Keysight Technologies U3042AE04 Multiport Test Set Extension

For serial number US50120118 and above

Notice: This document contains references to Agilent. Please note that Agilent's Test and Measurement business has become Keysight Technologies. For more information, go to www.keysight.com.

Use this manual with the following document:
PNA Series Network Analyzer Online Help System

KEYSIGHT TECHNOLOGIES

User's and Service Guide

Notices

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WARNING

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U3042AE04

U3042AE04

KEYSIGHT TECHNOLOGIES

Introduction

This document describes how to use and service the U3042AE04 Multiport Test Set Extension.

Figure 1 4-Port PNA-L with U3042AE04

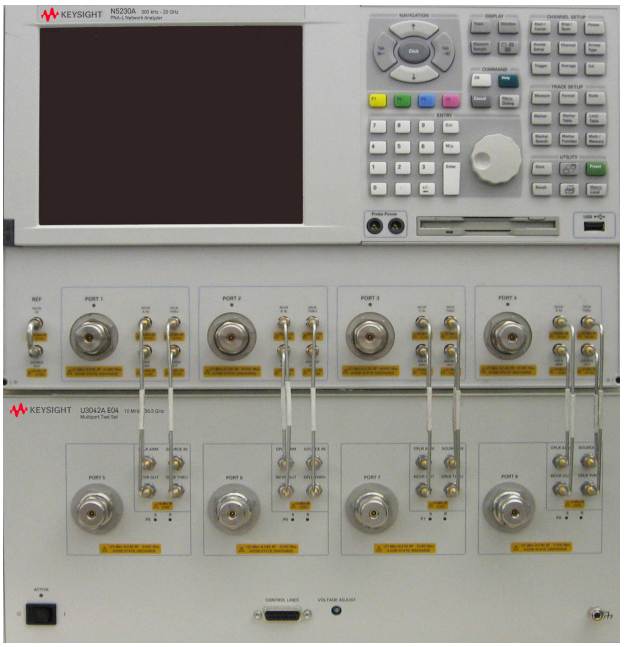


Figure 2 4-Port PNA or PNA-X with U3042AE04

Description

The U3042AE04 is a Multiport Test Set that adds 4 ports to extend the 4-port network analyzer to 8 full crossbar test ports with N-Port calibration capability.

The U3042AE04 has the following key features:

- 4 test ports (3.5 mm male connectors)
- High speed, solid state RF switching
- Frequency Range of Operation: 10 MHz to 26.5 GHz (performance degrades above 20 GHz for Option 001 & 002).

The N5222A/B PNA, N5232A/B PNA-L and N5242A/B PNA-X Network Analyzers will be referred to as the PNA, PNA-L and PNA-X throughout this document. Analyzer refers to all series of PNA, PNA-L and PNA-X. The U3042AE04 will be referred to as the test set. The N5221A/B, N5231A/B and N5241A/B can be used, but will limit the frequency range to 13.5 GHz.

NOTE The "B" Model analyzers have the darker Keysight color format. The Test Set color format has changed to match this Keysight color.

Verifying the Shipment

To verify the contents shipped with your product, refer to the “Box Content List” included with the shipment.

Inspect the shipping container. If the container or packing material is damaged, it should be kept until the contents of the shipment have been checked mechanically and electrically. If there is physical damage refer to “Contacting Keysight” on page 100. Keep the damaged shipping materials (if any) for inspection by the carrier and an Keysight Technologies representative.

Measurement Application Note

Low Loss DUT Measurements

Low loss trace stability is a product of switch repeatability and calibration technique. Low insertion loss measurements exhibiting 0.1 dB of uncertainty is not uncommon.

PNA and PNA-X Receiver Compression Note

Systems configured with PNA and PNA-X series Network Analyzers will show compression at the beginning of the frequency range when the power level is increased. Typically, this will occur when the power level is increased above 5 dBm. This occurs because the PNA and PNA-X analyzers use couplers at the test port and the multiport extension test set has a directional bridge at the test port. The PNA and PNA-X receivers are calibrated at the factory, and due to the higher coupling factor, the coupler at low frequency and the receiver gain are set high to compensate. The multiport test set directional bridge has a lower coupling factor at low frequencies, which results in compression when the power level of the PNA/PNA-X is increased. We recommend that you increase the receiver attenuation in the PNA and PNA-X to reduce this receiver compression issue.

Network Analyzer Requirements

For multiport operation (N-port error correction and measurement capability), all "A" model network analyzers require Option 551 and all "B" model analyzers require Software Application S93551B. For "B" models in which the system is configured with more than eight test ports, it is recommended to use PLTS Software N1930B to manage/control any advanced network analyzer measurement applications and their large data files.

Table 1 provides a listing of other network analyzer option requirements. The analyzer's frequency range must be equal to or exceed that of the test set so that the measurement system covers the full frequency range of the test set.

The test set files indicated in Table 1 must be installed into this network analyzer file directory location: C:\Program Files (x86)\Agilent\Network Analyzer\TestSets.

For the "B" model PNA-X: C:\Program Files (x86)\Agilent\Keysight\Network Analyzer\TestSets.

Table 1 Network Analyzer Configuration Requirements

4-Port Network Analyzer	**Options**	**Test Set File**	**System Figure**
N5221A/B & N5222A/B PNA	401, 417, or 419	u3042ae04_pnax_p4.tsx	Figure 2[a]
N5231A/B & N5232A/B PNA-L	416	u3042ae04_p4.tsx	Figure 1[a]
N5241A/B & N5242A/B PNA-X	400	u3042ae04_pnax_p4.tsx	Figure 2

a. The image does not show the exact analyzer, but the port configuration is similar.

Ensure that the network analyzer has the latest version of firmware installed. The following web site links provide the necessary information needed:

- Network Analyzers - http://www.keysight.com/find/pna
- Network Analyzer Firmware - http://na.support.keysight.com/pna/firmware/
- U3042AE04 Test Set Files - http://na.support.keysight.com/multiport/testsetsupport.html

Available Options

Test Set Option

The test set has three available options:
Refer to "System Block Diagram" on page 73.

- Option 700 - Standard, Solid-State switches (no Option 001 or 002 on the serial tag)
- Option 001 - Solid-state switches with amplifiers to improve dynamic range.
- Option 002 - Solid-state switches with amplifiers and bias-tees for each port.

The Options 700, 001 and 002 limit the frequency range due to blocking capacitors in the switches and amplifiers performance. Solid State switches degrade frequencies below 2 MHz and Options 001 or 002 amplifiers degrade performance above 20 GHz.

Rack Mounting Kits

Available options for system cabinet mounting:

- U3042AE04-1CM, Rack Mount Kit without Handles (1CM114A*) 5063-9216
- U3042AE04-1CN, Front Handle Kit with Handles (1CN103A*) 5063-9229
- U3042AE04-1CP, Rack Mount Kit with Handles (1CP106A*) 5063-9236

* New dark color version (Keysight Palette 2015)

Network Analyzer Interface Kit Options

The U3042AE04 requires one of the following kits to interface the test set with your network analyzer. The interface kit model option includes the hardware lock-link and cable kit listed in Table 2.

Table 2 Interface Kit Options

8-Port System	Interface Kit Option	Hardware Lock-link	Cable Kit Connector Type
N5221A/B & N5222A/B PNA	U3021PL3 Opt 442	U3021-60002[a]	U3021-60047[b], SMA m/m
N5231A/B & N5232A/B PNA-L	U3021PL3 Opt 430	U3021-60001[c]	U3021-60045[d], SMA m/m
N5241A/B & N5242A/B PNA-X	U3021PL3 Opt 442	U3021-60002[a]	U3021-60047[b], SMA m/m

a. "Hardware Lock-link Installation (U3021-60002)" on page 23.
b. "PNA or PNA-X RF Interface Cable Connections (U3021-60047)" on page 28.
c. "Hardware Lock-link Installation (U3021-60001)" on page 20.
d. "PNA-L RF Interface Cable Connections (U3021-60045)" on page 26.

General Specifications

Specifications for the test set are characteristic for the system performance of the network analyzer and the test set. Before using the analyzer and test set a calibration is recommended for best measurement performance. Actual performance of the system is based on the customer's analyzer and options that are used with the test set. A functional certificate is only offered for the test set.

When connected to a analyzer, this test set will degrade the performance at the test ports. The internal switch paths reduce test port power and power to the receivers. This affects the test port power of the analyzer and also reduces dynamic range. The reflection tracking provided in Table 5 or Table 6 on page 16 can be subtracted from the analyzers dynamic range to determine the approximate performance of the system.

Power Requirements

Verify that the required ac power is available before installing the test set to the analyzer.

- U3042AE04 maximum power is 350 W.
- 100/120/220/240 VAC (50/60Hz)
- The instruments can operate with mains supply voltage fluctuations up to ± 10% of the nominal voltage.
- Air conditioning equipment (or other motor–operated equipment) should not be placed on the same ac line that powers the test set and analyzer.

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 product is likely to make the product dangerous. Intentional interruption is prohibited

Environmental Requirements

Refer to the analyzer's standard documentation for environmental requirements.

Environmental Tests

The test set complies with all applicable safety and regulatory requirements for the intended location of use.

- Operating Environment (indoor use)
- Temperature 0 - 55 °C
- Pressure Altitude
  3,000 meters (~10,000 feet)
- The instrument can safely operate in a relative humidity of 80% for temperatures to 31 degrees C, decreasing linearly to 50% relative humidity at 40 degrees C.

Equipment Heating and Cooling

If necessary, install air conditioning and heating to maintain the ambient temperature within the appropriate range.

CAUTION

Ventilation Requirements: When installing the instrument in a cabinet, the convection into and out of the instrument 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, forced convection must be used.

Required Conditions for Accuracy Enhanced Measurement

Accuracy–enhanced (error–corrected) measurements require the ambient temperature of the analyzer and test set to be maintained within ± 1 °C of the ambient temperature at calibration.

Dimensions and Space Requirements

Standard installation of the test set and analyzer includes configuration and installation on a customer provided lab bench or table top of adequate size and strength. For weight, dimensions and space requirements, refer to the analyzer documentation that is used to configure the test set.

CAUTION

The network analyzer is heavy. It is recommended that two individuals, or a mechanical lift be used to lift or transport the instrument.

Table 3 Instrument Dimension

Model OPT	Weight	Height	Width	Depth
STD	11.4 kg (25 lb)	19.1 cm (7.5 in)	42.5 cm (16.7 in)	43.2 cm (17 in)
OPT001	12.0 kg (26.5 lb)	19.1 cm (7.5 in)	42.5 cm (16.7 in)	43.2 cm (17 in)
OPT002	12.5 kg (27.6 lb)	19.1 cm (7.5 in)	42.5 cm (16.7 in)	43.2 cm (17 in)

Frequency Range and Power Levels

NOTE When the test set is configured with your network analyzer, the system frequency range of operation will be determined by the frequency range limits of this combination.

CAUTION It is recommended that you do not operate components near damage levels (+30 dBm). The power levels must be 3 dB below maximum level to ensure no damage.

Refer to your analyzer's specifications to determine the maximum input power levels for the access and test ports, or to optimize the power levels in the receivers.

Table 4 Maximum Power Levels

U3042AE04 Test Port RF Power Levels:	
PORT 5-8	+27 dBm
U3042AE04 Access Ports:	
SOURCE OUT	+20 dBm
CPLR ARM	+20 dBm
CPLR THRU	+20 dBm
RCVR OUT	+20 dBm

NOTE Damage and maximum levels are not necessarily the optimum level.

Typical Reflection Tracking

Performance for the test set is typical. System performance for the analyzer and test set are only characteristic and are intended as non-warranted information.

NOTE Typical performance is based on 1 to 2 units, see Table 5 and Table 6.

Table 5 Typical Reflection Tracking PNA-L

Frequency	Standard 700	Option 001	Option 002
300 MHz to 10 MHz[a]	-80	-100	-100
10 MHz to 4 GHz	-10	+2	+1
4 GHz to 6 GHz	-12	+1	+0
6 GHz to 10.5 GHz	-13	-2	-3
10.5 GHz to 13.5 GHz	-14	-3	-4
13.5 GHz to 15 GHz	-15	-3	-4
15 GHz to 20 GHz	-20	-13	-15

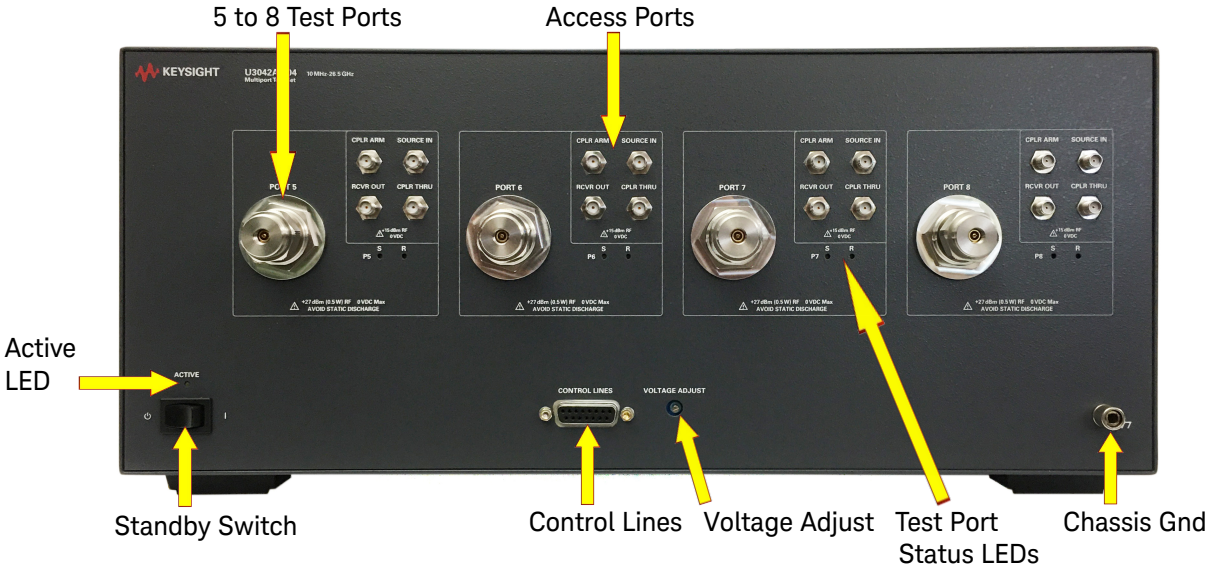
a. Generally improves at 3 MHz to -6 dBm.

Table 6 Typical Reflection Tracking PNA and PNA-X

Frequency	Standard 700	Option 001	Option 002
10 MHz to 50 MHz	-3	+5	+4
50 MHz to 500 MHz	-5	+5	+4
500 MHz to 3.2 GHz	-10	+2	+1
3.2 GHz to 10 GHz	-12	-2	-3
10 GHz to 16 GHz	-17	-4	-5
16 GHz to 20 GHz	-20	-13	-15
20 GHz to 24 GHz	-22	-21	-23
24 GHz to 26.5 GHz	-25	-35	-37

Front and Rear Panel Features

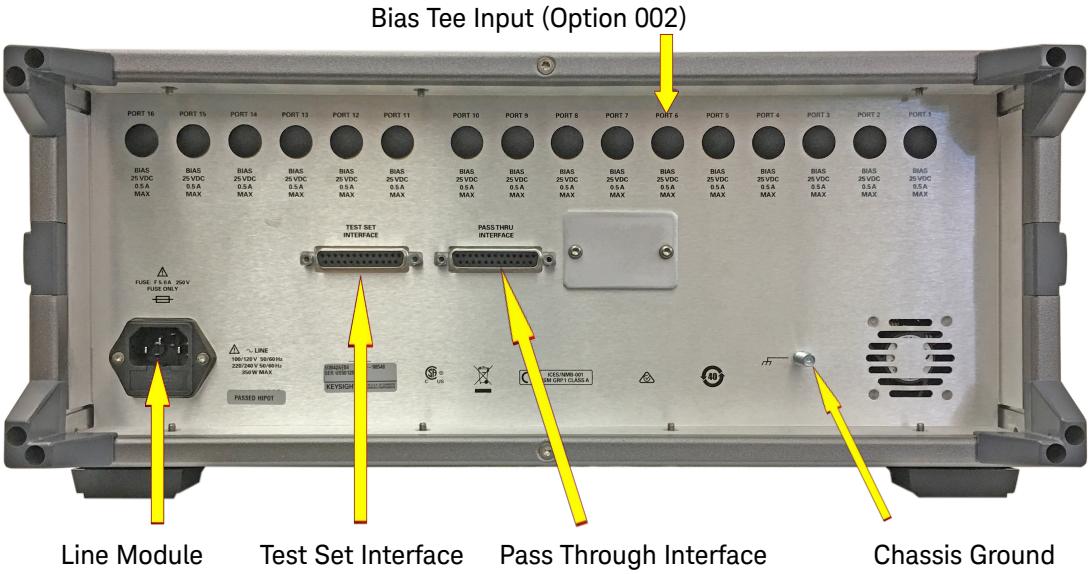
Figure 3 U3042AE04 Front Panel



Test Ports 3.5 mm Bulkhead (male)	Port 5-8
Access Ports – SMA (female)	· CPLR ARM · SOURCE IN · CPLR THRU · RCVR OUT
Ground	Ground is provided for ESD and safety connection.
Test Port Status LEDs	An illuminated LED indicates an active port in Source or Receiver mode. On the front panel “S” indicates Source test ports and “R” indicates Receiver test ports.
Control Lines and Voltage Adjust	For further information pertaining to control lines and voltage adjustments see “Control Lines” on page 55.
Standby Switch	Note that this switch is Standby only, not a line switch. The main power cord can be used as the system disconnecting device. It disconnects the mains circuits from the mains supply.
Active LED	When the Test Set is connected and addressed by a PNA-X, the LED is ON (illuminated). The LED is Off when the Test Set is in Standby, or not addressed by the PNA-X.

NOTE When the two Test Sets are connected together, as in the multi-Test Set system, the first Test Set connected to the PNA-X will never have an "ON" Active LED. Instead, the last Test Set in the I/O cable chain will be the Test Set showing the "Active LED" status for all.

Figure 4 U3042AE04 Rear Panel



Bias Tee Input DUT BNC DC input bias connectors for Option 002. Maximum 25 Vdc, 500 mA.

Chassis Ground A threaded terminal post for connecting the test set to a conductive object, cabinet or structure to ensure a common potential and reduce leakage current in a system. Requires an English 1/4-20 thread nut (2950-0084) and lock washer (2190-0067).

Pass Through Interface The Pass Through Interface is used to connection to another test set.

Test Set Interface The Test Set I/O connector is used to send address and data to the test set from the network analyzer.

Line Module The line fuse, as well as a spare, reside within the line module. Figure 5 on page 19 illustrates where the fuse(s) are located and how to access them.

Install the instrument so that the detachable power cord is readily identifiable and is easily reached by the operator. 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. Alternatively, an externally installed switch or circuit breaker (which is readily identifiable and is easily reached by the operator) may be used as a disconnecting device.

Available Fuses Fuse (F 5 A/250V, 2110-0709) UL listed and CSA certified.

WARNING **For continued protection against fire hazard replace line fuse only with same type and rating. The use of other fuses or material is prohibited.**

Figure 5 Line Module and Fuse

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 damage to the product.

CAUTION Verify that the premise electrical voltage supply is within the range specified on the instrument.

Hardware Lock-link Installation (U3021-60001)

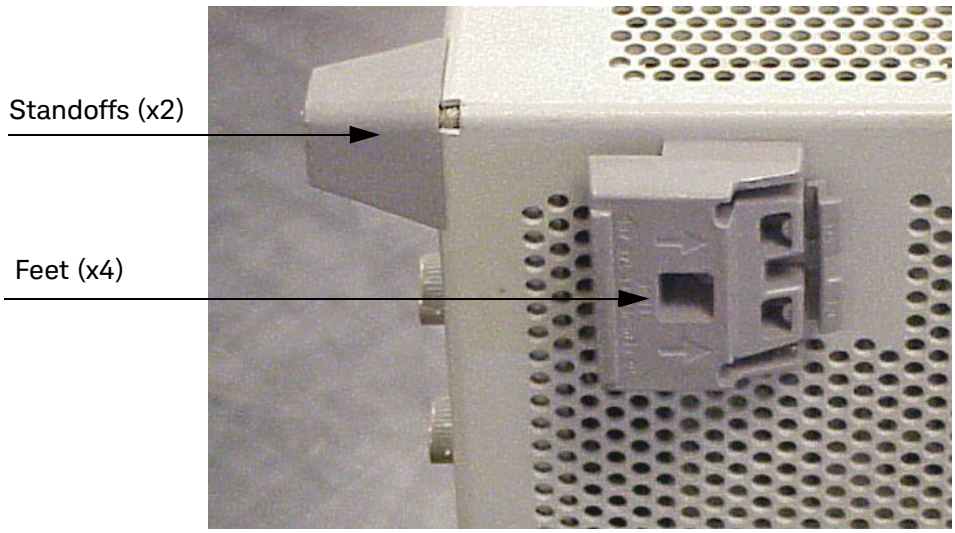
If your system is to be rack mounted, this installation procedure does not have to be performed.

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

Locking the Test Set to the PNA-L

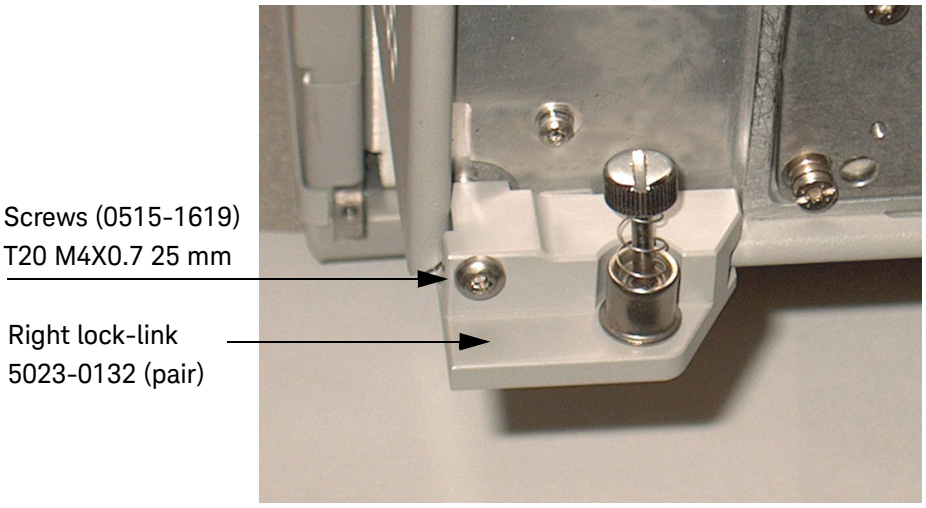
1. The lock-link kit (U3021-60002) includes:
   - 5023-9253 - Lock-link kit (left, 5022-2816 & right 5022-2817), Test Set
   - 5023-0132 - Lock-link kit (left, right and screws), Analyzer
2. Remove the feet from the bottom of the analyzer.
3. Remove the 2 lower standoffs on the rear panel of the analyzer using a T20 torx driver.

Figure 6 Rear Bottom Feet



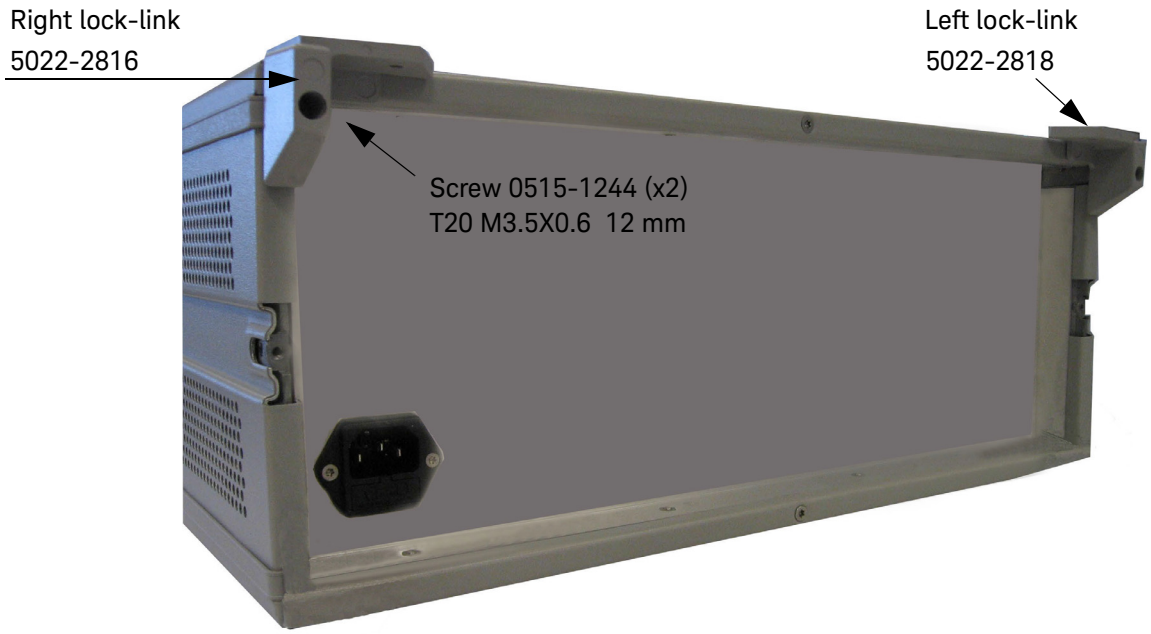
4. Install the lower lock-links (left not shown) onto the analyzer.

Figure 7 Install Lock-links to the Analyzer



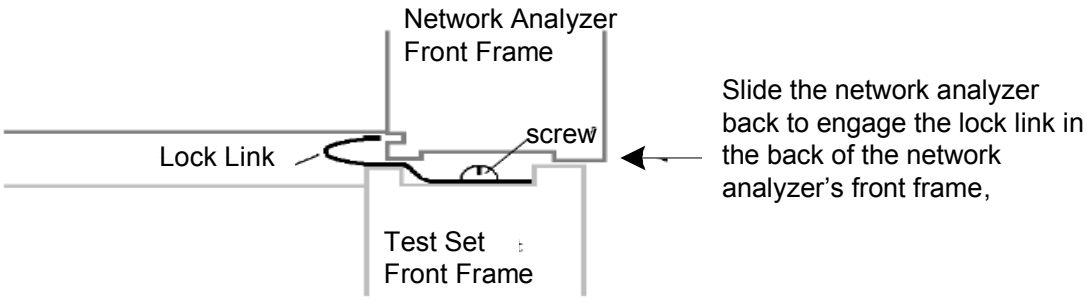
5. Remove the two upper standoffs on the rear panel of the test set using a T20 torx driver.
6. Install the left and right lock-links onto the test set.

Figure 8 Rear Lock-links to the Test Set



7. Place the analyzer on top of the test set and ensure that the front frame of the analyzer is positioned slightly forward of the locks that are attached to the test set. Slide the analyzer back so the locks engage the front frame of the analyzer.

Figure 9 Locking the Analyzer



8. Secure the analyzer's lower lock-links to the test set's upper lock-link using the spring–loaded screws. If the analyzer's lock-links are not aligned with the screw holes, loosen the screws securing the feet to the instrument to align and tighten.

Figure 10 Lock-Link Secured

NOTE Refer to "Network Analyzer Interface Kit Options" on page 11.

