Keysight Technologies
U3042AM20
Multiport Test Set Extension

Use this manual with the following documents:
PNA Series Network Analyzer On-Line Help
System

KEYSIGHT
TECHNOLOGIES

User's and
Service Guide

Notices

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In this document the terms "master" and "slave" have been replaced with "primary" and "secondary."

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CAUTION

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

WARNING

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

U3042AM20

U3042AM20

Introduction

This document describes how to use and service the U3042AM20 Multiport Test Set.

Figure 1   N5242A with U3042AM20 (Option 129 shown)
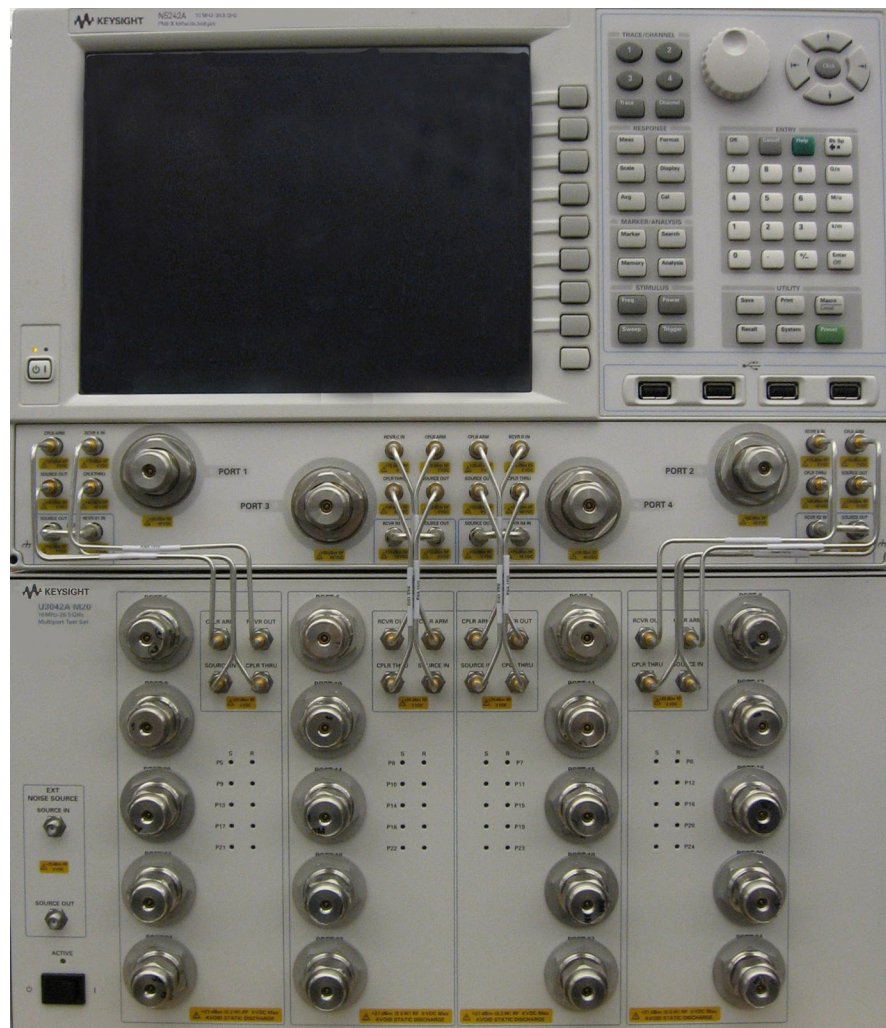
Description

The U3042AM20 is a Multiport Test Set Extension designed to be configured in a 24 Port network analyzer measurement system. The U3042AM20 has the following key features:

- 20 Test Ports (3.5mm Male connectors)
- Low Loss mechanical RF switching
- Frequency Range of Operation: 300 KHz - 26.5 GHz
- Keysight PNA compatibility with rear panel Test Set I/O interface for operational control. The PNA Option 551 is required. An external personal computer is not required.

> **NOTE** The PNA, PNA-L, and PNA-X Network Analyzers used in this system will be referred to throughout this document as the Analyzer. The U3042AM20 will be referred to as the Test Set. The N5221A/B, N5231/2A/B, N5239B, N5241A/B, and N5249B Network Analyzers can be used, but the frequency range will be limited by these analyzers.

Measurement Application Notes

Low Loss DUT Measurements

Low loss trace ripple is a product of switch repeatability and calibration technique. Low insertion loss measurements exhibiting a 0.1 dB uncertainty ripple residing on the measurement response is not uncommon.

Switch Configuration Command Speed

When writing address and data values to the test set directly, include a 15ms wait before issuing another address and data set. The delay of 15ms is required for the test set internal switches to settle. Failure to add the delay could cause the test set internal switches to stick or cause intermittent failures.

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 98. Keep the damaged shipping materials (if any) for inspection by the carrier and an Keysight Technologies representative.

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 8 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 network 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 the analyzer's file directory: c:\Program Files\Keysight\Network Analyzer\TestSets.

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

Table 1   Network Analyzer Configuration Requirements

4-Port Network Analyzer	Options	Test Set File	System Figure
N5222A/B PNA	401, 417 or 419	u3042am20_pnax_p4.tsx	Figure 1 on page 2[1]
N5232A /B, N5239B PNA-L	416	u3042am20_p4.tsx	
N5241/2A/B, N5249B PNA-X	400	u3042am20_pnax_p4.tsx	Figure 1 on page 2

1. This graphic is not a N5222A network 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:

— Documentation - http://www.keysight.com/find/pna

— Network Analyzer Firmware - http://na.support.keysight.com/pna/firmware/firmware.htm

— U3042AM20 Test Set Files - http://na.support.keysight.com/multiport/testsets/testset_files.html

Available Options

Test Set Options

The test set has three available options:
Refer to "System Block Diagrams" on page 70 and 71.

— Option 700   Standard (no Option 129 on the serial tag)

— Option 129 - external source path switch ports 1, 5, 9, 13, 17 and 21.

Rack Mounting Kits

Installation instructions are included in the option package.

— U3042AM20-1CM - Rackmount Kit without Handles (5063-9216)

— U3042AM20-1CN - Front Handle Kit (5063-9229)

— U3042AM20-1CP - Rackmount with Front Handle Kit (5063-9223)

Network Analyzer Interface Kit Options

The U3042AM20 requires the following kits to interface the test set with your analyzer. The interface kit model option includes the hardware lock-link and cable kit listed in Table 2.

Table 2   Interface Kit Options

24-Port Network Analyzer System	Interface Kit Option	Hardware Lock-link	Cable Kit, Connector Type
N5222A/B PNA	U3021PX3 Opt 442	U3021-60005[1]	U3021-60077[2], SMA m/m
N5232A/B, N5239B PNA-L	U3021PX3 Opt 430	U3021-60004[3]	U3021-60075[4], SMA m/m
N5241/2A/B, N5249B PNA-X	U3021PX3 Opt 442	U3021-60005[1]	U3021-60077[2], SMA m/m

1. "Hardware Lock-link Installation (U3021-60005)" on page 16.
2. "N5222A/B and N5242A/B RF Interface Cable Connections (U3021-60077)" on page 22.
3. "Hardware Lock-link Installation (U3021-60004)" on page 13.
4. "N5232A/B RF Interface Cable Connections (U3021-60075)" on page 20.

General Specifications

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

An N-Port calibration should be performed for optimum measurement accuracy.

A periodic calibration is not required. The Operators Check should be performed after System Setup, or if performance is in question.

When connected to a PNA, the 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 values measured in the "Cal Kit Operational Check" on page 59 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 PNA.

— 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.

— U3042AM20 maximum power is 350 W.

WARNING   This is a Safety Class I product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall be inserted only into a socket outlet provided with a protective earth contact. Any interruption of the protective conductor, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited.

Environmental Requirements

Refer to your network analyzer's standard documentation for environmental requirements.

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

— Pressure Altitude (Operation)
   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 network 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 Dimensions

Model	Weight	Height	Width	Depth
U3042AM20	14 kg (30.8 lb)	22.15 cm (8.7 in)	42.5 cm (16.7 in)	50 cm (20 in)

Maximum 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.

Table 4   U3042AM20 Maximum Power Levels

Maximum Test Port RF Power Levels:	
PORT 5-24	+27 dBm
U3042AM20 Access Ports:	
SOURCE OUT	+20 dBm
CPLR ARM	+20 dBm
CPLR THRU	+20 dBm
RCVR OUT	+20 dBm

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

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

Typical Reflection Tracking

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

NOTE	Typical performance are based on 1 to 2 units performance, as shown in Table 5.

Table 5   Typical Reflection Tracking PNA-X

Frequency	Ports 1 to 4	Ports 5 to 24
10 MHz to 50 MHz[1]	−0.5	> 20
50 MHz to 500 MHz[1]	−2	> 0
500 MHz to 3.2 GHz	−4	−5
3.2 GHz to 10 GHz	−7	−7
10 GHz to 16 GHz	−8	−8
16 GHz to 20 GHz	−10	−10
20 GHz to 24 GHz	−12	−12
24 GHz to 26.5 GHz	−13	−13

1. 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.

Front and Rear Panel Features

Figure 2   U3042AM20 Front Panel (Option 129 shown)
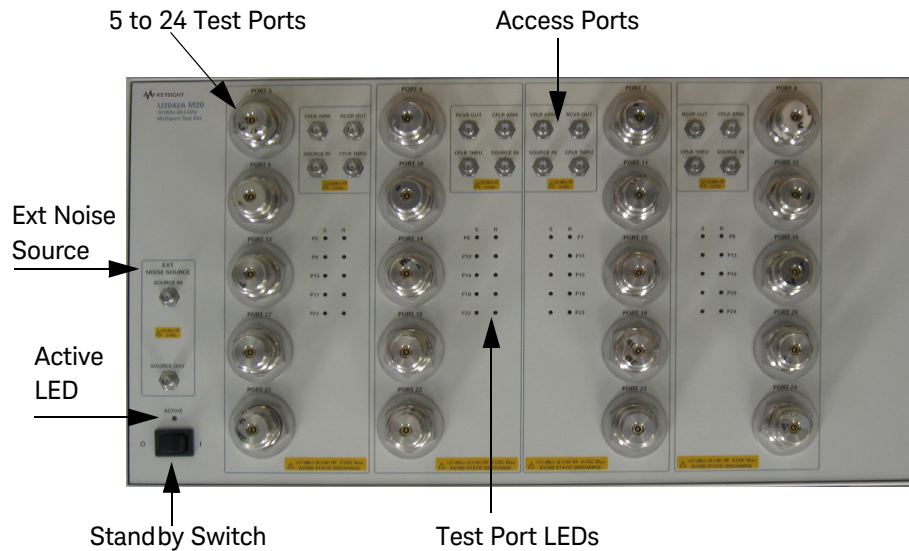
Test Ports - 3.5 mm Bulkhead (male)

— Port 5 – 24

Access Ports – SMA (female)

— CPLR ARM

— SOURCE IN

— CPLR THRU

— RCVR OUT

Test Port 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.

Standby Switch

The switch is only a Standby switch, not a AC line power switch.The main power cord can be used as the system disconnecting device. It disconnects the mains circuits from the mains supply.

Active LED

The Active LED is on when the test set is connected and addressed by a network analyzer. The LED is off when the test set is in Standby, or not addressed by the network analyzer.

Ext Noise Source – SMA (female)

— SOURCE OUT

— SOURCE IN

Figure 3   U3042AM20 Rear Panel

Control Lines Voltage Adjust

Line Module   Test Set Interface   Pass Through Interface   Chassis Ground
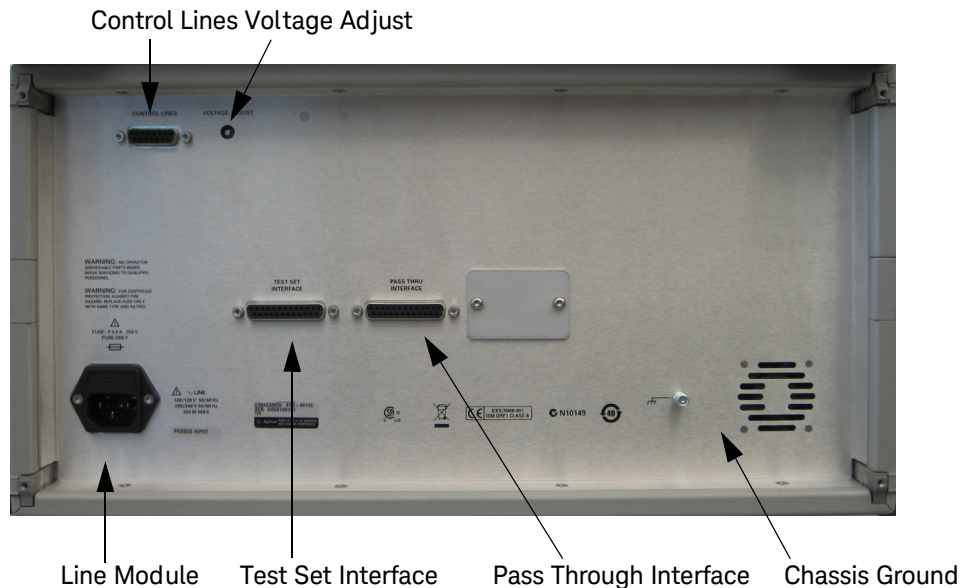
Control Lines and Voltage Adjust

For further information pertaining to control lines and voltage adjustments see "Control Lines" on page 54.

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 (2950-0004) and lock washer (2190-0067).

Pass Through Interface

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

This assembly houses the line cord connection, line fuse, and line voltage selector. Remove the line module cover to replace or change the fuse. Line voltage selection is automatic and no setting is required.

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 4   Line Module and Fuse

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

Hardware Lock-link Installation (U3021-60004)

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 the user to dangerous voltages. Disconnect the instrument from all voltage sources before being opened.

Locking the Test Set to the PNA-L

1. The lock-link kit (U3021-60004) includes:

   – 0515-1619 - Screw T20 M4x0.7 25 mm (x2), Analyzer

   – 0515-2317 - Screw T15 M3.5x0.6 12 mm (x2), Test Set

   – N5242-20208 - Right Lock-link, Test Set

   – N5242-20209 - Left Lock-link, Test Set

   – N5242-20210 - Right Lock-link, Analyzer

   – N5242-20211 - Left Lock-link, Analyzer

2. Remove the feet from the bottom of the analyzer.

3. Remove the 2 lower standoffs from the rear panel on the analyzer using a T20 Torx driver.

Figure 5   Rear Bottom Feet & Standoffs

Standoffs (x2)

Feet (x4)
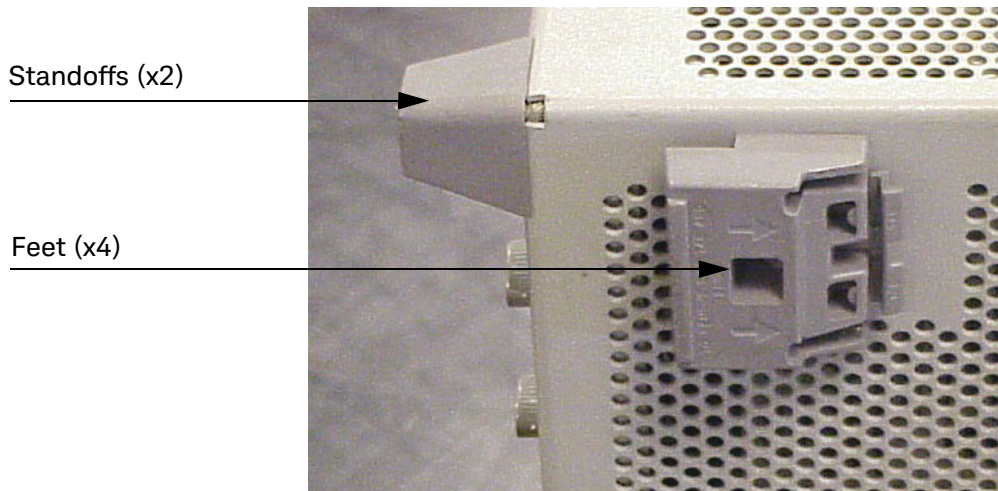
4. Install the lower lock-links (N5242-20210, right and N5242-20211, left not shown) onto the analyzer, as shown in Figure 6.

Figure 6   Install Lock-links to the Analyzer
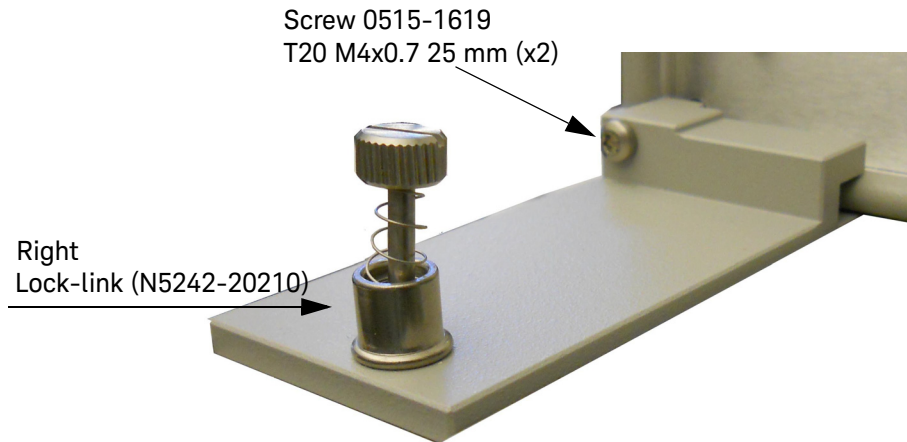
Screw 0515-1619
T20 M4x0.7 25 mm (x2)

Right
Lock-link (N5242-20210)

5. Remove the two upper standoffs from the rear panel of the test set using a T20 Torx driver.

6. Install the left and right lock-links onto the test set, as shown in Figure 7.

Figure 7   Install Lock-links to the Test Set

Screw 0515-2317 (x2)   Right lock-link   Left lock-link
T15 M3.5X0.6 12 mm   N5242-20208   N5242-20209

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.

Figure 8　　　　Locking the Analyzer

Network Analyzer
Front Frame

Slide the network analyzer back to engage the lock link in the back of the network analyzer's front frame,

screw

Lock Link

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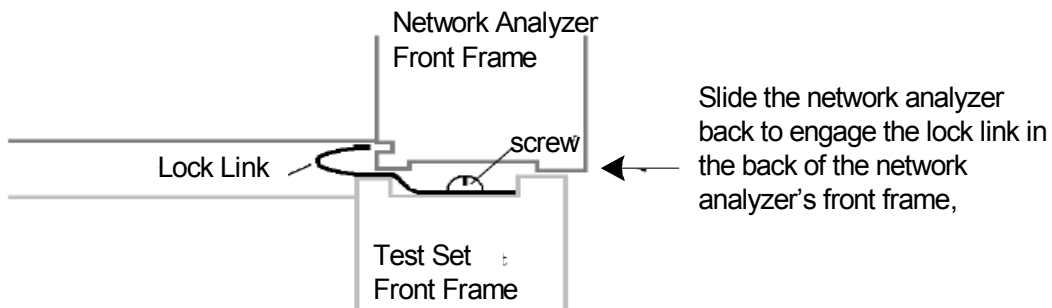
8. Secure the analyzer's lower lock-links to the test set's upper lock-links using the spring–loaded screw. If the analyzer's lock-links are not aligned with the screw holes, loosen the screws securing the feet to the instrument to align and tighten.

