Keysight Technologies U3042AM12

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Use this manual with the following document:
PNA Series Network Analyzer On-line Help System

KEYSIGHT TECHNOLOGIES

User's and Service Guide

Notices

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WARNING

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What's Changed

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

U3042AM12

U3042AM12

KEYSIGHT TECHNOLOGIES

Introduction

This document describes how to use and service the U3042AM12 Multiport Test Set Extension.

Figure 1 4-Port PNA-L with U3042M12

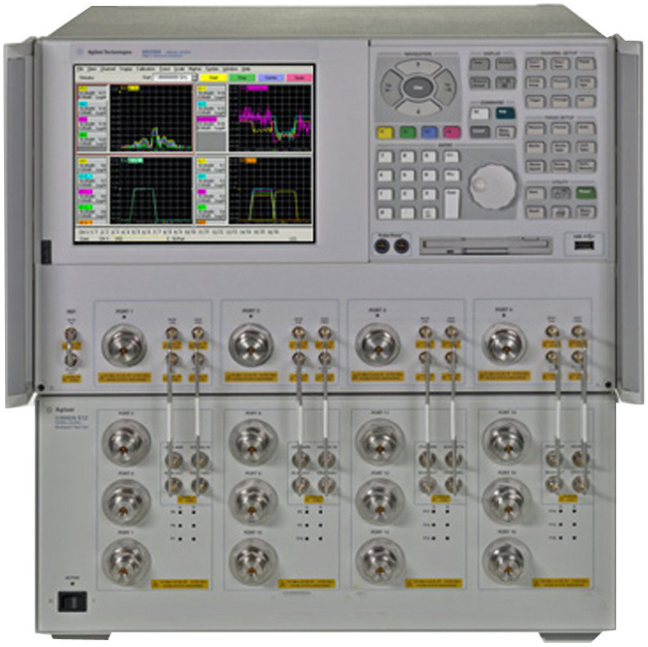


Figure 2 4-Port PNA or PNA-X with U3042M12

Description

The U3042AM12 is a Multiport Test Set Extension designed to be configured in a 16 Port network analyzer measurement system. The U3042AM12 has the following key features:

- 12 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 U3042AM12 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.

PNA and PNA-X Receiver Compression Note

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

Table 1 U3042AM12 Accessories Supplied

Description	Part Number	Quantity
Short, Coax 2.4 mm (Female)	85052-60007	1
User's and Service Guide (U3042AM12)	U3042-90006	1

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 94. Keep the damaged shipping materials (if any) for inspection by the carrier and a 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 2 provides a listing of other network analyzer option requirements. The analyzer’s frequency range must be equal to or exceed that of the test set so that the measurement system covers the full frequency range of the test set.

The U3042AM12 Option 129 test set requires that the analyzer also have option H29 or 029 installed in order to use the test set for noise figure measurements.

The Test Set files indicated in Table 2 must be installed into this network analyzer file directory location: C:\Program Files\Keysight\Network Analyzer\TestSets.
For "B" model PNA-X: C:\Program Files (x86)\Agilent\Keysight\Network Analyzer \Keysight\TestSets

Table 2 Network Analyzer Configuration Requirements

4 Port Network Analyzer	Options	Test Set File	System Figure
N5221/2A/B PNA	401 or 417 or 419	U3042AM12_pnax_p4.tsx	2[a]
N5230A/C PNA-L	145 or 146 or 245 or 246	U3042AM12_p4.tsx	1
N5231/2A/B, N5239B PNA-L	416	U3042AM12_p4.tsx	1[a]
N5241/2A/B, N5249B PNA-X	400	U3042AM12_pnax_p4.tsx	2

a. Image does not show the actual analyzer but the port configuration is similar.

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

- Network Analyzer Firmware - http://na.support.keysight.com/pna/firmware/firmware.html
- U3042AM12 Test Set Files - http://na.support.keysight.com/multiport (see test set files link)

Available Options

Test Set Options

The Test Set has two available options:
Refer to "System Block Diagram" on page 72 and 73.

- Standard - Mechanical switches for low loss.
- Option 129 - External source path switch ports 1, 5, 9, and 13.

Accessory Options

Installation instructions are included in the option package.

- U3042A-ICM - Rackmount Kit (5063-9215)
- U3042A-1CN - Front Handle Kit (5063-9228)
- U3042A-1CP - Rackmount with Front Handle Kit (5063-9222)

Network Analyzer Interface Kit Options

The U3042AM12 will require one of the following kits to interface the test set with your network analyzer. The Interface kit model option includes the hardware lock-link and cable kit listed in Table 3.

Table 3 Interface Kit Options

4 Port Analyzer	Interface Kit Option	Hardware Lock-Link	Cable Kit - Conn. Type
N5221/2A/B PNA	U3021PL3 Opt 442	U3021-60002[c]	U3021-60047, SMA m/m[d]
N5230A/C, N5231/2A/B, N5239B PNA-L	U3021PL3 Opt 430	U3021-60001[a]	U3021-60045, SMA m/m[b]
N5241/2A/B, N5249B PNA-X	U3021PL3 Opt 442	U3021-60002[c]	U3021-60047, SMA m/m[d]

a. Refer to "System Setup with N5230C and N5232A/B" on page 18.
b. Refer to "PNA-L RF Interface Cable Connections" on page 21.
c. Refer to "System Setup with N5222A/B and N5242A/B" on page 23.
d. Refer to "N5222A/B or N5242A/B RF Interface Cable Connections" on page 26.

