N5247B 2-Port and 4-Port PNA-X Microwave Network Analyzers - Service Guide

N5247B Series -
(900 Hz /900 Hz/10 MHz - 67 GHz)

This is the Service Guide for the N5247B Series Microwave Network Analyzers.

KEYSIGHT

SERVICE GUIDE

Notices

Trademark Acknowledgments

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Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

NOTICE: This document contains references to Agilent Technologies. Agilent's former Test and Measurement business has become Keysight Technologies. For more information, go to **www.keysight.com.**

KEYSIGHT
TECHNOLOGIES

4. Troubleshooting

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

KEYSIGHT TECHNOLOGIES

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.

WARNING Use Keysight supplied power cord or one with same or better electrical rating.

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.

Before Applying Power

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

WARNING If an instrument handle is damaged, you should replace it immediately. Damaged handles can break while you are moving or lifting the instrument and cause personal injury or damage to the instrument.

WARNING Supply voltages which oscillate between the two normal input ranges of the autoranging line voltage input will damage the power supply. In rare cases, this damage has become a user safety concern. If unstable power levels are expected, the analyzer input power must be buffered by a line conditioner.

CAUTION This instrument has autoranging line voltage input. Be sure the supply voltage is within the specified range.

CAUTION This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 61010-1:2001 and 664 respectively.

CAUTION Do not operate the analyzer with the outer cover removed for more than 30 minutes, as this could cause the analyzer to overheat which could result in costly damage.

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

CAUTION The measuring terminals on this instrument are designed to be used with external signals described in Measurement Category I, but NOT with external signals described in Categories II, III, and IV. The input of this instrument cannot be connected to the mains.

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 Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended. Discard used batteries according to local ordinances and/or 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 No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock, do not remove covers.

WARNING The opening of covers or removal of parts may expose dangerous voltages. Disconnect the instrument from all voltage sources while it is being opened.

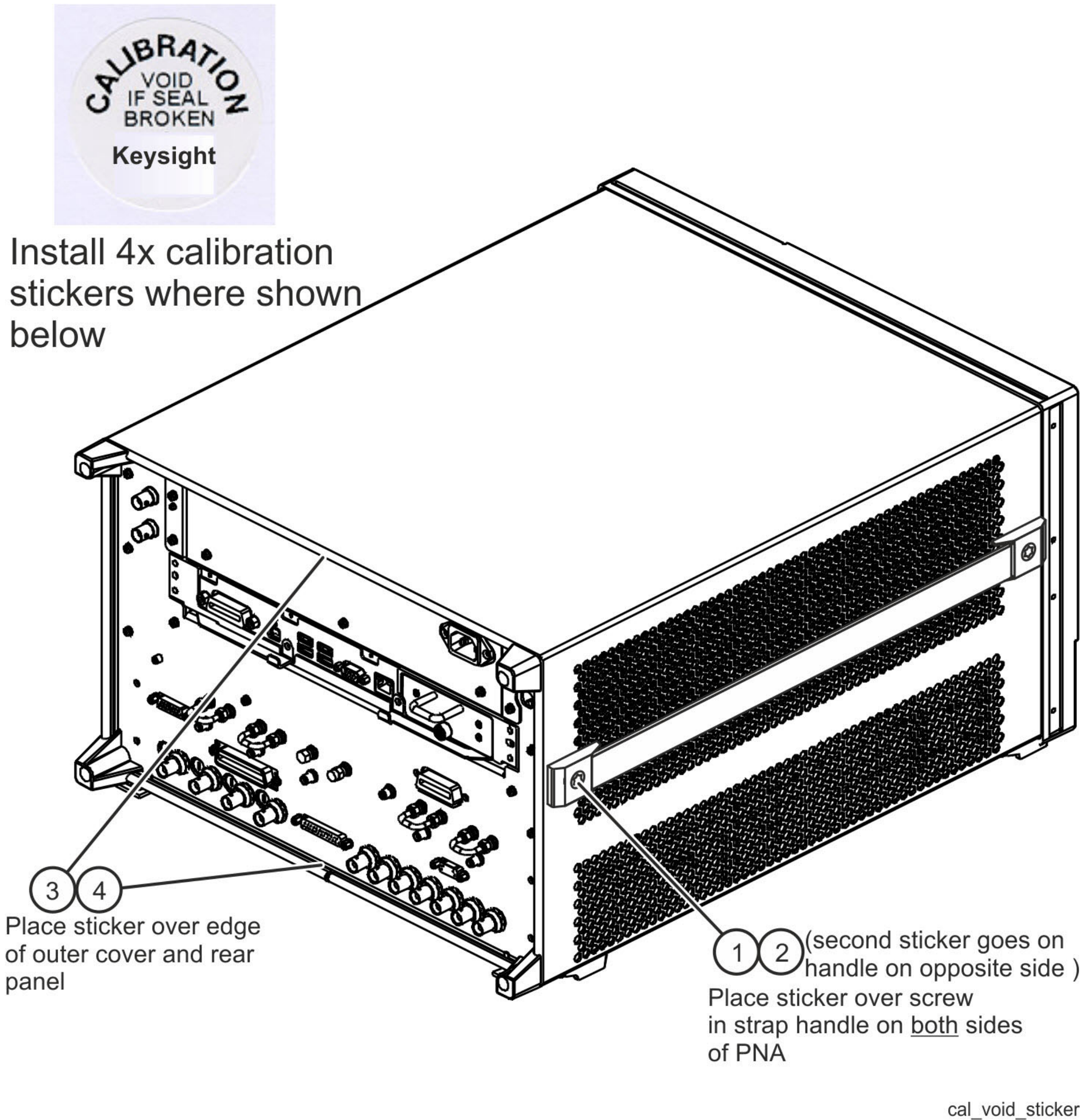
WARNING The detachable power cord is the instrument disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the instrument. The front panel switch is only a standby switch and is not a LINE switch (disconnecting device).

CAUTION Do not operate the analyzer with the outer cover removed for more than 30 minutes, as this could cause the analyzer to overheat which could result in costly damage.

NOTE There are no replaceable fuses in the mains input or within the power supply assembly.

NOTE Keysight personnel: after calibration is completed, attach four "calibration void if seal broken" stickers to the PNA as shown in Figure 1-1.

Figure 1-1 Location of Calibration Stickers on PNA



Electrostatic Discharge Protection

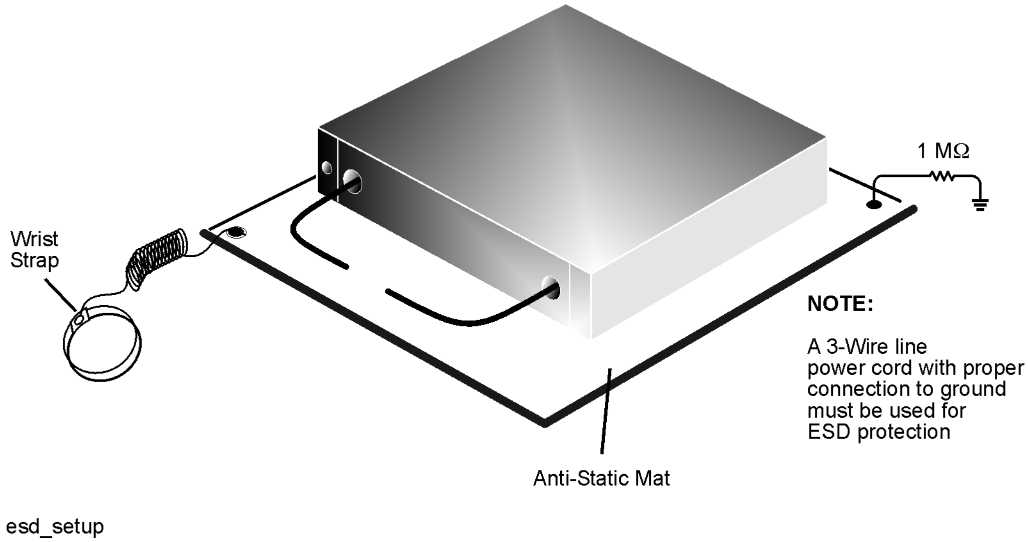
Protection against electrostatic discharge (ESD) is essential while removing assemblies from or connecting cables to the network analyzer. Static electricity can build up on your body and can easily damage sensitive internal circuit elements when discharged. Static discharges too small to be felt can 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 MΩ 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 1-2 shows a typical ESD protection setup using a grounded mat and wrist strap. Refer to “ESD Supplies” on page 6-206 for part numbers.

Figure 1-2 ESD Protection Setup



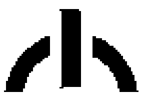
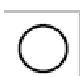
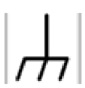
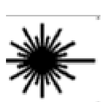
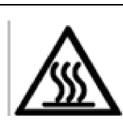
Regulatory Information

This section contains information that is required by various government regulatory agencies.

Instrument Markings

The table below lists the definitions of markings that may be on or with the product. Familiarize yourself with each marking and its meaning before operating the instrument.

NOTE Samples instrument markings may not appear on your analyzer.

	This symbol marks the standby position of the power line switch.
	This symbol marks the ON position of the power line switch.
	This symbol marks the OFF position of the power line switch.
	This symbol indicates that the input power required is AC.
	This symbol indicates DC voltage
	This symbol indicates a three-phase alternating current.
	This symbol indicates Frame or chassis Terminal.
	The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to the instruction in the documentation.
	This symbol indicate the presence of a Laser device.
	This symbol indicates the surface can be hot.
	This symbol indicated the product is sensitive to electrostatic discharge.

	This symbol identifies the Protective Conductor terminal.
	This symbol indicates the equipment is protected throughout by double or reinforced insulation.
CE	The CE mark is a registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven). It indicates that the product complies with all the relevant directives.
UK CA	The UK conformity mark is a UK government owned mark. Products showing this mark comply with all applicable UK regulations.
ccr.keysight@keysight.com	The Keysight email address is required by EU directives applicable to our product.
C SA ® US	The CSA mark is a registered trademark of the CSA International.
	Two person lift required.
CAN ICES/NMB-001(A)	Canada EMC label. Interference-Causing Equipment Standard for industrial, scientific and medical (ISM) equipment. Matériel industriel, scientifique et médical (ISM).
ICES/NMB-001 CE ISM GRP.1 CLASS A	CE/ICES/ISM label. (Old mark for reference only.) This is a space saver label that combines three markings - CE with CAN ICES and ISM (see above) and ISM (see below).
CE CAN ICES/NMB-001(A) ISM GRP 1-A	This is a space saver label that combines three markings - CE with CAN ICES and ISM (see above) and ISM (see below).
	The RCM mark is a registered trademark of the Australian Communications and Media Authority.
CAN ICES/NMB-001(A) ISM GRP 1-A	This is a space saver label that combines two markings - CAN ICES and ISM.
ISM 1-A	This is a symbol of an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 5).
	South Korean Certification (KC) mark. It includes the marking's identifier code.

	The crossed-out wheeled bin symbol indicates that separate collection for waste electric and electronic equipment (WEEE) is required, as obligated by the EU DIRECTIVE and other National legislation. Please refer to www.keysight.com/go/takeback to understand your trade-in options with Keysight, in addition to product takeback instructions.
	China Restricted Substance Product Label. The EPUP (environmental protection use period) number in the center indicates the time period during which no hazardous or toxic substances or elements are expected to leak or deteriorate during normal use and generally reflects the expected useful life of the product.
	Universal recycling symbol. This symbol indicates compliance with the China standard GB 18455-2001 as required by the China RoHS regulations for paper/fiberboard packaging.
IP x y	This mark indicates product has been designed to meet the requirements of "IP x y", where "x" is the solid particle protection and "y" is the liquid ingress protection.

Environmental Information

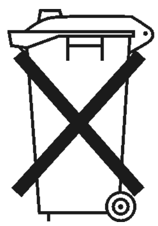
NOTE Samples of this product have been type-tested in accordance with the Keysight Environmental Test Manual and verified to be robust against the environmental stresses of storage, transportation and end-use; those stresses include but are not limited to temperature, humidity, shock, vibration, altitude, and power-line conditions. Test methods are aligned with IEC 60068-2 and levels are similar to MIL-PRF-28800F Class 3.

Parameter	Required Values/Ranges
Operating Environment	For Indoor Use ONLY This instrument has no air filters on the fan ports. Operation in dirty, dusty, or similar environments must be avoided.
Operating Temperature	0 °C to +40 °C The instrument powers-up and displays no error messages within this temperature range (except for "source unleveled" error message that may occur at temperatures outside the specified performance temperature range of 25 ± 5 °C).
Storage Temperature	–40 °C to +70 °C
Error-corrected range	23 °C ±3 °C with less than 1 °C deviation from calibration temperature.

Parameter	Required Values/Ranges
Operating Altitude	0 to 4,600 meters (15,000 feet)
Relative humidity	Type tested, 0% to 95% at 40 °C, non-condensing In conditions of very high humidity (below 95%) at changing temperature, there is a small risk of internal condensation that could cause the CPU real-time clock to temporarily stop incrementing time.

Lithium Battery Disposal

If the battery on the A21 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 Keysight Technologies for disposal. Refer to "Contacting Keysight" on page 2-7 for assistance.



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

For instructions on removing and replacing the battery on the A21 CPU board assembly, refer to "Removing and Replacing the Lithium Battery" on page 7-90.

2 General Product Information

Information in This Chapter

Chapter Two at-a-Glance

Maintenance

Physical 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.**

Electrical Maintenance

Refer to "Review the Principles of Connector Care" on page 3-5.

Analyzer Options, Accessories, and Upgrades Available

To see a list of the accessories and upgrades available for the network analyzers, including ordering information, refer to the *Keysight PNA Family Microwave Network Analyzers Configuration Guide*, available online at https://www.keysight.com/us/en/assets/7018-05185/configuration-guides/5992-1465.pdf (5992-1465EN).

NOTE Only Keysight approved accessories shall be used.

Pulse I/O Adapter-N1966A

An adapter for connecting between the analyzer's rear-panel PULSE I/O connector and the coaxial inputs and outputs of external pulse generators and external pulse modulators. The adapter contains 11 SMB-male coaxial connectors and a mating connector for the rear-panel PULSE I/O connector.

This adapter can be ordered as model number N1966A.

Figure 2-1 N1966A Pulse I/O Adapter

Required Service Test Equipment

Equipment[a]	Critical Specifications	Recommended Model or Part Number	Alternate Model or Part Number	Use[b]
Test Instruments and Software				
Compression test set	None specified	U3070AK01 or U3070BK01	None	P
Dynamic accuracy test set	None specified	U3020AD01 or U3020BD01	None	P
Test software[c]	N/A	N7840A	None	P
Frequency counter	Freq: 10 MHz to 20 GHz Accuracy : ±0.5 ppm	53151A Opt 001	None	P, A,T
Signal generator	CW Freq: 1.185 GHz	N5181A, Option 503	E8257D, Option 520	P, A, T
Power meter	Accuracy: ±0.0068 dB	N1913A/14A	E4418A/B,	P, A,T
Power sensor	Freq: 10 MHz to 4.2 GHz Range: –30 to +20 dBm	N8482A	8482A	P, A,T
Power sensor	Freq: 50 MHz to 40 or 50 GHz Range: –30 to +20 dBm	N8487A	8487A	P, A,T
Power sensor[e]	Freq: 50 MHz to 67 GHz Range: –30 to +20 dBm	V8486A	None	P, A,T
Adapter[e] (WR-15 to 1.85 mm)	Return Loss: ≥ 22 dB	V281A	None	P, A,T
Spectrum analyzer	Min Freq: 1 MHz Max Freq: > 4 GHz Resolution BW: 300 Hz	E444xA PSA series, N90xxA signal analyzer family	856xE	A,T
Digital voltmeter	Resolution: 10 mV	Any	Any	T
Printer	N/A	Any printer with Microsoft Windows XP or Windows 7 driver		--
Mouse	N/A	Any	Any	--
Keyboard	N/A	Any	Any	--

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 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.
d. If an accurate measurement of the dynamic accuracy specification is not required, the E4418A or E4419A can be used.
e. This sensor and adapter must be calibrated together by the Keysight factory. The data supplied is only valid as long as the sensor and adapter remain connected.

Equipment[a]	Critical Specifications	Recommended Model or Part Number	Alternate Model or Part Number	Use[b]
Calibration and Verification Tools				
1.85 mm calibration kit	--	85058B DC to 67 GHz	85058E DC to 67GHz	P,T
1.85 mm verification kit	--	85058V 45 MHz to 67 GHz	None	V
ECal module	--	N4694A 10 MHz to 67 GHz	None	V
Cables				
BNC cable (2 required)	50Ω, length ≥ 60 cm	8120-1839	None	A
1.85 mm RF cable (Qty 2)	50Ω, length ≥ 60 cm	N4697E	Equivalent	P,A,V
GPIB cable	N/A	10833A/B/C/D	None	P,A
Adapters				
1.85 mm (f) to 1.85 mm (f)	Return Loss: ≥ 20 dB	N5520B[c]	None	P,A,T
2.4 mm (f) to Type-N (f)[d]	Return Loss: ≥ 28 dB	11903B	None	P,A,T
Attenuators				
1.85 mm (m, f), 10-dB fixed attenuator	Freq: DC to 67 GHz	8490G Option 010	None	P
1.85 mm (m, f), 20-dB fixed attenuator	Freq: DC to 67 GHz	8490G 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 85058B/E calibration kits.
d. The 1.85 mm connector has the same ruggedness and is compatible with the 2.4 mm connectors. 1.85 mm and 2.4 mm adapters may be used interchangeably.

Equipment[a]	Critical Specifications	Recommended Model or Part Number	Alternate Model Number	Use[b]
Tools				
T-8 TORX driver	0.6 N-m (5 in-lb) setting	N/A	N/A	R

Equipment[a]	Critical Specifications	Recommended Model or Part Number	Alternate Model Number	Use[b]
T-10 TORX driver	0.5, 0.8, and 1.0 N-m (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	1.1 and 2.4 N-m (10 and 21 in-lb) settings (for semi-rigid cables)	N/A	N/A	T,R
1-inch, open-end torque wrench	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)	N/A	N/A	R
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				
USB flash ROM drive	N/A	Any	None	P,A,R

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

Keysight Support, Services, and Assistance

Information on the following topics is included in this section.

– “Service and Support Options”
– “Contacting Keysight”
– “Shipping Your Analyzer to Keysight for Service or Repair”

Service and Support Options

The analyzer’s standard warranty period is one-year from the time of initial delivery. All repairs require the analyzer to be shipped to the nearest Keysight Technologies service center. Extended warranty periods can be purchased with the initial product purchase.

There are many other repair and calibration options available from the Keysight Technologies support organization. These options cover a range of service agreements with a variety of time frames. The following support products with their associated options are available for purchase with the initial product purchase.

– R1280A Return to Keysight Warranty and Service Plan
  Options are available to extend the warranty period to five years.
– R1282A Return to Keysight Calibration Plan
  The analyzer is delivered with a one-year calibration certificate. Options are available to have Keysight Technologies provide three or five year calibration coverage (perform the annual calibration two or four times). Options for basic calibration or SO/IEC 17025 or ANSI/NCSL Z540.3–2006 standards compliant calibrations are available. After calibration, the analyzer will be returned with a calibration label, a calibration certificate, and the calibration data.
– R1288A Return to Keysight On-Site Warranty and Service Plan
  Same as R1280A, but the service is provided at the customer site.
– R1298A Return to Keysight On-Site Calibration Plan
  Same as R1282A, but the service is provided at the customer site.

For more information on these and other service, please visit https://support.keysight.com/or refer to “Contacting Keysight” on page 2-7. If the warranty or calibration plan period has expired, these services are available on a per-incident basis. Visit this InfoLine web site or contact Keysight to obtain a quote.

Contacting Keysight

Assistance with test and measurements needs and information or finding a local Keysight office are available on the Web at: http://www.keysight.com/find/assist.

If you do not have access to the Internet, please contact your Keysight field engineer.

NOTE

In any correspondence or telephone conversation, refer to the Keysight product by its model number and full serial number. With this information, the Keysight representative can determine whether your product is still within its warranty period.

To contact Keysight for sales and technical support, refer to support links on the following Keysight websites: http://www.keysight.com/find (product specific information and support, software and documentation updates) http://www.keysight.com/find/assist (worldwide contact information for repair and service).

Shipping Your Analyzer to Keysight for Service or Repair

NOTE

Keysight Technologies reserves the right to reformat or replace the solid state drive in your analyzer as part of its repair. This will erase all user information stored on the solid state drive. It is imperative, therefore, that you make a backup copy of your critical test data located on the analyzer's solid state drive before shipping it to Keysight for repair.

If you wish to send your network analyzer to Keysight 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.

– Remove and retain the front handles and all rack mount hardware. The analyzer should be sent to Keysight in the same configuration as it was originally shipped.

– Ship the analyzer using the original or comparable packaging and antistatic materials. Shipping the analyzer in anything other than the original or comparable packaging and antistatic materials may result in non-warranted damage.

– Contact Keysight for instructions on where to ship your analyzer.

Keysight Microwave Network Analyzers
2-Port and 4-Port PNA-X

Service Guide

3 Tests and Adjustments

Information in This Chapter

This chapter contains procedures to help you check, verify, and adjust your PNA.

- 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.

Conventions Used for Hardkeys, Softkeys, and Menu Items

The following conventions are used in this document:

Hardkey	This represents a “hardkey”, a key that is physically located on the instrument.
Tab	This represents a “tab”, whose label is determined by the instrument firmware.
Softkey	This represents a “softkey”, a key whose label is determined by the instrument firmware.
Menu Item	This represents an item in a drop-down or pop-up menu.

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: – Verify the Operating Environment – Protect Against Electrostatic Discharge (ESD) – Allow the Analyzer to Warm Up – Review the Principles of Connector Care – Setting the Instrument Preferences to Default	page 3-4

KEYSIGHT TECHNOLOGIES

Section Title	Summary of Content	Start Page
Performance Tests[a]	A brief summary of each performance test: – Source Maximum Power Output Test – Source Power Linearity Test – Frequency Accuracy Test – Trace Noise Test – Receiver Compression Test – Noise Floor Test – Calibration Coefficients Test – Dynamic Accuracy Test – Receiver Noise Figure Test – Noise State Calibration Coefficients – Noise Jitter Test – Noise Receiver Linearity Test – Noise Receiver Compression Test – Dynamic Accuracy at Low Frequency (Available With Low Frequency Extension (LFE) Installed Option 205/425) – DC Continuity Test the LFE Board and Test Ports (Available With Low Frequency Extension (LFE) Installed Option 205/425)	page 3-32
Adjustments[b]	Setups and procedures for adjusting your analyzer: – Touchscreen Adjustment and Verification – 10 MHz Frequency Reference Adjustment – Synthesizer Bandwidth Adjustment – Source Adjustment – IF Gain Adjustment – Receiver Characterization – Receiver Adjustment – EE Default Adjustment – IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed) – LFE Receiver Adjustment (Option 425) – Noise Figure Adjustment (Available with Option 029 or E29 with S93029A/B Installed)	page 3-53

a. These performance tests are included in the analyzer's firmware for Options S93898A.
b. These adjustments are included in the analyzer's firmware on all models and options.

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

NOTE **Keysight personnel: see Figure 1-1 on page 1-6 to review where the calibration stickers should be placed on the PNA.**

Verify the Operating Environment

Due to their operating specifications, the verification and calibration kit devices determine the limits of 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 °C ± 3 °C (Error-corrected temperature range)

  Once the measurement calibration has been done, the ambient temperature must be maintained to within ± 1 °C of the calibration temperature.
- Humidity: 0% to 95% at 40 °C maximum, non-condensing
- Altitude: 0 to 4,600 meters (≈15,000 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 1-7, for all of the procedures in this chapter.**

Allow the Analyzer to Warm Up

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

Review the Principles of Connector Care

WARNING **Cleaning connectors with alcohol shall only be done with the instrument power cord removed and in a well-ventilated area. Allow all residual alcohol moisture to evaporate, and the fumes to dissipate prior to energizing the instrument.**

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 Keysight Technologies. Refer to "Contacting Keysight" on page 2-7.

Table 3-1 Connector Care Quick Reference Guide

	Handling and Storage		
Do	– Keep connectors clean	Do Not	– Touch mating-plane surfaces
	– Extend sleeve or connector nut		– Set connectors contact-end down
	– Use plastic end-caps during storage		– Store connectors or adapters loose
	Visual Inspection		
Do	– Inspect all connectors carefully	Do Not	– Use a damaged connector - ever
	– Look for metal particles, scratches, and dents		
	Connector Cleaning		
Do	– Try compressed air first	Do Not	– Use any abrasives
	– Use isopropyl alcohol[a]		– Get liquid into plastic support beads
	– Clean connector threads		
	Gaging Connectors		
Do	– Clean and zero the gage before use	Do Not	– Use an out-of-specification connector
	– Use the correct gage type		

Table 3-1 Connector Care Quick Reference Guide

	– Use correct end of calibration block		
	– Gage all connectors before first use		
Making Connections			
Do	– Align connectors carefully	Do Not	– Apply bending force to connection
	– Make preliminary connection contact lightly		– Over tighten preliminary connection
	– Turn only the connector nut		– Twist or screw any connection
	– Use a torque wrench for final connection		– Tighten past torque wrench “break” point

a. Cleaning connectors with alcohol shall only be done with the instrument’s power cord removed, and in a well-ventilated area. Allow all residual alcohol moisture to evaporate, and the fumes to dissipate prior to energizing the instrument.

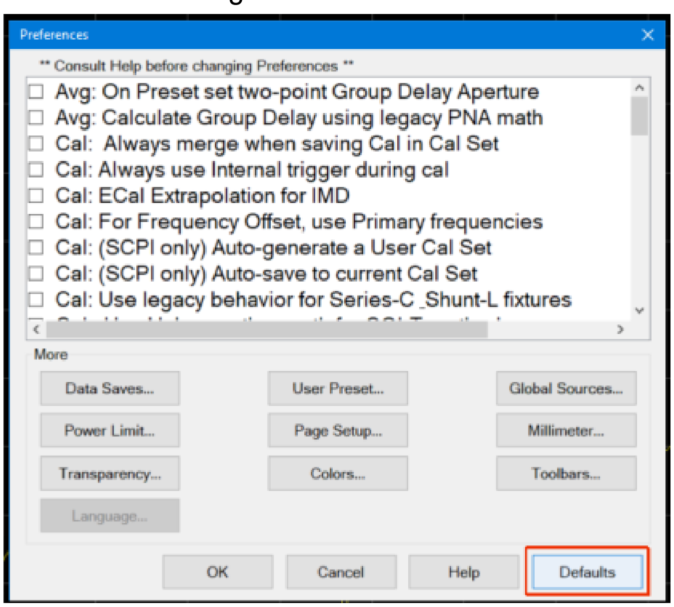
Setting the Instrument Preferences to Default

CAUTION IMPORTANT! The instrument Preferences need to be set to factory default for any specification to apply.

Procedure

1. Press **Utility** > **System** > **System Setup** > **Preferences...**
2. In the **Preferences** dialog box that opens, press Defaults.

Figure 3-1 Preferences Dialog Box



3. Press **OK** in the Confirmation window.

About System Verification and Performance Tests

The performance of the network analyzer is specified in two ways: system specifications, and instrument specifications. It is the end user's responsibility to determine which set of specifications is applicable to their use of the PNA.

A network analyzer measurement "system" includes the analyzer, calibration kit, test cables, and any necessary adapters. The system verification software in the PNA is used to verify the system's conformance to the "system" specifications. A "pass" result demonstrates that the analyzer, test cables, and adapters, perform correctly as a system. It DOES NOT demonstrate that any one component performs according to its individual specifications. A change to any part of this measurement system requires a re-verification of the system.

Instrument specifications specify the network analyzer's uncorrected measurement port characteristics and its output and input behavior. The PNA performance tests are used to verify the analyzer's conformance to "instrument" specifications.

System Specifications

System specifications specify warranted performance of the measurement system when making error-corrected measurements using the same calibration kit and test cables used during the system verification routine. System specifications are applicable only when the measurement system is used to make error-corrected measurements.

The analyzer's system specifications are described in the *"N5247B Technical Specifications" in the section titled "Corrected System Performance"*, available online at:
https://www.keysight.com/us/en/assets/9018-04526/data-sheets/9018-04526.pdf (N5247-90029).

System specifications are expressed in two ways:

- residual errors of the measurement system shown as tabular specification values
- graphs of measurement uncertainty versus reflection and transmission coefficients

System specifications are verified in one of the following ways:

- Complete the system verification procedure using a certified verification kit and certified calibration kit that will be used for future measurements, or
- Complete all of the performance tests using a certified 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

The analyzer's instrument specifications are described in the *"N5247B Technical Specifications" in the section titled "Corrected System Performance"*, available online at:
https://www.keysight.com/us/en/assets/9018-04526/data-sheets/9018-04526.pdf (N5247-90029).

These specifications apply when the analyzer is used to make either raw or error-corrected measurements.

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.

The procedure consists of calibrating the analyzer with a calibration kit, measuring a set of characterized devices, and comparing the resultant measured data to the data and uncertainty limits supplied with the verification kit. The device data provided with the verification kit has a traceable path to NIST. The total measurement uncertainty limits for the performance verification are the sum of the factory measurement uncertainties and the uncertainties associated with measuring the same devices on the system being verified. The difference between the factory-measured data and the verification-measured data must fall within the total uncertainty limits at all frequencies for the total system uncertainty test to pass.

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.**

Performance Tests

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

Performance tests are contained in the N7840A software package and are embedded in the analyzer's firmware with Option S93898A/B These two testing solutions are equivalent and are described at "Performance Tests" on page 3-32.

An illustrated outline of the performance verification procedure:

– for ANSI/NCSL Z540.3-2006 and ISO/IEC 17025 verification, is shown in Figure 3-2 on page 3-10.

– for non-standards verification, is shown in Figure 3-3 on page 3-11.

Customers can send their instrument to their local Keysight service center to have these tests performed or they can run the embedded tests if they own the full set of supported test equipment.

Certificate of Calibration

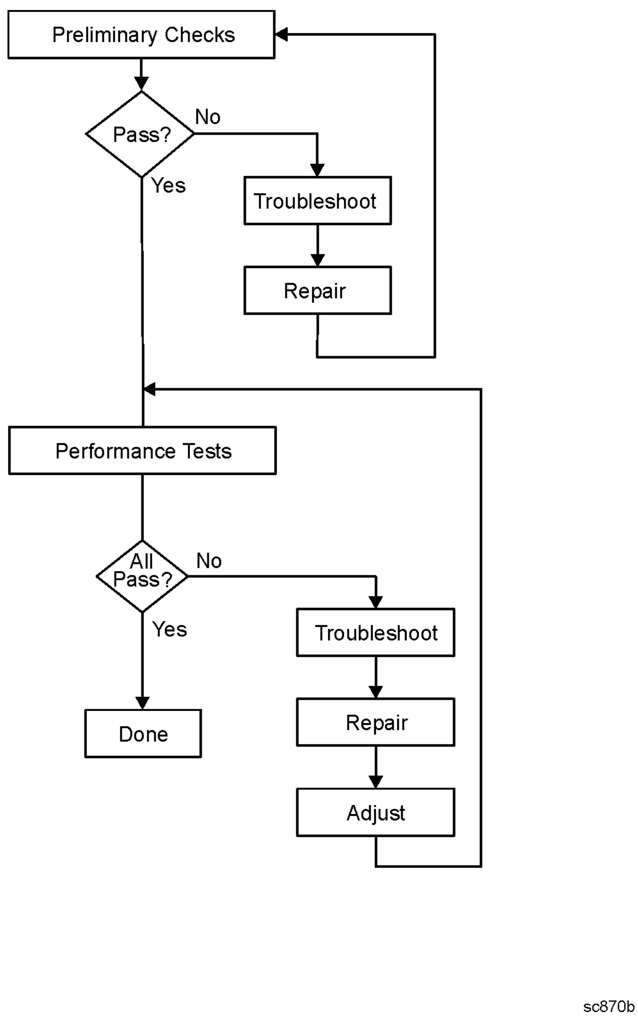
Keysight Technologies will issue a certificate of calibration upon successful completion of system verification or completion of the performance tests by Keysight service personnel. The certificate of calibration will apply to the “system” (analyzer, calibration kit, test cables, and any necessary adapters) 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 apply to the PNA as an independent instrument. Any customers using the embedded performance tests will need to create their own certificate of calibration stating the conditions under which the tests were performed. This, along with the test report created by the embedded performance tests, will constitute a completed calibration. 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 Keysight Technologies service office to verify only a subset of the specifications. However, this “limited calibration” creates the possibility of making inaccurate measurements if you then use the analyzer in an application requiring additional capabilities.

ANSI/NCSL Z540.3–2006 and ISO/IEC 17025 Verification

To meet the criteria for ANSI/NCSL Z540.3-2006 and ISO/IEC 17025 verification, perform the preliminary checks and all performance tests **without stopping to repair or adjust**[1]. Refer to Figure 3-2 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 set of performance tests and generate a new set of data.

Figure 3-2 ANSI/NCSL Z540.3–2006 and ISO/IEC 17025 Verification Flowchart

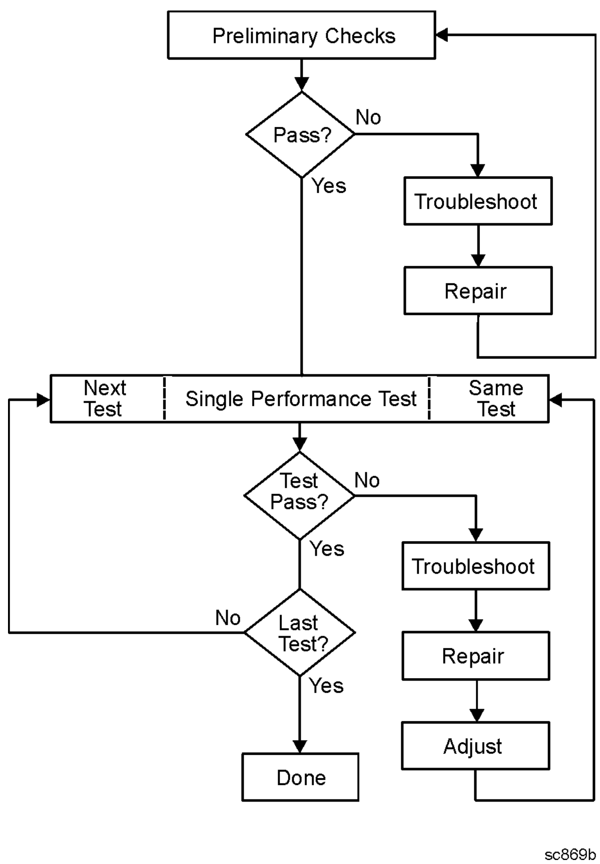


1. Stop only in case of a catastrophic failure or cable connector damage

Non-Standards Compliant Verification

To meet the criteria for non-standards compliant verification, perform the preliminary checks and the performance tests while **stopping to troubleshoot.** Refer to Figure 3-3 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.

Figure 3-3 Non–Standards Compliant Verification Flowchart



Preliminary Checks

Preliminary checks include the following:

– "The Operator's Check" on page 3-12

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

– "The Test Port Cable Checks" on page 3-15

  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 15 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 all of the measurement port signal paths. By performing the operator's check, the following are tested:

– attenuation ranges of all installed attenuators

– calibration of the receivers

– frequency response of the receivers

– phase lock and leveling

– basic functional test of noise floor and trace noise

Accessories Used in the Operator's Check

Equipment Type	Part Number
Female short, 1.85 mm	(any short from the 85058B/E calibration kits)
Female open, 1.85 mm	(any open from the 85058B/E calibration kits)

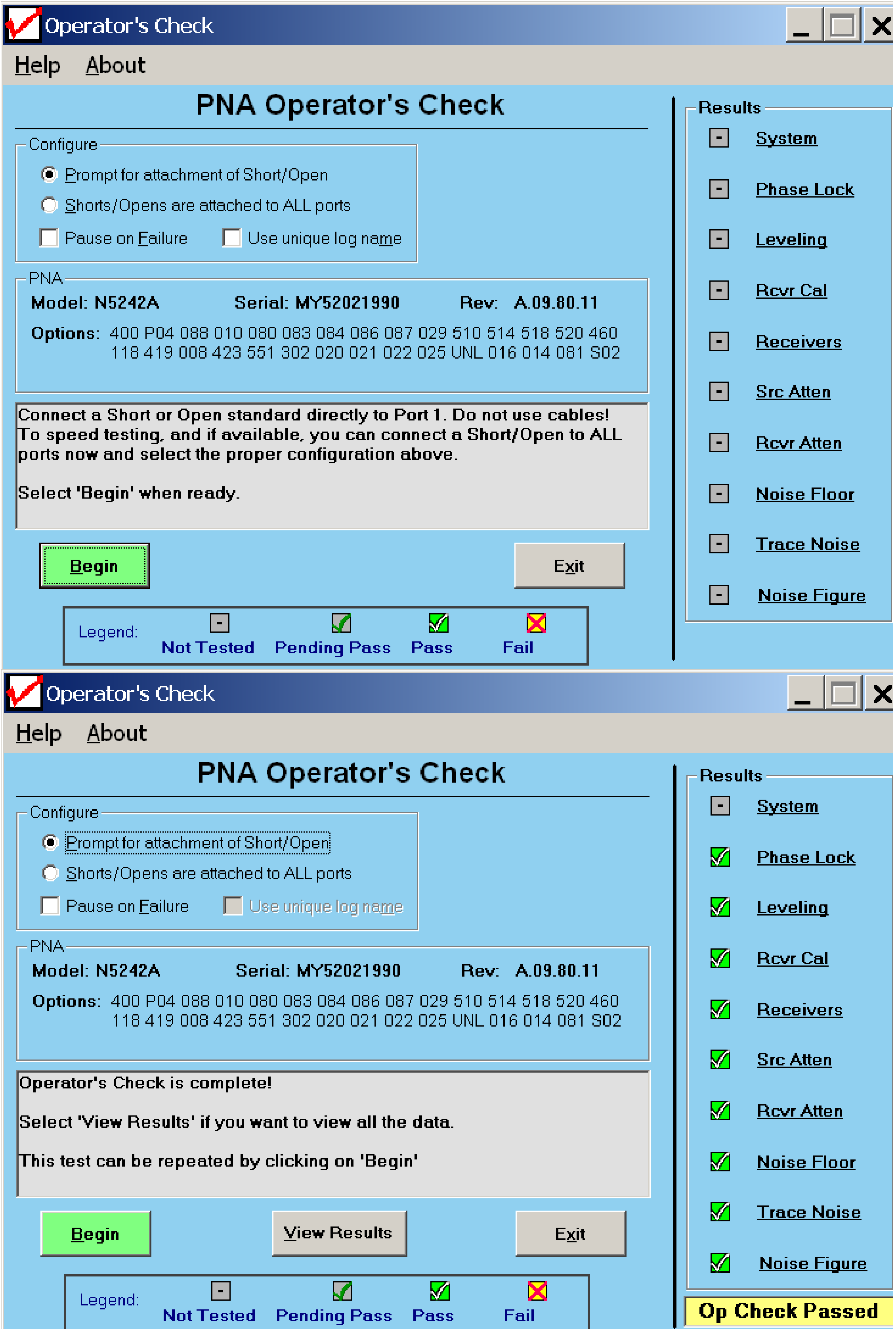
Performing the Operator's Check

1. Press UTILITY System, then Service, then Operator's Check.
2. In the PNA Operator's Check dialog box (refer to Figure 3-4), under Configure, select either Prompt for attachment of Short/Open, to pause at each step in the process to allow moving the short/open to the appropriate port, or Shorts/Opens are attached to ALL ports, to run through the test without stopping. Shorts and opens can be mixed on the test ports.
3. Click Begin.

4. If shorts and opens are not connected to all ports, you will be prompted to connect them as needed.

5. The result of the operator's check will be shown as a PASS or FAIL next to each test (refer to Figure 3-4). The PNA Operator's Check dialog box will look different for different PNA model numbers and installed options. Some of the tests are performed only if the appropriate options are installed in the PNA.

Figure 3-4 Operator’s Check Dialog Boxes



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. Refer to “Measurement System Troubleshooting” on page 4-29 to begin troubleshooting to determine the faulty component.

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 3-15
– “Cable Insertion Loss Check” on page 3-16
– “Cable Magnitude and Phase Stability Check” on page 3-18
– “Cable Connector Repeatability Check” on page 3-20

Accessories Used in the Test Port Cable Checks

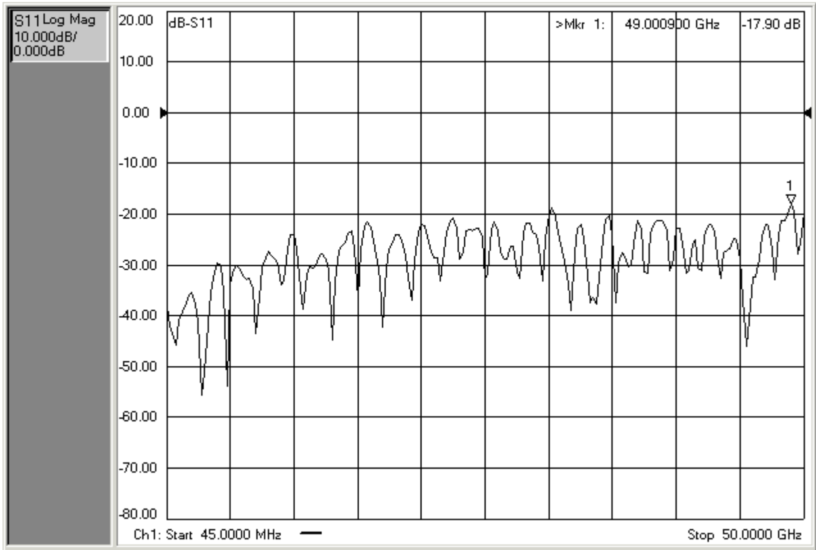
Equipment Type	Model or Part Number	Alternate Model or Part Number
Calibration kit, 1.85 mm	85058B	85058E
Test cable, 1.85 mm (f) to 1.85 mm (f)	N4697E	N4697-60200

Cable Return Loss Check

3. Press UTILITY [Preset].
4. Perform a one-port calibration on Port 1, 1-Port Reflection. Refer to the embedded help in the analyzer if necessary.
5. 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.
6. Press MARKER/ANALYSIS [Search], then Search. In the Marker Search dialog box, in the Search Type box, make sure Maximum is selected. Click Execute, and then click OK.
7. 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 3-5.

Figure 3-5 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.

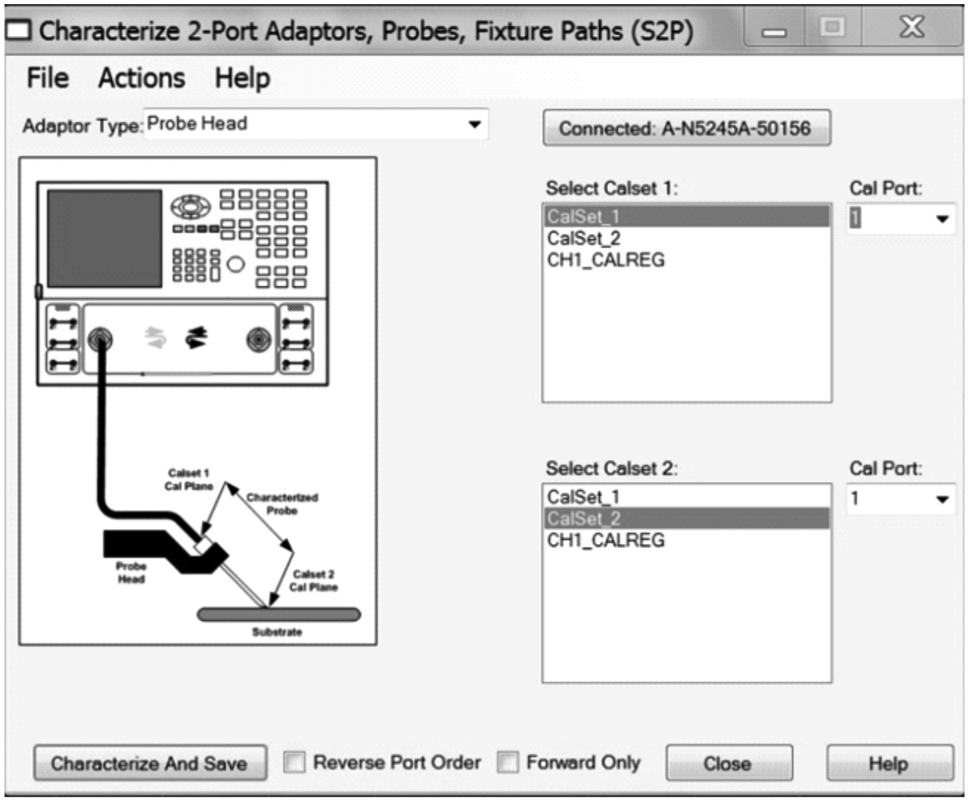
Cable Insertion Loss Check

NOTE The method below runs on the PNA environment using a mechanical Cal kit. An appropriate ECal could be used as well to replace the mechanical Cal kit if desired.

1. Press UTILITY Preset.
2. Press STIMULUS Sweep, then Number of Points, and set to 801.
3. Press RESPONSE Avg, then IF Bandwidth, and set the IF Bandwidth to 30 Hz.
4. Press STIMULUS Power and set the power level to -17 dBm.
5. Perform a 1-port calibration on the PNA Port 1 using SmartCal (Guided Calibration). Follow the calibration wizard instructions. After calibration, the PNA prompts you to save the cal set as a user Calset. Save the cal set data as CalSet_1.cst.
6. Connect the test port cable to the PNA Port 1 and perform a 1-port calibration again at the end of the cable. After calibration, save the cal set data as CalSet_2.cst.

7. Press UTILITY Macro , then Adapter Char . Select Calset 1 and Calset 2 as shown below in Figure 3-6.

Figure 3-6 Adapter Characterize Dialog Box



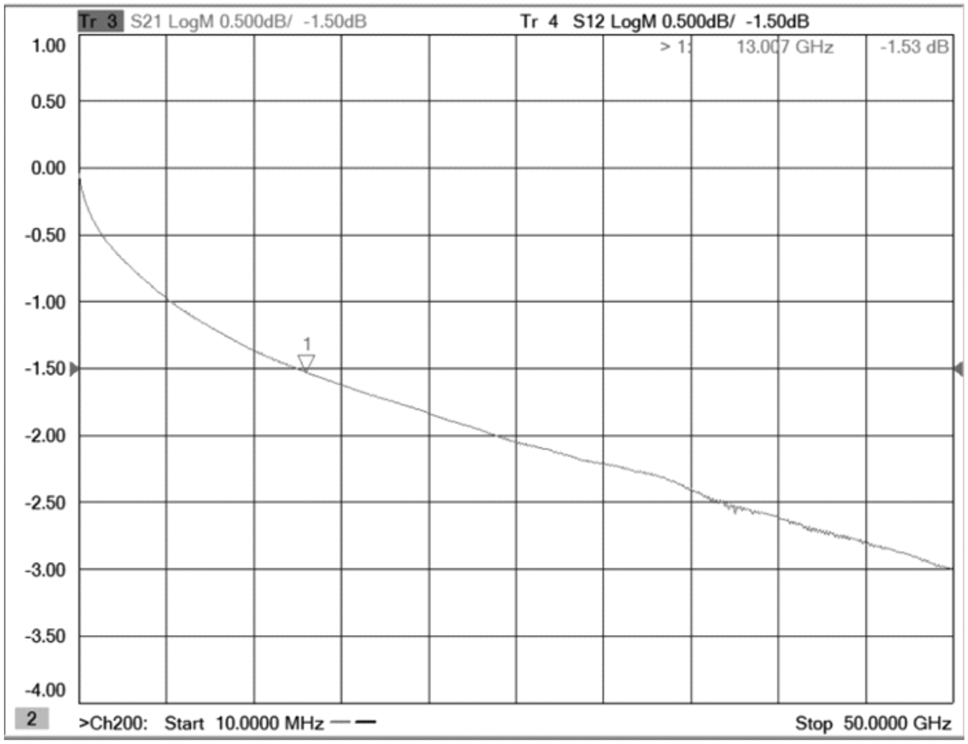
N5245_001_304

8. Click the Characterize And Save button in the lower-left corner of the dialog box. Save the cable S2P file.

9. Retrieve the saved cable S2P to plot out the insertion loss trace. S2P data also can be viewed directly on the PNA by pressing UTILITY Recall . Refer to the analyzer's embedded Help section "Save and Recall a File" if necessary.

10. 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 3-7.

Figure 3-7 Typical Cable Insertion Loss Response



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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 UTILITY Preset.
3. Press TRACE/CHANNEL Traces, then New Trace... . In the New Trace dialog box, click the S11 box, and then click OK.
4. Press RESPONSE Format, then Phase, then ENTRY Enter.
5. Press RESPONSE Avg. Verify that Average ON/off is ON. If not, press the Average on/OFF softkey to toggle it ON.

   The Averaging Factor box will appear directly above the display. In the Averaging Factor box, type 50 or click the arrows to select 50, and then press ENTRY Enter.

6. To provide a good reference, hold the test cable in a straight line perpendicular to the front panel of the network analyzer.

7. Press RESPONSE Avg , then Averaging Restart .

8. Wait for the analyzer to average the measurement 50 times (approximately two seconds).

9. To normalize the data trace: press MARKER/ANALYSIS Memory , then Data Trace , then Data Math , then Data/Memory , then ENTRY Enter .

10. Slowly make a 180 degree bend in the middle of the cable and hold it in that position.

11. For each trace: press RESPONSE Scale , then Scale .

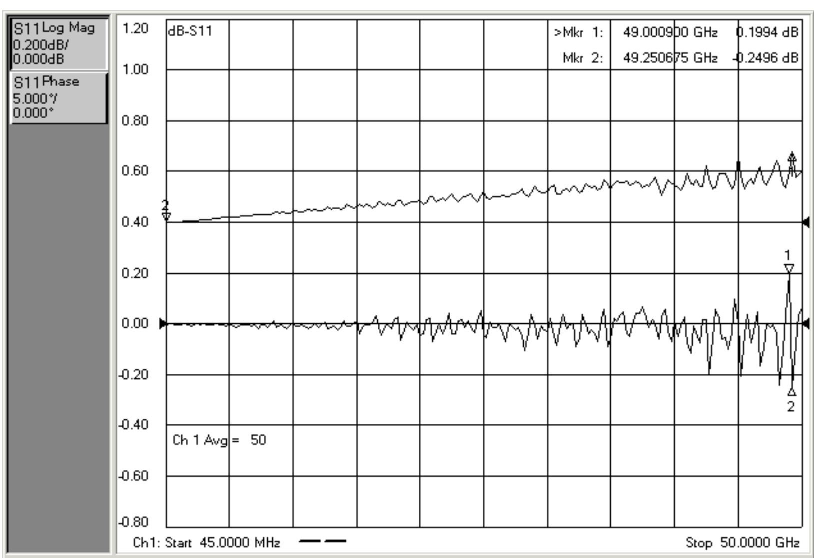
    The Scale Per Division box will appear directly above the display. Set the Scale Per Division for optimum viewing as shown in Figure 3-8.

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 3-8.

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 3-8 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 UTILITY [Preset].
3. Press RESPONSE [Avg]. Verify that Average ON/off is ON. If not, press the Average on/OFF softkey to toggle it ON.

   The Averaging Factor box will appear directly above the display. In the Averaging Factor box, type 100 or click the arrows to select 100, and then press ENTRY [Enter].
4. Wait for the analyzer to average the measurement 100 times (approximately five seconds).
5. To normalize the data trace: press MARKER/ANALYSIS [Memory], then Data Trace, then Data Math, then Data/Memory, then ENTRY [Enter].
6. To adjust the display scale:
   a. Press RESPONSE [Scale], then Scale.

      The Scale Per Division box will appear directly above the display. Set the Scale Per Division for 0.5 dB. Press ENTRY [Enter].
   b. Press Reference Level.

      The Reference Level box will appear directly above the display. Set the Reference Level for 0 dB. Press ENTRY [Enter].
7. Disconnect and then reconnect the cable to the test port. Tighten the connection to the specified torque for the connector type.
8. Press RESPONSE [Avg], then Averaging Restart.
9. Look at the trace for spikes or modes.

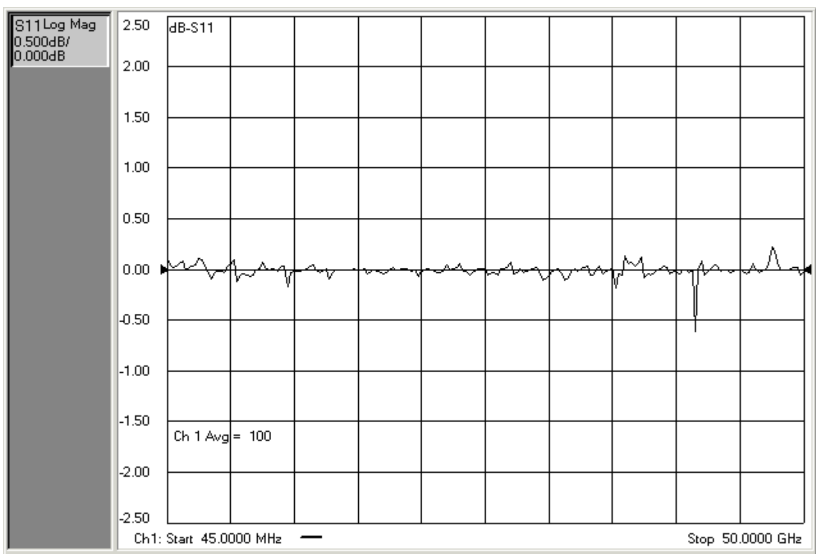
10. To re-normalize the data trace of the reconnected cable: press MARKER/ANALYSIS Memory, then Data->Memory, then ENTRY Enter.

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 3-9.

12. For the Port 2, 3, and 4 Check, connect the cable (with the load attached) to the respective port and repeat steps 2 through 11.

Figure 3-9 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.

NOTE

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

together as a “system”. It DOES NOT verify that any of these components pass their specifications independently. The user is responsible for independently calibrating and verifying the proper operation of the calibration kit and test port cables prior to performing the system verification.

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.

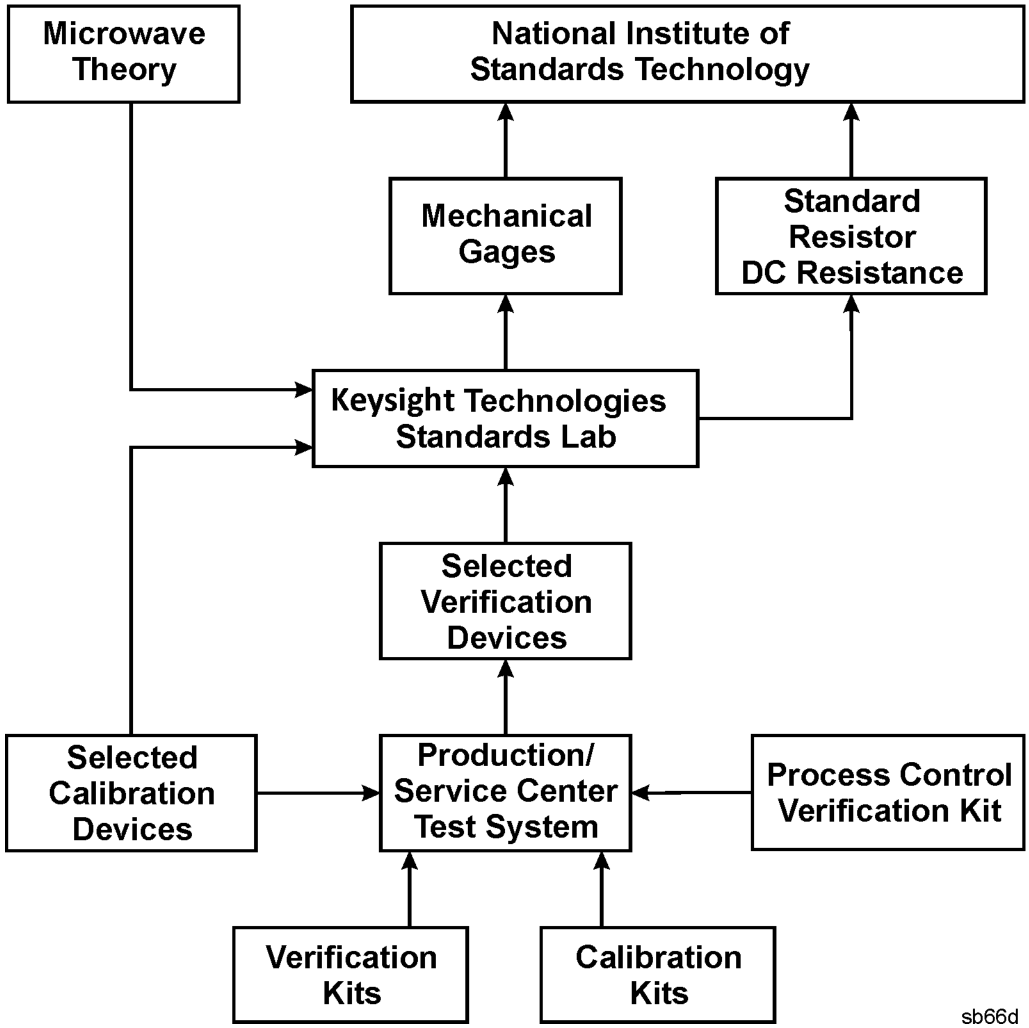
Any measurement result is the vector sum of the actual test device response plus all error terms. The precise effect of each error term depends on its magnitude and phase relationship to the actual test device response. When the phase of an error response is not known, phase is assumed to be worst-case (–180° to +180°). 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 a Keysight 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 3-10). This chain of measurements defines how the verification process brings traceability to the network analyzer system.

Figure 3-10 NIST Traceability Path for Calibration and Verification Standard



Performing System Verification

The following verification procedure is automated by the analyzer firmware. The process for the verification is:

- connect cables to the analyzer test ports
- perform a calibration or recall a recent calibration
- run the system verification program for the verification devices

Each time through the verification process, you are prompted to make necessary connections and perform or recall a calibration as part of performing the verification. If you select to perform a calibration, you are guided through the calibration procedure. This part of the process can be eliminated if you choose to load an existing recent calibration that was created by the verification process. If necessary, refer to the analyzer's on-line embedded help for information on storing and recalling calibrations.

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 For system verification to perform correctly, it is NECESSARY that the verification devices be measured with their female connectors connected to port 1 or 3 and their male connectors connected to port 2 or 4.

NOTE Although the performance for all 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	1.85 mm	2.4 mm	3.5 mm	Type-N
Calibration kit	85058B/E N4694A ECal	85056B/D N4692A ECal	85052B, C, D N4691 ECal	85054B/D N4690A E-cal
Verification kit	85058V	85057B	85053B	85055A
Cables	N4697E	85133C/D/E/F	Single cable: 85134E Cable pair: 85134F	Single cable: 85135E (2.4 mm NMD to 7 mm) Cable pair: 85135F (2.4 mm NMD to 7 mm)
Adapters	None required	None required	None required	With single cable: an 85130E adapter and a 7mm to Type-N adapter from the 85054B calibration kit. With cable pair: Two 7mm to Type-N adapters from the 85054B calibration kit.

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 be regularly tested.

If the system verification is performed with a non-Keysight cable, ensure that the cable meets or exceeds the specifications for the test cable specified in the previous table, "Equipment Used in the System Verification Procedure." Refer to the cable's user's guide for specifications.

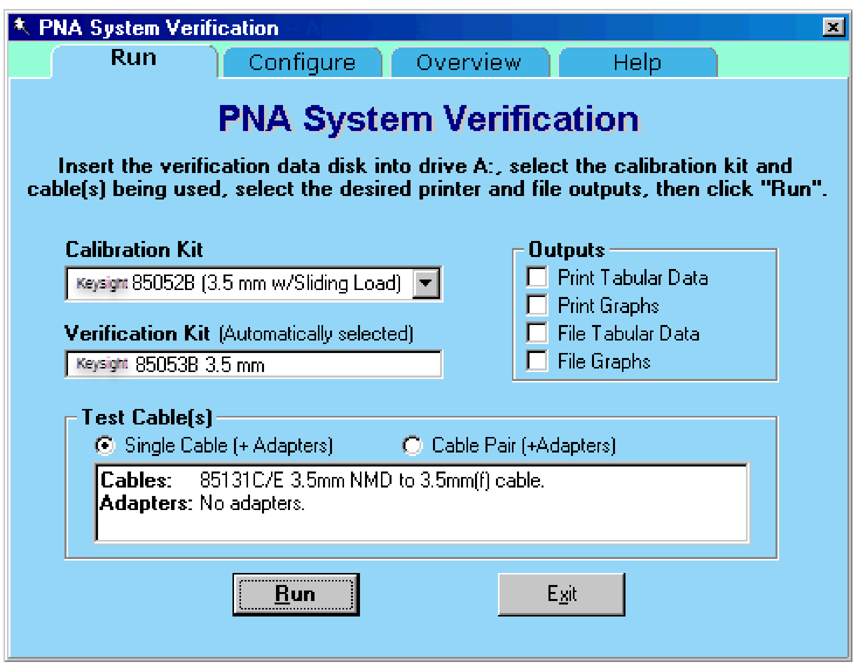
Kit Substitution

Non-Keysight calibration kits and verification kits are not recommended nor supported.

System Verification Procedure

1. 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.
2. Insert the verification kit disk into the analyzer disk drive.
3. Press UTILITY System, then Service, then System Verification. The System Verification dialog box is displayed; refer to Figure 3-11.

Figure 3-11 System Verification Dialog Box



4. In the Calibration Kit box, select the calibration kit or electronic calibration module (ECal) 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 3-11.
5. Under Printer Output, click one of the following options. Refer to Figure 3-11.

– Print Tabular Data: Prints the verification data in tabular form which includes measured data and uncertainty limits. For an example, refer to Figure 3-13 on page 3-29.

– Print Graphs: 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 3-14 on page 3-31.

– File Tabular Data: Writes the tabular data to a text file in the Windows XP directory
C:\Program Files\Keysight\Network Analyzer\Documents or the Windows 7 directory
C:\Users\Public\Public Documents\Network Analyzer\Documents\SysVer.

– File Graphs: Saves a screen image in PNG format in the Windows XP directory
C:\Program Files\Keysight\Network Analyzer\Documents or the Windows 7 directory
C:\Users\Public\Public Documents\Network Analyzer\Documents\SysVer.

NOTE For printed output, it is assumed that the printer has been tested and the Windows 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.)

To modify the number of ports to be verified or to change the number of devices to measure, click on the Configure tab and make the desired selections.

6. Click Run.
7. Follow the instructions on the analyzer for performing a full calibration or recalling an existing recent calibration.
8. Follow the instructions on the analyzer for performing the system verification; inserting the verification devices as prompted.

If the System Fails the Verification Test

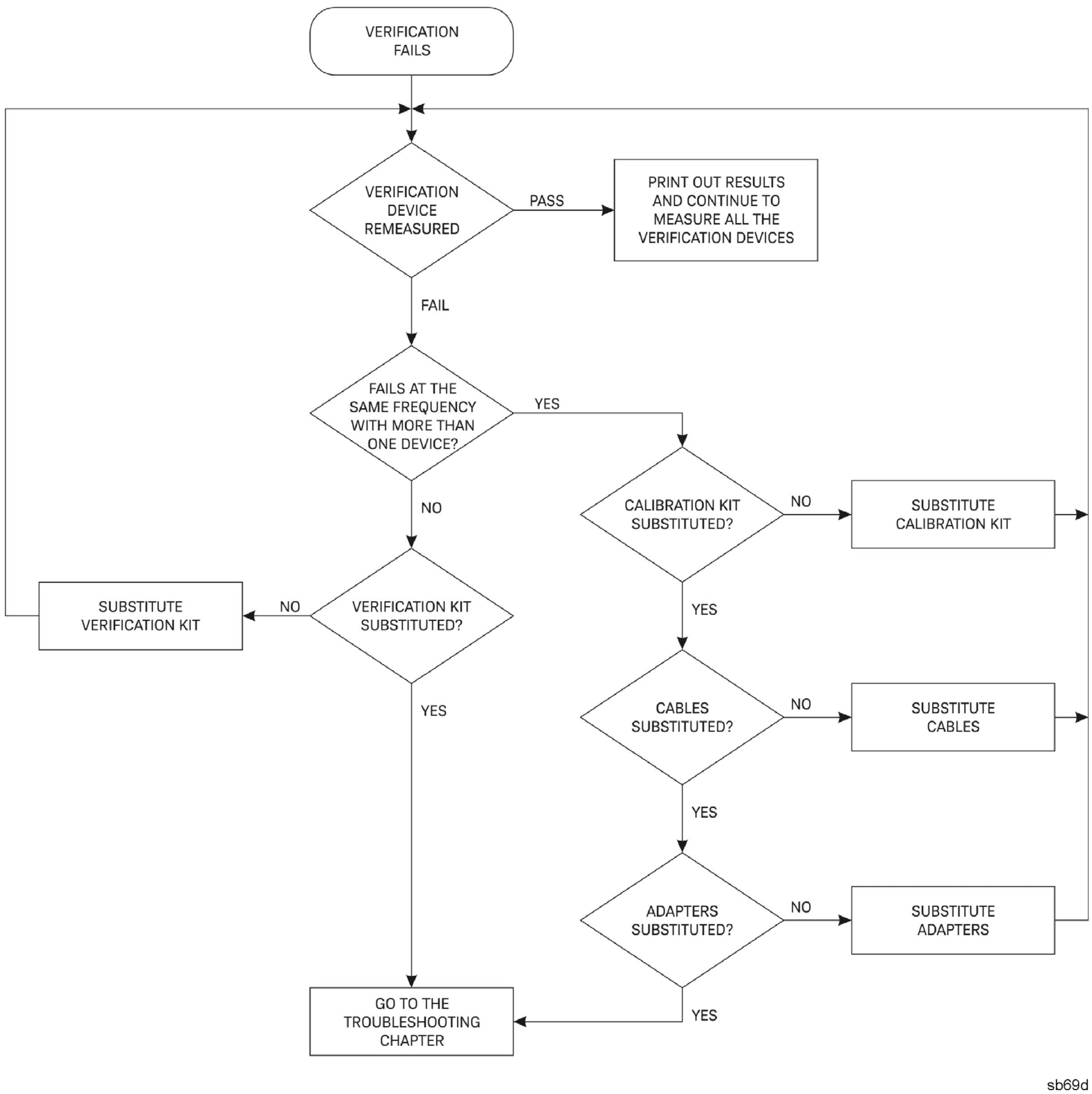
NOTE Inspect all connections. Do not remove the cable from the analyzer test port. This will invalidate the calibration that you performed earlier.

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 8-6.

5. Refer to Figure 3-12 for additional troubleshooting steps.

Figure 3-12 System Verification Failure Flowchart



Interpreting the Verification Results

Figure 3-13 shows an example of typical verification results with Print 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 3-13 Example of Printed Tabular Verification Results

PNA System Verification

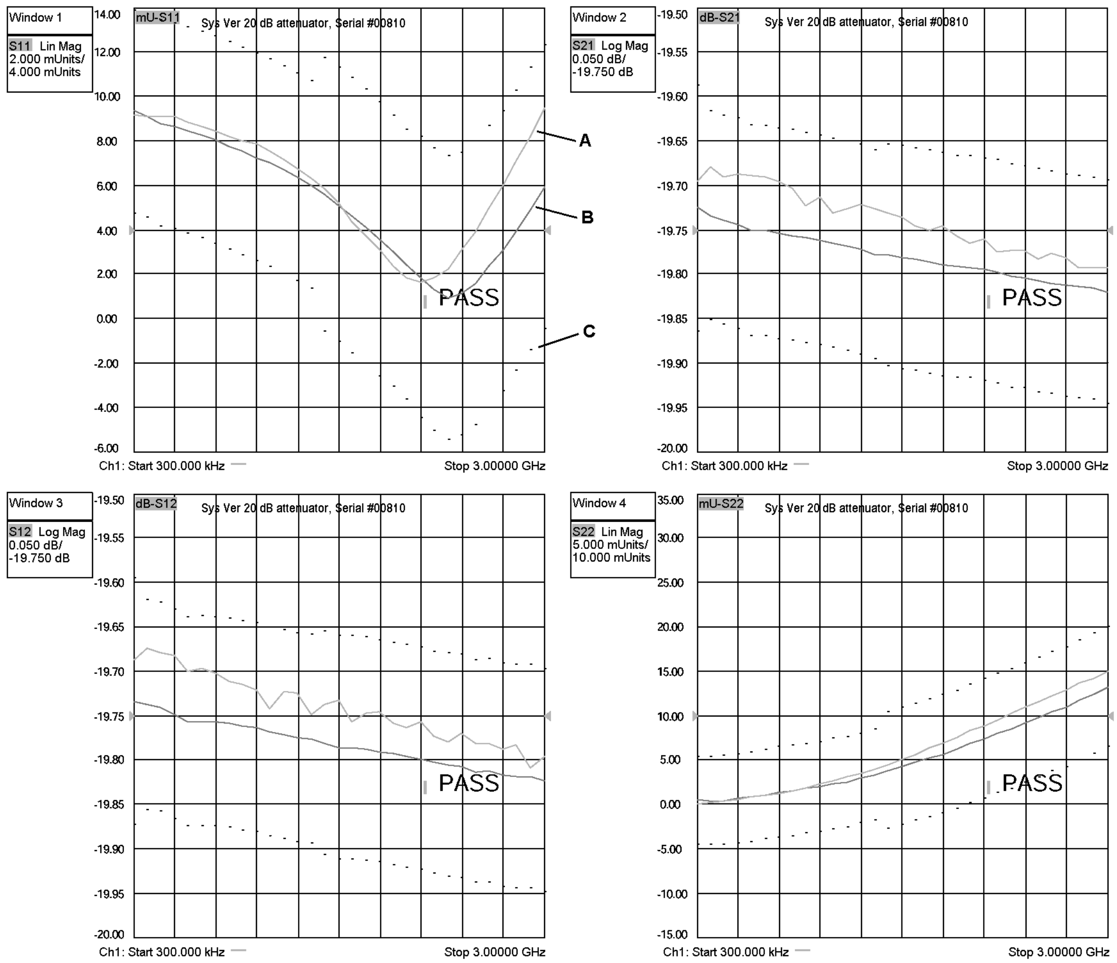
Model: N5230A 225 Ser. Num.: US43390055 Test Time: 12/8/2004 2:08:35 PM
Device: 20 dB Attenuator, Serial #02743 S11 Results PASS

	S11 MAGNITUDE (lin)				S11 PHASE (deg)			
Freq [GHz]	Lower Limit (lin)	Meas'd Data (lin)	Upper Limit (lin)	Total Uncert +/-	Lower Limit (deg)	Meas'd Data (deg)	Upper Limit (deg)	Total Uncert +/-
0.045	0.0067	0.0045	0.0113	0.0090	n/a	177.46	n/a	n/a
0.50	0.0067	0.0046	0.0114	0.0091	n/a	155.77	n/a	n/a
1.00	0.0057	0.0047	0.0125	0.0091	n/a	127.90	n/a	n/a
1.50	0.0043	0.0050	0.0139	0.0091	n/a	99.52	n/a	n/a
2.00	0.0034	0.0055	0.0148	0.0091	n/a	72.43	n/a	n/a
2.50	0.0076	0.0061	0.0208	0.0142	n/a	46.58	n/a	n/a
3.00	0.0068	0.0067	0.0216	0.0142	n/a	21.57	n/a	n/a
3.50	0.0066	0.0075	0.0227	0.0146	n/a	-0.45	n/a	n/a
4.00	0.0060	0.0086	0.0233	0.0146	n/a	-20.94	n/a	n/a
4.50	0.0056	0.0098	0.0237	0.0147	n/a	-39.48	n/a	n/a
5.00	0.0053	0.0109	0.0241	0.0147	n/a	-56.13	n/a	n/a
5.50	0.0051	0.0118	0.0242	0.0147	n/a	-71.75	n/a	n/a
6.00	0.0050	0.0125	0.0244	0.0147	n/a	-86.47	n/a	n/a
6.50	0.0049	0.0131	0.0244	0.0147	n/a	-100.81	n/a	n/a
7.00	0.0057	0.0136	0.0236	0.0147	n/a	-113.94	n/a	n/a
7.50	0.0061	0.0138	0.0232	0.0147	n/a	-125.68	n/a	n/a
8.00	0.0059	0.0138	0.0234	0.0147	n/a	-135.63	n/a	n/a
8.50	0.0110	0.0136	0.0287	0.0198	n/a	-144.53	n/a	n/a
9.00	0.0107	0.0133	0.0290	0.0199	n/a	-152.31	n/a	n/a
9.50	0.0101	0.0130	0.0297	0.0199	n/a	-159.32	n/a	n/a
10.00	0.0092	0.0129	0.0305	0.0199	n/a	-165.12	n/a	n/a
10.50	0.0080	0.0129	0.0317	0.0199	n/a	-169.47	n/a	n/a
11.00	0.0066	0.0130	0.0332	0.0199	n/a	-172.95	n/a	n/a
11.50	0.0051	0.0135	0.0347	0.0199	n/a	-176.46	n/a	n/a
12.00	0.0035	0.0140	0.0364	0.0199	n/a	-179.98	n/a	n/a

Figure 3-14 shows an example of typical verification results with Print Graphs selected in the Printer Output area of the System Verification dialog box. 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 3-14.
- Data measured at the factory from the verification kit. Labeled as B in Figure 3-14.
- Upper and lower limit points as defined by the total system uncertainty system. Labeled as C in Figure 3-14.

Figure 3-14 Example of Printed Graphical Verification Results



Performance Tests

The performance tests verify the electrical performance of your PNA. These performance tests are included in the N7840A software package and are embedded in the analyzer's firmware with Option S93898A/B. Your analyzer is automatically configured for each individual test.

The model numbers of the equipment used by these performance tests are specified under "Required Service Test Equipment" on page 2-4.

There are nine tests in the Option S93898A performance test package:

– Source Power Accuracy Test
– Source Maximum Power Output Test
– Source Power Linearity Test
– Frequency Accuracy Test
– Trace Noise Test
– Receiver Compression Test
– Noise Floor Test
– Calibration Coefficients Test
– Dynamic Accuracy Test
– Dynamic Accuracy at Low Frequency (Available with LFE Option 205/220/420/425)
– Receiver Noise Figure Test
– Noise State Calibration Coefficients
– Noise Jitter Test
– Noise Receiver Linearity Test
– Noise Receiver Compression 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:

– Power meter
– Power sensors

– Any necessary adapters

Description of the Test:

1. The analyzer is Preset.
2. The analyzer is set up for a CW reflection measurement on the test port to be measured.
3. A power sensor is connected to the test port, using any necessary adapters.
4. The analyzer frequency is set to the desired value.
5. The power meter correction table is set to the same frequency.
6. The output power is measured, and the value is compared to the Preset setting.
7. This process is repeated at hundreds of frequencies across the analyzer's full range. The difference between the measured power and the output setting must fall within the specified accuracy range at all points for the test to pass.

If the Analyzer Fails this Test:

– Perform the "Source Adjustment" on page 3-55 and repeat this test.

– If the analyzer still fails this test, troubleshoot the source section of the analyzer and then repeat this test. Refer to "Checking the Source Group" on page 4-35.

Source Maximum Power Output Test

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

Specification Tested: Test Port Output–Maximum Leveled Power

Equipment Used:

– Power meter

– Power sensors

– Any necessary adapters

Description of the Test:

1. The analyzer is Preset.
2. The analyzer is set up for a CW reflection measurement on the test port to be measured.
3. A power sensor is connected to the test port, using any necessary adapters.
4. The analyzer frequency is set to the desired value.

5. The power meter correction table is set to the same frequency.
6. The analyzer's output power is increased until a "Source Unleveled" error is detected. The output power is then decreased in increments of 0.01 dB until the error goes away. if the output power reaches +18 dBm without any error, the power is left at this level.
7. The power level at this point is measured and compared to the maximum output power specification.
8. This process is repeated at hundreds of frequencies across the analyzer's full range in every specified path configuration.

If the Analyzer Fails this Test:

Troubleshoot the source section of the analyzer and then repeat this test. Refer to "Checking the Source Group" on page 4-35.

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:

– Test cable
– 20 dB attenuator if the analyzer does not have an internal step attenuator

Description of the Test:

Ports 1 and 2 are tested as a pair. The Port 2 receiver is used to test the linearity of the source power out of Port 1, and vice versa. Ports 3 and 4 are similarly tested as a pair on 4-Port analyzers. The receiver linearity is the standard against which the source linearity is checked.

1. The analyzer is Preset.
2. The analyzer is set up for a CW transmission measurement on the test port pair to be measured.
3. A test cable is connected between the port pair to be tested with 20 dB of attenuation in series with the cable. This is done with an internal source step attenuator or an external 20 dB attenuator. This attenuation ensures that the receiver remains in its linear range.
4. The receiver measurement is normalized at this Preset power level.
5. The source setting is then stepped from the minimum to the maximum ALC power setting range in 1 dB steps, and the receiver power is measured at each setting.

6. The non-linearity in dB at each frequency point is calculated as the difference between the change in the source power setting away from Preset and the change in the receiver power reading.
7. This power linearity measurement is repeated at several CW frequencies across the full frequency range of the analyzer.

If the Analyzer Fails this Test:

– Perform the "Source Adjustment" on page 3-55 and repeat this test.

– If the analyzer still fails this test, troubleshoot the source section of the analyzer and then repeat this test. Refer to "Checking the Source Group" on page 4-35.

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:

– Frequency counter

– Test cable

– Adapters

Description of the Test:

This test is performed over the full frequency range of the source synthesizer board, not the full frequency range of the analyzer. To generate the higher frequencies, the analyzer passes the synthesizer signal through a series of frequency doublers. These doublers exactly double the source frequency, so the deviation from a perfectly accurate frequency is exactly doubled. The frequency accuracy is specified as the ratio parts per million (ppm), so this ratio is unaffected by the signal doubling. Therefore, only the frequency accuracy of the synthesizer board needs to be tested.

1. The analyzer is Preset.
2. The analyzer is set up for a CW measurement on Port 1.
3. A test cable is connected between Port 1 and a frequency counter with any necessary adapters.
4. The signal frequency is measured and compared with the analyzer source frequency setting. The difference must be less than the source frequency divided by 16 for a 1 part per million (ppm) specification.
5. This test is repeated at several frequencies across the range of the source synthesizer board.

If the Analyzer Fails this Test:

– Verify the accuracy of the 10 MHz OCXO by using a frequency counter to measure 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 3-54 and then 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:

Trace Noise is a calculation of the standard deviation of a 201 point CW measurement. In a healthy analyzer, this measurement is only affected by the sampling error of the analog to digital converters on the SPAM board.

Ports 1 and 2 are tested as a pair using S21 and S12 measurements. Ports 3 and 4 are similarly tested as a pair on 4-port analyzers using S43 and S34 measurements.

1. The analyzer is Preset.
2. The analyzer is set up for a 201 point CW transmission measurement for the port pair to be tested with the specified IF bandwidth (typically 1 kHz). Both a magnitude and a phase trace are displayed.
3. A test cable is connected between the port pair to be tested.
4. The analyzer is set to a series of CW frequencies across its full frequency range. The analyzer's trace statistics function is used to calculate the standard deviation of both the magnitude trace and the phase trace.
5. These standard deviation values are reported as the analyzer's trace noise and are compared with the Trace Noise magnitude and phase specifications.

If the Analyzer Fails this Test:

A failure of this test indicates a fault in the receiver's IF chain between the mixer and the A12 SPAM board. This can indicate a faulty assembly or a loose cable.

– Check for proper torquing of all semi-rigid cables in the receiver chain, and then repeat this test.

– If the analyzer still fails this test, replace the A12 SPAM board and repeat this test. Most failures are due to this board. Refer to "Removing and Replacing the A4–A17 Boards" on page 7-20.

– If the analyzer still fails this test, replace the mixer module for the failing receiver, and then 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:

– U3070AK01 or U3070BK01 Compression Test Set
– Power meter
– Power sensors
– Two test cables
– Calibration kit
– 10-dB and 20-dB pads if the analyzer does not have an internal step attenuator

Description of the Test:

For most analyzer models, the receiver compression level is higher than the maximum source output power. Therefore, an external amplifier is required. This test also requires that two attenuators be switched in and out of the RF path. These requirements are met with the use of the Compression Test Set. The procedure outlined here is for those models which require the test set.

1. The analyzer is Preset. The two test set output attenuators are set to 0 dB.
2. The analyzer is set up for a 201 point CW transmission measurement for the port pair to be tested with the specified IF bandwidth (typically 1 kHz).
3. A test cable is connected between the analyzer source port and the test set input port. A test cable is connected to the test set output port.
4. A power sensor is connected to the end of the test cable.
5. For a series of CW frequencies across the analyzer's full frequency range, the source output level is adjusted to achieve the specified receiver compression power level (typically the receiver's maximum input power level).
6. The power sensor is disconnected from the test cable and the cable is connected to the port to be tested.
7. The analyzer steps through each CW frequency as the absolute log magnitude value (dBm) and the relative phase for the receiver under test is read (Pa).
8. The first test set output attenuator is set to 20 dB.
9. The magnitude and phase measurements using the receiver under test are read: (Pb).
10. The second test set output attenuator is set to 20 dB.

11. The magnitude and phase measurements using the receiver under test are read: (Pc).

12. The first test set output attenuator is set to 0 dB.

13. The magnitude and phase measurements using the receiver under test are read: (Pd).

14. The compression for each point is calculated as (Pa–Pb) – (Pd–Pc).

If the Analyzer Fails this Test:

– Run the Receiver Characterization adjustment, and repeat this test.

– If the analyzer still fails this test, replace the A23 mixer brick for a Port 1 or Port 2 failure or the A24 mixer brick for a Port 3 or Port 4 failure, then repeat this test. Refer to "Removing and Replacing the A27 and A28 Mixer Bricks" on page 7-43.

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:

– Power meter

– Power sensors

– Test cable

– Calibration kit

Description of the Test:

This test uses the source signal out of one analyzer test port as part of the noise floor measurement on another test port. Port 2 is the source port when measuring the noise floor of Port 1. Port 1 is the source port when measuring the noise floor of Ports 2, 3, and 4.

1. The analyzer is Preset.

2. The analyzer is set up for a CW transmission measurement between the source port and the test port to be measured. The analyzer is set to an IF bandwidth of 1 kHz and 801 points per sweep.

3. A test cable is connected to the source port.

4. A power sensor is connected to the end of the test cable with any necessary adapters.

5. For hundreds of frequencies across the analyzer's full range, a source power calibration is performed to ensure a flat power response at the end of the cable at the Preset power level.

6. The power sensor is disconnected and the cable is connected to the port to be tested.
7. A CW linear measurement sweep is measured for each test point. The receiver reference power level, Pref, in dBm is calculated for each point from the mean of each sweep.
8. The test cable is removed and loads are connected to both ports.
9. A CW linear measurement sweep is measured for each test point. The receiver test power level, Ptest, in dBm is calculated for each point from the mean of each sweep.
10. The corrected noise floor in dBm is calculated for a 10 Hz IF bandwidth using: PNoiseFloor = Ptest – 19.96 dB – (Preset Power – Pref).

If the Analyzer Fails this Test:

– If the analyzer fails this test, replace the A23 mixer brick for a Port 1 or Port 2 failure or the A24 mixer brick for a Port 3 or Port 4 failure, then repeat this test. Refer to "Removing and Replacing the A27 and A28 Mixer Bricks" on page 7-43.

– If the analyzer still fails this test, replace the A12 SPAM board and then repeat this test. Refer to "Removing and Replacing the A4–A17 Boards" on page 7-20.

Calibration Coefficients Test

Function of the Test: To verify the uncorrected calibration coefficients of your analyzer. The calibration coefficients are specified at the test port without any cables, so calibrations must be performed in both the forward and reverse directions to eliminate the effects of the test cable.

Specification Tested: Uncorrected System Performance

Equipment Used:

– Calibration kit

– Test cable

Description of the Test:

Two full SOLT 2-port calibrations are performed on each port pair. Ports 1 and 2 are tested as a pair. Ports 3 and 4 are tested as a pair on 4-port analyzers. Isolation is turned off during each calibration.

1. A test cable is connected to Port 1.
2. A calibration is performed between the end of the test cable and Port 2. The Port 2 directivity and source match and the S21 load match are retrieved from the analyzer.
3. The test cable is moved to Port 2.

4. A calibration is performed between the end of the test cable and Port 1. The Port 1directivity and source match and the S12 load match are retrieved from the analyzer.
5. On some older analyzer models, the reflection tracking and transmission tracking error terms were also specified. For those models, these error terms are also retrieved from the analyzer.
6. This process is repeated for Ports 3 and 4 on 4-port analyzers.

If the Analyzer Fails this Test:

– Failure of the directivity error term is often due to a faulty test port coupler. Replace the coupler and repeat this test.
– Failure of the source or load match error terms is due to faulty hardware between the test port and the internal source. Refer to Chapter 7, “Repair and Replacement Procedures.” for instructions on replacing the suspected faulty component or assembly.

Dynamic Accuracy Test

This description applies to all N522xB, N5231B/32B/34B/35B/39B, and N5247B instruments **without** LFE. For all instruments with LFE, see test “Dynamic Accuracy at Low Frequency (Available with LFE Option 205/220/420/425)” on page 3-41.

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

Specification Tested: Test Port Input–Dynamic Accuracy

Equipment Used:

– U3020AD01 or U3020BD01 dynamic accuracy test set
– Signal generator
– Power meter
– Power sensor
– Two tes t 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. A test cable is connected between the analyzer's source port and the dynamic accuracy test set's Source 1 In port. A test cable is connected between the signal generator and the test set's Source 2 In port. A test cable is connected to the test set's Receiver Out port, and the power sensor is connected to the end of this cable.

The test set's output attenuator is set to 20 dB. With the signal generator RF turned off, the PNA source power is adjusted until the power sensor reads -20 dBm. The PNA source is then turned off, the signal generator RF is turned on, and the signal generator power is adjusted until the power sensor reads -20 dBm.

3. The power sensor is disconnected and the test cable is attached to the analyzer port under test.

4. Both sources are turned on and the signal generator's frequency is set to 2 Hz above the analyzer's frequency. By combining these two signals together, the resultant signal will be a perfect sine wave with a magnitude which varies from -17 dBm to -23 dBm at a rate of 2 Hz.

5. The analyzer's receiver measurement is retrieved and compared with a perfect sine wave. Any deviation is due to receiver non-linearity.

6. The test set's output attenuator is changed in 5 dB steps from 0 to 60 dB, and this measurement is repeated.

7. With the 1 dB of overlap in each measurement, the data for each attenuator setting can be stitched together to provide a complete receiver linearity profile from +3 dBm to -63 dBm.

8. This test is repeated for each receiver.

If the Analyzer Fails this Test:

- If the analyzer fails this test, rerun the test.
- If the analyzer fails this test repeatedly, replace the A23 mixer brick for a Port 1 or Port 2 failure or the A24 mixer brick for a Port 3 or Port 4 failure, then repeat this test. Refer to "Removing and Replacing the A27 and A28 Mixer Bricks" on page 7-43.
- If the analyzer still fails this test, replace the A12 SPAM board and repeat this test. Refer to "Removing and Replacing the A4–A17 Boards" on page 7-20.

Dynamic Accuracy at Low Frequency (Available with LFE Option 205/220/420/425)[1]

This description applies to all instruments with low frequency extension (LFE) Option 205, 220, 405, 420, and 425.

1. Your model PNA may not have available all of the LFE Options listed.

Function of the Test: This test will be set to the LFE path at 99.6 MHz. The test procedure is the same as the Dynamic Accuracy test process except that the LFE test process uses a 2-channel function generator as the source which has sufficient power range to cover each power step. Therefore a test set is not required.

Specification Tested: Dynamic Accuracy at Low Frequency

Equipment Used:

– Function generator (33622A)
– Power splitter (11667B)
– Fixed attenuator (10dB x2) – (8493C Option 010)
– Four test cables

Description of the Test:

NOTE

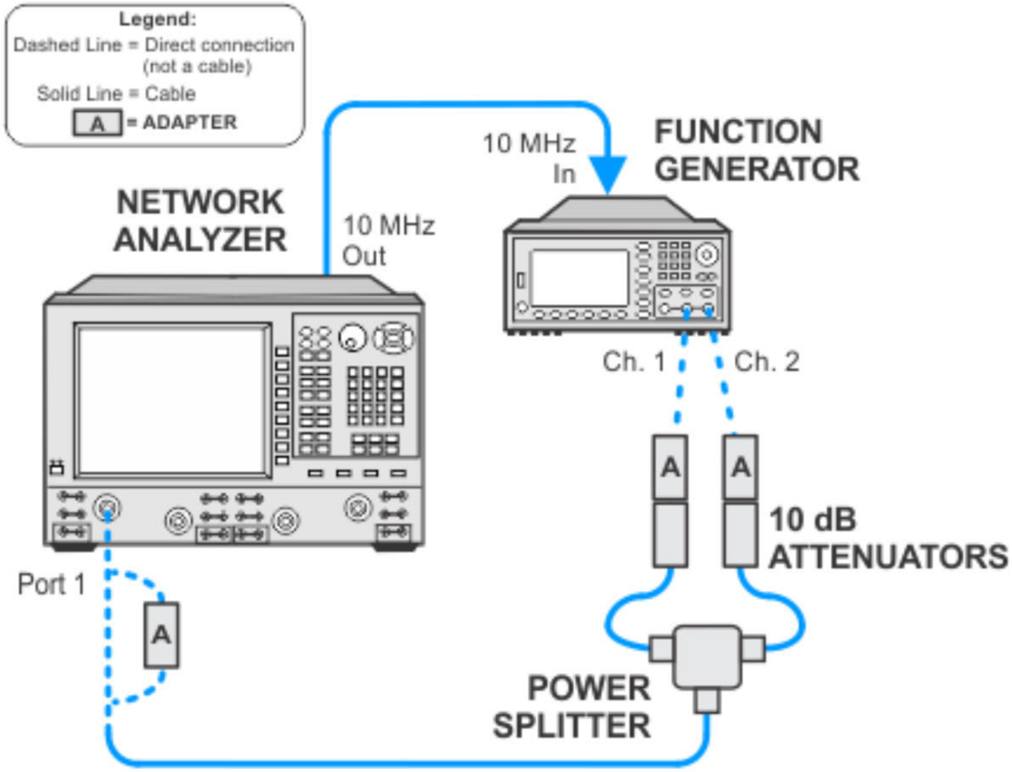
Due to the complexity of the PNA family of analyzers, the following notes apply to illustrations in the PNA Help:

– Only a single representative model will be shown.
– Some illustrations may differ than those in TME.
– If the test procedure applies to multiple ports, illustrations will show the setup on only one test port.
– Setups for some option configurations may not appear in the Help.

NOTE

For the two cables between the power splitter and attenuators, choose short but flexible cables.

Figure 3-15 Dynamic Accuracy at Low Frequency Setup



If the Analyzer Fails this Test:

- If the analyzer fails this test, rerun the test.
- If the analyzer fails this test repeatedly, run the DC continuity test. Refer to "DC Continuity Test the LFE Board and Test Ports (Available With Low Frequency Extension (LFE) Installed Option 205/425)" on page 3-52 and to "Removing and Replacing the A70 or A75 Low Frequency Extension (LFE) Board" on page 7-72.
- If the analyzer still fails this test, replace the A70 LFE board and repeat this test. Refer to "Removing and Replacing the A70 or A75 Low Frequency Extension (LFE) Board" on page 7-72.
- If the analyzer fails this test repeatedly, replace the A23 mixer brick for a Port 1 or Port 2 failure or the A24 mixer brick for a Port 3 or Port 4 failure, then repeat this test. Refer to "Removing and Replacing the A27 and A28 Mixer Bricks" on page 7-43.
- If the analyzer still fails this test, replace the A12 SPAM board and repeat this test. Refer to "Removing and Replacing the A4–A17 Boards" on page 7-20.

DC Continuity Test the LFE Board and Test Ports (Available with LFE Option 205/220/420/425)[1]

The DC continuity test verifies that the LFE board is installed correctly and does not have any opens or shorts in the DC path.

1. Using a DVM, connect one test probe to the center conductor of the RF port 1 on the front panel.
2. Connect the other test probe to the port 1 bias input (**BIAS 1 IN**) on the rear panel.
3. Verify the DVM measures <10Ω.
4. Repeat these steps for each of the other test ports.

NOTE If the DVM value is 0Ω or >10Ω, then something is incorrectly installed or there is an open or short somewhere in the LFE board/cable path:

– Verify the gray DC bias cables installed in "Top Assemblies and Cables, All Options, Serial Number Prefixes <6021" on page 6-18, "Top Assemblies and Cables, All Options, Serial Number Prefixes ≥6021" on page 6-24 and the blue RF flexible cables installed in Chapter 6 in the "Bottom Assemblies" section—for your LFE option—are connected correctly and not open or shorted.

Receiver Noise Figure Test

Function of the Test: To measure the noise figure of the PNA-X noise receiver system.

Specification Tested: Test Port Input: Option 029 or E29 – Receiver Noise Figure

Equipment Used:

– 346C noise source

– BNC cable

Description of the Test:

1. The analyzer is Preset.
2. The 346C noise source is connected to Port 2. A BNC cable is connected between the noise source and the +28V VDC output on the rear panel of the analyzer.
3. The analyzer is set to make a noise power density measurement with an 800 kHz noise IF bandwidth using hundreds of points across the full frequency range of the noise receiver.

1. Your model PNA may not have available all of the LFE Options listed.

4. The ENR data file for the noise source is read into the analyzer.
5. The noise source is turned on and a hot noise response is measured, Phot.
6. The noise source is turned off and a cold noise response is measured, Pcold.
7. The receiver noise figure for each point is calculated from:

$$NF = 10 * log10\left(\frac{ENR}{\frac{Phot}{Pcold} - 1}\right)$$

8. This test is repeated for 2, 4, 8, and 24 MHz noise IF bandwidths.

If the Analyzer Fails this Test:

A failure of this test indicates a fault in the noise receiver chain. This can indicate a faulty assembly or a loose cable.

– Check for proper torquing of all semi-rigid cables in the receiver chain, and then repeat this test.
– If the analyzer still fails this test, replace the A7 Noise Receiver board and repeat this test. Refer to “Removing and Replacing the A4–A17 Boards” on page 7-20.

Noise State Calibration Coefficients

CAUTION

IMPORTANT!

For the most current information on the Table 7-2 “Verification, Performance, and Other Tests and Procedures” column’s content, refer to https://cal.software.keysight.com/PNA/Help/N7840AWebHelp.htm.

Noise Jitter Test

Function of the Test: To measure the stability of a signal in the internal noise receiver system.

Specification Tested: Test Port Input: Option 029 or E29 – Noise Jitter

Equipment Used: Load standard

Description of the Test:

Noise jitter is a calculation of the standard deviation of a 201 point CW measurement using the noise receiver. In a healthy analyzer, this measurement is only affected by the sampling error of the analog to digital converter on the noise receiver board.

1. The analyzer is Preset.

2. The analyzer is set to make a noise power density measurement with the noise gain set to 0 dB and the noise bandwidth set to 4 MHz. The analyzer is set up for a 201 point CW transmission measurement using the noise receiver.

3. A load is connected to Port 2.

4. At each of hundreds of points across the full frequency range of the noise receiver, the noise jitter of the sweep is calculated from:

$$NJ = 10 * log10\left(\frac{1+\sigma}{mean}\right)$$

5. This test is repeated for the 15 and 30 dB noise gain settings.

If the Analyzer Fails this Test:

A failure of this test indicates a fault in the noise receiver chain. This can indicate a faulty assembly or a loose cable.

– Check for proper torquing of all semi-rigid cables in the receiver chain, and then repeat this test.

– If the analyzer still fails this test, replace the A7 Noise Receiver board and repeat this test. Refer to “Removing and Replacing the A4–A17 Boards” on page 7-20.

Noise Receiver Linearity Test

Function of the Test: To measure the relative power linearity of the analyzer’s noise receiver.

Specification Tested: Test Port Input: Option 029 or E29 – Noise Receiver Linearity

Equipment Used:

– U3020AD01 or U3020BD01 dynamic accuracy test set

– Signal generator

– Power meter

– Power sensor

– Two test cables

Description of the Test:

The linearity of the noise receiver is tested over its full dynamic range at a sing CW frequency. All three gain stages are tested at 2 dB increments with 8 noise averages per point. Since the PNA-X source cannot be on while noise figure measurements are made, an external signal source is required.

1. The signal generator is connected to the dynamic accuracy test set's source port and the dynamic accuracy test set's receiver port is connected to the PNA-X Port 2. A power sensor is connected to the dynamic accuracy test set's power meter port.
2. Within the dynamic accuracy test set, the source signal is routed through a small amplifier and a 10 dB step attenuator, A1, to a power splitter. One side of the power splitter is connected to the power sensor port. The signal from the other side of the splitter is routed through a 110 dB step attenuator, A2, to the receiver port.
3. The PNA-X is set to make a relative noise power measurement with the noise gain set to 0 dB.
4. With the amplifier active and A1 set to 0 dB, the signal generator power is adjusted to achieve exactly
   - 10.0 dBm at the power sensor. This is the power meter reference reading, Pmr.
5. A2 is set to 50, 60, or 70 dB, depending on the gain stage being tested, and the analyzer's noise receiver power level is measured. This is the analyzer reference reading, Par.
6. A1 is changed to 2, 4, 6, 8 and 10 dB. At each point, delta power levels are read on the power meter, Pmd and the analyzer, Pad.
7. The power linearity error at each point is calculated as Pe = (Pmr – Pmd) – (Par – Pad).
8. A2 is incremented 10 dB, A1 is set to 0 dB, and the signal generator's source power is adjusted until the receiver power level is exactly the same as it was before the attenuators were switched.
9. New power meter and analyzer receiver reference readings are recorded. The process is repeated until the total attenuation reaches the minimum test level.
10. The process is reset to the reference levels from step 4, and it is run in reverse until the total attenuation reaches the maximum test level.
11. This test is repeated for the 15 and 30 dB noise gain settings.

If the Analyzer Fails this Test:

A failure of this test indicates a fault in the noise receiver chain. This can indicate a faulty assembly or a loose cable.

– Check for proper torquing of all semi-rigid cables in the receiver chain, and then repeat this test.
– If the analyzer still fails this test, replace the A7 Noise Receiver board and repeat this test. Refer to "Removing and Replacing the A4–A17 Boards" on page 7-20.

Noise Receiver Compression Test

Function of the Test: To measure the PNA-X noise receiver compression at the receiver's specified maximum input power level.

Specification Tested: Test Port Input: Option 029 or E29 – Noise Receiver Input Range

Equipment Used:

– Power meter

– Power sensors

– Test cables

– 10 dB attenuator

Description of the Test:

The noise receiver compression level varies from -16 dBm for the high band of the low gain stage down to -52 dBm for the low band of the high gain stage. This range is too wide to get an accurate source power calibration for each gain stage using a standard power sensor. So the source power is calibrated at a higher power level, and the analyzer's standard receiver is used to accurately measure the effect of the added source attenuation which is needed to bring the source power down to the compression level.

To ensure that the match between the analyzer source and receiver is optimal for the most accurate measurements, an external 10 dB attenuator is used.

1. The analyzer is Preset.
2. A test cable is attached to Port 1 with a 10 dB attenuator at the end of the cable.
3. Using the low frequency power sensor, a source power calibration is performed at the end of the cable for dozens of frequency points. The power level is set between -9 and -18 dBm, at a multiple of 10 dB above the specified compression level.
4. This process is repeated for each of the three gain stages since each stage requires a different power setting.
5. Steps 3 and 4 are repeated using the high frequency power sensor.
6. The test cable and attenuator are attached to Port 2.
7. A receiver measurement is made at the calibration level and the receiver response is normalized.
8. The Port 1 source attenuator is set such that the power level matches the compression level and another sweep is made. The source power calibration is adjusted for any deviation from the expected power level change.
9. Steps 7 and 8 are repeated for each of the three gain stages.

10. The analyzer is set for a noise power density measurement using the noise receiver and a standard receiver measurement using the B receiver.

11. The source power calibration for the appropriate gain stage is applied and a sweep is made.

12. The source attenuator is set for an additional 10 dB and another sweep is made.

13. The noise receiver compression is calculated as the difference between the noise power density measurements minus the difference between the standard receiver measurements. The standard receiver is operating within its linear range, so it is used as the linearity standard for this measurement.

14. Steps 11 to 13 are repeated for each of the three gain stages.

If the Analyzer Fails this Test:

A failure of this test indicates a fault in the noise receiver chain. This can indicate a faulty assembly or a loose cable.

- Check for proper torquing of all semi-rigid cables in the receiver chain, and then repeat this test.
- If the analyzer still fails this test, replace the A7 Noise Receiver board and repeat this test. Refer to "Removing and Replacing the A4–A17 Boards" on page 7-20.

Dynamic Accuracy at Low Frequency (Available With Low Frequency Extension (LFE) Installed Option 205/425)

This description applies to all instruments with low frequency extension (LFE) Option 205, 220, 405, 420, or 425.

Function of the Test: This test will be set to the LFE path at 99.6 MHz. The test procedure is the same as the Dynamic Accuracy test process except that the LFE test process uses a 2-channel function generator as the source which has sufficient power range to cover each power step. Therefore a test set is not required.

Specification Tested: Dynamic Accuracy at Low Frequency

Equipment Used:

– Function generator (33622A)
– Power splitter (11667B)
– Fixed attenuator (10dB x2) – (8493C Option 010)
– Four test cables

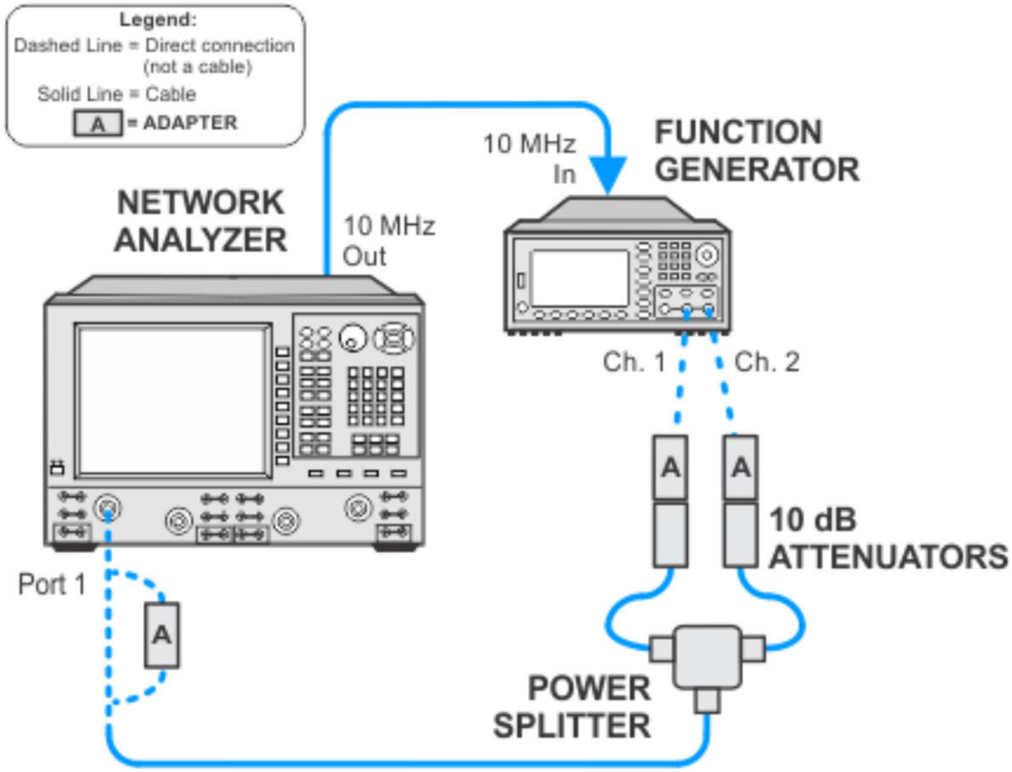
Description of the Test:

NOTE Due to the complexity of the PNA family of analyzers, the following notes apply to illustrations in the PNA Help:

– Only a single representative model will be shown.
– Some illustrations may differ than those in TME.
– If the test procedure applies to multiple ports, illustrations will show the setup on only one test port.
– Setups for some option configurations may not appear in the Help.

NOTE For the two cables between the power splitter and attenuators, choose short but flexible cables.

Figure 3-16 Dynamic Accuracy at Low Frequency Setup



If the Analyzer Fails this Test:

– If the analyzer fails this test, rerun the test.

– If the analyzer fails this test repeatedly, run the DC continuity test. Refer to "DC Continuity Test the LFE Board and Test Ports (Available With Low Frequency Extension (LFE) Installed Option 205/425)" on page 3-52 and to "Removing and Replacing the A70 or A75 Low Frequency Extension (LFE) Board" on page 7-72.

– If the analyzer still fails this test, replace the A70 LFE board and repeat this test. Refer to "Removing and Replacing the A70 or A75 Low Frequency Extension (LFE) Board" on page 7-72.

– If the analyzer fails this test repeatedly, replace the A23 mixer brick for a Port 1 or Port 2 failure or the A24 mixer brick for a Port 3 or Port 4 failure, then repeat this test. Refer to "Removing and Replacing the A27 and A28 Mixer Bricks" on page 7-43.

– If the analyzer still fails this test, replace the A12 SPAM board and repeat this test. Refer to "Removing and Replacing the A4–A17 Boards" on page 7-20.

DC Continuity Test the LFE Board and Test Ports (Available With Low Frequency Extension (LFE) Installed Option 205/425)

The DC continuity test verifies that the LFE board is installed correctly and does not have any opens or shorts in the DC path.

1. Using a DVM, connect one test probe to the center conductor of the RF port 1 on the front panel.
2. Connect the other test probe to the port 1 bias input (**BIAS 1 IN**) on the rear panel.
3. Verify the DVM measures <10Ω.
4. Repeat these steps for each of the other test ports.

NOTE If the DVM value is 0Ω or >10Ω, then something is incorrectly installed or there is an open or short somewhere in the LFE board/cable path:

– Verify the gray DC bias cables installed in "Top Assemblies and Cables, All Options, Serial Number Prefixes <6021" on page 6-18 and the blue RF flexible cables installed in Chapter 6 in the "Bottom Assemblies" section—for your LFE option—are connected correctly and not open or shorted.

Adjustments

These adjustments are firmware-driven tests that are used to fine-tune your analyzer.

If multiple adjustments are to be performed, perform them in the order listed.

– "10 MHz Frequency Reference Adjustment" on page 3-54
– "Synthesizer Bandwidth Adjustment" on page 3-55
– "Source Adjustment" on page 3-55
– "IF Gain Adjustment" on page 3-57
– "Receiver Characterization" on page 3-57
– "Receiver Adjustment" on page 3-57
– "EE Default Adjustment" on page 3-59
– "IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)" on page 3-60
– "LFE Receiver Adjustment (Option 425)" on page 3-60
– "Noise Figure Adjustment (Available with Option 029 or E29 with S93029A/B Installed)" on page 3-61

These adjustments are described on the following pages.

Touchscreen Adjustment and Verification

NOTE For best results, use a touchscreen soft touch pen for the following adjustments.

The touchscreen adjustment (calibration) is used to correct the touchscreen accuracy when you replace your front panel, or your SSD. Refer to "Calibration Procedure".

The touchscreen verification can be run to verify the touchscreen has been correctly calibrated. Refer to "Verification Procedure" on page 3-54.

Calibration Procedure

NOTE If your touchscreen is not behaving as expected, you can reset your display using the Table PC Setting window and re-calibrate the touch settings using the "Calibration Procedure" below.

Step 1. Verify your instrument is powered up.

Step 2. Press **Instrument** > **Display** > **Display Setup** > **Calibrate Touchscreen...**

Step 3. In the Table PC Setting window that opens, press **Calibrate...**

Step 4. When the User Account Control opens, press **Yes**.

Step 5. After pressing all of the cross hair calibration points a Digitizer Calibration Tool window opens, press **Yes**.

Step 6. In the Tablet PC Settings window, press **OK**.

Verification Procedure

NOTE If your display fails the verification process, you can reset your display using the Table PC Setting window. Refer to "Calibration Procedure" on page 3-53.

Step 1. Verify your instrument is powered up.

Step 2. Press **System** > **Service** > **Display...** > **Display Setup** > **Calibrate Touchscreen...**

Step 3. In the Table PC Setting window that opens, press **Calibrate...**

Step 4. Follow the instrument's display prompts.

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 A14 frequency reference board assembly.

Equipment Used for the 10 MHz Frequency Reference Adjustment

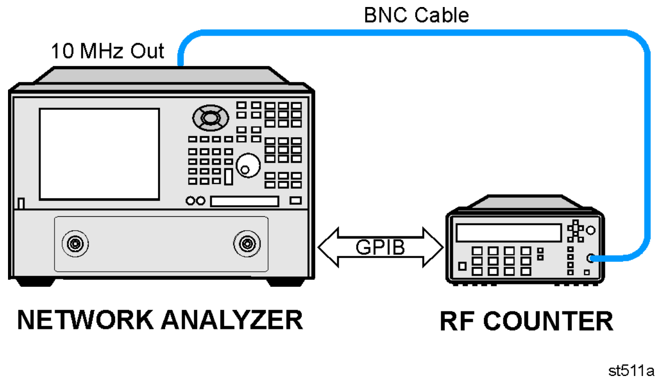
Equipment Type	Model or Part Number	Alternate Model or Part Number
Cable, BNC, 50Ω, 24 inch	8120-1839	Any
Frequency counter	53151A, Option 001	Any that will measure a signal at 10 MHz.

Procedure

NOTE This adjustment typically adjusts to within ±0.01 ppm.

1. Connect the equipment as shown in Figure 3-17. Connect a GPIB cable between the network analyzer and the frequency counter.

Figure 3-17 Equipment Setup for the 10 MHz Frequency Reference Adjustment



2. Press UTILITY System, then Service, then Adjustment Routines, then click 10 MHz Freq Adjustment.
3. Ensure the GPIB settings are correct.
4. Follow the instructions and prompts as they are displayed.

Synthesizer Bandwidth Adjustment

This adjusts the bandwidth of the 13.5 GHz synthesizers.

Procedure

1. Press UTILITY System, then Service, then Adjustment Routines, then click Synthesizer Bandwidth Adj.
2. Follow the instructions and prompts as they are displayed.

Source Adjustment

The source calibration is used to adjust your network analyzer for a flat source power across its full frequency range. There are differences between each test port; therefore, an adjustment is required for each port.

Equipment Used for the Source Adjustment

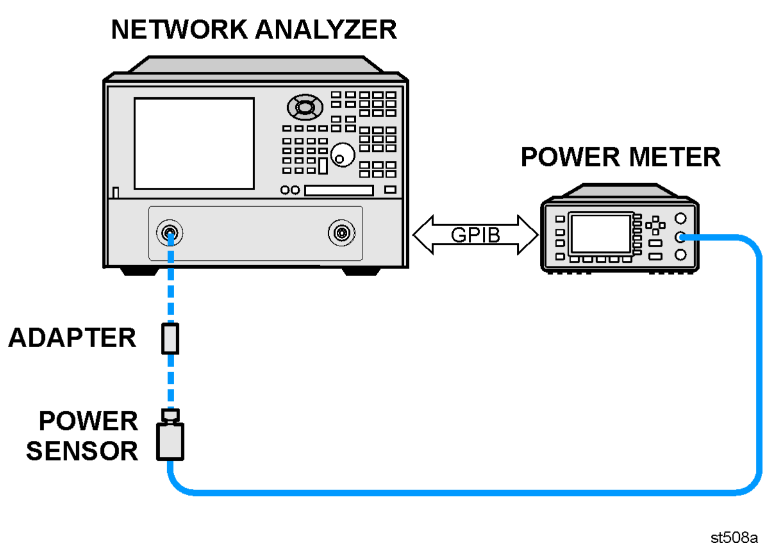
Equipment Type	Model or Part Number	Alternate Model or Part Number
Power meter	E4418B/E4419B	E4418A/E4419A
Power sensor, Type-N	8482A	None
Power sensor, 2.4 mm	8487A	None
Power sensor, V-Band[a]	V8486A	None
Adapter, WR-15 to 1.85 mm (m)	V281B	None
Adapter, 1.85 mm (f) to 1.85 mm (f)	85058-60114	None
Adapter, 2.4 mm (f) to 2.4 mm (f)	11900B	85056-60007
Adapter, Type-N (f) to 2.4 mm (f)[b]	11903B	None

a. This sensor and adapter must be calibrated together by the Keysight factory. The data supplied is only valid as long as the sensor and adapter remain connected.
b. The 1.85 mm connector has the same ruggedness and is compatible with the 2.4 mm connectors. 1.85 mm and 2.4 mm adapters are interchangeable.

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 Equipment Setup for the Source Adjustment



2. .Press UTILITY System, then Service, then Adjustment Routines, then click Source Adjustment.
3. Ensure the GPIB settings are correct.

4. Follow the instructions and prompts as they are displayed.

IF Gain Adjustment

The IF gain adjustment is used to adjust the IF gain of the network analyzer.

Procedure

1. Press UTILITY System, then Service, then Adjustment Routines, then click IF Gain Adjustment.
2. Follow the instructions and prompts as they are displayed.

Receiver Characterization

This characterizes the receivers in your analyzer.

Procedure

1. Press UTILITY System, then Service, then Adjustment Routines, then click Receiver Characterization.
2. Follow the instructions and prompts as they are displayed.

Receiver 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 test port 1 and test port 2, 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 solid state drive. The data are used in subsequent measurements.

If the solid state 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. If using multiple disk drives (e.g. classified and general usage), then these files must be replaced on each individual disk drive.

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

Equipment Used for the Receiver Adjustment

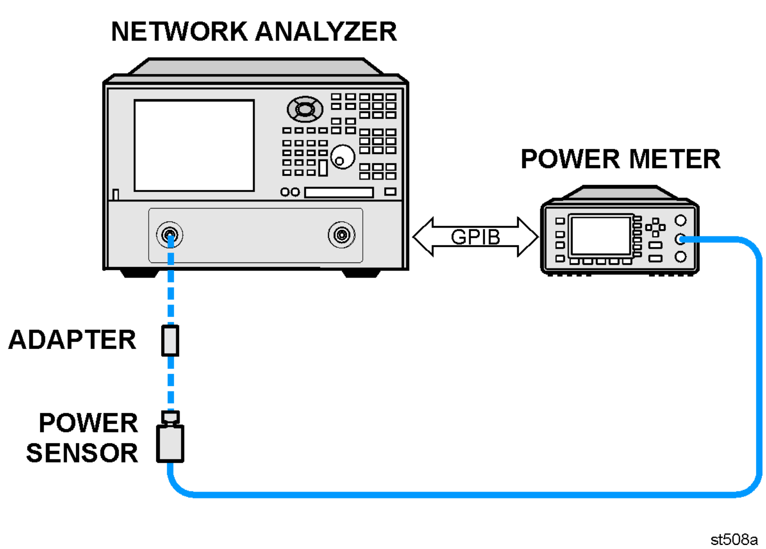
Equipment Type	Model or Part Number	Alternate Model Part Number
Power meter	E4418B/E4419B	E4418A/E4419A
Power sensor, Type-N	8482A	None
Power sensor, 2.4 mm	8487A	None
Power sensor, V-Band[a]	V8486A	None
Adapter WR-15 to 1.85 mm (m)	V281B	None
Adapter, 2.4 mm (f) to 2.4 mm (f)	11900B	85056-60007
Adapter, Type-N (f) to 2.4 mm (f)[b]	11903B	None
Adapter, 1.85 mm (f) to 1.85 mm (f)	85058-60114	None
Test cable, 2.4 mm (f) to 2.4 mm (f)	85133C	85133E
Test cable 1.85 mm (f) to 1.85 mm (f)	N4697E	N4697-60200

a. This sensor and adapter must be calibrated together by the Keysight factory. The data supplied is only valid as long as the sensor and adapter remain connected.
b. The 1.85 mm connector has the same ruggedness and is compatible with the 2.4 mm connectors. 1.85 mm and 2.4 mm adapters are interchangeable.

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 Equipment Setup 1 for the Receiver Adjustment



2. Press UTILITY System, then Service, then Adjustment Routines, then click Receiver Adjustment.
3. Ensure the GPIB settings are correct.
4. Follow the instructions and prompts as they are displayed.

Figure 3-20 Equipment Setup 2 for the Receiver Adjustment

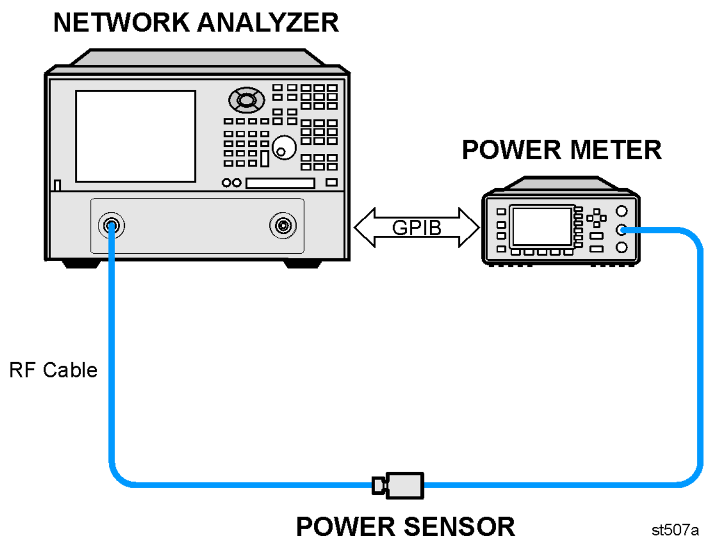
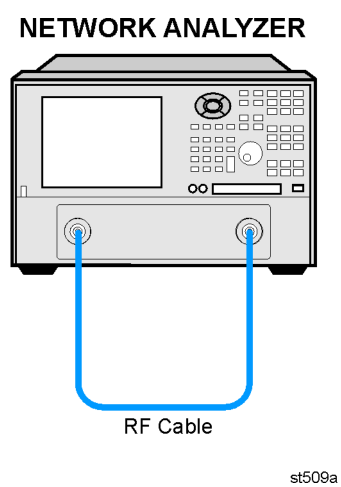


Figure 3-21 Equipment Setup 3 for the Receiver Adjustment



EE Default Adjustment

This sets the EEPROM data to their default values.

Procedure

1. Press UTILITY System, then Service, then Adjustment Routines, then click EE Default Adjustment.
2. Follow the instructions and prompts as they are displayed.

IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)

NOTE In A models these options were 090 and 093 or 094.

The IF Response adjustment is required when upgrading to Option 090, 093 and or 094. In addition, this adjustment must be performed each time a new configuration is set up or if cables are changed:

Procedure

1. Press UTILITY System, then Service, then Adjustment Routines, then click IF Response Adjustment.
2. Follow the instructions and prompts as they are displayed.

LFE Receiver Adjustment (Option 425)[1]

The LFE Receiver adjustment is required when upgrading to Option 205, 220, 405, 420, and 425. In addition, this adjustment must be performed each time a new configuration is set up or if cables are changed.

Procedure

1. Press UTILITY System, then Service, then Adjustment Routines, then click LFE Receiver Adjustment.
2. Follow the instructions and prompts as they are displayed.

1. Your model PNA may not have available all of the LFE Options listed.

Noise Figure Adjustment (Available with Option 029 or E29 with S93029A/B Installed)

NOTE Option 029 enables noise figure measurements up to 50 GHz.
Option E29 enables noise figure measurements up to 67 GHz.

The noise figure adjustment should be performed after replacing any component in the noise figure circuitry, or if the PNA fails the noise IF gain portion of the Op check. The noise figure adjustment consists of the following four sections:

– Noise Compression Adjustment: sets the warning level for overpower conditions at the noise receiver.
– IF Gain Cal Adjustment: sets IF Gain flatness for the noise receiver.
– Bandwidth Offset Adjustment: removes any offset that may occur between various bandwidth settings.
– Noise Correction Adjustment: overwrites the factory noise receiver calibration.

Equipment Used for the Noise Figure Adjustment

Equipment Type	Model or Part Number
Power Meter	N1914A or equivalent
Power Sensor	8487A, N8487A, or N8488A
RF Cable, 2.4 mm -f- to -f- -or- RF Cable, 1.85 mm -f- to -f-	85133C or 85133E N4697E
ECal module, 2.4 mm, -m- to -f- -or- ECal module, 2.4 mm, -m- to -f-	N4693A-M0F N4694A-M0F

NOTE Adapters may be required, depending on the equipment you use. Equipment with 2.4 mm connectors can be used since noise figure measurements are not recommended above 50 GHz.

Procedure

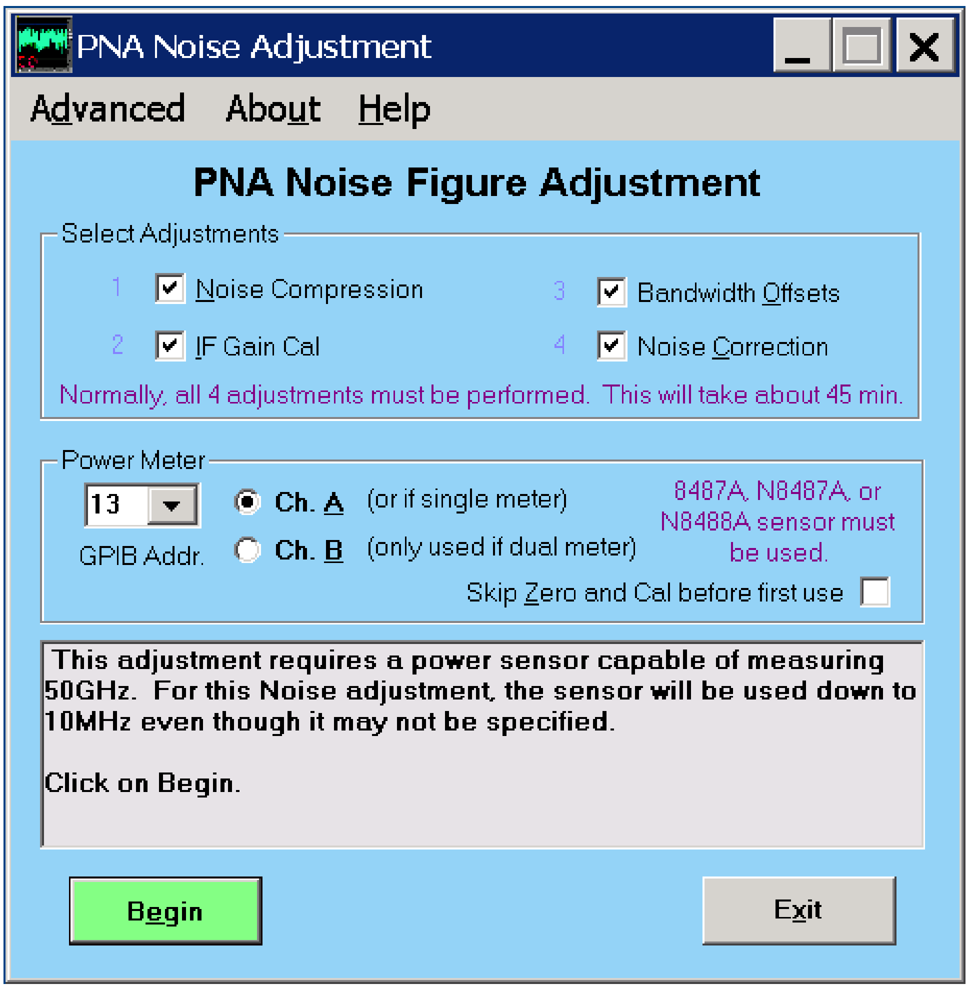
1. Press UTILITY System, then Service, then Adjustment Routines, then click Noise Adjustment.
2. On the PNA Noise Adjustment dialog box (see Figure 3-22):

a. In “Select Adjustments,” leave all four adjustments selected by default.

b. In “Power Meter”

- Set the GPIB address to match the address of the power meter.
- If using a single channel power meter, use the default setting Ch. A. If using a dual channel power meter and the sensor is attached to the B channel, select Ch. B.
- If the sensor has already been zeroed and calibrated, select Skip Zero and Cal before first use.

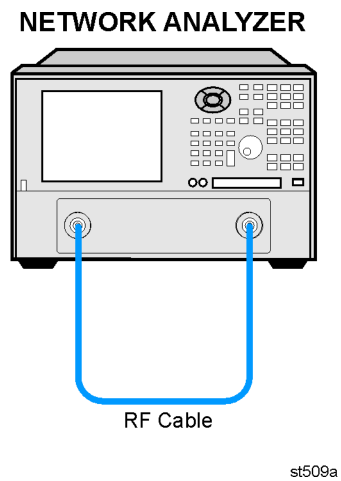
Figure 3-22 PNA Noise Adjustment Dialog Box



3. Click Begin.

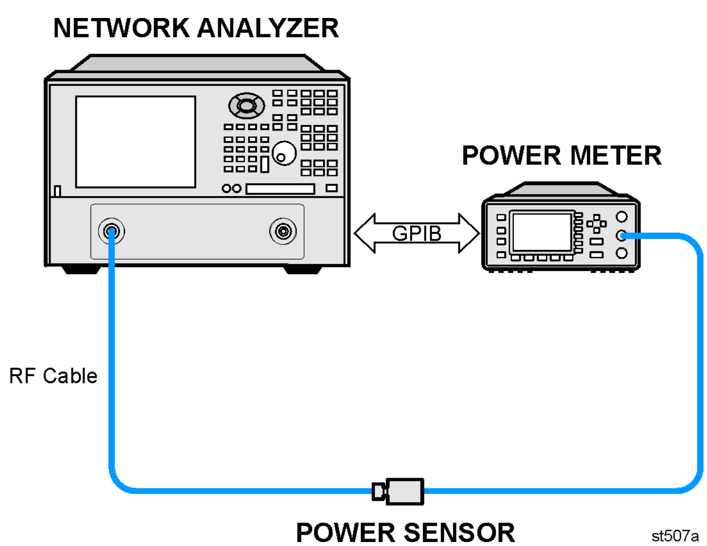
4. As shown in Figure 3-23, connect an RF cable between the network analyzer test ports 1 and 2.

Figure 3-23 Equipment Setup 1 for the Receiver Adjustment



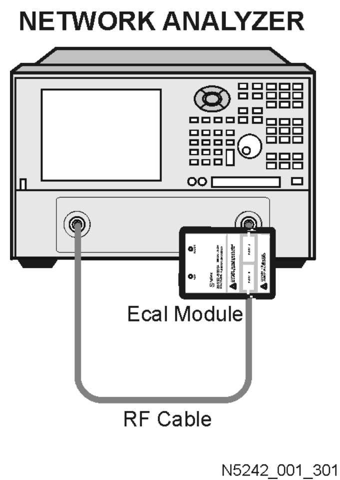
5. When prompted, disconnect the cable from port 2 and connect it to the power sensor. See Figure 3-24.

Figure 3-24 Equipment Setup 2 for the Receiver Adjustment



6. When prompted, disconnect the sensor from the cable, and insert the ECal module between port 2 and the free end of the cable. Connect the ECal module directly to port 2 without using any adapters if possible. See Figure 3-25.

Figure 3-25 Equipment Setup 3 for the Receiver Adjustment



The entire procedure takes about 30 to 45 minutes.

4 Troubleshooting

Information in This Chapter

The information in this chapter helps you:

- Identify the portion of the analyzer at fault.
- Locate the specific troubleshooting procedure to identify the assembly or peripheral at fault.

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

Chapter Four at-a-Glance

Section Title	Summary of Content	Start Page
Getting Started with Troubleshooting	A starting point for troubleshooting.	page 4-5
Power Up Troubleshooting	Power-up problems: – Power supply problems – LCD problems – Bootup for the network analyzer interface	page 4-7
Front Panel Troubleshooting	Problems occurring after the network analyzer interface is loaded: – Does the display color appear correct? – Do the front panel keys function properly? – Does the front panel USB connector function properly?	page 4-15
Rear Panel Troubleshooting	Problems associated with the rear panel interconnects. **The data found at these rear panel interconnects can be used to troubleshoot the CPU board.**	page 4-22
Measurement System Troubleshooting	Problems with the measurement portion of the analyzer. – Checking the A, B, R1, and R2 signals. – Checking the source group. – Checking the signal separation group. – Checking the receiver group.	page 4-29

Section Title	Summary of Content	Start Page
Instrument Block Diagrams	Block diagrams for the analyzer including all options.	
– "Instrument Simplified Block Diagrams – LFE" on page 4-56		page 4-56
Non-LFE Block Diagrams:		
– "Instrument Block Diagrams – 2-Port (Sheet 1), Non-LFE and Non-DDS (Version 6 Synthesizers)" on page 4-62		page 4-62
– "Instrument Block Diagrams – 2-Port (Sheet 2), Non-LFE and DDS (Version 7 Synthesizer Assemblies)" on page 4-64		page 4-64
– "Instrument Block Diagrams – 4-Port (Sheet 3), Non-LFE and Non-DDS (Version 6 Synthesizers)" on page 4-66		page 4-66
– "Instrument Block Diagrams – 4-Port (Sheet 4), LFE and Non-DDS (Version 6 Synthesizers)" on page 4-68		page 4-68
– "Instrument Block Diagrams – 4-Port (Sheet 5), Non-LFE and DDS (Version 7 Synthesizer Assemblies)" on page 4-70		page 4-70
– "Instrument Block Diagrams – 4-Port (Sheet 6), LFE and DDS (Version 7 Synthesizer Assemblies)" on page 4-72		page 4-72

Conventions Used for Hardkeys, Softkeys, and Menu Items

The following conventions are used in this document:

Hardkey	This represents a "hardkey", a key that is physically located on the instrument.
Tab	This represents a "tab", whose label is determined by the instrument firmware.
Softkey	This represents a "softkey", a key whose label is determined by the instrument firmware.
Menu Item	This represents an item in a drop-down or pop-up menu.

Operating the Analyzer With Covers Removed

CAUTION Do not operate the analyzer with the outer cover removed for more than 30 minutes, as this could cause the analyzer to overheat which could result in costly damage.

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 1-7, 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 Chapter 7, "Repair and Replacement Procedures."

Step 3. Perform the necessary adjustments. Refer to Chapter 3, "Tests and Adjustments."

Step 4. Perform the necessary performance tests. Refer to 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 4-6. You should then be able to determine where in the troubleshooting procedure to begin, to locate the failed assembly.

Check the Basics

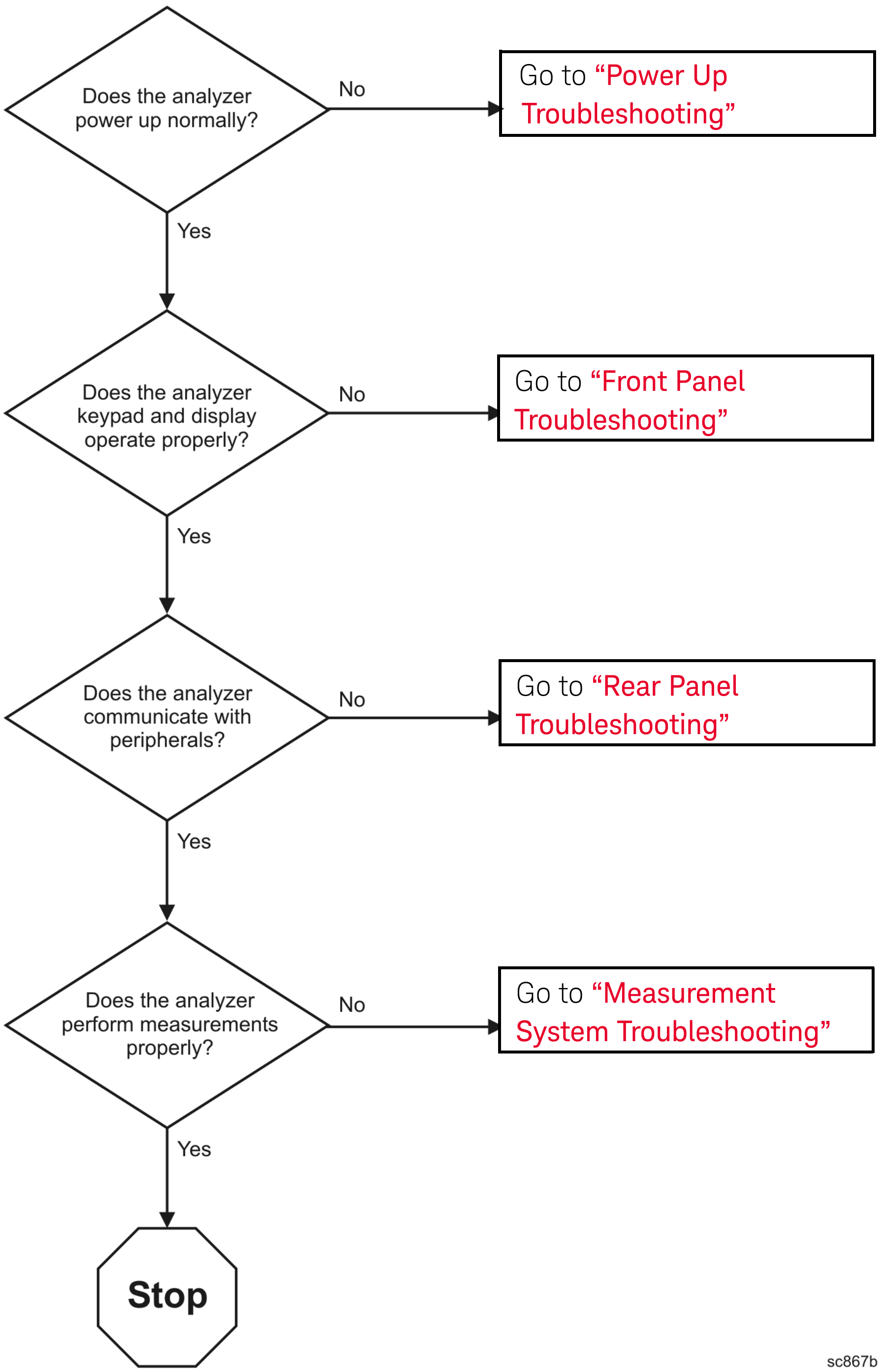
A problem can often be solved by repeating the procedure you were following when the problem occurred. Before calling Keysight Technologies or returning the instrument for service, please perform the following checks:

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 displays a light. 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 4-7.
3. Is the Windows operating system running? If not, refer to "Operating System Recovery" in Chapter 8 for instructions.
4. If other equipment, cables, and connectors are being used with the instrument, make sure they are clean, 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 **UTILITY** > **Main** > 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 "Firmware Upgrades" in Chapter 8 for instructions.
9. If the necessary test equipment is available, perform the operator's check and system verification in Chapter 3, "Tests and Adjustments."

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



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 green.
- 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 solid state drive. These checks return an error message if a problem is detected.
- The Windows operating system should start.
- The network analyzer measurement interface should open with an S_{11} measurement displayed.

Step 3. If the analyzer powers up correctly, continue troubleshooting with "Front Panel Troubleshooting" on page 4-15.

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

- If the line switch does not glow, go to "Power Supply Check" on page 4-8.
- If you cannot hear the fans operating, go to "If the Fans Are Not Operating" on page 4-12.
- If the line switch displays a green light 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 Keysight. Refer to "Contacting Keysight" on page 2-7.

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 the power supply LED indicators:

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 displays a yellow light - this indicates that the power supply standby line is active and functional.

2. Turn on the instrument power and verify that the line switch displays a green light - this indication that the power supply is active and does not sense an over-current condition.

3. You can determine which power supplies are functioning by viewing the LED indicators on the A19 midplane board. Refer to Figure 4-2.

   To view the LED indicators, it is necessary to remove the instrument's outer and inner covers. Refer to "Removing the Covers" on page 7-8 for removal procedures. To determine the location of the A19 midplane board, refer to "Top Assemblies and Cables, All Options, Serial Number Prefixes <6021" on page 6-18.

CAUTION Do not operate the analyzer with the outer cover removed for more than 30 minutes, as this could cause the analyzer to overheat which could result in costly damage.

4. If any power supply voltage is missing, it is likely that the problem is a defective A20 power supply, the A19 midplane board, or another assembly that is loading down the A20 power supply. Continue with "If Any Supply Voltage Is Missing" on page 4-10 to determine the cause of the problem.

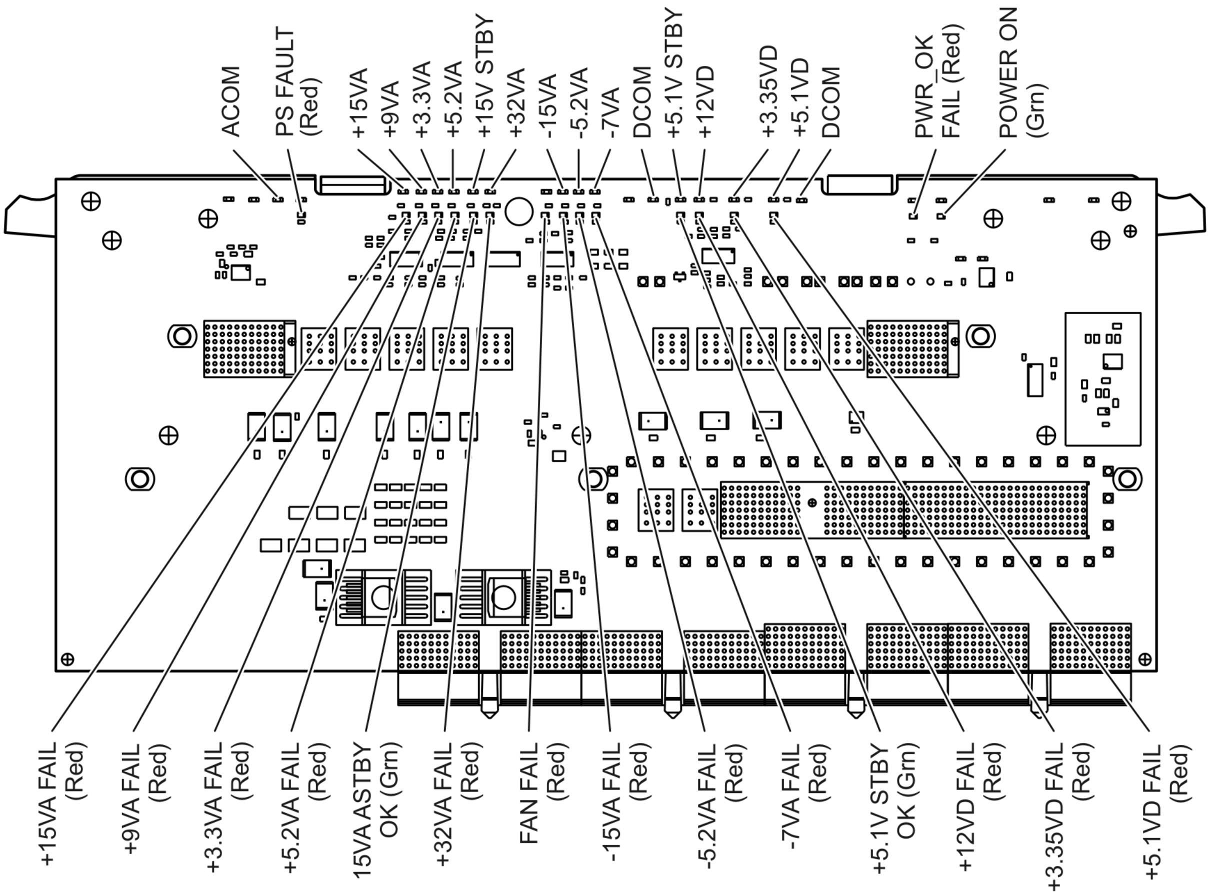
5. If the line switch is lit correctly, and all the power supply voltages appear to be present, as indicated by the LEDs as shown in Figure 4-2, the power supply has not suffered a catastrophic failure. However, the power supply could still be at fault. Continue at "Measure the Individual Supply Voltages" to verify that the actual supply voltages are correct.

Measure the Individual Supply Voltages

Measure the power supply voltages using a digital multi-meter. Use the point labeled ACOM as ground reference for analog supplies and the point marked DCOM as ground reference for digital supplies.

Refer to Figure 4-2 for the power supply measurement points on the A19 midplane board. Refer to Table 4-1 on page 4-10 for the correct voltages.

Figure 4-2 A19 Midplane Board Power Supply LED Indicators and Measurement Points



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.

CAUTION

Do not operate the analyzer with the outer cover removed for more than 30 minutes, as this could cause the analyzer to overheat which could result in costly damage.

NOTE

any one individual voltage supply from the A20 power supply develops an over-voltage or over-current problem, all supplies are affected. The cause of the over-voltage or over-current condition can be the A20 power supply itself, or any assembly to which the A20 power supply provides voltage. To isolate the cause, continue to the assembly removal process as described in the section titled "If Any Supply Voltage Is Missing" on page 4-10.

Table 4-1 Power Supply Measurement Points

Test Point	Supply Name	Expected Level (Vdc)	Test Point	Supply Name	Expected Level (Vdc)
TP517	Analog Ground	0 V	TP516	–5.2 V analog	–5.2 ±0.1
TP509	+15 V analog	+15.0 ±0.1	TP514	–7 V analog	–7.0 ±0.1
TP511	+9 V analog	+9.0 ±0.1	TP500	Digital Ground	0 V
TP515	+3.5 V analog	+3.5 ±0.1	TP502	+5.1 V standby	+5.1 ±0.1
TP513	+5.2 V analog	+5.2 ±0.1	TP503	+12 V digital	+12.0 ±0.1
TP501	+15 V standby	+15.0 ±0.1	TP507	+3.35 V digital	+3.35 ±0.1
TP504	+32 V analog	+32.0 ±0.1	TP505	+5.1 V digital	+5.1 ±0.1
TP512	–15 V analog	–15.0 ±0.1	TP519	Digital Ground	0 V

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 "Front Panel Troubleshooting" on page 4-15.

If Any Supply Voltage Is 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.**

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

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

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

1. Unplug the A23 test set motherboard ribbon cable from the A23 test set motherboard (refer to "Removing and Replacing the A23 Test Set Motherboard" on page 7-34).
2. Unplug the A23 test set motherboard to A24 IF multiplexer board ribbon cable from the A24 IF multiplexer board (refer to "Removing and Replacing the A24 IF Multiplexer Board" on page 7-36).

3. Unplug the front panel interface cable from the A1 front panel interface board (refer to "Removing the A1 Front Panel Interface Board and Keypad Assembly" on page 7-12).
4. Remove the A16 SPAM board (refer to "Removing and Replacing the A4–A17 Boards" on page 7-20).
5. Remove the A10 source board (refer to "Removing and Replacing the A4–A17 Boards" on page 7-20).
6. Remove the A5 source board, if present (refer to "Removing and Replacing the A4–A17 Boards" on page 7-20).
7. Remove the A15 13.5 GHz synthesizer board (refer to "Removing and Replacing the A4–A17 Boards" on page 7-20).
8. Remove the A17 13.5 GHz synthesizer board (refer to "Removing and Replacing the A4–A17 Boards" on page 7-20).
9. Remove the A4 13.5 GHz synthesizer board, if present (refer to "Removing and Replacing the A4–A17 Boards" on page 7-20)
10. Remove the A14 frequency reference board (refer to "Removing and Replacing the A4–A17 Boards" on page 7-20).
11. Remove the A22 GPIB board (refer to "Removing and Replacing the A22 GPIB Board" on page 7-32). Reinstall the A20 power supply assembly and the A21 CPU board assembly.
12. Unplug the A55 solid state drive from the A21 CPU board (refer to "Removing and Replacing the A55 Solid State Drive (SSD)" on page 7-60).

The minimum required assemblies to power up the analyzer are:

– A20 power supply
– A19 midplane board
– A18 system motherboard
– A21 CPU board

To further isolate the failure in the three remaining assemblies, measure the resistance (with the power turned off) from the power supply test points to either ACOM or DCOM.

NOTE Make sure that the only assemblies plugged in are the four 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 four boards in the following order, and recheck the shorted test point after each board is removed. You should be able to determine if the shorted condition has changed.

Isolate the remaining three assemblies:

- remove the A21 CPU board
- remove the A20 power supply
- remove the A19 midplane board
- This leaves only the A18 system motherboard installed. If the resistance measurements are still incorrect, this is the suspected faulty assembly.

If the Fans Are Not Operating

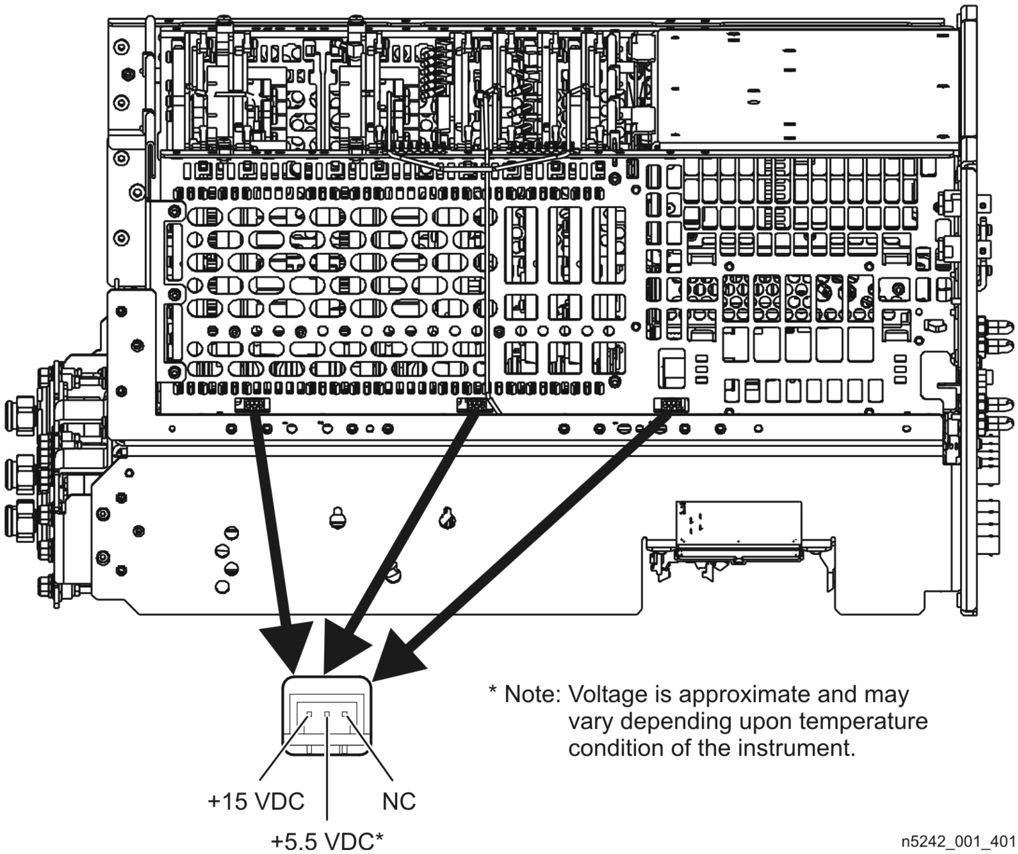
CAUTION The power supply may be in thermal shutdown if the instrument has been operating without the fans running. Allow the instrument to cool down before troubleshooting.

