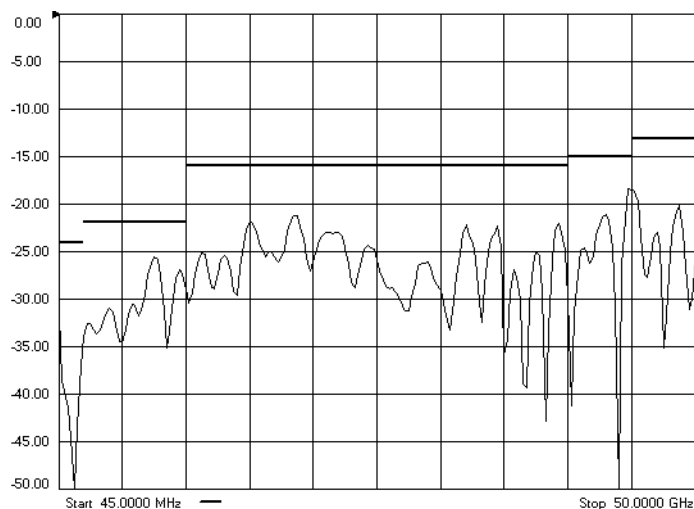
Typical Cause of Failure

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 4-46](#).

Figure A-3 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.

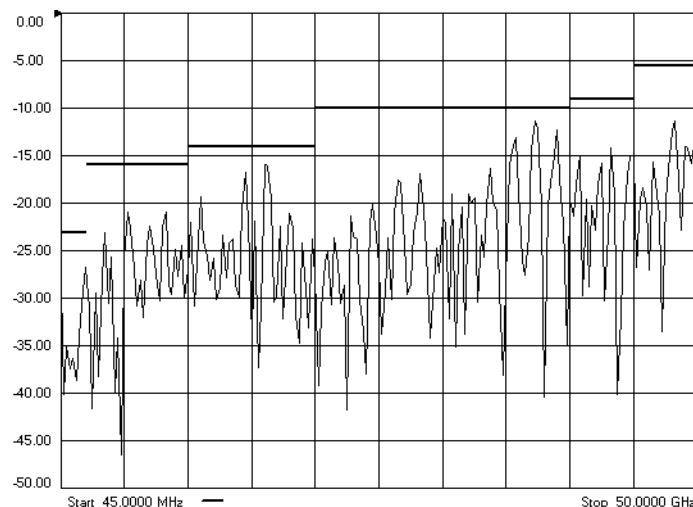
Typical Cause of Failure

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, then suspect the analyzer *switch splitter, step attenuator, or coupler*.

To troubleshoot, refer to “[Checking the Signal Separation Group](#)” on page 4-46.

Figure A-4 Typical E_{SF}/E_{SR} Without Cables



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.

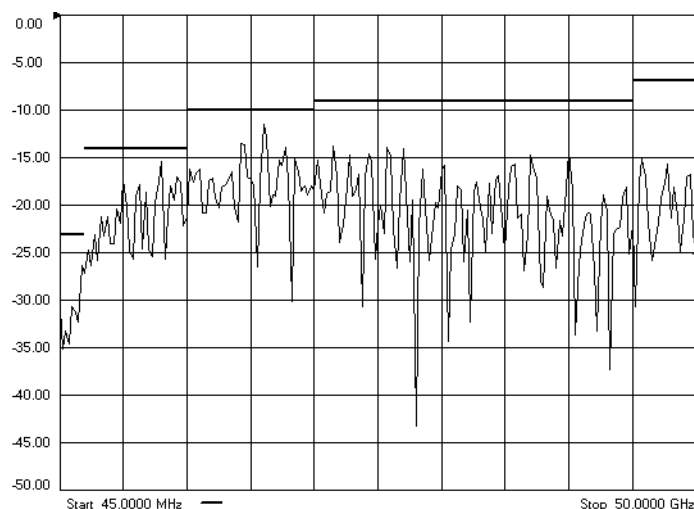
Typical Cause of Failure

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, then suspect the analyzer *test port coupler*, *step attenuator*, or *the test receiver* at the bad port.

To troubleshoot, refer to [“Checking the Receiver Group” on page 4-50](#) or to [“Checking the Signal Separation Group” on page 4-46](#).