Hardware Lock-link Installation (U3021-60002)

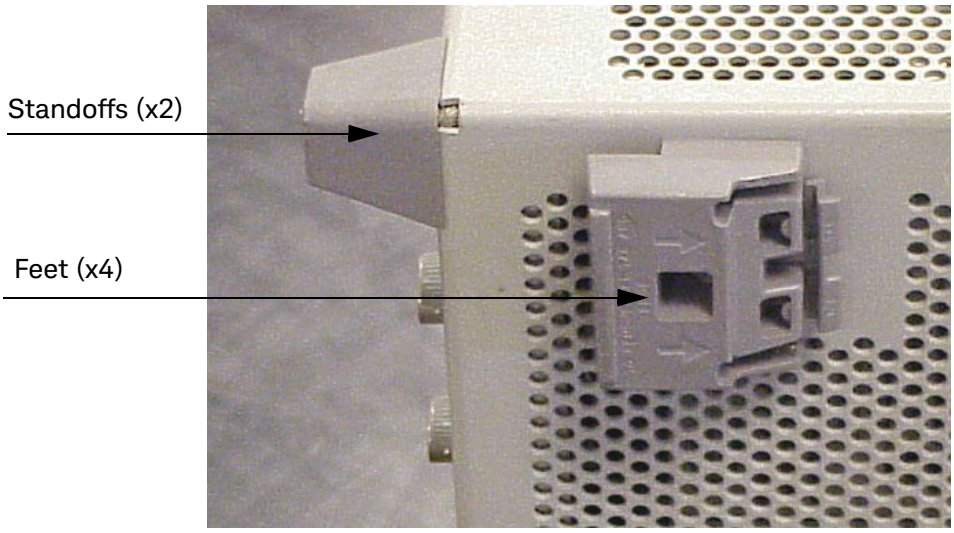
If your system is to be rack mounted, this installation procedure does not have to be performed.

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

Locking the Test Set to the PNA or PNA-X

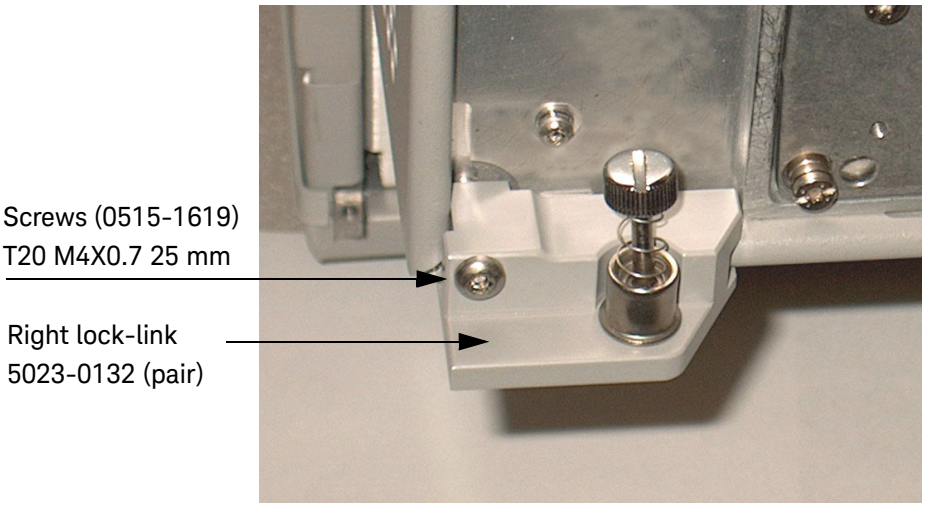
1. The lock-link kit (U3021-60002) includes:
   - 5023-0132 - Lock-link kit (left, right and screws), Analyzer
   - 0515-2317 - Screw T15 M3.5x0.6 12 mm
   - N5242-20138 – Right Lock-link, Test Set
   - N5242-20139 – Left Lock-link, Test Set
2. Remove the feet from the bottom of the analyzer.
3. Remove the 2 lower standoffs on the rear panel of the analyzer using a T20 torx driver.

Figure 11 Rear Bottom Feet



4. Install the lower lock-links (left not shown) onto the analyzer.

Figure 12 Install Lock-links to the Analyzer

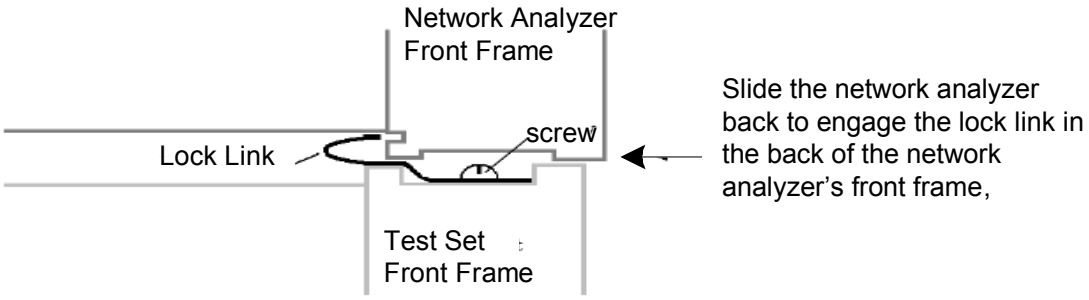


5. Remove the two upper standoffs on the rear panel of the test set using a T20 torx driver.
6. Install the left and right lock-links onto the test set.

Figure 13 Rear Lock-links to the Test Set

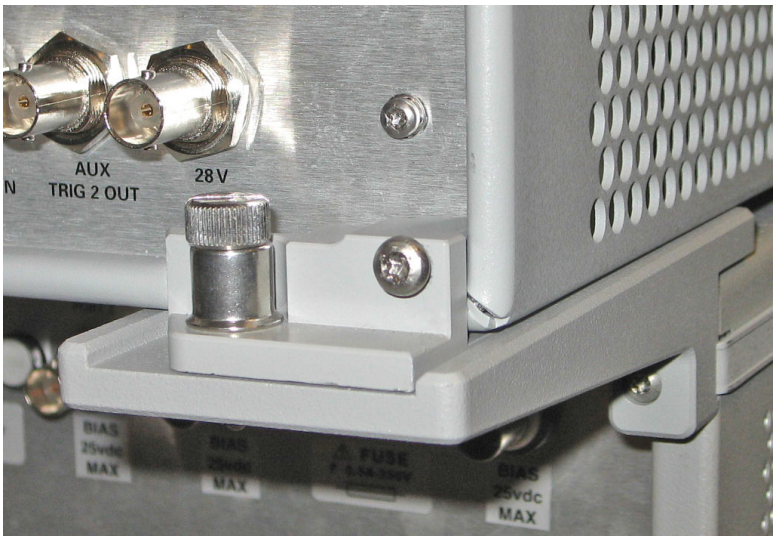
7. Place the analyzer on top of the test set and ensure that the front frame of the analyzer is positioned slightly forward of the locks that are attached to the test set. Slide the analyzer back so the locks engage the front frame of the analyzer.

Figure 14 Locking the Analyzer



8. Secure the analyzer's lower lock-links to the test set's upper lock-link using the spring–loaded screws. If the analyzer's lock-links are not aligned with the screw holes, loosen the screws securing the feet to the instrument to align and tighten.

Figure 15 Lock-Link Secured



PNA-L RF Interface Cable Connections (U3021-60045)

Figure 16 illustrates the cable configuration of the test set to the analyzer. The cables have been supplied with Cable Kit (U3021-60045).

1. Remove the SOURCE OUT to CPLR THRU and RCVR IN to CPLR ARM jumpers (x16) on the analyzer. The RCVR R1-R4 to SOURCE OUT reference loop jumpers (x1) remain on the front panel.
2. Connect the RF interconnect cables, supplied with this option, from the analyzer to the test set. As you are connecting each cable, torque to 8 in-lb.The Z5623-20418 is the short cable and the Z5623-20419 is the long cable. Refer to Table 7 and Figure 16 on page 27.

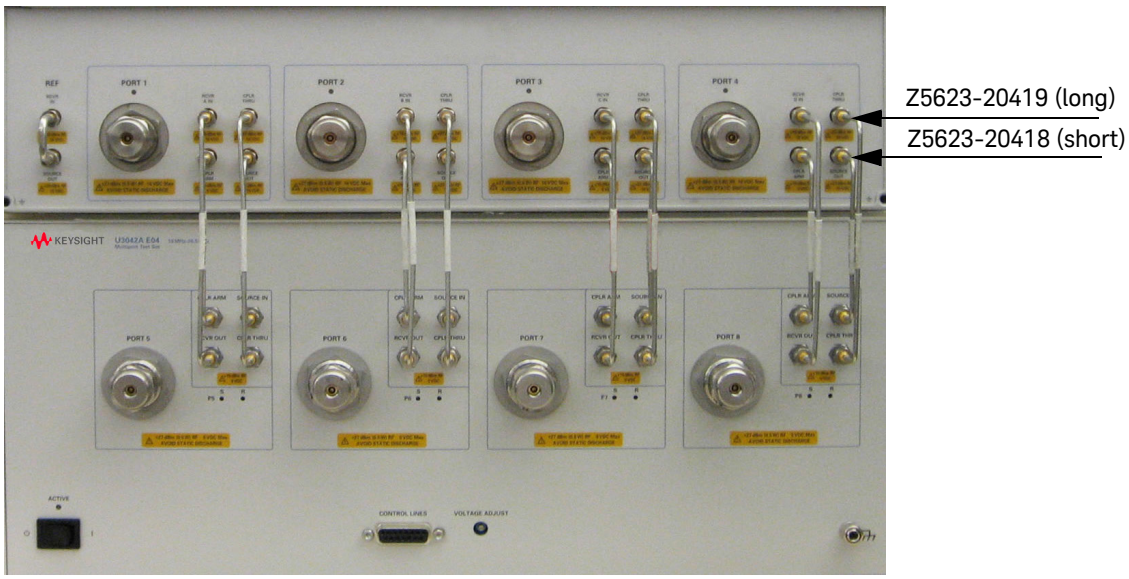
CAUTION Over torque will cause damage to the test set and may cause connectors to spin or become loose.

CAUTION Each end of the interconnect RF cables have a different length from the bend. When connecting the RF Interconnect cables be sure that the longer end (from the bend) is connected to the PNA-L.

Table 7 PNA-L Interface Cable Connection (U3021-60045)

RF Cables	From: PNA-L	To: Test Set
Z5623-20418	SOURCE OUT	SOURCE OUT
Z5623-20418	CPLR ARM	CPLR ARM
Z5623-20419	CPLR THRU	CPLR THRU
Z5623-20419	RCVR IN	RCVR OUT

Figure 16 PNA-L Interface Connections



3. Connect the Test Set I/O cable (N4011-21002) to the Test Set Interface connector on the rear panel, similar to Figure 18 on page 30.

Refer to "System Operational Checks" on page 31 for turn-on verification of the multiport system.

PNA or PNA-X RF Interface Cable Connections (U3021-60047)

Figure 17 illustrates the cable configuration of the test set to the analyzer. The cables have been supplied with Cable Kit (U3021-60047).

1. Remove the SOURCE OUT to CPLR THRU and RCVR IN to CPLR ARM jumpers (x8) on the analyzer. The RCVR R1-R4 to SOURCE OUT reference loop jumpers (x4) remain on the front panel.
2. Connect the RF interconnect cables from the analyzer to the test set in the order listed. As you are connecting each cable, torque to 8 in-lb. The longer, straight end of each cable is connected to the test set Refer to Table 8 and Figure 17 on page 29.

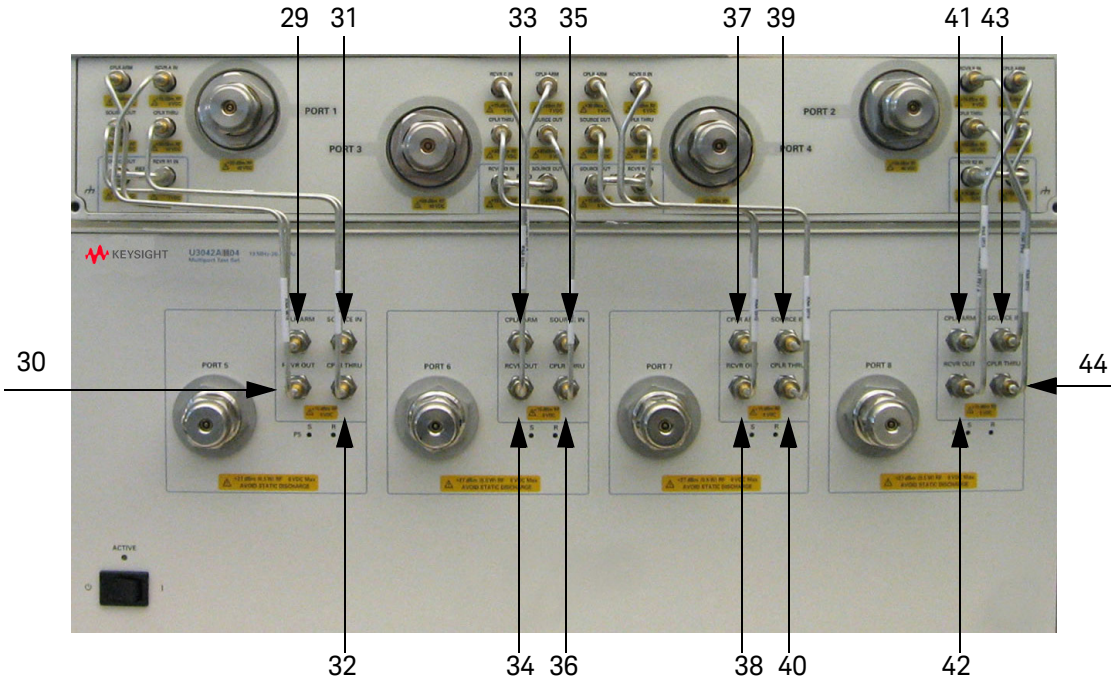
CAUTION Over torque will cause damage to the test set and may cause connectors to spin or become loose.

Table 8 PNA and PNA-X Interface Cable Connection (U3021-60047)

Numeric Order	RF Cables	From: PNA_X	To: Test Set
1	U3042-20031	Port 1 SOURCE OUT	Port 5 SOURCE IN
2	U3042-20032	Port 1 CPLR THRU	Port 5 CPLR THRU
3	U3042-20029	Port 1 CPLR ARM	Port 5 CPLR ARM
4	U3042-20030	Port 1 RCVR A IN	Port 5 RCVR IN
5	U3042-20035	Port 3 SOURCE OUT	Port 6 SOURCE IN
6	U3042-20033	Port 3 CPLR ARM	Port 6 CPLR ARM
7	U3042-20034	Port 3 RCVR C IN	Port 6 RCVR OUT
8	U3042-20036	Port 3 CPLR THRU	Port 6 CPLR THRU
9	U3042-20037	Port 4 CPLR ARM	Port 7 CPLR ARM
10	U3042-20038	Port 4 RCVR D IN	Port 7 RCVR OUT
11	U3042-20039	Port 4 SOURCE OUT	Port 7 SOURCE IN
12	U3042-20040	Port 4 CPLR THRU	Port 7 CPLR THRU
13	U3042-20043	Port 2 SOURCE OUT	Port 8 SOURCE IN
14	U3042-20041	Port 2 CPLR ARM	Port 8 CPLR ARM
15	U3042-20044	Port 2 CPLR THRU	Port 8 CPLR THRU
16	U3042-20042	Port 2 RCVR B IN	Port 8 RCVR OUT

Figure 17 illustrates the final two digits of the part number for each cable. The cables must be connected in the numeric order listed in Table 8 on page 28.

Figure 17 PNA and PNA-X Interface Connections

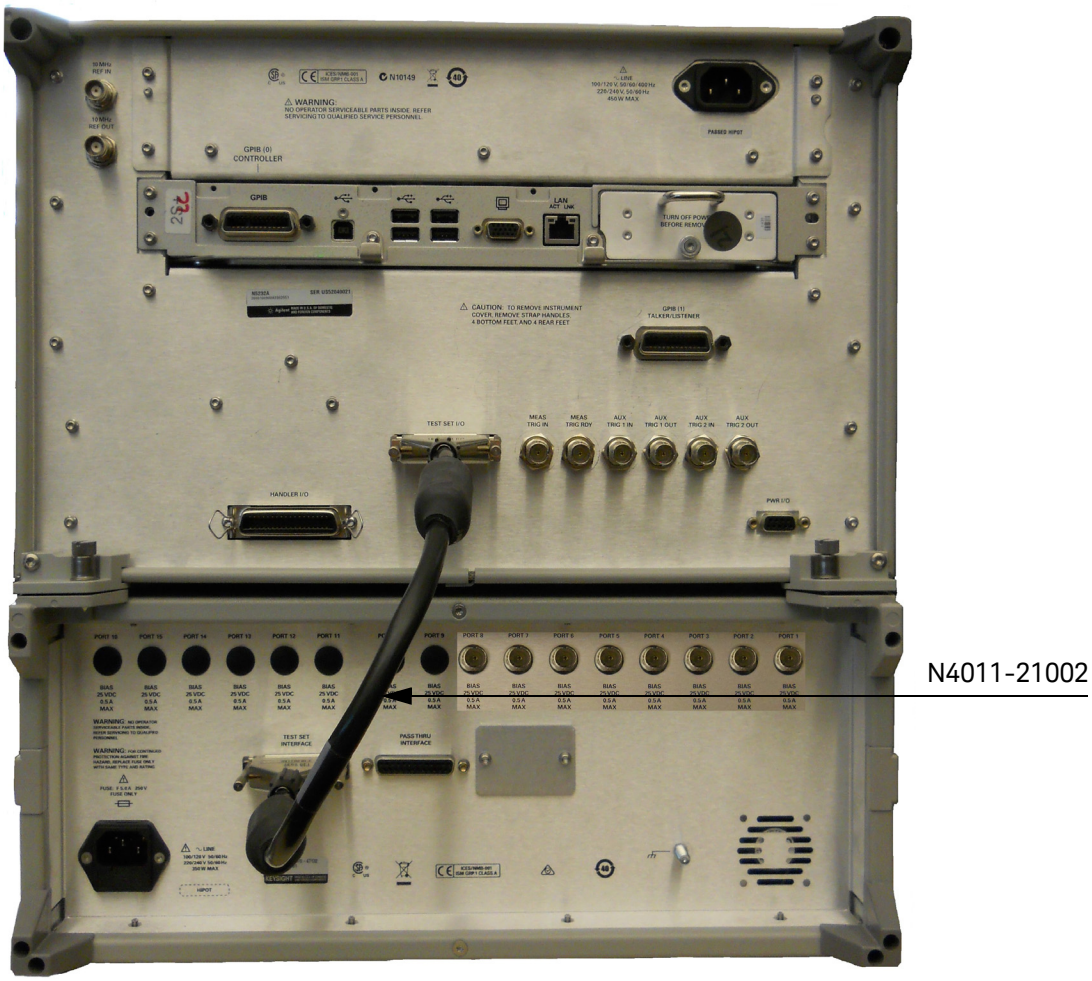


3. Connect the Test Set I/O cable (N4011-21002) to the Test Set Interface connector on the rear panel, similar to Figure 18 on page 30.

Test Set I/O Cable Installation

1. Connect the Test Set I/O cable (N4011-21002) to the Test set Interface connector on the rear panels, similar to Figure 18.

Figure 18 Test Set I/O Cable Connection



Interconnect Cable Verification

1. Perform the “System Operational Checks” on page 31.
2. If the problem still exists, perform the “RF Switching Failures” on page 81.
3. If a power hole or other failure still exists, refer to “Contacting Keysight” on page 100.

System Operational Checks

The following procedure will confirm that the RF interface cables between the test set and analyzer are installed and the system is working correctly. Ensure that your analyzer is calibrated by measuring the short on each port before connecting the test set.

NOTE This section is written using the PNA-X as an example. It is valid for the PNA and PNA-L, simply adjust the settings accordingly.

Complete the following steps before beginning this procedure:

- Stack the analyzer on top of the test set.
- Install the Test Set I/O cable on the rear panel.
- Install all of the RF interface cables on the front panel.
- Install the included female 3.5 mm short (85052-60007) to Port 1 on the analyzer.

Equipment Setup

- Turn on the test set and analyzer.
- Preset the analyzer and complete the following settings:
  - Set to Multi-Port Mode (refer to “Multiport Mode (Option 551)” on page 38.
  - Frequency range: 10 MHz to 26.5 GHz
  - IFBW: 1 kHz
  - Scale: 10 dB/Div
  - Set the analyzer to measure S11.

Verify Results

The 3.5 mm short will be relocated to each Test Port and an uncorrected reflection response trace should be displayed that resembles the following plots indicated in the table below. If you suspect an RF signal path problem, refer to the RF cable diagram and check the interface cables associated with this signal path for proper installation.

Table 9 Reflection Response Results

Ports Tested	Response Trace STD	Signal Path STD	Response Trace (Opt 001/002)	Signal Path (Opt 001)
Port 1 to 4	Figure 19	Figure 20	Figure 21	Figure 22
Ports 5 to 8	Figure 23	Figure 24	Figure 25	Figure 26

NOTE The trace ripple (peak-peak variation) will be higher than when using an ECal Module due to variation in your Short's performance. If response is in question perform "Cal Kit Operational Check" on page 61.

Figure 19 Typical Reflection Response Ports 1 to 4 (Std)

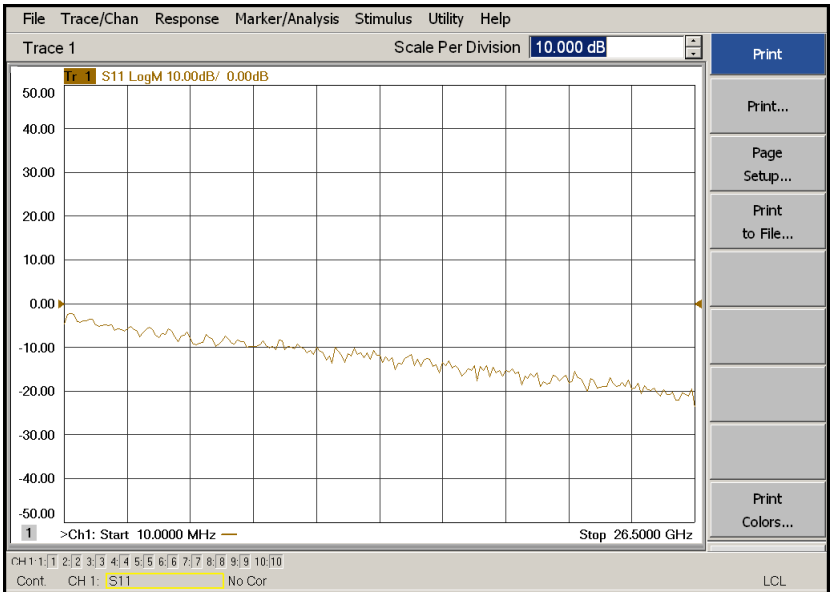


Figure 20 Reflection Response Signal Path Diagram Ports 1 to 4 (Std)

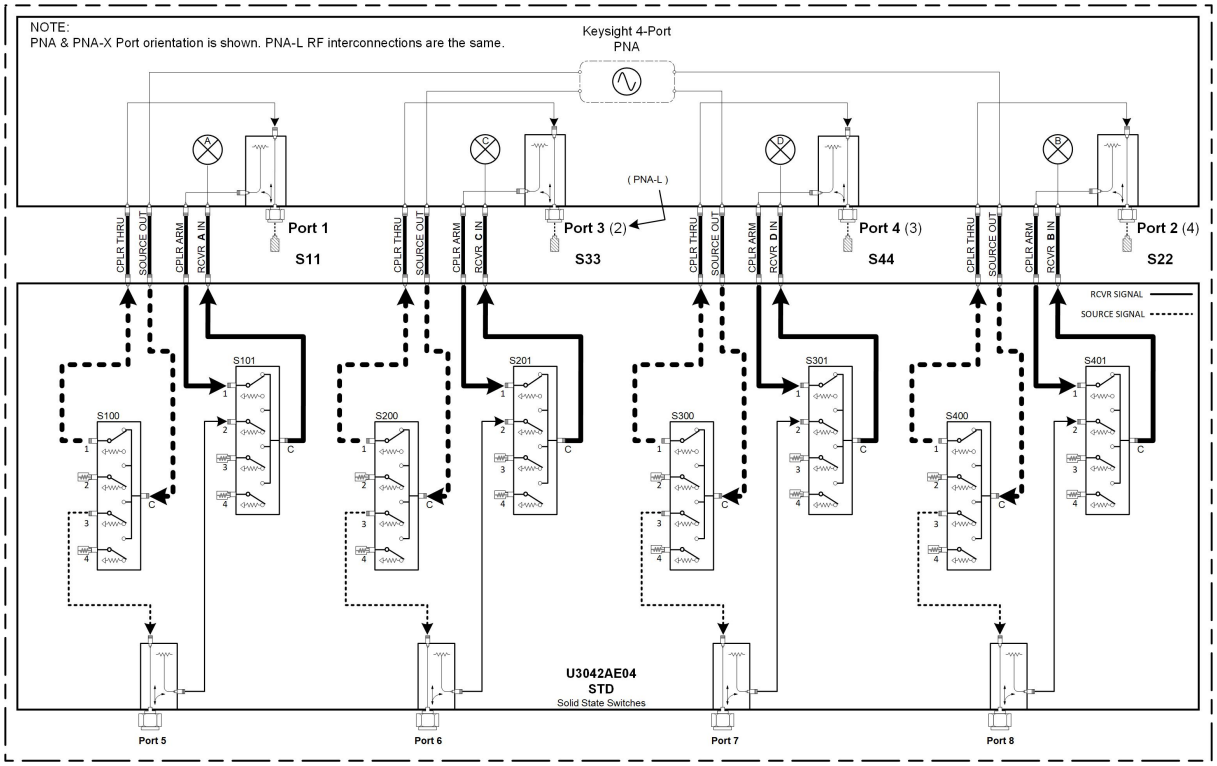


Figure 21 Typical Reflection Response Ports 1 to 4 (Option 001/002)

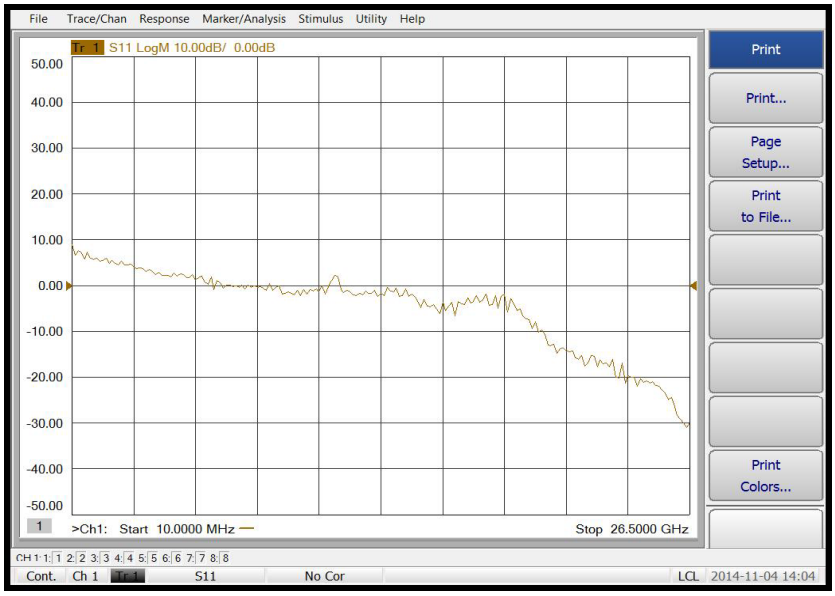


Figure 22 Reflection Response Signal Path Diagram Ports 1 to 4 (Option 001)