If all five fans are not operating, suspect a power supply problem or a defective A18 system motherboard. Refer to "Power Supply Check" on page 4-8 to check the individual supplies. If the supplies are within specifications, the most probable cause is a defective A18 system motherboard. Refer to "Removing and Replacing the A18 System Motherboard" on page 7-23.

If only one or two fans are not functioning, and the power supplies are within specifications, suspect the A18 system motherboard or defective fan(s). Perform the following procedure.

1. Remove the fan bracket, with fans attached, from the analyzer to expose the fan power cable connections on the A18 system motherboard. Refer to Figure 4-3 for location of these connections. Refer to "Removing and Replacing the Fans" on page 7-88.
2. Plug in the power cord and measure the fan voltages at all three connectors on the A18 system motherboard. THIS MUST BE DONE QUICKLY AS THE ANALYZER WILL RAPIDLY OVERHEAT WITHOUT THE COOLING EFFECT OF THE FANS. DO NOT PLUG IN THE POWER CORD UNTIL READY TO PERFORM MEASUREMENTS.

Figure 4-3 Fan Power Cable Connections



3. If the correct voltage is present at each connection and the fan connectors are in good mechanical condition, suspect a defective fan. Refer to "Removing and Replacing the Fans" on page 7-88.

4. If the correct voltage is not present, suspect a defective A18 system motherboard. Refer to "Removing and Replacing the A18 System Motherboard" on page 7-23.

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 "A3 Display Test" on page 4-18.

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

1. If the display is dim, the A3 display assembly is defective. Refer to "Removing and Replacing the A1–A3 and Other Front Panel Subassemblies" on page 7-12.

2. If the display is dark (not visible), connect an external VGA monitor to the rear panel Monitor output connector. (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 A21 CPU board. Refer to "Removing and Replacing the A21 CPU Board Assembly" on page 7-30.

3. If the external VGA monitor displays the correct information, verify that the front panel interface ribbon cable is properly plugged into the motherboard connector. Refer to "Removing and Replacing the Front Panel Assembly" on page 7-10.

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)
   - A1 front panel interface board
   - A3 display assembly

Front Panel Troubleshooting

The front panel assembly consists of the A1 front panel interface board, the keypad, the A2 USB board, and the A3 display assembly. 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 4-7.

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

– "Front Panel Keypad and RPG Test" on this page
– "A3 Display Test" on page 4-18
– "Checking the A2 USB Board" on page 4-19
– "A1 Front Panel Interface Board" on page 4-20

If all assemblies are working correctly, continue troubleshooting with "Rear Panel Troubleshooting" on page 4-22.

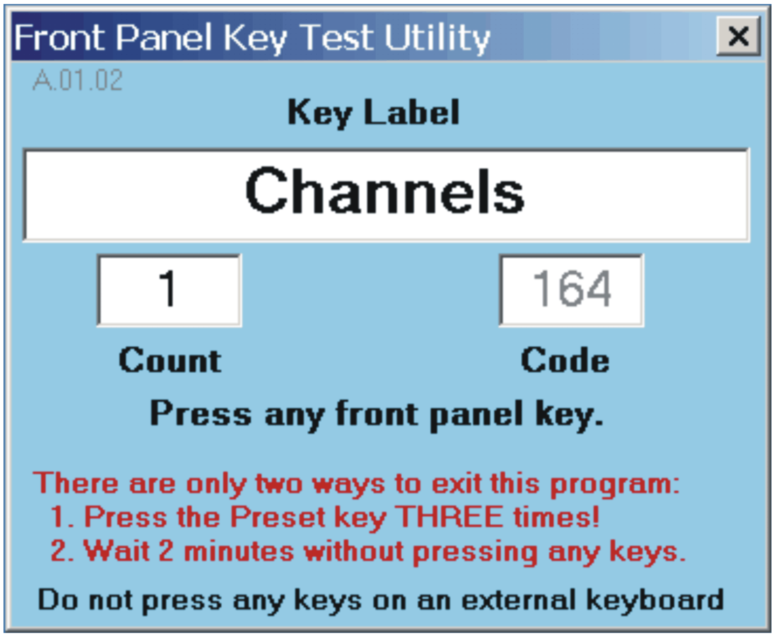
Front Panel Keypad and RPG Test

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

Press UTILITY System, then Service, then Diagnostics, then Front Panel Test.

A **Front Panel Key Test Utility** dialog box will be displayed, as shown in Figure 4-4.

Figure 4-4 Front Panel Key Test Utility Dialog Box



n5242_001_403

Checking the Front Panel Keys

To check the front panel keys, push each key and compare the name in the Key Label box to the name physically labeled on the key cap. These names are also in Table 4-2 below. Verify that the Key Label and the Codes match.

– If all the key names are correct, then the front panel keypad is working. If some of the keys are not working, suspect a faulty keypad. To replace the keypad, refer to "Removing the A1 Front Panel Interface Board and Keypad Assembly" on page 7-12.

– If none of the keys are working correctly, suspect a faulty touchscreen controller board or the A1 front panel interface board. To replace the touchscreen controller board, refer to "Removing the Touchscreen Controller Board" on page 7-13. To replace the A1 front panel interface board, refer to "Removing the A1 Front Panel Interface Board and Keypad Assembly" on page 7-12.

– To close the Key Label window and return to the instrument display, press **Preset** three times.

Table 4-2 Front Panel Keyboard Key Names

INSTRUMENT Keys	Keypad Code	STIMULUS Keys	Keypad Code	ENTRY[a] Keys	Keypad Code	ENTRY[a] Keys (cont.)	Keypad Code
Prev	239	Freq	223	OK	154	1	198
Next	240	Power	157	Cancel	186	2	199
Trace	160	Sweep	163	Bk Sp	233	3	192
Channel	164	Trigger	171	T/p	242	k/m	232
Display	238	**Navigation[a] Keys**	**Keypad Code**	7	182	0	206
Setup	241	Knob (CW)	101	8	183	. (decimal point)	207
RESPONSE Keys	**Keypad Code**	Know (CCW)	102	9	176	+/-	201
Meas	179	Click (Rotary Knob press)	159	G/n	177	Enter Off	193
Format	180	↑	151	4	190	**UTILITY Keys**	**Keypad Code**
Scale	181	←	150	5	191	Save/Recall	203
Math	197	→	152	6	184	Macro	213
Avg BW	172	↓	158	M/u	185	Undo	243
Cal	173					System	231
Marker	187					Help	170
Search	195					Preset	205

a. There are no Entry or Navigation labels on the display. Entry and Navigation titles are for functional reference only.

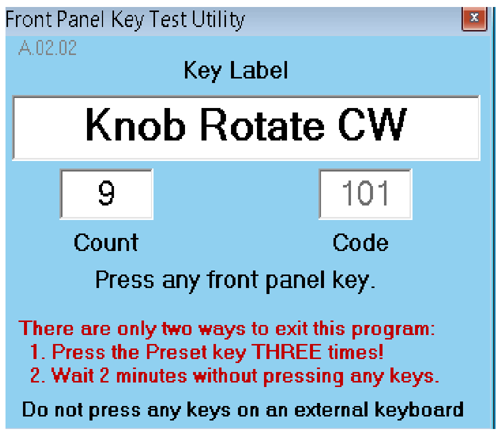
Checking the RPG (Front Panel Knob)

NOTE This section assumes you have completed the introduction and opened the Front Panel Key Test Utility window. Refer to "Front Panel Keypad and RPG Test" on page 4-15.

To check the RPG knob:

1. Rotate the knob clockwise (cw) and check for a fluid movement of numbers on the analyzer display and verify that **Knob Rotate CW** is displayed. Refer to Figure 4-5.

Figure 4-5 RPG Knob Clockwise Verification



2. Rotate the knob counter clockwise (ccw) and check for a fluid movement of numbers on the analyzer display and verify that **Knob Rotate CCW** is displayed.
3. Press the knob and verify that **Knob Click** is displayed.
4. If the movement of numbers is not smooth or no numbers appear at all, suspect a faulty RPG board or the A1 front panel interface board. To replace the RPG board, refer to "Removing the RPG Assembly" on page 7-12. To replace the A1 front panel interface board, refer to "Removing the A1 Front Panel Interface Board and Keypad Assembly" on page 7-12.
5. When done to close the Key Label window and return to the instrument display, press **Preset** three times.

A3 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 dark, refer to "Removing the A3 Display Assembly and the Touchscreen" on page 7-14 and to "Removing the Touchscreen Controller Board" on page 7-13.

What Is a Damaged Pixel?

A pixel is a picture element that combines to create the image on the display. A pixel is about the size of a small pin point.

A damaged pixel is a pixel that has a constant blue, green, red, black, or other color appearance that will not change.

How to Run the Display Test

To run the display test, perform the following:

Press UTILITY System, then Service, then Diagnostics, then Display Test... .

A multi-color screen is displayed. Be prepared to look for the symptoms described in "How to Identify a Faulty Display." Follow the instructions on the screen.

How to Identify a Faulty Display

A display is considered faulty if:

– More than 6 pixels and or any two faulty pixels within 15 mm of each other (used—under warranty) of the total pixels have a constant blue, green, red, or black appearance that will not change.

– Three or more consecutive pixels and or any two faulty pixels within 15 mm of each other, have a constant blue, green, red, purple, black and or other colors, appearance that will not change.

– Also, for the Gray gradient screen, verify their are no black vertical/horizontal lines

If the A3 display assembly is determined to be faulty, replace it. Refer to "Removing the A3 Display Assembly and the Touchscreen" on page 7-14.

Checking the A2 USB Board

To verify proper operation of the USB board:

1. Connect a known good USB device, such as a USB mouse, to a front panel USB port.
2. Wait 15 seconds for the analyzer to verify the device connection, and then check the operation of the USB device.
3. If the device performs correctly, the USB board is functioning properly.

   Else, skip to step 5.
4. Repeat steps 1 thru 3 for all front and rear USB ports.

5. If the device does not perform correctly, the USB may need to be reset. Use Windows Device Manager to look for any cautions or warnings and repair those first. Refer to Windows Help.

NOTE The Windows Device Manager can be used to enable/disable the USB drivers and may repair your USB hub(s). Refer to Windows Help.

6. If the device still does not perform correctly, the USB board is faulty. Refer to “Removing the A2 USB Board” on page 7-12.

A1 Front Panel Interface Board

This assembly performs the following functions:

– All signals from the front panel interface board are routed through the motherboard/midplane board to the CPU.

– It routes USB signals between the front-panel USB connector and the A17 CPU board.

– The speaker produces the audio output from signals supplied by the A17 CPU board.

– It routes key pad commands from the keypad to the A17 CPU board.

– It routes display signals from the A17 CPU board to the A3 display assembly.

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:

1. Press **File** > **Minimize Application**, then press the Speaker icon () on the Windows Toolbar.

2. The windows slider opens. Verify the volume is not muted, then slide volume up or down.

   Else, skip to step 4.

3. Optional, if audible tone is heard, reset volume slider to zero or mute.

4. If the audio is still not heard, suspect a faulty speaker. Refer to “Removing the A1 Front Panel Interface Board and Keypad Assembly” on page 7-12 and to “Removing the Speaker Assembly” on page 7-14.

Checking the Operation of the Key Pad Commands

To verify the key pad functionality, refer to “Front Panel Keypad and RPG Test” on page 4-15.

Checking the Display

To verify the display functionality, refer to "A3 Display Test" on page 4-18.

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 x 4
- Monitor (VGA)
- GPIB (0) CONTROLLER
- GPIB (1) TALKER/LISTENER
- LAN

Checking the USB Ports

To verify proper operation of any rear panel 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, remove the non-working USB device, wait 15 seconds, and then reconnect the device to the rear panel USB port.
- If the USB device still does not work and has been verified to work elsewhere, then the A21 CPU board is faulty. Refer to "Removing and Replacing the A21 CPU Board Assembly" on page 7-30.

Checking the CONTROLLER Port

The network analyzer uses a National Instruments 488.2 GPIB controller and associated driver software. This software includes a test utility that 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. Press UTILITY System, then Configure, then SICL/GPIB... . A **SICL/GPIB/SCPI** 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. If the Window Desktop is not displayed, press UTILITY System, then Configure, then Control Panel... to view the Windows Taskbar menu at the bottom of the display.
5. On the **Windows Taskbar** menu, click Start then 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.

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 4-26.

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`.
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. If the Windows Desktop is not displayed, press UTILITY [System], then Configure, then Control Panel... to view the Windows Taskbar menu at the bottom of the display.
   b. On the **Windows Taskbar** menu, click Start, 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 ENTRY **Enter** on the front panel. Refer to Step 5 for the results of a successful ping.

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, XP, or 7 and while at a DOS prompt, type in `ping xxx.xxx.xxx.xxx`[2]. Then press ENTRY **Enter** on the front panel. 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.

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

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.

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 4-26.

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

Now follow the steps in “How to Ping from the Analyzer to the Local Area Network (LAN)” on page 4-24 to have the first analyzer ping the second analyzer. When done, repeat the procedure having the second analyzer ping the first. If both procedures function properly, the LAN circuitry on both analyzers is verified.

If neither function properly:

– One or both IP addresses could be wrong.

– One or both LAN states could be set to off.

– The crossover cable could be miswired.

– One or both analyzers could be defective.

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

Constructing a Crossover Cable

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

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

NOTE

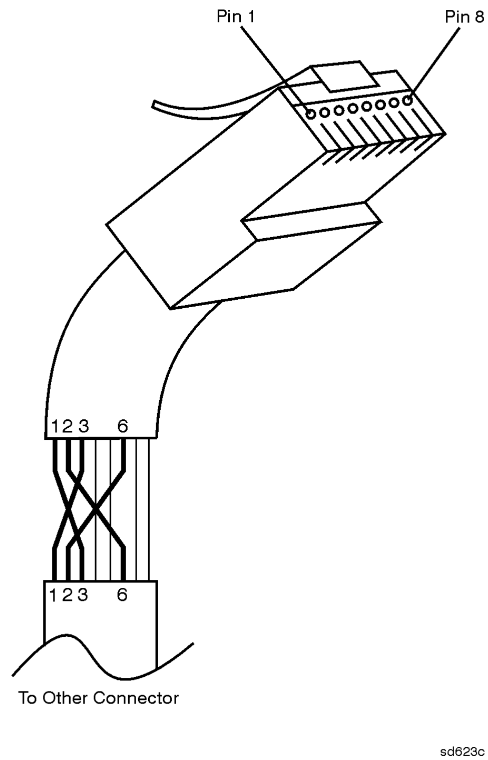
Pins 1, 2, 3, and 6 of the connectors must be located to determine which wires to cut in the following steps. Most, but not all, LAN cables use the color coding listed in Table 4-3. If your cable does not use this color scheme, you will have to determine the locations of the appropriate wires before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

Table 4-3 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 4-6 Construction of a Crossover Cable



Measurement System Troubleshooting

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

NOTE

Some procedures in this chapter reference your analyzer's DSP version. Click Help > About Network Analyzer and note the DSP version shown.

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, C, D, and R Traces (Standard S-Parameter Mode)" on page 4-31.

You should also consider the problem indications that are observed and whether the observed condition is a **soft** failure or a **hard** failure.

Soft 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 "Error Terms" on page 8-2. This will help to isolate most problems. If additional tests are required, refer to "Performance Tests" on page 3-32.

Hard Failure

With a **hard** failure, the PNA does not perform well and displays one or more error messages. To diagnose and repair a hard failure:

– Check "Help About" to verify that the model number and options listed match the actual analyzer model and options.

– Check "EEPROM Headers" on page 4-30 to verify that the data there is correct.

– Check error messages. Refer to "Error Messages" and follow the suggestions outlined there for each applicable error message.

Help About

Go to the Help About screen by pressing UTILITY System, then Help, then About NA... . Verify that the information displayed in this screen is correct for your analyzer. If any of the information is incorrect, contact Keysight Technologies. Refer to "Contacting Keysight" on page 2-7.

EEPROM Headers

The network analyzer application uses the firmware revision information stored in the PC board header EEPROM. If the information stored in any EEPROM is incorrect, the network analyzer may not operate properly.

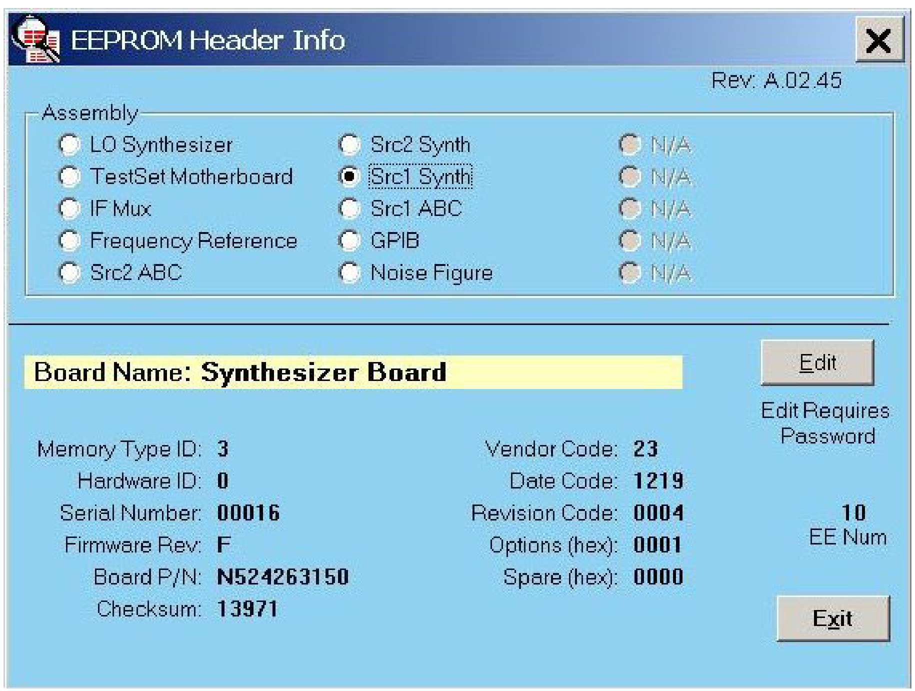
The following link lists the pc boards in your network analyzer that contain EEPROM headers. The pc boards are listed by name and part number and the correct firmware revision code is given for each. Refer to: Appendix A: “EEPROM Address Assignments and Location (N5227A&B PNA and N5247A&B PNA-X Instruments),” on page A-1.

To view this EEPROM header information on the network analyzer display:

press UTILITY System, then Service, then Utilities, then View EEPROM Headers. Refer to Figure 4-7.

If the information is incorrect for any of the PC boards, contact Keysight Technologies. Refer to “Contacting Keysight” on page 2-7.

Figure 4-7 EEPROM Header Info Dialog Window



Error Messages

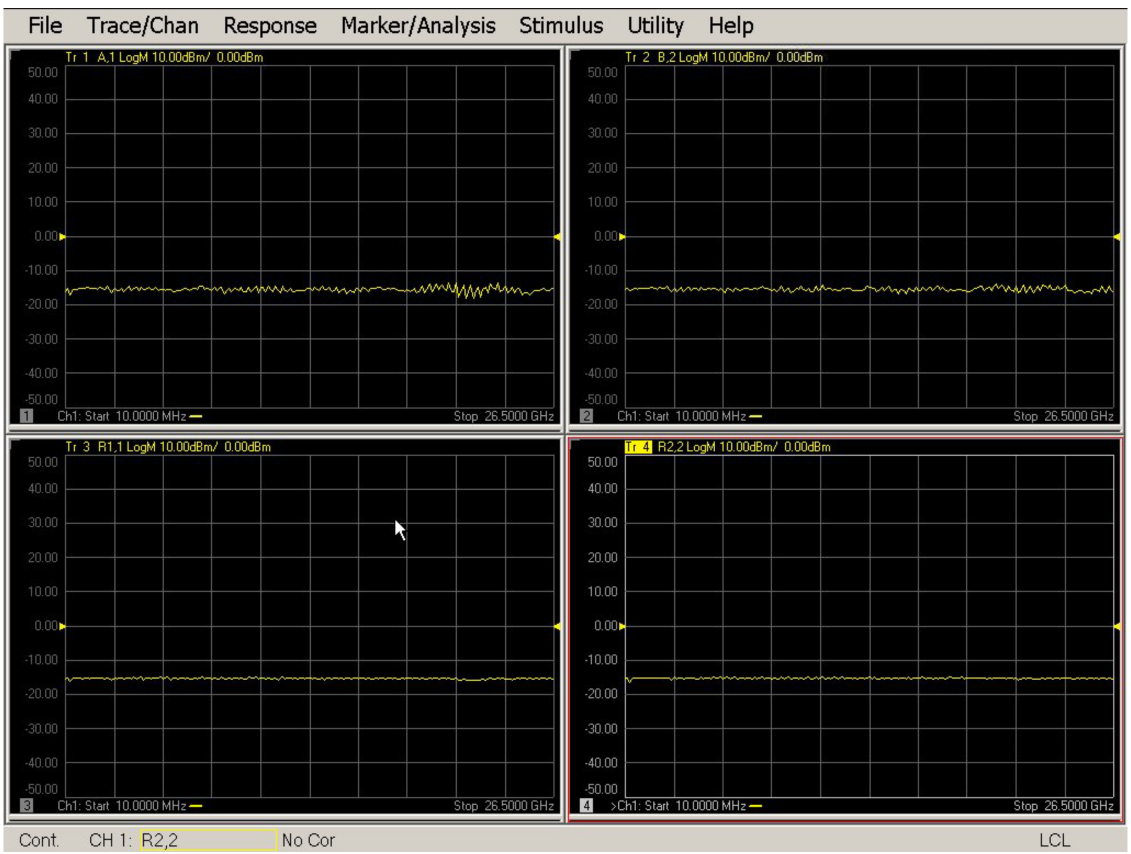
`SOURCE UNLEVELED:` The source ALC circuit on the A23 test set motherboard is running open-loop. Check the cable connections for the A25 HMA26.5 and the A23 test set motherboard.

Verifying the A, B, C, D, and R Traces (Standard S-Parameter Mode)

The first step is to verify that the A, B,C, D, and R traces are present and that they are approximately level:

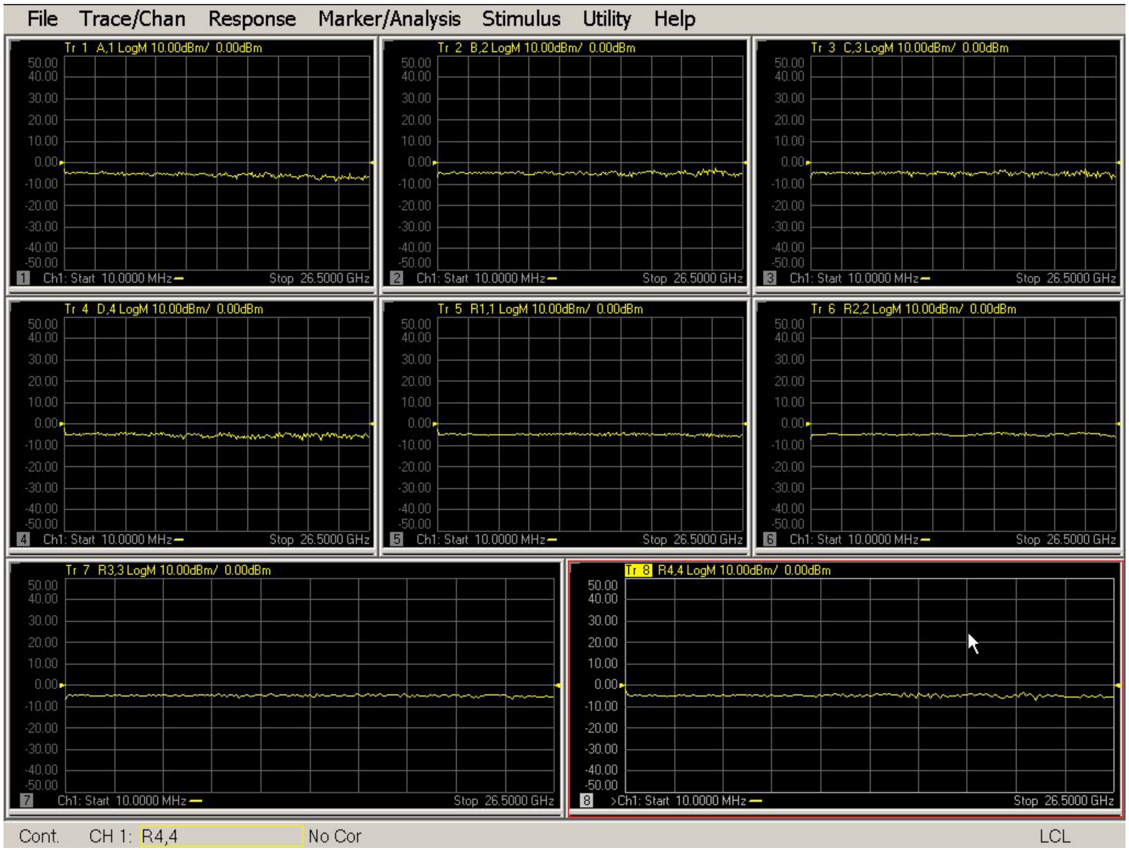
- Connect an Open or Short standard from a mechanical calibration kit to each test port (use adapters if necessary).
- Press UTILITY System, then Service, then Utilities, then Receiver Display.
- For 2-port analyzer models, traces A, B, R1, and R2 are displayed in four separate data windows as shown in Figure 4-8. Identifying discrepancies of the traces in these windows can help you to isolate the faulty assembly.

Figure 4-8 Typical 4-Receiver Display for 2-Port Models



- For 4-port analyzer models, traces A, B, C, D, and R1, R2, R3, and R4 are displayed in eight 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 5-Receiver Display for 4-Port Models



- If all traces are present and are similar to the traces in Figure 4-8 or 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 Keysight. Refer to "Contacting Keysight" on page 2-7.

- 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 and LO group

    - A14 frequency reference[1]
    - A4 and A17 (A17 optional on 2-port analyzers) 13.5 GHz source synthesizers[1]
    - A5 and A10 (A10 optional on 2-port analyzers) sources
    - A15 13.5 GHz LO synthesizer[2] (models with serial prefixes <6021 only)
    - A15 direct digital synthesizer (DDS) assembly[2] (models with serial prefixes ≥6021 or with version 7 synthesizer assembly upgrades only)
    - A25 HMA26.5[3]
    - A26 splitter[3]
    - A70 and A75 Low Frequency Extension (LFE) board
    - A23 test set motherboard
- the signal separation group
    - A50, A51, A52, and A53 mechanical switches (optional)
    - A54 combiner (optional)
    - A29, A30, A31, and A32 reference couplers
    - A38, A39, A40, and A41 60-dB source step attenuators (optional)
    - A42, A43, A44, and A45 60-dB bias tees (optional)
    - A71, A72, A73, or A74 bias combiner
    - A33, A34, A35, and A36 test port couplers
    - A23 test set motherboard
- the receiver group
    - A37 reference mixer switch
    - A46, A47, A48, and A49 35-dB receiver step attenuators (optional)
    - A27 and A28 mixer bricks
    - A16 SPAM board
    - A24 IF multiplexer board
    - A23 test set motherboard

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

1. A4, A11, A10, A13, A21, A22 boards and components apply only to PNA models with serial number prefixes <6021.
2. If your PNA has a serial prefix ≥6021, then A15 is a direct digital synthesizer (DDS) assembly. If your PNA has a serial prefix <6021, then A11 is a 13.5 GHz synthesizer board.
3. Some PNAs have installed a legacy HMA26.5 (5087-7765) that is used with a discrete A26 splitter. Some PNAs have installed a new HMA26.5 (N5240-60101) with an integrated splitter. To identify which HMA26.5 is installed in your PNA, refer to “Verify the Model/Version of HMA26.5 Installed” on page 4-41.

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

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

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. Press UTILITY System, then Configure, then Control Panel... . In the Address box, click the down arrow and then click My Computer. In an open area of the My Computer window, click the right mouse button and then click **Properties** in the resulting pop-up menu.

   Click the **Hardware** tab, click **Device Manager**, and then expand **Keysight PNA DSP Device** in the resulting list. The following entry should be listed: **Keysight Technologies DSP Driver #2** and should be enabled.

2. If the entry is not present or if the icon to the left of the name is a yellow box containing an exclamation mark (!), navigate the following directories and 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 4-35.

– **If the traces exhibit power drops in some frequency bands**, the problem is in the source group. Go to "Source Group Tests" on page 4-35 and perform the tests that correspond to the problems seen.

Single Trace (A, B, C, D, R1, R2, R3, or R4) Only

If the trace is missing in all bands or has notches or roll-off, go to "Checking the Signal Separation Group" on page 4-47.

A, B, R1, and R2 Traces Only

The problem is in the source 1 group, go to "Checking the Source Group" on page 4-35.

C, D, R3, and R4 Traces Only

The problem is in the source 2 group, go to "Checking the Source Group" on page 4-35.

Checking the Source Group

Source Group Tests

Before checking the source group 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 front and rear panel connections except installed jumpers.
3. Remove the outer and inner covers from the analyzer. Refer to “Removing the Covers” on page 7-8.

WARNING Procedures described in this document are performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

4. With the covers off, plug in the analyzer and turn on the power.

CAUTION Do not operate the analyzer with the outer cover removed for more than 30 minutes, as this could cause the analyzer to overheat which could result in costly damage.

CAUTION **IMPORTANT!** In 2020, the PNA added direct digital synthesis (DDS) capability to all serial number prefix ≥6021 instruments. The effect of installing this DDS assembly is that the A4, A10, A11[a], A13 boards are integrated into a single A11[a] direct digital synthesizer assembly, and the individual A4, A10, A11[a], and A13 boards do **not** apply to serial number prefix instruments ≥6021.

a. If your PNA has a serial prefix ≥6021 or has been upgraded with a version 7 synthesizer assembly, then A15 is a direct digital synthesizer (DDS) assembly. If your PNA has a serial prefix <6021, then A11 is a 13.5 GHz synthesizer board.

Frequency Banded vs. Broadband Failure

There are two main types of failures that are related to the source group. Frequency banded failures are indicated by all receiver traces having partial dropouts across the frequency range. Broadband failures are indicated by all receiver traces being in the noise floor.

RF Signal Troubleshooting

Check the output power of the A, B, C, and D signals:

Equipment Used for This Check

Equipment Type	Model or Part Number	Alternate Model or Part Number
Power meter	E4418B/E4419B	E4418A/E4419A
Power sensor, 2.4 mm	E8487A	None
Adapter, 2.4 mm (f) to 2.4 mm (f)	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 4-8 or Figure 4-9) is not on the analyzer screen, perform the following: Press UTILITY System, then Service, then Utilities, then Receiver Display.
3. Set the sweep speed for a 10 second sweep: Press STIMULUS Sweep, then Sweep Time. Set the time to 10.000 seconds in the **Sweep Time** box.

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

1. Note the power reading displayed on the power meter; it should be the preset power level +/- 1 dB.
2. Connect the power sensor, in turn, to Ports 2, 3, and 4 and set trace to measure S22, S33, and S44 respectively. Note the power reading displayed on the power meter.

– If the power level is low or high on all test ports, the problem is LO signal related. Continue with "Checking the A14 50 MHz Reference Outputs".

– If the power level is low or high on only one of the test ports, the problem is either source group or in the signal separation group. Continue with "Checking the A14 50 MHz Reference Outputs" to check the source group.

Checking the A14 50 MHz Reference Outputs[1]

1. Refer to the block diagram at the end of this chapter and to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21. Locate flexible cables W75, W76, and W77, at the A14 frequency reference board.
2. Disconnect cables W75, W76, and W77, one at a time, from the A14 board.
3. Connect the spectrum analyzer to the open connector on the A14 board.
4. The spectrum analyzer should measure a signal at 50 MHz.
5. If any of the 50 MHz signals are not present, replace the A14 frequency reference board. Refer to "Removing and Replacing the A4–A17 Boards" on page 7-20.
6. If the 50 MHz signals are present, reconnect the cables, and then:
   - for LO related problems, continue testing at "Checking the A15 13.5 GHz LO Synthesizer Output".
   - for source related problems, continue testing at "Checking the A4 and A17 Source Synthesizer Outputs" on page 4-43.

Checking the A15 Direct Digital Synthesizer (DDS) Assembly Outputs[2]

The instrument must be sufficiently reassembled, so it can be safely powered up.

1. Power up the instrument.
2. Note any error messages in the bottom right hand corner of the PNA's display (e.g., "`A power on self test error has occurred. Please contact...`"). Refer to Figure 4-10 on page 4-38.
3. A log file is generated by PNA after every power up. To access this log file, on the PNA, navigate to E:/log/PowerOnTest (Verify that hidden files is selected). A failure indication similar to "`FAIL: Slug S/N not found`", indicates the DDS assembly is faulty, for an example of this error in a log file, refer to Figure 4-11 on page 4-39.
4. If an DDS failure (e.g., "`FAIL: Slug...`") is observed:
   a. Power down the instrument.
   b. Verify that the A15 DDS assembly is seated properly.

1. A14 frequency reference board only applies to instruments with serial number prefixes <6021.
2. The A15 direct digital synthesizer assembly only applies to PNAs with serial number prefixes ≥6021 or that has been upgraded with a version 7 synthesizer assembly.

   c. Verify that all cable connections to the A15 DDS assembly are connected properly.

   d. Repeat steps 1 through.3.

   e. If the instrument still has a similar “Slug” failure then the DDS is faulty and needs to be replaced.

5. If the A15 DDS assembly is faulty, contact Keysight Technologies for help. Refer to “Contacting Keysight” on page 2-7.

Figure 4-10 Example of Power On Self Test Error

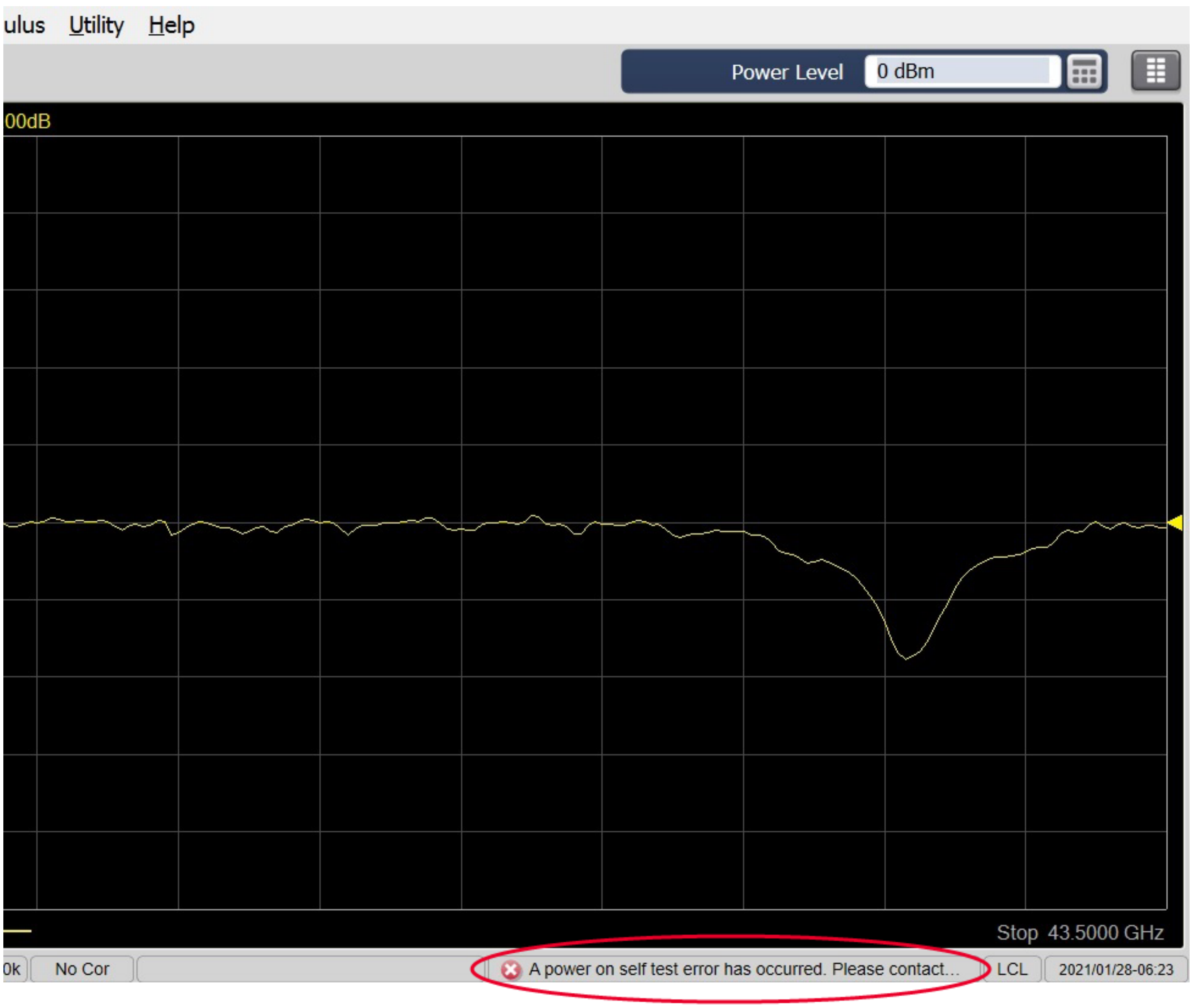


Figure 4-11 Example of Instrument Power Up Log Data with A15 DDS Assembly Failure Data

```
01/27/2021,02:38:59
Keysight Technologies,N5224B,US51010066,Z.13.41.191
c0:      info: Carrier Present test: WriteVal=43690; ReadVal=43690.
c0:      info: Carrier Present test: WriteVal=21845; ReadVal=21845.
c0:      info: Carrier Present test: WriteVal=65535; ReadVal=65535.
c0:      info: Carrier Present test: Carrier Present = 1

c0:      info: Carrier fpgaMajorRevision:4 fpgaMinorRevision:21 boardVersion:2 boardType:2

c0:      info: Carrier  S/N N524063223 30 2005 00004

c0:      info: Assembly S/N N524060223 23 2010 00506

c0:      pass: Carrier reset; ready in 1.700000 sec after setting reset bit.
c0:      pass: Carrier DC Power Status PGOOD_N5p2V_A   :1
c0:      pass: Carrier DC Power Status PGOOD_6p3V_G1   :1
c0:      pass: Carrier DC Power Status PGOOD_6p3V_G0   :1
c0:      pass: Carrier DC Power Status PGOOD_3p3V_OP   :1
c0:      pass: Carrier DC Power Status PGOOD_3p3V_M1   :1
c0:      pass: Carrier DC Power Status PGOOD_3p3V_M0   :1
c0:      pass: Carrier DC Power Status PGOOD_3p3V_CLK  :1
c0:      pass: Carrier DC Power Status PGOOD_6V        :1
c0:      pass: Carrier DC Power Status PGOOD_3p3V_CAR  :1
c0:      pass: Carrier DC Power Status PGOOD_3p3V_B    :1
c0:      pass: Carrier DC Power Status PGOOD_3p3V_A    :1
c0:      pass: Carrier DC Power Status PGOOD_15V_SUB   :1
c0:      pass: Carrier DC Power Status PGOOD_P9V       :1
c0:      pass: Carrier DC Power Status PGOOD_P15V      :1
c0:      pass: Carrier DC Power Status PGOOD_N5p2V     :1

c0:      pass: Carrier ABUS node P32V_F           28.800000    35.200000    32.558700    Pass
c0:      pass: Carrier ABUS node P9V_F            8.550000     9.450000     8.936500     Pass
c0:      pass: Carrier ABUS node P5_2VF           4.940000     5.460000     5.167300     Pass
c0:      pass: Carrier ABUS node N5_2VF           -5.460000    -4.940000    -5.149400    Pass
c0:      pass: Carrier ABUS node N9V_F            -9.900000    -8.100000    -9.036000    Pass
c0:      pass: Carrier ABUS node P6V_F            5.400000     6.600000     6.026900     Pass
c0:      pass: Carrier ABUS node P3_3V_DWA_F      3.135000     3.465000     3.321500     Pass
c0:      pass: Carrier ABUS node P3_3V_DWB_F      3.135000     3.465000     3.343500     Pass
c0:      pass: Carrier ABUS node P3_3V_CAR_F      3.135000     3.465000     3.302700     Pass
c0:      pass: Carrier ABUS node P15V_SUB_F       14.250000    15.750000    15.037400    Pass
c0:      pass: Carrier ABUS node N5_2V_DWA_F      -5.460000    -4.940000    -5.168700    Pass
c0:      pass: Carrier ABUS node P15V_STBY_F      13.500000    16.500000    14.637900    Pass
c0:      pass: Carrier ABUS node BD_TEMP          0.000000     85.000000    28.552200    Pass
c0:      pass: Carrier ABUS node DCOM             -0.010000    0.010000     0.002800     Pass

c0:      pass: Carrier Load OCXO Cal Succeeded

c0:s0:   pass: Slug shouldBePresent:1 isPresent:1 boardID:10 FPGA: majorRev:0 minorRev:0 revision:2 patch:2

c0:s0:   FAIL: Slug S/N not found

c0:s1:   pass: Slug shouldBePresent:1 isPresent:1 boardID:9 FPGA: majorRev:0 minorRev:0 revision:2 patch:2

c0:s1:    info: Slug S/N M935563001 79 2003 31176 002
```

Checking the A15 13.5 GHz LO Synthesizer Output[1]

1. Refer to the block diagram at the end of this chapter and to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21. Locate the flexible cable W51 at the A15 LO synthesizer board.
2. Disconnect W51 from J1207.
3. Connect the spectrum analyzer to J1207.

1. A15 13.5 GHz LO Synthesizer board only applies to instruments with serial number prefixes <6021.

4. Refer to the NOTE notice on page 4-29. Set the network analyzer for an 800 MHz CW frequency and observe the spectrum analyzer measurement. or analyzers with DSP version 4.0, an 807.61 MHz signal should be present. For analyzers with DSP version 5.0, an 807.44 MHz signal should be present.

5. If the observed problem was frequency banded rather than broadband related, set the analyzer frequency to the center of the problem band. The spectrum analyzer should measure a signal above the network analyzer setting. For analyzers with DSP version 4.0, the signal is 7.61 MHz above the network analyzer setting. For analyzers with DSP version 5.0, the signal is 7.44 MHz above the network analyzer setting.

6. If the LO signal is not present but the 50 MHz reference signal from "Checking the A14 50 MHz Reference Outputs" is present, replace the A15 LO synthesizer board. Refer to "Removing and Replacing the A4–A17 Boards" on page 7-20.

7. If the signal is present, reconnect cable W41, and then continue with "Checking the A25 HMA26.5 Output".

Checking the A25 HMA26.5 Output

NOTE IMPORTANT! Some PNAs have installed a legacy HMA26.5 (5087-7765) that is used with a discrete A26 splitter. Some PNAs have installed a new HMA26.5 (N5240-60101) with an integrated splitter. To identify which HMA26.5 is installed in your PNA, refer to Figure 4-12 on page 4-42.

1. Refer to the block diagram at the end of this chapter and to "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84 or in "4-Port Configurations, Serial Number Prefix ≥6021" on page 6-136. Locate the semirigid cable W52 (4-port models with a legacy HMA26.5) or W80 (2-port models and for all models with a new HMA26.5) at the A25 HMA26.5.

2. Disconnect W52 (4-port models with a legacy HMA26.5) or W80 (2-port models and all models with a new HMA26.5) from the A25 HMA 26.5.

3. Connect the spectrum analyzer to the open connector on the A25 HMA 26.5.

4. Refer to the NOTE notice on page 4-29. Set the network analyzer for an 800 MHz CW frequency and observe the spectrum analyzer measurement. For analyzers with DSP version 4.0, an 807.61 MHz signal should be present. For analyzers with DSP version 5.0, an 807.44 MHz signal should be present.

5. If the observed problem was frequency banded rather than broadband related, set the analyzer frequency to the center of the problem band. The spectrum analyzer should measure a signal above the network analyzer

setting. For analyzers with DSP version 4.0, the signal is 7.61 MHz above the network analyzer setting. For analyzers with DSP version 5.0, the signal is 7.44 MHz above the network analyzer setting

6. If the signal is not present but the signal is present, from “Checking the A15 13.5 GHz LO Synthesizer Output” (S/N prefixes <6021) or “Checking the A15 Direct Digital Synthesizer (DDS) Assembly Outputs” (LO Output, prefixes ≥6021), replace the A25 HMA 26.5. Refer to “Removing and Replacing the A25 HMA26.5” on page 7-38.

7. If the signal is present, reconnect cable W52 or W80 and then:
   - for 2-port models, continue checking with “Checking the Receiver Group” on page 4-52.
   - for 4-port models, continue checking with “Checking the A26 Splitter Output”.

Verify the Model/Version of HMA26.5 Installed

The installed components in your PNA model may be either using the legacy HMA26.5 part number 5087-7765 or if your PNA is using the newer HMA26.5 part number N5240-60101.

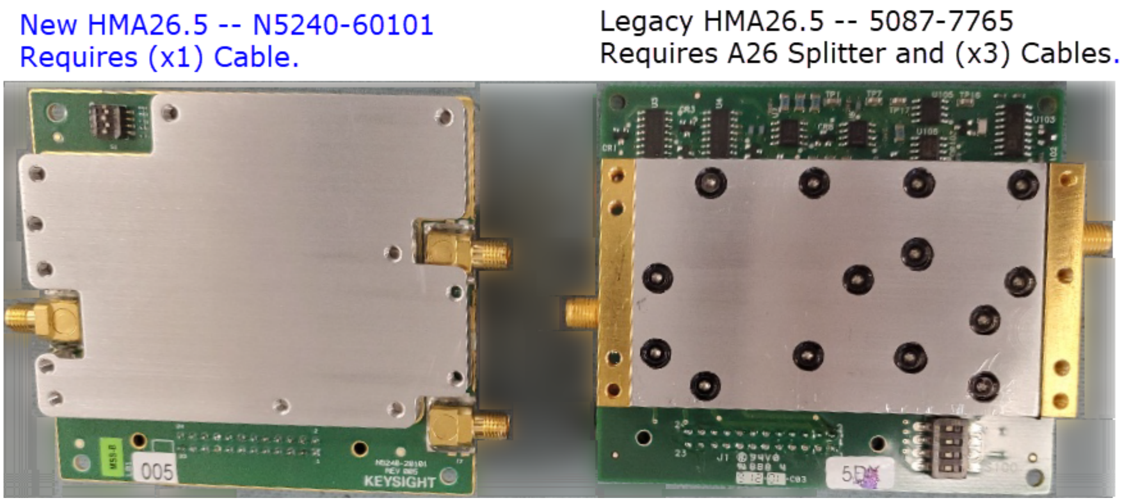
Legacy HMA26.5 Use the Following Components:

- A22 splitter 5087-7139
- W42 N5222-20009
- W43 N5222-20007
- W44 N5222-20008

The new N5240-60101 HMA26.5 has the splitter integrated into the assembly and uses an N5222-20126 cable. Refer to Figure 4-12 on page 4-42.

See also Chapter 6, “Replaceable Parts.” and the “Bottom Assemblies and Cables” section for your configuration and serial number prefix.

Figure 4-12 Comparison of Legacy HMA26.5 (5087-7765) and New HMA26.5 (N5240-60101)



Checking the A26 Splitter Output

NOTE

IMPORTANT! Some PNAs have installed a legacy HMA26.5 (5087-7765) that is used with a discrete A26 splitter. Some PNAs have installed a new HMA26.5 (N5240-60101) with an integrated splitter. To identify which HMA26.5 is installed in your PNA, refer to Figure 4-12 on page 4-42.

1. Refer to the block diagram at the end of this chapter and to "Bottom RF Cables, Standard 4-Port Configuration, Option 401, S/N Prefixes <6201" on page 6-87. Locate the semi-rigid cables W53 and W54, at the A26 splitter.
2. Disconnect W53 and W54, one at a time, from the A26 splitter.
3. Connect the spectrum analyzer to the open connector.
4. Refer to the NOTE notice on page 4-29. Set the network analyzer for an 800 MHz CW frequency and observe the spectrum analyzer measurement. For analyzers with DSP version 4.0, an 807.61 MHz signal should be present. For analyzers with DSP version 5.0, an 807.44 MHz signal should be present.
5. If the observed problem was frequency banded rather than broadband related, set the analyzer frequency to the center of the problem band. The spectrum analyzer should measure a signal above the network analyzer setting. For analyzers with DSP version 4.0, the signal is 7.61 MHz above the network analyzer setting. For analyzers with DSP version 5.0, the signal is 7.44 MHz above the network analyzer setting.
6. If the signal is not present but the signal from "Checking the A25 HMA26.5 Output," is present, replace the A26 splitter. Refer to "Removing and Replacing the A26 Splitter" on page 7-41.
7. If the signal is present, reconnect cables W53 and W54, and then continue with "Checking the Receiver Group" on page 4-52.

Checking the A4 and A17 Source Synthesizer Outputs[1]

1. Refer to the block diagram at the end of this chapter and to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21. Locate either the cable W1 at the A4 source 1 synthesizer board or W2 at the A17 source 2 synthesizer board. (W2 and A17 are only available in 4-port models and 2-port models with Option 224.)
2. Disconnect W1 or W2 from J1207.
3. Connect the spectrum analyzer to J1207.

1. A4 and A17 synthesizer boards only applies to PNAs with serial number prefixes <6021.

4. Set the network analyzer for an 800 MHz CW frequency and observe the spectrum analyzer measurement. An 800 MHz signal should be present.

5. Refer to the NOTE notice on page 4-29. If the observed problem was frequency banded rather than broadband related, set the analyzer frequency to the center of the problem band. The spectrum analyzer should measure a signal above the network analyzer setting. For analyzers with DSP version 4.0, the signal is 7.61 MHz above the network analyzer setting. For analyzers with DSP version 5.0, the signal is 7.44 MHz above the network analyzer setting.

6. If the signal is not present but the 50 MHz reference signal from "Checking the A14 50 MHz Reference Outputs" is present, replace the faulty synthesizer board. Refer to "Removing and Replacing the A4–A17 Boards" on page 7-20.

7. If the signal is present, reconnect cables W1 and W2, and then continue with "Checking the A5 and A10 Source Outputs".

Checking the A5 and A10 Source Outputs

1. Refer to the block diagram at the end of this chapter and to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21. Locate the cables W3 and W4 at the A5 source 1 board or cables W7 and W8 at the A10 source 2 board. (W7, W8, and A10 are only available in 4-port models and 2-port models with Option 224.)

2. Disconnect cables W3 and W4 or cables W7 and W8, dependent on which source board is to be checked, at the A7, A8, A12, or A13 40 GHz Doubler board.

3. Connect the spectrum analyzer to the open connector at the end of the cable that connects to the source board to be checked.

4. Set the network analyzer for an 800 MHz CW frequency and observe the spectrum analyzer measurement. An 800 MHz signal should be present.

5. Refer to the NOTE notice on page 4-29. If the observed problem was frequency banded rather than broadband related, set the analyzer frequency to the center of the problem band. The spectrum analyzer should measure a signal above the network analyzer setting. For analyzers with DSP version 4.0, the signal is 7.61 MHz above the network analyzer setting. For analyzers with DSP version 5.0, the signal is 7.44 MHz above the network analyzer setting.

6. If the signal is not present but the signals from "Checking the A4 and A17 Source Synthesizer Outputs" are present, replace the appropriate source board. Refer to "Removing and Replacing the A4–A17 Boards" on page 7-20.

7. If the signal is present, reconnect all cables, and then continue with "Checking the A7, A8, A12, and A13 40 GHz Doubler Outputs".

Checking the A7, A8, A12, and A13 40 GHz Doubler Outputs

1. Refer to the block diagram at the end of this chapter and to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21. Locate cable W11 on the A7 doubler board, cable W17 on the A8 doubler board, cable W13 on the A12 doubler board, and cable W15 on the A13 doubler board. (A12 and A13 are only available in 4-port models and 2-port models with Option 224.)
2. Disconnect cable W11 or W17 or W13 or W15, dependent on which doubler board is to be checked.
3. Connect the spectrum analyzer to the open connector on the doubler board to be checked.
4. Set the network analyzer for an 800 MHz CW frequency and observe the spectrum analyzer measurement. An 800 MHz signal should be present.
5. Refer to the NOTE notice on page 4-29. If the observed problem was frequency banded rather than broadband related, set the analyzer frequency to the center of the problem band. The spectrum analyzer should measure a signal above the network analyzer setting. For analyzers with DSP version 4.0, the signal is 7.61 MHz above the network analyzer setting. For analyzers with DSP version 5.0, the signal is 7.44 MHz above the network analyzer setting.
6. If the signal is not present but the signals from "Checking the A4 and A17 Source Synthesizer Outputs" are present, replace the appropriate doubler board. Refer to "Removing and Replacing the A4–A17 Boards" on page 7-20.
7. If the signal is present, reconnect all cables, and then continue with "Checking the Signal Separation Group" on page 4-47.

Checking the A60, A61, A62, and A63 70 GHz Doubler Outputs

1. Refer to the block diagram at the end of this chapter and "Bottom RF Cables, 4-Port, Option 423 with and without 029 (Ports 1 and 2), S/N Prefixes <6201" on page 6-108, "Bottom RF Cables, 4-Port, Option 423 with and without Option 029 (Ports 3 and 4), S/N Prefixes <6201" on page 6-113 or to "Bottom RF Cables, 4-Port, Option 423 with and without 029 or E29 (Ports 1 and 2), S/N Prefixes ≥6201" on page 6-162, and "Bottom RF Cables, 4-Port, Option 423 with and without Option 029 or E29 (Ports 3 and 4), S/N Prefixes ≥6201" on page 6-167. Locate the following cables. (Boards A61 and A62 are available only in 4-port models and 2-port models with Option 224.)
   - W27 on the A60 doubler board,
   - W28 on the A61 doubler board
   - W29 on the A62 doubler board

   – W30 on the A63 doubler board

2. Disconnect cable W27 or W28 or W29 or W30, depending on which doubler board is to be checked.

3. Connect the spectrum analyzer to the open connector on the doubler board to be checked.

4. Set the PNA for an 800 MHz CW output frequency and observe the spectrum analyzer display. An 800 MHz signal should be present.

5. Refer to the NOTE notice on page 4-29. If the PNA problem you are troubleshooting is frequency banded rather than broadband related, set the PNA output frequency to the center of the problem band. The spectrum analyzer should display a signal above the PNA setting. For analyzers with DSP version 4.0, the signal is 7.61 MHz above the network analyzer setting. For analyzers with DSP version 5.0, the signal is 7.44 MHz above the network analyzer setting.

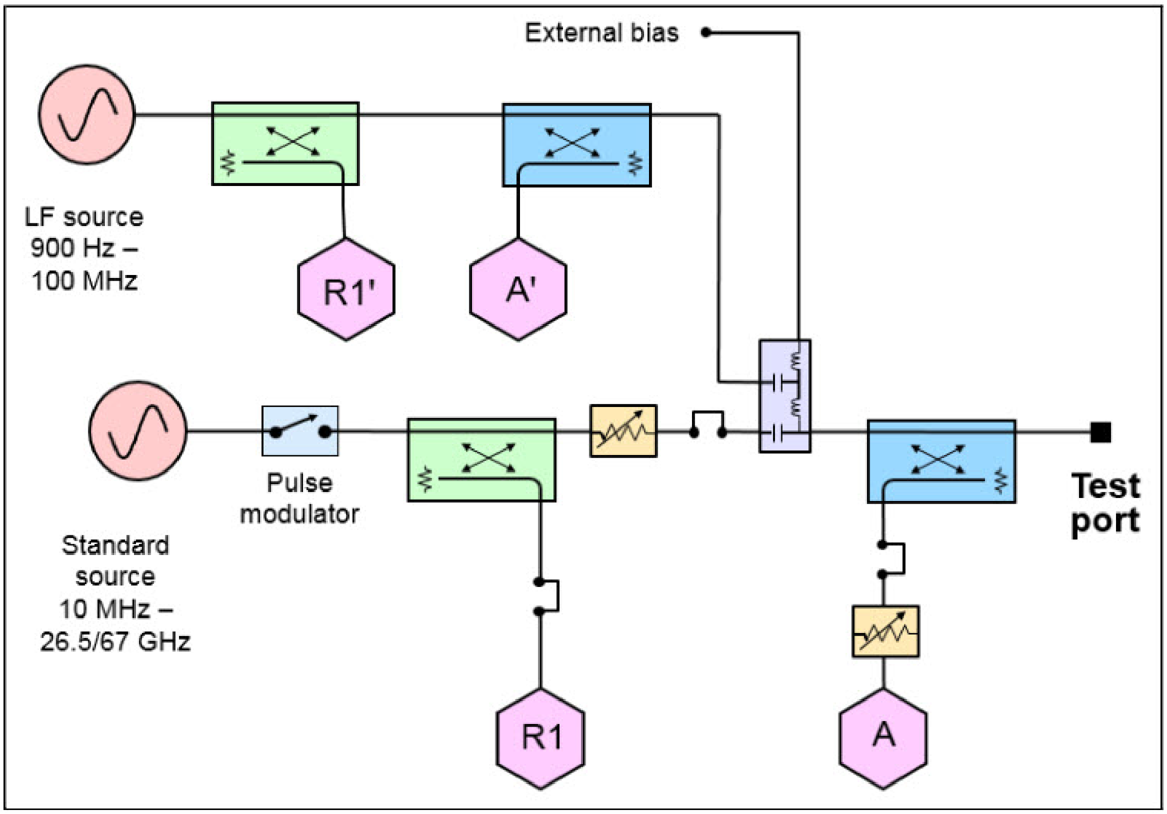
6. If the signal is not present but the signals described in “Checking the A4 and A17 Source Synthesizer Outputs” on page 4-43 are present, replace the appropriate doubler board. Refer to “Removing and Replacing the A60–A63 70 GHz Doublers” on page 7-62.

7. If the signal is present, reconnect all cables, and then continue with “Checking the Signal through the Signal Separation Path” on page 4-49.

Checking the A70/A75 Low Frequency Extension (LFE) Board and the Bias Combiners

The 2-port and 4-port Low Frequency Extension (LFE) options add additional hardware to extend the start frequency of the VNA down to 900 Hz.

Figure 4-13 LFE Block Diagram - Single Port Configuration Shown. Other Ports are Similar.



Checking the Signal Separation Group

Before checking the signal separation group 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 front and rear panel connections except installed jumpers.

3. Remove the outer cover from the analyzer. Refer to "Removing the Covers" on page 7-8.

WARNING Procedures described in this document are performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

4. With the covers off, plug in the analyzer and turn on the power.

CAUTION Do not operate the analyzer with the outer cover removed for more than 30 minutes, as this could cause the analyzer to overheat which could result in costly damage.

Checking the Output Power of the A, B, C, and D Signals

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

Equipment Used for This Check

Equipment Type	Model or Part Number	Alternate Model or Part Number
Power meter	E4418B/E4419B	E4418A/E4419A
Power sensor, 2.4 mm	E8487A	None
Adapter, 2.4 mm (f) to 2.4 mm (f)	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 4-8 or Figure 4-9) is not on the analyzer screen, perform the following: Press UTILITY System, then Service, then Utilities, then Receiver Display.
3. Set the sweep speed for a 10 second sweep: Press STIMULUS Sweep, then Sweep Time. Set the time to 10.000 seconds in the **Sweep Time** box.

Checking Port 1, 2, 3, or 4 Power Outputs (A, B, C, or D Signals)

The object of this check is to verify the power of the output signal across the entire frequency range. Perform this test if there is an observed problem only with one receiver 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 the suspect port.
2. Set the trace to measure S_{11}, S_{22}, S_{33}, or S_{44}, dependent on the suspect port.
3. Observe the power reading on the power meter as the sweep occurs on the analyzer.
4. The measured output power on the power meter should be at least the preset power level ±1 dB over the entire frequency range.
   – If the measured power is correct, go to "Checking the Receiver Group" on page 4-52.
   – If the measured power is not correct, go to "Checking the Signal through the Signal Separation Path" on page 4-49.

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 any of the following that are appropriate:

– "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32
– "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84
– "2-Port Configurations, Serial Number Prefixes ≥6021" on page 6-58
– "4-Port Configurations, Serial Number Prefix ≥6021" on page 6-136

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

– A50, A51, A52, or A53 mechanical switch and A54 combiner (A54 is only available in 4-port models with Option 423 and 2-port models with Option 224.)
– A29, A30, A31, or A32 reference coupler
– A38, A39, A40, or A41 source step attenuator
– A42, A43, A44, or A45 bias tee
– A33, A34, A35, and A36 test port coupler

Equipment Used for These Tests

Equipment Type	Model or Part Number	Alternate Model or Part Number
Spectrum analyzer	8565E	856xE[a]

a. 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 output of the source board to the output port.

Set the network analyzer for an S_{11}, S_{22}, S_{33}, or S_{44}, measurement for Port 1, 2, 3, or 4 respectively, with a CW frequency of 800 MHz.

Perform the following checks in the order presented.

Checking the A29, A30, A31, and A32 Reference Couplers

1. Locate the appropriate semirigid cable at the output of the reference coupler to be checked:
   - Options 201 and 400
     - Port 1; W19 of A29
     - Port 2; W31 of A32
     - Port 3; W23 of A30
     - Port 4; W27 of A31
   - Options 219, 224, 419, and 423
     - Port 1; W81 of A29
     - Port 2; W93 of A32
     - Port 3; W85 of A30
     - Port 4; W89 of A31
2. Using a 5/16-

   torque wrench, disconnect the semirigid cable at the reference coupler.
3. Connect the spectrum analyzer to the open reference coupler connector. Set the spectrum analyzer to measure a signal at 800 MHz.
4. If the 800 MHz signal is not present and the analyzer has mechanical switches, continue testing at "Checking the A50, A51, A52, and A53 Mechanical Switches" on page 4-51.
5. If the 800 MHz signal is not present and the analyzer does not have mechanical switches, replace the reference coupler. Refer to "Removing and Replacing the A29 –A32 Reference Couplers and Reference Coupler Mounting Brackets" on page 7-45.

6. If the 800 MHz signal is present and the analyzer has source attenuators and bias tees, reconnect the cable to the reference coupler and continue testing at "Checking the A38, A39, A40, and A41 60-dB Source Step Attenuators" on page 4-51

7. If the 800 MHz signal is present and the analyzer does not have source attenuators and bias tees, replace the test port coupler. Refer to "Removing and Replacing the A33–A36 Test Port Couplers" on page 7-48.

Checking the A38, A39, A40, and A41 60-dB Source Step Attenuators

1. Locate the appropriate semirigid cable at the output of the source step attenuator to be checked:

   – Options 219, 224, 419, and 423

     – Port 1; W82 of A38

     – Port 2; W94 of A41

     – Port 3; W86 of A39

     – Port 4; W90 of A40

2. Using a 5/16-inch torque wrench, disconnect the semirigid cable at the step attenuator.

3. Connect the spectrum analyzer to the open step attenuator connector. Set the spectrum analyzer to measure a signal at 800 MHz.

4. If the 800 MHz signal is not present, replace the source step attenuator. Refer to "Removing and Replacing the A38–A41 Source Attenuators and the A46–A49 Receiver Attenuators" on page 7-52.

5. If the 800 MHz signal is present, replace the associated bias tee. Refer to "Removing and Replacing the A38–A41 Source Attenuators and the A46–A49 Receiver Attenuators" on page 7-52.

Checking the A50, A51, A52, and A53 Mechanical Switches

1. Locate the appropriate semirigid cable at the output of the mechanical switch to be checked:

   – Options 224 and 423

     – Port 1; W106 of A50

     – Port 2; W120 of A53

     – Port 3; W112 of A51

     – Port 4; W116 of A52

2. Using a 5/16-inch torque wrench, disconnect the semirigid cable at the bypass switch.

3. Connect the spectrum analyzer to the open bypass switch connector. Set the spectrum analyzer to measure a signal at 800 MHz.

4. If the 800 MHz signal is not present, replace the mechanical switch. Refer to "Removing and Replacing the A50–A53 Bypass Switches and the A54 Combiner" on page 7-57.

5. If the 800 MHz signal is present, replace the associated reference coupler. Refer to "Removing and Replacing the A29 –A32 Reference Couplers and Reference Coupler Mounting Brackets" on page 7-45.

Checking the A70–A74 Bias Combiners

Refer to "Checking the A70/A75 Low Frequency Extension (LFE) Board and the Bias Combiners" on page 4-47.

Checking the Receiver Group

Equipment Used for These Tests

Equipment Type	Model or Part Number	Alternate Model or Part Number
Spectrum analyzer	8565E	856xE[a]

a. Refer to the NOTE notice on page 4-29. Must be capable of measuring a signal at 7.61 MHz (analyzers with DSP version 4.0), or 7.44 MHz (analyzers with DSP version 5.0), and 1 GHz.

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

– "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32
– "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84
– "2-Port Configurations, Serial Number Prefixes ≥6021" on page 6-58
– "4-Port Configurations, Serial Number Prefix ≥6021" on page 6-136

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 front and rear panel connections except installed jumpers.

3. Remove the outer and inner covers from the analyzer. Refer to "Removing the Covers" on page 7-8.

WARNING Procedures described in this document are performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

4. With the covers off, plug in the analyzer and turn on the power.

CAUTION Do not operate the analyzer with the outer cover removed for more than 30 minutes, as this could cause the analyzer to overheat which could result in costly damage.

Checking the A27 and A28 Mixer Brick Receiver Outputs

Set the network analyzer for an S_{11} measurement with a CW frequency of 1 GHz.

1. Locate the following flexible cables at the receiver IF outputs of the mixer brick(s).
   - 2-port models
     - Receiver A; W61 of A27
     - Receiver R1; W62 of A27
     - Receiver R2; W63 of A27
     - Receiver B; W64 of A27
   - 4-port models
     - Receiver A; W61 of A27
     - Receiver R1; W62 of A27
     - Receiver R2; W63 of A27
     - Receiver B; W64 of A27
     - Receiver C; W68 of A28
     - Receiver R3; W67 of A28
     - Receiver R4; W66 of A28
     - Receiver D; W65 of A28
2. Disconnect the flexible cable at the suspect receiver.
3. Connect the spectrum analyzer to the suspect receiver connector.
4. Refer to the NOTE notice on page 4-29. The measured signal on the spectrum analyzer should be at 7.61 MHz (analyzers with DSP version 4.0), or 7.44 MHz (analyzers with DSP version 5.0), and 1 GHz.

5. If the measured signal is present, continue testing at "Checking the A24 IF Multiplexer Board" on page 4-55.
6. If the measured signal is missing on the R1 receiver, continue testing at "Checking the A37 Reference Mixer Switch" on page 4-54.

   If the measured signal is missing on any receiver (other than the R1 receiver noted above) and the analyzer does not have receiver attenuators, replace the A27 or A28 mixer brick, whichever is appropriate. Refer to "Removing and Replacing the A27 and A28 Mixer Bricks" on page 7-43.

   If the measured signal is missing on the A, B, C, or D receivers and the analyzer has receiver attenuators, continue testing at "Checking the A46, A47, A48, and A49 35-dB Receiver Step Attenuators" on page 4-54.

Checking the A37 Reference Mixer Switch

1. Remove the front panel REF 1 jumper and connect a spectrum analyzer to the front-panel REF 1 SOURCE OUT connector.
2. If the measured signal is present, replace the A27 mixer brick. Refer to "Removing and Replacing the A27 and A28 Mixer Bricks" on page 7-43.
3. If the measured signal is not present, replace the A37 reference mixer switch. Refer to "Removing and Replacing the A37 Reference Mixer Switch" on page 7-50.

Checking the A46, A47, A48, and A49 35-dB Receiver Step Attenuators

1. Locate the appropriate semirigid cable at the output of the receiver step attenuator to be checked:
   - Options 219, 224, 419, and 423
     - Port 1; W98 of A46
     - Port 2; W104 of A49
     - Port 3; W100 of A47
     - Port 4; W102 of A48
2. Disconnect the appropriate semirigid cable from the output of the step attenuator.
3. Connect the spectrum analyzer to the open step attenuator connector. Set the spectrum analyzer to measure a signal at 800 MHz.
4. If the 800 MHz signal is not present, replace the receiver step attenuator. Refer to "Removing and Replacing the A38–A41 Source Attenuators and the A46–A49 Receiver Attenuators" on page 7-52.
5. If the 800 MHz signal is present, replace the associated mixer brick, A27 or A28. Refer to "Removing and Replacing the A27 and A28 Mixer Bricks" on page 7-43.

Checking the A24 IF Multiplexer Board

1. Locate each of the flexible RF cables at the output receivers of the IF multiplexer board:
   - 2-port models
     - Receiver A; W69
     - Receiver R1; W72
     - Receiver R2; W73
     - Receiver B; W70
   - 4-port models
     - Receiver A; W69
     - Receiver B; W70
     - Receiver C; W72
     - Receiver D; W73
     - Receiver R; W71
2. Disconnect the appropriate flexible RF cable from the output receiver to be tested on the A24 IF multiplexer board.
3. Connect the spectrum analyzer to the open connector.
4. Refer to the NOTE notice on page 4-29. The measured signal on the spectrum analyzer should be at 7.61 MHz (analyzers with DSP version 4.0), or 7.44 MHz (analyzers with DSP version 5.0), and 1 GHz.
5. If the measured signal is present, replace the A16 SPAM board. Refer to "Removing and Replacing the A4–A17 Boards" on page 7-20.
6. If the measured signal is not present, replace the A24 IF multiplexer board. Refer to "Removing and Replacing the A24 IF Multiplexer Board" on page 7-36.

Instrument Simplified Block Diagrams – LFE[1]

2-Port N5290A System Block Diagram (201 and 205)

Figure 4-14 System Block Diagram Legend

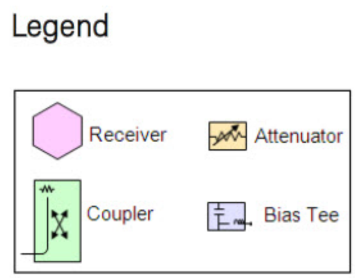
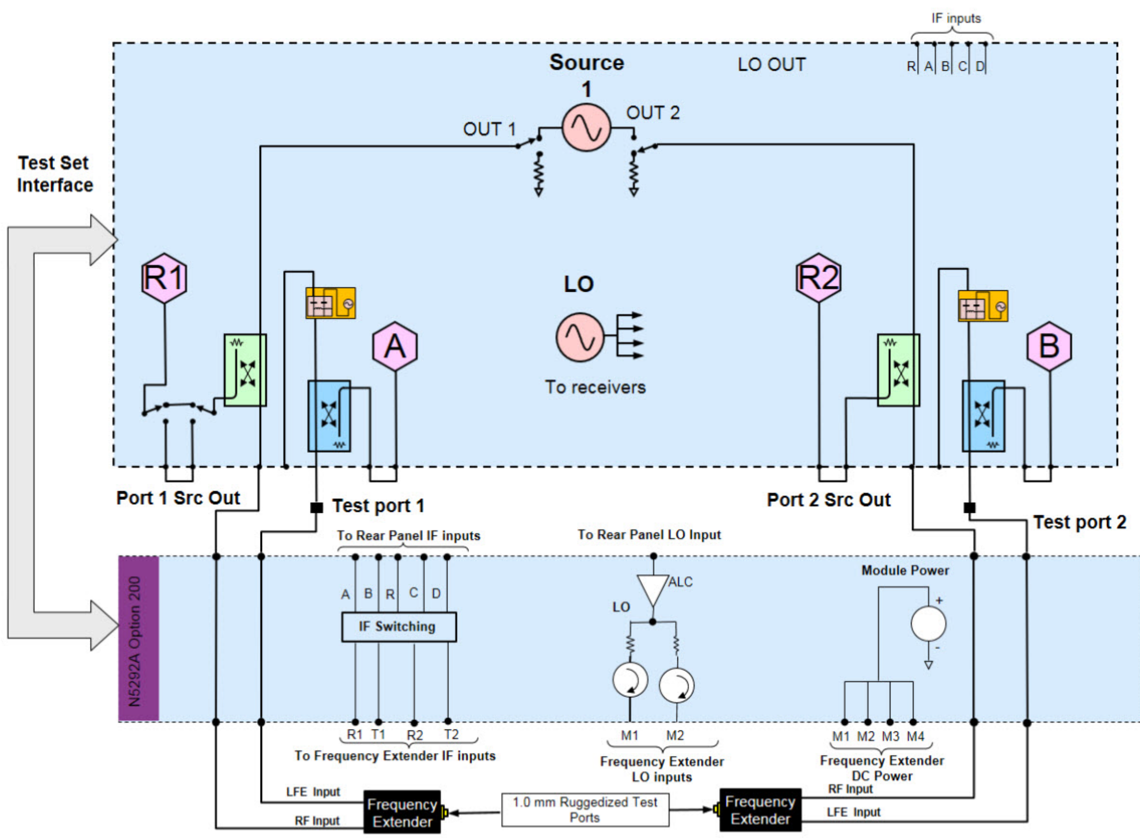


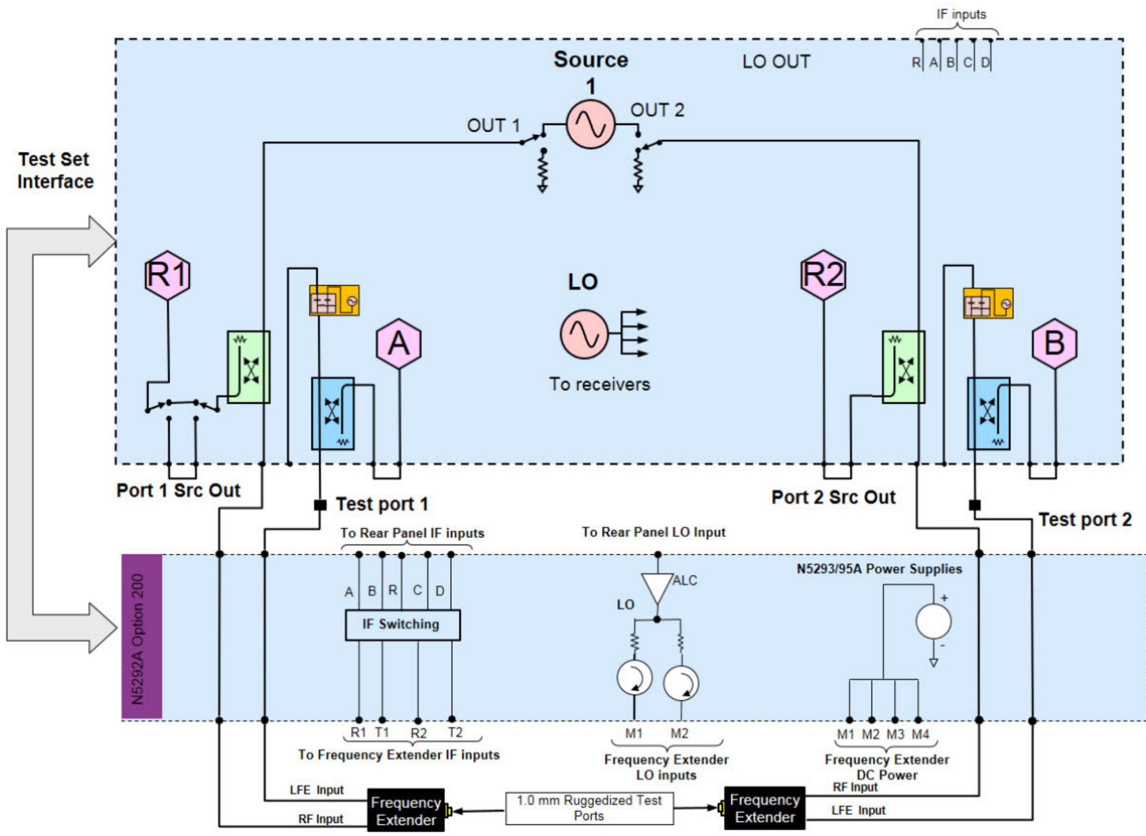
Figure 4-15 2-Port N5290A System Simplified Block Diagram (201 and 205)



1. Your model PNA may not have available all of the LFE Options listed.

2-Port N5290A System Block Diagram (202 and 205)

Figure 4-16 2-Port N5290A System Simplified Block Diagram (202 and 205)



4-Port N5290A System Block Diagram (401)

Figure 4-17 4-Port N5290A System Simplified Block Diagram (401)

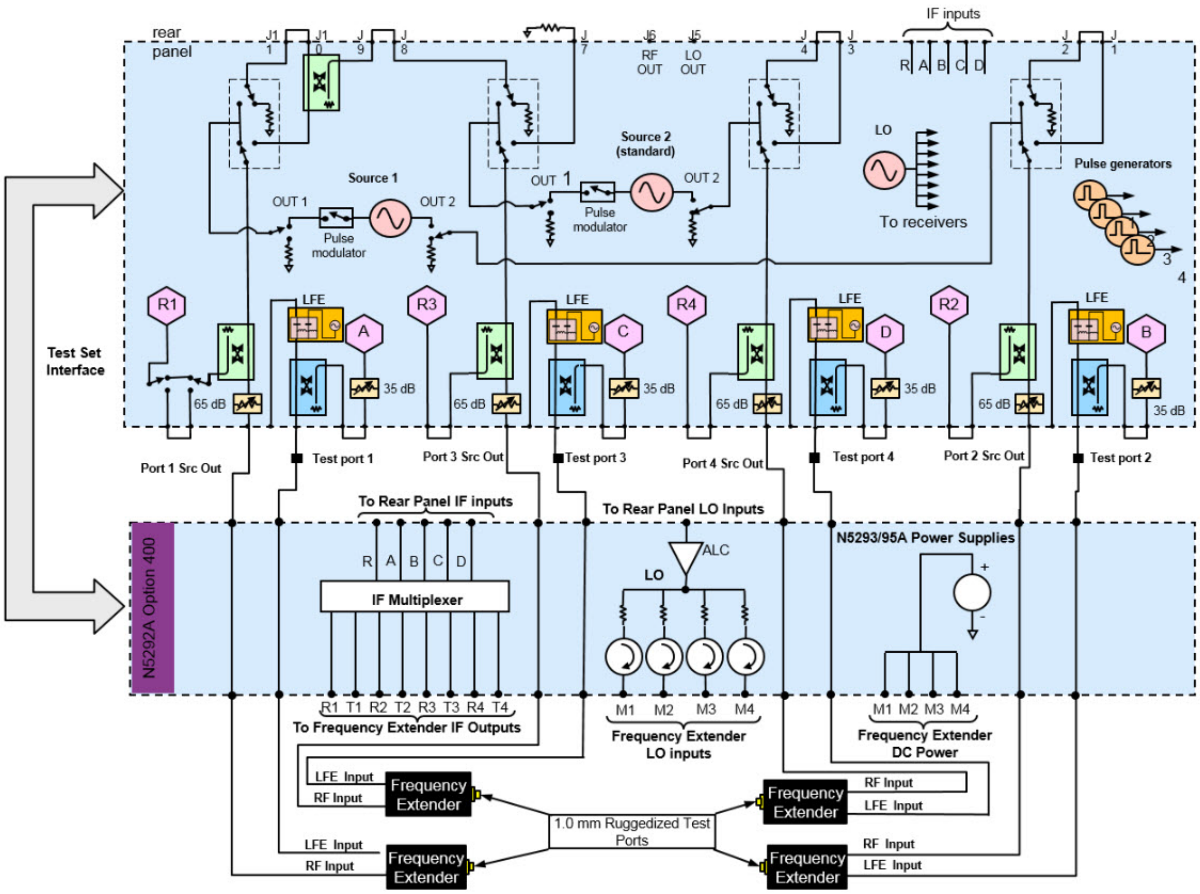


Figure 4-18 4-Port N5290A System Simplified Block Diagram (402)

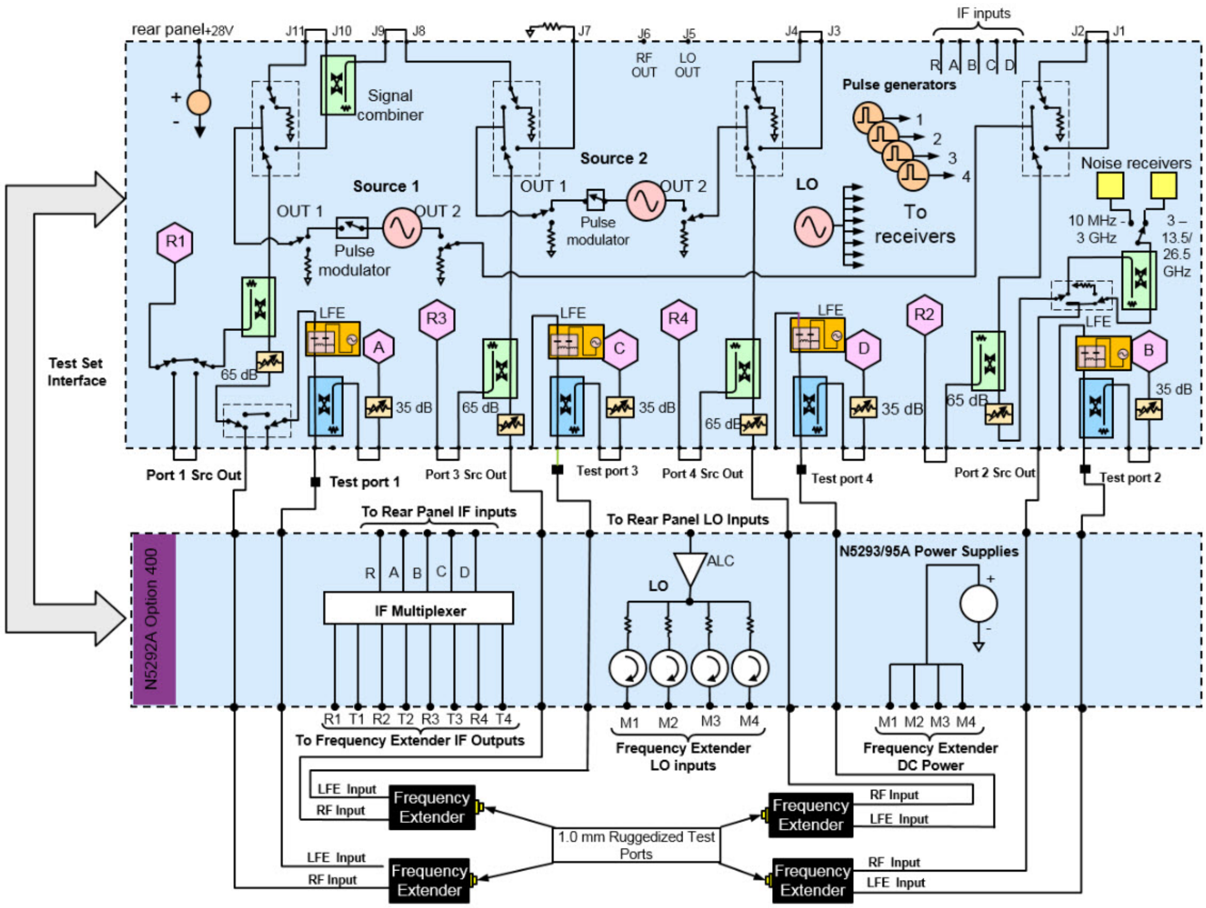
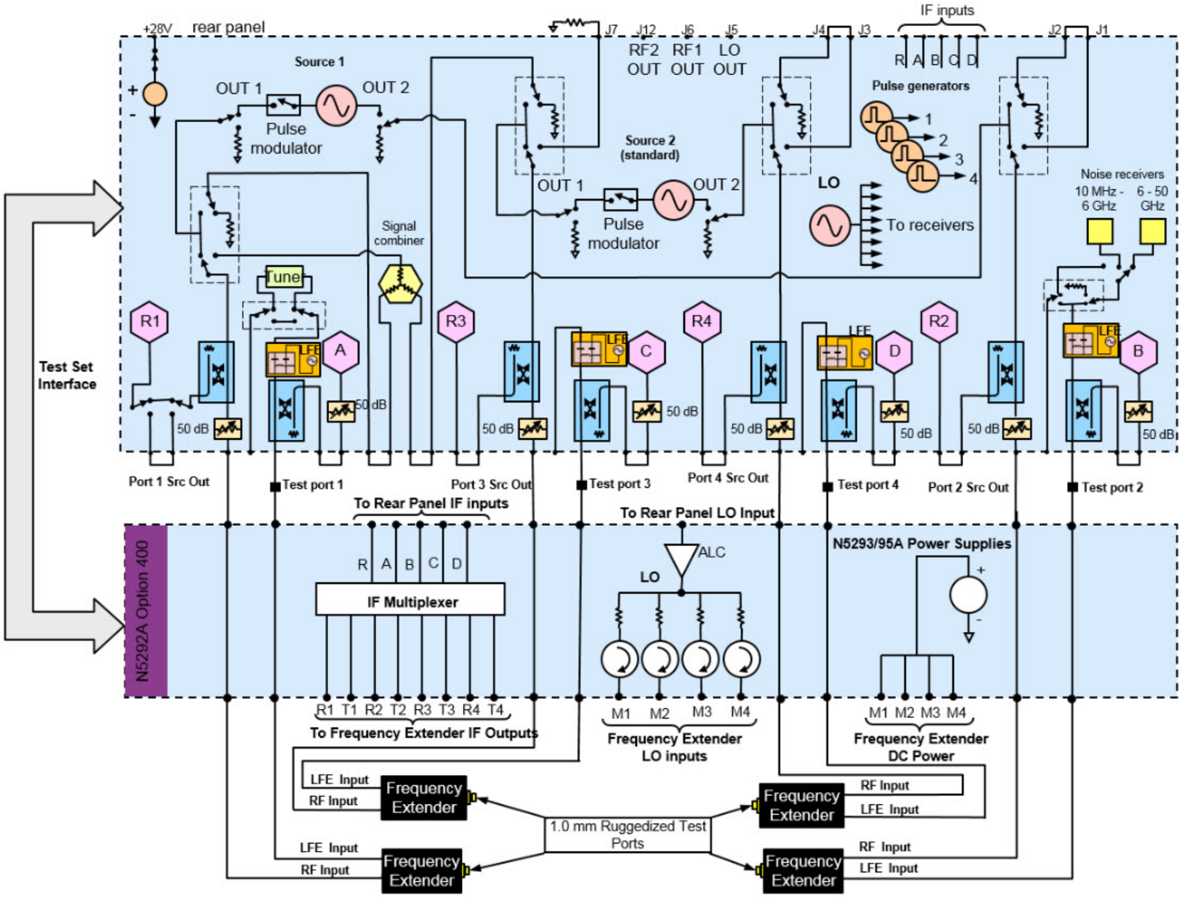


Figure 4-19 4-Port N5290A System Simplified Block Diagram (403)



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Instrument Block Diagrams – 2-Port (Sheet 1), Non-LFE and Non-DDS (Version 6 Synthesizers)

Microwave PNA-X, N5247B – 2-Port, Non-LFE and Non-DDS (Version 6 Synthesizers)

Band	Mixer Brick L.O. Harmonic Number	❶ A15 Synthesizer Frequency (GHz)	❷ A25 HMA26.5 Frequency (GHz)	❸ A4/A17 Source Synthesizer Frequency (GHz)	❹ A5/A10 Source Frequency (GHz)	❺ A7/A8/A12/A13 40 GHz Doubler Frequency (GHz)	❻ A60/A61/A62/A63 70 GHz Doubler Frequency (GHz)
1	-	-	-	-	-	-	-
2	1	0.01254 to 0.01654	0.01254 to 0.01654	0.010 to 0.014	0.010 to 0.014	0.010 to 0.014	0.010 to 0.014
3	1	0.01654 to 0.02154	0.01654 to 0.02154	0.014 to 0.019	0.014 to 0.019	0.014 to 0.019	0.014 to 0.019
4	1	0.02154 to 0.02954	0.02154 to 0.02954	0.019 to 0.027	0.019 to 0.027	0.019 to 0.027	0.019 to 0.027
5	1	0.02954 to 0.04054	0.02954 to 0.04054	0.027 to 0.038	0.027 to 0.038	0.027 to 0.038	0.027 to 0.038
6	1	0.04054 to 0.05554	0.04054 to 0.05554	0.038 to 0.053	0.038 to 0.053	0.038 to 0.053	0.038 to 0.053
7	1	0.06061 to 0.08261	0.06061 to 0.08261	0.053 to 0.075	0.053 to 0.075	0.053 to 0.075	0.053 to 0.075
8	1	0.08261 to 0.11261	0.08261 to 0.11261	0.075 to 0.105	0.075 to 0.105	0.075 to 0.105	0.075 to 0.105
9	1	0.11261 to 0.15361	0.11261 to 0.15361	0.105 to 0.146	0.105 to 0.146	0.105 to 0.146	0.105 to 0.146
10	1	0.15361 to 0.21261	0.15361 to 0.21261	0.146 to 0.205	0.146 to 0.205	0.146 to 0.205	0.146 to 0.205
11	1	0.21261 to 0.25761	0.21261 to 0.25761	0.205 to 0.250	0.205 to 0.250	0.205 to 0.250	0.205 to 0.250
12	1	0.25761 to 0.40361	0.25761 to 0.40361	0.250 to 0.396	0.250 to 0.396	0.250 to 0.396	0.250 to 0.396
13	1	0.40361 to 0.50761	0.40361 to 0.50761	0.396 to 0.500	0.396 to 0.500	0.396 to 0.500	0.396 to 0.500
14	1	0.50761 to 0.63561	0.50761 to 0.63561	0.500 to 0.628	0.500 to 0.628	0.500 to 0.628	0.500 to 0.628
15	1	0.63561 to 1.00761	0.63561 to 1.00761	0.628 to 1.000	0.628 to 1.000	0.628 to 1.000	0.628 to 1.000
16	1	1.0076 to 1.5076	1.0076 to 1.5076	1.000 to 1.500	1.000 to 1.500	1.000 to 1.500	1.000 to 1.500
17	1	1.5076 to 2.0076	1.5076 to 2.0076	1.500 to 2.000	1.500 to 2.000	1.500 to 2.000	1.500 to 2.000
18	1	2.0076 to 3.0076	2.0076 to 3.0076	2.000 to 3.000	2.000 to 3.000	2.000 to 3.000	2.000 to 3.000
19	1	3.0076 to 3.2076	3.0076 to 3.2076	3.000 to 3.200	3.000 to 3.200	3.000 to 3.200	3.000 to 3.200
20	1	3.2076 to 4.0076	3.2076 to 4.0076	3.200 to 4.000	3.200 to 4.000	3.200 to 4.000	3.200 to 4.000
21	1	4.0076 to 5.3396	4.0076 to 5.3396	4.000 to 5.332	4.000 to 5.332	4.000 to 5.332	4.000 to 5.332
22	1	5.3396 to 6.7596	5.3396 to 6.7596	5.332 to 6.752	5.332 to 6.752	5.332 to 6.752	5.332 to 6.752
23	1	6.7596 to 8.0076	6.7596 to 8.0076	6.752 to 8.000	6.752 to 8.000	6.752 to 8.000	6.752 to 8.000
24	1	8.0076 to 8.5076	8.0076 to 8.5076	8.000 to 8.500	8.000 to 8.500	8.000 to 8.500	8.000 to 8.500
25	1	8.5076 to 10.6716	8.5076 to 10.6716	8.500 to 10.664	8.500 to 10.664	8.500 to 10.664	8.500 to 10.664
26	1	10.6716 to 12.0076	10.6716 to 12.0076	10.664 to 12.000	10.664 to 12.000	10.664 to 12.000	10.664 to 12.000
27	1	12.0076 to 12.8076	12.0076 to 12.8076	12.000 to 12.800	12.000 to 12.800	12.000 to 12.800	12.000 to 12.800
28	1	12.8076 to 13.5176	12.8076 to 13.5176	12.800 to 13.510	12.800 to 13.510	12.800 to 13.510	12.800 to 13.510
29	1	6.7588 to 7.7038	13.5176 to 15.4076	6.755 to 7.700	13.510 to 15.400	13.510 to 15.400	13.510 to 15.400
30	1	7.7038 to 8.0038	15.4076 to 16.0076	7.700 to 8.000	15.400 to 16.000	15.400 to 16.000	15.400 to 16.000
31	1	8.0038 to 9.5038	16.0076 to 19.0076	8.000 to 9.500	16.000 to 19.000	16.000 to 19.000	16.000 to 19.000
32	1	9.5038 to 10.0038	19.0076 to 20.0076	9.500 to 10.000	9.500 to 10.000	19.000 to 20.000	19.000 to 20.000
33	1	10.0038 to 10.6678	20.0076 to 21.3356	10.000 to 10.664	10.000 to 10.664	20.000 to 21.328	20.000 to 21.328
34	1	10.6678 to 12.0038	21.3356 to 24.0076	10.664 to 12.000	10.664 to 12.000	21.328 to 24.000	21.328 to 24.000
35	1	12.0038 to 13.2538	24.0076 to 26.5076	12.000 to 13.250	12.000 to 13.250	24.000 to 26.500	24.000 to 26.500
36	3	8.8359 to 9.0052	8.8359 to 9.0052	13.250 to 13.504	13.250 to 13.504	26.500 to 27.008	26.500 to 27.008
37	3	9.0052 to 10.6692	9.0052 to 10.6692	6.752 to 8.000	13.504 to 16.000	27.008 to 32.000	27.008 to 32.000
38	3	10.6692 to 13.3359	10.6692 to 13.3359	8.000 to 10.000	16.000 to 20.000	32.000 to 40.000	32.000 to 40.000
39	3	13.3359 to 13.5025	13.3359 to 13.5025	10.000 to 10.125	10.000 to 10.125	20.000 to 20.250	40.000 to 40.500
40	3	6.7513 to 7.1106	13.5025 to 14.2212	10.125 to 10.664	10.125 to 10.664	20.250 to 21.328	40.500 to 42.656
41	3	7.1106 to 7.7013	14.2212 to 15.4025	10.664 to 11.550	10.664 to 11.550	21.328 to 23.100	42.656 to 46.200
42	3	7.7013 to 8.0013	15.4025 to 16.0025	11.550 to 12.000	11.550 to 12.000	23.100 to 24.000	46.200 to 48.000
43	3	8.0013 to 8.3346	16.0025 to 16.6692	12.000 to 12.500	12.000 to 12.500	24.000 to 25.000	48.000 to 50.000
44	3	8.3346 to 9.0039	16.6692 to 18.0079	12.500 to 13.504	12.500 to 13.504	25.000 to 27.008	50.000 to 54.016
45	3	9.0039 to 10.0013	18.0079 to 20.0025	6.752 to 7.500	13.504 to 15.000	27.008 to 30.000	54.016 to 60.000
46	3	10.0013 to 10.6679	20.0025 to 21.3359	7.500 to 8.000	15.000 to 16.000	30.000 to 32.000	60.000 to 64.000
47	3	10.6679 to 11.1679	21.3359 to 22.3359	8.000 to 8.375	16.000 to 16.750	32.000 to 33.500	64.000 to 67.000
48	3	11.1679 to 11.6679	22.3359 to 23.3359	8.375 to 8.750	16.750 to 17.500	33.500 to 35.000	67.000 to 70.000

Test Node	Error Description	Assembly	Frequency Band
8	Unleveled, Source 1, Out 1	A5	0.01 - 13.5 GHz
		A7	13.5 - 40 GHz
		A29	40 - 70 GHz
9	Unleveled, Source 1, Out 2	A5	0.01 - 13.5 GHz
		A8	13.5 - 40 GHz
		A32	40 - 70 GHz
10	Unleveled, Source 1 Synthesizer	A4	Full Range
11	Unleveled, Source 2, Out 1	A10	0.01 - 13.5 GHz
		A12	13.5 - 40 GHz
		A30	40 - 70 GHz
12	Unleveled, Source 2, Out 2	A10	0.01 - 13.5 GHz
		A13	13.5 - 40 GHz
		A31	40 - 70 GHz
13	Unleveled, Source 2 Synthesizer	A17	Full Range
14	Unleveled, LO Drive	A25	Full Range
15	Unleveled, LO Synthesizer	A15	Full Range
16	Unlocked, Source 1 Synthesizer, Integrator Low	A4	Full Range
17	Unlocked, Source 1 Synthesizer, Integrator High	A4	Full Range
19	Unlocked, Source 2 Synthesizer, Integrator Low	A17	Full Range
20	Unlocked, Source 2 Synthesizer, Integrator High	A17	Full Range
22	Unlocked, LO Synthesizer, Integrator Low	A15	Full Range
23	Unlocked, LO Synthesizer, Integrator High	A15	Full Range
25	Unleveled, Doubler 1 Prelevel	A7	13.5 - 70 GHz
26	Unleveled, Doubler 2 Prelevel	A8	13.5 - 70 GHz
27	Unleveled, Doubler 3 Prelevel	A12	13.5 - 70 GHz
28	Unleveled, Doubler 4 Prelevel	A13	13.5 - 70 GHz
29	Unleveled, Source 1, P4	A5	13.5 - 70 GHz
30	Unleveled, Source 2, P4	A10	13.5 - 70 GHz

Instrument Block Diagrams – 2-Port (Sheet 2), Non-LFE and DDS (Version 7 Synthesizer Assemblies)

Microwave PNA-X, N5247B – 2-Port, Non-LFE and DDS (Version 7 Synthesizer Assemblies)

Band	Mixer Brick LO Harmonic Number	❶ LO Synthesizer Frequency (GHz)	❷ A25 HMA26.5 Frequency (GHz)	❸ RF Synthesizer Frequency (GHz)	❹ A5/A10 Source Frequency (GHz)	❺ A7/A8/A12/A13 40 GHz Doubler Frequency (GHz)	❻ A60/A61/A62/A63 70 GHz Doubler Frequency (GHz)
0	1	--	--	--	--	--	--
1	1	--	--	--	--	--	--
2	1	0.01248 to 0.01648	0.01248 to 0.01648	0.010 to 0.014	0.010 to 0.014	0.010 to 0.014	0.010 to 0.014
3	1	0.01648 to 0.02148	0.01648 to 0.02148	0.014 to 0.019	0.014 to 0.019	0.014 to 0.019	0.014 to 0.019
4	1	0.02148 to 0.02948	0.02148 to 0.02948	0.019 to 0.027	0.019 to 0.027	0.019 to 0.027	0.019 to 0.027
5	1	0.02948 to 0.04048	0.02948 to 0.04048	0.027 to 0.038	0.027 to 0.038	0.027 to 0.038	0.027 to 0.038
6	1	0.04048 to 0.05548	0.04048 to 0.05548	0.038 to 0.053	0.038 to 0.053	0.038 to 0.053	0.038 to 0.053
7	1	0.06044 to 0.08244	0.06044 to 0.08244	0.053 to 0.075	0.053 to 0.075	0.053 to 0.075	0.053 to 0.075
8	1	0.08244 to 0.11244	0.08244 to 0.11244	0.075 to 0.105	0.075 to 0.105	0.075 to 0.105	0.075 to 0.105
9	1	0.11244 to 0.15344	0.11244 to 0.15344	0.105 to 0.146	0.105 to 0.146	0.105 to 0.146	0.105 to 0.146
10	1	0.15344 to 0.21244	0.15344 to 0.21244	0.146 to 0.205	0.146 to 0.205	0.146 to 0.205	0.146 to 0.205
11	1	0.21244 to 0.25744	0.21244 to 0.25744	0.205 to 0.250	0.205 to 0.250	0.205 to 0.250	0.205 to 0.250
12	1	0.25744 to 0.40344	0.25744 to 0.40344	0.250 to 0.396	0.250 to 0.396	0.250 to 0.396	0.250 to 0.396
13	1	0.40344 to 0.50744	0.40344 to 0.50744	0.396 to 0.500	0.396 to 0.500	0.396 to 0.500	0.396 to 0.500
14	1	0.50744 to 0.63544	0.50744 to 0.63544	0.500 to 0.628	0.500 to 0.628	0.500 to 0.628	0.500 to 0.628
15	1	0.63544 to 1.0074	0.63544 to 1.0074	0.628 to 1.000	0.628 to 1.000	0.628 to 1.000	0.628 to 1.000
16	1	1.0074 to 1.5074	1.0074 to 1.5074	1.000 to 1.500	1.000 to 1.500	1.000 to 1.500	1.000 to 1.500
17	1	1.5074 to 2.0074	1.5074 to 2.0074	1.500 to 2.000	1.500 to 2.000	1.500 to 2.000	1.500 to 2.000
18	1	2.0074 to 3.2074	2.0074 to 3.2074	2.000 to 3.200	2.000 to 3.200	2.000 to 3.200	2.000 to 3.200
19	1	3.2074 to 5.3394	3.2074 to 5.3394	3.200 to 5.332	3.200 to 5.332	3.200 to 5.332	3.200 to 5.332
20	1	5.3394 to 6.0074	5.3394 to 6.0074	5.332 to 6.000	5.332 to 6.000	5.332 to 6.000	5.332 to 6.000
21	1	6.0074 to 7.6074	6.0074 to 7.6074	6.000 to 7.600	6.000 to 7.600	6.000 to 7.600	6.000 to 7.600
22	1	7.6074 to 8.5074	7.6074 to 8.5074	7.600 to 8.500	7.600 to 8.500	7.600 to 8.500	7.600 to 8.500
23	1	8.5074 to 9.5274	8.5074 to 9.5274	8.500 to 9.520	8.500 to 9.520	8.500 to 9.520	8.500 to 9.520
24	1	9.5274 to 12.0074	9.5274 to 12.0074	9.520 to 12.000	9.520 to 12.000	9.520 to 12.000	9.520 to 12.000
25	1	12.0074 to 12.8074	12.0074 to 12.8074	12.000 to 12.800	12.000 to 12.800	12.000 to 12.800	12.000 to 12.800
26	1	12.8074 to 13.5174	12.8074 to 13.5174	12.800 to 13.510	12.800 to 13.510	12.800 to 13.510	12.800 to 13.510
27	1	6.7587 to 7.6037	13.5174 to 15.2074	6.755 to 7.600	13.510 to 15.200	13.510 to 15.200	13.510 to 15.200
28	1	7.6037 to 8.3537	15.2074 to 16.7074	7.700 to 8.000	15.200 to 16.700	15.200 to 16.700	15.200 to 16.700
29	1	8.3537 to 9.5237	16.7074 to 19.0474	8.000 to 9.500	16.700 to 19.040	16.700 to 19.040	16.700 to 19.040
30	1	9.5237 to 10.0037	19.0474 to 20.0074	9.500 to 10.000	19.040 to 20.000	19.040 to 20.000	19.040 to 20.000
31	1	10.0037 to 10.6537	20.0074 to 21.3074	10.000 to 10.664	10.000 to 10.664	20.000 to 21.328	20.000 to 21.328
32	1	10.6537 to 12.0037	21.3074 to 24.0074	10.664 to 12.000	10.664 to 12.000	21.328 to 24.000	21.328 to 24.000
33	1	12.0037 to 13.2537	24.0074 to 26.5074	12.000 to 13.250	12.000 to 13.250	24.000 to 26.500	24.000 to 26.500
34	3	8.8358 to 9.0051	8.8358 to 9.0051	13.250 to 13.510	13.250 to 13.510	26.500 to 27.020	26.500 to 27.020
35	3	9.0051 to 9.5025	9.0051 to 9.5025	6.755 to 7.125	13.510 to 14.250	27.020 to 28.500	27.020 to 28.500
36	3	9.5025 to 10.1358	9.5025 to 10.1358	7.125 to 7.600	14.250 to 15.200	28.500 to 30.400	28.500 to 30.400
37	3	10.1358 to 10.6691	10.1358 to 10.6691	7.600 to 8.000	15.200 to 16.000	30.400 to 32.000	30.400 to 32.000
38	3	10.6691 to 12.0358	10.6691 to 12.0358	8.000 to 9.025	16.000 to 18.050	32.000 to 36.100	32.000 to 36.100
39	3	12.0358 to 12.6958	12.0358 to 12.6958	9.025 to 9.520	18.050 to 19.040	36.100 to 38.080	36.100 to 38.080
40	3	12.6958 to 13.3358	12.6958 to 13.3358	9.520 to 10.000	19.040 to 20.000	38.080 to 40.000	38.080 to 40.000
41	3	13.3358 to 13.5125	13.3358 to 13.5125	10.000 to 10.133	10.000 to 10.133	20.000 to 20.265	40.000 to 40.530
42	3	6.7562 to 7.6379	13.5125 to 15.2758	10.133 to 11.455	10.133 to 11.455	20.265 to 22.910	40.530 to 45.820
43	3	7.6379 to 8.0012	15.2758 to 16.0025	11.455 to 12.000	11.455 to 12.000	22.910 to 24.000	45.820 to 48.000
44	3	8.0012 to 8.3346	16.0025 to 16.6691	12.000 to 12.500	12.000 to 12.500	24.000 to 25.000	48.000 to 50.000
45	3	8.3346 to 8.8346	16.6691 to 17.6691	12.500 to 13.250	12.500 to 13.250	25.000 to 26.500	50.000 to 53.000
46	3	8.8346 to 9.0079	17.6691 to 18.0158	13.250 to 13.510	13.250 to 13.510	26.500 to 27.020	53.000 to 54.040
47	3	9.0079 to 9.5512	18.0158 to 19.1025	6.755 to 7.163	13.510 to 14.325	27.020 to 28.650	54.040 to 57.300
48	3	9.5512 to 10.0179	19.1025 to 20.0358	7.163 to 7.513	14.325 to 15.025	28.650 to 30.050	57.300 to 60.100
49	3	10.0179 to 10.1346	20.0358 to 20.2691	7.513 to 7.600	15.025 to 15.200	30.050 to 30.400	60.100 to 60.800
50	3	10.1346 to 10.6679	20.2691 to 21.3358	7.600 to 8.000	15.200 to 16.000	30.400 to 32.000	60.800 to 64.000
51	3	10.6679 to 11.1346	21.3358 to 22.2691	8.000 to 8.350	16.000 to 16.700	32.000 to 33.400	64.000 to 66.800
52	3	11.1346 to 11.6679	22.2691 to 23.3358	8.350 to 8.750	16.700 to 17.500	33.400 to 35.000	66.800 to 70.000

Test Node	Error Description	Assembly	Frequency Band
8	Unleveled, Source 1, Out 1	A5	0.01 - 13.5 GHz
		A7	13.5 - 40 GHz
		A29	40 - 70 GHz
9	Unleveled, Source 1, Out 2	A5	0.01 - 13.5 GHz
		A8	13.5 - 40 GHz
		A32	40 - 70 GHz
10	Unleveled, Source 1 Synthesizer	A4	Full Range
11	Unleveled, Source 2, Out 1	A10	0.01 - 13.5 GHz
		A12	13.5 - 40 GHz
		A30	40 - 70 GHz
12	Unleveled, Source 2, Out 2	A10	0.01 - 13.5 GHz
		A13	13.5 - 40 GHz
		A31	40 - 70 GHz
13	Unleveled, Source 2 Synthesizer	A17	Full Range
14	Unleveled, LO Drive	A25	Full Range
15	Unleveled, LO Synthesizer	A15	Full Range
16	Unlocked, Source 1 Synthesizer, Integrator Low	A4	Full Range
17	Unlocked, Source 1 Synthesizer, Integrator High	A4	Full Range
19	Unlocked, Source 2 Synthesizer, Integrator Low	A17	Full Range
20	Unlocked, Source 2 Synthesizer, Integrator High	A17	Full Range
22	Unlocked, LO Synthesizer, Integrator Low	A15	Full Range
23	Unlocked, LO Synthesizer, Integrator High	A15	Full Range
25	Unleveled, Doubler 1, Prelevel	A7	13.5 - 70 GHz
26	Unleveled, Doubler 2, Prelevel	A8	13.5 - 70 GHz
27	Unleveled, Doubler 3, Prelevel	A12	13.5 - 70 GHz
28	Unleveled, Doubler 4, Prelevel	A13	13.5 - 70 GHz
29	Unleveled, Source 1, P4	A5	13.5 - 70 GHz
30	Unleveled, Source 2, P4	A10	13.5 - 70 GHz

N5247B 2-Port Overall Block Diagram

Including Options 201-Standard, 219-Attenuators and Bias Tees
224-Attenuators, Bias Tees, Combiner and Source Bypass Switches

Service Guide: N5247-90026

Instrument Block Diagrams – 4-Port (Sheet 3), Non-LFE and Non-DDS (Version 6 Synthesizers)

Microwave PNA-X, N5247B – 4-Port, Non-LFE and Non-DDS (Version 6 Synthesizers)

N5247B 4-Port Overall Block Diagram

Including Options 401-Standard; 419-Attenuators and Bias Tees;
423-Attenuators, Bias Tees, Combiner and Source Bypass Switches

Band	Mixer Brick L.O. Harmonic Number	❶ A15 Synthesizer Frequency (GHz)	❷ A25 HMA26.5 Frequency (GHz)	❸ A4/A17 Source Synthesizer Frequency (GHz)	❹ A5/A10 Source Frequency (GHz)	❺ A7/A8/A12/A13 40 GHz Doubler Frequency (GHz)	❻ A60/A61/A62/A63 70 GHz Doubler Frequency (GHz)
1	-	-	-	-	-	-	-
2	1	0.01254 to 0.01654	0.01254 to 0.01654	0.010 to 0.014	0.010 to 0.014	0.010 to 0.014	0.010 to 0.014
3	1	0.01654 to 0.02154	0.01654 to 0.02154	0.014 to 0.019	0.014 to 0.019	0.014 to 0.019	0.014 to 0.019
4	1	0.02154 to 0.02954	0.02154 to 0.02954	0.019 to 0.027	0.019 to 0.027	0.019 to 0.027	0.019 to 0.027
5	1	0.02954 to 0.04054	0.02954 to 0.04054	0.027 to 0.038	0.027 to 0.038	0.027 to 0.038	0.027 to 0.038
6	1	0.04054 to 0.05554	0.04054 to 0.05554	0.038 to 0.053	0.038 to 0.053	0.038 to 0.053	0.038 to 0.053
7	1	0.06061 to 0.08261	0.06061 to 0.08261	0.053 to 0.075	0.053 to 0.075	0.053 to 0.075	0.053 to 0.075
8	1	0.08261 to 0.11261	0.08261 to 0.11261	0.075 to 0.105	0.075 to 0.105	0.075 to 0.105	0.075 to 0.105
9	1	0.11261 to 0.15361	0.11261 to 0.15361	0.105 to 0.146	0.105 to 0.146	0.105 to 0.146	0.105 to 0.146
10	1	0.15361 to 0.21261	0.15361 to 0.21261	0.146 to 0.205	0.146 to 0.205	0.146 to 0.205	0.146 to 0.205
11	1	0.21261 to 0.25761	0.21261 to 0.25761	0.205 to 0.250	0.205 to 0.250	0.205 to 0.250	0.205 to 0.250
12	1	0.25761 to 0.40361	0.25761 to 0.40361	0.250 to 0.396	0.250 to 0.396	0.250 to 0.396	0.250 to 0.396
13	1	0.40361 to 0.50761	0.40361 to 0.50761	0.396 to 0.500	0.396 to 0.500	0.396 to 0.500	0.396 to 0.500
14	1	0.50761 to 0.63561	0.50761 to 0.63561	0.500 to 0.628	0.500 to 0.628	0.500 to 0.628	0.500 to 0.628
15	1	0.63561 to 1.00761	0.63561 to 1.00761	0.628 to 1.000	0.628 to 1.000	0.628 to 1.000	0.628 to 1.000
16	1	1.0076 to 1.5076	1.0076 to 1.5076	1.000 to 1.500	1.000 to 1.500	1.000 to 1.500	1.000 to 1.500
17	1	1.5076 to 2.0076	1.5076 to 2.0076	1.500 to 2.000	1.500 to 2.000	1.500 to 2.000	1.500 to 2.000
18	1	2.0076 to 3.0076	2.0076 to 3.0076	2.000 to 3.000	2.000 to 3.000	2.000 to 3.000	2.000 to 3.000
19	1	3.0076 to 3.2076	3.0076 to 3.2076	3.000 to 3.200	3.000 to 3.200	3.000 to 3.200	3.000 to 3.200
20	1	3.2076 to 4.0076	3.2076 to 4.0076	3.200 to 4.000	3.200 to 4.000	3.200 to 4.000	3.200 to 4.000
21	1	4.0076 to 5.3396	4.0076 to 5.3396	4.000 to 5.332	4.000 to 5.332	4.000 to 5.332	4.000 to 5.332
22	1	5.3396 to 6.7596	5.3396 to 6.7596	5.332 to 6.752	5.332 to 6.752	5.332 to 6.752	5.332 to 6.752
23	1	6.7596 to 8.0076	6.7596 to 8.0076	6.752 to 8.000	6.752 to 8.000	6.752 to 8.000	6.752 to 8.000
24	1	8.0076 to 8.5076	8.0076 to 8.5076	8.000 to 8.500	8.000 to 8.500	8.000 to 8.500	8.000 to 8.500
25	1	8.5076 to 10.6716	8.5076 to 10.6716	8.500 to 10.664	8.500 to 10.664	8.500 to 10.664	8.500 to 10.664
26	1	10.6716 to 12.0076	10.6716 to 12.0076	10.664 to 12.000	10.664 to 12.000	10.664 to 12.000	10.664 to 12.000
27	1	12.0076 to 12.8076	12.0076 to 12.8076	12.000 to 12.800	12.000 to 12.800	12.000 to 12.800	12.000 to 12.800
28	1	12.8076 to 13.5176	12.8076 to 13.5176	12.800 to 13.510	12.800 to 13.510	12.800 to 13.510	12.800 to 13.510
29	1	6.7588 to 7.7038	13.5176 to 15.4076	6.755 to 7.700	13.510 to 15.400	13.510 to 15.400	13.510 to 15.400
30	1	7.7038 to 8.0038	15.4076 to 16.0076	7.700 to 8.000	15.400 to 16.000	15.400 to 16.000	15.400 to 16.000
31	1	8.0038 to 9.5038	16.0076 to 19.0076	8.000 to 9.500	16.000 to 19.000	16.000 to 19.000	16.000 to 19.000
32	1	9.5038 to 10.0038	19.0076 to 20.0076	9.500 to 10.000	9.500 to 10.000	19.000 to 20.000	19.000 to 20.000
33	1	10.0038 to 10.6678	20.0076 to 21.3356	10.000 to 10.664	10.000 to 10.664	20.000 to 21.328	20.000 to 21.328
34	1	10.6678 to 12.0038	21.3356 to 24.0076	10.664 to 12.000	10.664 to 12.000	21.328 to 24.000	21.328 to 24.000
35	1	12.0038 to 13.2538	24.0076 to 26.5076	12.000 to 13.250	12.000 to 13.250	24.000 to 26.500	24.000 to 26.500
36	3	8.8359 to 9.0052	8.8359 to 9.0052	13.250 to 13.504	13.250 to 13.504	26.500 to 27.008	26.500 to 27.008
37	3	9.0052 to 10.6692	9.0052 to 10.6692	6.752 to 8.000	13.504 to 16.000	27.008 to 32.000	27.008 to 32.000
38	3	10.6692 to 13.3359	10.6692 to 13.3359	8.000 to 10.000	16.000 to 20.000	32.000 to 40.000	32.000 to 40.000
39	3	13.3359 to 13.5025	13.3359 to 13.5025	10.000 to 10.125	10.000 to 10.125	20.000 to 20.250	40.000 to 40.500
40	3	6.7513 to 7.1106	13.5025 to 14.2212	10.125 to 10.664	10.125 to 10.664	20.250 to 21.328	40.500 to 42.656
41	3	7.1106 to 7.7013	14.2212 to 15.4025	10.664 to 11.550	10.664 to 11.550	21.328 to 23.100	42.656 to 46.200
42	3	7.7013 to 8.0013	15.4025 to 16.0025	11.550 to 12.000	11.550 to 12.000	23.100 to 24.000	46.200 to 48.000
43	3	8.0013 to 8.3346	16.0025 to 16.6692	12.000 to 12.500	12.000 to 12.500	24.000 to 25.000	48.000 to 50.000
44	3	8.3346 to 9.0039	16.6692 to 18.0079	12.500 to 13.504	12.500 to 13.504	25.000 to 27.008	50.000 to 54.016
45	3	9.0039 to 10.0013	18.0079 to 20.0025	6.752 to 7.500	13.504 to 15.000	27.008 to 30.000	54.016 to 60.000
46	3	10.0013 to 10.6679	20.0025 to 21.3359	7.500 to 8.000	15.000 to 16.000	30.000 to 32.000	60.000 to 64.000
47	3	10.6679 to 11.1679	21.3359 to 22.3359	8.000 to 8.375	16.000 to 16.750	32.000 to 33.500	64.000 to 67.000
48	3	11.1679 to 11.6679	22.3359 to 23.3359	8.375 to 8.750	16.750 to 17.500	33.500 to 35.000	67.000 to 70.000

Test Node	Error Description	Assembly	Frequency Band
8	Unleveled, Source 1, Out 1	A5	0.01 - 13.5 GHz
		A7	13.5 - 40 GHz
		A29	40 - 70 GHz
9	Unleveled, Source 1, Out 2	A5	0.01 - 13.5 GHz
		A8	13.5 - 40 GHz
		A32	40 - 70 GHz
10	Unleveled, Source 1 Synthesizer	A4	Full Range
11	Unleveled, Source 2, Out 1	A10	0.01 - 13.5 GHz
		A12	13.5 - 40 GHz
		A30	40 - 70 GHz
12	Unleveled, Source 2, Out 2	A10	0.01 - 13.5 GHz
		A13	13.5 - 40 GHz
		A31	40 - 70 GHz
13	Unleveled, Source 2 Synthesizer	A17	Full Range
14	Unleveled, LO Drive	A25	Full Range
15	Unleveled, LO Synthesizer	A15	Full Range
16	Unlocked, Source 1 Synthesizer, Integrator Low	A4	Full Range
17	Unlocked, Source 1 Synthesizer, Integrator High	A4	Full Range
19	Unlocked, Source 2 Synthesizer, Integrator Low	A17	Full Range
20	Unlocked, Source 2 Synthesizer, Integrator High	A17	Full Range
22	Unlocked, LO Synthesizer, Integrator Low	A15	Full Range
23	Unlocked, LO Synthesizer, Integrator High	A15	Full Range
25	Unleveled, Doubler 1 Prelevel	A7	13.5 - 70 GHz
26	Unleveled, Doubler 2 Prelevel	A8	13.5 - 70 GHz
27	Unleveled, Doubler 3 Prelevel	A12	13.5 - 70 GHz
28	Unleveled, Doubler 4 Prelevel	A13	13.5 - 70 GHz
29	Unleveled, Source 1, P4	A5	13.5 - 70 GHz
30	Unleveled, Source 2, P4	A10	13.5 - 70 GHz

Instrument Block Diagrams – 4-Port (Sheet 4), LFE and Non-DDS (Version 6 Synthesizers)

Microwave PNA-X, N5247B – 4-Port, LFE and Non-DDS (Version 6 Synthesizers)

Band	Mixer Brick L.O. Harmonic Number	❶ A15 Synthesizer Frequency (GHz)	❷ A25 HMA26.5 Frequency (GHz)	❸ A4/A17 Source Synthesizer Frequency (GHz)	❹ A5/A10 Source Frequency (GHz)	❺ A7/A8/A12/A13 40 GHz Doubler Frequency (GHz)	❻ A60/A61/A62/A63 70 GHz Doubler Frequency (GHz)
1	-	-	-	-	-	-	-
2	1	0.01254 to 0.01654	0.01254 to 0.01654	0.010 to 0.014	0.010 to 0.014	0.010 to 0.014	0.010 to 0.014
3	1	0.01654 to 0.02154	0.01654 to 0.02154	0.014 to 0.019	0.014 to 0.019	0.014 to 0.019	0.014 to 0.019
4	1	0.02154 to 0.02954	0.02154 to 0.02954	0.019 to 0.027	0.019 to 0.027	0.019 to 0.027	0.019 to 0.027
5	1	0.02954 to 0.04054	0.02954 to 0.04054	0.027 to 0.038	0.027 to 0.038	0.027 to 0.038	0.027 to 0.038
6	1	0.04054 to 0.05554	0.04054 to 0.05554	0.038 to 0.053	0.038 to 0.053	0.038 to 0.053	0.038 to 0.053
7	1	0.06061 to 0.08261	0.06061 to 0.08261	0.053 to 0.075	0.053 to 0.075	0.053 to 0.075	0.053 to 0.075
8	1	0.08261 to 0.11261	0.08261 to 0.11261	0.075 to 0.105	0.075 to 0.105	0.075 to 0.105	0.075 to 0.105
9	1	0.11261 to 0.15361	0.11261 to 0.15361	0.105 to 0.146	0.105 to 0.146	0.105 to 0.146	0.105 to 0.146
10	1	0.15361 to 0.21261	0.15361 to 0.21261	0.146 to 0.205	0.146 to 0.205	0.146 to 0.205	0.146 to 0.205
11	1	0.21261 to 0.25761	0.21261 to 0.25761	0.205 to 0.250	0.205 to 0.250	0.205 to 0.250	0.205 to 0.250
12	1	0.25761 to 0.40361	0.25761 to 0.40361	0.250 to 0.396	0.250 to 0.396	0.250 to 0.396	0.250 to 0.396
13	1	0.40361 to 0.50761	0.40361 to 0.50761	0.396 to 0.500	0.396 to 0.500	0.396 to 0.500	0.396 to 0.500
14	1	0.50761 to 0.63561	0.50761 to 0.63561	0.500 to 0.628	0.500 to 0.628	0.500 to 0.628	0.500 to 0.628
15	1	0.63561 to 1.00761	0.63561 to 1.00761	0.628 to 1.000	0.628 to 1.000	0.628 to 1.000	0.628 to 1.000
16	1	1.0076 to 1.5076	1.0076 to 1.5076	1.000 to 1.500	1.000 to 1.500	1.000 to 1.500	1.000 to 1.500
17	1	1.5076 to 2.0076	1.5076 to 2.0076	1.500 to 2.000	1.500 to 2.000	1.500 to 2.000	1.500 to 2.000
18	1	2.0076 to 3.0076	2.0076 to 3.0076	2.000 to 3.000	2.000 to 3.000	2.000 to 3.000	2.000 to 3.000
19	1	3.0076 to 3.2076	3.0076 to 3.2076	3.000 to 3.200	3.000 to 3.200	3.000 to 3.200	3.000 to 3.200
20	1	3.2076 to 4.0076	3.2076 to 4.0076	3.200 to 4.000	3.200 to 4.000	3.200 to 4.000	3.200 to 4.000
21	1	4.0076 to 5.3396	4.0076 to 5.3396	4.000 to 5.332	4.000 to 5.332	4.000 to 5.332	4.000 to 5.332
22	1	5.3396 to 6.7596	5.3396 to 6.7596	5.332 to 6.752	5.332 to 6.752	5.332 to 6.752	5.332 to 6.752
23	1	6.7596 to 8.0076	6.7596 to 8.0076	6.752 to 8.000	6.752 to 8.000	6.752 to 8.000	6.752 to 8.000
24	1	8.0076 to 8.5076	8.0076 to 8.5076	8.000 to 8.500	8.000 to 8.500	8.000 to 8.500	8.000 to 8.500
25	1	8.5076 to 10.6716	8.5076 to 10.6716	8.500 to 10.664	8.500 to 10.664	8.500 to 10.664	8.500 to 10.664
26	1	10.6716 to 12.0076	10.6716 to 12.0076	10.664 to 12.000	10.664 to 12.000	10.664 to 12.000	10.664 to 12.000
27	1	12.0076 to 12.8076	12.0076 to 12.8076	12.000 to 12.800	12.000 to 12.800	12.000 to 12.800	12.000 to 12.800
28	1	12.8076 to 13.5176	12.8076 to 13.5176	12.800 to 13.510	12.800 to 13.510	12.800 to 13.510	12.800 to 13.510
29	1	6.7588 to 7.7038	13.5176 to 15.4076	6.755 to 7.700	13.510 to 15.400	13.510 to 15.400	13.510 to 15.400
30	1	7.7038 to 8.0038	15.4076 to 16.0076	7.700 to 8.000	15.400 to 16.000	15.400 to 16.000	15.400 to 16.000
31	1	8.0038 to 9.5038	16.0076 to 19.0076	8.000 to 9.500	16.000 to 19.000	16.000 to 19.000	16.000 to 19.000
32	1	9.5038 to 10.0038	19.0076 to 20.0076	9.500 to 10.000	9.500 to 10.000	19.000 to 20.000	19.000 to 20.000
33	1	10.0038 to 10.6678	20.0076 to 21.3356	10.000 to 10.664	10.000 to 10.664	20.000 to 21.328	20.000 to 21.328
34	1	10.6678 to 12.0038	21.3356 to 24.0076	10.664 to 12.000	10.664 to 12.000	21.328 to 24.000	21.328 to 24.000
35	1	12.0038 to 13.2538	24.0076 to 26.5076	12.000 to 13.250	12.000 to 13.250	24.000 to 26.500	24.000 to 26.500
36	3	8.8359 to 9.0052	8.8359 to 9.0052	13.250 to 13.504	13.250 to 13.504	26.500 to 27.008	26.500 to 27.008
37	3	9.0052 to 10.6692	9.0052 to 10.6692	6.752 to 8.000	13.504 to 16.000	27.008 to 32.000	27.008 to 32.000
38	3	10.6692 to 13.3359	10.6692 to 13.3359	8.000 to 10.000	16.000 to 20.000	32.000 to 40.000	32.000 to 40.000
39	3	13.3359 to 13.5025	13.3359 to 13.5025	10.000 to 10.125	10.000 to 10.125	20.000 to 20.250	40.000 to 40.500
40	3	6.7513 to 7.1106	13.5025 to 14.2212	10.125 to 10.664	10.125 to 10.664	20.250 to 21.328	40.500 to 42.656
41	3	7.1106 to 7.7013	14.2212 to 15.4025	10.664 to 11.550	10.664 to 11.550	21.328 to 23.100	42.656 to 46.200
42	3	7.7013 to 8.0013	15.4025 to 16.0025	11.550 to 12.000	11.550 to 12.000	23.100 to 24.000	46.200 to 48.000
43	3	8.0013 to 8.3346	16.0025 to 16.6692	12.000 to 12.500	12.000 to 12.500	24.000 to 25.000	48.000 to 50.000
44	3	8.3346 to 9.0039	16.6692 to 18.0079	12.500 to 13.504	12.500 to 13.504	25.000 to 27.008	50.000 to 54.016
45	3	9.0039 to 10.0013	18.0079 to 20.0025	6.752 to 7.500	13.504 to 15.000	27.008 to 30.000	54.016 to 60.000
46	3	10.0013 to 10.6679	20.0025 to 21.3359	7.500 to 8.000	15.000 to 16.000	30.000 to 32.000	60.000 to 64.000
47	3	10.6679 to 11.1679	21.3359 to 22.3359	8.000 to 8.375	16.000 to 16.750	32.000 to 33.500	64.000 to 67.000
48	3	11.1679 to 11.6679	22.3359 to 23.3359	8.375 to 8.750	16.750 to 17.500	33.500 to 35.000	67.000 to 70.000

Test Node	Error Description	Assembly	Frequency Band
8	Unleveled, Source 1, Out 1	A5	0.01 - 13.5 GHz
		A7	13.5 - 40 GHz
		A29	40 - 70 GHz
9	Unleveled, Source 1, Out 2	A5	0.01 - 13.5 GHz
		A8	13.5 - 40 GHz
		A32	40 - 70 GHz
10	Unleveled, Source 1 Synthesizer	A4	Full Range
11	Unleveled, Source 2, Out 1	A10	0.01 - 13.5 GHz
		A12	13.5 - 40 GHz
		A30	40 - 70 GHz
12	Unleveled, Source 2, Out 2	A10	0.01 - 13.5 GHz
		A13	13.5 - 40 GHz
		A31	40 - 70 GHz
13	Unleveled, Source 2 Synthesizer	A17	Full Range
14	Unleveled, LO Drive	A25	Full Range
15	Unleveled, LO Synthesizer	A15	Full Range
16	Unlocked, Source 1 Synthesizer, Integrator Low	A4	Full Range
17	Unlocked, Source 1 Synthesizer, Integrator High	A4	Full Range
19	Unlocked, Source 2 Synthesizer, Integrator Low	A17	Full Range
20	Unlocked, Source 2 Synthesizer, Integrator High	A17	Full Range
22	Unlocked, LO Synthesizer, Integrator Low	A15	Full Range
23	Unlocked, LO Synthesizer, Integrator High	A15	Full Range
25	Unleveled, Doubler 1 Prelevel	A7	13.5 - 70 GHz
26	Unleveled, Doubler 2 Prelevel	A8	13.5 - 70 GHz
27	Unleveled, Doubler 3 Prelevel	A12	13.5 - 70 GHz
28	Unleveled, Doubler 4 Prelevel	A13	13.5 - 70 GHz
29	Unleveled, Source 1, P4	A5	13.5 - 70 GHz
30	Unleveled, Source 2, P4	A10	13.5 - 70 GHz

N5247B 4-Port Overall Block Diagram

Including Options 425-LFE, Attenuators, Bias Tees, Combiner and Source Bypass Switches

13 Aug 2019
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Instrument Block Diagrams – 4-Port (Sheet 5), Non-LFE and DDS (Version 7 Synthesizer Assemblies)

Microwave PNA-X, N5247B – 4-Port, Non-LFE and DDS (Version 7 Synthesizer Assemblies)

Band	Mixer Brick LO Harmonic Number	LO Synthesizer Frequency (GHz)	A25 HMA26.5 Frequency (GHz)	RF Synthesizer Frequency (GHz)	A5/A10 Source Frequency (GHz)	A7/A8/A12/A13 40 GHz Doubler Frequency (GHz)	A60/A61/A62/A63 70 GHz Doubler Frequency (GHz)
0	1	--	--	--	--	--	--
1	1	--	--	--	--	--	--
2	1	0.01248 to 0.01648	0.01248 to 0.01648	0.010 to 0.014	0.010 to 0.014	0.010 to 0.014	0.010 to 0.014
3	1	0.01648 to 0.02148	0.01648 to 0.02148	0.014 to 0.019	0.014 to 0.019	0.014 to 0.019	0.014 to 0.019
4	1	0.02148 to 0.02948	0.02148 to 0.02948	0.019 to 0.027	0.019 to 0.027	0.019 to 0.027	0.019 to 0.027
5	1	0.02948 to 0.04048	0.02948 to 0.04048	0.027 to 0.038	0.027 to 0.038	0.027 to 0.038	0.027 to 0.038
6	1	0.04048 to 0.05548	0.04048 to 0.05548	0.038 to 0.053	0.038 to 0.053	0.038 to 0.053	0.038 to 0.053
7	1	0.06044 to 0.08244	0.06044 to 0.08244	0.053 to 0.075	0.053 to 0.075	0.053 to 0.075	0.053 to 0.075
8	1	0.08244 to 0.11244	0.08244 to 0.11244	0.075 to 0.105	0.075 to 0.105	0.075 to 0.105	0.075 to 0.105
9	1	0.11244 to 0.15344	0.11244 to 0.15344	0.105 to 0.146	0.105 to 0.146	0.105 to 0.146	0.105 to 0.146
10	1	0.15344 to 0.21244	0.15344 to 0.21244	0.146 to 0.205	0.146 to 0.205	0.146 to 0.205	0.146 to 0.205
11	1	0.21244 to 0.25744	0.21244 to 0.25744	0.205 to 0.250	0.205 to 0.250	0.205 to 0.250	0.205 to 0.250
12	1	0.25744 to 0.40344	0.25744 to 0.40344	0.250 to 0.396	0.250 to 0.396	0.250 to 0.396	0.250 to 0.396
13	1	0.40344 to 0.50744	0.40344 to 0.50744	0.396 to 0.500	0.396 to 0.500	0.396 to 0.500	0.396 to 0.500
14	1	0.50744 to 0.63544	0.50744 to 0.63544	0.500 to 0.628	0.500 to 0.628	0.500 to 0.628	0.500 to 0.628
15	1	0.63544 to 1.0074	0.63544 to 1.0074	0.628 to 1.000	0.628 to 1.000	0.628 to 1.000	0.628 to 1.000
16	1	1.0074 to 1.5074	1.0074 to 1.5074	1.000 to 1.500	1.000 to 1.500	1.000 to 1.500	1.000 to 1.500
17	1	1.5074 to 2.0074	1.5074 to 2.0074	1.500 to 2.000	1.500 to 2.000	1.500 to 2.000	1.500 to 2.000
18	1	2.0074 to 3.2074	2.0074 to 3.2074	2.000 to 3.200	2.000 to 3.200	2.000 to 3.200	2.000 to 3.200
19	1	3.2074 to 5.3394	3.2074 to 5.3394	3.200 to 5.332	3.200 to 5.332	3.200 to 5.332	3.200 to 5.332
20	1	5.3394 to 6.0074	5.3394 to 6.0074	5.332 to 6.000	5.332 to 6.000	5.332 to 6.000	5.332 to 6.000
21	1	6.0074 to 7.6074	6.0074 to 7.6074	6.000 to 7.600	6.000 to 7.600	6.000 to 7.600	6.000 to 7.600
22	1	7.6074 to 8.5074	7.6074 to 8.5074	7.600 to 8.500	7.600 to 8.500	7.600 to 8.500	7.600 to 8.500
23	1	8.5074 to 9.5274	8.5074 to 9.5274	8.500 to 9.520	8.500 to 9.520	8.500 to 9.520	8.500 to 9.520
24	1	9.5274 to 12.0074	9.5274 to 12.0074	9.520 to 12.000	9.520 to 12.000	9.520 to 12.000	9.520 to 12.000
25	1	12.0074 to 12.8074	12.0074 to 12.8074	12.000 to 12.800	12.000 to 12.800	12.000 to 12.800	12.000 to 12.800
26	1	12.8074 to 13.5174	12.8074 to 13.5174	12.800 to 13.510	12.800 to 13.510	12.800 to 13.510	12.800 to 13.510
27	1	6.7587 to 7.6037	13.5174 to 15.2074	6.755 to 7.600	13.510 to 15.200	13.510 to 15.200	13.510 to 15.200
28	1	7.6037 to 8.3537	15.2074 to 16.7074	7.700 to 8.000	15.200 to 16.700	15.200 to 16.700	15.200 to 16.700
29	1	8.3537 to 9.5237	16.7074 to 19.0474	8.000 to 9.500	16.700 to 19.040	16.700 to 19.040	16.700 to 19.040
30	1	9.5237 to 10.0037	19.0474 to 20.0074	9.500 to 10.000	19.040 to 20.000	19.040 to 20.000	19.040 to 20.000
31	1	10.0037 to 10.6537	20.0074 to 21.3074	10.000 to 10.664	10.000 to 10.664	20.000 to 21.328	20.000 to 21.328
32	1	10.6537 to 12.0037	21.3074 to 24.0074	10.664 to 12.000	10.664 to 12.000	21.328 to 24.000	21.328 to 24.000
33	1	12.0037 to 13.2537	24.0074 to 26.5074	12.000 to 13.250	12.000 to 13.250	24.000 to 26.500	24.000 to 26.500
34	3	8.8358 to 9.0051	8.8358 to 9.0051	13.250 to 13.510	13.250 to 13.510	26.500 to 27.020	26.500 to 27.020
35	3	9.0051 to 9.5025	9.0051 to 9.5025				
36	3	9.5025 to 10.1358	9.5025 to 10.1358				
37	3	10.1358 to 10.6691	10.1358 to 10.6691	7.600 to 8.000	15.200 to 16.000	30.400 to 32.000	30.400 to 32.000
38	3	10.6691 to 12.0358	10.6691 to 12.0358	8.000 to 9.025	16.000 to 18.050	32.000 to 36.100	32.000 to 36.100
39	3	12.0358 to 12.6958	12.0358 to 12.6958	9.025 to 9.520	18.050 to 19.040	36.100 to 38.080	36.100 to 38.080
40	3	12.6958 to 13.3358	12.6958 to 13.3358	9.520 to 10.000	19.040 to 20.000	38.080 to 40.000	38.080 to 40.000
41	3	13.3358 to 13.5125	13.3358 to 13.5125	10.000 to 10.133	10.000 to 10.133	20.000 to 20.265	40.000 to 40.530
42	3	6.7562 to 7.6379	13.5125 to 15.2758	10.133 to 11.455	10.133 to 11.455	20.265 to 22.910	40.530 to 45.820
43	3	7.6379 to 8.0012	15.2758 to 16.0025	11.455 to 12.000	11.455 to 12.000	22.910 to 24.000	45.820 to 48.000
44	3	8.0012 to 8.3346	16.0025 to 16.6691	12.000 to 12.500	12.000 to 12.500	24.000 to 25.000	48.000 to 50.000
45	3	8.3346 to 8.8346	16.6691 to 17.6691	12.500 to 13.250	12.500 to 13.250	25.000 to 26.500	50.000 to 53.000
46	3	8.8346 to 9.0079	17.6691 to 18.0158	13.250 to 13.510	13.250 to 13.510	26.500 to 27.020	53.000 to 54.040
47	3	9.0079 to 9.5512	18.0158 to 19.1025	6.755 to 7.163	13.510 to 14.325	27.020 to 28.650	54.040 to 57.300
48	3	9.5512 to 10.0179	19.1025 to 20.0358	7.163 to 7.513	14.325 to 15.025	28.650 to 30.050	57.300 to 60.100
49	3	10.0179 to 10.1346	20.0358 to 20.2691	7.513 to 7.600	15.025 to 15.200		60.100 to 60.800
50	3	10.1346 to 10.6679	20.2691 to 21.3358	7.600 to 8.000	15.200 to 16.000		60.800 to 64.000
51	3	10.6679 to 11.1346	21.3358 to 22.2691	8.000 to 8.	16.000 to 16.700		64.000 to 66.800
52	3	11.1346 to 11.6679	22.2691 to 23.3358	8.350 to 8.750	16.700 to 17.500		66.800 to 70.000

Test Node	Error Description	Assembly	Frequency Band
8	Unleveled, Source 1, Out 1	A5	0.01 - 13.5 GHz
		A7	13.5 - 40 GHz
		A29	40 - 70 GHz
9	Unleveled, Source 1, Out 2	A5	0.01 - 13.5 GHz
		A8	13.5 - 40 GHz
		A32	40 - 70 GHz
10	Unleveled, Source 1 Synthesizer	A4	Full Range
11	Unleveled, Source 2, Out 1	A10	0.01 - 13.5 GHz
		A12	13.5 - 40 GHz
		A30	40 - 70 GHz
12	Unleveled, Source 2, Out 2	A10	0.01 - 13.5 GHz
		A13	13.5 - 40 GHz
		A31	40 - 70 GHz
13	Unleveled, Source 2 Synthesizer	A17	Full Range
14	Unleveled, LO Drive	A25	Full Range
15	Unleveled, LO Synthesizer	A15	Full Range
16	Unlocked, Source 1 Synthesizer, Integrator Low	A4	Full Range
17	Unlocked, Source 1 Synthesizer, Integrator High	A4	Full Range
19	Unlocked, Source 2 Synthesizer, Integrator Low	A17	Full Range
20	Unlocked, Source 2 Synthesizer, Integrator High	A17	Full Range
22	Unlocked, LO Synthesizer, Integrator Low	A15	Full Range
23	Unlocked, LO Synthesizer, Integrator High	A15	Full Range
25	Unleveled, Doubler 1, Prelevel	A7	13.5 - 70 GHz
26	Unleveled, Doubler 2, Prelevel	A8	13.5 - 70 GHz
27	Unleveled, Doubler 3, Prelevel	A12	13.5 - 70 GHz
28	Unleveled, Doubler 4, Prelevel	A13	13.5 - 70 GHz
29	Unleveled, Source 1, P4	A5	13.5 - 70 GHz
30	Unleveled, Source 2, P4	A10	13.5 - 70 GHz

N5247B 4-Port Overall Block Diagram

Including Options 401-Standard; 419-Attenuators and Bias Tees;
423-Attenuators, Bias Tees, Combiner and Source Bypass Switches

Instrument Block Diagrams – 4-Port (Sheet 6), LFE and DDS (Version 7 Synthesizer Assemblies)

Microwave PNA-X, N5247B – 4-Port, LFE and DDS (Version 7 Synthesizer Assemblies)

Band	Mixer Brick LO Harmonic Number	1 LO Synthesizer Frequency (GHz)	2 A25 HMA26.5 Frequency (GHz)	3 RF Synthesizer Frequency (GHz)	4 A5/A10 Source Frequency (GHz)	5 A7/A8/A12/A13 40 GHz Doubler Frequency (GHz)	6 A60/A61/A62/A63 70 GHz Doubler Frequency (GHz)
0	1	--	--	--	--	--	--
1	1	--	--	--	--	--	--
2	1	0.01248 to 0.01648	0.01248 to 0.01648	0.010 to 0.014	0.010 to 0.014	0.010 to 0.014	0.010 to 0.014
3	1	0.01648 to 0.02148	0.01648 to 0.02148	0.014 to 0.019	0.014 to 0.019	0.014 to 0.019	0.014 to 0.019
4	1	0.02148 to 0.02948	0.02148 to 0.02948	0.019 to 0.027	0.019 to 0.027	0.019 to 0.027	0.019 to 0.027
5	1	0.02948 to 0.04048	0.02948 to 0.04048	0.027 to 0.038	0.027 to 0.038	0.027 to 0.038	0.027 to 0.038
6	1	0.04048 to 0.05548	0.04048 to 0.05548	0.038 to 0.053	0.038 to 0.053	0.038 to 0.053	0.038 to 0.053
7	1	0.06044 to 0.08244	0.06044 to 0.08244	0.053 to 0.075	0.053 to 0.075	0.053 to 0.075	0.053 to 0.075
8	1	0.08244 to 0.11244	0.08244 to 0.11244	0.075 to 0.105	0.075 to 0.105	0.075 to 0.105	0.075 to 0.105
9	1	0.11244 to 0.15344	0.11244 to 0.15344	0.105 to 0.146	0.105 to 0.146	0.105 to 0.146	0.105 to 0.146
10	1	0.15344 to 0.21244	0.15344 to 0.21244	0.146 to 0.205	0.146 to 0.205	0.146 to 0.205	0.146 to 0.205
11	1	0.21244 to 0.25744	0.21244 to 0.25744	0.205 to 0.250	0.205 to 0.250	0.205 to 0.250	0.205 to 0.250
12	1	0.25744 to 0.40344	0.25744 to 0.40344	0.250 to 0.396	0.250 to 0.396	0.250 to 0.396	0.250 to 0.396
13	1	0.40344 to 0.50744	0.40344 to 0.50744	0.396 to 0.500	0.396 to 0.500	0.396 to 0.500	0.396 to 0.500
14	1	0.50744 to 0.63544	0.50744 to 0.63544	0.500 to 0.628	0.500 to 0.628	0.500 to 0.628	0.500 to 0.628
15	1	0.63544 to 1.0074	0.63544 to 1.0074	0.628 to 1.000	0.628 to 1.000	0.628 to 1.000	0.628 to 1.000
16	1	1.0074 to 1.5074	1.0074 to 1.5074	1.000 to 1.500	1.000 to 1.500	1.000 to 1.500	1.000 to 1.500
17	1	1.5074 to 2.0074	1.5074 to 2.0074	1.500 to 2.000	1.500 to 2.000	1.500 to 2.000	1.500 to 2.000
18	1	2.0074 to 3.2074	2.0074 to 3.2074	2.000 to 3.200	2.000 to 3.200	2.000 to 3.200	2.000 to 3.200
19	1	3.2074 to 5.3394	3.2074 to 5.3394	3.200 to 5.332	3.200 to 5.332	3.200 to 5.332	3.200 to 5.332
20	1	5.3394 to 6.0074	5.3394 to 6.0074	5.332 to 6.000	5.332 to 6.000	5.332 to 6.000	5.332 to 6.000
21	1	6.0074 to 7.6074	6.0074 to 7.6074	6.000 to 7.600	6.000 to 7.600	6.000 to 7.600	6.000 to 7.600
22	1	7.6074 to 8.5074	7.6074 to 8.5074	7.600 to 8.500	7.600 to 8.500	7.600 to 8.500	7.600 to 8.500
23	1	8.5074 to 9.5274	8.5074 to 9.5274	8.500 to 9.520	8.500 to 9.520	8.500 to 9.520	8.500 to 9.520
24	1	9.5274 to 12.0074	9.5274 to 12.0074	9.520 to 12.000	9.520 to 12.000	9.520 to 12.000	9.520 to 12.000
25	1	12.0074 to 12.8074	12.0074 to 12.8074	12.000 to 12.800	12.000 to 12.800	12.000 to 12.800	12.000 to 12.800
26	1	12.8074 to 13.5174	12.8074 to 13.5174	12.800 to 13.510	12.800 to 13.510	12.800 to 13.510	12.800 to 13.510
27	1	6.7587 to 7.6037	13.5174 to 15.2074	6.755 to 7.600	13.510 to 15.200	13.510 to 15.200	13.510 to 15.200
28	1	7.6037 to 8.3537	15.2074 to 16.7074	7.700 to 8.000	15.200 to 16.700	15.200 to 16.700	15.200 to 16.700
29	1	8.3537 to 9.5237	16.7074 to 19.0474	8.000 to 9.500	16.700 to 19.040	16.700 to 19.040	16.700 to 19.040
30	1	9.5237 to 10.0037	19.0474 to 20.0074	9.500 to 10.000	19.040 to 20.000	19.040 to 20.000	19.040 to 20.000
31	1	10.0037 to 10.6537	20.0074 to 21.3074	10.000 to 10.664	10.000 to 10.664	20.000 to 21.328	20.000 to 21.328
32	1	10.6537 to 12.0037	21.3074 to 24.0074	10.664 to 12.000	10.664 to 12.000	21.328 to 24.000	21.328 to 24.000
33	1	12.0037 to 13.2537	24.0074 to 26.5074	12.000 to 13.250	12.000 to 13.250	24.000 to 26.500	24.000 to 26.500
34	3	8.8358 to 9.0051	8.8358 to 9.0051	13.250 to 13.510	13.250 to 13.510	26.500 to 27.020	26.500 to 27.020
35	3	9.0051 to 9.5025	9.0051 to 9.5025	6.755 to 7.125	13.510 to 14.250	27.020 to 28.500	27.020 to 28.500
36	3	9.5025 to 10.1358	9.5025 to 10.1358	7.125 to 7.600	14.250 to 15.200	28.500 to 30.400	28.500 to 30.400
37	3	10.1358 to 10.6691	10.1358 to 10.6691	7.600 to 8.000	15.200 to 16.000	30.400 to 32.000	30.400 to 32.000
38	3	10.6691 to 12.0358	10.6691 to 12.0358	8.000 to 9.025	16.000 to 18.050	32.000 to 36.100	32.000 to 36.100
39	3	12.0358 to 12.6958	12.0358 to 12.6958	9.025 to 9.520	18.050 to 19.040	36.100 to 38.080	36.100 to 38.080
40	3	12.6958 to 13.3358	12.6958 to 13.3358	9.520 to 10.000	19.040 to 20.000	38.080 to 40.000	38.080 to 40.000
41	3	13.3358 to 13.5125	13.3358 to 13.5125	10.000 to 10.133	10.000 to 10.133	20.000 to 20.265	40.000 to 40.530
42	3	6.7562 to 7.6379	13.5125 to 15.2758	10.133 to 11.455	10.133 to 11.455	20.265 to 22.910	40.530 to 45.820
43	3	7.6379 to 8.0012	15.2758 to 16.0025	11.455 to 12.000	11.455 to 12.000	22.910 to 24.000	45.820 to 48.000
44	3	8.0012 to 8.3346	16.0025 to 16.6691	12.000 to 12.500	12.000 to 12.500	24.000 to 25.000	48.000 to 50.000
45	3	8.3346 to 8.8346	16.6691 to 17.6691	12.500 to 13.250	12.500 to 13.250	25.000 to 26.500	50.000 to 53.000
46	3	8.8346 to 9.0079	17.6691 to 18.0158	13.250 to 13.510	13.250 to 13.510	26.500 to 27.020	53.000 to 54.040
47	3	9.0079 to 9.5512	18.0158 to 19.1025	6.755 to 7.163	13.510 to 14.325	27.020 to 28.650	54.040 to 57.300
48	3	9.5512 to 10.0179	19.1025 to 20.0358	7.163 to 7.513	14.325 to 15.025	28.650 to 30.050	57.300 to 60.100
49	3	10.0179 to 10.1346	20.0358 to 20.2691	7.513 to 7.600	15.025 to 15.200	30.050 to 30.400	60.100 to 60.800
50	3	10.1346 to 10.6679	20.2691 to 21.3358	7.600 to 8.000	15.200 to 16.000	30.400 to 32.000	60.800 to 64.000
51	3	10.6679 to 11.1346	21.3358 to 22.2691	8.000 to 8.350	16.000 to 16.700	32.000 to 33.400	64.000 to 66.800
52	3	11.1346 to 11.6679	22.2691 to 23.3358	8.350 to 8.750	16.700 to 17.500	33.400 to 35.000	66.800 to 70.000

Test Node	Error Description	Assembly	Frequency Band
8	Unleveled, Source 1, Out 1	A5	0.01 - 13.5 GHz
		A7	13.5 - 40 GHz
		A29	40 - 70 GHz
9	Unleveled, Source 1, Out 2	A5	0.01 - 13.5 GHz
		A8	13.5 - 40 GHz
		A32	40 - 70 GHz
10	Unleveled, Source 1 Synthesizer	A4	Full Range
11	Unleveled, Source 2, Out 1	A10	0.01 - 13.5 GHz
		A12	13.5 - 40 GHz
		A30	40 - 70 GHz
12	Unleveled, Source 2, Out 2	A10	0.01 - 13.5 GHz
		A13	13.5 - 40 GHz
		A31	40 - 70 GHz
13	Unleveled, Source 2 Synthesizer	A17	Full Range
14	Unleveled, LO Drive	A25	Full Range
15	Unleveled, LO Synthesizer	A15	Full Range
16	Unlocked, Source 1 Synthesizer, Integrator Low	A4	Full Range
17	Unlocked, Source 1 Synthesizer, Integrator High	A4	Full Range
19	Unlocked, Source 2 Synthesizer, Integrator Low	A17	Full Range
20	Unlocked, Source 2 Synthesizer, Integrator High	A17	Full Range
22	Unlocked, LO Synthesizer, Integrator Low	A15	Full Range
23	Unlocked, LO Synthesizer, Integrator High	A15	Full Range
25	Unleveled, Doubler 1, Prelevel	A7	13.5 - 70 GHz
26	Unleveled, Doubler 2, Prelevel	A8	13.5 - 70 GHz
27	Unleveled, Doubler 3, Prelevel	A12	13.5 - 70 GHz
28	Unleveled, Doubler 4, Prelevel	A13	13.5 - 70 GHz
29	Unleveled, Source 1, P4	A5	13.5 - 70 GHz
30	Unleveled, Source 2, P4	A10	13.5 - 70 GHz

N5247B 4-Port Overall Block Diagram

Including Options 425-LFE, Attenuators, Bias Tees, Combiner and Source Bypass Switches

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5 Theory of Operation

Information in This Chapter

This chapter provides a general description of the operating theory of the N524xA 2-port and 4-port PNA 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.”