Figure 9　　　　Secure and Tighten
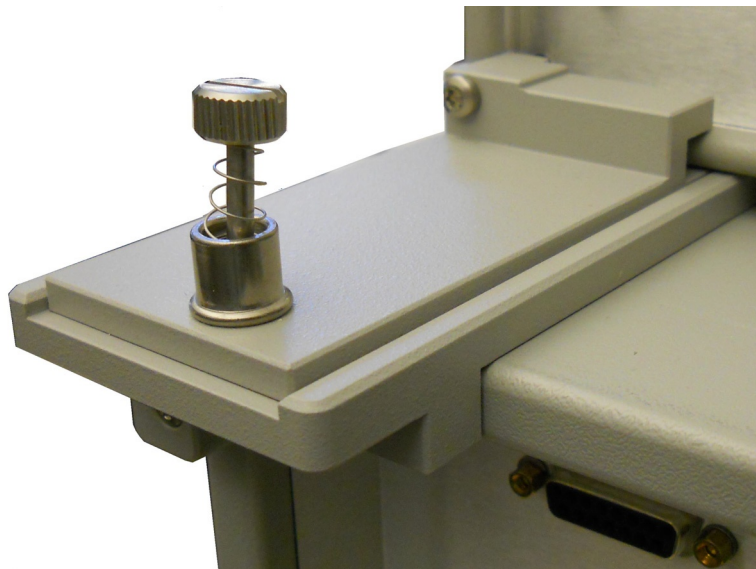
NOTE　　　　Refer to "Network Analyzer Interface Kit Options" on page 5.

Hardware Lock-link Installation (U3021-60005)

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 the user to dangerous voltages. Disconnect the instrument from all voltage sources before being opened.

Locking the Test Set to the PNA or PNA-X

1. The lock-link kit (U3021-60005) includes the following components:

   – 0515-1619 - Screw T20 M4x0.7 25 mm

   – 0515-2317 - Screw T15 M3.5x0.6 12 mm

   – 5023-0132 - Lock-links kit (left, right pair and screws), Analyzer

   – N5242-20206 - Right Lock-link, Test Set

   – N5242-20207 - Left Lock-link, Test Set

2. Remove the feet from the bottom of the analyzer.

3. Remove the 2 lower standoffs from the rear panel on the analyzer using a T20 Torx driver.

Figure 10   Rear Bottom Feet & Standoffs

Standoffs (x2)

Feet (x4)
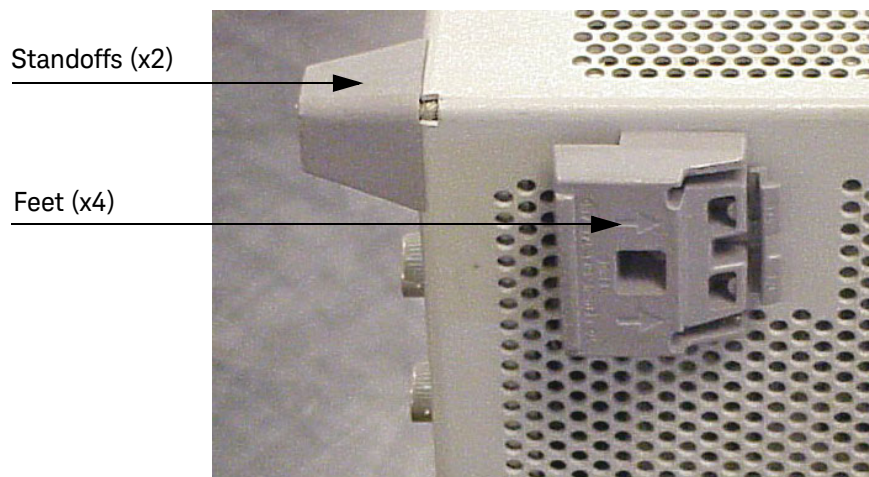
4. Install the two lower rear lock-links (left not shown) onto the analyzer, as shown in Figure 11.

Figure 11   Install Lock-links to the Analyzer
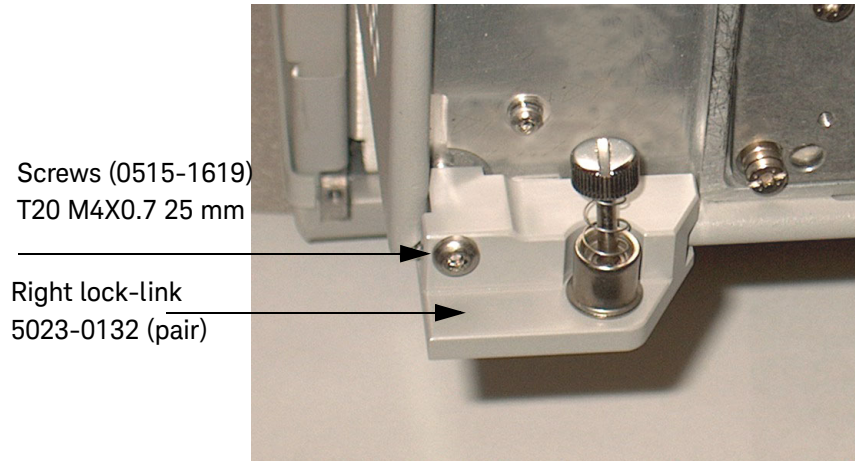
Screws (0515-1619)
T20 M4X0.7 25 mm

Right lock-link
5023-0132 (pair)

5. Remove the two upper standoffs from the rear panel of the test set using a T20 Torx driver.

6. Install the left and right lock-links onto the test set, as shown in Figure 12.

Figure 12   Install Locking Feet on the Test Set

Right lock-link
N5242-20206

Left lock-link
N5242-20207

Screw 0515-2317
(x2) T15 M3.5X0.6
12 mm

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 13   Locking the Analyzer

Network Analyzer
Front Frame

Slide the network analyzer back to engage the lock link in the back of the network analyzer's front frame,

screw

Lock Link

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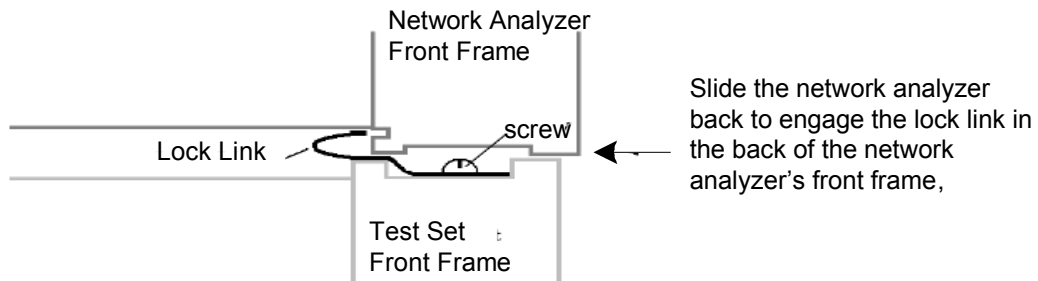
8. Secure the analyzer's lower lock-links to the test set's upper lock-link using the spring–loaded screws. If the analyzer's lock-links are not aligned with the screw holes, loosen the screws securing the feet to the instrument to align and tighten.

Figure 14   Locked
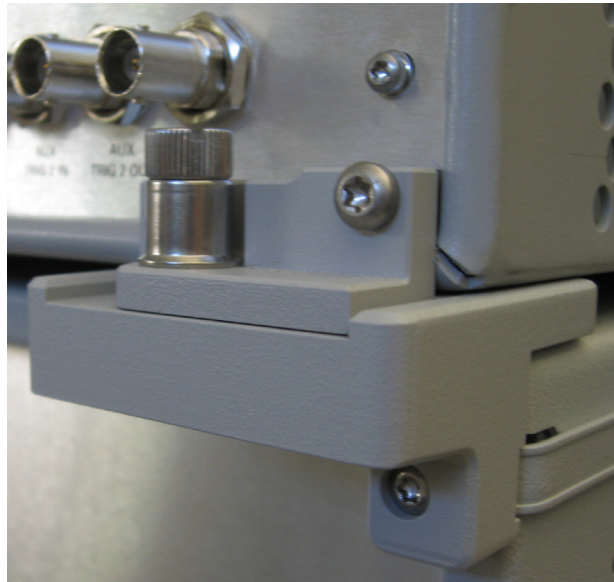
N5232A/B RF Interface Cable Connections (U3021-60075)

Figure 15 illustrates the cable configuration of the test set to the PNA-L. The cables have been supplied with the kit (U3021-60075).

Cable Connection Procedure

1. Remove the SOURCE OUT to CPLR THRU and RCVR IN to CPLR ARM jumpers (x8) on the analyzer. The RCVR R1 to SOURCE OUT reference loop jumper (x1) remain on the front panel.

2. Connect the RF interconnect cables, supplied with this option, from the PNA-L to the test set. Torque each cable to 8 in-lb. Refer to Table 6 and Figure 15.

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

Table 6   PNA-L Interface Cable Connection (U3021-60075)

Numeric Order	RF Cables	From: PNA-L	To: Test Set
1	U3042-20182	Port 1 SOURCE OUT	Port 5 SOURCE IN
2	U3042-20183	Port 1 CPLR THRU	Port 5 CPLR THRU
3	U3042-20185	Port 1 CPLR ARM	Port 5 CPLR ARM
4	U3042-20184	Port 1 RCVR A IN	Port 5 RCVR OUT
5	U3042-20189	Port 2 CPLR ARM	Port 6 CPLR ARM
6	U3042-20188	Port 2 RCVR B IN	Port 6 RCVR OUT
7	U3042-20186	Port 2 SOURCE OUT	Port 6 SOURCE IN
8	U3042-20187	Port 2 CPLR THRU	Port 6 CPLR THRU
9	U3042-20191	Port 3 CPLR THRU	Port 7 CPLR THRU
10	U3042-20190	Port 3 SOURCE OUT	Port 7 SOURCE IN
11	U3042-20193	Port 3 CPLR ARM	Port 7 CPLR ARM
12	U3042-20192	Port 3 RCVR C IN	Port 7 RCVR OUT
13	U3042-20197	Port 4 CPLR ARM	Port 8 CPLR ARM
14	U3042-20195	Port 4 CPLR THRU	Port 8 CPLR THRU
15	U3042-20196	Port 4 SOURCE OUT	Port 8 SOURCE IN
16	U3042-20194	Port 4 RCVR D IN	Port 8 RCVR OUT

Figure 15   PNA-L RF Interface Connections
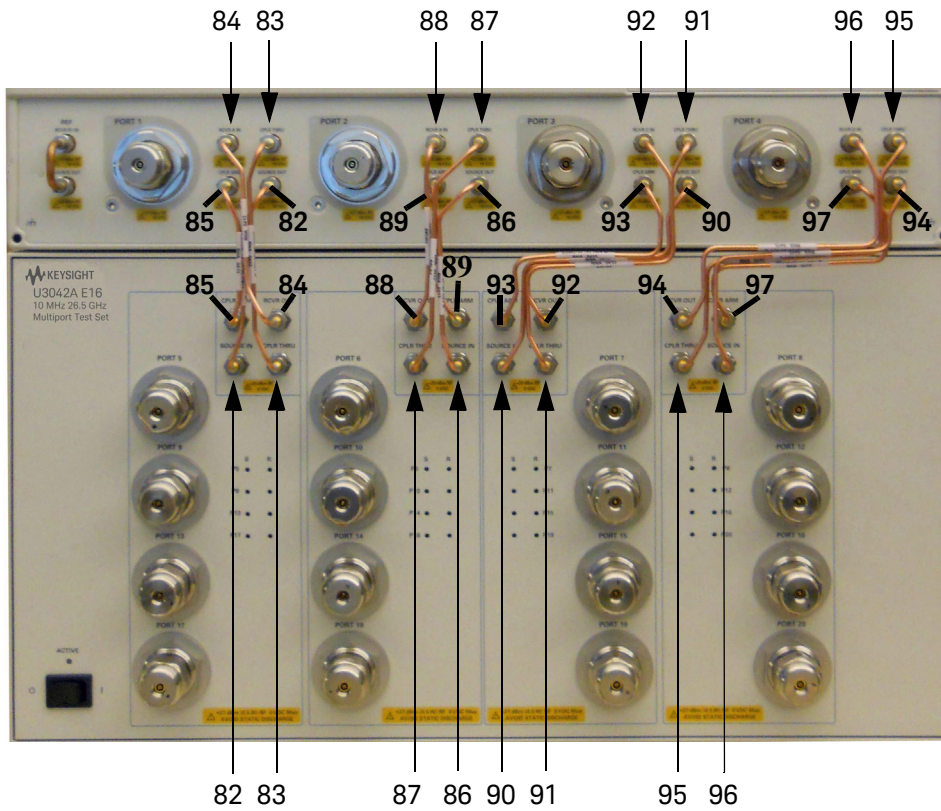
| NOTE | The Test Set shown is not a U3042AM20, but the interface cable connects shown are the same. |

3. Connect the Test Set I/O cable (N4011-21002) to the Test Set Interface connector on the rear panel, similar Figure 17 on page 24.

   Refer to "System Operational Check" on page 25 for turn-on verification of the multiport system.

N5222A/B and N5242A/B RF Interface Cable Connections (U3021–60077)

Figure 16 on page 23 illustrates the cable configuration of the Test Set to the analyzer. The cables have been supplied with the kit (U3021–60077).

Cable Connection Procedure

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 PNA or PNA-X 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 7 and Figure 16 on page 23.

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

Table 7   PNA or PNA-X RF Interface Cable Connection (U3021–60077)

Numeric Order	RF Cables	From PNA-X	To Test Set
1	U3042-20122	Port 1 CPLR THRU	Port 5 CPLR THRU
2	U3042-20120	Port 1 SOURCE OUT	Port 5 SOURCE IN
3	U3042-20119	Port 1 CPLR ARM	Port 5 CPLR ARM
4	U3042-20121	Port 1 RCVR A IN	Port 5 RCVR OUT
5	U3042-20123	Port 3 CPLR ARM	Port 6 CPLR ARM
6	U3042-20123	Port 3 RCVR C IN	Port 6 RCVR OUT
7	U3042-20124	Port 3 SOURCE OUT	Port 6 SOURCE IN
8	U3042-20124	Port 3 CPLR THRU	Port 6 CPLR THRU
9	U3042-20123	Port 4 RCVR D IN	Port 7 RCVR OUT
10	U3042-20123	Port 4 CPLR ARM	Port 7 CPLR ARM
11	U3042-20124	Port 4 SOURCE OUT	Port 7 SOURCE IN
12	U3042-20124	Port 4 CPLR THRU	Port 7 CPLR THRU
13	U3042-20126	Port 2 CPLR THRU	Port 8 CPLR THRU
14	U3042-20128	Port 2 SOURCE OUT	Port 8 SOURCE IN
15	U3042-20125	Port 2 RCVR B IN	Port 8 RCVR OUT

Table 7   PNA or PNA-X RF Interface Cable Connection (U3021-60077)

Numeric Order	RF Cables	From PNA-X	To Test Set
16	U3042-20127	Port 2 CPLR ARM	Port 8 CPLR ARM

Refer to "Interconnect Cable Verification" on page 24.

Figure 16 illustrates the final two digits of the part number for each cable. The cables must be connected in the numeric order listed in Table 7 on page 22.

Figure 16   RF Interface Cable Connections
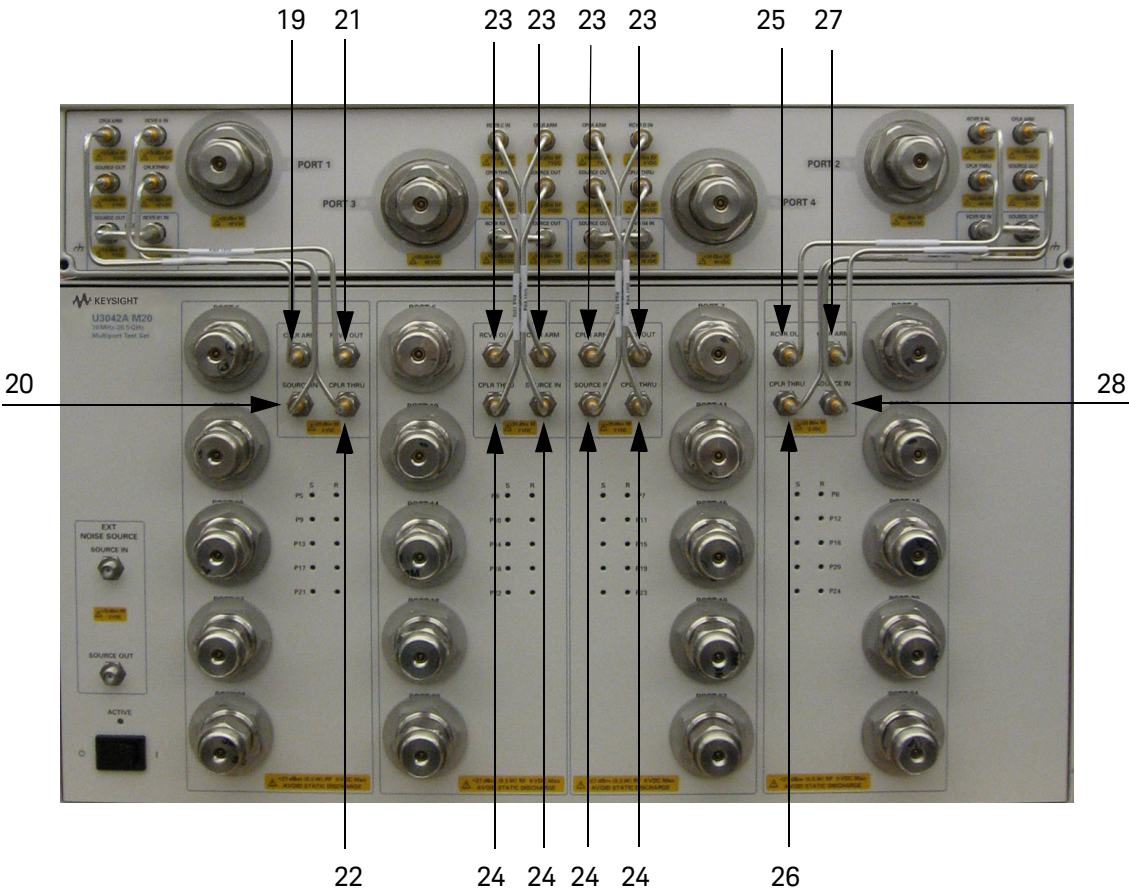
Refer to "Test Set I/O Cable Installation" on page 24.

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 panel, similar to Figure 17.

Figure 17   Test Set I/O Cable Connection

N4011-21002
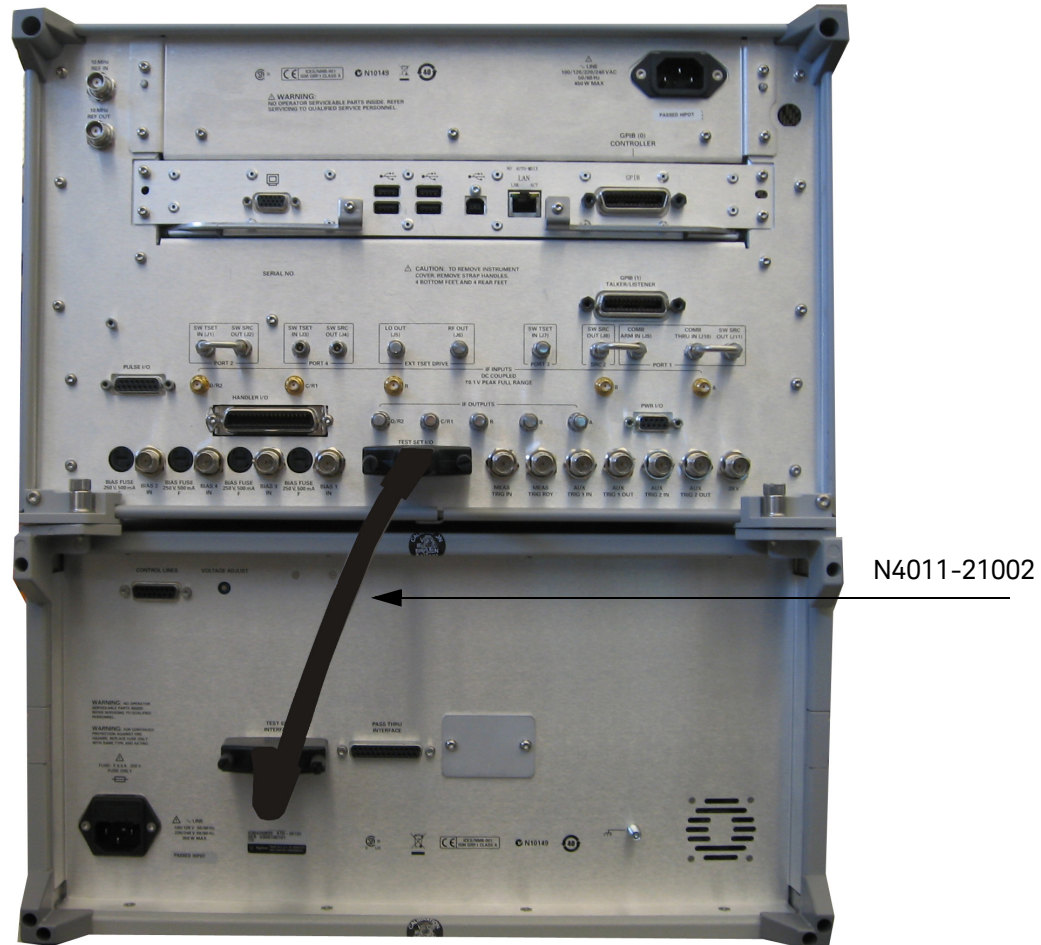
Interconnect Cable Verification

1. Perform the "System Operational Check" on page 25.

2. If the problem still exists, perform the "RF Switching Failures" on page 77.

3. If a power hole or other failure still exists, refer to 0.

System Operational Check

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 operating before connecting the test set.