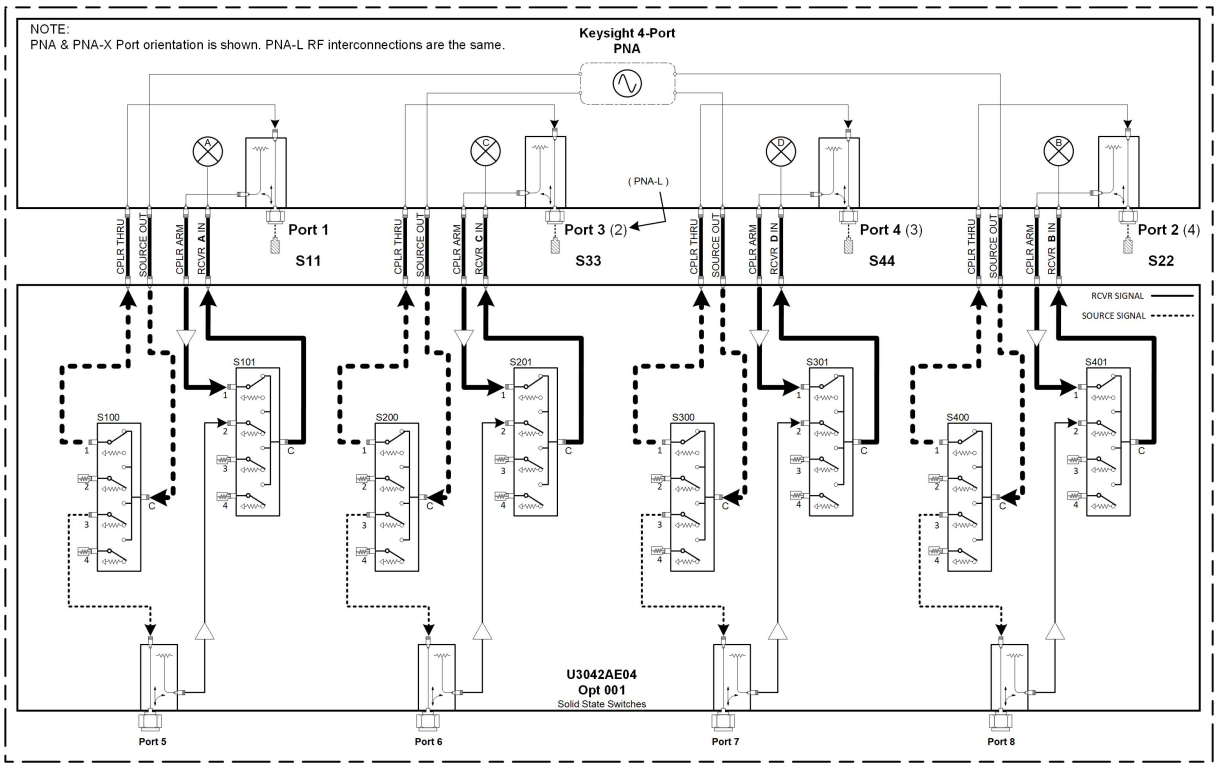


Figure 23 Typical Reflection Response Ports 5 to 8 (Std)

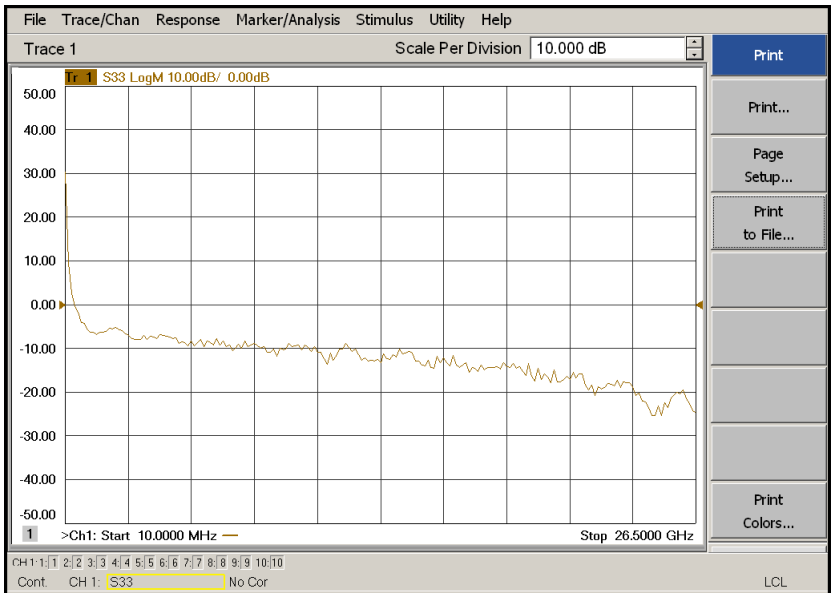


Figure 24 Reflection Response Signal Path Diagram Ports 5 to 8 (Std)

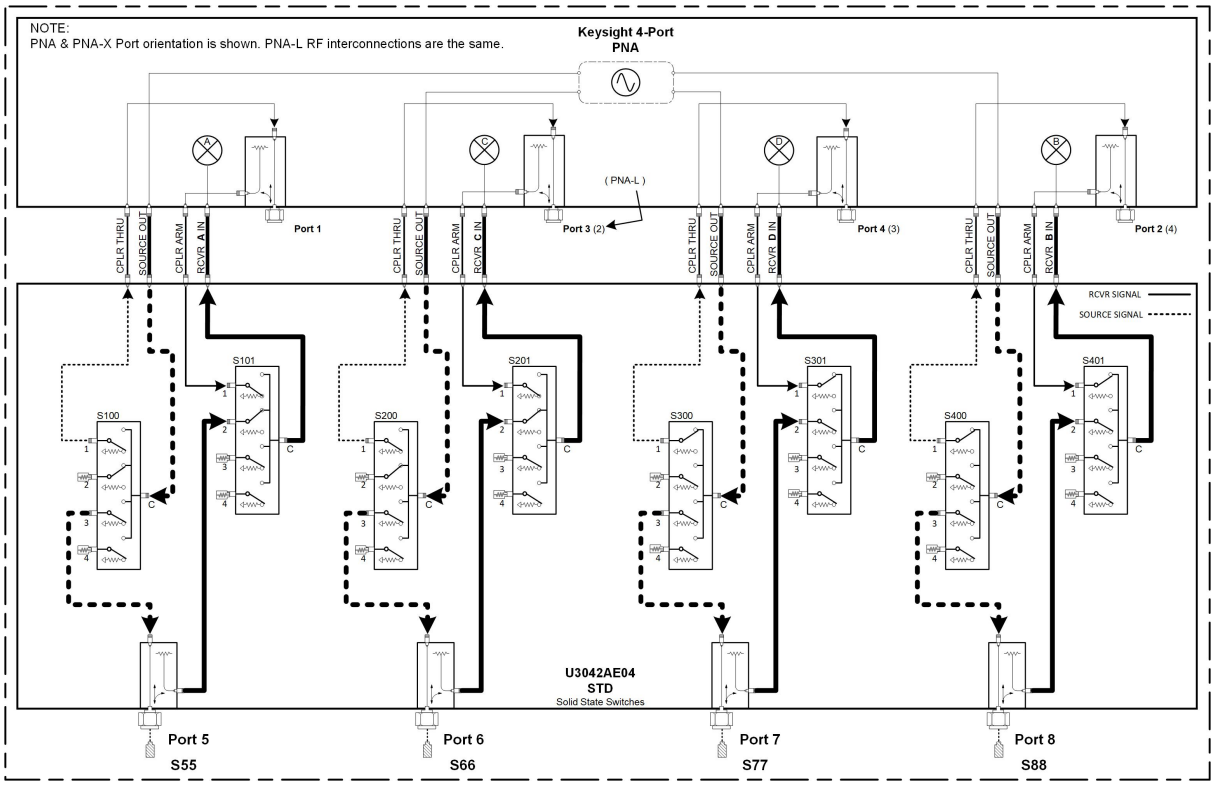


Figure 25 Typical Reflection Response Ports 5 to 8 (Option 001/002)

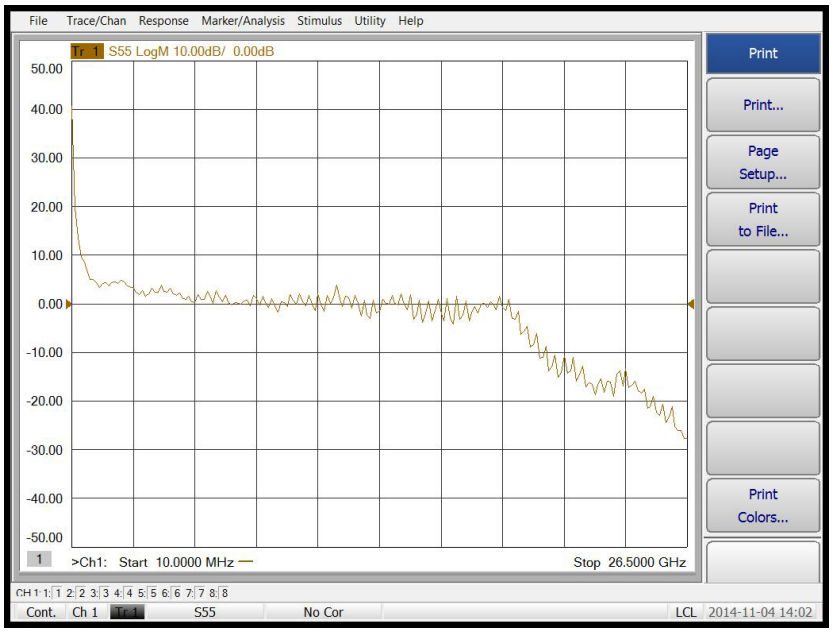
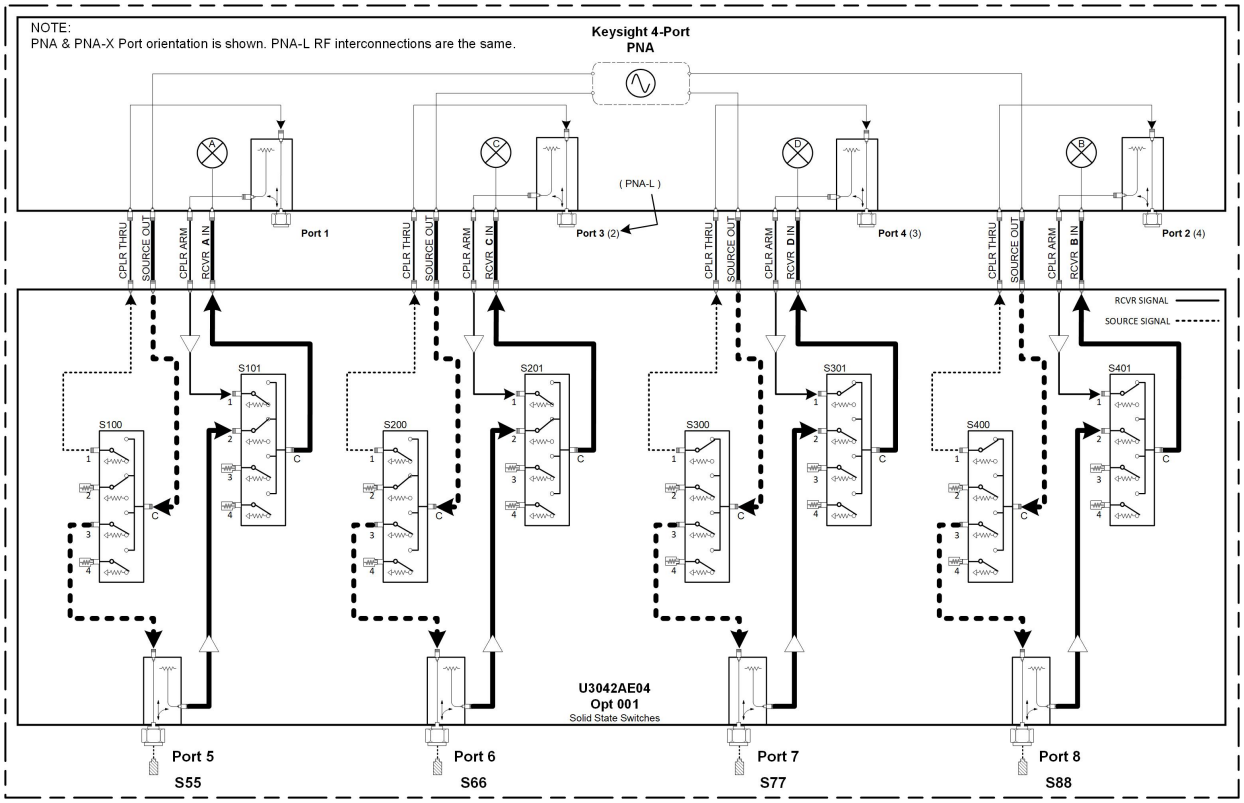


Figure 26 Reflection Response Signal Path Diagram Ports 5 to 8 (Option 001)



Controlling the Test Set

This section will describe how to operate the test set with the analyzer.

NOTE The internal of the analyzer has not been modified for this test set option. Power levels may differ from those indicated on the network analyzer when the test set is connected.

The test set is considered a “secondary” instrument. A network analyzer must be used to control the test set. There are three methods to control the test set. Multiport mode is recommended due to ease of use, and multiport calibration capability (N-Port).

- “Multiport Mode (Option 551)” on page 38
- “Interface Control Mode” on page 45
- “SCPI Control Mode” on page 49

Typeface Key Conventions

The following key conventions are used throughout this document.

- **[HARDKEYS]** are labeled front panel keys
- **SOFTKEYS** are indicated on the instrument display
- *(Italicized in parenthesis)* are menu paths for the 'B' model analyzer

Definitions for Specifications

Specifications describe the warranted performance of calibrated instruments that have been stored for a minimum of 2 hours within the operating temperature range of 0 to 55 °C, unless otherwise stated, and after a 45 minute warm-up period. Data represented in this document are specifications unless otherwise noted.

Characteristics describe product performance that is useful in the application of the product, but that is not covered by the product warranty. Characteristics are often referred to as Typical or Nominal values.

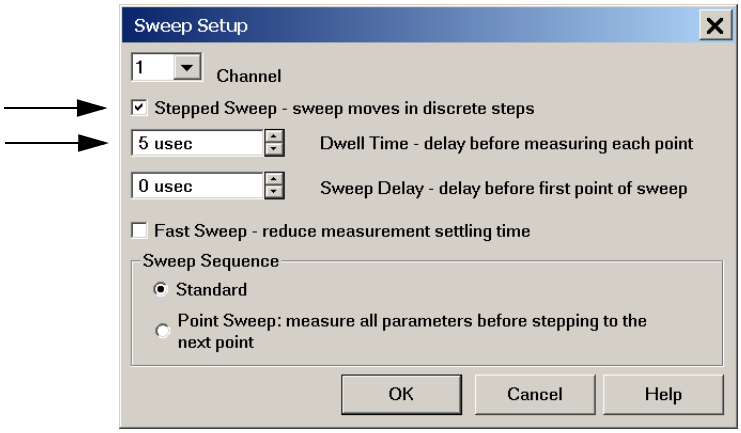
- **Nominal** describes representative performance that is useful in the application of the product when operated over a 20 to 30 °C temperature range. Nominal performance is not warranted.
- **Typical** describes characteristic performance, which 80% of instruments are expected to meet when operated over a 20 to 30 °C temperature range. Typical performance is not warranted.

Sweep Setup for Multiport and Standalone Modes

Due to the extra electrical length of the Test Set and test port cables, it is recommended that the analyzer's Sweep Setup be configured to Stepped Sweep before calibrating. This is slower than the Analog Sweep, but is more accurate. Stepped Sweep is available on all PNA models.

1. On the PNA select **STIMULUS** > **Sweep** > **Sweep Setup**.
2. Select **Stepped Sweep**.
3. Set the **Dwell Time** to **5 µs** > **OK**.

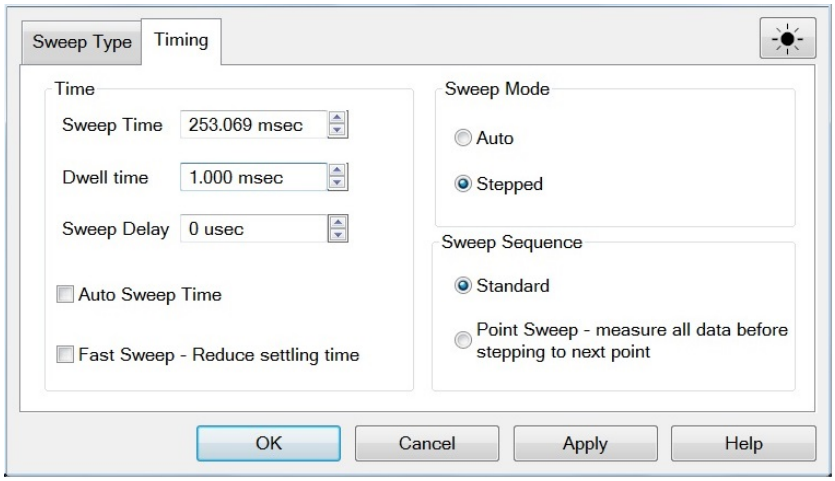
Figure 27 Sweep Setup



Sweep Setup for PNA-X N52xxB Models

1. Select **[Sweep]** > **Sweep Setup** > **Timing**.
2. Select **Timing** tab.
3. Select **Sweep Mode: Stepped**.
4. Deselect **Time: Auto Sweep Time**.
5. Set **Dwell Time** > **Apply** > **OK**.

Figure 28 Sweep Setup, N52xxB



Multiport Mode (Option 551)

Multiport mode selects the test set file that will enable the analyzer to control the test set. Multiport mode allows you to complete a N-Port calibration using the Cal Wizard application in the analyzer. Refer to the Help system for more information.

The following Test Set file must be installed into network analyzer file directory: c:\Program Files\Keysight\Network Analyzer\testsets

4-Port PNA-L requires Test Set: u3042ae04_p4.tsx

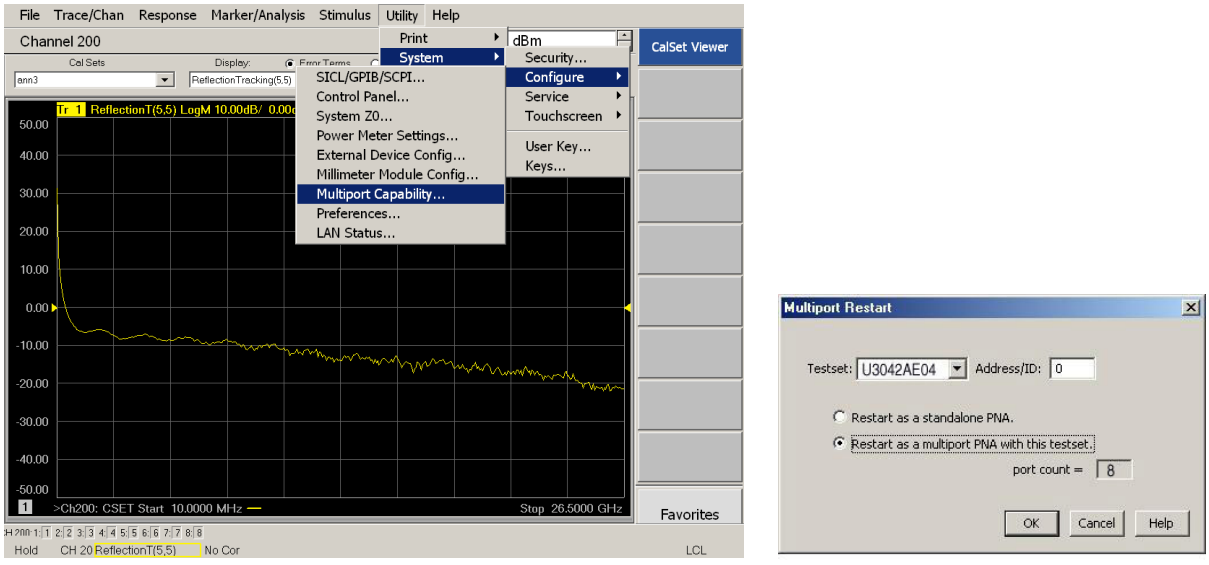
4-Port PNA or PNA-X requires Test Set: u3042ae04_pnax_p4.tsx

How to Access Multiport Mode

1. The Option 551 must be installed for multiport capability. To access the multiport application select **[Utility] › System › Configure › Multiport Capability -OR-** ***(Instrument › Setup › External Hardware › Multiport Configuration...)***.
2. Select **U3042AE04** (8-Port System) from the drop-down menu and select **Restart as a multiport PNA with this testset** › **OK**. The analyzer will restart the network application with the test set interface features.

If the test set is not available in the drop-down list, it will be necessary for you to copy the required test set file to the analyzer's hard drive. The current version of the test set files are available on the web at http://na.support.keysight.com/multiport/testsetsupport.html. Copy the appropriate file to c:\program files \keysight\Network Analyzer\testsets directory.

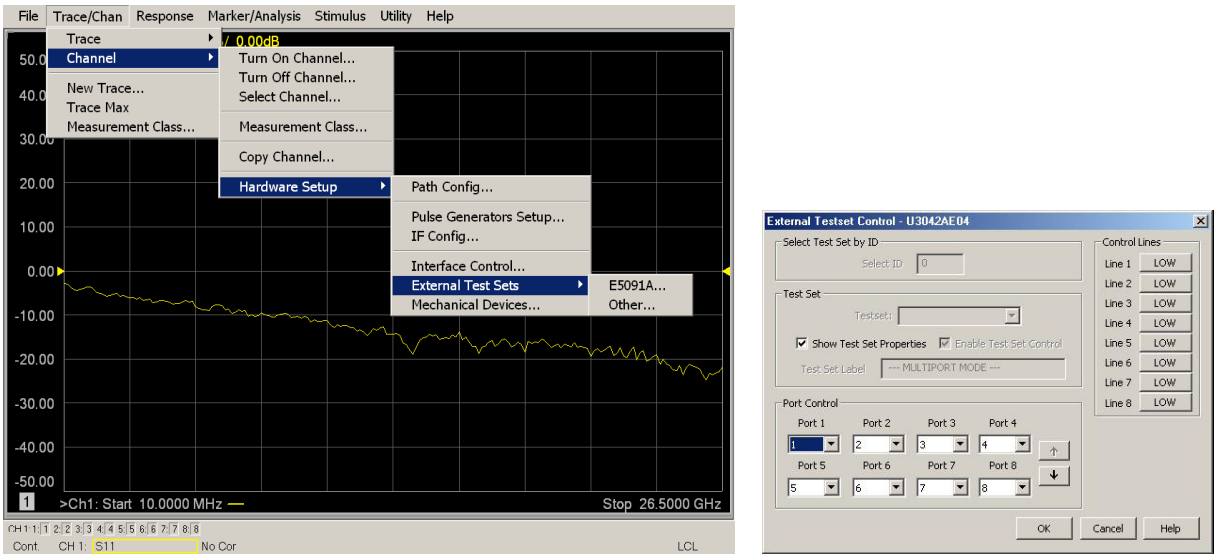
Figure 29 Selecting Multiport Mode



External Test Set Control Feature

To verify that the network application has the test set interface features, select **Trace/Chan** > **Channel** > **Hardware Setup** > **External Test Set** > **Other -OR-** ***(Instrument*** > ***Setup*** > ***External Hardware*** > ***External Device...*** > ***Multiport*** > ***Other Test Set Setup...)***. The test set will be displayed as **External Test Set Control-U3042AE04**.

Figure 30 External Test Set Control



This menu will allow the physical Ports 1 thru 8 to be identified as any port for your convenience. For example; Port 5 can be re-named Port 2.

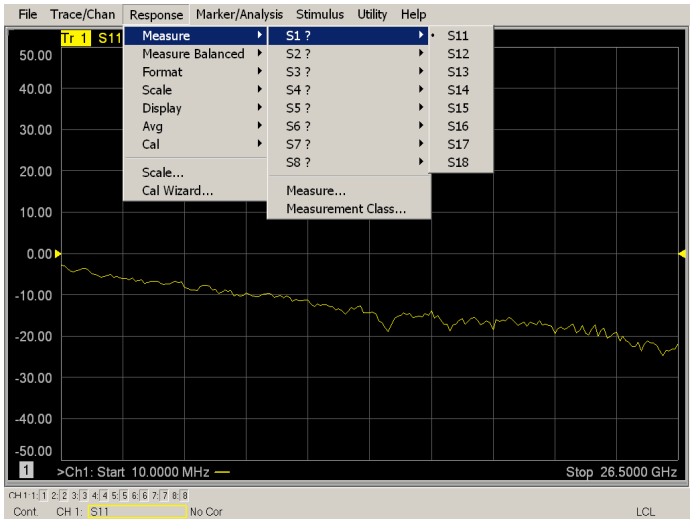
The **External Test Set Control-U3042AE04** also allows control of the DUT control lines, refer to “Control Lines” on page 55. To change the state from LOW to HIGH, select the graphical user interface (GUI) for the specific control (LINE 1 to 8), click **OK**. Each line can be controlled separately.

Trace Measure S-Parameter

S-Parameter selection can be accomplished using **Response > Measure**. Use the drop-down menu to select 1 of 64 S-Parameters for the 8-Port system. The first number in the Sxx selection is the Receiver Port and the second number will be the Source Port. Any port can be selected to be the Receiver, Source or both, as in S11. The front panel R LED indicates the port is the Receiver and the S LED indicates the port is the Source.

The 'B' model analyzer provides an S-parameter selection method by using the keypad. For example, to select S25: **MEAS [MEAS] > Enter S-Parameters > [2].[.][5] [Enter]**

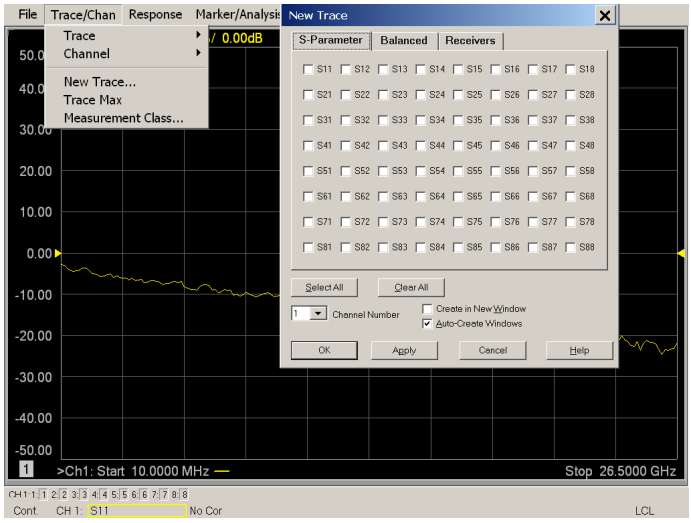
Figure 31 S-Parameter Measurement



New Trace Measure S-Parameter

S-Parameter Tab: Multiple S-Parameters can be made from the **New Trace** menu. In the drop-down menu select **Trace/Chan > Trace > New Trace -OR-** ***(Instrument > Trace > New Trace)***. The dialog box allows the selection of any of the 64 S-Parameters.

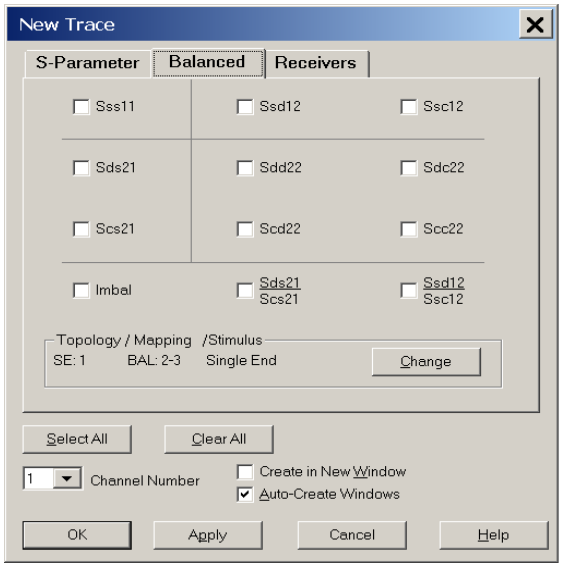
Figure 32 New S-Parameter Measurement



Balanced Tab: Balanced Measurements can be configured by selecting the Balance tab in the New Trace menu.