NOTE Although simplified block diagrams are included within the description of each functional group, it is recommended that the more detailed block diagrams, located at the end of Chapter 4, be available for reference, as you read the information in this chapter.

NOTE Some paragraphs of this chapter reference your analyzer’s DSP version. Click Help > About Network Analyzer and note the DSP version shown.

Chapter Five at-a-Glance

Network Analyzer System Operation

The PNA network analyzer generates two (2-port models) or four (4-port models) phase-locked incident signals and an LO signal from the internal synthesized source. By means of signal separation, the incident signals are divided into reference signals and test signals.

The reference signals are applied to the receiver group, while the test signals are applied to the device under test (DUT) and then to the receiver group. The LO signal is applied directly to the receiver group where it is mixed with the test and reference signals to produce IF signals for each of the eight receivers (A–D, R1–R4) for 4-port models or four receivers (A, B, R1, R2) for 2-port models. These IF signals are downconverted and then sampled and digitally processed.

If configured with the optional 2nd source, the 2-port models provide two auxiliary source outputs, SRC 2 OUT 1 and SRC 2 OUT 2.

Figure 5-1 is a simplified block diagram of the 4-port network analyzer system and Figure 5-2 is a simplified block diagram of the 2-port network analyzer system.

Figure 5-1 4-Port System Simplified Block Diagram

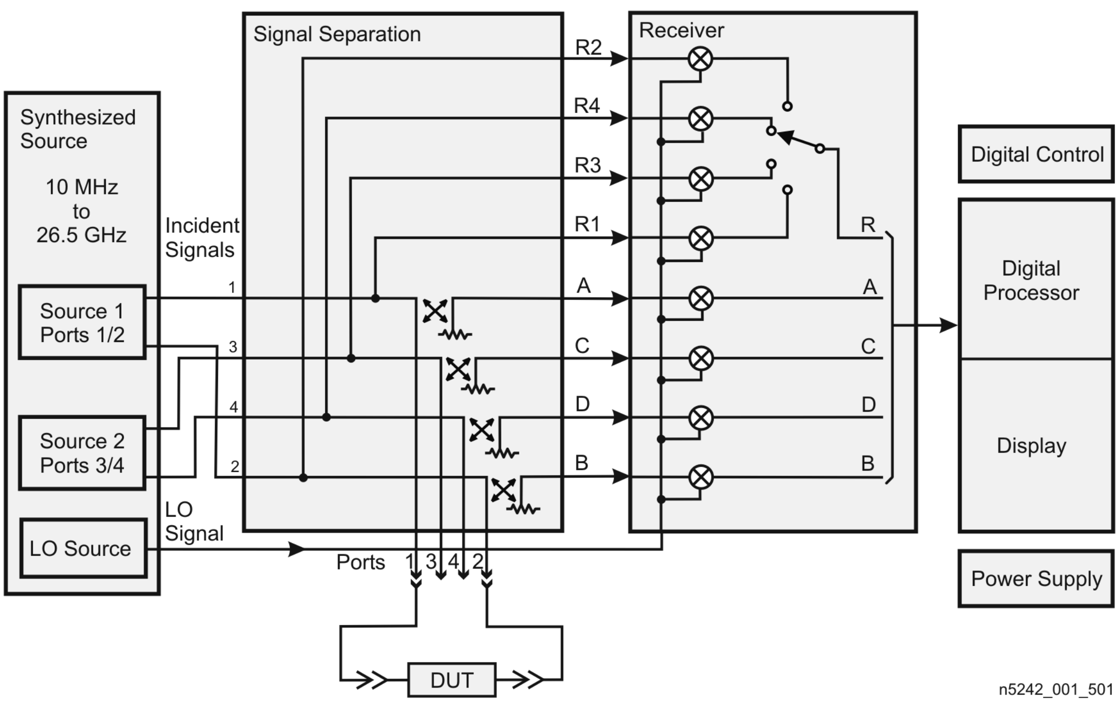


Figure 5-2 2-Port System Simplified Block Diagram

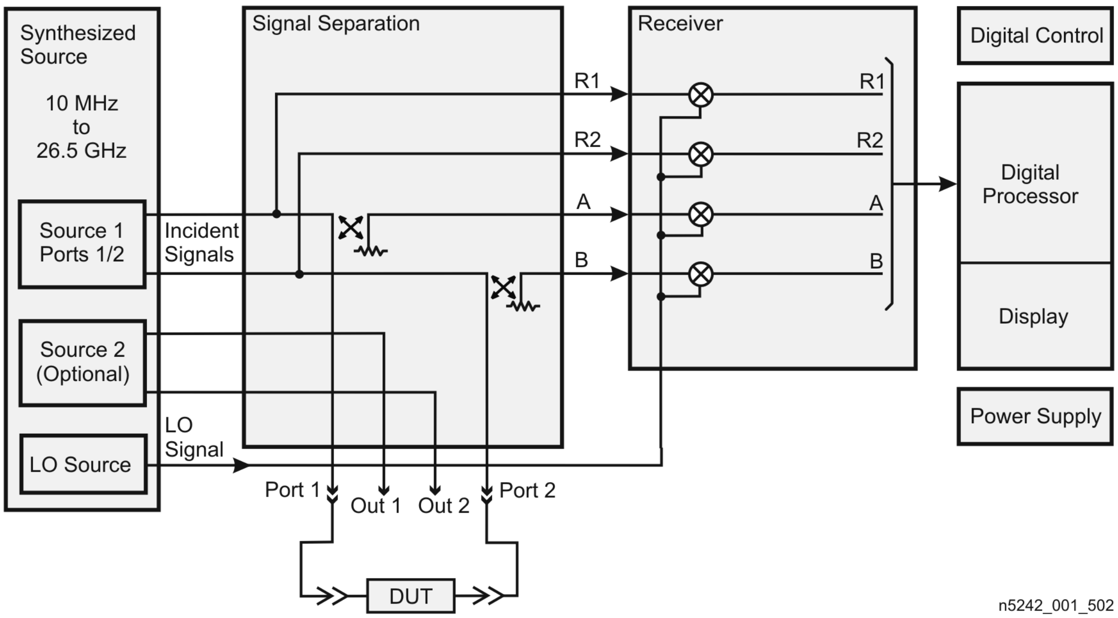


Figure 5-3 System Block Diagram Legend – LFE Block Diagrams

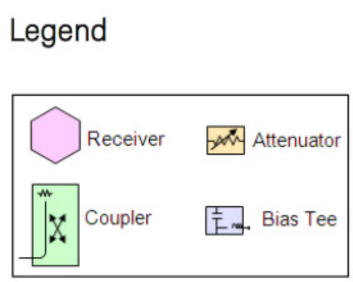


Figure 5-4 4-Port N5290A System Simplified Block Diagram (401) – with LFE

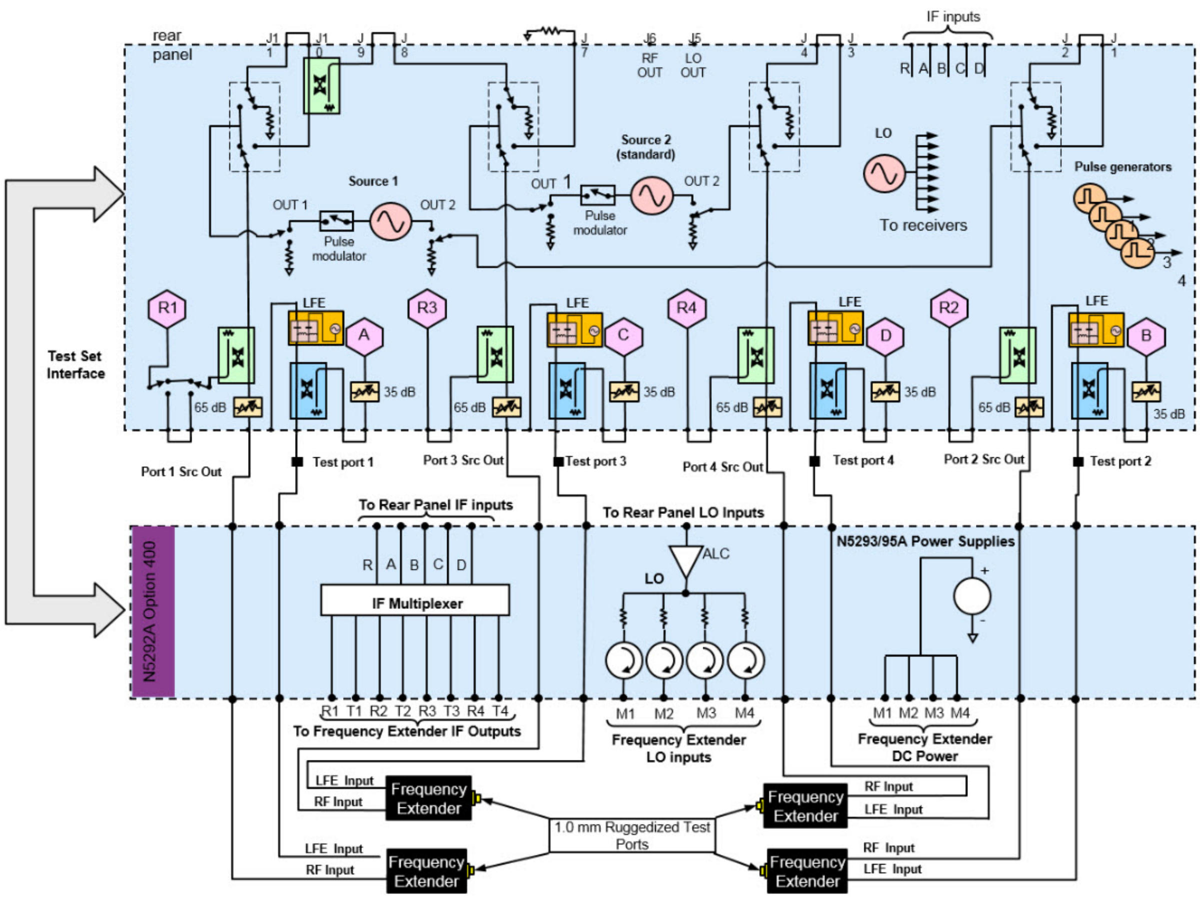
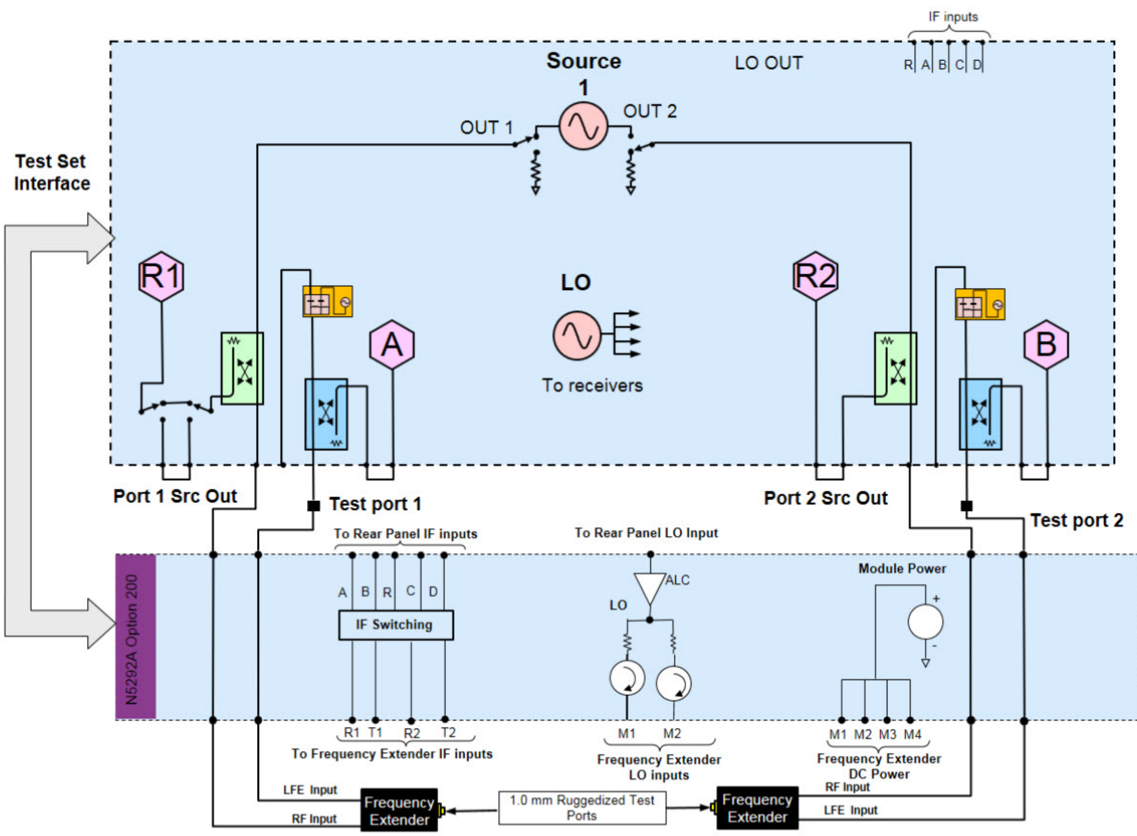


Figure 5-5 2-Port N5290A System Simplified Block Diagram (201 and 205) – with LFE



Functional Groups of the Network Analyzer

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

- Synthesized Source Group
- Signal Separation Group
- Receiver Group
- Digital Processor and Digital Control Group
- Power Supply Group

Synthesized Source Group

Refer to the NOTE notice on page 5-1.

Version 6 Synthesizers and below:

The built-in synthesized source generates a swept, stepped, or continuous wave (CW) signal in the frequency ranges as listed in the "N5247B– (900 Hz) 10 MHz to 67 GHz -with synthesizer revision 6 or earlier",[1] available online at: https://www.keysight.com/upload/cmc_upload/All/N5247B_Synth6.pdf.

The source group provides five signals: an LO signal and four incident signals. The LO signal and the four incident signals are offset in frequency by the receiver IF. For analyzers with DSP version 4.0, the receiver IF is 7.606 MHz (at tuned frequencies below 53 MHz the IF and the offset is 2.535 MHz). For analyzers with DSP version 5.0, the receiver IF is 7.438 MHz (at tuned frequencies below 53 MHz the IF and the offset is 0.826 MHz).

Version 7 Synthesizers:

The built-in direct digital synthesized (DDS) source assembly generates a swept, stepped, or continuous wave (CW) signal in the frequency ranges as listed in the "N5247B– (900 Hz) 10 MHz to 67 GHz Data Sheet and Technical Specifications",[2] available online at: https://www.keysight.com/us/en/assets/9018-04526/data-sheets/9018-04526.pdf (N5247-90029).

The source group provides five signals: an LO signal and four incident signals. The LO signal and the four incident signals are offset in frequency by the receiver IF. For analyzers with DDS assemblies, the receiver IF is 7.438 MHz (at tuned frequencies below 53 MHz the IF and the offset is 0.826 MHz).

LO Behavior without LFE (Low Frequency Extension) – All Synthesizers:

The LO signal is sent directly to the mixers in the receiver group. The incident signals are routed to the front panel test ports and then to the device under test (DUT) as the test signal.

A portion of each incident signal is coupled off (in the signal separation group) and sent to the mixers in the receiver group as reference signals. These reference signals are compared (mixed) with the LO signal in the receiver group.

1. Version 6 synthesizers: For PNA-X frequency ranges and maximum output power levels, refer to the section "Test Port Output" in the online Keysight document, **"N5247B– (900 Hz) 10 MHz to 67 GHz -with synthesizer revision 6 or earlier."** See the hyperlink above.
2. Version 7 synthesizers: For PNA-X frequency ranges and maximum output power levels, refer to the section "Test Port Output" in the online Keysight document, **"N5247B– (900 Hz) 10 MHz to 67 GHz Data Sheet and Technical Specifications."** See the hyperlink above.

For Version 6 and below synthesizers, analyzers with DSP version 4.0, the comparison (mix) produces the 7.606 MHz (or 2.535 MHz at frequencies below 53 MHz) IF signal. For analyzers with DSP version 5.0, the comparison (mix) produces the 7.438 MHz (or 0.826 MHz at frequencies below 53 MHz) IF signal.

For Version 7 synthesizers, the comparison (mix) produces the 7.438 MHz (or 0.826 MHz at frequencies below 53 MHz) IF signal.

LO Behavior with LFE (Low Frequency Extension):

On the direct digital synthesizer (DDS) assembly (Version 7 synthesizers) or on the synthesizer board (Version 6 synthesizers and below), there is a LFE output that is limited by the L-C filter and by the 250 MHz low pass filter.

Below 20 MHz, the LFE is signal is directly converted. Exceptions are shown in Figure 5-15 on page 5-45. See also, "A70 4-Port and A75 2-Port Low Frequency Extension (LFE) Board" on page 5-32.

The incident signal output power is leveled by an internal automatic leveling control (ALC) circuit.

For version 6 synthesizers, the maximum output power level of the network analyzer at the test ports is shown in the "N5247B– (900 Hz) 10 MHz to 67 GHz -with synthesizer revision 6 or earlier", available online at: https://www.keysight.com/upload/cmc_upload/All/N5247B_Synth6.pdf

For version 7 synthesizers, the maximum output power level of the network analyzer at the test ports is shown in the "N5247B– (900 Hz) 10 MHz to 67 GHz – Data Sheet and Technical Specifications", available online at: https://www.keysight.com/us/en/assets/9018-04526/data-sheets/9018-04526.pdf (N5247-90029).

Refer to "Synthesized Source Group Operation" on page 5-10.

Signal Separation Group

Each of the incident signals from the source group 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 is then transmitted to the receiver group.

The signal separation group includes:

– RF path switching to allow forward and reverse measurements
– external connections for the DUT (configurable test set)
– optional step attenuators in the source and receiver paths
– optional mechanical switches
– optional bias tees

Refer to "Signal Separation Group Operation" on page 5-46.

Receiver Group

Refer to the NOTE notice on page 5-1. The receiver converts the test and reference signals to 7.606 MHz intermediate frequency (IF) signals for signal processing, retaining both magnitude and phase characteristics. For analyzers with DSP version 4.0, the IF signals are 7.606 MHz. For analyzers with DSP version 5.0, the IF signals are 7.438 MHz. The IF signals are converted to digital information by the digital processing group.

Refer to “Receiver Group Operation” on page 5-53.

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 the output to the display, in addition to signal processing and analyzer control.

Refer to “Digital Processing and Digital Control Group Operation” on page 5-59.

Power Supply Group

The power supply functional group provides power for the other assemblies in the instrument.

Refer to “Power Supply Group Operation” on page 5-64.

Synthesized Source Group Operation

Version 6 Synthesizers:

The source group produces a stable output signal by phase locking a synthesized voltage-controlled oscillator (VCO).

For the full frequency range of the version 6 synthesizers or earlier, refer to the "Data Sheet for N5247B with synthesizer revision 6 or earlier",[1] available online at: https://www.keysight.com/upload/cmc_upload/All/N5247B_Synth6.pdf.

The outputs at the front panel test ports are swept, stepped or CW signals. Maximum leveled output powers are also listed in the online Keysight document, "Data Sheet for N5247B with synthesizer revision 6 or earlier." For a simple block diagram of the source group, refer to Figure 5-6 on page 5-13.

Version 7 Synthesizers:

The source group produces an output signal by multiplying up using a synthesized oven-controlled crystal-oscillator (OCXO) and using this signal as the direct digital synthesizer (DDS) assembly's reference.

For the full frequency range of the version 7 synthesizer assemblies, refer to the "N5247B– (900 Hz) 10 MHz to 67 GHz – Data Sheet and Technical Specifications",[2] available online at:
https://www.keysight.com/us/en/assets/9018-04526/data-sheets/9018-04526.pdf (N5247-90029)

The outputs at the front panel test ports are swept, stepped or CW signals. Maximum leveled output powers are also listed in the online Keysight document, "N5247B– (900 Hz) 10 MHz to 67 GHz – Data Sheet and Technical Specifications." For a simple block diagram of the source group, refer to Figure 5-6 on page 5-13.

In this section the following are described:

- Basic Operation
- A4, A15, and A17 13.5 GHz Synthesizer Boards (S/N Prefixes <6021 Only)
- A5 and A10 26.5 GHz Source Boards
- A7, A8, A12, and A13 40 GHz Doubler Boards
- A25 Multiplier/Amplifier 26.5 Board (HMA26.5)
- A14 Frequency Reference Board (S/N prefixes <6021 Only) (including rear-panel interconnects)

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1. Version 6 synthesizers: For PNA-X frequency ranges and maximum output power levels, refer to the section "Test Port Output" in the **"Data Sheet for N5247B with synthesizer revision 6 or earlier."** See the hyperlink above.
2. Version 7 synthesizers: For PNA-X frequency ranges and maximum output power levels, refer to the section "Test Port Output" in the online Keysight document, **"N5247B– (900 Hz) 10 MHz to 67 GHz Data Sheet and Technical Specifications."** See the hyperlink above.

– A23 Test Set Motherboard (including rear-panel interconnects)
– A70 4-Port and A75 2-Port Low Frequency Extension (LFE) Board (including rear-panel interconnects)

Basic Operation

This section contains the following:

– “Version 6 Synthesizers Basic Operation”
– “Version 7 Synthesizers Basic Operation” on page 5-19

Version 6 Synthesizers Basic Operation

Table 5-7 on page 5-15 lists the L.O. harmonic number, the synthesizer frequencies (A4, A15, and A17), the main source frequency (A5 and A10), and the doubler frequencies (A7, A8, A12, and A13) 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 A14 frequency reference board produces a constant phase locked reference signal of 50 MHz that is sent to the A4, A15, and A17 13.5 GHz synthesizer boards.

Refer to the NOTE notice on page 5-1. The A15 13.5 GHz synthesizer board produces an LO signal that is sent through the A25 LO multiplier/amplifier 26.5 board to the A27 and A28 mixer bricks (via the A26 splitter).[1] The frequency is synthesized such that the mixing product of this LO signal with the test signal output is a constant IF signal. For analyzers with DSP version 4.0, the IF signal is 7.606 MHz (at frequencies below 53 MHz the IF is 2.535 MHz). For analyzers with DSP version 5.0, the IF is 7.438 MHz (at frequencies below 53 MHz the IF signal is 0.826 MHz). This IF signal is sent to the A16 SPAM board for digital processing.

The A4 13.5 GHz synthesizer board produces an incident signal that is sent through the A5 26.5 GHz source board and then through the A7 and A8 doubler boards to the front panel outputs. Likewise, the A17 13.5 GHz synthesizer board produces an incident signal that is sent through the A10 26.5 GHz source board and then through the A12 and A13 doubler boards to the front panel outputs. Portions of these signals are coupled off and sent to the A27 and A28 mixer bricks (A–D and R1–R4) where they are mixed with the LO signal from the A26 splitter[1] to produce the IF signal. For analyzers with DSP version 4.0, the IF signal is 7.606 MHz (or 2.535 MHz). For analyzers with DSP version 5.0, the IF signal is 7.438 MHz (or 0.826 MHz).

The A4, A15, and A17 13.5 GHz synthesizer boards each contain their own phase lock circuitry. The A15 board produces an independently phase locked LO signal while the A4 and A17 boards produce independently phase locked test signals. This makes it possible for the LO signal to be tuned to a different

1. A26 splitter only applies to PNAs with serial number prefix <6021.

frequency than the test signal. With frequency offset mode disabled, the LO signal is a frequency value higher than the test signal. For analyzers with DSP version 4.0, the frequency value is 7.606 MHz. For analyzers with DSP version 5.0, the frequency value is 7.438 MHz. Since the A4, A15, and A17 13.5 GHz synthesizer boards each receive their 50 MHz input reference signal from the exact same source, frequency drift error is eliminated.

Figure 5-6 Source Group, Version 6, Part 1

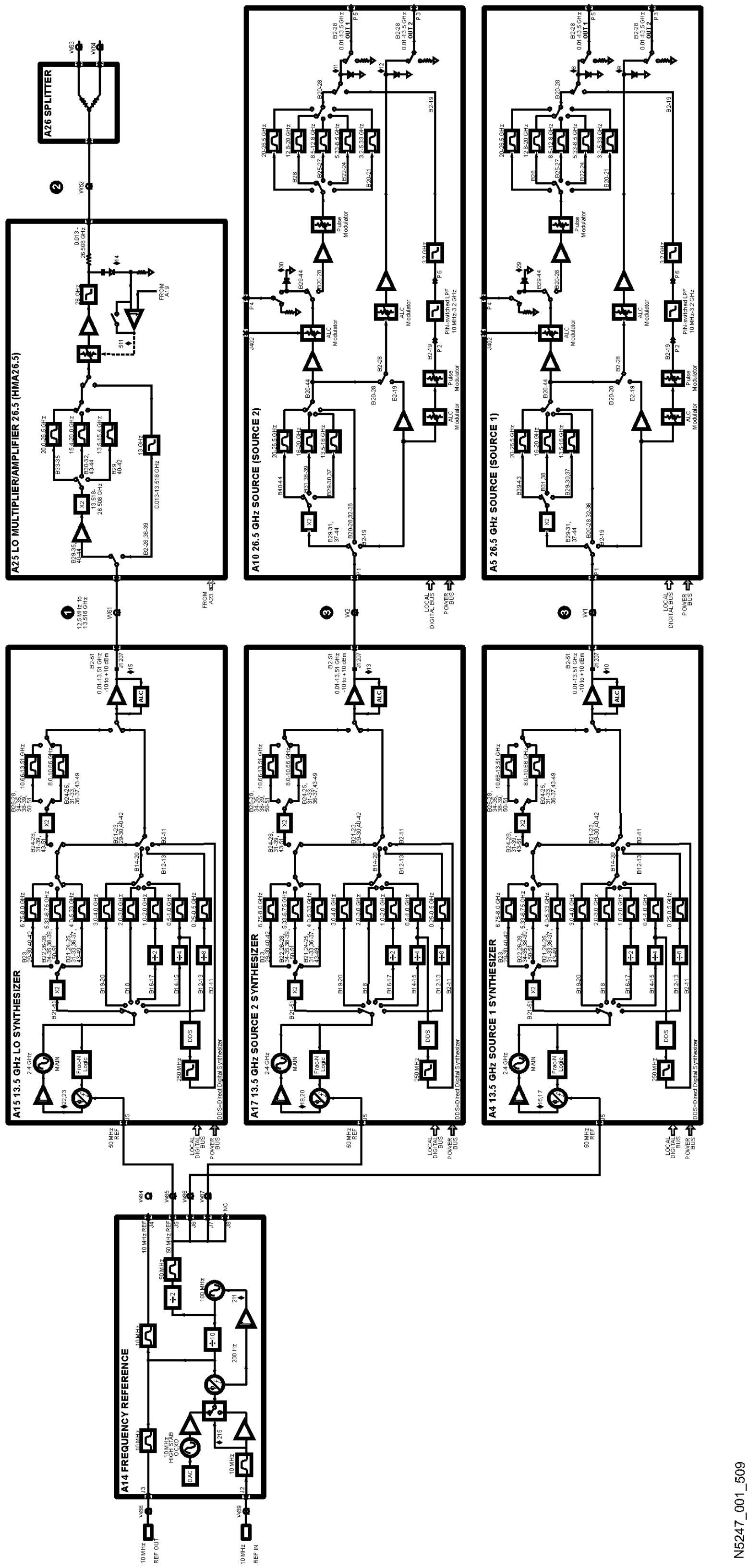
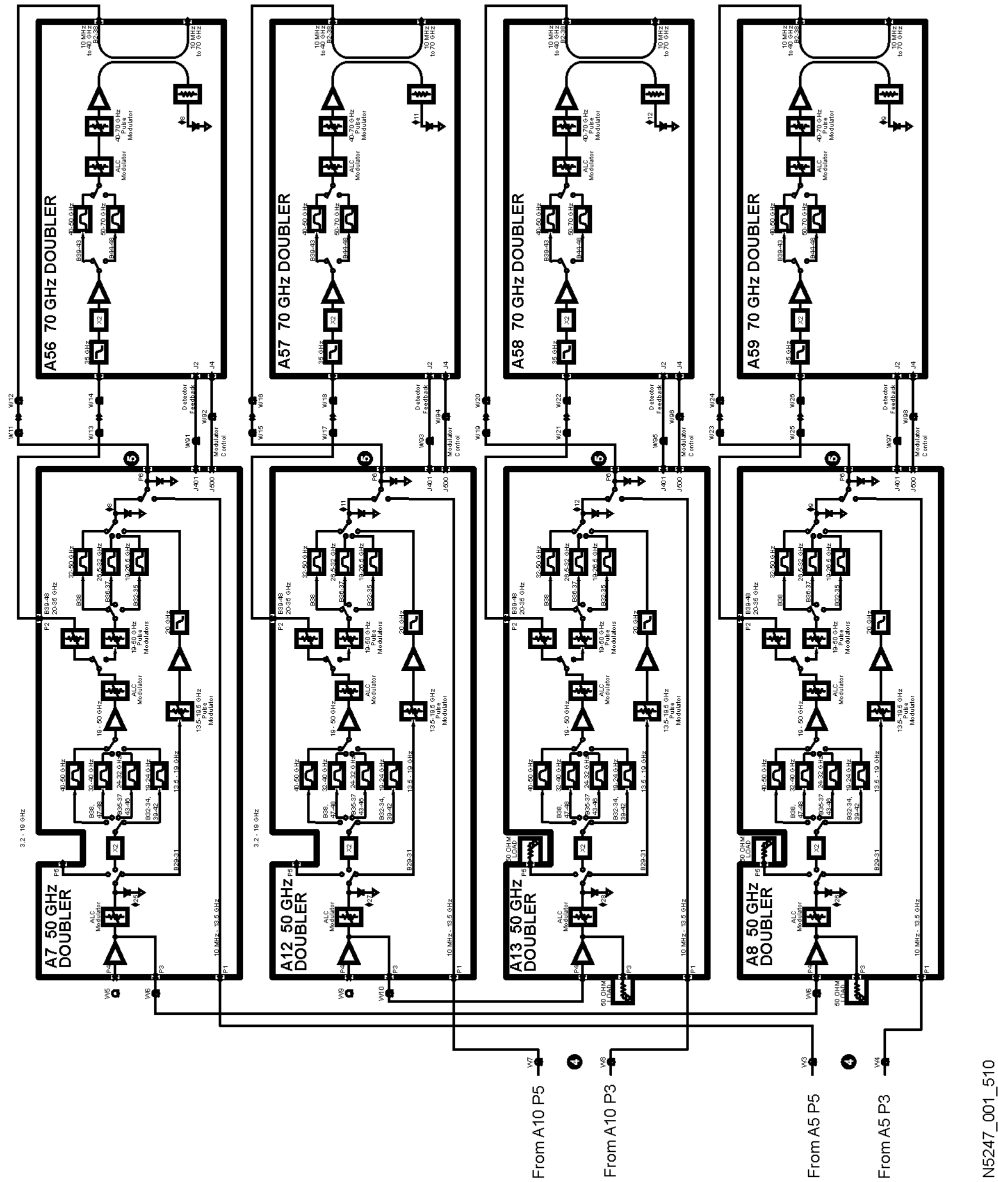


Figure 5-7 Source Group, Version 6 and Version 7 Synthesizers, Part 2



IMPORTANT!

– For Version 6 synthesizers, the signals into the A12 and A13 50 GHz Doublers are generated on the A10 Frequency Reference board. See figure above.

– For Version 7 synthesizers, the signals into the A12 and A13 50 GHz Doublers are generated on the A15 direct digital synthesizer (DDS) assembly. Not shown in figure above. See also, Figure 5-8 on page 5-20.

CAUTION The following band table is for version 6 synthesizers and below. For version 7 synthesizers band values, refer to the table on Table 5-2 on page 5-21.

Table 5-1 Version 6 and Below Synthesizers – Subsweep Frequencies

Band	Mixer Brick L.O. Harmonic Number (N)	❶ A15 Synthesizer Frequency (GHz)	❷ A25 HMA26.5 Frequency (GHz)	❸ A4/A17 Synthesizer Frequency (GHz)	❹ A5/A10 Source Frequency (GHz)	❺ A7/A8/A12/A13 50 GHz Doubler Frequency (GHz)	❻ A60/A61 / A62/A63 70 GHz Doubler Frequency (GHz)
0	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-
2	1	0.01254 to 0.01654	0.01254 to 0.01654	0.010 to 0.014	0.010 to 0.014	0.010 to 0.014	0.010 to 0.014
3	1	0.01654 to 0.02154	0.01654 to 0.02154	0.014 to 0.019	0.014 to 0.019	0.014 to 0.019	0.014 to 0.019
4	1	0.02154 to 0.02954	0.02154 to 0.02954	0.019 to 0.027	0.019 to 0.027	0.019 to 0.027	0.019 to 0.027
5	1	0.02954 to 0.04054	0.02954 to 0.04054	0.027 to 0.038	0.027 to 0.038	0.027 to 0.038	0.027 to 0.038
6	1	0.04054 to 0.05554	0.04054 to 0.05554	0.038 to 0.053	0.038 to 0.053	0.038 to 0.053	0.038 to 0.053
7	1	0.06061 to 0.08261	0.06061 to 0.08261	0.053 to 0.075	0.053 to 0.075	0.053 to 0.075	0.053 to 0.075
8	1	0.08261 to 0.11261	0.08261 to 0.11261	0.075 to 0.105	0.075 to 0.105	0.075 to 0.105	0.075 to 0.105
9	1	0.11261 to 0.15361	0.11261 to 0.15361	0.105 to 0.146	0.105 to 0.146	0.105 to 0.146	0.105 to 0.146
10	1	0.15361 to 0.21261	0.15361 to 0.21261	0.146 to 0.205	0.146 to 0.205	0.146 to 0.205	0.146 to 0.205
11	1	0.21261 to 0.25761	0.21261 to 0.25761	0.205 to 0.250	0.205 to 0.250	0.205 to 0.250	0.205 to 0.250
12	1	0.25761 to 0.40361	0.25761 to 0.40361	0.250 to 0.396	0.250 to 0.396	0.250 to 0.396	0.250 to 0.396
13	1	0.40361 to 0.50761	0.40361 to 0.50761	0.396 to 0.500	0.396 to 0.500	0.396 to 0.500	0.396 to 0.500

Table 5-1 Version 6 and Below Synthesizers – Subsweep Frequencies

Band	Mixer Brick L.O. Harmonic Number (N)	❶ A15 Synthesizer Frequency (GHz)	❷ A25 HMA26.5 Frequency (GHz)	❸ A4/A17 Synthesizer Frequency (GHz)	❹ A5/A10 Source Frequency (GHz)	❺ A7/A8/A12/A13 50 GHz Doubler Frequency (GHz)	❻ A60/A61/A62/A63 70 GHz Doubler Frequency (GHz)
14	1	0.50761 to 0.63561	0.50761 to 0.63561	0.500 to 0.628	0.500 to 0.628	0.500 to 0.628	0.500 to 0.628
15	1	0.63561 to 1.00761	0.63561 to 1.00761	0.628 to 1.000	0.628 to 1.000	0.628 to 1.000	0.628 to 1.000
16	1	1.00761 to 1.50761	1.00761 to 1.50761	1.000 to 1.500	1.000 to 1.500	1.000 to 1.500	1.000 to 1.500
17	1	1.50761 to 2.00761	1.50761 to 2.00761	1.500 to 2.000	1.500 to 2.000	1.500 to 2.000	1.500 to 2.000
18	1	2.00761 to 3.00761	2.00761 to 3.00761	2.000 to 3.000	2.000 to 3.000	2.000 to 3.000	2.000 to 3.000
19	1	3.00761 to 3.20761	3.00761 to 3.20761	3.000 to 3.200	3.000 to 3.200	3.000 to 3.200	3.000 to 3.200
20	1	3.20761 to 4.00761	3.20761 to 4.00761	3.200 to 4.000	3.200 to 4.000	3.200 to 4.000	3.200 to 4.000
21	1	4.00761 to 5.33961	4.00761 to 5.33961	4.000 to 5.332	4.000 to 5.332	4.000 to 5.332	4.000 to 5.332
22	1	5.33961 to 6.75961	5.33961 to 6.75961	5.332 to 6.752	5.332 to 6.752	5.332 to 6.752	5.332 to 6.752
23	1	6.75961 to 8.00761	6.75961 to 8.00761	6.752 to 8.000	6.752 to 8.000	6.752 to 8.000	6.752 to 8.000
24	1	8.00761 to 8.50761	8.00761 to 8.50761	8.000 to 8.500	8.000 to 8.500	8.000 to 8.500	8.000 to 8.500
25	1	8.50761 to 10.67161	8.50761 to 10.67161	8.500 to 10.664	8.500 to 10.664	8.500 to 10.664	8.500 to 10.664
26	1	10.67161 to 12.00761	10.67161 to 12.00761	10.664 to 12.000	10.664 to 12.000	10.664 to 12.000	10.664 to 12.000
27	1	12.00761 to 12.80761	12.00761 to 12.80761	12.000 to 12.800	12.000 to 12.800	12.000 to 12.800	12.000 to 12.800
28	1	12.80761 to 13.51761	12.80761 to 13.51761	12.800 to 13.510	12.800 to 13.510	12.800 to 13.510	12.800 to 13.510

Table 5-1 Version 6 and Below Synthesizers – Subsweep Frequencies

Band	Mixer Brick L.O. Harmonic Number (N)	❶ A15 Synthesizer Frequency (GHz)	❷ A25 HMA26.5 Frequency (GHz)	❸ A4/A17 Synthesizer Frequency (GHz)	❹ A5/A10 Source Frequency (GHz)	❺ A7/A8/A12/A13 50 GHz Doubler Frequency (GHz)	❻ A60/A61 / A62/A63 70 GHz Doubler Frequency (GHz)
29	1	6.75880 to 7.70380	13.51761 to 15.40761	6.755 to 7.700	13.510 to 15.400	13.510 to 15.400	13.510 to 15.400
30	1	7.70380 to 8.00380	15.40761 to 16.00761	7.700 to 8.000	15.400 to 16.000	15.400 to 16.000	15.400 to 16.000
31	1	8.00380 to 9.5038	16.00761 to 19.00761	8.000 to 9.500	16.000 to 19.000	16.000 to 19.000	16.000 to 19.000
32	1	9.50380 to 10.00380	19.00761 to 20.00761	9.500 to 10.000	9.500 to 10.000	19.000 to 20.000	19.000 to 20.000
33	1	10.00380 to 10.66781	20.00761 to 21.33561	10.000 to 10.664	10.000 to 10.664	20.000 to 21.328	20.000 to 21.328
34	1	10.66781 to 12.00381	21.33561 to 24.00761	10.664 to 12.000	10.664 to 12.000	21.328 to 24.000	21.328 to 24.000
35	1	12.00381 to 13.25381	24.00761 to 26.50761	12.000 to 13.250	12.000 to 13.250	24.000 to 26.500	24.000 to 26.500
36	3	8.83587 to 9.00520	8.83587 to 9.00520	13.250 to 13.504	13.250 to 13.504	26.500 to 27.008	26.500 to 27.008
37	3	9.00520 to 10.66920	9.00520 to 10.66920	6.752 to 8.000	13.504 to 16.000	27.008 to 32.000	27.008 to 32.000
38	3	10.66920 to 13.3359	10.66920 to 13.3359	8.000 to 10.000	16.000 to 20.000	32.000 to 40.000	32.000 to 40.000
39	3	13.3359 to 13.5025	13.3359 to 13.50254	10.000 to 10.125	10.250 to 10.125	20.000 to 20.250	40.000 to 40.500
40	3	6.7513 to 7.1106	13.50254 to 14.22120	10.125 to 10.664	10.125 to 10.664	20.250 to 21.328	40.500 to 42.656
41	3	7.1106 to 7.7013	14.22120 to 15.4025	10.664 to 11.550	10.664 to 11.550	21.328 to 23.100	42.656 to 46.200
42	3	7.7013 to 8.0013	15.4025 to 16.0025	11.550 to 12.000	11.550 to 12.000	23.100 to 24.000	46.200 to 48.000
43	3	8.0013 to 8.3346	16.0025 to 16.6692	12.000 to 12.500	12.000 to 12.500	24.000 to 25.000	48.000 to 50.000

Table 5-1 Version 6 and Below Synthesizers – Subsweep Frequencies

Band	Mixer Brick L.O. Harmonic Number (N)	❶ A15 Synthesizer Frequency (GHz)	❷ A25 HMA26.5 Frequency (GHz)	❸ A4/A17 Synthesizer Frequency (GHz)	❹ A5/A10 Source Frequency (GHz)	❺ A7/A8/A12/A13 50 GHz Doubler Frequency (GHz)	❻ A60/A61/A62/A63 70 GHz Doubler Frequency (GHz)
44	3	8.3346 to 9.0039	16.6692 to 18.0079	12.500 to 13.504	12.500 to 13.504	25.000 to 27.008	50.000 to 54.016
45	3	9.0039 to 10.0013	18.0079 to 20.0025	6.752 to 7.500	13.504 to 15.000	27.008 to 30.000	54.016 to 60.000
46	3	10.0013 to 10.6679	20.0025 to 21.3359	7.500 to 8.000	15.000 to 16.000	30.000 to 32.000	60.000 to 64.000
47	3	10.6679 to 11.1679	21.3359 to 22.3359	8.000 to 8.375	16.000 to 16.750	32.000 to 33.500	64.000 to 67.000
48	3	11.1679 to 11.6679	22.3359 to 23.3359	8.375 to 8.750	16.750 to 17.500	33.500 to 35.000	67.000 to 70.000

Version 7 Synthesizers Basic Operation

Table 5-2 on page 5-21 lists the L.O. harmonic number, the direct digital synthesizer (DDS) frequencies (A15), the main source frequency (A5 and A10), and the doubler frequencies (A7, A8, A12, and A13) 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 A15 DDS assembly provides stable reference frequencies to the rest of the instrument. A high stability 100 MHz signal is generated on the DDS and used to generate a 10 MHz reference signal. A high stability 100 MHz oven-controlled crystal oscillator (OCXO) on the DDS, normally provides the frequency standard. However, if a 10 MHz external reference signal is detected at the 10 MHz EXT REF s port on the rear panel, it is used as the frequency reference instead.

Refer to the NOTE notice on page 5-1. The A15 13.5 GHz DDS assembly produces an LO signal that is sent through the A25 LO multiplier/amplifier 26.5 board to the A27 and A28 mixer bricks (via the A25 HMA26.5 internal splitter).[1] The frequency is synthesized such that the test signal output is a constant signal. For analyzers with DSP version 5.0 or DDS assemblies, the IF is 7.438 MHz (at frequencies below 53 MHz the IF signal is 0.826 MHz). This signal is signal is sent to the A16 SPAM board for digital processing.

The A15 13.5 GHz DDS assembly produces an incident signal that is sent through the A5 26.5 GHz source board and then through the A7 and A8 doubler boards to the front panel outputs. Likewise, the A15 13.5 GHz DDS assembly produces a separate incident signal that is sent through the A10 26.5 GHz source board and then through the A12 and A13 doubler boards to the front panel outputs. Portions of these signals are coupled off and sent to the A27 and A28 mixer bricks (A–D and R1–R4) where they are mixed with the LO signal from the A25 HMA26.5 internal splitter[1] to produce the IF signal. For analyzers with DSP version 5.0 or DDS assemblies, the IF signal is 7.438 MHz (or 0.826 MHz).

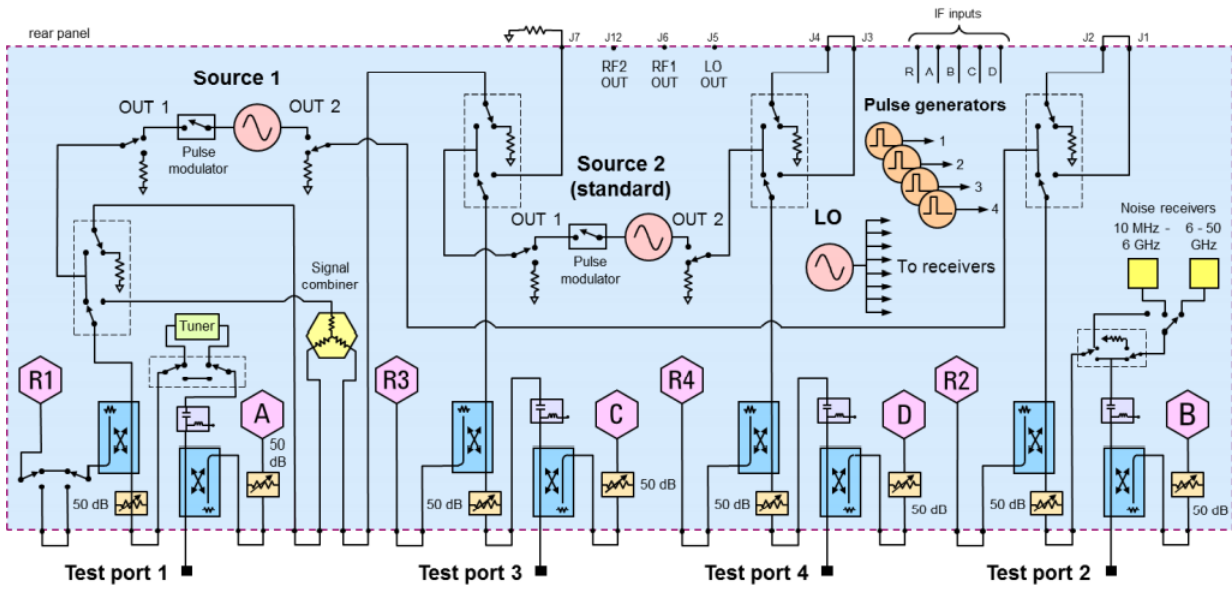
The A15 13.5 GHz DDS assembly contains its own phase lock circuitry. The A15 assembly produces either internal reference that is free running for the LO Signal and test signals. Or if an external reference is available a phase locked LO signal and it produces phase locked test signals based on the external reference. Regardless of whether the internal or external reference is used each DDS has its own set of digital registers that enable the output to be set to a different frequency. This makes it possible for the LO signal to be tuned to a different frequency than the test signal. With frequency offset mode disabled, the LO signal is a frequency value higher than the test signal. Since the A15 13.5 GHz DDS assembly receives 10 MHz input reference signal from the exact same source, frequency drift error is eliminated.

1. A26 splitter only applies to PNAs with serial number prefix <6021.

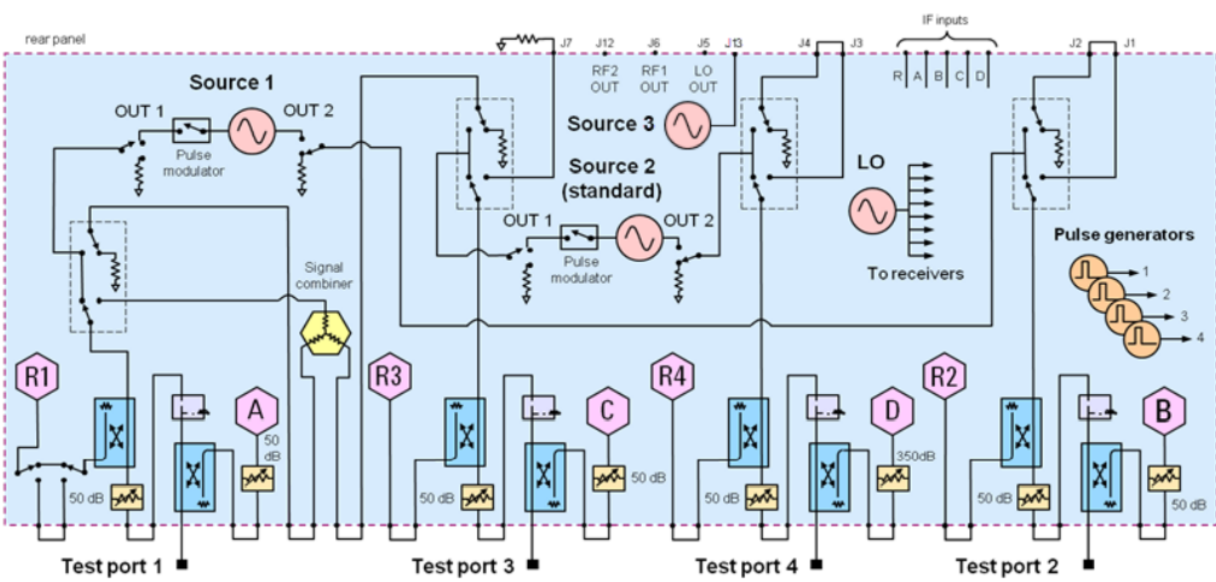
Figure 5-8 Source Group, Version 7, Part 1 (Example of Option 423 with Option 029 or E29 and with Option XSB)

4-Port N5247B Option 423 with 029

Also shown, Option 025 adds 4 pulse generators. Option 021 and 022 adds pulse modulators.



4-Port N5247B Option 423 with XSB



NOTE Option XSB is available with Option 422 also. Option 422 does not have the bias tees.

CAUTION The following band table is for version 7 synthesizers. For version 6 synthesizers and below band values, refer to the table on page 5-15.

Table 5-2 Version 7 Synthesizer Bands – Subsweep Frequencies

Band	Mixer Brick L.O. Harmonic Number (N)	❶ A15 Direct Digital Synthesizer (DDS) – (GHz)	❷ A25 HMA26.5 Frequency (GHz)	❸ A5/A10 Source Frequency (GHz)	❹ A7/A8/A12/A13 50 GHz Doubler Frequency (GHz)	❺ A60/A61/ A62/A63 70 GHz Doubler Frequency (GHz)
0	-	-	-	-	-	-
1	-	-	-	-	-	-
2	1	0.010 to 0.014	0.012479 to 0.016479	0.010 to 0.014	0.010 to 0.014	0.010 to 0.014
3	1	0.014 to 0.019	0.016479 to 0.021479	0.014 to 0.019	0.014 to 0.019	0.014 to 0.019
4	1	0.019 to 0.027	0.021479 to 0.029479	0.019 to 0.027	0.019 to 0.027	0.019 to 0.027
5	1	0.027 to 0.038	0.029479to 0.040479	0.027 to 0.038	0.027 to 0.038	0.027 to 0.038
6	1	0.038 to 0.053	0.040479to 0.055479	0.038 to 0.053	0.038 to 0.053	0.038 to 0.053
7	1	0.053 to 0.075	0.060438to 0.082438	0.053 to 0.075	0.053 to 0.075	0.053 to 0.075
8	1	0.075 to 0.105	0.082438 to 0.112438	0.075 to 0.105	0.075 to 0.105	0.075 to 0.105
9	1	0.105 to 0.146	0.112438 to 0.153438	0.105 to 0.146	0.105 to 0.146	0.105 to 0.146
10	1	0.146 to 0.205	0.153438 to 0.212438	0.146 to 0.205	0.146 to 0.205	0.146 to 0.205
11	1	0.205 to 0.250	0.212438 to 0.25738	0.205 to 0.250	0.205 to 0.250	0.205 to 0.250
12	1	0.250 to 0.396	0.257438 to 0.403438	0.250 to 0.396	0.250 to 0.396	0.250 to 0.396
13	1	0.396 to 0.500	0.403438 to 0.507438	0.396 to 0.500	0.396 to 0.500	0.396 to 0.500
14	1	0.500 to 0.628	0.507438 to 0.635438	0.500 to 0.628	0.500 to 0.628	0.500 to 0.628

Table 5-2 Version 7 Synthesizer Bands – Subsweep Frequencies

Band	Mixer Brick L.O. Harmonic Number (N)	❶ A15 Direct Digital Synthesizer (DDS) – (GHz)	❷ A25 HMA26.5 Frequency (GHz)	❸ A5/A10 Source Frequency (GHz)	❹ A7/A8/A12/A13 50 GHz Doubler Frequency (GHz)	❺ A60/A61/A62/A63 70 GHz Doubler Frequency (GHz)
15	1	0.628 to 1.000	0.635438 to 1.007438	0.628 to 1.000	0.628 to 1.000	0.628 to 1.000
16	1	1.000 to 1.500	1.007438to 1.507438	1.000 to 1.500	1.000 to 1.500	1.000 to 1.500
17	1	1.500 to 2.000	1.50438 to 2.007438	1.500 to 2.000	1.500 to 2.000	1.500 to 2.000
18	1	2.000 to 3.200	2.007438 to 3.207438	2.000 to 3.200	2.000 to 3.200	2.000 to 3.200
19	1	3.200 to 5.332	3.207438 to 5.339438	3.200 to 5.332	3.200 to 5.332	3.200 to 5.332
20	1	5.332 to 6.000	5.339438 to 6.007438	5.332 to 6.000	5.332 to 6.000	5.332 to 6.000
21	1	6.000 to 7.600	6.007438 to 7.607438	6.000 to 7.600	6.000 to 7.600	6.000 to 7.600
22	1	7.600 to 9.520	7.607438 to 8.507438	7.600 to 8.500	7.600 to 8.500	7.600 to 8.500
23	1	7.600 to 9.520	8.507438 to 9.527438	8.500 to 9.250	8.500 to 9.250	8.500 to 9.520
24	1	9.520 to 12.000	9.527438 to 12.007438	9.250 to 12.000	9.250 to 12.000	9.520 to 12.000
25	1	12.000 to 13.510	12.007438 to 12.807438	12.000 to 12.800	12.000 to 12.800	12.000 to 12.800
26	1	12.000 to 13.510	12.807438 to 13.517438	12.800 to 13.510	12.800 to 13.510	12.800 to 13.510
27	1	6.000 to 7.600	6.758719 to 7.603719	13.510 to 15.200	13.510 to 15.200	13.510 to 15.200
28	1	7.600 to 9.520	7.603719 to 8.003719	15.200 to 16.000	15.200 to 16.000	15.200 to 16.000
29	1	7.600 to 9.520	8.003719 to 9.523719	16.000 to 19.040	16.000 to 19.040	16.000 to 19.040
30	1	9.520 to 12.000	9.523719 to 10.003719	9.520 to 10.000	19.040 to 20.000	19.040 to 20.000

Table 5-2 Version 7 Synthesizer Bands – Subsweep Frequencies

Band	Mixer Brick L.O. Harmonic Number (N)	❶ A15 Direct Digital Synthesizer (DDS) – (GHz)	❷ A25 HMA26.5 Frequency (GHz)	❸ A5/A10 Source Frequency (GHz)	❹ A7/A8/A12/A 13 50 GHz Doubler Frequency (GHz)	❺ A60/A61/ A62/A63 70 GHz Doubler Frequency (GHz)
31	1	9.520 to 12.000	10.003719 to 10.653719	10.000 to 10.650	20.000 to 21.300	20.000 to 21.300
32	1	9.520 to 12.000	10.653719 to 12.003719	10.650 to 12.000	21.300 to 24.000	21.300 to 24.000
33	1	12.000 to 13.510	12.003719 to 13.253719	12.000 to 13.250	24.000 to 26.500	24.000 to 26.500
34	3	12.000 to 13.510	8.835813 to 9.009146	13.250 to 13.510	26.500 to 27.020	26.500 to 27.020
35	3	6.000 to 7.600	9.009146 to 9.502479	13.510 to 14.250	27.020 to 28.500	27.020 to 28.500
36	3	6.000 to 7.600	9.502479 to 10.135813	14.250 to 15.200	28.500 to 30.400	28.500 to 30.400
37	3	7.600 to 9.520	10.135813 to 10.669146	15.200 to 16.000	30.400 to 32.000	30.400 to 32.000
38	3	7.600 to 9.520	10.669146 to 12.035813	16.000 to 18.050	32.000 to 36.100	32.000 to 36.100
39	3	7.600 to 9.520	12.035813 to 12.695813	18.050 to 19.040	36.100 to 38.080	36.100 to 38.080
40	3	9.520 to 12.000	12.695813 to 13.335813	19.040 to 20.000	38.080 to 40.000	38.080 to 40.000
41	3	9.520 to 12.000	13.335813 to 13.512479	10.000 to 10.133	20.000 to 20.265	40.000 to 40.530
42	3	9.520 to 12.000	6.756240 to 7.637906	10.330 to 11.455	20.265 to 22.910	40.530 to 45.820
43	3	9.520 to 12.000	7.637906 to 8.001240	11.455 to 12.000	22.910 to 24.000	45.820 to 48.000
44	3	12.000 to 13.510	8.001240 to 8.334573	12.000 to 12.500	24.000 to 25.000	48.000 to 50.000
45	3	12.000 to 13.510	8.334573 to 8.334573	12.500 to 13.250	25.000 to 26.500	50.000 to 53.000
46	3	12.000 to 13.510	8.334573 to 9.007906	13.250 to 13.510	26.500 to 27.020	53.000 to 54.040

Table 5-2 Version 7 Synthesizer Bands – Subsweep Frequencies

Band	Mixer Brick L.O. Harmonic Number (N)	❶ A15 Direct Digital Synthesizer (DDS) – (GHz)	❷ A25 HMA26.5 Frequency (GHz)	❸ A5/A10 Source Frequency (GHz)	❹ A7/A8/A12/A13 50 GHz Doubler Frequency (GHz)	❺ A60/A61/ A62/A63 70 GHz Doubler Frequency (GHz)
47	3	6.000 to 7.600	9.007906 to 9.551240	13.510 to 14.325	27.020 to 28.650	54.040 to 57.300
48	3	6.000 to 7.600	9.551240 to 10.017906	14.325 to 15.025	28.650 to 30.050	57.300 to 60.100
49	3	6.000 to 7.600	10.017906 to 10.134573	15.025 to 15.200	30.050 to 30.400	60.100 to 60.800
50	3	7.600 to 9.520	10.134573 to 10.667906	15.200 to 16.000	30.400 to 32.000	60.800 to 64.000
51	3	7.600 to 9.520	10.667906 to 11.134573	16.000 to 16.700	32.000 to 33.400	64.000 to 66.800
42	3	7.600 to 9.520	11.134573 to 11.667906	16.700 to 17.500	33.400 to 35.000	66.800 to 70.000

A4, A15, and A17 13.5 GHz Synthesizer Boards (S/N Prefixes <6021 Only)

On 2-ports models, the A17 13.5 GHz synthesizer board is optional and included only with Option 224.

The A4, A15, and A17 13.5 GHz synthesizer boards use the 50 MHz reference signal from the A14 frequency reference board to tune two VCO circuits: one that sweeps from 2 GHz to 4 GHz and one that is set to a fixed CW frequency of 3.4 GHz.

In bands 2-13, the fixed 3.4 GHz signal is mixed with 3.41 GHz to 3.90 GHz signals from the 2–4 GHz oscillator to produce the output frequencies of 10 MHz to 500 MHz as listed in Table 5-1 on page 5-15.

In bands 14 and 15, the output of the swept VCO is passed through a divide-by-4 circuit to produce the output frequencies listed in Table 5-1 on page 5-15.

In bands 16 and 17, the swept VCO signal is passed through a divide-by-2 circuit to produce the output frequencies listed in Table 5-1 on page 5-15.

In bands 18–20, the swept VCO signal is passed directly to the output of the synthesizer board to produce the output frequencies listed in Table 5-1 on page 5-15.

In bands 21–44, the swept VCO signal is passed through a doubler circuit where bands 21–23, 29–30, and 37 are sent directly to the output of the synthesizer board while bands 24–28, 31–36 and 38–44 are passed through another doubler circuit then to the output of the synthesizer board to produce the output frequencies listed in Table 5-1 on page 5-15.

Refer to the NOTE notice on page 5-1. The output of the A15 13.5 GHz synthesizer board (the LO synthesizer) is a frequency value higher than the output of the A4 and A17 13.5 GHz synthesizer boards (the source synthesizers). (For analyzers with DSP version 4.0, the frequency value is 7.606 MHz. For analyzers with DSP version 5.0, the frequency value is 7.438 MHz.) This is because the output of the A15 13.5 GHz synthesizer board is routed through the A25 LO multiplier/amplifier 26.5 board to the A27 and A28 mixer bricks where they are mixed with the test signals to produce a 7.606 MHz IF signal for each of eight receivers (A–D and R1–R4). Refer to “A27 and A28 Mixer Bricks” on page 5-53 for a more complete description.

A15 Version 7 Digital to Digital Synthesizer (DDS) Assembly (S/N Prefixes ≥6021 Only)

For instruments with s/n prefixes ≥6021, there are three A15 Digital Synthesizer (DDS) assemblies: N5240-60222 contains two DDS chips (standard 2-port and an optional N5240-60102 containing a four DDS chip assembly, is required for 4-port models and for adding a 3rd source (Option XSB, requires Option 422 or Option 423).

The A15 Direct Digital Synthesizer (DDS) assembly uses an internally generated 10 MHz reference signal that is derived from the 100 MHz OCXO circuit (if present, this signal may be locked to an external reference).

The 100 MHz OCXO signal is coupled off to a divide-by-10 section and the resulting 10 MHz synchronized clock-signal is output from the DDS carrier board to the input of the A16 SPAM board (SPAM CLK) and to the rear panel (REF OUT).

The DDS assembly's carrier board's also produces a 19.2 GHz signal that is split and sent to each of the DDS Slugs to drive the LO, SRC1, SRC2, and SRC3 (SRC3 requires, Option XSB).

In bands 2 to 21, the DDS Slug's output is used to produce the output frequencies of 10 MHz to 6 GHz that is transmitted to the DDS assembly multiplier section as listed in Table 5-2 on page 5-21.

In bands 21–52, the DDS Slug's signal is passed through a doubler circuit where bands 21–24, 27–32, 35–43, and 47–52 are sent directly to the output of the DDS assembly while bands 25–26, 33–34, and 44–46 are passed through another doubler circuit then to the output of the DDS assembly to produce the output frequencies listed in Table 5-2 on page 5-21.

Refer to the NOTE notice on page 5-1. The output of the A15 13.5 GHz DDS assembly (the LO synthesizer section) is a frequency value higher than the output of the source 1 and source 2 13.5 GHz synthesizer portions of the DDS assembly. This is because the output of the A15 13.5 GHz synthesizer assembly is routed through the A25 LO multiplier/amplifier 26.5 board to the A27 and A28 mixer bricks where they are mixed with the test signals to produce a 7.606 MHz IF signal for each of eight receivers (A–D and R1–R4). Refer to "A27 and A28 Mixer Bricks" on page 5-53 for a more complete description.

Rear-Panel Interconnects

SRC3 J13	SMA connector, enables the 3rd source output. (Requires Option XSB, 422/423 with and without Option 029 or E29 only).
REF INPUT (s/n prefixes ≥6021 only)	A BNC connector that allows an external frequency reference signal to be used to phase lock the analyzer for increased frequency accuracy. 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.
REF OUTPUT (s/n prefixes ≥6021 only)	A BNC connector that allows a reference signal, produced by the A15 direct digital synthesizer (DDS) assembly, to be output for use in phase locking external test equipment.

A5 and A10 26.5 GHz Source Boards

On 2-port models, the A10 26.5 GHz source board is optional and included only with Option 224.

In bands 2–19, the A5 and A10 26.5 GHz source boards input signals from the A4 or A17 13.5 GHz synthesizer board are passed through to both outputs (main and secondary) unchanged.

For bands 20–28 and 32–36, the input signals are passed directly to the secondary output or amplified and filtered, then sent to the main output.

For bands 29–31 and 37–44, the input signals are doubled, filtered, and amplified. The signals for these bands are then either passed directly to the secondary output or passed through more amplification and filtering and sent to the main output.

A7, A8, A12, and A13 40 GHz Doubler Boards

On 2-port models, the A12 and A13 40 GHz doubler boards are optional and included only with Option 224.

For bands 2–28, the lowband input ports of the A7, A8, A12, and A13 40 GHz doubler boards receive their signals from the A5 and A10 source module OUT 1 and OUT 2 outputs. These signals are passed through to the doubler board output unchanged.

For bands 29–48, the highband input ports of the A7 and A12 40 GHz doubler boards receive their signals from the A5 and A10 source module P4 outputs. These signals are amplified by the A7 and A12 doubler boards and output via the highband output ports to the highband input ports on the A8 and A13 doubler boards.

For bands 29–38, the input signals of all four doubler boards are doubled, amplified and filtered, then sent to the doubler board output P6, creating the full synthesized source output frequency range of 10 MHz to 40 GHz.

For bands 39–48, the input signals of all four doubler boards are doubled, amplified and filtered, then sent to the doubler board output P2, creating the full synthesized source output frequency range of 20 GHz to 35 GHz.

The output frequencies for each band are listed in Table 5-7.

The A7 40 GHz doubler board provides an EXT TSET DRIVE RF OUT signal to the rear panel. This signal is output in bands 20–31 at a frequency range of 3.2–19 GHz for use with an external test set. This output is terminated with a 50-ohm load on the A8, A12, and A13 doubler boards.

The companion signal, EXT TEST SET DRIVE LO, is output from the A27 mixer brick. Refer to “A27 and A28 Mixer Bricks” on page 5-53.

A60, A61, A62, and A63 70 GHz Doubler Boards

The 70 GHz doubler boards create the full output frequency range of 10 MHz to 70 GHz by combining two input signals from the 40 GHz doubler boards.

The first input signals are from the 40 GHz doubler P2 output (bands 39 - 48), where the signals are filtered, doubled, amplified, and sent to the combiner. The second input signals are from the 40 GHz doubler P6 output (bands 2 - 38), where the signals are passed through the 70 GHz doubler and sent to the combiner. The forward combiner then combines both signals to create a full range of 10 MHz to 70 GHz output.

A25 Multiplier/Amplifier 26.5 Board (HMA26.5)

In bands 2–28 and 36–39, the synthesized LO input is filtered, amplified, and passed through to the A26 splitter[1] (4-port only). In bands 29–35 and 40–44, the input is amplified, doubled, and filtered, then sent to the output.

Together, these signal paths create the full output frequency range of 12.5 MHz to 26.508 GHz that is sent to the A26 splitter (<6021 S/N prefixes, 4-port) or internal splitter (≥6021, 4-port only) where the signal is divided and sent to the A27 and A28 (4-port only) mixer bricks as the LO signal.

A14 Frequency Reference Board (S/N prefixes <6021 Only)

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. The output of this VCO is then divided by ten to produce the 10 MHz EXT REF OUT rear panel signal and also a 10 MHz reference signal for the A16 signal processing

1. A26 splitter only applies to PNAs with serial number prefix **<**6021.

ADC module (SPAM) board. The VCO output is also divided by two to produce 50 MHz reference signals for the A4, A15, and A17 13.5 GHz synthesizer boards.

Rear-Panel Interconnects

10 MHz REF INPUT (s/n prefixes <6021 only)	A BNC connector that allows an external frequency reference signal to be used to phase lock the analyzer for increased frequency accuracy. 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.
10 MHz REF OUTPUT (s/n prefixes <6021 only)	A BNC connector that allows a 10 MHz reference signal, produced by the A14 frequency reference board, to be output for use in phase locking external test equipment.

A23 Test Set Motherboard

The A23 test set motherboard serves these functions:

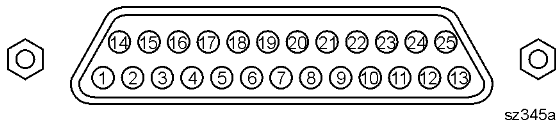
- to act as an interface between the A21 CPU board and the auxiliary rear panel interconnects.
- to provide ALC signals to the A25 HMA26.5.
- to route control signals to the signal separation group. Refer to "Signal Separation Group Operation" on page 5-46 for more information.

Rear Panel Interconnects

The A23 test set motherboard includes the following rear panel interconnects.

TEST SET I/O	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 5-30. Up to 16 test sets may be "daisy-chained" on the bus at one time. The Test Set I/O is not compatible with 8753 network analyzer test sets.
HANDLER I/O	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 5-31. 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). Connector settings can be changed using SCPI and COM commands. The settings are not accessible from the front panel.
PWR I/O	A DB-9 female connector. Pin assignments are listed in Table 5-5 on page 5-32.

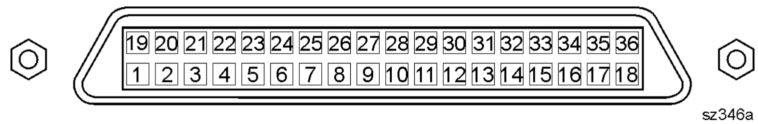
Table 5-3 TEST SET I/O Connector Pin Assignments



DB-25 Female Connector

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 μs 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 μs 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 μs min)
25	RLW	TTL out, high = read, low = write

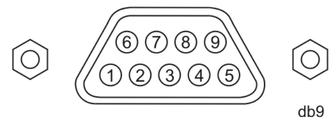
Table 5-4 HANDLER I/O Connector Pin Assignments



Rectangular 36-Pin Female Connector

Pin Numbers	Name	Function
1	GND	0 V, ground reference
2	INPUT1	TTL in, negative pulse (1 ms min) latches OUTPUT1-2
3–4	OUTPUT1–2	TTL out, latched
5–12	Port A0–7 Out	TTL out, latched
13–17, 19–21	Port B0–7 Out	TTL out, latched
18	Ext. Trigger	TTL in, latched
22–25	Port C I/O	TTL I/O, latched
26–29	Port D I/O	TTL I/O, latched
30	Port C Status	TTL out, low = input mode, high = output mode
31	Port D Status	TTL out, low = input mode, high = output mode
32	Output Strobe Write Strobe	TTL out, active low data write strobe (1 μs min)
33	Pass Fail	TTL out, latched, indicates pass fail (programmable polarity)
34	Sweep End	TTL out, active low (10 μs min) indicates sweep done
35	+5 V	+5 Vdc, 100 mA max.
13–17, 19–21	Port B0–7 Out	TTL out, latched
36	Pass/Fail Write Strobe	TTL out, active low pass/fail write strobe (1 ms min)

Table 5-5 PWR I/O Connector Pin Assignments



DB-9 Female Connector

Pin	Name	Description
1	+15V	+15 V @ 400 mA
2	-15V	-15 V @ 400 mA
3	AnalogOut1	Analog Output Voltage Programmable ±10 V @ 100 mA out Nominally 0 ohms 2.44 mV typical resolution 1 MHz BW
4	AnalogOut2	Analog Output Voltage Programmable ±10 V @ 100 mA out Nominally 0 ohms 2.44 mV typical resolution 1 MHz BW
5	ACOM	System ground
6	GndSense	Ground sense for Analog In and Analog Out Connected with 51.1 ohms to ACOM
7	AnalogIn1	Analog input: ±10 V @ 1.22 mV typical resolution Rin > 1 M-ohm BW ≈ 1 MHz ADC conversion time < 1 us typical
8	AnalogIn2	Analog input: ±10 V @ 1.22 mV typical resolution Rin > 1 M-ohm BW ≈ 1 MHz ADC conversion time < 1 us typical
9	Power Button	Open collector input Active low replicates power button key press.

A70 4-Port and A75 2-Port Low Frequency Extension (LFE) Board

Provides a 900 Hz to 100 MHz LFE signal for measurements. Refer to www.keysight.com/find/pna.

The Low Frequency Extension (LFE) option in the PNA consists of an LFE board A70 4-port or A75 2-port) and a new 4-Port bias combiners (A70-A74). See also "A38–A41 50-dB Source Step Attenuators and A71–74 Bias Tee Combiners (Optional)" on page 5-51.

This board is designed to extend the frequency bandwidth at the low end, down to 900 Hz. And, the high end of the LFE board is 100 MHz. Between 10 MHz and 100 MHz either LFE or non-LFE mode can be used.

The inputs and outputs connectors of the LFE board:

PNA 2 ports:

Inputs:

– LFE output of the Synthesizer #1 board J102 connected to LFE board J20.
– LFE output of the LO board J102 connected to LFE board J18.
– The main connector of the Motherboard bus to LFE board connector J1.

Outputs:

– LF output J2, 900 Hz - 100 MHz, Port 1, to be connected to the bias combiner Port 1.
– LF output J3, Port 2, to be connected to the bias combiner Port 2.
– 4 IF outputs J11, J12, J13, J14, to be connected to the LFE inputs of the IF MUX board: A, B, R1, R2.

PNA 4 ports:

The inputs are:

– LFE output of the LO board J102 connected to LFE board J18.
– LFE output of the Synthesizer #1 board J102 connected to LFE board J20.
– LFE output of the Synthesizer #2 board J102 connected to LFE board J21.
– The main connector of the Motherboard bus to LFE board connector J1.

The outputs are:

– LF output J2, 900 Hz - 100 MHz, Port 1, to be connected to the bias combiner Port 1.
– LF output J3, Port 2, to be connected to the bias combiner Port 2.
– LF output J4, Port 3, to be connected to the bias combiner Port 3.
– LF output J5, Port 4, to be connected to the bias combiner Port 4.
– 5 IF outputs J7, J11, J12, J13, J14, to be connected to the IF MUX board: A, B, C, D and R.

Figure 5-9 Block Diagram with Synthesizer Board and LFE Board

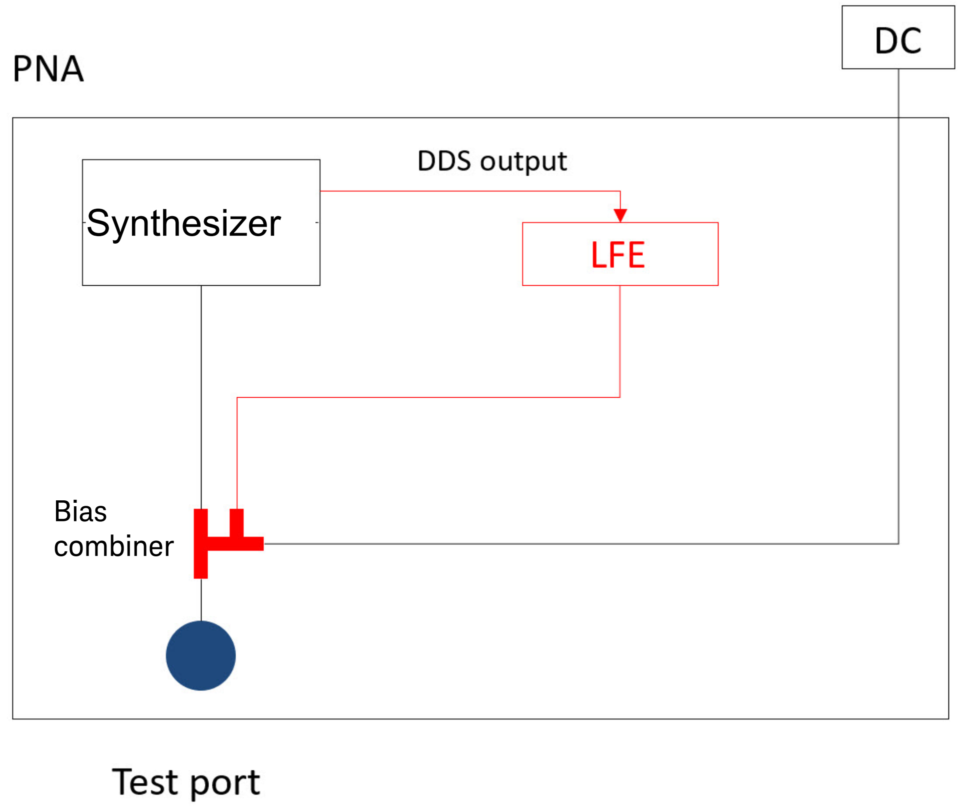


Figure 5-10 2-Port with LFE

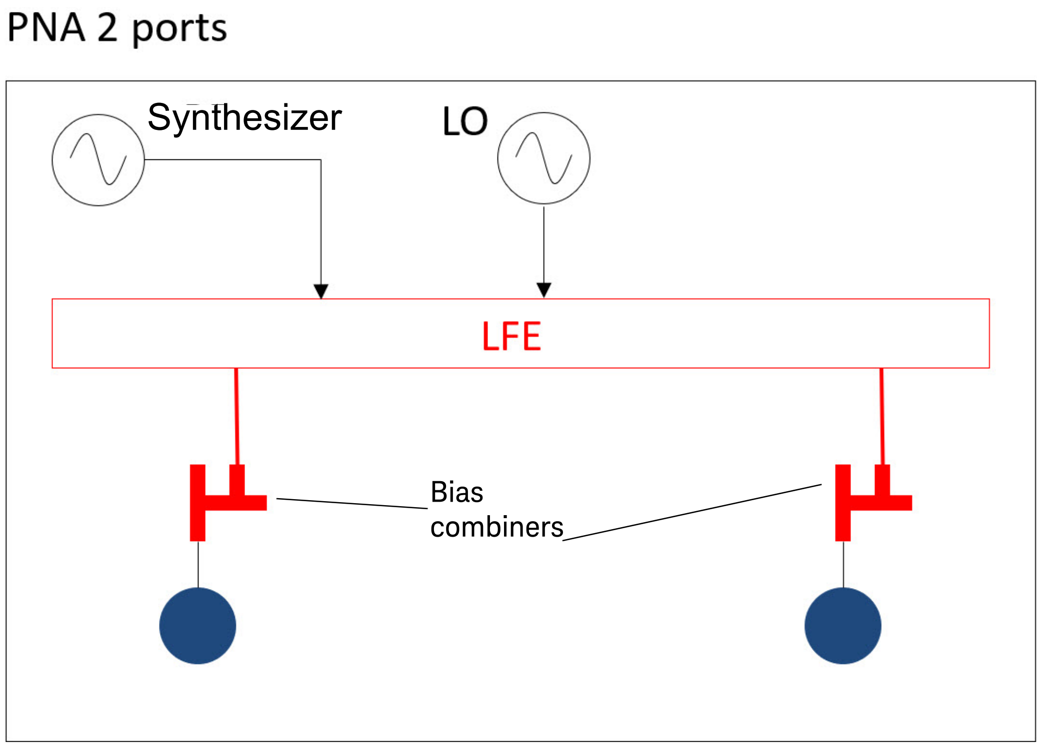


Figure 5-11 4-Port with LFE

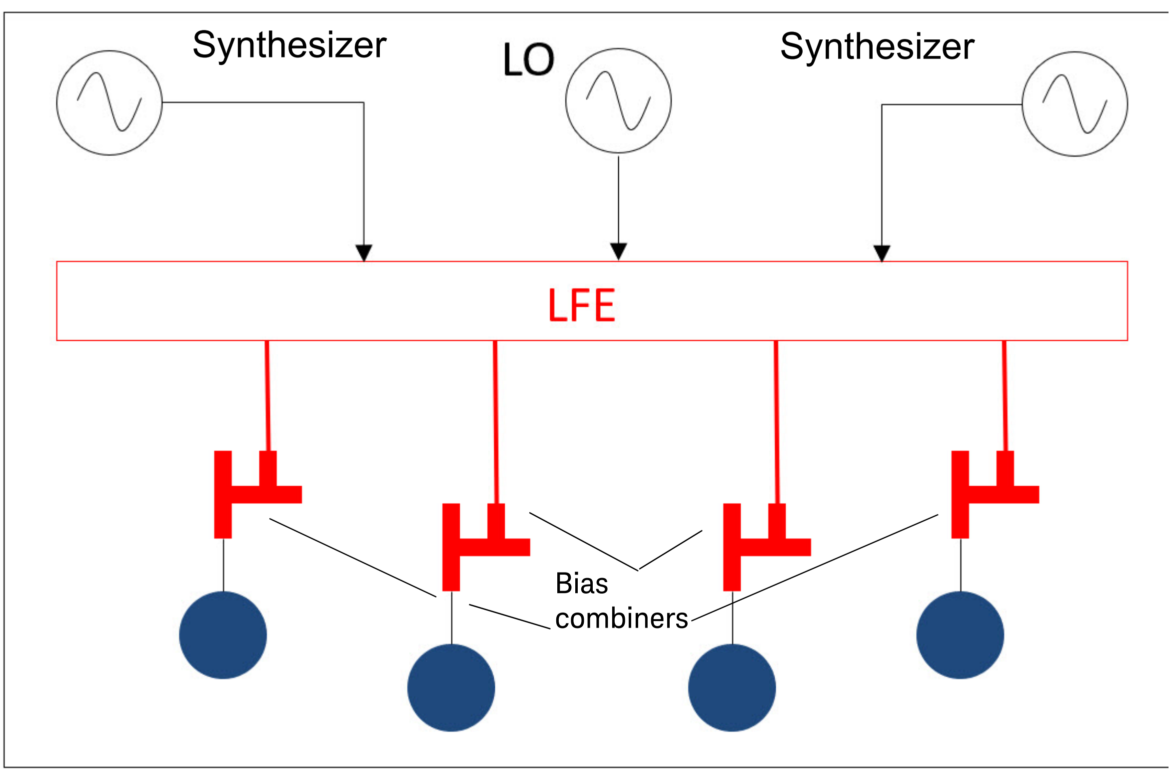


Figure 5-12 2-Port LFE with IF MUX Board

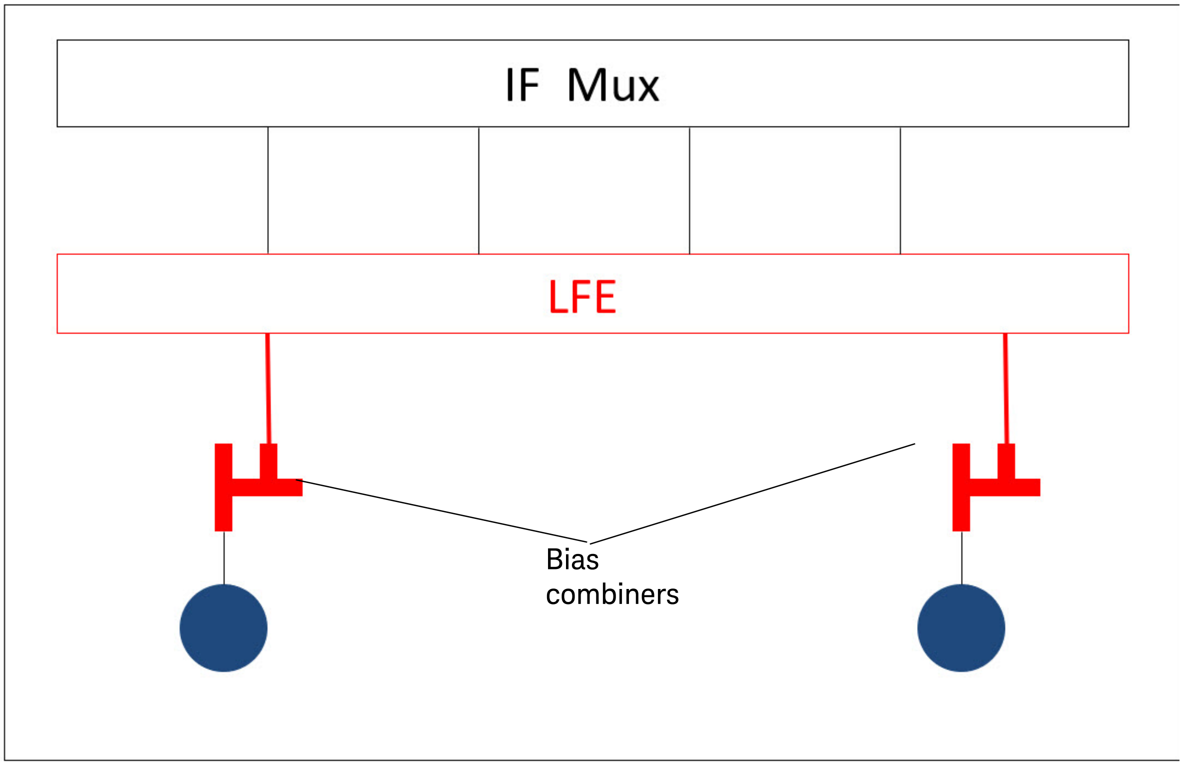
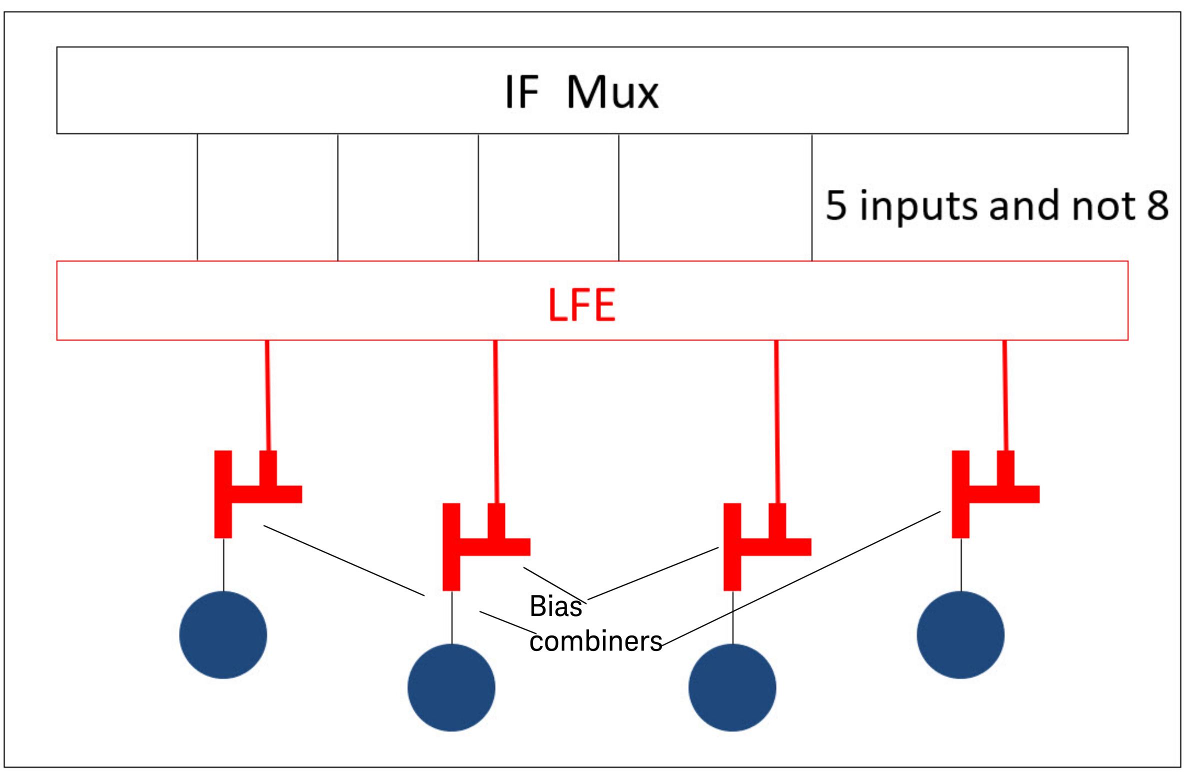


Figure 5-13 4-Port LFE with IF MUX Board



Low Frequency Extension (LFE) – (Bands Table 1 of 2) –(Option 205/220/405/420/425 Only)[1] – (S/N Prefix <6021 Only)

See also “Low Frequency Extension (LFE) – (Bands Table (Continued) – 2 of 2) –(Option 205/220/405/420/425 Only) – (S/N Prefix <6021 Only)” on page 5-39.

Table 5-6 LFE Bands (1 of 2) – (S/N Prefix <6021 Only)

Band	Instrument Frequency	A11 Source Synthesizer (GHz)- (VCO)[a]	Div / 4 (U1006)	Div / N (DDS)	Div / Total	A4 / A13 SRC Synthesizer (LFE OUT)
0	0.000 to 0.0000	-	–	–	–	–
1	0.0005 to 0.00095	2.000 to 4.000	4	1048576	4194304	0.00048 to 0.00095
	0.00095 to 0.00191	2.000 to 4.000	4	524288	2097152	0.00095 to 0.00191
	0.00191 to 0.00381	2.000 to 4.000	4	262144	1048576	0.00191 to 0.00381
	0.00381 to 0.00763	2.000 to 4.000	4	131072	524288	0.00381 to 0.00763
	0.00763 to 0.01526	2.000 to 4.000	4	65536	262144	0.00763 to 0.01526
	0.01526 to 0.03052	2.000 to 4.000	4	32768	131072	0.01526 to 0.03052
	0.03052 to 0.06104	2.000 to 4.000	4	16384	65536	0.03052 to 0.06104
	0.06104 to 0.12207	2.000 to 4.000	4	8192	32768	0.06104 to 0.12207
	0.12207 to 0.24414	2.000 to 4.000	4	4096	16384	0.12207 to 0.24414
	0.24414 to 0.48828	2.000 to 4.000	4	2048	8192	0.24414 to 0.48828

1. Some of the LFE options are not available on all models.

Table 5-6 LFE Bands (1 of 2) – (S/N Prefix <6021 Only)

Band	Instrument Frequency	A11 Source Synthesizer (GHz)– (VCO)[a]	Div / 4 (U1006)	Div / N (DDS)	Div / Total	A4 / A13 SRC Synthesizer (LFE OUT)
	0.48828 to 0.97656	2.000 to 4.000	4	1024	4096	0.48828 to 0.97656
	0.97656 to 1.00000	2.000 to 4.000	4	512	2048	0.97656 to 1.95313
2	1.0000 to 1.95313	2.000 to 4.000	4	512	2048	0.97656 to 1.95313
	1.95313 to 3.90000	2.000 to 4.000	4	256	1024	1.95313 to 3.90625
	3.90000 to 7.81000	2.000 to 4.000	4	128	512	3.90625 to 7.81250
	7.81000 to 9.9000	2.000 to 4.000	4	64	256	7.81250 to 15.62500
3	9.9000 to 10.01000	2.000 to 4.000	4	64	256	7.81250 to 15.62500
4	10.01000 to 19.99000	2.000 to 4.000	4	64	256	7.81250 to 15.62500
5	1.99000 to 31.25000	2.000 to 4.000	4	32	128	15.62500 to 31.25000
	31.5000 to 53.0000	2.000 to 4.000	4	16	64	31.25000 to 62.50000
6	53.0000 to 62.50000	2.000 to 4.000	4	16	64	31.25000 to 62.50000
	62.50000 to 1000.0000	2.000 to 4.000	4	8	32	62.50000 to 125.0000

a. A15 Source synthesizer VCO column only applies to version 6 synthesizers in instruments with a s/n prefix <6021.

Low Frequency Extension (LFE) – (Bands Table (Continued) – 2 of 2) –(Option 205/220/405/420/425 Only)[1] – (S/N Prefix <6021 Only)

See also "Low Frequency Extension (LFE) – (Bands Table 1 of 2) –(Option 205/220/405/420/425 Only) – (S/N Prefix <6021 Only)" on page 5-37.

Table 5-7 LFE Bands (2 of 2) – (S/N Prefix <6021 Only)

Band	A15 LO Synthesizer (VCO)[a]	IF Mode	DIV / N	Synth RF Path	Synth RF Output
0	–	-	-	–	–
1	2.000 to 4.000	IF2	4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE

1. Some of the LFE options are not available on all models.

Table 5-7 LFE Bands (2 of 2) – (S/N Prefix <6021 Only)

Band	A15 LO Synthesizer (VCO)[a]	IF Mode	DIV / N	Synth RF Path	Synth RF Output
2	1.0000 to 1.95313	Thru	4	DDS_CLK	LFE
	1.95313 to 3.90000		4	DDS_CLK	LFE
	3.90000 to 7.81000		4	DDS_CLK	LFE
	7.81000 to 9.9000		4	DDS_CLK	LFE
3	9.9000 to 10.01000	IF2	4	DDS_CLK	LFE
4	10.01000 to 19.99000	Thru	4	DDS_CLK	LFE
5	1.99000 to 31.25000	IF1	4	DDS_CLK	LFE
	31.5000 to 53.0000		4	DDS_CLK	LFE
6	53.0000 to 62.50000	IF2	4	DDS_CLK	LFE
	62.50000 to 1000.0000		4	DDS_CLK	LFE

a. A15 Source synthesizer VCO column only applies to version 6 synthesizers in instruments with a s/n prefix <6021.

Low Frequency Extension (LFE) – (Bands Table 1 of 2) –(Option 205/220/405/420/425 Only)[1] – (S/N Prefix ≥6021 Only)

See also "Low Frequency Extension (LFE) – (Bands Table (Continued) – 2 of 2) –(Option 205/220/405/420/425 Only) – (S/N Prefix ≥6021 Only))" on page 5-42.

Table 5-8 LFE Bands[a] (1 of 2) – (S/N Prefix ≥6021 Only)

Band	A15 Direct Digital Synthesizer (DDS) – (Source LFE OUT) – (MHz)	A15Direct Digital Synthesis (DDS) – (Receiver LFE OUT) – (MHz)
0	-	–
1	0.0005 to 1.0000	7.4385 to 8.4380
2	0.0005 to 0.0005	0.00005 to 0.00005
3	4.0000 to 9.9900	0.00005 to 0.00005
4	9.9900 to 10.0100	17.4280 to 17.4480
5	10.0100 to 19.9900	0.0005 to 0.0005
6	19.9900 to 53.0000	21.6429 to 54.6529
7	53.0000 to 100.0000	60.4380 to 107.4380

a. A15 Direct Digital Synthesizer (DDS) assembly column only applies to version 7 synthesizers in instruments with a s/n prefix ≥6021 or that have been updated to version 7 synthesizers.

1. Some of the LFE options are not available on all models.

Low Frequency Extension (LFE) – (Bands Table (Continued) – 2 of 2) –(Option 205/220/405/420/425 Only)[1] – (S/N Prefix ≥6021 Only))

See also "Low Frequency Extension (LFE) – (Bands Table 1 of 2) –(Option 205/220/405/420/425 Only) – (S/N Prefix ≥6021 Only)" on page 5-41.

Table 5-9 LFE Bands (2 of 2) – (S/N Prefix ≥6021 Only)

Band	A15 DDS LO Synthesizer (OCXO)[a]	IF Mode	DIV / N	Synth RF Path	Synth RF Output
0	–	-	-	–	–
1	2.000 to 4.000	IF2	4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE
	2.000 to 4.000		4	DDS_CLK	LFE

1. Some of the LFE options are not available on all models.

Table 5-9 LFE Bands (2 of 2) – (S/N Prefix ≥6021 Only)

Band	A15 DDS LO Synthesizer (OCXO)[a]	IF Mode	DIV / N	Synth RF Path	Synth RF Output
2	1.0000 to 1.95313	Thru	4	DDS_CLK	LFE
	1.95313 to 3.90000		4	DDS_CLK	LFE
	3.90000 to 7.81000		4	DDS_CLK	LFE
	7.81000 to 9.9000		4	DDS_CLK	LFE
3	9.9000 to 10.01000	IF2	4	DDS_CLK	LFE
4	10.01000 to 19.99000	Thru	4	DDS_CLK	LFE
5	1.99000 to 31.25000	IF1	4	DDS_CLK	LFE
	31.5000 to 53.0000		4	DDS_CLK	LFE
6	53.0000 to 62.50000	IF2	4	DDS_CLK	LFE
	62.50000 to 1000.0000		4	DDS_CLK	LFE

Understanding LFE vs. Legacy PNA Environment

To understand several parts of the LFE board behavior, we must consider the non-LFE behavior of the PNA (i.e., what is already in place on different boards that did not change).

On the synthesizer board, there is a LFE output coming almost directly from the direct digital synthesis (DDS). There is a 250 MHz Low Pass Filter. The low frequency extension uses this output to 100 MHz.

A L–C High Pass Filter limits the lowest frequency.

With LFE mode, we use dedicated mixers, which are the LFE board. These mixers downconvert the RF signals in LFE mode and create dedicated IF signals. These IF signals are then sent to the A20 IF MUX board.

On the A20 IF MUX board, the configuration between the Main IF signals and LFE IF signals are very different.

First, the connectors are different. For the main IF signals, on a 4-Port PNA, there are 8 IF input connectors. The switches to select the R1.4 signals are on the A20 IF MUX board. For the LFE IF signals, there are only 5 IF input connectors. So, the switches to select the R signal are on the LFE board.

Second, the amplifier/attenuator/switch chains are different for the Main and LFE IF signals.

The A14 motherboard bus supplies, among other things, the power supplies to the LFE board. Many boards are already connected to these power supplies in the PNA. So, different power supplies are close or very close to their limit in terms of available current/power. This fact has an influence on which power line can used to generate the voltages needed.

The A70 LFE board (4-port) and A75 (2-port) works with the A70-A74 bias combiners. The design of this combiner has an impact on the design of the board. Performances desired at the PNA test port are impacted significantly by the bias combiner.

LFE frequency band

The LFE extension is changing the way we measure with the PNA at the low end.

This section contains:

- Version 6 Synthesizers and below, on page 5-44
- Version 7 Synthesizers, on page 5-45

Version 6 synthesizers and below: Below 100MHz, the LFE option is enabled in the firmware. Depending on the frequency measured, the LFE board receiver will be in ‘mixer mode’ or in ‘direct conversion mode’. See also, “Version 7 synthesizers” on page 5-45.

Version 7 synthesizers: Below 100MHz, the LFE option is enabled in the firmware. With the direct digital synthesizer (DDS) assembly, a new LFE band break is introduced at 4 MHz. This 4 MHz band break, corresponds to a switch that directs the DDS output either through a balun (above 4 MHz) or bypasses the balun (below 4 MHz). See also, "Version 6 synthesizers and below" on page 5-44.

The Figure 5-14 on page 5-45 shows an example of current frequency bands in a PNA. In an N5247B PNA, the IF frequency will change around 53 MHz. Figure 5-14 on page 5-45 shows the new structure of the frequency bands with the LFE option. The two receiver modes, mixer and direct conversion, are used in different frequency bands.

Figure 5-14 Frequency Bands Without LFE – Version 6 and Below Synthesizers (<6021)

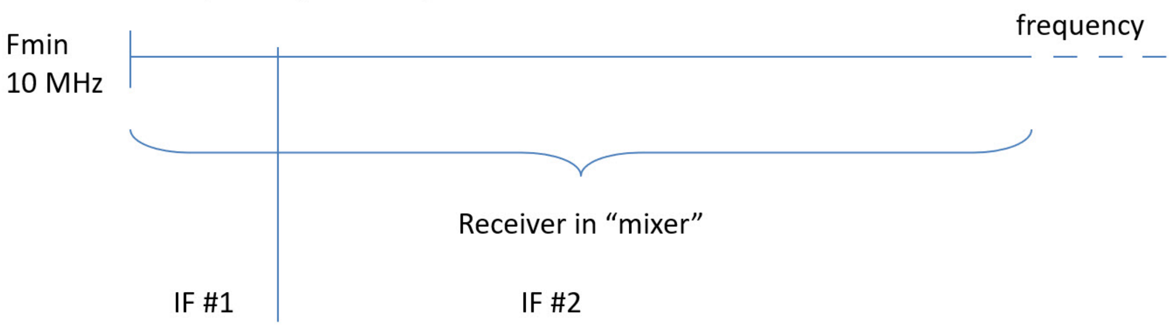
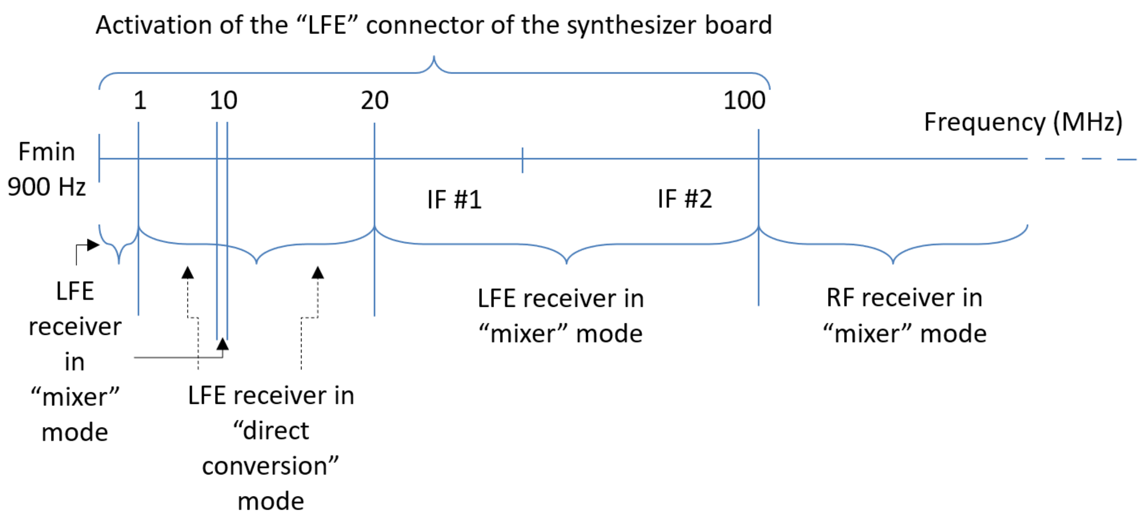


Figure 5-15 Frequency Bands with LFE – Version 6 and Below Synthesizers (<6021)



Signal Separation Group Operation

The signal separation group divides the source incident signals into a reference path and a test path. Refer to Figure 5-16 on page 5-49 and Figure 5-17 on page 5-50.

- The reference signals are transmitted to the receiver group as the R1, R2, R3, and R4 inputs for 4-port models or the R1 and R2 inputs for 2-port models.
- The test signals are transmitted through—and reflected from—the device under test (DUT) and then transmitted to the receiver group as the A, B, C, and D inputs for 4-port models or the A and B inputs for 2-port models.
- Control lines to this group are routed from the A23 test set motherboard.

In this section, the following assemblies are described:

- A29–A32 Reference Couplers
- A33–A36 Test Port Couplers
- Front Panel Jumpers—Configurable Test Set
- A38–A41 50-dB Source Step Attenuators and A42–A45 Bias Tees (Optional)
- A38–A41 50-dB Source Step Attenuators and A71–74 Bias Tee Combiners (Optional)
- A50–A53 Mechanical Switches and A54 Combiner (Optional)

Configurable Test Set

The configurable test set is included in the standard analyzer and allows you to measure devices with higher power and higher dynamic range limits than an analyzer without the configurable test set. On 4-port models, twelve signal paths, routed through front panel SMA jumpers, comprise the configurable test set. On 2-port models, there are six signal paths routed through front panels jumpers in the configurable test set.

As shown in Figure 5-16 on page 5-49 and Figure 5-17 on page 5-50, these jumpers are installed between the components listed below. Ports 3 and 4 apply only to 4-port models.

- the A29 port 1 reference coupler and the A27 mixer brick receiver R1
- the A30 port 3 reference coupler and the A28 mixer brick receiver R3
- the A31 port 4 reference coupler and the A28 mixer brick receiver R4
- the A32 port 2 reference coupler and the A27 mixer brick receiver R2
- the A29 port 1 reference coupler and the A33 test port 1 coupler
- the A30 port 3 reference coupler and the A34 test port 3 coupler

– the A31 port 4 reference coupler and the A35 test port 4 coupler
– the A32 port 2 reference coupler and the A36 test port 2 coupler
– the A33 test port 1 coupler and the A27 mixer brick receiver A
– the A34 test port 3 coupler and the A28 mixer brick receiver C
– the A35 test port 4 coupler and the A28 mixer brick receiver D
– the A36 test port 2 coupler and the A27 mixer brick receiver B

Normal Measurement Configuration

The Option 419 analyzer is equipped with a configurable test set and source attenuators. 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.

High Dynamic Range Measurement Configuration

With a few jumper changes, you can configure the measurement configuration 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, for example, the signal flow through the test port 2 coupler (A36) is reversed by arranging the front panel jumpers such that RCVR B IN connects to CPLR THRU and CPLR ARM connects to SOURCE OUT.

While increasing forward (S21) dynamic range, the reverse (S12) dynamic range is degraded by the same amount.

A29–A32 Reference Couplers

The source incident signals from the A5 and A10 26.5 GHz sources are sent to the A29–A32 reference couplers where a portion of each signal is coupled off to provide the R1, R2, R3, and R4 receiver reference signals for 4-port models or R1 and R2 reference signals for 2-port models.

These reference signals are routed through front-panel jumpers to the A27 and A28 mixer bricks. Refer to “A27 and A28 Mixer Bricks” on page 5-53 for additional information.

The test signals each go through the through-line arm of a reference coupler, then through a front panel jumper to the A33–A36 test port couplers.

A33–A36 Test Port Couplers

The test signals go 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 for measurement (through front panel jumpers), as inputs A, B, C, and D for 4-port models or inputs A and B for 2-port models. The coupling coefficient of the directional couplers is nominally 15 dB for all frequencies above 500 MHz. The coupling coefficient increases for frequencies below 500 MHz.

Figure 5-16 4-Port Signal Separation Group

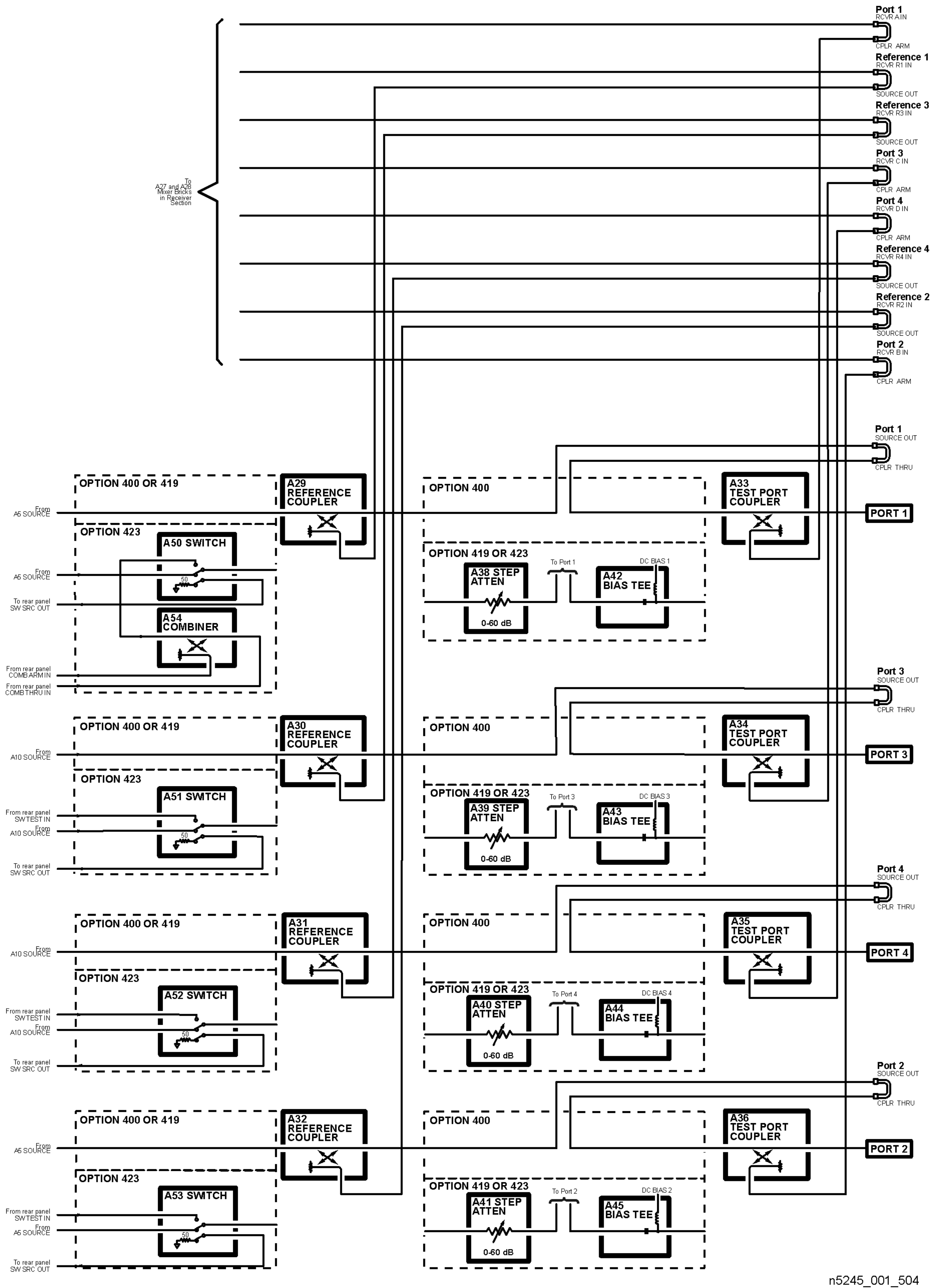
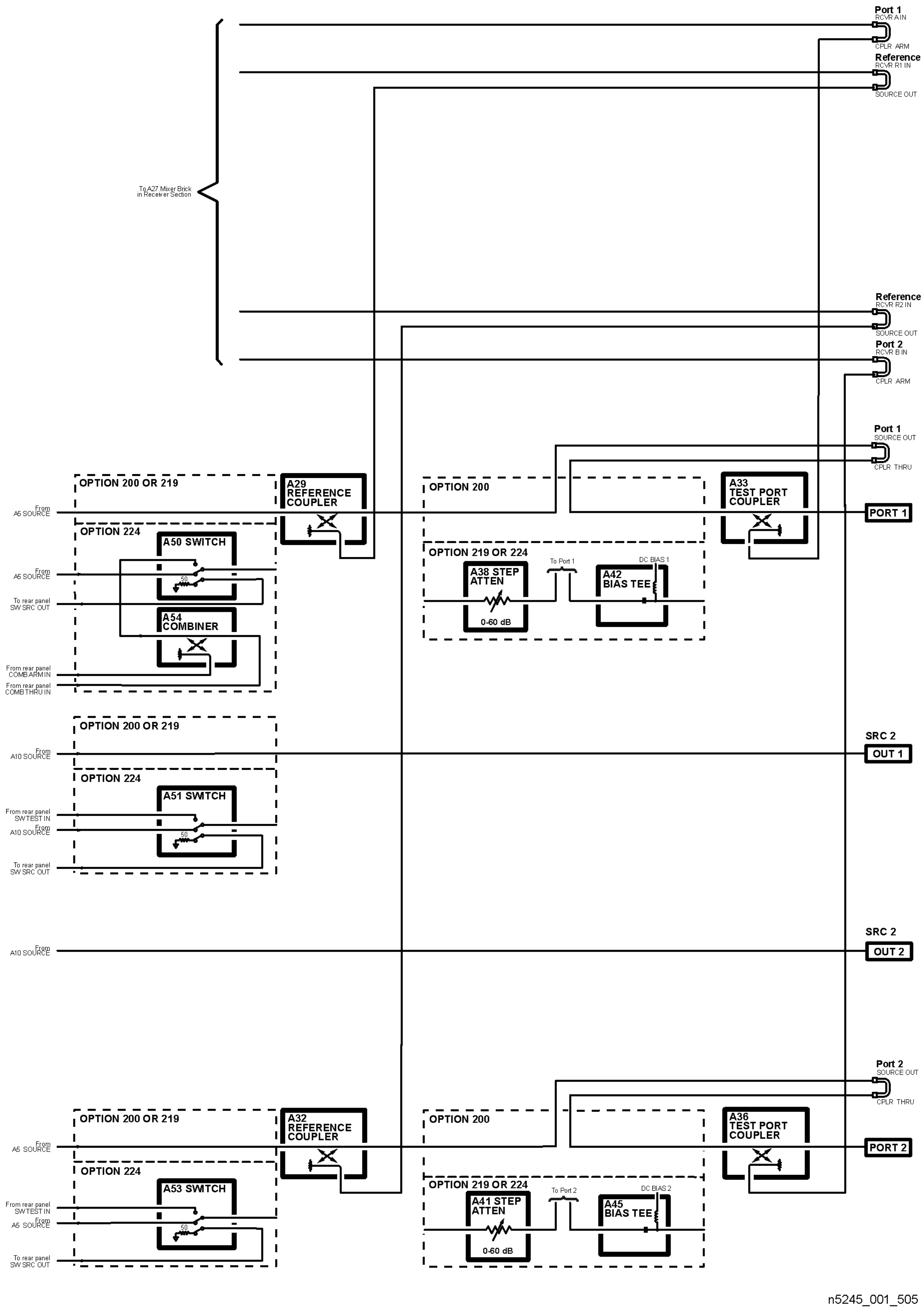


Figure 5-17 2-Port Signal Separation Group



A38–A41 50-dB Source Step Attenuators and A42–A45 Bias Tees (Optional)

On 4-port models with Option 419 or 423, a step attenuator and a bias tee are placed in the signal path of each test port between the A29–A32 reference couplers and the A33–A36 test port couplers.

On 2-port models with Option 219 or 224, a step attenuator and a bias tee are placed in the signal path of each test port between the A29–A32 reference couplers and the A33 and A36 test port couplers.

The 50-dB step attenuators provide coarse power control for the test signals. They are electro-mechanical step attenuators that provide 0 to 50 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. These attenuators are controlled by the A21 CPU board.

The bias tees are to provide DC biasing for the DUT.

A38–A41 50-dB Source Step Attenuators and A71–74 Bias Tee Combiners (Optional)

On 4-port models with Option 405, 420, and 425, a step attenuator and a bias tee are placed in the signal path of each test port between the A29–A32 reference couplers and the A33–A36 test port couplers.

On 2-port models with Option 205 or 220, a step attenuator and a bias tee are placed in the signal path of each test port between the A29 and A32 reference couplers and the A33 and A36 test port couplers.

The 50-dB step attenuators provide coarse power control for the test signals. They are electro-mechanical step attenuators that provide 0 to 50 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. These attenuators are controlled by the A21 CPU board.

The bias tee combiners are to provide DC biasing for the DUT via the N5292A PNA Millimeter Test Set and millimeter heads. Refer to www.keysight.com/find/pna.

A50–A53 Mechanical Switches and A54 Combiner (Optional)

On 4-port models with Option 423, a mechanical switch is placed in the signal path of each test port between the A5 and A10 26.5 GHz sources and the A29–A32 reference couplers.

On 2-port models with Option 224, a mechanical switch is placed in the signal path of each test port between the A5 and A10 26.5 GHz sources and the A29–A32 reference couplers.

These switches allow the source signal to be routed to or from rear-panel connectors. The internal source signal can be sent out through a rear-panel connector to be made available for external use or an external source signal can be input through a rear-panel connector to be used in place of the internal source signal.

In the port 1 signal path, there is an additional reference coupler (A54) which, when switched into the signal path, is used as a combiner to combine two source signals from the rear panel. These signals typically come from the analyzer's two internal sources and are jumpered on the rear panel.

Receiver Group Operation

The receiver group measures and processes the input signals into digital information for processing and eventual display. Figure 5-18 on page 5-57 and Figure 5-19 on page 5-58 are simplified block diagrams of the receiver functional group for 2-port and 4-port analyzers respectively.

In this section the following assemblies are described:

– A46–A49 50-dB Receiver Step Attenuators (Optional)

– A37 Reference Mixer Switch

– A27 and A28 Mixer Bricks

– A24 IF Multiplexer Board

– A16 SPAM Board (Analog Description)

A46–A49 50-dB Receiver Step Attenuators (Optional)

A step attenuator is placed in the signal path of each of the A, B, C, and D receiver inputs for 4-port models and A and B receiver inputs for 2-port models.

These 50-dB step attenuators provide power control for the input signals to the mixer bricks. They are electro-mechanical step attenuators that provide 0 to 50 dB of attenuation in 10-dB steps. These attenuators are controlled by the A21 CPU board.

A37 Reference Mixer Switch

The A37 reference mixer switch is placed in the R1 reference signal path allowing this reference signal to be switched in and out of the signal path when an external mixer is being used in test configuration.

An external mixer is placed in measurement configuration between REFERENCE 1 SOURCE OUT and RCVR R1 IN where there would normally be a front panel jumper. The A37 reference mixer switch can then be used to switch this external mixer in and out of the measurement configuration without having to manually connect/disconnect the external mixer and remove/replace the front panel jumper.

A27 and A28 Mixer Bricks

Each of these assemblies contain four identical amplifiers, mixers, and filters for a total of eight of each. For 2-port models, only the A27 mixer brick is present; the A28 mixer brick is omitted since only four receivers are needed.

Refer to the NOTE notice on page 5-1. For frequencies at or above 53 MHz, the test signals (receivers A, B, C, and D for 4-port models and A and B for 2-port models) and the reference signals (receivers R1, R2, R3, and R4 for 4-port models and R1 and R2 for 2-port models) are mixed with a synthesized LO signal that is a frequency value higher than the source incident signal to produce an IF signal. For analyzers with DSP version 4.0, the IF is 7.606 MHz (at frequencies below 53 MHz the IF is 2.535 MHz). For analyzers with DSP version 5.0, the IF is 7.438 MHz (at frequencies below 53 MHz the IF is 0.826 MHz) This synthesized LO comes from the A25 HMA26.5 (via the A26 splitter[1] for 4-port models).

At frequencies below 53 MHz, the IF is set to 2.535 MHz.

The analog IF signal is sent to the A24 IF multiplexer board where it is amplified and then sent to the A16 SPAM board.

The A27 mixer brick sends the EXT TSET DRIVE LO OUT signal to a rear-panel connector for use with an external test set. This same output connector on the A28 mixer brick is terminated.

A24 IF Multiplexer Board

This assembly provides pulse modulation capability and routes the IF signal out through the rear panel connectors for external use and routes external signals in through rear panel connectors to be included in the signal processing.

In this assembly, on 4-port models, a single reference signal is selected from R1, R2, R3, and R4 to be sent on to the A16 SPAM. On 2-port models the R1 and R2 reference signals are sent to the A16 SPAM.

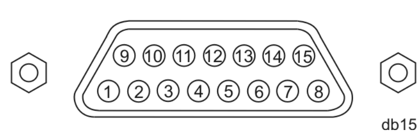
The analog IF signals (A, B, C, D, and R for 4-port models and A, B, R1, and R2 for 2-port models) are sent to the A16 SPAM board where they are converted to digital information.

Rear Panel Interconnects

The A24 IF multiplexer board includes the following rear panel interconnects.

PULSE I/O	A DB-15 female connector. Pin assignments are listed in Table 5-10 on page 5-54.

Table 5-10 PULSE I/O Connector Pin Assignments

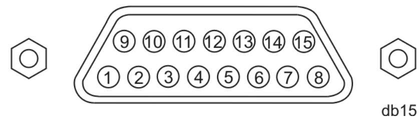


DB-15 Female Connector

Pin	Name	Description
1	IFGateAin	IF pulse gate input A (TTL)
2	IFGateBin	IF pulse gate input B (TTL)

1. A26 splitter only applies to PNAs with serial number prefix <6021.

Table 5-10 PULSE I/O Connector Pin Assignments



DB-15 Female Connector

Pin	Name	Description
3	IFGateCin	IF pulse gate input C (TTL)
4	IFGateDin	IF pulse gate input D (TTL)
5	IFGateRin	IF pulse gate input R (TTL)
6	DCOM	Digital ground
7	PulseSyncIn	Pulse generator synchronization trigger input (TTL)
8	RFPulseModIn	RF source pulse modulation drive input (TTL)
9	DCOM	Digital ground
10	Pulse1Out	Programmable pulse train output #1 (TTL)
11	Pulse2Out	Programmable pulse train output #2 (TTL)
12	Pulse3Out	Programmable pulse train output #3 (TTL)
13	Pulse4Out	Programmable pulse train output #4 (TTL)
14	NC	No connect
15	DCOM	Digital ground

A16 SPAM Board (Analog Description)

The A16 SPAM board contains digital and analog circuitry. For digital descriptions, refer to "A16 SPAM Board (Digital Description)" on page 5-62.

In this assembly, the IF signals (A, B, C, D, and R for 4-port models and A, B, R1, and R2 for 2-port models) from the A24 IF multiplexer board go through a gain stage where small signals are amplified to ensure that they can be detected by the analog-to-digital converter (ADC).

All input 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 5-59 for more information on signal processing.

Figure 5-18 4-Port Receiver Group

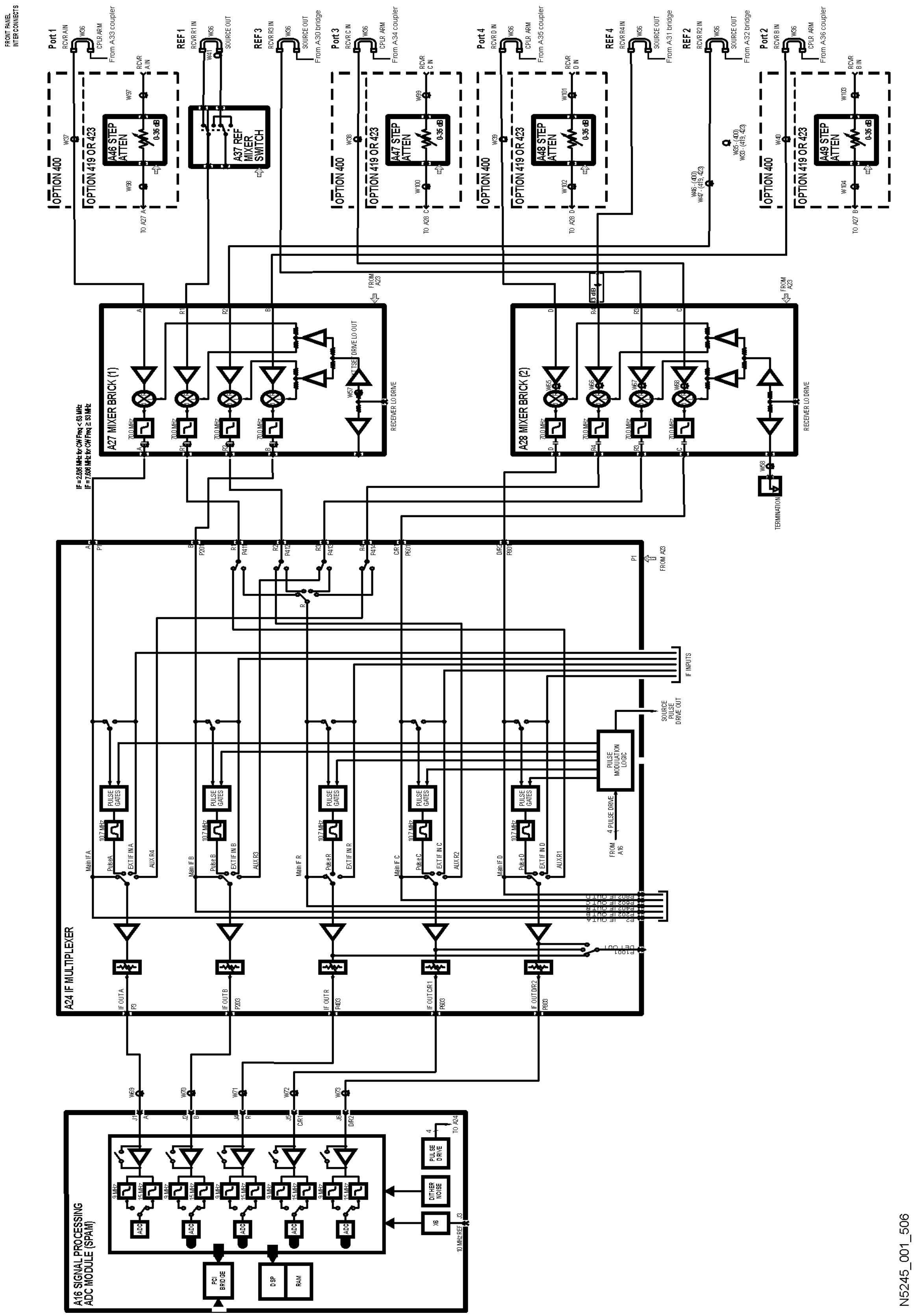
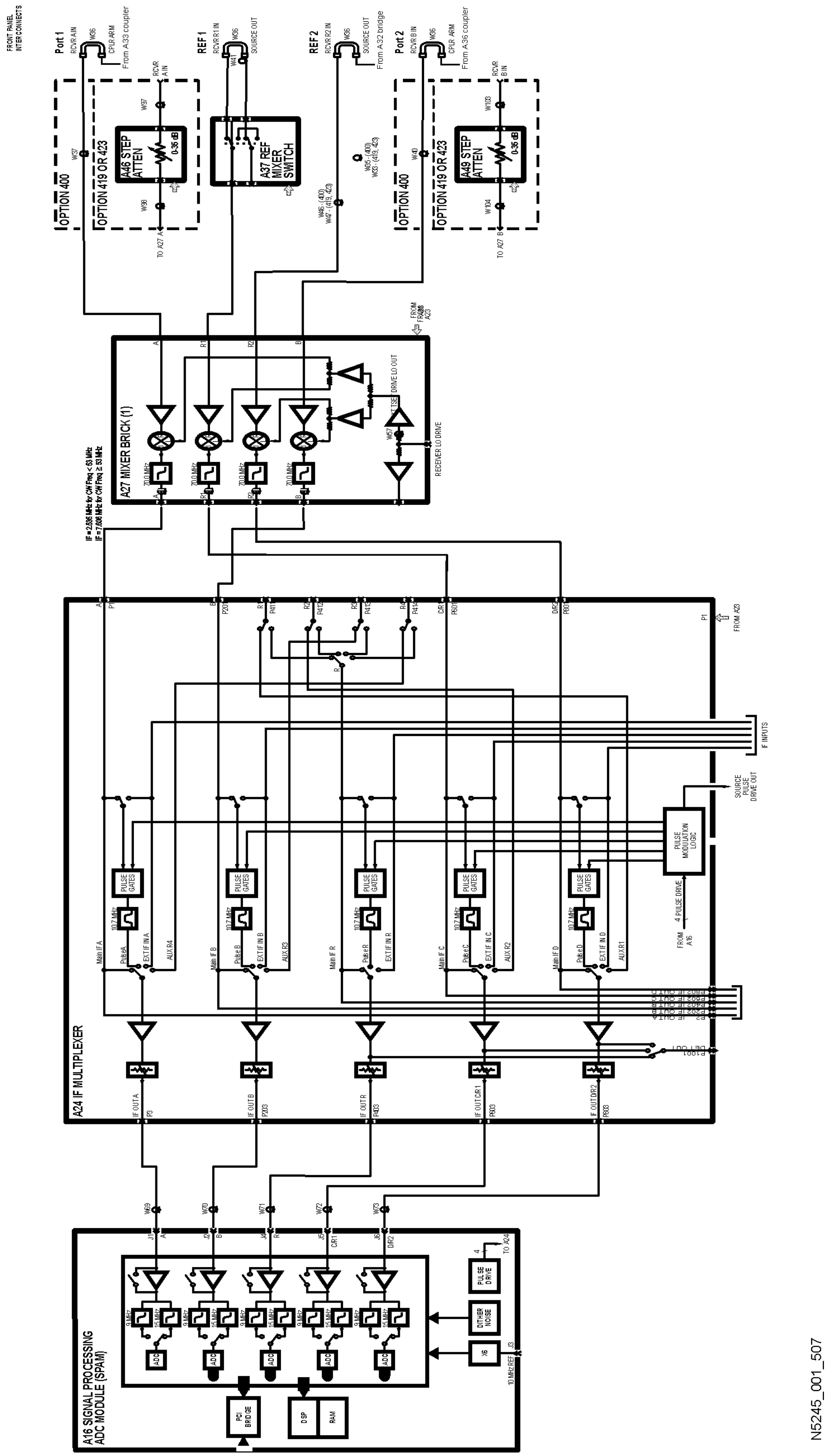


Figure 5-19 2-Port Receiver Group



Digital Processing and Digital Control Group Operation

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

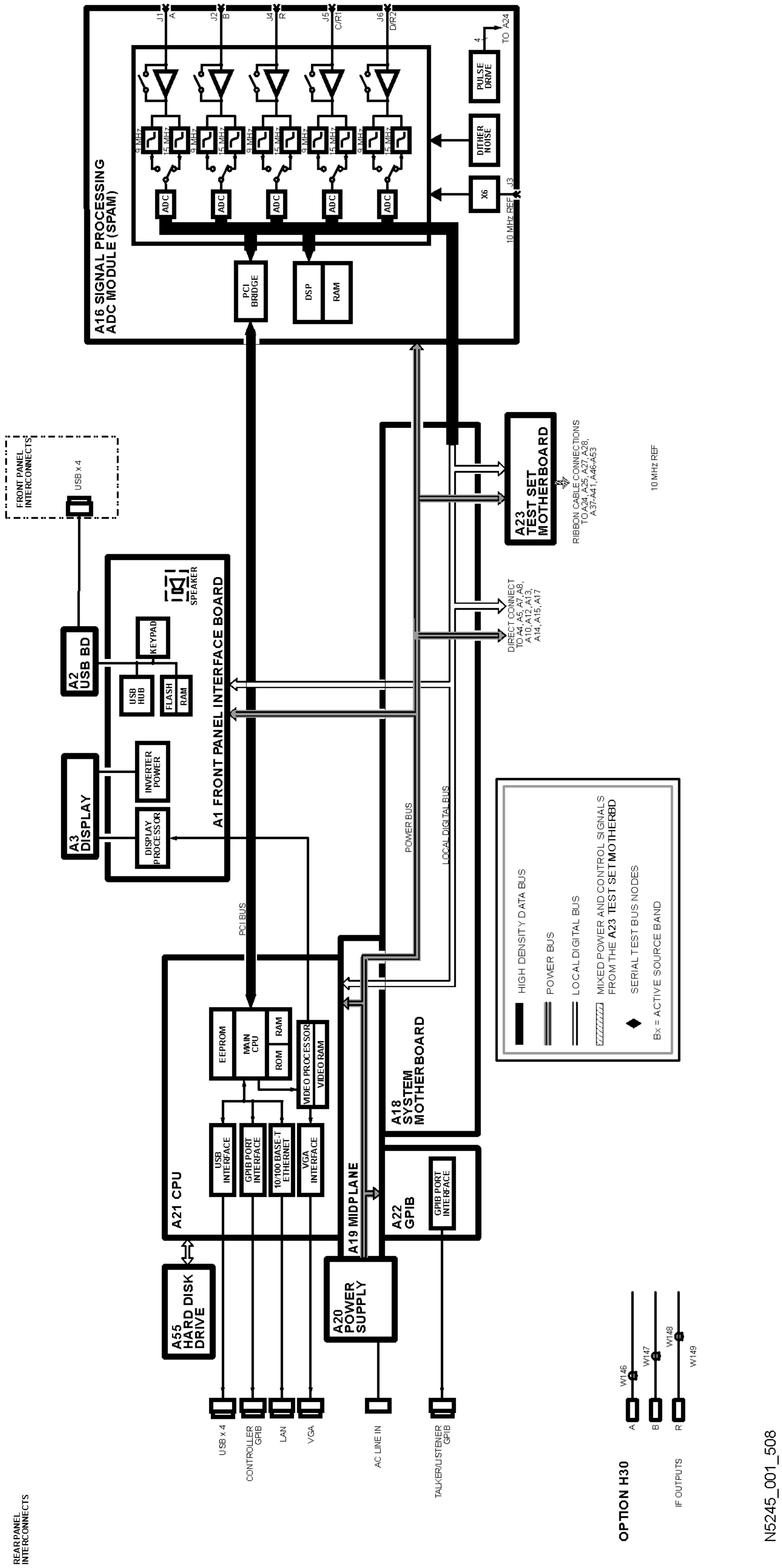
- front panel operation,
- output to the display,
- math processing functions, and
- communications between the analyzer and an external controller or peripherals.

A block diagram of the digital control functional group is shown in Figure 5-20 on page 5-60.

The digital control functional group consists of two subgroups:

- Front Panel Subgroup
  - A1 Front Panel Display Board
  - A2 USB Board
  - A3 Display Assembly
  - Keypad Assembly
  - A18 System Motherboard
- Data Acquisition and Processing Subgroup
  - A16 SPAM Board (Digital Description)
  - A21 CPU Board
  - A55 Solid State Drive

Figure 5-20 Digital Processing and Digital Control Group



Front Panel Subgroup

The front panel subgroup contains the following assemblies:

– A1 Front Panel Display Board

– A2 USB Board

– A3 Display Assembly

– Keypad Assembly

A1 Front Panel Display Board

The A1 front panel display board detects and decodes user inputs from the keypad assembly and front panel knob, and transmits them to the A21 CPU board by way of the A18 system motherboard. It also decodes video data from the video processor on the A21 CPU board and supplies this to the A3 display assembly. Power from the power bus on the A18 system motherboard is buffered and routed to the keypad assembly and the A3 display assembly. All data and power signals are routed through a single cable connector to the A18 system motherboard.

The A1 front panel interface board also includes a speaker that emits the audio signals received from the A21 CPU board.

A2 USB Board

This board provides four universal serial bus (USB) jacks that are industry standard 4-pin connectors allowing multiple USB devices to be connected to the analyzer's front panel.

A3 Display Assembly

The A3 display assembly contains a 10-inch LCD with associated drive circuitry and backlight inverter. Two cables between the A3 display assembly and the A1 front panel display board provide all necessary power and data for normal operation. The two cables are:

7. **A cable to the inverter that supplies buffered power.**

8. **A cable to the display circuitry that supplies decoded data from the video processor on the A21 CPU board and the necessary drive circuit power. The video data received from the A21 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

Keypad Assembly

The 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.

Data Acquisition and Processing Subgroup

The data acquisition and processing subgroup contain the following assemblies. See Figure 5-20 on page 5-60.

– A16 SPAM Board (Digital Description)
– A21 CPU Board (including rear-panel interconnects)
– A55 Solid State Drive

A16 SPAM Board (Digital Description)

The A16 SPAM board contains digital and analog circuitry. For analog descriptions, refer to “A16 SPAM Board (Analog Description)” on page 5-55.

The digital signal processor (DSP) receives digitized data from the digital circuitry of the A16 SPAM board. It computes discrete Fourier transforms to extract the complex phase and magnitude data from the analog IF signal. The resulting raw data is written into the main random access memory (RAM). The data taking sequence is triggered either externally from the rear panel or by firmware on the A21 CPU board.

A21 CPU Board

The A21 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 x4	Four universal serial bus (USB) jacks (industry standard 4-pin connectors).
GPIB (0) Controller	A 24-pin, female, type D-24 connector that meets IEEE-488 standards.
GPIB (1) Talker/Listener	A 24-pin, female, type D-24 connector that meets IEEE-488 standards.
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.

A55 Solid State Drive

The solid state drive (SSD) is a Serial Advanced Technology Attachment (SATA) data storage device which is connected directly to, and physically mounted within the enclosure of, the A21 CPU board. The full operating system and firmware for the network analyzer is stored on the A55 solid state drive.

Power Supply Group Operation

The A20 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.

WARNING **Supply voltages which oscillate between the two normal input ranges of the autoranging line voltage input will damage the power supply. In rare cases, this damage has become a user safety concern. If unstable power levels are expected, the analyzer input power must be buffered by a line conditioner.**

The dc output voltages of the A20 power supply assembly are:

- +15 V analog
- +9 V analog
- +3.3 V analog
- +5.2 V analog
- +15 V standby (always on)
- +32 V analog
- –15 V analog
- –5.2 V analog
- –7 V analog
- +5.1 V standby
- +12 V digital
- +3.35 V digital
- +5.1 V digital

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

Noise Measurement Group Operation (Option 029 or E29)

The noise measurement group measures the noise figure up to 50 GHz. Refer to Figure 5-21 on page 5-67 and the detailed block diagrams at the end of Chapter 4.

In this section the following assemblies are described:

– A56 Test Port 1 Option 029 or E29 Switch
– A64 Test Port 1 Option 029 or E29 Tuner
– A57 Test Port 2 Option 029 or E29 Switch
– A59 Noise Downconverter
– A9 Noise Receiver Board

A56 Test Port 1 Option 029 or E29 Switch

The A56 bypass switch is placed in the Port 1 source path, allowing the source signal to be switched between normal test mode configuration and internal noise tuner configuration.

A64 Test Port 1 Option 029 or E29 Tuner

The A64 internal tuner is placed in the Port 1 source path together with the Port 1 switch. The internal tuner is used to vary the Port 1 transmission line impedance during a noise figure calibration. This enables the source port to be fully vector corrected during subsequent noise figure measurements.

A57 Test Port 2 Option 029 or E29 Switch

The A57 bypass switch is placed in the Port 2 source path, allowing switching between normal test mode configuration and noise figure measurement mode. When the PNA-X is switched into noise figure measurement mode, the switch allows both the source incident signal and the noise incident signal from the DUT to simultaneously pass through to the A59 Noise Downconverter.

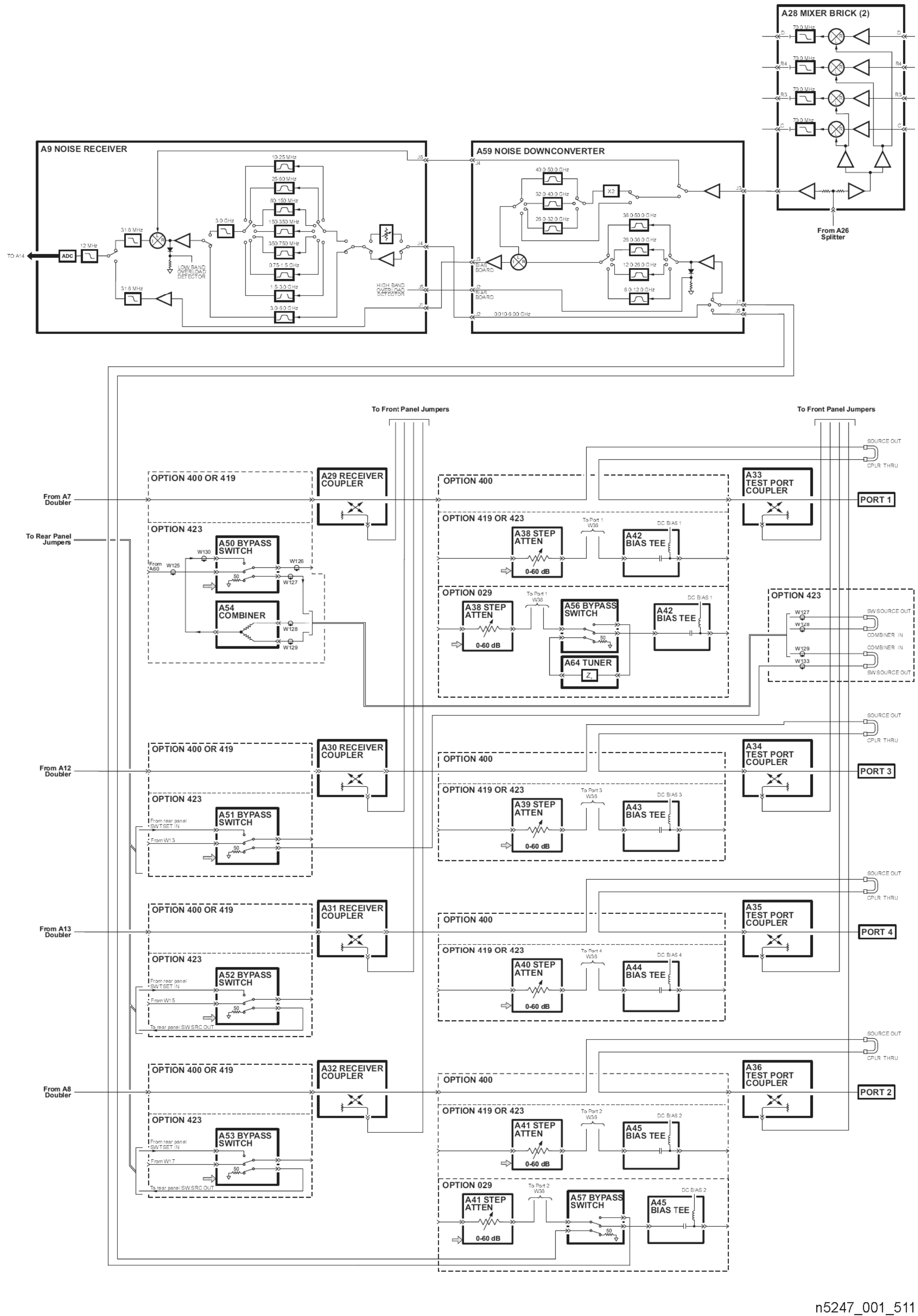
A59 Noise Downconverter

The A59 noise downconverter contains an input Low Noise Amplifier (LNA), an RF Filter Bank, an LO Filter Bank, and a mixer. For 6 – 50 GHz signals, the LNA provides the necessary gain to enable measurements on low noise and low gain devices. The signals are routed through the RF Filter Bank where the noise signal is filtered for third harmonic conversion rejection. The noise signals are mixed with the LO synthesized signal to produce IF noise signals before being sent to the A9 Noise Receiver board. For frequencies between 10 MHz – 6 GHz, the noise signals bypass the A59 noise downconverter, going to the A9 noise receiver board, where the signals are amplified, filtered, and mixed with the LO synthesized signal to produce the IF noise signals.

A9 Noise Receiver Board

In the A9 noise receiver board, the IF noise signals from the A59 noise downconverter are further amplified and filtered before being sent to ADC for sampling. The 10 MHz – 6 GHz noise signals that passed through the A59 noise downconverter are amplified, filtered, and mixed with the LO synthesized signal to produce IF noise signals. These are filtered and sent to the ADC for sampling. In the ADC, the signals are processed and converted to digital form at the sampling rate of 40 MHz. The digitized data is then sent to the A18 system motherboard via the data bus.