Figure A-5 Typical E_{LF}/E_{LR}



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

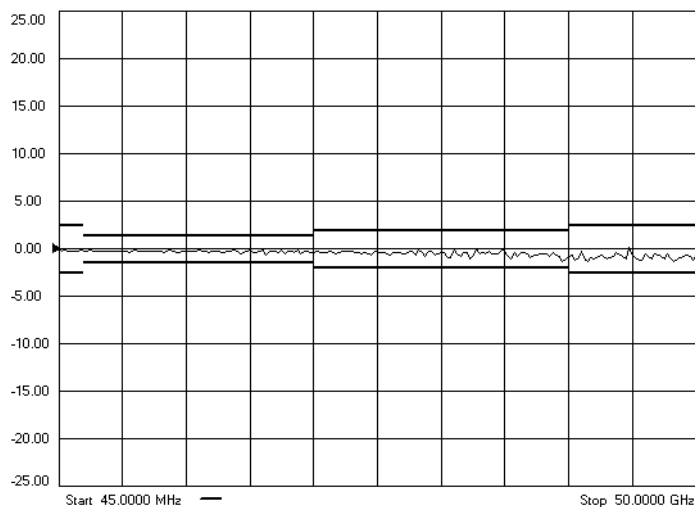
The *calibration kit open or short* is the most common cause of reflection tracking specification failure.

If the open or short performance has been independently verified, suspect the following:

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

To troubleshoot, refer to “Checking the Receiver Group” on page 4-50 or to “Checking the Signal Separation Group” on page 4-46.

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



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

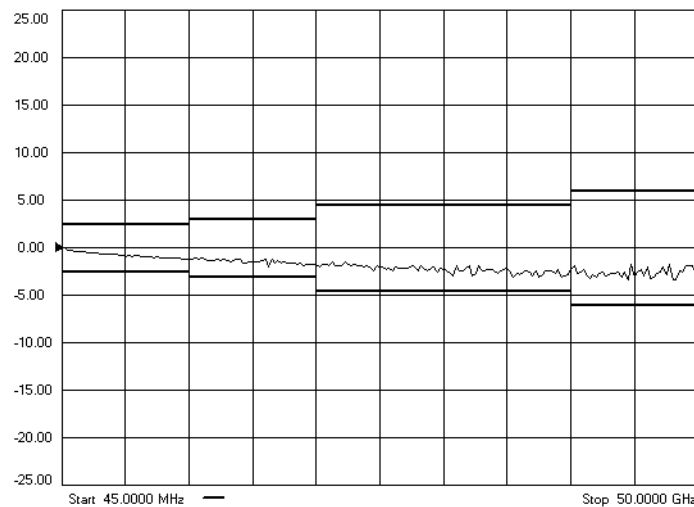
The *test port cable* is the most common cause of transmission tracking specification failure.

If the test port cable performance has been independently verified, suspect the following:

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

To troubleshoot, refer to [“Checking the Receiver Group” on page 4-50](#) or to [“Checking the Signal Separation Group” on page 4-46](#).

Figure A-7 Typical E_{TF}/E_{TR}



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

Isolation, or crosstalk, 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).

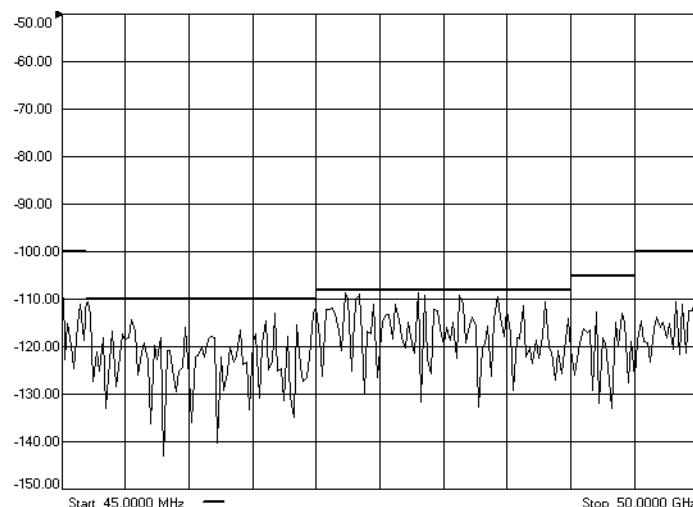
Typical Cause of Failure

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, and associated cabling.