Before beginning this procedure complete the following steps:

— 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 female 3.5 mm short (85056-60007, included) to Port 1 on the analyzer.

Equipment Setup

— Turn on the test set and analyzer.

— Preset the analyzer and make the following settings:

   — Set to Multi-Port Mode

   — Frequency range: 10 MHz to 26.5 GHz (depending on your analyzer)

   — 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 8   Reflection Response Results

Reflection Port	Response Trace	Cable Path Diagram
Port 1 to 4	Figure 18 on page 26	Figure 19 on page 27
Ports 5 to 24	Figure 20 on page 28	Figure 21 on page 29

| 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 59. |

Figure 18   Typical Reflection Response Ports 1 to 4
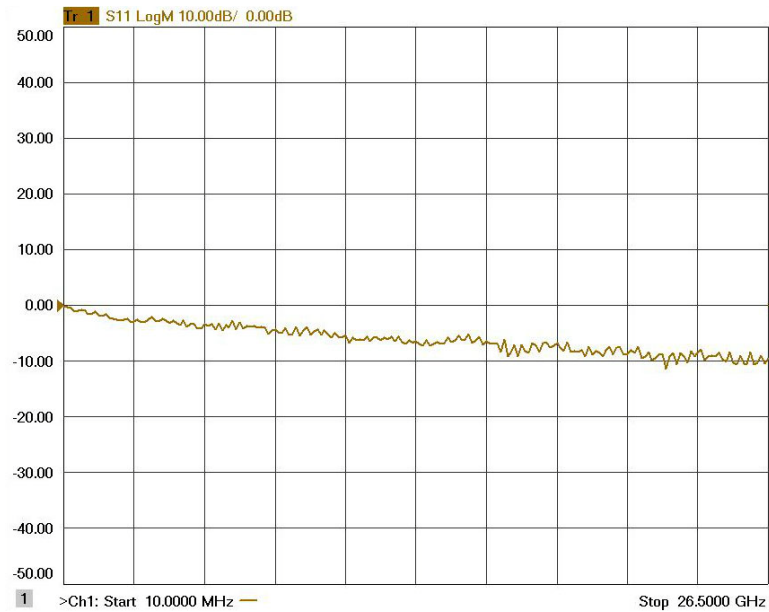
Figure 19   Reflection Response Signal Path Diagram Ports 1 to 4
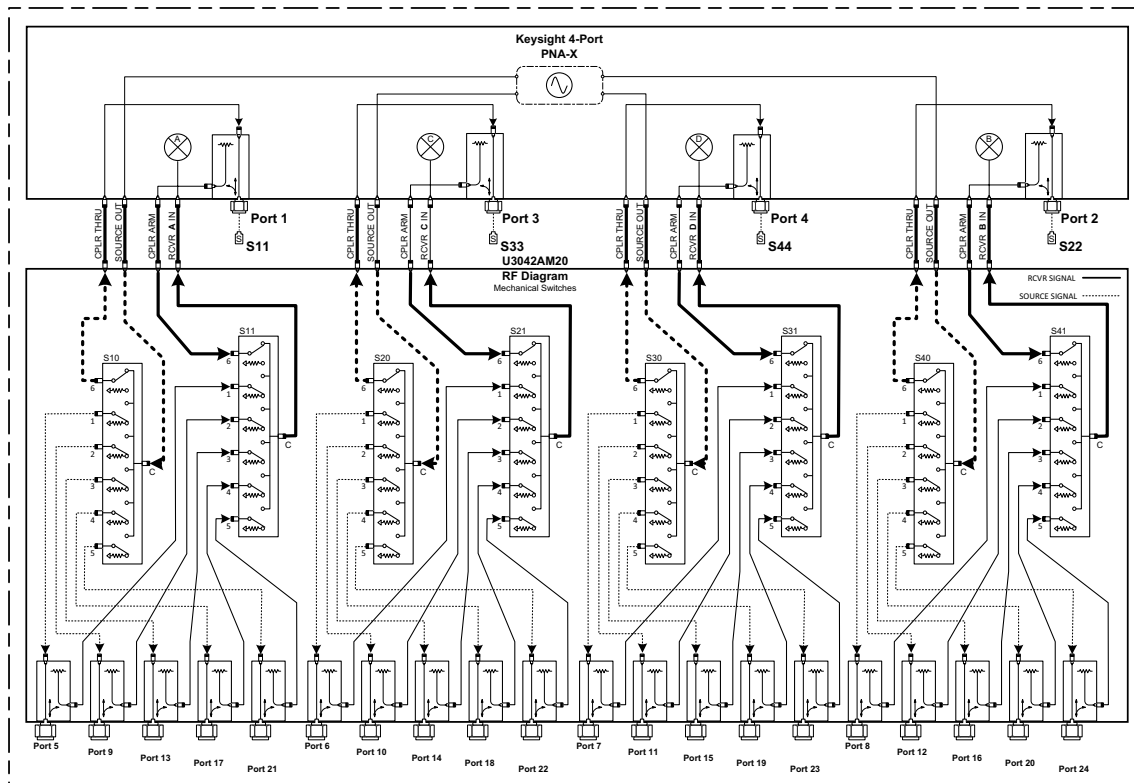
Figure 20   Typical Reflection Response Ports 5 to 24
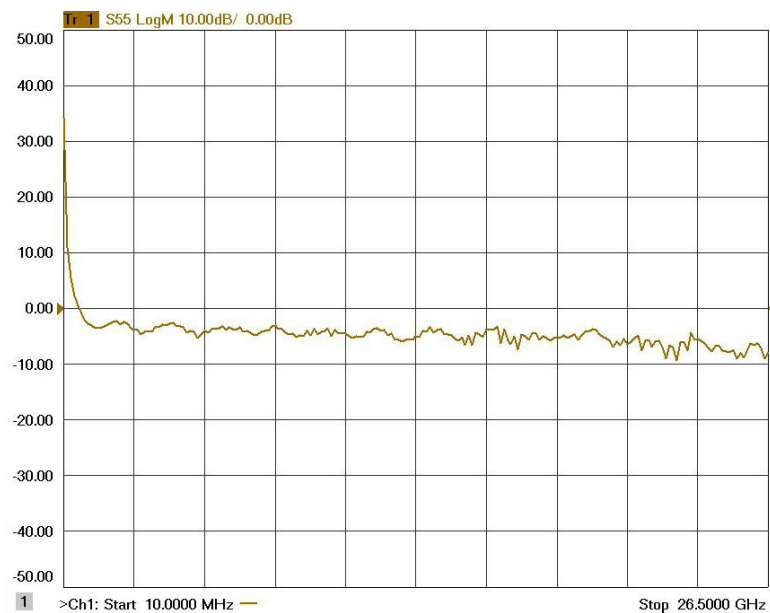
Figure 21   Reflection Response Signal Path Diagram Ports 5 to 24
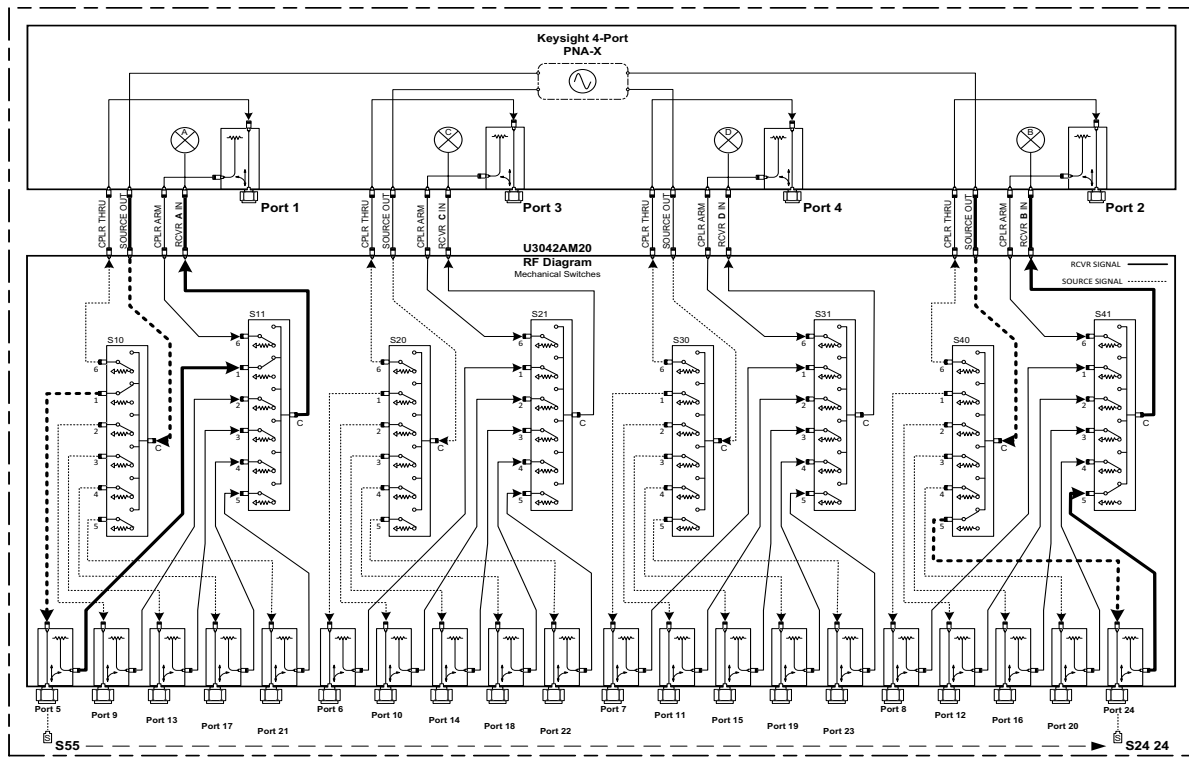
Controlling the Test Set with the Analyzer

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

NOTE	The internal firmware 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 PNA, PNA-X or PNA-L must be used to control the test set. There are three methods to control the test set. Multiport mode is recommended due to calibration and ease of use.

— "Multiport Mode (Option 551)" on page 32.

— "Interface Control Mode" on page 41.

— "SCPI Control Mode" on page 45.

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

Sweep Setup for Multiport and Standalone Modes

When the Test Set is connected to the network analyzer, 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 due to the extra electrical length of the Test Set and test port cables. Stepped Sweep is available on all models.

1. On the analyzer select **STIMULUS > Sweep > Sweep Setup**.

2. Select **Stepped Sweep** (sweep moves in discrete steps).

3. Set the **Dwell Time** to **5 μs > OK**.

Figure 22   Sweep Setup
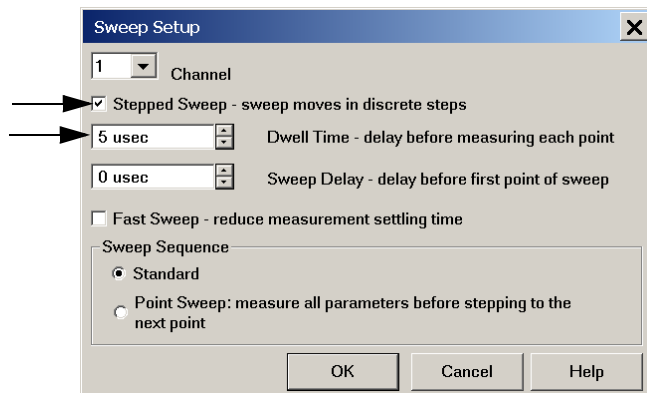
Multiport Mode (Option 551)

The analyzer requires Option 551 for Multiport mode. The analyzer must have the test set file installed to enable the analyzer to control the test set. The analyzer multiport mode allows you to select measurement ports, complete an N–Port calibration, operate control lines, and rename test ports. Refer to the Help menu for more information.

Multiport Mode Operation

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 > Multiport Configuration...).

2. Select **U3042AM20 (24-Port System)** from the drop-down menu and select **Restart as a multiport PNA with this test set > 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.keysight.com/multiport. Copy the appropriate file to the **c:\program files\Keysight\Network Analyzer\testsets** directory.

Figure 23   Selecting Multiport Mode
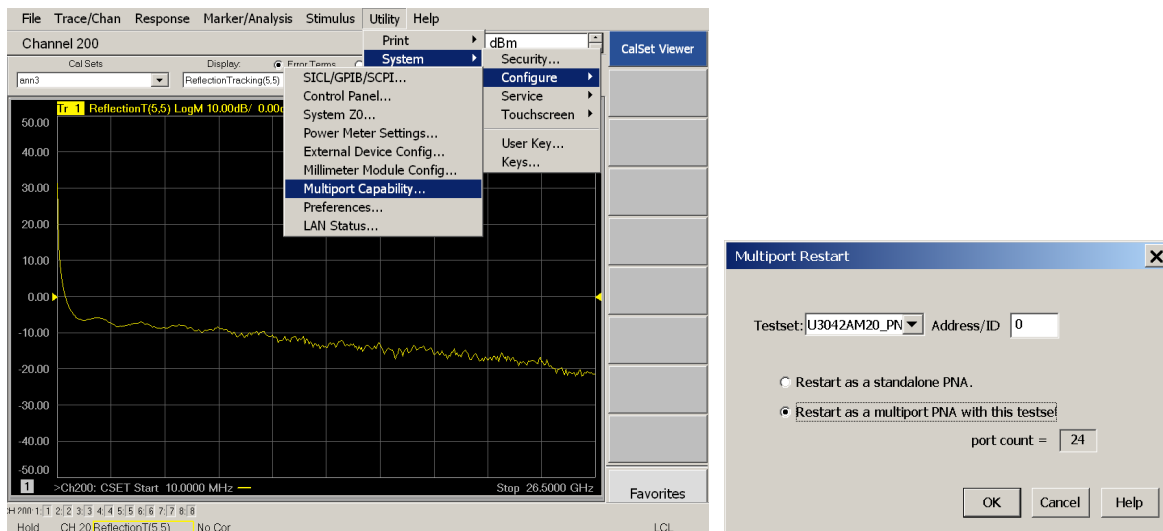
External Test Set Control Feature

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 Setup...).* The test set will be displayed as External Test Set
Control-U3042AM20.

Figure 24   External Test Set Control
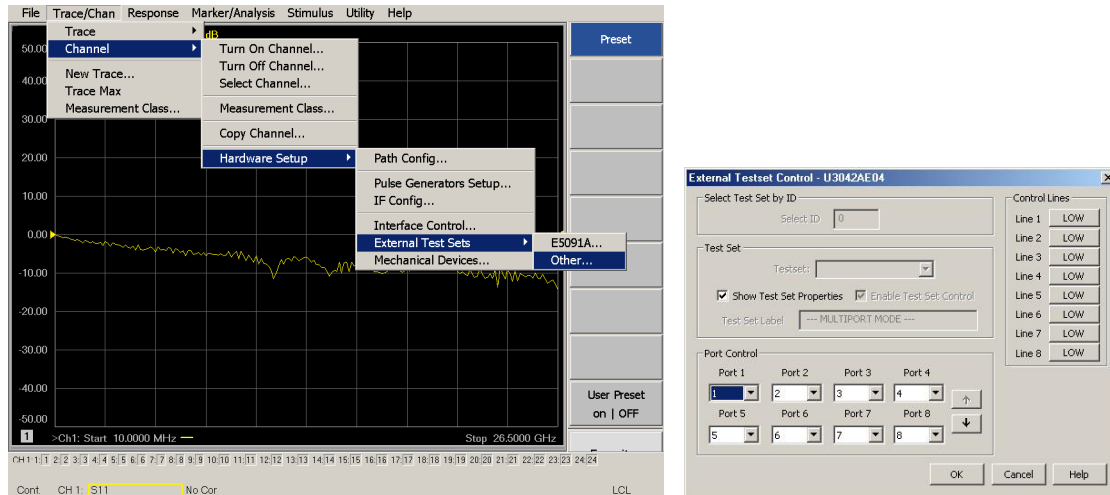
This menu will allow the physical Ports 1 thru 24 to be identified as any port
for your convenience. For example, Port 5 can be re-named Port 2.

The **External Test Set Control-U3042AM20** also allows control of the DUT
control lines, refer to "Control Lines" on page 54. To change the state from
LOW to HIGH, select the graphical user interface (GUI) for the specific control
(LINE 1 thru 8), click **OK**. Each line can be controlled separately.

Selecting S-Parameter Measurement

S-Parameter selection can be accomplished using **Response > Measure**. Use the drop-down menu to select 1 of 567 S-Parameters for the 24-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 using the keypad. For example, to select S25: *MEAS [MEAS] > Enter S-Parameters > [2][.][5] [Enter]*.

Figure 25   S-Parameter Measurement ('A' Model Analyzers Only)
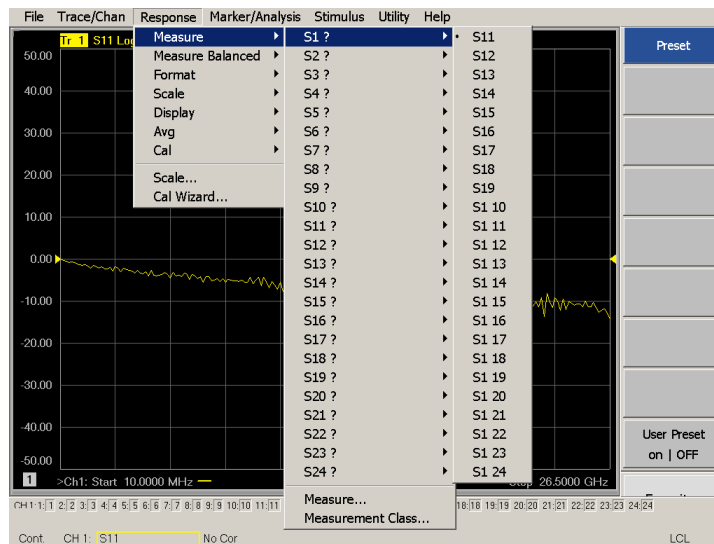
Selecting New S-Parameter Measurement

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 144 S-Parameters.