Figure 5-21 Noise Measurement Group (Option 029 or E29)



6 Replaceable Parts

Information in This Chapter

This chapter:

- identifies the replaceable parts for the Keysight PNA series microwave network analyzer.
- 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

KEYSIGHT TECHNOLOGIES

Ordering Information

To order a part listed in the replaceable parts lists:

- include the part number
- indicate the quantity required
- Contact Keysight Technologies for instructions on where to send the order. Refer to
"Contacting Keysight" on page 2-7.

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 Keysight Technologies for instructions on where to send the order. Refer to
"Contacting Keysight" on page 2-7.

Assembly Replacement Sequence

The following steps describe how 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.”

Step 6. Keysight personnel: see Figure 1-1 on page 1-6 to review where the calibration stickers should be placed on the PNA.

Rebuilt-Exchange Assemblies

Under the rebuilt-exchange assembly program:

– Certain factory-repaired and tested assemblies are available on a trade-in basis.

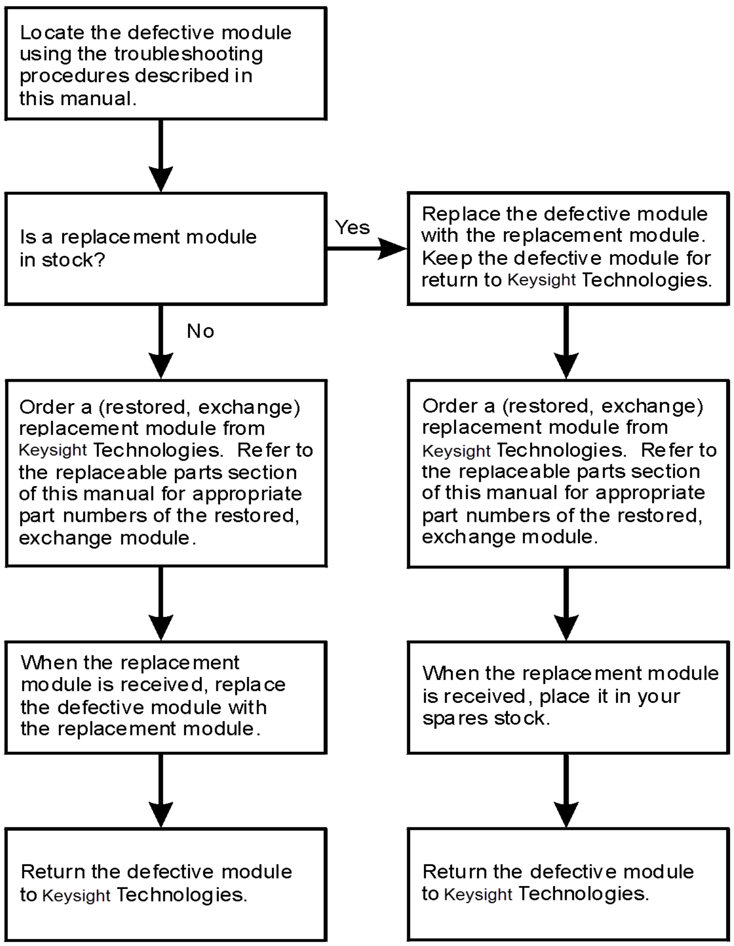
– Exchange assemblies are offered for lower cost than a new assembly, but meet all factory specifications required of a new assembly.

– The defective assembly must be returned for credit under the terms of the rebuilt-exchange assembly program.

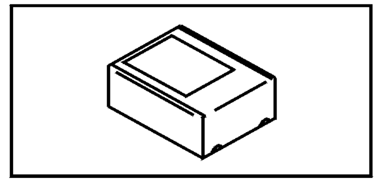
– Spare assembly stock desired should be ordered using the new assembly part number.

Figure 6-1 Module Exchange Procedure

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

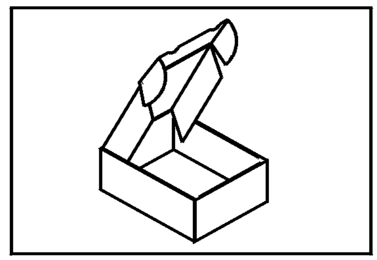


A.



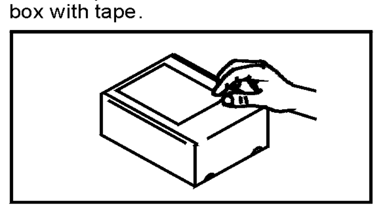
Restored, exchange modules are shipped individually in boxes as shown above. In addition to the module, the box contains an exchange-assembly failure report and a return-shipping label.

B.



Open the box carefully so that it can be used to return the defective module to Keysight Technologies. Complete the exchange-assembly failure report. Remove the return-shipping label from inside the box. Place the defective module and the failure report in the box. Seal the box with tape.

C.



For shipping within the USA, affix the return-shipping label over the existing label. Mail the box to Keysight Technologies. (Postage is paid by Keysight Technologies on boxes mailed within the USA.)
Outside the USA, address and mail the box to the nearest Keysight Technologies office. Do not use the return-shipping label.

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Replaceable Parts Listings

This section contains the replacement part numbers and their descriptions for your Keysight microwave PNA. 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 Part Number Listing by Reference Designator

Reference Designator	Description	Location
A1	front-panel interface board	"Front-panel Assembly, Back Side, All Options" on page 6-14
A2	USB board	
A3	Display assembly	

Table 6-1 Part Number Listing by Reference Designator (Continued)

Reference Designator	Description	Location
A4	13.5 GHz source 1 synthesizer board (Applies to PNA models with serial numbers <6021 only)	"Top Assemblies and Cables, All Options:" on page 6-10.
A5	26.5 GHz source board 1	
A6	Not used	
A7	Doubler 1 board	
A8	Doubler 2 board	
A9	Noise board	
A10	26.5 GHz source board 2	
A11	Not used	
A12	Doubler 3 board	
A13	Doubler 4 board	
A14	Frequency reference board	
A15	13.5 GHz (LO) synthesizer board (Applies to PNA models with serial numbers <6021 only)	
A15 (DDS)	Direct digital synthesizer (DDS) assembly (Applies to PNA models with serial numbers ≥6021 or with version 7 synthesizer assembly upgrades only)	
A16	Signal processing ADC module (SPAM) board	
A17	13.5 GHz source 2 synthesizer board (Applies to PNA models with serial numbers <6021 only)	
A18	System motherboard	
A19	Midplane board	
A20	Power supply	
A21	CPU board	
A22	GPIB board	
A23	Testset motherboard	Your option set determines which assemblies are in your PNA. Refer to "Bottom Assemblies and Cables by Option Set:" in Table 6-2 on page 6-10
A24	IF multiplexer board	
A25[a]	LO Multiplier/amplifier 26.5 (HMA26.5)	
A26[a]	Splitter	
A27	Mixer Brick 1	

Table 6-1 Part Number Listing by Reference Designator (Continued)

Reference Designator	Description	Location
A28	Mixer Brick 2	
A29	Port 1 reference coupler	
A30	Port 3 reference coupler	
A31	Port 4 reference coupler	
A32	Port 2 reference coupler	
A33	Port 1 test port coupler	
A34	Port 3 test port coupler	
A35	Port 4 test port coupler	
A36	Port 2 test port coupler	
A37	Reference mixer switch	
A38	Port 1 source step attenuator	Your option set determines which assemblies are in your PNA. Refer to "Bottom Assemblies and Cables by Option Set:" in Table 6-2 on page 6-10.
A39	Port 3 source step attenuator	
A40	Port 4 source step attenuator	
A41	Port 2 source step attenuator	
A42	Port 1 bias tee	
A43	Port 3 bias tee	
A44	Port 4 bias tee	
A45	Port 2 bias tee	
A46	Port 1 receiver step attenuator	
A47	Port 3 receiver step attenuator	
A48	Port 4 receiver step attenuator	
A49	Port 2 receiver step attenuator	
A50	Port 1 mechanical switch	
A51	Port 3 mechanical switch	
A52	Port 4 mechanical switch	
A53	Port 2 mechanical switch	
A54	Combiner	
A55	Solid state drive	"Top Assemblies and Cables, All Options:" on page 6-10.

Table 6-1 Part Number Listing by Reference Designator (Continued)

Reference Designator	Description	Location
A56	Port 1 noise bypass switch (Option 029 or E29 only)	
A57	Port 2 noise bypass switch (Option 029 or E29 only)	
A58	Not used	
A59	noise receiver (downconverter) – (Option 029 or E29 only)	
A60	70 GHz doubler 1	Your option set determines which assemblies are in your PNA. Refer to "Bottom Assemblies and Cables by Option Set:" in Table 6-2 on page 6-10.
A61	70 GHz doubler 3	
A62	70 GHz doubler 4	
A63	70 GHz doubler 2	
A64	Tuner	
A70	LFE Board	
A71	Port 1 bias combiner	
A72	Port 3 bias combiner	
A73	Port 4 bias combiner	
A74	Port 2 bias combiner	

a. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184, and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

Table 6-2 Part Number Listing by Type of Part

Table 6-2 Part Number Listing by Type of Part

Miscellaneous (Continued)

– USB Accessories on page 6-206
– ESD Supplies on page 6-206
– Rack Mount Kits and Handle Kits on page 6-206

Front-panel Assembly, Front Side, All Options

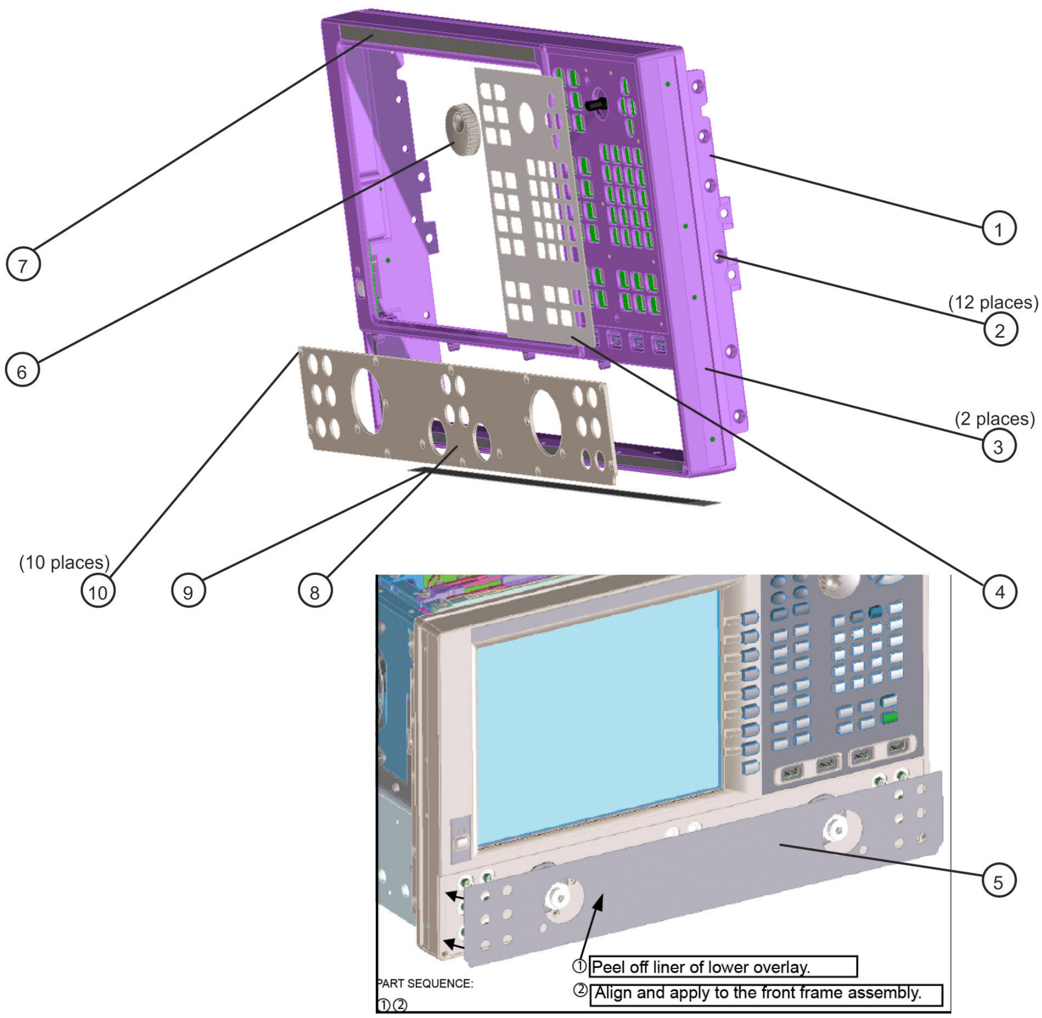
NOTE **The N5240-60071 front panel assembly a contain the items shown in the following table.**

Reference Designator	Part Number	Qty	Description
①	N5240-20089	1	Front frame, machined, 1-piece, 2-port (frame only, not the assembly) (Requires: Lower front panel overlay. See below.)
	8160-0660	1.2 m	RFI gasket material, 1.2 meters in length (Must be ordered separately from front frame.)
②	0515-2044	12	Machine screw, M4.0 x 12 flat head (To attach front frame to chassis.)
③	5041-7908	2	Trim strip, filler (For analyzers with handles.)
④	N5240-80040	1	Keypad overlay
⑤	N5247-80020	1	Lower front panel overlay, 2-port (Option 201 and Option 219)
	N5247-80018		Lower front panel overlay, 2-port (Options 224)
	N5247-80022		Lower front panel overlay, 2-port (Options 224/029/6E9)
	N5247-80021		Front-panel overlay, 4-port (Option 401 and Option 419)
	N5247-80019		Front-panel overlay, 4-port (Option 423)
	N5247-80023		Front-panel overlay, 4-port (Option 423 with 029/E29)
	N5247-80027		Front-panel overlay, 4-port (Option 425)
	N5247-80028		Front-panel overlay, 4-port (Option 425 with 029/E29)
⑥	W1312-40180	1	Front panel (RPG) knob, 32 mm
⑦	N5247-80017	1	Nameplate, N5247B
	N5247-80026		Nameplate, N5247B with Option 425
⑧	N5240-00010	1	Lower Dress Panel, 2-Port (ALL PNA models). Goes on, before lower front panel overlay (⑤). Attach with 0515-1946 subpanel screws.
	N5240-00009		Lower Dress Panel, 4-Port (ALL PNA models). Goes on, before lower front panels overlay (⑤). Attach with 0515-1946 subpanel screws.
⑨	N5240-40002	1	Trim, bottom, goes on the outside, underneath the Front Frame frame (①). (All PNA models)
⑩	0515-1946	12[a]	Machine screw, M3 x 6 mm flat head (To attach lower dress panel overlay frame to chassis.)
Not Shown	N5242-00048	2	Guard, jumper cables, side—2-Port & 4-Port

Reference Designator	Part Number	Qty	Description
Not Shown	N5242-00049	1	Guard, jumper cables, center–4-Port
Not shown	5023-3074	2	Front handle

a. Some options require 14 of the 0515-1946 screws to secure dress panel overlay subpanel.

Figure 6-2 Front-panel Assembly, Front Side, All Options



Front-panel Assembly, Back Side, All Options

Reference Designator	Part Number	Qty	Description
A1	N5340-63081	1	Front panel interface board
A2	N5240-60082	1	USB board
not shown	N5240-60090	1	Ribbon cable, 60-wire, A14 system motherboard J9 to A1 front panel interface board J1
①	N5240-40004	1	Keypad assembly, main
②	0515-0430	34	Machine screw, M3.0 x 6 mm pan head (6 to attach LCD Mounting plate to LCD brackets, 3 to attach LCD cable to mounting plate, 7 to attach keypad assembly onto front frame, 5 to attach USB board to front panel interface board, 2 to attach power switch board to slot in front frame, and 11 to attach LCD assembly to front frame.)
③	0535-1157	1	Nut-Hex M9 x 2 mm (to attach RPG board)
④	2190-0016	1	Washer, RPG secure (to attach RPG board)
⑤	N5240-63083	1	RPG board
⑥	2090-1140	1	Touch display LCD, 12.1 inch
⑦	N5242-00045 (LCD)	1	LCD Mounting plate
⑧	W1312-40016	1	Foam mount, speaker (to attach speaker assembly)
⑨	N5240-60072	1	Speaker assembly (Do NOT touch top of speaker's clear diaphragm! Attach cable to interface board J11.)
⑩	2090-1088	1	Touch screen controller board
⑪	0515-1934	6	Machine screw, M2.5 x 6 mm pan head (4 to attach controller board to LCD mounting plate and 2 to attach LED driver board to LCD mounting plate.)
⑫	0950-5452 (LED)	1	LED Driver board (Backlight converter board)
⑬	0380-5485	2	Standoff-Hex nuts Male-Female M3 x 4.5 mm (To attach to keypad PCA)
⑭	1400-1334	2	Cable clamp (with adhesive backing)
⑮	N5240-63084	1	Power switch board (PCA for Power button keypad)
⑯	N5242-40014	1	Power button keypad
A3			Display assembly
⑰	N9912-20043	2	Tape (To secure cable E5071-61653 to 2090-1140 LCD's connector and to secure cable E5071-61653 to J8 on the Interface board)
A3			Display assembly (continued from previous page)

Reference Designator	Part Number	Qty	Description
⑱	0515-2151	4	Machine screw, M2.0 x 4 mm pan head (4—2 for each bracket—to attach LCD side bracket(s) to 2090-1140 LCD)
⑲	N5242-00046 (LCD)	2	LCD display side bracket (In Figure 6-5 on page 6-17, only one bracket is shown.)
⑳	8121-2173	1	LCD Cable assembly 30 AWG 300V 12-pin plug to 8-pin plug
㉑	E5071-61653	1	LCD display cable
㉒	N5240-60073	1	Touch screen controller board cable
㉓	N5242-60075	1	Cable, A3 LED Driver board (Backlight converter board) to interface board
㉔	N5242-60074	1	Power switch cable
㉕	E5071-61660	1	Wire assembly, RPG (to attach RPG board (N5240-63083) to Interface board (J10)

Figure 6-3 Front Panel Assembly, Back Side, All Options

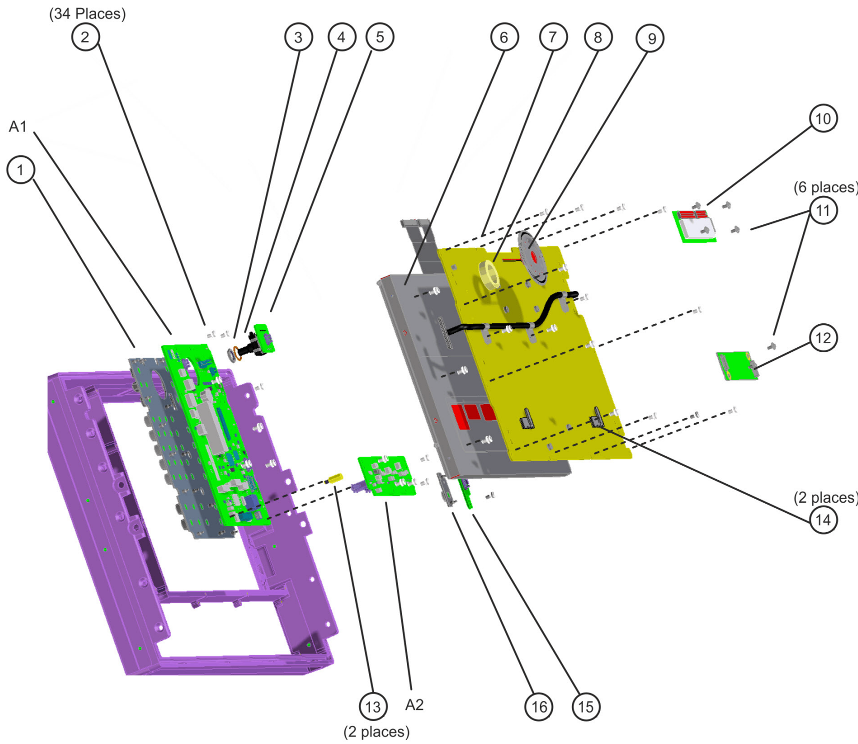


Figure 6-4 A3 Display Assembly with Interface Board/USB Assemblies

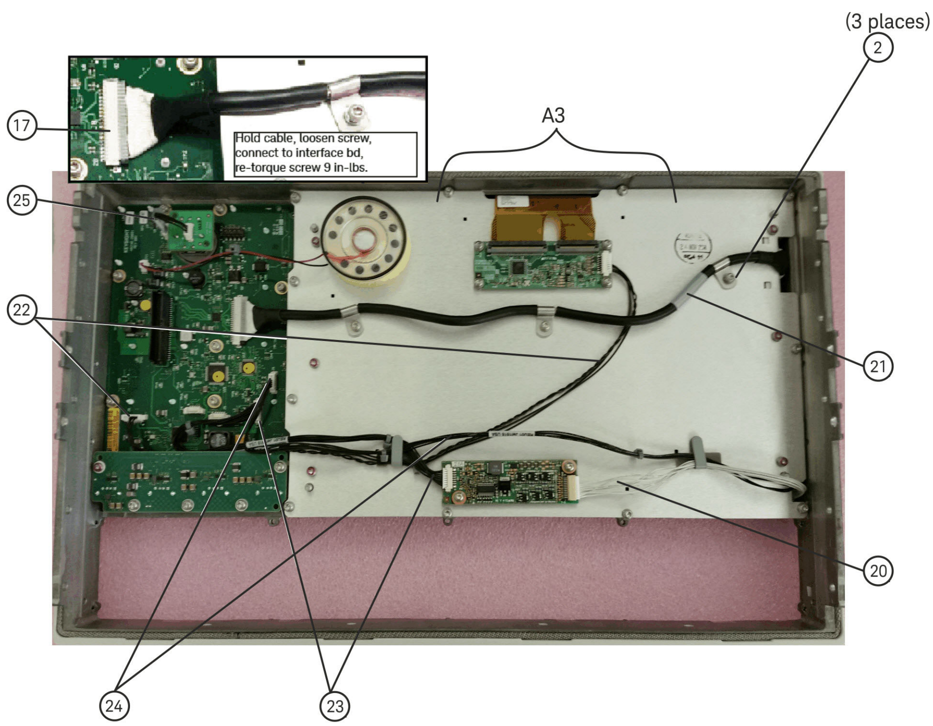
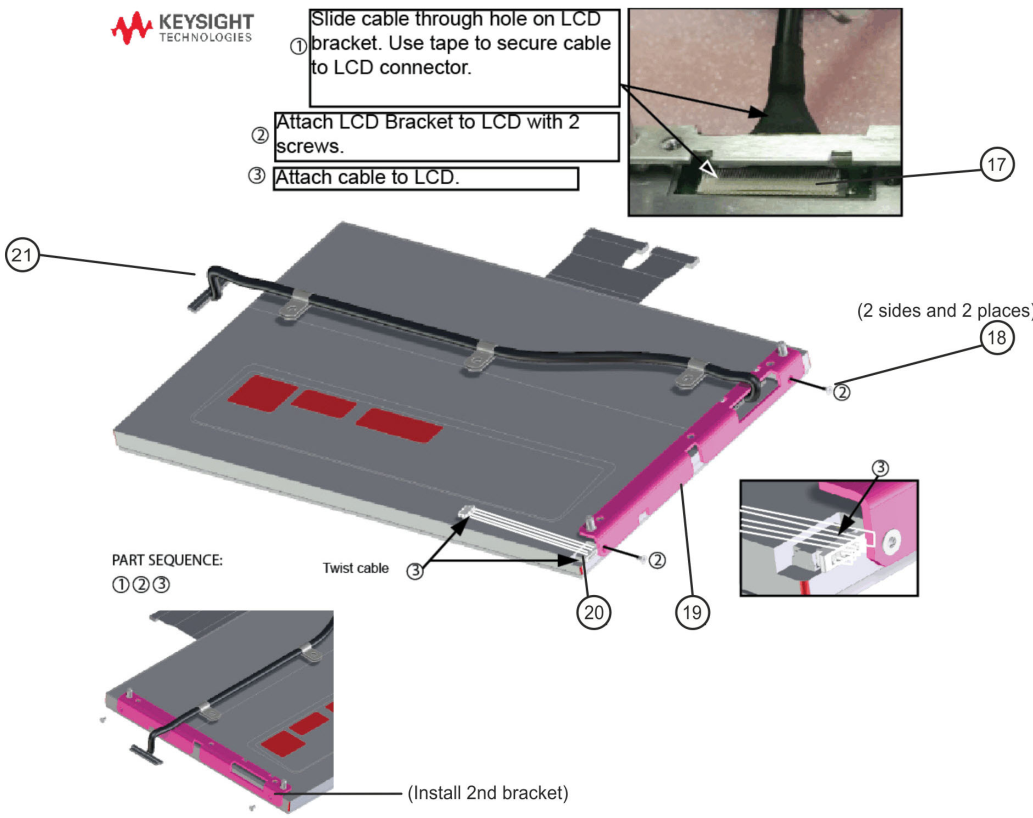


Figure 6-5 A3 Display Assembly with LCD Display 2090-1140 (LED) and Side Brackets



Top Assemblies and Cables, All Options, Serial Number Prefixes <6021

This section contains the following:

– "Top Assemblies, All Options, S/N Prefixes <6021" on page 6-18
– "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21

See also, "Top Assemblies and Cables, All Options, Serial Number Prefixes ≥6021" on page 6-24.

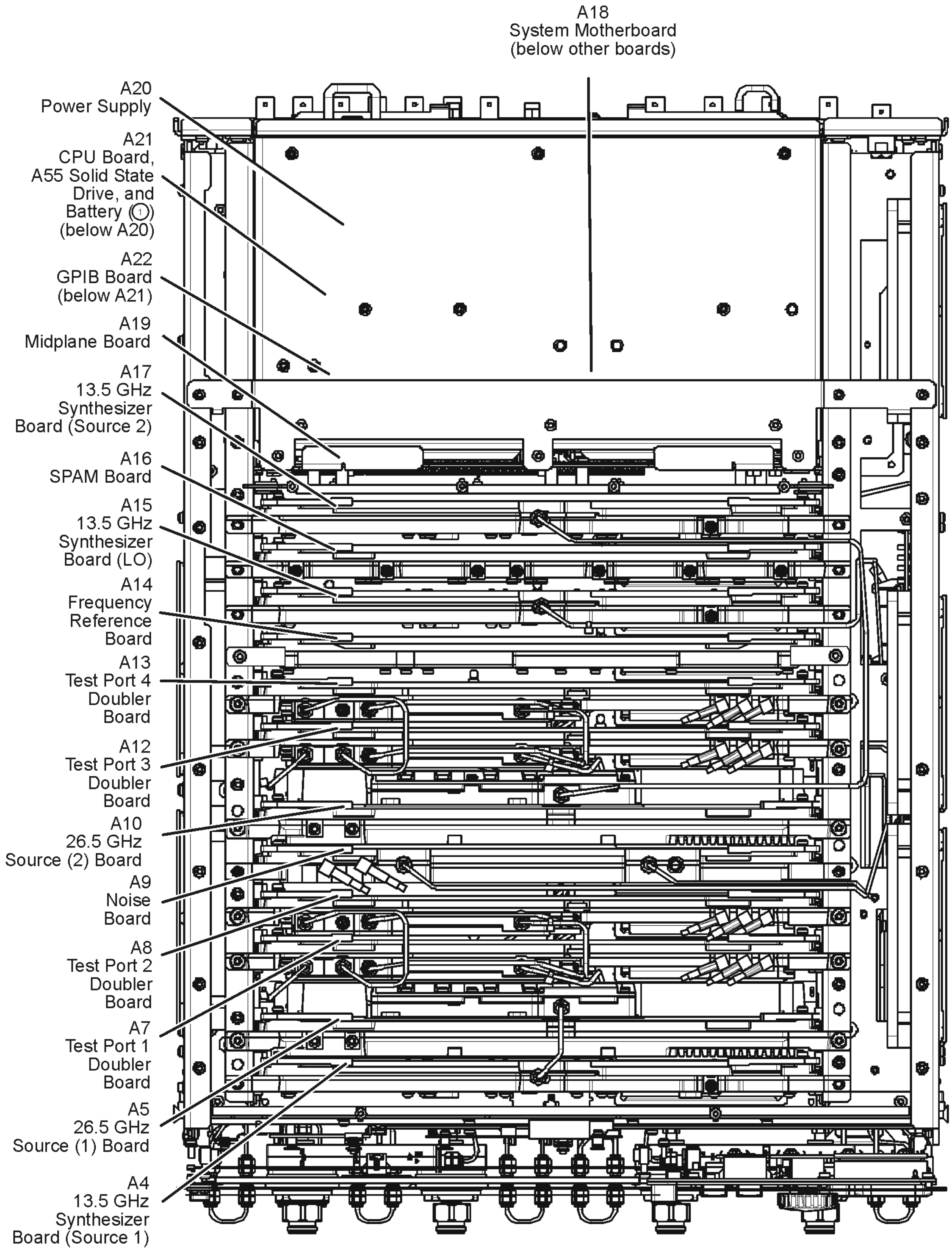
Top Assemblies, All Options, S/N Prefixes <6021

Reference	Part Number	Qty	Description
A4	N5240-60074 Was N5242-60150	1	13.5 GHz (source 1) synthesizer board
A5	5087-7780 5087-6780	1	26.5 GHz source (1) board
A6			Not used.
A7	5087-7346	1	40 GHz doubler assembly port 1
A8	5087-7346	1	40 GHz doubler assembly port 2
A9	N5245-60124	1	Noise receiver board (Option 029 only)
A10	5087-7780 5087-6780	1	26.5 GHz source (2) board (On 2-port models, this assembly is included only with Option 224.)
A11			Not used.
A12	5087-7346	1	40 GHz doubler assembly port 3 (On 2-port models, assembly A12 is included only with Option 224.)
A13	5087-7346	1	40 GHz doubler assembly port 4 (On 2-port models, assembly A13 is included only with Option 224.)
A14	N5240-60069 Was N5240-60061	1	Frequency reference board
A15	N5240-60074 Was N5242-60150	1	13.5 GHz (LO) synthesizer board
A16	N5240-60077 Was N5240-600056	1	Signal Processing ADC Module (SPAM) board
A17	N5240-60074 Was N5242-60150	1	13.5 GHz (source 2) synthesizer board (On 2-port models, this assembly is included only with Option 224.)
A18	N5247-60002	1	System motherboard
A19	W1312-60376	1	Midplane board
A20	0950-4934	1	Power supply

Reference	Part Number		Qty	Description
A21 (See critical note)	Version 8	W1312-60522	1	CPU board assembly[a]
	Version 7	W1312-60213 Was:W1312-60211 Was: W1312-60210		
A22		N5240-60059	1	GPIB board
A55 [b, c]	Version 8	N5242-60136	1	Solid state drive (SSD) for Windows 10 Operating System- to be used with the Version 8 System CPU[d]
	Version 7	N5242-60135		Solid state drive (SSD) for Windows 10 Operating System- to be used with the Version 7 System CPU[d]
	Version 7	N8985A[e]		Solid state drive (SSD) upgrade for Windows 10 Operating System- to be used with the Version 7 System CPU[d]
	Version 7	N5242-60134		Solid state drive (SSD) for Windows 7 Operating System- to be used with the Version 7 System CPU[d]
①		1420-0356	1	Battery, lithium manganese dioxide, 3V, 0.22A-hr.[f]

a. For the latest information on CPUs and associated drives, visit: https://www.keysight.com/us/en/assets/9922-01369/miscellaneous/PNA-Hard-Drives-and-CPUs.pdf.
b. The A55 solid state disk drive for the 2.2 GHz CPU board plugs into the A21 CPU board assembly from the rear panel. Refer to "Removing and Replacing the A55 Solid State Drive (SSD)" on page 7-60 for an illustration.
c. To learn more about all PNA/PNA-L/PNA-X Series Windows Upgrades, refer to https://www.keysight.com/us/en/lib/resources/miscellaneous/pna-windows-upgrades.html.
d. You can learn your System CPU version using the PNA software. On the PNA front panel, press **Help** > **About Network Analyzer**. In the window displayed, find "System CPU Version."
e. For more information on the N8985A SSD, refer to the Windows 10 Operating System Upgrade Kit Installation Note, available online at https://www.keysight.com/us/en/assets/9018-04733/installation-guides/9018-04733.pdf (N8985-90001).
f. The lithium battery is located inside the A21 CPU board assembly. Refer to "Removing and Replacing the Lithium Battery" on page 7-90 for an illustration.

Figure 6-6 Top Assemblies, All Options, S/N Prefixes <6021



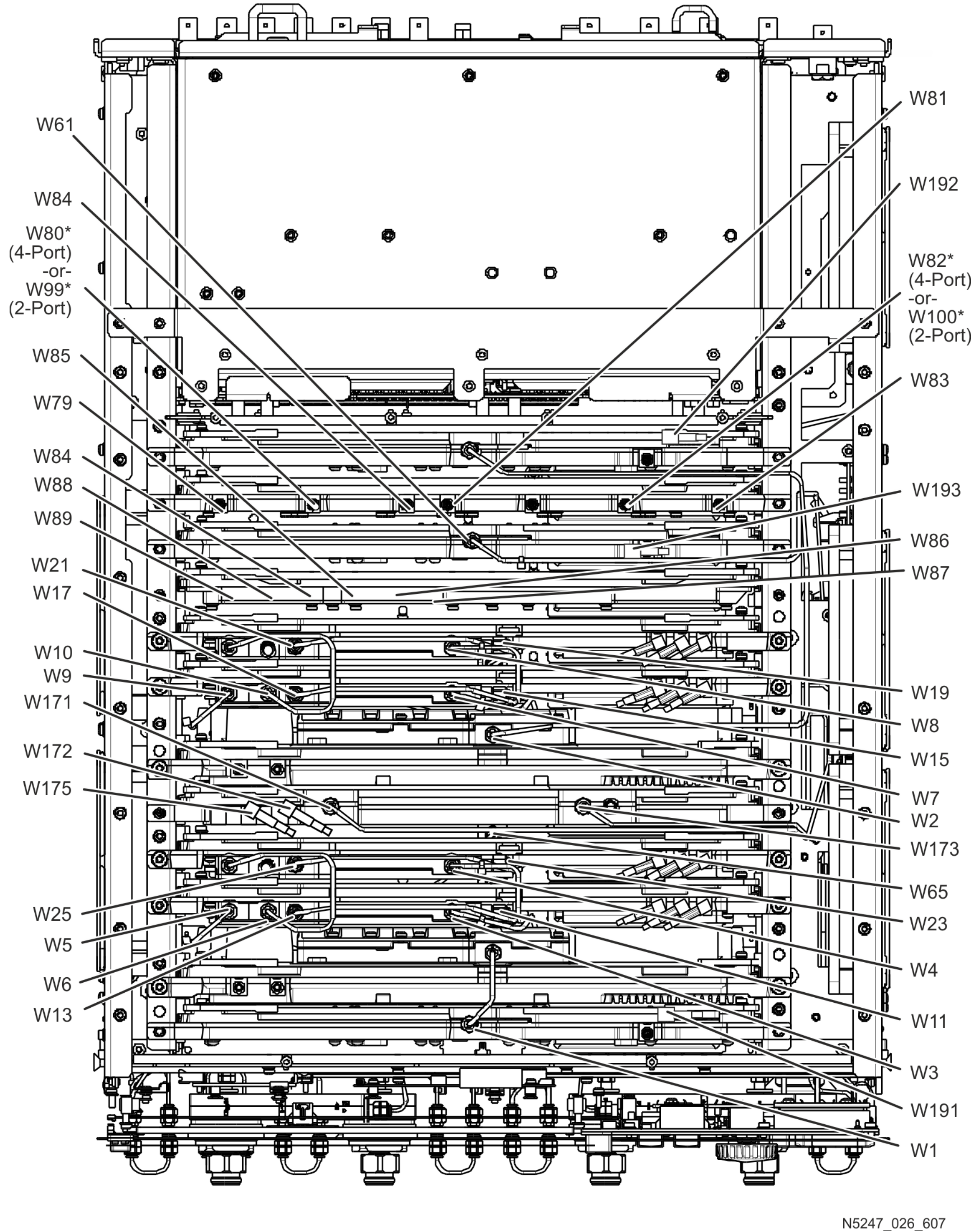
Top Cables, All Cables—All Options, S/N Prefixes <6021

Ref. Desig.	Type[a]	Part Number	Qty	Description
W1	SR	N5245-20114	1	A4 13.5 GHz (source 1) synthesizer board J1207 to A5 26.5 GHz source (1) board P1
W2	SR	N5245-20100	1	A10 source (2) P1 to A17 13.5 GHz source (2) synthesizer J1207 (On 2-port models, W2 is included only with Option 224.)
W3	SR	N5245-20034	1	A5 source (1) P5 to A7 port 1 40 GHz doubler P1
W4	SR	N5247-20125	1	A5 source (1) P3 to A8 port 2 40 GHz doubler P1
W5	SR	N5245-20032	1	A5 source (1) P4 to A7 port 1 40 GHz doubler P4
W6	SR	N5245-20033	1	A7 port 1 40 GHz doubler P3 to A8 port 2 40 GHz doubler P4
W7	SR	N5245-20034	1	A10 source (2) P5 to A12 port 3 40 GHz doubler P1 (On 2-port models, W7 is included only with Option 224.)
W8	SR	N5247-20125	1	A10 source (2) P3 to A13 port 4 40 GHz doubler P1 (On 2-port models, W8 is included only with Option 224.)
W9	SR	N5245-20032	1	A10 source (2) P4 to A12 port 3 40 GHz doubler P4
W10	SR	N5245-20033	1	A12 port 3 40 GHz doubler P3 to A13 port 4 40 GHz doubler P4 (On 2-port models, W10 is included only with Option 224.)
W11	SR	N5247-20114	1	A7 port 1 40 GHz doubler P6 to W12
W13	SR	N5247-20086	1	A7 port 1 40 GHz doubler P2 to W14
W15	SR	N5247-20114	1	A12 port 3 40 GHz doubler P6 to W16. (On 2-port models, W15 is included only with Option 224.)
W17	SR	N5247-20086	1	A12 port 3 doubler P2 to W18 (On 2-port models, W17 is included only with Option 224.)
W19	SR	N5247-20114	1	A13 port 4 40 GHz doubler P6 to W20 (On 2-port models, W19 is included only with Option 224.)
W21	SR	N5247-20086	1	A13 port 4 40 GHz doubler P2 to W22 (On 2-port models, W21 is included only with Option 224.)
W23	SR	N5247-20114	1	A8 port 2 40 GHz doubler P6 to W24
W25	SR	N5247-20086	1	A8 port 2 40 GHz doubler P2 to W26
W61	SR	N5240-20125[b] Was:N5247-20110	1	A15 13.5 GHz (LO) synthesizer board J1207 to A25 HMA26.5
W65	SR	N5247-20113	1	A7 port 1 40 GHz doubler P5 to W66
W67	SR	N5247-20096	1	A12 port 3 40 GHz doubler P5 to W68 (On 2-port models, W67 is included only with Option 224.)
W79	F	N5242-60012	1	A24 IF multiplexer board P3 to A16 SPAM board J1

Ref. Desig.	Type[a]	Part Number	Qty	Description
W80	F	N5242-60014	1	A24 IF multiplexer board P403 to A16 SPAM board J4 (SPAM 5, 4-Port)
W82	F	N5242-60015	1	A24 IF multiplexer board P603 to A16 SPAM board J5 (SPAM 5, 4-port))
W83	F	N5242-60016	1	A24 IF multiplexer board P803 to A16 SPAM board J6
W84	F	N5242-60027	1	A14 frequency reference board J4 to A16 SPAM board J3
W85	F	N5242-60028	1	A14 frequency reference board J5 to A15 13.5 GHz (LO) synthesizer board J5
W86	F	N5242-60029	1	A14 frequency reference board J6 to A4 13.5 GHz (source 1) synthesizer board J5
W87	F	N5242-60030	1	A14 frequency ref (J7) to A17 13.5 GHz (source 2) Synth (J5) (On 2-port models, W87 is included only with Option 224.)
W88	F	8120-5063	2	A14 frequency reference board J3 to rear-panel 10 MHz REF OUT
W89				A14 frequency reference board J2 to rear-panel 10 MHz REF IN
W149	F	N5247-60023	1	A24 IF multiplexer board P603 to A16 SPAM board J2 (SPAM 5, 2-Port)
W150	F	N5247-60024	1	A24 IF multiplexer board P203 to A16 SPAM board J5 (SPAM 5, 2-Port)
W171	SR	N5247-20144	1	A59 noise receiver (downconverter) to A9 noise board (Option 029 only)
W172	F	N5245-60020	1	A9 noise board J1 to A59 noise receiver (downconverter) J3 (Option 029 only)
W173	SR	N5247-20145	1	A59 noise receiver (downconverter) to A9 noise board (Option 029 only)
W175	F	N5245-60019	1	A9 noise board J5 to A59 noise receiver (downconverter) J2 (Option 029 only)
W191	F	N5245-60027	1	Cable, assy RF CA, A70/A75 LFE SRC1 J20 - Synth SRC1 J102
W192	F	N5242-60079	1	Cable, assy RF CA, A70 LFE SRC2 J21 - Synth SRC2 J102
W193	F	N5242-60080	1	Cable, assy RF CA, A70/A75 LFE LO J18 - Synth LO J102

a. SR = semirigid coaxial cable; F = flexible coaxial cable; nR = n wires in a ribbon (flat) cable; nW = n wires in a wire harness
b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, and N5247-20110 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

Figure 6-7 Top Cables, All Cables—All Options, S/N Prefixes <6021



*SPAM 5 boards use W149 & W150 for 2-ports. RF cables W80 & W82 apply to 4-Port models.

Top Assemblies and Cables, All Options, Serial Number Prefixes ≥6021

This section contains the following:

– "Top Assemblies, All Options, S/N Prefixes ≥6021" on page 6-24

– "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28

See also, "Top Assemblies and Cables, All Options, Serial Number Prefixes <6021" on page 6-18.

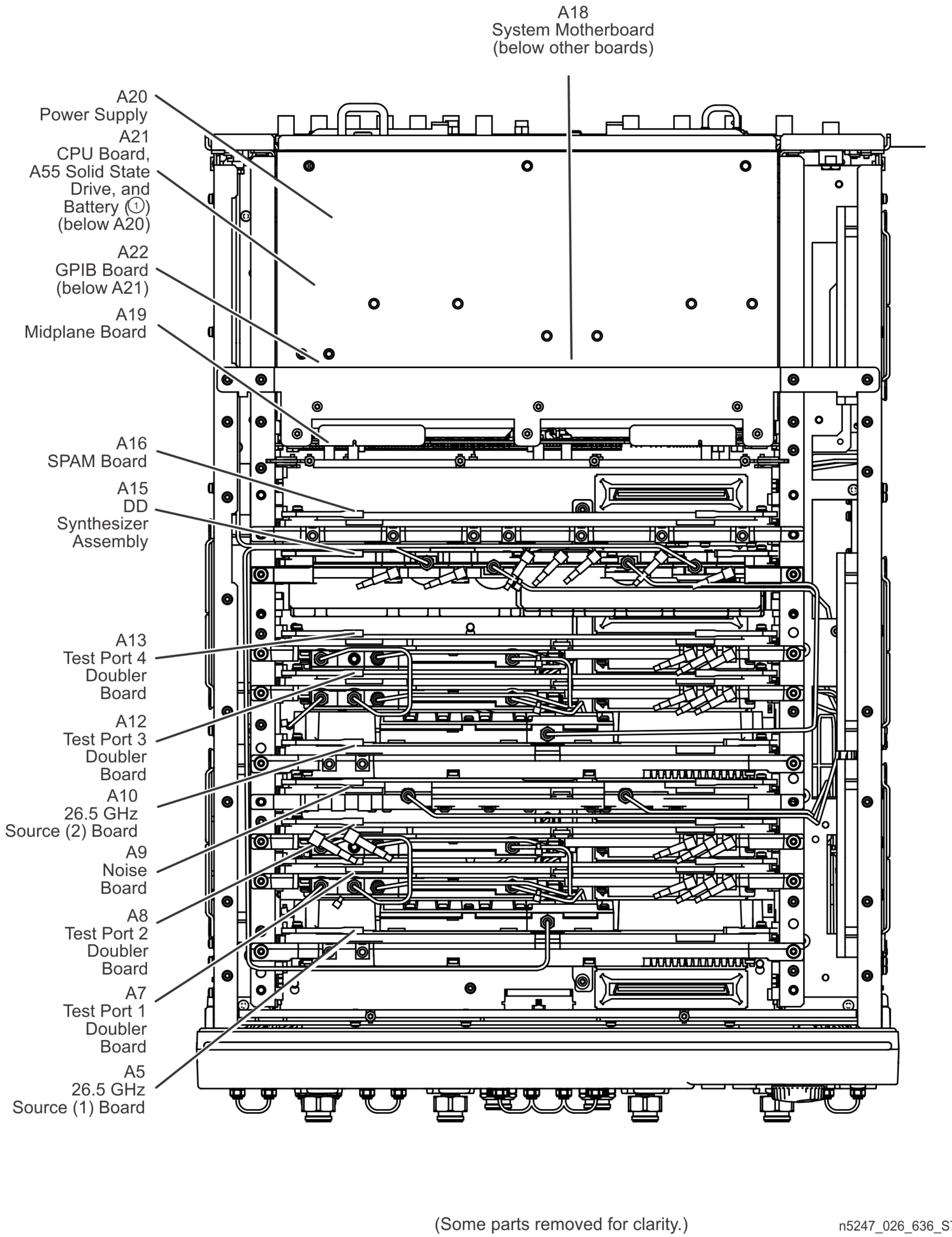
Top Assemblies, All Options, S/N Prefixes ≥6021

Reference	Part Number	Qty	Description
A4			Not used
A5	5087-7780 5087-6780	1	26.5 GHz source (1) board
A6			Not used
A7	5087-7346	1	40 GHz doubler assembly port 1
A8	5087-7346	1	40 GHz doubler assembly port 2
A9	N5245-60124	1	Noise receiver board (Option 029/E29 only)
A10	5087-7780 5087-6780	1	26.5 GHz source (2) board (On 2-port models, this assembly is included only with Option 224.)
A11			Not used
A12	5087-7346	1	40 GHz doubler assembly port 3 (On 2-port models, assembly A12 is included only with Option 224.)
A13	5087-7346	1	40 GHz doubler assembly port 4 (On 2-port models, assembly A13 is included only with Option 224.)
A14			not used
A15	N5240-60102 *N5240-69102* N5240-60223 *N5240-69223* N5240-60222 *N5240-69222*	1	Assy, DD 4x Synthesizer (for Options 423) Assy, DD 3x Synthesizer (for Options 22x, 40x, 41x, 425) Assy, DD 2x Synthesizer (for Options 20x, 21x)
A16	N5240-60077 Was N5240-60056	1	Signal Processing ADC Module (SPAM) board
A17			not used
A18	N5247-60002	1	System motherboard
A19	W1312-60376	1	Midplane board
A20	0950-4934	1	Power supply

Reference	Part Number		Qty	Description
A21 (See critical note)	Version 8	W1312-60522	1	CPU board assembly[a]
	Version 7	W1312-60213 Was:W1312-60211 Was: W1312-60210	1	
A22		N5240-60059	1	GPIB board
A55[b]	Version 8	N5242-60136	1	Solid state drive (SSD) for Windows 10 Operating System- to be used with the Version 8 System CPU[c]
	Version 7	N5242-60135		Solid state drive (SSD) for Windows 10 Operating System- to be used with the Version 7 System CPU[c]
	Version 7	N8985A[d]		Solid state drive (SSD) upgrade for Windows 10 Operating System- to be used with the Version 7 System CPU[c]
	Version 7	N5242-60134		Solid state drive (SSD) for Windows 7 Operating System- to be used with the Version 7 System CPU[c]
①		1420-0356	1	Battery, lithium manganese dioxide, 3V, 0.22A-hr.[e]

a. For the latest information on CPUs and associated drives, visit: https://www.keysight.com/us/en/assets/9922-01369/miscellaneous/PNA-Hard-Drives-and-CPUs.pdf.
b. The A55 solid state disk drive for the 2.2 GHz CPU board plugs into the A21 CPU board assembly from the rear panel. Refer to “Removing and Replacing the A55 Solid State Drive (SSD)” on page 7-60 for an illustration.
c. You can learn your System CPU version using the PNA software. On the PNA front panel, press **Help** > **About Network Analyzer**. In the window displayed, find “System CPU Version.”
d. For more information on the N8985A SSD, refer to the Windows 10 Operating System Upgrade Kit Installation Note, available online at https://www.keysight.com/us/en/assets/9018-04733/installation-guides/9018-04733.pdf (N8985-90001).
e. The lithium battery is located inside the A21 CPU board assembly. Refer to “Removing and Replacing the Lithium Battery” on page 7-90 for an illustration.

Figure 6-8 Top Assemblies, All Options, S/N Prefixes ≥6021



Top Cables, All Cables—All Options, S/N Prefixes ≥6021

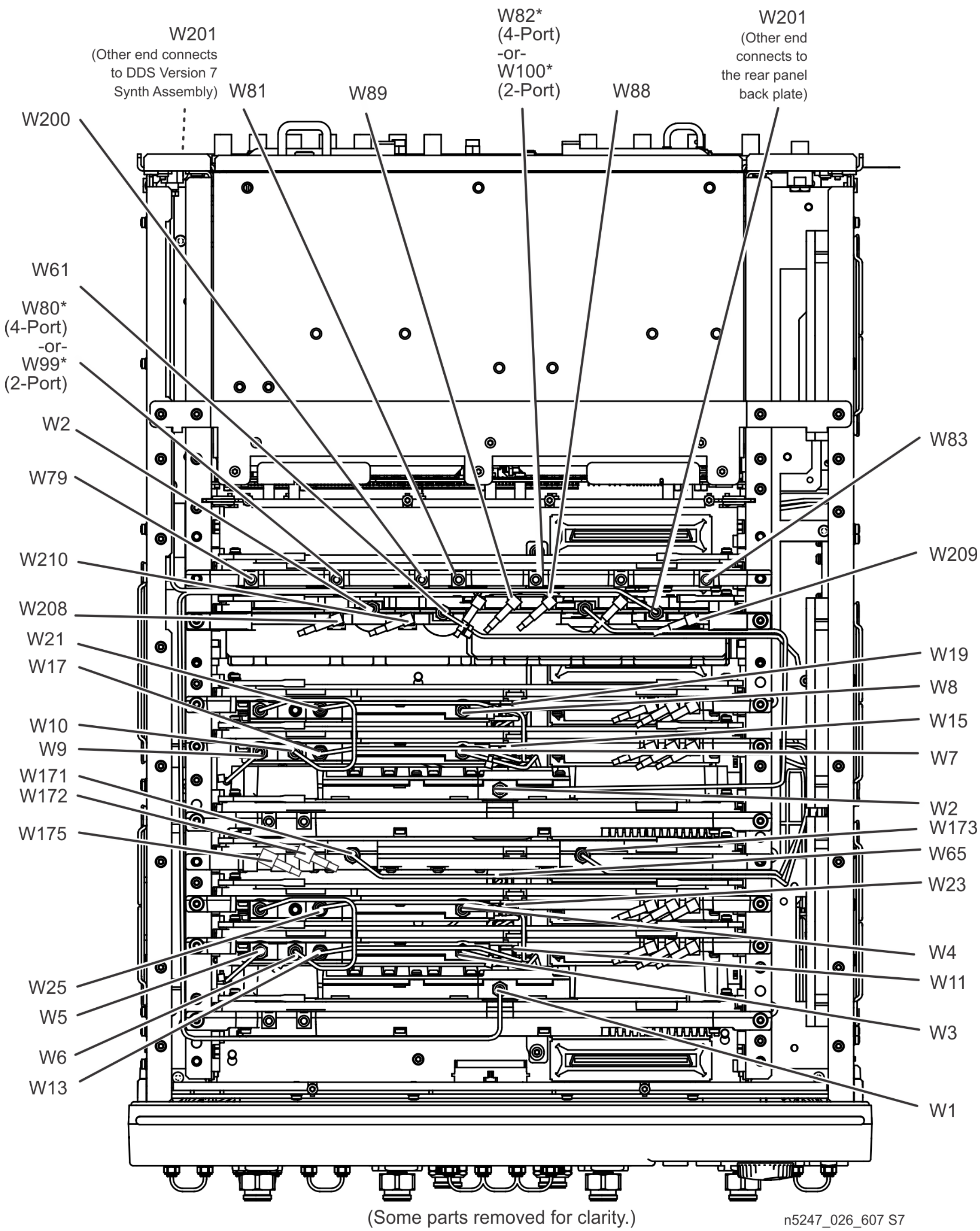
Ref. Desig.	Type[a]	Part Number	Qty	Description
W1	SR	N5240-20124	1	A15 13.5 GHz (source 1) DD synthesizer board (J4) to A5 26.5 GHz (source 1) board SRC 1 RF IN
W2	SR	N5240-20126	1	A15 13.5 GHz (source 2) DD synthesizer board (J6) to A10 26.5 GHz source (2) board SRC 2 – (On 2-port models, W2 is included only with Option 224.)
W3	SR	N5245-20034	1	A5 source (1) P5 to A7 port 1 40 GHz doubler P1
W4	SR	N5247-20125	1	A5 source (1) P3 to A8 port 2 40 GHz doubler P1
W5	SR	N5245-20032	1	A5 source (1) P4 to A7 port 1 40 GHz doubler P4
W6	SR	N5245-20033	1	A7 port 1 40 GHz doubler P3 to A8 port 2 40 GHz doubler P4
W7	SR	N5245-20034	1	A10 source (2) P5 to A12 port 3 40 GHz doubler P1 (On 2-port models, W7 is included only with Option 224.)
W8	SR	N5247-20125	1	A10 source (2) P3 to A13 port 4 40 GHz doubler P1 (On 2-port models, W8 is included only with Option 224.)
W9	SR	N5245-20032	1	A10 source (2) P4 to A12 port 3 40 GHz doubler P4
W10	SR	N5245-20033	1	A12 port 3 40 GHz doubler P3 to A13 port 4 40 GHz doubler P4 (On 2-port models, W10 is included only with Option 224.)
W11	SR	N5247-20114	1	A7 port 1 40 GHz doubler P6 to W12
W13	SR	N5247-20086	1	A7 port 1 40 GHz doubler P2 to W14
W15	SR	N5247-20114	1	A12 port 3 40 GHz doubler P6 to W16. (On 2-port models, W15 is included only with Option 224.)
W17	SR	N5247-20086	1	A12 port 3 doubler P2 to W18 (On 2-port models, W17 is included only with Option 224.)
W19	SR	N5247-20114	1	A13 port 4 40 GHz doubler P6 to W20 (On 2-port models, W19 is included only with Option 224.)
W21	SR	N5247-20086	1	A13 port 4 40 GHz doubler P2 to W22 (On 2-port models, W21 is included only with Option 224.)
W23	SR	N5247-20114	1	A8 port 2 40 GHz doubler P6 to W24
W25	SR	N5247-20086	1	A8 port 2 40 GHz doubler P2 to W26
W61	SR	N5240-20125[b] Was:N5247-20110	1	A15 13.5 GHz LO synthesizer board J5 to A25 HMA26.5
W65	SR	N5247-20113	1	A7 port 1 40 GHz doubler P5 to W66
W67	SR	N5247-20096	1	A12 port 3 40 GHz doubler P5 to W68 (On 2-port models, W67 is included only with Option 224.)

Ref. Desig.	Type[a]	Part Number	Qty	Description
W79	F	N5242-60012	1	A24 IF multiplexer board P3 to A16 SPAM board J1
W80	F	N5242-60014	1	A24 IF multiplexer board P403 to A16 SPAM board J4 (SPAM 5, 4-Port)
W82	F	N5242-60015	1	A24 IF multiplexer board P603 to A16 SPAM board J5 (SPAM 5, 4-port))
W83	F	N5242-60016	1	A24 IF multiplexer board P803 to A16 SPAM board J6
W88	F	8120-5063	2	A15 DD synthesizer board J10 to rear-panel REF OUT
W89				A15 DD synthesizer board J9 to rear-panel REF IN
W149	F	N5247-60023	1	A24 IF multiplexer board P603 to A16 SPAM board J2 (SPAM 5, 2-Port)
W150	F	N5247-60024	1	A24 IF multiplexer board P203 to A16 SPAM board J5 (SPAM 5, 2-Port)
W171	SR	N5247-20144	1	A59 noise receiver (downconverter) to A9 noise board (Option 029/E29 only)
W172	F	N5245-60020	1	A9 noise board J1 to A59 noise receiver (downconverter) J3 (Option 029/E29 only)
W173	SR	N5247-20145	1	A59 noise receiver (downconverter) to A9 noise board (Option 029/E29 only)
W175	F	N5245-60019	1	A9 noise board J5 to A59 noise receiver (downconverter) J2 (Option 029/E29 only)
W200	F	N5240-60115	1	A15 SRC DD synth J16 to SPAM J3
W201	SR	N5240-20127	1	A15 DD synth J7 to rear panel Source 3 Out - (Option 422/423 Only)
W208	F	N5240-60112	1	A70/A75 LFE board to A15 DD Synth Source 1 J12 to A70 LFE J20
W209	F	N5240-60114	1	A70 LFE board to A15 DD Synth Source 2 J14 to A70 LFE J21
W210	F	N5240-60113	1	A70/A75 LFE board to A15 DD Synth LO J13 to A70 LFE J18

a. SR = semirigid coaxial cable; F = flexible coaxial cable; nR = n wires in a ribbon (flat) cable; nW = n wires in a wire harness

b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, and N5247-20110 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184, and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

Figure 6-9 Top Cables, All Cables—All Options, S/N Prefixes ≥6021



*SPAM 5 boards use W149 & W150 for 2-ports. RF cables W80 & W82 apply to 4-Port models.

2-Port Configurations, Serial Number Prefixes <6021

This section contains the following:

See also, "2-Port Configurations, Serial Number Prefixes ≥6021" on page 6-58.

2-Port Configuration, Option 201, S/N Prefixes <6201

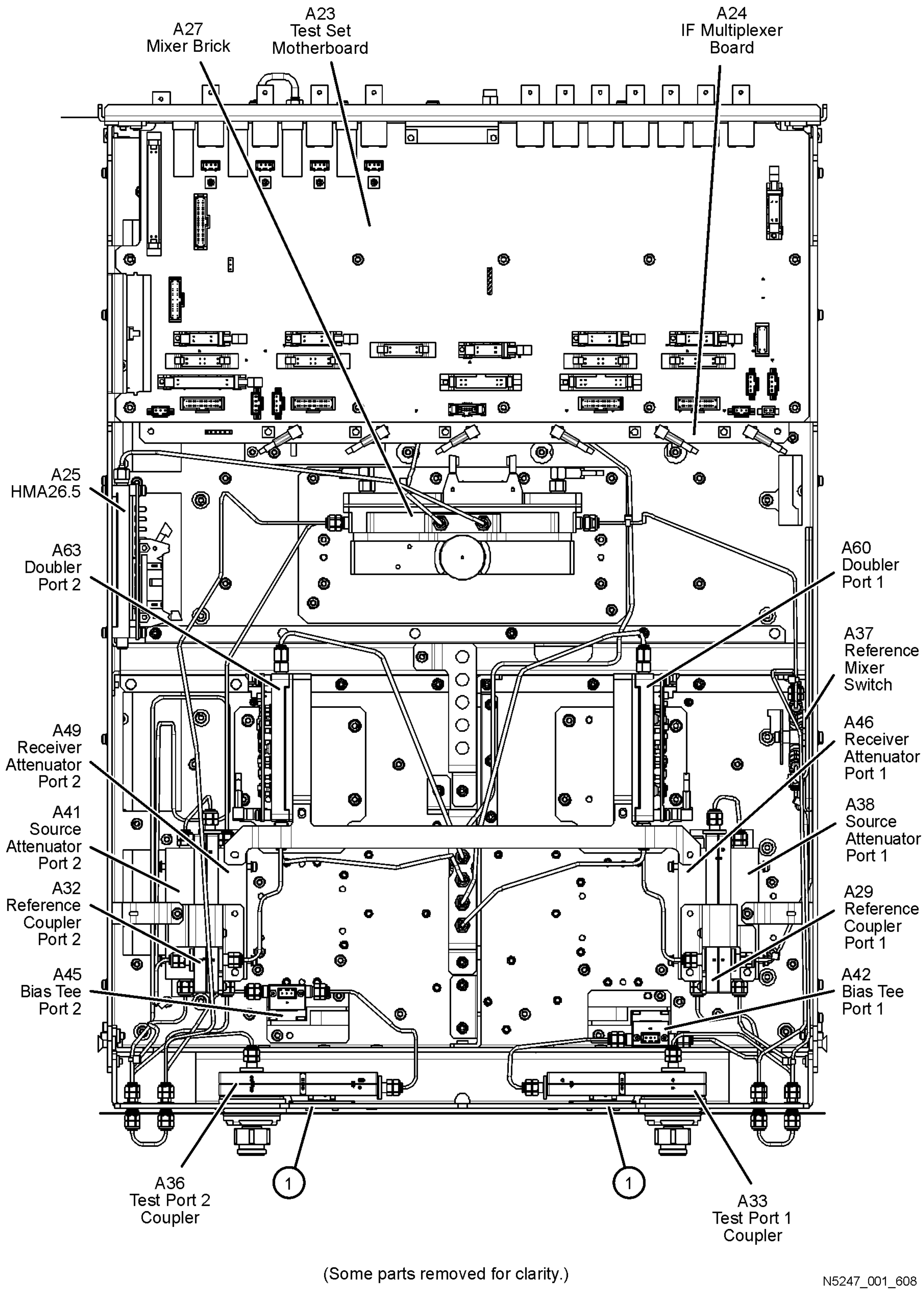
Bottom Assemblies, Standard 2-Port Configuration, Option 201, S/N Prefixes <6201

Reference Designator	Part Number[a]	Qty	Description
A23	N5245-60157 Was N5247-60001	1	Test set motherboard
A24	N5240-60062[b] was:N5240-60045	1	IF multiplexer board
A25	N5240-60101 Was:5087-7765	1	LO Multiplier/amplifier 26.5 (HMA26.5)
A27	5087-7337	1	Mixer brick
A29 A32	5087-7744	2	Test port 1 reference coupler Test port 2 reference coupler
A33 A36	5087-7778	2	Test port 1 coupler Test port 2 coupler
A37	5087-7759	1	Reference mixer switch
A60 A63	5087-7336	2	70 GHz doubler assembly port 1 70 GHz doubler assembly port 2
①	N5240-60058	2	front-panel LED board

a. Part numbers in italic typeface are for rebuilt exchange assemblies. Refer to "Rebuilt-Exchange Assemblies" on page 6-4.

b. All new units built after August 2009, no longer use the N5242-60031 cable that was attached to connector P1001 and Source 2. As a result of this change, the IF multiplexer boards have had their P1001 connectors removed. If your instrument contains a N5242-60031 cable, remove it from your instrument.

Figure 6-10 Bottom Assemblies, Standard 2-Port Configuration, Option 201, S/N Prefixes <6201



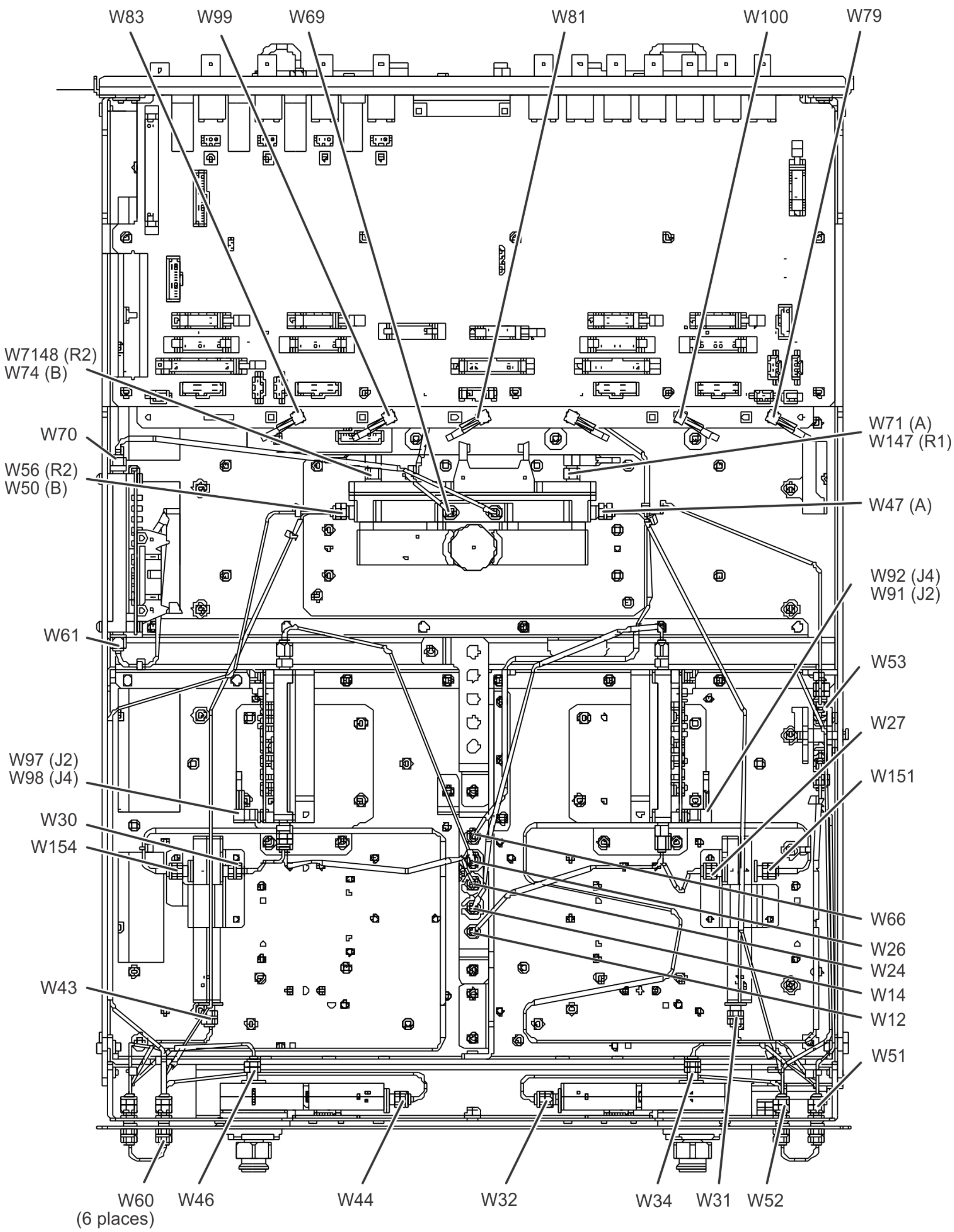
Bottom RF Cables, Standard 2-Port Configuration, Option 201, S/N Prefixes <6201

Reference Designator	Type[a]	Part Number	Qty	Description
W12	SR	N5247-20059	1	A60 port 1 70 GHz doubler to W11
W14	SR	N5247-20072	1	A60 port 1 70 GHz doubler to W13
W24	SR	N5247-20061	1	A63 port 2 70 GHz doubler to W23
W26	SR	N5247-20051	1	A63 port 2 70 GHz doubler to W25
W27	SR	N5247-20074	1	A60 port 1 70 GHz doubler to A29 port 1 reference coupler
W30	SR	N5247-20052	1	A63 port 2 70 GHz doubler to A32 port 2 reference coupler
W31	SR	N5247-20037	1	A29 port 1 ref coupler to front-panel port 1 SOURCE OUT
W32	SR	N5247-20049	1	Port 1 CPLR THRU to A33 port 1 coupler
W34	SR	N5247-20039	1	A33 port 1 coupler to front-panel port 1 CPLR ARM
W43	SR	N5247-20036	1	A32 port 2 ref coupler to front-panel port 2 SOURCE OUT
W44	SR	N5247-20050	1	Port 2 CPLR THRU to A36 port 2 coupler
W46	SR	N5247-20041	1	A36 port 2 coupler to front-panel port 2 CPLR ARM
W47	SR	N5247-20053	1	Port 1 RCVR A IN to A27 mixer brick (A)
W50	SR	N5247-20054	1	front-panel port 2 RCVR B IN to A27 mixer brick (B)
W51	SR	N5247-20011	1	Front-panel REF 1 SOURCE OUT to A37 ref mixer switch
W52	SR	N5247-20012	1	REF 1 RCVR R1 IN to A37 reference mixer switch
W53	SR	N5247-20048	1	A37 reference mixer switch to A27 mixer brick (R1)
W56	SR	N5247-20055	1	REF 2 RCVR R2 IN to A27 mixer brick (R2)
W60	SR	N5247-20107	6	front-panel jumper
W61	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21.		
W66	SR	N5247-20109	1	W65 to rear-panel EXT TSET DRIVE RF OUT (J6)
W69	SR	N5247-20112	1	A27 mix brick to r. panel EXT TSET DRIVE LO OUT (J5)
W70[b]	SR	N5247-20100	1	A25 HMA26.5 to A27 mixer brick
W71	F	N5242-60017	1	A27 mixer brick (A) to A24 IF multiplexer (P1)
W74	F	N5242-60018	1	A27 mixer brick (B) to A24 IF multiplexer (P201)
W79-83	F	Refer to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21.		
W91	F	N5247-60006	1	A60 port 1 70 GHz doubler J2 to A7 40 GHz doubler J401

Reference Designator	Type[a]	Part Number	Qty	Description
W92	F	N5247-60007	1	A60 port 1 70 GHz doubler J4 to A7 40 GHz doubler J500
W97	F	N5247-60008	1	A63 port 2 70 GHz doubler J2 to A8 40 GHz doubler J401
W98	F	N5247-60009	1	A63 port 2 70 GHz doubler J4 to A8 40 GHz doubler J500
W147	F	N5242-60025	1	A27 mixer brick (R1) to A24 IF multiplexer (P601)
W148	F	N5242-60026	1	A27 mixer brick (R2) to A24 IF multiplexer (P801)
W149 & W150	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21.		
W151	SR	N5247-20056	1	A29 port 1 reference coupler to A37 reference mixer switch
W154	SR	N5247-20057	1	A32 port 2 ref coupler to front-panel REF 2 SOURCE OUT

a. SR = semirigid coaxial cable; F = flexible coaxial cable
b. On legacy instruments using the 5087-7765 HMA26.5, the N5245-20100 cable is used only on 2-port instruments. On instruments with a new HMA26.5 the N5245-20100 cable is used in all instruments. If you are unclear which HMA26.5 assembly your PNA has installed, refer to "Verify the Model/Version of HMA26.5 Installed" on page 7-40 and to Figure 7-17 on page 40.

Figure 6-11 Bottom RF Cables, Standard 2-Port Configuration, Option 201, S/N Prefixes <6201



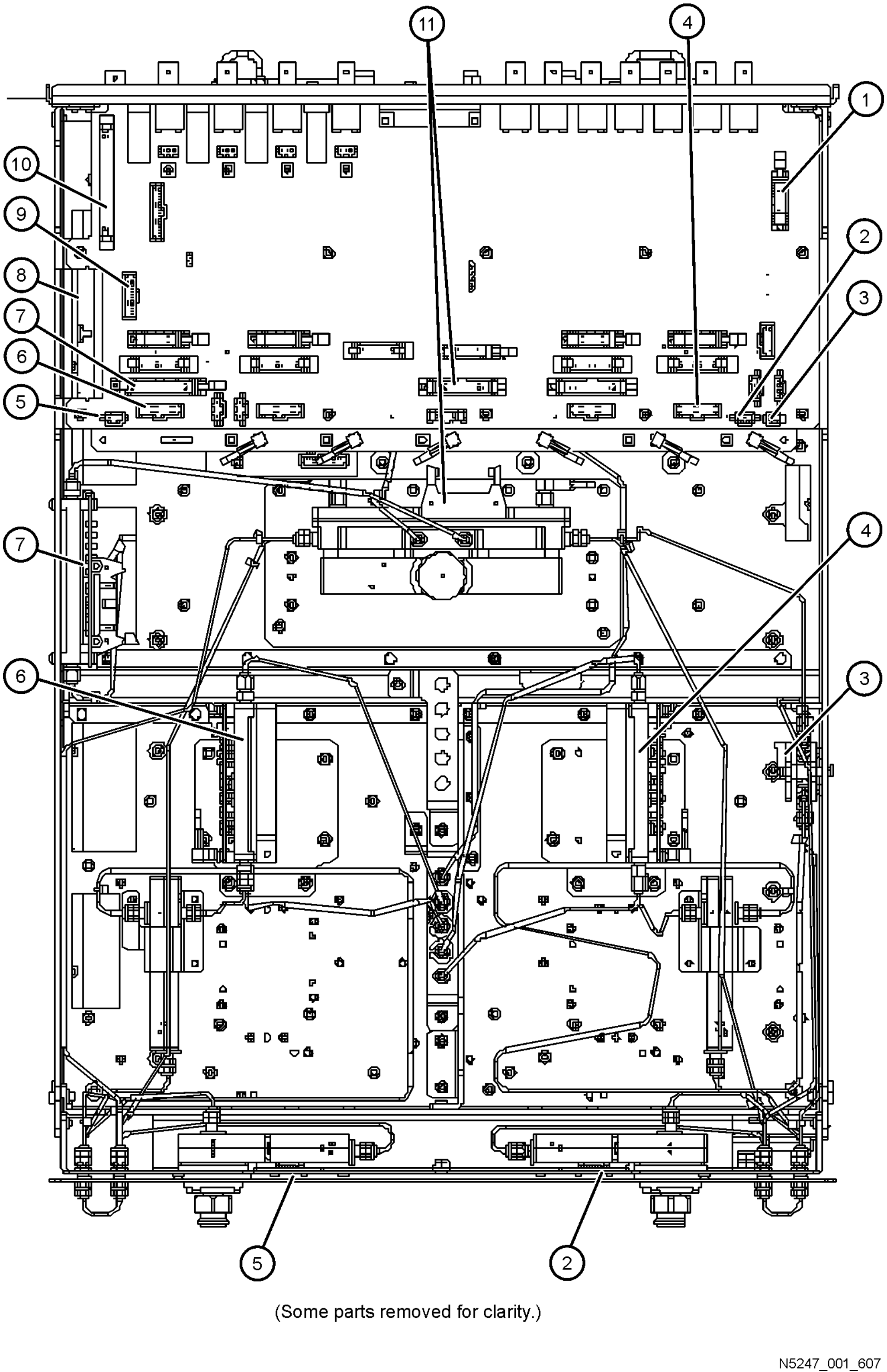
*SPAM 5 boards use W149 & W150 for 2-ports. RF cables W80 & W82 apply to 4-Port models (not shown). See also "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21.

Bottom Ribbon Cables and Wire Harnesses, 2-Port, Option 201, S/N Prefixes <6201

Reference Designator	Type[a]	Part Number	Description
①	10R	N5242-60005	rear-panel PWR I/O to A23 test set motherboard J301
②	3W	N5247-60016	A23 test set motherboard J221 to ports 1 LED board J1
③	2W	8121-0966	A23 test set motherboard J554 to A37 reference mixer switch
④	30R	N5247-60018	A60 port 1 70 GHz doubler J1 to A23 test set motherboard J4
⑤	3W	N5247-60016	A23 test set motherboard J222 to ports 2 LED board J1
⑥	30R	N5247-60018	A63 port 2 70 GHz doubler J1 to A23 test set motherboard J6
⑦	24R	N5247-60022	A23 test set motherboard J209 to A25 HMA26.5 J1
⑧	100R	N5242-60004	A18 system motherboard J1 to A23 test set motherboard J1 to A24 IF multiplexer board J1
⑨	25R	E4410-60160	A18 system motherboard J13 to A23 test set motherboard J545
⑩	36R	8121-0834	rear-panel HANDLER I/O to A23 test set motherboard J400
⑪	20R	N5247-60014	A23 test set motherboard J551 to A27 mixer brick (1) J52

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

Figure 6-12 Bottom Ribbon Cables and Wire Harnesses, Standard 2-Port Configuration, Option 201, S/N Prefixes <6201



(Some parts removed for clarity.)

2-Port Configuration, Option 219, S/N Prefixes <6201

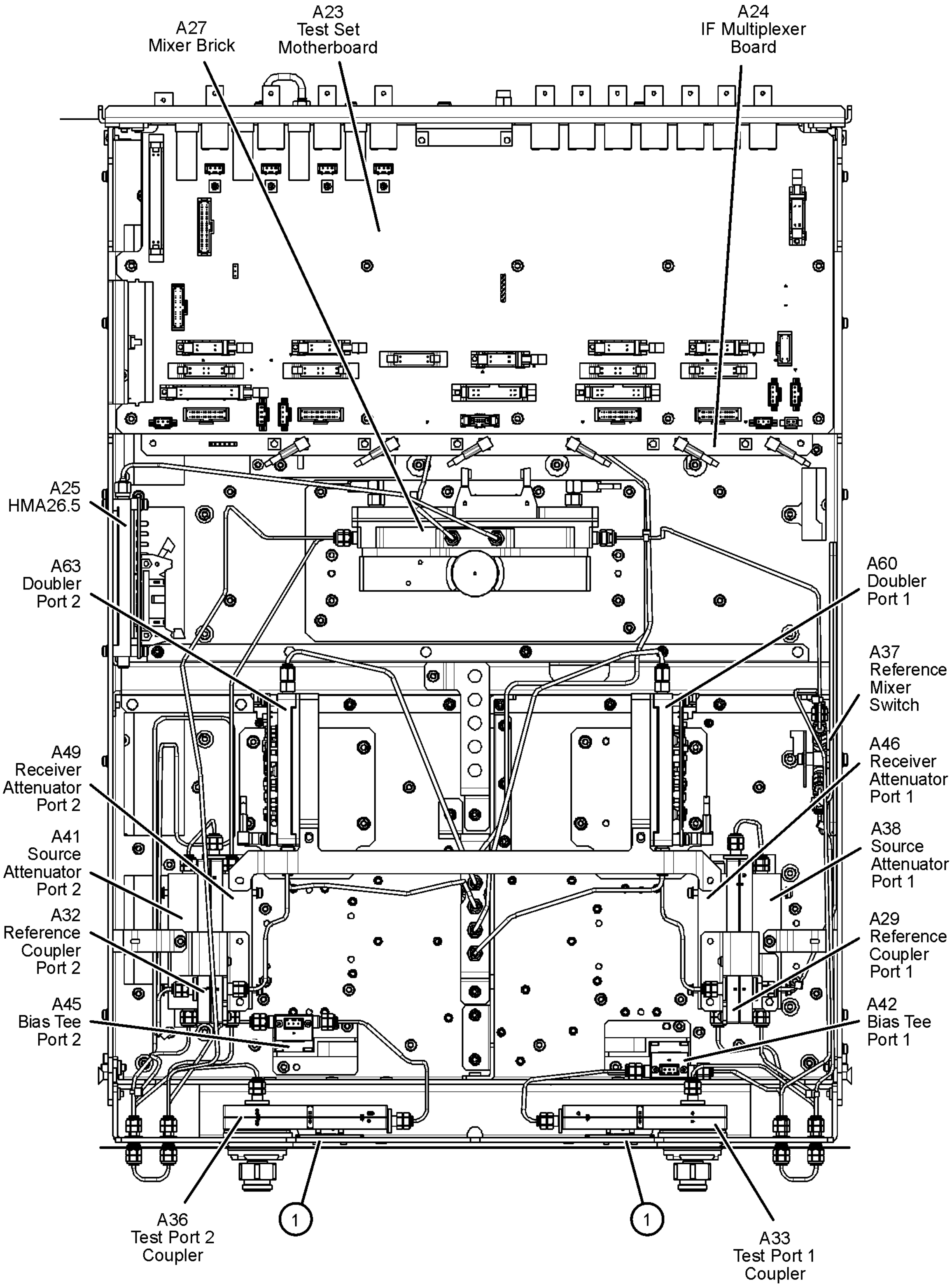
Bottom Assemblies, 2-Port Configuration, Options 219, S/N Prefixes <6201

Reference Designator	Part Number[a]	Qty	Description
A23	N5245-60157 Was N5247-60001	1	Test set motherboard
A24	N5240-60062[b] Was: N5240-60045	1	IF multiplexer board
A25	N5240-60101 Was:5087-7765	1	LO Multiplier/amplifier 26.5 (HMA26.5)
A27	5087-7337	1	Mixer brick
A29 A32	5087-7744	2	Test port 1 reference coupler Test port 2 reference coupler
A33 A36	5087-7778	2	Test port 1 coupler Test port 2 coupler
A37	5087-7759	1	Reference mixer switch
A38 A41	84905-60004 was: 84905-60002	2	Test port 1 source attenuator Test port 2 source attenuator
A42 A45	5087-7732 Was 5086-7020	2	Test port 1 bias tee Test port 2 bias tee
A46 A49	84905-60004 was: 84905-60002	2	Port 1 receiver attenuator Port 2 receiver attenuator
A60 A63	5087-7336	2	70 GHz doubler assembly port 1 70 GHz doubler assembly port 2
①	N5240-60058	2	front-panel LED board

a. Part numbers in italic typeface are for rebuilt exchange assemblies. Refer to “Rebuilt-Exchange Assemblies” on page 6-4.

b. All new units built after August 2009, no longer use the N5242-60031 cable that was attached to connector P1001 and Source 2. As a result of this change, the IF multiplexer boards have had their P1001 connectors removed. If your instrument contains a N5242-60031 cable, remove it from your instrument.

Figure 6-13 Bottom Assemblies, 2-Port, Options 219, S/N Prefixes <6201



(Some parts removed for clarity.)

N5247_001_608

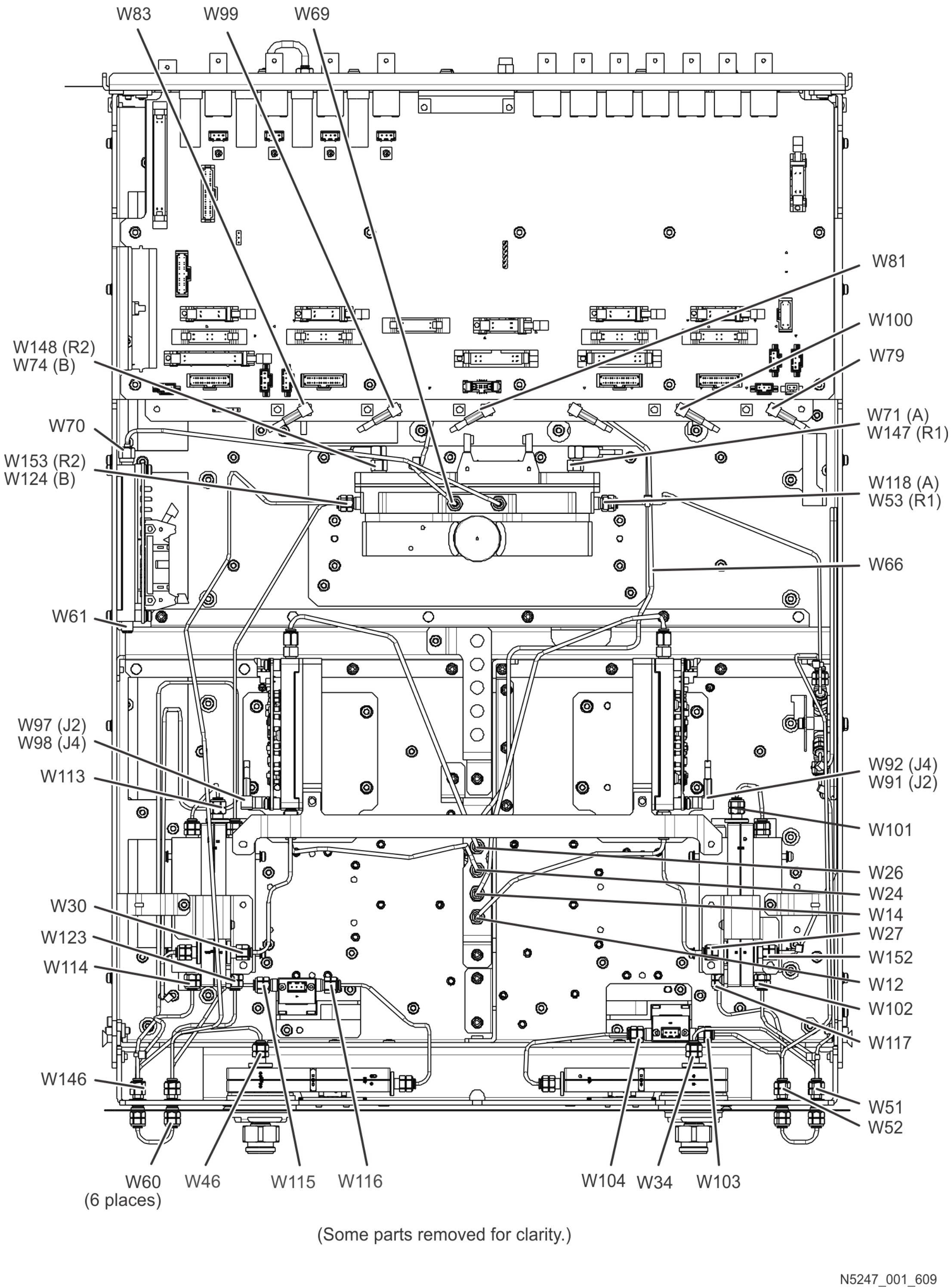
Bottom RF Cables, 2-Port, Options 219, S/N Prefixes <6201

Reference Designator	Type[a]	Part Number	Qty	Description
W12	SR	N5247-20059	1	A60 port 1 70 GHz doubler to W11
W14	SR	N5247-20072	1	A60 port 1 70 GHz doubler to W13
W24	SR	N5247-20061	1	A63 port 2 70 GHz doubler to W23
W26	SR	N5247-20051	1	A63 port 2 70 GHz doubler to W25
W27	SR	N5247-20044	1	A60 port 1 70 GHz doubler to A29 port 1 reference coupler
W30	SR	N5247-20043	1	A63 port 2 70 GHz doubler to A32 port 2 reference coupler
W34	SR	N5247-20039	1	A33 port 1 coupler to front-panel REF 1 CPLR ARM
W46	SR	N5247-20041	1	A36 port 2 coupler to front-panel port 2 CPLR ARM
W51	SR	N5247-20011	1	Front-panel REF 1 SOURCE OUT to A37 ref mixer switch
W52	SR	N5247-20012	1	REF 1 RCVR R1 IN to A37 reference mixer switch
W53	SR	N5247-20048	1	A37 reference mixer switch to A27 mixer brick (R1)
W60	SR	N5247-20107	6	front-panel jumper
W61	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21.		
W66	SR	N5247-20109	1	W65 to rear-panel EXT TSET DRIVE RF OUT (J6)
W69	SR	N5247-20112	1	A27 mix brick to r. panel EXT TSET DRIVE LO OUT (J5)
W70[b]	SR	N5247-20100	1	A25 HMA26.5 to A27 mixer brick
W71	F	N5242-60017	1	A27 mixer brick (A) to A24 IF multiplexer (P1)
W74	F	N5242-60018	1	A27 mixer brick (B) to A24 IF multiplexer (P201)
W79-83	F	Refer to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21.		
W91	F	N5247-60006	1	A60 port 1 70 GHz doubler J2 to A7 40 GHz doubler J401
W92	F	N5247-60007	1	A60 port 1 70 GHz doubler J4 to A7 40 GHz doubler J500
W97	F	N5247-60008	1	A63 port 2 70 GHz doubler J2 to A8 40 GHz doubler J401
W98	F	N5247-60009	1	A63 port 2 70 GHz doubler J4 to A8 40 GHz doubler J500
W101	SR	N5247-20083	1	A29 port 1 reference coupler to A38 port 1 source attenuator
W102	SR	N5247-20014	1	A38 port 1 source attenuator to front-panel port 1 SOURCE OUT
W103	SR	N5247-20081	1	Front-panel port 1 CPLR THRU to A42 port 1 bias tee
W104	SR	N5247-20040	1	A33 port 1 coupler to A42 port 1 bias tee
W113	SR	N5247-20083	1	A32 port 2 reference coupler to A41 port 2 source attenuator
W114	SR	N5247-20034	1	A41 port 2 source attenuator to front-panel port 2 SOURCE OUT

Reference Designator	Type[a]	Part Number	Qty	Description
W115	SR	N5247-20027	1	Front-panel port 2 CPLR THRU to A45 port 2 bias tee
W116	SR	N5247-20042	1	A36 port 2 coupler to A45 port 2 bias tee
W117	SR	N5247-20013	1	Front-panel port 1 RCVR A IN to A46 port 1 receiver attenuator
W118	SR	N5247-20047	1	A46 port 1 receiver attenuator to A27 mixer brick (A)
W123	SR	N5247-20020	1	Port 2 RCVR B IN to A49 port 2 receiver attenuator
W124	SR	N5247-20046	1	A49 port 2 receiver attenuator to A27 mixer brick (B)
W146	SR	N5247-20058	1	A32 port 2 ref coupler to front-panel REF 2 SOURCE OUT
W147	F	N5242-60025	1	A27 mixer brick (R1) to A24 IF multiplexer (P601)
W148	F	N5242-60026	1	A27 mixer brick (R2) to A24 IF multiplexer (P801)
W149 & W150	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21.		
W152	SR	N5247-20079	1	A29 port 1 reference coupler to A37 reference mixer switch
W153	SR	N5247-20045	1	A27 mixer brick (R2) to front-panel REF 2 RCVR R2 IN

a. SR = semirigid coaxial cable; F = flexible coaxial cable
b. On legacy instruments using the 5087-7765 HMA26.5, the N5245-20100 cable is used only on 2-port instruments. On instruments with a new HMA26.5 the N5245-20100 cable is used in all instruments. If you are unclear which HMA26.5 assembly your PNA has installed, refer to "Verify the Model/Version of HMA26.5 Installed" on page 7-40 and to Figure 7-17 on page 40.

Figure 6-14 Bottom RF Cables, 2-Port, Options 219, S/N Prefixes <6201



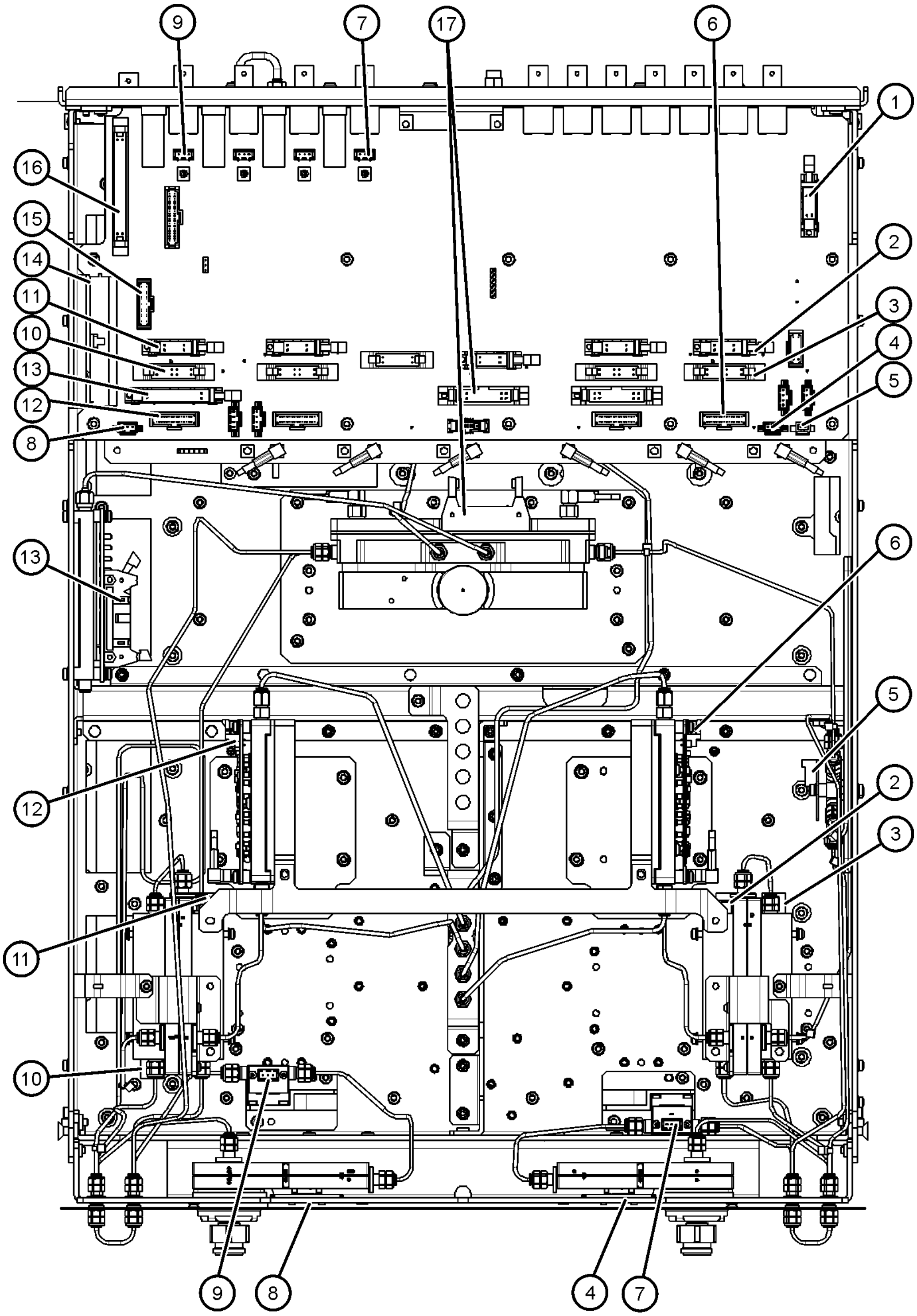
*SPAM 5 boards use W149 & W150 for 2-ports. RF cables W80 & W82 apply to 4-Port models (not shown). See also “Top Cables, All Cables—All Options, S/N Prefixes <6021” on page 6-21.

Bottom Ribbon Cables and Wire Harnesses, 2-Port, Options 219, S/N Prefixes <6201

Reference Designator	Type[a]	Part Number	Description
①	10R	N5242-60005	rear-panel PWR I/O to A23 test set motherboard J301
②	10R	N5247-60020	A23 test set motherboard J205 to A46 port 1 receiver attenuator
③	16R	N5245-60006	A23 test set motherboard J549 to A38 port 1 source attenuator
④	3W	N5247-60016	A23 test set motherboard J221 to port 1 LED board J1
⑤	2W	8121-0966	A23 test set motherboard J554 to A37 reference mixer switch
⑥	30R	N5247-60018	A60 port 1 70 GHz doubler J1 to A23 test set motherboard J4
⑦	2W	N5247-60021	A23 test set motherboard J541 to A42 port 1 bias tee
q	3W	N5247-60016	A23 test set motherboard J222 to port 2 LED board J1
⑨	2W	N5247-60021	A23 test set motherboard J542 to A45 port 2 bias tee
s	16R	N5245-60006	A23 test set motherboard J546 to A41 port 2 source attenuator
⑪	10R	N5247-60020	A23 test set motherboard J208 to A49 port 2 receiver attenuator
⑫	30R	N5247-60018	A63 port 2 70 GHz doubler J1 to A23 test set motherboard J6
⑬	24R	N5247-60022	A23 test set motherboard J209 to A25 HMA26.5 J1
⑭	100R	N5242-60004	A18 system motherboard J1 to A23 test set motherboard J1 to A24 IF multiplexer board J1
⑮	25R	E4410-60160	A18 system motherboard J13 to A23 test set motherboard J545
⑯	36R	8121-0834	rear-panel HANDLER I/O to A23 test set motherboard J400
⑰	20R	N5247-60014	A23 test set motherboard J551 to A27 mixer brick (1) J52

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

Figure 6-15 Bottom Ribbon Cables and Wire Harnesses, 2-Port, Options 219, S/N Prefixes <6201



(Some parts removed for clarity.)

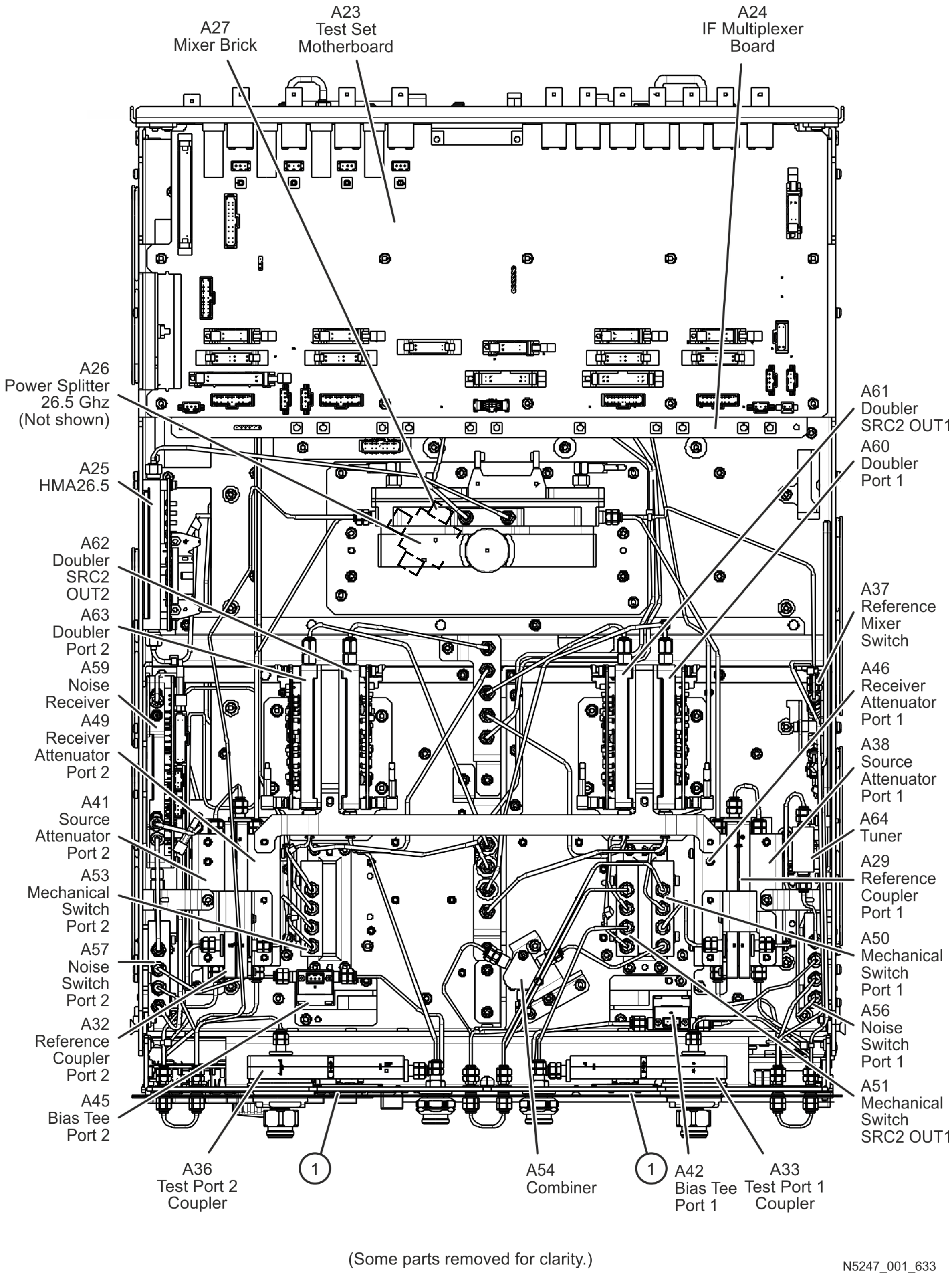
2-Port Configuration, Option 224 with and without Option 029, S/N Prefixes <6201

Bottom Assemblies, 2-Port, Option with and without Option 029, S/N Prefixes <6201

Reference Designator	Part Number[a]	Qty	Description
A23	N5245-60157 Was N5247-60001	1	Test set motherboard
A24	N5240-60062[b] Was: N5240-60045	1	IF multiplexer board[c]
A25	N5240-60101 Was:5087-7765	1	LO Multiplier/amplifier 26.5 (HMA26.5)
A26	5067-4086	1	Power splitter 26.5 GHz (Indicated, but not shown. See also, Figure 7-18 on page 7-42.)
A27	5087-7337	1	Mixer brick
A29 A32	5087-7744	2	Test port 1 reference coupler Test port 2 reference coupler
A33 A36	5087-7778	2	Test port 1 coupler Test port 2 coupler
A37	5087-7759	1	Reference mixer switch
A38 A41	84905-60004 was: 84905-60002	2	Test port 1 source attenuator Test port 2 source attenuator
A42 A45	5087-7732 Was 5086-7020	2	Test port 1 bias tee Test port 2 bias tee
A46 A49	84905-60004 was: 84905-60002	2	Port 1 receiver attenuator Port 2 receiver attenuator
A50 A51 A53	N1811-60010	5	Port 1 mechanical switch SRC2 OUT1 mechanical switch Port 2 mechanical switch
A54	11667-60016	1	Combiner
A56 A57	N1811-60010	5	Port 1 noise bypass switch (Option 029 only) Port 2 noise bypass switch (Option 029 only)
A59	5087-7344	1	noise receiver (downconverter)
A60 A61 A62 A63	5087-7336	4	70 GHz doubler assembly port 1 70 GHz doubler assembly port SRC 2 OUT 1 70 GHz doubler assembly port SRC 2 OUT 2 70 GHz doubler assembly port 2
A64	5087-7345	1	Tuner (Option 029 only)
①	N5240-60058	2	front-panel LED board

a. Part numbers in italic typeface are for rebuilt exchange assemblies. Refer to "Rebuilt-Exchange Assemblies" on page 6-4.
b. All new units built after August 2009, no longer use the N5242-60031 cable that was attached to connector P1001 and Source 2. As a result of this change, the IF multiplexer boards have had their P1001 connectors removed. If your instrument contains a N5242-60031 cable, remove it from your instrument.
c. All new units built after August 2009, no longer use the N5242-60031 cable that was attached to connector P1001 and Source 2. As a result of this change, the IF multiplexer boards have had their P1001 connectors removed. If your instrument contains a N5242-60031 cable, remove it from your instrument.

Figure 6-16 Bottom Assemblies, 2-Port, Option 224 with and without Option 029, S/N Prefixes <6201



A56, A57, A59, and A64 only with Option 029.

Bottom RF Cables, 2-Port, Option 224 with and without Option 029, S/N Prefixes <6201

For the following table, refer to Figure 6-17 on page 6-53 and Figure 6-18 on page 6-54.

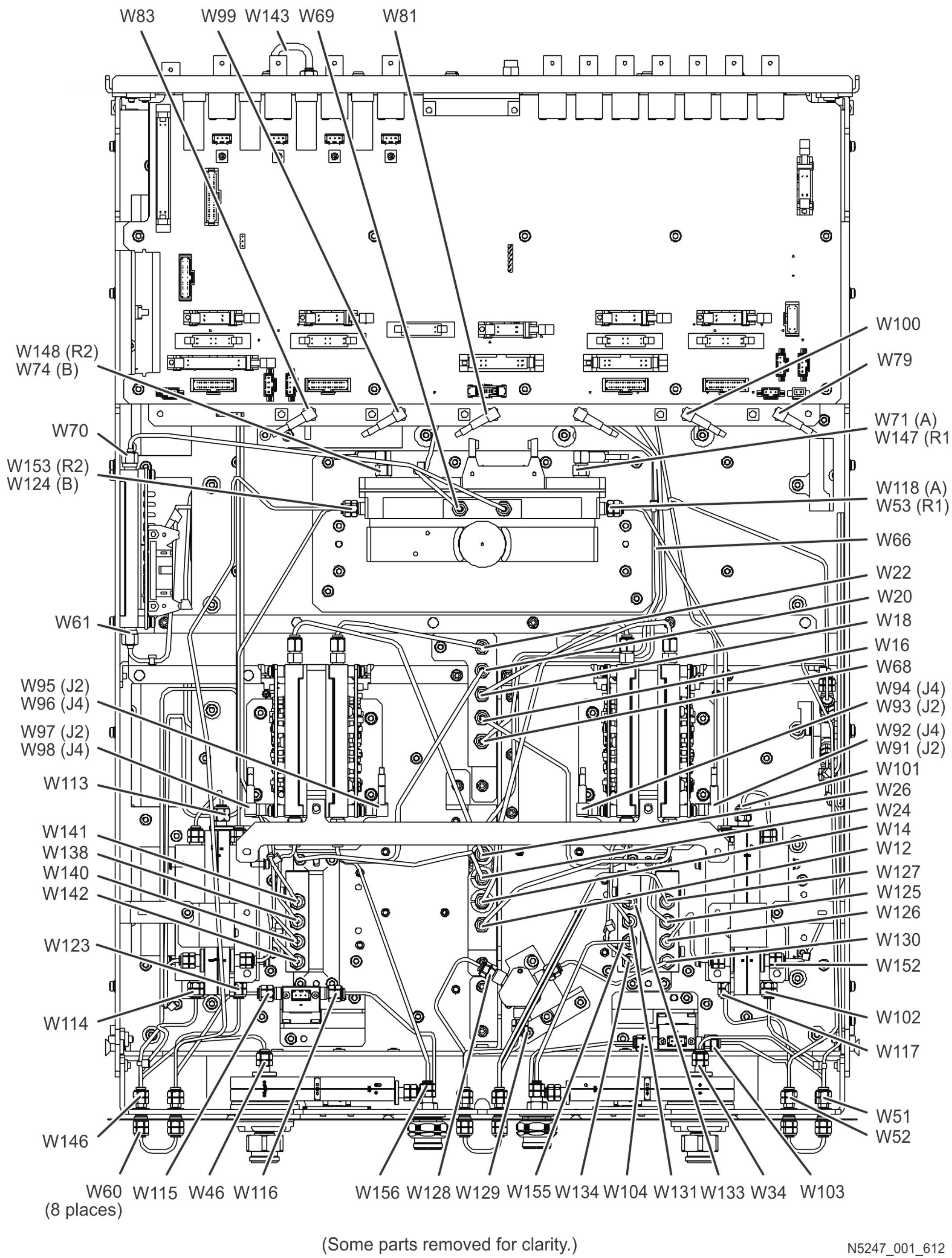
Reference Designator	Type[a]	Part Number	Qty	Description
W12	SR	N5247-20059	1	A60 port 1 70 GHz doubler to W11
W14	SR	N5247-20072	1	A60 port 1 70 GHz doubler to W13
W16	SR	N5247-20060	1	A61 port 3 70 GHz doubler to W15
W18	SR	N5247-20084	1	A61 port 3 70 GHZ doubler to W17
W20	SR	N5247-20015	1	A62 port 4 70 GHz doubler to W19
W22	SR	N5247-20068	1	A62 port 4 70 GHZ doubler to W21
W24	SR	N5247-20061	1	A63 port 2 70 GHz doubler to W23
W26	SR	N5247-20051	1	A63 port 2 70 GHz doubler to W25
W34	SR	N5247-20039	1	A33 port 1 coupler to front-panel port 1 CPLR ARM
W46	SR	N5247-20041	1	A36 port 2 coupler to front-panel port 2 CPLR ARM
W51	SR	N5247-20011	1	A37 reference mixer switch to front-panel REF 1 SOURCE OUT
W52	SR	N5247-20012	1	REF 1 RCVR R1 IN to A37 reference mixer switch
W53	SR	N5247-20048	1	A37 reference mixer switch to A27 mixer brick (R1)
W60	SR	N5247-20107	8	front-panel jumper
W61	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21.		
W62[b]	SR	N5247-20111	1	A25 HMA26.5 to A26 splitter
W63[b]	SR	N5245-20023	1	RF cable, A26 splitter to A27 mixer brick
W66	SR	N5247-20109	1	W65 to rear-panel EXT TSET DRIVE RF OUT (J6)
W68	SR	N5247-20088	1	rear-panel port RF2 OUT (J12) to W67
W69	SR	N5247-20112	1	A27 mixer brick to rear-panel EXT TSET DRIVE LO OUT (J5)
W70[c]	SR	N5247-20100	1	A25 HMA26.5 to A27 mixer brick
W71	F	N5242-60017	1	A27 mixer brick (A) to A24 IF multiplexer (P1)
W74	F	N5242-60018	1	A27 mixer brick (B) to A24 IF multiplexer (P201)
W79-83	F	Refer to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21.		
W91	F	N5247-60006	1	A60 port 1 70 GHz doubler J2 to A7 40 GHz doubler J401
W92	F	N5247-60007	1	A60 port 1 70 GHz doubler J4 to A7 40 GHz doubler J500

Reference Designator	Type[a]	Part Number	Qty	Description
W93	F	N5247-60010	1	A61 port SRC 2 OUT 1 70GHz dblr J2 to A12 40 GHz dblr J401
W94	F	N5247-60011	1	A61 port SRC 2 OUT 1 70GHz dblr J4 to A12 40 GHz dblr J500
W95	F	N5247-60012	1	A62 port SRC 2 OUT 2 70GHz dblr J2 to A13 40 GHz dblr J401
W96	F	N5247-60013	1	A62 port SRC 2 OUT 2 70GHz dblr J4 to A13 40 GHz dblr J500
W97	F	N5247-60008	1	A63 port 2 70 GHz doubler J2 to A8 40 GHz doubler J401
W98	F	N5247-60009	1	A63 port 2 70 GHz doubler J4 to A8 40 GHz doubler J500
W101	SR	N5247-20083	1	A29 port 1 reference coupler to A38 port 1 source attenuator
W102	SR	N5247-20014	1	A38 port 1 source attenuator to front-panel port 1 SOURCE OUT
W103	SR	N5247-20081	1	Front-panel port 1 CPLR THRU to A42 port 1 bias tee (withOUT Option 029 only)
W104	SR	N5247-20040	1	A33 port 1 coupler to A42 port 1 bias tee
W113	SR	N5247-20083	1	A32 port 2 reference coupler to A41 port 2 source attenuator
W114	SR	N5247-20034	1	A41 port 2 source attenuator to front-panel port 2 SOURCE OUT
W115	SR	N5247-20027	1	Front-panel port 2 CPLR THRU to A45 port 2 bias tee (withOUT Option 029 only)
W116	SR	N5247-20042	1	A36 port 2 coupler to A45 port 2 bias tee
W117	SR	N5247-20013	1	Front-panel port 1 RCVR A IN to A46 port 1 receiver attenuator
W118	SR	N5247-20047	1	A46 port 1 receiver attenuator to A27 mixer brick (A)
W123	SR	N5247-20020	1	Port 2 RCVR B IN to A49 port 2 receiver attenuator
W124	SR	N5247-20046	1	A49 port 2 receiver attenuator to A27 mixer brick (B)
W125	SR	N5247-20030	1	A50 port 1 mechanical switch to A60 port 1 70 GHz doubler
W126	SR	N5247-20031	1	A50 port 1 mechanical switch to A29 port 1 reference coupler
W127	SR	N5247-20102	1	A50 port 1 mechanical switch to PORT 1 SW SRC OUT
W128	SR	N5247-20104	1	Front-panel PORT 1 COMB THRU IN to A54 combiner
W129	SR	N5247-20103	1	Front-panel PORT 1 COMB ARM IN to A54 combiner
W130	SR	N5247-20105	1	A50 port 1 mechanical switch to A54 combiner
W131	SR	N5247-20032	1	A51 SRC2 OUT1 mechanical switch to A61 port 3 70 GHz doubler
W133	SR	N5247-20101	1	A51 SRC2 OUT1 mechanical switch to f. panel SW SRC OUT
W134	SR	N5247-20095	1	rear-panel PORT 3 SW TSET IN (J7) to A51 SRC2 OUT1 m. switch
W138	SR	N5247-20032	1	A53 port 2 mechanical switch to A63 70 GHz doubler
W140	SR	N5247-20033	1	A53 port 2 mechanical switch to A32 port 2 reference coupler

Reference Designator	Type[a]	Part Number	Qty	Description
W141	SR	N5247-20099	1	A53 port 2 mechanical switch to PORT 2 SW SRC OUT (J2)
W142	SR	N5247-20089	1	A53 port 2 mechanical switch to PORT 2 TSET IN (J1)
W143	SR	N5247-20107	1	rear-panel jumper
W146	SR	N5247-20058	1	A32 port 2 ref coupler to front-panel REF 2 SOURCE OUT
W147	F	N5242-60025	1	A27 mixer brick (R1) to A24 IF multiplexer (P601)
W148	F	N5242-60026	1	A27 mixer brick (R2) to A24 IF multiplexer (P801)
W149 & W150	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21.		
W152	SR	N5247-20079	1	A29 port 1 reference coupler to A37 reference mixer switch
W153	SR	N5247-20045	1	A27 mixer brick (R2) to front-panel REF 2 RCVR R2 IN
W155	SR	N5247-20038	1	A51 SRC2 OUT1 mech switch to front-panel SRC 2 OUT 1 – (2-port only)
W156	SR	N5247-20106	1	A62 SRC 2 OUT 2 70 GHz doubler to front-panel SRC 2 OUT 2 – (2-port only)
W162	SR	N5247-20120	1	A42 port 1 bias tee to A56 port 1 noise bypass switch (Option 029 only)
W163	SR	N5247-20117	1	A64 tuner to A56 port 1 noise bypass switch (Option 029 only)
W164	SR	N5247-20118	1	A64 tuner to A56 port 1 noise bypass switch (Option 029 only)
W165	SR	N5247-20119	1	Front-panel port 1 CPLR THRU to A56 port 1 noise bypass switch (Option 029 only)
W166	SR	N5247-20124	1	Front-panel port 2 CPLR THRU to A57 port 2 noise bypass switch (Option 029 only)
W167	SR	N5247-20123	1	A57 port 2 noise bypass switch to A45 port 2 bias tee (Option 029 only)
W168	SR	N5247-20121	1	A59 noise receiver (downconverter) to A57 port 2 noise bypass switch (Option 029 only)
W169	SR	N5247-20122	1	A59 noise receiver (downconverter) to A57 port 2 noise bypass switch (Option 029 only)
W171, W172, W173, W175	Refer to "Top Assemblies and Cables, All Options, Serial Number Prefixes <6021" on page 6-18. (Option 029 only)			
W176[b]	SR	N5247-20146	1	A59 noise receiver (downconverter) to A26 splitter (Option 029 only)
W204[b]	SR	N5247-20185	1	A25 HMA26.5 to A28 mixer brick (2) – (2-ports with Option 029 only)
W207[b]	SR	N5247-20184	1	RF cable, A25 HMA26.5 to A59 noise receiver (downconverter) – (2-Port with Option 029 only)

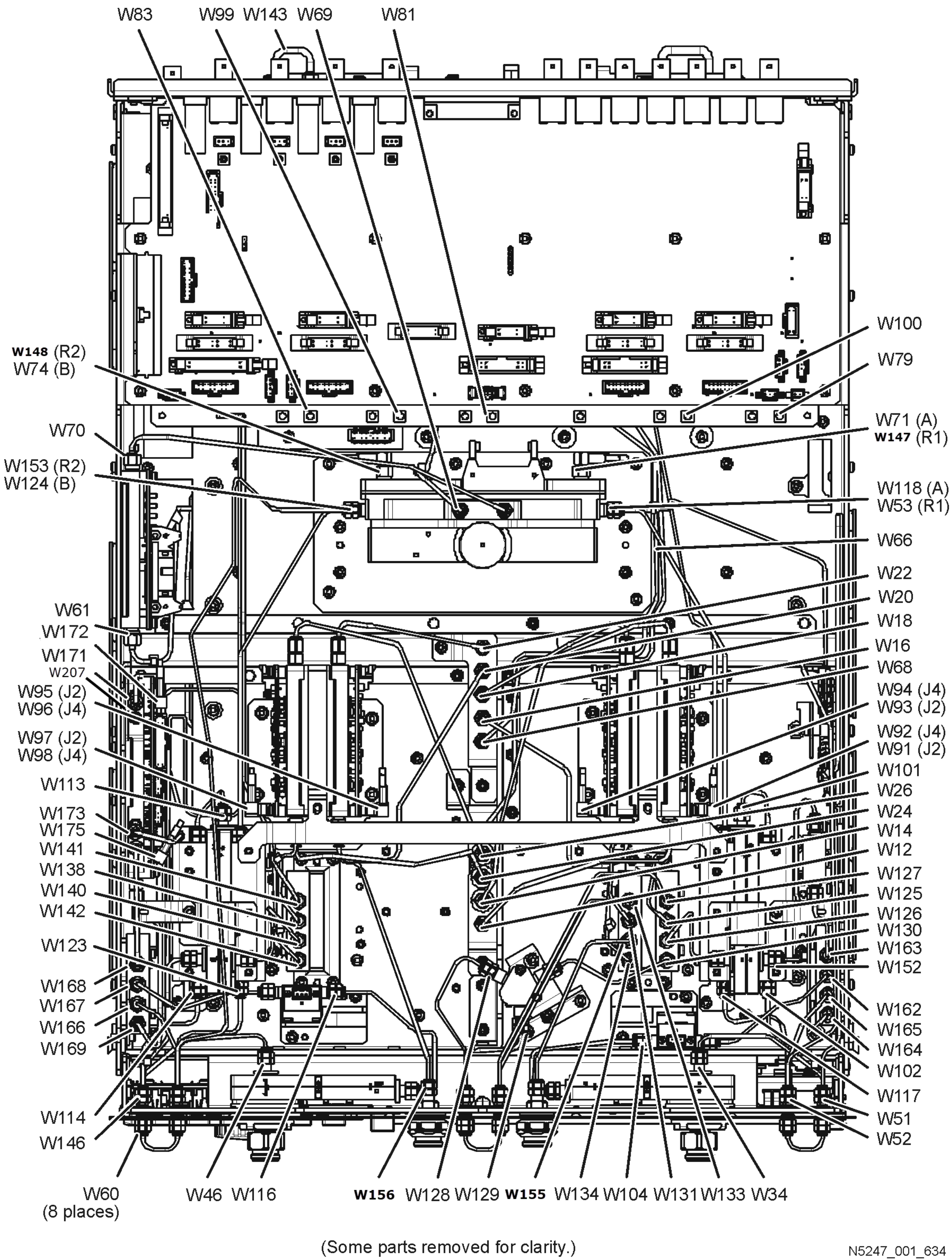
a. SR = semirigid coaxial cable; F = flexible coaxial cable
b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 “2-Port Configurations, Serial Number Prefixes <6021” on page 6-32 and “4-Port Configuration, Serial Number Prefixes <6021” on page 6-84.
c. On legacy instruments using the 5087-7765 HMA26.5, the N5245-20100 cable is used only on 2-port instruments. On instruments with a new HMA26.5 the N5245-20100 cable is used in all instruments. If you are unclear which HMA26.5 assembly your PNA has installed, refer to “Verify the Model/Version of HMA26.5 Installed” on page 7-40 and to Figure 7-17 on page 40.

Figure 6-17 Bottom RF Cables, 2-Port, Options 224, S/N Prefixes <6201



*SPAM 5 boards use W149 & W150 for 2-ports. RF cables W80 & W82 apply to 4-Port models (not shown). See also “Top Cables, All Cables—All Options, S/N Prefixes <6021” on page 6-21.

Figure 6-18 Bottom RF Cables, 2-Port, Option 224 with Option 029, S/N Prefixes <6201



*SPAM 5 boards use W149 & W150 for 2-ports. RF cables W80 & W82 apply to 4-Port models (not shown). See also “Top Cables, All Cables—All Options, S/N Prefixes <6021” on page 6-21.

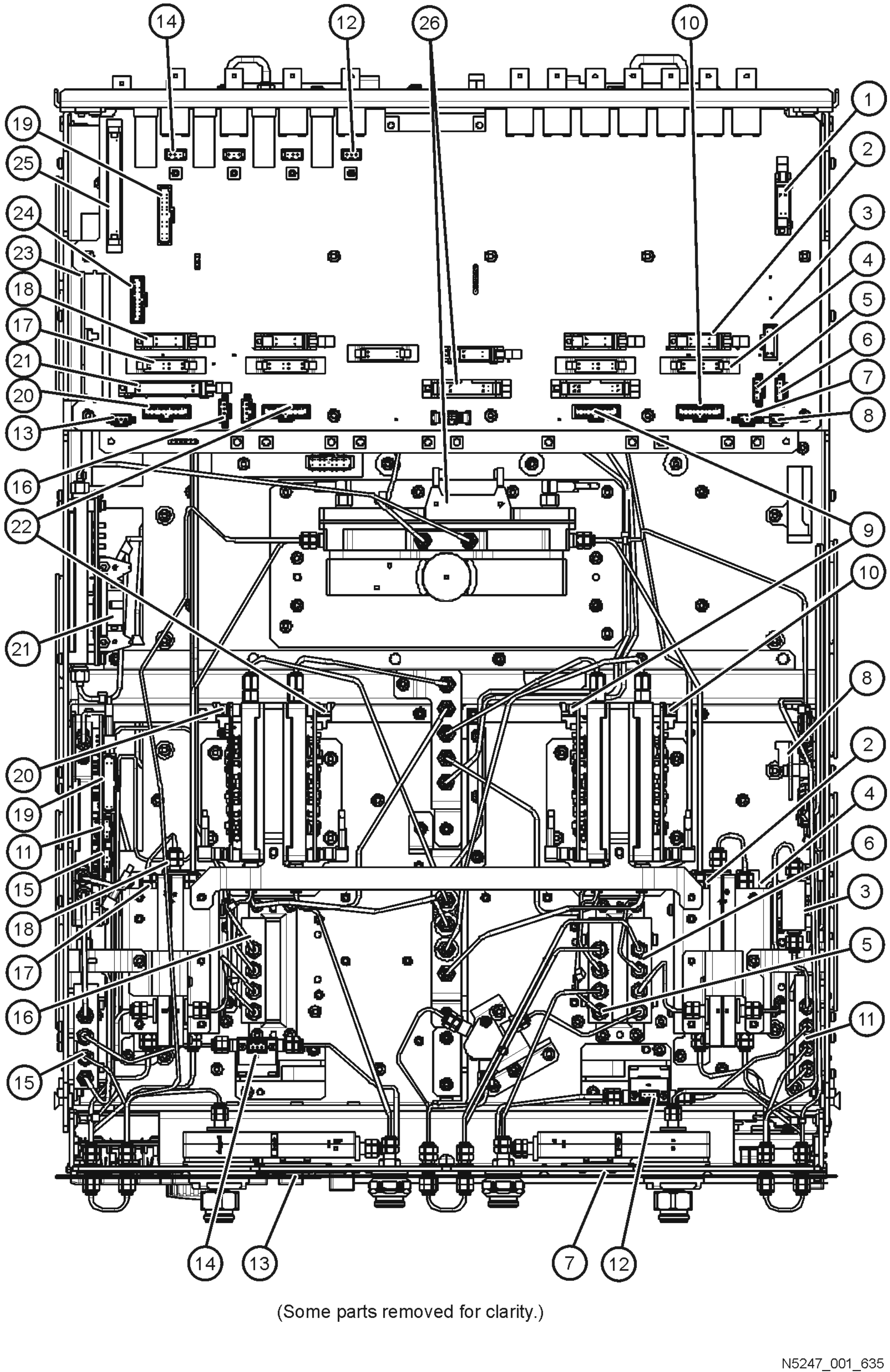
Bottom Ribbon Cables and Wire Harnesses, 2-Port, Option 224 with and without Option 029, S/N Prefixes <6201

Reference Designator	Type[a]	Part Number	Description
①	10R	N5242-60005	rear-panel PWR I/O to A23 test set motherboard J301
②	10R	N5247-60020	A23 test set motherboard J205 to A46 port 1 receiver attenuator
③	20R	N5245-60021	A64 tuner J9 to A23 test set motherboard J7 (Option 029 only)
④	16R	N5245-60006	A23 test set motherboard J549 to A38 port 1 source attenuator
⑤	4W	--	P/O A51 SRC2 OUT1 mechanical switch (to A23 test set motherboard J104). Refer to "2-Port Configuration, Option 224 with and without Option 029, S/N Prefixes <6201" on page 6-46.
⑥	4W	--	P/O A50 port 1 mechanical switch (to A23 test set motherboard J101). Refer to "2-Port Configuration, Option 224 with and without Option 029, S/N Prefixes <6201" on page 6-46.
⑦	3W	N5247-60016	A23 test set motherboard J221 to ports 1 LED board J1
q	2W	8121-0966	A23 test set motherboard J554 to A37 reference mixer switch
⑨	30R	N5247-60018	A61 SRC 2 OUT 1 70 GHz doubler J1 to A23 test set motherboard J5
⑩	30R	N5247-60018	A60 port 1 70 GHz doubler J1 to A23 test set motherboard J4
⑪	4W	--	P/O A56 port 1 noise bypass switch (to A59 noise receiver (downconverter) J42 port 1). Refer to "2-Port Configuration, Option 224 with and without Option 029, S/N Prefixes <6201" on page 6-46. (Option 029 only)
⑫	2W	N5247-60021	A23 test set motherboard J541 to A42 port 1 bias tee
⑬	3W	N5247-60016	A23 test set motherboard J222 to ports 2 LED board J1
⑭	2W	N5247-60021	A23 test set motherboard J542 to A45 port 2 bias tee
⑮	4W	--	P/O A57 port 2 noise bypass switch (to A59 noise receiver (downconverter) J41 port 2). Refer to "2-Port Configuration, Option 224 with and without Option 029, S/N Prefixes <6201" on page 6-46. (Option 029 only)
⑯	4W	--	P/O A53 port 2 mechanical switch (to A23 test set motherboard J102). Refer to "2-Port Configuration, Option 224 with and without Option 029, S/N Prefixes <6201" on page 6-46.
⑰	16R	N5245-60006	A23 test set motherboard J546 to A41 port 2 source attenuator
⑱	10R	N5247-60020	A23 test set motherboard J208 to A49 port 2 receiver attenuator
⑲	40R	N5245-60018	A59 noise receiver (downconverter) J1 to A23 test set motherboard J548
⑳	30R	N5247-60018	A63 port 2 70 GHz doubler J1 to A23 test set motherboard J6
㉑	24R	N5247-60022	A23 test set motherboard J209 to A25 HMA26.5 J1
㉒	30R	N5247-60018	A62 SRC 2 OUT 2 70 GHz doubler J1 to A23 test set motherboard J3

Reference Designator	Type[a]	Part Number	Description
㉓	100R	N5242-60004	A18 system motherboard J1 to A23 test set motherboard J1 to A24 IF multiplexer board J1
㉔	25R	E4410-60160	A18 system motherboard J13 to A23 test set motherboard J545
㉕	36R	8121-0834	rear-panel HANDLER I/O to A23 test set motherboard J400
㉖	20R	N5247-60014	A23 test set motherboard J551 to A27 mixer brick (1) J52

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

Figure 6-19 Bottom Ribbon Cables and Wire Harnesses, 2-Port, Option 224 with and without Option 029, S/N Prefixes <6201



Cables 3, 11, 15, and 19 apply only with Option 029.

2-Port Configurations, Serial Number Prefixes ≥6021

This section contains the following:

– “2-Port Configuration, Option 201, S/N Prefixes ≥6201” on page 6-58
– “2-Port Configuration, Option 219, S/N Prefixes ≥6201” on page 6-65
– “2-Port Configuration, Option 224 with and without Option 029/E29, S/N Prefixes ≥6201” on page 6-72
– See also, “2-Port Configurations, Serial Number Prefixes <6021” on page 6-32.

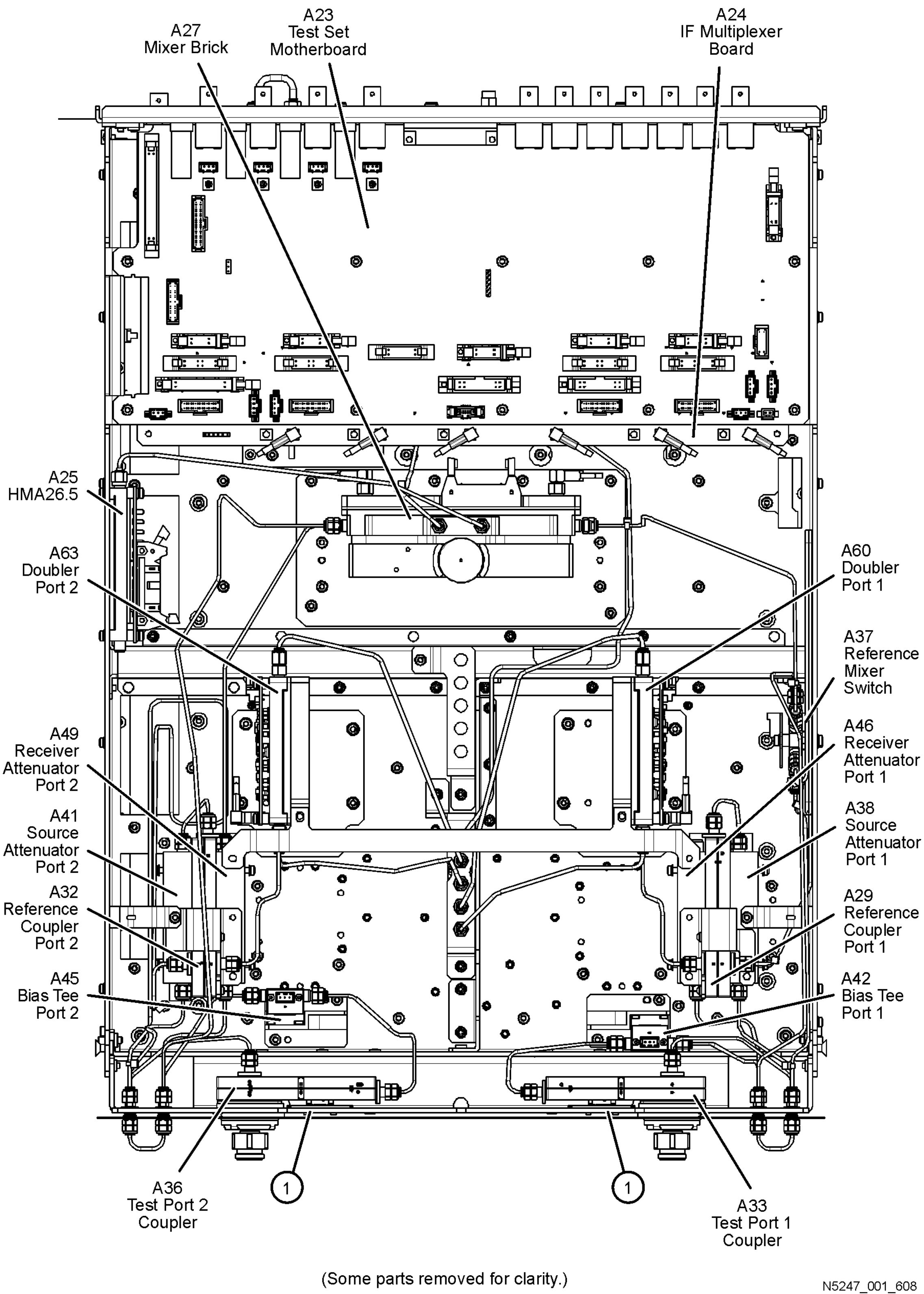
2-Port Configuration, Option 201, S/N Prefixes ≥6201

Bottom Assemblies, Standard 2-Port Configuration, Option 201, S/N Prefixes ≥6201

Reference Designator	Part Number[a]	Qty	Description
A23	N5245-60157 Was N5247-60001	1	Test set motherboard
A24	N5240-60062[b] was:N5240-60045	1	IF multiplexer board
A25	N5240-60101 Was: 5087-7765	1	LO Multiplier/amplifier 26.5 (HMA26.5)
A27	5087-7337	1	Mixer brick
A29 A32	5087-7744	2	Test port 1 reference coupler Test port 2 reference coupler
A33 A36	5087-7778	2	Test port 1 coupler Test port 2 coupler
A37	5087-7759	1	Reference mixer switch
A60 A63	5087-7336	2	70 GHz doubler assembly port 1 70 GHz doubler assembly port 2
①	N5240-60058	2	front-panel LED board

a. Part numbers in italic typeface are for rebuilt exchange assemblies. Refer to “Rebuilt-Exchange Assemblies” on page 6-4.
b. All new units built after August 2009, no longer use the N5242-60031 cable that was attached to connector P1001 and Source 2. As a result of this change, the IF multiplexer boards have had their P1001 connectors removed. If your instrument contains a N5242-60031 cable, remove it from your instrument.

Figure 6-20 Bottom Assemblies, Standard 2-Port Configuration, Option 201, S/N Prefixes ≥6201



Bottom RF Cables, Standard 2-Port Configuration, Option 201, S/N Prefixes ≥6201

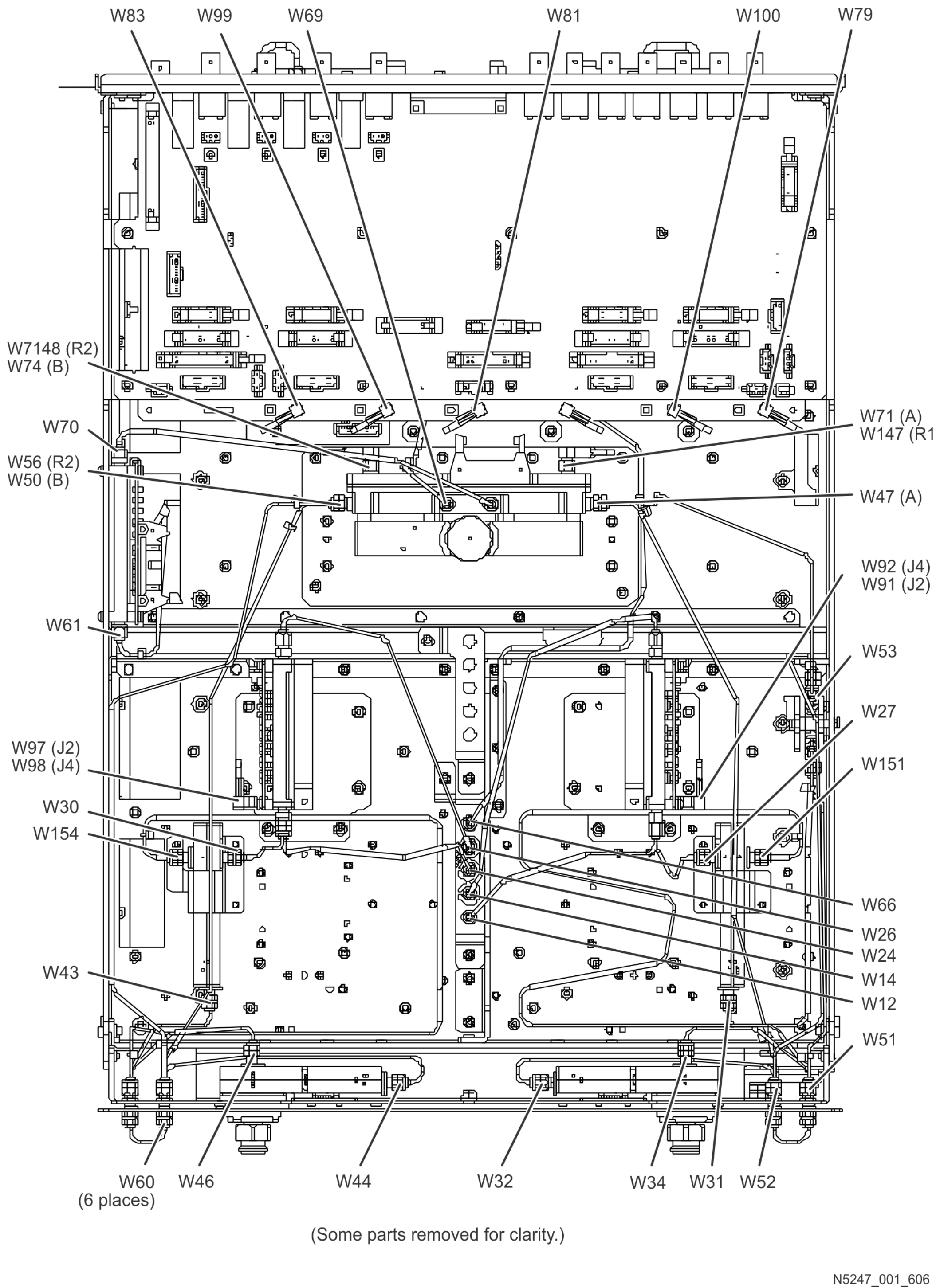
Reference Designator	Type[a]	Part Number	Qty	Description
W12	SR	N5247-20059	1	A60 port 1 70 GHz doubler to W11
W14	SR	N5247-20072	1	A60 port 1 70 GHz doubler to W13
W24	SR	N5247-20061	1	A63 port 2 70 GHz doubler to W23
W26	SR	N5247-20051	1	A63 port 2 70 GHz doubler to W25
W27	SR	N5247-20074	1	A60 port 1 70 GHz doubler to A29 port 1 reference coupler
W30	SR	N5247-20052	1	A63 port 2 70 GHz doubler to A32 port 2 reference coupler
W31	SR	N5247-20037	1	A29 port 1 ref coupler to front-panel port 1 SOURCE OUT
W32	SR	N5247-20049	1	Port 1 CPLR THRU to A33 port 1 coupler
W34	SR	N5247-20039	1	A33 port 1 coupler to front-panel port 1 CPLR ARM
W43	SR	N5247-20036	1	A32 port 2 ref coupler to front-panel port 2 SOURCE OUT
W44	SR	N5247-20050	1	Port 2 CPLR THRU to A36 port 2 coupler
W46	SR	N5247-20041	1	A36 port 2 coupler to front-panel port 2 CPLR ARM
W47	SR	N5247-20053	1	Port 1 RCVR A IN to A27 mixer brick (A)
W50	SR	N5247-20054	1	front-panel port 2 RCVR B IN to A27 mixer brick (B)
W51	SR	N5247-20011	1	Front-panel REF 1 SOURCE OUT to A37 ref mixer switch
W52	SR	N5247-20012	1	REF 1 RCVR R1 IN to A37 reference mixer switch
W53	SR	N5247-20048	1	A37 reference mixer switch to A27 mixer brick (R1)
W56	SR	N5247-20055	1	REF 2 RCVR R2 IN to A27 mixer brick (R2)
W60	SR	N5247-20107	6	front-panel jumper
W61	SR	Refer to “Top Cables, All Cables—All Options, S/N Prefixes ≥6021” on page 6-28.		
W66	SR	N5247-20109	1	W65 to rear-panel EXT TSET DRIVE RF OUT (J6)
W69	SR	N5247-20112	1	A27 mix brick to r. panel EXT TSET DRIVE LO OUT (J5)
W70[b]	SR	N5247-20100	1	A25 HMA26.5 to A27 mixer brick (1)
W71	F	N5242-60017	1	A27 mixer brick (A) to A24 IF multiplexer (P1)
W74	F	N5242-60018	1	A27 mixer brick (B) to A24 IF multiplexer (P201)
W79-83	F	Refer to “Top Cables, All Cables—All Options, S/N Prefixes ≥6021” on page 6-28.		
W91	F	N5247-60006	1	A60 port 1 70 GHz doubler J2 to A7 40 GHz doubler J401

Reference Designator	Type[a]	Part Number	Qty	Description
W92	F	N5247-60007	1	A60 port 1 70 GHz doubler J4 to A7 40 GHz doubler J500
W97	F	N5247-60008	1	A63 port 2 70 GHz doubler J2 to A8 40 GHz doubler J401
W98	F	N5247-60009	1	A63 port 2 70 GHz doubler J4 to A8 40 GHz doubler J500
W147	F	N5242-60025	1	A27 mixer brick (R1) to A24 IF multiplexer (P601)
W148	F	N5242-60026	1	A27 mixer brick (R2) to A24 IF multiplexer (P801)
W149 & W150	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W151	SR	N5247-20056	1	A29 port 1 reference coupler to A37 reference mixer switch
W154	SR	N5247-20057	1	A32 port 2 ref coupler to front-panel REF 2 SOURCE OUT

a. SR = semirigid coaxial cable; F = flexible coaxial cable

b. On legacy instruments using the 5087-7765 HMA26.5, the N5245-20100 cable is used only on 2-port instruments. On instruments with a new HMA26.5 the N5245-20100 cable is used in all instruments. If you are unclear which HMA26.5 assembly your PNA has installed, refer to "Verify the Model/Version of HMA26.5 Installed" on page 7-40 and to Figure 7-17 on page 40.

Figure 6-21 Bottom RF Cables, Standard 2-Port Configuration, Option 201, S/N Prefixes ≥6201



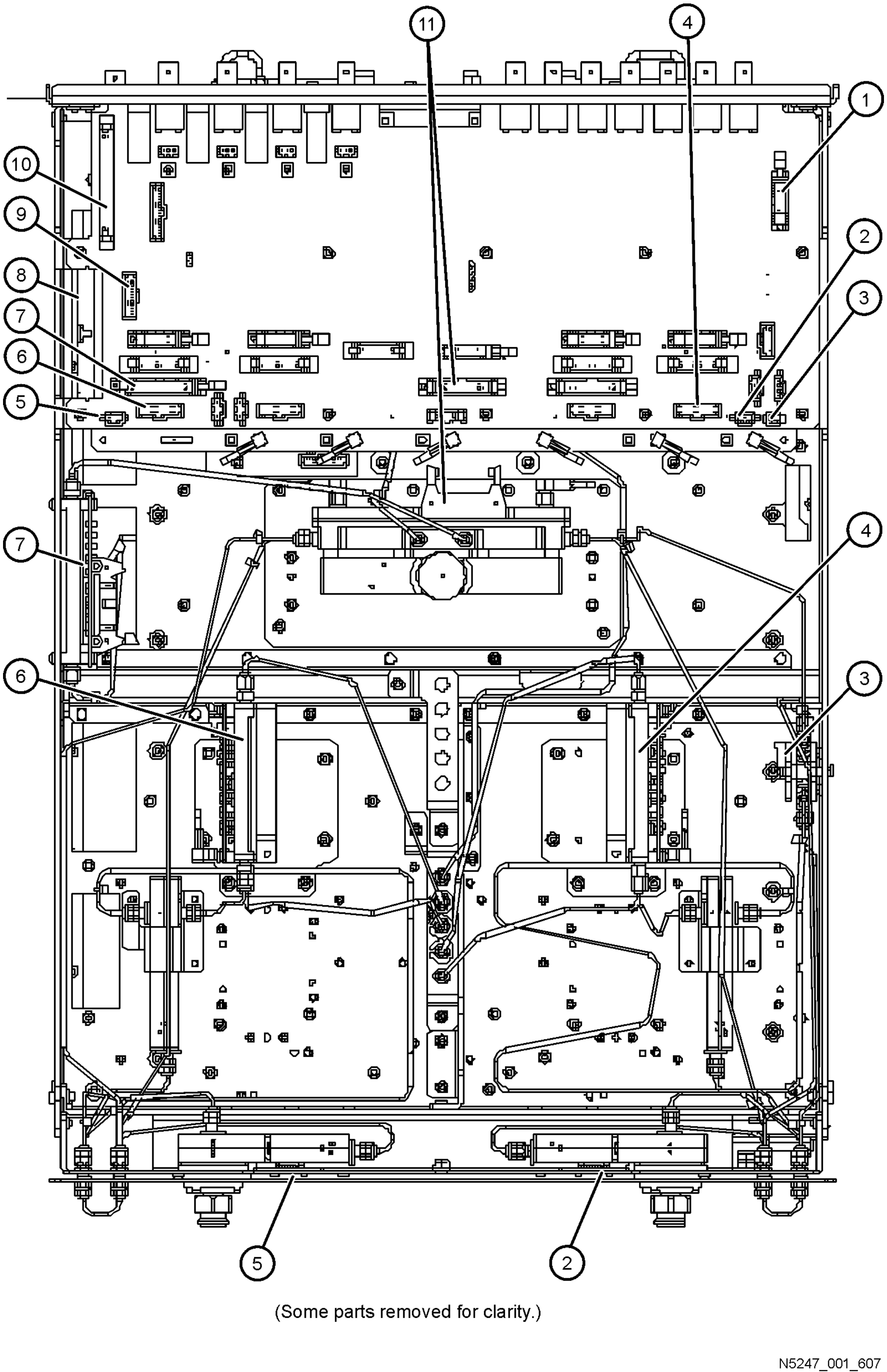
*SPAM 5 boards use W149 & W150 for 2-ports. RF cables W80 & W82 apply to 4-Port models (not shown). See also "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.