To troubleshoot, refer to “Checking the Receiver Group” on page 4-50 or to “Checking the Signal Separation Group” on page 4-46.

Figure A-8 Typical E_{XF}/E_{XR} with 10 Hz Bandwidth



B Option Enable Utility

Information in This Appendix

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

Appendix B at-a-Glance

Section Title	Summary of Content	Start Page
Accessing the Option Enable Utility	How to access the option enable utility within the analyzer's menu system.	Page B-3
Installing or Removing Options	How to add or remove options from the analyzer's option list.	Page B-4
Repairing and Recovering Option Data	How to recover lost option data.	Page B-5
Installing or Changing a Serial Number	How to install a new serial number for the analyzer or change the existing serial number.	Page B-6

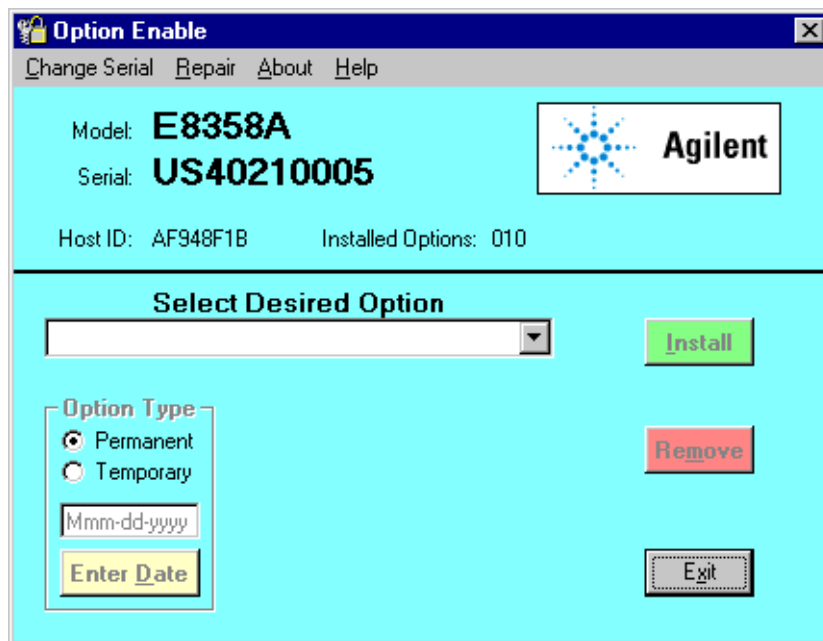
Accessing the Option Enable Utility

To start the option enable application:

- On the **System** menu, point to **Service**, and then click **Option Enable**.
- The dialog box illustrated in [Figure B-1](#) 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 [“Contacting Agilent” on page 2-9](#).

Figure B-1 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 needed for the hardware changes. It is necessary to reinstall hardware options if the A16 test set motherboard is replaced
- **Software option:** This option involves loading software to initialize your new option. The option enable utility is part of this process. It is necessary to reinstall software options if the A10 frequency reference board is replaced.

Click the arrow in the **Select Desired Option** box. A list of available options, similar to the list below, will appear.

010 - Time Domain
UNL - Bias Tees w/Atten
014 - Configurable Test Set
016 - Receiver Attenuators
080 - Frequency Offset Mode
081 - Reference Transfer Switch
082 - Active Device Meas Appl
083 - Mixer Measurement Appl
??? - Enter Unlisted Option

Select the option that you wish to either install or remove, by clicking on it. Click either **Install** or **Remove**, whichever is appropriate.

If the desired option is not available in the list, select **Enter Unlisted Option**. A dialog box appears that will allow you to enter the option number. Enter the option number and follow the instructions on the display.

Repairing and Recovering Option Data

License, option, and model number data are stored in an EPROM on the A10 frequency reference board and written into the `gen.lic` file on the hard disk drive. If the data stored in either of these items is lost, it can be recovered from the other item.

If the data on both the hard disk drive and the frequency reference board is lost, it can not be recovered. Contact Agilent for assistance. Refer to [“Contacting Agilent” on page 2-9](#).

Recovery of Data After Repair

- If the A10 frequency reference board is replaced, use the **Repair** selection to recover data that has been lost as a result of the repair:
 1. Select **Repair** from the **Option Enable** menu bar (see [Figure B-1](#)).
 2. Click the **Freq Ref board has been replaced** check box.
 3. Click **Begin Repair**. The data is written from the `gen.lic` file into the EPROM.
- If the hard disk drive is replaced, a new `gen.lic` file is automatically created when the **Network Analyzer** application starts, by retrieving the data from the EPROM.