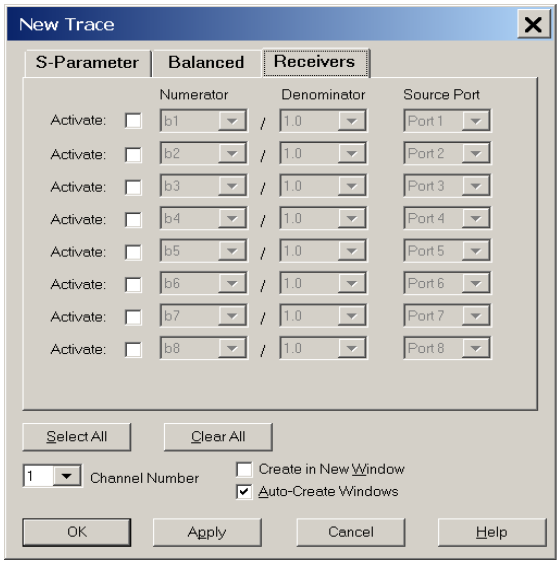
For more information on balanced (differential) component measurement, refer to the Application Note 1373-1 and 1373-2 (5988-5634EN and 5988-5635EN) at http://www.keysight.com. In the search menu type “Multiport and Balanced.”

Figure 33 Selecting Balanced Measurements



Receivers Tab: The S-Parameter measurements can be ratioed with selectable Denominators for each port and receiver. Refer to the standard documentation for more information.

Figure 34 Receiver Measurements

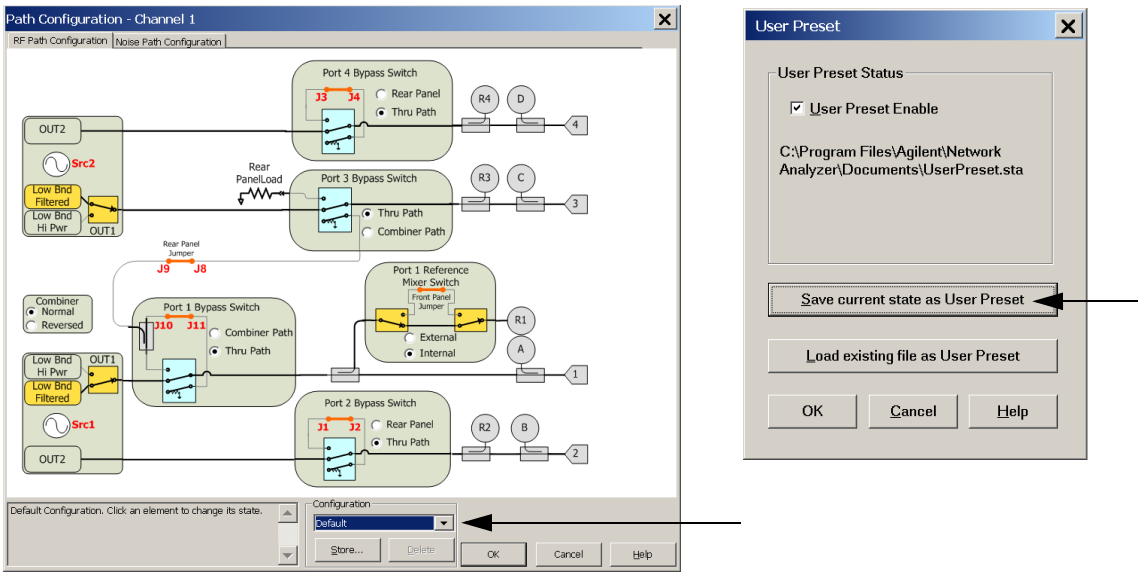


RF Path Configuration with Option 029

If the analyzer has Option 029 or H29 (noise figure capability) verify that the path configuration is set to Default. If it is not in Default configuration, Port 5 will not operate correctly.

1. Select **Trace/Chan** > **Channel** > **Hardware Setup** > **Path Config... -OR-** ***(Instrument*** > ***Setup*** > ***Internal Hardware*** > ***RF Path Config...)*** and in the drop-down menu select **Default** > **OK**. Save this configuration as a User Preset by selecting **Save** > **User Preset** > **Save current state as User Preset**. Do not use the factory Preset (User Preset Off), the analyzer will return to Option 029 path configuration.
2. Verify that the Port 1 Noise Tuner Switch is set to external. Select **Utilities System**> **Configure** > **Preferences -OR-** ***(Utility*** > ***System*** > ***System Setup*** > ***Preferences*** > ***User Preset)***. If not, select **Meas: Port 1 Noise Tuner Switch is set to external**.

Figure 35 RF Path Configuration



N-Port Calibration

It is recommended that you perform an ECal characterization to minimize the connections required for multiple port calibration. The N4691B Option M0F is recommended with cable (85133F) if you are calibrating directly on the analyzer and test set ports.

Characterize the ECal module with adapters that will not be used in the measurement of the DUT. To characterize the ECal module select **Response** > **Cal** > **More** > **ECal** > **Characterize ECal Module** -OR-
(Responses > ***Cal*** > ***Cal Sets & Cal Kits*** > ***Characterize ECals...)***.

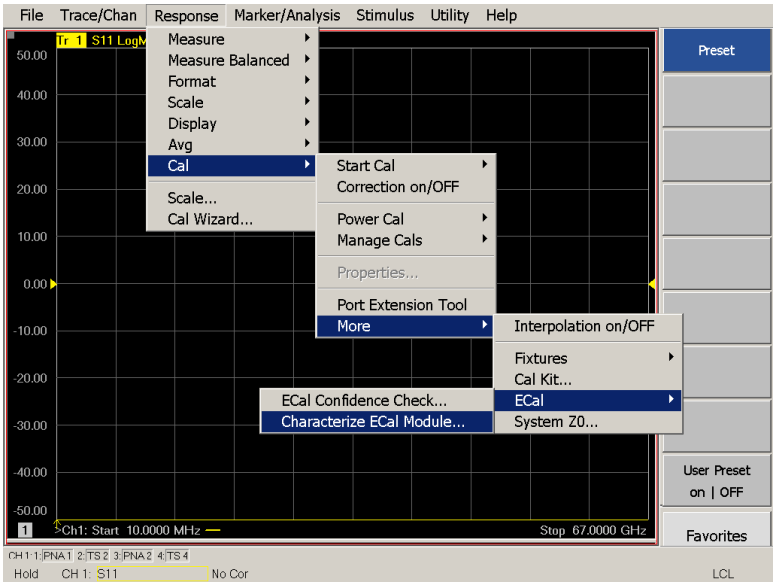
Calibrate at the end of the test port RF cables and any adapters that are used to connect the DUT. This removes the effect on the measurement of the DUT. Failure to do this will create ripple and other measurement errors.

NOTE

If measurement errors occur, ensure the newest version of firmware is installed on the analyzer. Measurement errors can be a result of firmware algorithms. Consult with Keysight Service or firmware web page for the latest Option 551 firmware revisions and history at http://na.support.keysight.com/pna/firmware/firmware.html

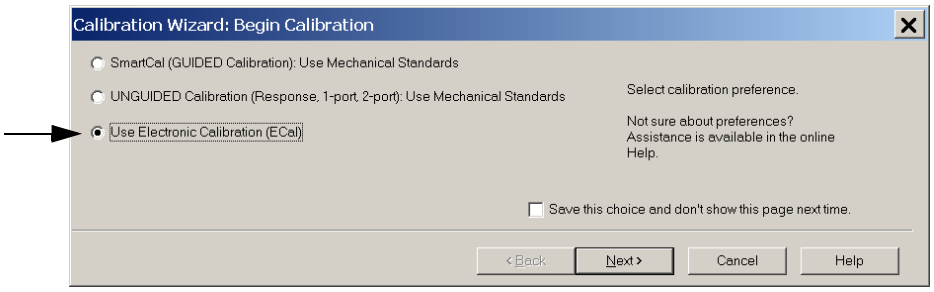
1. To perform an ECal characterization select
   Response > **Cal Wizard** > **Characterize ECal Module** -OR-
   (Response > ***Cal*** > ***Other Cals*** > ***ECal...)*** and follow the prompts.
2. Save the ECal characterization file. Refer to the Help menu for characterizing information.

Figure 36 ECal Characterization and Calibration Wizard



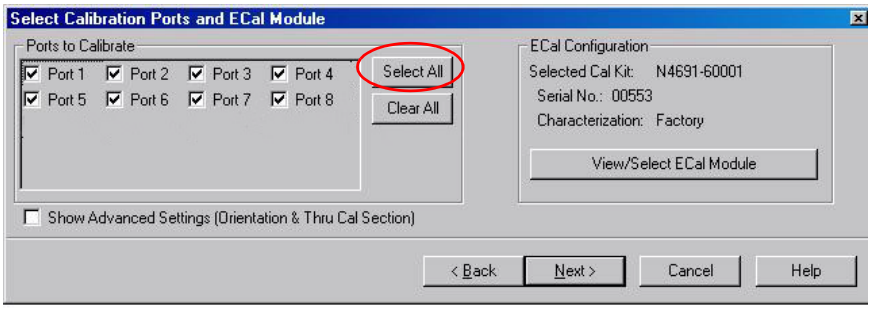
3. On the analyzer select **Response** > **Cal Wizard** -OR- ***(Response > Cal > Other Cals...)***.
   a. If using a mechanical cal kit, select **SmartCal (Guided Calibration)** > **Next**.
   b. If using an ECal module, connect the ECal to an available USB port and select **Use Electronic Calibration (ECal)** > **Next** -OR- ***(Response > Cal > Other Cals... > ECal...)***.

Figure 37 Begin Calibration



4. Continue following the Cal Wizard prompts. In the "Select Calibration Ports and ECal Module" dialog box press **Select All**, or select the ports you are calibrating and press **Next**. If an ECal characterization has been done, select **View/Select ECal Module** and select the previously saved user file from step 3.

Figure 38 8-Port Calibration



5. Connect the ECal or the mechanical cal kit to the ports you are calibrating following the Cal Wizard prompts and click **Measure** after each connection. The electrical delay value may be shown in the dialog box after the last measurement, click **OK**.
6. At the Calibration Completed prompt, select **Save As User Calset**, type the name and **Save**. See Figure 50 on page 64.
7. After calibrating test set ports, use a quality load and short to verify the calibration on each port or end of the test cable. Measure reflection and confirm the return loss is as expected. If the result is not as expected, repeat the calibration without the test set and ensure that the analyzer is in standard (non-multiport) mode.

NOTE

If measurement errors occur, ensure the newest version of firmware is installed on the analyzer. Measurement errors can be a result of firmware algorithms. Consult with Keysight Service or firmware web page for the latest Option 551 firmware revisions and history at http://na.support.keysight.com/pna/firmware/firmware.html

Interface Control Mode

NOTE

Interface Control mode will not function properly when using multiport mode. Multiport mode will reset the switch path commands of the interface control. It is recommended that the network analyzer be restarted in stand-alone mode if the interface control is being used. Select **Utility** > **System** > **Configure** > **Multiport Capability**. In the dialog box select **Restart as a standalone PNA** > **OK**

Overview of the Interface control

The Interface Control feature allows you to send data and remote commands to control external equipment using the GPIB, Handler I/O, Test Set I/O, Dwell After Command and Aux I/O without the need of an external computer. Refer to analyzer's Help menu, "Rear Panel Tour" and "Interface Control."

- A unique set of control data can be sent for each channel. In addition, a unique set of control data can be sent before the channel sweep starts and after the sweep ends.
- Interface Control settings can be saved and recalled from the "Interface Control" dialog box or with Instrument State Save and Recall.
- Interface Control settings can be copied to other channels using Copy Channels.
- Control data can only be WRITTEN to the interfaces, NOT READ from the interfaces.
- Control data is sent in the following order and this order cannot be changed: Refer to the Help menu.

1. GPIB Commands - BEFORE
2. Handler I/O Control
3. Test Set I/O Control (addr.data)
4. Dwell After Command
5. Aux I/O Output Voltage

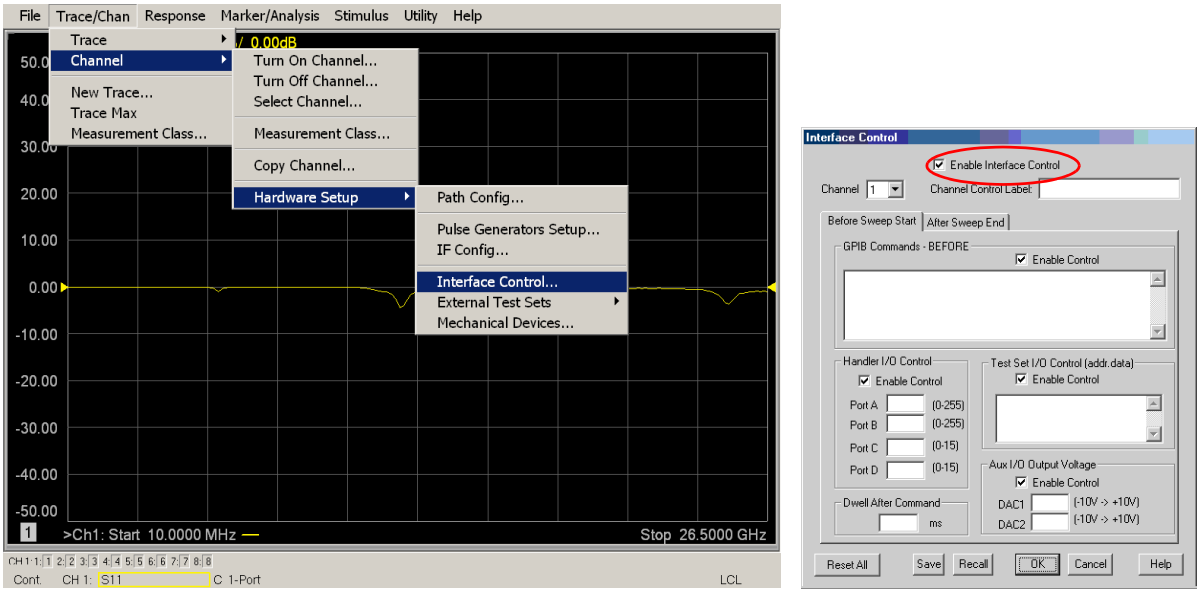
How to Access Interface Control Mode

1. To access the Interface Control mode, select
   Trace/Chan > Channel > Hardware Setup > Interface Control -OR-
   ***(Instrument > Setup > Internal Hardware > Interface Control...)* in the drop-down menu, and select Enable Interface Control.**

NOTE

The analyzer includes the Interface Control application and rear panel connection. Please review this application before connecting the test set to the network analyzer. Information regarding this application can be found in the Help menu, Interface Control.

Figure 39 Interface Control



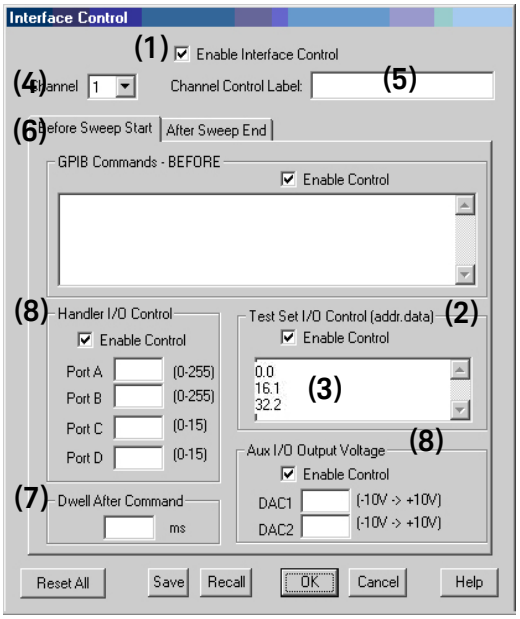
Using Interface Control Mode

An Instrument Preset will reset all of the fields to their default settings.

NOTE

If an error is encountered when sending Interface Control data, an error message is displayed on the analyzer's screen and the Channel Trigger State is set to Hold. You must fix the condition that caused the error, then change the Channel Trigger State to its original setting.

Figure 40 Interface Control



Enable Interface Control: (1)

Enables and disables ALL Interface Control communication. When cleared (default setting) Interface Control is disabled and NO data is sent. To send data, the individual interfaces must also be enabled.

Test Set I/O Control (addr.data): (2)

Provides control of the Test Set I/O Interface on the rear panel of the analyzer. Used to control your test set.

Only positive integers are allowed to select switch positions or states of DUT control interface lines. Refer to "Address and Data Values" on page 53.

Address and data integers must be separated by a period. Each set of entries should be separated by a new line, or carriage return. The front panel Enter key can be used to insert a new line into the field. The quantity of Test Set I/O entries that can be entered is limited by the available memory of the analyzer.

Address and Data example: **addr.data (3)**

0.0
16.1
32.2

Channel: (4)	Specifies the channel number for dialog settings. Each channel is configured individually. The drop-down list illustrates the channels that currently have measurements. There must be at least one displayed trace for the Test Set I/O Interface to function.
Channel Control Label: (5)	Specifies the label to be displayed on the analyzer's screen during the channel sweep.
Before Sweep Start – After Sweep End Tabs: (6)	Commands (GPIB, I/O's and Dwell) can be sent Before Sweep Start and After Sweep End. However, they are configured and enabled separately on the "Interface Control" dialog box. For example; to send a command before and after a PNA sweep, the "Enable Interface Control" check box must be selected and commands entered in both the Before Sweep Start and After Sweep End tabs. The **Before Sweep Start** data is sent before the first trace on the channel begins sweeping. The **After Sweep Start** data is sent after the last trace on the channel sweep is completed.
Dwell After Command: (7)	Specifies a wait time, in milliseconds, after all commands to all interfaces are sent. Any positive integer is allowed. This is used to allow all external devices to settle before beginning a measurement. An erratic trace could indicate that more settling time is necessary.
Handler I/O Control and Aux I/O Output Voltage: (8)	Provides I/O interface control through the rear panel of the PNA. Refer to the PNA Help menu for further information.
Reset All:	Sets all fields on all channels to their default values.
Save and Recall:	Saves and recalls the contents of the dialog box. If the "Interface Control" dialog box is populated with settings during an Instrument State Save, the settings are automatically recalled with the instrument state settings. Interface control uses an *.xml file type. An example file is stored on the PNA hard drive. You can recall it into the dialog, or you can open and edit it with a word processor, such as Word Pad.
OK:	Applies the settings and closes the dialog box.
Cancel:	Does not apply changes that were made and closes the dialog box.
Help:	Provides additional information for using the interface control application.

SCPI Control Mode

The Command Processor feature allows you to send remote commands and data to the analyzer's rear-panel GPIB connector and Test Set I/O connector. More information regarding the Command Processor can be found in the Help menu.

Overview of the SCPI Control

The Command Processor allows you to send address and data to control an external test set without creating a remote program. This allows you to control the test set without Option 551, or in non-standard measurement classes, such as Scalar Mixer/ Converter, Swept IMD, Noise Figure Cold Source, etc. The user is required to manually input address and data using the Command Processor Console in the Help menu.

- Command Processor settings can not be saved or recalled.
- Address and data can be *written* from the Command Processor.

How to Access the Command Processor

1. To access the Command Processor, select **Utility** > **System** > **Configure** > **SICL /GPIB/SCPI** -OR- ***(System Setup*** > ***Remote Interface*** > ***SCPI Monitor Input*** > ***Show SCPI Parser Console)*** and check the SCPI Command Processor Console Box.

Figure 41 Command Console for 'A' Model Analyzers

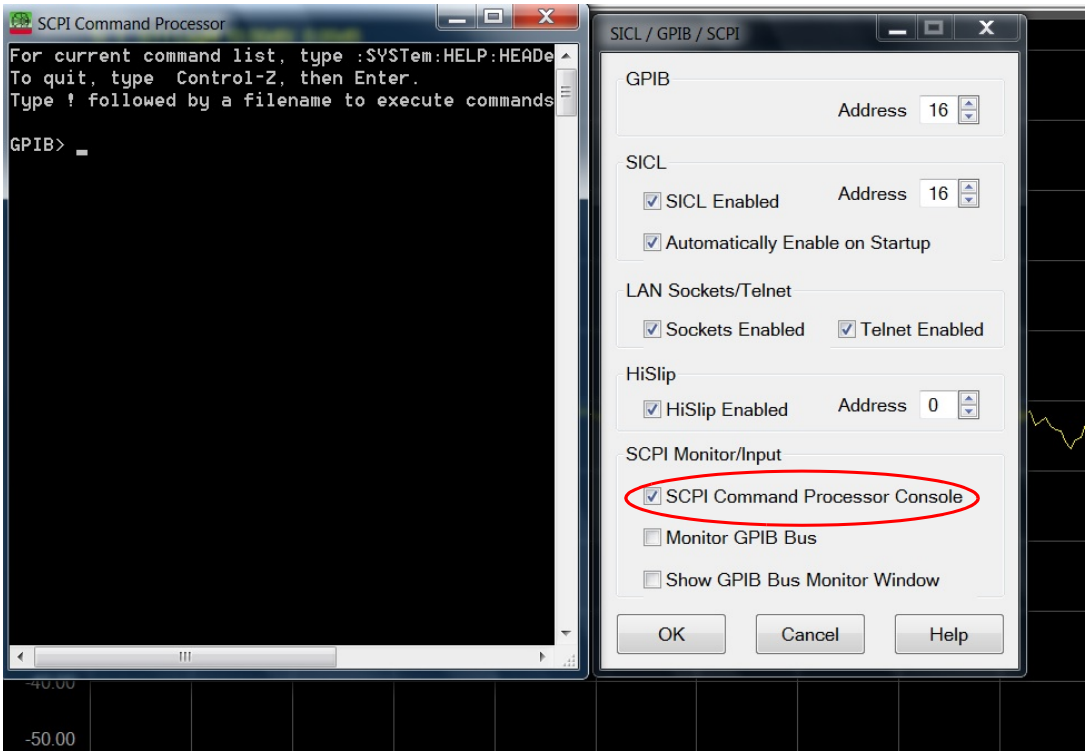
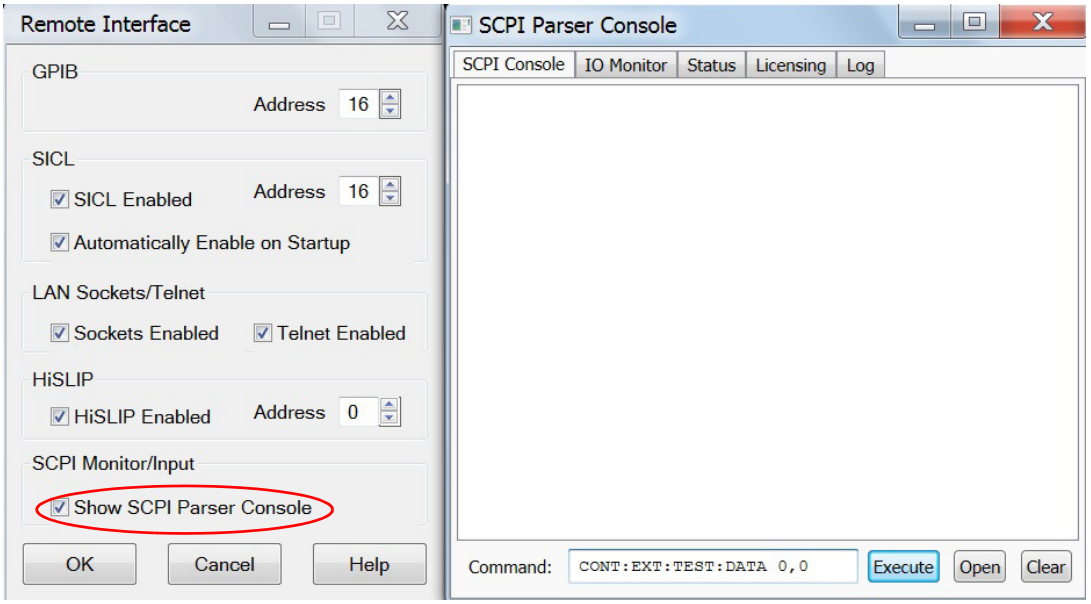


Figure 42 Command Console for 'B' Model Analyzers



SCPI Command Processor Console

There are two methods in which the PNA-X Command Processor Console can be used to control the Test Set internal switches to configure the Multiport system for S-Parameter measurements.

When the Command Processor Console is opened as instructed in the previous page, examples of the two control methods will be provided.

Method 1 - Using GPIB/SCPI Command Values

This method is available while the system is in Multiport mode only.

The Test Set internal switch settings are programmed into the Test Set firmware; they are configured by the PNA-X S-parameter values. Method 1 provides more PNA-X control capability than Method 2.

The following example shows two executable commands needed to create an S-parameter measurement on your Multiport system.

Figure 43 Method 1 - Using GPIB/SCPI Command Values

This first command creates a new S10_10 measurement on channel 1 of the PNA-X, named “ch1_S10_10,” and configures the internal Test Set RF switches.

CALC1:PAR:EXT 'ch1_S10_10', 'S10_10'

This second command feeds the newly created measurement named “ch1_S10_10” to trace 2 on the PNA-X so that it will be displayed on the PNA-X screen.

DISP:WIND1:TRAC2:FEED 'ch1_S10_10'

NOTE: Here are syntax format examples for single digit S-parameters:

‘ch1_S99’ ‘ch1_S22’ ‘ch1_S9_10’ ‘ch1_S10_9’

Method 2 - Using the Test Set Address and Data Values

This method is available while the system is in Standalone mode only.

The Address and Data values for the Test Set can be found in the “Address and Data Values” section on page 53.

The Test Set internal switch settings are programmed into the firmware of the Test Set and can be controlled with the specific Address and Data values. Each Address and Data value pair sets the Source or Receiver switch paths. For an S-parameter measurement, two pairs of Address and Data values will be needed.

Address and Data values are separated by a comma. Commands should be separated by a new line, or carriage return.

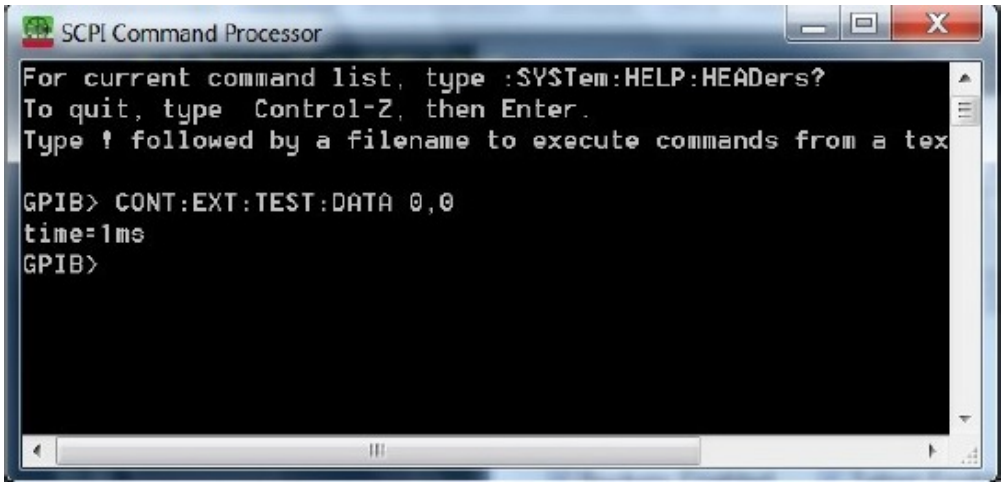
For example:

CONT:EXT:TEST:DATA <address>,<data>

CONT:EXT:TEST:DATA 0,0

Example: CONT:EXT:TEST:DATA 0,0

Figure 44 Method 2 - Using Test Set Address and Data Values



Address and Data Values

Setting the Test Port Paths with Address and Data

Refer to Table 10, Table 11 on page 54 and Figure 45 on page 54 for information to set the internal switch paths of the test set.