Bottom Ribbon Cables and Wire Harnesses, 2-Port, Option 201, S/N Prefixes ≥6201

Reference Designator	Type[a]	Part Number	Description
①	10R	N5242-60005	rear-panel PWR I/O to A23 test set motherboard J301
②	3W	N5247-60016	A23 test set motherboard J221 to ports 1 LED board J1
③	2W	8121-0966	A23 test set motherboard J554 to A37 reference mixer switch
④	30R	N5247-60018	A60 port 1 70 GHz doubler J1 to A23 test set motherboard J4
⑤	3W	N5247-60016	A23 test set motherboard J222 to ports 2 LED board J1
⑥	30R	N5247-60018	A63 port 2 70 GHz doubler J1 to A23 test set motherboard J6
⑦	24R	N5247-60022	A23 test set motherboard J209 to A25 HMA26.5 J1
q	100R	N5242-60004	A18 system motherboard J1 to A23 test set motherboard J1 to A24 IF multiplexer board J1
⑨	25R	E4410-60160	A18 system motherboard J13 to A23 test set motherboard J545
s	36R	8121-0834	rear-panel HANDLER I/O to A23 test set motherboard J400
⑪	20R	N5247-60014	A23 test set motherboard J551 to A27 mixer brick (1) J52

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

Figure 6-22 Bottom Ribbon Cables and Wire Harnesses, Standard 2-Port Configuration, Option 201, S/N Prefixes ≥6201



2-Port Configuration, Option 219, S/N Prefixes ≥6201

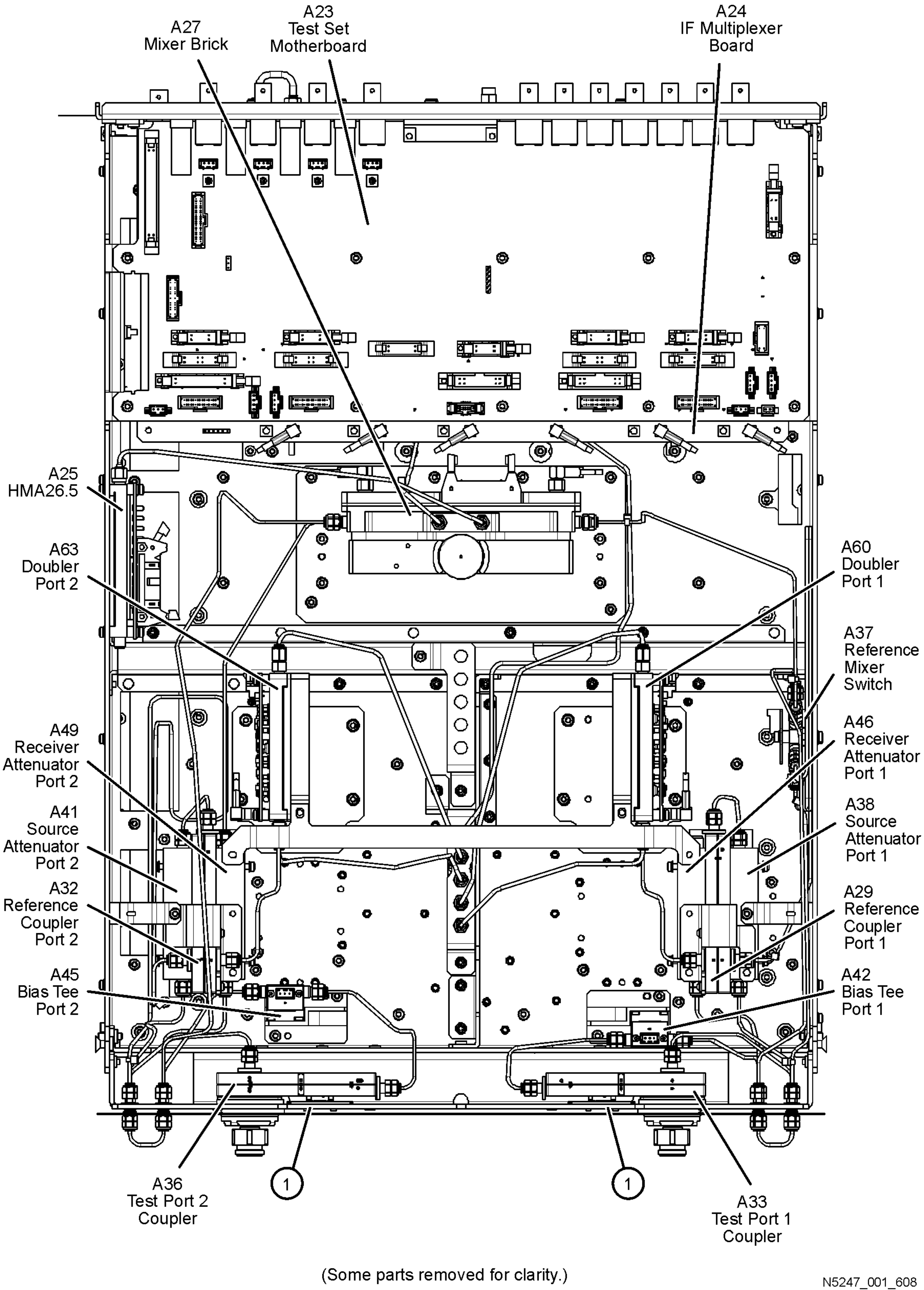
Bottom Assemblies, 2-Port Configuration, Options 219, S/N Prefixes ≥6201

Reference Designator	Part Number[a]	Qty	Description
A23	N5245-60157 Was N5247-60001	1	Test set motherboard
A24	N5240-60062[b] Was: N5240-60045	1	IF multiplexer board
A25	N5240-60101 Was: 5087-7765	1	LO Multiplier/amplifier 26.5 (HMA26.5)
A27	5087-7337	1	Mixer brick
A29 A32	5087-7744	2	Test port 1 reference coupler Test port 2 reference coupler
A33 A36	5087-7778	2	Test port 1 coupler Test port 2 coupler
A37	5087-7759	1	Reference mixer switch
A38 A41	84905-60004 was: 84905-60002	2	Test port 1 source attenuator Test port 2 source attenuator
A42 A45	5087-7732 Was 5086-7020	2	Test port 1 bias tee Test port 2 bias tee
A46 A49	84905-60004 was: 84905-60002	2	Port 1 receiver attenuator Port 2 receiver attenuator
A60 A63	5087-7336	2	70 GHz doubler assembly port 1 70 GHz doubler assembly port 2
①	N5240-60058	2	front-panel LED board

a. Part numbers in italic typeface are for rebuilt exchange assemblies. Refer to "Rebuilt-Exchange Assemblies" on page 6-4.

b. All new units built after August 2009, no longer use the N5242-60031 cable that was attached to connector P1001 and Source 2. As a result of this change, the IF multiplexer boards have had their P1001 connectors removed. If your instrument contains a N5242-60031 cable, remove it from your instrument.

Figure 6-23 Bottom Assemblies, 2-Port, Options 219, S/N Prefixes ≥6201



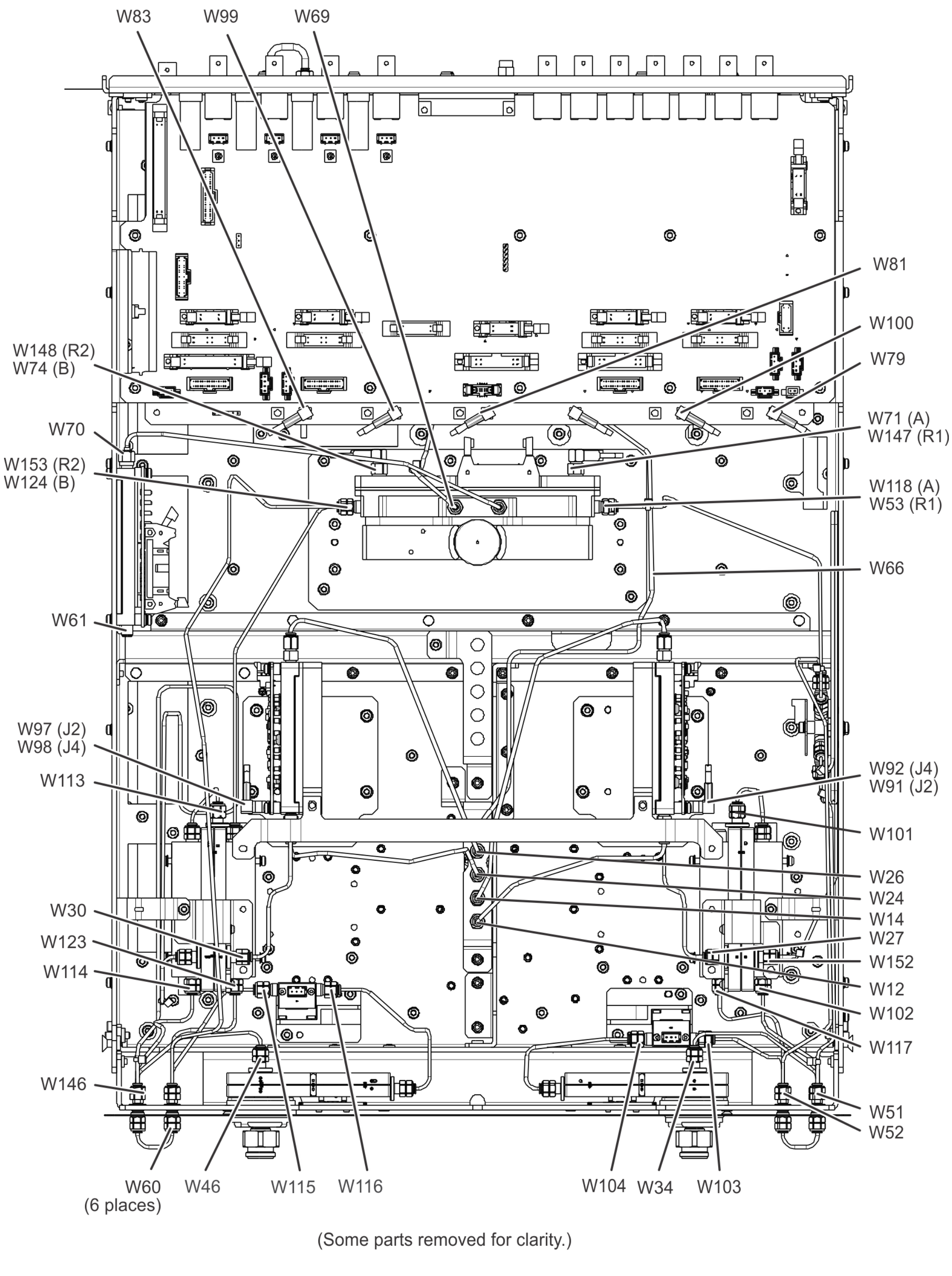
Bottom RF Cables, 2-Port, Options 219, S/N Prefixes ≥6201

Reference Designator	Type[a]	Part Number	Qty	Description
W12	SR	N5247-20059	1	A60 port 1 70 GHz doubler to W11
W14	SR	N5247-20072	1	A60 port 1 70 GHz doubler to W13
W24	SR	N5247-20061	1	A63 port 2 70 GHz doubler to W23
W26	SR	N5247-20051	1	A63 port 2 70 GHz doubler to W25
W27	SR	N5247-20044	1	A60 port 1 70 GHz doubler to A29 port 1 reference coupler
W30	SR	N5247-20043	1	A63 port 2 70 GHz doubler to A32 port 2 reference coupler
W34	SR	N5247-20039	1	A33 port 1 coupler to front-panel REF 1 CPLR ARM
W46	SR	N5247-20041	1	A36 port 2 coupler to front-panel port 2 CPLR ARM
W51	SR	N5247-20011	1	Front-panel REF 1 SOURCE OUT to A37 ref mixer switch
W52	SR	N5247-20012	1	REF 1 RCVR R1 IN to A37 reference mixer switch
W53	SR	N5247-20048	1	A37 reference mixer switch to A27 mixer brick (R1)
W60	SR	N5247-20107	6	front-panel jumper
W61	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W66	SR	N5247-20109	1	W65 to rear-panel EXT TSET DRIVE RF OUT (J6)
W69	SR	N5247-20112	1	A27 mix brick to r. panel EXT TSET DRIVE LO OUT (J5)
W70[b]	SR	N5247-20100	1	A25 HMA26.5 to A27 mixer brick
W71	F	N5242-60017	1	A27 mixer brick (A) to A24 IF multiplexer (P1)
W74	F	N5242-60018	1	A27 mixer brick (B) to A24 IF multiplexer (P201)
W79-83	F	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W91	F	N5247-60006	1	A60 port 1 70 GHz doubler J2 to A7 40 GHz doubler J401
W92	F	N5247-60007	1	A60 port 1 70 GHz doubler J4 to A7 40 GHz doubler J500
W97	F	N5247-60008	1	A63 port 2 70 GHz doubler J2 to A8 40 GHz doubler J401
W98	F	N5247-60009	1	A63 port 2 70 GHz doubler J4 to A8 40 GHz doubler J500
W101	SR	N5247-20083	1	A29 port 1 reference coupler to A38 port 1 source attenuator
W102	SR	N5247-20014	1	A38 port 1 source attenuator to front-panel port 1 SOURCE OUT
W103	SR	N5247-20081	1	Front-panel port 1 CPLR THRU to A42 port 1 bias tee
W104	SR	N5247-20040	1	A33 port 1 coupler to A42 port 1 bias tee
W113	SR	N5247-20083	1	A32 port 2 reference coupler to A41 port 2 source attenuator
W114	SR	N5247-20034	1	A41 port 2 source attenuator to front-panel port 2 SOURCE OUT

Reference Designator	Type[a]	Part Number	Qty	Description
W115	SR	N5247-20027	1	Front-panel port 2 CPLR THRU to A45 port 2 bias tee
W116	SR	N5247-20042	1	A36 port 2 coupler to A45 port 2 bias tee
W117	SR	N5247-20013	1	Front-panel port 1 RCVR A IN to A46 port 1 receiver attenuator
W118	SR	N5247-20047	1	A46 port 1 receiver attenuator to A27 mixer brick (A)
W123	SR	N5247-20020	1	Port 2 RCVR B IN to A49 port 2 receiver attenuator
W124	SR	N5247-20046	1	A49 port 2 receiver attenuator to A27 mixer brick (B)
W146	SR	N5247-20058	1	A32 port 2 ref coupler to front-panel REF 2 SOURCE OUT
W147	F	N5242-60025	1	A27 mixer brick (R1) to A24 IF multiplexer (P601)
W148	F	N5242-60026	1	A27 mixer brick (R2) to A24 IF multiplexer (P801)
W149 & W150	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W152	SR	N5247-20079	1	A29 port 1 reference coupler to A37 reference mixer switch
W153	SR	N5247-20045	1	A27 mixer brick (R2) to front-panel REF 2 RCVR R2 IN

a. SR = semirigid coaxial cable; F = flexible coaxial cable
b. On legacy instruments using the 5087-7765 HMA26.5, the N5245-20100 cable is used only on 2-port instruments. On instruments with a new HMA26.5 the N5245-20100 cable is used in all instruments. If you are unclear which HMA26.5 assembly your PNA has installed, refer to "Verify the Model/Version of HMA26.5 Installed" on page 7-40 and to Figure 7-17 on page 40.

Figure 6-24 Bottom RF Cables, 2-Port, Options 219, S/N Prefixes ≥6201



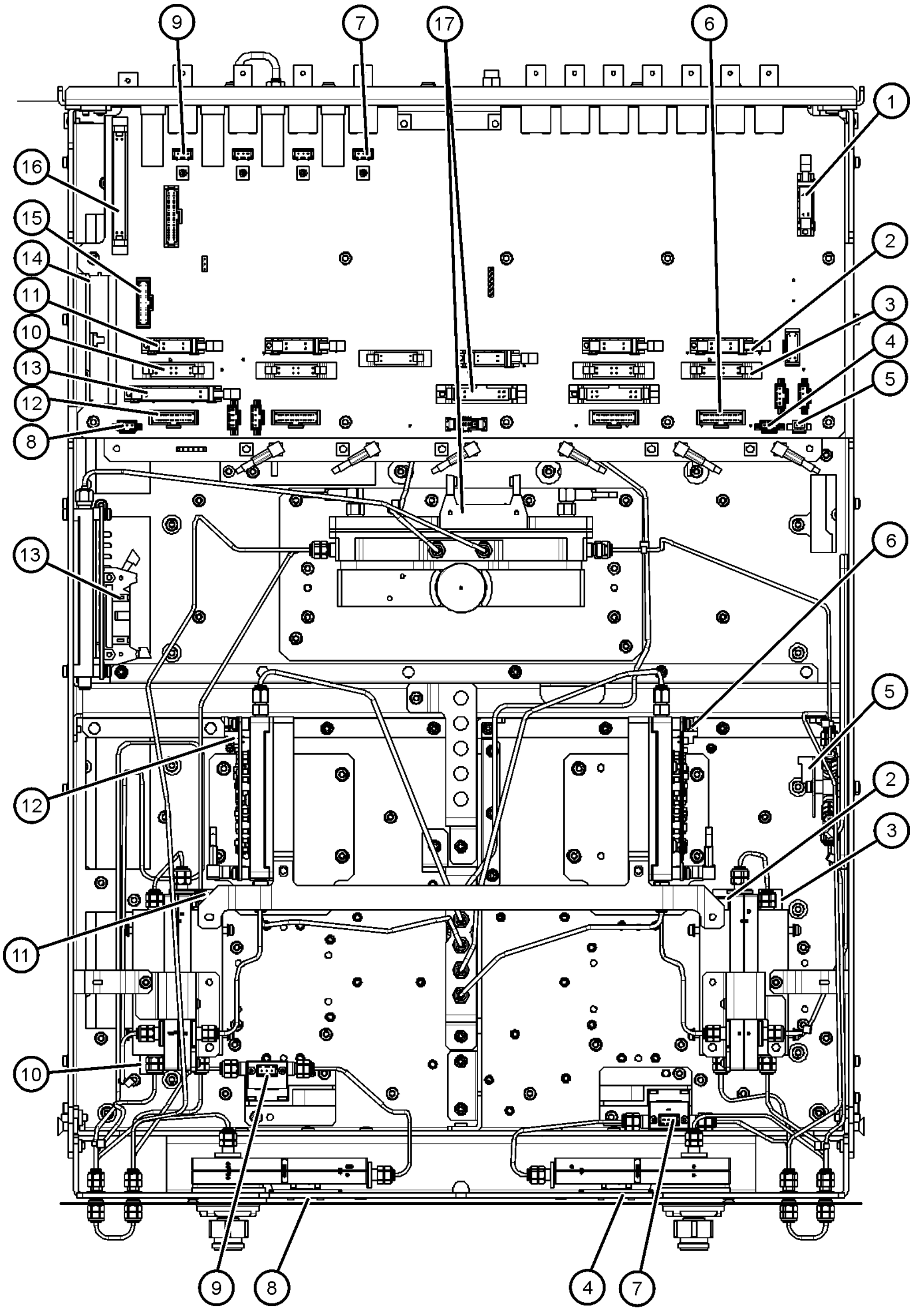
*SPAM 5 boards use W149 & W150 for 2-ports. RF cables W80 & W82 apply to 4-Port models (not shown). See also "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.

Bottom Ribbon Cables and Wire Harnesses, 2-Port, Options 219, S/N Prefixes ≥6201

Reference Designator	Type[a]	Part Number	Description
①	10R	N5242-60005	rear-panel PWR I/O to A23 test set motherboard J301
②	10R	N5247-60020	A23 test set motherboard J205 to A46 port 1 receiver attenuator
③	16R	N5245-60006	A23 test set motherboard J549 to A38 port 1 source attenuator
④	3W	N5247-60016	A23 test set motherboard J221 to port 1 LED board J1
⑤	2W	8121-0966	A23 test set motherboard J554 to A37 reference mixer switch
⑥	30R	N5247-60018	A60 port 1 70 GHz doubler J1 to A23 test set motherboard J4
⑦	2W	N5247-60021	A23 test set motherboard J541 to A42 port 1 bias tee
⑧	3W	N5247-60016	A23 test set motherboard J222 to port 2 LED board J1
⑨	2W	N5247-60021	A23 test set motherboard J542 to A45 port 2 bias tee
s	16R	N5245-60006	A23 test set motherboard J546 to A41 port 2 source attenuator
⑪	10R	N5247-60020	A23 test set motherboard J208 to A49 port 2 receiver attenuator
⑫	30R	N5247-60018	A63 port 2 70 GHz doubler J1 to A23 test set motherboard J6
⑬	24R	N5247-60022	A23 test set motherboard J209 to A25 HMA26.5 J1
⑭	100R	N5242-60004	A18 system motherboard J1 to A23 test set motherboard J1 to A24 IF multiplexer board J1
⑮	25R	E4410-60160	A18 system motherboard J13 to A23 test set motherboard J545
⑯	36R	8121-0834	rear-panel HANDLER I/O to A23 test set motherboard J400
⑰	20R	N5247-60014	A23 test set motherboard J551 to A27 mixer brick (1) J52

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

Figure 6-25 Bottom Ribbon Cables and Wire Harnesses, 2-Port, Options 219, S/N Prefixes ≥6201



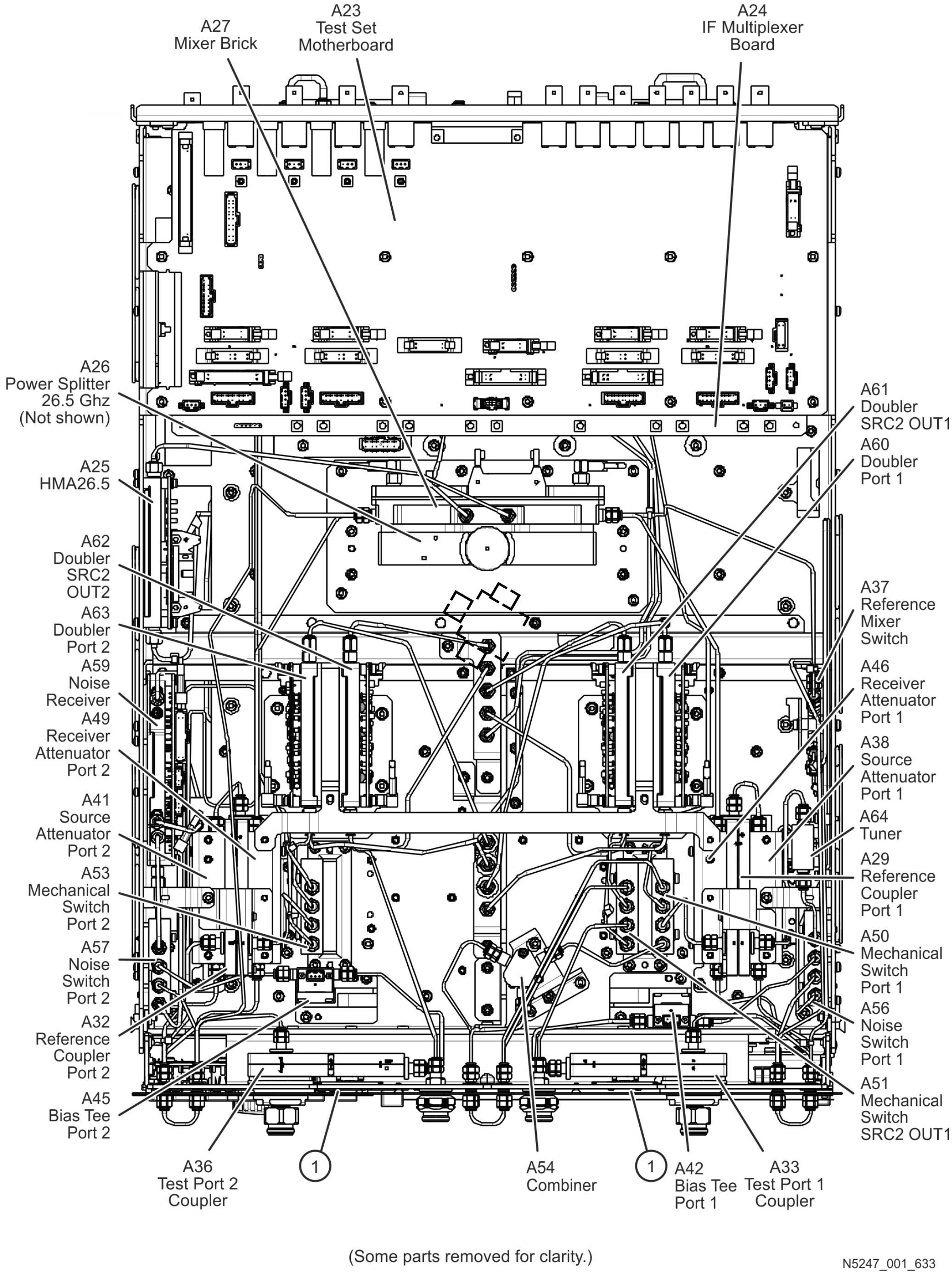
(Some parts removed for clarity.)

2-Port Configuration, Option 224 with and without Option 029/E29, S/N Prefixes ≥6201

Reference Designator	Part Number[a]	Qty	Description
A23	N5245-60157 Was N5247-60001	1	Test set motherboard
A24	N5240-60062[b] Was: N5240-60045	1	IF multiplexer board[c]
A25	N5240-60101 Was: 5087-7765	1	LO Multiplier/amplifier 26.5 (HMA26.5)
A27	5087-7337	1	Mixer brick
A29 A32	5087-7744	2	Test port 1 reference coupler Test port 2 reference coupler
A33 A36	5087-7778	2	Test port 1 coupler Test port 2 coupler
A37	5087-7759	1	Reference mixer switch
A38 A41	84905-60004 was: 84905-60002	2	Test port 1 source attenuator Test port 2 source attenuator
A42 A45	5087-7732 Was 5086-7020	2	Test port 1 bias tee Test port 2 bias tee
A46 A49	84905-60004 was: 84905-60002	2	Port 1 receiver attenuator Port 2 receiver attenuator
A50 A51 A53	N1811-60010	5	Port 1 mechanical switch SRC2 OUT1 mechanical switch Port 2 mechanical switch
A54	11667-60016	1	Combiner
A56 A57	N1811-60010	5	Port 1 noise bypass switch (Option 029/E29 only) Port 2 noise bypass switch (Option 029/E29 only)
A59	5087-7464	1	67 GHz noise receiver (downconverter) (Option E29 only)
	5087-7344		50 GHz noise receiver (downconverter) (Option 029 only)
A60 A61 A62 A63	5087-7336	4	70 GHz doubler assembly port 1 70 GHz doubler assembly port SRC 2 OUT 1 70 GHz doubler assembly port SRC 2 OUT 2 70 GHz doubler assembly port 2
A64	5087-7345	1	Tuner (Option 029/E29 only)
①	N5240-60058	2	front-panel LED board

a. Part numbers in italic typeface are for rebuilt exchange assemblies. Refer to "Rebuilt-Exchange Assemblies" on page 6-4.
b. All new units built after August 2009, no longer use the N5242-60031 cable that was attached to connector P1001 and Source 2. As a result of this change, the IF multiplexer boards have had their P1001 connectors removed. If your instrument contains a N5242-60031 cable, remove it from your instrument.
c. All new units built after August 2009, no longer use the N5242-60031 cable that was attached to connector P1001 and Source 2. As a result of this change, the IF multiplexer boards have had their P1001 connectors removed. If your instrument contains a N5242-60031 cable, remove it from your instrument.

Figure 6-26 Bottom Assemblies, 2-Port, Option 224 with and without Option 029/E29, S/N Prefixes ≥6201



A56, A57, A59, and A64 only with Option 029/E29.

Bottom RF Cables, 2-Port, Option 224 with and without Option 029/E29, S/N Prefixes ≥6201

For the following table, refer to Figure 6-17 on page 6-53 and Figure 6-18 on page 6-54.

Reference Designator	Type[a]	Part Number	Qty	Description
W12	SR	N5247-20059	1	A60 port 1 70 GHz doubler to W11
W14	SR	N5247-20072	1	A60 port 1 70 GHz doubler to W13
W16	SR	N5247-20060	1	A61 port 3 70 GHz doubler to W15
W18	SR	N5247-20084	1	A61 port 3 70 GHZ doubler to W17
W20	SR	N5247-20015	1	A62 port 4 70 GHz doubler to W19
W22	SR	N5247-20068	1	A62 port 4 70 GHZ doubler to W21
W24	SR	N5247-20061	1	A63 port 2 70 GHz doubler to W23
W26	SR	N5247-20051	1	A63 port 2 70 GHz doubler to W25
W34	SR	N5247-20039	1	A33 port 1 coupler to front-panel port 1 CPLR ARM
W46	SR	N5247-20041	1	A36 port 2 coupler to front-panel port 2 CPLR ARM
W51	SR	N5247-20011	1	A37 reference mixer switch to front-panel REF 1 SOURCE OUT
W52	SR	N5247-20012	1	REF 1 RCVR R1 IN to A37 reference mixer switch
W53	SR	N5247-20048	1	A37 reference mixer switch to A27 mixer brick (R1)
W60	SR	N5247-20107	8	front-panel jumper
W61	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W62[b]	SR	N5247-20111	1	A25 HMA26.5 to A26 splitter
W63[b]	SR	N5245-20023	1	RF cable, A26 splitter to A27 mixer brick
W66	SR	N5247-20109	1	W65 to rear-panel EXT TSET DRIVE RF OUT (J6)
W68	SR	N5247-20088	1	rear-panel port RF2 OUT (J12) to W67
W69	SR	N5247-20112	1	A27 mixer brick to rear-panel EXT TSET DRIVE LO OUT (J5)
W70[c]	SR	N5247-20100	1	A25 HMA26.5 to A27 mixer brick (1)
W71	F	N5242-60017	1	A27 mixer brick (A) to A24 IF multiplexer (P1)
W74	F	N5242-60018	1	A27 mixer brick (B) to A24 IF multiplexer (P201)
W79-83	F	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W91	F	N5247-60006	1	A60 port 1 70 GHz doubler J2 to A7 40 GHz doubler J401
W92	F	N5247-60007	1	A60 port 1 70 GHz doubler J4 to A7 40 GHz doubler J500

Reference Designator	Type[a]	Part Number	Qty	Description
W93	F	N5247-60010	1	A61 port SRC 2 OUT 1 70GHz dblr J2 to A12 40 GHz dblr J401
W94	F	N5247-60011	1	A61 port SRC 2 OUT 1 70GHz dblr J4 to A12 40 GHz dblr J500
W95	F	N5247-60012	1	A62 port SRC 2 OUT 2 70GHz dblr J2 to A13 40 GHz dblr J401
W96	F	N5247-60013	1	A62 port SRC 2 OUT 2 70GHz dblr J4 to A13 40 GHz dblr J500
W97	F	N5247-60008	1	A63 port 2 70 GHz doubler J2 to A8 40 GHz doubler J401
W98	F	N5247-60009	1	A63 port 2 70 GHz doubler J4 to A8 40 GHz doubler J500
W101	SR	N5247-20083	1	A29 port 1 reference coupler to A38 port 1 source attenuator
W102	SR	N5247-20014	1	A38 port 1 source attenuator to front-panel port 1 SOURCE OUT
W103	SR	N5247-20081	1	Front-panel port 1 CPLR THRU to A42 port 1 bias tee (withOUT Option 029/E29 only)
W104	SR	N5247-20040	1	A33 port 1 coupler to A42 port 1 bias tee
W113	SR	N5247-20083	1	A32 port 2 reference coupler to A41 port 2 source attenuator
W114	SR	N5247-20034	1	A41 port 2 source attenuator to front-panel port 2 SOURCE OUT
W115	SR	N5247-20027	1	Front-panel port 2 CPLR THRU to A45 port 2 bias tee (withOUT Option E29 only)
W116	SR	N5247-20042	1	A36 port 2 coupler to A45 port 2 bias tee
W117	SR	N5247-20013	1	Front-panel port 1 RCVR A IN to A46 port 1 receiver attenuator
W118	SR	N5247-20047	1	A46 port 1 receiver attenuator to A27 mixer brick (A)
W123	SR	N5247-20020	1	Port 2 RCVR B IN to A49 port 2 receiver attenuator
W124	SR	N5247-20046	1	A49 port 2 receiver attenuator to A27 mixer brick (B)
W125	SR	N5247-20030	1	A50 port 1 mechanical switch to A60 port 1 70 GHz doubler
W126	SR	N5247-20031	1	A50 port 1 mechanical switch to A29 port 1 reference coupler
W127	SR	N5247-20102	1	A50 port 1 mechanical switch to PORT 1 SW SRC OUT
W128	SR	N5247-20104	1	Front-panel PORT 1 COMB THRU IN to A54 combiner
W129	SR	N5247-20103	1	Front-panel PORT 1 COMB ARM IN to A54 combiner
W130	SR	N5247-20105	1	A50 port 1 mechanical switch to A54 combiner
W131	SR	N5247-20032	1	A51 SRC2 OUT1 mechanical switch to A61 port 3 70 GHz doubler
W133	SR	N5247-20101	1	A51 SRC2 OUT1 mechanical switch to f. panel SW SRC OUT
W134	SR	N5247-20095	1	rear-panel PORT 3 SW TSET IN (J7) to A51 SRC2 OUT1 m. switch
W138	SR	N5247-20032	1	A53 port 2 mechanical switch to A63 70 GHz doubler
W140	SR	N5247-20033	1	A53 port 2 mechanical switch to A32 port 2 reference coupler

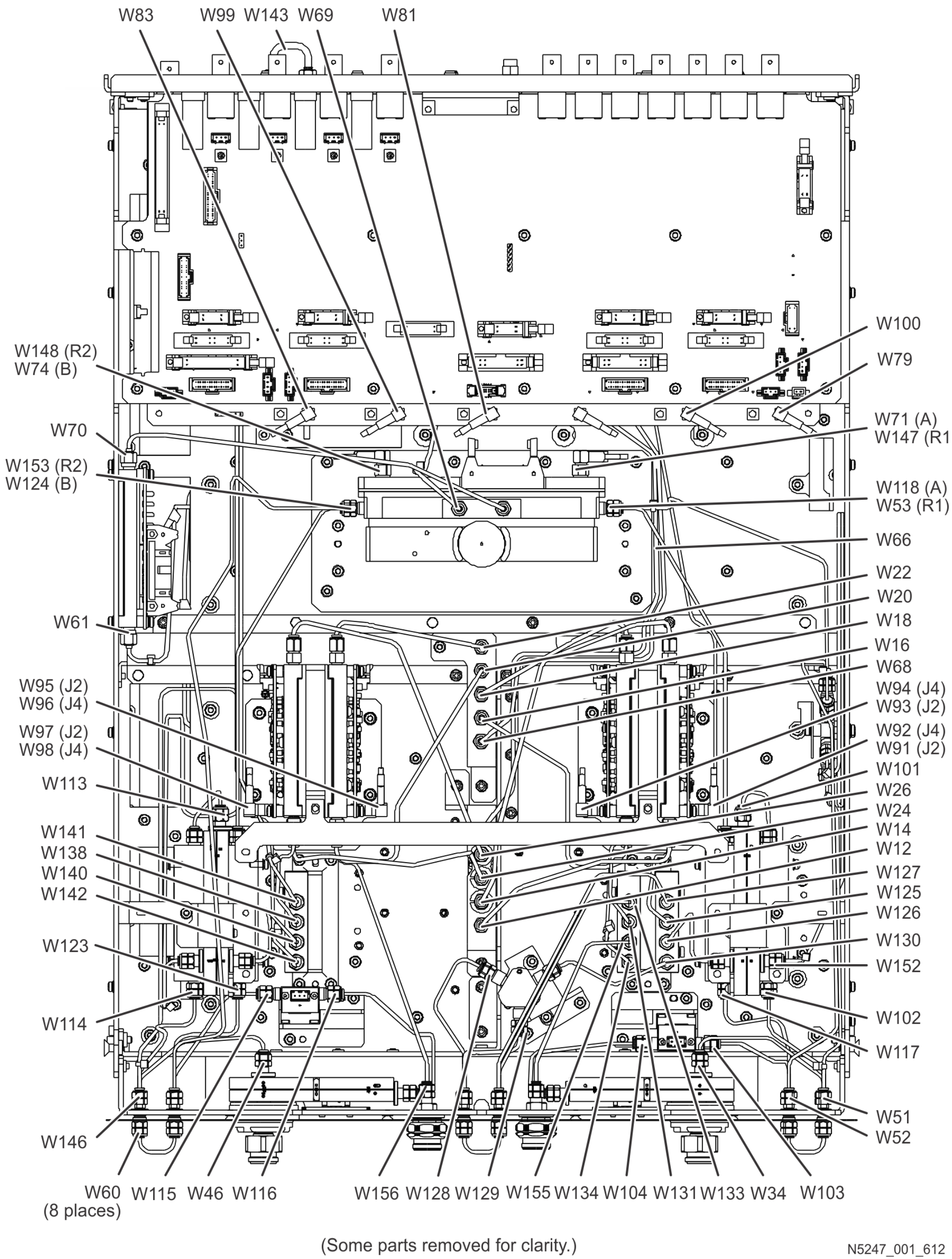
Reference Designator	Type[a]	Part Number	Qty	Description
W141	SR	N5247-20099	1	A53 port 2 mechanical switch to PORT 2 SW SRC OUT (J2)
W142	SR	N5247-20089	1	A53 port 2 mechanical switch to PORT 2 TSET IN (J1)
W143	SR	N5247-20107	1	rear-panel jumper
W146	SR	N5247-20058	1	A32 port 2 ref coupler to front-panel REF 2 SOURCE OUT
W147	F	N5242-60025	1	A27 mixer brick (R1) to A24 IF multiplexer (P601)
W148	F	N5242-60026	1	A27 mixer brick (R2) to A24 IF multiplexer (P801)
W149 & W150	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W152	SR	N5247-20079	1	A29 port 1 reference coupler to A37 reference mixer switch
W153	SR	N5247-20045	1	A27 mixer brick (R2) to front-panel REF 2 RCVR R2 IN
W162	SR	N5247-20120	1	A42 port 1 bias tee to A56 port 1 noise bypass switch (Option 029 or E29 or 6E9 only)
W163	SR	N5247-20117	1	A64 tuner to A56 port 1 noise bypass switch (Option 029 or E29 only)
W164	SR	N5247-20118	1	A64 tuner to A56 port 1 noise bypass switch (Option 029 or E29 only)
W165	SR	N5247-20119	1	Front-panel port 1 CPLR THRU to A56 port 1 noise bypass switch (Option 029 or E29 only)
W166	SR	N5247-20124	1	Front-panel port 2 CPLR THRU to A57 port 2 noise bypass switch (Option 029 or E29 only)
W167	SR	N5247-20123	1	A57 port 2 noise bypass switch to A45 port 2 bias tee (Option 029 or E29 only)
W168	SR	N5247-20121	1	A59 noise receiver (downconverter) to A57 port 2 noise bypass switch (Option 029 or E29 only)
W169	SR	N5247-20122	1	A59 noise receiver (downconverter) to A57 port 2 noise bypass switch (Option 029 or E29 only)
W171, W172, W173, W175	Refer to "Top Assemblies and Cables, All Options, Serial Number Prefixes ≥6021" on page 6-24. (Option 029 or E29 only)			
W176[b]	SR	N5247-20146	1	A59 noise receiver (downconverter) to A26 splitter (Option 029 or E29 only)
W204[b]	SR	N5247-20185	1	A25 HMA26.5 to A28 mixer brick (2)
W207[b]	SR	N5247-20184	1	RF cable, A25 HMA26.5 to A59 noise receiver (downconverter) – (2-Port with Option 029 or E29 only)

a. SR = semirigid coaxial cable; F = flexible coaxial cable

b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N547-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

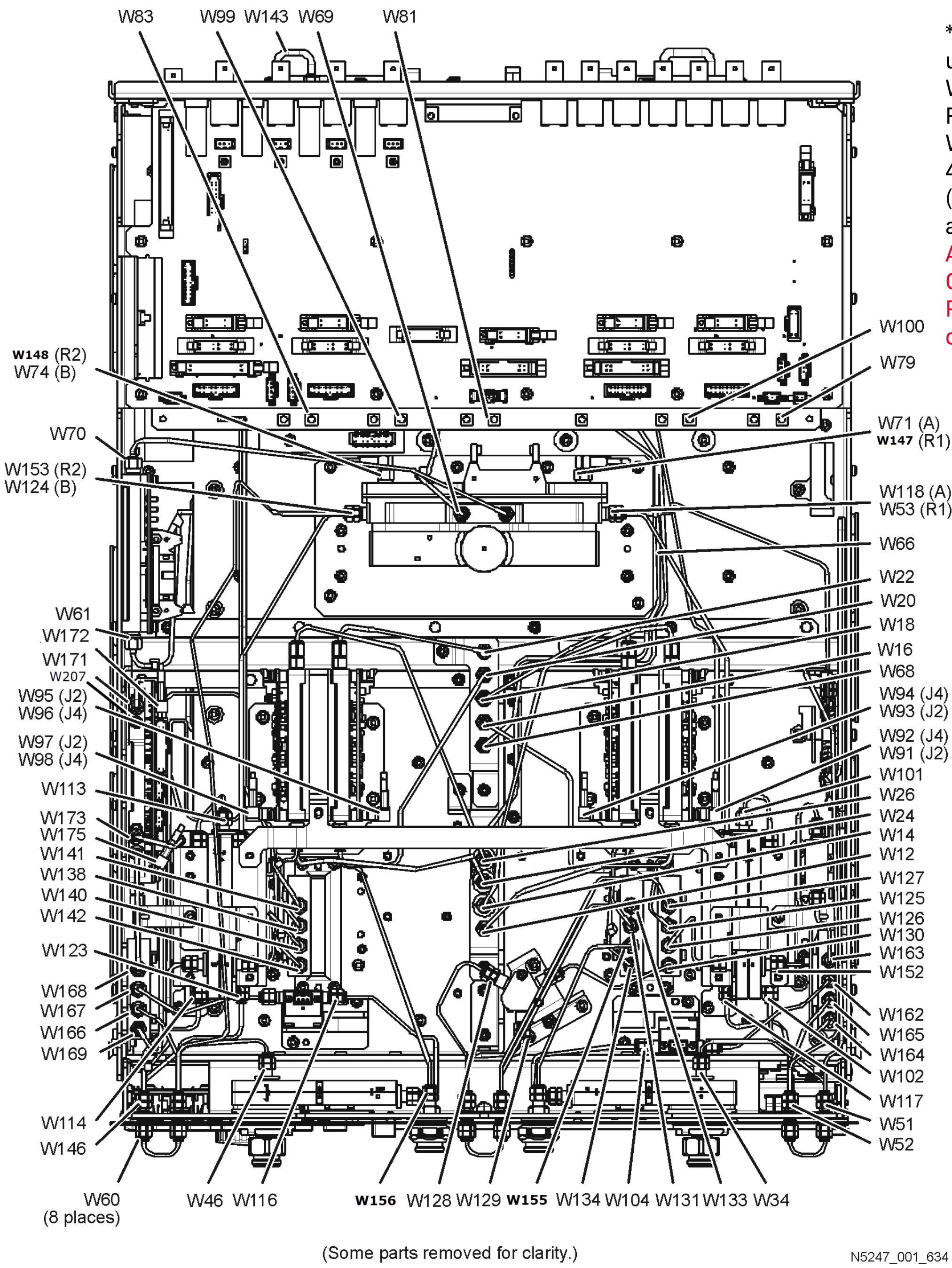
c. On legacy instruments using the 5087-7765 HMA26.5, the N5245-20100 cable is used only on 2-port instruments. On instruments with a new HMA26.5 the N5245-20100 cable is used in all instruments. If you are unclear which HMA26.5 assembly your PNA has installed, refer to "Verify the Model/Version of HMA26.5 Installed" on page 7-40 and to Figure 7-17 on page 40.

Figure 6-27 Bottom RF Cables, 2-Port, Options 224, S/N Prefixes ≥6201



*SPAM 5 boards use W149 & W150 for 2-ports. RF cables W80 & W82 apply to 4-Port models (not shown). See also "Top Cables, All Cables–All Options, S/N Prefixes ≥6021" on page 6-28.

Figure 6-28 Bottom RF Cables, 2-Port, Option 224 with Option 029 or E29, S/N Prefixes ≥6201



*SPAM 5 boards use W149 & W150 for 2-ports. RF cables W80 & W82 apply to 4-Port models (not shown). See also "Top Cables, All Cables–All Options, S/N Prefixes ≥6021" on page 6-28.

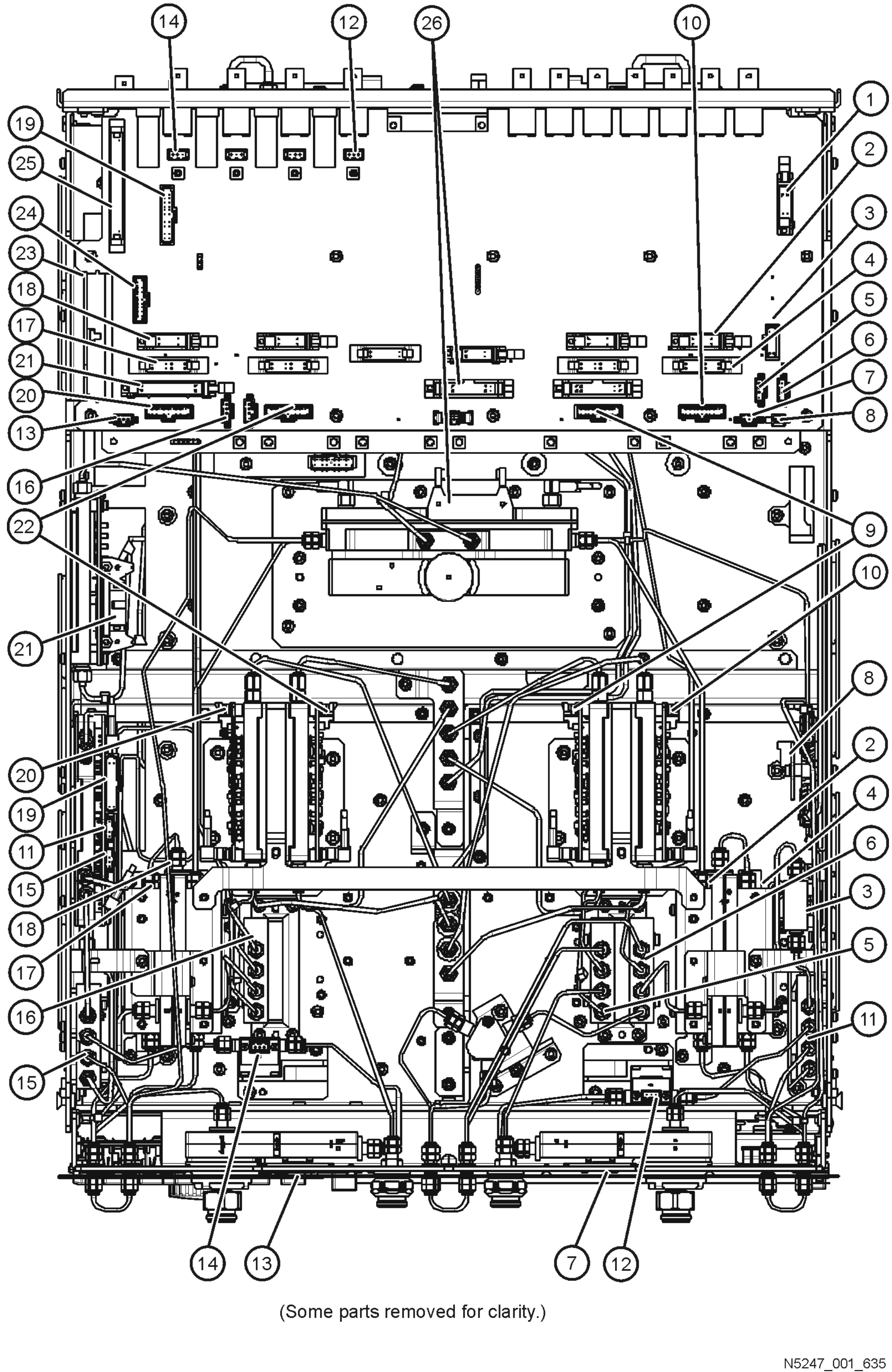
Bottom Ribbon Cables and Wire Harnesses, 2-Port, Option 224 with and without Option 029 or E29, S/N Prefixes ≥6201

Reference Designator	Type[a]	Part Number	Description
①	10R	N5242-60005	rear-panel PWR I/O to A23 test set motherboard J301
②	10R	N5247-60020	A23 test set motherboard J205 to A46 port 1 receiver attenuator
③	20R	N5245-60021	A64 tuner J9 to A23 test set motherboard J7 (Option 029 or E29 only)
④	16R	N5245-60006	A23 test set motherboard J549 to A38 port 1 source attenuator
⑤	4W	--	P/O A51 SRC2 OUT1 mechanical switch (to A23 test set motherboard J104). Refer to "2-Port Configuration, Option 224 with and without Option 029/E29, S/N Prefixes ≥6201" on page 6-72.
⑥	4W	--	P/O A50 port 1 mechanical switch (to A23 test set motherboard J101). Refer to "2-Port Configuration, Option 224 with and without Option 029/E29, S/N Prefixes ≥6201" on page 6-72.
⑦	3W	N5247-60016	A23 test set motherboard J221 to ports 1 LED board J1
⑧	2W	8121-0966	A23 test set motherboard J554 to A37 reference mixer switch
⑨	30R	N5247-60018	A61 SRC 2 OUT 1 70 GHz doubler J1 to A23 test set motherboard J5
s	30R	N5247-60018	A60 port 1 70 GHz doubler J1 to A23 test set motherboard J4
⑪	4W	--	P/O A56 port 1 noise bypass switch (to A59 noise receiver (downconverter) J42 port 1). Refer to "2-Port Configuration, Option 224 with and without Option 029/E29, S/N Prefixes ≥6201" on page 6-72. (Option 029 or E29only)
⑫	2W	N5247-60021	A23 test set motherboard J541 to A42 port 1 bias tee
⑬	3W	N5247-60016	A23 test set motherboard J222 to ports 2 LED board J1
⑭	2W	N5247-60021	A23 test set motherboard J542 to A45 port 2 bias tee
⑮	4W	--	P/O A57 port 2 noise bypass switch (to A59 noise receiver (downconverter) J41 port 2). Refer to "2-Port Configuration, Option 224 with and without Option 029/E29, S/N Prefixes ≥6201" on page 6-72. (Option 029 or E29 only)
⑯	4W	--	P/O A53 port 2 mechanical switch (to A23 test set motherboard J102). Refer to "2-Port Configuration, Option 224 with and without Option 029/E29, S/N Prefixes ≥6201" on page 6-72.
⑰	16R	N5245-60006	A23 test set motherboard J546 to A41 port 2 source attenuator
⑱	10R	N5247-60020	A23 test set motherboard J208 to A49 port 2 receiver attenuator
⑲	40R	N5245-60018	A59 noise receiver (downconverter) J1 to A23 test set motherboard J548 (Option 029 or E29 only)
⑳	30R	N5247-60018	A63 port 2 70 GHz doubler J1 to A23 test set motherboard J6
㉑	24R	N5247-60022	A23 test set motherboard J209 to A25 HMA26.5 J1
㉒	30R	N5247-60018	A62 SRC 2 OUT 2 70 GHz doubler J1 to A23 test set motherboard J3

Reference Designator	Type[a]	Part Number	Description
㉓	100R	N5242-60004	A18 system motherboard J1 to A23 test set motherboard J1 to A24 IF multiplexer board J1
㉔	25R	E4410-60160	A18 system motherboard J13 to A23 test set motherboard J545
㉕	36R	8121-0834	rear-panel HANDLER I/O to A23 test set motherboard J400
㉖	20R	N5247-60014	A23 test set motherboard J551 to A27 mixer brick (1) J52

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

Figure 6-29 Bottom Ribbon Cables and Wire Harnesses, 2-Port, Option 224 with and without Option 029 or E29, S/N Prefixes ≥6201



Cables 3, 11, 15, and 19 apply only with Option 029.

4-Port Configuration, Serial Number Prefixes <6021

This section contains the following:

See also, "4-Port Configurations, Serial Number Prefix ≥6021" on page 6-136.

4-Port Configuration, Option 401, S/N Prefixes <6201

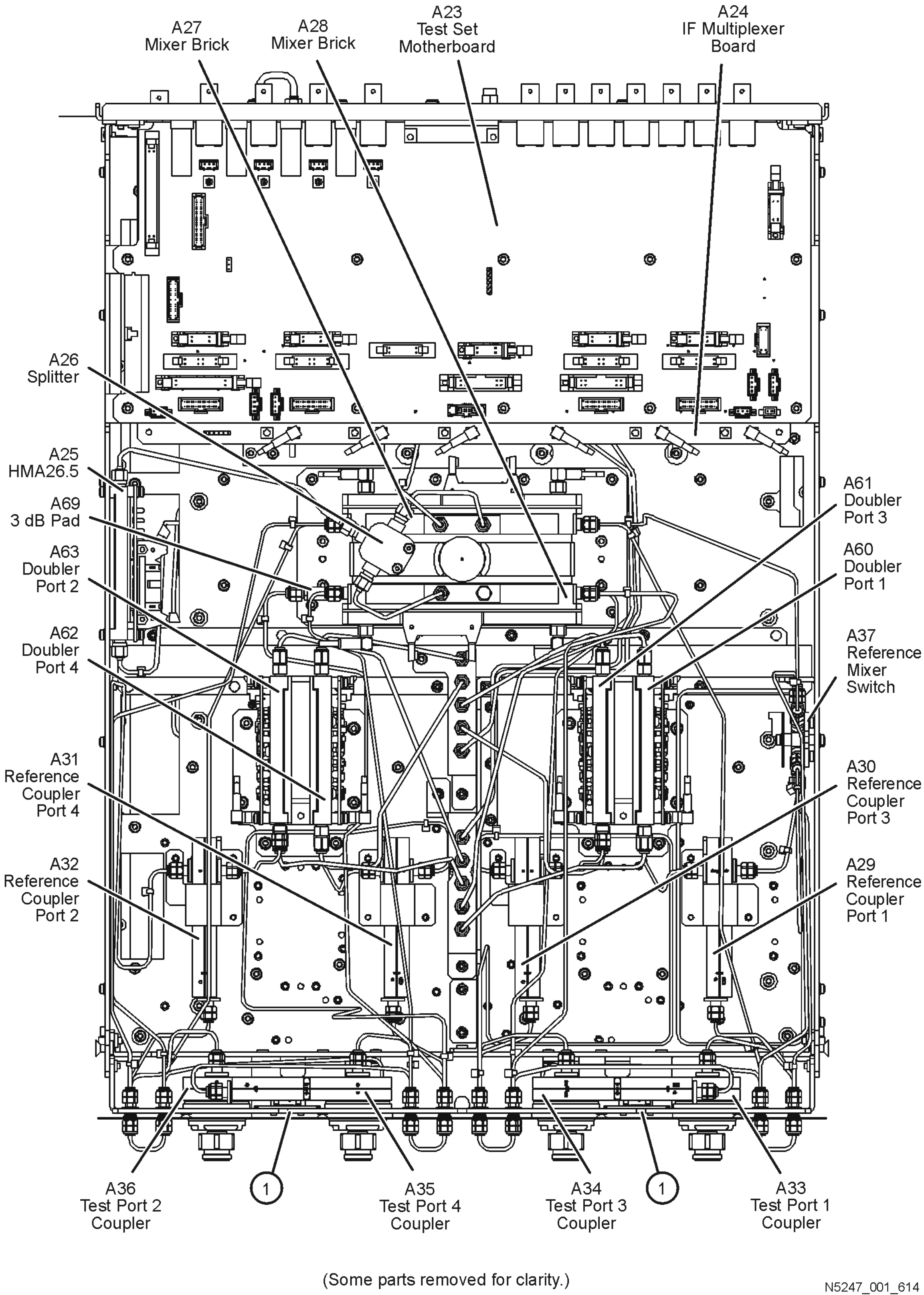
Bottom Assemblies, Standard 4-Port Configuration, Option 401, S/N Prefixes <6201

Reference Designator	Part Number[a]	Qty	Description
A23	N5245-60157 Was N5247-60001	1	Test set motherboard
A24	N5240-60062[b] Was: N5240-60045	1	IF multiplexer board
A25	5087-7765	1	LO Multiplier/amplifier 26.5 (HMA26.5)
A26	5067-4086	1	Splitter
A27 A28	5087-7337	2	Mixer brick
A29 A30 A31 A32	5087-7744	4	Test port 1 reference coupler Test port 3 reference coupler Test port 4 reference coupler Test port 2 reference coupler
A33 A34 A35 A36	5087-7778	4	Test port 1 coupler Test port 3 coupler Test port 4 coupler Test port 2 coupler
A37	5087-7759	1	Reference mixer switch
A60 A61 A62 A63	5087-7336	4	70 GHz doubler assembly port 1 70 GHz doubler assembly port 3 70 GHz doubler assembly port 4 70 GHz doubler assembly port 2
A69	08490-60037	1	3-dB attenuator (A28 mixer brick (R4)

Reference Designator	Part Number[a]	Qty	Description
①	N5240-60058	2	front-panel LED board

a. Part numbers in italic typeface are for rebuilt exchange assemblies. Refer to "Rebuilt-Exchange Assemblies" on page 6-4.
b. All new units built after August 2009, no longer use the N5242-60031 cable that was attached to connector P1001 and Source 2. As a result of this change, the IF multiplexer boards have had their P1001 connectors removed. If your instrument contains a N5242-60031 cable, remove it from your instrument.

Figure 6-30 Bottom Assemblies, Standard 4-Port Configuration, Option 401, S/N Prefixes <6201



Bottom RF Cables, Standard 4-Port Configuration, Option 401, S/N Prefixes <6201

Reference Designator	Type[a]	Part Number	Qty	Description
W12	SR	N5247-20059	1	A60 port 1 70 GHz doubler to W11
W14	SR	N5247-20072	1	A60 port 1 70 GHz doubler to W13
W16	SR	N5247-20060	1	A61 port 3 70 GHZ doubler to W15
W18	SR	N5247-20084	1	A61 port 3 70 GHZ doubler to W17
W20	SR	N5247-20015	1	A62 port 4 70 GHZ doubler to W19
W22	SR	N5247-20068	1	A62 port 4 70 GHZ doubler to W21
W24	SR	N5247-20061	1	A63 port 2 70 GHz doubler to W23
W26	SR	N5247-20051	1	A63 port 2 70 GHz doubler to W25
W27	SR	N5247-20074	1	A60 port 1 70 GHz doubler to A29 port 1 reference coupler
W28	SR	N5247-20052	1	A61 port 3 70 GHz doubler to A30 port 3 ref coupler
W29	SR	N5247-20074	1	A62 port 4 70 GHz doubler to A31 port 4 reference coupler
W30	SR	N5247-20052	1	A63 port 2 70 GHz doubler to A32 port 2 ref coupler
W31	SR	N5247-20037	1	A29 port 1 ref coupler to front-panel port 1 SOURCE OUT
W32	SR	N5247-20016	1	Port 1 CPLR THRU to A33 port 1 coupler
W33	SR	N5247-20078	1	A29 port 1 reference coupler to A37 reference mixer switch
W34	SR	N5247-20082	1	A33 port 1 coupler to front-panel port 1 CPLR ARM
W35	SR	N5247-20023	1	A30 port 3 ref coupler to front-panel port 3 SOURCE OUT
W36	SR	N5247-20006	1	port 3 CPLR THRU to A34 port 3 coupler
W37	SR	N5247-20077	1	A30 port 3 ref coupler to front-panel REF 3 SOURCE OUT
W38	SR	N5247-20007	1	A34 port 3 coupler to front-panel port 3 CPLR ARM
W39	SR	N5247-20035	1	A31 port 4 ref coupler to front-panel port 4 SOURCE OUT
W40	SR	N5247-20017	1	Port 4 CPLR THRU to A35 port 4 coupler
W41	SR	N5247-20075	1	A31 port 4 ref coupler to front-panel REF 4 SOURCE OUT
W42	SR	N5247-20026	1	A35 port 4 coupler to front-panel port 4 CPLR ARM
W43	SR	N5247-20036	1	A32 port 2 ref coupler to front-panel port 2 SOURCE OUT
W44	SR	N5247-20018	1	Port 2 CPLR THRU to A36 port 2 coupler
W45	SR	N5247-20076	1	A32 port 2 ref coupler to front-panel REF 2 SOURCE OUT
W46	SR	N5247-20019	1	A36 port 2 coupler to front-panel port 2 CPLR ARM

Reference Designator	Type[a]	Part Number	Qty	Description
W47	SR	N5247-20053	1	Port 1 RCVR A IN to A27 mixer brick (A)
W48	SR	N5247-20063	1	Port 3 RCVR C IN to A28 mixer brick (C)
W49	SR	N5247-20073	1	Port 4 RCVR D IN to A28 mixer brick (D)
W50	SR	N5247-20054	1	Port 2 RCVR B IN to A27 mixer brick (B)
W51	SR	N5247-20011	1	A37 reference mixer switch to front-panel REF 1 SOURCE OUT
W52	SR	N5247-20012	1	REF 1 RCVR R1 IN to A37 reference mixer switch
W53	SR	N5247-20048	1	A37 reference mixer switch to A27 mixer brick (R1)
W54	SR	N5247-20062	1	REF 3 RCVR R3 IN to A28 mixer brick (R3)
W55	SR	N5247-20067	1	REF 4 RCVR R4 IN to A69 3 dB pad on A28 mixer brick (R4)
W56	SR	N5247-20055	1	REF 2 RCVR R2 IN to A27 mixer brick (R2)
W58	cap	N5247-20138		2.4 mm cap for A28 mixer brick
W60	SR	N5247-20107	12	front-panel jumper
W61	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W62[b]	SR	N5247-20111	1	A25 HMA26.5 to A26 splitter
W63[b]	SR	N5245-20023	1	RF cable, A26 splitter to A27 mixer brick
W64[b]	SR	N5245-20022	1	A26 splitter to A28 mixer brick
W66	SR	N5247-20109	1	W65 to rear-panel EXT TSET DRIVE RF OUT (J6)
W68	SR	N5247-20088	1	rear-panel port RF2 OUT (J12) to W67
W69	SR	N5247-20112	1	A27 mixer brick to EXT TSET DRIVE LO OUT (J5)
W70[c]	SR	N5247-20100	1	A25 HMA26.5 to A27 mixer brick (1)
W71	F	N5242-60017	1	A27 mixer brick (A) to A24 IF multiplexer (P1)
W72	F	N5242-60021	1	A27 mixer brick (R1) to A24 IF multiplexer (P411)
W73	F	N5242-60022	1	A27 mixer brick (R2) to A24 IF multiplexer (P412)
W74	F	N5242-60018	1	A27 mixer brick (B) to A24 IF multiplexer (P201)
W75	F	N5242-60024	1	A28 mixer brick (D) to A24 IF multiplexer (P801)
W76	F	N5242-60019	1	A28 mixer brick (R4) to A24 IF multiplexer (P414)
W77	F	N5242-60020	1	A28 mixer brick (R3) to A24 IF multiplexer (P413)
W78	F	N5242-60023	1	A28 mixer brick (C) to A24 IF multiplexer (P601)
W80	F	N5242-60013	1	A24 IF multiplexer board P203 to A16 SPAM board J2

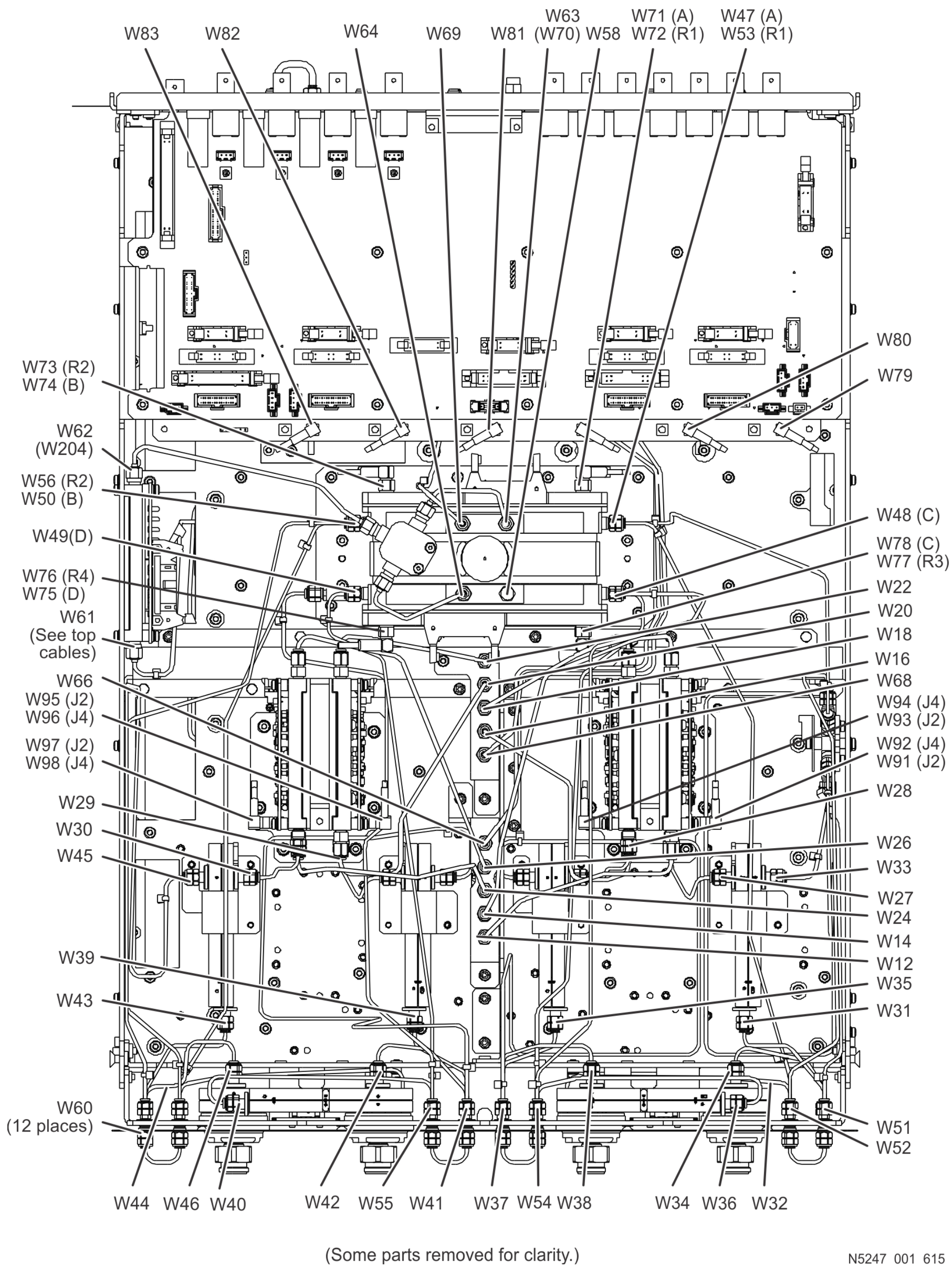
Reference Designator	Type[a]	Part Number	Qty	Description
W79, 81	F	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W82	F	N5242-60015	1	A24 IF multiplexer board P603 to A16 SPAM board J5
W83	F	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W91	F	N5247-60006	1	A60 port 1 70 GHz doubler J2 to A7 40 GHz doubler J401
W92	F	N5247-60007	1	A60 port 1 70 GHz doubler J4 to A7 40 GHz doubler J500
W93	F	N5247-60010	1	A61 port 3 70 GHz doubler J2 to A12 40 GHz doubler J401
W94	F	N5247-60011	1	A61 port 3 70 GHz doubler J4 to A12 40 GHz doubler J500
W95	F	N5247-60012	1	A62 port 4 70 GHz doubler J2 to A13 40 GHz doubler J401
W96	F	N5247-60013	1	A62 port 4 70 GHz doubler J4 to A13 40 GHz doubler J500
W97	F	N5247-60008	1	A63 port 2 70 GHz doubler J2 to A8 40 GHz doubler J401
W98	F	N5247-60009	1	A63 port 2 70 GHz doubler J4 to A8 40 GHz doubler J500
W204[b]	F	N5247-20185	1	A25 HMA26.5 to A28 mixer brick (2)

a. SR = semirigid coaxial cable; F = flexible coaxial cable

b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

c. On legacy instruments using the 5087-7765 HMA26.5, the N5245-20100 cable is used only on 2-port instruments. On instruments with a new HMA26.5 the N5245-20100 cable is used in all instruments. If you are unclear which HMA26.5 assembly your PNA has installed, refer to "Verify the Model/Version of HMA26.5 Installed" on page 7-40 and to Figure 7-17 on page 40.

Figure 6-31 Bottom RF Cables, Standard 4-Port Configuration, Option 401, S/N Prefixes <6201[1]



1. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 “2-Port Configurations, Serial Number Prefixes <6021” on page 6-32 and “4-Port Configuration, Serial Number Prefixes <6021” on page 6-84.

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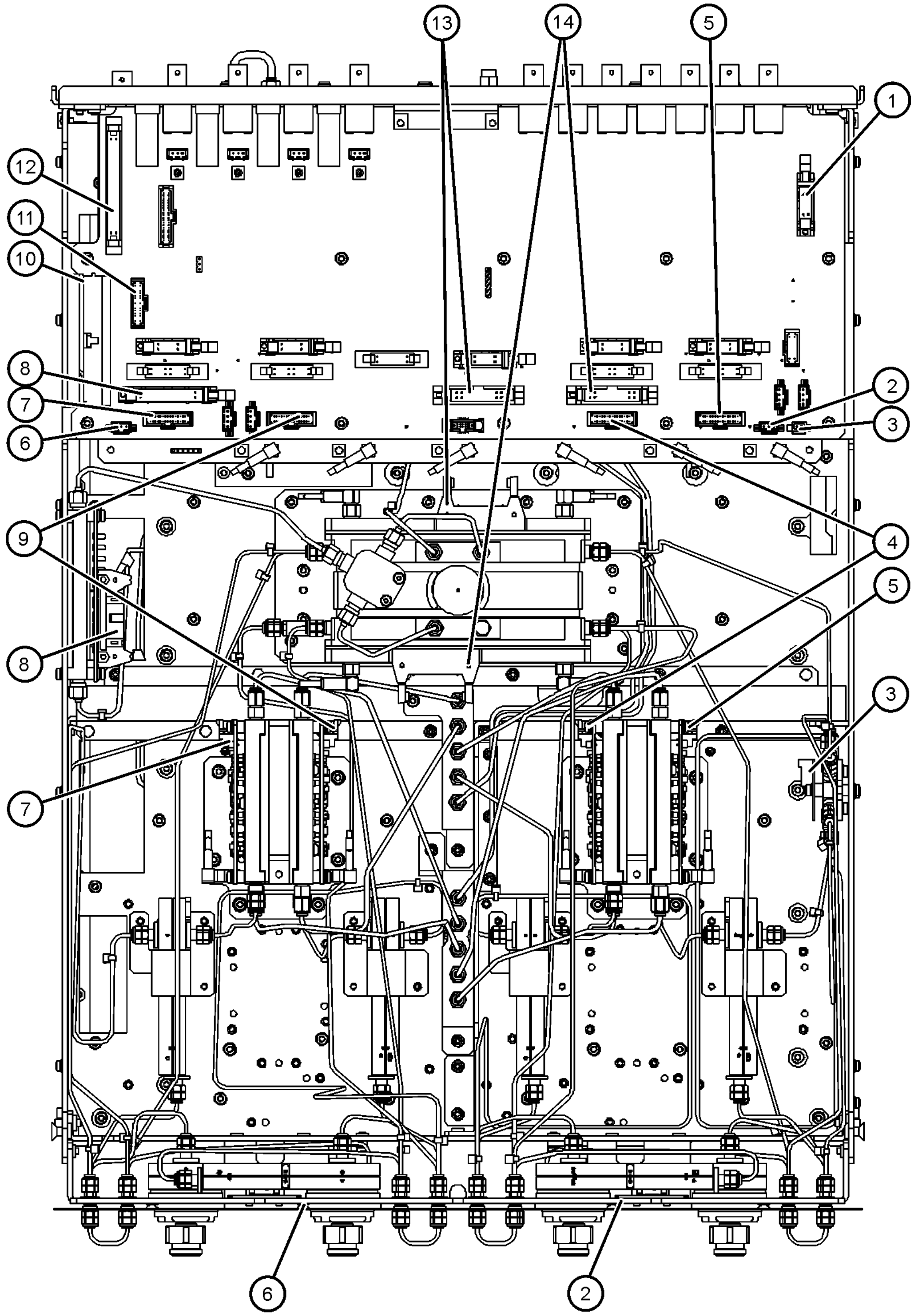
Bottom Ribbon Cables and Wire Harnesses, Standard 4-Port Configuration, Option 401, S/N Prefixes <6201

Reference Designator	Type[a]	Part Number	Description
①	10R	N5242-60005	rear-panel PWR I/O to A23 test set motherboard J301
②	3W	N5247-60016	A23 test set motherboard J221 to ports 1/3 LED board J1
③	2W	8121-0966	A23 test set motherboard J554 to A37 reference mixer switch
④	30R	N5247-60018	A61 port 3 70 GHz doubler J1 to A23 test set motherboard J5
⑤	30R	N5247-60018	A60 port 1 70 GHz doubler J1 to A23 test set motherboard J4
⑥	3W	N5247-60016	A23 test set motherboard J222 to ports 2/4 LED board J1
⑦	30R	N5247-60018	A63 port 2 70 GHz doubler J1 to A23 test set motherboard J6
⑧	24R	N5247-60022	A23 test set motherboard J209 to A25 HMA26.5 J1
⑨	30R	N5247-60018	A62 port 4 70 GHz doubler J1 to A23 test set motherboard J3
s	100R	N5242-60004	A18 system motherboard J1 to A23 test set motherboard J1 to A24 IF multiplexer board J1
⑪	25R	E4410-60160	A18 system motherboard J13 to A23 test set motherboard J545
⑫	36R	8121-0834	rear-panel HANDLER I/O to A23 test set motherboard J400
⑬	20R	N5247-60014	A23 test set motherboard J551 to A27 mixer brick (1) J52
⑭	20R	N5247-60015	A23 test set motherboard J552 to A28 mixer brick (2) J52

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

Figure 6-32 Bottom Ribbon Cables and Wire Harnesses, Standard 4-Port Configuration, Option 401, S/N Prefixes <6201



(Some parts removed for clarity.)

N5247_001_616

4-Port Configuration, Options 419, S/N Prefixes <6201

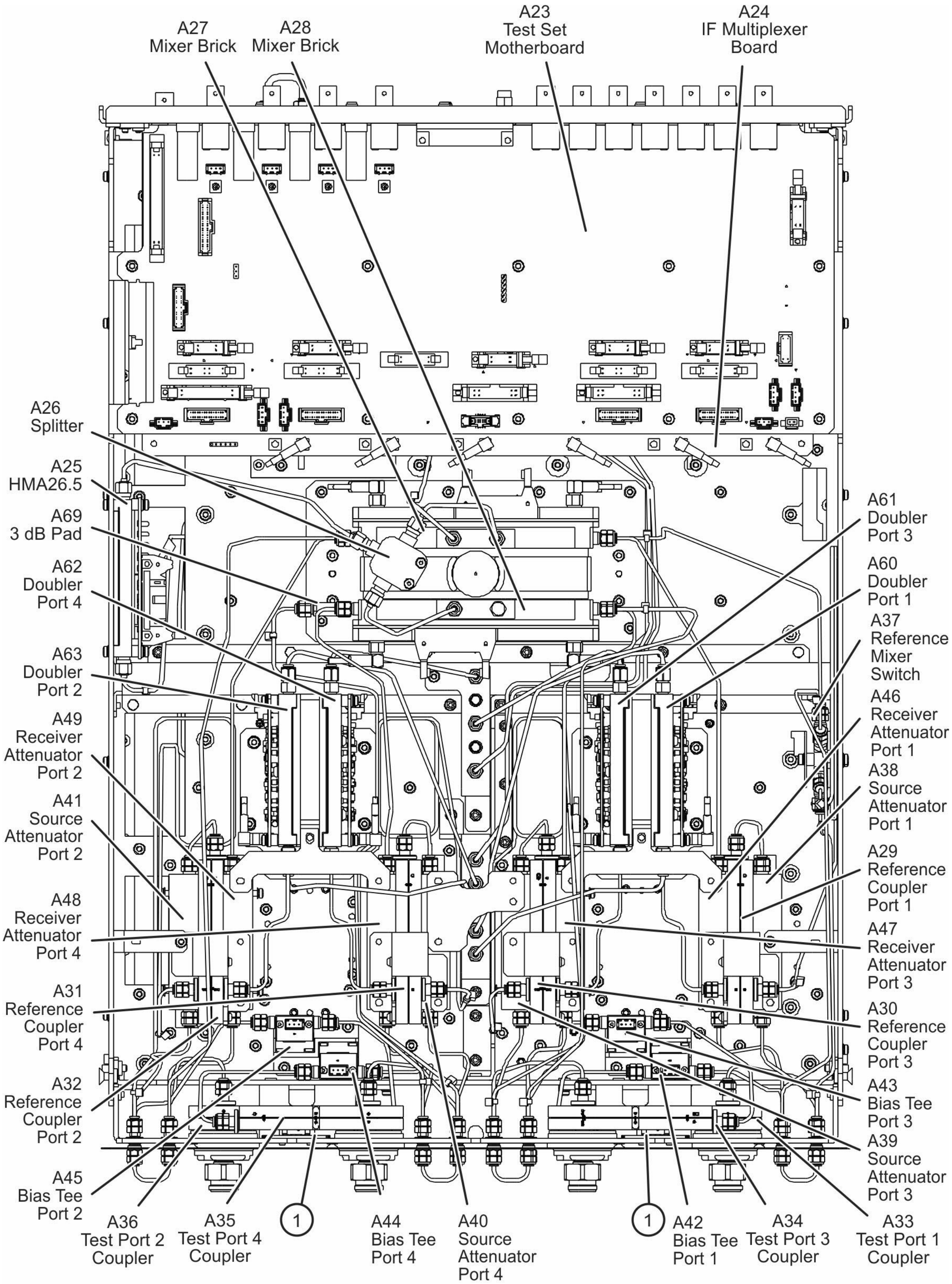
Bottom Assemblies, 4-Port, Options 419, S/N Prefixes <6201

Reference Designator	Part Number[a]	Qty	Description
A23	N5245-60157 Was N5247-60001	1	Test set motherboard
A24	N5240-60062[b] Was: N5240-60045	1	IF multiplexer board
A25	5087-7765	1	LO Multiplier/amplifier 26.5 (HMA26.5)
A26	5067-4086	1	Splitter
A27 A28	5087-7337	2	Mixer brick
A29 A30 A31 A32	5087-7744	4	Test port 1 reference coupler Test port 3 reference coupler Test port 4 reference coupler Test port 2 reference coupler
A33 A34 A35 A36	5087-7778	4	Test port 1 coupler Test port 3 coupler Test port 4 coupler Test port 2 coupler
A37	5087-7759	1	Reference mixer switch
A38 A39 A40 A41	84905-60004 was: 84905-60002	4	Test port 1 source attenuator Test port 3 source attenuator Test port 4 source attenuator Test port 2 source attenuator
A42 A43 A44 A45	5087-7732 Was 5086-7020	4	Test port 1 bias tee Test port 3 bias tee Test port 4 bias tee Test port 2 bias tee
A46 A47 A48 A49	84905-60004 was: 84905-60002	4	Port 1 receiver attenuator Port 3 receiver attenuator Port 4 receiver attenuator Port 2 receiver attenuator
A60 A61 A62 A63	5087-7336	4	70 GHz doubler assembly port 1 70 GHz doubler assembly port 3 70 GHz doubler assembly port 4 70 GHz doubler assembly port 2
A69	08490-60037	1	3-dB attenuator (A28 mixer brick (R1)
①	N5240-60058	2	front-panel LED board

a. Part numbers in italic typeface are for rebuilt exchange assemblies. Refer to "Rebuilt-Exchange Assemblies" on page 6-4.

b. All new units built after August 2009, no longer use the N5242-60031 cable that was attached to connector P1001 and Source 2. As a result of this change, the IF multiplexer boards have had their P1001 connectors removed. If your instrument contains a N5242-60031 cable, remove it from your instrument.

Figure 6-33 Bottom Assemblies, 4-Port, Options 419, S/N Prefixes <6201



(Some parts removed for clarity.)

N5247_026_617

Bottom RF Cables, 4-Port, Options 419 (Ports 1 and 2), S/N Prefixes <6201

Reference Designator	Type[a]	Part Number	Qty	Description
W12	SR	N5247-20059	1	A60 port 1 70 GHz doubler to W11
W14	SR	N5247-20072	1	A60 port 1 70 GHz doubler to W13
W24	SR	N5247-20061	1	A63 port 2 70 GHz doubler to W23
W26	SR	N5247-20051	1	A63 port 2 70 GHz doubler to W25
W27	SR	N5247-20044	1	A60 port 1 70 GHz doubler to A29 port 1 reference coupler
W30	SR	N5247-20043	1	A63 port 2 70 GHz doubler to A32 port 2 reference coupler
W34	SR	N5247-20082	1	A33 port 1 coupler to front-panel port 1 CPLR ARM
W46	SR	N5247-20019	1	A36 port 2 coupler to front-panel port 2 CPLR ARM
W51	SR	N5247-20011	1	A37 reference mixer switch to front-panel REF 1 SOURCE OUT
W52	SR	N5247-20012	1	REF 1 RCVR R1 IN to A37 reference mixer switch
W53	SR	N5247-20048	1	A37 reference mixer switch to A27 mixer brick (R1)
W60	SR	N5247-20107	12	front-panel jumper
W61	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W62[b]	SR	N5247-20125	1	A25 HMA26.5 to A27 mixer block
W63[b]	SR	N5245-20023	1	RF cable, A26 splitter to A27 mixer brick (Option 029 only)
W66	SR	N5247-20109	1	W65 to rear-panel EXT TSET DRIVE RF OUT (J6)
W69	SR	N5247-20112	1	A27 mixer brick to EXT TSET DRIVE LO OUT (J5)
W70[c]	SR	N5247-20100	1	A25 HMA26.5 to A27 mixer brick
W71	F	N5242-60017	1	A27 mixer brick (A) to A24 IF multiplexer (P1)
W72	F	N5242-60021	1	A27 mixer brick (R1) to A24 IF multiplexer (P411)
W73	F	N5242-60022	1	A27 mixer brick (R2) to A24 IF multiplexer (P412)
W74	F	N5242-60018	1	A27 mixer brick (B) to A24 IF multiplexer (P201)
W79, 81, 83	F	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W91	F	N5247-60006	1	A60 port 1 70 GHz doubler J2 to A7 40 GHz doubler J401
W92	F	N5247-60007	1	A60 port 1 70 GHz doubler J4 to A7 40 GHz doubler J500
W97	F	N5247-60008	1	A63 port 2 70 GHz doubler J2 to A8 40 GHz doubler J401
W98	F	N5247-60009	1	A63 port 2 70 GHz doubler J4 to A8 40 GHz doubler J500
W101	SR	N5247-20083	1	A29 port 1 reference coupler to A38 port 1 source attenuator

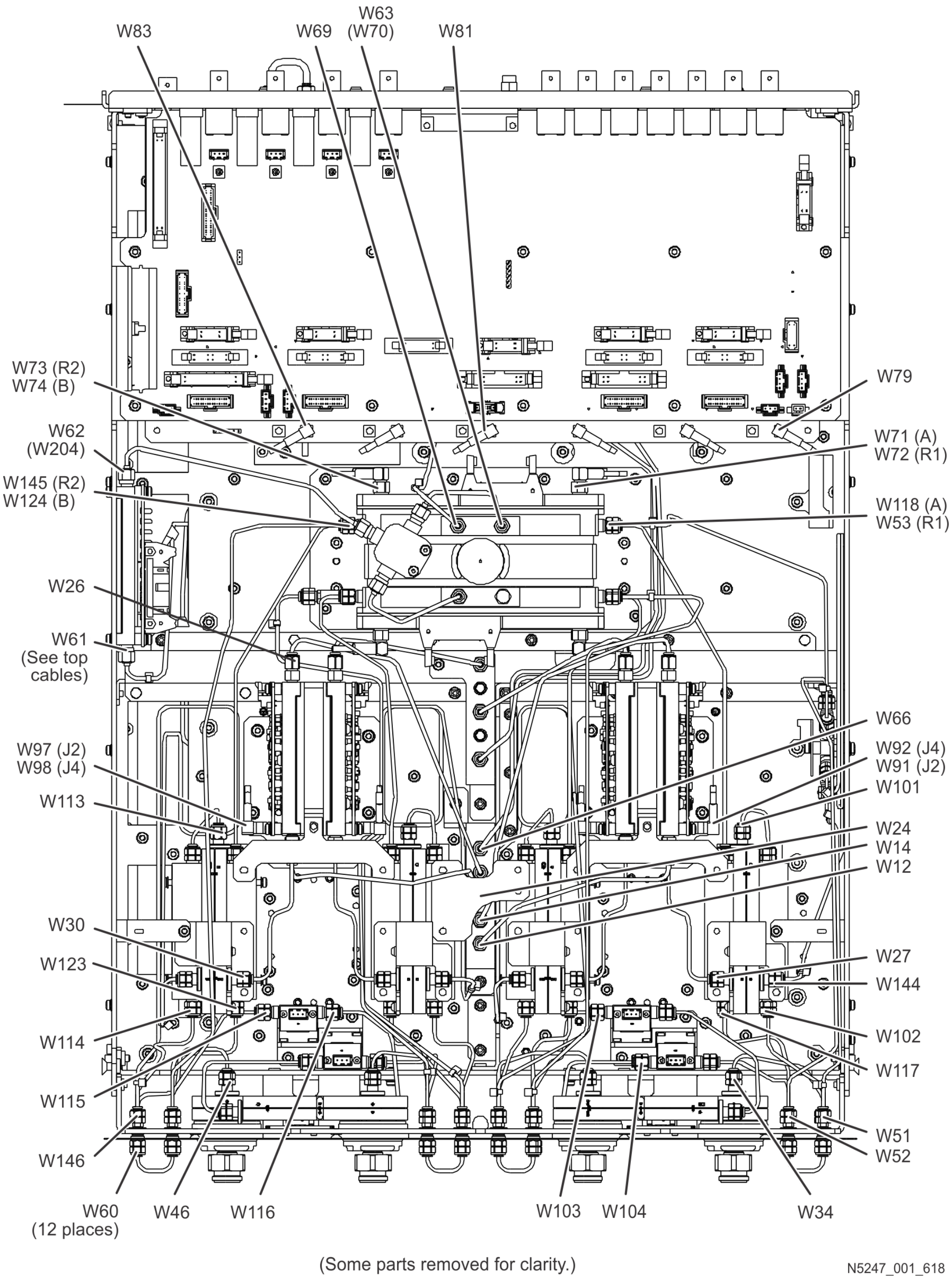
Reference Designator	Type[a]	Part Number	Qty	Description
W102	SR	N5247-20014	1	A38 port 1 source attenuator to front-panel port 1 SOURCE OUT
W103	SR	N5247-20081	1	Front-panel port 1 CPLR THRU to A42 port 1 bias tee
W104	SR	N5247-20022	1	A33 port 1 coupler to A42 port 1 bias tee
W113	SR	N5247-20083	1	A32 port 2 reference coupler to A41 port 2 source attenuator
W114	SR	N5247-20034	1	A41 port 2 source attenuator to front-panel port 2 SOURCE OUT
W115	SR	N5247-20027	1	Port 2 CPLR THRU to A45 port 2 bias tee
W116	SR	N5247-20080	1	A45 port 2 bias tee to A36 port 2 coupler
W117	SR	N5247-20013	1	Front-panel port 1 RCVR A IN to A46 port 1 receiver attenuator
W118	SR	N5247-20047	1	A46 port 1 receiver attenuator to A27 mixer brick (A)
W123	SR	N5247-20020	1	Port 2 RCVR B IN to A49 port 2 receiver attenuator
W124	SR	N5247-20046	1	A49 port 2 receiver attenuator to A27 mixer brick (B)
W144	SR	N5247-20071	1	A29 port 1 reference coupler to A37 reference mixer switch
W145	SR	N5247-20066	1	REF 2 RCVR R2 IN to A27 mixer brick (R2)
W146	SR	N5247-20058	1	A32 port 2 ref coupler to front-panel REF 2 SOURCE OUT
W204[b]	SR	N5247-20185	1	A25 HMA26.5 to A28 mixer brick (2) (See also, ports 3 & 4, Figure 6-35 on page 6-101).

a. SR = semirigid coaxial cable; F = flexible coaxial cable

b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

c. On legacy instruments using the 5087-7765 HMA26.5, the N5245-20100 cable is used only on 2-port instruments. On instruments with a new HMA26.5 the N5245-20100 cable is used in all instruments. If you are unclear which HMA26.5 assembly your PNA has installed, refer to "Verify the Model/Version of HMA26.5 Installed" on page 7-40 and to Figure 7-17 on page 40.

Figure 6-34 Bottom RF Cables, 4-Port, Options 419 (Ports 1 and 2), S/N Prefixes <6201[1]



1. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

Bottom RF Cables, 4-Port, Options 419 (Ports 3 and 4), S/N Prefixes <6201

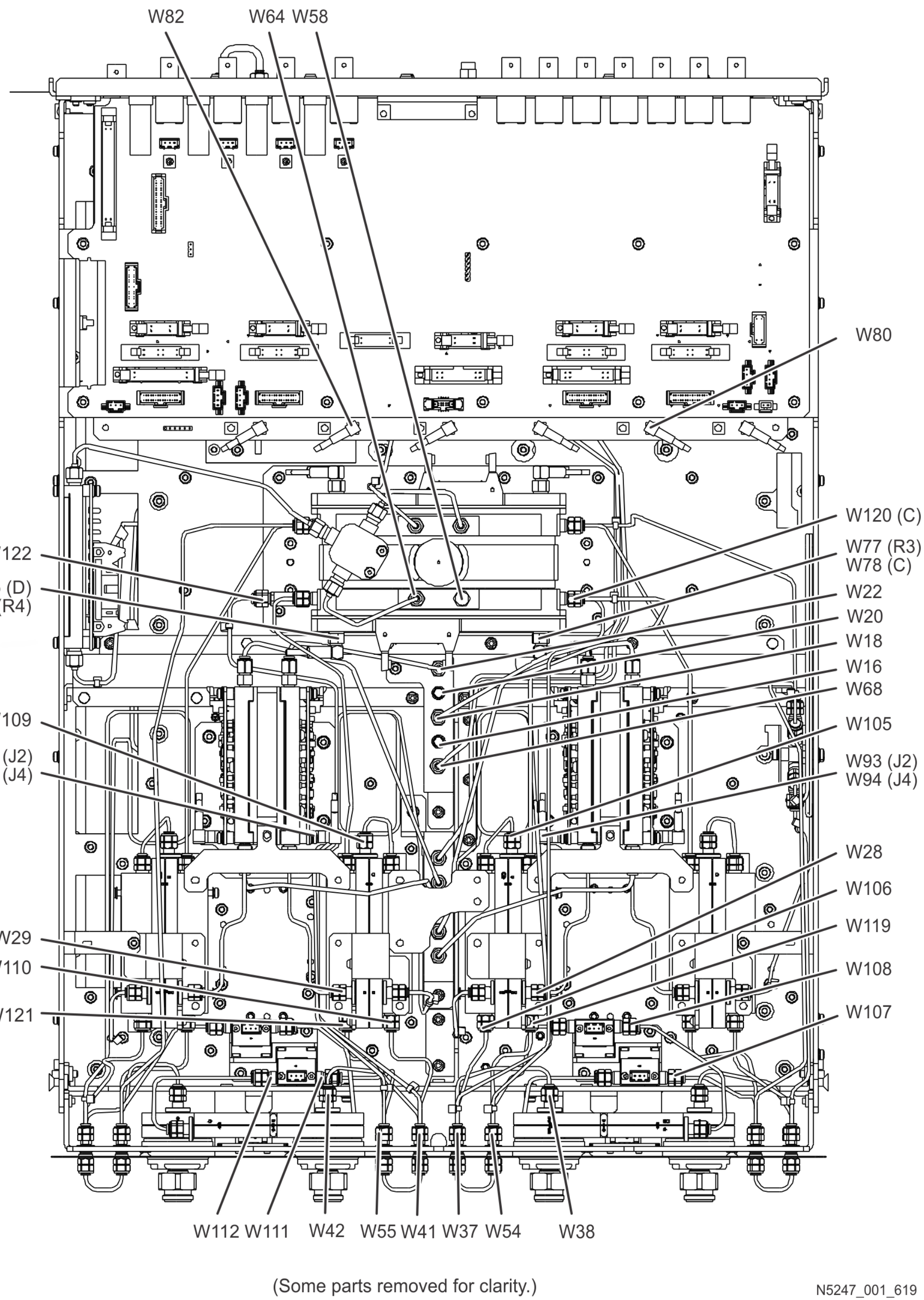
Reference Designator	Type[a]	Part Number	Qty	Description
W16	SR	N5247-20060	1	A61 port 3 70 GHZ doubler to W15
W18	SR	N5247-20084	1	A61 port 3 70 GHZ doubler to W17
W20	SR	N5247-20015	1	A62 port 4 70 GHZ doubler to W19
W22	SR	N5247-20068	1	A62 port 4 70 GHZ doubler to W21
W28	SR	N5247-20043	1	A61 port 3 70 GHz doubler to A30 port 3 reference coupler
W29	SR	N5247-20044	1	A62 port 4 70 GHz doubler to A31 port 4 reference coupler
W37	SR	N5247-20070	1	A30 port 3 reference coupler to front-panel REF 3 SOURCE OUT
W38	SR	N5247-20007	1	A34 port 3 coupler to front-panel port 3 CPLR ARM
W41	SR	N5247-20069	1	A31 port 4 reference coupler to front-panel REF 4 SOURCE OUT
W42	SR	N5247-20026	1	A35 port 4 coupler to front-panel port 4 CPLR ARM
W54	SR	N5247-20062	1	REF 3 RCVR R3 IN to A28 mixer brick (R3)
W55	SR	N5247-20067	1	REF 4 RCVR R4 IN to A69 3 dB pad on A28 mixer brick (R4)
W58	cap	N5247-20138		2.4 mm cap for A28 mixer brick
W64[b]	SR	N5245-20022	1	A26 splitter to A28 mixer brick
W68	SR	N5247-20088	1	rear-panel port RF2 OUT (J12) to W67
W75	F	N5242-60024	1	A28 mixer brick (D) to A24 IF multiplexer (P801)
W76	F	N5242-60019	1	A28 mixer brick (R4) to A24 IF multiplexer (P414)
W77	F	N5242-60020	1	A28 mixer brick (R3) to A24 IF multiplexer (P413)
W78	F	N5242-60023	1	A28 mixer brick (C) to A24 IF multiplexer (P601)
W80	F	N5242-60013	1	A24 IF multiplexer board P203 to A16 SPAM board J2
W82	F	N5242-60015	1	A24 IF multiplexer board P603 to A16 SPAM board J5
W93	F	N5247-60010	1	A61 port 3 70 GHz doubler J2 to A12 40 GHz doubler J401
W94	F	N5247-60011	1	A61 port 3 70 GHz doubler J4 to A12 40 GHz doubler J500
W95	F	N5247-60012	1	A62 port 4 70 GHz doubler J2 to A13 40 GHz doubler J401
W96	F	N5247-60013	1	A62 port 4 70 GHz doubler J4 to A13 40 GHz doubler J500
W105	SR	N5247-20083	1	A30 port 3 reference coupler to A39 port 3 source attenuator
W106	SR	N5247-20009	1	A39 port 3 source attenuator to front-panel port 3 SOURCE OUT
W107	SR	N5247-20010	1	Port 3 CPLR THRU to A43 port 3 bias tee

Reference Designator	Type[a]	Part Number	Qty	Description
W108	SR	N5247-20028	1	A43 port 3 bias tee to A34 port 3 coupler
W109	SR	N5247-20083	1	A31 port 4 reference coupler to A40 port 4 source attenuator
W110	SR	N5247-20025	1	A40 port 4 source attenuator to front-panel port 4 SOURCE OUT
W111	SR	N5247-20021	1	Port 4 CPLR THRU to A44 port 4 bias tee
W112	SR	N5247-20029	1	A44 port 4 bias tee to A35 port 4 coupler
W119	SR	N5247-20008	1	Port 3 RCVR C IN to A47 port 3 receiver attenuator
W120	SR	N5247-20064	1	A47 port 3 receiver attenuator to A28 mixer brick (C)
W121	SR	N5247-20024	1	Port 4 RCVR D IN to A48 port 4 receiver attenuator
W122	SR	N5247-20065	1	A48 port 4 receiver attenuator to A28 mixer brick (D)

a. SR = semirigid coaxial cable; F = flexible coaxial cable

b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

Figure 6-35 Bottom RF Cables, 4-Port, Options 419 (Ports 3 and 4), S/N Prefixes <6201[1]



1. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

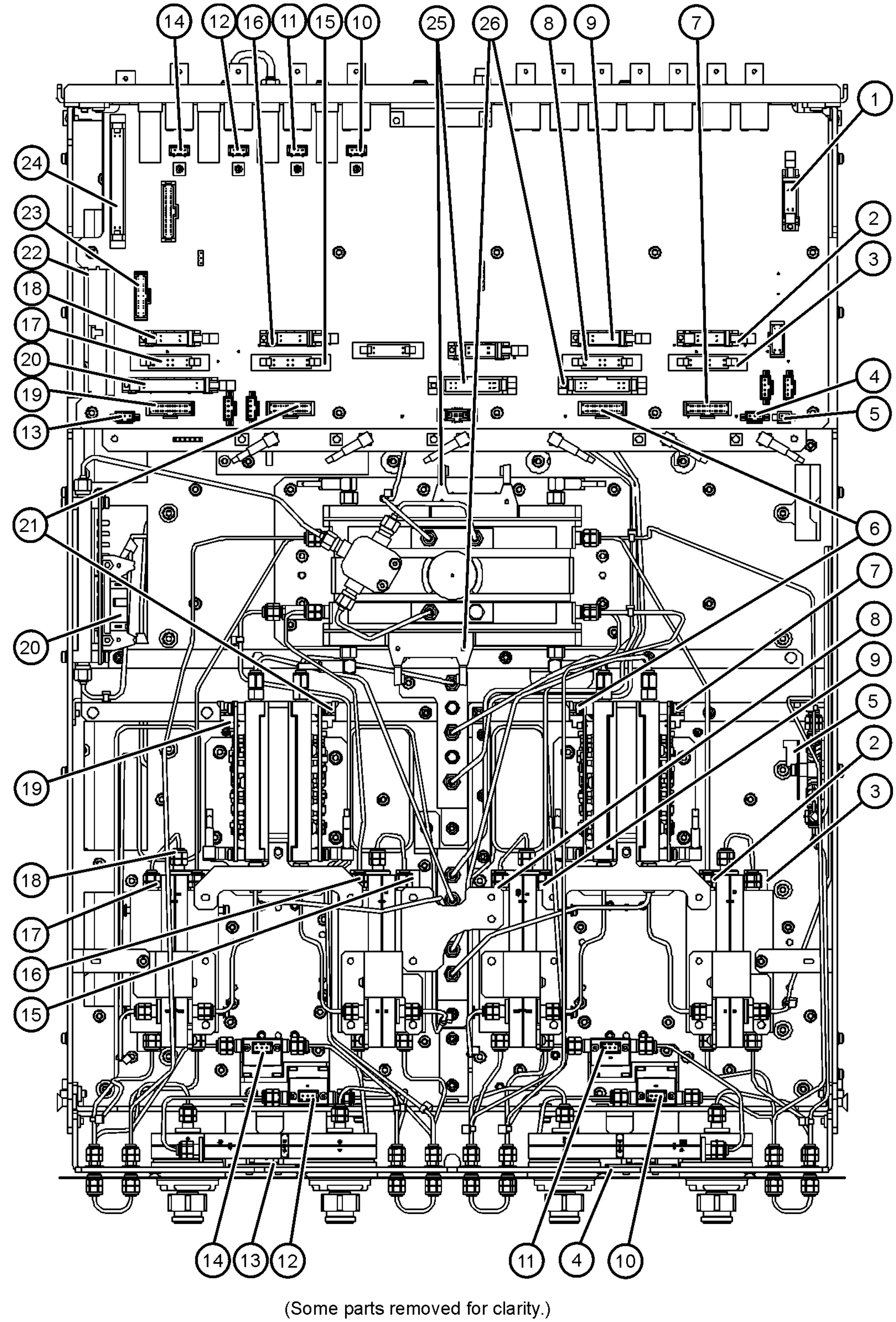
Bottom Ribbon Cables and Wire Harnesses, 4-Port, Options 419, S/N Prefixes <6201

Reference Designator	Type[a]	Part Number	Description
①	10R	N5242-60005	rear-panel PWR I/O to A23 test set motherboard J301
②	10R	N5247-60020	A23 test set motherboard J205 to A46 port 1 receiver attenuator
③	16R	N5245-60006	A23 test set motherboard J549 to A38 port 1 source attenuator
④	3W	N5247-60016	A23 test set motherboard J221 to ports 1/3 LED board J1
⑤	2W	8121-0966	A23 test set motherboard J554 to A37 reference mixer switch
⑥	30R	N5247-60018	A61 port 3 70 GHz doubler J1 to A23 test set motherboard J5
⑦	30R	N5247-60018	A60 port 1 70 GHz doubler J1 to A23 test set motherboard J4
q	16R	N5245-60006	A23 test set motherboard J547 to A39 port 3 source attenuator
⑨	10R	N5247-60020	A23 test set motherboard J206 to A47 port 3 receiver attenuator
s	2W	N5247-60021	A23 test set motherboard J541 to A42 port 1 bias tee
⑪	2W	N5247-60021	A23 test set motherboard J543 to A43 port 3 bias tee
⑫	2W	N5247-60021	A23 test set motherboard J544 to A44 port 4 bias tee
⑬	3W	N5247-60016	A23 test set motherboard J222 to ports 2/4 LED board J1
⑭	2W	N5247-60021	A23 test set motherboard J542 to A45 port 2 bias tee
⑮	16R	N5245-60006	A23 test set motherboard J548 to A40 port 4 source attenuator
⑰	16R	N5245-60006	A23 test set motherboard J546 to A41 port 2 source attenuator
⑯	10R	N5247-60020	A23 test set motherboard J207 to A48 port 4 receiver attenuator
⑱	10R	N5247-60020	A23 test set motherboard J208 to A49 port 2 receiver attenuator
⑲	30R	N5247-60018	A63 port 2 70 GHz doubler J1 to A23 test set motherboard J6
⑳	24R	N5247-60022	A23 test set motherboard J209 to A25 HMA26.5 J1
㉑	30R	N5247-60018	A62 port 4 70 GHz doubler J1 to A23 test set motherboard J3
㉒	100R	N5242-60004	A18 system motherboard J1 to A23 test set motherboard J1 to A24 IF multiplexer board J1
㉓	25R	E4410-60160	A18 system motherboard J13 to A23 test set motherboard J545
㉔	36R	8121-0834	rear-panel HANDLER I/O to A23 test set motherboard J400
㉕	20R	N5247-60014	A23 test set motherboard J551 to A27 mixer brick (1) J52

Reference Designator	Type[a]	Part Number	Description
㉖	20R	N5247-60015	A23 test set motherboard J552 to A28 mixer brick (2) J52

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

Figure 6-36 Bottom Ribbon Cables and Wire Harnesses, 4-Port, Options 419, S/N Prefixes <6201



4-Port Configuration, Option 423 with and without Option 029, S/N Prefixes <6201

Bottom Assemblies, 4-Port, Option 423 with and without Option 029, S/N Prefixes <6201

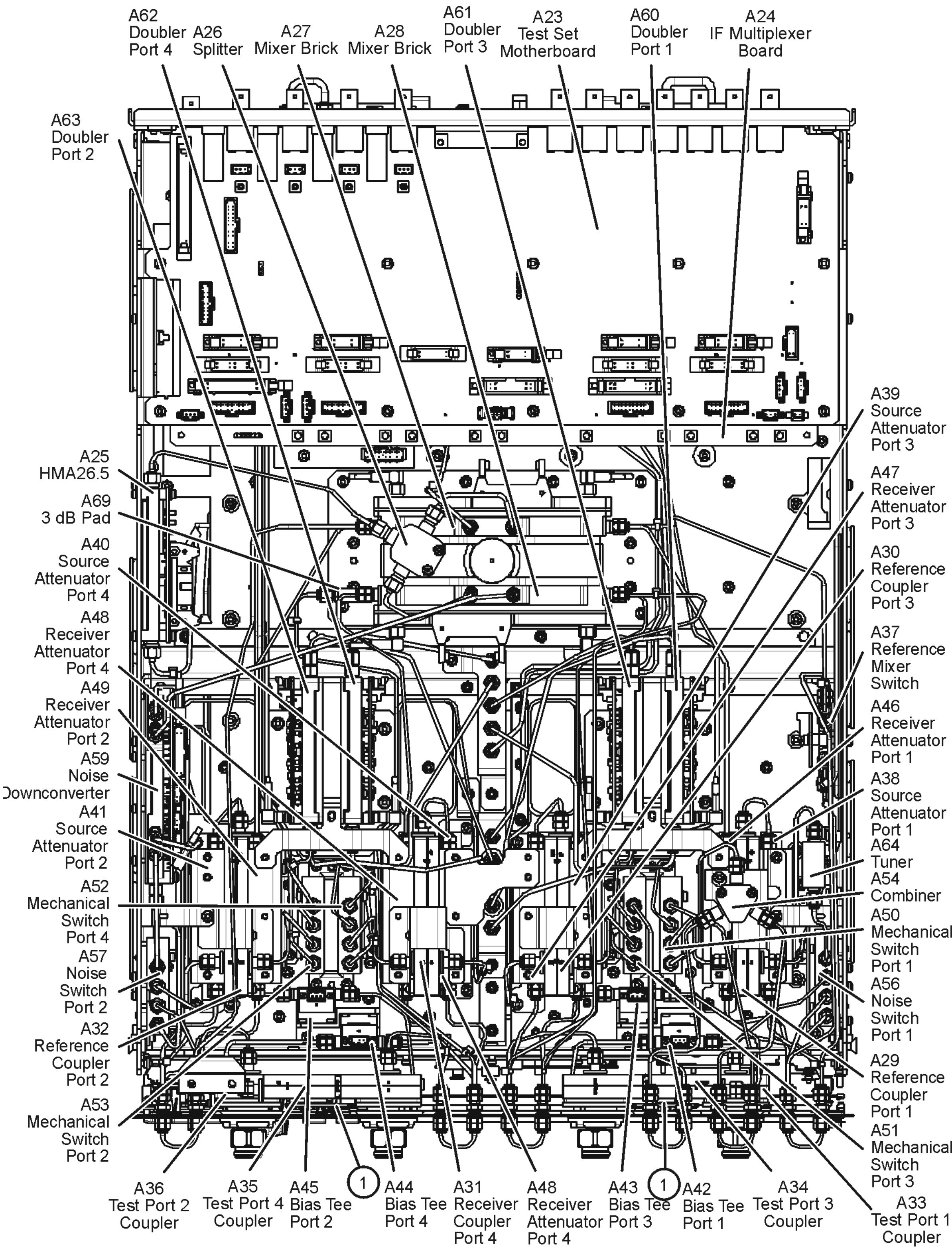
Reference Designator	Part Number[a]	Qty	Description
A23	N5245-60157 Was N5247-60001	1	Test set motherboard
A24	N5240-60062[b] Was: N5240-60045	1	IF multiplexer board
A25	5087-7765	1	LO Multiplier/amplifier 26.5 (HMA26.5)
A26	5067-4086	1	Splitter
A27 A28	5087-7337	2	Mixer brick
A29 A30 A31 A32	5087-7744	4	Test port 1 reference coupler Test port 3 reference coupler Test port 4 reference coupler Test port 2 reference coupler
A33 A34 A35 A36	5087-7778	4	Test port 1 coupler Test port 3 coupler Test port 4 coupler Test port 2 coupler
A37	5087-7759	1	Reference mixer switch
A38 A39 A40 A41	84905-60004 was: 84905-60002	4	Test port 1 source attenuator Test port 3 source attenuator Test port 4 source attenuator Test port 2 source attenuator
A42 A43 A44 A45	5087-7732 Was 5086-7020	4	Test port 1 bias tee Test port 3 bias tee Test port 4 bias tee Test port 2 bias tee
A46 A47 A48 A49	84905-60004 was: 84905-60002	4	Port 1 receiver attenuator Port 3 receiver attenuator Port 4 receiver attenuator Port 2 receiver attenuator
A50 A51 A52 A53	N1811-60010	6	Port 1 mechanical switch Port 3 mechanical switch Port 4 mechanical switch Port 2 mechanical switch
A54	11667-60016	1	Combiner
A56 A57	N1811-60010	2	Port 1 noise bypass switch Port 2 noise bypass switch

Reference Designator	Part Number[a]	Qty	Description
A59	5087-7344	1	noise receiver (downconverter)
A60 A61 A62 A63	5087-7336	4	70 GHz doubler assembly port 1 70 GHz doubler assembly port 3 70 GHz doubler assembly port 4 70 GHz doubler assembly port 2
A64	5087-7345	1	Tuner
A69	08490-60037	1	3-dB attenuator (A28 mixer brick (R1)
①	N5240-60058	2	front-panel LED board

a. Part numbers in italic typeface are for rebuilt exchange assemblies. Refer to “Rebuilt-Exchange Assemblies” on page 6-4.

b. All new units built after August 2009, no longer use the N5242-60031 cable that was attached to connector P1001 and Source 2. As a result of this change, the IF multiplexer boards have had their P1001 connectors removed. If your instrument contains a N5242-60031 cable, remove it from your instrument.

Figure 6-37 Bottom Assemblies, 4-Port, Option 423 with and without 029, S/N Prefixes <6201



Bottom RF Cables, 4-Port, Option 423 with and without 029 (Ports 1 and 2), S/N Prefixes <6201

Reference Designator	Type[a]	Part Number	Qty	Description
W12	SR	N5247-20059	1	A60 port 1 70 GHz doubler to W11
W14	SR	N5247-20072	1	A60 port 1 70 GHz doubler to W13
W24	SR	N5247-20061	1	A63 port 2 70 GHz doubler to W23
W26	SR	N5247-20051	1	A63 port 2 70 GHz doubler to W25
W34	SR	N5247-20082	1	A33 port 1 coupler to front-panel port 1 CPLR ARM
W46	SR	N5247-20019	1	A36 port 2 coupler to front-panel port 2 CPLR ARM
W51	SR	N5247-20011	1	A37 reference mixer switch to front-panel REF 1 SOURCE OUT
W52	SR	N5247-20012	1	REF 1 RCVR R1 IN to A37 reference mixer switch
W53	SR	N5247-20048	1	A37 reference mixer switch to A27 mixer brick (R1)
W60	SR	N5247-20107	14	front-panel jumper
W61	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21.		
W62[b]	SR	N5247-20111	1	A25 HMA26.5 to A26 splitter
W63[b]	SR	N5245-20023	1	RF cable, A26 splitter to A27 mixer brick
W66	SR	N5247-20109	1	W65 to rear-panel EXT TSET DRIVE RF OUT (J6)
W69	SR	N5247-20112	1	A27 mixer brick to EXT TSET DRIVE LO OUT (J5)
W70[c]	SR	N5247-20100	1	A25 HMA26.5 to A27 mixer brick (1)
W71	F	N5242-60017	1	A27 mixer brick (A) to A24 IF multiplexer (P1)
W72	F	N5242-60021	1	A27 mixer brick (R1) to A24 IF multiplexer (P411)
W73	F	N5242-60022	1	A27 mixer brick (R2) to A24 IF multiplexer (P412)
W74	F	N5242-60018	1	A27 mixer brick (B) to A24 IF multiplexer (P201)
W79, 81. 83	F	Refer to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21.		
W91	F	N5247-60006	1	A60 port 1 70 GHz doubler J2 to A7 40 GHz doubler J401
W92	F	N5247-60007	1	A60 port 1 70 GHz doubler J4 to A7 40 GHz doubler J500
W97	F	N5247-60008	1	A63 port 2 70 GHz doubler J2 to A8 40 GHz doubler J401
W98	F	N5247-60009	1	A63 port 2 70 GHz doubler J4 to A8 40 GHz doubler J500
W101	SR	N5247-20083	1	A29 port 1 reference coupler to A38 port 1 source attenuator
W102	SR	N5247-20014	1	A38 port 1 source attenuator to front-panel port 1 SOURCE OUT
W103	SR	N5247-20081	1	Front-panel port 1 CPLR THRU to A42 port 1 bias tee
W104	SR	N5247-20022	1	A33 port 1 coupler to A42 port 1 bias tee
W113	SR	N5247-20083	1	A32 port 2 reference coupler to A41 port 2 source attenuator
W114	SR	N5247-20034	1	A41 port 2 source attenuator to front-panel port 2 SOURCE OUT

Reference Designator	Type[a]	Part Number	Qty	Description
W115	SR	N5247-20027	1	Port 2 CPLR THRU to A45 port 2 bias tee (withOUT Option 029 only)
W116	SR	N5247-20080	1	A45 port 2 bias tee to A36 port 2 coupler
W117	SR	N5247-20013	1	Front-panel port 1 RCVR A IN to A46 port 1 receiver attenuator
W118	SR	N5247-20047	1	A46 port 1 receiver attenuator to A27 mixer brick (A)
W123	SR	N5247-20020	1	Port 2 RCVR B IN to A49 port 2 receiver attenuator
W124	SR	N5247-20046	1	A49 port 2 receiver attenuator to A27 mixer brick (B)
W125	SR	N5247-20030	1	A50 port 1 mechanical switch to A60 port 1 70 GHz doubler
W126	SR	N5247-20031	1	A50 port 1 mechanical switch to A29 port 1 reference coupler
W127	SR	N5247-20091	1	A50 port 1 mechanical switch to PORT 1 SW SRC OUT
W128	SR	N5247-20092	1	Front-panel PORT 1 COMB THRU IN to A54 combiner
W130	SR	N5247-20094	1	A50 port 1 mechanical switch to A54 combiner
W139	SR	N5247-20032	1	A53 port 2 mechanical switch to A63 port 2 70 GHz doubler
W140	SR	N5247-20033	1	A53 port 2 mechanical switch to A32 port 2 reference coupler
W141	SR	N5247-20099	1	A53 port 2 mechanical switch to PORT 2 SW SRC OUT (J2)
W142	SR	N5247-20089	1	A53 port 2 mechanical switch to PORT 2 TSET IN (J1)
W143	SR	N5247-20107	2	rear-panel jumper
W144	SR	N5247-20071	1	A29 port 1 reference coupler to A37 reference mixer switch
W145	SR	N5247-20066	1	REF 2 RCVR R2 IN to A27 mixer brick (R2)
W146	SR	N5247-20058	1	A32 port 2 ref coupler to front-panel REF 2 SOURCE OUT
W162	SR	N5247-20120	1	A42 port 1 bias tee to A56 port 1 noise bypass switch
W163	SR	N5247-20117	1	A64 tuner to A56 port 1 noise bypass switch
W164	SR	N5247-20118	1	A64 tuner to A56 port 1 noise bypass switch
W165	SR	N5247-20119	1	Front-panel port 1 CPLR THRU to A56 port 1 noise bypass switch
W166	SR	N5247-20124	1	Front-panel port 2 CPLR THRU to A57 port 2 noise bypass switch
W167	SR	N5247-20123	1	A57 port 2 noise bypass switch to A45 port 2 bias tee
W168	SR	N5247-20121	1	A59 noise receiver (downconverter) to A57 port 2 noise bypass
W169	SR	N5247-20122	1	A59 noise receiver (downconverter) to A57 port 2 noise bypass
W171, W172, W173	Refer to "Top Assemblies and Cables, All Options, Serial Number Prefixes <6021" on page 6-18.			
W174	SR	N5247-20143	1	A59 noise receiver (downconverter) to A28 mixer brick
W175	Refer to "Top Assemblies and Cables, All Options, Serial Number Prefixes <6021" on page 6-18.			

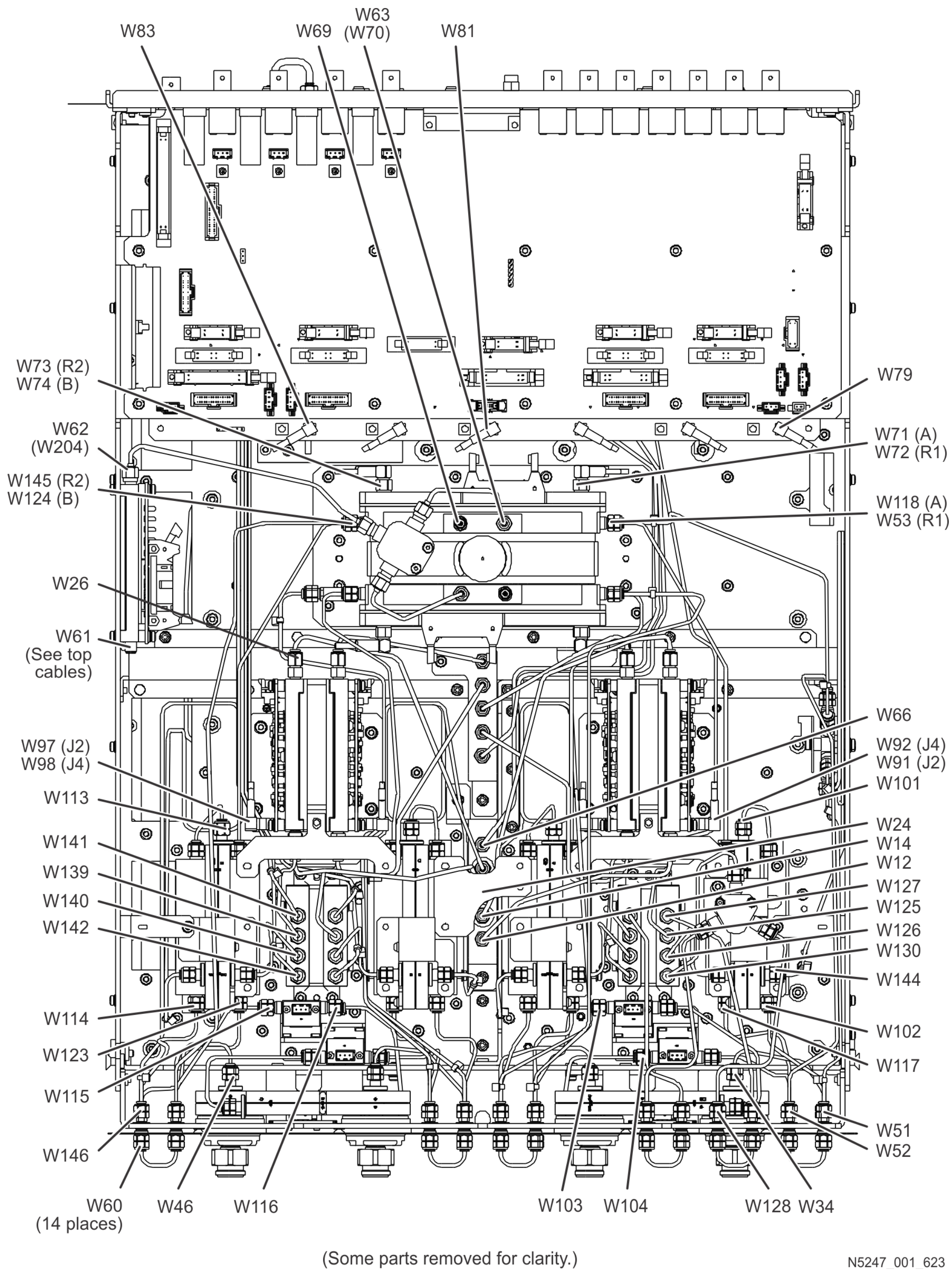
Reference Designator	Type[a]	Part Number	Qty	Description
W204[b]	SR	N5247-20185	1	A25 HMA26.5 to A28 mixer brick (2) (See also, ports 3 & 4, Figure 6-40 on page 6-115 & Figure 6-41 on page 6-116).

a. SR = semirigid coaxial cable; F = flexible coaxial cable

b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 “2-Port Configurations, Serial Number Prefixes <6021” on page 6-32 and “4-Port Configuration, Serial Number Prefixes <6021” on page 6-84.

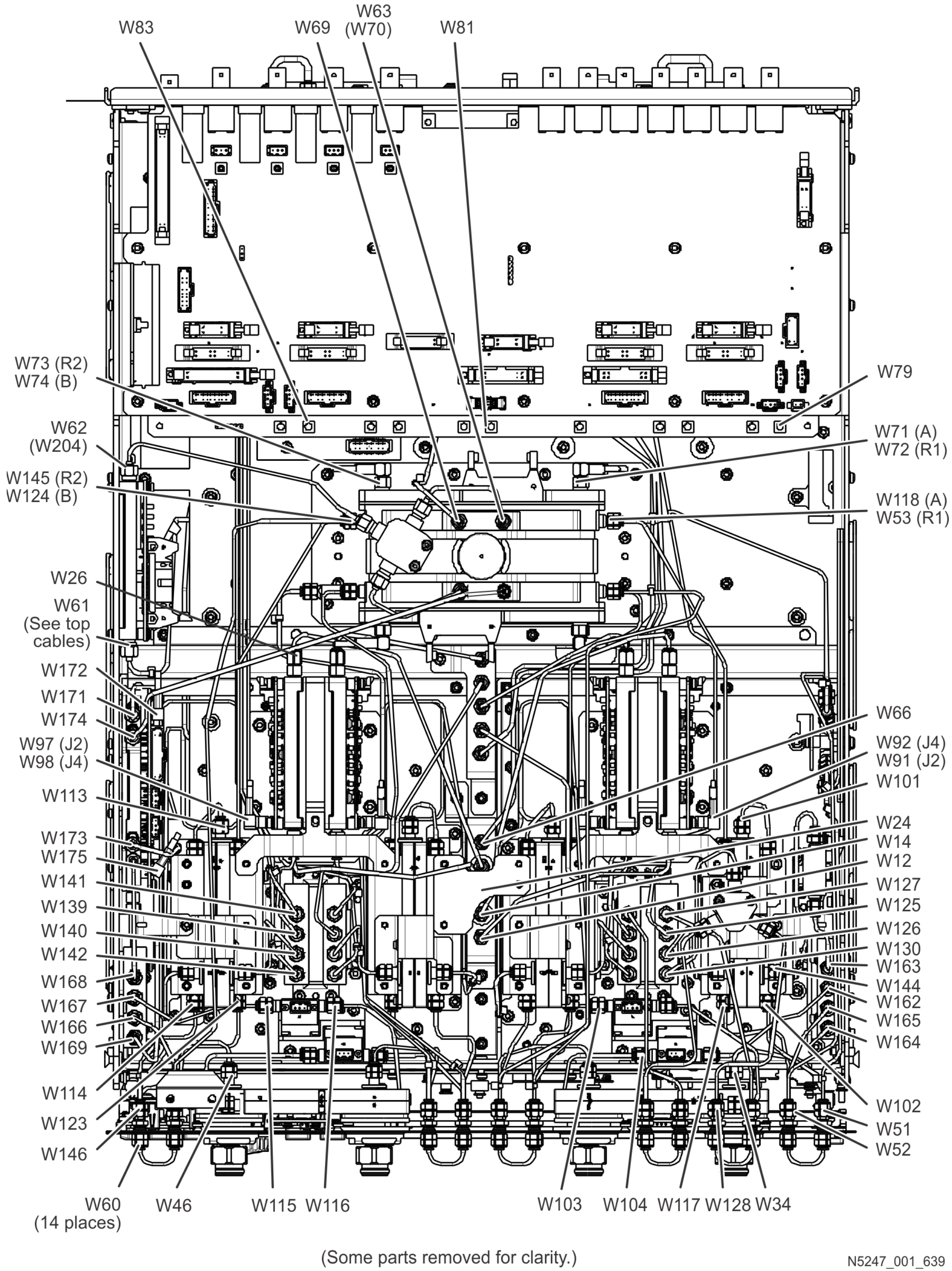
c. On legacy instruments using the 5087-7765 HMA26.5, the N5245-20100 cable is used only on 2-port instruments. On instruments with a new HMA26.5 the N5245-20100 cable is used in all instruments. If you are unclear which HMA26.5 assembly your PNA has installed, refer to “Verify the Model/Version of HMA26.5 Installed” on page 7-40 and to Figure 7-17 on page 40.

Figure 6-38 Bottom RF Cables, 4-Port, Options 423 (Ports 1 and 2), S/N Prefixes <6201[1]



1. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 “2-Port Configurations, Serial Number Prefixes <6021” on page 6-32 and “4-Port Configuration, Serial Number Prefixes <6021” on page 6-84.

Figure 6-39 Bottom RF Cables, 4-Port, Option 423 with Option 029 (Ports 1 and 2), S/N Prefixes <6201[1]



1. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

Bottom RF Cables, 4-Port, Option 423 with and without Option 029 (Ports 3 and 4), S/N Prefixes <6201

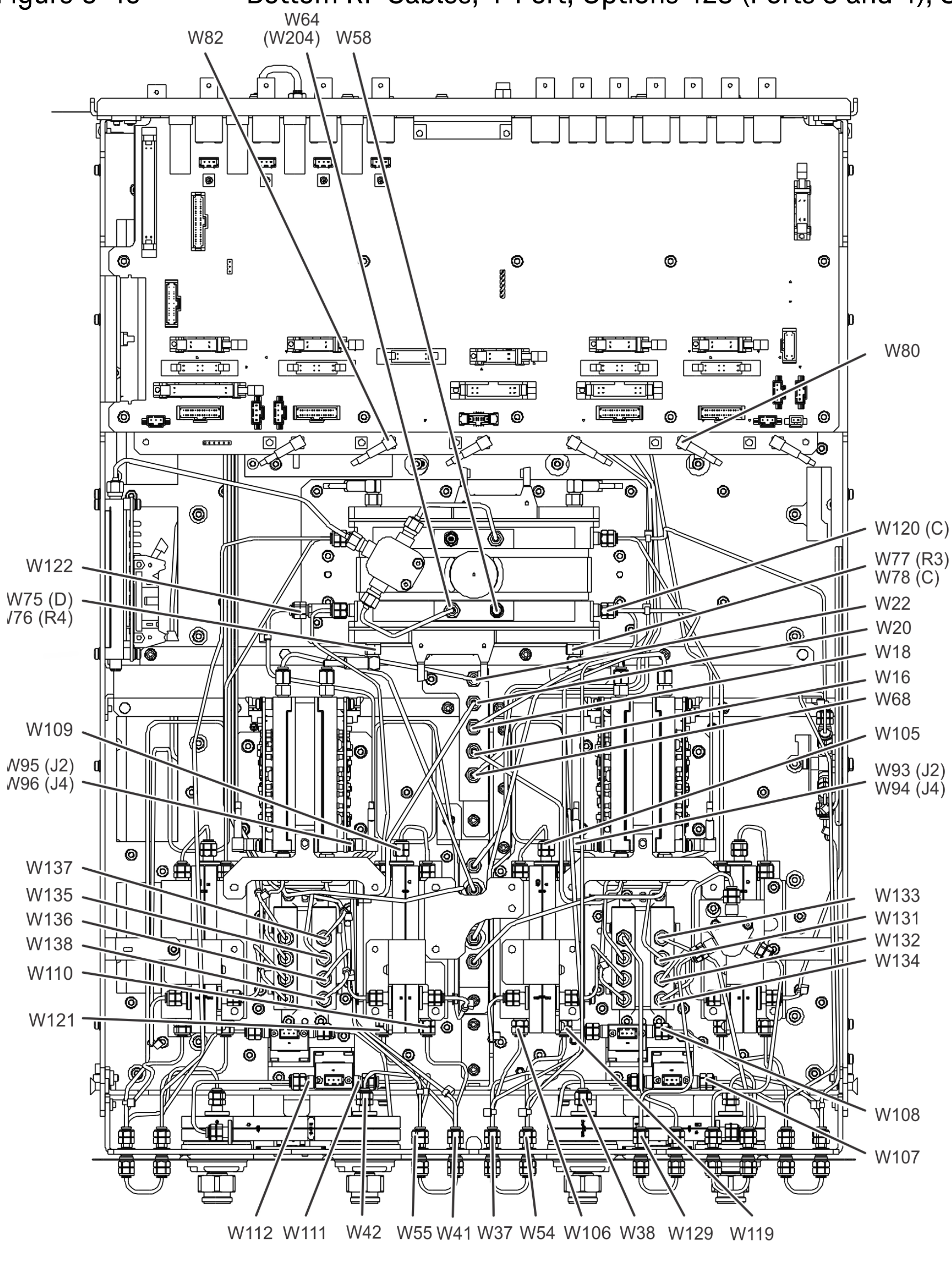
Reference Designator	Type[a]	Part Number	Qty	Description
W16	SR	N5247-20060	1	A61 port 3 70 GHz doubler to W15
W18	SR	N5247-20084	1	A61 port 3 70 GHz doubler to W17
W20	SR	N5247-20015	1	A62 port 4 70 GHz doubler to W19
W22	SR	N5247-20068	1	A62 port 4 70 GHz doubler to W21
W37	SR	N5247-20070	1	A30 port 3 ref coupler to front-panel REF 3 SOURCE OUT
W38	SR	N5247-20007	1	A34 port 3 coupler to front-panel port 3 CPLR ARM
W41	SR	N5247-20069	1	A31 port 4 ref coupler to front-panel REF 4 SOURCE OUT
W42	SR	N5247-20026	1	A35 port 4 coupler to front-panel port 4 CPLR ARM
W54	SR	N5247-20062	1	REF 3 RCVR R3 IN to A28 mixer brick (R3)
W55	SR	N5247-20067	1	REF 4 RCVR R4 IN to A28 mixer brick (R4)
W58	cap	N5247-20138	1	2.4 mm cap for A28 mixer brick (withOUT Option 029 only)
W64[b]	SR	N5245-20022	1	A26 splitter to A28 mixer brick
W68	SR	N5247-20088	1	rear-panel port RF2 OUT (J12) to W67
W75	F	N5242-60024	1	A28 mixer brick (D) to A24 IF multiplexer (P801)
W76	F	N5242-60019	1	A28 mixer brick (R4) to A24 IF multiplexer (P414)
W77	F	N5242-60020	1	A28 mixer brick (R3) to A24 IF multiplexer (P413)
W78	F	N5242-60023	1	A28 mixer brick (C) to A24 IF multiplexer (P601)
W80	F	N5242-60013	1	A24 IF multiplexer board P203 to A16 SPAM board J2
W82	F	N5242-60015	1	A24 IF multiplexer board P603 to A16 SPAM board J5
W93	F	N5247-60010	1	A61 port 3 70 GHz doubler J2 to A12 40 GHz doubler J401
W94	F	N5247-60011	1	A61 port 3 70 GHz doubler J4 to A12 40 GHz doubler J500
W95	F	N5247-60012	1	A62 port 4 70 GHz doubler J2 to A13 40 GHz doubler J401
W96	F	N5247-60013	1	A62 port 4 70 GHz doubler J4 to A13 40 GHz doubler J500
W105	SR	N5247-20083	1	A30 port 3 reference coupler to A39 port 3 source attenuator
W106	SR	N5247-20009	1	A39 port 3 source attenuator to front-panel port 3 SOURCE OUT
W107	SR	N5247-20010	1	Port 3 CPLR THRU to A43 port 3 bias tee
W108	SR	N5247-20028	1	A43 port 3 bias tee to A34 port 3 coupler
W109	SR	N5247-20083	1	A31 port 4 reference coupler to A40 port 4 source attenuator

Reference Designator	Type[a]	Part Number	Qty	Description
W110	SR	N5247-20025	1	A40 port 4 source attenuator to front-panel port 4 SOURCE OUT
W111	SR	N5247-20021	1	Port 4 CPLR THRU to A44 port 4 bias tee
W112	SR	N5247-20029	1	A44 port 4 bias tee to A35 port 4 coupler
W119	SR	N5247-20008	1	Port 3 RCVR C IN to A47 port 3 receiver attenuator
W120	SR	N5247-20064	1	A47 port 3 receiver attenuator to A28 mixer brick (C)
W121	SR	N5247-20024	1	Port 4 RCVR D IN to A48 port 4 receiver attenuator
W122	SR	N5247-20065	1	A48 port 4 receiver attenuator to A28 mixer brick (D)
W129	SR	N5247-20093	1	Front-panel PORT 3 COMB ARM IN to A54 combiner
W131	SR	N5247-20032	1	A51 port 3 mechanical switch to A61 port 3 70 GHz doubler
W132	SR	N5247-20033	1	A51 port 3 mechanical switch to A30 port 3 reference coupler
W133	SR	N5247-20090	1	A51 port 3 mechanical switch to PORT 3 SW SRC OUT
W134	SR	N5247-20095	1	rear-panel PORT 3 SW TSET IN (J7) to A51 port 3 mechanical switch
W135	SR	N5247-20030	1	A52 port 4 mechanical switch to A62 port 4 70 GHz doubler
W136	SR	N5247-20031	1	A52 port 4 mechanical switch to A31 port 4 reference coupler
W137	SR	N5247-20097	1	A52 port 4 mechanical switch to PORT 4 SW SRC OUT (J4)
W138	SR	N5247-20098	1	A52 port 4 mechanical switch to PORT 4 SW TSET (J3)
W204[b]	SR	N5247-20185	1	A25 HMA26.5 to A28 mixer brick (2) (See also, ports 1 & 2, Figure 6-38 on page 6-111 & Figure 6-39 on page 6-112).

a. SR = semirigid coaxial cable; F = flexible coaxial cable

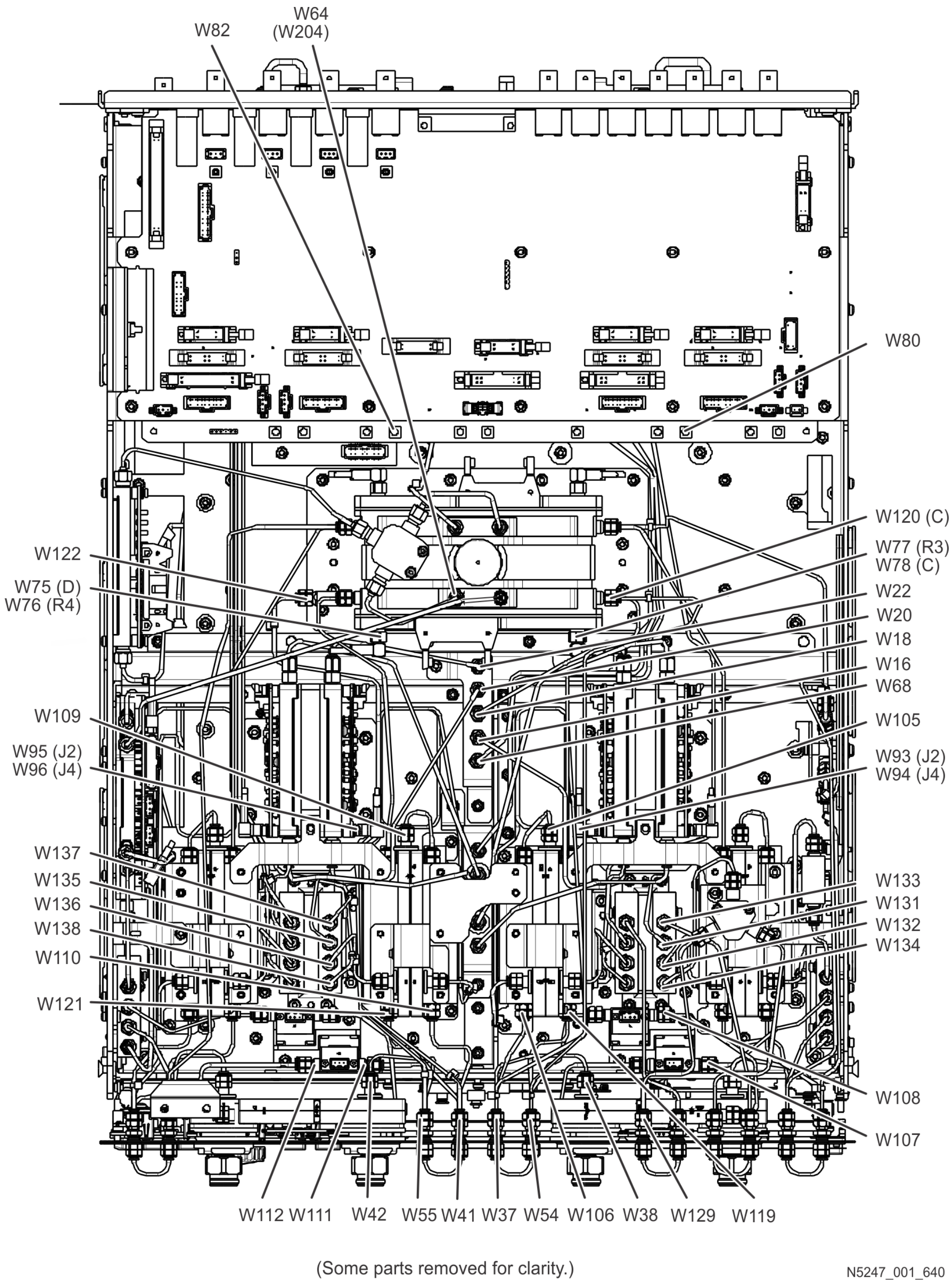
b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 “2-Port Configurations, Serial Number Prefixes <6021” on page 6-32 and “4-Port Configuration, Serial Number Prefixes <6021” on page 6-84.

Figure 6-40 Bottom RF Cables, 4-Port, Options 423 (Ports 3 and 4), S/N Prefixes <6201[1]



1. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

Figure 6-41 Bottom RF Cables, 4-Port, Option 423 with and without Option 029 (Ports 3 and 4), S/N Prefixes <6201[1]



1. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

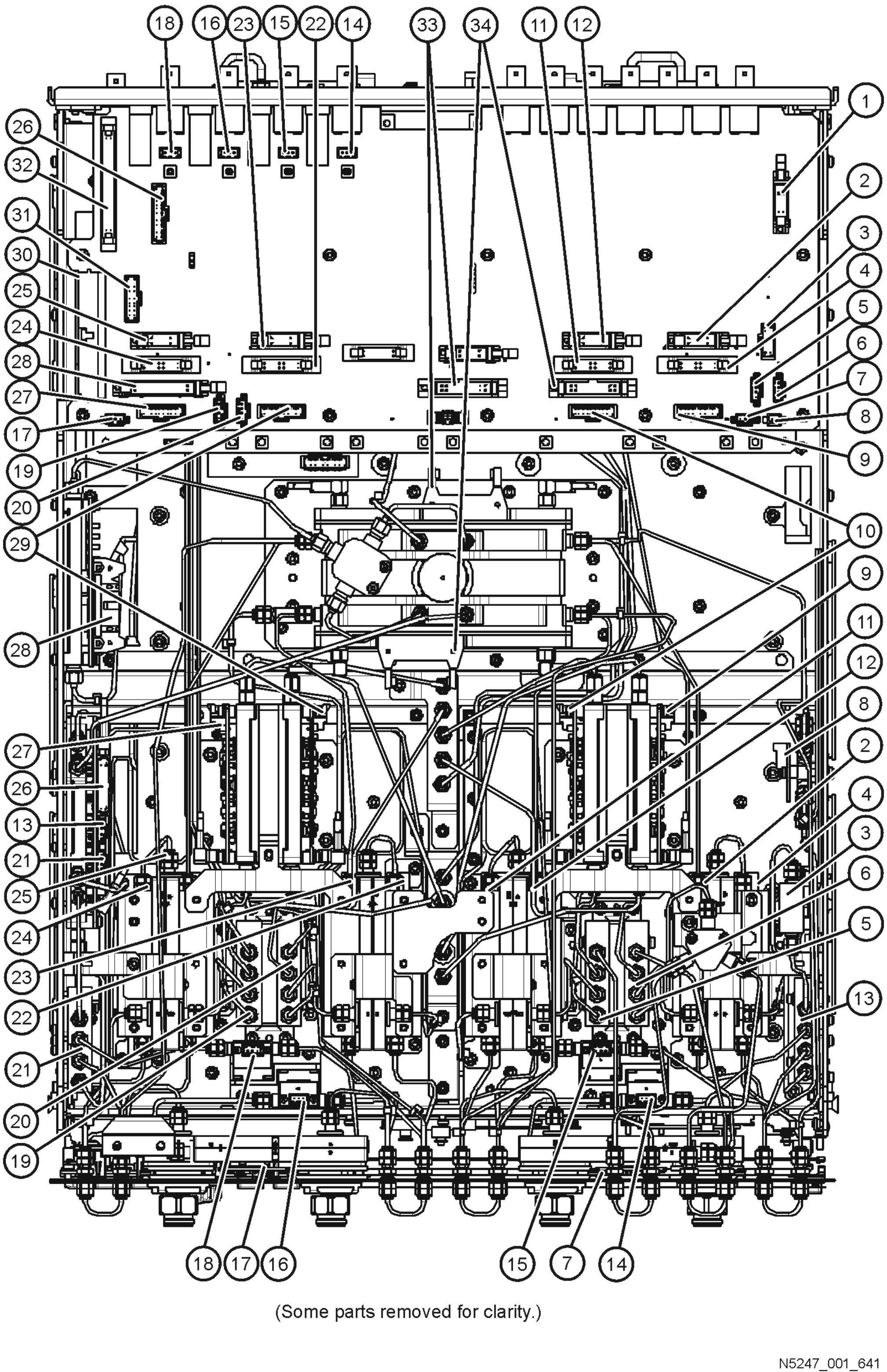
Bottom Ribbon Cables and Wire Harnesses, 4-Port, Option 423 with and without Option 029, S/N Prefixes <6201

Reference Designator	Type[a]	Part Number	Description
①	10R	N5242-60005	rear-panel PWR I/O to A23 test set motherboard J301
②	10R	N5247-60020	A23 test set motherboard J205 to A46 port 1 receiver attenuator
③	20R	N5245-60021	A64 tuner J9 to A23 test set motherboard J7 (Option 029 only)
④	16R	N5245-60006	A23 test set motherboard J549 to A38 port 1 source attenuator
⑤	4W	--	P/O A51 port 3 mechanical switch (to A23 test set motherboard J102). Refer to "4-Port Configuration, Option 423 with and without Option 029, S/N Prefixes <6201" on page 6-105.
⑥	4W	--	P/O A50 port 1 mechanical switch (to A23 test set motherboard J101). Refer to "4-Port Configuration, Option 423 with and without Option 029, S/N Prefixes <6201" on page 6-105.
⑦	3W	N5247-60016	A23 test set motherboard J221 to ports 1/3 LED board J1
q	2W	8121-0966	A23 test set motherboard J554 to A37 reference mixer switch
⑨	30R	N5247-60018	A60 port 1 70 GHz doubler J1 to A23 test set motherboard J4
s	30R	N5247-60018	A61 port 3 70 GHz doubler J1 to A23 test set motherboard J5
⑪	16R	N5245-60006	A23 test set motherboard J547 to A39 port 3 source attenuator
⑫	10R	N5247-60020	A23 test set motherboard J206 to A47 port 3 receiver attenuator
⑬	4W	--	P/O A56 port 1 noise bypass switch (to A59 noise receiver (downconverter) J42 port 1). Refer to "4-Port Configuration, Option 423 with and without Option 029, S/N Prefixes <6201" on page 6-105.
⑭	2W	N5247-60021	A23 test set motherboard J541 to A42 port 1 bias tee
⑮	2W	N5247-60021	A23 test set motherboard J543 to A43 port 3 bias tee
⑯	2W	N5247-60021	A23 test set motherboard J544 to A44 port 4 bias tee
⑰	3W	N5247-60016	A23 test set motherboard J222 to ports 2/4 LED board J1
⑱	2W	N5247-60021	A23 test set motherboard J542 to A45 port 2 bias tee (Option 029 only)
⑲	4W	--	P/O A53 port 2 mechanical switch (to A23 test set motherboard J104). Refer to "4-Port Configuration, Option 423 with and without Option 029, S/N Prefixes <6201" on page 6-105.
⑳	4W	--	P/O A52 port 4 mechanical switch (to A23 test set motherboard J103). Refer to "4-Port Configuration, Option 423 with and without Option 029, S/N Prefixes <6201" on page 6-105.
㉑	4W	--	P/O A57 port 2 noise bypass switch (to A59 noise receiver (downconverter) J41 port 2). Refer to "4-Port Configuration, Option 423 with and without Option 029, S/N Prefixes <6201" on page 6-105. (Option 029 only)
㉒	16R	N5245-60006	A23 test set motherboard J548 to A40 port 4 source attenuator

Reference Designator	Type[a]	Part Number	Description
㉓	10R	N5247-60020	A23 test set motherboard J207 to A48 port 4 receiver attenuator
㉔	16R	N5245-60006	A23 test set motherboard J546 to A41 port 2 source attenuator
㉕	10R	N5247-60020	A23 test set motherboard J208 to A49 port 2 receiver attenuator
㉖	40R	N5245-60018	A59 noise receiver (downconverter) J1 to A23 test set motherboard J548 (Option 029 only)
㉗	30R	N5247-60018	A63 port 2 70 GHz doubler J1 to A23 test set motherboard J6
㉘	24R	N5247-60022	A23 test set motherboard J209 to A25 HMA26.5 J1
㉙	30R	N5247-60018	A62 port 4 70 GHz doubler J1 to A23 test set motherboard J3
㉚	100R	N5242-60004	A18 system motherboard J1 to A23 test set motherboard J1 to A24 IF multiplexer board J1
㉛	25R	E4410-60160	A18 system motherboard J13 to A23 test set motherboard J545
㉜	36R	8121-0834	rear-panel HANDLER I/O to A23 test set motherboard J400
㉝	20R	N5247-60014	A23 test set motherboard J551 to A27 mixer brick (1) J52
㉞	20R	N5247-60015	A23 test set motherboard J552 to A28 mixer brick (2) J52

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

Figure 6-42 Bottom Ribbon Cables and Wire Harnesses, 4-Port, Option 423 with and without Option 029, S/N Prefixes <6201



Cables 3, 18, 21, and 26 apply only with Option 029.