Recovery of Data if Option or Model Numbers are Incorrect

If the analyzer option or model numbers are not listed correctly on the analyzer display, in either the Option Enable Dialog Box or the About Network Analyzer display, you should regenerate the options license file, `gen.lic`:

1. Exit the **Network Analyzer** application.
2. Remove (or rename) the existing `gen.lic` file:
 - a. Open **Windows Explorer** and navigate to `C:\Program Files\Agilent\Network Analyzer`.
 - b. Delete (or rename) `gen.lic`.
3. Exit the **Windows Explorer** application.
4. Open the **Network Analyzer** application. The application will generate a new `gen.lic` file when it starts.
5. Check the option listing:
 - a. On the **System** menu, point to **Service**, and then click **Option Enable**, or
 - b. On the **Help** menu, click **About Network Analyzer**.
6. If the options are still not listed correctly, contact Agilent for assistance. Refer to [“Contacting Agilent” on page 2-9](#).

Installing or Changing a Serial Number

It is necessary to reinstall the instrument serial number if the A16 test set motherboard is replaced.

The instrument serial number is printed on a tag located in the lower rear corner of the right-hand side of the outer cover.

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 (see [Figure B-1](#)). 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 Agilent to obtain the clear-code. Refer to [“Contacting Agilent” on page 2-9](#).

C Firmware Upgrades

Information in This Appendix

This appendix provides instructions for installing firmware upgrades in your PNA series microwave network analyzer.

Appendix C at-a-Glance

Section Title	Summary of Content	Start Page
Downloading from the Internet	How to download firmware upgrades from the Internet.	Page C-2
Downloading Using Option 099, Firmware Upgrade	How to download firmware upgrades from a CD-ROM.	Page C-3

How to Check the Current Firmware Version

1. With the **Network Analyzer** application running, click **Help, About Network Analyzer**.
A dialog box showing the current installed Application Code Version is displayed.
2. To determine if a firmware update is available, proceed to [“Downloading from the Internet.”](#)

Downloading from the Internet

If your network analyzer is connected to the Internet, there are two methods available for checking the availability of, and 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 2-4](#) 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 specified in [“USB Accessories” on page 6-45](#). 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 4-25](#) 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.

D Operating System Recovery

Information in This Appendix

Appendix D at-a-Glance

Section Title	Summary of Content	Start Page
Overview	Overview of the analyzer's hard disk drive file storage system and the impact of the operating system recovery procedure on that file storage system.	Page D-2
System Recovery Procedure	Step-by-step instructions for how to restore the operating system on your analyzer.	Page D-4

Overview

This recovery procedure will completely restore the operating system of the PNA series network analyzer to the original factory condition. It will not function if the hard drive is damaged.

If you have made an emergency repair disk, you may be able to recover from some Windows system problems without the loss of data. Refer to Windows 2000 Help or contact your systems administrator.

Use this procedure for the following types of situations:

- If you are recovering from a corrupted operating system.
- If you have security concerns where all previous usage remnants need to be eliminated.
- If the network analyzer must be in a known configuration, such as for rental companies.

The hard drive in the PNA series network analyzer has two partitions (drives):

- **C:** drive—contains the Windows 2000 operating system (NTFS format). This is the normally used partition and it contains all the programs and other needed files.
- **D:** drive—is the Disaster Recovery Partition. It contains a compressed image of the C: drive as it existed when shipped from the factory, plus its support files. It may also contain other items such as drivers or firmware. **DO NOT USE THIS DRIVE FOR NORMAL DAY-TO-DAY USE.**

IMPORTANT The recovery procedure will erase the entire C: drive and the following information will be lost:

- all changes and additions made to the network analyzer since it's purchase (except options)

- all user accounts and passwords
 - all added programs
 - all saved instrument states
 - all user configurations and Windows settings
-

The above listed information can be saved by copying it to a floppy disk or to a folder on the D: drive; the D: drive will not be affected by the restoration process. In addition, factory instrument calibration will not be affected if no changes have been made since the original factory calibration. If changes have been made through the service routines, copy all files that are prefixed with mxcalfile_ in the C:/Program Files/Agilent/Network Analyzer directory to the D:/Calfiles directory. Permanent instrument options should not be lost.