The address is the first value in the Test Set I/O control or GPIB data command. The second value controls the source and receiver paths of the ports. To select a test set port configuration both switches must be set to complete the source and receiver paths. To do this you must add the data values together to determine the data command value for each port, which is the second number in the Test Set I/O or GPIB command. Refer to "Interface Control Mode" on page 45 and in "SCPI Control Mode" on page 49.

Example 1: If the ports have different addresses, two separate address data commands must be used. Refer to Figure 45 on page 54.

Port 5 is the Source and Port 6 is the Receiver.

Source Port 5 = address 0, data 1 and Receiver Port 6 = address 16, data 16. Two separate commands must to be sent, you may use the same dialog box. The entry will be 0.2 in one command line, and 16.32 in the second line.

Example 2: If the ports have the same address, only one command is needed.

Port 1 is the Source and Ports 5 is the Receiver.

Source Port 1 = address 0, data 1 and Receiver Port 5 = address 0, data 16. The data values are added together, the entry will be 0.17.

Table 10 Port Address and Data Values

Address		PNA-L				PNA or PNA-X			
		Source Path		Receiver Path		Source Path		Receiver Path	
	Data	1	2	16	32	1	2	16	32
0	Ports	1	5	1	5	1	5	1	5
16	Ports	2	6	2	6	3	6	3	6
32	Ports	3	7	3	7	4	7	4	7
64	Ports	4	8	4	8	2	8	2	8

Refer to "System Block Diagram" on page 73 for in-depth RF path information

Figure 45 Example 1: Address and Data (Port 5 and 6)

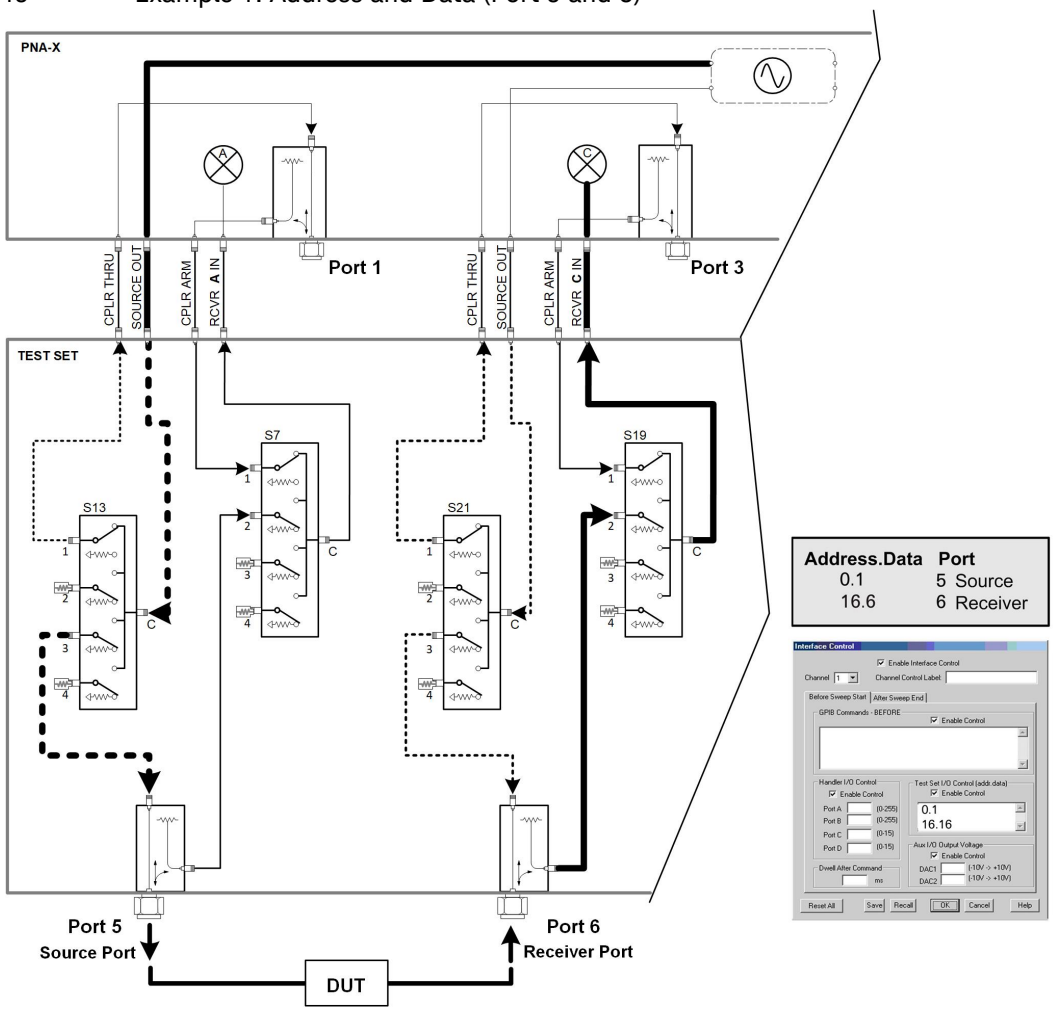


Table 11 Example: Source and Receiver Path Values

	PNA-L		PNA or PNA-X	
Ports	**Source Path**	**Receiver Path**	**Source Path**	**Receiver Path**
1	0.1	0.16	0.1	0.16
2	16.1	16.16	64.1	64.16
3	32.1	32.16	16.1	16.16
4	64.1	64.16	32.1	32.16
5	0.2	0.32	0.2	0.32
6	16.2	16.32	16.2	16.32
7	32.2	32.32	32.2	32.32
8	64.2	64.32	64.2	64.32

Control Lines

The 15 pin female D-Sub connector on the front panel provides 8 latched data lines that can be used to control your device under test (DUT). The lines can be controlled with the Multiport External Test Set control, or Test Set I/O commands. Refer to "External Test Set Control Feature" on page 39 and "Setting the Control Lines with Address and Data Values" on page 59. See Table 12 for DUT control line specification.

The output voltage of the lines can be from the internal adjustable voltage source (+2 to +5 Vdc), or an external DC power supply depending on how the connection to the control line is configured. When using an external power supply a positive or negative voltage can be used. Refer to Figure 47 on page 57 and Table 13 on page 56 for control line pin location and description. Refer to "Internal Voltage Supply Configuration" on page 57 and "External Voltage Supply Configuration" on page 58 for configurations.

Table 12 DUT Control Specifications

Item	Specifications
Connector Type	15–pin female D–Sub
Max Output Line Current	100 mA (each line)
Control Line DC resistance	< 10 W (each line)
Voltage Range:	
Positive Input	0 to +5 V
Negative Input	–5 to 0 V
Internal Variable Voltage	+2 to +5 V

Figure 46 DUT control Line Pin Assignment (rear panel view)

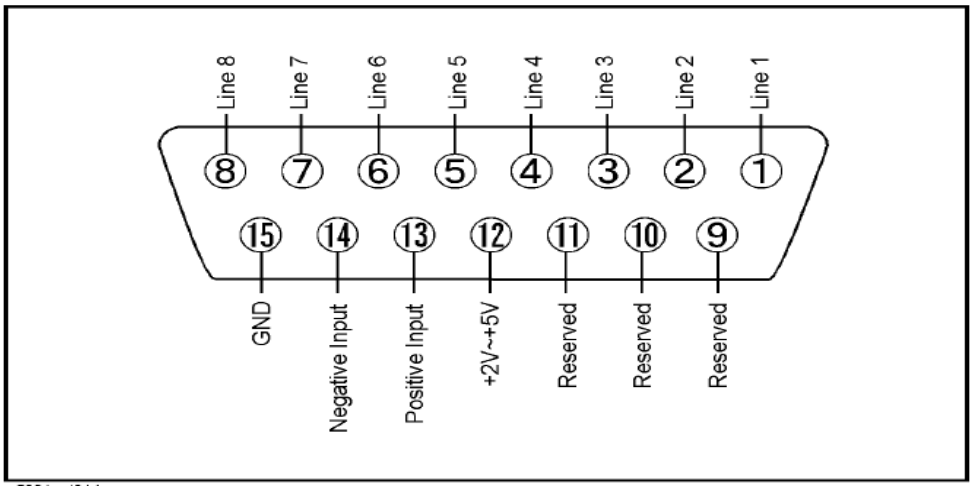


Table 13 DUT Control Pin Assignment

Pin	Signal Name	Description
1	Line 1	Control Line Output of the voltage from pin 13 or pin 14.
2	Line 2	Control Line Output of the voltage from pin 13 or pin 14.
3	Line 3	Control Line Output of the voltage from pin 13 or pin 14.
4	Line 4	Control Line Output of the voltage from pin 13 or pin 14.
5	Line 5	Control Line Output of the voltage from pin 13 or pin 14.
6	Line 6	Control Line Output of the voltage from pin 13 or pin 14.
7	Line 7	Control Line Output of the voltage from pin 13 or pin 14.
8	Line 8	Control Line Output of the voltage from pin 13 or pin 14.
9,10 &11		Not used
12	+2 V to +5 V	Internal voltage output, adjusted with the trimmer on the rear panel.
13	Positive Input	Connection for internal (pin 12) or external positive voltage supply.
14	Negative Input	Connection for ground (pin 15) or external negative voltage supply.
15	Gnd	ground terminal

Internal Voltage Supply Configuration

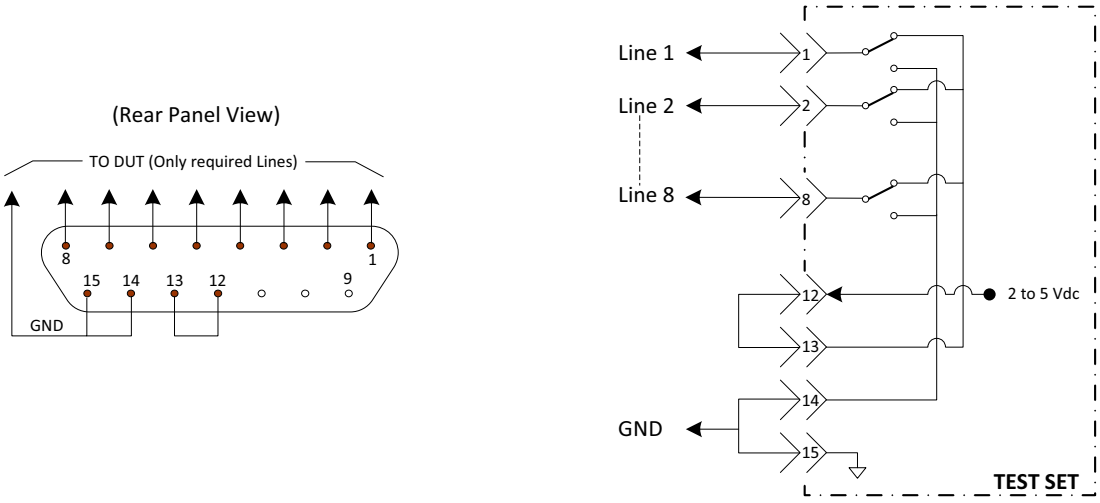
The output voltage of pin 12 can be adjusted from +2 to +5 V. Perform the following procedure to set the voltage:

1. Turn on the test set.
2. Measure the voltage between pin 12 and 15 using a multimeter.
3. Rotate the voltage adjustment trimmer on the rear panel until the multimeter indicates the selected voltage

Figure 47 illustrates an example of the connection between the DUT and the test set using the internal DC power supply. Connect pin 12 to pin 13 and pin 14 to pin 15 to provide the ground path. Connect the control lines to the external DUT.

CAUTION You may only connect pin 12–13, and pin 14–15, damage may result if any other paths are short-circuited.

Figure 47 Internal DC Power Configuration (rear panel view)



External Voltage Supply Configuration

Figure 48 illustrates an example of the connection with an external DC power supply. Connect the positive and negative voltage supply from the external power supply to the positive input (pin 13) and the negative input (pin 14). Connect the power supply DC ground to pin 15.

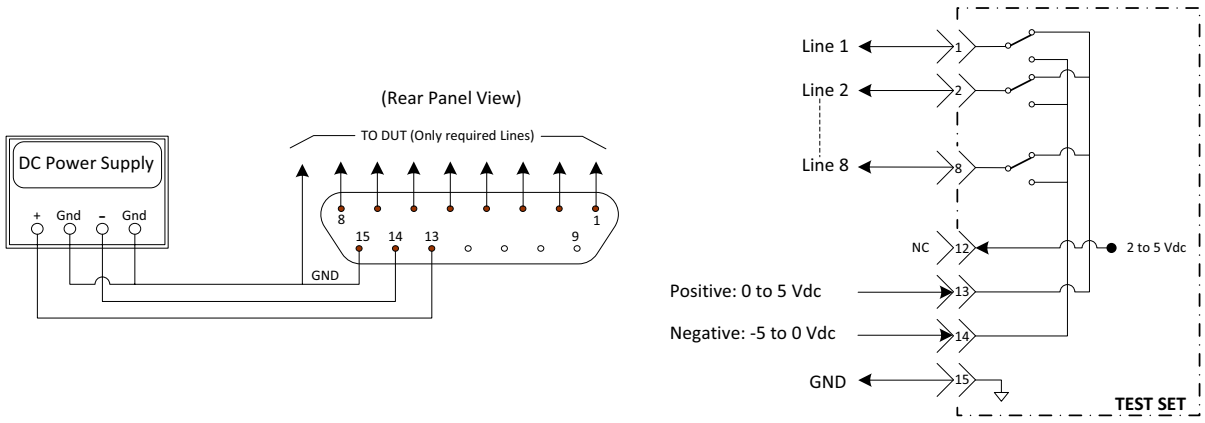
Turning On the Test Set using an External Power Supply.

1. Turn on the test set.
2. Connect the DUT.
3. Turn on the external power supply.

Turning On the Test Set using an External Power Supply.

1. Turn off the Power Supply.
2. Turn off the test set.
3. Disconnect the DUT.

Figure 48 Test Set to the DUT and External DC Power Supply



Setting the Control Lines with Address and Data Values

This section describes how to control the rear panel DUT control lines.

NOTE The following control feature will function only while the analyzer is in Standalone Mode.

Setting the Network Analyzer to Standalone Mode.

1. **Select Utility > System > Configure > Multiport Capability -OR-** ***(Instrument > Setup > External Hardware > Multiport > Multiport Configuration...)***. In the dialog box, select **Restart as a standalone PNA > OK**.

As described in "Setting the Test Port Paths with Address and Data" on page 53, the <address>.<data> values are determined in a similar manor, with the following exceptions:

- Table 14 will be used.
- The <address> value is always = 112

Table 14 Test Set DUT Control Address and Data Logic Table

<Address>	<Data>	Description	Line/Pin
112	0	ALL DUT Control Lines set to logic high or connected to Pin 13	1-8
112	255	ALL DUT Control Lines set to logic high or connected to Pin 14	1-8
112	1	DUT Control Line 1 set to logic low or connected to Pin 14	1
112	2	DUT Control Line 2 set to logic low or connected to Pin 14	2
112	4	DUT Control Line 3 set to logic low or connected to Pin 14	3
112	8	DUT Control Line 4 set to logic low or connected to Pin 14	4
112	16	DUT Control Line 5 set to logic low or connected to Pin 14	5
112	32	DUT Control Line 6 set to logic low or connected to Pin 14	6
112	64	DUT Control Line 7 set to logic low or connected to Pin 14	7
112	128	DUT Control Line 8 set to logic low or connected to Pin 14	8

After a power reset all DUT control lines are initially configured to a logic high state or connected to Pin 13, refer to Figure 47 on page 57. To reset all control lines to logic high, without having to reset the power switch on the test set, make the following analyzer entry:

Front panel analyzer Interface Control Mode line entry = **112.0 > OK**.

Always determine which control lines you want set to a logic zero, the other remaining lines will automatically be set to a logic high. Note the <data> value of these lines and calculate the SUM of their <data> values.

Listed are two examples to illustrate this concept. Refer to Figure 46 on page 56 shown with all lines = logic high.

Example 1:
To change lines 1 & 8 to equal logic low, all others logic high.

1. Line 1 (<address> = 112 and <data> = 1)
2. Line 8 (<address> = 112 and <data> = 128)
3. The SUM of the <data> values = 129
4. Front panel analyzer Interface Control Mode line entry = 112.129 > OK.

Example 2:
From Example 1 to only change Lines 2 & 3 to equal logic low, all others logic high.

1. Line 2 (<address> = 112 and <data> = 2)
2. Line 3 (<address> = 112 and <data> = 4)
3. The SUM of the <data> values = 6
4. Front panel analyzer Interface Control Mode line entry = 112.6 > OK.

NOTE Since all control lines have the same <address>, only one "<address>.<data>" command line is needed to control all 8 lines.

Cal Kit Operational Check

The following procedure can be used to confirm that the test set and analyzer are operational. The operation verification limits provided ensure that your test set and analyzer are operating properly within the limits. Refer to "General Specifications" on page 12.

Equipment Required

The test set requires that the user be familiar with the equipment and components listed in Table 15.

This section provides an equipment list and setup of the analyzer and test set.

Table 15 Equipment Required

Description	Qty
N4691A 3.5 mm ECal Module 10 MHz to 26.5 GHz (Option 00F or M0F) *or* N4691B 3.5 mm ECal Module 300 kHz to 26.5 GHz (Option 00F or M0F) *or* Mechanical cal kit 85052B or 85052D	1
N5230C 4-Port Network Analyzer (Option 245 and 551) *or* N5222A/B, N5232A/B or N5242A/B Option 400 and 551	1
Set of interconnect cables (PNA and test set), see "PNA-L RF Interface Cable Connections (U3021-60045)" on page 26 or "PNA or PNA-X RF Interface Cable Connections (U3021-60047)" on page 28.	1

Verification Limits

Typical performance is based on 1 to 2 units, refer to Table 16 and Table 17. System performance for the analyzer and test set are only characteristic and intended as non-warranted information. Only a functional certificate is provided for the test set.

It is recommended that you return your instrument to Keysight Technologies for servicing or repair if the test set and analyzer performance exceed the operational verification limits.

A periodic calibration is not required. The Operators Check should be performed after System Setup, or if performance is in question. An N-Port calibration should be performed before making a measurement.

NOTE If you suspect that your 8-Port configuration is not operating properly, ensure that all front RF jumper interconnect cables are correctly attached.

Table 16 PNA-L Reflection Tracking Limits[a]

Frequency	Standard Port 1- 8[b]	Option 001 or 002 Port 1-8
10 MHz to 4 GHz	-10 dB	0 dB
4 MHz to 6 GHz	-13 dB	-2.5 dB
6 MHz to 10 GHz	-16 dB	-5.0 dB
10 GHz to 15 GHz	-17 dB	-7.5 dB
15 GHz to 20 GHz	-25 dB	-15 dB

a. Reflection Tracking takes into account Source Loss, Receiver Loss, Margin, and PNA Mixer Cal.
b. A standard unit is one without Options 001 or 002.

Table 17 PNA or PNA-X Reflection Tracking Limits[a]

Frequency	Standard Port 1- 8[b]	Option 001 or 002 Port 1-8
10 MHz to 4 GHz	-10 dB	0 dB
4 MHz to 6 GHz	-13 dB	-2.5 dB
6 MHz to 10 GHz	-16 dB	-5.0 dB
10 GHz to 15 GHz	-17 dB	-7.5 dB
15 GHz to 20 GHz	-25 dB	-15 dB
20 GHz to 26.5 GHz	-30 dB	-40 dB

a. Reflection Tracking takes into account Source Loss, Receiver Loss, Margin, and PNA Mixer Cal.
b. A standard unit is one without Options 001 or 002.

Operational Check Procedure

The sequence of this procedure is very important and must be followed or the performance accuracy and results may vary from the reference plots provided. Ensure that the test set is not connected to the analyzer if you are performing an Operator's Check. The analyzer will indicate false failures if the test set is connected.

Preparing the Network Analyzer

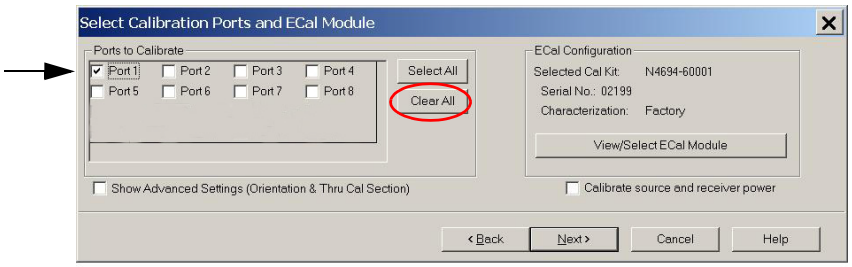
1. Connect the test set to the analyzer using the interconnect cables as shown in "Hardware Lock-link Installation (U3021-60001)" on page 20 and "Hardware Lock-link Installation (U3021-60002)" on page 23.
2. Turn on the test set.
3. Select **Response** > **Cal** > **Manage Cals** > **Cal Set**. Delete or rename any Cal Sets titled "999.1" thru "999.8" (8-Port), although it is unlikely that you will find Cal Sets with these names.
4. Verify that the analyzer is in Multiport mode. See the bottom of the measurement window.
   a. If only four S-Parameters are listed, select Ut**ility** > **System** > **Configure** > **Multiport Capability** -OR- ***(Instrument*** > ***Setup External hardware*** > ***Multiport*** > ***Multiport Configuration...)***. Select **Restart as multiport PNA with this testset** and select **U3042AE04** (8-Port) from the drop-down menu > **OK**. Refer to Figure 29 on page 38.
5. Press **[Preset]**.
6. Verify that the **[Start Frequency]** is set to **[10 MHz]**.
7. Set the **[Stop Frequency]** is set to **[20 GHz or 26.5 GHz]**.
8. Select **[Power]** > **Power Level** and enter **[0 dBm]**.
9. Select **Response** > **Avg** > **IF Bandwidth** > **100 Hz** > **OK**.
10. Select **Stimulus** > **Sweep** > **Number of Points** > **401**.
11. Connect the ECal module to an available USB port on the front or rear panel of the analyzer. This procedure assumes you are using a ECal. If you are not, see "1-Port Calibration and Verification Procedure" on page 64, step 2.

Allow the ECal module, test set and analyzer to warm up for a minimum of 30 minutes.

1-Port Calibration and Verification Procedure

1. Connect the ECal or the mechanical cal kit to Port 1 or the port you are testing. Torque to 8 in-lb. For further information refer to the Help menu.
2. Perform a 1-Port Calibration on Port 1. On the analyzer, select **Response** > **Cal** > **Start Cal** > **Calibration Wizard** -OR- ***(Response** > **Cal** > **Other Cals)***.
   a. If using a mechanical cal kit, select **SmartCal (Guided Calibration)** > **Next**.
   b. If using an ECal module, connect the ECal to a analyzer's USB port. Select **Use Electronic Calibration (ECal)** > **Next**.
3. Continue following the Cal Wizard prompts. In the Select Calibration Ports and ECal Module dialog box click **Clear All**, then select **Port 1** > **Next** > **Measure**.
4. Ensure the Cal Kit you are using is indicated on the right side of the dialog box.

Figure 49 1-Port Calibration

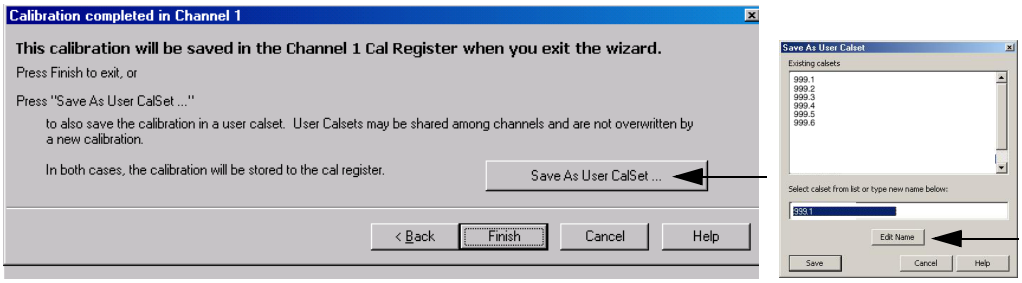


5. Continue to follow the prompts. At the Calibration Completed dialog box, select **Save As User Calset**, type the name **999.1**. Overwrite the Calset if it already exists and **Save**.

NOTE If you do not have a key board, select **Save As User Calset** > **Edit Name** and save as **999.x**. X is the port number you are calibrating. Use the numeric keypad on the analyzer front panel to enter "999.1."

6. Repeat step 1 thru step 5 for Ports 2 thru 8. When finished, there should be 8 Cal Sets saved with the titles "999.1" thru "999.8" (8-Port).
   If you are using an ECal module you can verify the individual port calibration by selecting **Response** > **CAL** > **More** > **ECAL** > **ECAL Confidence Check**. Select **Change Measurement** and select the test port S-Parameter > **Apply** > **OK** > **Read Module Data**. For further information refer to the Help menu.

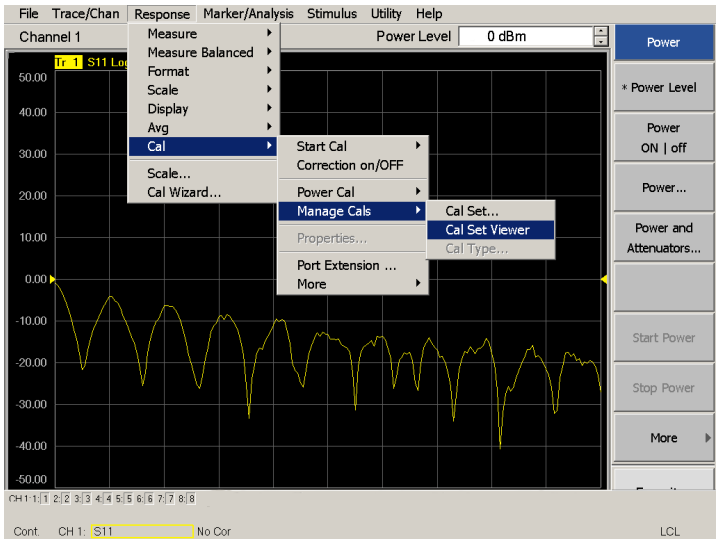
Figure 50 Calibration Complete



Cal Set Verification

1. Select **Trace/Chan > Trace > Delete Trace**. There should be no traces on the display.
2. To launch the Cal Set Viewer toolbar. Select **Response > Cal > Manage Cals > Cal Set Viewer**.

Figure 51 Calibration, Cal Set Viewer



3. From the Cal Sets drop-down menu, select **999.1** and select **Enable**. Select the **Reflection Tracking(x,x),** where x,x is the port being tested. Ensure that the **Enable** and **Error Terms** check boxes are selected.
4. Compare the Reflection Tracking (1,1) trace to the appropriate limits in Table 17 on page 62. The trace should be above the limit.
5. Repeat step 3 and step 4 for Cal Sets "999.1" thru "999.8" (8-Port).