4-Port Configuration, Option 425 with and without 029, S/N Prefixes <6021

Bottom Assemblies, 4-Port, Option 425 with and without 029, S/N Prefixes <6021

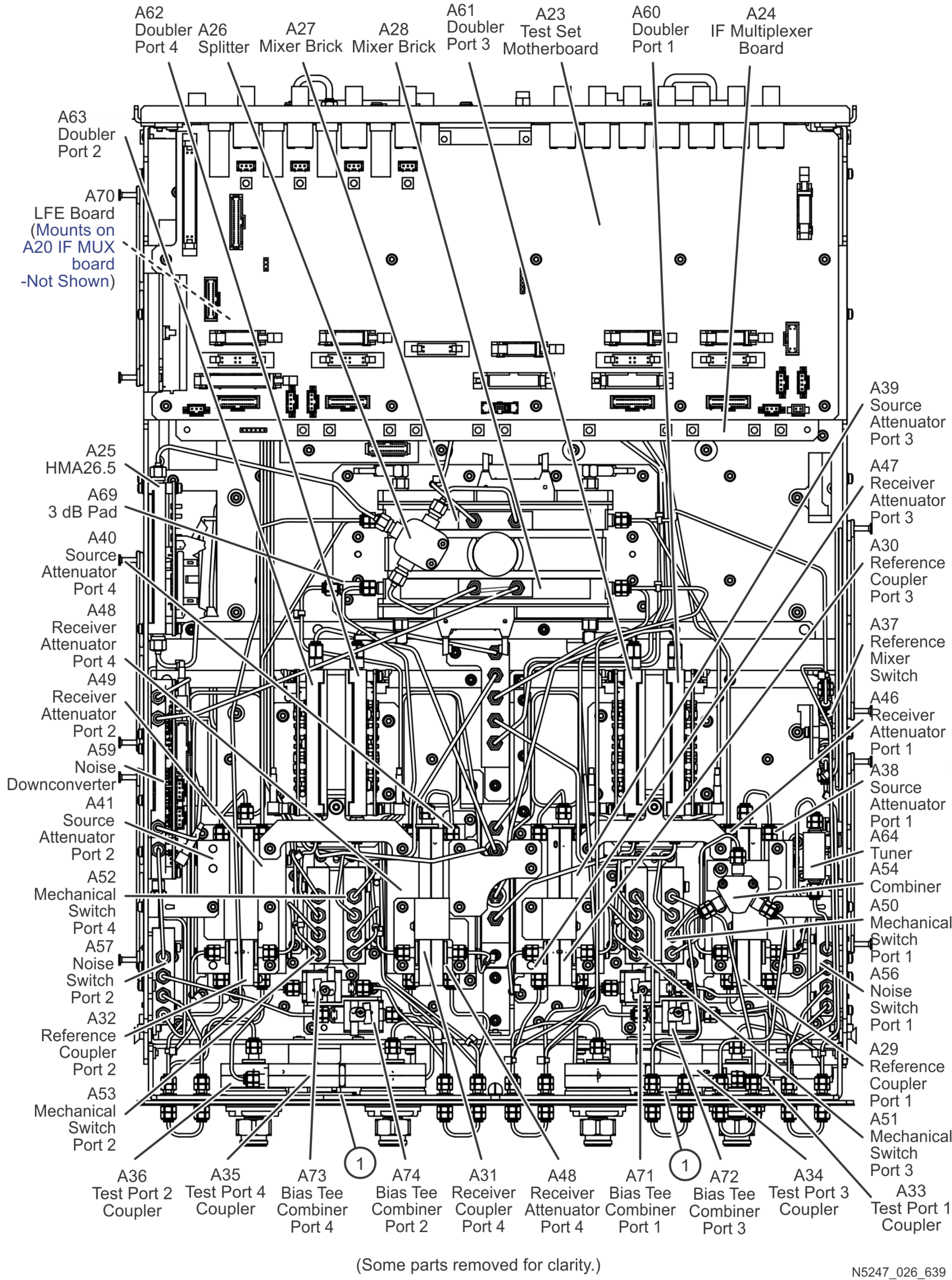
Reference Designator	Part Number[a]	Qty	Description
A23	N5245-60157 Was N5247-60001	1	Test set motherboard
A24	N5240-60062[b] Was: N5240-60045	1	IF multiplexer board
A25	5087-7765	1	LO Multiplier/amplifier 26.5 (HMA26.5)
A26	5067-4086	1	Splitter
A27 A28	5087-7337	2	Mixer brick
A29 A30 A31 A32	5087-7744	4	Test port 1 reference coupler Test port 3 reference coupler Test port 4 reference coupler Test port 2 reference coupler
A33 A34 A35 A36	5087-7778	4	Test port 1 coupler Test port 3 coupler Test port 4 coupler Test port 2 coupler
A37	5087-7759	1	Reference mixer switch
A38 A39 A40 A41	84905-60004 was: 84905-60002	4	Test port 1 source attenuator Test port 3 source attenuator Test port 4 source attenuator Test port 2 source attenuator
A46 A47 A48 A49	84905-60004 was: 84905-60002	4	Port 1 receiver attenuator Port 3 receiver attenuator Port 4 receiver attenuator Port 2 receiver attenuator
A50 A51 A52 A53	N1811-60010	6	Port 1 mechanical switch Port 3 mechanical switch Port 4 mechanical switch Port 2 mechanical switch
A54	11667-60016	1	Combiner
A56 A57	N1811-60010	2	Port 1 noise bypass switch Port 2 noise bypass switch
A59	5087-7344	1	noise receiver (downconverter)

Reference Designator	Part Number[a]	Qty	Description
A60 A61 A62 A63	5087-7336	4	70 GHz doubler assembly port 1 70 GHz doubler assembly port 3 70 GHz doubler assembly port 4 70 GHz doubler assembly port 2
A64	5087-7345	1	Tuner
A69	08490-60037	1	3-dB attenuator (A28 mixer brick (R1)
A70	N5291-60001	1	LFE board
A71	5087-7403	4	Bias combiner port 1 (includes wire harness)
A72			Bias combiner port 3 (includes wire harness)
A73			Bias combiner port 4 (includes wire harness)
A74			Bias combiner port 2 (includes wire harness)
①	N5240-60058	2	front-panel LED board

a. Part numbers in italic typeface are for rebuilt exchange assemblies. Refer to “Rebuilt-Exchange Assemblies” on page 6-4.

b. All new units built after August 2009, no longer use the N5242-60031 cable that was attached to connector P1001 and Source 2. As a result of this change, the IF multiplexer boards have had their P1001 connectors removed. If your instrument contains a N5242-60031 cable, remove it from your instrument.

Figure 6-43 Bottom Assemblies, 4-Port, Option 425 with and without Option 029, S/N Prefixes <6021



A56, A57,

Bottom RF Cables, 4-Port, Option 425 with and without Option 029 (Ports 1 and 2), S/N Prefixes <6021

Reference Designator	Type[a]	Part Number	Qty	Description
W12	SR	N5247-20059	1	A60 port 1 70 GHz doubler to W11
W14	SR	N5247-20072	1	A60 port 1 70 GHz doubler to W13
W24	SR	N5247-20061	1	A63 port 2 70 GHz doubler to W23
W26	SR	N5247-20051	1	A63 port 2 70 GHz doubler to W25
W34	SR	N5247-20082	1	A33 port 1 coupler to front-panel port 1 CPLR ARM
W46	SR	N5247-20019	1	A36 port 2 coupler to front-panel port 2 CPLR ARM
W51	SR	N5247-20011	1	A37 reference mixer switch to front-panel REF 1 SOURCE OUT
W52	SR	N5247-20012	1	REF 1 RCVR R1 IN to A37 reference mixer switch
W53	SR	N5247-20048	1	A37 reference mixer switch to A27 mixer brick (R1)
W60	SR	N5247-20107	14	front-panel jumper
W61	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21.		
W62[b]	SR	N5247-20111	1	A25 HMA26.5 to A26 splitter
W63[b]	SR	N5245-20023	1	RF cable, A26 splitter to A27 mixer brick
W66	SR	N5247-20109	1	W65 to rear-panel EXT TSET DRIVE RF OUT (J6)
W69	SR	N5247-20112	1	A27 mixer brick to EXT TSET DRIVE LO OUT (J5)
W70[c]	SR	N5247-20100	1	A25 HMA26.5 to A27 mixer brick (1)
W71	F	N5242-60017	1	A27 mixer brick (A) to A24 IF multiplexer (P1)
W72	F	N5242-60021	1	A27 mixer brick (R1) to A24 IF multiplexer (P411)
W73	F	N5242-60022	1	A27 mixer brick (R2) to A24 IF multiplexer (P412)
W74	F	N5242-60018	1	A27 mixer brick (B) to A24 IF multiplexer (P201)
W79, 81, 83	F	Refer to "Top Cables, All Cables—All Options, S/N Prefixes <6021" on page 6-21.		
W91	F	N5247-60006	1	A60 port 1 70 GHz doubler J2 to A7 40 GHz doubler J401
W92	F	N5247-60007	1	A60 port 1 70 GHz doubler J4 to A7 40 GHz doubler J500
W97	F	N5247-60008	1	A63 port 2 70 GHz doubler J2 to A8 40 GHz doubler J401
W98	F	N5247-60009	1	A63 port 2 70 GHz doubler J4 to A8 40 GHz doubler J500
W101	SR	N5247-20083	1	A29 port 1 reference coupler to A38 port 1 source attenuator
W102	SR	N5247-20014	1	A38 port 1 source attenuator to front-panel port 1 SOURCE OUT
W113	SR	N5247-20083	1	A32 port 2 reference coupler to A41 port 2 source attenuator
W114	SR	N5247-20034	1	A41 port 2 source attenuator to front-panel port 2 SOURCE OUT
W117	SR	N5247-20013	1	Front-panel port 1 RCVR A IN to A46 port 1 receiver attenuator
W118	SR	N5247-20047	1	A46 port 1 receiver attenuator to A27 mixer brick (A)

Reference Designator	Type[a]	Part Number	Qty	Description
W123	SR	N5247-20020	1	Port 2 RCVR B IN to A49 port 2 receiver attenuator
W124	SR	N5247-20046	1	A49 port 2 receiver attenuator to A27 mixer brick (B)
W125	SR	N5247-20030	1	A50 port 1 mechanical switch to A60 port 1 70 GHz doubler
W126	SR	N5247-20031	1	A50 port 1 mechanical switch to A29 port 1 reference coupler
W127	SR	N5247-20091	1	A50 port 1 mechanical switch to PORT 1 SW SRC OUT
W128	SR	N5247-20092	1	Front-panel PORT 1 COMB THRU IN to A54 combiner
W130	SR	N5247-20094	1	A50 port 1 mechanical switch to A54 combiner
W139	SR	N5247-20032	1	A53 port 2 mechanical switch to A63 port 2 70 GHz doubler
W140	SR	N5247-20033	1	A53 port 2 mechanical switch to A32 port 2 reference coupler
W141	SR	N5247-20099	1	A53 port 2 mechanical switch to PORT 2 SW SRC OUT (J2)
W142	SR	N5247-20089	1	A53 port 2 mechanical switch to PORT 2 TSET IN (J1)
W143	SR	N5247-20107	2	rear-panel jumper
W144	SR	N5247-20071	1	A29 port 1 reference coupler to A37 reference mixer switch
W145	SR	N5247-20066	1	REF 2 RCVR R2 IN to A27 mixer brick (R2)
W146	SR	N5247-20058	1	A32 port 2 ref coupler to front-panel REF 2 SOURCE OUT
W163	SR	N5247-20117	1	A64 tuner to A56 port 1 noise bypass switch (Option 029 only)
W164	SR	N5247-20118	1	A64 tuner to A56 port 1 noise bypass switch (Option 029 only)
W165	SR	N5247-20119	1	Front-panel port 1 CPLR THRU to A56 port 1 noise bypass switch (Option 029 only)
W166	SR	N5247-20124	1	Front-panel port 2 CPLR THRU to A57 port 2 noise bypass switch (Option 029 only)
W168	SR	N5247-20121	1	A59 noise receiver (downconverter) to A57 port 2 noise bypass switch (Option 029 only)
W169	SR	N5247-20122	1	A59 noise receiver (downconverter) to A57 port 2 noise bypass switch (Option 029 only)
W171, W172, W173	Refer to “Top Assemblies and Cables, All Options, Serial Number Prefixes <6021” on page 6-18. (Option 029 only)			
W174	SR	N5247-20143	1	A59 noise receiver (downconverter) to A28 mixer brick (Option 029 only)
W175	Refer to “Top Assemblies and Cables, All Options, Serial Number Prefixes <6021” on page 6-18. (Option 029 only)			
W181	SR	N5247-20167	1	Cable, assy-RF, Port 1 CPLR THRU to A71 port 1 bias combiner (Option 425 only withOUT Option 029)
W182	SR	N5247-20162	1	Cable, assy-RF, A71 Bias combiner-A33 Coupler FP, Port 1

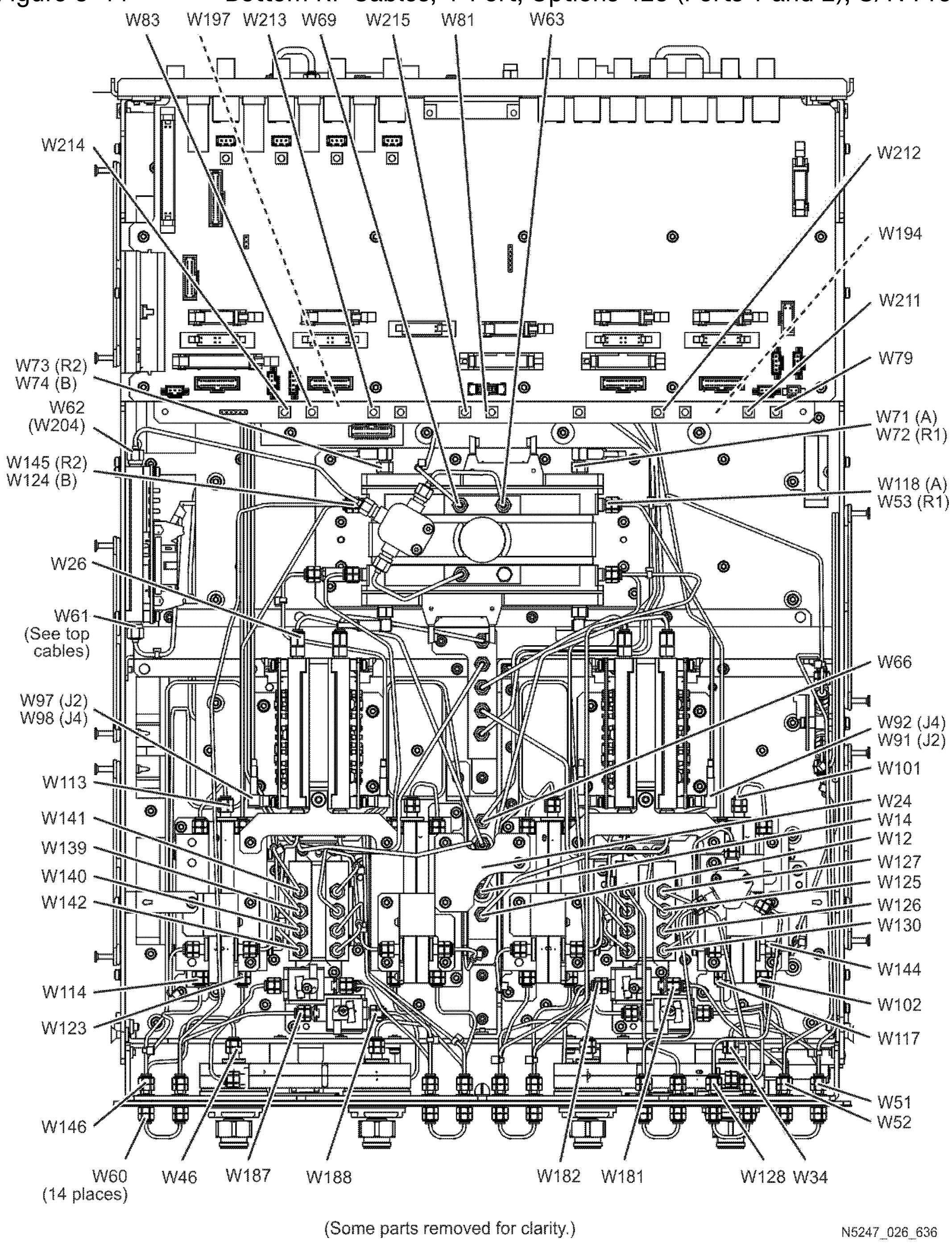
Reference Designator	Type[a]	Part Number	Qty	Description
W187	SR	N5247-20163	1	Cable, assy-RF, Port 2 CPLR THRU to A74 bias combiner (Option 425 only)
W188	SR	N5247-20169	1	Cable, assy-RF, A74 Bias combiner–A36 Coupler FP, Port 2
W189	SR	N5247-20172	1	Cable, assy-RF, A56 noise bypass SW- A71Bias T combiner, Port 1 (Option 029 only)
W190	SR	N5247-20173	1	Cable, assy-RF, A57 noise bypass SW- A74 Bias T combiner, Port 2 (Option 029 only)
W191–W193	SR	Refer to “Top Cables, All Cables—All Options, S/N Prefixes <6021” on page 6-21.		
W194	F	N5240-60097	2	Cable (long), assy, coaxial LFE, RF (Port 2 bias combiner “RF-IN” to “Port2” A70 LFE board)
W197				Cable (long), assy, coaxial LFE, RF (Port 1 bias combiner “RF-IN” to “Port1” A70 LFE board)
W204[b]	SR	N5247-20185	1	A25 HMA26.5 to A28 mixer brick (2) – (See also, ports 3 & 4, Figure 6-46 on page 6-130 & Figure 6-47 on page 6-131).
W211	F	8120-5014	1	RF cable, A70 LFE J14 to A24 IF Multiplexer P4
W212	F	8120-5017	1	RF cable, A70 LFE J13 to A24 IF Multiplexer P204
W213	F	8120-5014	1	RF cable, A70 LFE J7 to A24 IF Multiplexer P404
W214	F	8120-5017	1	RF cable, A70 LFE J7 to A24 IF Multiplexer P404
W215	F	8120-5017	1	RF cable, A70 LFE J11 to A24 IF Multiplexer P804

a. SR = semirigid coaxial cable; F = flexible coaxial cable

b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 “2-Port Configurations, Serial Number Prefixes <6021” on page 6-32 and “4-Port Configuration, Serial Number Prefixes <6021” on page 6-84.

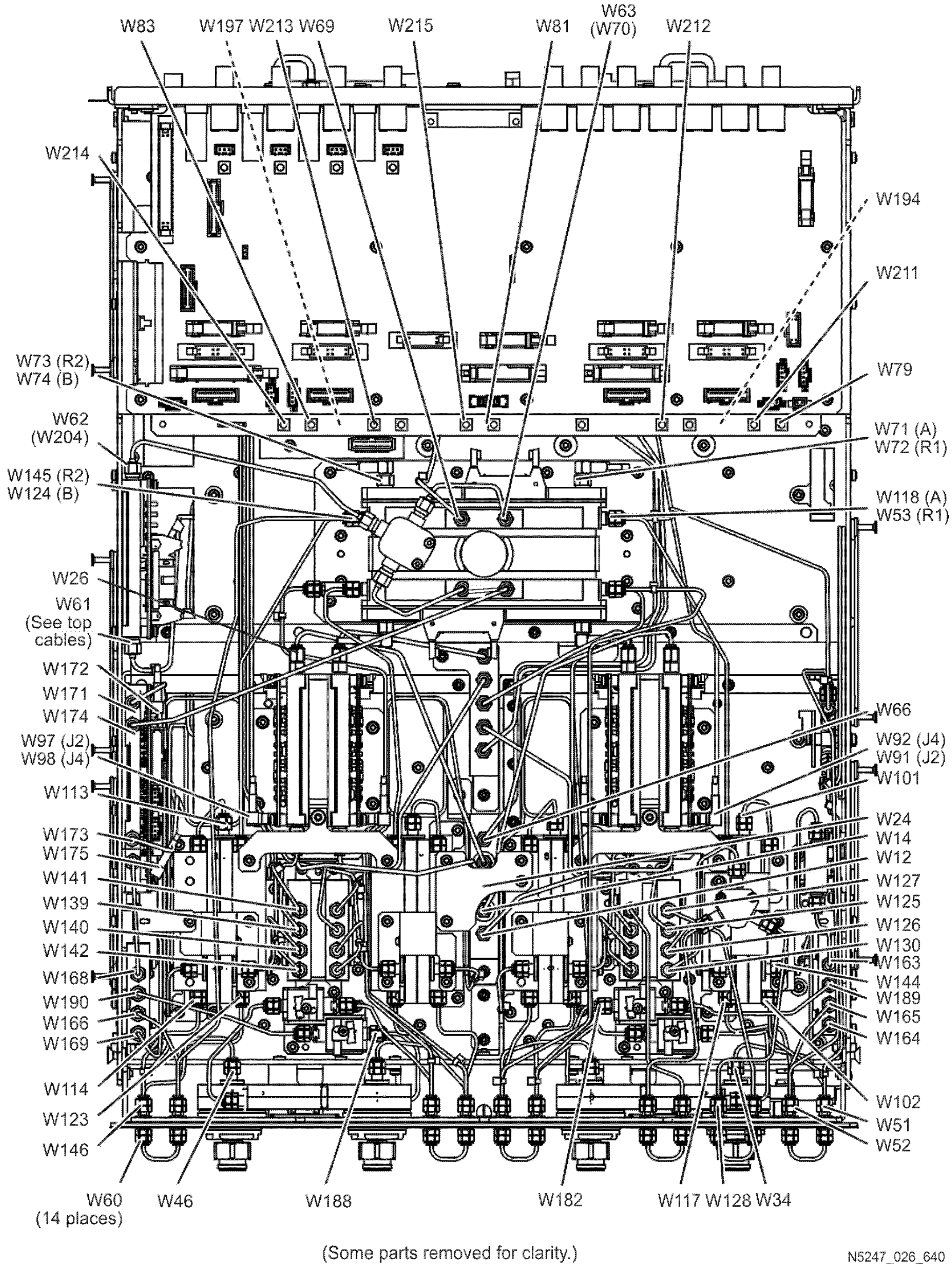
c. On legacy instruments using the 5087-7765 HMA26.5, the N5245-20100 cable is used only on 2-port instruments. On instruments with a new HMA26.5 the N5245-20100 cable is used in all instruments. If you are unclear which HMA26.5 assembly your PNA has installed, refer to “Verify the Model/Version of HMA26.5 Installed” on page 7-40 and to Figure 7-17 on page 40.

Figure 6-44 Bottom RF Cables, 4-Port, Options 425 (Ports 1 and 2), S/N Prefixes <6021[1]



1. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

Figure 6-45 Bottom RF Cables, 4-Port, Option 425 with Option 029 (Ports 1 and 2), S/N Prefixes <6021[1]



1. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

Bottom RF Cables, 4-Port, Option 425 with and without Option 029 (Ports 3 and 4), S/N Prefixes <6021

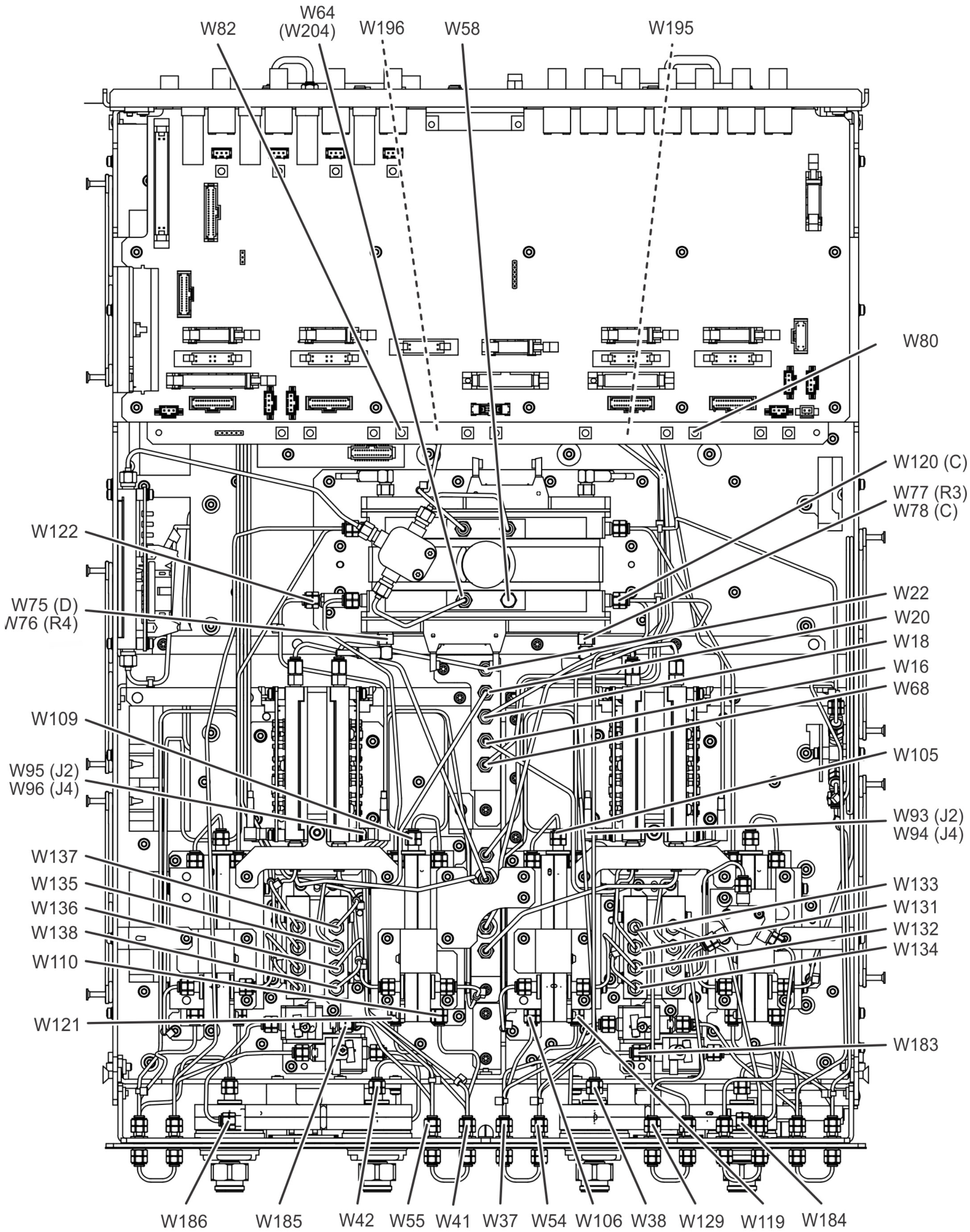
Reference Designator	Type[a]	Part Number	Qty	Description
W16	SR	N5247-20060	1	A61 port 3 70 GHz doubler to W15
W18	SR	N5247-20084	1	A61 port 3 70 GHz doubler to W17
W20	SR	N5247-20015	1	A62 port 4 70 GHz doubler to W19
W22	SR	N5247-20068	1	A62 port 4 70 GHz doubler to W21
W37	SR	N5247-20070	1	A30 port 3 ref coupler to front-panel REF 3 SOURCE OUT
W38	SR	N5247-20007	1	A34 port 3 coupler to front-panel port 3 CPLR ARM
W41	SR	N5247-20069	1	A31 port 4 ref coupler to front-panel REF 4 SOURCE OUT
W42	SR	N5247-20026	1	A35 port 4 coupler to front-panel port 4 CPLR ARM
W54	SR	N5247-20062	1	REF 3 RCVR R3 IN to A28 mixer brick (R3)
W55	SR	N5247-20067	1	REF 4 RCVR R4 IN to A28 mixer brick (R4)
W64[b]	SR	N5245-20022	1	A26 splitter to A28 mixer brick
W68	SR	N5247-20088	1	rear-panel port RF2 OUT (J12) to W67
W75	F	N5242-60024	1	A28 mixer brick (D) to A24 IF multiplexer (P801)
W76	F	N5242-60019	1	A28 mixer brick (R4) to A24 IF multiplexer (P414)
W77	F	N5242-60020	1	A28 mixer brick (R3) to A24 IF multiplexer (P413)
W78	F	N5242-60023	1	A28 mixer brick (C) to A24 IF multiplexer (P601)
W80	F	N5242-60013	1	A24 IF multiplexer board P203 to A16 SPAM board J2
W82	F	N5242-60015	1	A24 IF multiplexer board P603 to A16 SPAM board J5
W93	F	N5247-60010	1	A61 port 3 70 GHz doubler J2 to A12 40 GHz doubler J401
W94	F	N5247-60011	1	A61 port 3 70 GHz doubler J4 to A12 40 GHz doubler J500
W95	F	N5247-60012	1	A62 port 4 70 GHz doubler J2 to A13 40 GHz doubler J401
W96	F	N5247-60013	1	A62 port 4 70 GHz doubler J4 to A13 40 GHz doubler J500
W105	SR	N5247-20083	1	A30 port 3 reference coupler to A39 port 3 source attenuator
W106	SR	N5247-20009	1	A39 port 3 source attenuator to front-panel port 3 SOURCE OUT
W109	SR	N5247-20083	1	A31 port 4 reference coupler to A40 port 4 source attenuator
W110	SR	N5247-20025	1	A40 port 4 source attenuator to front-panel port 4 SOURCE OUT
W119	SR	N5247-20008	1	Port 3 RCVR C IN to A47 port 3 receiver attenuator
W120	SR	N5247-20064	1	A47 port 3 receiver attenuator to A28 mixer brick (C)

Reference Designator	Type[a]	Part Number	Qty	Description
W121	SR	N5247-20024	1	Port 4 RCVR D IN to A48 port 4 receiver attenuator
W122	SR	N5247-20065	1	A48 port 4 receiver attenuator to A28 mixer brick (D)
W129	SR	N5247-20093	1	Front-panel PORT 3 COMB ARM IN to A54 combiner
W131	SR	N5247-20032	1	A51 port 3 mechanical switch to A61 port 3 70 GHz doubler
W132	SR	N5247-20033	1	A51 port 3 mechanical switch to A30 port 3 reference coupler
W133	SR	N5247-20090	1	A51 port 3 mechanical switch to PORT 3 SW SRC OUT
W134	SR	N5247-20095	1	rear-panel PORT 3 SW TSET IN (J7) to A51 port 3 mechanical switch
W135	SR	N5247-20030	1	A52 port 4 mechanical switch to A62 port 4 70 GHz doubler
W136	SR	N5247-20031	1	A52 port 4 mechanical switch to A31 port 4 reference coupler
W137	SR	N5247-20097	1	A52 port 4 mechanical switch to PORT 4 SW SRC OUT (J4)
W138	SR	N5247-20098	1	A52 port 4 mechanical switch to PORT 4 SW TSET (J3)
W183	SR	N5247-20170	1	Cable, assy-RF FP, COUP THRU to A72 bias combiner, port 3
W184	SR	N5247-20164	1	Cable, assy-RF FP A34 port 3 test port coupler to A72 bias combiner, port 3
W185	SR	N5247-20165	1	Cable, assy-RF FP, COUP THRU to A73 bias combiner, port 4
W186	SR	N5247-20171	1	Cable, assy-RF, FP A35 port 4 test port coupler to A73 bias combiner, port 4
W195	F	N5240-60097	1	Cable (long), assy, coaxial LFE, RF (Port 3 bias combiner "RF-IN" to "Port3" A70 LFE board)
W196	F			Cable (long), assy, coaxial LFE, RF (Port 4 bias combiner "RF-IN" to "Port4" A70 LFE board)
W204[b]	SR	N5247-20185	1	A25 HMA26.5 to A28 mixer brick (2) – (See also, ports 1 & 2, Figure 6-44 on page 6-126 & Figure 6-45 on page 6-127).

a. SR = semirigid coaxial cable; F = flexible coaxial cable

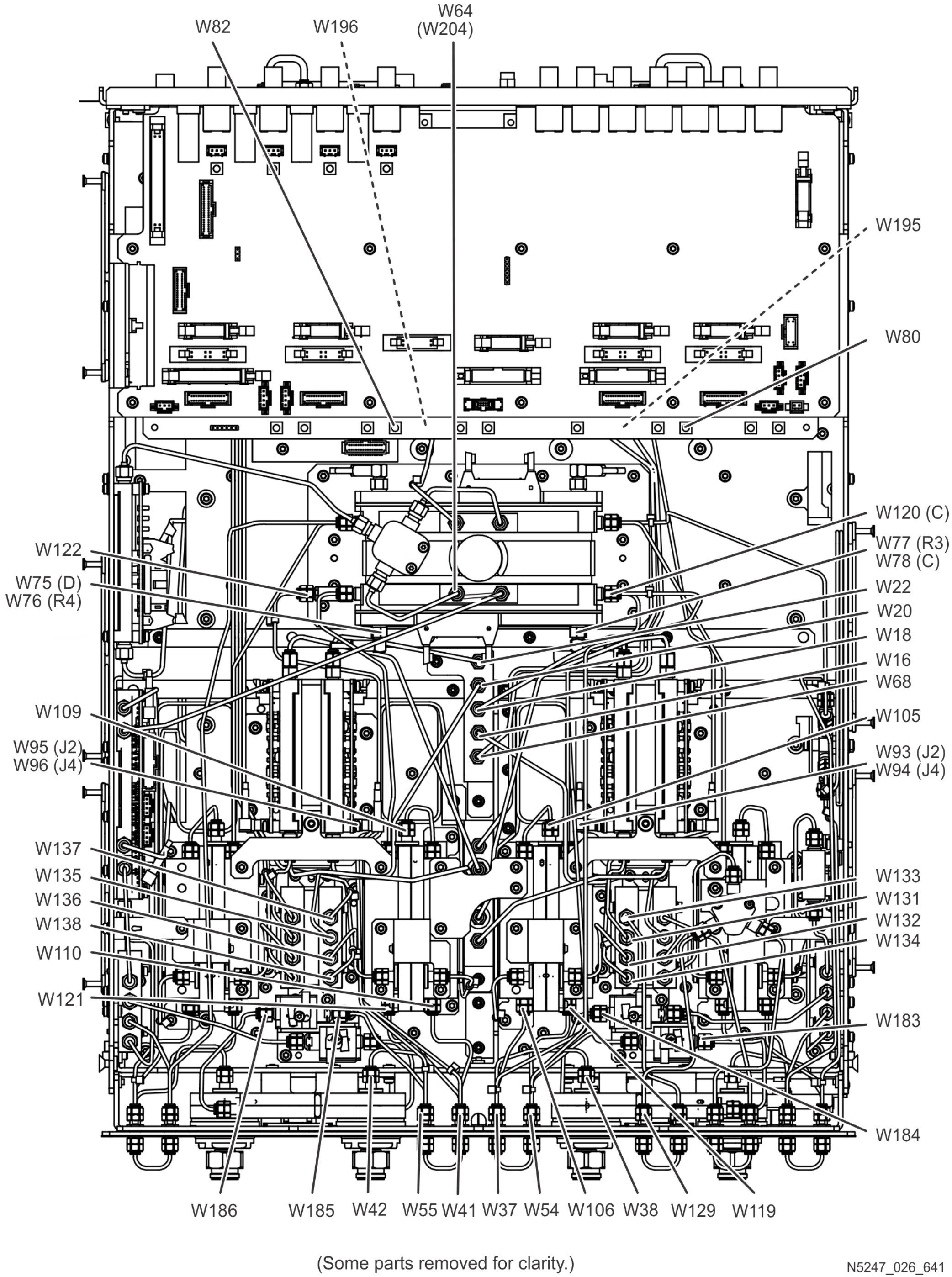
b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 and cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

Figure 6-46 Bottom RF Cables, 4-Port, Options 425 (Ports 3 and 4), S/N Prefixes <6021[1]



1. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

Figure 6-47 Bottom RF Cables, 4-Port, Option 425 with Option 029 (Ports 3 and 4), S/N Prefixes <6021[1]



1. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

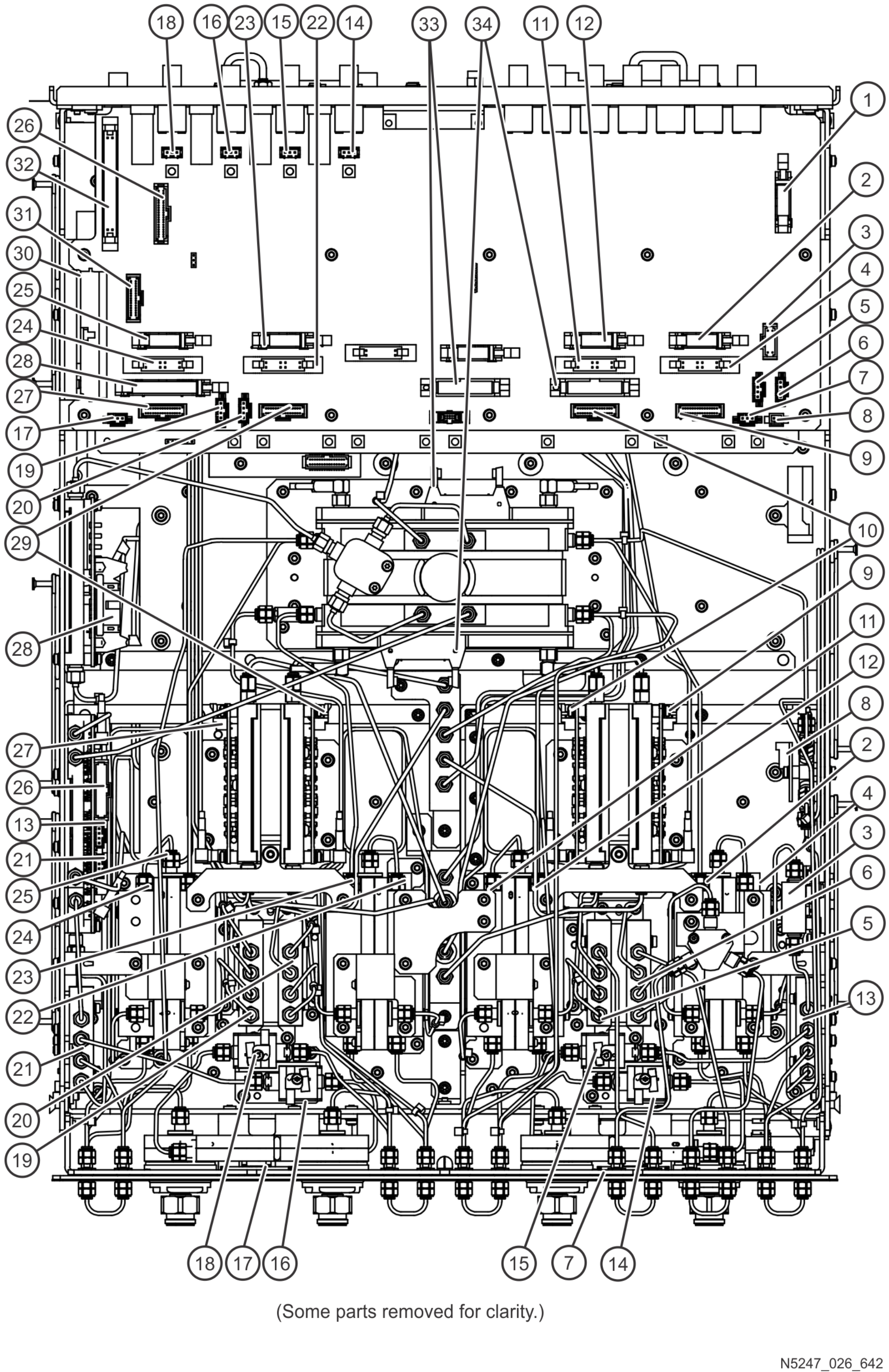
Bottom Ribbon Cables and Wire Harnesses, 4-Port, Options 425/029, S/N Prefixes <6021

Reference Designator	Type[a]	Part Number	Description
①	10R	N5242-60005	rear-panel PWR I/O to A23 test set motherboard J301
②	10R	N5247-60020	A23 test set motherboard J205 to A46 port 1 receiver attenuator
③	20R	N5245-60021	A64 tuner J9 to A23 test set motherboard J7 (Option 029 only)
④	16R	N5245-60006	A23 test set motherboard J549 to A38 port 1 source attenuator
⑤	4W	--	P/O A51 port 3 mechanical switch (to A23 test set motherboard J102). Refer to "4-Port Configuration, Option 425 with and without 029, S/N Prefixes <6021" on page 6-120.
⑥	4W	--	P/O A50 port 1 mechanical switch (to A23 test set motherboard J101). Refer to "4-Port Configuration, Option 425 with and without 029, S/N Prefixes <6021" on page 6-120.
⑦	3W	N5247-60016	A23 test set motherboard J221 to ports 1/3 LED board J1
⑧	2W	8121-0966	A23 test set motherboard J554 to A37 reference mixer switch
⑨	30R	N5247-60018	A60 port 1 70 GHz doubler J1 to A23 test set motherboard J4
s	30R	N5247-60018	A61 port 3 70 GHz doubler J1 to A23 test set motherboard J5
⑪	16R	N5245-60006	A23 test set motherboard J547 to A39 port 3 source attenuator
⑫	10R	N5247-60020	A23 test set motherboard J206 to A47 port 3 receiver attenuator
⑬	4W	--	P/O A56 port 1 noise bypass switch (to A59 noise receiver (downconverter) J42 port 1). Refer to "4-Port Configuration, Option 425 with and without 029, S/N Prefixes <6021" on page 6-120.
⑭	2W	N5240-60091 P/O Bias combiners	A19 test set motherboard J541 to A71 port 1 bias tee combiner
⑮	2W		A19 test set motherboard J543 to A72 port 3 bias tee combiner
⑯	2W		A19 test set motherboard J544 to A73 port 4 bias tee combiner
⑰	3W	N5247-60016	A23 test set motherboard J222 to ports 2/4 LED board J1
⑱	2W	N5240-60091 P/O Bias	A19 test set motherboard J542 to A74 port 2 bias tee combiner
⑲	4W	--	P/O A53 port 2 mechanical switch (to A23 test set motherboard J104). Refer to "4-Port Configuration, Option 425 with and without 029, S/N Prefixes <6021" on page 6-120.
⑳	4W	--	P/O A52 port 4 mechanical switch (to A23 test set motherboard J103). Refer to "4-Port Configuration, Option 425 with and without 029, S/N Prefixes <6021" on page 6-120.
㉑	4W	--	P/O A57 port 2 noise bypass switch (to A59 noise receiver (downconverter) J41 port 2). Refer to "4-Port Configuration, Option 425 with and without 029, S/N Prefixes <6021" on page 6-120. (Option 029 only)
㉒	16R	N5245-60006	A23 test set motherboard J548 to A40 port 4 source attenuator

Reference Designator	Type[a]	Part Number	Description
㉓	10R	N5247-60020	A23 test set motherboard J207 to A48 port 4 receiver attenuator
㉔	16R	N5245-60006	A23 test set motherboard J546 to A41 port 2 source attenuator
㉕	10R	N5247-60020	A23 test set motherboard J208 to A49 port 2 receiver attenuator
㉖	40R	N5245-60018	A59 noise receiver (downconverter) J1 to A23 test set motherboard J548 (Option 029 only)
㉗	30R	N5247-60018	A63 port 2 70 GHz doubler J1 to A23 test set motherboard J6
㉘	24R	N5247-60022	A23 test set motherboard J209 to A25 HMA26.5 J1
㉙	30R	N5247-60018	A62 port 4 70 GHz doubler J1 to A23 test set motherboard J3
㉚	100R	N5242-60004	A18 system motherboard J1 to A23 test set motherboard J1 to A24 IF multiplexer board J1
㉛	25R	E4410-60160	A18 system motherboard J13 to A23 test set motherboard J545
㉜	36R	8121-0834	rear-panel HANDLER I/O to A23 test set motherboard J400
㉝	20R	N5247-60014	A23 test set motherboard J551 to A27 mixer brick (1) J52
㉞	20R	N5247-60015	A23 test set motherboard J552 to A28 mixer brick (2) J52

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

Figure 6-48 Bottom Ribbon Cables and Wire Harnesses, 4-Port, Option 425 with and without Option 029, S/N Prefixes <6021



Cables 3, 13, 21, and 26 apply only with Option 029.

4-Port Configurations, Serial Number Prefix ≥6021

This section contains the following:

- "4-Port Configuration, Option 401, S/N Prefixes ≥6201" on page 6-136
- "4-Port Configuration, Options 419, S/N Prefixes ≥6201" on page 6-146
- "4-Port Configuration, Option 423 with and without Option 029 or E29, S/N Prefixes ≥6201" on page 6-158
- "4-Port Configuration, Option 425 with and without 029 or E29, S/N Prefixes ≥6021" on page 6-174
- See also, "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

4-Port Configuration, Option 401, S/N Prefixes ≥6201

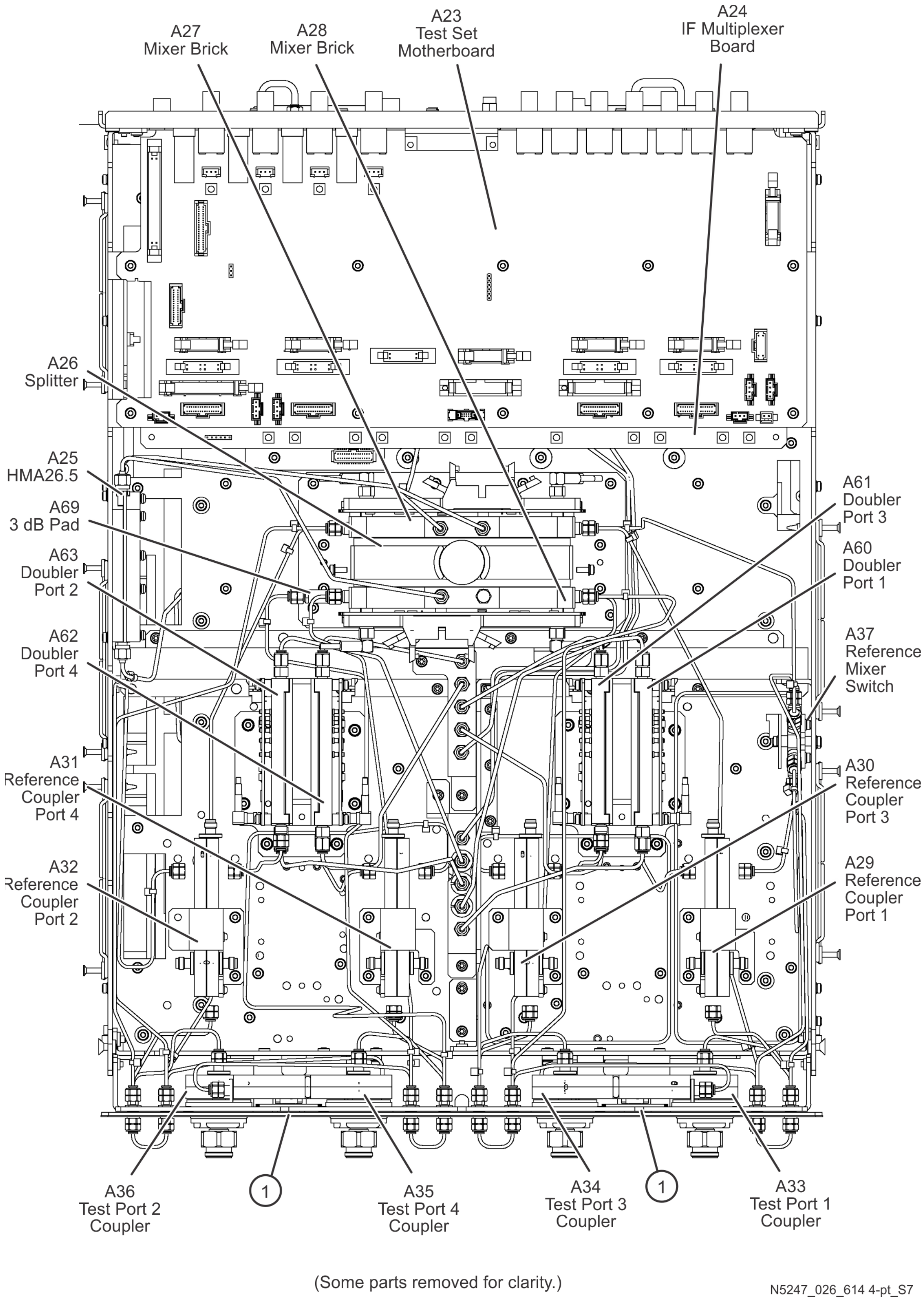
Bottom Assemblies, Standard 4-Port Configuration, Option 401, S/N Prefixes ≥6201

Reference Designator	Part Number[a]	Qty	Description
A23	N5245-60157 Was N5247-60001	1	Test set motherboard
A24	N5240-60062[b] Was: N5240-60045	1	IF multiplexer board
A25	N5240-60101 Was: 5087-7765	1	LO Multiplier/amplifier 26.5 (HMA26.5)
A27 A28	5087-7337	2	Mixer brick
A29 A30 A31 A32	5087-7744	4	Test port 1 reference coupler Test port 3 reference coupler Test port 4 reference coupler Test port 2 reference coupler
A33 A34 A35 A36	5087-7778	4	Test port 1 coupler Test port 3 coupler Test port 4 coupler Test port 2 coupler
A37	5087-7759	1	Reference mixer switch
A60 A61 A62 A63	5087-7336	4	70 GHz doubler assembly port 1 70 GHz doubler assembly port 3 70 GHz doubler assembly port 4 70 GHz doubler assembly port 2
A69	08490-60037	1	3-dB attenuator (A28 mixer brick (R1)
①	N5240-60058	2	front-panel LED board

a. Part numbers in italic typeface are for rebuilt exchange assemblies. Refer to "Rebuilt-Exchange Assemblies" on page 6-4.

b. All new units built after August 2009, no longer use the N5242-60031 cable that was attached to connector P1001 and Source 2. As a result of this change, the IF multiplexer boards have had their P1001 connectors removed. If your instrument contains a N5242-60031 cable, remove it from your instrument.

Figure 6-49 Bottom Assemblies, Standard 4-Port Configuration, Option 401, S/N Prefixes ≥6201



Bottom RF Cables, Standard 4-Port Configuration, Option 401, S/N Prefixes ≥6201

Reference Designator	Type[a]	Part Number	Qty	Description
W12	SR	N5247-20059	1	A60 port 1 70 GHz doubler to W11
W14	SR	N5247-20072	1	A60 port 1 70 GHz doubler to W13
W16	SR	N5247-20060	1	A61 port 3 70 GHZ doubler to W15
W18	SR	N5247-20084	1	A61 port 3 70 GHZ doubler to W17
W20	SR	N5247-20015	1	A62 port 4 70 GHZ doubler to W19
W22	SR	N5247-20068	1	A62 port 4 70 GHZ doubler to W21
W24	SR	N5247-20061	1	A63 port 2 70 GHz doubler to W23
W26	SR	N5247-20051	1	A63 port 2 70 GHz doubler to W25
W27	SR	N5247-20074	1	A60 port 1 70 GHz doubler to A29 port 1 reference coupler
W28	SR	N5247-20052	1	A61 port 3 70 GHz doubler to A30 port 3 ref coupler
W29	SR	N5247-20074	1	A62 port 4 70 GHz doubler to A31 port 4 reference coupler
W30	SR	N5247-20052	1	A63 port 2 70 GHz doubler to A32 port 2 ref coupler
W31	SR	N5247-20037	1	A29 port 1 ref coupler to front-panel port 1 SOURCE OUT
W32	SR	N5247-20016	1	Port 1 CPLR THRU to A33 port 1 coupler
W33	SR	N5247-20078	1	A29 port 1 reference coupler to A37 reference mixer switch
W34	SR	N5247-20082	1	A33 port 1 coupler to front-panel port 1 CPLR ARM
W35	SR	N5247-20023	1	A30 port 3 ref coupler to front-panel port 3 SOURCE OUT
W36	SR	N5247-20006	1	port 3 CPLR THRU to A34 port 3 coupler
W37	SR	N5247-20077	1	A30 port 3 ref coupler to front-panel REF 3 SOURCE OUT
W38	SR	N5247-20007	1	A34 port 3 coupler to front-panel port 3 CPLR ARM
W39	SR	N5247-20035	1	A31 port 4 ref coupler to front-panel port 4 SOURCE OUT
W40	SR	N5247-20017	1	Port 4 CPLR THRU to A35 port 4 coupler
W41	SR	N5247-20075	1	A31 port 4 ref coupler to front-panel REF 4 SOURCE OUT
W42	SR	N5247-20026	1	A35 port 4 coupler to front-panel port 4 CPLR ARM
W43	SR	N5247-20036	1	A32 port 2 ref coupler to front-panel port 2 SOURCE OUT
W44	SR	N5247-20018	1	Port 2 CPLR THRU to A36 port 2 coupler
W45	SR	N5247-20076	1	A32 port 2 ref coupler to front-panel REF 2 SOURCE OUT
W46	SR	N5247-20019	1	A36 port 2 coupler to front-panel port 2 CPLR ARM

Reference Designator	Type[a]	Part Number	Qty	Description
W47	SR	N5247-20053	1	Port 1 RCVR A IN to A27 mixer brick (A)
W48	SR	N5247-20063	1	Port 3 RCVR C IN to A28 mixer brick (C)
W49	SR	N5247-20073	1	Port 4 RCVR D IN to A28 mixer brick (D)
W50	SR	N5247-20054	1	Port 2 RCVR B IN to A27 mixer brick (B)
W51	SR	N5247-20011	1	A37 reference mixer switch to front-panel REF 1 SOURCE OUT
W52	SR	N5247-20012	1	REF 1 RCVR R1 IN to A37 reference mixer switch
W53	SR	N5247-20048	1	A37 reference mixer switch to A27 mixer brick (R1)
W54	SR	N5247-20062	1	REF 3 RCVR R3 IN to A28 mixer brick (R3)
W55	SR	N5247-20067	1	REF 4 RCVR R4 IN to A69 3 dB pad on A28 mixer brick (R4)
W56	SR	N5247-20055	1	REF 2 RCVR R2 IN to A27 mixer brick (R2)
W58	cap	N5247-20138		2.4 mm cap for A28 mixer brick
W60	SR	N5247-20107	12	front-panel jumper
W61	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W62[b]	SR	N5247-20111	1	A25 HMA26.5 to A26 splitter
W63[b]	SR	N5245-20023	1	RF cable, A26 splitter to A27 mixer brick
W64[b]	SR	N5245-20022	1	A26 splitter to A28 mixer brick
W66	SR	N5247-20109	1	W65 to rear-panel EXT TSET DRIVE RF OUT (J6)
W68	SR	N5247-20088	1	rear-panel port RF2 OUT (J12) to W67
W69	SR	N5247-20112	1	A27 mixer brick to EXT TSET DRIVE LO OUT (J5)
W70[c]	SR	N5247-20100	1	A25 HMA26.5 to A27 mixer brick (1)
W71	F	N5242-60017	1	A27 mixer brick (A) to A24 IF multiplexer (P1)
W72	F	N5242-60021	1	A27 mixer brick (R1) to A24 IF multiplexer (P411)
W73	F	N5242-60022	1	A27 mixer brick (R2) to A24 IF multiplexer (P412)
W74	F	N5242-60018	1	A27 mixer brick (B) to A24 IF multiplexer (P201)
W75	F	N5242-60024	1	A28 mixer brick (D) to A24 IF multiplexer (P801)
W76	F	N5242-60019	1	A28 mixer brick (R4) to A24 IF multiplexer (P414)
W77	F	N5242-60020	1	A28 mixer brick (R3) to A24 IF multiplexer (P413)
W78	F	N5242-60023	1	A28 mixer brick (C) to A24 IF multiplexer (P601)
W80	F	N5242-60013	1	A24 IF multiplexer board P203 to A16 SPAM board J2

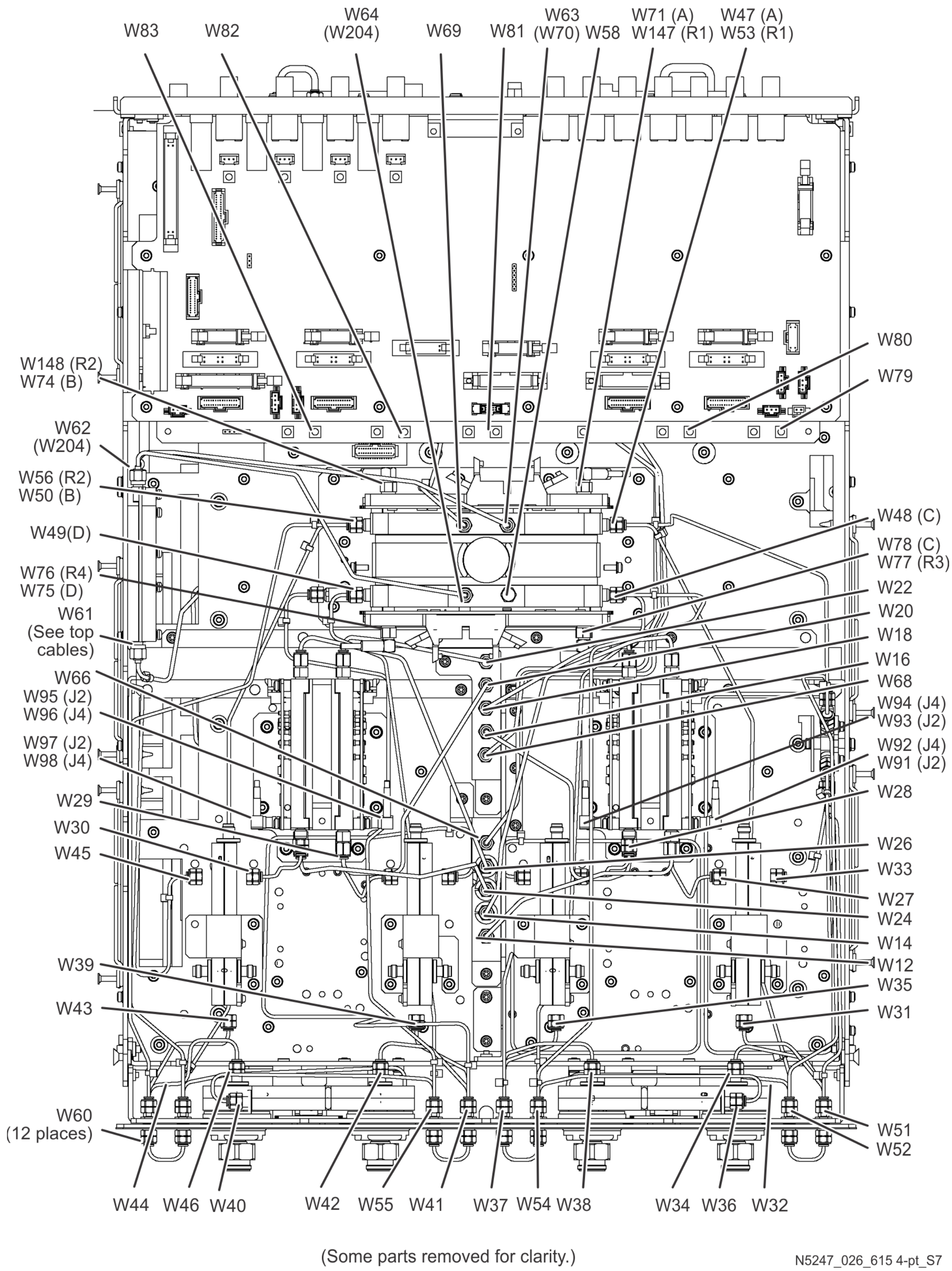
Reference Designator	Type[a]	Part Number	Qty	Description
W79, 81	F	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W82	F	N5242-60015	1	A24 IF multiplexer board P603 to A16 SPAM board J5
W83	F	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W91	F	N5247-60006	1	A60 port 1 70 GHz doubler J2 to A7 40 GHz doubler J401
W92	F	N5247-60007	1	A60 port 1 70 GHz doubler J4 to A7 40 GHz doubler J500
W93	F	N5247-60010	1	A61 port 3 70 GHz doubler J2 to A12 40 GHz doubler J401
W94	F	N5247-60011	1	A61 port 3 70 GHz doubler J4 to A12 40 GHz doubler J500
W95	F	N5247-60012	1	A62 port 4 70 GHz doubler J2 to A13 40 GHz doubler J401
W96	F	N5247-60013	1	A62 port 4 70 GHz doubler J4 to A13 40 GHz doubler J500
W97	F	N5247-60008	1	A63 port 2 70 GHz doubler J2 to A8 40 GHz doubler J401
W98	F	N5247-60009	1	A63 port 2 70 GHz doubler J4 to A8 40 GHz doubler J500
W204[b]	SR	N5247-20185	1	A25 HMA26.5 to A28 mixer brick (2)

a. SR = semirigid coaxial cable; F = flexible coaxial cable

b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

c. On legacy instruments using the 5087-7765 HMA26.5, the N5245-20100 cable is used only on 2-port instruments. On instruments with a new HMA26.5 the N5245-20100 cable is used in all instruments. If you are unclear which HMA26.5 assembly your PNA has installed, refer to "Verify the Model/Version of HMA26.5 Installed" on page 7-40 and to Figure 7-17 on page 40.

Figure 6-50 Bottom RF Cables, Standard 4-Port Configuration, Option 401, S/N Prefixes ≥6201



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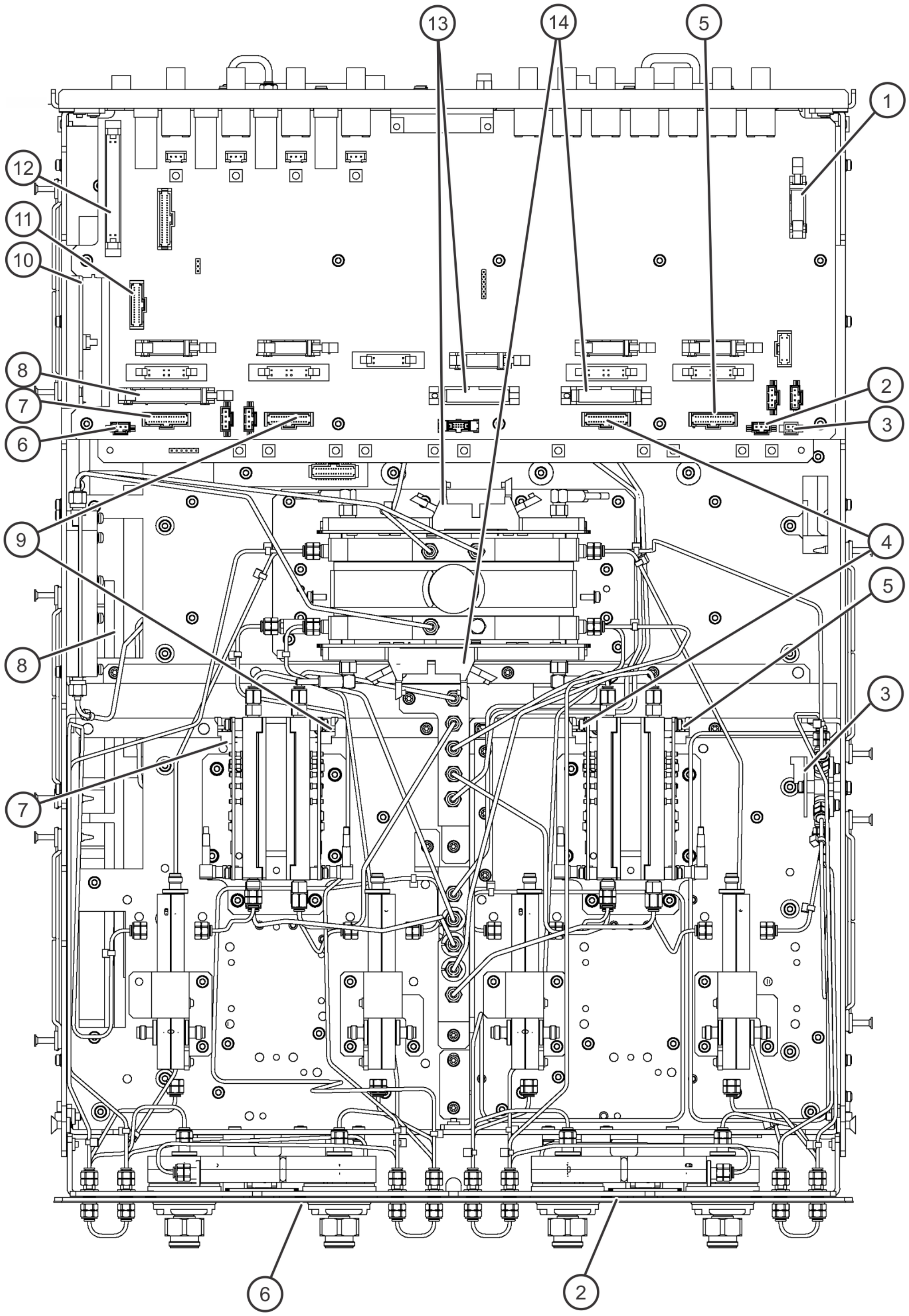
Bottom Ribbon Cables and Wire Harnesses, Standard 4-Port Configuration, Option 401, S/N Prefixes ≥6201

Reference Designator	Type[a]	Part Number	Description
①	10R	N5242-60005	rear-panel PWR I/O to A23 test set motherboard J301
②	3W	N5247-60016	A23 test set motherboard J221 to ports 1/3 LED board J1
③	2W	8121-0966	A23 test set motherboard J554 to A37 reference mixer switch
④	30R	N5247-60018	A61 port 3 70 GHz doubler J1 to A23 test set motherboard J5
⑤	30R	N5247-60018	A60 port 1 70 GHz doubler J1 to A23 test set motherboard J4
⑥	3W	N5247-60016	A23 test set motherboard J222 to ports 2/4 LED board J1
⑦	30R	N5247-60018	A63 port 2 70 GHz doubler J1 to A23 test set motherboard J6
⑧	24R	N5247-60022	A23 test set motherboard J209 to A25 HMA26.5 J1
⑨	30R	N5247-60018	A62 port 4 70 GHz doubler J1 to A23 test set motherboard J3
s	100R	N5242-60004	A18 system motherboard J1 to A23 test set motherboard J1 to A24 IF multiplexer board J1
⑪	25R	E4410-60160	A18 system motherboard J13 to A23 test set motherboard J545
⑫	36R	8121-0834	rear-panel HANDLER I/O to A23 test set motherboard J400
⑬	20R	N5247-60014	A23 test set motherboard J551 to A27 mixer brick (1) J52
⑭	20R	N5247-60015	A23 test set motherboard J552 to A28 mixer brick (2) J52

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

Figure 6-51 Bottom Ribbon Cables and Wire Harnesses, Standard 4-Port Configuration, Option 401, S/N Prefixes ≥6201



(Some parts removed for clarity.)

4-Port Configuration, Options 419, S/N Prefixes ≥6201

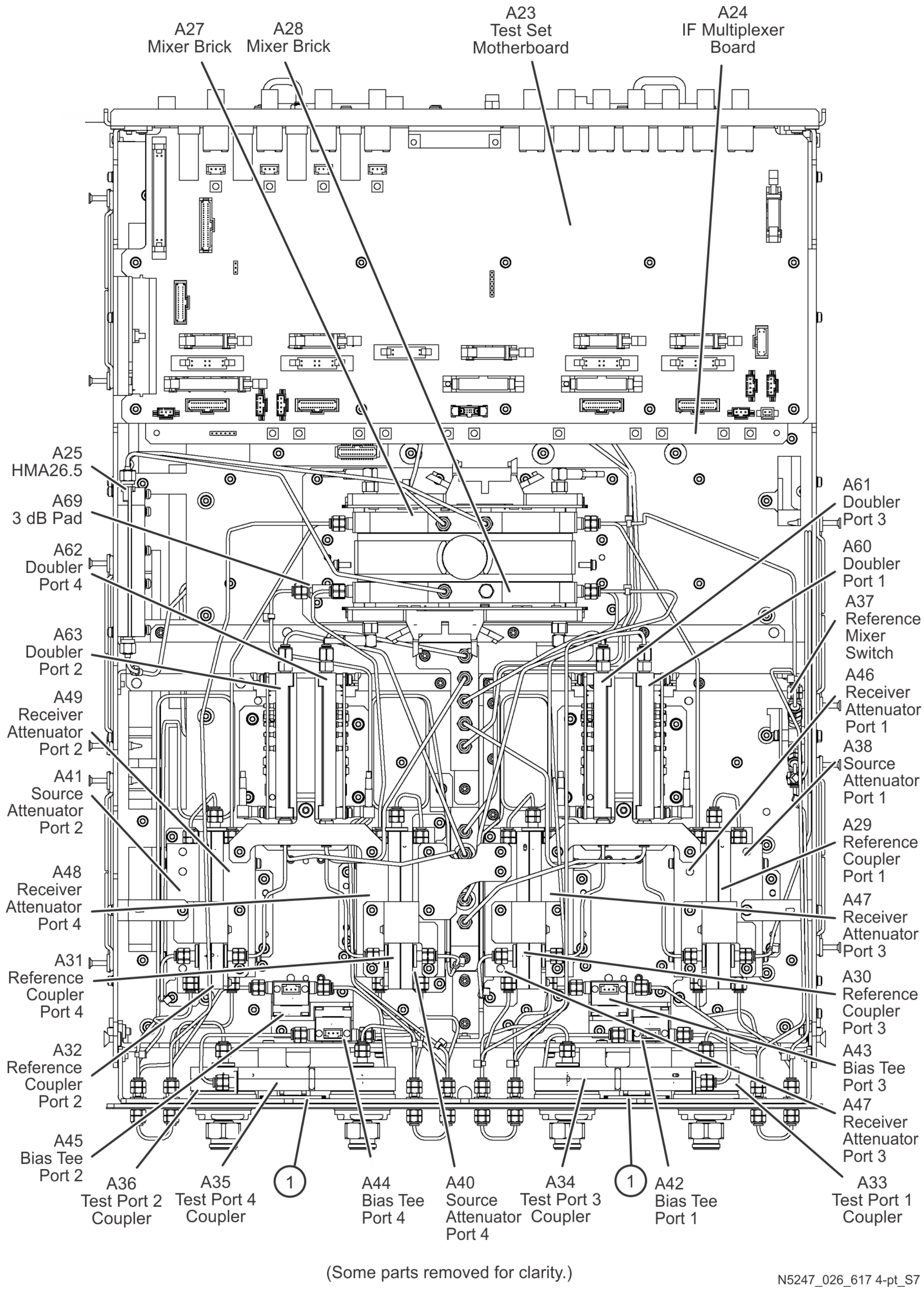
Bottom Assemblies, 4-Port, Options 419, S/N Prefixes ≥6201

Reference Designator	Part Number[a]	Qty	Description
A23	N5245-60157 Was N5247-60001	1	Test set motherboard
A24	N5240-60062[b] Was: N5240-60045	1	IF multiplexer board
A25	N5240-60101 Was: 5087-7765	1	LO Multiplier/amplifier 26.5 (HMA26.5)
A27 A28	5087-7337	2	Mixer brick
A29 A30 A31 A32	5087-7744	4	Test port 1 reference coupler Test port 3 reference coupler Test port 4 reference coupler Test port 2 reference coupler
A33 A34 A35 A36	5087-7778	4	Test port 1 coupler Test port 3 coupler Test port 4 coupler Test port 2 coupler
A37	5087-7759	1	Reference mixer switch
A38 A39 A40 A41	84905-60004 was: 84905-60002	4	Test port 1 source attenuator Test port 3 source attenuator Test port 4 source attenuator Test port 2 source attenuator
A42 A43 A44 A45	5087-7732 Was 5086-7020	4	Test port 1 bias tee Test port 3 bias tee Test port 4 bias tee Test port 2 bias tee
A46 A47 A48 A49	84905-60004 was: 84905-60002	4	Port 1 receiver attenuator Port 3 receiver attenuator Port 4 receiver attenuator Port 2 receiver attenuator
A60 A61 A62 A63	5087-7336	4	70 GHz doubler assembly port 1 70 GHz doubler assembly port 3 70 GHz doubler assembly port 4 70 GHz doubler assembly port 2
A69	08490-60037	1	3-dB attenuator (A28 mixer brick (R1)
①	N5240-60058	2	front-panel LED board

a. Part numbers in italic typeface are for rebuilt exchange assemblies. Refer to “Rebuilt-Exchange Assemblies” on page 6-4.

b. All new units built after August 2009, no longer use the N5242-60031 cable that was attached to connector P1001 and Source 2. As a result of this change, the IF multiplexer boards have had their P1001 connectors removed. If your instrument contains a N5242-60031 cable, remove it from your instrument.

Figure 6-52 Bottom Assemblies, 4-Port, Options 419, S/N Prefixes ≥6201



Bottom RF Cables, 4-Port, Options 419 (Ports 1 and 2), S/N Prefixes ≥6201

Reference Designator	Type[a]	Part Number	Qty	Description
W12	SR	N5247-20059	1	A60 port 1 70 GHz doubler to W11
W14	SR	N5247-20072	1	A60 port 1 70 GHz doubler to W13
W24	SR	N5247-20061	1	A63 port 2 70 GHz doubler to W23
W26	SR	N5247-20051	1	A63 port 2 70 GHz doubler to W25
W27	SR	N5247-20044	1	A60 port 1 70 GHz doubler to A29 port 1 reference coupler
W30	SR	N5247-20043	1	A63 port 2 70 GHz doubler to A32 port 2 reference coupler
W34	SR	N5247-20082	1	A33 port 1 coupler to front-panel port 1 CPLR ARM
W46	SR	N5247-20019	1	A36 port 2 coupler to front-panel port 2 CPLR ARM
W51	SR	N5247-20011	1	A37 reference mixer switch to front-panel REF 1 SOURCE OUT
W52	SR	N5247-20012	1	REF 1 RCVR R1 IN to A37 reference mixer switch
W53	SR	N5247-20048	1	A37 reference mixer switch to A27 mixer brick (R1)
W60	SR	N5247-20107	12	front-panel jumper
W61	SR	Refer to “Top Cables, All Cables—All Options, S/N Prefixes ≥6021” on page 6-28.		
W62[b]	SR	N5247-20111	1	A25 HMA26.5 to A26 splitter
W63[b]	SR	N5245-20023	1	RF cable, A26 splitter to A27 mixer brick
W66	SR	N5247-20109	1	W65 to rear-panel EXT TSET DRIVE RF OUT (J6)
W69	SR	N5247-20112	1	A27 mixer brick to EXT TSET DRIVE LO OUT (J5)
W70[c]	SR	N5247-20100	1	A25 HMA26.5 to A27 mixer brick (1)
W71	F	N5242-60017	1	A27 mixer brick (A) to A24 IF multiplexer (P1)
W72	F	N5242-60021	1	A27 mixer brick (R1) to A24 IF multiplexer (P411)
W73	F	N5242-60022	1	A27 mixer brick (R2) to A24 IF multiplexer (P412)
W74	F	N5242-60018	1	A27 mixer brick (B) to A24 IF multiplexer (P201)
W79, 81, 83	F	Refer to “Top Cables, All Cables—All Options, S/N Prefixes ≥6021” on page 6-28.		
W91	F	N5247-60006	1	A60 port 1 70 GHz doubler J2 to A7 40 GHz doubler J401
W92	F	N5247-60007	1	A60 port 1 70 GHz doubler J4 to A7 40 GHz doubler J500
W97	F	N5247-60008	1	A63 port 2 70 GHz doubler J2 to A8 40 GHz doubler J401
W98	F	N5247-60009	1	A63 port 2 70 GHz doubler J4 to A8 40 GHz doubler J500
W101	SR	N5247-20083	1	A29 port 1 reference coupler to A38 port 1 source attenuator

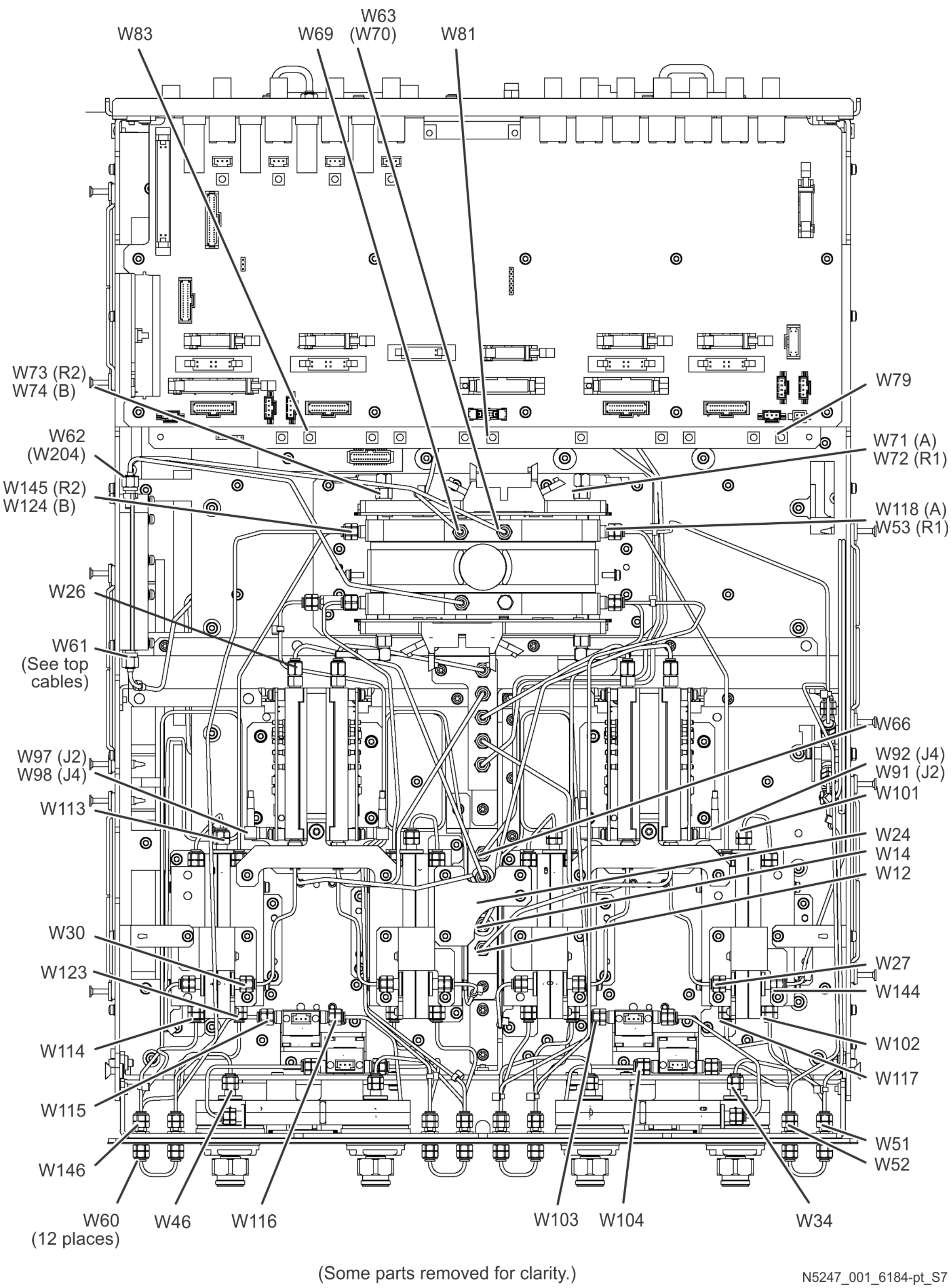
Reference Designator	Type[a]	Part Number	Qty	Description
W102	SR	N5247-20014	1	A38 port 1 source attenuator to front-panel port 1 SOURCE OUT
W103	SR	N5247-20081	1	Front-panel port 1 CPLR THRU to A42 port 1 bias tee
W104	SR	N5247-20022	1	A33 port 1 coupler to A42 port 1 bias tee
W113	SR	N5247-20083	1	A32 port 2 reference coupler to A41 port 2 source attenuator
W114	SR	N5247-20034	1	A41 port 2 source attenuator to front-panel port 2 SOURCE OUT
W115	SR	N5247-20027	1	Port 2 CPLR THRU to A45 port 2 bias tee
W116	SR	N5247-20080	1	A45 port 2 bias tee to A36 port 2 coupler
W117	SR	N5247-20013	1	Front-panel port 1 RCVR A IN to A46 port 1 receiver attenuator
W118	SR	N5247-20047	1	A46 port 1 receiver attenuator to A27 mixer brick (A)
W123	SR	N5247-20020	1	Port 2 RCVR B IN to A49 port 2 receiver attenuator
W124	SR	N5247-20046	1	A49 port 2 receiver attenuator to A27 mixer brick (B)
W144	SR	N5247-20071	1	A29 port 1 reference coupler to A37 reference mixer switch
W145	SR	N5247-20066	1	REF 2 RCVR R2 IN to A27 mixer brick (R2)
W146	SR	N5247-20058	1	A32 port 2 ref coupler to front-panel REF 2 SOURCE OUT

a. SR = semirigid coaxial cable; F = flexible coaxial cable

b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 “2-Port Configurations, Serial Number Prefixes <6021” on page 6-32 and “4-Port Configuration, Serial Number Prefixes <6021” on page 6-84.

c. On legacy instruments using the 5087-7765 HMA26.5, the N5245-20100 cable is used only on 2-port instruments. On instruments with a new HMA26.5 the N5245-20100 cable is used in all instruments. If you are unclear which HMA26.5 assembly your PNA has installed, refer to “Verify the Model/Version of HMA26.5 Installed” on page 7-40 and to Figure 7-17 on page 40.

Figure 6-53 Bottom RF Cables, 4-Port, Options 419 (Ports 1 and 2), S/N Prefixes ≥6201



Bottom RF Cables, 4-Port, Options 419 (Ports 3 and 4), S/N Prefixes ≥6201

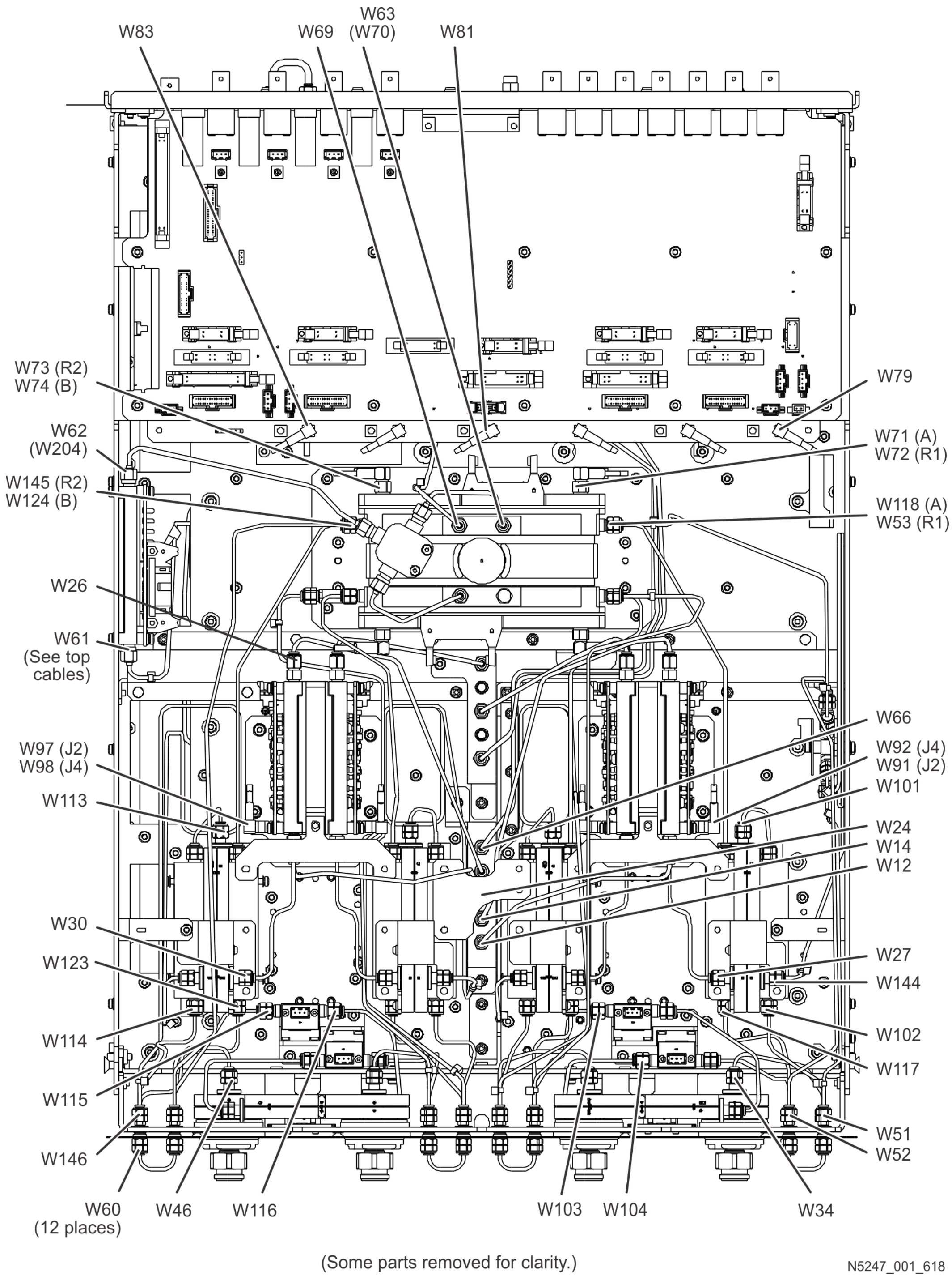
Reference Designator	Type[a]	Part Number	Qty	Description
W16	SR	N5247-20060	1	A61 port 3 70 GHZ doubler to W15
W18	SR	N5247-20084	1	A61 port 3 70 GHZ doubler to W17
W20	SR	N5247-20015	1	A62 port 4 70 GHZ doubler to W19
W22	SR	N5247-20068	1	A62 port 4 70 GHZ doubler to W21
W28	SR	N5247-20043	1	A61 port 3 70 GHz doubler to A30 port 3 reference coupler
W29	SR	N5247-20044	1	A62 port 4 70 GHz doubler to A31 port 4 reference coupler
W37	SR	N5247-20070	1	A30 port 3 reference coupler to front-panel REF 3 SOURCE OUT
W38	SR	N5247-20007	1	A34 port 3 coupler to front-panel port 3 CPLR ARM
W41	SR	N5247-20069	1	A31 port 4 reference coupler to front-panel REF 4 SOURCE OUT
W42	SR	N5247-20026	1	A35 port 4 coupler to front-panel port 4 CPLR ARM
W54	SR	N5247-20062	1	REF 3 RCVR R3 IN to A28 mixer brick (R3)
W55	SR	N5247-20067	1	REF 4 RCVR R4 IN to A69 3 dB pad on A28 mixer brick (R4)
W58	cap	N5247-20138		2.4 mm cap for A28 mixer brick
W64[b]	SR	N5245-20022	1	A26 splitter to A28 mixer brick
W68	SR	N5247-20088	1	rear-panel port RF2 OUT (J12) to W67
W75	F	N5242-60024	1	A28 mixer brick (D) to A24 IF multiplexer (P801)
W76	F	N5242-60019	1	A28 mixer brick (R4) to A24 IF multiplexer (P414)
W77	F	N5242-60020	1	A28 mixer brick (R3) to A24 IF multiplexer (P413)
W78	F	N5242-60023	1	A28 mixer brick (C) to A24 IF multiplexer (P601)
W80	F	N5242-60013	1	A24 IF multiplexer board P203 to A16 SPAM board J2
W82	F	N5242-60015	1	A24 IF multiplexer board P603 to A16 SPAM board J5
W93	F	N5247-60010	1	A61 port 3 70 GHz doubler J2 to A12 40 GHz doubler J401
W94	F	N5247-60011	1	A61 port 3 70 GHz doubler J4 to A12 40 GHz doubler J500
W95	F	N5247-60012	1	A62 port 4 70 GHz doubler J2 to A13 40 GHz doubler J401
W96	F	N5247-60013	1	A62 port 4 70 GHz doubler J4 to A13 40 GHz doubler J500
W105	SR	N5247-20083	1	A30 port 3 reference coupler to A39 port 3 source attenuator
W106	SR	N5247-20009	1	A39 port 3 source attenuator to front-panel port 3 SOURCE OUT
W107	SR	N5247-20010	1	Port 3 CPLR THRU to A43 port 3 bias tee

Reference Designator	Type[a]	Part Number	Qty	Description
W108	SR	N5247-20028	1	A43 port 3 bias tee to A34 port 3 coupler
W109	SR	N5247-20083	1	A31 port 4 reference coupler to A40 port 4 source attenuator
W110	SR	N5247-20025	1	A40 port 4 source attenuator to front-panel port 4 SOURCE OUT
W111	SR	N5247-20021	1	Port 4 CPLR THRU to A44 port 4 bias tee
W112	SR	N5247-20029	1	A44 port 4 bias tee to A35 port 4 coupler
W119	SR	N5247-20008	1	Port 3 RCVR C IN to A47 port 3 receiver attenuator
W120	SR	N5247-20064	1	A47 port 3 receiver attenuator to A28 mixer brick (C)
W121	SR	N5247-20024	1	Port 4 RCVR D IN to A48 port 4 receiver attenuator
W122	SR	N5247-20065	1	A48 port 4 receiver attenuator to A28 mixer brick (D)
W204[b]	SR	N5247-20185	1	A25 HMA26.5 to A28 mixer brick (2)

a. SR = semirigid coaxial cable; F = flexible coaxial cable

b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

Figure 6-54 Bottom RF Cables, 4-Port, Options 419 (Ports 3 and 4), S/N Prefixes ≥6201[1]



1. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

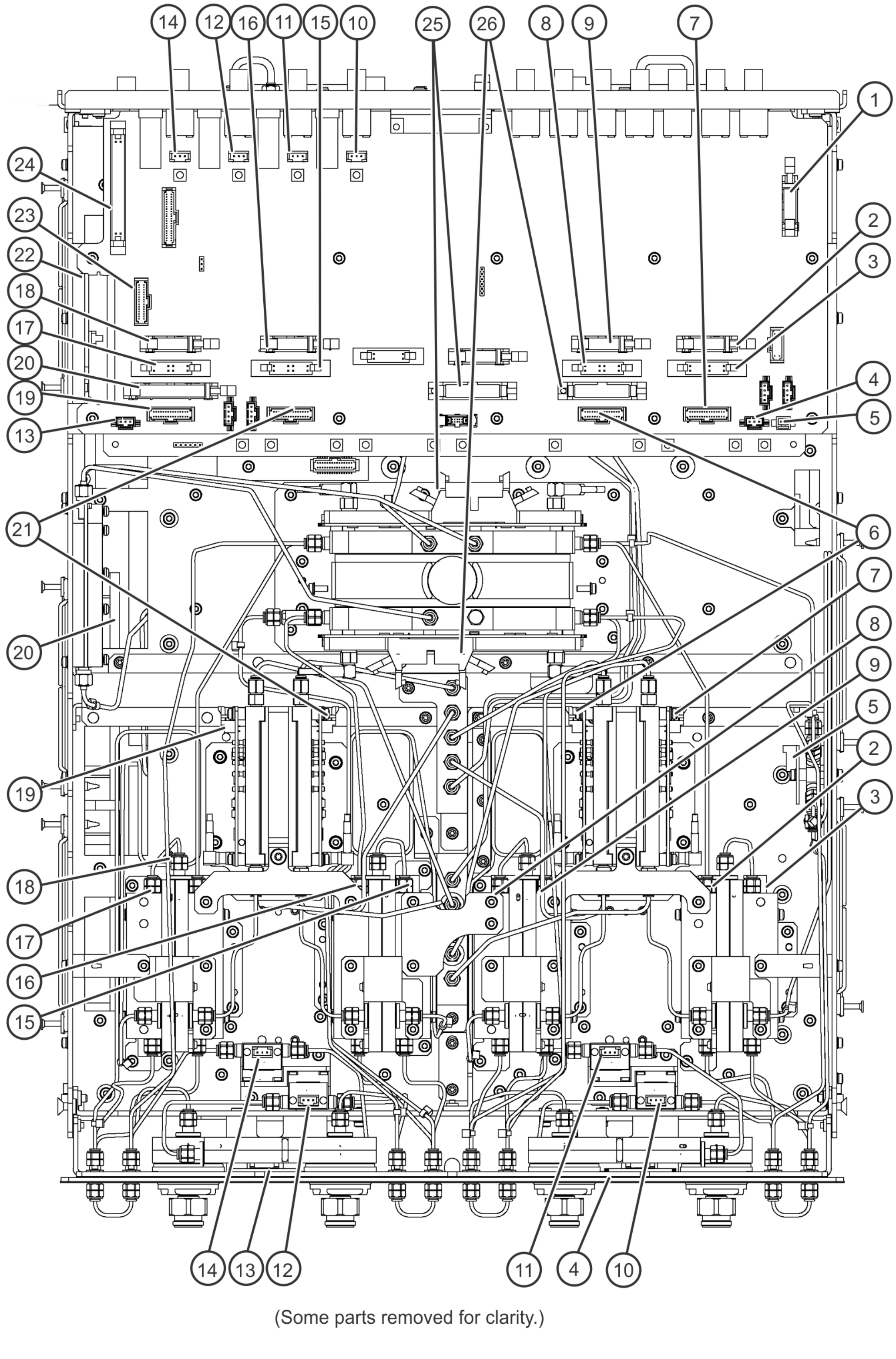
Bottom Ribbon Cables and Wire Harnesses, 4-Port, Options 419, S/N Prefixes ≥6201

Reference Designator	Type[a]	Part Number	Description
①	10R	N5242-60005	rear-panel PWR I/O to A23 test set motherboard J301
②	10R	N5247-60020	A23 test set motherboard J205 to A46 port 1 receiver attenuator
③	16R	N5245-60006	A23 test set motherboard J549 to A38 port 1 source attenuator
④	3W	N5247-60016	A23 test set motherboard J221 to ports 1/3 LED board J1
⑤	2W	8121-0966	A23 test set motherboard J554 to A37 reference mixer switch
⑥	30R	N5247-60018	A61 port 3 70 GHz doubler J1 to A23 test set motherboard J5
⑦	30R	N5247-60018	A60 port 1 70 GHz doubler J1 to A23 test set motherboard J4
⑧	16R	N5245-60006	A23 test set motherboard J547 to A39 port 3 source attenuator
⑨	10R	N5247-60020	A23 test set motherboard J206 to A47 port 3 receiver attenuator
s	2W	N5247-60021	A23 test set motherboard J541 to A42 port 1 bias tee
⑪	2W	N5247-60021	A23 test set motherboard J543 to A43 port 3 bias tee
⑫	2W	N5247-60021	A23 test set motherboard J544 to A44 port 4 bias tee
⑬	3W	N5247-60016	A23 test set motherboard J222 to ports 2/4 LED board J1
⑭	2W	N5247-60021	A23 test set motherboard J542 to A45 port 2 bias tee
⑮	16R	N5245-60006	A23 test set motherboard J548 to A40 port 4 source attenuator
⑰	16R	N5245-60006	A23 test set motherboard J546 to A41 port 2 source attenuator
⑯	10R	N5247-60020	A23 test set motherboard J207 to A48 port 4 receiver attenuator
⑱	10R	N5247-60020	A23 test set motherboard J208 to A49 port 2 receiver attenuator
⑲	30R	N5247-60018	A63 port 2 70 GHz doubler J1 to A23 test set motherboard J6
⑳	24R	N5247-60022	A23 test set motherboard J209 to A25 HMA26.5 J1
㉑	30R	N5247-60018	A62 port 4 70 GHz doubler J1 to A23 test set motherboard J3
㉒	100R	N5242-60004	A18 system motherboard J1 to A23 test set motherboard J1 to A24 IF multiplexer board J1
㉓	25R	E4410-60160	A18 system motherboard J13 to A23 test set motherboard J545
㉔	36R	8121-0834	rear-panel HANDLER I/O to A23 test set motherboard J400
㉕	20R	N5247-60014	A23 test set motherboard J551 to A27 mixer brick (1) J52

Reference Designator	Type[a]	Part Number	Description
㉖	20R	N5247-60015	A23 test set motherboard J552 to A28 mixer brick (2) J52

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

Figure 6-55 Bottom Ribbon Cables and Wire Harnesses, 4-Port, Options 419, S/N Prefixes ≥6201



(Some parts removed for clarity.)

4-Port Configuration, Option 423 with and without Option 029 or E29, S/N Prefixes ≥6201

Bottom Assemblies, 4-Port, Option 423 with and without Option 029 or E29, S/N Prefixes ≥6201

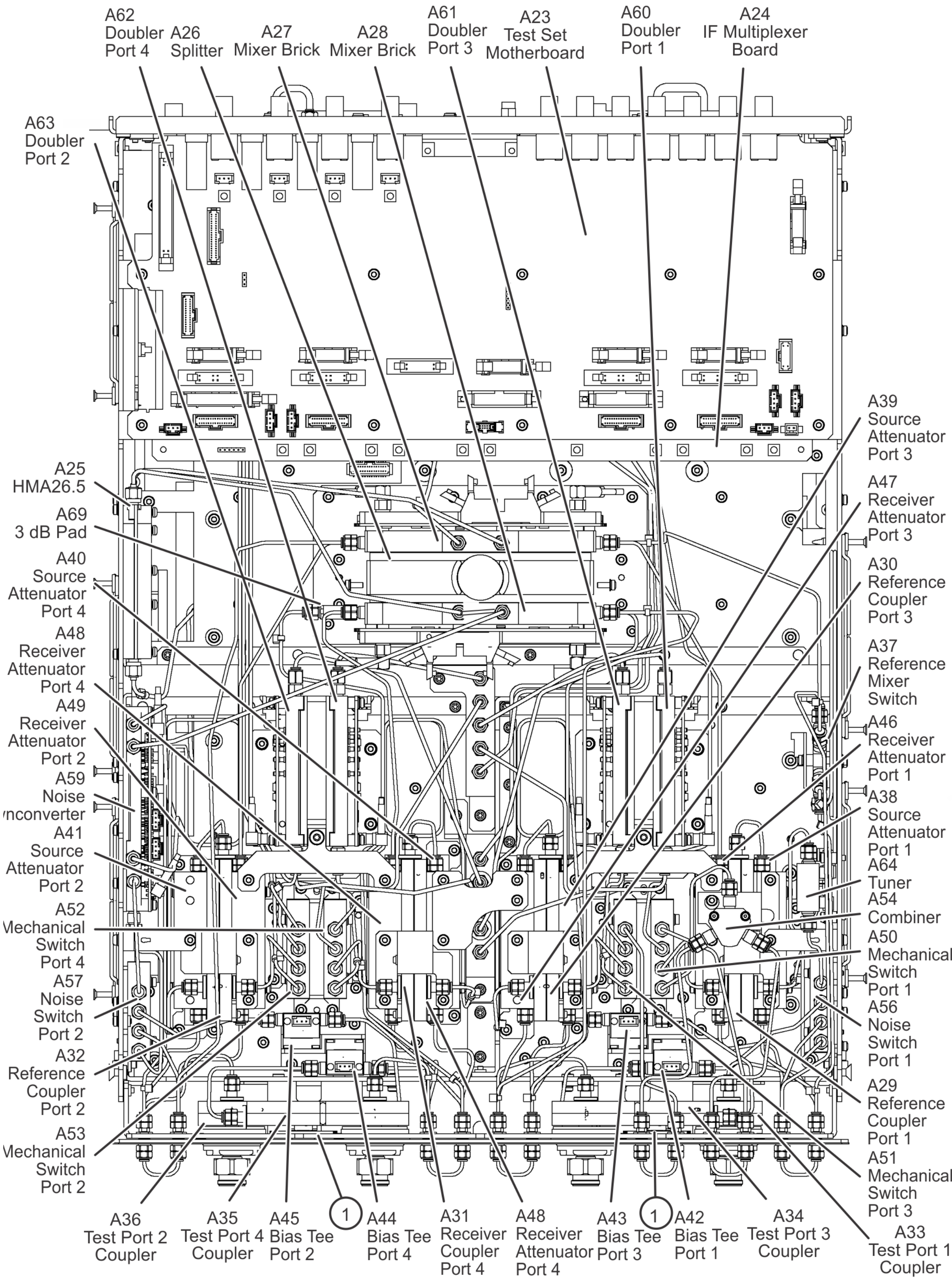
Reference Designator	Part Number[a]	Qty	Description
A23	N5245-60157 Was N5247-60001	1	Test set motherboard
A24	N5240-60062[b] Was: N5240-60045	1	IF multiplexer board
A25	N5240-60101 Was: 5087-7765	1	LO Multiplier/amplifier 26.5 (HMA26.5)
A27 A28	5087-7337	2	Mixer brick
A29 A30 A31 A32	5087-7744	4	Test port 1 reference coupler Test port 3 reference coupler Test port 4 reference coupler Test port 2 reference coupler
A33 A34 A35 A36	5087-7778	4	Test port 1 coupler Test port 3 coupler Test port 4 coupler Test port 2 coupler
A37	5087-7759	1	Reference mixer switch
A38 A39 A40 A41	84905-60004 was: 84905-60002	4	Test port 1 source attenuator Test port 3 source attenuator Test port 4 source attenuator Test port 2 source attenuator
A42 A43 A44 A45	5087-7732 Was 5086-7020	4	Test port 1 bias tee Test port 3 bias tee Test port 4 bias tee Test port 2 bias tee
A46 A47 A48 A49	84905-60004 was: 84905-60002	4	Port 1 receiver attenuator Port 3 receiver attenuator Port 4 receiver attenuator Port 2 receiver attenuator
A50 A51 A52 A53	N1811-60010	6	Port 1 mechanical switch Port 3 mechanical switch Port 4 mechanical switch Port 2 mechanical switch
A54	11667-60016	1	Combiner
A56 A57	N1811-60010	2	Port 1 noise bypass switch Port 2 noise bypass switch

Reference Designator	Part Number[a]	Qty	Description
A59	5087-7464	1	67 GHz noise receiver (downconverter) (Option E29 only)
	5087-7344		50 GHz noise receiver (downconverter) (Option 029 only)
A60 A61 A62 A63	5087-7336	4	70 GHz doubler assembly port 1 70 GHz doubler assembly port 3 70 GHz doubler assembly port 4 70 GHz doubler assembly port 2
A64	5087-7345	1	Tuner
A69	08490-60037	1	3-dB attenuator (A28 mixer brick (R1)
①	N5240-60058	2	front-panel LED board

a. Part numbers in italic typeface are for rebuilt exchange assemblies. Refer to "Rebuilt-Exchange Assemblies" on page 6-4.

b. All new units built after August 2009, no longer use the N5242-60031 cable that was attached to connector P1001 and Source 2. As a result of this change, the IF multiplexer boards have had their P1001 connectors removed. If your instrument contains a N5242-60031 cable, remove it from your instrument.

Figure 6-56 Bottom Assemblies, 4-Port, Option 423 with and without 029 or E29, S/N Prefixes ≥6201



(Some parts removed for clarity.)

N5247_001_638 4-pt_S7

Bottom RF Cables, 4-Port, Option 423 with and without 029 or E29 (Ports 1 and 2), S/N Prefixes ≥6201

Reference Designator	Type[a]	Part Number	Qty	Description
W12	SR	N5247-20059	1	A60 port 1 70 GHz doubler to W11
W14	SR	N5247-20072	1	A60 port 1 70 GHz doubler to W13
W24	SR	N5247-20061	1	A63 port 2 70 GHz doubler to W23
W26	SR	N5247-20051	1	A63 port 2 70 GHz doubler to W25
W34	SR	N5247-20082	1	A33 port 1 coupler to front-panel port 1 CPLR ARM
W46	SR	N5247-20019	1	A36 port 2 coupler to front-panel port 2 CPLR ARM
W51	SR	N5247-20011	1	A37 reference mixer switch to front-panel REF 1 SOURCE OUT
W52	SR	N5247-20012	1	REF 1 RCVR R1 IN to A37 reference mixer switch
W53	SR	N5247-20048	1	A37 reference mixer switch to A27 mixer brick (R1)
W60	SR	N5247-20107	14	front-panel jumper
W61	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W62[b]	SR	N5247-20111	1	A25 HMA26.5 to A26 splitter
W63[b]	SR	N5245-20023	1	RF cable, A26 splitter to A27 mixer brick
W66	SR	N5247-20109	1	W65 to rear-panel EXT TSET DRIVE RF OUT (J6)
W69	SR	N5247-20112	1	A27 mixer brick to EXT TSET DRIVE LO OUT (J5)
W70[c]	SR	N5247-20100	1	A25 HMA26.5 to A27 mixer brick (1)
W71	F	N5242-60017	1	A27 mixer brick (A) to A24 IF multiplexer (P1)
W72	F	N5242-60021	1	A27 mixer brick (R1) to A24 IF multiplexer (P411)
W73	F	N5242-60022	1	A27 mixer brick (R2) to A24 IF multiplexer (P412)
W74	F	N5242-60018	1	A27 mixer brick (B) to A24 IF multiplexer (P201)
W79, 81. 83	F	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W91	F	N5247-60006	1	A60 port 1 70 GHz doubler J2 to A7 40 GHz doubler J401
W92	F	N5247-60007	1	A60 port 1 70 GHz doubler J4 to A7 40 GHz doubler J500
W97	F	N5247-60008	1	A63 port 2 70 GHz doubler J2 to A8 40 GHz doubler J401
W98	F	N5247-60009	1	A63 port 2 70 GHz doubler J4 to A8 40 GHz doubler J500
W101	SR	N5247-20083	1	A29 port 1 reference coupler to A38 port 1 source attenuator
W102	SR	N5247-20014	1	A38 port 1 source attenuator to front-panel port 1 SOURCE OUT
W103	SR	N5247-20081	1	Front-panel port 1 CPLR THRU to A42 port 1 bias tee
W104	SR	N5247-20022	1	A33 port 1 coupler to A42 port 1 bias tee
W113	SR	N5247-20083	1	A32 port 2 reference coupler to A41 port 2 source attenuator
W114	SR	N5247-20034	1	A41 port 2 source attenuator to front-panel port 2 SOURCE OUT

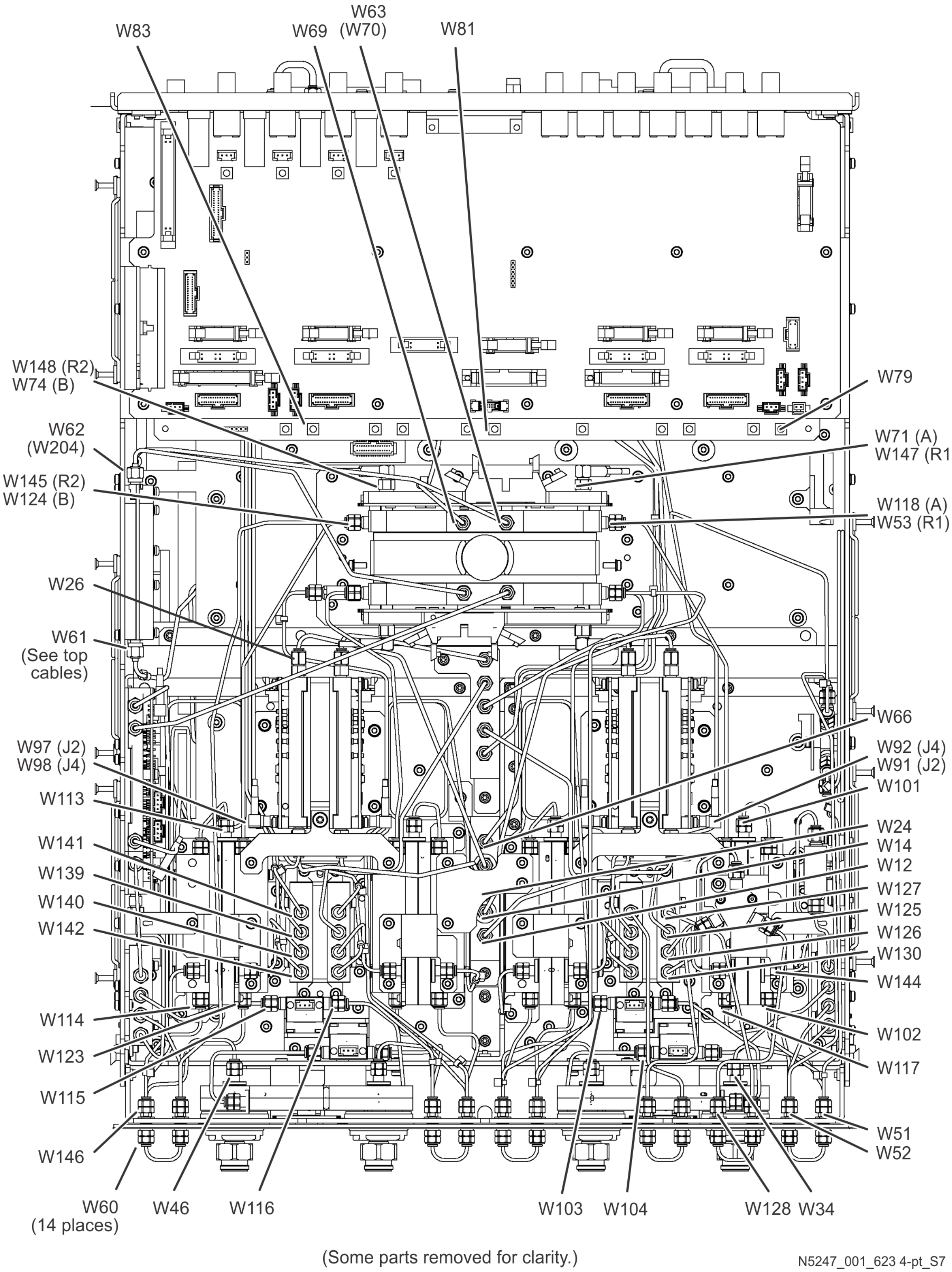
Reference Designator	Type[a]	Part Number	Qty	Description
W115	SR	N5247-20027	1	Port 2 CPLR THRU to A45 port 2 bias tee (withOUT Option 029 or E29 only)
W116	SR	N5247-20080	1	A45 port 2 bias tee to A36 port 2 coupler
W117	SR	N5247-20013	1	Front-panel port 1 RCVR A IN to A46 port 1 receiver attenuator
W118	SR	N5247-20047	1	A46 port 1 receiver attenuator to A27 mixer brick (A)
W123	SR	N5247-20020	1	Port 2 RCVR B IN to A49 port 2 receiver attenuator
W124	SR	N5247-20046	1	A49 port 2 receiver attenuator to A27 mixer brick (B)
W125	SR	N5247-20030	1	A50 port 1 mechanical switch to A60 port 1 70 GHz doubler
W126	SR	N5247-20031	1	A50 port 1 mechanical switch to A29 port 1 reference coupler
W127	SR	N5247-20091	1	A50 port 1 mechanical switch to PORT 1 SW SRC OUT
W128	SR	N5247-20092	1	Front-panel PORT 1 COMB THRU IN to A54 combiner
W130	SR	N5247-20094	1	A50 port 1 mechanical switch to A54 combiner
W139	SR	N5247-20032	1	A53 port 2 mechanical switch to A63 port 2 70 GHz doubler
W140	SR	N5247-20033	1	A53 port 2 mechanical switch to A32 port 2 reference coupler
W141	SR	N5247-20099	1	A53 port 2 mechanical switch to PORT 2 SW SRC OUT (J2)
W142	SR	N5247-20089	1	A53 port 2 mechanical switch to PORT 2 TSET IN (J1)
W143	SR	N5247-20107	2	rear-panel jumper
W144	SR	N5247-20071	1	A29 port 1 reference coupler to A37 reference mixer switch
W145	SR	N5247-20066	1	REF 2 RCVR R2 IN to A27 mixer brick (R2)
W146	SR	N5247-20058	1	A32 port 2 ref coupler to front-panel REF 2 SOURCE OUT
W162	SR	N5247-20120	1	A42 port 1 bias tee to A56 port 1 noise bypass switch
W163	SR	N5247-20117	1	A64 tuner to A56 port 1 noise bypass switch
W164	SR	N5247-20118	1	A64 tuner to A56 port 1 noise bypass switch
W165	SR	N5247-20119	1	Front-panel port 1 CPLR THRU to A56 port 1 noise bypass switch
W166	SR	N5247-20124	1	Front-panel port 2 CPLR THRU to A57 port 2 noise bypass switch
W167	SR	N5247-20123	1	A57 port 2 noise bypass switch to A45 port 2 bias tee
W168	SR	N5247-20121	1	A59 noise receiver (downconverter) to A57 port 2 noise bypass
W169	SR	N5247-20122	1	A59 noise receiver (downconverter) to A57 port 2 noise bypass
W171, W172, W173	Refer to "Top Assemblies and Cables, All Options, Serial Number Prefixes ≥6021" on page 6-24.			
W174	SR	N5247-20143	1	A59 noise receiver (downconverter) to A28 mixer brick
W175	Refer to "Top Assemblies and Cables, All Options, Serial Number Prefixes ≥6021" on page 6-24.			

a. SR = semirigid coaxial cable; F = flexible coaxial cable

b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 “2-Port Configurations, Serial Number Prefixes <6021” on page 6-32 and “4-Port Configuration, Serial Number Prefixes <6021” on page 6-84.

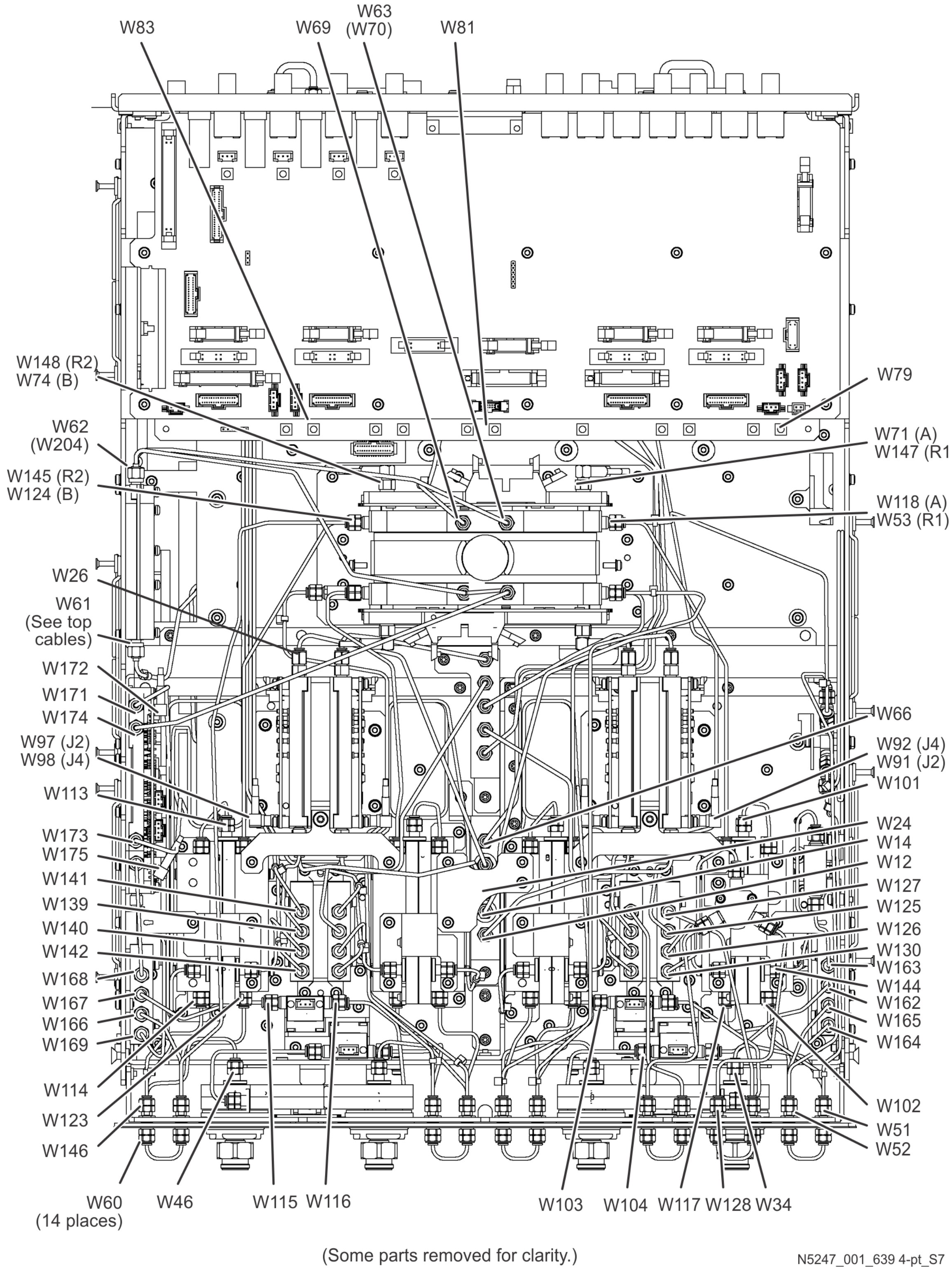
c. On legacy instruments using the 5087-7765 HMA26.5, the N5245-20100 cable is used only on 2-port instruments. On instruments with a new HMA26.5 the N5245-20100 cable is used in all instruments. If you are unclear which HMA26.5 assembly your PNA has installed, refer to “Verify the Model/Version of HMA26.5 Installed” on page 7-40 and to Figure 7-17 on page 40.

Figure 6-57 Bottom RF Cables, 4-Port, Options 423 (Ports 1 and 2), S/N Prefixes ≥6201



Option 423 with 029 is shown, but similar to Option 423 without Option 029

Figure 6-58 Bottom RF Cables, 4-Port, Option 423 with Option 029 or E29 (Ports 1 and 2), S/N Prefixes ≥6201



Bottom RF Cables, 4-Port, Option 423 with and without Option 029 or E29 (Ports 3 and 4), S/N Prefixes ≥6201

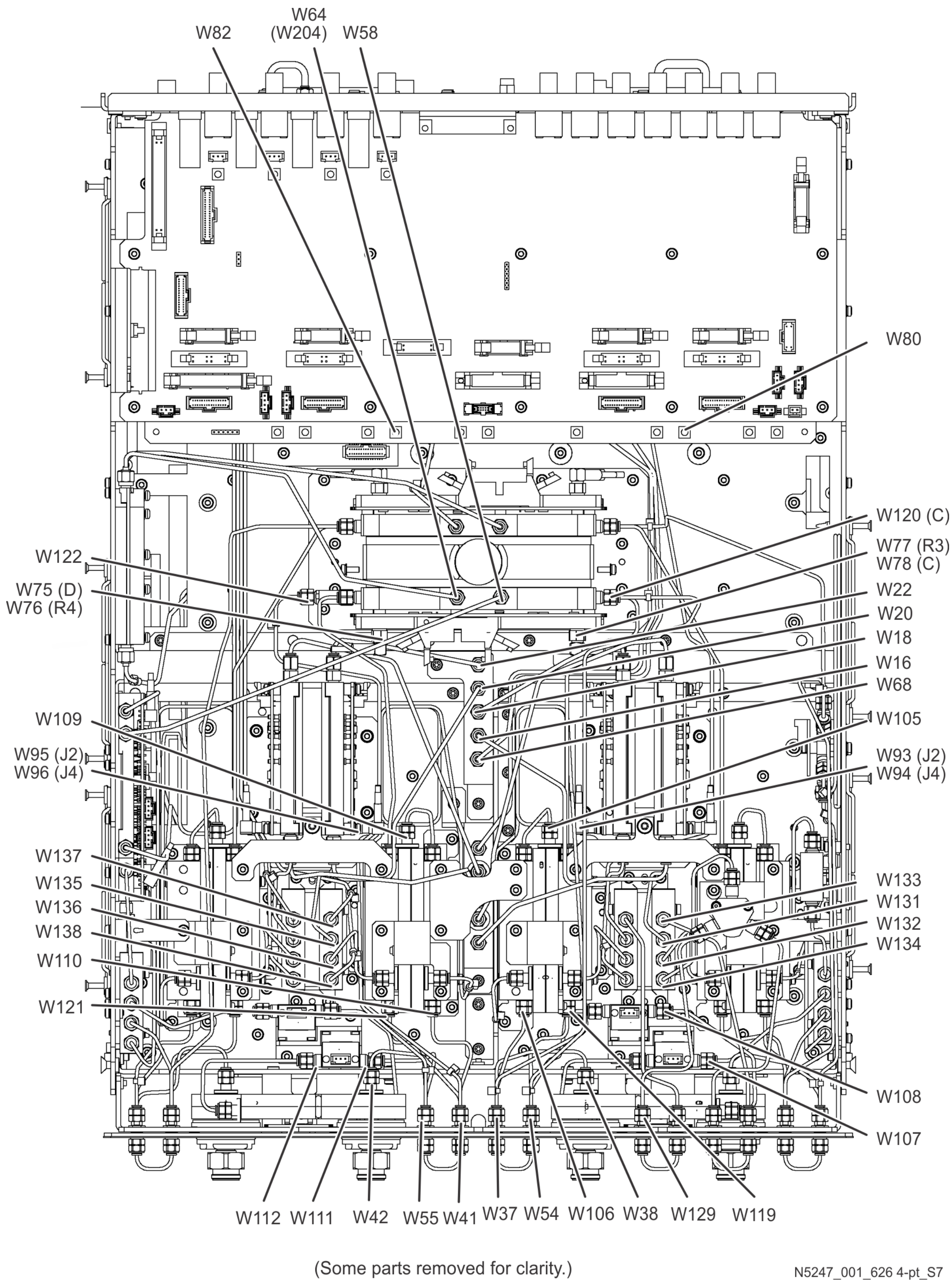
Reference Designator	Type[a]	Part Number	Qty	Description
W16	SR	N5247-20060	1	A61 port 3 70 GHz doubler to W15
W18	SR	N5247-20084	1	A61 port 3 70 GHz doubler to W17
W20	SR	N5247-20015	1	A62 port 4 70 GHz doubler to W19
W22	SR	N5247-20068	1	A62 port 4 70 GHz doubler to W21
W37	SR	N5247-20070	1	A30 port 3 ref coupler to front-panel REF 3 SOURCE OUT
W38	SR	N5247-20007	1	A34 port 3 coupler to front-panel port 3 CPLR ARM
W41	SR	N5247-20069	1	A31 port 4 ref coupler to front-panel REF 4 SOURCE OUT
W42	SR	N5247-20026	1	A35 port 4 coupler to front-panel port 4 CPLR ARM
W54	SR	N5247-20062	1	REF 3 RCVR R3 IN to A28 mixer brick (R3)
W55	SR	N5247-20067	1	REF 4 RCVR R4 IN to A28 mixer brick (R4)
W58	cap	N5247-20138	1	2.4 mm cap for A28 mixer brick (withOUT Option 029 or E29 only)
W64[b]	SR	N5245-20022	1	A26 splitter to A28 mixer brick
W68	SR	N5247-20088	1	rear-panel port RF2 OUT (J12) to W67
W75	F	N5242-60024	1	A28 mixer brick (D) to A24 IF multiplexer (P801)
W76	F	N5242-60019	1	A28 mixer brick (R4) to A24 IF multiplexer (P414)
W77	F	N5242-60020	1	A28 mixer brick (R3) to A24 IF multiplexer (P413)
W78	F	N5242-60023	1	A28 mixer brick (C) to A24 IF multiplexer (P601)
W80	F	N5242-60013	1	A24 IF multiplexer board P203 to A16 SPAM board J2
W82	F	N5242-60015	1	A24 IF multiplexer board P603 to A16 SPAM board J5
W93	F	N5247-60010	1	A61 port 3 70 GHz doubler J2 to A12 40 GHz doubler J401
W94	F	N5247-60011	1	A61 port 3 70 GHz doubler J4 to A12 40 GHz doubler J500
W95	F	N5247-60012	1	A62 port 4 70 GHz doubler J2 to A13 40 GHz doubler J401
W96	F	N5247-60013	1	A62 port 4 70 GHz doubler J4 to A13 40 GHz doubler J500
W105	SR	N5247-20083	1	A30 port 3 reference coupler to A39 port 3 source attenuator
W106	SR	N5247-20009	1	A39 port 3 source attenuator to front-panel port 3 SOURCE OUT
W107	SR	N5247-20010	1	Port 3 CPLR THRU to A43 port 3 bias tee
W108	SR	N5247-20028	1	A43 port 3 bias tee to A34 port 3 coupler
W109	SR	N5247-20083	1	A31 port 4 reference coupler to A40 port 4 source attenuator

Reference Designator	Type[a]	Part Number	Qty	Description
W110	SR	N5247-20025	1	A40 port 4 source attenuator to front-panel port 4 SOURCE OUT
W111	SR	N5247-20021	1	Port 4 CPLR THRU to A44 port 4 bias tee
W112	SR	N5247-20029	1	A44 port 4 bias tee to A35 port 4 coupler
W119	SR	N5247-20008	1	Port 3 RCVR C IN to A47 port 3 receiver attenuator
W120	SR	N5247-20064	1	A47 port 3 receiver attenuator to A28 mixer brick (C)
W121	SR	N5247-20024	1	Port 4 RCVR D IN to A48 port 4 receiver attenuator
W122	SR	N5247-20065	1	A48 port 4 receiver attenuator to A28 mixer brick (D)
W129	SR	N5247-20093	1	Front-panel PORT 3 COMB ARM IN to A54 combiner
W131	SR	N5247-20032	1	A51 port 3 mechanical switch to A61 port 3 70 GHz doubler
W132	SR	N5247-20033	1	A51 port 3 mechanical switch to A30 port 3 reference coupler
W133	SR	N5247-20090	1	A51 port 3 mechanical switch to PORT 3 SW SRC OUT
W134	SR	N5247-20095	1	rear-panel PORT 3 SW TSET IN (J7) to A51 port 3 mechanical switch
W135	SR	N5247-20030	1	A52 port 4 mechanical switch to A62 port 4 70 GHz doubler
W136	SR	N5247-20031	1	A52 port 4 mechanical switch to A31 port 4 reference coupler
W137	SR	N5247-20097	1	A52 port 4 mechanical switch to PORT 4 SW SRC OUT (J4)
W138	SR	N5247-20098	1	A52 port 4 mechanical switch to PORT 4 SW TSET (J3)
W204[b]	SR	N5247-20185	1	A25 HMA26.5 to A28 mixer brick (2)

a. SR = semirigid coaxial cable; F = flexible coaxial cable

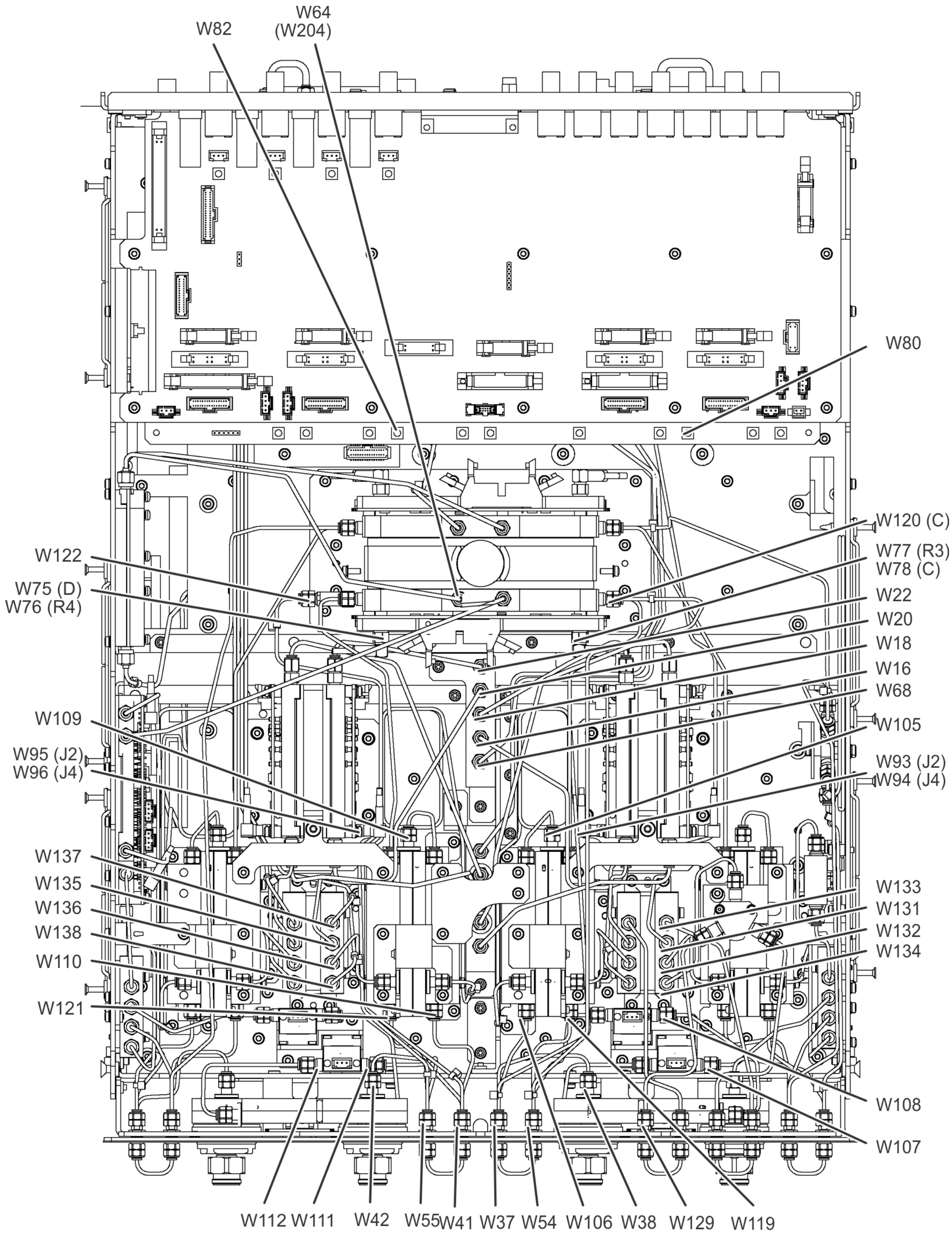
b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 “2-Port Configurations, Serial Number Prefixes <6021” on page 6-32 and “4-Port Configuration, Serial Number Prefixes <6021” on page 6-84.

Figure 6-59 Bottom RF Cables, 4-Port, Options 423 (Ports 3 and 4), S/N Prefixes ≥6201



Option 423 with 029 is shown, but similar to Option 423 without Option 029

Figure 6-60 Bottom RF Cables, 4-Port, Option 423 with Option 029 or E29 (Ports 3 and 4), S/N Prefixes ≥6201



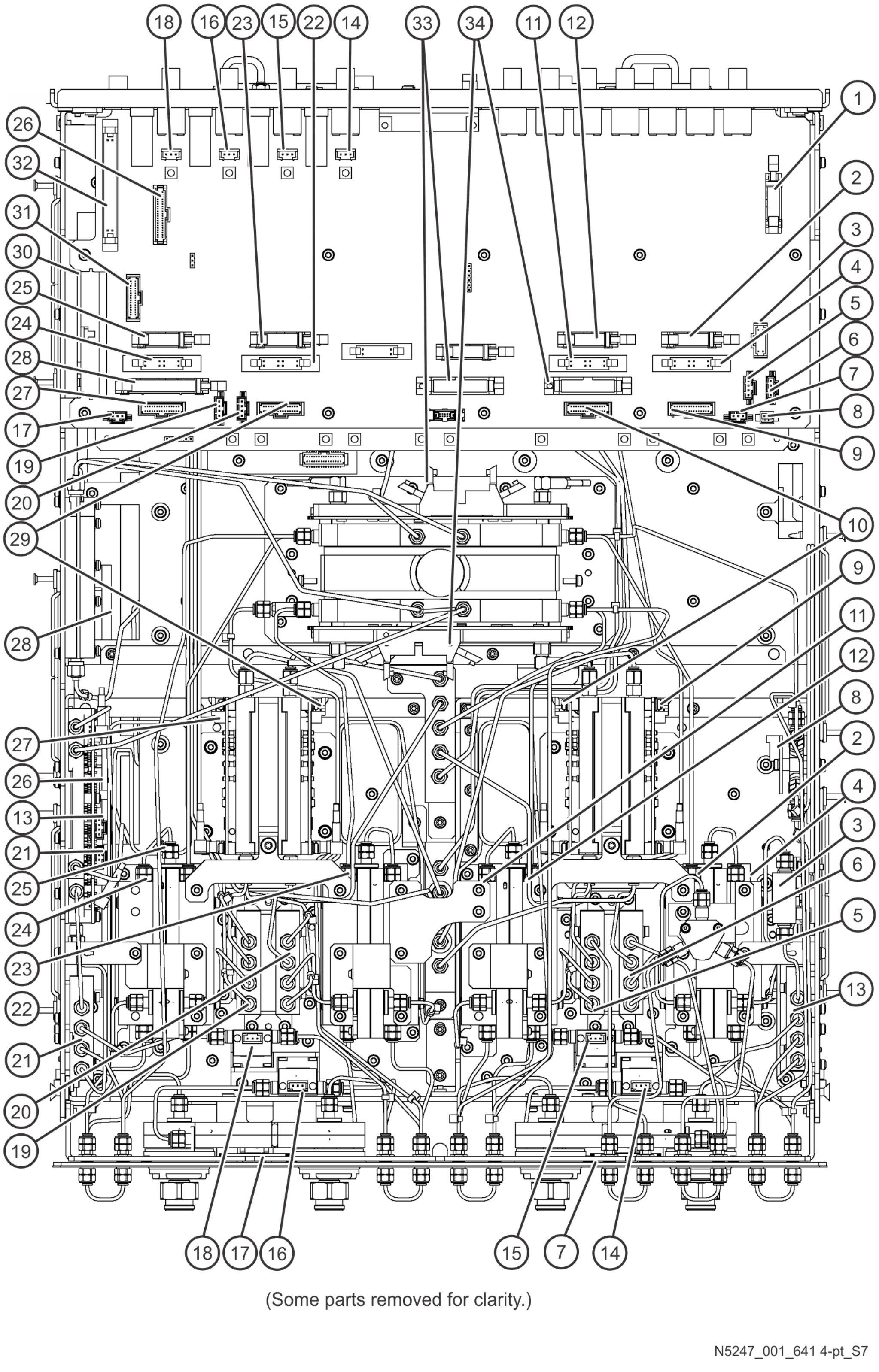
Bottom Ribbon Cables and Wire Harnesses, 4-Port, Option 423 with and without Option 029 or E29, S/N Prefixes ≥6201

Reference Designator	Type[a]	Part Number	Description
①	10R	N5242-60005	rear-panel PWR I/O to A23 test set motherboard J301
②	10R	N5247-60020	A23 test set motherboard J205 to A46 port 1 receiver attenuator
③	20R	N5245-60021	A64 tuner J9 to A23 test set motherboard J7 (Option 029 or E29 only)
④	16R	N5245-60006	A23 test set motherboard J549 to A38 port 1 source attenuator
⑤	4W	--	P/O A51 port 3 mechanical switch (to A23 test set motherboard J102). Refer to "4-Port Configuration, Option 423 with and without Option 029 or E29, S/N Prefixes ≥6201" on page 6-158.
⑥	4W	--	P/O A50 port 1 mechanical switch (to A23 test set motherboard J101). Refer to "4-Port Configuration, Option 423 with and without Option 029 or E29, S/N Prefixes ≥6201" on page 6-158.
⑦	3W	N5247-60016	A23 test set motherboard J221 to ports 1/3 LED board J1
q	2W	8121-0966	A23 test set motherboard J554 to A37 reference mixer switch
⑨	30R	N5247-60018	A60 port 1 70 GHz doubler J1 to A23 test set motherboard J4
s	30R	N5247-60018	A61 port 3 70 GHz doubler J1 to A23 test set motherboard J5
⑪	16R	N5245-60006	A23 test set motherboard J547 to A39 port 3 source attenuator
⑫	10R	N5247-60020	A23 test set motherboard J206 to A47 port 3 receiver attenuator
⑬	4W	--	P/O A56 port 1 noise bypass switch (to A59 noise receiver (downconverter) J42 port 1). Refer to "4-Port Configuration, Option 423 with and without Option 029 or E29, S/N Prefixes ≥6201" on page 6-158.
⑭	2W	N5247-60021	A23 test set motherboard J541 to A42 port 1 bias tee
⑮	2W	N5247-60021	A23 test set motherboard J543 to A43 port 3 bias tee
⑯	2W	N5247-60021	A23 test set motherboard J544 to A44 port 4 bias tee
⑰	3W	N5247-60016	A23 test set motherboard J222 to ports 2/4 LED board J1
⑱	2W	N5247-60021	A23 test set motherboard J542 to A45 port 2 bias tee (Option 029 or E29
⑲	4W	--	P/O A53 port 2 mechanical switch (to A23 test set motherboard J104). Refer to "4-Port Configuration, Option 423 with and without Option 029 or E29, S/N Prefixes ≥6201" on page 6-158.
⑳	4W	--	P/O A52 port 4 mechanical switch (to A23 test set motherboard J103). Refer to "4-Port Configuration, Option 423 with and without Option 029 or E29, S/N Prefixes ≥6201" on page 6-158.
㉑	4W	--	P/O A57 port 2 noise bypass switch (to A59 noise receiver (downconverter) J41 port 2). Refer to "4-Port Configuration, Option 423 with and without Option 029 or E29, S/N Prefixes ≥6201" on page 6-158. (Option 029 or E29 only)
㉒	16R	N5245-60006	A23 test set motherboard J548 to A40 port 4 source attenuator

Reference Designator	Type[a]	Part Number	Description
㉓	10R	N5247-60020	A23 test set motherboard J207 to A48 port 4 receiver attenuator
㉔	16R	N5245-60006	A23 test set motherboard J546 to A41 port 2 source attenuator
㉕	10R	N5247-60020	A23 test set motherboard J208 to A49 port 2 receiver attenuator
㉖	40R	N5245-60018	A59 noise receiver (downconverter) J1 to A23 test set motherboard J548 (Option 029 or E29 only)
㉗	30R	N5247-60018	A63 port 2 70 GHz doubler J1 to A23 test set motherboard J6
㉘	24R	N5247-60022	A23 test set motherboard J209 to A25 HMA26.5 J1
㉙	30R	N5247-60018	A62 port 4 70 GHz doubler J1 to A23 test set motherboard J3
㉚	100R	N5242-60004	A18 system motherboard J1 to A23 test set motherboard J1 to A24 IF multiplexer board J1
㉛	25R	E4410-60160	A18 system motherboard J13 to A23 test set motherboard J545
㉜	36R	8121-0834	rear-panel HANDLER I/O to A23 test set motherboard J400
㉝	20R	N5247-60014	A23 test set motherboard J551 to A27 mixer brick (1) J52
㉞	20R	N5247-60015	A23 test set motherboard J552 to A28 mixer brick (2) J52

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

Figure 6-61 Bottom Ribbon Cables and Wire Harnesses, 4-Port, Option 423 with and without Option 029 or E29, S/N Prefixes ≥6201



(Some parts removed for clarity.)

Cables 3, 18, 21, and 26 apply only with Option 029 or E29.

4-Port Configuration, Option 425 with and without 029 or E29, S/N Prefixes ≥6021

Bottom Assemblies, 4-Port, Option 425 with and without 029 or E29, S/N Prefixes ≥6021

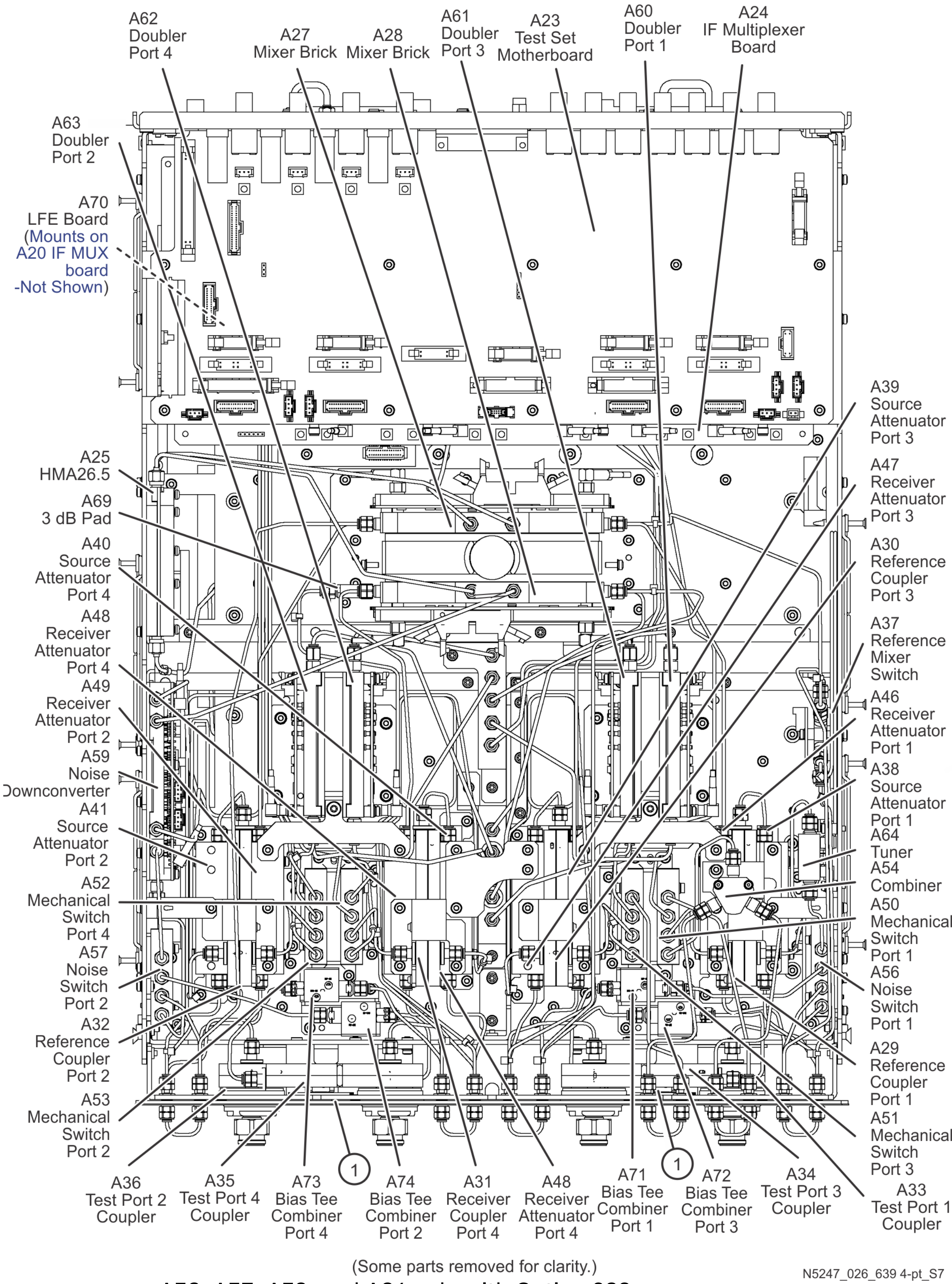
Reference Designator	Part Number[a]	Qty	Description
A23	N5245-60157 Was N5247-60001	1	Test set motherboard
A24	N5240-60062[b] Was: N5240-60045	1	IF multiplexer board
A25	N5240-60101 Was: 5087-7765	1	LO Multiplier/amplifier 26.5 (HMA26.5)
A27 A28	5087-7337	2	Mixer brick
A29 A30 A31 A32	5087-7744	4	Test port 1 reference coupler Test port 3 reference coupler Test port 4 reference coupler Test port 2 reference coupler
A33 A34 A35 A36	5087-7778	4	Test port 1 coupler Test port 3 coupler Test port 4 coupler Test port 2 coupler
A37	5087-7759	1	Reference mixer switch
A38 A39 A40 A41	84905-60004 was: 84905-60002	4	Test port 1 source attenuator Test port 3 source attenuator Test port 4 source attenuator Test port 2 source attenuator
A46 A47 A48 A49	84905-60004 was: 84905-60002	4	Port 1 receiver attenuator Port 3 receiver attenuator Port 4 receiver attenuator Port 2 receiver attenuator
A50 A51 A52 A53	N1811-60010	6	Port 1 mechanical switch Port 3 mechanical switch Port 4 mechanical switch Port 2 mechanical switch
A54	11667-60016	1	Combiner
A56 A57	N1811-60010	2	Port 1 noise bypass switch Port 2 noise bypass switch
A59	5087-7464	1	67 GHz noise receiver (downconverter) (Option E29 only)
	5087-7344		50 GHz noise receiver (downconverter) (Option 029 only)

Reference Designator	Part Number[a]	Qty	Description
A60 A61 A62 A63	5087-7336	4	70 GHz doubler assembly port 1 70 GHz doubler assembly port 3 70 GHz doubler assembly port 4 70 GHz doubler assembly port 2
A64	5087-7345	1	Tuner
A69	08490-60037	1	3-dB attenuator (A28 mixer brick (R1)
A70	N5291-60001	1	LFE board
A71	5087-7403	4	Bias combiner port 1 (includes wire harness)
A72			Bias combiner port 3 (includes wire harness)
A73			Bias combiner port 4 (includes wire harness)
A74			Bias combiner port 2 (includes wire harness)
①	N5240-60058	2	front-panel LED board

a. Part numbers in italic typeface are for rebuilt exchange assemblies. Refer to “Rebuilt-Exchange Assemblies” on page 6-4.

b. All new units built after August 2009, no longer use the N5242-60031 cable that was attached to connector P1001 and Source 2. As a result of this change, the IF multiplexer boards have had their P1001 connectors removed. If your instrument contains a N5242-60031 cable, remove it from your instrument.

Figure 6-62 Bottom Assemblies, 4-Port, Option 425 with and without Option 029 or E29, S/N Prefixes ≥6021



A56, A57, A59, and A64 only with Option 029.