Figure 26   New S-Parameter Measurement
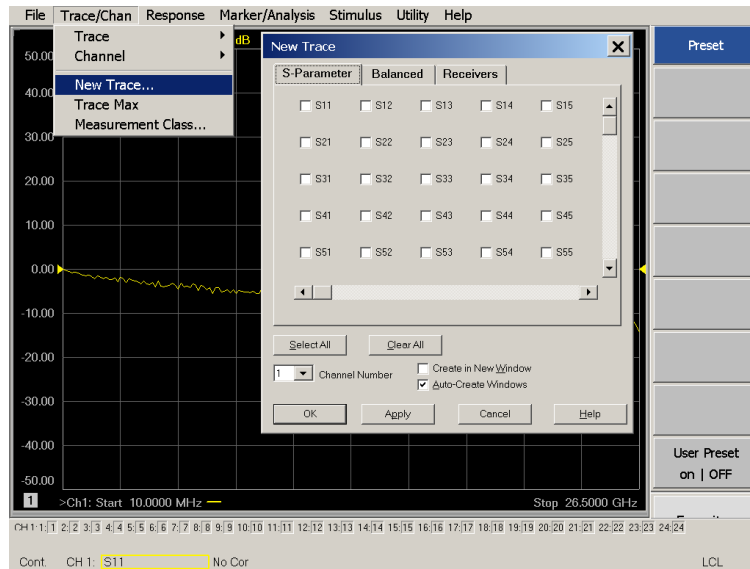
Balanced Tab

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 27   Selecting Balanced Measurements
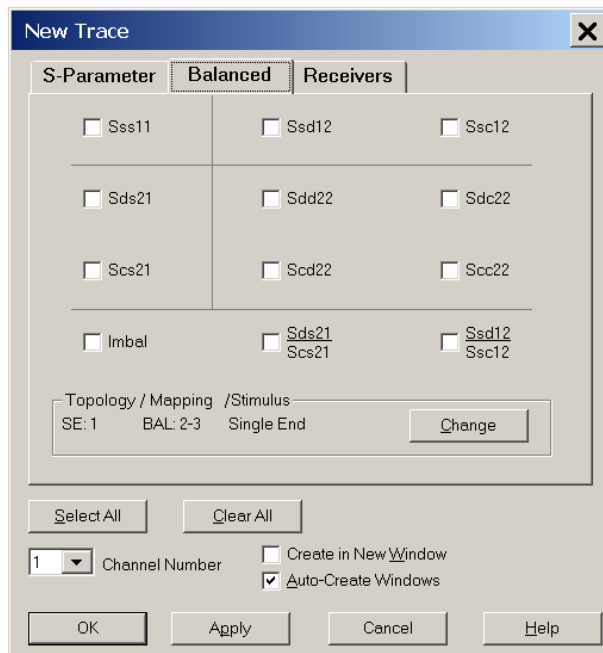
Receivers Tab

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

Figure 28   Receiver Measurements
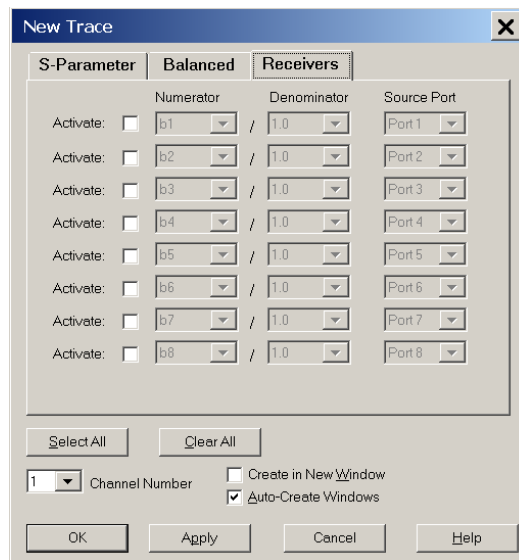
N-Port Calibration

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 (85131F) if you are calibrating at 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–
(Response > 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 network analyzer. Measurement errors can be a result of firmware algorithms. Consult with Keysight Service or firmware web page for the latest PNA-X Option 551 firmware revisions and history.
http://na.support.keysight.com/pna/firmware/firmware.html

Figure 29   ECal Characterization and Calibration Wizard
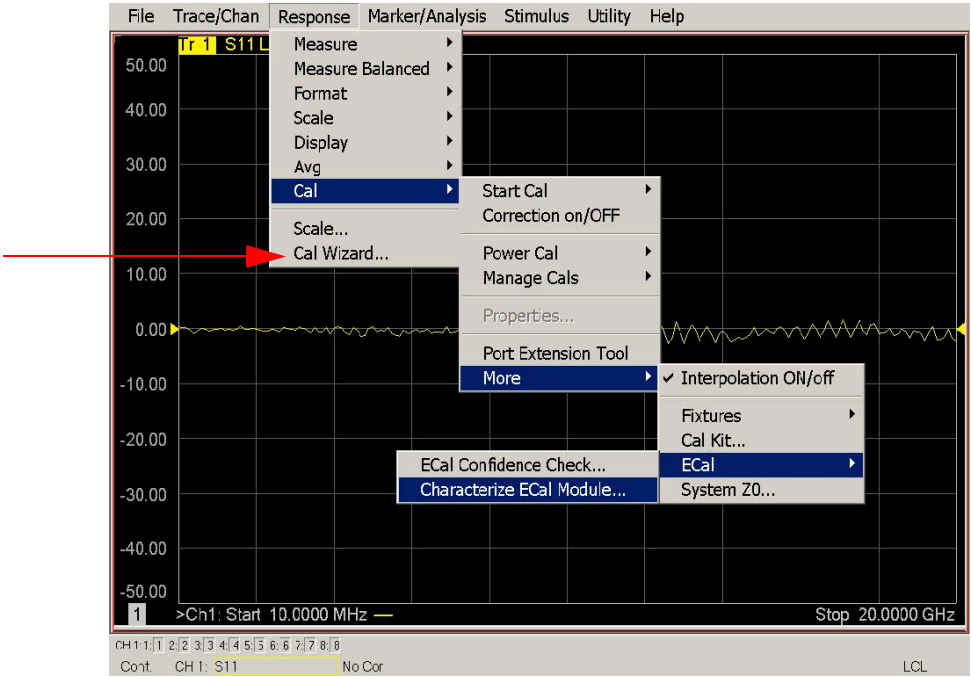
NOTE   If the analyzer has Option 029 or H29 (noise figure capability), verify that the path configuration is set to Default. If it is not in Default configuration, ports 5 and 9 will not operate correctly.
Select **Trace/Chan > Channel > Hardware Setup > Path Config...** –OR– *(Instrument > Setup > Internal Hardware > 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.

Figure 30   RF Path Configuration
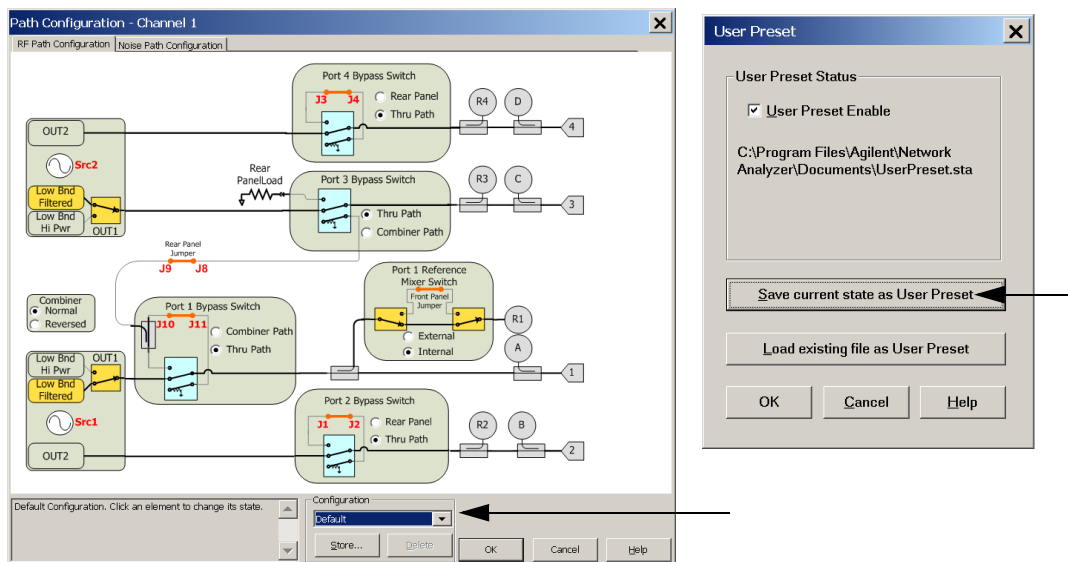
1. On the analyzer select **Response > Cal Wizard** –OR–
   (Response > Cal > Other Cals).

   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) > Nex**t –OR–
      (Response > Cal > Other Cals > ECals...).

Figure 31   Begin Calibration
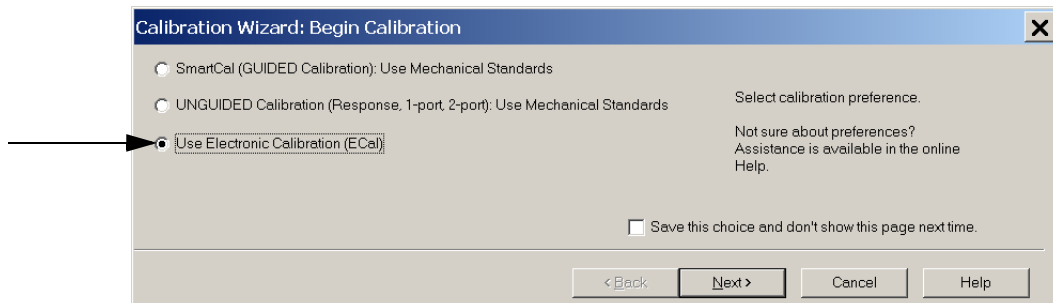
2. Continue following the Cal Wizard prompts. In the "Select Calibration
   Ports and ECal Module" dialog box press Select All, or select the ports you
   are calibrating and press Next. If an ECal characterization has been done,
   select View/Select ECal Module and select the previously saved user file
   from See "On the analyzer select Response > Cal Wizard." on page 39.

Figure 32   24-Port Calibration
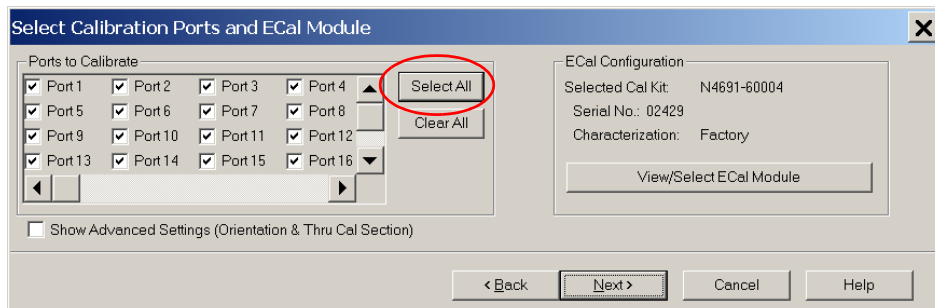
3. Connect the ECal or the mechanical cal kit to the ports you are calibrating
   following the Cal Wizard prompts and click Measure after each connection.
   The electrical delay value may be shown in the dialog box after the last
   measurement, click OK.

4. At the Calibration Completed prompt, select Save As User Calset and type
   the name desired and Save. See Figure 44 on page 63.

5. 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 firmware revisions and history.
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.

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 needing to create a remote program. Refer to PNA Help menu, "Rear Panel Tour."

— 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 PNA 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 Settings

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

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**.

<div>
NOTE
</div>

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 33   Enable Interface Control
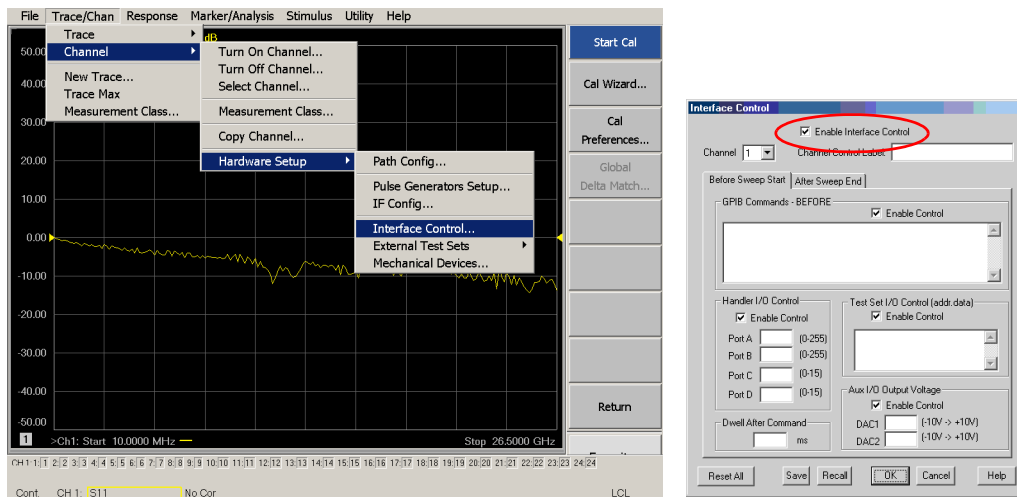
Using Interface Control Mode

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

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 34   Interface Control
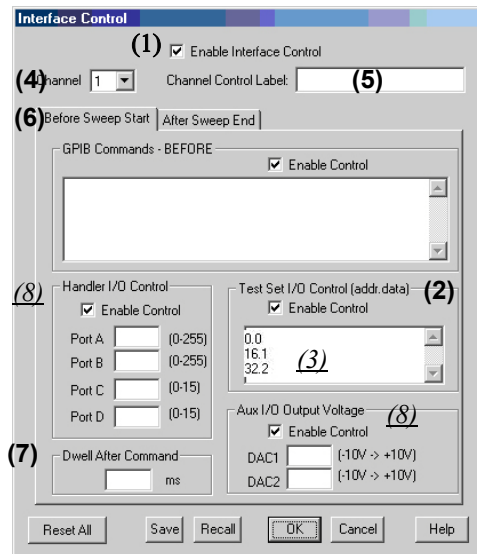
Enable Interface Control: (1)
Enables and disables ALL Interface Control communication. When cleared (default setting) Interface Control is disabled and NO data is sent. To send data, the individual interfaces must also be enabled.

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 47.

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 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).

2. Check the **SCPI Command Console** box –OR– *(Show SCPI Parser Console)* box.

Figure 35   Command Console for 'A' Model Analyzers
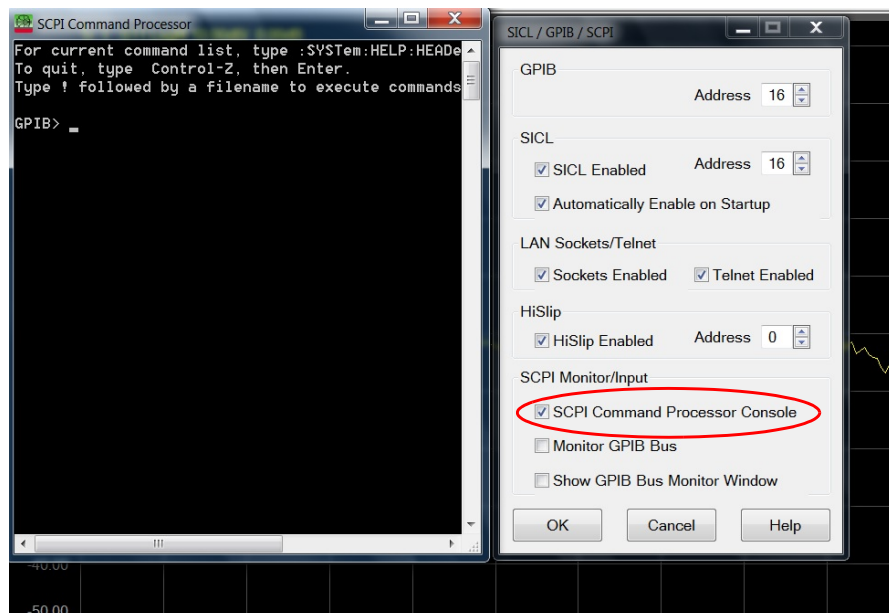
Figure 36   Command Console for 'B' Model Analyzers
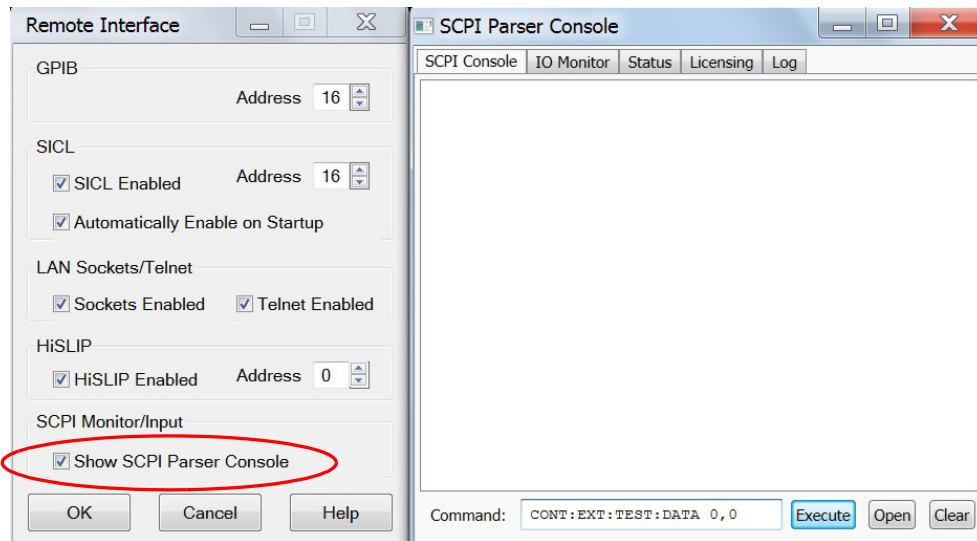
SCPI Command Processor Console

Write Commands

Once the Command Processor Console is open, commands can remotely control the external test set I/O connector by sending the following:

address: an integer number
data: an integer number

Address and data 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
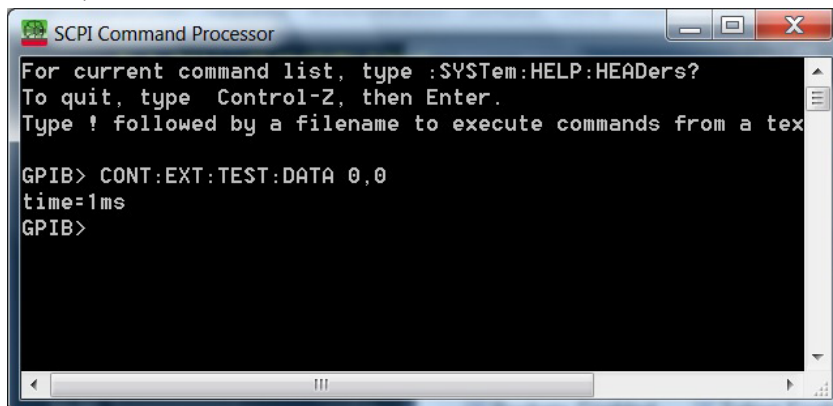
Refer to "Address and Data Values" on page 47.

Address and Data Values

Setting the Test Port Paths with Address and Data

Refer to Table 9, Table 10, Table 11 on page 48 and Figure 37 on page 49 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 41 and in "SCPI Control Mode" on page 45.

Example 1: Refer to Figure 37 on page 49.

If the ports have different addresses, two separate address data commands must be used.

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 0.1 in one command line, and 16.16 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 0 and Receiver Port 5 = address 0, data 16. The data values are added together, the entry will be 0.16.

Example 3: (Option 129) Refer to Figure 38 on page 50.

Port 9 is the Source and Ports 5 is the Receiver.

Noise Source Port 5 = address 0, data 9, and Receiver Port 9 = address 0, data 16.

Two separate commands must be sent, you may use the same dialog box. The entry will be 0.9 in one command line, and 16.16 in the second line.

Table 9   N52x2A Port Address and Data Values for STD.

Address		Source Path						Receiver Path					
	Data	0	1	2	3	4	5	0	16	32	48	64	80
0	Ports	1	5	9	13	17	21	1	5	9	13	17	21
16	Ports	3	6	10	14	18	22	3	6	10	14	18	22
32	Ports	4	7	11	15	19	23	4	7	11	15	19	23
64	Ports	2	8	12	16	20	24	2	8	12	16	20	24

Table 10   Analyzer Port Address and Data Values for STD.