General Specifications

Specifications for the Test Set are characteristic for the system performance of the analyzer and Test Set. Actual performance of the system is based on the customers analyzer that is used with the Test Set. A functional certificate is only offered for the Test Set.

When connected to a analyzer, the Test Set will degrade the performance at the test ports. The internal switch paths reduce test port power to the receivers. This affects the test port power of the analyzer and also reduces dynamic range. The reflection tracking values measured on page 60 can be subtracted from the analyzer's dynamic range to determine the approximate performance of the system.

Power Requirements

Verify that the required ac power is available before installing the Test Set to the analyzer.

- 100/120/220/240 V (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.
- U3042M08 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 only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the instrument, is likely to make the product dangerous. Intentional interruption is prohibited.

Environmental Requirements

Refer to the PNA, PNA-L and PNA-X standard documentation for environmental specifications.

The U3042AM12 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 is 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 4 Instrument Dimension

Model	Weight	Height	Width	Depth
U3042M12	11.4 kg (25 lb)	19.1 cm (7.5 in)	42.5 cm (16.7 in)	43.2 cm (17 in)

Maximum and Recommended Power Levels

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 5 Recommended Power Levels

U3042M12 Test Port RF Power Levels:	
PORT 5-12	+27 dBm 0 Vdc
U3042M12 Access Ports:	
SOURCE OUT	+20 dBm 0 Vdc
CPLR ARM	+20 dBm 0 Vdc
CPLR THRU	+20 dBm 0 Vdc
RCVR OUT	+20 dBm 0 Vdc
Noise Source IN/OUT	+20 dBm 0 Vdc

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

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

Typical Reflection Tracking

Performance for the test set is typical. System performance for the analyzer and Test Set are only characteristic and are intended as non-warranted information. A functional certificate is provided for the U3042AM12 only.

NOTE Typical performance is based on 1 to 2 units, see Table 6 and Table 7.

Table 6 Typical Reflection Tracking with PNA-L

Frequency	Standard 700
300 kHz to 10 MHz	-0.2
10 MHz to 4 GHz	-3
4 GHz to 6 GHz	-4
6 GHz to 10.5 GHz	-5
10.5 GHz to 13.5 GHz	-6
13.5 GHz to 15 GHz	-7
15 GHz to 20 GHz	-10

Table 7 Typical Reflection Tracking with PNA or PNA-X

Frequency	Standard 700
10 MHz to 50 MHz	-0.5
50 MHz to 500 MHz	-2
500 MHz to 3.2 GHz	-3
3.2 GHz to 10 GHz	-5
10 GHz to 16 GHz	-7
16 GHz to 20 GHz	-10
20 GHz to 24 GHz	-11
24 GHz to 26.5 GHz	-12