Bottom RF Cables, 4-Port, Option 425 with and without Option 029 or E29 (Ports 1 and 2), S/N Prefixes ≥6021

Reference Designator	Type[a]	Part Number	Qty	Description
W12	SR	N5247-20059	1	A60 port 1 70 GHz doubler to W11
W14	SR	N5247-20072	1	A60 port 1 70 GHz doubler to W13
W24	SR	N5247-20061	1	A63 port 2 70 GHz doubler to W23
W26	SR	N5247-20051	1	A63 port 2 70 GHz doubler to W25
W34	SR	N5247-20082	1	A33 port 1 coupler to front-panel port 1 CPLR ARM
W46	SR	N5247-20019	1	A36 port 2 coupler to front-panel port 2 CPLR ARM
W51	SR	N5247-20011	1	A37 reference mixer switch to front-panel REF 1 SOURCE OUT
W52	SR	N5247-20012	1	REF 1 RCVR R1 IN to A37 reference mixer switch
W53	SR	N5247-20048	1	A37 reference mixer switch to A27 mixer brick (R1)
W60	SR	N5247-20107	14	front-panel jumper
W61	SR	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W62[b]	SR	N5247-20111	1	A25 HMA26.5 to A26 splitter
W63[b]	SR	N5245-20023	1	RF cable, A26 splitter to A27 mixer brick
W66	SR	N5247-20109	1	W65 to rear-panel EXT TSET DRIVE RF OUT (J6)
W69	SR	N5247-20112	1	A27 mixer brick to EXT TSET DRIVE LO OUT (J5)
W70[c]	SR	N5247-20100	1	A25 HMA26.5 to A27 mixer brick (1)
W71	F	N5242-60017	1	A27 mixer brick (A) to A24 IF multiplexer (P1)
W72	F	N5242-60021	1	A27 mixer brick (R1) to A24 IF multiplexer (P411)
W73	F	N5242-60022	1	A27 mixer brick (R2) to A24 IF multiplexer (P412)
W74	F	N5242-60018	1	A27 mixer brick (B) to A24 IF multiplexer (P201)
W79, 81, 83	F	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28.		
W91	F	N5247-60006	1	A60 port 1 70 GHz doubler J2 to A7 40 GHz doubler J401
W92	F	N5247-60007	1	A60 port 1 70 GHz doubler J4 to A7 40 GHz doubler J500
W97	F	N5247-60008	1	A63 port 2 70 GHz doubler J2 to A8 40 GHz doubler J401
W98	F	N5247-60009	1	A63 port 2 70 GHz doubler J4 to A8 40 GHz doubler J500
W101	SR	N5247-20083	1	A29 port 1 reference coupler to A38 port 1 source attenuator
W102	SR	N5247-20014	1	A38 port 1 source attenuator to front-panel port 1 SOURCE OUT
W113	SR	N5247-20083	1	A32 port 2 reference coupler to A41 port 2 source attenuator
W114	SR	N5247-20034	1	A41 port 2 source attenuator to front-panel port 2 SOURCE OUT
W117	SR	N5247-20013	1	Front-panel port 1 RCVR A IN to A46 port 1 receiver attenuator
W118	SR	N5247-20047	1	A46 port 1 receiver attenuator to A27 mixer brick (A)

Reference Designator	Type[a]	Part Number	Qty	Description
W123	SR	N5247-20020	1	Port 2 RCVR B IN to A49 port 2 receiver attenuator
W124	SR	N5247-20046	1	A49 port 2 receiver attenuator to A27 mixer brick (B)
W125	SR	N5247-20030	1	A50 port 1 mechanical switch to A60 port 1 70 GHz doubler
W126	SR	N5247-20031	1	A50 port 1 mechanical switch to A29 port 1 reference coupler
W127	SR	N5247-20091	1	A50 port 1 mechanical switch to PORT 1 SW SRC OUT
W128	SR	N5247-20092	1	Front-panel PORT 1 COMB THRU IN to A54 combiner
W130	SR	N5247-20094	1	A50 port 1 mechanical switch to A54 combiner
W139	SR	N5247-20032	1	A53 port 2 mechanical switch to A63 port 2 70 GHz doubler
W140	SR	N5247-20033	1	A53 port 2 mechanical switch to A32 port 2 reference coupler
W141	SR	N5247-20099	1	A53 port 2 mechanical switch to PORT 2 SW SRC OUT (J2)
W142	SR	N5247-20089	1	A53 port 2 mechanical switch to PORT 2 TSET IN (J1)
W143	SR	N5247-20107	2	rear-panel jumper
W144	SR	N5247-20071	1	A29 port 1 reference coupler to A37 reference mixer switch
W145	SR	N5247-20066	1	REF 2 RCVR R2 IN to A27 mixer brick (R2)
W146	SR	N5247-20058	1	A32 port 2 ref coupler to front-panel REF 2 SOURCE OUT
W163	SR	N5247-20117	1	A64 tuner to A56 port 1 noise bypass switch (Option 029 or E29 only)
W164	SR	N5247-20118	1	A64 tuner to A56 port 1 noise bypass switch (Option 029 or E29 only)
W165	SR	N5247-20119	1	Front-panel port 1 CPLR THRU to A56 port 1 noise bypass switch (Option 029 or E29 only)
W166	SR	N5247-20124	1	Front-panel port 2 CPLR THRU to A57 port 2 noise bypass switch (Option 029 or E29 only)
W168	SR	N5247-20121	1	A59 noise receiver (downconverter) to A57 port 2 noise bypass switch (Option 029 or E29 only)
W169	SR	N5247-20122	1	A59 noise receiver (downconverter) to A57 port 2 noise bypass switch (Option 029 or E29 only)
W171, W172, W173	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28. (Option 029 or E29 only)			
W174	SR	N5247-20143	1	A59 noise receiver (downconverter) to A28 mixer brick (Option 029
W175	Refer to "Top Cables, All Cables—All Options, S/N Prefixes ≥6021" on page 6-28. (Option 029 or E29 only)			
W181	SR	N5247-20167	1	Cable, assy-RF, FP port 1 CPLR THRU to A71 port 1 bias combiner (Option 425 only withOUT Option 029 or E29)
W182	SR	N5247-20162	1	Cable, assy-RF, A71 Bias T combiner-A33 Coupler FP, Port 1
W187	SR	N5247-20163	1	Cable, assy-RF, FP port 2 CPLR THRU to A74 bias combiner (Option 425 only)

Reference Designator	Type[a]	Part Number	Qty	Description
W188	SR	N5247-20169	1	Cable, assy-RF, A74 Bias combiner–A36 test port coupler FP, Port 2
W189	SR	N5247-20172	1	Cable, assy-RF, A56 noise bypass SW- A70 Bias combiner, Port 1 (Option 029 or E29 only)
W190	SR	N5247-20173	1	Cable, assy-RF, A57 noise bypass SW- A74 Bias combiner, Port 2 (Option 029 or E29 only)
W208 & W210	SR	Refer to “Top Cables, All Cables—All Options, S/N Prefixes ≥6021” on page 6-28.		
W194	F	N5240-60097	2	Cable (long), assy, coaxial LFE, RF (Port 2 bias combiner “RF-IN” to “Port2” A70 LFE board)
W197				Cable (long), assy, coaxial LFE, RF (Port 1 bias combiner “RF-IN” to “Port1” A70 LFE board)
W211	F	8120-5014	1	RF cable, A70 LFE J14 to A24 IF Multiplexer P4
W212	F	8120-5017	1	RF cable, A70 LFE J13 to A24 IF Multiplexer P204
W213	F	8120-5014	1	RF cable, A70 LFE J7 to A24 IF Multiplexer P404
W214	F	8120-5017	1	RF cable, A70 LFE J7 to A24 IF Multiplexer P404
W215	F	8120-5017	1	RF cable, A70 LFE J11 to A24 IF Multiplexer P804

a. SR = semirigid coaxial cable; F = flexible coaxial cable

b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 “2-Port Configurations, Serial Number Prefixes <6021” on page 6-32 and “4-Port Configuration, Serial Number Prefixes <6021” on page 6-84.

c. On legacy instruments using the 5087-7765 HMA26.5, the N5245-20100 cable is used only on 2-port instruments. On instruments with a new HMA26.5 the N5245-20100 cable is used in all instruments. If you are unclear which HMA26.5 assembly your PNA has installed, refer to “Verify the Model/Version of HMA26.5 Installed” on page 7-40 and to Figure 7-17 on page 40.

Figure 6-63 Bottom RF Cables, 4-Port, Options 425 (Ports 1 and 2), S/N Prefixes ≥6021

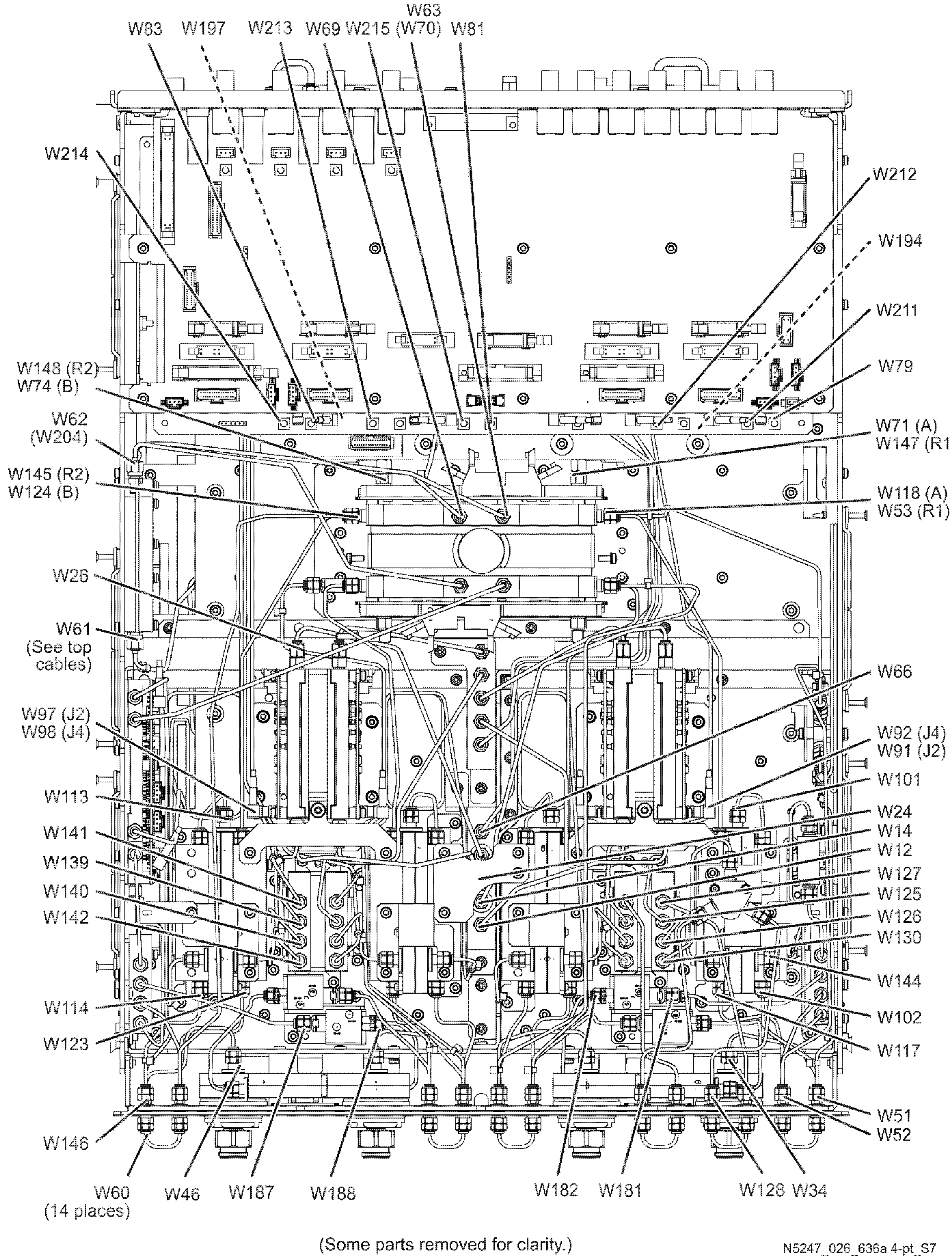
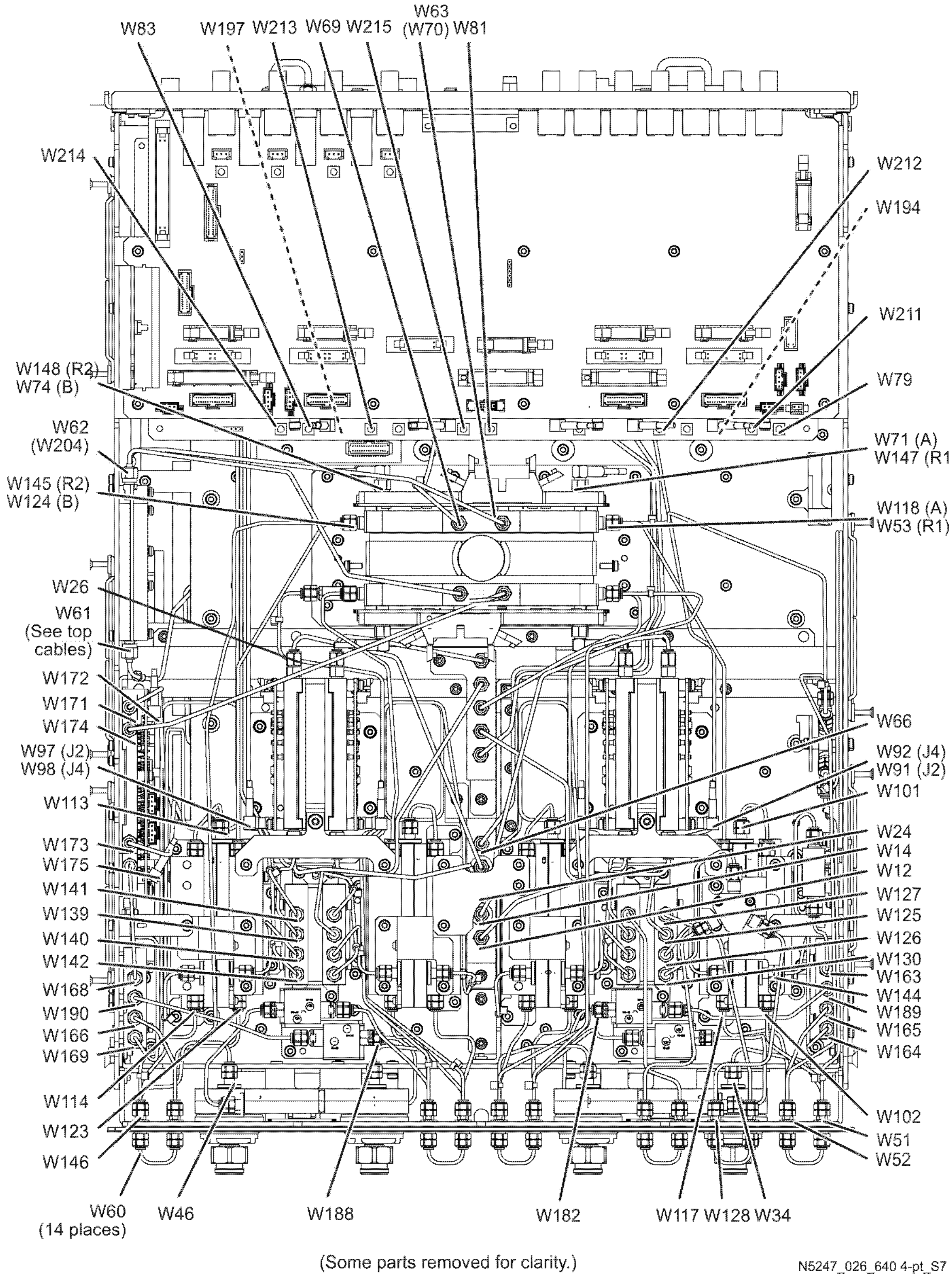


Figure 6-64 Bottom RF Cables, 4-Port, Option 425 with Option 029 or E29 (Ports 1 and 2), S/N Prefixes ≥6021



Bottom RF Cables, 4-Port, Option 425 with and without Option 029 or E29 (Ports 3 and 4), S/N Prefixes ≥6021

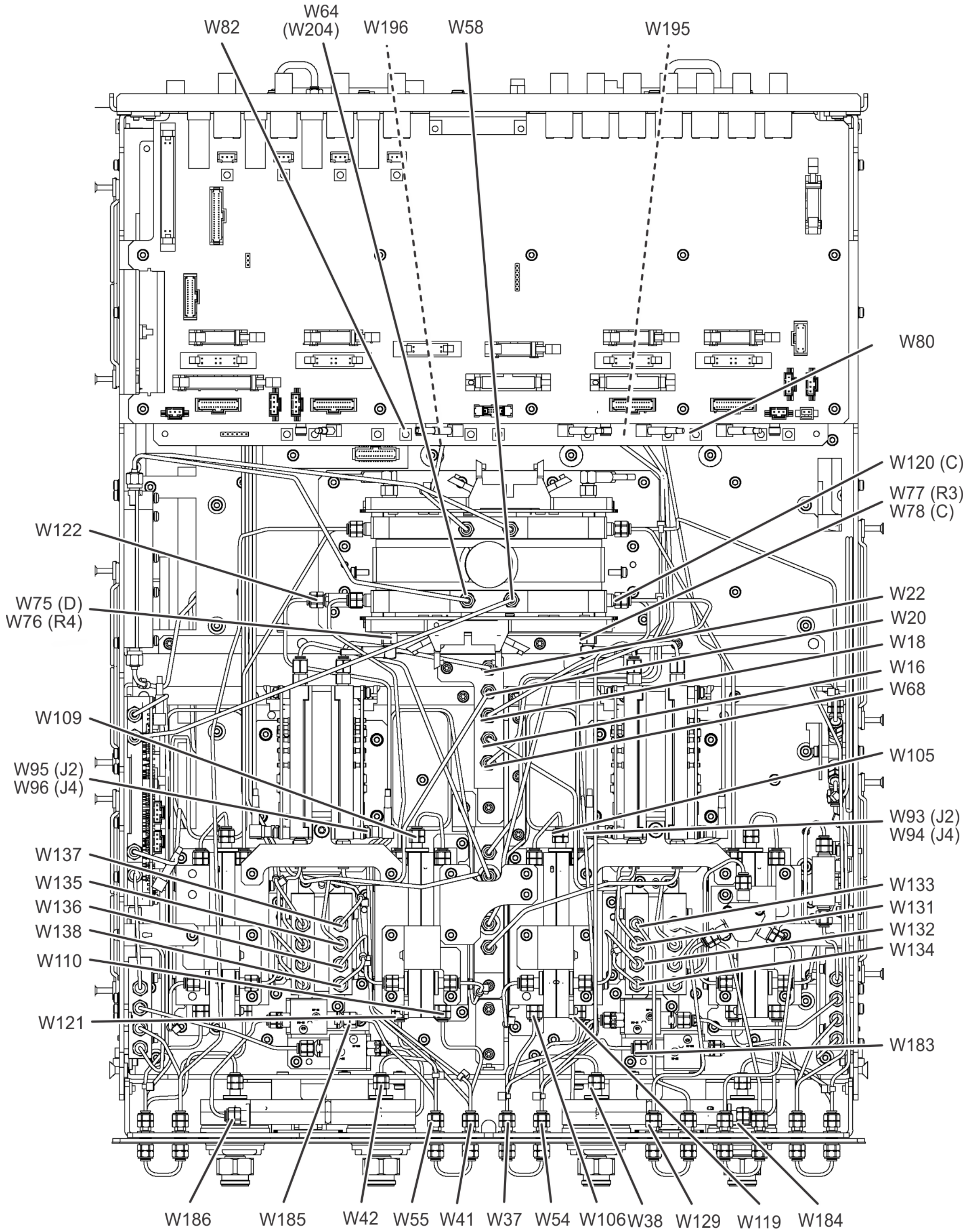
Reference Designator	Type[a]	Part Number	Qty	Description
W16	SR	N5247-20060	1	A61 port 3 70 GHz doubler to W15
W18	SR	N5247-20084	1	A61 port 3 70 GHz doubler to W17
W20	SR	N5247-20015	1	A62 port 4 70 GHz doubler to W19
W22	SR	N5247-20068	1	A62 port 4 70 GHz doubler to W21
W37	SR	N5247-20070	1	A30 port 3 ref coupler to front-panel REF 3 SOURCE OUT
W38	SR	N5247-20007	1	A34 port 3 coupler to front-panel port 3 CPLR ARM
W41	SR	N5247-20069	1	A31 port 4 ref coupler to front-panel REF 4 SOURCE OUT
W42	SR	N5247-20026	1	A35 port 4 coupler to front-panel port 4 CPLR ARM
W54	SR	N5247-20062	1	REF 3 RCVR R3 IN to A28 mixer brick (R3)
W55	SR	N5247-20067	1	REF 4 RCVR R4 IN to A28 mixer brick (R4)
W64[b]	SR	N5245-20022	1	A26 splitter to A28 mixer brick
W68	SR	N5247-20088	1	rear-panel port RF2 OUT (J12) to W67
W75	F	N5242-60024	1	A28 mixer brick (D) to A24 IF multiplexer (P801)
W76	F	N5242-60019	1	A28 mixer brick (R4) to A24 IF multiplexer (P414)
W77	F	N5242-60020	1	A28 mixer brick (R3) to A24 IF multiplexer (P413)
W78	F	N5242-60023	1	A28 mixer brick (C) to A24 IF multiplexer (P601)
W80	F	N5242-60013	1	A24 IF multiplexer board P203 to A16 SPAM board J2
W82	F	N5242-60015	1	A24 IF multiplexer board P603 to A16 SPAM board J5
W93	F	N5247-60010	1	A61 port 3 70 GHz doubler J2 to A12 40 GHz doubler J401
W94	F	N5247-60011	1	A61 port 3 70 GHz doubler J4 to A12 40 GHz doubler J500
W95	F	N5247-60012	1	A62 port 4 70 GHz doubler J2 to A13 40 GHz doubler J401
W96	F	N5247-60013	1	A62 port 4 70 GHz doubler J4 to A13 40 GHz doubler J500
W105	SR	N5247-20083	1	A30 port 3 reference coupler to A39 port 3 source attenuator
W106	SR	N5247-20009	1	A39 port 3 source attenuator to front-panel port 3 SOURCE OUT
W109	SR	N5247-20083	1	A31 port 4 reference coupler to A40 port 4 source attenuator
W110	SR	N5247-20025	1	A40 port 4 source attenuator to front-panel port 4 SOURCE OUT
W119	SR	N5247-20008	1	Port 3 RCVR C IN to A47 port 3 receiver attenuator
W120	SR	N5247-20064	1	A47 port 3 receiver attenuator to A28 mixer brick (C)

Reference Designator	Type[a]	Part Number	Qty	Description
W121	SR	N5247-20024	1	Port 4 RCVR D IN to A48 port 4 receiver attenuator
W122	SR	N5247-20065	1	A48 port 4 receiver attenuator to A28 mixer brick (D)
W129	SR	N5247-20093	1	Front-panel PORT 3 COMB ARM IN to A54 combiner
W131	SR	N5247-20032	1	A51 port 3 mechanical switch to A61 port 3 70 GHz doubler
W132	SR	N5247-20033	1	A51 port 3 mechanical switch to A30 port 3 reference coupler
W133	SR	N5247-20090	1	A51 port 3 mechanical switch to PORT 3 SW SRC OUT
W134	SR	N5247-20095	1	rear-panel PORT 3 SW TSET IN (J7) to A51 port 3 mechanical switch
W135	SR	N5247-20030	1	A52 port 4 mechanical switch to A62 port 4 70 GHz doubler
W136	SR	N5247-20031	1	A52 port 4 mechanical switch to A31 port 4 reference coupler
W137	SR	N5247-20097	1	A52 port 4 mechanical switch to PORT 4 SW SRC OUT (J4)
W138	SR	N5247-20098	1	A52 port 4 mechanical switch to PORT 4 SW TSET (J3)
W183	SR	N5247-20170	1	Cable, assy-RF FP, COUP THRU to A72 bias combiner, port 3
W184	SR	N5247-20164	1	Cable, assy-RF FP A34 port 3 test port coupler to A72 bias combiner, port 3
W185	SR	N5247-20165	1	Cable, assy-RF FP, COUP THRU to A73 bias combiner, port 4
W186	SR	N5247-20171	1	Cable, assy-RF, FP A35 port 4 test port coupler to A73 bias combiner, port 4
W195	F	N5240-60097	1	Cable (long), assy, coaxial LFE, RF (Port 3 bias combiner “RF-IN” to “Port3” A70 LFE board)
W196	F			Cable (long), assy, coaxial LFE, RF (Port 4 bias combiner “RF-IN” to “Port4” A70 LFE board)
W209	SR	Refer to “Top Cables, All Cables—All Options, S/N Prefixes ≥6021” on page 6-28.		

a. SR = semirigid coaxial cable; F = flexible coaxial cable

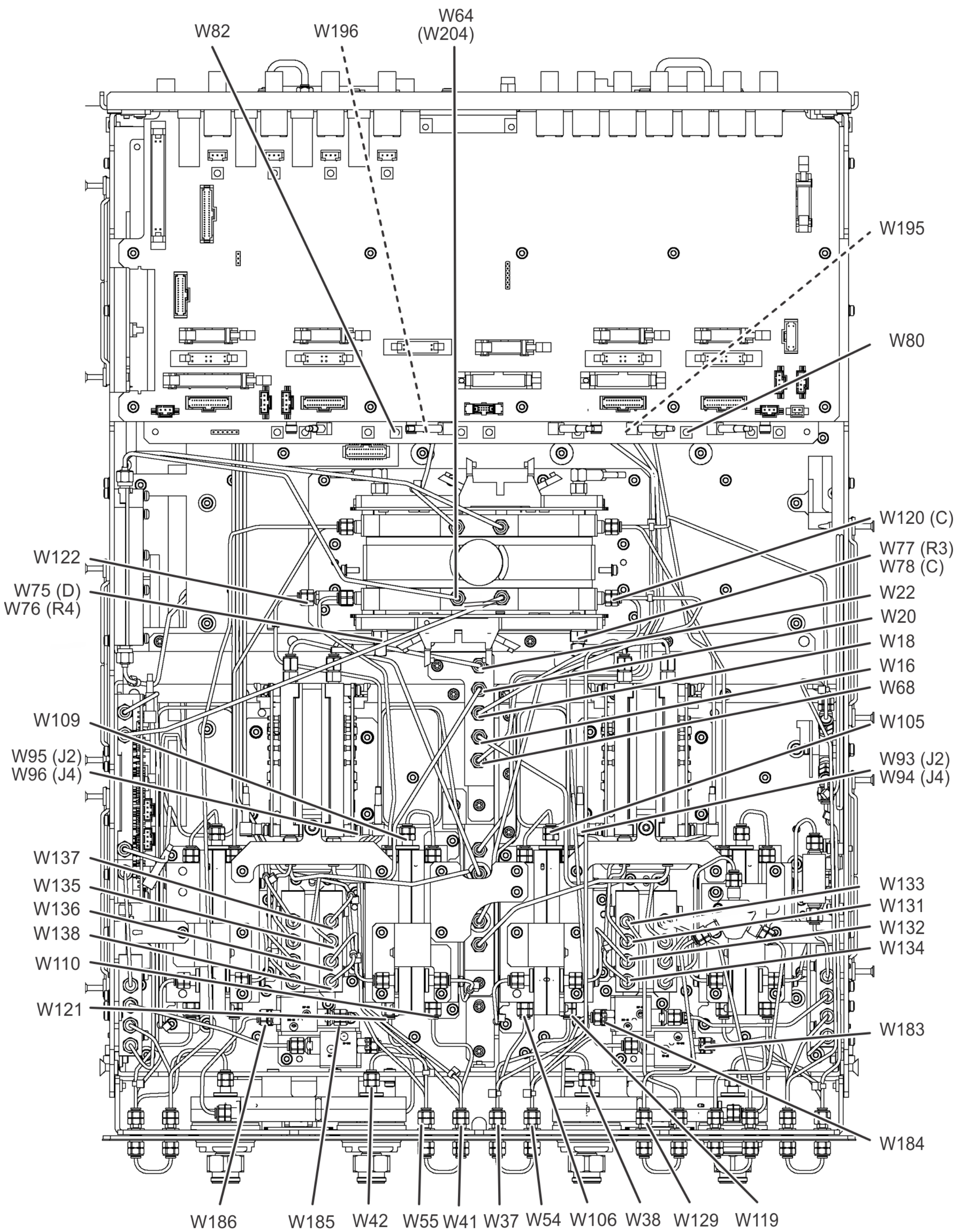
b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 “2-Port Configurations, Serial Number Prefixes <6021” on page 6-32 and “4-Port Configuration, Serial Number Prefixes <6021” on page 6-84.

Figure 6-65 Bottom RF Cables, 4-Port, Options 425 (Ports 3 and 4), S/N Prefixes ≥6021



(Some parts removed for clarity.)

Figure 6-66 Bottom RF Cables, 4-Port, Option 425 with Option 029 or E29 (Ports 3 and 4), S/N Prefixes ≥6021



(Some parts removed for clarity.)

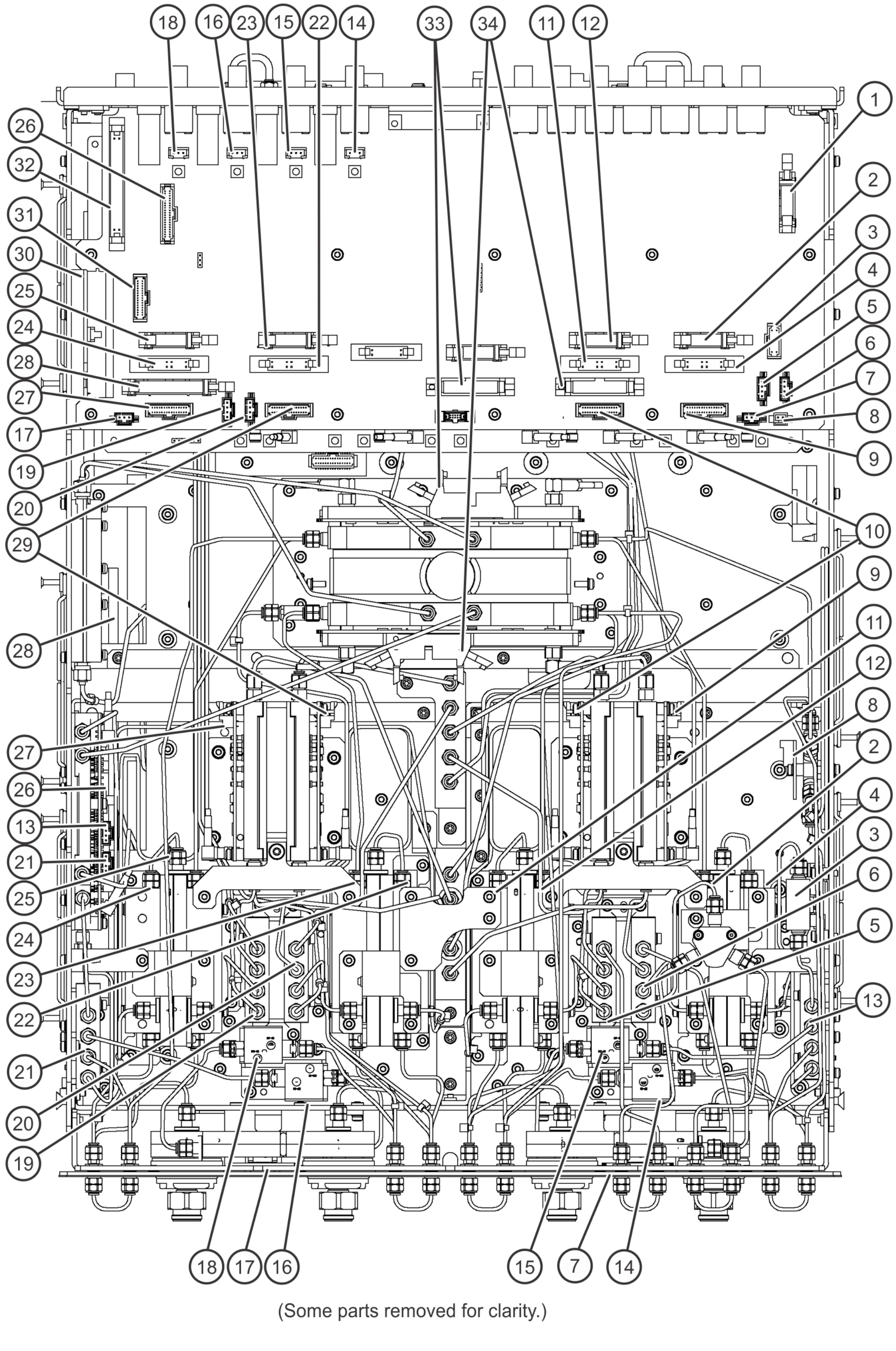
Bottom Ribbon Cables and Wire Harnesses, 4-Port, Options 425/029, S/N Prefixes ≥6021

Reference Designator	Type[a]	Part Number	Description
①	10R	N5242-60005	rear-panel PWR I/O to A23 test set motherboard J301
②	10R	N5247-60020	A23 test set motherboard J205 to A46 port 1 receiver attenuator
③	20R	N5245-60021	A64 tuner J9 to A23 test set motherboard J7 (Option 029 or E29 only)
④	16R	N5245-60006	A23 test set motherboard J549 to A38 port 1 source attenuator
⑤	4W	--	P/O A51 port 3 mechanical switch (to A23 test set motherboard J102). Refer to "4-Port Configuration, Option 425 with and without 029 or E29, S/N Prefixes ≥6021" on page 6-174.
⑥	4W	--	P/O A50 port 1 mechanical switch (to A23 test set motherboard J101). Refer to "4-Port Configuration, Option 425 with and without 029 or E29, S/N Prefixes ≥6021" on page 6-174.
⑦	3W	N5247-60016	A23 test set motherboard J221 to ports 1/3 LED board J1
⑧	2W	8121-0966	A23 test set motherboard J554 to A37 reference mixer switch"4-Port Configuration, Option 425 with and without 029 or E29, S/N Prefixes ≥6021" on page 6-174
⑨	30R	N5247-60018	A60 port 1 70 GHz doubler J1 to A23 test set motherboard J4
⑩	30R	N5247-60018	A61 port 3 70 GHz doubler J1 to A23 test set motherboard J5
⑪	16R	N5245-60006	A23 test set motherboard J547 to A39 port 3 source attenuator
⑫	10R	N5247-60020	A23 test set motherboard J206 to A47 port 3 receiver attenuator
⑬	4W	--	P/O A56 port 1 noise bypass switch (to A59 noise receiver (downconverter) J42 port 1). Refer to "4-Port Configuration, Option 425 with and without 029 or E29, S/N Prefixes ≥6021" on page 6-174.
⑭	2W	N5240-60091 P/O Bias combiners	A19 test set motherboard J541 to A71 port 1 bias tee combiner
⑮	2W		A19 test set motherboard J543 to A72 port 3 bias tee combiner
⑯	2W		A19 test set motherboard J544 to A73 port 4 bias tee combiner
⑰	3W	N5247-60016	A23 test set motherboard J222 to ports 2/4 LED board J1
⑱	2W	N5240-60091 P/O Bias	A19 test set motherboard J542 to A74 port 2 bias tee combiner
⑲	4W	--	P/O A53 port 2 mechanical switch (to A23 test set motherboard J104). Refer to "4-Port Configuration, Option 423 with and without Option 029 or E29, S/N Prefixes ≥6201" on page 6-158.
⑳	4W	--	P/O A52 port 4 mechanical switch (to A23 test set motherboard J103). Refer to "4-Port Configuration, Option 423 with and without Option 029 or E29, S/N Prefixes ≥6201" on page 6-158.

Reference Designator	Type[a]	Part Number	Description
㉑	4W	--	P/O A57 port 2 noise bypass switch (to A59 noise receiver (downconverter) J41 port 2). Refer to "4-Port Configuration, Option 423 with and without Option 029 or E29, S/N Prefixes ≥6201" on page 6-158. (Option 029 or E29 only)
㉒	16R	N5245-60006	A23 test set motherboard J548 to A40 port 4 source attenuator
㉓	10R	N5247-60020	A23 test set motherboard J207 to A48 port 4 receiver attenuator
㉔	16R	N5245-60006	A23 test set motherboard J546 to A41 port 2 source attenuator
㉕	10R	N5247-60020	A23 test set motherboard J208 to A49 port 2 receiver attenuator
㉖	40R	N5245-60018	A59 noise receiver (downconverter) J1 to A23 test set motherboard J548 (Option 029 or E29 only)
㉗	30R	N5247-60018	A63 port 2 70 GHz doubler J1 to A23 test set motherboard J6
㉘	24R	N5247-60022	A23 test set motherboard J209 to A25 HMA26.5 J1
㉙	30R	N5247-60018	A62 port 4 70 GHz doubler J1 to A23 test set motherboard J3
㉚	100R	N5242-60004	A18 system motherboard J1 to A23 test set motherboard J1 to A24 IF multiplexer board J1
㉛	25R	E4410-60160	A18 system motherboard J13 to A23 test set motherboard J545
㉜	36R	8121-0834	rear-panel HANDLER I/O to A23 test set motherboard J400
㉝	20R	N5247-60014	A23 test set motherboard J551 to A27 mixer brick (1) J52
㉞	20R	N5247-60015	A23 test set motherboard J552 to A28 mixer brick (2) J52

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

Figure 6-67 Bottom Ribbon Cables and Wire Harnesses, 4-Port, Option 425 with and without Option 029 or E29, S/N Prefixes ≥6021



Cables 3, 13, 21, and 26 apply only with Option 029 or E29.

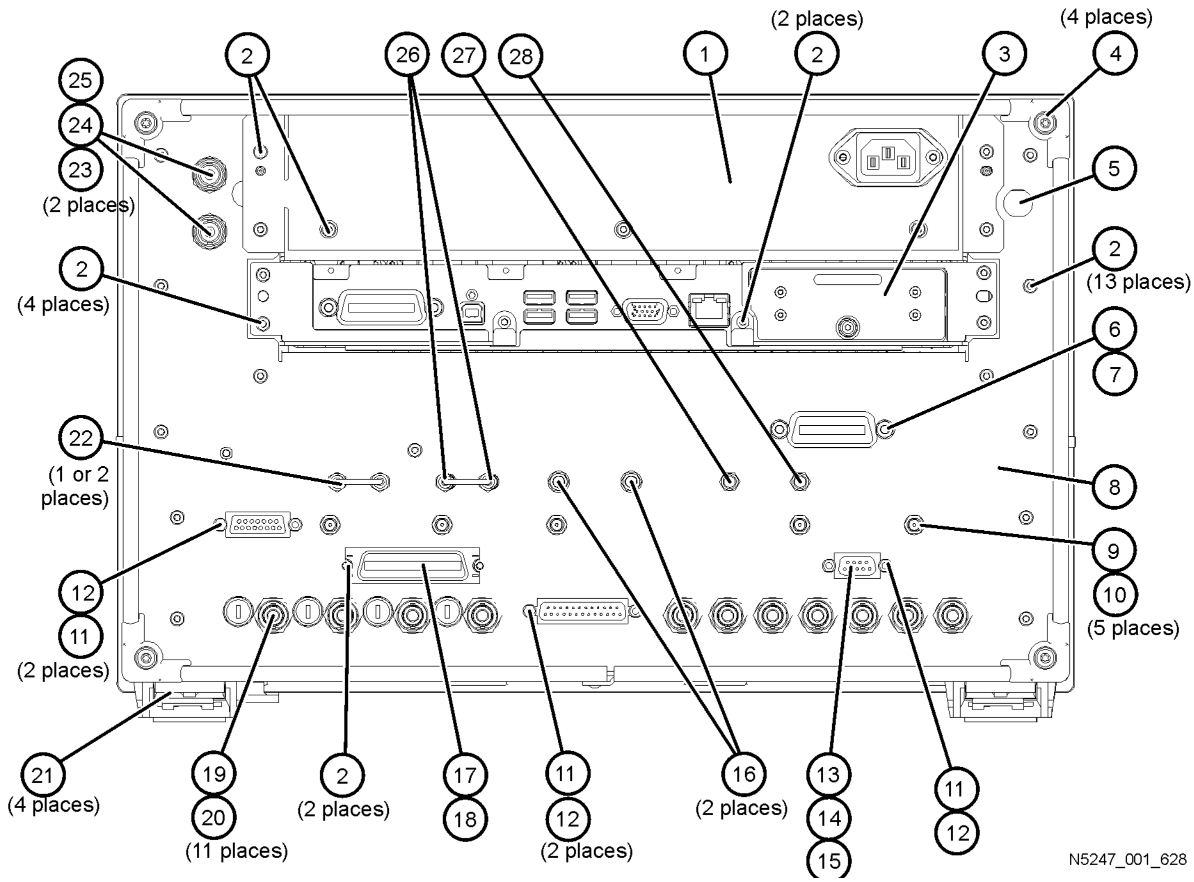
Rear-Panel Assembly, All Options

Item Number	Part Number	Qty	Description
①	N5240-00012	1	Power supply bracket, rear-panel
②	0515-0372	--	Machine screw, M3.0 x 8, pan head (To attach: CPU assy to ejector arms and left and right side inner brackets; rear-panel to chassis; power supply bracket to the power supply and rear-panel; handler I/O cable to rear-panel; test set deck to rear-panel.)
③	Solid state drive (SSD). Refer to "Top Assemblies and Cables, All Options, Serial Number Prefixes <6021" on page 6-18 and "Top Assemblies and Cables, All Options, Serial Number Prefixes ≥6021" on page 6-24 for part number.		
④	Rear foot and screw (Refer to "External Hardware and Miscellaneous Parts, All Options" on page 6-203.)		
⑤	6960-0149	1	Hole plug
⑥	2190-0958 Was 2190-0034	--	Lock washer
⑦	0380-0644	--	Jack screw
⑧	N5247-00010	1	rear-panel
⑨	3050-2330	--	Lock washer (For A24 IF MUX board connectors.)
⑩	2950-0414	--	Hex nut (For A24 IF MUX board connectors.)
⑪	2190-0584	--	Lock washer
⑫	0380-4670	--	Jack screw, 0.442 inch length
	1251-7812	--	Jack screw, 0.5 inch length
⑬	N5242-60005	1	PWR I/O cable assembly
⑭	1253-8234[a]	1	Connector-D-subminiature filter adapter
⑮	9170-2235[a]	1	Ferrite for ribbon cable N5242-60005
⑯	1250-4261 Was: 1810-0118	3	Termination, 50 ohm load (2 used for Option 201. 219; 3 used for Option 224, 400, 419, 423)
⑰	8121-0834	1	HANDLER I/O cable assembly
⑱	9170-2236[a]	1	Ferrite for ribbon cable 8121-0834
⑲	2190-0068	--	Lock washer (for rear-panel BNC connectors)
⑳	2950-0054	--	Hex nut (for rear-panel BNC connectors)

Item Number	Part Number	Qty	Description
㉑	Bottom foot (Refer to "External Hardware and Miscellaneous Parts, All Options" on page 6-203.)		
㉒	rear-panel jumper (1 used for Option 224; 2 used for Option 423) (Refer to "Bottom RF Cables, 4-Port, Option 423 with and without 029 (Ports 1 and 2), S/N Prefixes <6201" on page 6-108, "2-Port Configuration, Option 224 with and without Option 029, S/N Prefixes <6201" on page 6-46, "Bottom RF Cables, 4-Port, Option 423 with and without 029 or E29 (Ports 1 and 2), S/N Prefixes ≥6201" on page 6-162, or "2-Port Configuration, Option 224 with and without Option 029/E29, S/N Prefixes ≥6201" on page 6-72.)		
㉓	2190-0102	--	Lock washer (for 8120-5063 BNC cable)
㉔	2950-0035	--	Hex nut (for 8120-5063 BNC cable)
㉕	8120-5063	2	BNC cable
㉖	6960-0523	5	Hole plug (2 used for Option 224; 5 used for Option 201, 219, 400, and 419; none used for Option 423.)
㉗	6960-0076	1	Hole plug (1 used for Option 201 and 219)
㉘	0955-2394 Was N5247-20138	1	Termination, 2.4 mm 50 GHz load (1 used for Option 224 and 423)

a. This part number is no longer required on s/n's 5541, 5542, 5544, 5545, 5547, 5549 and newer. But, is included for your reference.

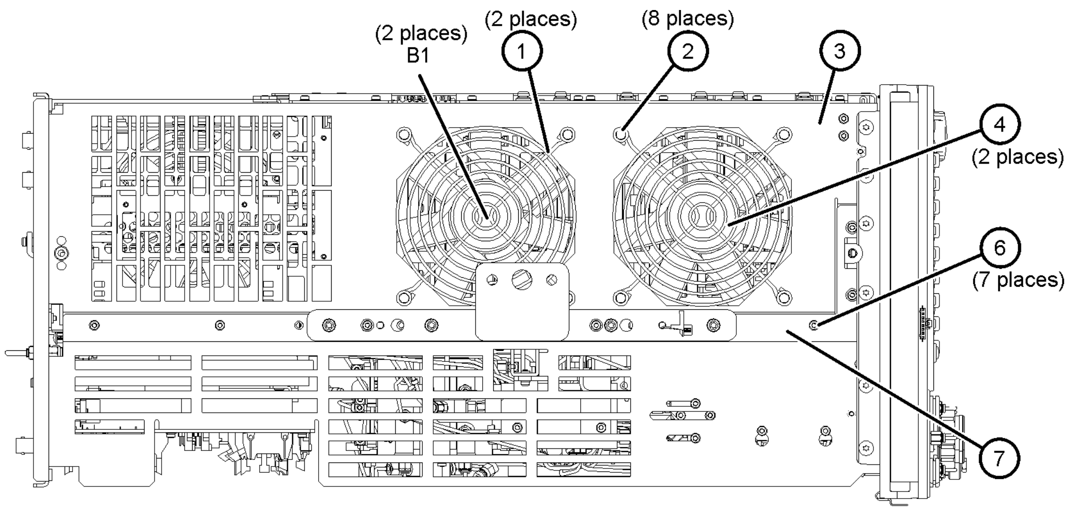
Figure 6-68 Rear-Panel Assembly, All Options

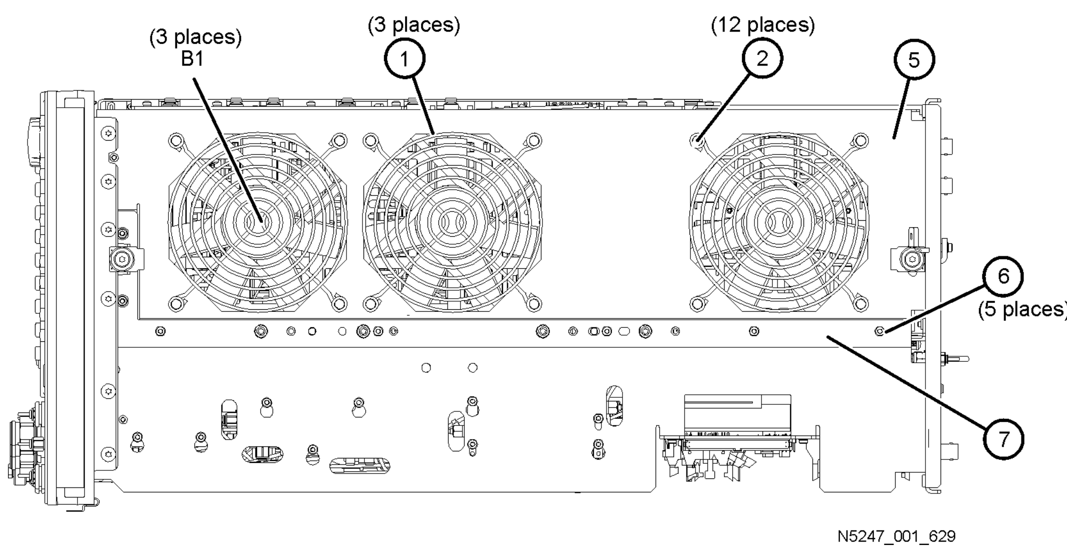


Fan Assemblies, All Options

Reference Designator	Part Number	Qty	Description
B1	3160-4199	5	Fan
①	3160-0281 Was 3160-4198	5	Fan guard
②	0361-1272	20	Fan rivet
③	N5245-00006	1	Fan bracket (for 2 fans)
④	E4440-00021	2	Fan EMI shield (for 2 fans)
⑤	N5245-00003	1	Fan bracket (for 3 fans)
⑥	0515-0372	--	Machine screw, M3.0 x 8, pan head (To attach: fan assemblies to chassis.)
⑦	Chassis (Refer to "Internal Hardware and Miscellaneous Parts, All Options" on page 6-201.)		

Figure 6-69 Fan Assemblies, Side View, All Options

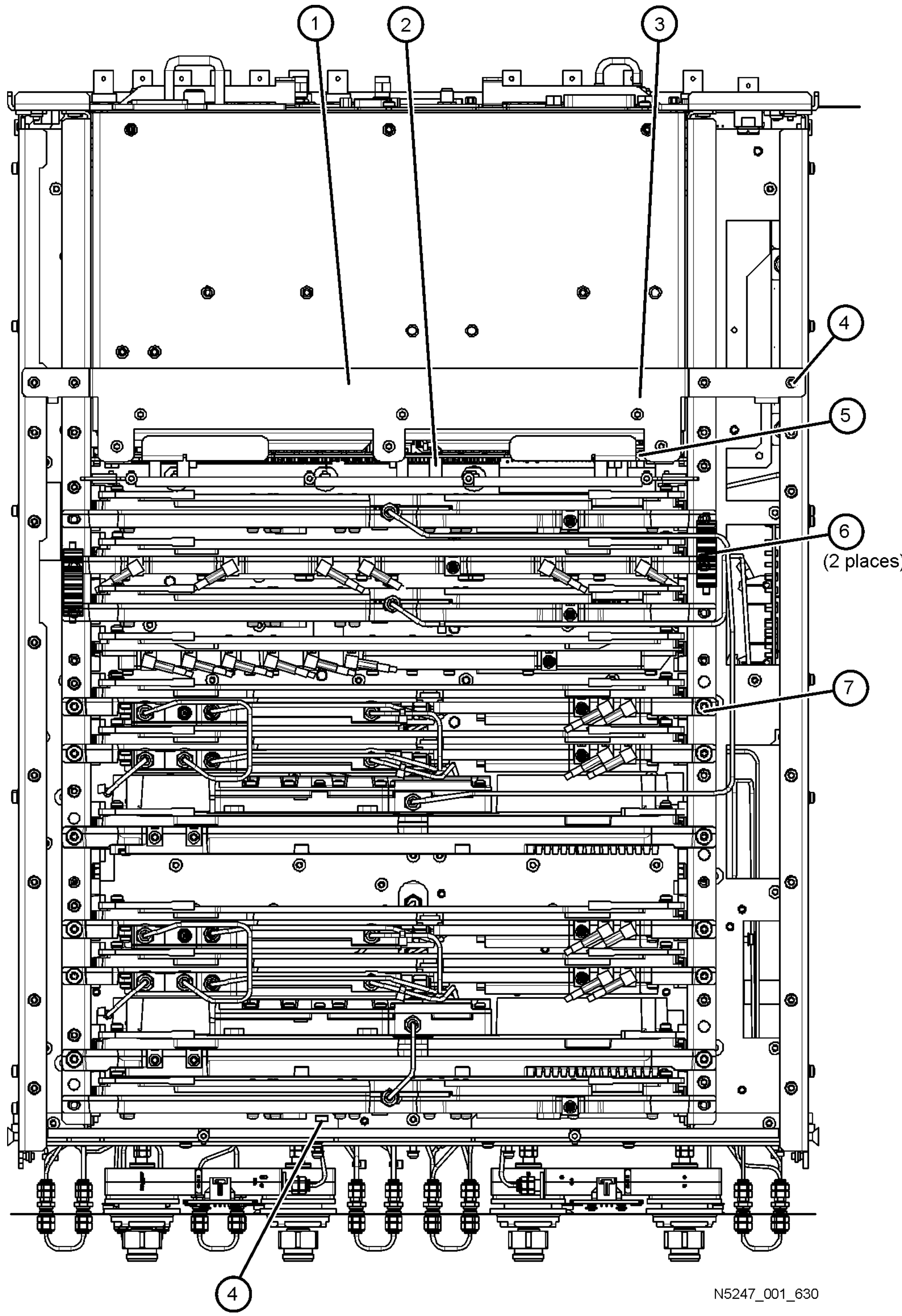




Top Hardware and Miscellaneous Parts, All Options

Reference Designator	Part Number	Qty	Description
①	W1312-00062	1	Power supply bracket
②	0515-0375	--	Machine screw, M3.0 x 16, pan head (To attach midplane board to midplane bracket.)
③	0515-1946	--	Machine screw, M3.0 x 6, flat head (To attach: power supply bracket to power supply; inner cover to chassis.)
④	0515-0372	--	Machine screw, M3.0 x 8, pan head (To attach: power supply bracket to inner panels; inner cover to chassis.)
⑤	0400-0353	18	Grommets for A19 midplane board (qty=6), and A18 system motherboard (qty=12) (not shown)
⑥	5041-7250	2	Wire loom (cable clip)
⑦	0515-0380	--	Machine screw, M4.0 x 10, pan head (To attach all doubler boards, the Spam board, all Synth boards, and all source boards to chassis inner panels.)
not shown	N5247-20136	2	Source (1) and source (2) bracket (On 2-port models, source (2) is included only with Option 224.)
not shown	0515-2078	--	Machine screw, M3.0 x 20, flat head (To attach source brackets to source (1) and source (2). (On 2-port models, source (2) is included only with Option 224.)
not shown	0515-0666	--	Machine screw, M3.0 x 18, pan head (To attach source brackets to source (1) and source (2). (On 2-port models, source (2) is included only with Option 224.)

Figure 6-70 Top Hardware and Miscellaneous Parts, Top View, All Options



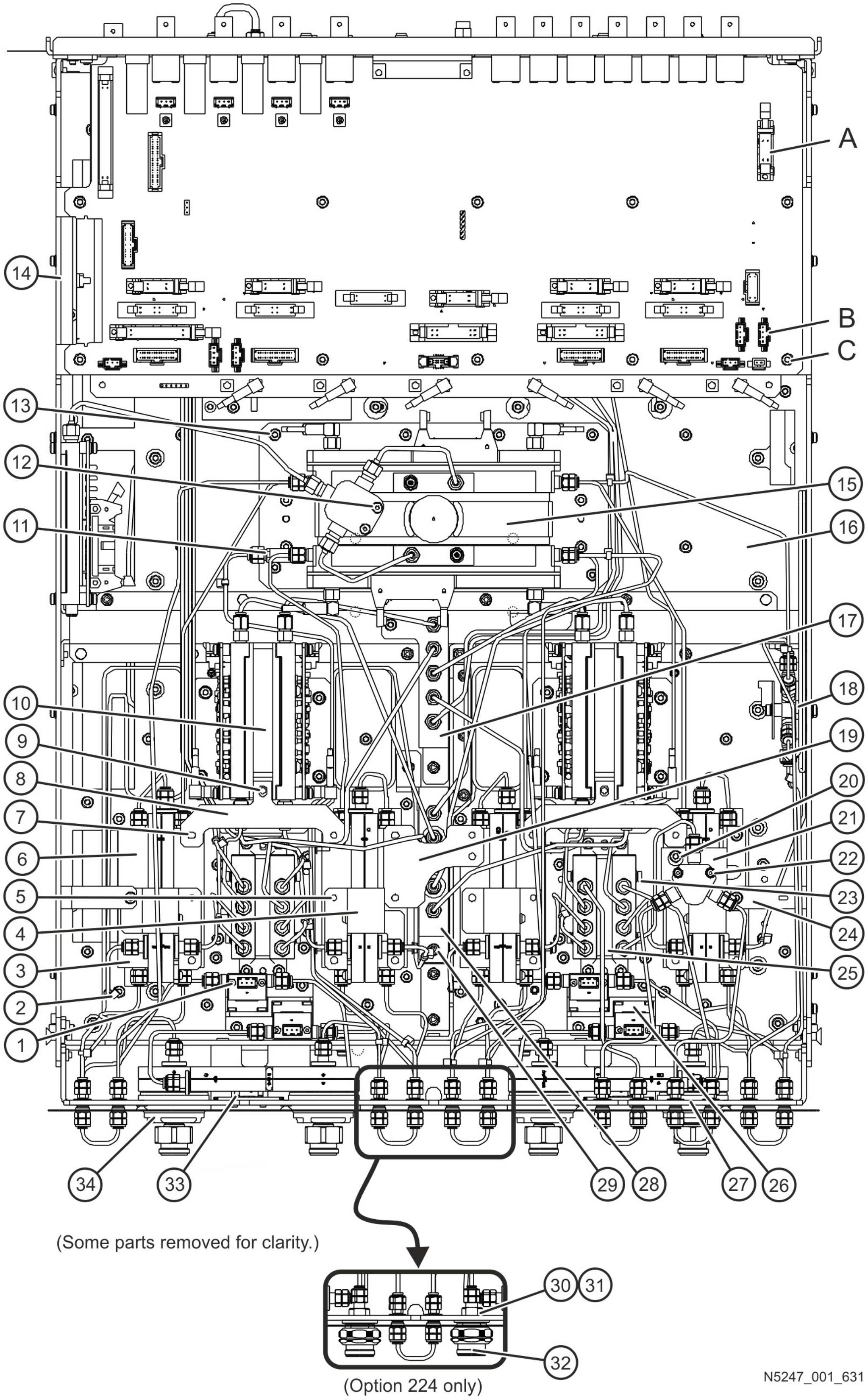
Bottom Hardware and Miscellaneous Parts

Reference Designator	Part Number	Qty	Description
①	0515-2994	3	Machine screw, M3.0 x 14, pan head (To attach A59 noise receiver (downconverter) to side of test set deck)
②	0515-1227	--	Machine screw, M3.0 x 6, flat head (To attach: coupler plate assy to side of test set deck; A42–A45 bias tees to their brackets.)
③	1400-0249	--	Tie wrap
④	N5247-00011	2	Bracket (For test ports 2 & 3 reference couplers.)
⑤	N5247-00012	2	Bracket (For test ports 1 & 4 reference couplers.)
⑥	0515-0658	--	Machine screw, M2.0 x 6, pan head (To attach test port reference couplers to brackets.)
⑦	N5247-00005	4	Bracket for source/receiver attenuator pairs (2 used in Opt 219, 224; 4 used in Opt 419, 423.)
⑧	0515-0372	-	Machine screw, M3.0 x 8, pan head (To attach: A23 test set motherboard to test set deck and stabilizer bracket; stabilizer bracket to A24 IF mux shield; A38 –A41 source attenuators to their brackets; A46–A49 receiver attenuators to their brackets; attenuator assemblies to test set deck; test set deck to chassis; A25 HMA26.5 to side of test set deck; reference coupler assemblies to test set deck; reference coupler assemblies to attenuator assemblies; A37 reference mixer switch to its bracket; reference mixer switch bracket to test set deck; coupler plate assy to front of test set deck; bias tee brackets to the test set deck; brace N5247-20131 to attenuator/reference coupler assemblies; switch/bracket assembly to test set deck; noise bypass switch brackets to the test set deck.)
⑨	N5247-20134	2	Brace, 4-port (To connect the attenuator/reference coupler assemblies with 70 GHz doubler assemblies.)
Near to ⑨	0515-0380	--	Machine screw, M4.0 x 10, pan head (To attach brace N5247-20134 to 70 GHz doubler mounts.)
⑩	N5247-20005	2	70 GHz doubler mount
⑫	0515-2007	--	Machine screw M3.0 x 14 (To attach splitter to top of mixer brick mounting block)
⑬	0515-0664	--	Machine screw M3.0 x 10 pan head (To attach: mixer brick assy to test set deck; 70 GHz doubler assy to test set deck; coupler plate assy to test set deck front; Option 029 or E29 tuner to side of test set deck.)
⑭	N5235-00018	1	Bracket, Ribbon Cable Clamp
⑮	N5247-20135	1	Mounting block (For A27 & A28 mixer bricks.)
⑯	N5247-00002	1	Test set deck
⑰	N5247-00006	1	Bracket, rear, bottom side - for semi rigid cables (Option 224 and 4-port models only.)

Reference Designator	Part Number	Qty	Description
⑱	N5245-00024	1	Bracket (For A37 reference mixer switch.)
⑲	N5247-20133	1	Brace, 4-port (To connect port 3 & port 4 attenuator/reference coupler assemblies.)
⑳	0515-0430	-	Machine screw M3.0 x 6 mm pan head (To attach A54 combiner bracket to top of attenuator pair bracket (option 423 only).
㉑	N5247-00007	1	Bracket (For A 58 combiner - option 423 only.)
㉒	0515-0661	--	Machine screw, M2 x 14, pan head (To attach A54 combiner to bracket.)
㉓	0515-0375	--	Machine screw, M3.0 x 16, pan head (To attach: 70 GHz doublers to doubler mounts; bypass switches to brackets.)
㉔	N5247-20132	2	Side brace (To attach attenuator/reference coupler assemblies to test set.)
㉕	N5247-20130	2	Bracket (For bypass switches.)
㉖	N5247-20129	2	Bracket (For both bias tee pairs.)
--	N5247-20149		Bracket (For LFE bias combiners – ports 1, 2, 3, & 4) – Implied by ㉖, but not shown in figure
㉗	N5247-00008	1	Test set front plate (2-port models only.)
	N5247-00009	1	Test set front plate (4-port models only.)
㉘	N5247-00003	1	Bracket, front, bottom side - for semi rigid cables
㉙	0515-0374	--	Machine screw M3.0 x 10 pan head (To attach: cross bracket to test set deck; bracket N5247-00017 to test set deck; cable bracket mounts to test set deck; side braces to chassis & to attenuator/reference coupler assemblies.)
㉚	2950-0132	2	Hex nut for bulkhead connectors (Option 224 only.)
㉛	2190-0104	2	Washers for bulkhead connectors (Option 224 only.)
㉜	5064-7891	2	Bulkhead connectors (Option 224 only.)
㉝	0515-1521	--	Machine screw, M3.0 x 5, flat head (To attach front-panel LED boards.)
㉞	5022-1087	4	Test port coupler dress nut (One for each coupler.)

Reference Designator	Part Number	Qty	Description
not shown	0515-1038	--	Machine screw M3.0 x 20 pan head (To attach mixer bricks to mount block.)
	0403-0285	4	Bumpers, adhesive (Installed on test port couplers in 2-port models only.)
	N5247-20131	1	Brace, 2-port (To connect the attenuator/reference coupler assemblies with the 70 GHz assemblies.)
	1400-1334	--	Cable clamp (with adhesive backing)
	0403-0179	4	Gap pad (Between each reference coupler and test set front sub panel.)
	E4403-20033	4	Gap pad (Between reference couplers 1 & 3, also 2 & 4.
	0460-2725	2	Coupler vibe mount, 4-port models (Between port 1 & port 2 couplers & test set front sub panel.)
	0515-0669	--	Machine screw, M4.0 x 0.7, pan head (To attach A24 IF MUX to test set deck.)
	N5242-00019	1	Stabilizer bracket (Between A23 test set motherboard and A24 IF mux board.)
	N5242-00048	2	Protective guard for front-panel jumpers - side
	N5242-00049	1	Protective guard for front-panel jumpers - center (4-port models only.)
	N5247-00024	1	Protective guard for front-panel jumpers - port 1 (4-port models only.)
	N5247-00025	1	Protective guard for front-panel jumpers - center (Option 224 only.)
	N5247-00017	1	Cross bracket on test set deck
	N5245-00033	2	Bracket, A56 and A57 noise bypass switches (Option 029 or E29)
	0515-1992	4	Machine screw M5.0 x 20 pan head (To attach noise bypass switch bracket to side of test set deck.)

Figure 6-71 Bottom Hardware and Miscellaneous Parts



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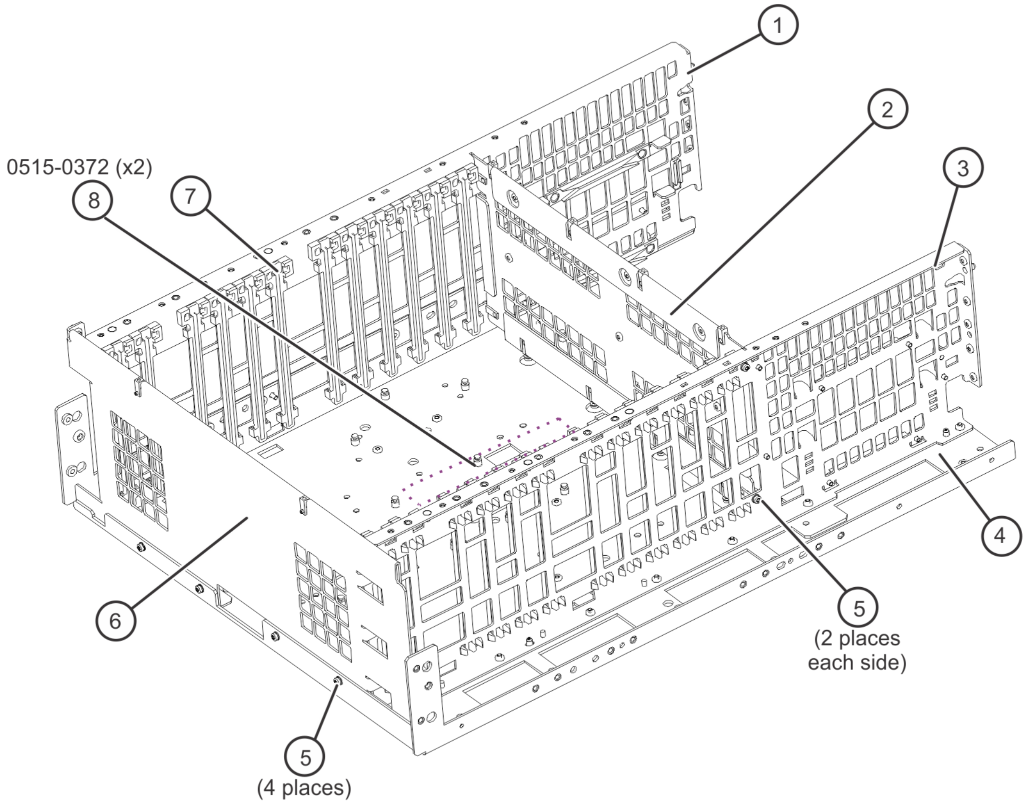
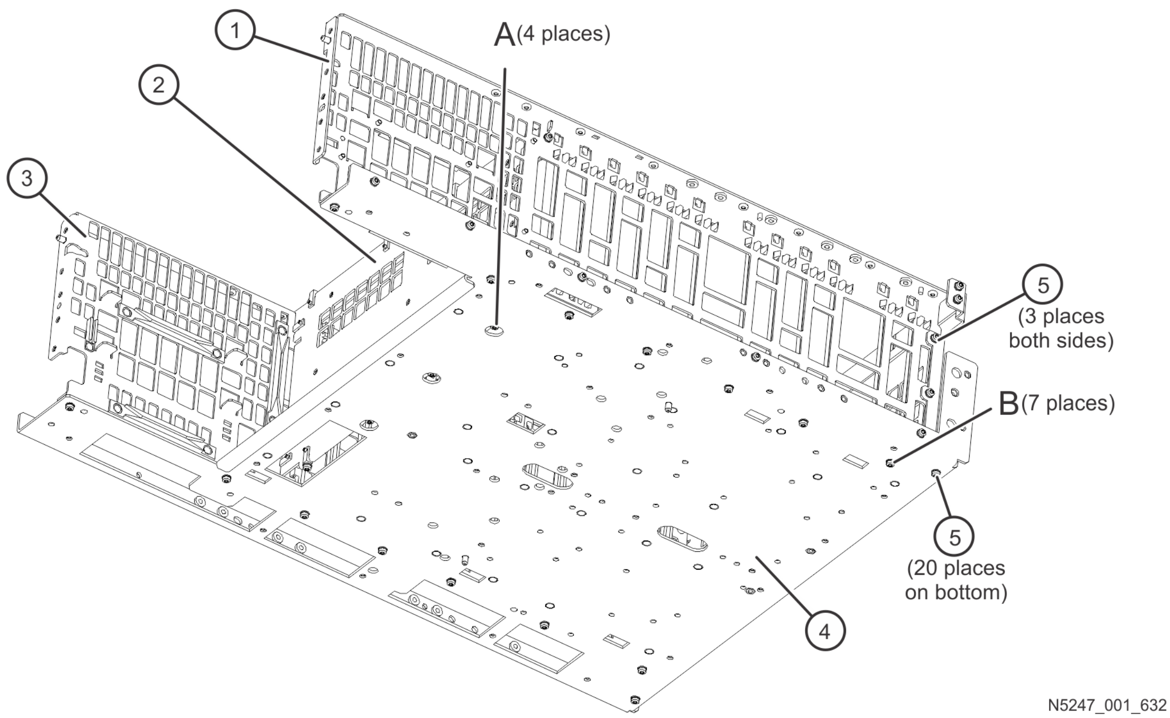
Internal Hardware and Miscellaneous Parts, All Options

Reference Designator	Part Number	Qty	Description
①	N5247-00016	1	Left side inner bracket
②	W1312-00048	1	Midplane bracket
③	N5247-00015	1	Right side inner bracket
④	N5247-00001	1	Chassis
⑤	0515-0372	--	Machine screw, M3.0 x 8, pan head (To attach: midplane bracket to left and right side inner brackets; front bracket to left and right side inner brackets; chassis to left and right side inner brackets, midplane bracket, and front bracket; motherboard to chassis, bracket (long) center.)
⑥	N5247-00013	1	Front bracket
⑦	N5242-40002	24	PC board guides
⑧	N5240-20136		Bracket Center, long
Not shown	5023-3074	2	Front handle

Figure 6-72 Internal Hardware and Miscellaneous Parts, All Options

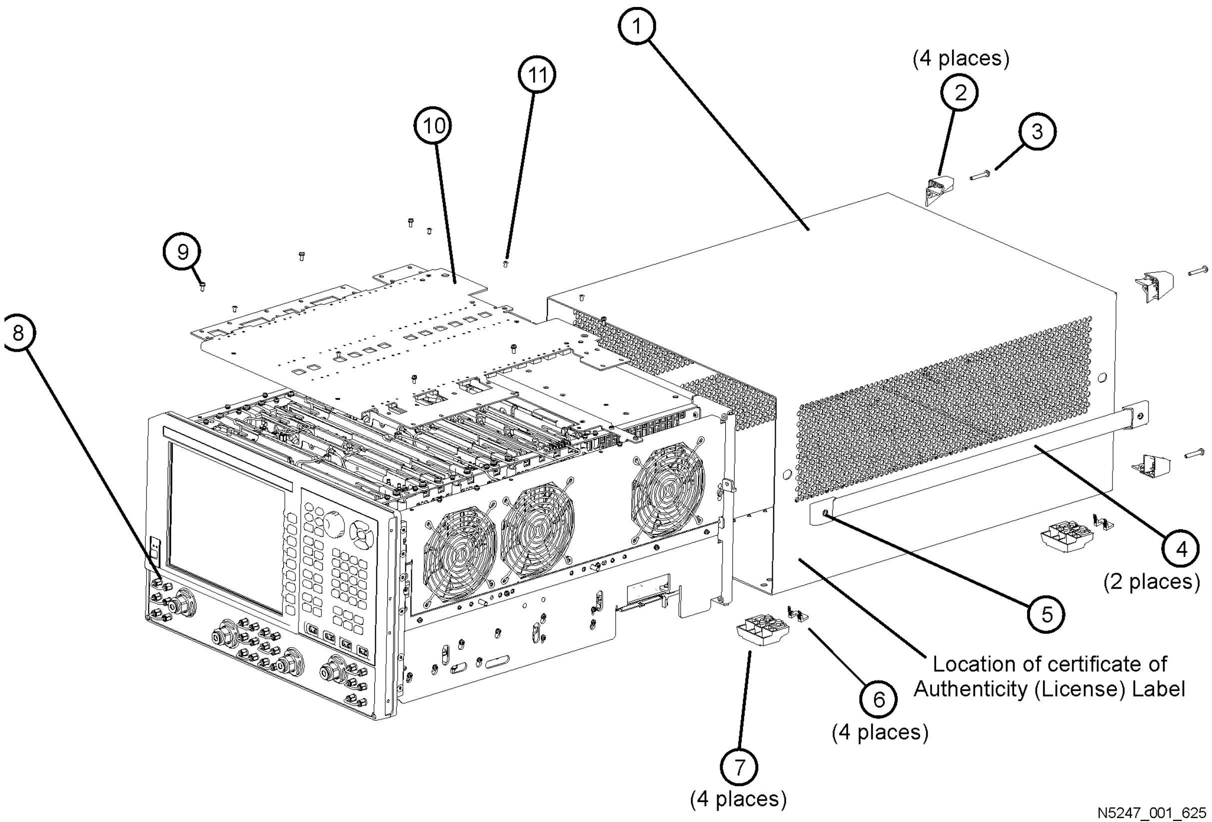




External Hardware and Miscellaneous Parts, All Options

Reference Designator	Part Number	Qty	Description
①	N5245-00035	1	Outer cover
②	5041-7903	4	Rear foot
③	0515-1619	--	Machine screw M4.0 x 25, pan head (To attach rear foot.)
④	N5247-60030	2	Strap handle assembly (Includes item ⑤)
⑤	0515-0710	--	Machine screw M5.0 x 18, flat head (To attach strap handle.)
⑥	5021-2840	4	Key lock (for bottom foot)
⑦	5041-7906	4	Bottom foot
	N9020-40007	4	Hole plug (When analyzer is rack mounted.)
⑧	1250-4747 Was: 5065-4673	24	Bulkhead connector, 1.85 mm female
	1250-3516	24	Nut for bulkhead connector
	1250-3310	24	Washer for bulkhead connector
⑨	0515-0372	--	Machine screw, M3.0 x 8, pan head (To attach inner cover.)
⑩	N5247-00004	1	Inner cover (retaining shield)
⑪	0515-1227	--	Machine screw, M3.0 x 6, flat head (To attach: inner cover; front-panel.)
Not shown	5023-3074	2	Front handle
Not shown	5041-9174	2	Side strips for front handle
Not shown	0515-2044	--	Machine screw, M4.0 x 12 flat head (To attach front handle to chassis.)
Not shown	N9040-40007	1	Front impact cover
Not shown	N9040-40008	1	Rear impact cover

Figure 6-73 External Hardware and Miscellaneous Parts, All Options



Miscellaneous Part Numbers

Table 6-3 Part Numbers for Miscellaneous Parts and Accessories

Description	Model or Part Number
Service Tools	
1/4 inch and 5/16 inch open-end wrench, thin profile	8710-0510
5/16 inch (8 mm), open-end wrench	8710-2174
1/2 inch to 9/16 inch (8 mm), open-end wrench	8710-1770
20 mm open-end torque wrench; 0.9 N-m (8 in-lb)	8710-1764
Spanner wrench	08513-20014
Documentation	
Installation and Quick Start Guide (for all PNA series analyzers) (Cannot be ordered. Part number is for reference only. Must be printed from the Keysight Web site.)	E8356-90001
Service Guide. (Not available in printed form. Part number is for reference only. Must be printed from the Keysight Web site.)	N5247-90001
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
Fuses	
Rear-panel Bias Input Fuse; Ports 1, 2, 3, and 4 (0.5 A, 125 V)	2110-0824 Was 2110-0046
Connector Caps	
Cap, protective, 0.812-ID	1401-0214
Cap, protective, 0.625-ID	1401-0225
Cap, protective, 1/4 - 36 threads	5188-5406
Battery	
Battery, lithium manganese dioxide, 3V, 0.22A-hr. (located on A21 CPU board assembly)	1420-0356

Table 6-3 Part Numbers for Miscellaneous Parts and Accessories (Continued)

Description	Model or Part Number
Analyzer Accessories	
Pulse I/O Adapter (For connecting between the analyzer's rear-panel PULSE I/O connector and the coaxial inputs and outputs of external pulse generators and external pulse modulators.)	N1966A
USB Accessories	
Mouse, optical	0960-3248 Was 1150-7799
Keyboard (U.S. style)	0960-3245 Was 1150-7896
USB to GPIB adapter	82357B
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
ESD heel strap	9300-1308
Rack Mount Kits and Handle Kits	
Rack mount kit for analyzers without handles (Option 1CM)	N5231AU-1CM or N5232AU-1CM or N5239AU-1CM
Option 1CM includes the following separately orderable items:	
Rack mount kit (rack mount flanges and hardware)	5063-1543
Rack mount rail set	E3663AC
Rack mount kit for analyzers with handles (Option 1CP)	N5231AU-1CP or N5232AU-1CP or N5239AU-1CP
Option 1CP includes the following separately orderable items:	
Rack mount kit (rack mount flanges and hardware)	5063-1555
Rack mount rail set	E3663AC
Front handle kit (two classic[a] handles and hardware)	5063-1542

a. For rack mount use, you must replace factory installed ruggedized handles (thick aluminum, no trim) with classic handles (thin aluminum with plastic trim), included with Option 1CP.

The options described in Chapter 2, "General Product Information." can be ordered as upgrades. Refer to "Analyzer Options, Accessories, and Upgrades Available" on page 2-3 for information on upgrades that are available for the N5247B analyzer. Refer to the section, "Analyzer Options, Accessories, and Upgrades Available" on page 2-3, for a complete description of each option included in the upgrades.

7 Repair and Replacement Procedures

CAUTION

Before replacing the A23 board, if possible:

Run EEBackup.exe using the directory for your Windows operating system:

Windows 7 OS:
C:/Program Files (x86)/Agilent/Network Analyzer/Service/EEBackup.exe. Click on Save EEPROM Backup, and then click on Backup TSMB Memory.

Windows 10 OS (32-bit):
C:/Program Files (x86)/Keysight/Network Analyzer/Service/EEBackup.exe. Click on Save EEPROM Backup, and then click on Backup TSMB Memory.

The firmware revision numbers for Win10 (32-bit) are A.13.30.xx through A.13.95.xx.

Windows 10 OS (64-bit):
C:/Program Files/Keysight/Network Analyzer/Service/EEBackup.exe. Click on Save EEPROM Backup, and then click on Backup TSMB Memory.

The firmware revision numbers for Win10 (64-bit) are A.14.00.xx and up.

Refer to “EEPROM Backup” on page 7-102.

If it is not possible to back up the EEPROMs and the TSMB Memory, the data files might not be the most current. In this case, the backup data will contain the original factory information. If you have problems, “Contacting Keysight” on page 2-7.

KEYSIGHT TECHNOLOGIES

Information in This Chapter

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

Chapter Seven at-a-Glance

CAUTION

The PNA contains extremely sensitive components that can be ruined if mishandled. Follow instructions carefully when making cable connections, especially wire harness connections.

The person performing the work accepts responsibility for the full cost of the repair or replacement of damaged components.

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 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 assembly. Wait at least 10 seconds, after disconnecting the plug, before removing the covers.

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)

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.

Electrostatic Discharge (ESD) Protection

CAUTION

Many of the assemblies in this instrument are very susceptible to damage from electrostatic discharge (ESD). Perform the following procedures only at a static-safe workstation and wear a 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 1-7, for all of the procedures in this chapter.

Removal and Replacement Procedures

Table 7-1 List of Procedures

Reference Designator	Assembly Description	Location
N/A	Covers, outer and inner	page 7-8
N/A	Fan bracket and fans	page 7-88
N/A	Front panel assembly	page 7-10
N/A	Front panel LED boards	page 7-86
A1 A2 A3	Front panel display board USB board Display assembly	page 7-12
A4, A17, A15 A15 A5, A10 A7, A8 A12, A13 A9 A14 A16	13.5 GHz synthesizer boards (s/n prefixes <6021 only) Direct digital synthesizer (DDS) assembly (s/n prefixes ≥6021 only) 26.5 GHz source boards Doubler boards Noise board Frequency reference board (s/n prefixes <6021 only) Signal processing ADC module (SPAM) board	page 7-20
A18	System motherboard	page 7-23
A19	Midplane board	page 7-26
A20	Power supply	page 7-28
A21	CPU board	page 7-30
A22	GPIB board	page 7-32
A23	Test set motherboard	page 7-34
A24	IF multiplexer board	page 7-36
A25	Multiplier/amplifier 26.5 (HMA26.5)	page 7-38
A26[a]	Splitter	page 7-41
A27, A28	Mixer bricks	page 7-43
A29 A30 A31 A32	Port 1 reference coupler Port 3 reference coupler Port 4 reference coupler Port 2 reference coupler	page 7-45
A33 A34 A35 A36	Port 1 test port coupler Port 3 test port coupler Port 4 test port coupler Port 2 test port coupler	page 7-48

Table 7-1 List of Procedures (Continued)

Reference Designator	Assembly Description	Location
A37	Reference mixer switch	page 7-50
A38 A39 A40 A41	Port 1 source step attenuator (Optional) Port 3 source step attenuator (Optional) Port 4 source step attenuator (Optional) Port 2 source step attenuator (Optional)	page 7-52
A42 A43 A44 A45	Port 1 bias tee (Optional) Port 3 bias tee (Optional) Port 4 bias tee (Optional) Port 2 bias tee (Optional)	page 7-55
A46 A47 A48 A49	Port 1 receiver step attenuator (Optional) Port 3 receiver step attenuator (Optional) Port 4 receiver step attenuator (Optional) Port 2 receiver step attenuator (Optional)	page 7-52
A50 A51 A52 A53	Port 1 mechanical switch (Optional) Port 3 mechanical switch (Optional) Port 4 mechanical switch (Optional) Port 2 mechanical switch (Optional)	page 7-57
A54	Combiner (Optional)	page 7-57
A55	Solid state drive	page 7-60
A56	Port 1 noise bypass switch (Optional)	page 7-57
A57	Port 2 noise bypass switch (Optional)	page 7-57
A59	noise receiver (downconverter) (Optional)	page 7-60
A60 A61 A62 A63	70 GHz doubler 1 70 GHz doubler 3 70 GHz doubler 4 70 GHz doubler 2	page 7-45
A64	Tuner (Optional)	page 7-60
A70 A75	LFE PC assembly	page 7-72
A71 A72 A73 A74	Port 1 LFE Bias-T combiner - port 1 Port 1 LFE Bias-T combiner - port 3 Port 1 LFE Bias-T combiner - port 4 Port 1 LFE Bias-T combiner - port 2	page 7-79
--	Rear panel	page 7-84
--	Front panel LED boards	page 7-86
--	Fans	page 7-88

Table 7-1 List of Procedures (Continued)

Reference Designator	Assembly Description	Location
--	Lithium battery	page 7-90

a. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, and N5247-20110 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

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. Do not place the analyzer on its front panel without the handles. This will damage the front panel assemblies.

Refer to Figure 7-1 for this procedure.

1. Disconnect the power cord.
2. Remove the strap handles (item ①) by loosening the screws (item ②), with a T-20 TORX driver, on both ends until the handle is free of the analyzer.
3. Remove the foot locks (item ③) from the four bottom feet (item ④) and then remove the four bottom feet from the outer cover.
4. Remove the four rear panel feet (item ⑤) by removing the center screws (item ⑥ with a T-20 TORX driver.
5. Slide the outer cover toward the rear of the analyzer and remove it.

Removing the Inner Cover

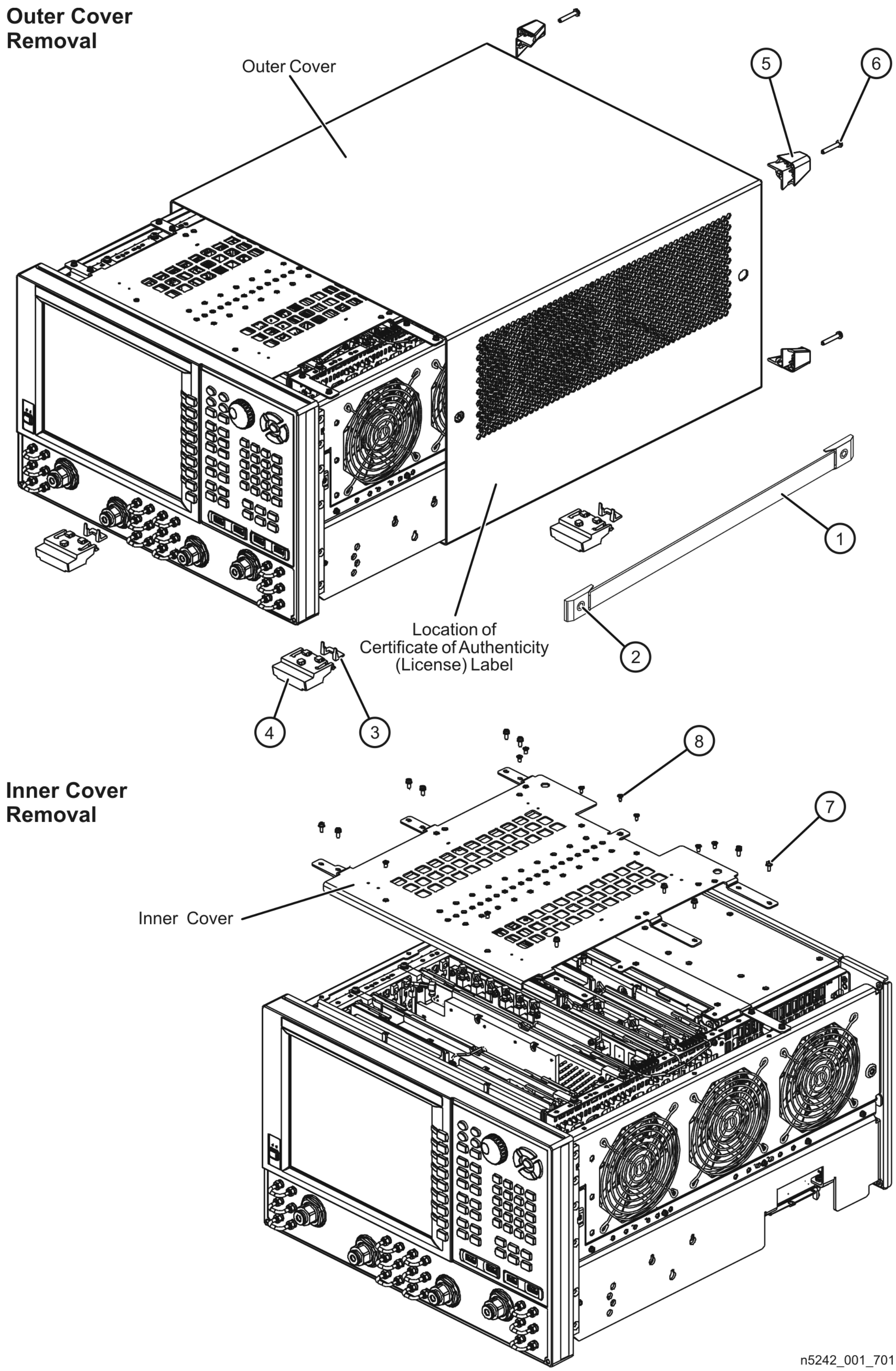
Refer to Figure 7-1 for this procedure.

1. With a T-10 TORX driver, remove the 12 pan head screws (item ⑦).
2. With a T-10 TORX driver, remove the 9 flat head screws (item ⑧).
3. Lift off the cover.

Replacement Procedure

1. On the top side of the PNA, carefully position the gray flex cables so they can't be pinched between the covers and the rails.
2. On the bottom side of the PNA, carefully fold or push down the ribbon cables and wires so they can't be pinched between the hardware and the outer cover. Ribbon cables and wires must never be positioned on top of hardware.
3. Reverse the order of the removal procedures above.

Figure 7-1 Outer and Inner Cover Removal



Removing and Replacing the Front Panel Assembly

Tools Required

– T-10 TORX driver (set to 9 in-lb)

– T-20 TORX driver (set to 21 in-lb)

– 5/16 inch open-end torque wrench (set to 10 in-lb)

– ESD grounding wrist strap

Removal Procedure

Refer to Figure 7-2 on page 7-11 for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to "Removing the Covers" on page 7-8.
3. With a 5/16 inch torque wrench, remove all the semi-rigid jumpers (item ①) from the front panel.
4. With a T-10 TORX driver, remove the 12 screws (item ②) from the sides of the frame.
5. Remove the lower panel overlay.
6. With a T-10 TORX, remove the 2 screws (2-Port) or 4 screws (4-Port).

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

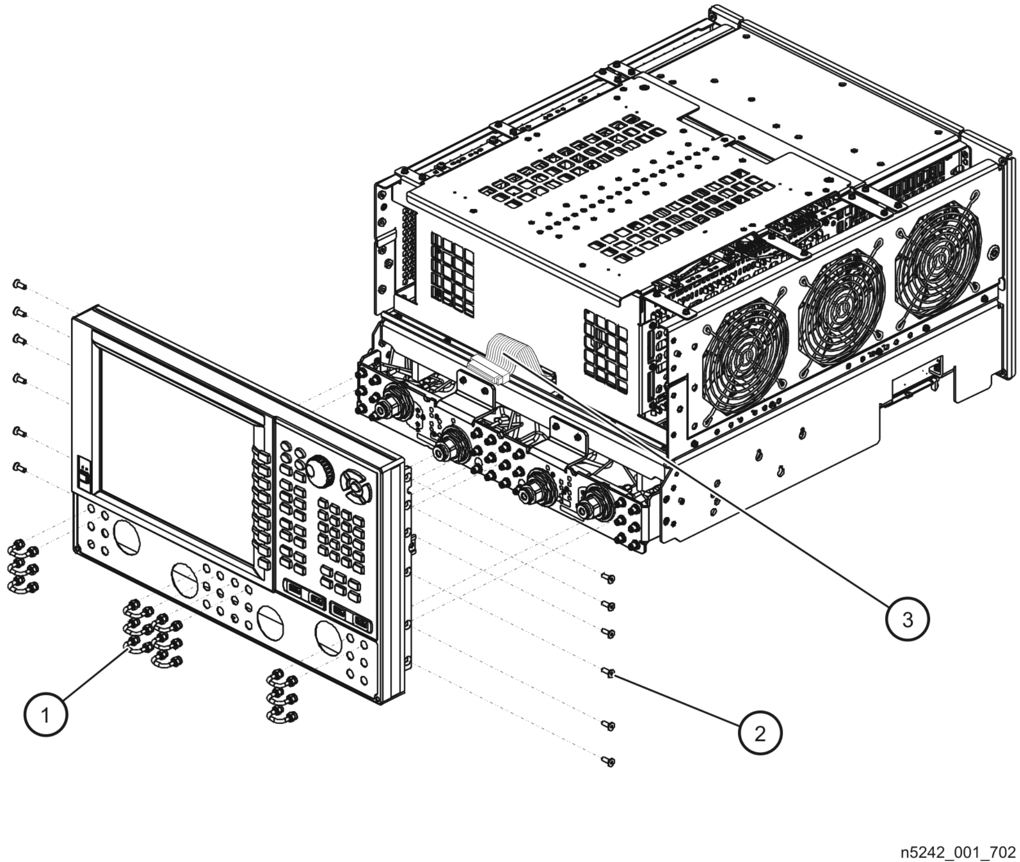
7. Slide the front panel over the test port connectors.
8. Disconnect the ribbon cable (item ③) from the A1 front panel interface board.

Replacement Procedure

NOTE When reconnecting the front-panel jumpers, torque the 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 7-92.

Figure 7-2 Front Panel Assembly Removal



Removing and Replacing the A1–A3 and Other Front Panel Subassemblies

Tools Required

– T-6 TORX driver (set to 3 in-lb)

– T-8 TORX driver (set to 8 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 9 in-lb)

– 5/16 inch open-end torque wrench (set to 10 in-lb)

– 11 mm socket wrench (set to 9 in-lb)

– ESD grounding wrist strap

Refer to Figure 7-3 on page 7-15, Figure 7-4 on page 7-16, Figure 7-5 on page 7-16, Figure 7-6 on page 7-17, Figure 7-7 on page 7-17, and Figure 7-8 on page 7-18 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.

Removing the RPG Assembly

1. Remove the round knob (RPG) from the front panel by gently pulling the knob forward.
2. Disconnect the RPG to Interface board cable (item [24]).
3. With the 11 mm socket wrench, remove the RPG board’s washer and hex nut.
4. Remove RPG assembly from the interface board.

Removing the A2 USB Board

1. Remove the five retaining screws (item ②) from the USB board and unplug it from the A1 front panel interface board.

Removing the A1 Front Panel Interface Board and Keypad Assembly

1. Remove the A2 USB board as outlined above.
2. Remove the RPG assembly as outlined above.
3. Disconnect the following cables from the A1 front panel interface board: tape (item [14]) from connector and the LCD display to interface board cable (item [18]), LED driver board (backlight converter board) to interface

board (item [11]), touch screen controller board to interface board cable (item [13]), power switch board to interface board cable (item [12]), and the speaker assembly cable.

4. Remove the seven screws (item ⑨) from the keypad/board and the two standoff-hex nuts (item ①) from the keypad/board assembly and remove it from the front panel assembly.
5. The keypad assembly can now be removed from the A1 front panel interface board by gently pulling each of the rubber tabs through the PC board.

Removing the LED Driver Inverter Board

1. Disconnect the LED driver inverter board to interface board cable connection (item [11]) and the LCD display cable (item [19]) from the LED driver inverter board.
2. Remove two screws (item ⑩) and remove the LED driver inverter board.

Removing the Touchscreen Controller Board

1. Disconnect the touchscreen controller board cable (item [13]) from the touchscreen controller board and front panel interface board.
2. Raise the retaining clamps on the LCD display flat flex cable's two connectors (item [15]).
3. Disconnect the flat flex cable from the touchscreen (item [15]).
4. With the T-8 TORX, remove the 4 screws (item ④) on the touchscreen controller board.
5. Remove the touchscreen controller board from the mounting plate.

Removing the Power Switch Board and Power Button Keypad

1. Disconnect the following cables from the A1 front panel interface board: tape (item [14]) from connector and the LCD display to interface board cable (item [18]), LED driver board (backlight converter board) to interface board (item [11]), touch screen controller board to interface board cable (item [13]), power switch board to interface board cable (item [12]), and the speaker assembly cable.
2. With the T-10 TORX, remove the eleven outer screws on the LCD mounting plate (item ⑤) and remove the A3 display assembly from the front panel assembly.
3. Disconnect the power switch cable (item [13]) from the power switch board.
4. Remove two screws (item ③) and remove the power switch board.
5. The power button keypad can now be removed from the power switch board by gently pulling each of the rubber tabs through the PC board.

Removing the Speaker Assembly

1. Disconnect the speaker cable from the interface board.
2. Remove the speaker assembly and speaker foam.

CAUTION

When handling the speaker avoid touching the top of the speaker. Hold only the sides of the speaker when re-attaching the new foam.

Avoid covering the Mounting Plate screw.

Removing the A3 Display Assembly and the Touchscreen

1. Disconnect the following cables from the A1 front panel interface board: tape (item [14]) from connector and the LCD display to interface board cable (item [18]), LED driver board (backlight converter board) to interface board (item [11]), touch screen controller board to interface board cable (item [13]), power switch board to interface board cable (item [12]), and the speaker assembly cable.
2. Remove eleven outer screws (item ⑤) from the A3 display assembly's mounting plate and remove the A3 display assembly from the front panel assembly.
3. Raise the retaining clamps on the LCD display flat flex cable's two connectors (item [15]).
4. Disconnect the flat flex cable from the touchscreen (item [15]).
5. The LED driver board cable (item 22) can be removed from the connection on the LCD Display.
6. The LCD display cable (item [18]) can be removed by removing the three screws (item [17]) that attach it to the LCD display mounting bracket.
7. Remove the 3 screws on the slotted hole side of the mounting plate (item [20]).
8. Remove the 3 screws on the round hole side of the mounting plate (item [20]).
9. With a T-6 TORX (set to 3-in-lb), remove the 2 screws (item [23]) on the side bracket that has the LCD cable (item [18]) attached to the LCD display.

CAUTION

During re-assembly of the side brackets to the LCD display, it is very important to avoid over-tightening.

10. With a T-6 TORX (set to 3-in-lb), remove the 2 screws (item 23) on the 2nd side bracket (item [21]).

CAUTION During re-assembly of the side brackets to the LCD display, it is very important to avoid over-tightening.

11. The touch screen can now be removed from the front panel assembly. Note the orientation of the touch screen in the front panel assembly for installation of the new touch screen.

Figure 7-3 Front Panel Sub-assemblies Removal

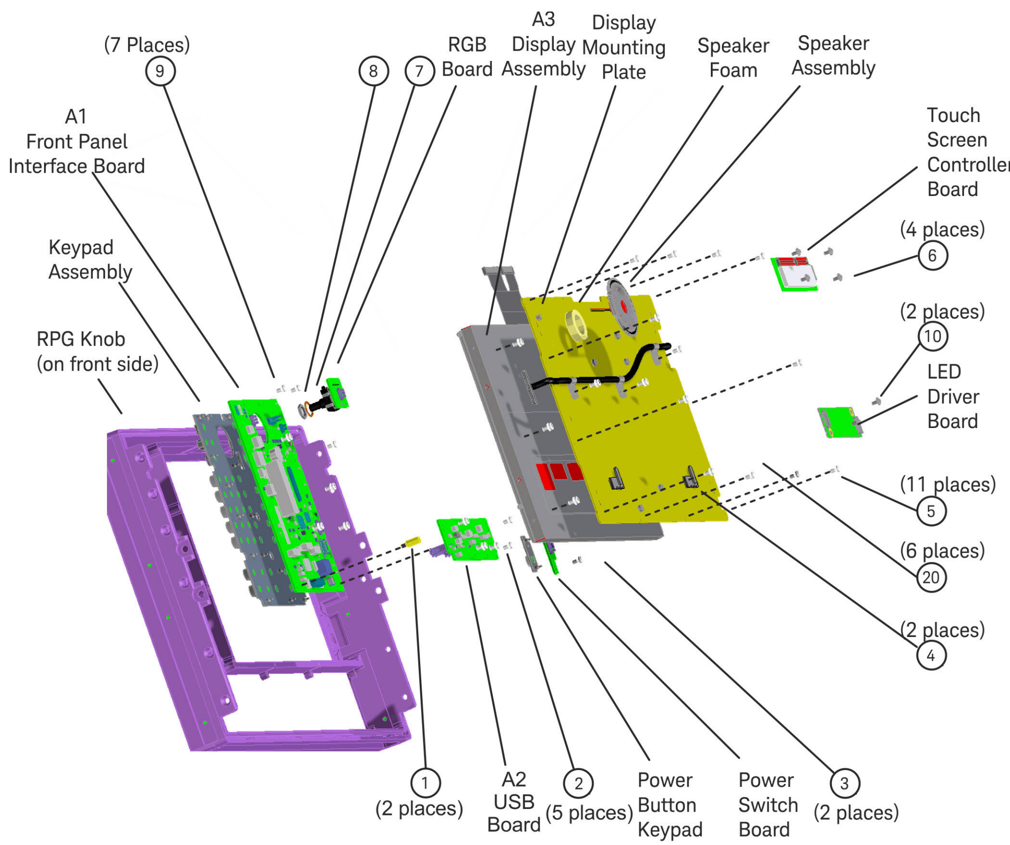


Figure 7-4 A3 Display Assembly with LCD Display - Cables

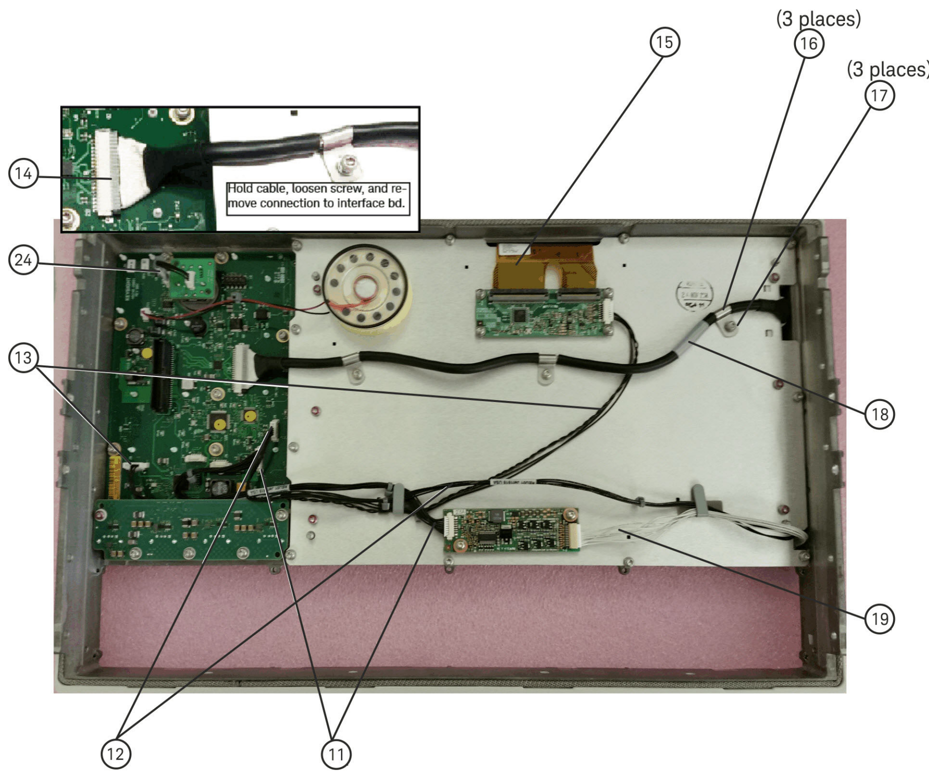


Figure 7-5 Remove LCD Cable, LCD to LED Inverter Board Cable, & Side Brackets

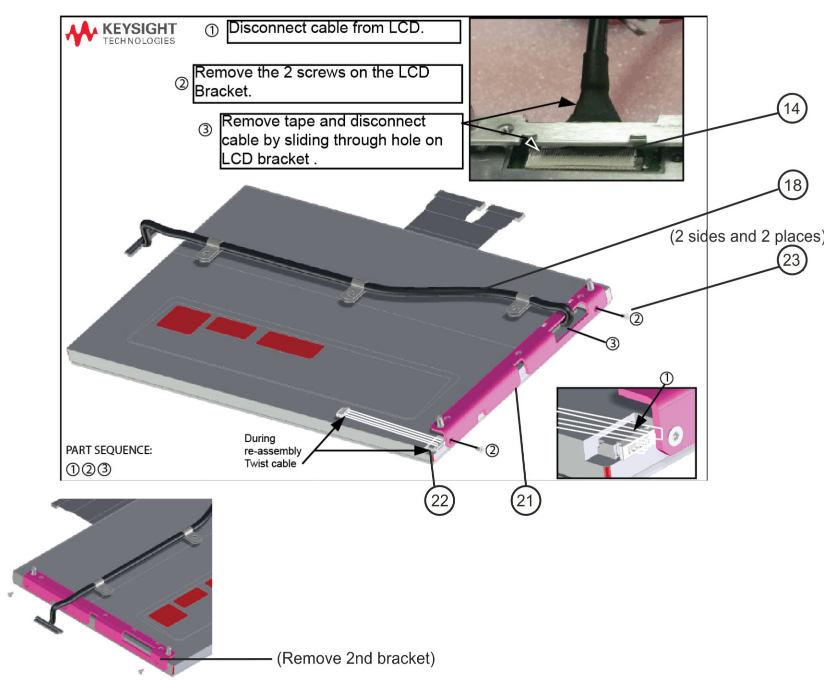


Figure 7-6 Remove LCD Mounting Plate to LCD Display & LCD Display Cable

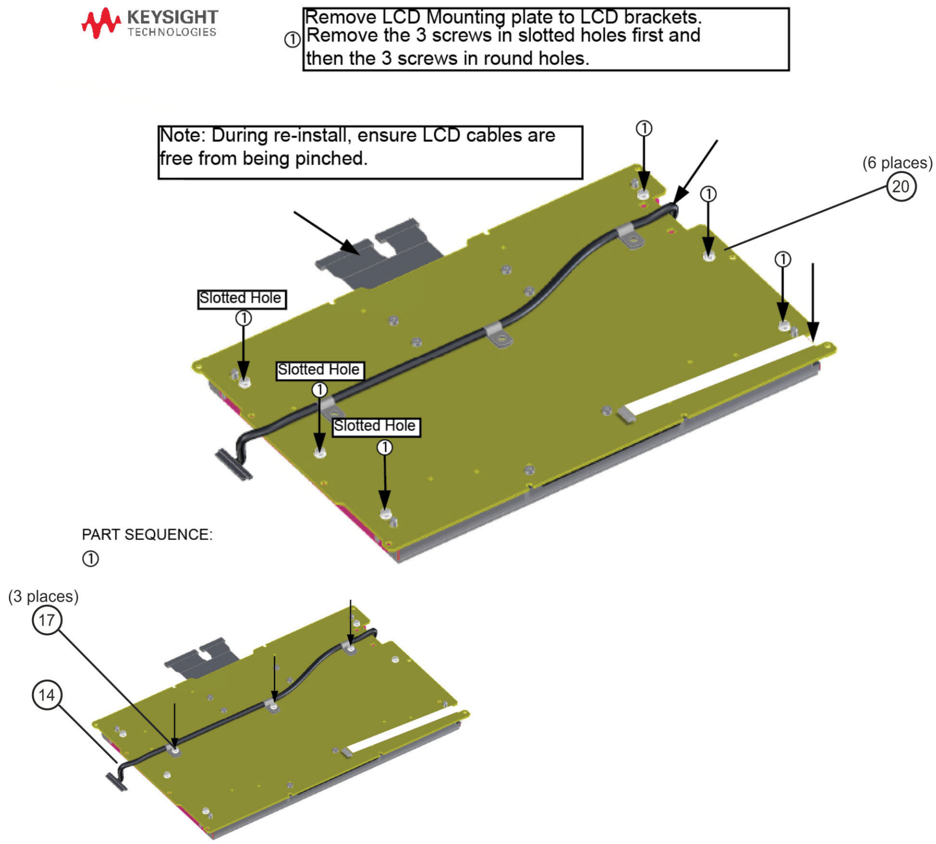


Figure 7-7 Removing the Flat Flex Cable from the LCD to the Controller Board

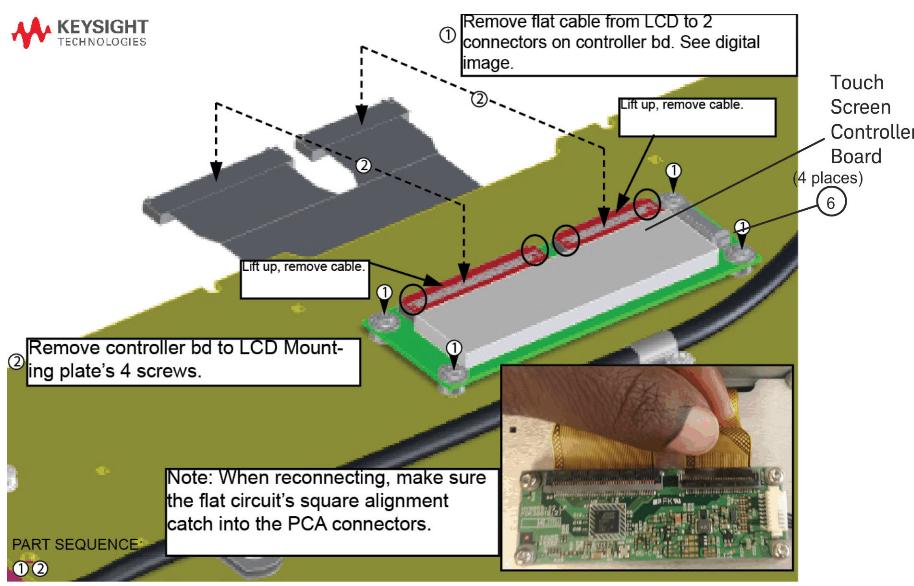


Figure 7-8 Power Keypad to Power Button Board

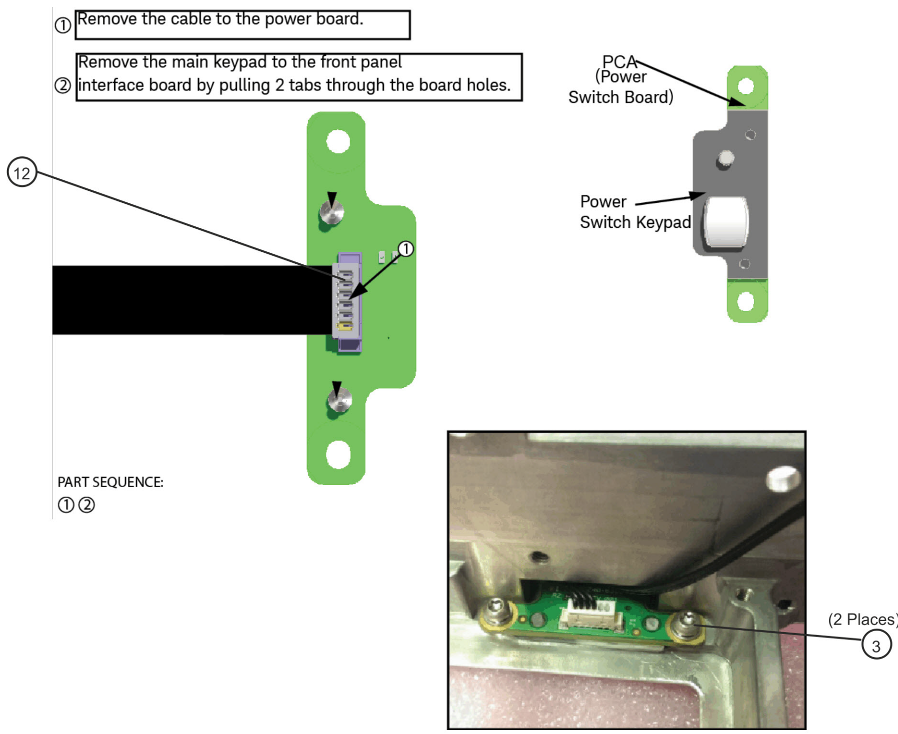
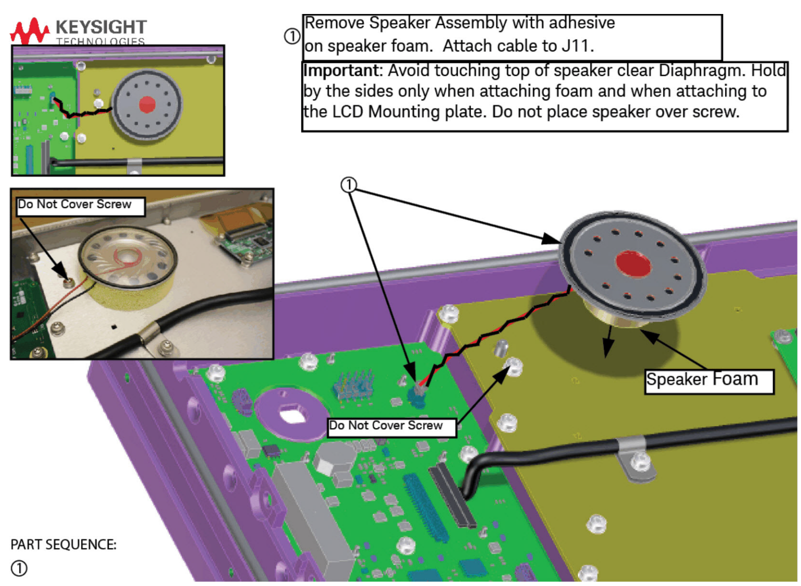


Figure 7-9 Remove Speaker Assembly and Mounting Foam



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 7-92.

Removing and Replacing the A4–A17 Boards

NOTE

If you have a PNA with a serial number prefix <6021 and have not had a 2S7 or 4S7 version 7 synthesizer assembly upgrade, then you have A4, A14, A15, and A17 boards.

If you have a PNA with a serial number prefix ≥6021 or have had a 2S7 or 4S7 version 7 synthesizer assembly upgrade, then you have an A15 direct digital synthesizer (DDS) assembly instead of the A4, A14, A15, and A17 boards.

Refer to “Top Assemblies and Cables, All Options, Serial Number Prefixes <6021” on page 6-18 and “Top Assemblies and Cables, All Options, Serial Number Prefixes ≥6021” on page 6-24.

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)
- 9 mm socket or open-end wrench (set to 21 in-lb)
- ESD grounding wrist strap

Removal Procedure

If you have a serial number prefix <6021, refer to Figure 6-6, “Top Assemblies, All Options, S/N Prefixes <6021” or Figure 6-6, “Top Assemblies, All Options, S/N Prefixes <6021” for this procedure. If you have a serial number prefix ≥6021, refer to Figure 6-8, “Top Assemblies, All Options, S/N Prefixes ≥6021”.

Regardless of your serial number prefix, if you have had your instrument upgraded to a version 7 synthesizer assembly, refer to Figure 6-8, “Top Assemblies, All Options, S/N Prefixes ≥6021”.

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to “Removing the Covers” on page 7-8.
3. Instructions for A5 and A10 source boards (Refer to Figure 6-7 on page 6-23 for cable locations):
    a. A10 source board only: on the bottom side of the analyzer, disconnect the cables from the A12 and A13 boards (item ①).
    b. A5 source board only: on the top side of the analyzer, disconnect all visible semirigid cables from the A4, A7, and A8 boards.
    c. On the top side of the analyzer, remove two screws (item ②), one at each end of the board, from the source board to be removed.
    d. Lift the two extractors (item ③), one at each end of the board. Adjust the slack in the gray flexible cable as needed to move it out of the way, and lift the board out of the chassis.

4. Instructions for A4, A7, A8, A12, A13, A14, A15, A16, and A17 boards:
   a. Remove all cables connected to the top of the board to be removed. Note the location of each cable for reinstallation.
   b. Lift the two extractors (item ③), one at each end of the board, and lift the board.
   c. Before removing the board, check the bottom of the board for any attached cables.

Replacement Procedure

1. Reverse the order of the removal procedure.
   Remember to connect any necessary cables to the bottom of the board before reinstalling it. If replacing a doubler board, make sure the new board has loads connected to the same ports as were used on the old board. This may require moving a load from the old board to the new board or removing the load from the new board.
   When replacing the A5 or A10 source board, remove the semirigid cables attached to the bottom of the old board and attach them to the bottom of the new board. Be sure to orient these cables the same as they were on the old board.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

NOTE The A4, A15, and A17 synthesizer boards will not perform correctly and will cause the PNA to display errors until the Synthesizer Bandwidth Adjustment and the EE Default Adjustment are completed, as per Table 7-2 on page 7-92.

NOTE If you have a new A15 version 7 synthesizer assembly installed, the A15 assembly will not perform correctly and will cause the PNA to display errors until the EE Default Adjustment synthesizer adjustments are completed, as per Table 7-2 on page 7-92.

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Removing and Replacing the A18 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)
- 5/8 inch nutsetter (set to 21 in-lb)
- ESD grounding wrist strap

Removal Procedure

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to "Removing the Covers" on page 7-8.
3. Remove the front panel assembly. Refer to "Removing and Replacing the Front Panel Assembly" on page 7-10.
4. Remove the A20 power supply. Refer to "Removing and Replacing the A20 Power Supply Assembly" on page 7-28.
5. Remove the A21 CPU. Refer to "Removing and Replacing the A21 CPU Board Assembly" on page 7-30.
6. Disconnect the rear panel cables.
7. Remove the threaded hardware from the rear panel.
8. Remove the rear panel.
9. Remove the A22 GPIB board. Refer to "Removing and Replacing the A22 GPIB Board" on page 7-32.
10. Remove the A19 midplane board. Refer to "Removing and Replacing the A19 Midplane Board" on page 7-26.
11. Remove the A4–A17 boards. Refer to "Removing and Replacing the A4–A17 Boards" on page 7-20.
12. Remove the right side and left side fan brackets. Disconnect the right fan wire and the left fan wire from the A18 System Motherboard, and then remove the fan brackets. Refer to "Removing and Replacing the Fans" on page 7-88.
13. Turn the analyzer over so that the bottom side is up and remove the A23 Test Set Motherboard and the A24 IF Mux. Disconnect the two ribbon cables from the A18 System Motherboard.

Refer to Figure 6-72 on page 6-202 for steps 14 and 15.

14. Remove four screws (item A) that secure the bottom of the midplane bracket to the chassis.

15. Remove seven screws (item B) that secure the left side inner bracket to the chassis.

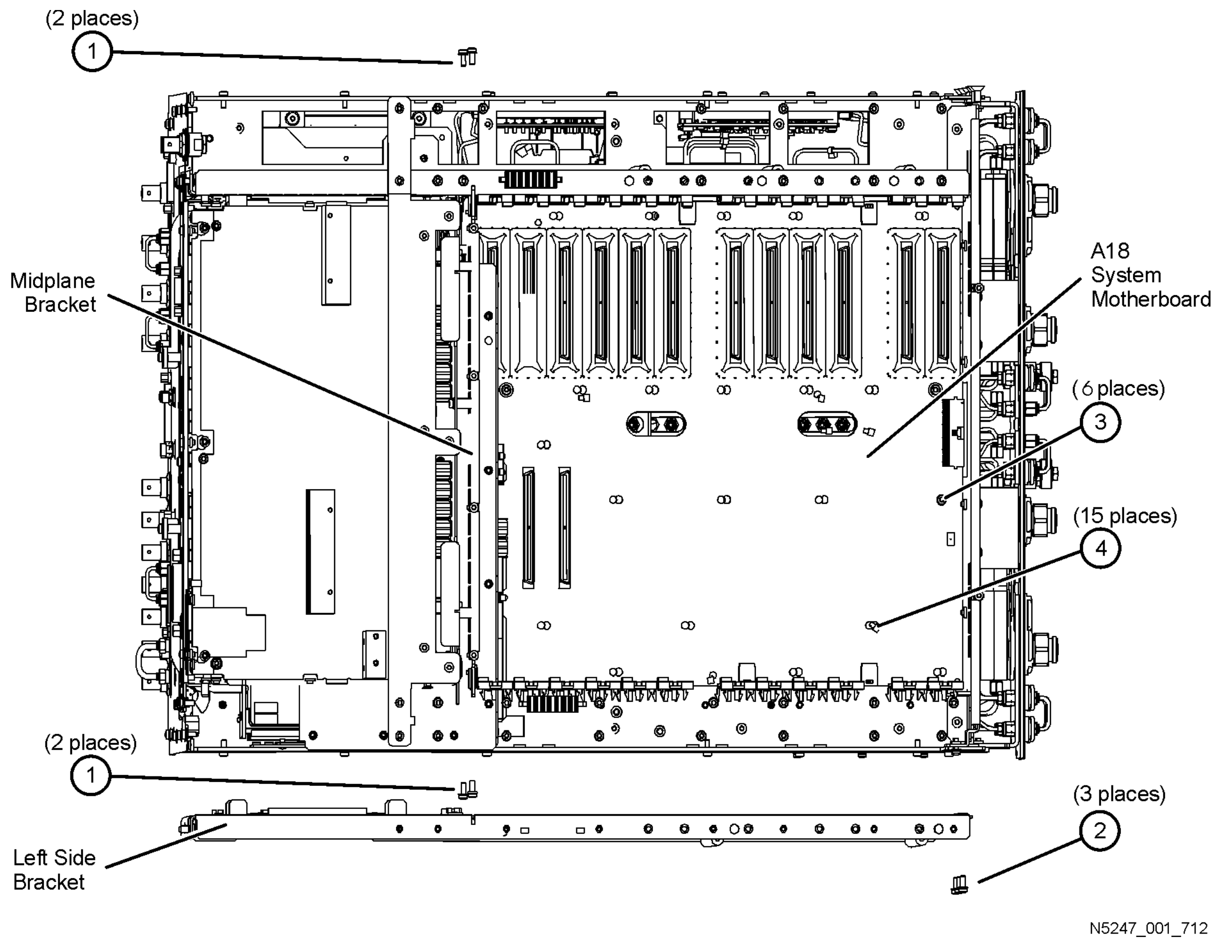
Refer to Figure 7-10 for the remaining steps in this procedure.

16. Turn the analyzer back over so that the top side is up. Remove two screws (item j) from each side that secure the midplane bracket to the chassis inner panels. Lift the midplane bracket out of the analyzer.
17. Remove the three screws (item ②) that secure the front bracket to the chassis left inner panel.
18. Remove six screws (item ③) that secure the A18 system motherboard to the chassis.
19. Slide the A18 system motherboard toward the rear of the analyzer to release it from the 15 keyhole standoffs (item ④) on the chassis.
20. Lift the A18 system motherboard out of the analyzer.
21. Remove the twelve rubber grommets from the A18 system motherboard guide pins. Keep them for reinstallation on the replacement motherboard.

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 7-92.

Figure 7-10 A18 System Motherboard Removal



Removing and Replacing the A19 Midplane 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 7-11 for this procedure.

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to "Removing the Covers" on page 7-8.
3. Remove the A20 power supply assembly. Refer to "Removing and Replacing the A20 Power Supply Assembly" on page 7-28.
4. Remove the A21 CPU board assembly. Refer to "Removing and Replacing the A21 CPU Board Assembly" on page 7-30.
5. Remove six screws (item ①) from the A19 midplane board.
6. Lift the board ejectors (item ②) to the upright position to disengage the A19 midplane board from the A18 system motherboard.
7. Note the positions of the six rubber grommets (item ③) on the bottom three A19 midplane board alignment pins. Remove these rubber grommets and retain them for reinstallation on the new A19 midplane board.
8. Lift the A19 midplane board out of the analyzer.

Replacement Procedure

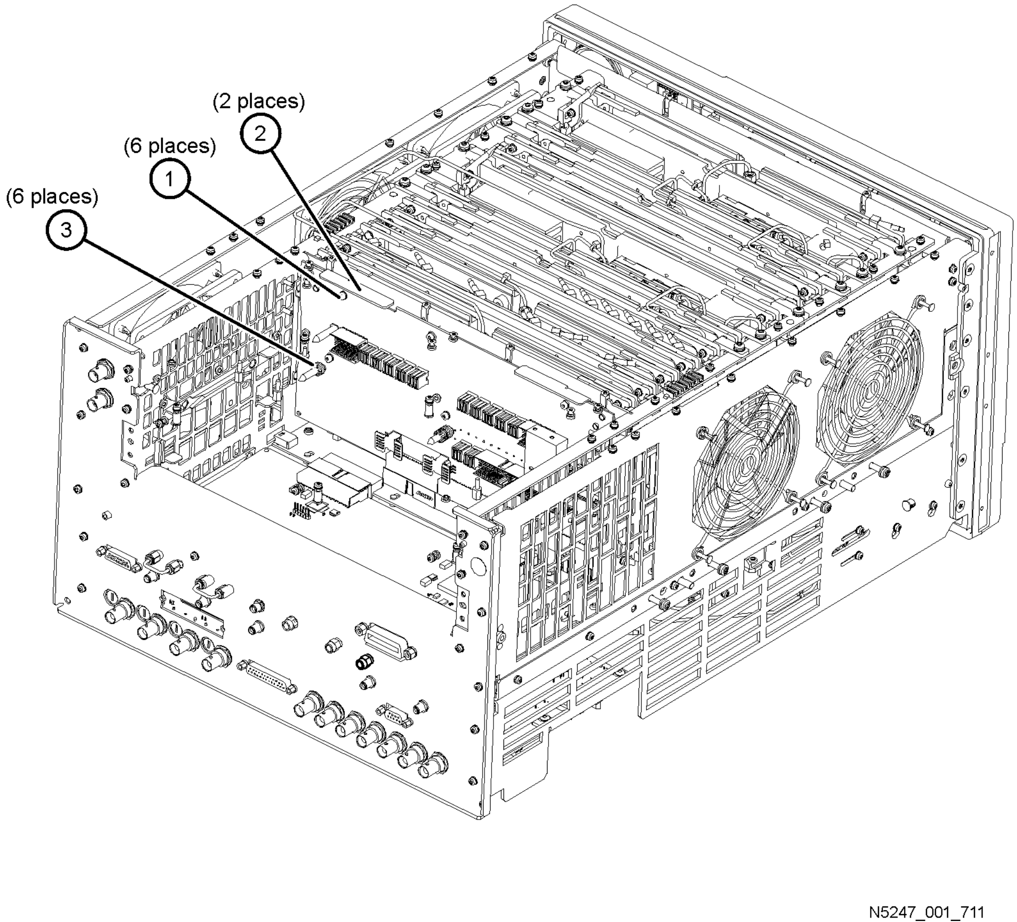
1. Reverse the order of the removal procedure.

   Be careful to align the guide pins on the A19 midplane board connectors with the slots on the A18 system motherboard connectors.

   The board ejectors should be in the upright position when installing the A19 midplane board. Align these ejectors with the slots in the chassis inner panels as the board is lowered into position and then push them down flat.

   Remember to install the six rubber grommets on the bottom three alignment pins.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Figure 7-11 A19 Midplane Board Removal



Removing and Replacing the A20 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

NOTE

IMPORTANT! If the rear power supply rear cover must be replaced, a new KC label is required (part number N5240-80041). Refer to "Keysight Support, Services, and Assistance" on page 2-7.

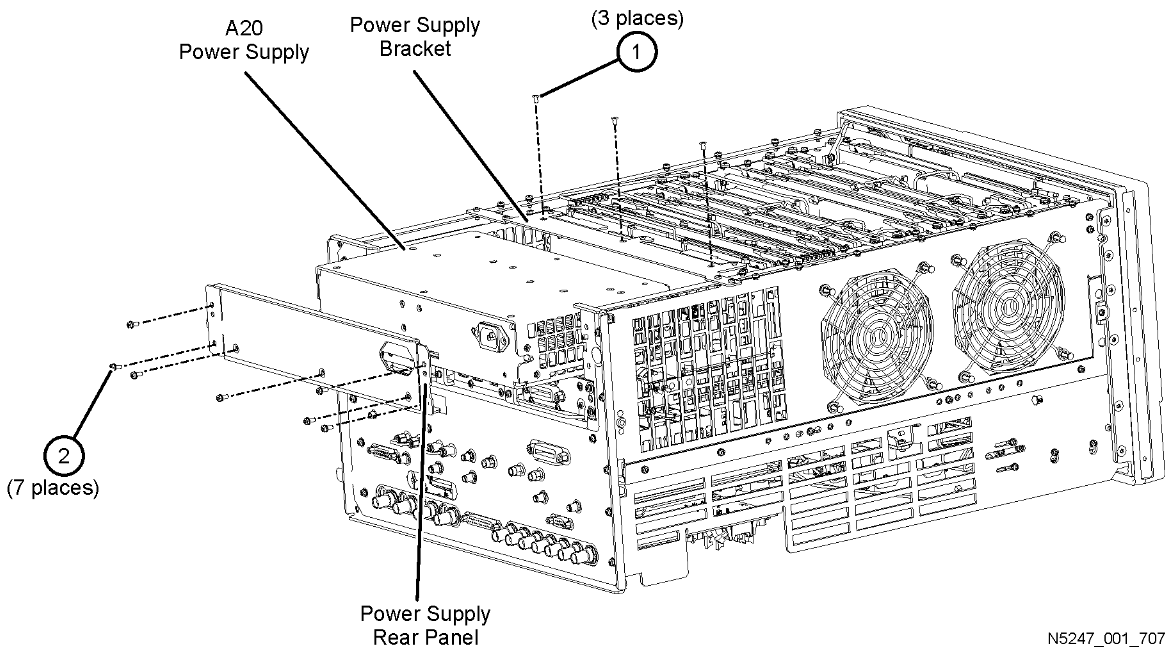
Refer to Figure 7-12 for this procedure.

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to "Removing the Covers" on page 7-8.
3. Remove the three flat head screws (item ①) from the power supply bracket.
4. Remove the seven pan head screws (item ②) from the power supply rear panel.
5. Slide the A20 power supply assembly out the rear 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 7-92.

Figure 7-12 A20 Power Supply Assembly Removal



Removing and Replacing the A21 CPU Board Assembly

Tools Required

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

Removal Procedure

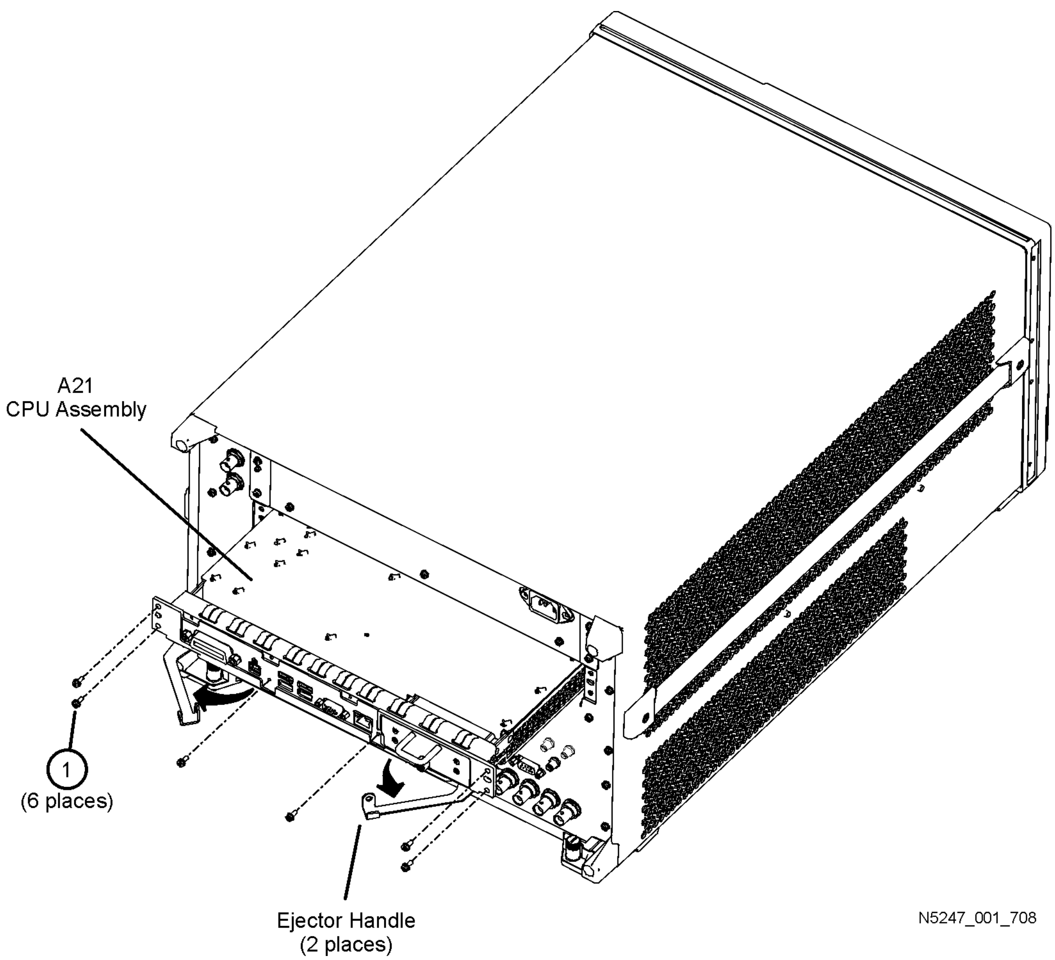
Refer to Figure 7-13 for this procedure.

1. Disconnect the power cord.
2. It is **not** necessary to remove the instrument cover(s) to remove the A21 CPU board assembly.
3. Remove six screws (item ①) from the A21 CPU board assembly - four from the CPU assembly rear panel and two from the ejector handles.
4. Grasp the two ejector handles and rotate them outward toward the sides of the analyzer as shown in the illustration. This will disengage the A21 CPU board assembly from the A19 midplane board.
5. Slide the A21 CPU board assembly out the rear of the analyzer.
6. If the A21 CPU board assembly is being replaced, you must first remove the A55 solid state drive for reinstallation in the new A21 CPU board assembly. Refer to "Removing and Replacing the A55 Solid State Drive (SSD)" on page 7-60.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. If a new Certificate of Authenticity (license) label is supplied with your new A21 CPU board assembly, adhere it to the outer cover in the location specified in Figure 7-10 on page 7-25.
3. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Figure 7-13 A21 CPU Board Assembly Removal



Removing and Replacing the A22 GPIB 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

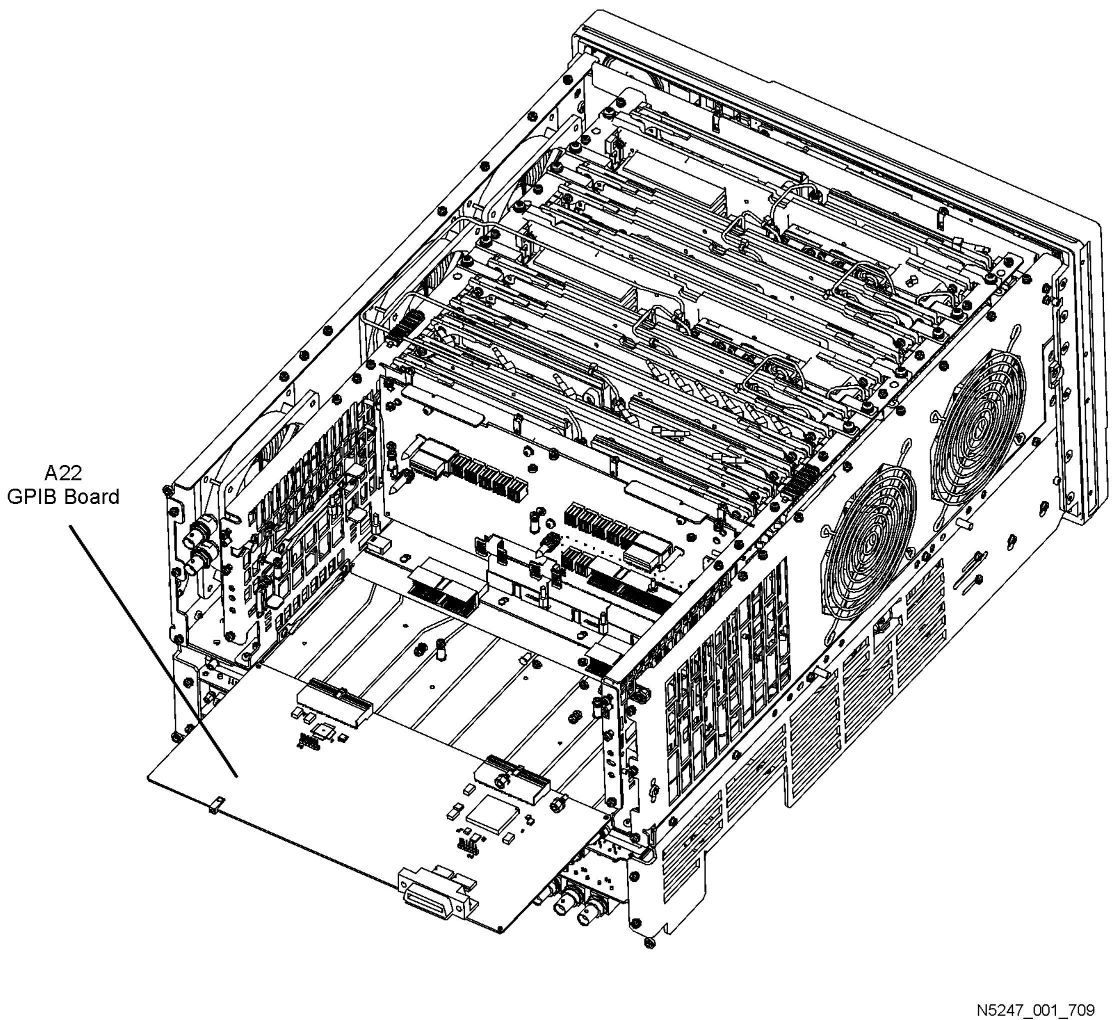
Refer to Figure 7-14 for this procedure.

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to "Removing the Covers" on page 7-8.
3. Remove the A20 power supply assembly. Refer to "Removing and Replacing the A20 Power Supply Assembly" on page 7-28.
4. Remove the A21 CPU board assembly. Refer to "Removing and Replacing the A21 CPU Board Assembly" on page 7-30.
5. Remove the rear panel. Refer to "Removing and Replacing the Rear Panel" on page 7-84.
6. Slide the A22 GPIB board out the rear 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 7-92.

Figure 7-14 A22 GPIB Board Removal



Removing and Replacing the A23 Test Set Motherboard

CAUTION

Before replacing the A23 test set motherboard, if possible:

Run EEBackup.exe using the directory for your Windows operating system:

Windows 7 OS:
C:/Program Files (x86)/Agilent/Network Analyzer/Service/EEBackup.exe. Click on Save EEPROM Backup, and then click on Backup TSMB Memory.

Windows 10 OS (32-bit):
C:/Program Files (x86)/Keysight/Network Analyzer/Service/EEBackup.exe. Click on Save EEPROM Backup, and then click on Backup TSMB Memory.

The firmware revision numbers for Win10 (32-bit) are A.13.30.xx through A.13.95.xx.

Windows 10 OS (64-bit):
C:/Program Files/Keysight/Network Analyzer/Service/EEBackup.exe. Click on Save EEPROM Backup, and then click on Backup TSMB Memory.

The firmware revision numbers for Win10 (64-bit) are A.14.00.xx and up.

Refer to “EEPROM Backup” on page 7-102.

If it is not possible to back up the EEPROMs and the TSMB Memory, the data files might not be the most current. In this case, the backup data will contain the original factory information. If you have problems, “Contacting Keysight” on page 2-7.

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)
- 5/8 inch nutsetter (set to 21 in-lb)
- ESD grounding wrist strap

Removal Procedure

Refer to Figure 6-71 on page 6-200 for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to “Removing the Covers” on page 7-8.
3. Position the analyzer bottom side up.
4. Disconnect ALL ribbon cables (item A) and ALL wire harnesses (item B) from the A23 test set motherboard.
5. Remove connector hardware from 11 rear panel BNC connectors.

6. Remove connector hardware from the rear panel TEST SET I/O connector.
7. Remove 10 screws (item C) from the A23 test set motherboard.
8. Slide the A23 test set motherboard toward the front of the instrument until the rear panel BNC connectors are free of the rear panel, 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 7-92.

Removing and Replacing the A24 IF Multiplexer 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 7-15 for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to "Removing the Covers" on page 7-8.
3. Position the analyzer bottom side up.
4. Remove the A23 test set motherboard. Refer to "Removing and Replacing the A23 Test Set Motherboard" on page 7-34.
5. Disconnect the ribbon cable (item ①) from the A24 IF multiplexer board.
6. Disconnect ALL gray flexible RF cables (item ②) from the A24 IF multiplexer board.
7. Remove connector hardware (item ③) from five rear panel RF connectors.
8. Remove connector hardware (item ④) from the rear panel PULSE I/O connector.
9. Remove four screws (item ⑤) from the stabilizer bracket and remove the stabilizer bracket.
10. Remove four screws (item ⑥) from the A24 IF multiplexer board.
11. Slide the A24 IF multiplexer board toward the front of the instrument until the rear panel connectors are free of the rear panel, then lift the motherboard and remove it from the analyzer.

Replacement Procedure

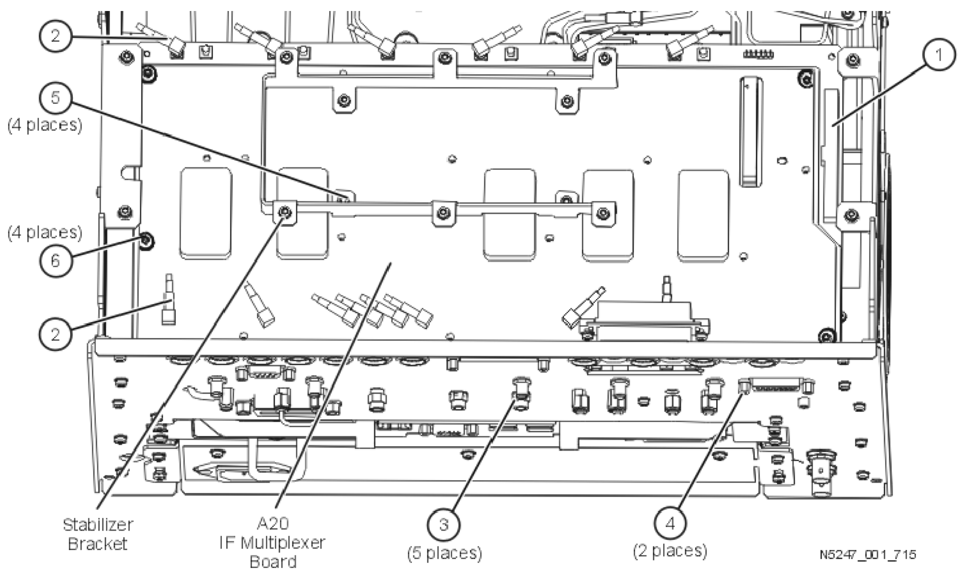
1. Reverse the order of the removal procedure.

   Attach the stabilizer bracket to the new A24 IF multiplexer board using the screws removed from the old one.

   Torque rear panel RF connector nuts to 21 in-lbs and PULSE I/O connector screws to 6 in-lbs.

2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Figure 7-15 A24 IF Multiplexer Board Removal



Removing and Replacing the A25 HMA26.5

Tools Required

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

Removal Procedure

Refer to Figure 7-16 and Figure 7-17 for this procedure.

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

1. Disconnect the power cord.
2. Remove the outer cover. Refer to "Removing the Covers" on page 7-8.
3. Position the analyzer bottom side up.
4. Disconnect the ribbon cable (item ①) from the A25 HMA26.5 assembly.
5. Disconnect cable W61 from the A25 HMA26.5.
6. Remove cable W62 from between the A25 HMA26.5 and the A26 splitter.[1]
7. Remove four screws (item ②) that hold the A25 HMA26.5 on the chassis side panel.

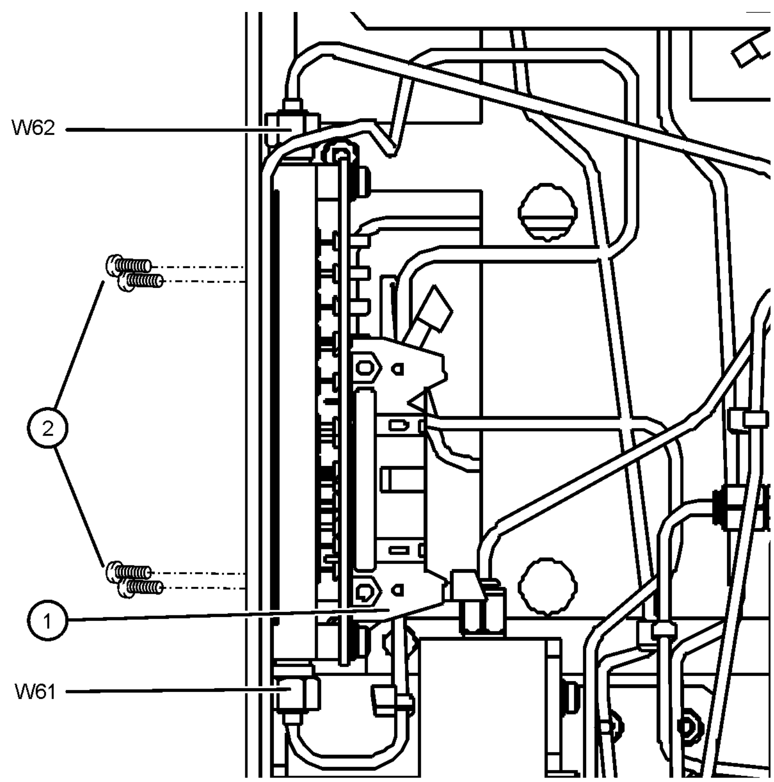
Replacement Procedure

1. Reverse the order of the removal procedure.

   Torque all RF cable connectors to 10 in-lbs.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

1. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, and N5247-20110 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

Figure 7-16 A25 HMA26.5 Removal



Verify the Model/Version of HMA26.5 Installed

This upgrade kit contains components for use with PNA models using the legacy HMA26.5 part number 5087-7765. If your PNA has the newer HMA26.5 part number N5240-60101 installed you may discard these parts:

– A26 splitter 5067-4086
– W62 N5247-20111
– W63 N5245-20023
– W64 N5245-20022

The new N5240-60101 HMA26.5 has the splitter integrated into the assembly. Refer to Figure 7-17 on page 7-40.

Figure 7-17 Comparison of Legacy HMA26.5 (5087-7765) and New HMA26.5 (N5240-60101)

Removing and Replacing the A26 Splitter[1]

Tools Required

- T-8 TORX driver (set to 6 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.

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

1. Disconnect the power cord.
2. Remove the outer cover. Refer to “Removing the Covers” on page 7-8.
3. Position the analyzer bottom side up.
4. Disconnect cable W62 at the A26 splitter connection.
5. Remove cable W63 from between the A26 splitter and the A27 mixer brick.
6. Remove cable W64 from between the A26 splitter and the A28 mixer brick.
7. Remove two screws (item ①) from the A26 splitter and lift the splitter out of the analyzer.

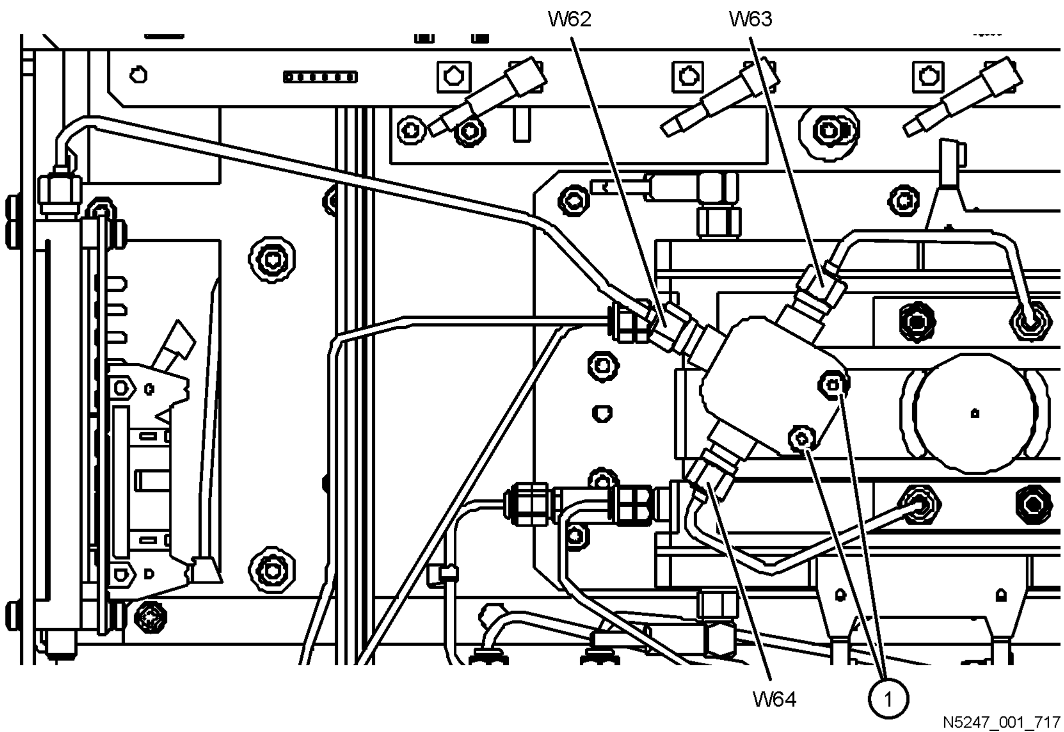
Replacement Procedure

1. Reverse the order of the removal procedure.

   Torque all RF cable connections to 10 in-lbs.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

1. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, and N5247-20110 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 “2-Port Configurations, Serial Number Prefixes <6021” on page 6-32 and “4-Port Configuration, Serial Number Prefixes <6021” on page 6-84.

Figure 7-18 A26 Splitter Removal[1]



1. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, and N5247-20110 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

Removing and Replacing the A27 and A28 Mixer Bricks

Tools Required

- T-8 TORX driver (set to 6 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 7-19 for this procedure.

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

1. Disconnect the power cord.
2. Remove the outer cover. Refer to "Removing the Covers" on page 7-8.
3. Position the analyzer bottom side up.
4. Remove the A26 splitter. Refer to "Removing and Replacing the A26 Splitter" on page 7-41.
5. The mixer bricks and the mounting blocks to which they are attached, must be removed as a complete assembly.
   Disconnect all semirigid cables (item ①) from the mixer bricks on the mounting blocks to be removed.
6. Disconnect the ribbon cables (item ②) from each of the mixer bricks.
7. Remove ten screws (item ③) from the mixer brick mounting block.
8. Move the disconnected semirigid cables out of the way and lift the mixer brick mounting block out of the analyzer just enough to allow the gray flexible RF cables (item ④) to be disconnected. It may be necessary to loosen the connector at the other end of some of the semirigid cables to allow them to be moved enough.