Address		Source Path						Receiver Path					
	Data	0	1	2	3	4	5	0	16	32	48	64	80
0	Ports	1	5	9	13	17	21	1	5	9	13	17	21
16	Ports	2	6	10	14	18	22	2	6	10	14	18	22
32	Ports	3	7	11	15	19	23	3	7	11	15	19	23
64	Ports	4	8	12	16	20	24	4	8	12	16	20	24

Table 11   Analyzer Port Address and Data Values for Option 129

Address	Data	Description
0	0	Selects STD Source Path to Port 1[1]
0	8	Selects Noise Source IN and OUT paths for Port 1 (Sx1)
0	9	Selects Noise Source IN and OUT paths for Port 5 (Sx5)
0	10	Selects Noise Source IN and OUT paths for Port 9 (Sx9)
0	11	Selects Noise Source IN and OUT paths Port 13 (Sx13)
0	12	Selects Noise Source IN and OUT paths for Port 17 (Sx17)
0	13	Selects Noise Source IN and OUT paths for Port 21 (Sx21)
0	8	Selects Noise Source IN and OUT paths and Receiver for Port 1 (S11)
0	25	Selects Noise Source IN and OUT paths and Receiver for Port 5 (S55)
0	42	Selects Noise Source IN and OUT paths and Receiver for Port 9 (S99)
0	59	Selects Noise Source IN and OUT paths and Receiver for Port 13 (S1313)
0	76	Selects Noise Source IN and OUT paths and Receiver for Port 17 (S1717)
0	93	Selects Noise Source IN and OUT paths and Receiver for Port 21 (S2121)

1. See standard Source Paths in Table 9 for Ports 5, 9, 13, 17 and 21.

Refer to "System Block Diagrams" on page 70 for in-depth RF path information.

Figure 37   Example 1   U3042AM20 Standard Block Diagram
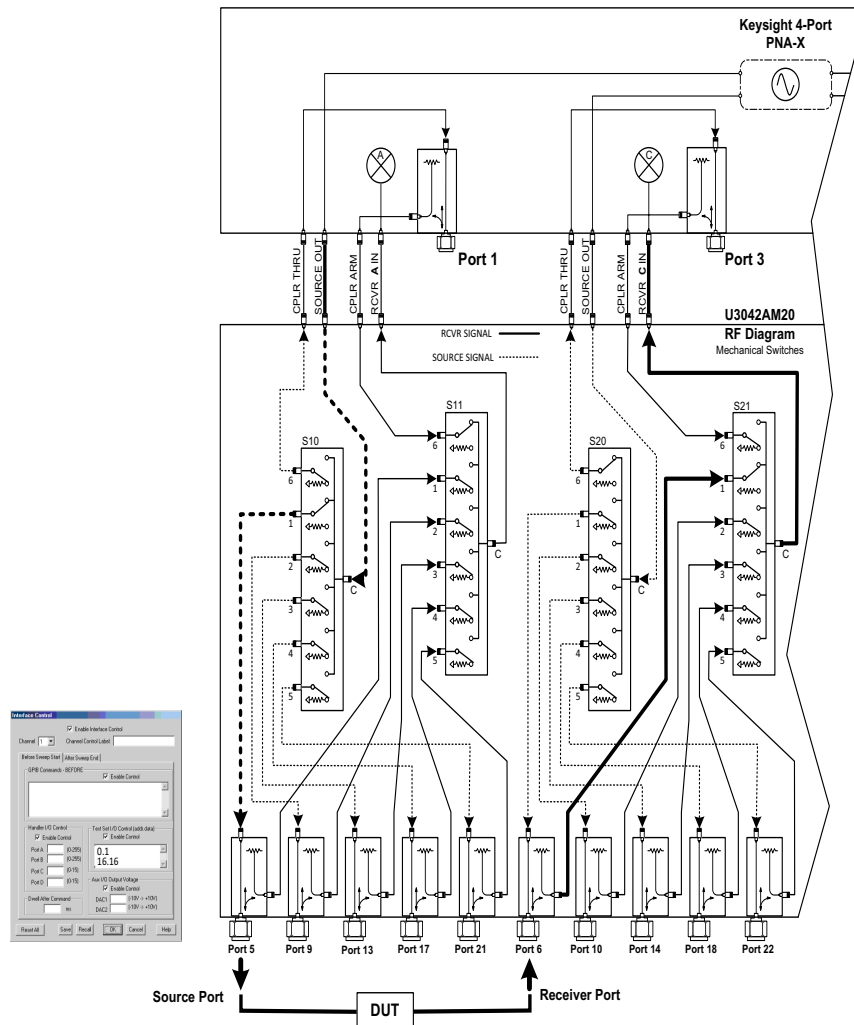
Figure 38   Example 3   U3042AM20 Option 129 Block Diagram
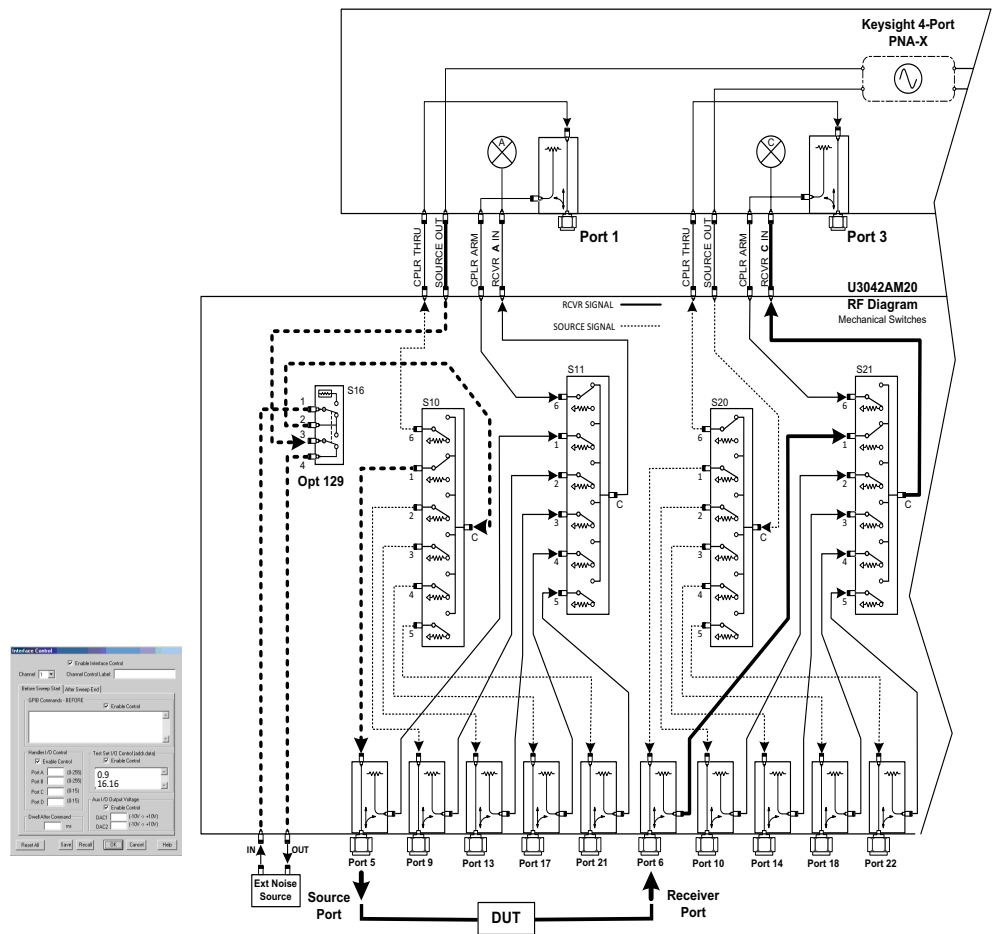
Option 129 External Noise Source

The U3042AM20 with Option 129 allows an external ECal module, or noise source to be switched into the Source path of Ports 1, 5, 9, 13, 17 or 21. Only one port can be the active source. The front panel EXT NOISE SOURCE IN is switched to the Output port, and the front panel EXT NOISE SOURCE OUT is switched to the Test Set SOURCE IN (connected to the PNA-X SOURCE OUT with a jumper cable) when the command is sent. Refer to Table 11 on page 48 and Figure 38 on page 50.

System Configuration

Figure 39 illustrated the PNA-X with the Test Set and N4691B Option MOF (ECal module) installed. The cable (U3042-20076) provided with Option 129 is intended to be used with the N46xx series ECal modules. The ECal module with Option M0F is recommended.

1. Connect the ECal module to the Test Set EXT NOISE SOURCE IN.

2. Connect the cable (U3042-20076) from the Test Set EXT NOISE SOURCE OUT to the ECal module.

3. Connect the ECal modules USB cable to one of the PNA-X USB ports.

Figure 39   N5242A System with ECal Module

USB Cable

N4691B

U3042–20076
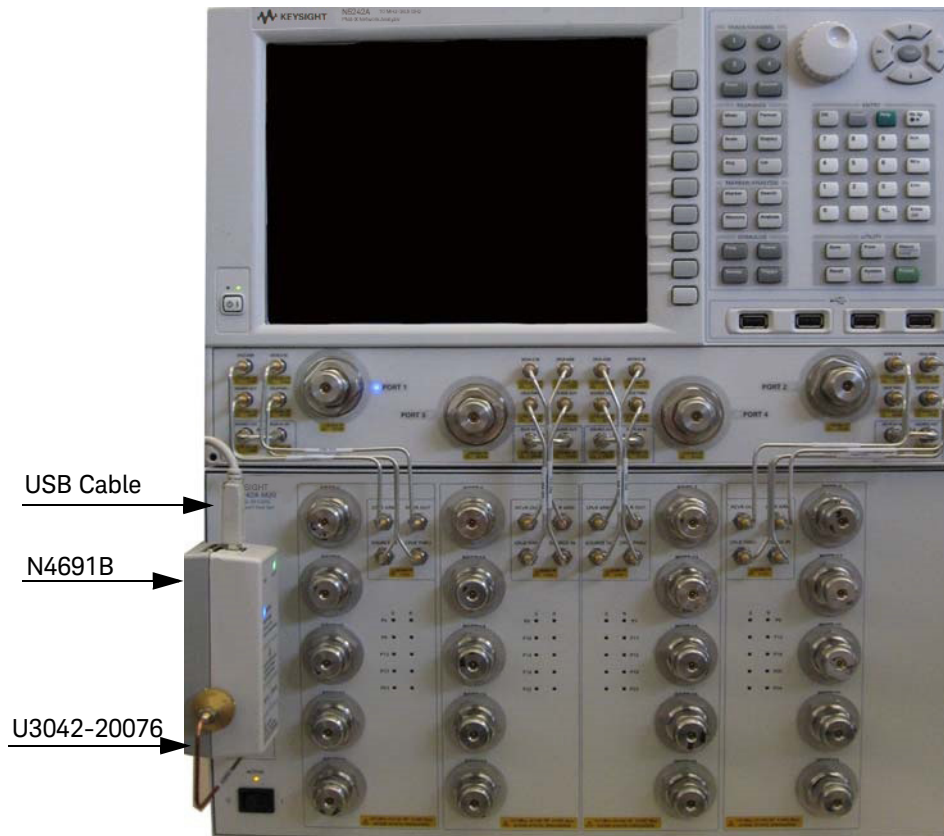
Setting Option 129 Source Path

1. Restart the PNA to Standalone Mode, if it is in Multiport Mode. Refer to Figure 23 on page 32.

2. Send command 0.0 and [Preset] the PNA-X.

3. Refer to "Interface Control Mode" on page 41. Use the values listed in Table 12 to set Port 1, 5, 9, 13, 17 or 21 as the noise source path.

| NOTE | The Test Set will not operate in multiport mode. Interface or GPIB control is required to set the Noise Source Path. |

Table 12   Option 129 Source Path Test Set I/O Commands

Address.Data	Source Path
0.0	Standard Port 1 (Option 129 is not enabled)
0.8	Noise Source Port 1
0.9	Noise Source Port 5
0.10	Noise Source Port 9
0.11	Noise Source Port 13
0.12	Noise Source Port 17
0.13	Noise Source Port 21

| NOTE | An 8 is added to the Data Value to activate the Option 129 switch, as indicated in Table 12. |

Control Lines

The 15 pin female D–Sub connector on the rear 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 33 and "Setting the Test Port Paths with Address and Data" on page 47. See Table 13 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 40 and Table 14 on page 55 for control line pin location and description. Refer to "Internal Voltage Supply Configuration" on page 56 and "External Voltage Supply Configuration" on page 57 for configurations.

Table 13   DUT Control Specifications

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

Figure 40   DUT Control Line Pin Assignment (rear panel view)
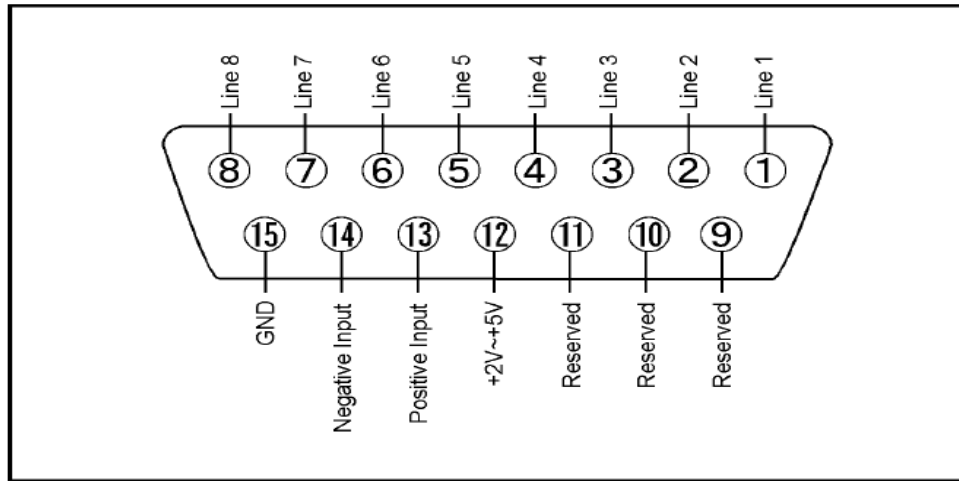
Table 14   DUT Control Line Interface Connector Pin Assignment

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 41 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 41　　　　　　Internal DC Power Configuration (rear panel view)
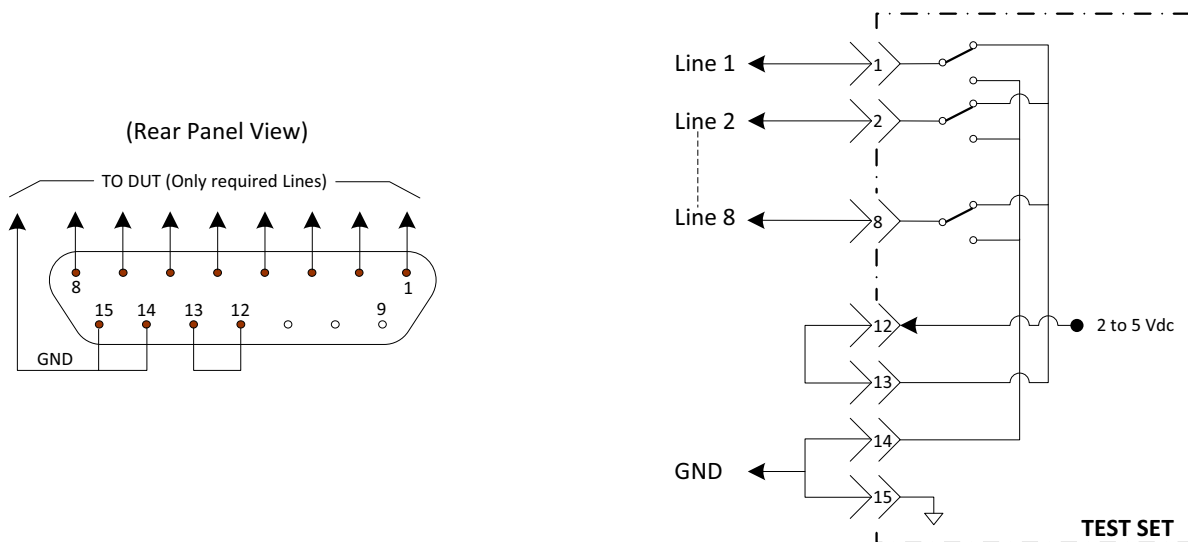
External Voltage Supply Configuration

Figure 42 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 Off 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 42   Test Set to the DUT and External DC Power Supply
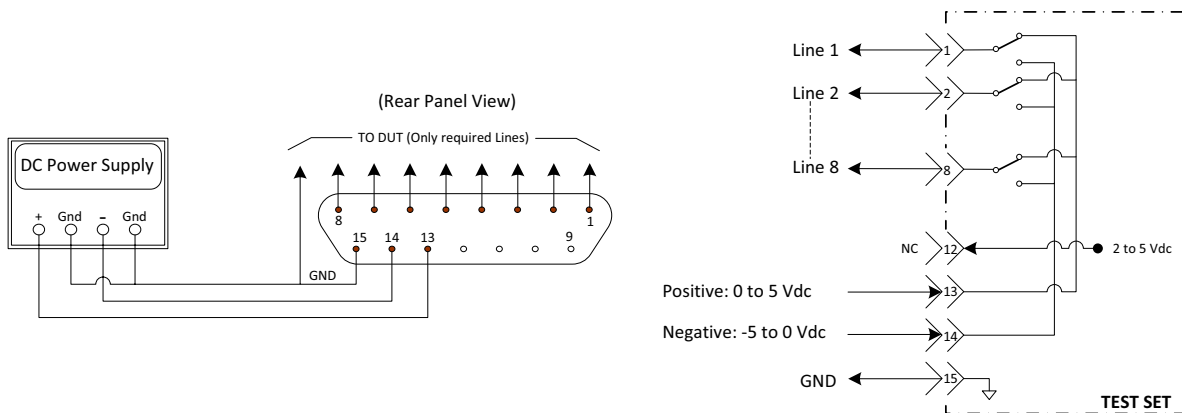
Setting the Control Lines with Address and Data Values

This section describes how to control the DUT control lines. Refer to **"Control Lines" on page 54**.

Setting the PNA 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 47**, the <address>.<data> values are determined in a similar manor, with the following exceptions:

— **Table 15** will be used.

— The <address> value is always = 112

All DUT control lines remain in a high logic state until set by the address data 0 = logic high. All control lines are set by the sum of the data sent to the Test Set.

Example: To set control line 1 and 8 to a low state send command 112.129 (1 + 128). All other lines remain in a high state.

Table 15   Test Set DUT Control Address and Data Logic Table

Address	Data	Description	Pin
112	0	ALL the Control Lines set to logic high	13
112	255	ALL the Control Lines set to logic low	14
112	1	DUT Control Line 1 set to logic low	1
112	2	DUT Control Line 2 set to logic low	2
112	4	DUT Control Line 3 set to logic low	3
112	8	DUT Control Line 4 set to logic low	4
112	16	DUT Control Line 5 set to logic lowe	5
112	32	DUT Control Line 6 set to logic low	6
112	64	DUT Control Line 7 set to logic low	7
112	128	DUT Control Line 8 set to logic low	8

Cal Kit Operational Check

The following procedure can be used to confirm that the test set and network analyzer are operational. The operation verification limits provided ensure that your test set and network analyzer is operating properly. Refer to "General Specifications" on page 6.

Verification Limits

Specifications for the Test Set are typical. 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 PNA-X 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.

Table 16   N5242A Operation Verification Limits for Reflection Tracking[1]

Frequency	Port 1-24
10 MHz to 4 GHz	−8 dB
4 GHz to 6 GHz	−9 dB
6 GHz to 10 GHz	−10 dB
10 GHz to 15 GHz	−12 dB
15 GHz to 20 GHz	−14 dB
20 GHz to 26.5 GHz	−15 dB

1. Reflection Tracking takes into account Source Loss, Receiver Loss, Margin, and PNA-X Mixer Cal.

NOTE   If you suspect that your 24-Port configuration is not operating properly, ensure that all front RF jumper interconnect cables are correctly attached.

Equipment Required

The U3042AM20 requires that the user be familiar with the equipment and components listed.

Table 17   Equipment List

Description	Qty
N4691A 3.5 mm ECal Module 10 MHz - 26.5 GHz (Option 00F or M0F) or N4691B 3.5 mm ECal Module 300 kHz - 26.5 GHz (Option 00F or M0F) or Mechanical cal kit 85052B or 85052D	1
N5242A Option 400 and 551	1
Set of interconnect cables (PNA-X and Test Set), see **"N5222A and N5242A RF Interface Cable Connections (U3021-60077)" on page 22**.	1

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.