Figure 52 Option 001 or 002 Reflection Tracking with PNA or PNA-X (Ports 1 to 4)

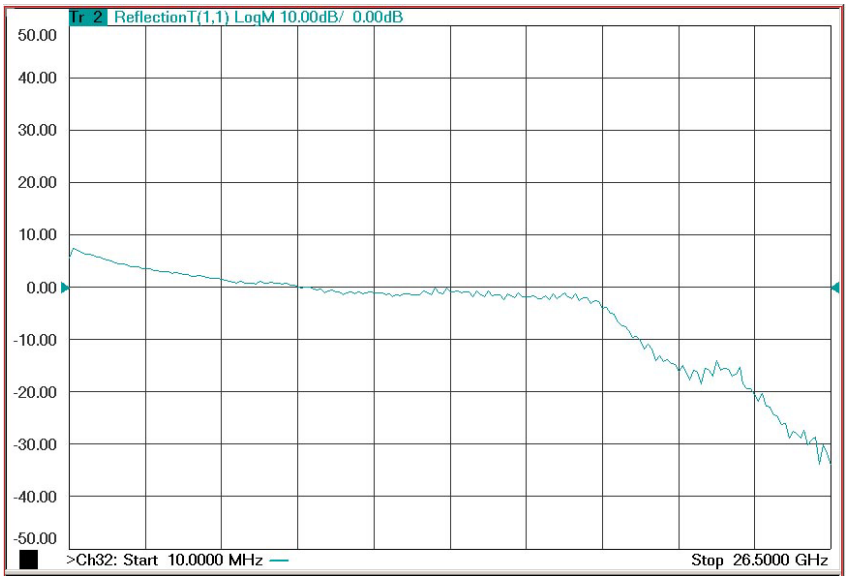
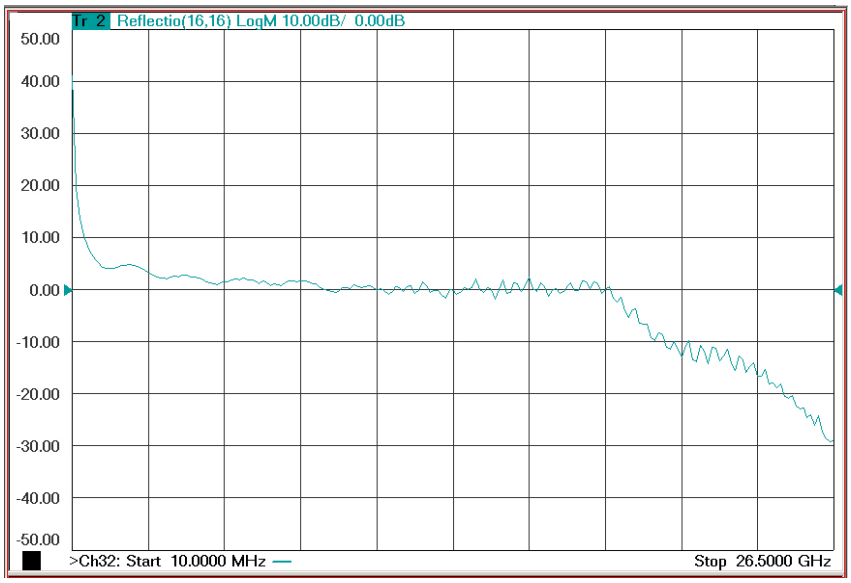


Figure 53 Option 001 or 002 Reflection Tracking with PNA or PNA-X (Ports 5 to 8)



NOTE Response from 10 MHz to 500 MHz is normal due to the PNA-X couplers in comparison to the test set bridges. The bridges have more gain in the coupled RF path.

Figure 54 Standard Reflection Tracking Trace with PNA or PNA-X (Ports 1 to 4)

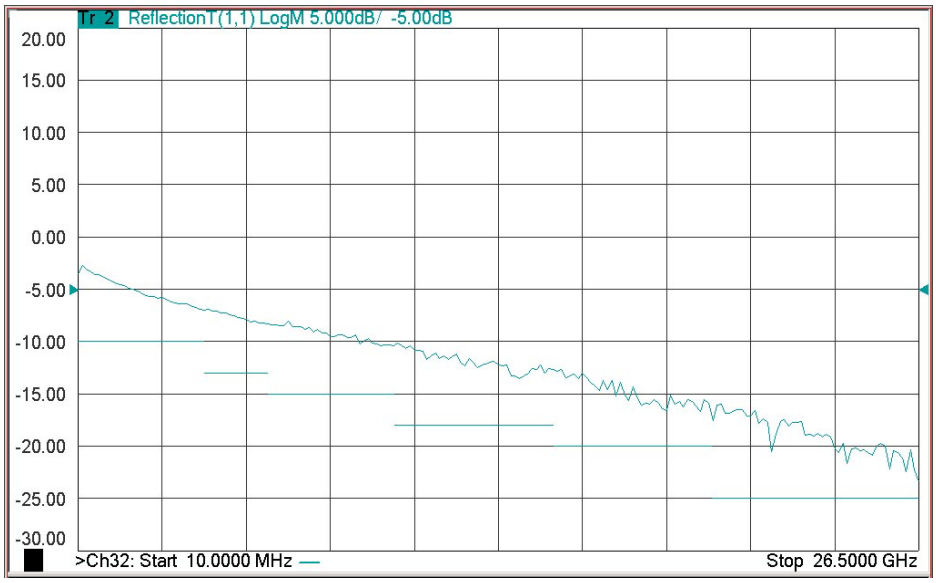
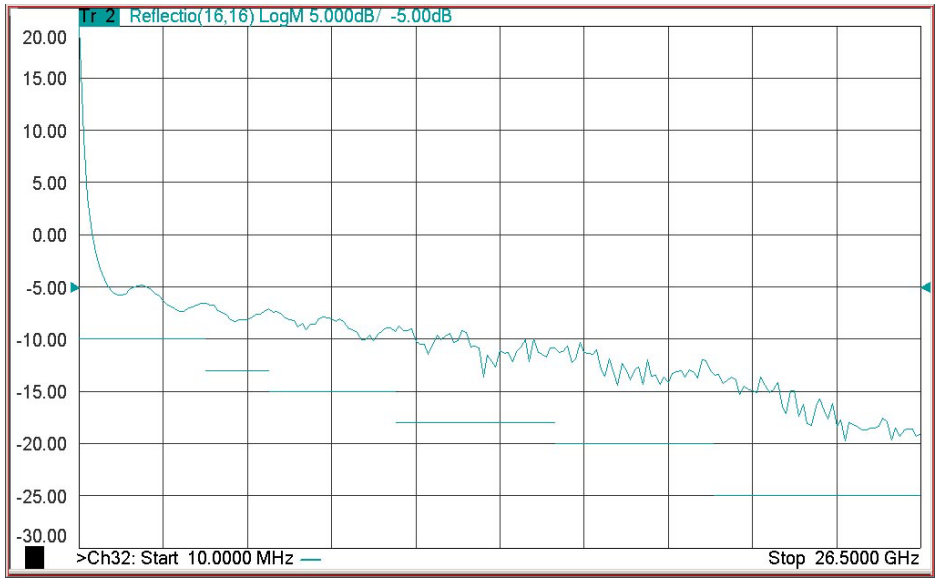


Figure 55 Standard Reflection Tracking Trace with PNA or PNA-X (Ports 5 to 8)



NOTE Response from 10 MHz to 500 MHz is normal due to the PNA-X couplers in comparison to the test set bridges. The bridges have more gain in the coupled RF path.

Figure 56 Option 001 or 002 Reflection Tracking with PNA-L (Ports 1 to 8)

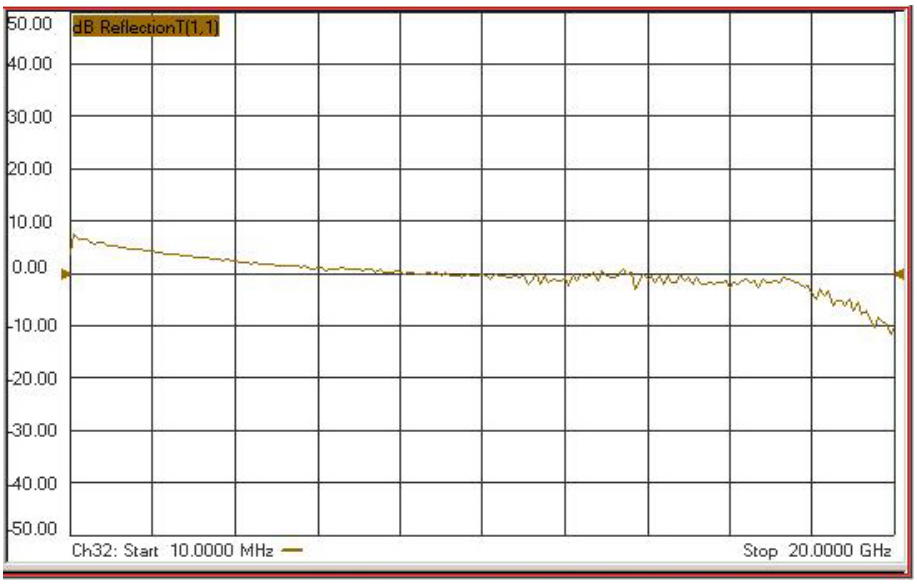
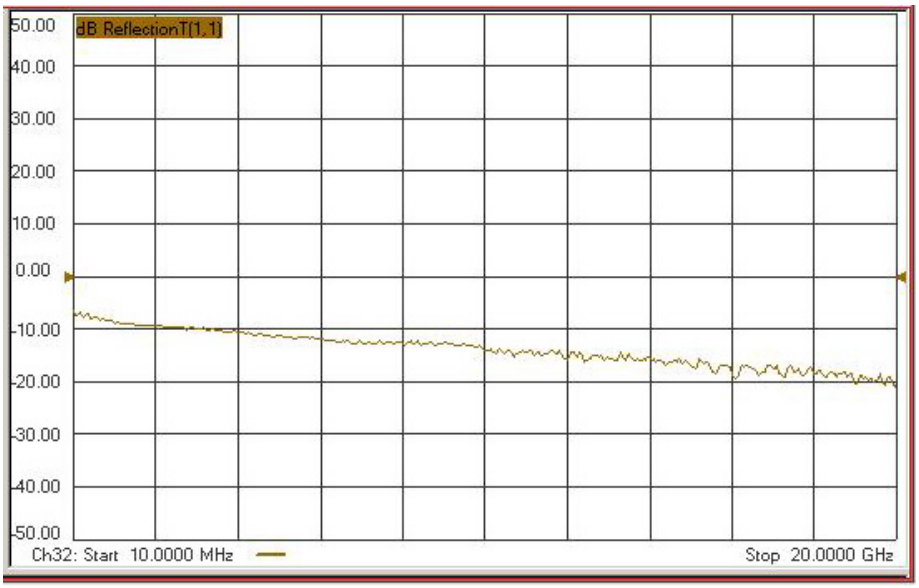


Figure 57 Standard Reflection Tracking with PNA-L (Ports 1 to 8)



Verifying Cal Kit Operational Check Failure

If your test results fail the Cal Kit Operational Check limits, see Table 5 and Table 6 on page 16 and verify the following:

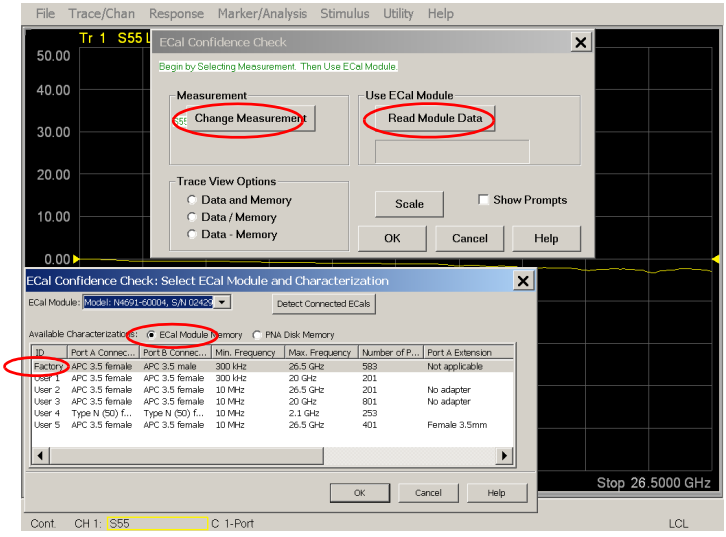
1. Ensure that the test set is turned On and connected to the analyzer.
2. Check all appropriate analyzer and test set connectors for damage, cleanliness, and proper torque.
3. Repeat the relevant 1-Port calibrations using another ECal or mechanical standard.
4. Verify that the analyzer is operating properly and meeting its published specifications. If the analyzer is connected to the test set it will fail the Operational Check. Refer to "Network Analyzer Requirements" on page 10.

ECal Confidence Check

The following procedure verifies the accuracy of a 1-Port calibration using mechanical standards or an ECal module. To perform this check, the test port of the ECal module must connect directly to the test port being verified (without adapters).

1. Perform a 1-Port calibration on the test set port being tested.
2. Connect the ECal Module to the port being tested. Terminate any remaining ports on the ECal Module.
3. Select the Cal Set to be tested, **[CAL] > Cal Set > Cal_File > Apply Cal > Close** -OR- ***([Cal] Cal Set & Cal Kit > Cal Set... > Apply Cal)***. If the Choose Stimulus Settings prompt appears, select **Change the active channel's stimulus > OK > Close**.
4. Select **[Response] > Cal > More > ECal > ECal Confidence Check** -OR- ***(Response > Cal > ECal Confidence Check...)***.
5. ECal Confidence Check dialog box: Click **Change Measurement,** then select the test port S-parameter > **Apply > OK**. Select **Read Module Data**.
6. Select **ECal Module** dialog box: Select the ECal Module you are using, and select the **ECal Module Memory and Factory ID > OK**.

Figure 58 ECal Confidence Check



Service Information

This section provides information to troubleshoot and repair the U3042AE04 Test Set. Refer to "Keysight Support, Services, and Assistance" on page 100 for information on returning your test set to Keysight Technologies.

NOTE

In January 2016, the U3042AE04 Multiport Test Set, serial number US50120118 and above, underwent a significant RF switch drive control change. The solid state switch driver board was made programmable to accommodate the implementation of the Option 002. This change will now be implemented on all future Standard and Option 001 versions as well. With the new switch driver board, U3042-63130, the RF switch connections and reference designators have changed. Be careful not to use pre-2016 switch driver board and reference diagrams during service operations.

The User's and Service Guide, for the earlier versions of the Standard and Option 001, is available at http://na.support.keysight.com/multiport.

WARNING

No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.

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.

Replaceable Parts

The following replaceable parts are available from Keysight Technologies.

Table 18 Available Replacement Parts (SPO)

Description	Keysight Part Number
Solid State Switch	5087-7306 *or* 5087-7751 (RoHS)
Coupler/Bridge	5087-7716 *or* 5087-7752 (RoHS)
Amplifier (Option 001 & 002)	5087-7290 *or* 5087-7750 (RoHS)
Bias Tee (Option 002)	5087-7788 (RoHS)
Fuse (5 A 250 V non-time delay (20 mm)	2110-0709
Fuse (8 A 250 V non-time delay (1.25 inch)	2110-0342

Table 18 Available Replacement Parts (SPO)

PWR Supply (AC/DC SWG 650W 9- Output	0950-4729
RF Cable, Port 1 CPLR ARM to CPLR ARM	U3042-20029
RF Cable, Port 1 RCVR A IN to RCVR OUT	U3042-20030
RF Cable, Port 1 SOURCE OUT to SOURCE IN	U3042-20031
RF Cable, Port 1 CPLR THRU to CPLR THRU	U3042-20032
RF Cable, Port 3 CPLR ARM to CPLR ARM	U3042-20033
RF Cable, Port 3 RCVR C IN to RCVR OUT	U3042-20034
RF Cable, Port 3 SOURCE OUT to SOURCE IN	U3042-20035
RF Cable, Port 3 CPLR THRU to CPLR THRU	U3042-20036
RF Cable, Port 4 CPLR ARM to CPLR ARM	U3042-20037
RF Cable, Port 4 RCVR D IN to RCVR OUT	U3042-20038
RF Cable, Port 4 SOURCE OUT to SOURCE IN	U3042-20039
RF Cable, Port 4 CPLR THRU to CPLR THRU	U3042-20040
RF Cable, Port 2 CPLR ARM to CPLR ARM	U3042-20041
RF Cable, Port 2 RCVR B to RCVR OUT	U3042-20042
RF Cable, Port 2 SOURCE OUT to SOURCE IN	U3042-20043
RF Cable, Port 2 CPLR THRU to CPLR THRU	U3042-20044
Test Set Rear Lock-link (right)	N5242-20138
Test Set Rear Lock-link (left)	N5242-20139
RF Cable, Semi-rigid Interface (refer to Table 7 on page 20)	Z5623-20418
RF Cable, Semi-rigid Interface (refer to Table 7 on page 20)	Z5623-20419
PNA, PNA-L & PNA-X Locking Feet	5023-0132
Test Set Locking kit	5063-9253
Screw, Torx-T15 M3.5X0.6 12 mm	0515-2317
Screw, Torx-T20 M4X0.7 25 mm	0515-1619
Screw, Lock-Washer Pan-HD Pozidrive M3.5X0.6 12 mm	0515-1244
Test Set I/O Cable	N4011-21002
DUT Control Board	U3020-63223
Fan (rear panel)	87050-60027
Fan (Deck)	87075-60021

The following replaceable parts may be ordered by sending an e-mail request to ctd-soco_support@keysight.com. Be sure to include test set model, options and serial number. Some parts may have long lead times.

Table 19 Replacement Parts (E04)

Description	Keysight Part Number
U3042AE04 User's and Service Guide	U3042-90008
LED Status Board, Test Port	N5261-63005
LED Status Ribbon Cable	N5261-60001
Switch Interface Board (Programmed)	U3042-63130 (RoHS)
Controller Board	N5261-63006
PNA-L Lock-link kit	U3021-60001
PNA or PNA-X Lock-link kit	U3021-60002
PNA-L Cable kit	U3021-60045
PNA or PNA-X Cable kit	U3021-60047
Power LED	Z5623-60221

System Block Diagram

Figure 59 U3042AE04 Standard Configuration

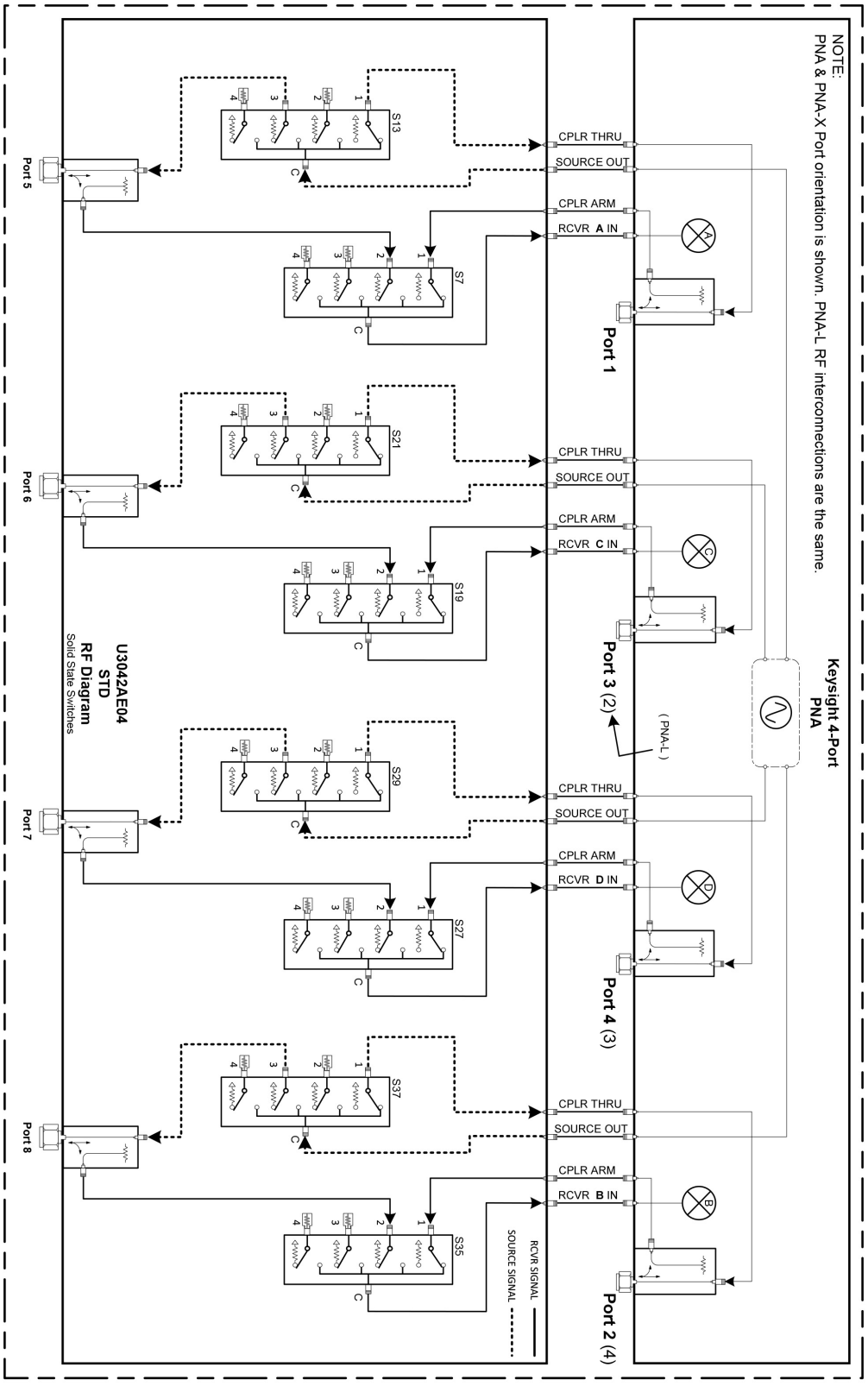


Figure 60 U3042AE04 Option 001 Configuration

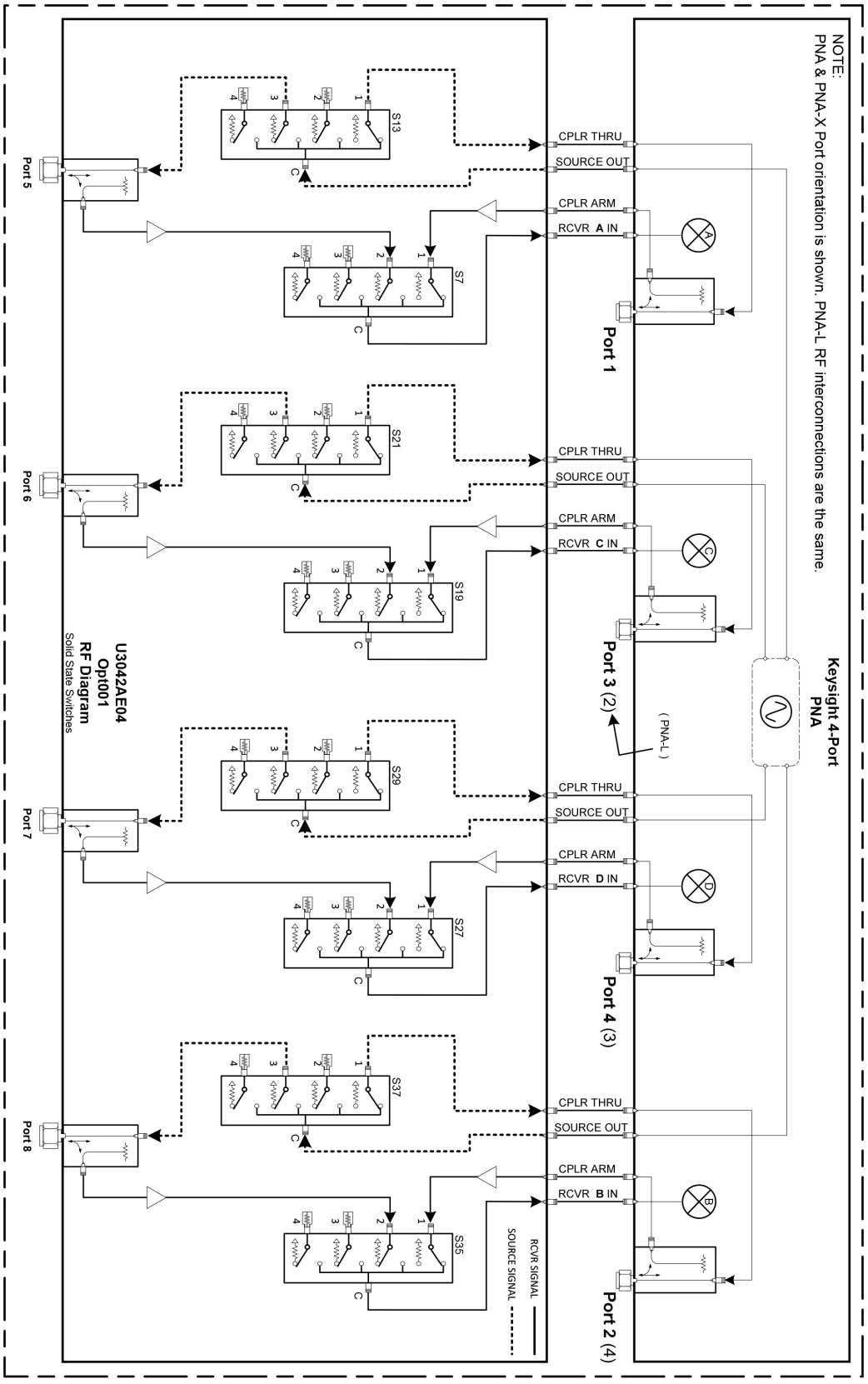
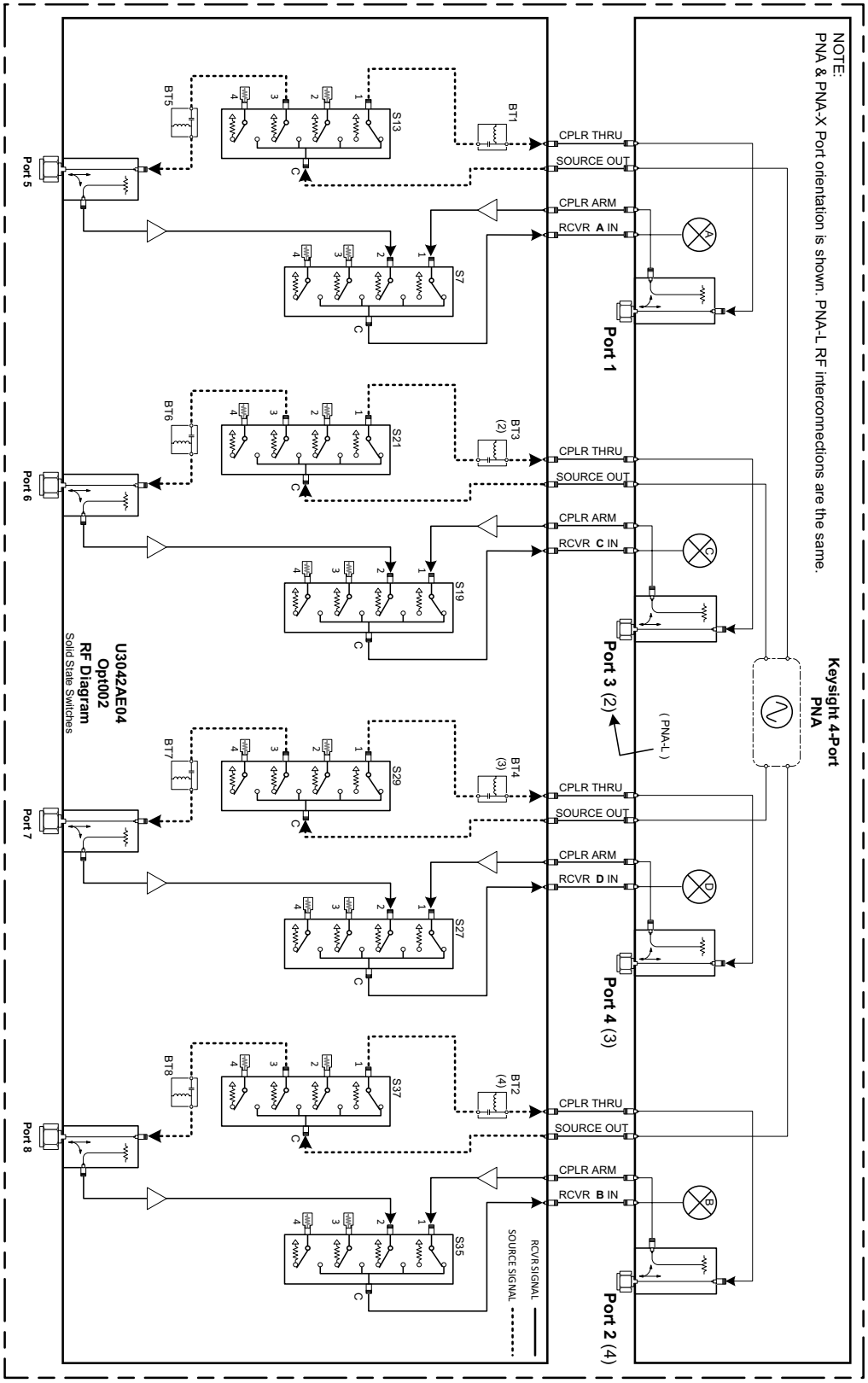


Figure 61 U3042AE04 Option 002 Configuration



Theory of Operation

The following is a description of the operation of the test set. Reference the test set block diagrams shown in “System Block Diagram” on page 73. This section assumes the user has a general understanding of couplers, switches, and network analyzers.