   Note the locations of each of the gray flexible cables for reconnection later. Disconnect these cables and remove the mixer brick mounting block with the mixer brick(s) from the analyzer.
9. If replacing a mixer brick, remove 3 screws (not shown) that fasten each mixer brick to the mixer brick mounting block.
10. If replacing the A28 mixer brick, remove the 3 dB pad (item ⑤) and keep it for reinstallation on the replacement mixer brick.

Replacement Procedure

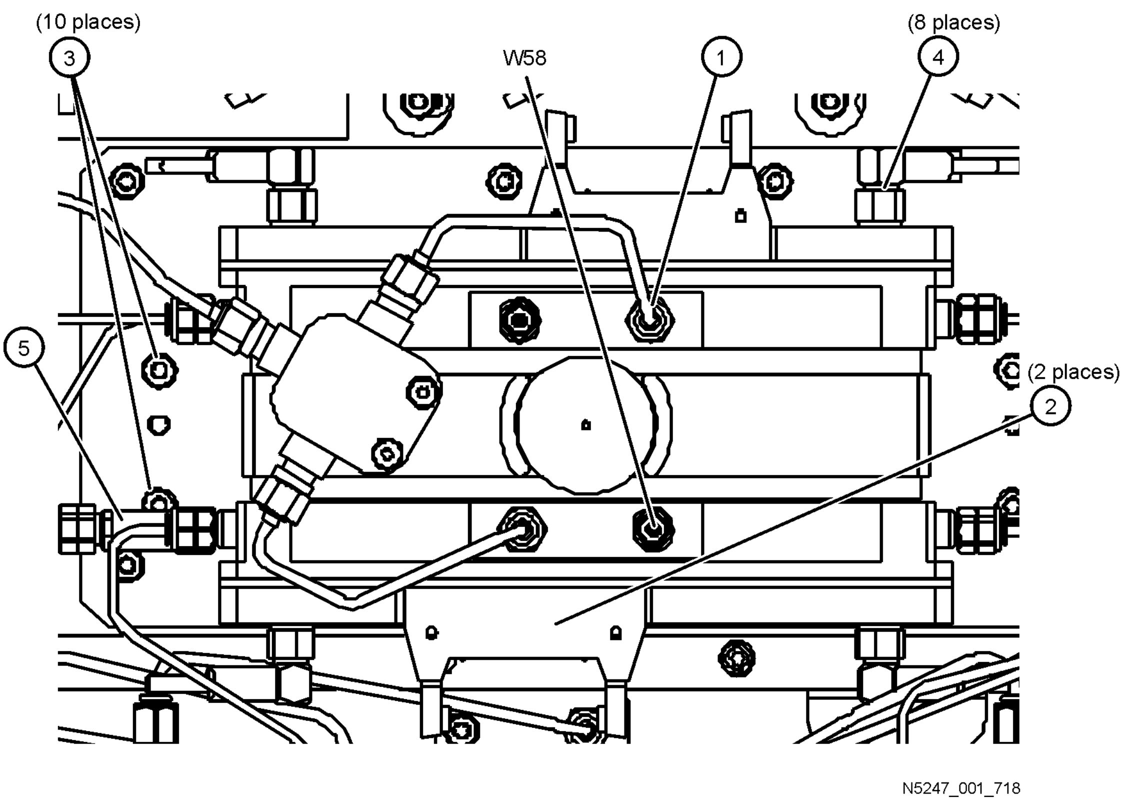
1. Reverse the order of the removal procedure.

   If replacing the A28 mixer brick, remember to install the W58 2.4 mm cap, removed from the old mixer brick, onto the new mixer brick in the same location.

   Torque all RF cable connections to 10 in-lbs.

2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Figure 7-19 A27 and A28 Mixer Bricks Removal[1]



1. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, and N5247-20110 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 “2-Port Configurations, Serial Number Prefixes <6021” on page 6-32 and “4-Port Configuration, Serial Number Prefixes <6021” on page 6-84.

Removing and Replacing the A29 –A32 Reference Couplers and Reference Coupler Mounting Brackets

Tools Required

– T-6 TORX driver (set to 4 in-lb)

– T-10 TORX driver (set to 9 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.

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

1. Disconnect the power cord.
2. Remove the outer cover. Refer to "Removing the Covers" on page 7-8.
3. Position the analyzer bottom side up.
4. Disconnect three semirigid cables (item ①) from the reference coupler to be replaced.
5. Remove three screws (item ②) from the mounting bracket of the reference coupler to be replaced.
6. Move the disconnected semirigid cables out of the way and lift the reference coupler mounting bracket, with the reference coupler attached, out of the analyzer. It may be necessary to loosen the connector at the other end of some of the semirigid cables to allow them to be moved enough.
7. Remove four screws that attach the reference coupler to be replaced to the reference coupler mounting bracket, and remove the reference coupler from the bracket.

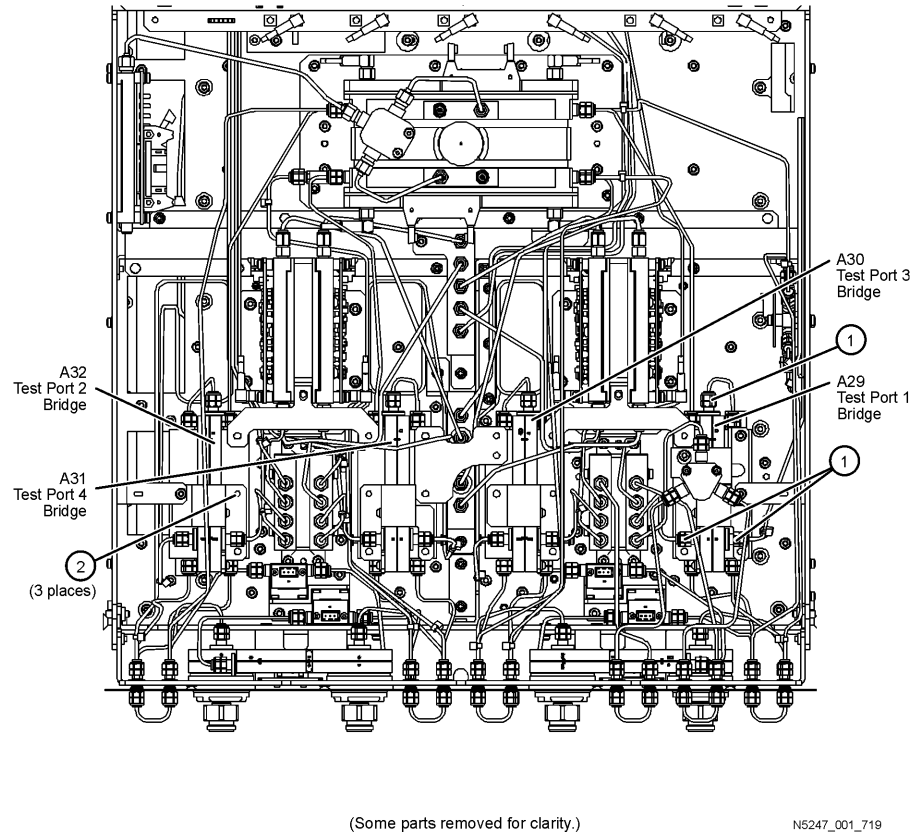
Replacement Procedure

1. Reverse the order of the removal procedure.

   Orient the position of the reference couplers and brackets as shown in Figure 7-21.

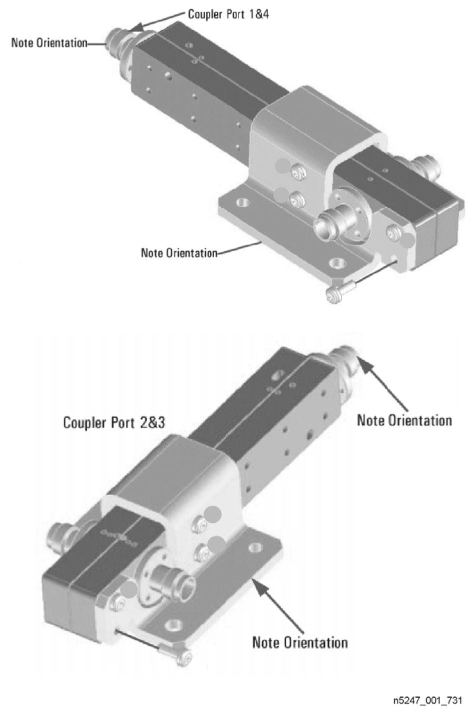
   Torque all RF connectors to 10 in-lbs.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Figure 7-20 A29 through A32 reference couplers removal[1]



1. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, and N5247-20110 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling, refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.

Figure 7-21 Orientation of Reference Couplers with Brackets



Removing and Replacing the A33–A36 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 7-22 for this procedure.

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

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. Position the analyzer bottom side up.
4. On 4-port models, it is necessary to remove the couplers in pairs: ports 1/3 and 2/4.
5. Disconnect two semirigid cables (item ①) from each coupler to be removed.
6. Disconnect the wire harness (item ②) from the corresponding front panel LED board and place it out of the way.
7. Remove the coupler nut (item ③) from each coupler to be removed.
8. Move the disconnected semirigid cables out of the way and remove the coupler(s) from the analyzer. It may be necessary to loosen the connector at the other end of some of the semirigid cables to allow them to be moved enough.

Replacement Procedure

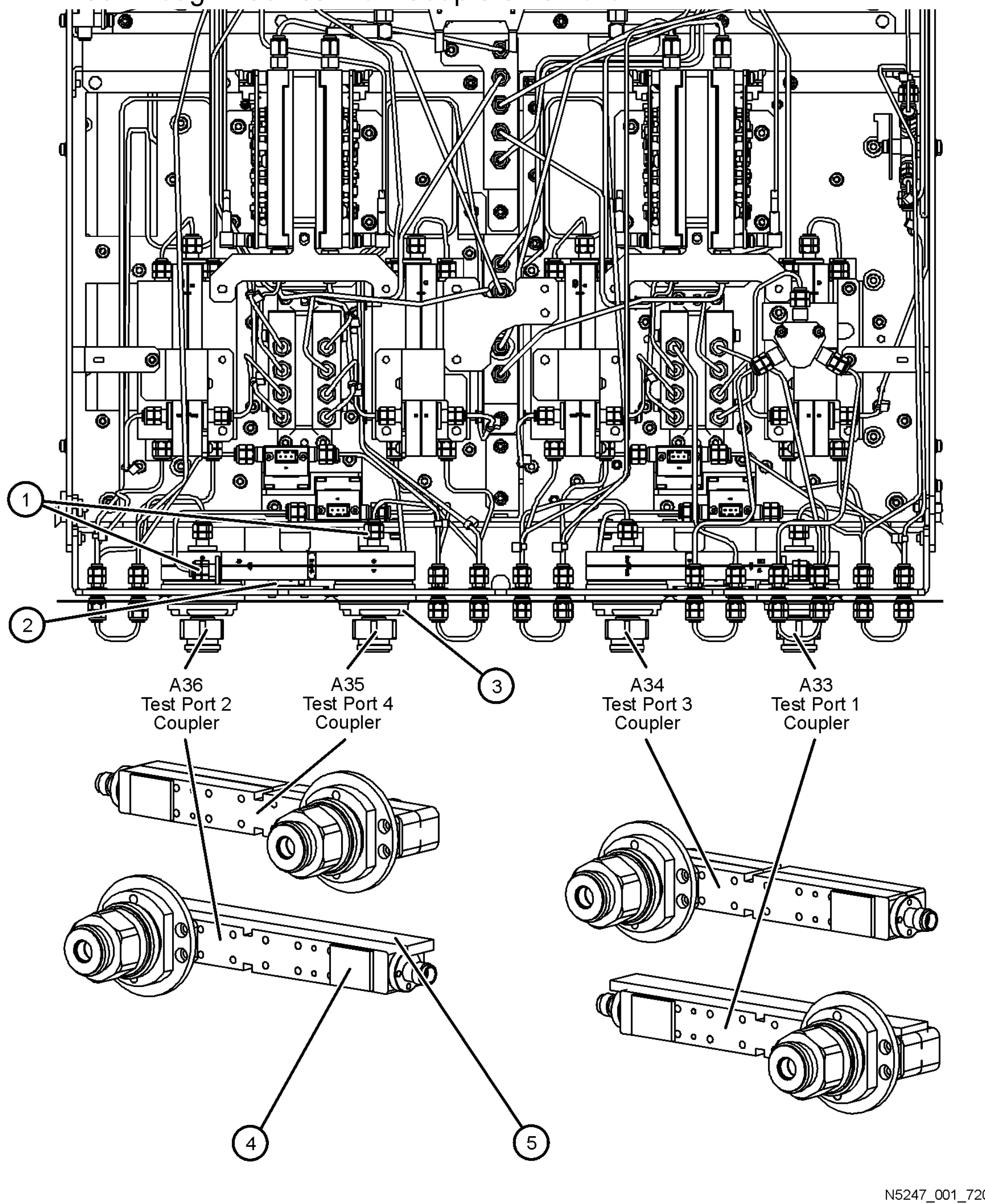
1. Reverse the order of the removal procedure.

   Adhere a new gap pad (4-port) or coupler bumper (2-port) (item ④) to the new coupler in the same location as on the old one. If necessary, replace the vibration mount (item ⑤). Refer to “Bottom Hardware and Miscellaneous Parts” on page 6-197 for replacement part numbers.

Torque all connectors to 10 in-lbs. Torque coupler nuts to 72 in-lbs.

2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Figure 7-22 A33 through A36 Test Port Couplers Removal



Removing and Replacing the A37 Reference Mixer Switch

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.

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

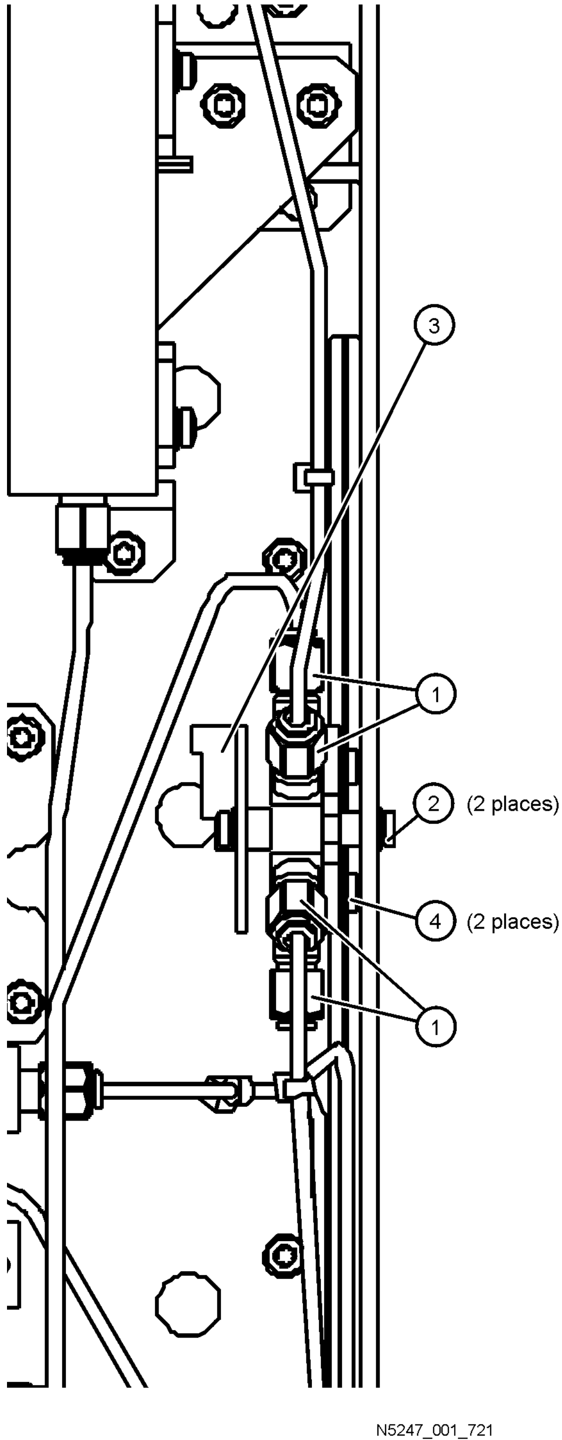
1. Disconnect the power cord.
2. Remove the outer cover. Refer to "Removing the Covers" on page 7-8.
3. Position the analyzer bottom side up.
4. Disconnect four semirigid cables (item ①) from the A37 reference mixer switch.
5. Remove two screws (item ②) that secure the A37 reference mixer switch to the side of the test set deck.
6. Move the disconnected semirigid cables out of the way and lift the A37 reference mixer switch and mounting bracket out of the analyzer. It may be necessary to loosen the connector at the other end of some of the semirigid cables to allow them to be moved enough.
7. Disconnect the wire harness cable (item ③) from the A37 reference mixer switch.
8. Remove two screws (item ④) that attach the A37 reference mixer switch to its mounting bracket.

Replacement Procedure

1. Reverse the order of the removal procedure.

   When reinstalling the A37 reference mixer switch into the analyzer, loosely install the two mounting screws (item ②). Connect the four semirigid cables (item ①) and torque the connectors to 10 in-lbs, then tighten the two mounting screws (item ②).
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Figure 7-23 A37 Reference Mixer Switch Removal



Removing and Replacing the A38–A41 Source Attenuators and the A46–A49 Receiver Attenuators

NOTE

IMPORTANT!

When an attenuator or a bypass switch is replaced in a PNA, it is important to reset the Mechanical Counter setting. Refer to “Resetting the Mechanical Counter” on page 7-101.

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 7-24 for this procedure.

CAUTION

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

1. Disconnect the power cord.
2. Remove the outer cover. Refer to “Removing the Covers” on page 7-8.
3. Position the analyzer bottom side up.
4. Disconnect the ribbon cable (item ①) from each attenuator to be removed.
5. The attenuators and the brackets to which they are attached, must be removed as a complete assembly.
   Disconnect two semirigid cables (item ②) from each attenuator to be removed. It may be necessary to remove additional cables to remove the attenuator bracket. If so, note the location and orientation of each for reinstallation later.
6. Remove four screws (item ③) that secure each attenuator bracket to the test set deck.
7. Move the disconnected semirigid cables out of the way and lift the attenuator bracket out of the analyzer, with the attenuator attached. It may be necessary to loosen the connector at the other end of some of the semirigid cables to allow them to be moved enough.
8. Remove two screws (not shown) from each attenuator to be removed from the mounting bracket.

Replacement Procedure

1. Reverse the order of the removal procedure.

   Orient the position of the attenuators and brackets as shown in Figure 7-25.

   Torque all cable connections to 10 in-lbs.

2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Figure 7-24 Source and Receiver Attenuators

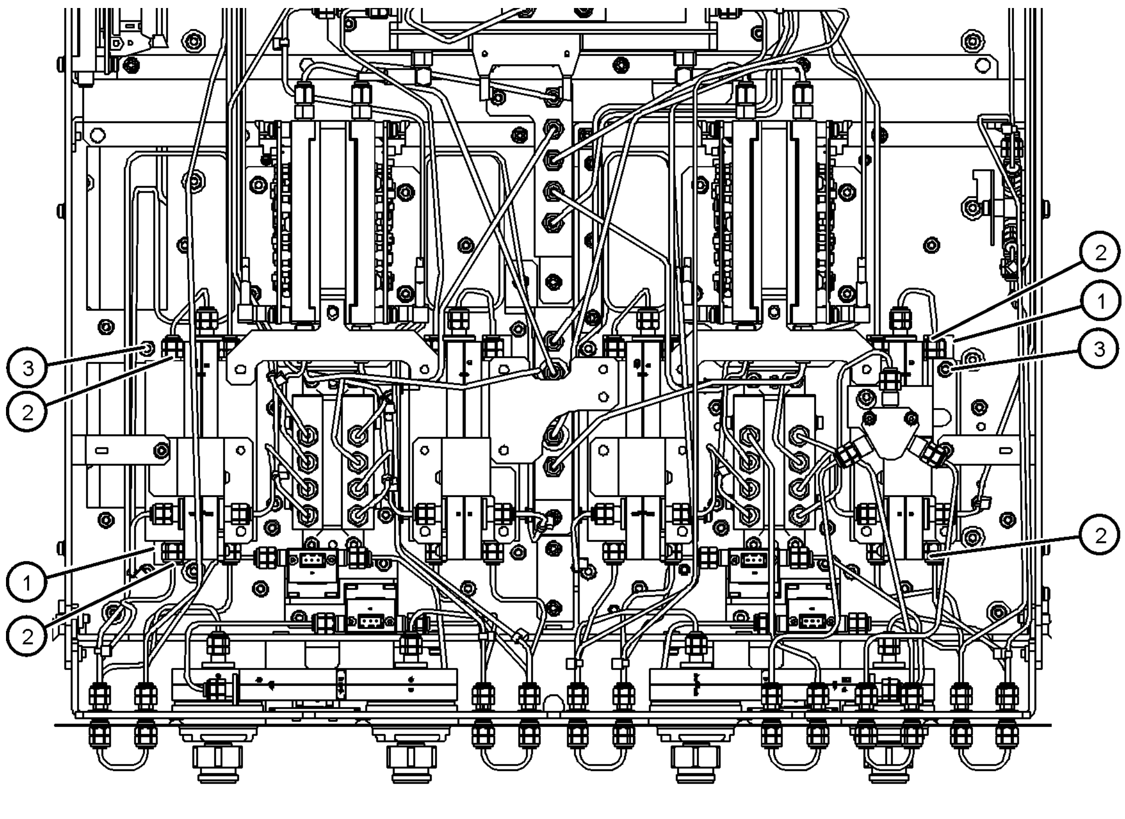
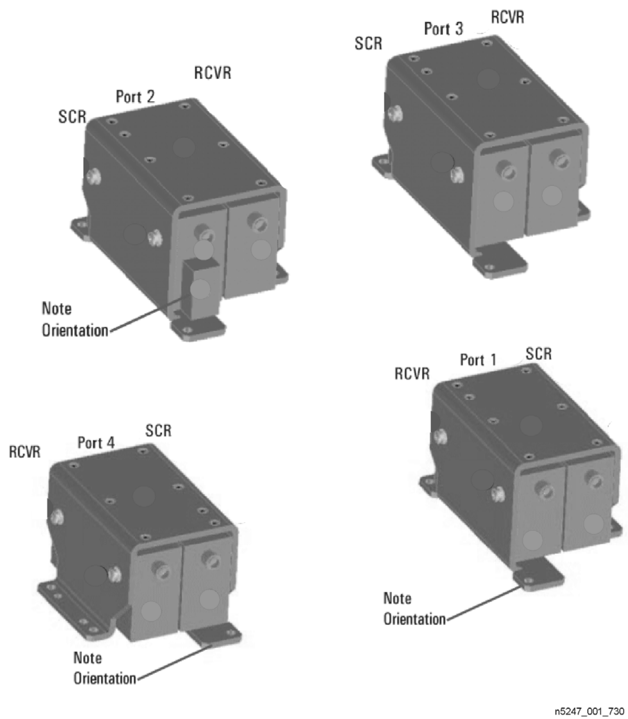


Figure 7-25 Orientation of Source and Receiver Attenuators with Brackets



Removing and Replacing the A42–A45 Bias Tees

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 7-26 for this procedure.

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

1. Disconnect the power cord.
2. Remove the outer cover. Refer to “Removing the Covers” on page 7-8.
3. Position the analyzer bottom side up.
4. The bias tees and the blocks to which they are attached, must be removed as a complete assembly.
   Disconnect four semirigid cables (item ①) from the bias tee block to be removed.
5. Disconnect the wire harness cable (item ②) from the bias tee.
6. Remove two test set deck screws (item ③) from the bias tee block to be removed.
7. Move the disconnected semirigid cables out of the way and remove the bias tee block from the analyzer. It may be necessary to loosen the connector at the other end of some of the semirigid cables to allow them to be moved enough.
8. Remove two screws from the bias tee in order to remove it from the bias tee block.

Replacement Procedure

1. Reverse the order of the removal procedure.

   Orient the position of the bias tees and block as shown in Figure 7-27.

   Torque all cable connections to 10 in-lbs.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Figure 7-26 A42 through A45 Bias Tees Removal

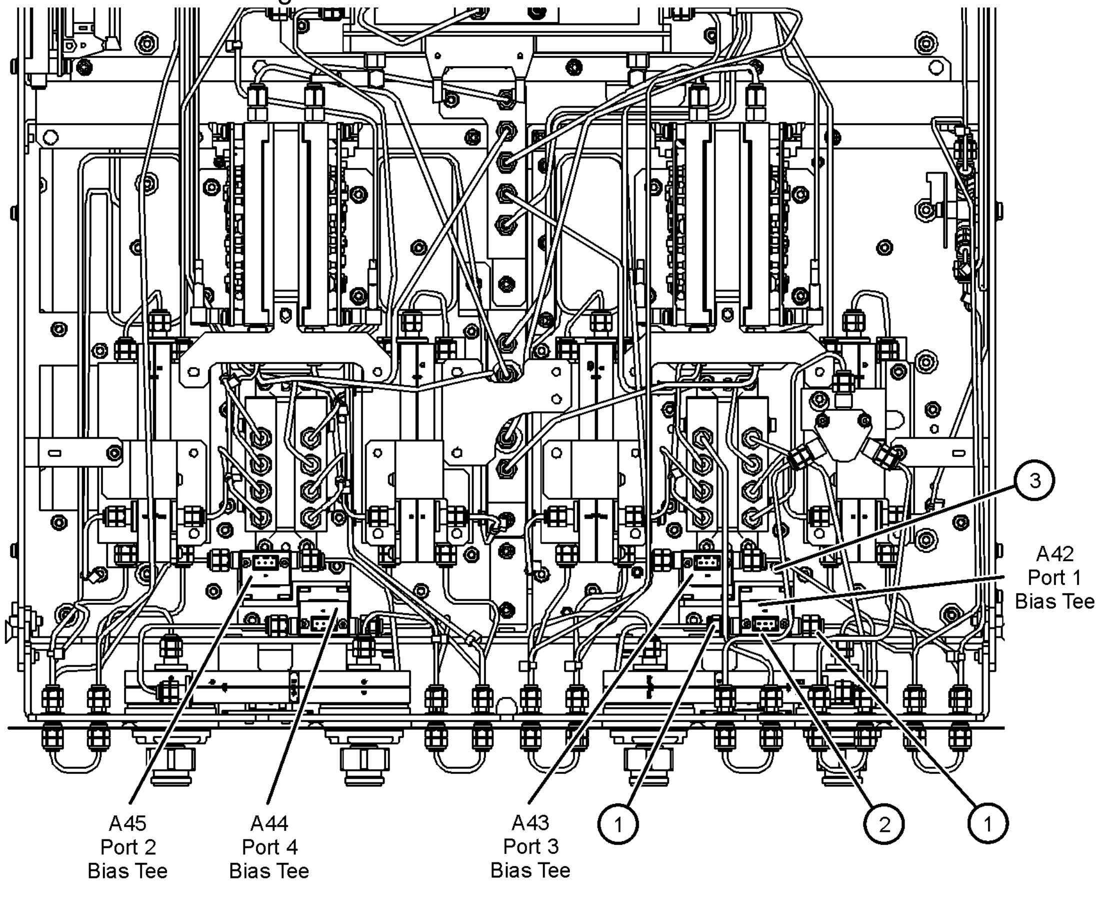
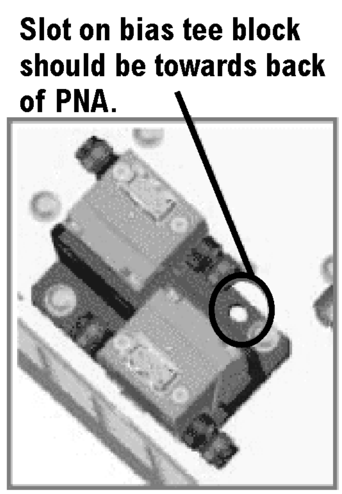


Figure 7-27 Orientation of Bias Tees with Block



Removing and Replacing the A50–A53 Bypass Switches and the A54 Combiner

NOTE

IMPORTANT!

When an attenuator or a bypass switch is replaced in a PNA-X, it is important to reset the Mechanical Counter setting. Refer to "Resetting the Mechanical Counter" on page 7-101.

Tools Required

T-6 TORX driver (set to 4 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 7-28 for this procedure.

CAUTION

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

1. Disconnect the power cord.
2. Remove the outer cover. Refer to "Removing the Covers" on page 7-8.
3. Position the analyzer bottom side up.
4. The bypass switches and the brackets to which they are attached, must be removed as a complete assembly.

   Disconnect all eight semirigid cables (item ①) from the bypass switches on the bracket to be removed.

   If removing the A54 combiner, disconnect three semirigid cables (item ②) from it.
5. Remove four screws (item ③) that secure the switch bracket to the test set deck.
6. Move the disconnected semirigid cables out of the way and remove the switch bracket, with the bypass switch attached, from the analyzer. It may be necessary to loosen the connector at the other end of some of the semirigid cables to allow them to be moved.
7. Disconnect the wire harness cable of the bypass switch to be removed from the test set motherboard.
8. Remove two screws that attach the bypass switch or the A54 combiner to its bracket.

Replacement Procedure

1. Reverse the order of the removal procedure.
   Torque all cable connectors to 10 in-lbs.
   Orient the A54 combiner so that the INPUT label is facing up.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Figure 7-28 A50 through A53 Bypass Switches and A54 Combiner Removal

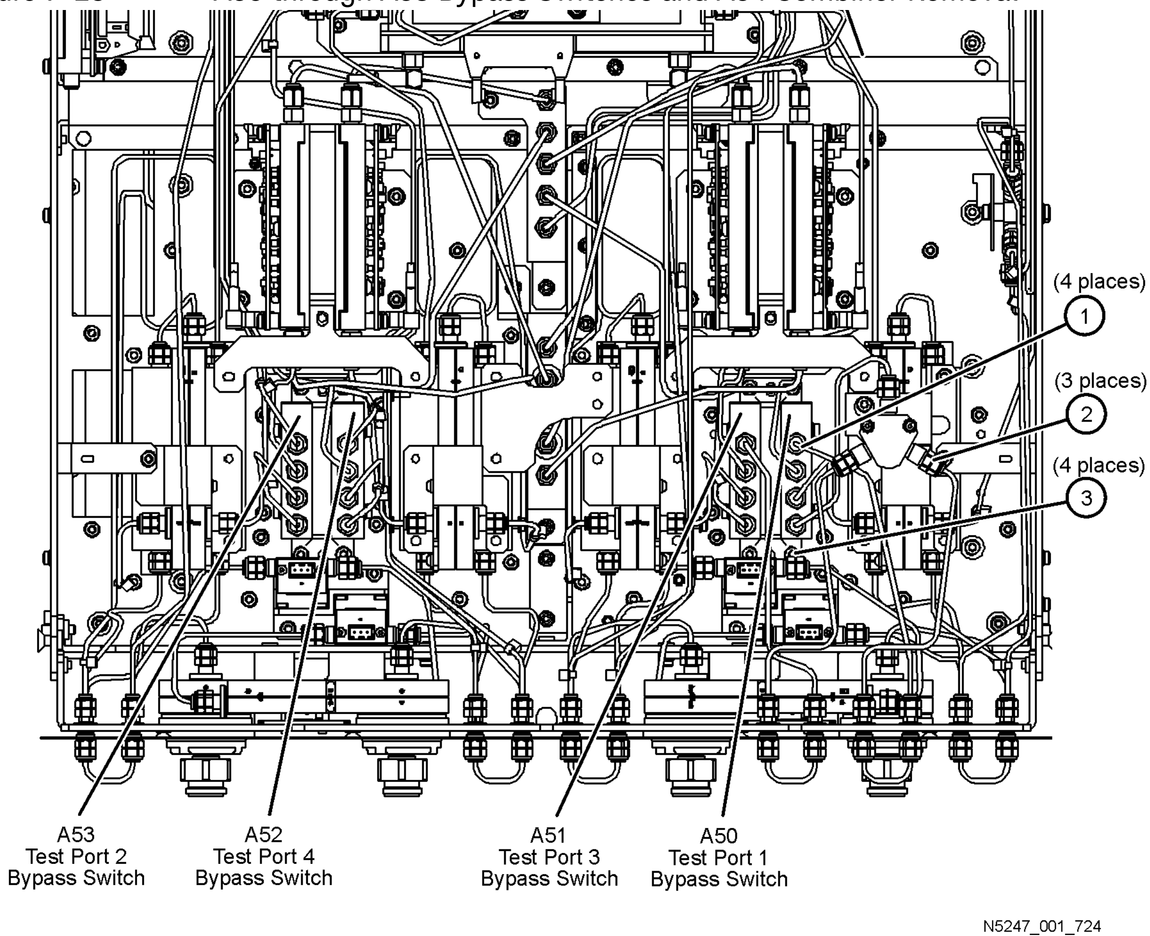
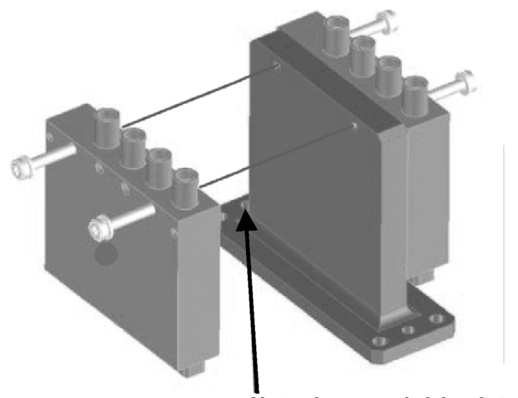


Figure 7-29 Orientation of Bypass Switches with Bracket



Removing and Replacing the A55 Solid State Drive (SSD)

Certain unique files exist on the SSD 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 SSD after it has been installed.

If you are replacing the SSD, the following procedure must be performed first.

Copy Unique Files from the Solid State Drive

– If installing an SSD for Windows XP: if the user has loaded unique calibration kit information, navigate to `C:\Program Files\Keysight\Network Analyzer` and copy USER_CALKITFILE to a USB flash memory drive. Also copy any personal user files that you wish to preserve.

  Obsolete. Reference only.

– If installing an SSD for Windows 7: for more information on the N8984A SSD, refer to the *Windows 7 Operating System Upgrade Kit Installation Note*, available online at https://www.keysight.com/us/en/assets/9018-04311/installation-guides/9018-04311.pdf (N8984-90001).

  Obsolete. Reference only.

– If installing an SSD for Windows 10: for more information on the N8985A SSD, refer to the *Windows 10 Operating System Upgrade Kit Installation Note*, available online at https://www.keysight.com/us/en/assets/9018-04733/installation-guides/9018-04733.pdf (N8985-90001).

Tools Required

– T-10 TORX driver (set to 9 in-lb; for solid state drive replacement)

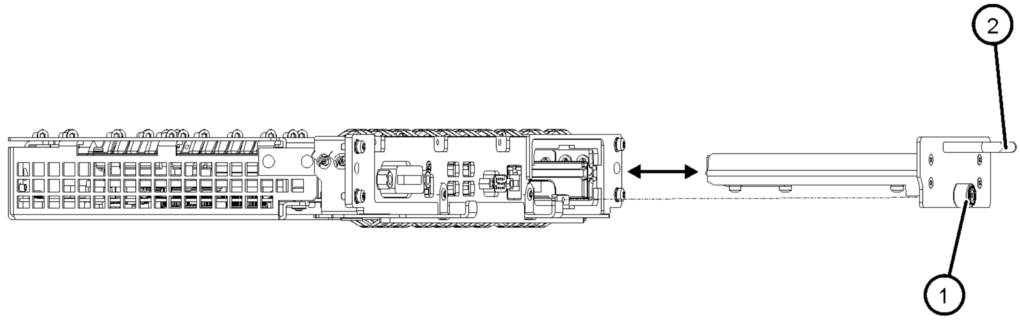
– ESD grounding wrist strap

Removal Procedure

Refer to Figure 7-30 for this procedure.

1. Disconnect the analyzer power cord.
2. Position the analyzer for access to the rear panel.
3. Loosen the SSD thumb screw (item ①).
4. Pull the SSD out from the CPU assembly, using the handle (item ②).

Figure 7-30 Solid State Drive Assembly Removal



Reinstalling the SSD

Reverse the order of the removal procedure.

Install Backup Files Onto the New Solid State Drive

The files that were previously saved onto a USB flash memory drive must now be installed onto the new SSD. The network analyzer must be powered up and operating.

Removing and Replacing the A60–A63 70 GHz Doublers

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 7-31 for this procedure.

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

1. Disconnect the power cord.
2. Remove the outer cover. Refer to “Removing the Covers” on page 7-8.
3. Position the analyzer bottom side up.
4. Remove the brace (item ①) connected to the 70 GHz doublers mounting bracket to be removed. For 4-port models, also remove the brace (item ②) that partially covers the front cable bracket (for 4 semirigid cables).
5. The 70 GHz doublers and the mounting brackets to which they are attached, must be removed as a complete assembly.
   Disconnect all semirigid cables (item ③) from each 70 GHz doubler on the mounting bracket to be removed.
6. Disconnect the ribbon cable (item ④) from each doubler.
7. Remove six screws (item ⑥) that attach the doubler mounting bracket to the test set deck.
8. Move the disconnected semirigid cables out of the way and lift the doubler mounting bracket, with the two doublers attached, out of the analyzer just enough to allow the gray flexible RF cables (item ⑤) to be disconnected. It may be necessary to loosen the connector at the other end of some of the semirigid cables to allow them to be moved enough.

   Note the locations of each of the gray flexible cables for reconnection later. Disconnect these cables and remove the doubler mounting bracket, with the two doublers attached, from the analyzer.
9. Remove three screws that attach the doubler to be replaced to its mounting bracket, and remove the doubler from the bracket.

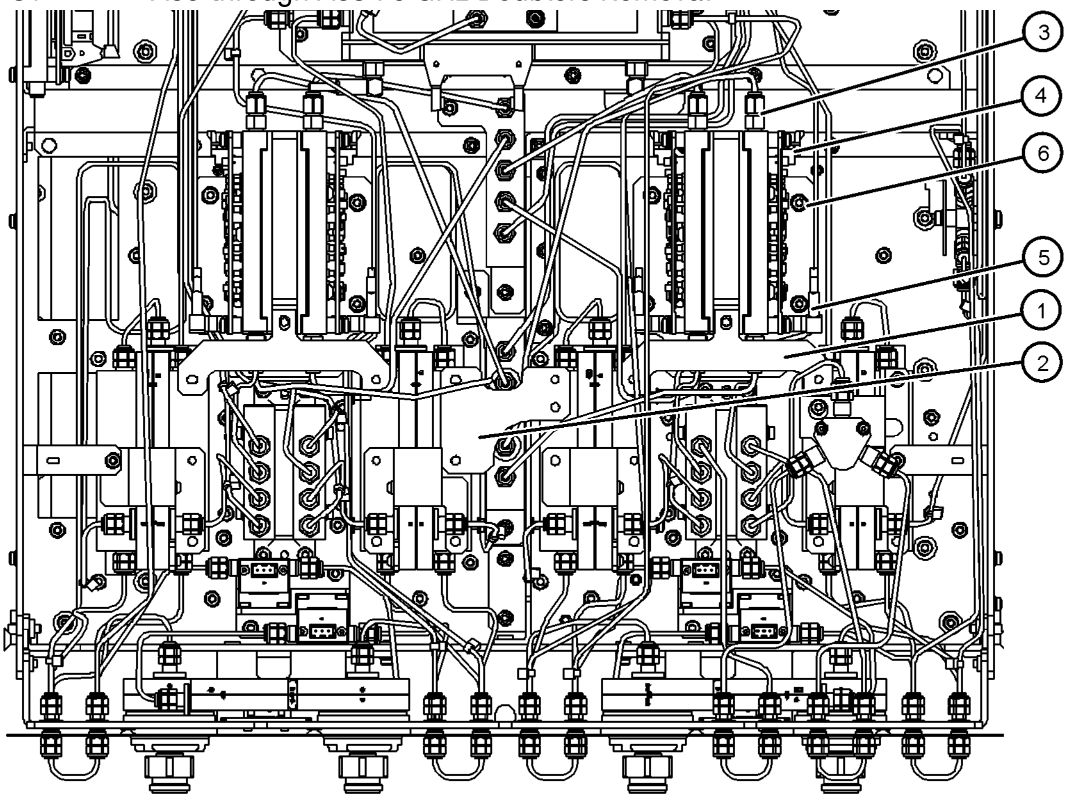
Replacement Procedure

1. Reverse the order of the removal procedure.

   Torque all cable connections to 10 in-lbs.

2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Figure 7-31 A60 through A63 70 GHz Doublers Removal



Removing and Replacing the A56 Port 1 Noise Bypass Switch (Option 029 or E29)

NOTE

IMPORTANT!

When an attenuator or a bypass switch is replaced in a PNA, it is important to reset the Mechanical Counter setting. Refer to "Resetting the Mechanical Counter" on page 7-101.

Tools Required

T-6 TORX driver (set to 4 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 7-32 for this procedure.

CAUTION

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

1. Disconnect the power cord.
2. Remove the outer cover. Refer to "Removing the Covers" on page 7-8.
3. Position the analyzer bottom side up.
4. Disconnect four semirigid cables (item ①) from the A56 port 1 bypass switch.

   It may be necessary to disconnect or remove other cables to gain access. If you do, make note of these cable connections for reconnection later.
5. Disconnect the A56 bypass switch wire harness cable (item ②) from the A59 noise receiver (downconverter). Make note of the routing of this wire harness so that the wire harness for the new bypass switch can be routed in the same manner.
6. Remove the two screws (item ③) that secure the switch to the switch bracket.
7. Move the disconnected semirigid cables out of the way and remove the switch from the analyzer. It may be necessary to loosen the other end of the cables to allow them to be moved. Do not overbend them.

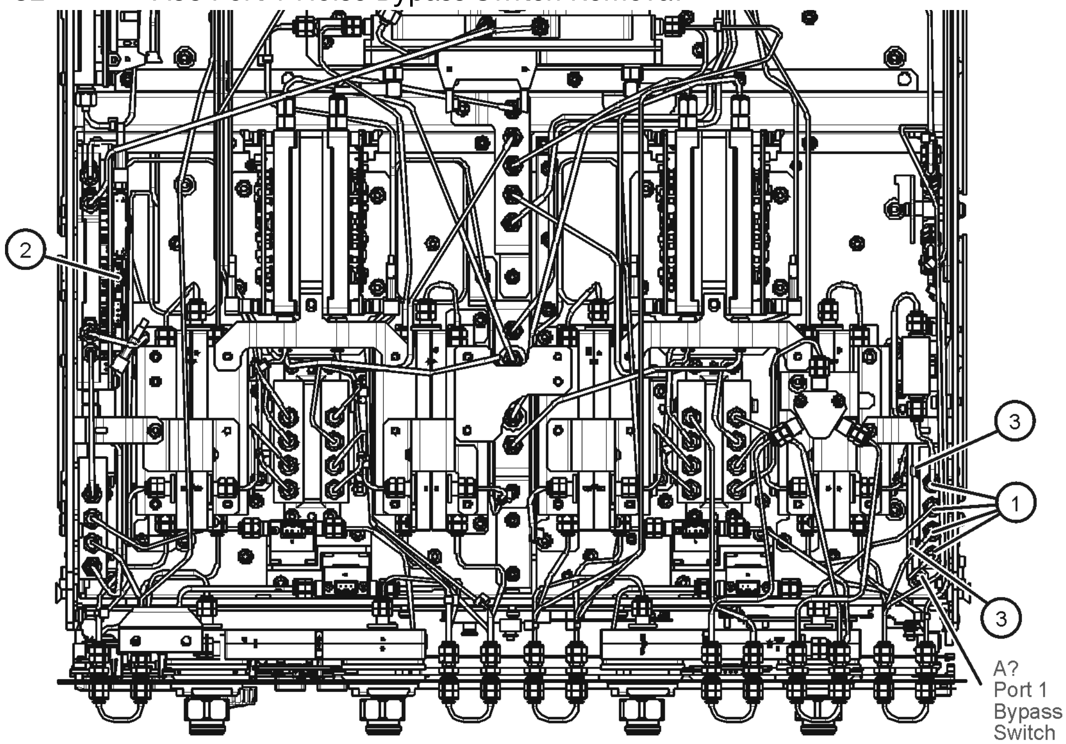
Replacement Procedure

1. Reverse the order of the removal procedure reusing the existing hardware.

   Torque all cable connectors to 10 in-lbs.

2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Figure 7-32 A56 Port 1 Noise Bypass Switch Removal



Removing and Replacing the A57 Port 2 Noise Bypass Switch (Option 029 or E29)

NOTE

IMPORTANT!

When an attenuator or a bypass switch is replaced in a PNA, it is important to reset the Mechanical Counter setting. Refer to "Resetting the Mechanical Counter" on page 7-101.

Tools Required

T-6 TORX driver (set to 4 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 7-33 for this procedure.

CAUTION

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

1. Disconnect the power cord.
2. Remove the outer cover. Refer to "Removing the Covers" on page 7-8.
3. Position the analyzer bottom side up.
4. Disconnect four semirigid cables (item ①) from the A57 port 2 bypass switch.

   It may be necessary to disconnect or remove other cables to gain access. If you do, make note of these cable connections for reconnection later.
5. Disconnect the A57 bypass switch wire harness cable (item ②) from the A59 noise receiver (downconverter). Make note of the routing of this wire harness so that the wire harness for the new bypass switch can be routed in the same manner.
6. Remove two screws (item ③) that secure the switch to the switch bracket.
7. Move the disconnected semirigid cables out of the way and remove the switch from the analyzer. It may be necessary to loosen the other end of the cables to allow them to be moved. Do not overbend them.

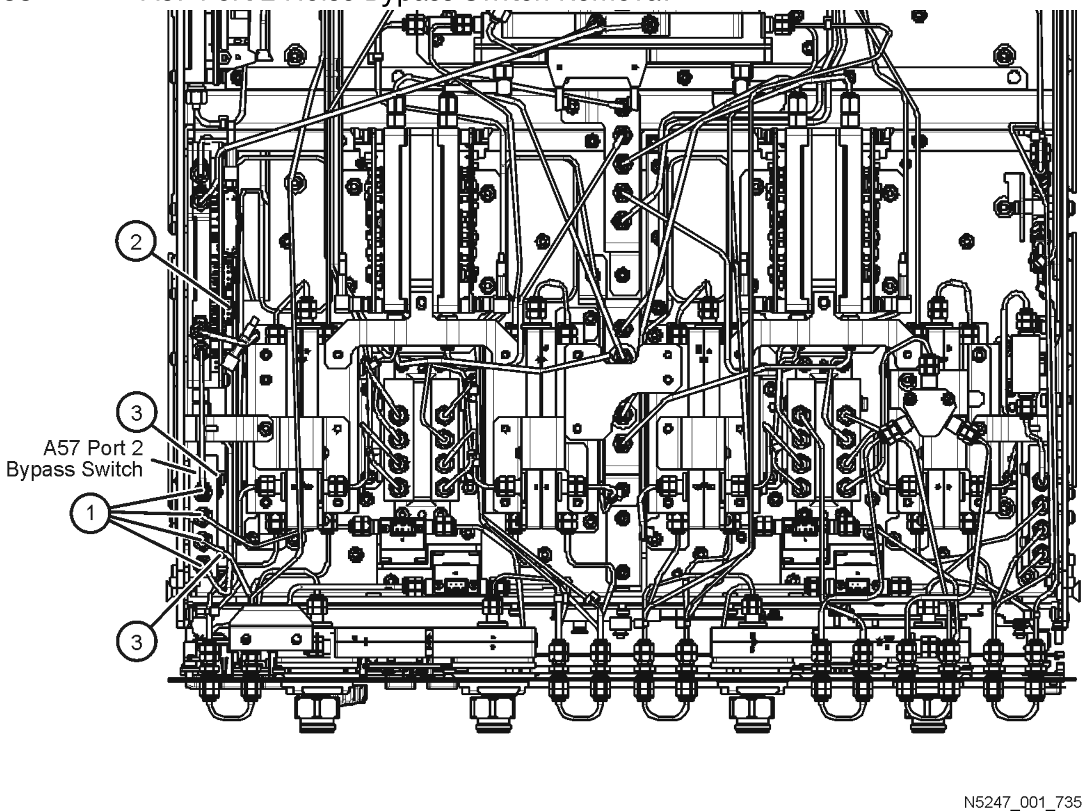
Replacement Procedure

1. Reverse the order of the removal procedure reusing the existing hardware.

   Torque all cable connectors to 10 in-lbs.

2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Figure 7-33 A57 Port 2 Noise Bypass Switch Removal



Removing and Replacing the A59 Noise Receiver (downconverter) – (Option 029 or E29)

Tools Required

T-6 TORX driver (set to 4 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 7-34 for this procedure.

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

1. Disconnect the power cord.
2. Remove the outer cover. Refer to "Removing the Covers" on page 7-8.
3. Position the analyzer bottom side up.
4. Disconnect all cables and wire harnesses from the A59 noise receiver (downconverter). Make note of all cable connections for reconnection later.

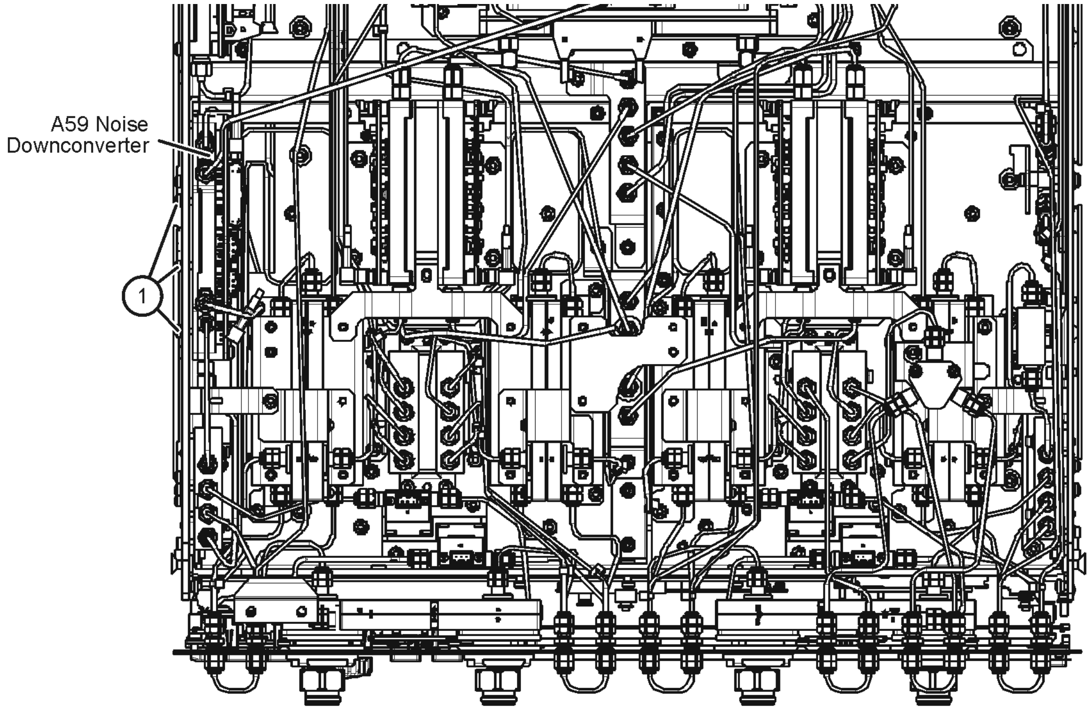
   It may be necessary to disconnect or remove other cables to gain access. If you do, make note of these cable connections for reconnection later.
5. Loosen three screws (item ①) that secure the A59 noise receiver (downconverter) to the chassis.
6. Move the disconnected cables out of the way and remove the A59 noise receiver (downconverter) from the analyzer. It may be necessary to loosen the other end of the coaxial cables to allow them to be moved. Do not overbend them.

Replacement Procedure

1. Reverse the order of the removal procedure reusing the existing hardware.

   Torque all cable connectors to 10 in-lbs.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Figure 7-34 A59 noise receiver (downconverter) Removal



Removing and Replacing the A64 Tuner (Option 029 or E29)

Tools Required

T-6 TORX driver (set to 4 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 7-33 for this procedure.

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

1. Disconnect the power cord.
2. Remove the outer cover. Refer to "Removing the Covers" on page 7-8.
3. Position the analyzer bottom side up.
4. Disconnect two semirigid cables (item ①) from the A64 tuner.

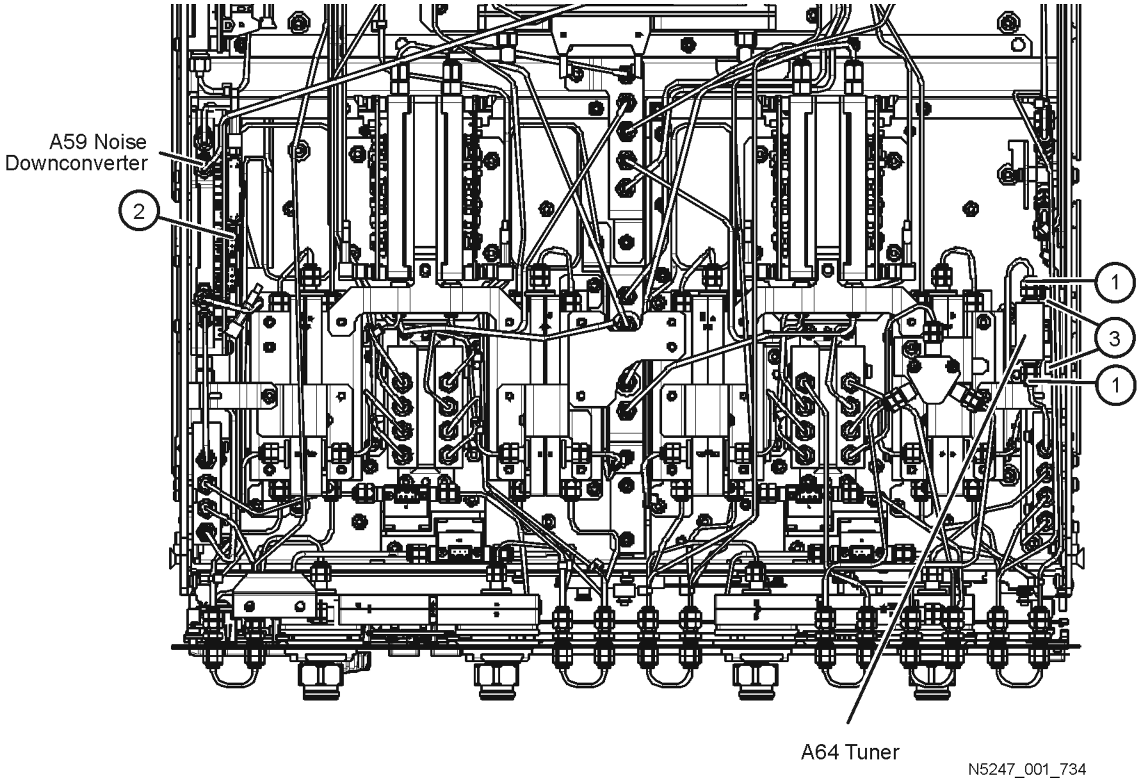
   It may be necessary to disconnect or remove other cables to gain access. If you do, make note of these cable connections for reconnection later.
5. Disconnect the A64 tuner wire harness cable (item ②) from the A59 noise receiver (downconverter). Make note of the routing of this wire harness so that it can be rerouted later in the same manner.
6. Remove two screws (item ③) that secure the A64 tuner to its bracket.
7. Move the disconnected semirigid cables out of the way and remove the tuner from the analyzer. It may be necessary to loosen the other end of the cables to allow them to be moved. Do not overbend them.

Replacement Procedure

1. Reverse the order of the removal procedure reusing the existing hardware.

   Torque all cable connectors to 10 in-lbs.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Figure 7-35 A64 Tuner Removal



Removing and Replacing the A70 or A75 Low Frequency Extension (LFE) Board

Tools Required

- T-10 TORX driver (torque to 9 in-lb or 1.02 N.m)
- T-20 TORX driver (torque to 21 in-lb or 2.38 N.m)
- 5/16 inch open-end torque wrench (torque to 10 in-lb or 1.13 N.m)
- ESD grounding wrist strap

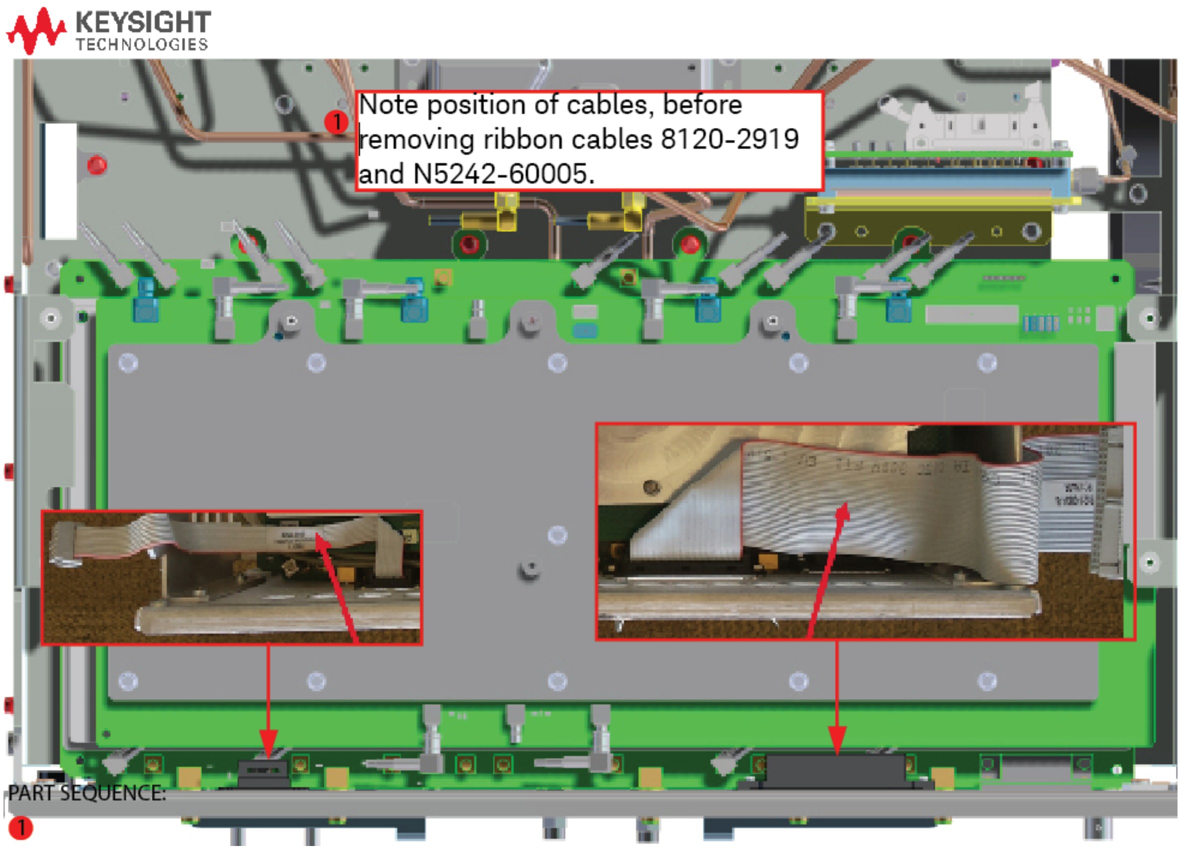
Removal Procedure

Refer to Figure 7-36 on page 7-73, Figure 7-37 on page 7-74, Figure 7-39 on page 7-76, Figure 7-40 on page 7-77, and Figure 7-41 on page 7-78 for this procedure.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to "Removing the Covers" on page 7-8.
3. Position the analyzer bottom side up.
4. Remove the A23 test set motherboard. Refer to "Removing and Replacing the A23 Test Set Motherboard" on page 7-34.

5. Disconnect the 8121-2919 and N5245-60005 ribbon cables. Refer to Figure 7-36 on page 7-73.

Figure 7-36 Disconnect Ribbon Cables from Rear Panel Connectors (8121-2919, N5245-60005)



6. Disconnect ALL gray flexible RF cables (item ① through ⑧) from the A70/A75 LFE board.
   - For Version 6 Synthesizers, refer to Figure 7-37 on page 7-74.
   - For Version 7 Synthesizers, refer to Figure 7-38 on page 7-75.

Figure 7-37 Version 6 Synthesizers: A70 4-Port LFE Board Remove Cables (8120-5014 (x2), 8120-5017 (x3), N5242-60079, N5242-60027, N5242-60080).

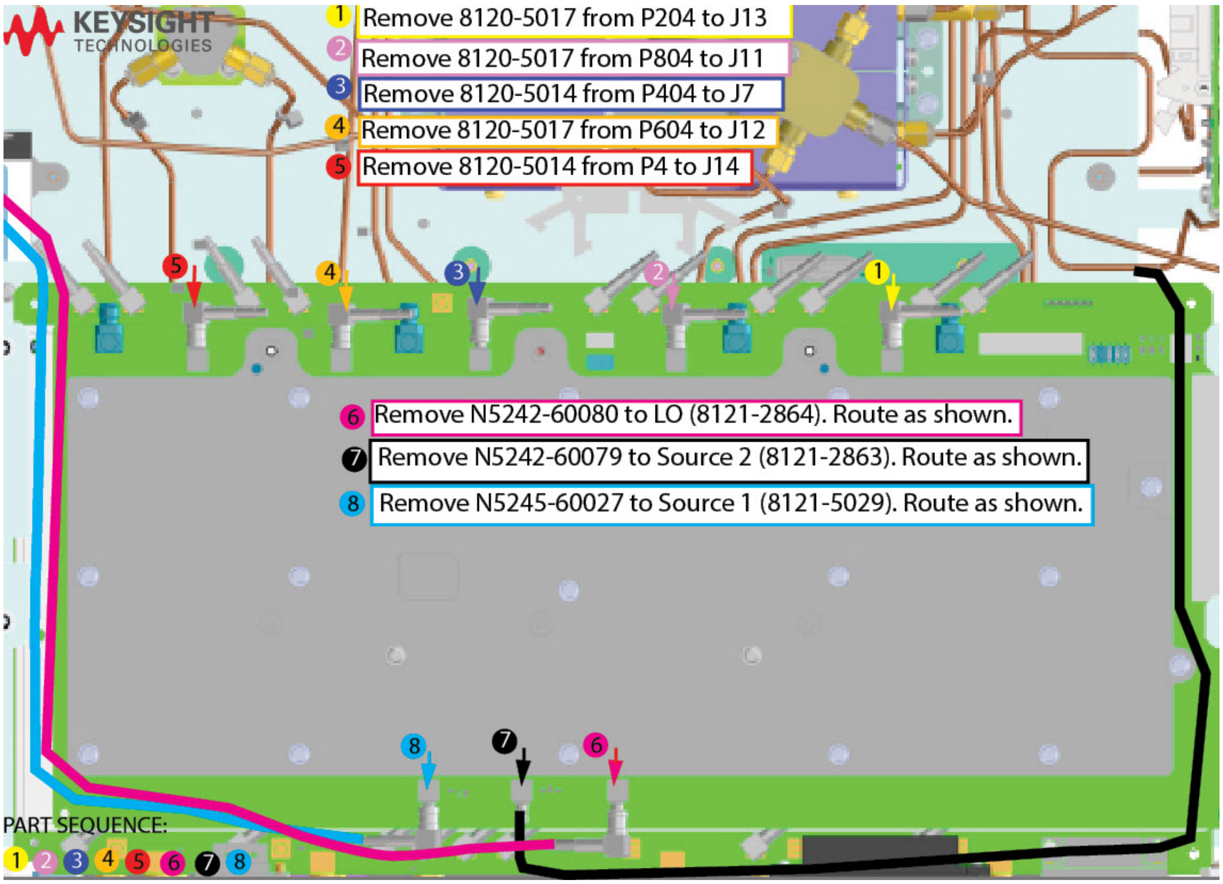
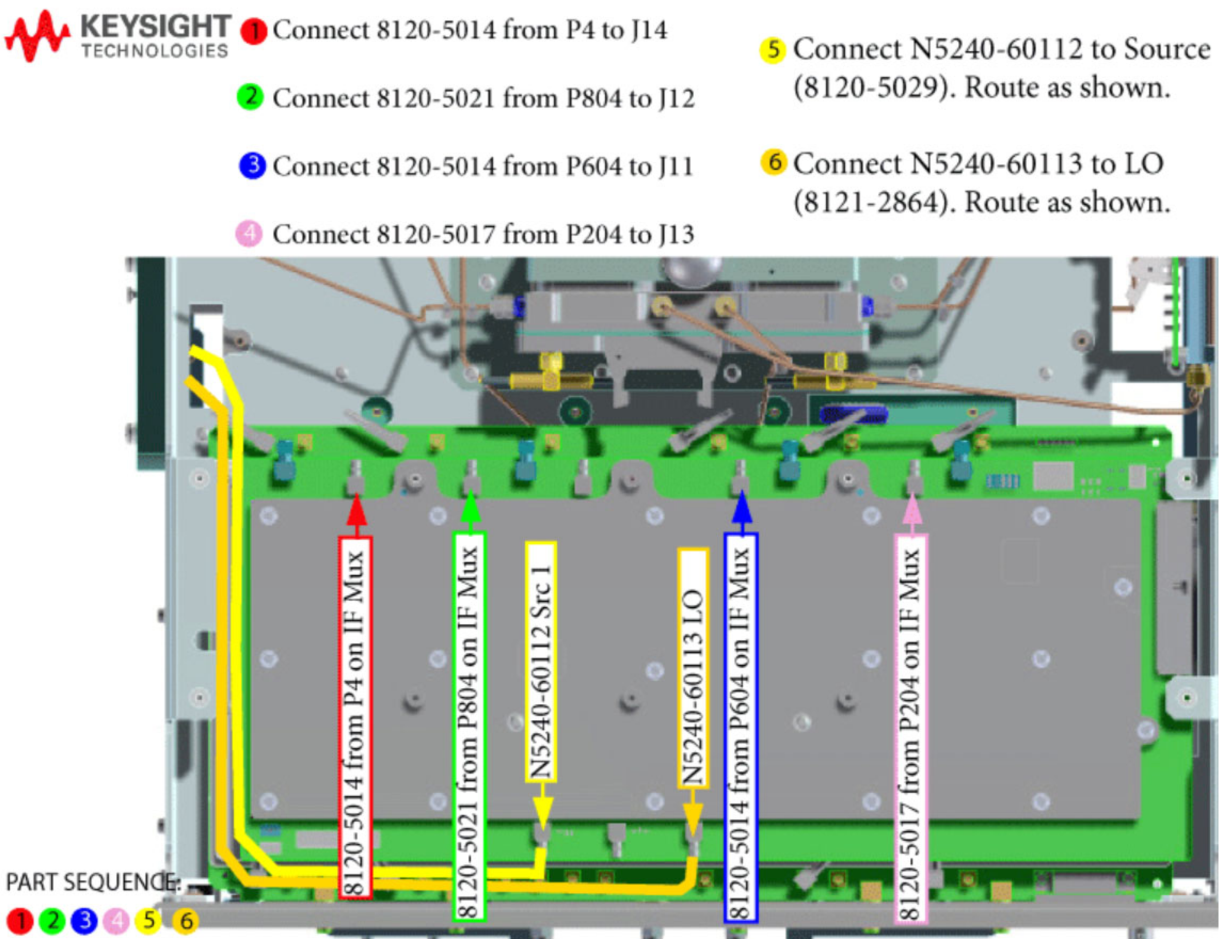
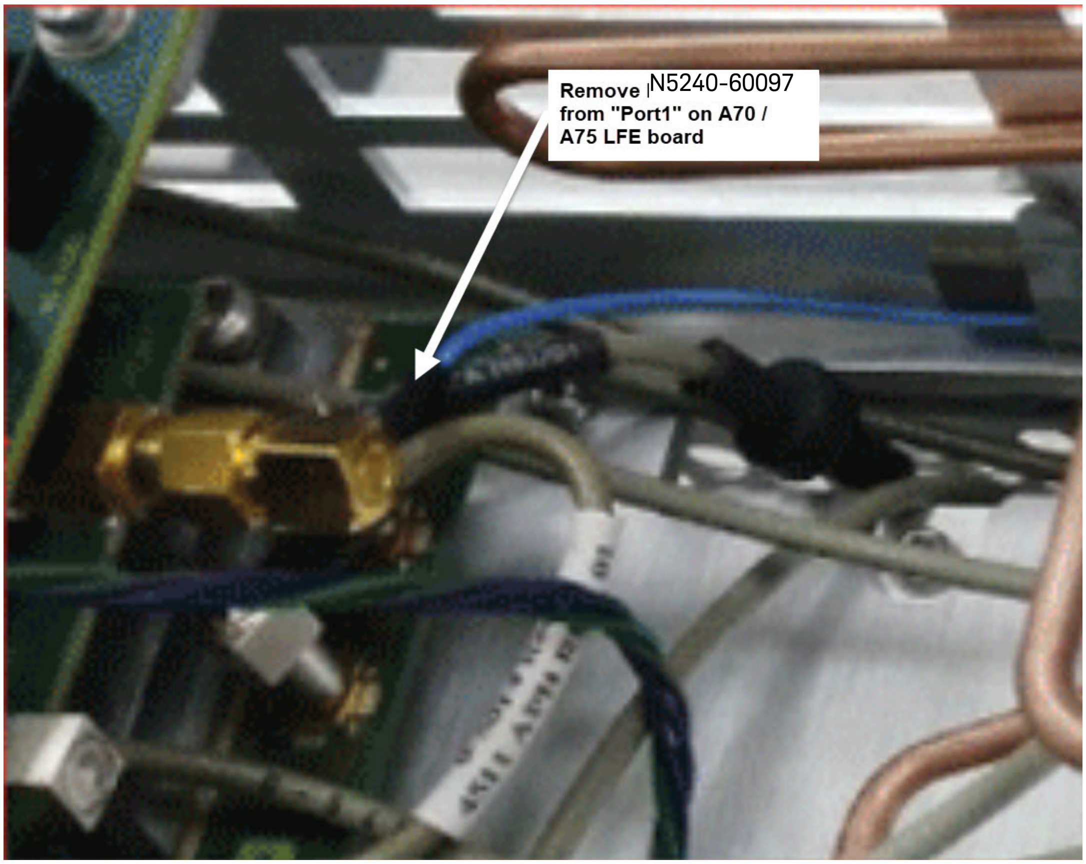


Figure 7-38 Version 7 Synthesizers: A70 4-Port LFE Board Remove Cables (8120-5014 (x2), 8120-5017 (x3), N5242-60079, N5242-60027, N5242-60080).



7. Remove port 1 bias combiner “RF IN” cable from the “Port1” connector on the LFE board. Refer to Figure 7-39 on page 7-76.

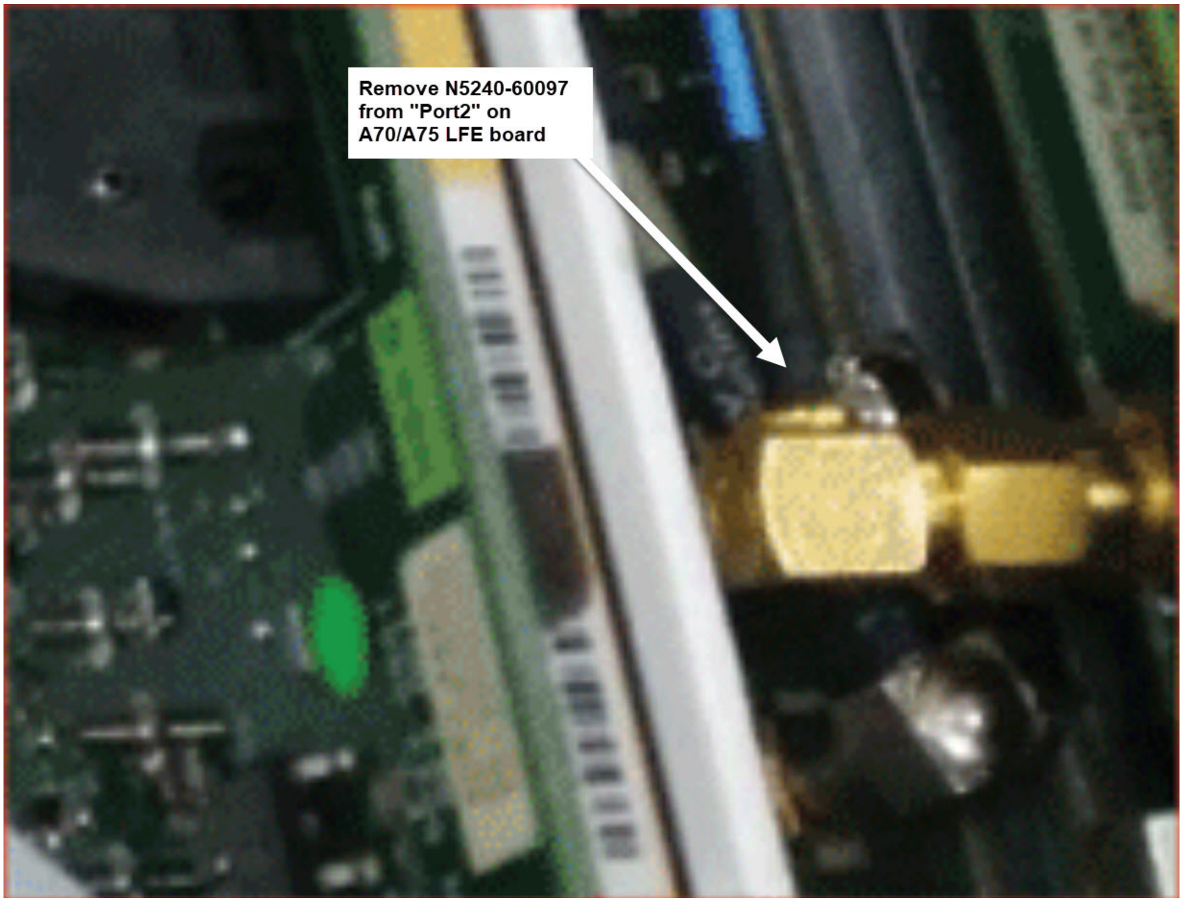
Figure 7-39 Remove A71 bias combiner cable (N5240-60097) from “Port1” connector on the A70 LFE board



8. **A70 LFE boards only**: Remove port 3 bias combiner “RF IN” cable from the “Port3” connector on the LFE board. Similar to Figure 7-39 on page 7-76.

9. Remove A74 port 2 bias combiner "RF IN" cable to "Port2" connector on the LFE board.

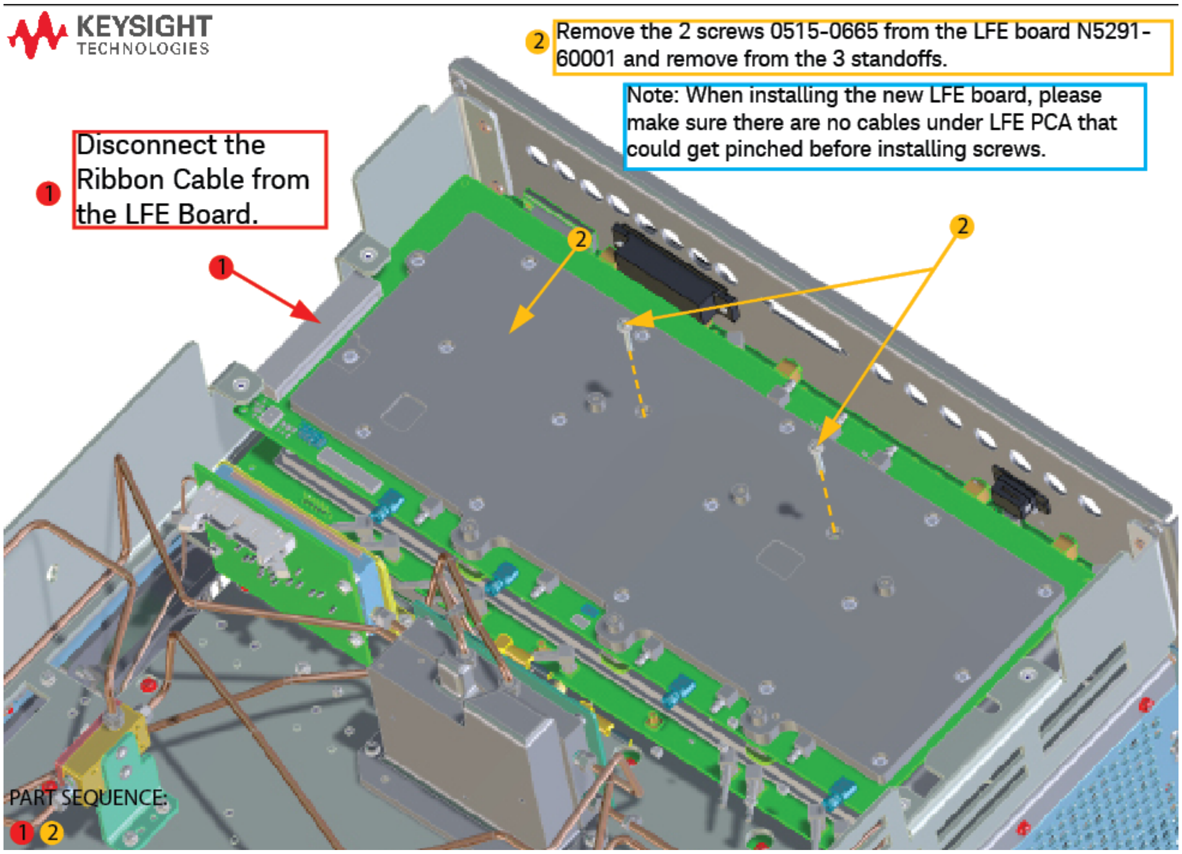
Figure 7-40 A74 port 2 bias combiner cable (N5240-60097) from "Port2" connector on the A70 LFE board



10. **A70 LFE boards only**: Remove port 4 bias combiner "RF IN" cable from the "Port4" connector on the LFE board. Similar to Figure 7-40 on page 7-77.

11. Disconnect the ribbon cable (item ①) from the A70 LFE board. Refer to Figure 7-41 on page 7-78.

Figure 7-41 A70 LFE Board Removal (N5291-60001, 0515-0665 (x2)). (A75 LFE Board (N5291-60005) Removal is Similar.)



12. Remove the two screws from the LFE board (item ②). Save for reuse. Refer to Figure 7-41 on page 7-78.

13. Lift the LFE board (N5291-60001) and remove it from the analyzer. Refer to Figure 7-41 on page 7-78.

Replacement Procedure

1. Reverse the order of the removal procedure.

   Attach the new A70/A75 LFE board to the standoffs using the screws removed from the old one.

2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Removing and Replacing the A71–A74 Bias Tee Combiners

NOTE

– Four port PNAs use the A70 LFE board.

– Two port PNAs use the A75 LFE board.

The A70 LFE board RF flexible cable's connector labels on port 3 and port 4 connectors on the A70 LFE board are similar to the A75 LFE board's port 1 and port 2 connector labels.

Tools Required

- T-6 TORX driver - set to 6 in-lbs (0.68 N.m)
- T-10 TORX driver (torque to 9 in-lb or 1.02 N.m)
- T-20 TORX driver (torque to 21 in-lb or 2.38 N.m)
- 5/16-inch open-end torque wrench (torque to 10 in-lb or 1.13 N.m)
- 5/16-inch open-end wrench (to stabilize the bias tee combiner when torquing cables)
- ESD grounding wrist strap

Removal Procedure

Refer to Figure 7-42 on page 7-81, Figure 7-43 on page 7-81, Figure 7-44 on page 7-82, Figure 7-45 on page 7-82, and Figure 7-46 on page 7-83 for this procedure.

CAUTION

Be careful not to damage the center pins of the semirigid cables. Some flexing of the cables is necessary to remove assemblies but do not over-bend them.

1. Disconnect the power cord.
2. Remove the outer cover. Refer to "Removing the Covers" on page 7-8.
3. Position the analyzer bottom side up.
4. Remove the A23 test set motherboard. Refer to "Removing and Replacing the A23 Test Set Motherboard" on page 7-34.
5. Disconnect the two semirigid cables (item ① and ④) from the bias tee combiner to be removed. Refer to Figure 7-42 on page 7-81.
6. Remove two screws from the bias tee combiner and bracket-to-chassis assembly to be removed (Do item ① only). Refer to Figure 7-43 on page 7-81.

   Do **not** remove the bias combiner from the bracket yet (item ② is done in step 8).

7. Make note of the orientation of the two cable wires and ground cable clamp for reinstallation later.

- Remove the DC bias cable (item ③) from the Bias Combiner. Refer to Figure 7-42 on page 7-81. See also Figure 7-44 on page 7-82.
- Remove the screw, cable ground clamp, and RF cable (item ②) from the Bias Combiner. Refer to Figure 7-42 on page 7-81. See also Figure 7-45 on page 7-82.

8. Remove two screws that attach the bias tee combiner to the bracket (Now do item ②). Refer to Figure 7-43 on page 7-81.

9. Repeat steps 4 through 7 for the other bias combiners.

Replacement Procedure

CAUTION Ensure that when the bias combiner semirigid cables are torqued that one 5/16 in wrench is used to stabilize the connector on the combiner and the second wrench is used to torque the semirigid cable to 10 in-lbs.

NOTE **IMPORTANT!** Some figures show examples of more than one bias combiner or bias combiner cable being remove. is It only necessary to remove the defective bias combiner.

1. Reverse the order of the removal procedure.

- Torque the bias combiner screws (x2) to the chassis to 9 in-lbs.
- Mark the bias combiner connectors with a fine permanent marker. Refer to Figure 7-46 on page 7-83.
- Remember to place the cable ground clamp on the bias tee combiner's RF IN connector.
- Torque the cable ground clamp to bias combiner to 6 in-lbs.
- Torque the bias combiner with bracket assembly (to the chassis) screws (x2) to 9 in-lbs.

2. As shown in Figure 7-43 on page 7-81, position the bias tees on the attenuator brackets as indicated.

3. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Figure 7-42 A71–A74 Bias Tee Combiners and Cables Removal. (N5222B Option 420 Shown. All Other PNA LFE Options are Similar.

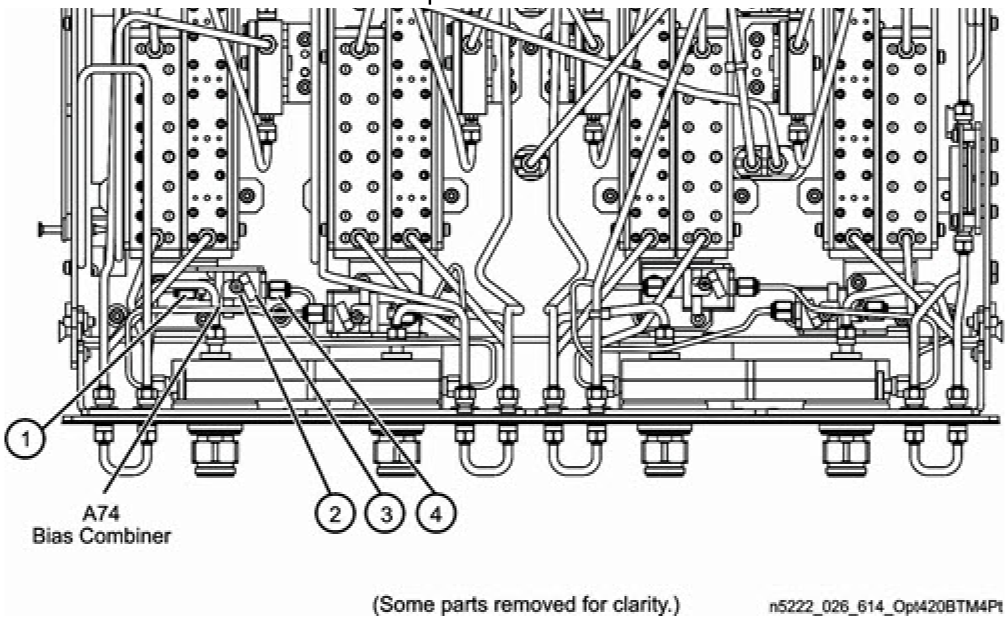


Figure 7-43 Remove Bias Combiner Bracket Assemblies from the Chassis (N5245-00036/N5245-00037, 0515-0372, 5087-7403, 0515-1227). (All Assemblies are Shown, but Only Remove the Defective Assembly.)

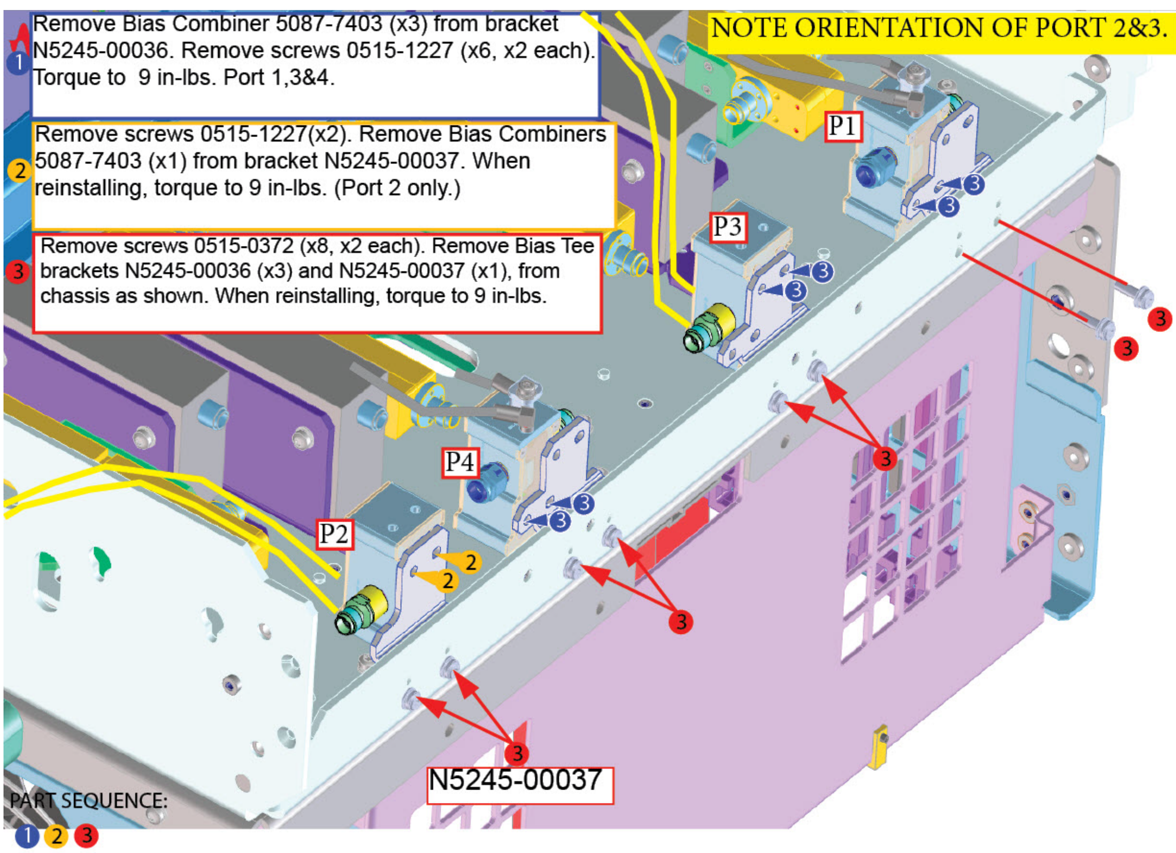


Figure 7-44 Remove DC Bias Cable from Bias Combiner (N5240-60091)

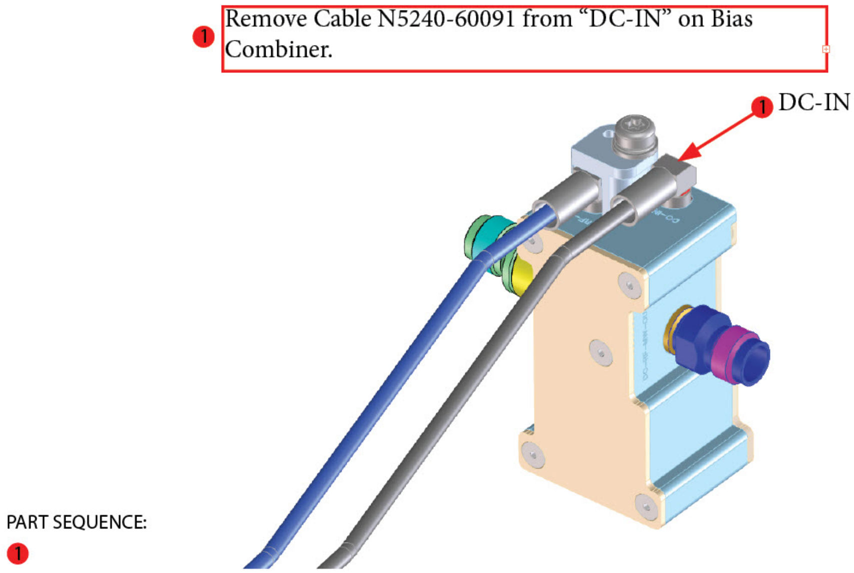


Figure 7-45 Remove Bias Combiner, Cables, and Clamps (5023-3299, 5087-7403, 0515-2141, and N5240-60097 (x2))

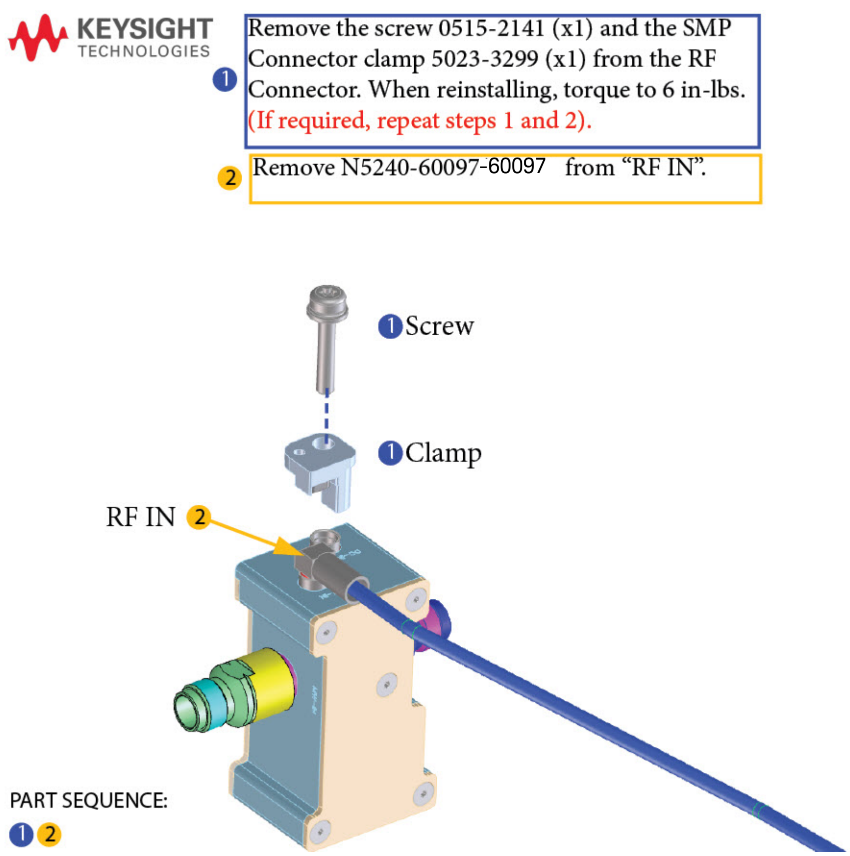
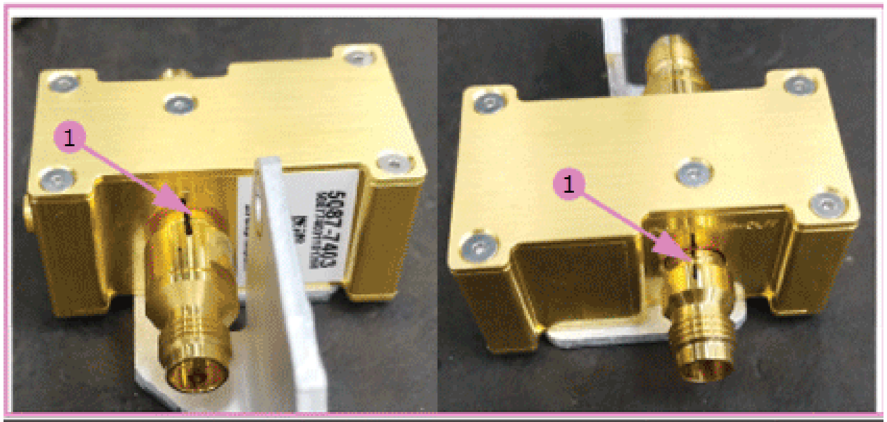


Figure 7-46 Mark Bias Combiner With a Permanent Marker



Removing and Replacing the Rear Panel

Tools Required

– T-10 TORX driver (set to 9 in-lb)
– T-20 TORX driver (set to 21 in-lb)
– 5/16 inch nutsetter (set to 10 in-lb)
– 5/16 inch nutsetter (set to 21 in-lb)
– 5/8 inch nutsetter (set to 21 in-lb)
– 9/32 inch nutsetter (set to 9 in-lb)
– 3/16 inch nutsetter (set to 6 in-lb)
– 9/16 inch nutsetter (set to 21 in-lb)
– 9 mm nutsetter (set to 21 in-lb)
– ESD grounding wrist strap

Removal Procedure

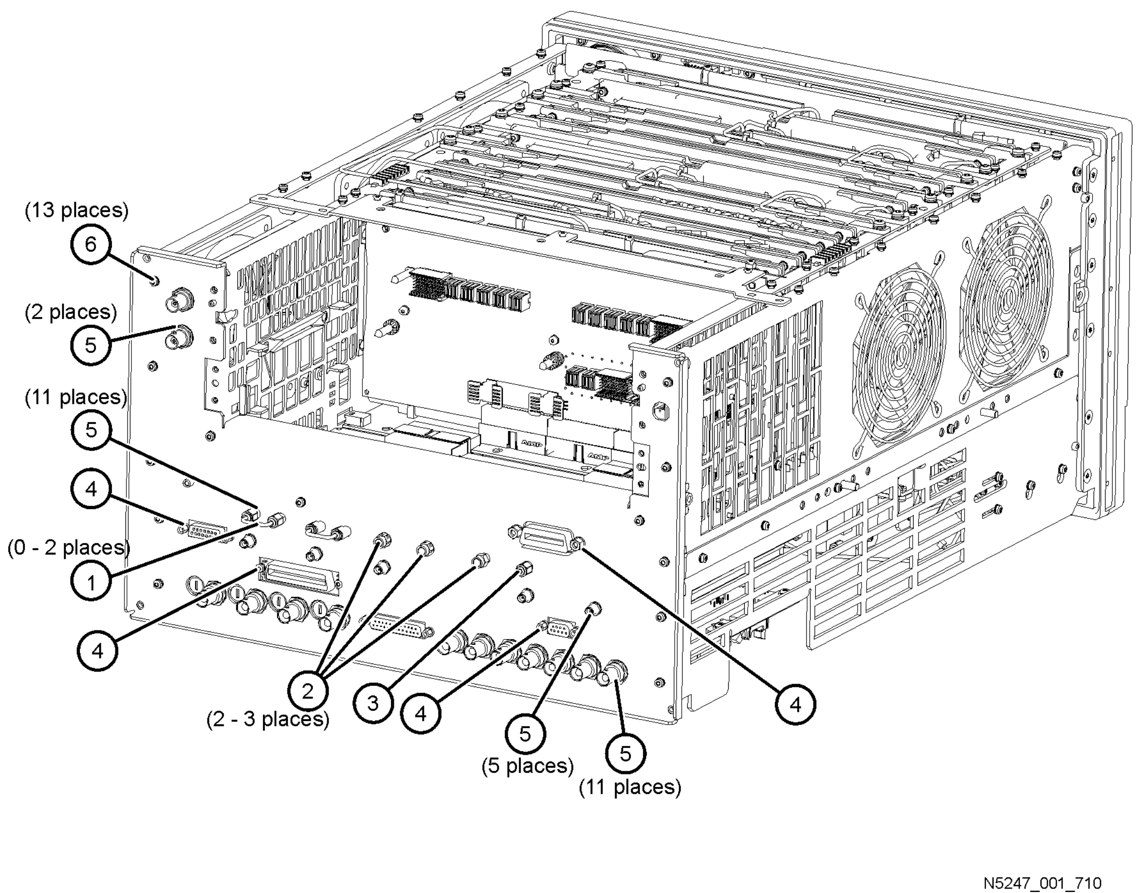
Refer to Figure 7-47 for this procedure.

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to “Removing the Covers” on page 7-8.
3. Remove the A20 power supply assembly. Refer to “Removing and Replacing the A20 Power Supply Assembly” on page 7-28.
4. Remove the A21 CPU board assembly. Refer to “Removing and Replacing the A21 CPU Board Assembly” on page 7-30.
5. If installed, remove all jumper cables (item ①) from the rear panel.
6. Remove the 50 ohm load(s) (item ②).
7. If installed, remove the cap (item ③).
8. Remove the connector hardware (item ④) from each of the five multi-pin connectors. The hardware is not the same on each connector so note which hardware goes with which connector.
9. Remove the connector hardware (item ⑤) from each of the RF connectors. The hardware is not the same on each connector so note which hardware goes with which connector.
10. Remove the 13 screws (item ⑥) that attach the rear panel to the chassis.
11. Slide the rear panel over the cable connectors and off 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 7-92.

Figure 7-47 Rear Panel Removal



Removing and Replacing the Front Panel LED Boards

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

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

1. Disconnect the power cord.
2. Remove the test port couplers. Refer to “Removing and Replacing the A33–A36 Test Port Couplers” on page 7-48.
3. Remove two screws from the LED board to be removed and remove the LED board from the analyzer. For the location of the screws, see Figure 6-71 on page 6-200.

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 7-92.

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Removing and Replacing the Fans

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

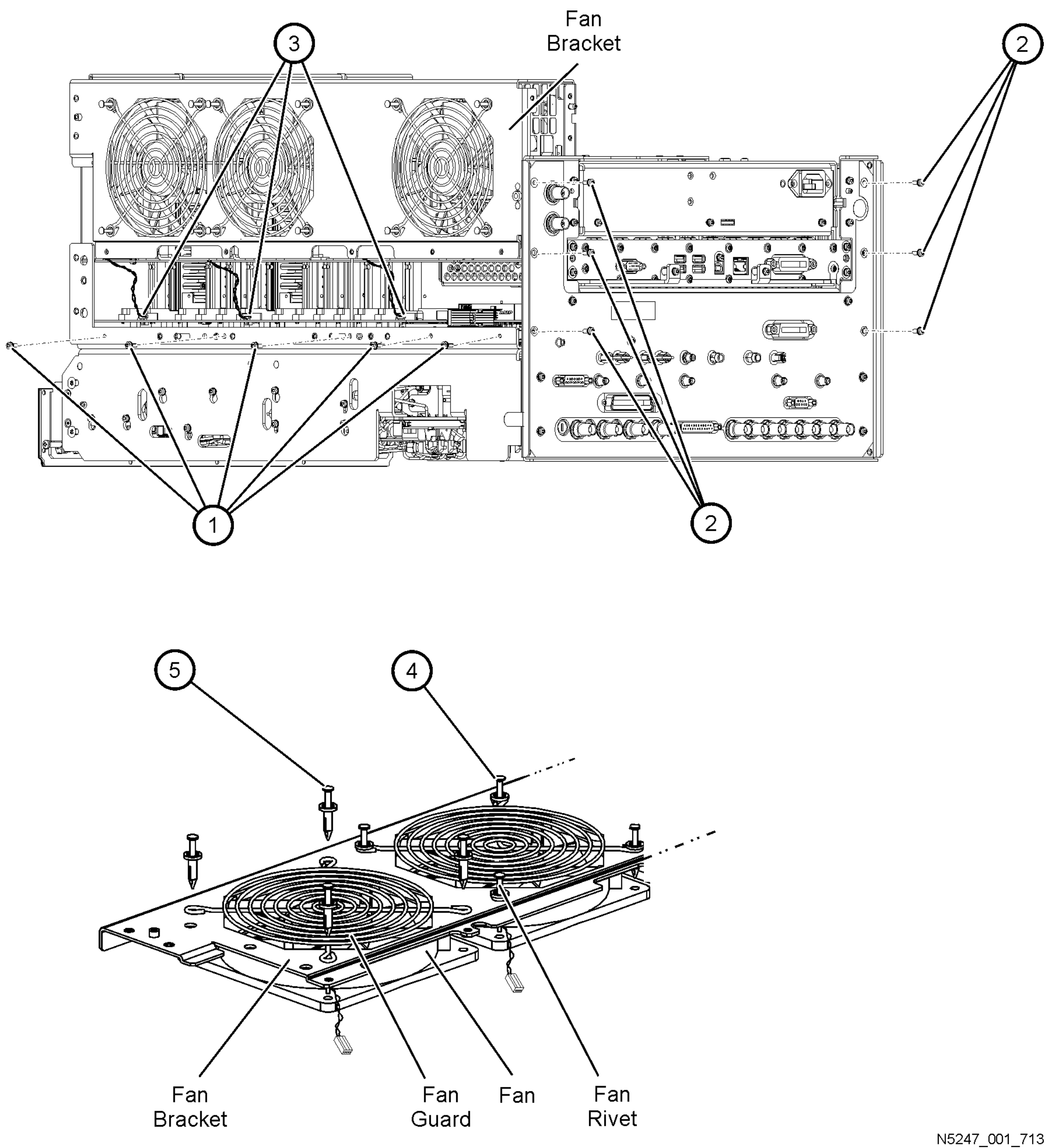
Refer to Figure 7-48 for this procedure.

1. Disconnect the power cord.
2. Remove the outer and inner covers. Refer to “Removing the Covers” on page 7-8.
3. Remove the front panel assembly. Refer to “Removing and Replacing the Front Panel Assembly” on page 7-10.
4. Remove the power supply bracket. It is not necessary to remove the entire power supply, just the power supply bracket. Refer to “Removing and Replacing the A20 Power Supply Assembly” on page 7-28.
5. Remove screws (item ①, five on the right side and seven on the left side) that attach the fan brackets to the chassis.
6. Remove three screws (item ②) on both sides that attach the rear panel to the fan bracket.
7. Raise the fan bracket out of both sides in the analyzer just enough to access the fan cables. Disconnect the fan cables from the A18 system motherboard connectors (item ③).
8. Remove the fan brackets and fans from the analyzer.
9. To remove a fan or fan guard from the fan bracket:
    a. Before removing a fan or fan guard, note the orientation of each fan and fan guard for reinstallation.
    b. Pull up the center pin of each of the fan rivets as shown by (item ④) in the illustration.
    c. Pull out the rivet completely (as shown by (item ⑤) in the illustration) to release the fan and fan guard.

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 7-92.

Figure 7-48 B1 Fan Removal



Removing and Replacing the Lithium Battery

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

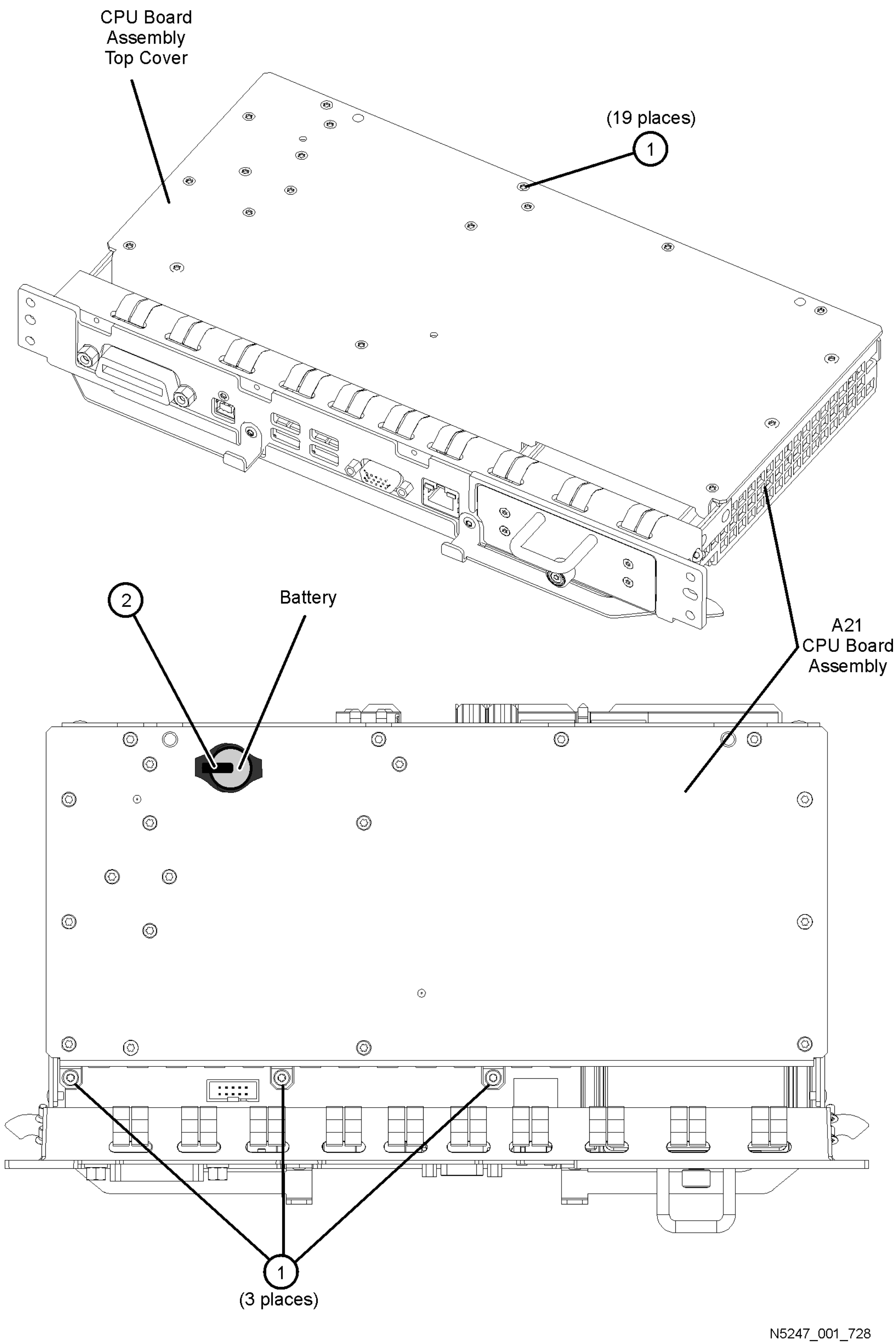
Refer to Figure 7-49 for this procedure.

1. Disconnect the power cord.
2. Remove the solid state drive (SSD) from the A21 CPU board. Refer to “Removing and Replacing the A55 Solid State Drive (SSD)” on page 7-60.
3. Remove 22 top cover attachment screws (item ①).
4. Remove the top cover from the A21 CPU board assembly.
5. Remove the battery from the battery holder by lifting it at the open end of the holder and then sliding it from under the clip (item ②).
6. DO NOT THROW AWAY THE BATTERY. COLLECT IT AS SMALL CHEMICAL WASTE. Refer to “Lithium Battery Disposal” on page 1-12 for additional information on battery disposal.

Replacement Procedure

1. Reverse the order of the removal procedure following all instructions included with the new battery.
2. Perform the post-repair adjustments, verifications, and performance tests that pertain to this removal procedure. Refer to Table 7-2 on page 7-92.

Figure 7-49 Lithium Battery Removal



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.

WARNING

STOP!

Before returning the repaired instrument to the customer, it is critical to ensure the product is safe for use. Before powering on the instrument, verify there is ground continuity between the ground terminal on the AC Inlet and the metal frame of the product. It is also critical to perform a voltage test on the outer surfaces of the product to confirm the instrument does not present an electric shock hazard.

CAUTION

IMPORTANT! Before you begin any testing on a System or instrument, always inspect the connectors on the instrument, the calibration kit, cables and adapters.

CAUTION

IMPORTANT!

For the most current information on the Table 7-2 “Verification, Performance, and Other Tests and Procedures” column’s content, refer to https://cal.software.keysight.com/PNA/Help/N7840AWebHelp.htm.

NOTE

Keysight personnel: see Figure 1-1 on page 1-6 to review where the calibration stickers should be placed on the PNA.

Table 7-2 Related Service Procedures

Replaced Assembly	Adjustments and Other Procedures	Verification, Performance, and Other Tests and Procedures
A1 front panel display board	No adjustment needed	Front Panel Keypad and RPG Test and A3 Display Test in Chapter 4
A2 USB board	No adjustment needed	Check for proper operation
A3 display assembly	Touchscreen Adjustment and Verification	A3 Display Test in Chapter 4

Table 7-2 Related Service Procedures (Continued)

Replaced Assembly	Adjustments and Other Procedures	Verification, Performance, and Other Tests and Procedures
A4 13.5 GHz source 1 synthesizer board (<6021 serial number prefixes)	EE Default Adjustment: Synth Src 1 only Synthesizer Bandwidth Adjustment[a] Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Frequency Accuracy Test Source Power Accuracy Test Source Maximum Power Output Test Source Power Linearity Test The Operator's Check
A5 26.5 GHz source board	Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Frequency Accuracy Test Source Power Accuracy Test Source Maximum Power Output Test Source Power Linearity Test The Operator's Check
A7, A8 40 GHz doubler board	Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Frequency Accuracy Test Source Power Accuracy Test Source Maximum Power Output Test Source Power Linearity Test The Operator's Check
A9 Noise receiver board (Option 029 or E29)[d]	"Noise Figure Adjustment (Available with Option 029 or E29 with S93029A/B Installed)" on page 3-61	Receiver Noise Figure Test Noise Jitter Test Noise Receiver Linearity Test Noise State Calibration Coefficients Noise Receiver Compression Test

Table 7-2 Related Service Procedures (Continued)

Replaced Assembly	Adjustments and Other Procedures	Verification, Performance, and Other Tests and Procedures
A10 26.5 GHz source board	Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Frequency Accuracy Test Source Power Accuracy Test Source Maximum Power Output Test Source Power Linearity Test The Operator’s Check
A12 40 GHz doubler board	Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Frequency Accuracy Test Source Power Accuracy Test Source Maximum Power Output Test Source Power Linearity Test The Operator’s Check
A13 40 GHz doubler board	Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Frequency Accuracy Test Source Power Accuracy Test Source Maximum Power Output Test Source Power Linearity Test The Operator’s Check
A14 frequency reference board (<6021 serial number prefixes)	10 MHz Frequency Reference AdjustmentEE Default Adjustment: Synth LO only Synthesizer Bandwidth Adjustment[a] Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed) Restore option data (Refer to “Repairing and Recovering Option Data” in Chapter 8.)	Frequency Accuracy Test Frequency Accuracy Test Source Power Accuracy Test Source Maximum Power Output Test Source Power Linearity Test The Operator’s Check

Table 7-2 Related Service Procedures (Continued)

Replaced Assembly	Adjustments and Other Procedures	Verification, Performance, and Other Tests and Procedures
A15 13.5 GHz LO synthesizer board (<6021 serial number prefixes)	EE Default Adjustment: Synth LO only Synthesizer Bandwidth Adjustment[a] Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Frequency Accuracy Test Source Power Accuracy Test Source Maximum Power Output Test Source Power Linearity Test The Operator's Check
A15 Digital to digital synthesizer (DDS) assembly (≥6021 serial number prefixes and all units with version 7 synthesizer upgrades) **NOTE** Open Windows Explorer, set Hidden Files and Folders to be shown, and navigate to the E:\Log folder. Select all items and sub-folders, right-click, and select Send To -> Compressed (Zipped) Folder. Email this zipped folder to csg.servicedesk@keysight.com with a note that it should be forwarded to PNA Customer Support.	EE Default Adjustment: Synth LO only Synthesizer Bandwidth Adjustment[a] Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Frequency Accuracy Test Source Power Accuracy Test Source Maximum Power Output Test Source Power Linearity Test The Operator's Check
A16 SPAM board	IF Gain Adjustment Receiver Characterization	Noise Floor Test Trace Noise Test

Table 7-2 Related Service Procedures (Continued)

Replaced Assembly	Adjustments and Other Procedures	Verification, Performance, and Other Tests and Procedures
A17 13.5 GHz source 2 synthesizer board (<6021 serial number prefixes)	EE Default Adjustment: Synth Src2 only Synthesizer Bandwidth Adjustment[a] Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Frequency Accuracy Test Source Power Accuracy Test Source Maximum Power Output Test Source Power Linearity Test The Operator's Check
A18 system motherboard	No adjustment needed	Front Panel Keypad and RPG Test and A3 Display Test in Chapter 4 The Operator's Check
A19 midplane board	No adjustment needed	None needed
A20 power supply assembly	No adjustment needed	None needed
A21 CPU board	No adjustment needed	The Operator's Check
A22 GPIB board	No adjustment needed	None needed
A23 test set motherboard	Reinstall the serial number. (Refer to "Installing or Changing a Serial Number" in Chapter 8.) Re-enable all hardware options. (Refer to "Software Entitlement Certificate" in Chapter 8.)	The Operator's Check
A24 IF multiplexer board	IF Gain Adjustment Receiver Adjustment	The Operator's Check

Table 7-2 Related Service Procedures (Continued)

Replaced Assembly	Adjustments and Other Procedures	Verification, Performance, and Other Tests and Procedures
A25 HMA26.5	EE Default Adjustment: LO Drive only EE Default Adjustment: LO Drive Noise Figure only (Option 029 or E29 equipped PNA) Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Frequency Accuracy Test Source Power Accuracy Test Source Maximum Power Output Test Source Power Linearity Test The Operator's Check
A26 splitter (PNAs with serial number prefixes <6021 only)[b]	Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Frequency Accuracy Test Source Power Accuracy Test Source Maximum Power Output Test Source Power Linearity Test The Operator's Check
A27 and A28 mixer bricks	Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Receiver Compression Test Noise Floor TestCalibration Coefficients Test Dynamic Accuracy Test
A60–A63 70 GHz doublers	Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Frequency Accuracy Test Source Power Accuracy Test Source Maximum Power Output Test Source Power Linearity Test The Operator's Check

Table 7-2 Related Service Procedures (Continued)

Replaced Assembly	Adjustments and Other Procedures	Verification, Performance, and Other Tests and Procedures
A29–A32 reference couplers	Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Source Maximum Power Output Test Calibration Coefficients Test Source Power Accuracy Test
A33–A36 test port couplers	Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Source Maximum Power Output Test Calibration Coefficients Test Source Power Accuracy Test
A37 reference mixer switch	No adjustment needed	The Operator's Check Resetting the Mechanical Counter
A38–A41 source step attenuators	Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Source Maximum Power Output Test Calibration Coefficients Test Source Power Accuracy Test Resetting the Mechanical Counter
A42–A45 bias tees	Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Source Maximum Power Output Test Calibration Coefficients Test Source Power Accuracy Test

Table 7-2 Related Service Procedures (Continued)

Replaced Assembly	Adjustments and Other Procedures	Verification, Performance, and Other Tests and Procedures
A46–A49 receiver step attenuators	Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Source Maximum Power Output Test Calibration Coefficients Test Source Power Accuracy Test Resetting the Mechanical Counter
A50–A53 mechanical switches	Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Source Maximum Power Output Test Calibration Coefficients Test Source Power Accuracy Test Resetting the Mechanical Counter
A54 combiner	Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed)	Source Maximum Power Output Test Calibration Coefficients Test Source Power Accuracy Test
A55 solid state drive	Restore previously saved receiver calibration data[c] perform Receiver Adjustment)	Read and write to the drive
A56 port 1 noise bypass switch	Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed) Noise Figure Adjustment (Available with Option 029 or E29 with S93029A/B Installed)	Receiver Noise Figure Test Source Power Accuracy Test Calibration Coefficients Test Resetting the Mechanical Counter

Table 7-2 Related Service Procedures (Continued)

Replaced Assembly	Adjustments and Other Procedures	Verification, Performance, and Other Tests and Procedures
A57 port 2 noise bypass switch	Source Adjustment IF Gain Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed) Noise Figure Adjustment (Available with Option 029 or E29 with S93029A/B Installed)	Receiver Noise Figure Test Source Power Accuracy Test Calibration Coefficients Test The Operator's Check Resetting the Mechanical Counter
A59 noise down converter[d]	"Noise Figure Adjustment (Available with Option 029 or E29 with S93029A/B Installed)" on page 3-61	Receiver Noise Figure Test Noise Jitter Test Noise Receiver Linearity Test Noise Receiver Compression Test Receiver Noise Figure Test Noise State Calibration Coefficients The Operator's Check
A64 tuner	No adjustment needed	Receiver Noise Figure Test
A70/A75 LFE board	Source Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed) Noise Figure Adjustment (Available with Option 029 or E29 with S93029A/B Installed) LFE Receiver Adjustment (Option 425)	Receiver Noise Figure Test Source Power Accuracy Test Calibration Coefficients Test The Operator's Check

Table 7-2 Related Service Procedures (Continued)

Replaced Assembly	Adjustments and Other Procedures	Verification, Performance, and Other Tests and Procedures
A71–A74 bias combiners	Source Adjustment Receiver Characterization Receiver Adjustment IF Response Adjustment (Available Only with Option S93093/4A/B and or S93900/1/2/4/5/7A/B Installed) Noise Figure Adjustment (Available with Option 029 or E29 with S93029A/B Installed) LFE Receiver Adjustment (Option 425)	Source Maximum Power Output Test Calibration Coefficients Test Source Power Accuracy Test The Operator's Check
B1 fan	No adjustment needed	Check for fan operation
Battery	No adjustment needed	None

a. Synthesizer Bandwidth Adjustment is only required, when the EE Default Adjustment is not sufficient.
b. The A26 splitter (5067-4086) and N5247-20111, N5245-20022, N5245-20023, N5247-20110, and N5247-20146 cables are only used with a legacy HMA26.5 p/n: 5087-7765. The N5240-20125, N5247-20184 and N5247-20185 cables are used only with the new N5240-60101 HMA-26.5. If you are unclear which HMA26.5 assembly your PNA has installed, refer to Chapter 7 Repairs and Figure 7-17 on page 40 and for details on A26 splitter and cabling , refer to your option-model in Chapter 6 "2-Port Configurations, Serial Number Prefixes <6021" on page 6-32 and "4-Port Configuration, Serial Number Prefixes <6021" on page 6-84.
c. 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 Adjustment."
d. For the most current information on the Table 7-2 on page 7-92 "Verification, Performance, and Other Tests and Procedures" column's content, refer to https://cal.software.keysight.com/PNA/Help/N7840AWebHelp.htm.

Resetting the Mechanical Counter

This process is to be performed anytime an attenuator or a bypass switch is replaced in an a PNA. Refer to Figure 7-50 on page 7-102.

Procedure Requirements

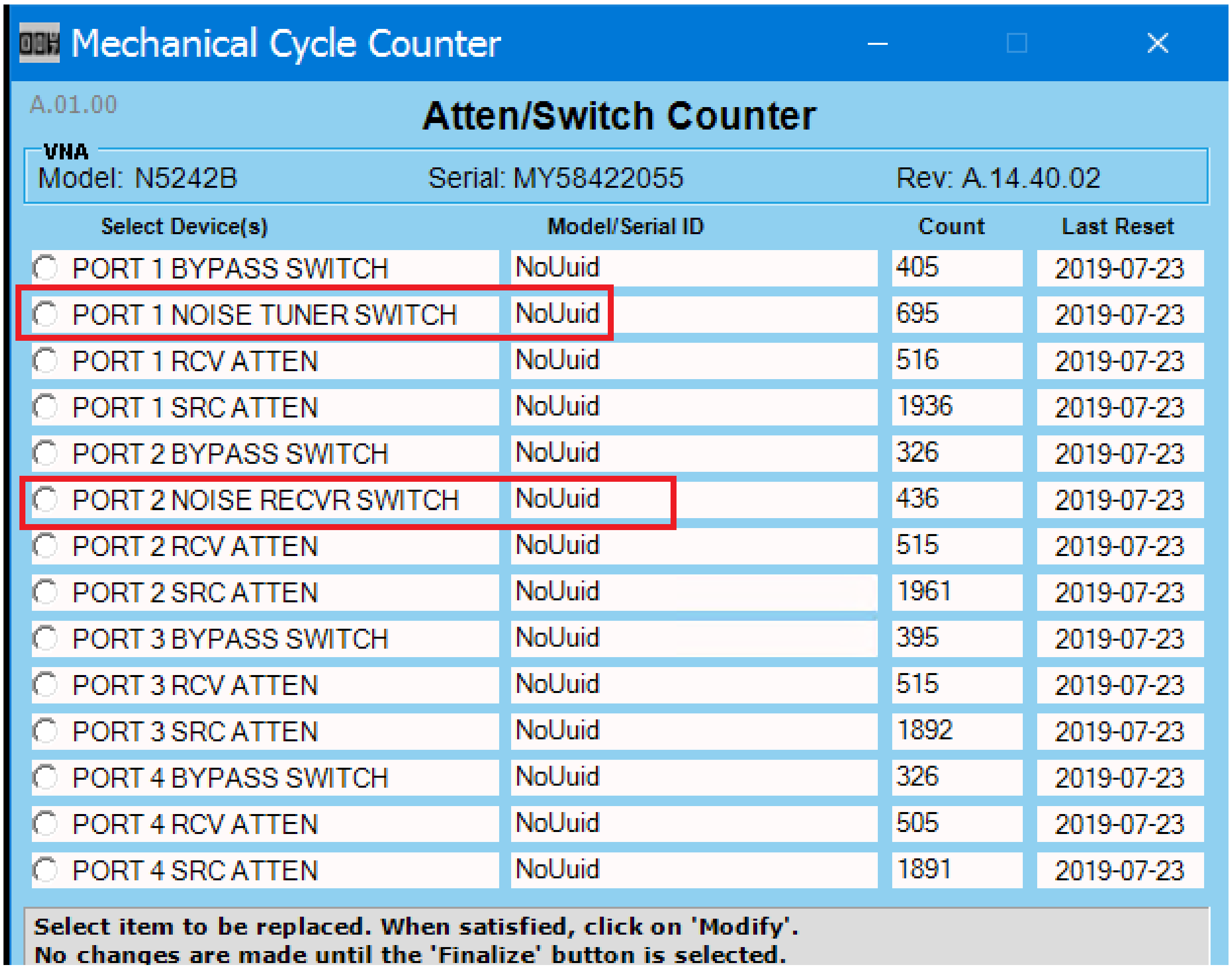
– The analyzer must be powered up and operating to perform this procedure.
– The Network Analyzer program must be running.
– A keyboard and mouse must be connected to the network analyzer.

1. Click **Utility** > **System** > **Service** > **Diagnostics** > **Mechanical Counter**
2. In the Mechanical Cycle Counter window that opens:
   a. Click all of the items that apply.

b. When satisfied, click on **Modify**.

c. Click **Exit**.

Figure 7-50 Mechanical Cycle Counter window (Port 1 NOISE TUNER SWITCH and Port 2 NOISE RECVR SWITCH are only applicable for Option 029 or E29)



EEPROM Backup

The analyzer uses arrays of correction constants to enable the analyzer to produce accurate, leveled source signals and receive clean test signals. These constants are stored in non-volatile EEPROM memory and in flash memory files.

The adjustments listed here generate new correction constants. The analyzer must have a backup of this new data in case any of the data becomes corrupted.

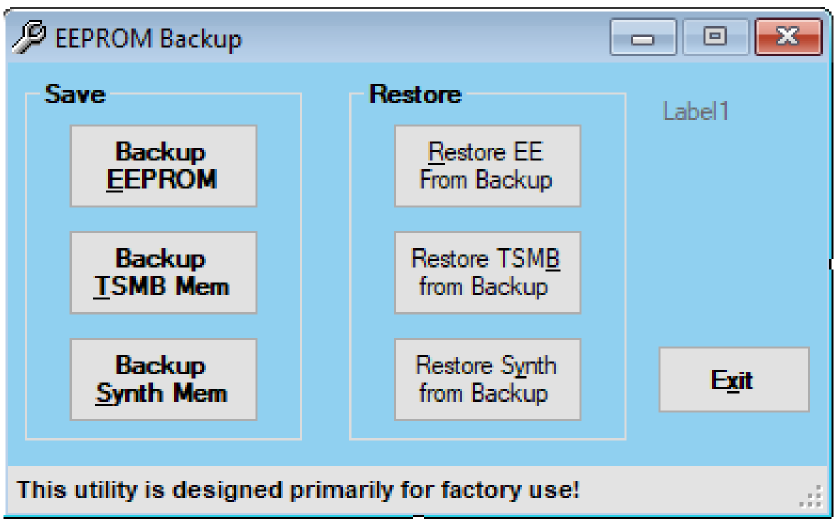
To store the backup data, perform these steps:

— Navigate to the EEPROM Backup Utility, located at:

- Windows 7 -- `C:\Program Files (x86)\Keysight\Network Analyzer\Service\eebackup.exe`
- Windows 10 -- `C:\Program Files\Keysight\Network Analyzer\Service\eebackup.exe`

- Run the program.
- Click Backup EEPROM.
- Click Backup TSMB Mem.
- Click Backup Synth Mem. (Applies to Version 7 Synthesizers Only)
- Click Exit when the program has finished.

Figure 8 EEPROM Backup Menu



8 General Purpose Maintenance Procedures

Information in This Chapter

Chapter Eight at-a-Glance

Conventions Used for Hardkeys, Softkeys, and Menu Items

The following conventions are used in this document:

Hardkey	This represents a "hardkey", a key that is physically located on the instrument.
Tab	This represents a "tab", whose label is determined by the instrument firmware.
Softkey	This represents a "softkey", a key whose label is determined by the instrument firmware.
Menu Item	This represents an item in a drop-down or pop-up menu.

KEYSIGHT TECHNOLOGIES

Error Terms

Using Error Terms as a Diagnostic Tool

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

The the most common causes of error term anomalies are:

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

These items also affect the magnitude and shape of the error terms. For highest measurement accuracy, make sure of the following:

- Use proper connector care. 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 8-1 on page 8-8.

To find assemblies related to error term failures, refer to error term descriptions in "Error Term Data" on page 8-8. Each 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.

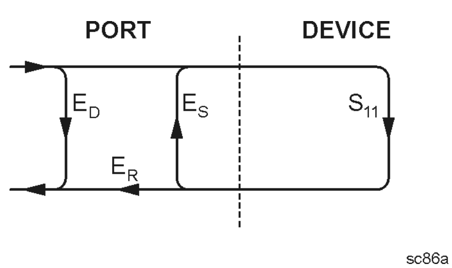
To reduce the chance of electrostatic discharge, follow all of the recommendations outlined in "Electrostatic Discharge Protection" on page 1-7, when performing the following calibration.

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 8-1, Figure 8-2, Figure 8-3, and Figure 8-4 illustrate the error terms associated with measurement calibration for 1-port, 2-port, 3-port, and 4-port configurations respectively.

Figure 8-1 Flowgraph of One-Port Error Terms for Port 1



where:

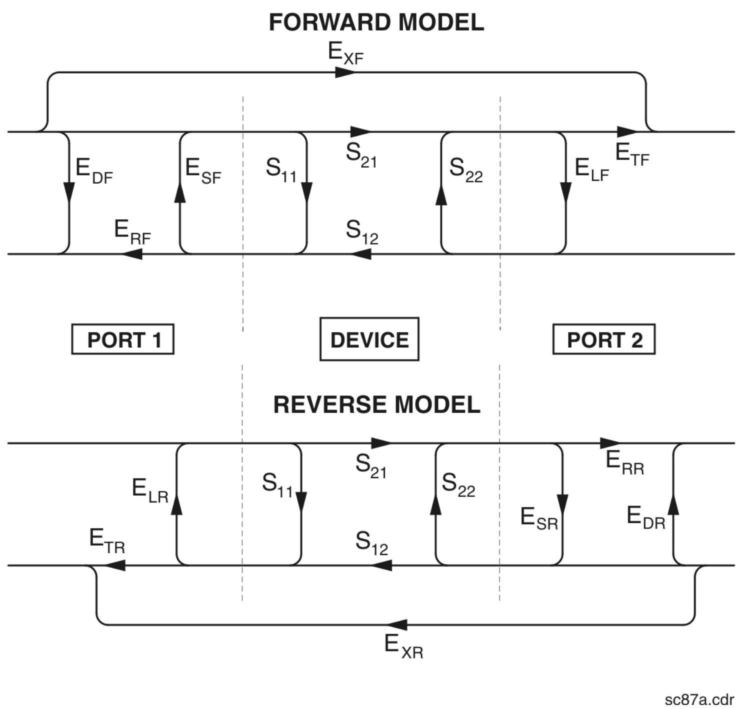
E = Error term

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 8-2 Flowgraph of Two-Port Error Terms



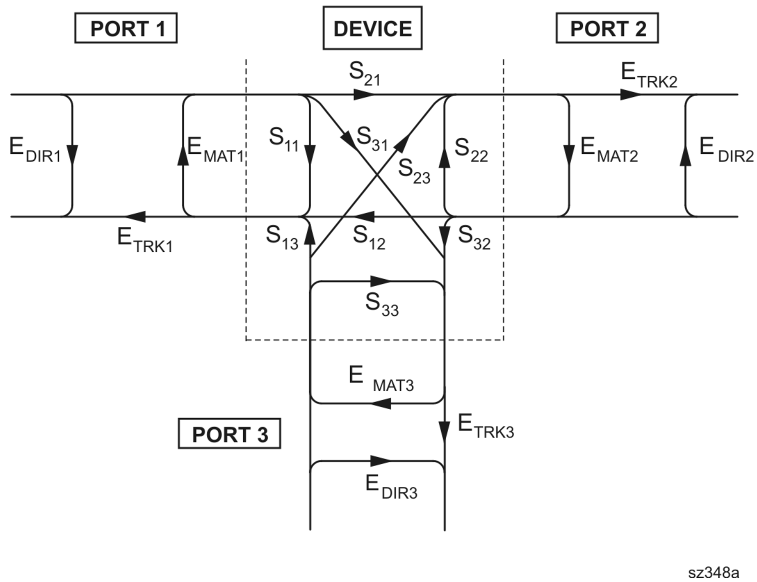
where:

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 (Ports 1 to Port 2)
R = reverse measurement (Ports 2 to Port 1)

Figure 8-3 Flowgraph of Three-Port Error Terms



where:

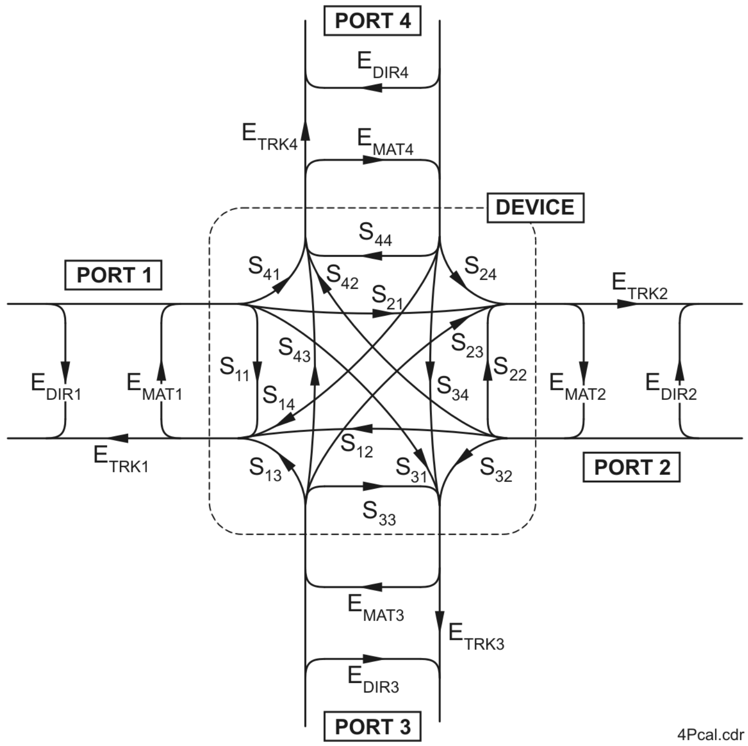
E = error term
DIR = Directivity
MAT = Forward Source Match and Reverse Load Match
TRK = Forward Reflection Tracking and Reverse Transmission Tracking

For the case of a full 3-port calibration, port 1 has three Match error terms:
- S11 source match
- S12 load match
- S13 load match

and three Tracking error terms:
- S11 reflection tracking
- S12 transmission tracking
- S13 transmission tracking

There are six isolation terms not shown.

Figure 8-4 Flowgraph of Four-Port Error Terms



where:

E = error term
DIR = Directivity
MAT = Forward Source Match and Reverse Load Match
TRK = Forward Reflection Tracking and Reverse Transmission Tracking

For the case of a full 4-port calibration, port 1 has
four Match error terms:
S11 source match
S12 load match
S13 load match
S14 load match
and four Tracking error terms:
S11 reflection tracking
S12 transmission tracking
S13 transmission tracking
S12 transmission tracking

There are eight isolation (crosstalk) terms not shown.

Accessing Error Terms

Error terms can be accessed either manually or programmatically:

Manually

– "Front Panel Access to Error Terms" on page 8-7

Programmatically

– "GPIB Access to Error Terms" on page 8-7
– "COM/DCOM Access to Error Terms" on page 8-7

Manual Access to Error Terms

Front Panel Access to Error Terms

NOTE Ensure that calibration correction is active by pressing RESPONSE Cal and verifying that the softkey label reads **Correction ON/off**. If not, press the Correction on/OFF key and it will toggle to read Correction ON/off.

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

1. Press RESPONSE Cal, then Manage Cals. Verify that Cal Set Viewer ON/off is ON. If not, press the softkey to toggle it ON.

   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 or Error Terms** button to view the raw measurement data from the standard or the corrected error term data.
4. In the **Standard** or **Error Terms** list, select the standard or error terms to view. Click the Enable check box to enable the selection.
5. Compare the displayed measurement trace to previously measured data or to the uncorrected performance specifications listed in Table 8-1 on page 8-8.
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
– description and significance of each error term
– measurements affected by each error term
– typical cause of failure for each error term

The same description applies to both the forward (F) and reverse (R) terms.

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

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.”.

Table 8-1 Error Term Data[a]

Parameter (All options, all ports)	Frequency Range					
	10 MHz to 50 MHz	50 MHz to 3.2 GHz	3.2 GHz to 10 GHz	10 GHz to 16 GHz	16 GHz to 24 GHz	24 GHz to 26.5 GHz
Directivity	16 dBm	24 dBm	23 dBm	16 dBm	16 dBm	16 dBm
Source Match	11 dBm	18 dBm	14 dBm	12 dBm	10 dBm	8 dBm
Load Match	11 dBm	17 dBm	13 dBm	10 dBm	9 dBm	8 dBm
	10 MHz to 50 MHz	50 MHz to 100 MHz	100 MHz to 500 MHz	500 MHz to 3.2 GHz	3.2 GHz to 20 GHz	20 GHz to 26.5 GHz
Crosstalk[b]	-84 dBm	-90 dBm	-110 dBm	-120 dBm	-122 dBm	-117 dBm

a. The data in this table are uncorrected system performance. The values apply over an environmental temperature range of 25 °C ±5 °C, with less than 1 °C deviation from the calibration temperature.
b. All crosstalk values are typical. Measurement conditions: normalized to a thru, measured with two shorts, 10 Hz IF bandwidth, averaging factor of 8, alternate mode, source power set to the lesser of the maximum power out or the maximum receiver power.

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 4-47.

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 shor**t 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 4-47.

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 4-52 or to "Checking the Signal Separation Group" on page 4-47.

Isolation (Crosstalk) (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 4-52 or to "Checking the Signal Separation Group" on page 4-47.

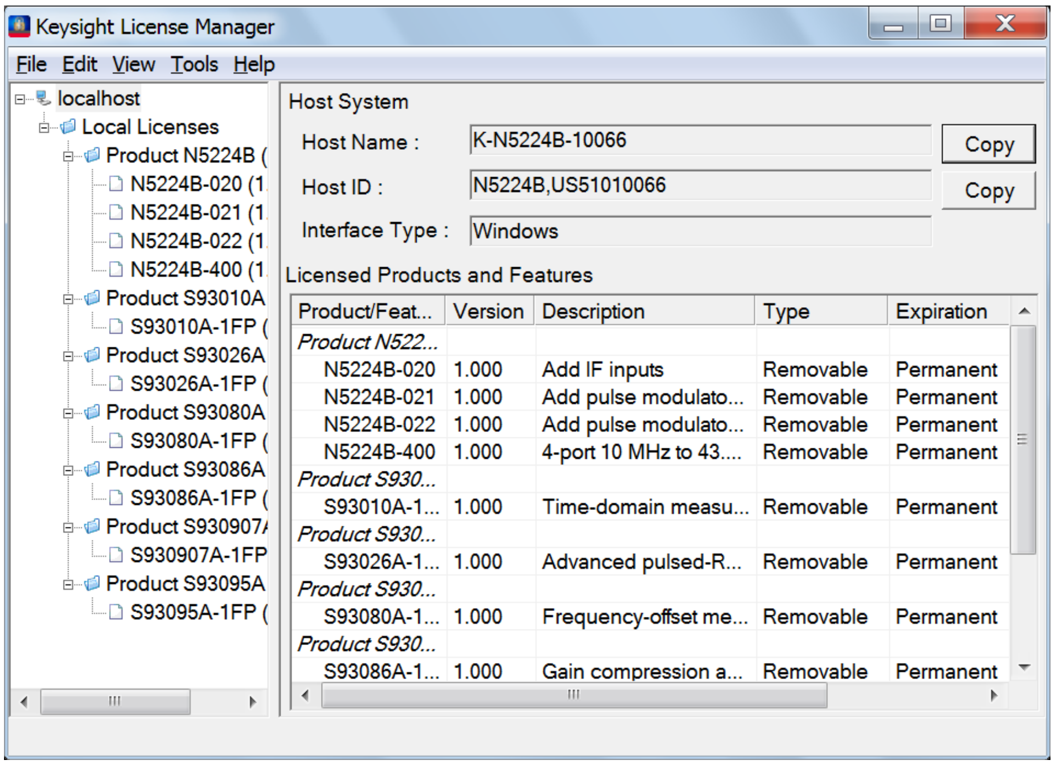
Keysight License Manager

Accessing the Keysight License Manager

To start the Keysight License Manager:

– Press **Start** > **Keysight License Manager** > **Keysight License Manager**. A Keysight License Manager dialog box will appear.

Figure 8-5 Keysight License Manager Window



Software Entitlement Certificate

If you have received an “Software Entitlement Certificate”, follow the instructions on the certificate, under “HOW TO USE THIS CERTIFICATE:”, to obtain license key file(s) for the option(s) listed on the certificate. See the important note below.

NOTE When upgrading from one model number to another, a new software entitlement certificate will be issued. When the new certificate is redeemed for a license key file, the automated system will ask for the instrument's Host ID. Be sure to use the old Host ID that is associated with the old model number.

Enabling or Removing Options

There are two types of options:

- Hardware: Hardware options involve adding additional hardware to the analyzer. After the proper hardware has been installed in the analyzer, the appropriate license can be installed using the Keysight License Manager.

  It is necessary to re-enable all installed hardware options, if the midplane board is replaced.

- Software: Software options add features or functionality to the analyzer without the need for additional hardware. These options are enabled by installing the appropriate licenses using the Keysight License Manager (KLM). Refer to https://www.keysight.com/us/en/assets/9018-04534/installation-guides/9018-04534.pdf (N5242-90024).

NOTE Some applications require a license key file that is provided by Keysight. If you do not have the required license key file, contact Keysight for assistance. Refer to "Contacting Keysight" on page 2-7.

To enable or remove an option:

1. Start the Keysight Software Manager. Refer to "Accessing the Keysight License Manager" on page 8-11.
2. In the Keysight License Manager window that opens, in the left hand column, press **local host** > **Local Licenses**. A list of available options, similar to the list below, will appear. Refer to Figure 8-5 on page 8-11.

   029 - Full Noise Measurements

   219 - Src/Rcvr Atten & Bias Ts 2-Port

   419 - Src/Rcvr Atten & Bias Ts 4-Port

   224 - 2nd Src w/Combiner & Switches

   423 - Combiner & Switches

   S93015A/B - Dynamic uncertainty for S-parameters

   S93025A/B - Basic pulsed-RF measurements

   S93086A/B - Gain Compression Application

   S93087A/B- IMD Measurements
3. Press and hold (or right click with a mouse) the option that you wish to either enable or remove, and then click **Install** or **Delete**, whichever is appropriate.

Repairing and Recovering Option Data

For information on repairing or recovering option data, refer to Keysight License Manager help on your instrument.

Installing or Changing a Serial Number

It is necessary to reinstall the instrument serial number if the test set midplane board is replaced.

NOTE To change an incorrect serial number, it is necessary for your instrument to be connected directly to the LAN and to a Keysight IP network. Refer to "Contacting Keysight" on page 2-7.

Firmware Upgrades

How to Check the Current Firmware Version

1. Press UTILITY System, then Help, then About NA... .

   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: https://www.keysight.com/us/en/lib/software-detail/instrument-firmware-software/n52xxb-pna-series-network-analyzer-firmware.html. (Select your analyzer's model at this web site to view available upgrades.)

– Press UTILITY System, then Service, then 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.

Operating System Recovery

Recovering from Solid State Drive Problems

If you suspect that you have a solid state drive problem, go to the "Hard Drive Recovery" link on the Keysight PNA Series: Service & Support Home Page on the Internet.

The URL for the Keysight PNA Series – Service & Support Home Page is:

https://support.keysight.com/s/

The URL for the Hard Drive Recovery page is:

https://www.keysight.com/us/en/assets/9922-01369/miscellaneous/PNA-Hard-Drives-and-CPUs.pdf

Correction Constants

The analyzer stores many correction constants in non-volatile EEPROM memory. These constants enable the analyzer to produce accurate, leveled source signals and receive clean test signals.

Storing Correction Constants

After performing any adjustment listed on page 3-53 in this manual, store the correction constants to a backup file on the analyzer solid state drive by performing these steps:

– Navigate to the EEPROM Backup Utility, located at:
C:\Program Files (x86)\Keysight\Network Analyzer\Service\eebackup.exe
– Run the program.
– Click Backup **EEPROM**.
– Click **Backup TSMB Mem**.
– Click **Exit** when the program has finished.

A: EEPROM Address Assignments and Location (N5227A&B PNA and N5247A&B PNA-X Instruments)

Table A-1 EEPROM Address Assignments and Location

<table>
<tr><th>EE#</th><th>Hex Addr</th><th>Physical Location</th><th>Board Rev Letter</th><th>Cal Body Contents</th></tr>
<tr><td>0</td><td>E080</td><td>A16 SPAM</td><td>B</td><td>Unused</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">E100</td><td>A15 LO Synth
rev 5 (N5242-60150/166)</td><td>F</td><td rowspan="2">Synth Power Cal</td></tr>
<tr><td>A15 LO Synth
rev 6 (N5240-60074/76)</td><td>G/H</td></tr>
<tr><td>2</td><td>E180</td><td>A23 TSMB
(N5245-60157)</td><td>F</td><td>HW Opt's, Instr SN, uCkt SN's, MA26 pwr</td></tr>
<tr><td>3</td><td>E200</td><td>TSMB</td><td>–</td><td>LO pwr, IF gain, SN's</td></tr>
<tr><td>4</td><td>E280</td><td>A24 IF Multiplexer
(N5240-60062)</td><td>B</td><td>Unused</td></tr>
<tr><td>5</td><td>E300</td><td>A14 Freq Reference</td><td>C</td><td>Ref dac, FlexLM backup</td></tr>
<tr><td>6</td><td>E380</td><td>A10 Source 2</td><td>C</td><td>Unused</td></tr>
<tr><td>7</td><td>E400</td><td>N/A</td><td>–</td><td>–</td></tr>
<tr><td>8</td><td>E480</td><td>N/A</td><td>–</td><td>–</td></tr>
<tr><td rowspan="2">9</td><td rowspan="2">E500</td><td>A17 LO Synth
rev 5 (N5242-60150/166)</td><td>F</td><td rowspan="2">Synth Power Cal</td></tr>
<tr><td>A17 LO Synth
rev 6 (N5240-60074/76)</td><td>G/H</td></tr>
<tr><td rowspan="2">10</td><td rowspan="2">E500</td><td>A4 LO Synth
rev 5 (N5242-60150/166)</td><td>F</td><td rowspan="2">Synth Power Cal</td></tr>
<tr><td>A4 LO Synth
rev 6 (N5240-60074/76)</td><td>G/H</td></tr>
</table>

Table A-1 (Continued)EEPROM Address Assignments and Location

EE#	Hex Addr	Physical Location	Board Rev Letter	Cal Body Contents
11	E600	A5 Source 1	C	Unused
12	E680	N/A	–	–
13	E700	N/A	–	–
14	E780	N/A	–	–
15	E800	N/A	–	–
16	E880	N/A	–	–
17	E900	A22 GPIB	A	Unused
18	E980	A7 Noise Figure[a] (N5245-60124)	B	Unused
19	EA00	A7 40 GHz Doubler (5087–7318 assembly, 5067–1335 bias board)	A	Unused
		A7 40 GHz Doubler (5087-7346 assembly, 5067-6418 bias board)	B/D	
20	EA80	A8 40 GHz Doubler (5087–7318 assembly, 5067–1335 bias board)	A	Unused
		A8 50 GHz Doubler (5087-7346 assembly, 5067-6418 bias board)	B/D	
21	EB00	A12 40 GHz Doubler (5087–7318 assembly, 5067–1335 bias board)	A	Unused
		A12 40 GHz Doubler (5087-7346 assembly, 5067-6418 bias board)	B/D	
22	EB80	A13 40 GHz Doubler (5087–7318 assembly, 5067–1335 bias board)	A	Unused
		A13 40 GHz Doubler (5087-7346 assembly, 5067-6418 bias board)	B/D	

a. Applies to PNA-X models only.

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