System Recovery Procedure

1. Click **Start**, **Shutdown**, and then **Restart**.

NOTE Normally, you can boot from the D: drive (recovery partition) which will allow you to erase and restore the C: drive. This is an available selection during the normal boot-up process. If this boot-up selection process is not functioning due to a damaged operating system, proceed to [“If the Operating System Does Not Boot From the Hard Disk Drive” on page D-5](#).

2. After the Agilent logo displays on the screen, you will have several seconds to select an alternative operating system from the default of Windows 2000.
 - a. Select the **Recovery** partition. A brief “splash” screen will appear indicating that you are booting from the recovery partition.
3. The analyzer will display a warning about proceeding and give you two chances to abort. After the second warning, if not aborted, the restoration process begins immediately.

Restoration takes from 30 to 60 minutes. There is no user interaction required. Near the end of the process, the network analyzer will reboot several times. The network analyzer application may start before the process is complete. Do not attempt to use the analyzer until the network analyzer application is running and all activity has been stopped for at least one minute.

Once the operating system is completely recovered, you can restore any files that you saved. The mxcalfile_ files that were stored on the D:/Calfiles directory will be restored automatically. Other files must be moved or copied manually.

NOTE If the network analyzer options are lost, rename the C:/Program Files/Agilent/Network Analyzer/gen.lic file to gen.bak, and then restart the network analyzer application. This should regenerate the options automatically and recreate the gen.lic file.

After recovery, 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. To do this:

1. Click **Start**, point to **Settings**, and then click **Control Panel**.
2. Double-click **System**.
3. In the **System Properties** window, click on the **Advanced** tab, and then click **Startup and Recovery**.
4. Modify **Display list of operating systems for xx seconds**, where xx is the desired time value. The factory recommended setting is 5 seconds.
5. Click **OK** in the **Startup and Recovery** window. Click **OK** in the **System Properties** window. Close the **Control Panel** window.

If the Operating System Does Not Boot From the Hard Disk Drive

If the network analyzer is unable to boot from the hard disk drive, then you must make a DOS boot disk. To make this disk, you will need:

- a floppy disk
- a computer that is currently running DOS or Windows® 95/98/ME/XP. Windows® NT or Windows® 2000 cannot be used.

To create the DOS boot disk:

1. Right click on the **A:** drive.
2. Select **Format**.
3. Select **Make System Disk** (or copy system files).

To boot from the DOS boot disk:

4. Insert the newly created system disk into the network analyzer floppy disk drive and restart the operating system. The network analyzer should detect this disk and boot from it. If not, proceed to [“If the Operating System Does Not Boot From the Floppy Disk Drive” on page D-6](#).
5. At the DOS prompt (A: \>) type `CD C:` and press **Enter**. You are really changing to the D: drive because a DOS operating system does not recognize the NTFS format used on the C: drive. Therefore, the first valid drive found is D:, and the operating system assumes it to be C:.
6. Type **Autoexc.bat** and press **Enter**.
7. Now that the analyzer system has booted, continue with the restoration procedure at step 2 of [“System Recovery Procedure” on page D-4](#).

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If the Operating System Does Not Boot From the Floppy Disk Drive

You may have to change the network analyzer Bios settings to have it scan the floppy disk drive before booting from the hard disk drive. Due to Bios revisions, the exact procedure may vary slightly from the following:

1. Attach a keyboard to the network analyzer and restart the network analyzer.
2. When the Agilent logo appears, press function key **F2**, on the keyboard, several times. The **Bios** menu will appear after several seconds.
3. Using the keyboard arrows, select Boot. Use the keyboard to edit the file to select booting from the floppy disk drive before attempting to boot from the hard disk drive.

NOTE	Once the restoration process is complete and the analyzer is functioning properly, remove the floppy disk and use this same procedure to change back to booting from the hard disk drive. If you do not do this, an error will result each time the analyzer is powered up with a floppy disk installed.
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4. Select **Save**, and then **Exit**.
5. Now that the Bios has been changed to allow the system to detect the DOS boot disk in the floppy disk drive, continue with the procedure at step 5 of [“If the Operating System Does Not Boot From the Hard Disk Drive”](#) on page D-5.

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