RF Coupler/Bridges

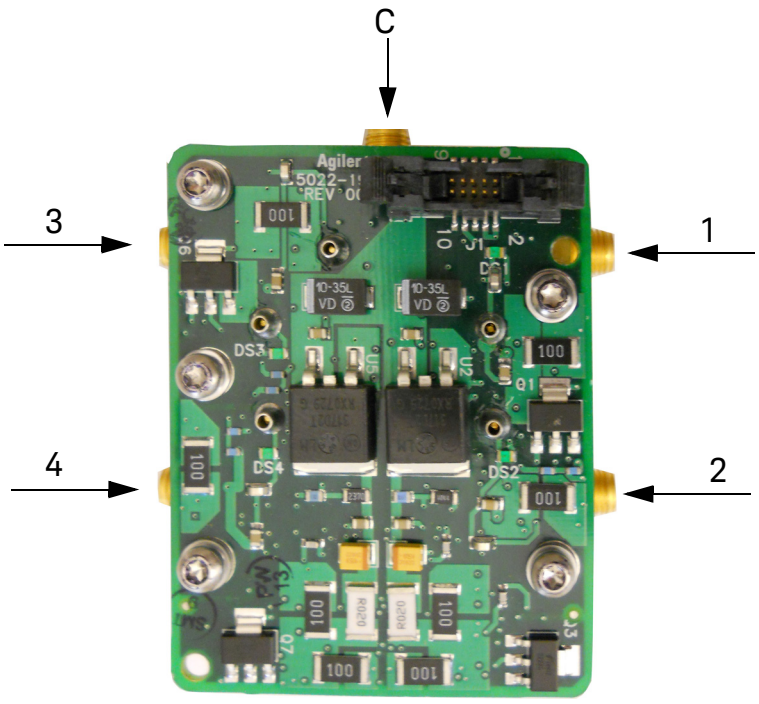
The test set uses four coupler/bridges (5087-7716 or RoHS compliant 5087-7752) on the front panel for RF Test Ports 5 to 8. The coupler/bridges provide the signal separation of the source and receiver paths, using resistor networks. The test set ports can receive from or stimulate a signal to the DUT.

The RF Test Port connectors are male 3.5 mm. The coupling factor is approximately -16 dB for the Coupled Arm (minimum -22 dB and max -12 dB at 26.5 GHz). The insertion loss through the CPLR THRU path is typically < 4 dB at 26.5 GHz. Do not use excessive RF power or DC voltage, or damage may occur to the internal resistors

RF Switch Components

The test set uses eight solid-state switches (5087-7306 or RoHS compliant 5087-7751) that have internal 50 Ohm termination for each path. The switches select the RF paths from the analyzer’s source and receiver through interconnect cables to the test set. Network analyzer Ports 1 thru 4 and test set ports paths 5 thru 8.

Figure 62 Switch



PNA-L Switch Paths

S13 - Source Output to Ports (1 and 5) Switch 13 provides control of the Source Output path to PNA Port 1 and test set Port 5. In the state shown in the block diagram, switch 13 routes the RF Source back to the PNA Port 1, and the test set Source path to Port 5 is terminated.

S21 - Source to Ports (2 and 6) Switch 21 provides control of the Source Output path to PNA Ports 2 and test set Port 6. In the state shown in the block diagram, switch 21 routes the RF Source back to the PNA Port 2, and the test set Source Output path to Port 6 is terminated.

S29 - Source to Ports (3 and 7) Switch 29 provides control of the Source Output path to PNA Port 3 and test set Port 7. In the state shown in the block diagram, switch 29 routes the RF Source back to the PNA Port 3, and the test set Source path to Port 7 is terminated.

S37 - Source to Ports (4 and 8) Switch 37 provides control of the Source Output path to PNA Port 4 and test set Port 8. In the state shown in the block diagram, switch 37 routes the RF Source back to the PNA Port 4, and the test set Source path to Port 8 is terminated.

S7 - Receiver to Ports (1 and 5) Switch 7 provides control of the Receiver Input path to PNA Port 1 and test set Port 5. In the state shown in the block diagram, switch 7 routes the Port 1 Coupler Arm to the Receiver, and test set Port 5 Coupler Arm path is terminated.

S19 - Receiver to Ports (2 and 6) Switch 19 provides control of the Receiver Input path to PNA Port 2 and test set Port 6. In the state shown in the block diagram, switch 19 routes the Port 2 Coupler Arm to the Receiver, and test set Port 6 Coupler Arm path is terminated.

S27 - Receiver to Ports (3 and 7) Switch 27 provides control of the Receiver Input path to PNA Port 3 and test set Port 7. In the state shown in the block diagram, switch 27 routes the Port 3 Coupler Arm to the Receiver, and test set Port 7 Coupler Arm path is terminated.

S35 - Receiver to Ports (4 and 8)) Switch 35 provides control of the Receiver Input path to PNA Port 4 and test set Port 8. In the state shown in the block diagram, switch 35 routes the Port 4 Coupler Arm to the Receiver, and test set Port 8 Coupler Arm path is terminated.

PNA-X Switch Paths

S13 - Source Output to Ports (1 and 5) Switch 13 provides control of the Source Output path to PNA Port 1 and test set Port 5. In the state shown in the block diagram, switch 13 routes the RF Source back to the PNA Port 1, and the test set Source path to Port 5 is terminated.

S21 - Source to Ports (3 and 6) Switch 21 provides control of the Source Output path to PNA Ports 3 and test set Port 6. In the state shown in the block diagram, switch 21 routes the RF Source back to the PNA Port 3, and the test set Source Output path to Port 6 is terminated.

S29 - Source to Ports (4 and 7) Switch 29 provides control of the Source Output path to PNA Port 4 and test set Port 7. In the state shown in the block diagram, switch 29 routes the RF Source back to the PNA Port 4, and the test set Source path to Port 7 is terminated.

S37 - Source to Ports (2 and 8) Switch 37 provides control of the Source Output path to PNA Port 2 and test set Port 8. In the state shown in the block diagram, switch 37 routes the RF Source back to the PNA Port 2, and the test set Source path to Port 8 is terminated.

S7 - Receiver to Ports (1 and 5) Switch 7 provides control of the Receiver Input path to PNA Port 1 and test set Port 5. In the state shown in the block diagram, switch 7 routes the Port 1 Coupler Arm to the Receiver, and test set Port 5 Coupler Arm path is terminated.

S19 - Receiver to Ports (3 and 6) Switch 19 provides control of the Receiver Input path to PNA Port 3 and test set Port 6. In the state shown in the block diagram, switch 19 routes the Port 3 Coupler Arm to the Receiver, and test set Port 6 Coupler Arm path is terminated.

S27 - Receiver to Ports (4 and 7) Switch 27 provides control of the Receiver Input path to PNA Port 4 and test set Port 7. In the state shown in the block diagram, switch 27 routes the Port 4 Coupler Arm to the Receiver, and test set Port 7 Coupler Arm path is terminated.

S35 - Receiver to Ports (2 and 8)) Switch 35 provides control of the Receiver Input path to PNA Port 2 and test set Port 8. In the state shown in the block diagram, switch 35 routes the Port 2 Coupler Arm to the Receiver, and test set Port 8 Coupler Arm path is terminated.

Troubleshooting the Test Set

If the test set is not operating properly, use the following procedures to isolate the problem. It is recommended that a qualified service technician perform the following procedures.

Refer to the Keysight PNA Series: Service & Support Home Page at: http://na.keysight.com/pna for further information.

To request service, please contact your local service center. In the US, call 800-829-4444. For Keysight support information, please visit us at http://keysight.com/find/service.

WARNING **No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.**

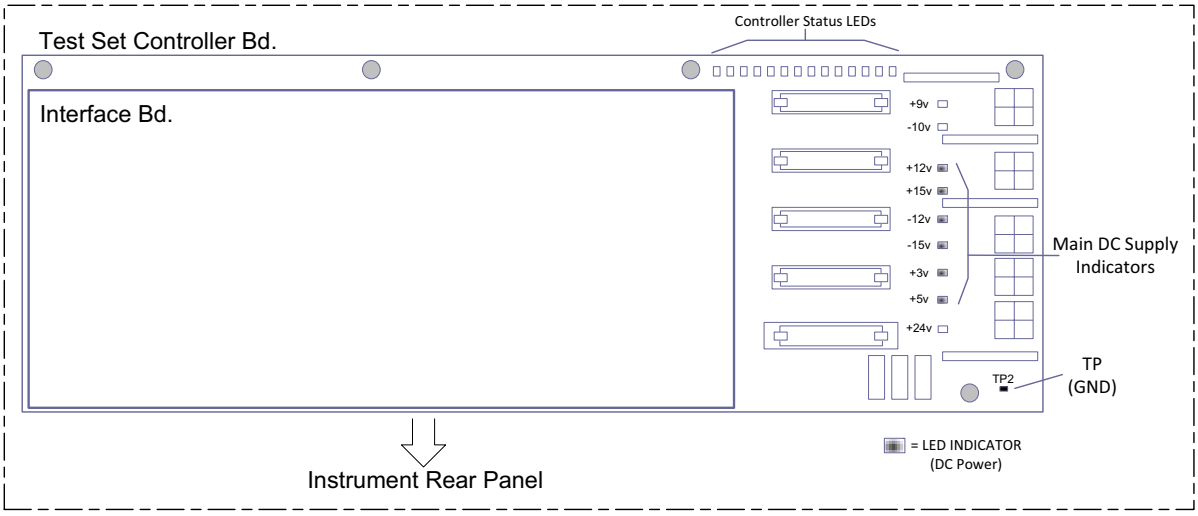
Non-RF Failures

Non RF failures are; Power Supply, Fans, Control Lines, Status LEDs or Interface not operating. Refer to Figure 59 on page 73.

1. Verify that the front panel Power Switch is operational. The front panel Active LED will be *off* unless the test set interface cable is connected and the test set is addressed by the network analyzer.
2. Turn on the test set and the analyzer.
3. The rear panel Deck and Internal power supply fans should be operational. If not, continue with step 4.
4. AC Line voltage checks (remove AC power from the instrument).
   a. Ensure the proper AC Line voltage is present at the instrument line cord.
   b. Remove the AC power cord from the instrument. Verify the instrument AC Line Module fuse (2119-0709) and replace if necessary. Refer to Figure 5 on page 19.
   c. Verify the Internal AC lines fuse (2110-0342). Remove the instrument bottom cover. Near the rear panel are two fuse holders, verify the fuses and replace if necessary. See Figure 72 on page 91.
5. Internal DC Power checks.
   a. Set the front panel switch to the Standby position. No fans or indicator lights should be operational
   b. Remove the top cover.
   c. Set the Standby switch to the *on* position. Both the rear panel and internal power supply fans should be operational. Verify that the DC indicator LEDs are *on* as shown in Figure 64 on page 81.

NOTE LEDs indicators for +9, -10 and +24 Vdc are off.

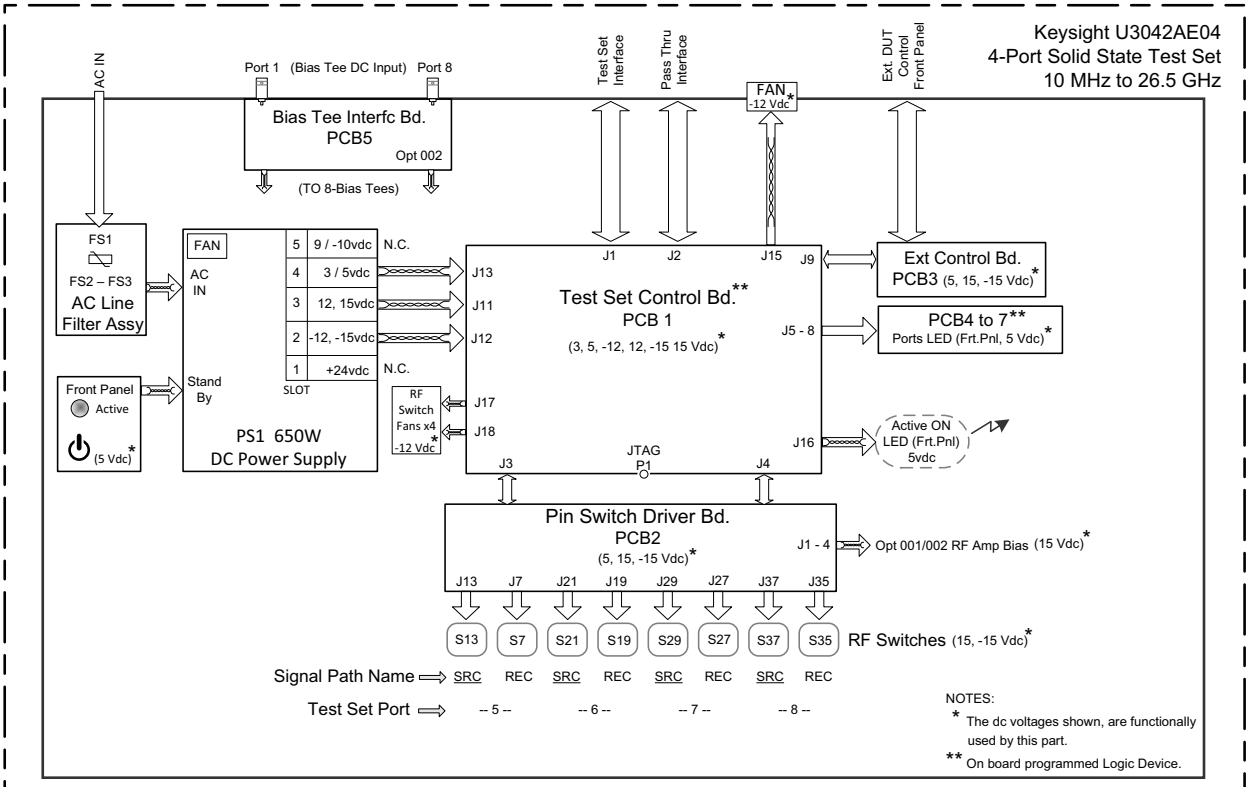
Figure 63 DC Power Status LEDs



d. If the DC Indicator LEDs are not on, suspect the main power supply module or front panel switch. The power supply (0950-4729) terminal connections should also be verified with a DVM. Verify the voltages on the power supply label.

e. If the rear panel or deck fans are not operating and the DC Indicator LEDs are on, replace fan.

Figure 64 Test Set Diagram



6. Front Panel R and S indicator LED Check.
   Verify the test set's Controller board Controller Status LEDs, shown in Figure 64 above.

   a. If none are on remove the Switch Driver board and recheck, if still no indication, replace the Controller board.

   b. If the Controller Status LEDs are on and the front panel Active LED is on, suspect the front panel LED boards or the ribbon cables. Replace as needed.

7. Control Lines are not working.

   a. Verify that the control voltage pin connections to the DUT control lines are connected properly. Refer to "Control Lines" on page 55.

   b. Verify that the rear panel DC voltage control adjustment can be set to 5 Vdc. Refer to Figure 4 on page 18.

RF Switching Failures

If the test set's RF signal functionality is not operating properly, use the following procedure to aid in isolating the source of problem. The internal RF solid state switches used in this instrument are biased with the +15 Vdc supply voltage and controlled logic signals coming from the test set Controller board and Switch Interface board.

1. Place the network analyzer and test set side by side (not stacked) and connect the I/O cable (N4011-21002). See Figure 4 on page 18.

2. Ensure that the network analyzer is *not* in Multiport Mode.
3. Using the Test Set I/O Data command values, confirm the correct address and data values are used, refer to "Address and Data Values" on page 53.
4. AC Line voltage checks (remove AC power from the instrument).
   a. Each RF solid state switch has a Bias/Logic control board. This board has four port status LEDs. When a switch control signal is created, the switch port status LED will indicate which switch port is being selected. Refer to "RF Switching Path Test" on page 83.
   b. If the LEDs *on* the Switch are *off* when that switch is selected, verify that the ribbon cable is installed on the correct connector on the Switch Interface board. If the connection is correct, substitute a working switch or ribbon cable. Swapping can be performed in this situation.

NOTE

If Port 5 is not functioning, refer to "RF Path Configuration with Option 029" on page 42.

RF Switching Path Test

If you suspect an RF signal path problem with the test set and have verified that the problem in not the front panel RF interface cables, the following procedure will check all of the RF signal paths through the test set.

- Install the Test Set I/O cable from the analyzer to the test set's rear panel.
- Remove the front panel RF interface cables and reinstall the analyzer's front panel jumper cables.

Equipment Required

If you suspect an RF signal path problem with the test set and have verified that the problem in not the front panel RF interface cables, the following procedure will check all of the RF signal paths through the test set.

- PNA, PNA-L or PNA-X Network Analyzer
- Two RF Flex Cables (3.5 mm male)
- 3.5 mm Adapters (female to female)
- Test Set I/O Cable

Equipment Setup

1. Turn on the test set and the analyzer.
2. **[Preset]** the analyzer and set it to **Standalone Mode**. Select **Utility** > **System** > **Configure** > **Multiport Capability -OR-** ***(Instrument*** > ***Setup*** > ***External Hardware*** > ***Multiport*** > ***Multiport Configuration...)***. In the dialog box select **Restart as a standalone PNA** > **OK**.
3. Confirm the frequency range is set to 10 MHz to 26.5 GHz. Option 001 set the Stop Frequency to 20 GHz.
4. Connect the RF flexible cables to Port 1 and 2. Connect the cables together using a 3.5 mm adapter.
5. Configure the analyzer to measure S21 and normalize the response trace.
6. Set the analyzer to **Interface Control Mode**: Select **Channel** > **Hardware Setup** > **More Interface Control**... -OR- ***(Instrument*** > ***Setup*** > ***Internal Hardware*** > ***Interface Control...)*** and click **Enable Interface Control** box.

NOTE

The <addrs>.<data> entries noted in the following Test Instructions table will be used to configure the RF switches for this testing. After making your entry select **<OK>** to execute the command, to return back for further entries, select **Interface Control** on the analyzer's display.

Source and Receiver Path Tests

Refer to Table 20 for measuring the S21 response of the Source and Receiver signal paths. The tables indicates RF cable connections as well as Address and Data command for each path test.

Connect the RF cables as indicated in the tables. The expected results should be similar to Figure 65 and Figure 66 on page 85.

Table 20 RCVR Signal Path Connections and Commands (Std/001/002)

PNA Port-2 to Test Set Port	PNA Port-1 to Test Set Port	<Addr>.<Data>	Path Components	Response (typical)
PNA-L Ports 1 & 5 or PNA/PNA-X Ports 1 & 5				
RCVR OUT	Port 5	0.32	P5 CPLR, S7	Figure 65 on page 85
RCVR OUT (Opt 001/002)			P5 CPLR, S7, AMP	Figure 66 on page 85
RCVR OUT	CPLR ARM	0.16	S7	Figure 67 on page 86
RCVR OUT (Opt 001/002)			S7, AMP	Figure 68 on page 86
PNA-L Ports 2 & 6 or PNA/PNA-X Ports 3 & 6				
RCVR OUT	Port 6	16.32	P6 CPLR, S19	Figure 65 on page 85
RCVR OUT (Opt 001/002)			P6 CPLR, S19, AMP	Figure 66 on page 85
RCVR OUT	CPLR ARM	16.16	S19	Figure 67 on page 86
RCVR OUT (Opt 001/002)			S19, AMP	Figure 68 on page 86
PNA-L Ports 3 & 7 or PNA/PNA-X Ports 4 & 7				
RCVR OUT	Port 7	32.32	P7 CPLR, S27	Figure 65 on page 85
RCVR OUT (Opt 001/002)			P7 CPLR, S27, AMP	Figure 66 on page 85
RCVR OUT	CPLR ARM	32.16	S27	Figure 67 on page 86
RCVR OUT (Opt 001/002)			S27, AMP	Figure 68 on page 86
PNA-L Ports 4 & 8 or PNA/PNA-X Ports 2 & 8				
RCVR OUT	Port 8	64.32	P8 CPLR, S35	Figure 65 on page 85
RCVR OUT (Opt 001/002)			P8 CPLR, S35, AMP	Figure 66 on page 85
RCVR OUT	CPLR ARM	64.16	S35	Figure 67 on page 86
RCVR OUT (Opt 001/002)			S35, AMP	Figure 68 on page 86

Figure 65 RCVR OUT to Ports 5-8 Path Response (Std)

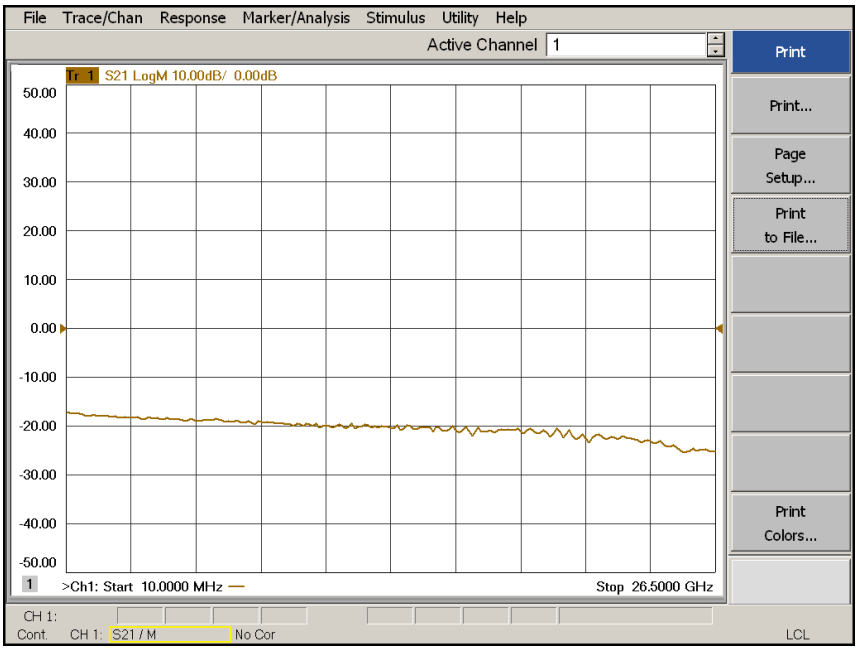


Figure 66 RCVR OUT to Ports 5-8 Path Response (Option 001/002)

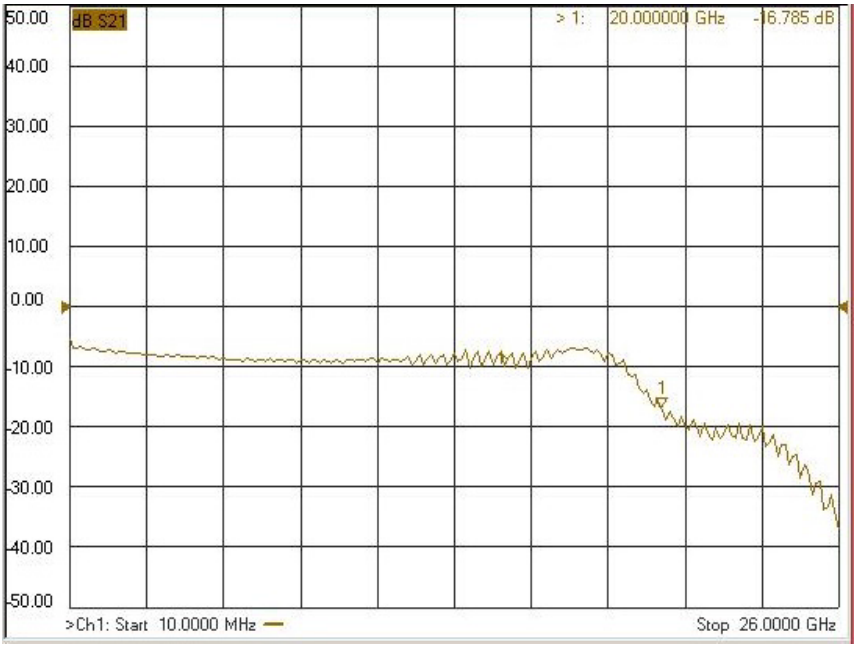


Figure 67 RCVR OUT to CPLR ARM Path Response (Std)

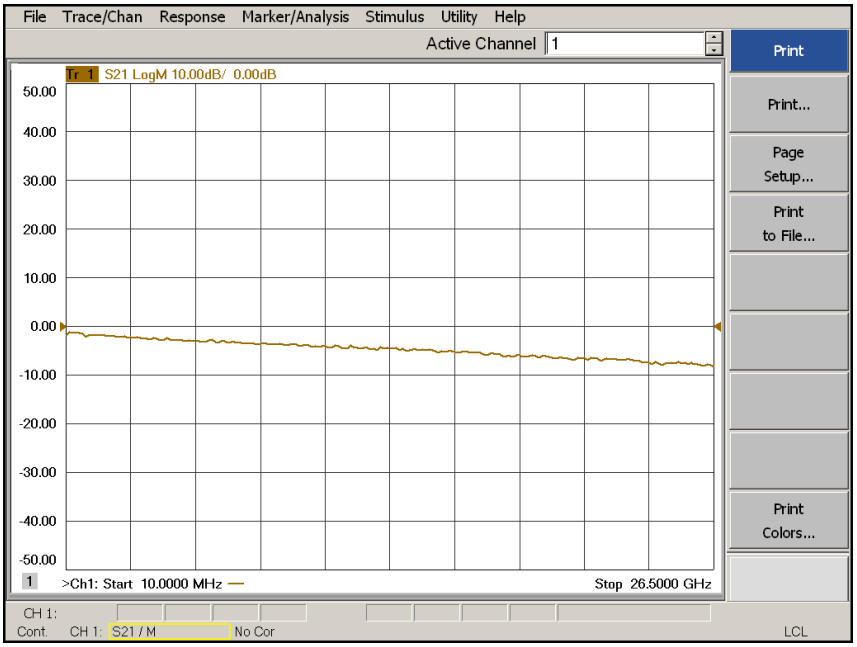


Figure 68 RCVR OUT to CPLR ARM Path Response (Option 001/002)

Table 21 Source Signal Path Connections and Commands (Std/001/002)