Preparing the N5242A

1. Connect the Test Set to the 4-Port PNA-X using the interconnect cables as shown in Figure 16 on page 23 and Table 7 on page 22.

2. Turn On the Test Set.

3. On the PNA-X, select **Response > Cal > Manage Cals > Cal Set**. Delete or Rename any Cal Sets titled "999.1" thru "999.24" (24-Port), although it is unlikely that you will find Cal Sets with these names.

4. Verify that the PNA-X is in 24-Port. See the bottom of the measurement window.

   a. If only four S-Parameters are listed, select
   Utility > System > Configure > Multiport Capability -OR-
   (Instrument > Setup External Hardware > Multiport > Multiport Configuration...). Select **Restart as multiport PNA with this test set** and select **U3042AM20 (24-Port)** from the drop-down menu > **OK**. Refer to Figure 23 on page 32.

5. Press **Preset**.

6. Verify that the **[Start Frequency]** is set to **[10 MHz]**.

7. Verify that the **[Stop Frequency]** is set to **[26.5 MHz]**.

8. Verify that the **[Power]** is to set to **[–5 dBm]**. If not, select **[Power]** > **Power Level** and enter **[–5 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 PNA-X USB port on the front or rear panel. Refer to Figure 16 on page 23. This procedure assumes you are using a ECal. If you are not, see "1-Port Calibration and Verification Procedure" on page 62, See "Perform a 1-Port Calibration on Port 1. On the analyzer, select Response > Cal > Start Cal > Calibration Wizard." on page 62.

12. Allow the ECal module, Test Set and PNA-X 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 press **Clear All**, then select **Port > Next
   > Measure**.

4. Ensure the Cal Kit you are using is indicated on the right side of the dialog box.

Figure 43   1-Port Calibration
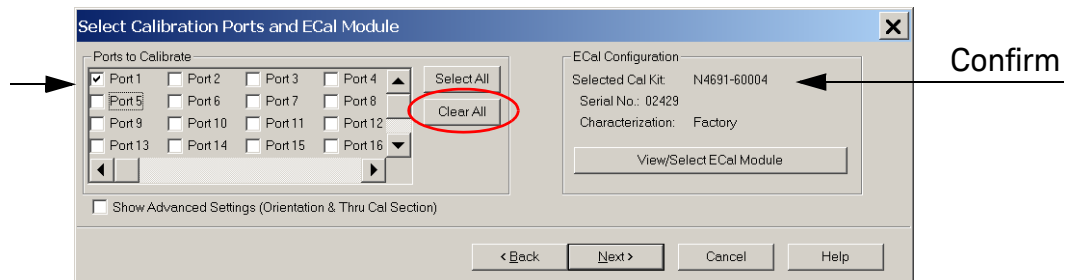
5. Continue to follow the prompts until the "Calibration Completed" dialog box appears.

6. At the Calibration Completed prompt, select **Save As User Calset** and type the name **999.1**. Overwrite the Calset if it already exists and **Save**.

NOTE   If you do not have a keyboard, 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 PNA-X front panel to enter "999.1."

Figure 44   Calibration Complete
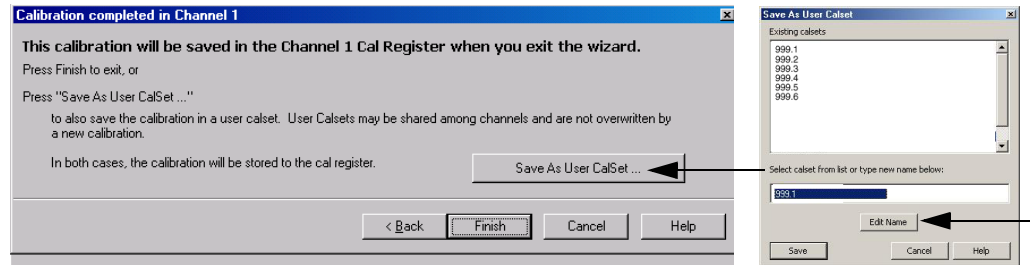
7. Repeat See "Connect the ECal or the mechanical cal kit to Port 1 or the port you are testing. Torque to 8 in-lb. For further information, refer to the Help menu" on page 62. thru See "At the Calibration Completed prompt, select Save As User Calset and type the name 999.1. Overwrite the Calset if it already exists and Save." on page 62. (1-Port Calibration Procedure) for Ports 2 thru 24. When finished, there should be 24 Cal Sets saved with the titles "999.1" thru "999.24" (24-Port).

    If you are using an ECal module you can verify the individual port calibration by selecting **Response > Cal > More > ECal > ECal Confidence Check**. Click **Change Measurement** and select the test port **S-Parameter > Apply > OK > Read Module Data**. For further information refer to the Help menu.

8. Select **Trace/Chan > Trace > Delete Trace**. There should be no traces on the analyzer's display. If traces are listed, select each individually and delete **> OK**.

9. To launch the Cal Set Viewer toolbar. Select **Response > Cal > Manage Cals > Cal Set Viewer**.

Figure 45   Calibration, Cal Set Viewer
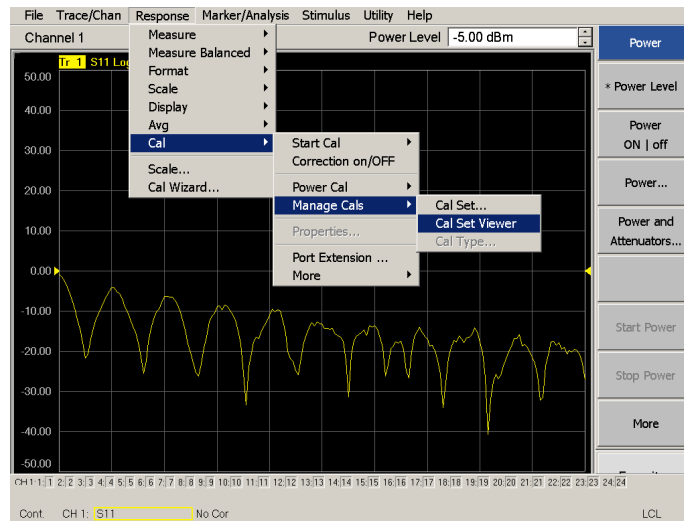
10. From the Cal Sets drop-down menu, select **999.1** and select **Enable**. Select the **Reflection Tracking(x,x)**, where x,x is the port being tested, term in the center drop-down menu and ensure that the Enable and Error Terms are selected.

11. Compare the Reflection Tracking (1,1) trace to the appropriate limits in Table 16 on page 59. Use the Marker function to measure trace values. The trace should be similar to Figure 46 on page 65.

12. Repeat step 10 above. Compare the Reflection Tracking (1,1) trace to the appropriate limits in Table 16 on page 59. Use the Marker function to measure trace values. The trace should be similar to Figure 46 on page 65 for Cal Sets "999.1" thru "999.24" (24-Port).

| 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 46   Standard Reflection Tracking Trace (Port 1 to 4) with PNA–X
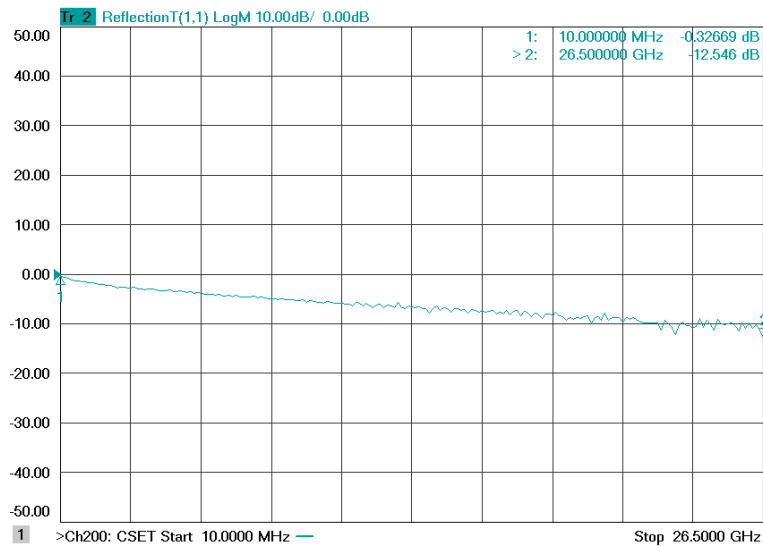
Figure 47   Standard Reflection Tracking Trace (Port 5 to 24) with PNA–X
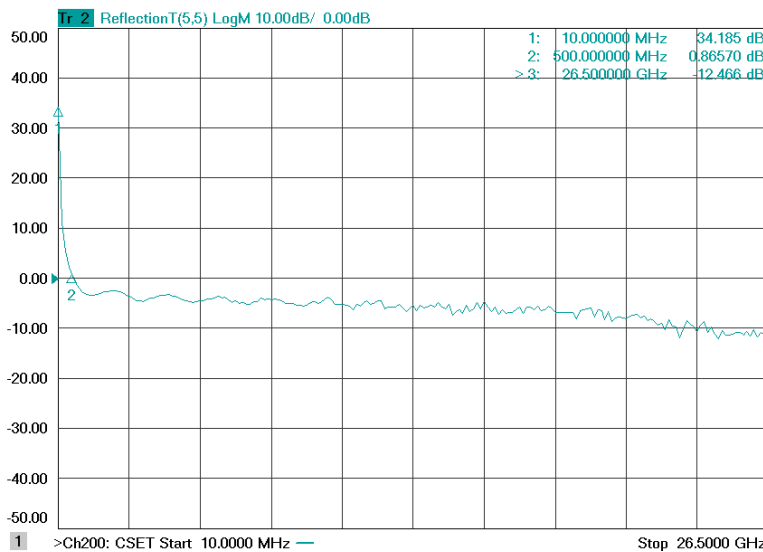
Verifying Cal Kit Operational Check Failures

If your test results fail the Operational Check limits, see Table 5 on page 9 and verify following:

1. Ensure that the test set is turned on and connected properly to the analyzer.

2. Check all appropriate connectors for damage, cleanliness, and proper torques.

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 4

ECal Confidence Check

The following ECal Confidence Check is a method the verify the accuracy of a 1-Port calibration performed with 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 an 1-Port Cal of the test set port being tested.

2. Connect the ECal Module to the Port being verified. Terminate any remaining ports on the ECal module.

3. Select the Cal Set to be verified. Select
   [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. Click Change Measurement and select the test port S-parameter **Apply > OK**. Click **Read Module Data**.

6. Select the ECal module you are using, and select **ECal Module Memory and Factory ID> OK**.

Figure 48   ECal Confidence Check
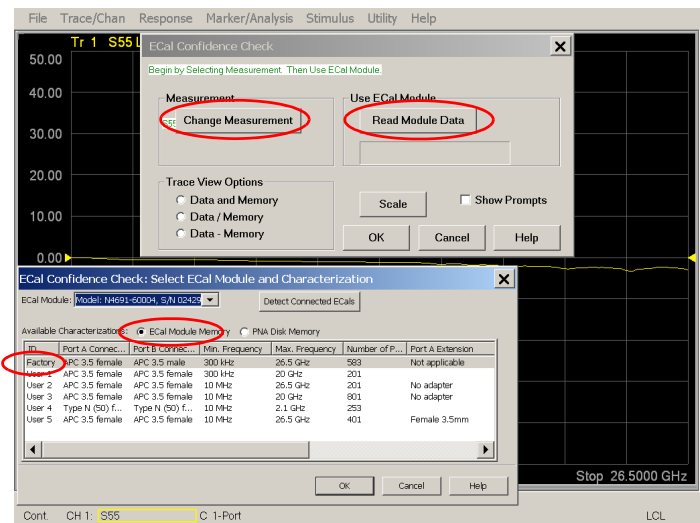
Service Information

This section provides information to troubleshoot and repair the test set. Refer to "Keysight Support, Services, and Assistance" on page 98 for information on returning your test set to Keysight Technologies.

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 "Find-A-Part" system on the web at http://www.keysight.com/my/faces/fapHomePage.jspx.

Table 18   Available Replacement Parts (SPO)

Description	Keysight Part Number
4-Port Terminated Latching Coax Switch with Opt 124, 026, 201, 302 and 403	N1811-60027[1]
Fuse (5 A 250 V non-time delay Socket	2110-0709
Fuse (8 A 250 V non-time delay 0.0146 Ohm	2110-0342
PWR Supply (AC/DC SWG 650W 9- Output	0950-4729
PNA-X Locking Feet	5023-0132
Coupler Bridge	5087-7716 or 5087-7752 RoHS
Test Set I/O Cable	N4011-21002
Fan (rear panel)	87050-60027
Switch, Multiport, SP6T, DC - 26.5 GHz	87106-60065
DUT Control Board	U3020-63223 (RoHS)

1. Instrument Option 129 only.

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   Replaceable Parts (M20)

Description	Keysight Part Number
Front Panel LED Board (programmed)	N5261-60005
Test Set Control Board (programmed)	N5261-60006
4-Port Terminated Latching Coax Switch with Options 124, 026, 201, 302 and 403	N1811-60027[1]
DUT Control Board (RoHS)	U3020-63223
SW Interface Board, programmed	U3025-60062
PNA or PNA-X Lock-link kit	U3021-60005[2]
PNA or PNA-X Cable kit	U3021-60077[3]
User's and Service Guide (Option M20)	U3042-90009

1. Instrument Option 129 only.
2. Refer to "Hardware Lock-link Installation (U3021-60005)" on page 16.
3. For individual cables refer to Table 7 on page 22.

System Block Diagrams

Figure 49   U3042AM20 RF Block Diagram
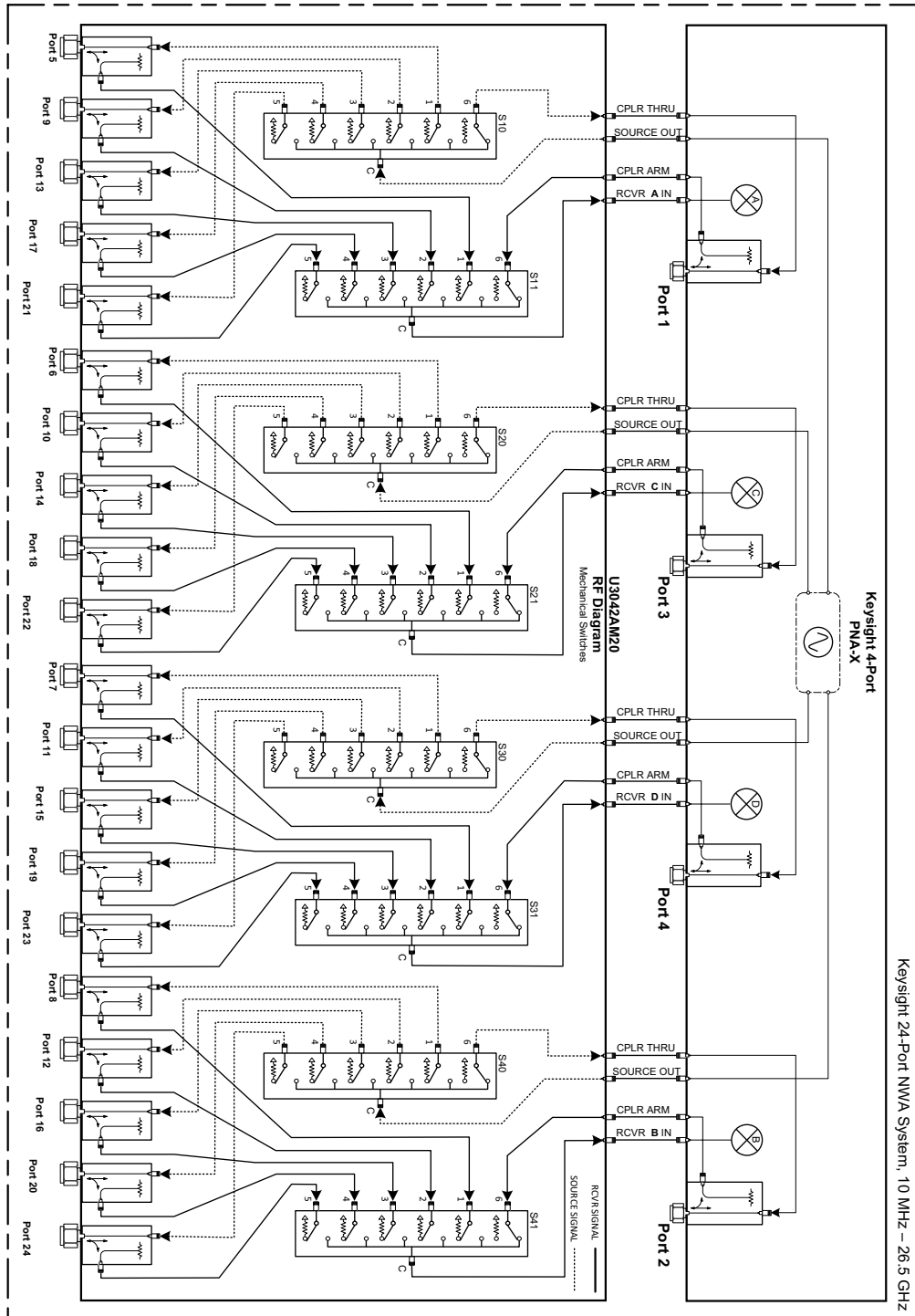
Figure 50   U3042AM20 Option 129 RF Block Diagram
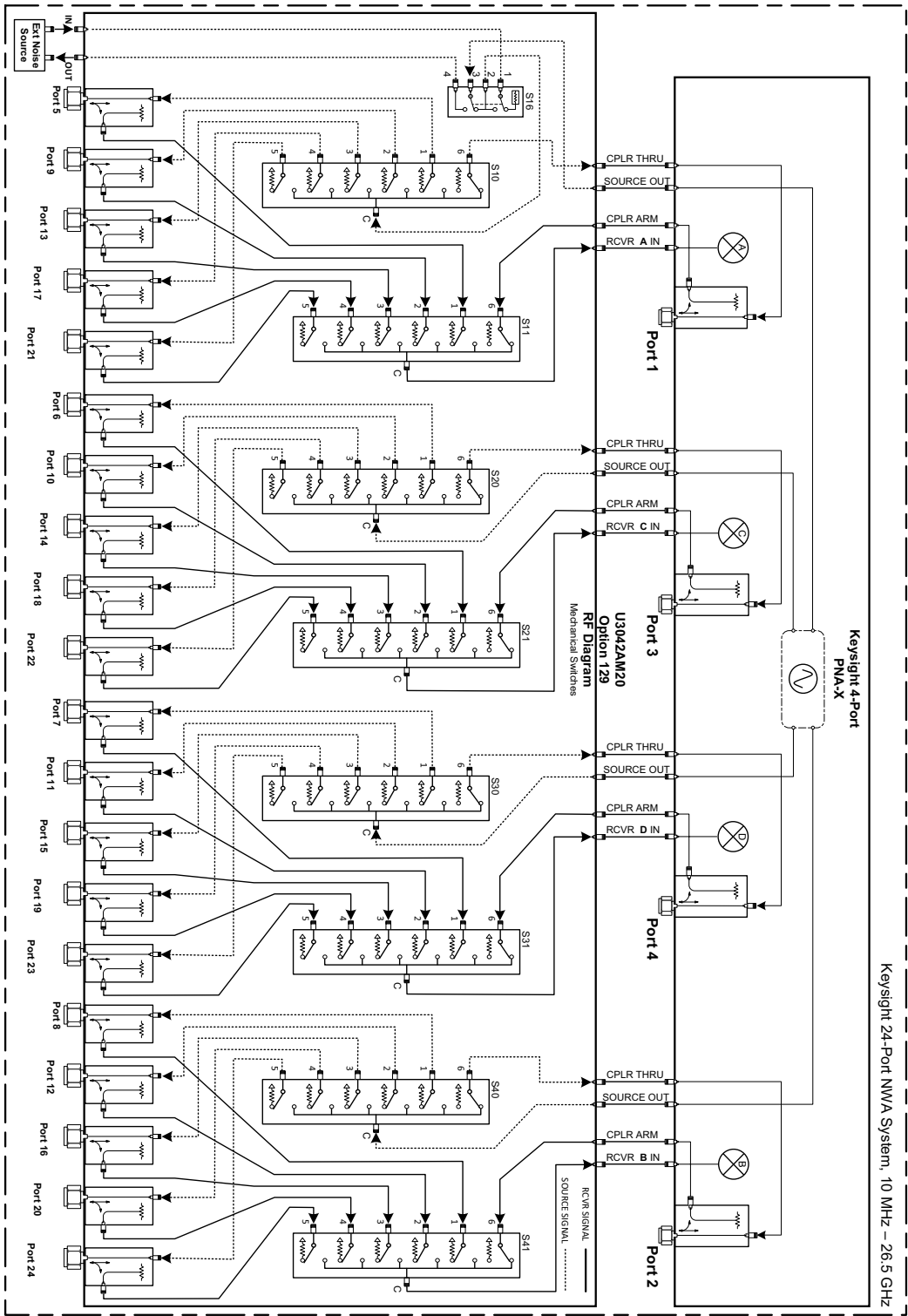
Theory of Operation

The following is a description of the operation of the Test Set. Reference the Test Set block diagrams shown in Figure 37 on page 49. This section assumes the user has a general understanding of couplers, switches, and network analyzers.