PNA Port-2 to Test Set Port	PNA Port-1 to Test Set Port	<Addr>.<Data>	Path Components	Response (typical)
PNA-L Ports 1 & 5 or PNA/PNA-X Ports 1 & 5				
Source IN	Port 5	0.2	P5 CPLR, S13	Figure 69 on page 88
Source IN (Opt 002)			P5 CPLR, S13, BT5	
Source IN	CPLR THRU	0.1	S13	Figure 70 on page 88
Source IN (Opt 002)			P5 CPLR, S13, BT1	
PNA-L Ports 2 & 6 or PNA/PNA-X Ports 3 & 6				
Source IN	Port 6	16.2	P6 CPLR, S21	Figure 69 on page 88
Source IN (Opt 002)			P6 CPLR, S21, BT6	
Source IN	CPLR THRU	16.1	S21	Figure 70 on page 88
Source IN (Opt 002)			P6 CPLR, S21, BT3	
PNA-L Ports 3 & 7 or PNA/PNA-X Ports 4 & 7				
Source IN	Port 7	32.2	P7 CPLR, S29	Figure 69 on page 88
Source IN (Opt 002)			P7 CPLR, S29, BT7	
Source IN	CPLR THRU	32.1	S29	Figure 70 on page 88
Source IN (Opt 002)			P7 CPLR, S29, BT4	
PNA-L Ports 4 & 8 or PNA/PNA-X Ports 2 & 8				
Source IN	Port 8	64.2	P8 CPLR, S37	Figure 69 on page 88
Source IN (Opt 002)			P8 CPLR, S37, BT8	
Source IN	CPLR THRU	64.1	S37	Figure 70 on page 88
Source IN (Opt 002)			P8 CPLR, S37, BT2	

Figure 69 Source IN to Ports 5-8 Path Response (Std/001/002)

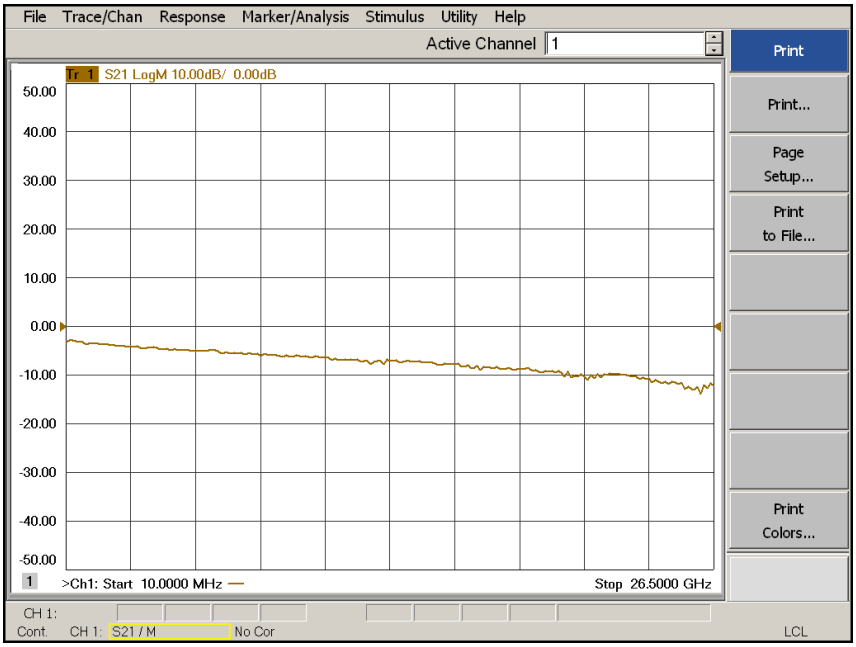
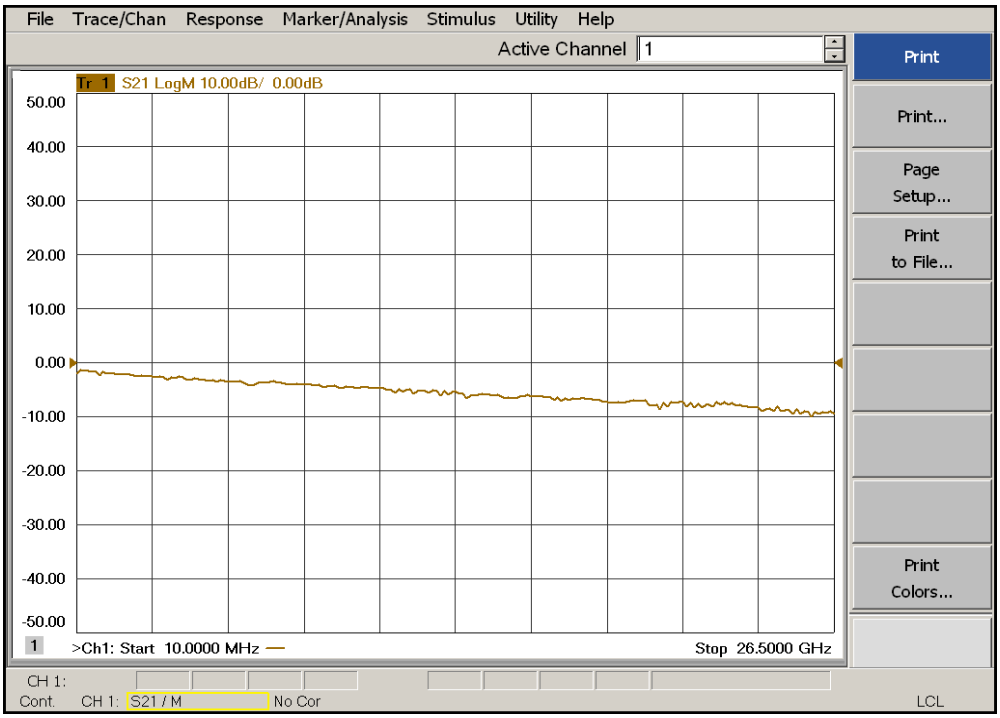


Figure 70 Source IN to CPLR THRU Path Response (Std/001/002)



Connection Tables and Diagrams

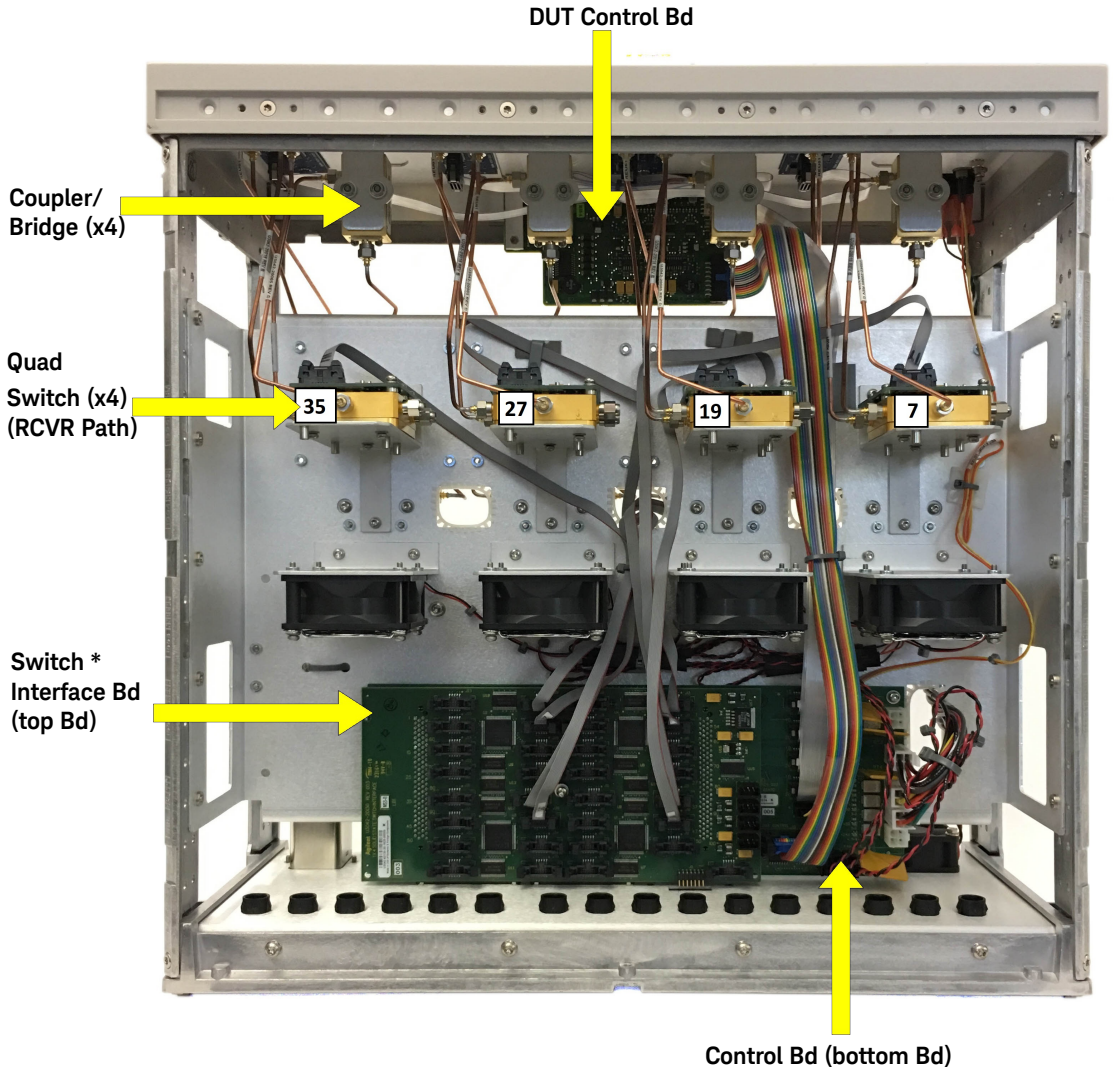
Table 22 Controller Board Connection

Controller Board	Connections
LED Ribbon Cables from the LED Board:	
J5	Port 5
J6	Port 6
J7	Port 7
J8	Port 8
Wire Harness Active LED:	
J16	Active LED
DUT Control Ribbon Cable:	
J9	DUT Controller Board
Power Supply Wire Harness:	
J11-13	Power Supply

Table 23 Switch Interface Board

Switch Interface Board	Connection
Switch Interface Board Connection:	
J13	Port 5 (Source)
J7	Port 5 (Receiver)
J21	Port 6 (Source)
J19	Port 6 (Receiver)
J29	Port 7 (Source)
J27	Port 7 (Receiver)
J37	Port 8 (Source)
J35	Port 8 (Receiver)

Figure 71 Top View (Std)



*** See Figure 68 for a current version board image.**

Figure 72 Top View (Opt 002)

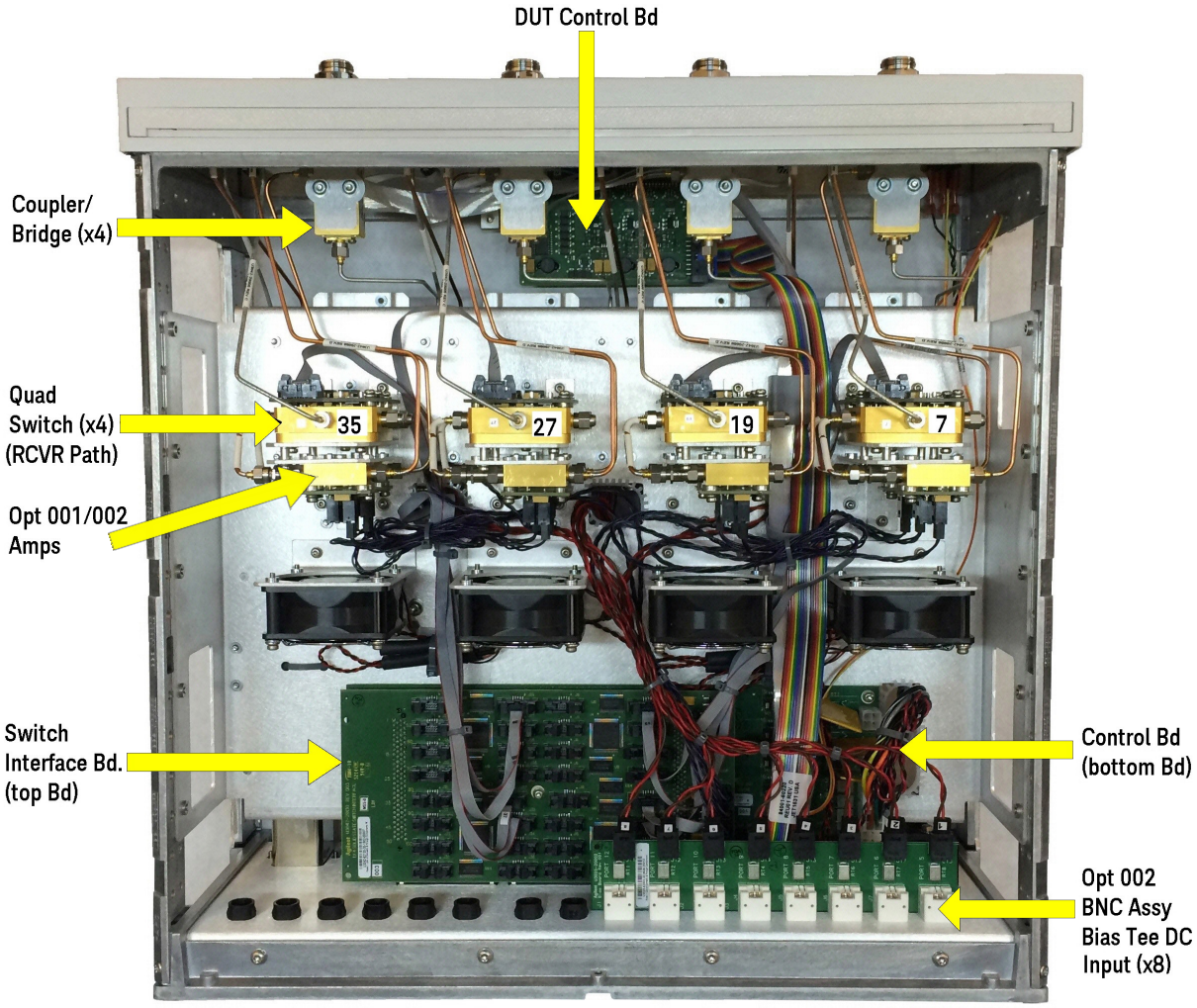


Figure 73 Bottom View (Std)

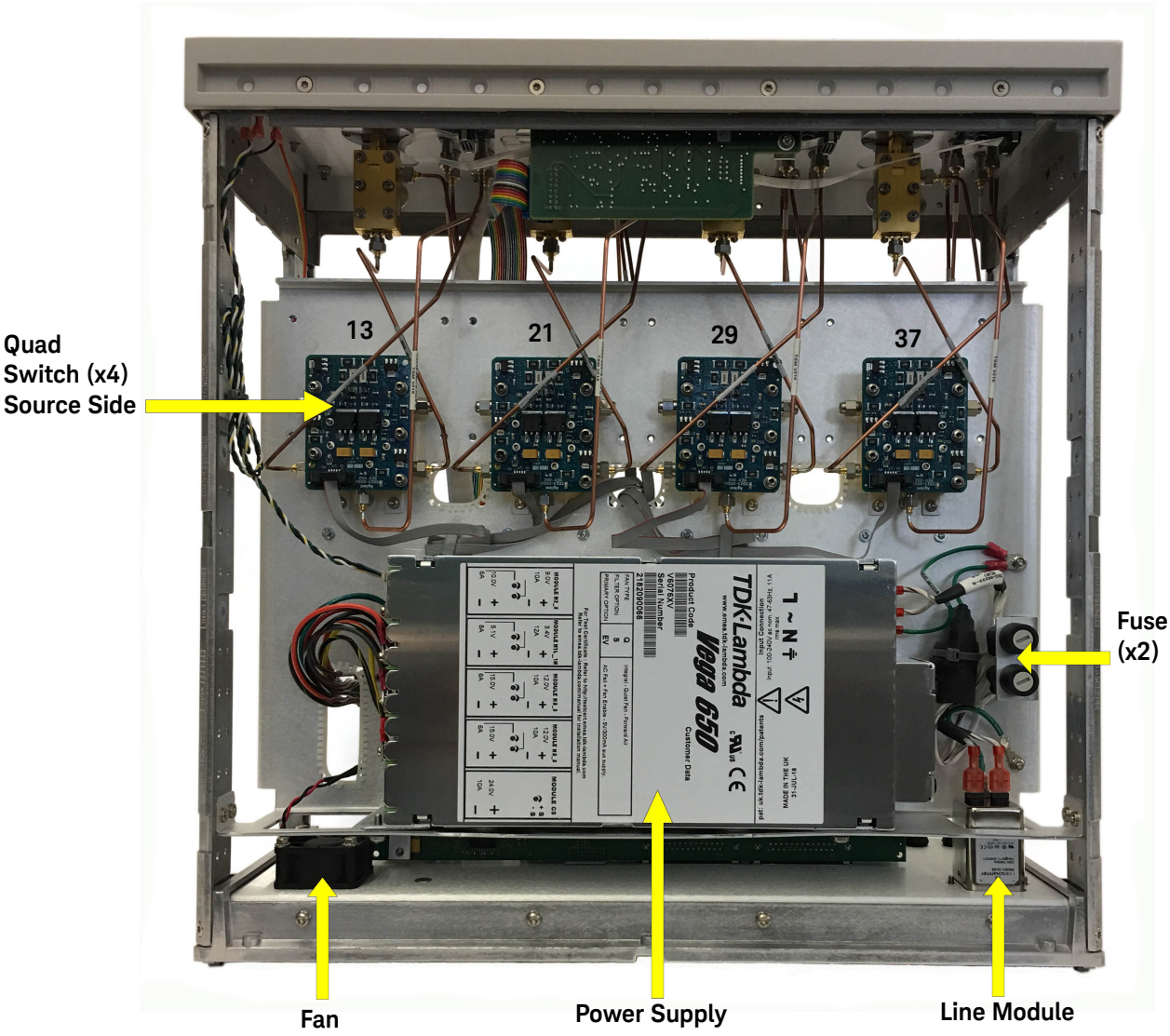
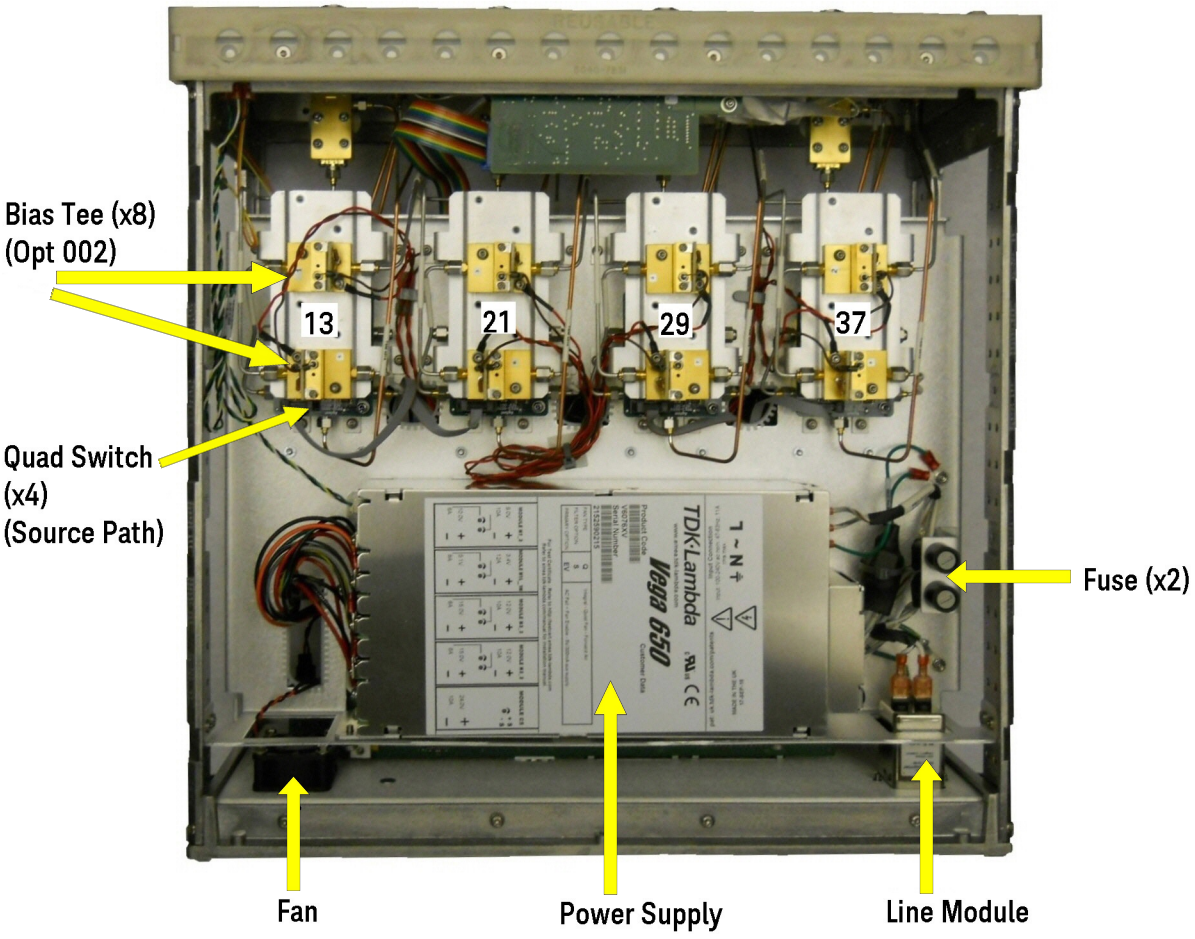


Figure 74 Bottom View (Opt 002)



Safety Information

Introduction

Review this product and related documentation to familiarize yourself with safety markings and instructions before you operate the instrument.

This product has been designed and tested in accordance with accepted industry standards, and has been supplied in a safe condition. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

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 be only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.**

CAUTION Always use the three prong AC power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause product damage and the risk of electrical shock.

Statement of Compliance

This product has been designed and tested in accordance with accepted industry standards, and has been supplied in a safe condition. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

Before Applying Power

Verify that the premises electrical supply is within the range of the instrument. The instrument has an autoranging power supply.

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.**

CAUTION The Mains wiring and connectors shall be compatible with the connector used in the premise electrical system. Failure, to ensure adequate earth grounding by not using the correct components may cause product damage, and serious injury.

CAUTION This product is designed for use in Installation Category II and Pollution Degree 2.

CAUTION Verify that the premise electrical voltage supply is within the range specified on the instrument.

CAUTION 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 product 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 This instrument has auto-ranging line voltage input, be sure the supply voltage is within the specified range and voltage fluctuations do not to exceed 10 percent of the nominal supply voltage.

WARNING **Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended. Discard used batteries according to manufacturer's instructions.**

WARNING **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 the user to dangerous voltages. Disconnect the instrument from all voltage sources before opening.**

WARNING **No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock, do not remove 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 **The power cord is connected to internal capacitors that may remain live for 5 seconds after disconnecting the plug from its power supply.**

Connector Care and Cleaning Precautions

Remove the power cord to the instrument. To clean the connectors use alcohol in a well ventilated area. Allow all residual alcohol moisture to evaporate, and fumes to dissipate prior to energizing the instrument.

WARNING **To prevent electrical shock, disconnect the** U3042AE04 **from mains electrical supply before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.**

WARNING **If flammable cleaning materials are used, the material shall not be stored, or left open in the area of the equipment. Adequate ventilation shall be assured to prevent the combustion of fumes, or vapors.**

Electrostatic Discharge Protection

Electrostatic discharge (ESD) can damage or destroy electronic components. The product is shipped in materials that prevent damage from static, and should only be removed from the packaging in an anti-static area ensuring that the correct anti-static precautions are taken.

Two types of ESD protection are listed below. Purchase acceptable ESD accessories from your local supplier.

- Conductive table-mat and wrist-strap combination
- Conductive floor-mat and heal-strap combination

Both types, when used together, provide a significant level of ESD protection. To ensure user safety, static-safe accessories must provide at least 1 MΩ of isolation from ground.

WARNING **These techniques for a static-safe work station should not be used when working on circuitry with a voltage potential greater than 500 volts.**

Regulatory Information

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

Instrument Markings


The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the documentation.


The AC symbol indicates the required nature of the line module input power.


This symbol indicates separate collection for electrical and electronic equipment, mandated under EU law as of August 13, 2005. All electric and electronic equipment are required to be separated from normal waste for disposal (Reference WEEE Directive, 2002/96/EC).

This symbol indicates that the power line switch is ON.


This symbol indicates that the power line switch is in the STANDBY position.


This symbol indicates that the power line switch is in the OFF position.


This symbol is used to identify a terminal which is internally connected to the product frame or chassis.


The CE marking 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 relevant directives.

ccr.keysight@keysight.com
The Keysight email address is required by EU directives applicable to our product.

The CSA mark is a registered trademark of the CSA International.

ISM1-A
This mark designates the product is an Industrial Scientific and Medical Group 1 Class A product (reference CISPR 11, Clause 5)

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


Direct Current.

IP 2 0
The instrument has been designed to meet the requirements of IP 2 0 for egress and operational environment.


The RCM mark is a registered trademark of the Australian Communications and Media Authority

Indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.


This symbol on all primary and secondary packaging indicates compliance to China standard GB 18455-2001.


South Korean Certification (KC) mark; includes the marking's identifier code which follows the format: MSIP-REM-YYY-ZZZZZZZZZZZZZZ.

Battery

Do not throw batteries away but collect as small chemical waste, or in accordance with your country's requirements. You may return the battery to Keysight Technologies for disposal. Refer to "Contacting Keysight" on page 100 for assistance.

EMC Compliance

Complies with the essential requirements of the European EMC Directive as well as current editions of the following standards (dates and editions are cited in the Declarations of Conformity):

- IEC/EN 61326-1
- CISPR Pub 11 Group 1, Class A
- AS/NZS CISPR 11
- ICES/NMB-001
  This ISM device complies with Canadian ICES-001.
  Cet appareil ISM est conforme a la norme NMB-001 du Canada.

South Korean Class A EMC Declaration

If there is a "KC" mark on the instrument, then the following statement applies:

This equipment has been conformity assessed for use in business environments. In a residential environment, this equipment may cause radio interference.

※ This EMC statement applies to the equipment only for use in a business environment.

사 용 자 안 내 문
이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

※ 사용자 안내문은 "업무용 방송통신기자재"에만 적용한다.

Safety

This instrument complies with the essential requirements of the European Low Voltage Directive.

Acoustic Statement (European Machinery Directive)

Acoustic noise emission
LpA <70 dB
Operator position
Normal operation mode per ISO 7779

Declaration of Conformity

To find a current Declaration of Conformity for a specific Keysight product, go to:
https://regulations.about.keysight.com/DoC/default.htm

Keysight Support, Services, and Assistance

NOTE

In January 2016, the U3042AE04 Multiport Test Set, serial number US50120118 and above, underwent a significant RF switch drive control change. The solid state switch driver board was made programmable to accommodate the implementation of the Option 002. This change will now be implemented on all future Standard and Option 001 versions as well. With the new switch driver board, U3042-63130, the RF switch connections and reference designators have changed. Be careful not to use pre-2016 switch driver board and reference diagrams during service operations.

The User's and Service Guide, for the earlier versions of the Standard and Option 001, is available at http://na.support.keysight.com/multiport.

Service and Support Options

There are many other repair and calibration options available from the Keysight Technologies support organization. These options cover a range of service agreements with varying response times. Contact Keysight for additional information on available service agreements for this product.

Contacting Keysight

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

If you do not have access to the Internet, contact your 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 the warranty status of your unit.

Shipping Your Product to Keysight for Service or Repair

IMPORTANT

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

If you wish to send your instrument to Keysight Technologies for service or repair:

- To improve turn-around time, return your test set along with your analyzer and cables to Keysight so that we may verify the operation of the complete system.

- 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 antistatic packaging materials.
- Contact Keysight for instructions on where to ship your analyzer.

This information is subject to change without notice.

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KEYSIGHT TECHNOLOGIES

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