The module is a set of switches controlling source and receiver paths of the PNA port and five couplers in the column under the PNA port. There are four modules, one for each of the PNA ports and Test Set ports.

RF Coupler/Bridges

The Test Set uses twenty coupler/bridges (5087-7716 or 5087-7752 RoHS) on the front panel for RF Test Ports 5 - 24. 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 mechanical switches that have internal 50 Ω termination. The switches select the RF paths from the PNA-X source and receiver through interconnect cables to the Test Set. PNA-X Ports 1 thru 4 and Test Set Ports paths 5 thru 24. If your Test Set includes Option 129 an additional switch has been installed to provide the Ext Noise Source path to Port 1, 5, 9, 13, 17 or 21.

PNA-X Switch Paths

S10 - Source to Ports (1, 5, 9, 13, 17 and 21)

Switch 10 provides control of the Source Output path to PNA-X Port 1 and Test Set Ports 5, 9, 13, 17 and 21. In the state shown in the block diagram, switch 10 routes the RF Source back to the PNA-X Port 1, and the Test Set Source path to Port 5, 9, 13, 17 and 21 are terminated.

S20 - Source to Ports (3, 6, 10, 14, 18 and 22)

Switch 20 provides control of the Source Output path to PNA-X Port 3 and Test Set Port 6, 10, 14, 18 and 22. In the state shown in the block diagram, switch 20 routes the RF Source back to the PNA-X Port 3, and the Test Set Source path to Ports 6, 14, 18 and 22 are terminated.

S30 - Source to Ports (4, 7, 11, 15, 19 and 23)

Switch 30 provides control of the Source Output path to PNA-X Port 4 and Test Set Port 7, 11, 15, 19 and 23. In the state shown in the block diagram, switch 30 routes the RF Source back to the PNA-X Port 4, and the Test Set Source path to Ports 7, 11, 15, 19 and 23 are terminated.

S40 - Source to Ports (2, 8, 12, 16, 20 and 24)

Switch 40 provides control of the Source Output path to PNA-X Port 2 and Test Set Port 8, 12, 16, 20 and 24. In the state shown in the block diagram, switch 40 routes the RF Source back to the PNA-X Port 2, and the Test Set Source path to Ports 8, 12, 16, 20 and 24 are terminated.

S11 - Receiver to Ports (1, 5, 9, 13, 17 and 21)

Switch 11 provides control of the Receiver Input path to PNA-X Port 1 and Test Set Port 5, 9, 13, 17 and 21. In the state shown in the block diagram, switch 11 routes the Port 1 Coupler Arm to the Receiver, and Test Set Ports 5, 9, 13, 17 and 21 Coupler Arm path is terminated.

S21 - Receiver to Ports (3, 6, 10, 14, 18 and 22)

Switch 21 provides control of the Receiver Input path to PNA-X Port 3 and Test Set Ports 6, 10, 14, 18 and 22. In the state shown in the block diagram, switch 21 routes the Port 3 Coupler Arm to the Receiver, and Test Set Ports 6, 10, 14, 18 and 22 Coupler Arm path is terminated.

S31 - Receiver to Ports (4, 7, 11, 15, 19 and 23)

Switch 31 provides control of the Receiver Input path to PNA-X Port 4 and Test Set Ports 7, 11, 15, 19 and 23. In the state shown in the block diagram, switch 31 routes the Port 4 Coupler Arm to the Receiver, and Test Set Ports 7, 11, 15, 19 and 23 Coupler Arm path is terminated.

S41 - Receiver to Ports (2, 8, 12, 16, 20 and 24)

Switch 41 provides control of the Receiver Input path to PNA-X Port 2 and Test Set Port 8, 12, 16, 20 and 24. In the state shown in the block diagram, switch 41 routes the Port 2 Coupler Arm to the Receiver, and Test Set Ports 8, 12, 16, 20 and 24 Coupler Arm path is terminated.

S16 - Option 129 Ext Noise Source

Switch 16 provides control of the Ext Source Noise path to Port 1, 5, 9, 13, 17 and 21.

Troubleshooting the Test Set

If the test set is not operating properly, use the following procedures to aid in isolating the problem.

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 a listing of service centers worldwide, please visit us at www.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 52 on page 76.

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 Standby Switch.

   a. The rear panel Deck and Internal power supply fans should be operational. If not continue with See "AC Line voltage checks (remove AC power from the instrument)." on page 74..

3. 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 4 on page 12.

   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 60 on page 89.

| **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 being opened. |

U3042AM20
Troubleshooting the Test Set

4. 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 bottom 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 51 on page 75.

> **NOTE** LEDs indicators for +9 and −10 Vdc are off.

Figure 51 DC Power Status LEDs
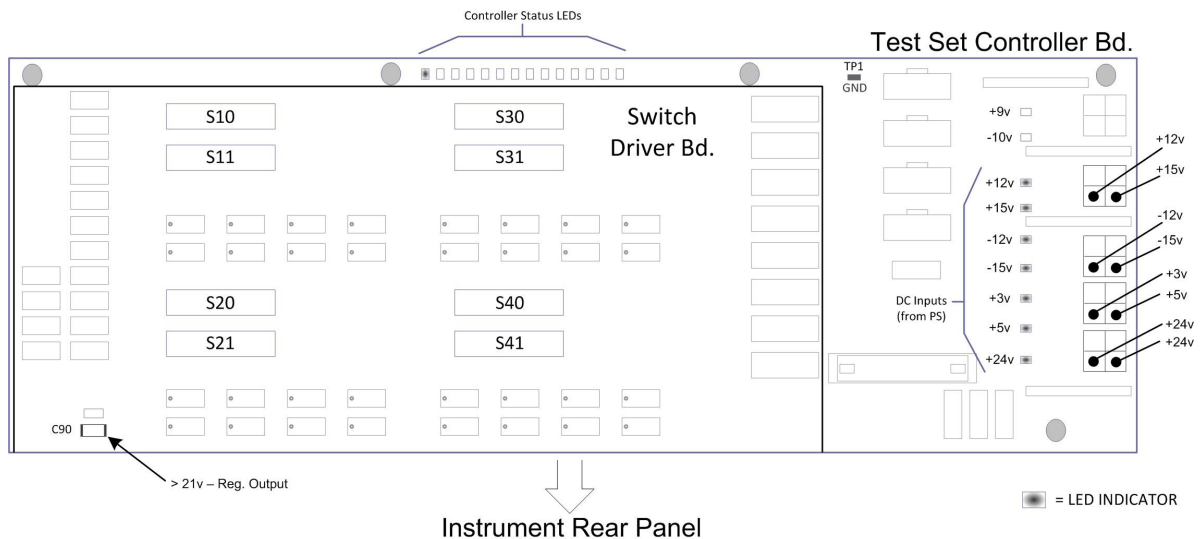
    d. If the DC Indicator LEDs are not on, suspect the main power supply module or front panel switch. The power supply (0950-4729) terminal connections should also be verified with a DVM. Verify the voltages on the power supply label.

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

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Figure 52   Test Set Diagram
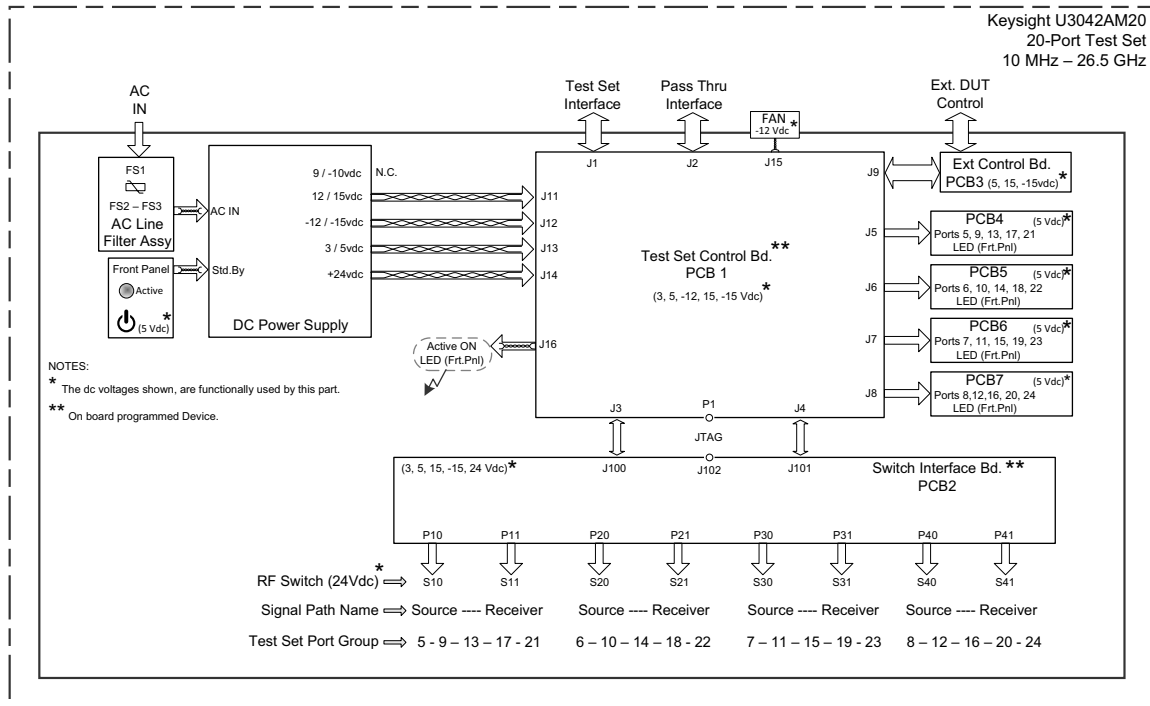
5. Front Panel R and S indicator LED Check.

   a. Verify the test set Controller board Controller Status LEDs, shown in Figure 51 on page 75.

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

   c. 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.

6. 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 54.

   b. Verify that the rear panel DC voltage control adjustment can be set to 5 Vdc. Refer to Figure 3 on page 11.

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 RF internal mechanical switches used in this instrument are biased with the +24 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 3 on page 11.

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 47.

4. 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.

Test Set and 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 rear panel.

— Remove the front panel RF interface cables and reinstall the analyzer's front panel jumper cables.

Equipment Required

— 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**. 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.

4. Connect the RF cables to the analyzer's Ports 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...** 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 PNA display. |

Table 20   RF Signal Path Insertion Loss (S21)

RF Path Description	Signal	Insertion Loss (typical)
Source IN to Ports 5-24	Source	Figure 53 on page 80
RCVR OUT to Ports 5-24	Receiver	Figure 54 on page 82
Source IN to CPLR THRU	Source	Figure 55 on page 83
RCVR OUT to CPLR ARM	Receiver	Figure 55 on page 83

Source and Receiver Path Tests

Refer to Table 21 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 53 on page 80 and Figure 54 on page 82.

Table 21   Source Signal Path Test Instructions (see Figure 53 on page 80)

Path #	RF Path Description	Control Mode <Address>.<Data>	Path Components
1	Source IN to Port 5[1]	0.1	P5 CPLR, S10
2	Source IN to Port 9	0.2	P9 CPLR, S10
3	Source IN to Port 13	0.3	P13 CPLR, S10
4	Source IN to Port 17	0.4	P17 CPLR, S10
5	Source IN to Port 21	0.5	P21 CPLR, S10
6	Source IN to Port 6	16.1	P6 CPLR, S20
7	Source IN to Port 10	16.2	P10 CPLR, S20
8	Source IN to Port 14	16.3	P14 CPLR, S20
9	Source IN to Port 18	16.4	P18 CPLR, S20
10	Source IN to Port 22	16.5	P22 CPLR, S20
11	Source IN to Port 7	32.1	P7 CPLR, S30
12	Source IN to Port 11	32.2	P11 CPLR, S30
13	Source IN to Port 15	32.3	P15 CPLR, S30
14	Source IN to Port 19	32.4	P19 CPLR, S30
15	Source IN to Port 23	32.5	P23 CPLR, S30
16	Source IN to Port 8	64.1	P8 CPLR, S40
17	Source IN to Port 12	64.2	P12 CPLR, S40
18	Source IN to Port 16	64.3	P16 CPLR, S40
19	Source IN to Port 20	64.4	P20 CPLR, S40
20	Source IN to Port 24	64.5	P24 CPLR, S40

1. Use the Source IN port associated with this group of test ports.

Figure 53   Source IN to Ports 5 to 24 Path Response (Std)
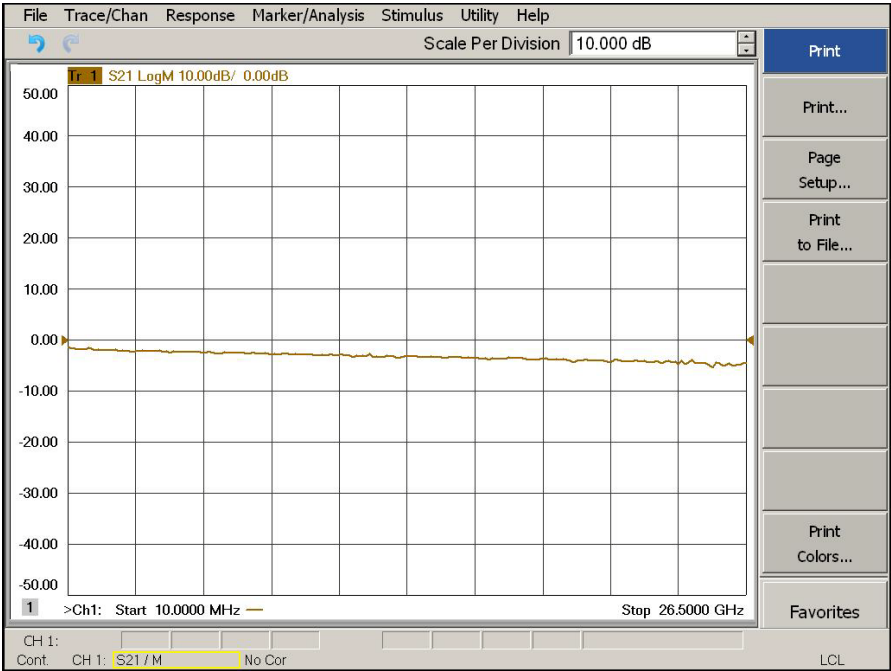
Table 22   Receiver Signal Path Test Instructions (see Figure 54 on page 82)

Path #	RF Path Description	Control Mode <Address>.<Data>	Path Components
1	RCVR OUT to Port 5[1]	0.16	P5 CPLR, S11
2	RCVR OUT to Port 9	0.32	P9 CPLR, S11
3	RCVR OUT to Port 13	0.48	P13 CPLR, S11
4	RCVR OUT to Port 17	0.64	P17 CPLR, S11
5	RCVR OUT to Port 21	0.80	P21 CPLR, S11
6	RCVR OUT to Port 6	16.6	P6 CPLR, S21
7	RCVR OUT to Port 10	16.32	P10 CPLR, S21
8	RCVR OUT to Port 14	16.48	P14 CPLR, S21
9	RCVR OUT to Port 18	16.64	P18 CPLR, S21
10	RCVR OUT to Port 22	16.80	P22 CPLR, S21
11	RCVR OUT to Port 7	32.16	P7 CPLR, S31
12	RCVR OUT to Port 11	32.32	P11 CPLR, S31
13	RCVR OUT to Port 15	32.48	P15 CPLR, S31
14	RCVR OUT to Port 19	32.64	P19 CPLR, S31
15	RCVR OUT to Port 23	32.80	P23 CPLR, S31
16	RCVR OUT to Port 8	64.16	P8 CPLR, S41
17	RCVR OUT to Port 12	64.32	P12 CPLR, S41
18	RCVR OUT to Port 16	64.48	P16 CPLR, S41
19	RCVR OUT to Port 20	64.64	P20 CPLR, S41
20	RCVR OUT to Port 24	64.80	P24 CPLR, S41

1. Use the Source IN port associated with this group of test ports.

Figure 54   RCVR OUT to Ports 5 to 24 Path Response (Std)
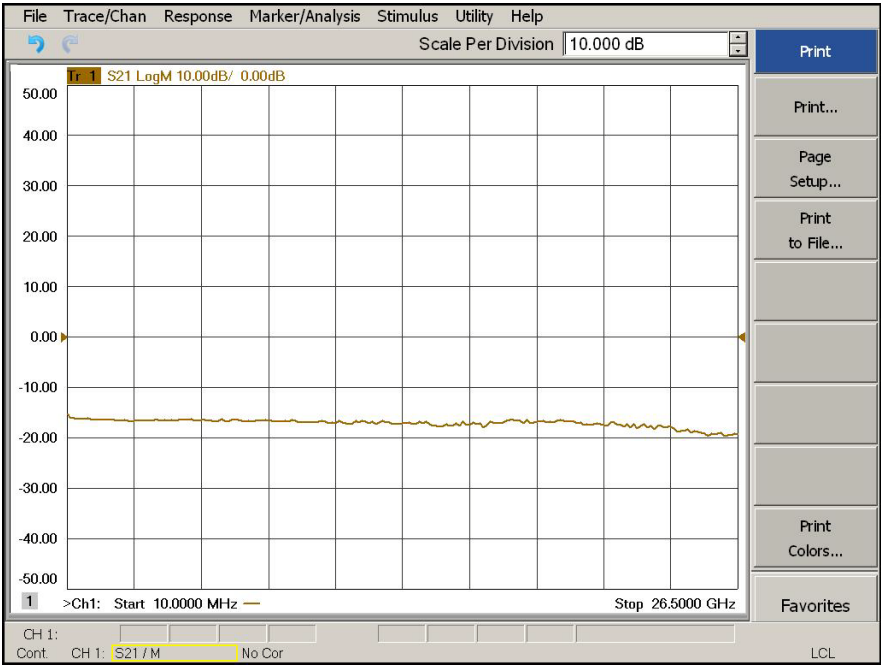
Table 23   Source Bypass Signal Path Test Instructions (see Figure 55)

Path #	Test Port Group	RF Path Description	Control Mode <Address>.<Data>	Path Components
1	Port 5	Source IN to CPLR THRU	0.0	S10
2	Port 6	Source IN to CPLR THRU	16.0	S20
3	Port 7	Source IN to CPLR THRU	32.0	S30
4	Port 8	Source IN to CPLR THRU	64.0	S40

Table 24   Receiver Bypass Signal Path Test Instructions (see Figure 55)

Path #	Test Port Group	RF Path Description	Control Mode <Address>.<Data>	Path Components
1	Port 5	RCVR OUT to CPLR ARM	0.0	S11
2	Port 6	RCVR OUT to CPLR ARM	16.0	S21
3	Port 7	RCVR OUT to CPLR ARM	32.0	S31
4	Port 8	RCVR OUT to CPLR ARM	64.0	S41

Figure 55   Source IN to CPLR THRU or RCVR OUT to CPLR ARM Path Response (Std)
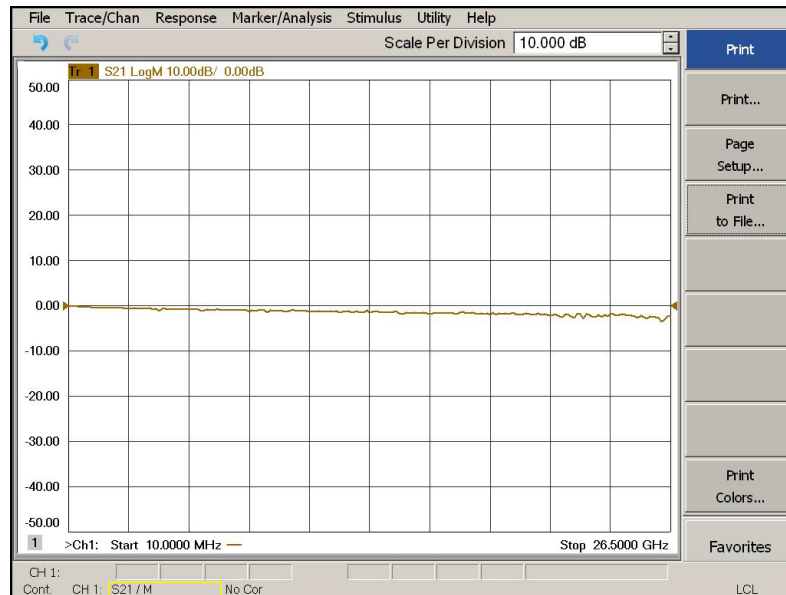
Option 129 Path Test

This test will verify the RF paths of Option 129 in standard mode. This measures the insertion loss of the Noise Source In to Port 1, 5, 9, 13, 17 or 21 and the Noise Source Out to CPLR THRU.

Noise Source In Test

Ext Noise Source In to CPLR THRU

1. Set the PNA to Standalone Mode.

2. Remove all of the interface cables.

3. Connect two RF test cables to the Ports 1 and 2 on the analyzer, and connect the two cables together using an adapter.

4. Perform a Response Calibration to normalize and remove the loss created by the test cables.

5. Move the adapter to Port 5.

6. Connect the cable from Port 1 to Noise Source In.

7. Connect the cable from Port 2 to CPLR THRU (near Port 5).

8. Send the Test Set I/O command 0.8.

9. Set trace S21 and verify that the trace is similar to Figure 56 on page 85.

Ext Noise Source In to Ports 5, 9, 13, 17 and 21

10. Repeat for Port 5, 9, 13, 17 and 21. Refer to Table 25 for Test Set I/O command to be sent. Verify that the LED for the port being tested is illuminated. Verify that the trace is similar to Figure 57 on page 85.

Table 25   Address and Data Port Commands

Command	Port
0.8	CPLR THRU
0.25	Port 5
0.42	Port 9
0.59	Port 13
0.76	Port 17
0.93	Port 21

Figure 56   Ext Noise Source In to CPLR THRU Path Response
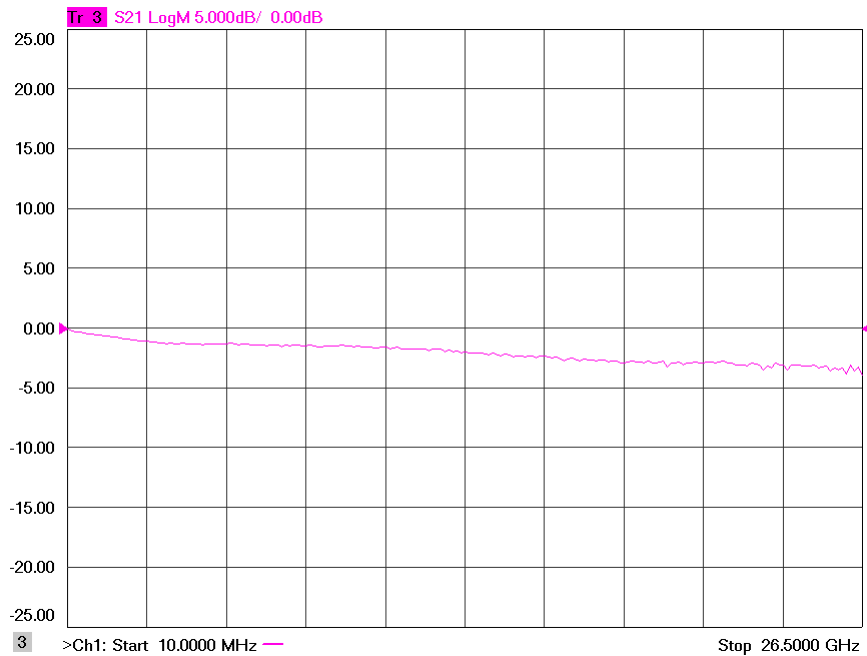
Figure 57   Ext Noise Source In to Ports 5, 9, 13, 17 or 21 Path Response
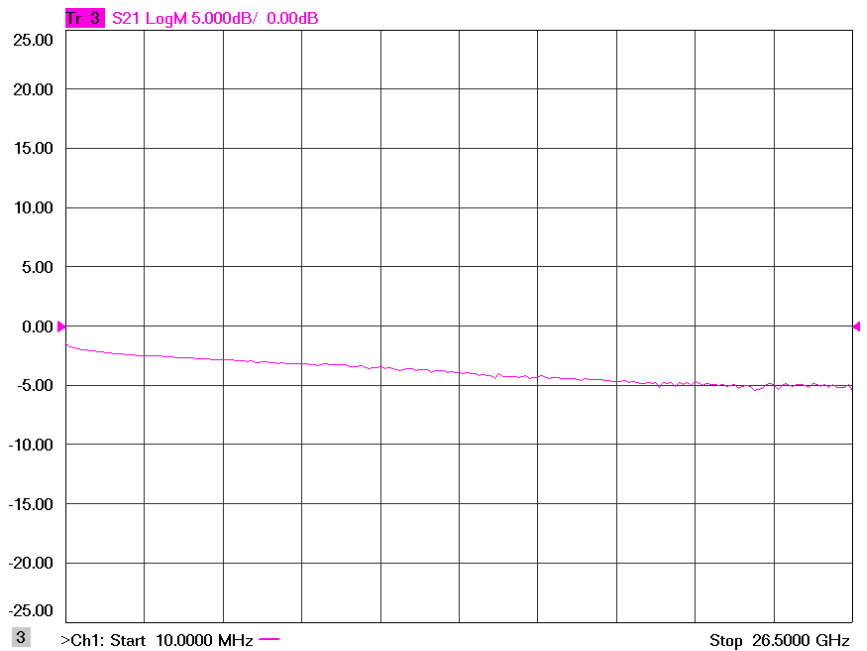
Noise Source Out Test

Ext Noise Source Out to Source In (near Port 5)

1. Set the PNA to Standalone Mode.

2. Connect two RF test cables to the PNA-X Ports 1 and 2. Connect the two cables together using an adapter.

3. Perform a response calibration to normalize and remove the loss created by the test cables.

4. Remove the adapter.

5. Connect the cable from Port 1 to Ext Noise Source Out.

6. Connect the cable from Port 2 to the Test Set Source In.

7. Send the Test Set I/O command 0.8. Verify that the Ext Noise Source front panel LED
is On.

8. Set trace S21 and verify that the trace is similar to Figure 58.

Figure 58   Noise Source Out to Source In Path Response
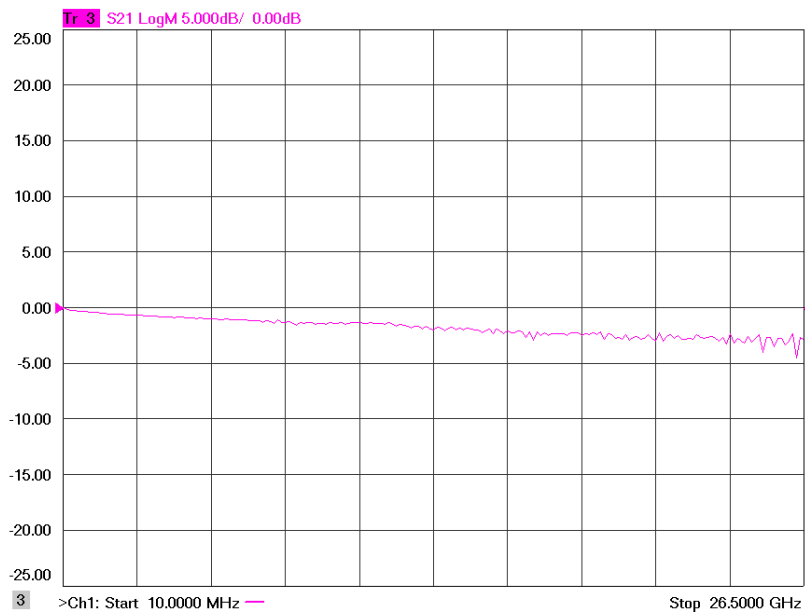
Connection Tables and Diagrams

Table 26   Controller Board Connections

Controller Board Connection	Connection
LED Ribbon Cables From the LED Board	
J5	Ports 5, 9, 13, 17 and 21
J6	Ports 6, 10, 14, 18 and 22
J7	Ports 7, 11, 15, 19 and 23
J8	Ports 8, 12, 16, 20 and 24
Wire harness Active LED	
P16	Active LED
DUT Control Ribbon Cable	
J9	DUT Controller Board
Power Supply Wire Harness	
J11- 14	Power Supply

Table 27   Switch Interface Board

Switch #	Interface Bd Connection	Ports	Path
10	P10	Ports 5, 9, 13, 17 and 21	Source
11	P11	Ports 5, 9, 13, 17 and 21	Source
20	P20	Ports 6, 10, 14, 18 and 22	Receiver
21	P21	Ports 6, 10, 14, 18 and 22	Receiver
30	P30	Ports 7, 11, 15, 19 and 23	Source
31	P31	Ports 7, 11, 15, 19 and 23	Source
40	P40	Ports 8, 12, 16, 20 and 24	Receiver
41	P41	Ports 8, 12, 16, 20 and 24	Receiver
16	J16	Option 129 (Ext Noise Source)	Source

Figure 59   Top View

Figure 60   Bottom View

Couplers (x20)

S10   **S20**   **S30**   **S40**

**Option 129
Connector
(S16)**

S11   **S21**   **S31**   **S41**

Fuse (x2)

Fan   **Power Supply**   **Line Module**
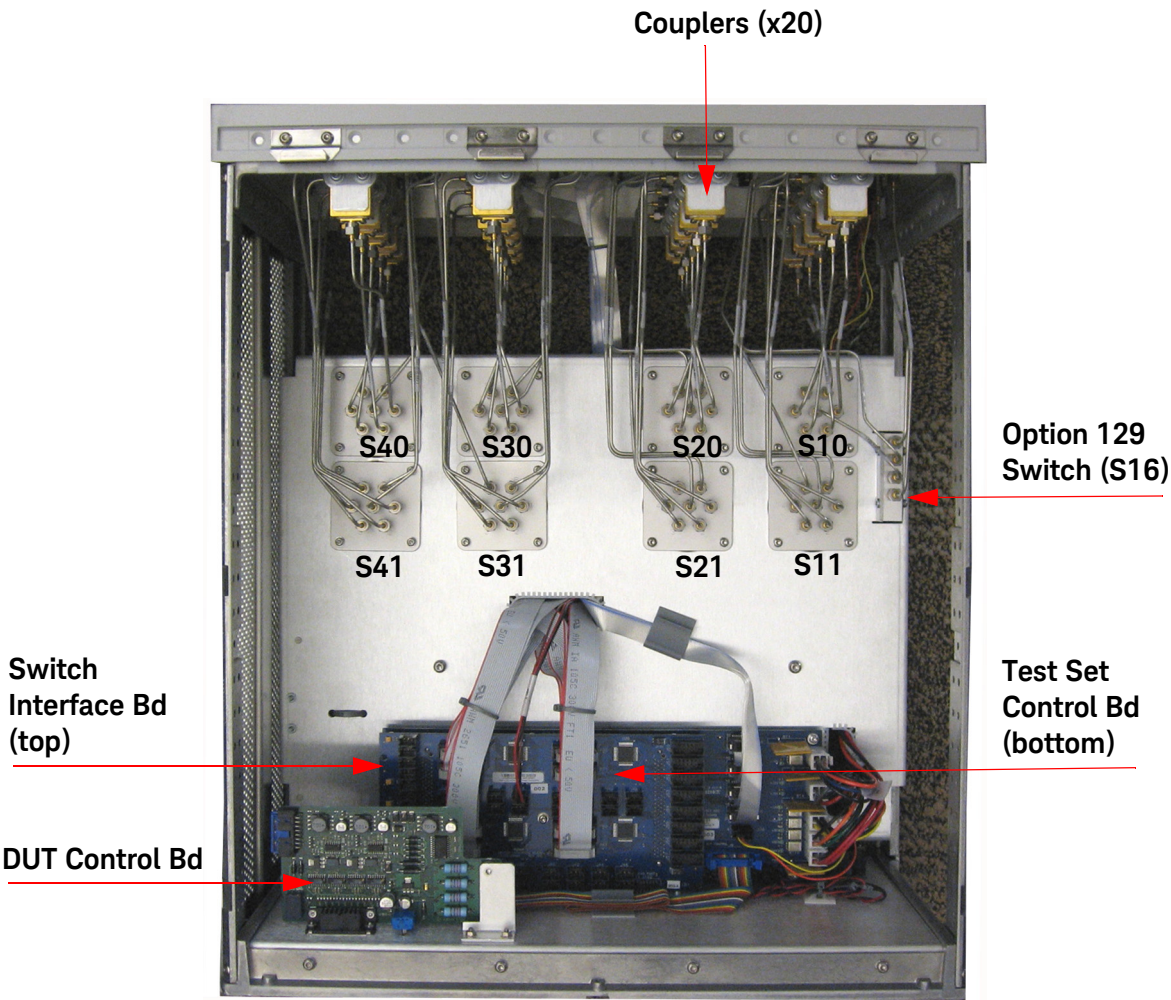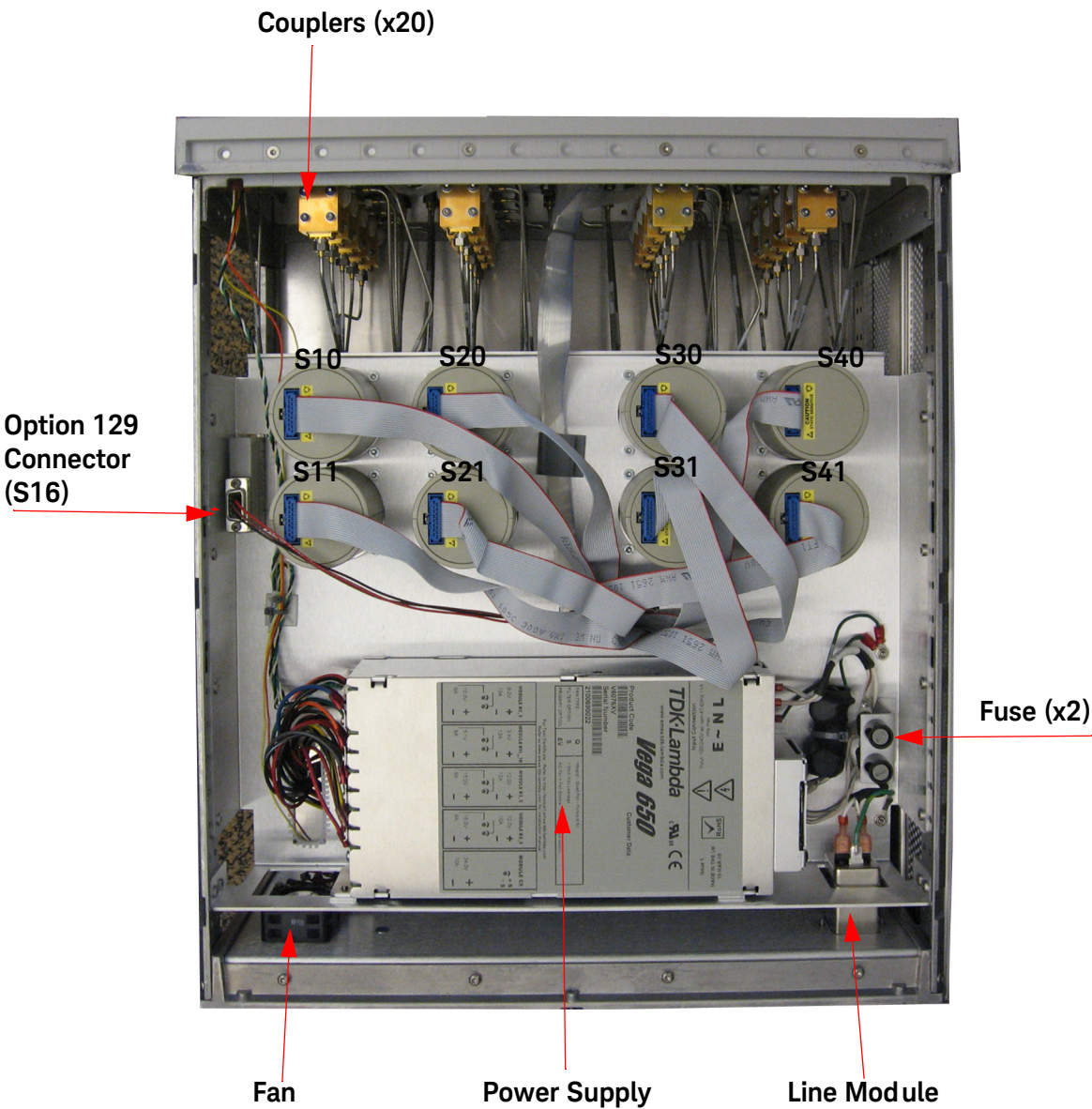
Safety and Information

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 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	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.

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

CAUTION	Before switching on this instrument, make sure the supply voltage is in the specified range.

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

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.

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

WARNING   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).

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 Keysight U3042AM20 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.

Instrument Markings

Listed below are definitions for the markings that may be found on the product.

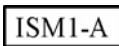|	
⚠	The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the documentation.
∼	The AC symbol indicates the required nature of the line module input power.
♲	This symbol indicates separate collection for electrical and electronic equipment, mandated under EU law. All electric and electronic equipment are required to be separated from normal waste for disposal (Reference WEEE Directive).
I	This symbol indicates that the power line switch is ON.
⏻	This symbol indicates that the power line switch is in the STANDBY position.
O	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.
CE	The CE mark is a registered trademark of the European Community.
ccr.keysight@keysight.com	The Keysight email address is required by EU directives applicable to our product.
CSA ® C US	The CSA mark is a registered trademark of the CSA International.
ISM1-A	This is a symbol of an Industrial Scientific and Medical Group 1 Class A product (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.
RCM	The RCM mark is a registered trademark of the Australian Communications and Media Authority.
40	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.
KC	South Korean Certification (KC) mark; includes the marking's identifier code which follows the format: MSIP-REM-YYY-ZZZZZZZZZZZZZZZ.

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 98 for assistance.

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

- IEC/EN 61326-1
- CISPR Pub 11 Group 1, class A
- AS/NZS CISPR 11
- ICES/NMB-00 1
  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: Complies with the essential requirements of the European Low Voltage Directive as well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity):

- IEC/EN 61010-1
- Canada: CSA C22.2 No. 61010-1
- USA: UL std no. 61010-1

Acoustic Statement: (European Machinery Directive):

- Acoustical noise emission
  LpA<70 dB
  Operator position
  Normal operation mode Per ISO 7779

Declaration of Conformity

A copy of the Declaration of Conformity is available upon request, or a copy is available on the Keysight Technologies web site at:
https://regulations.about.keysight.com/DoC/search.htm

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.

Keysight Support, Services, and Assistance

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 measurement needs, and information on finding a local Keysight office are available on the Internet 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:

— 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.

— 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.

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

KEYSIGHT
TECHNOLOGIES

U3042-90009
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