Front and Rear Panel Features

Figure 3 Standard Front Panel

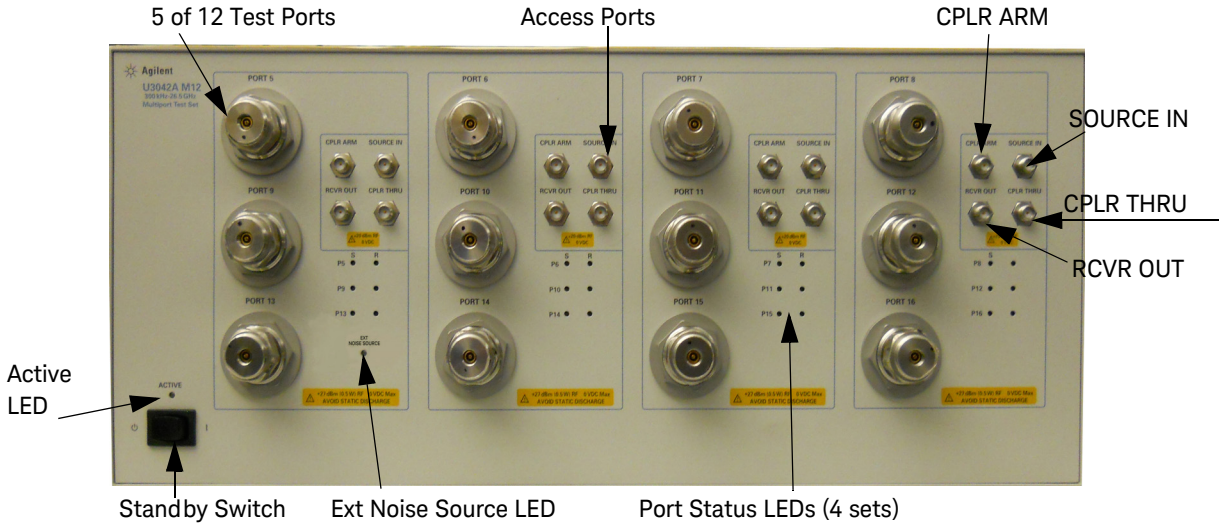
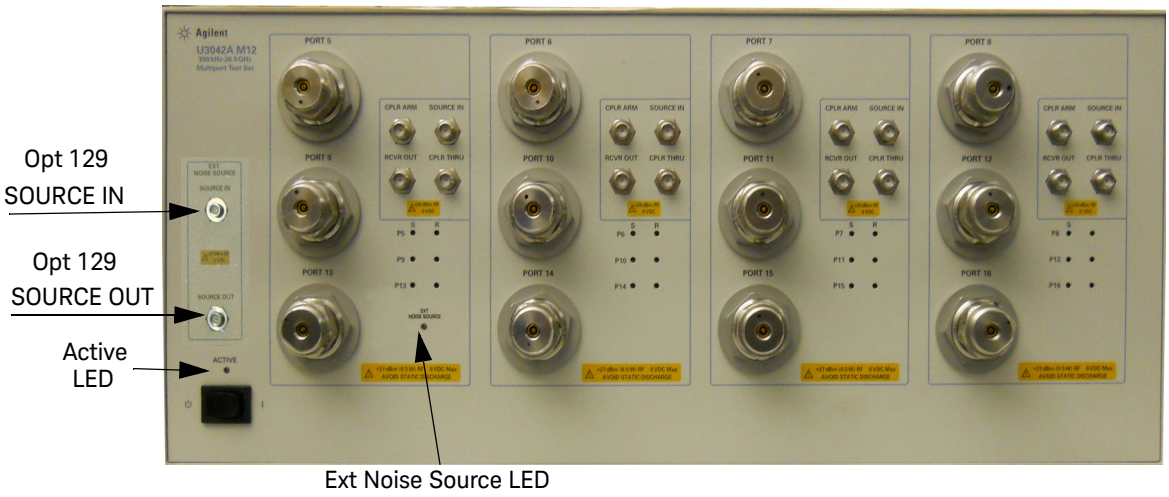
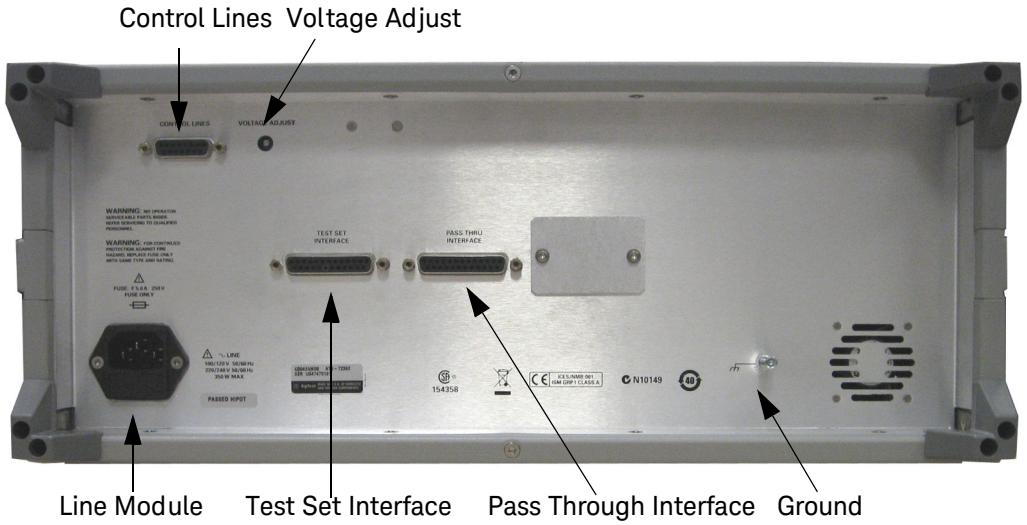


Figure 4 Option 129 Front Panel



Test Ports 3.5 mm Bulkhead (male)	Port 5-16
Access Ports – SMA (female)	· CPLR ARM · SOURCE IN · CPLR THRU · RCVR (A-D) OUT · Noise Source SOURCE IN (Option 129) · Noise Source SOURCE OUT (Option 129)
Test Port Status LEDs	An illuminated LED indicates an active port in Source or Receiver mode. On the front panel “S” indicates Source test ports and “R” indicates Receiver test ports.
External Noise Source LED	An illuminated LED indicates when the External Noise Source path is active.
Standby Switch	Note that this switch is Standby only, not a line switch. The main power cord can be used as the system disconnecting device. It disconnects the mains circuits from the mains supply.
Active LED	When the Test Set is connected and addressed by a PNA-X, the LED is On (illuminated). The LED is Off (not illuminated) when the Test Set is in Standby, or not addressed by the PNA-X.
NOTE	When the two Test Sets are connected together, as in the multi-Test Set system, the first Test Set connected to the PNA-X will never have an "ON" Active LED. Instead, the last Test Set in the I/O cable chain will be the Test Set showing the "Active LED" status for all.

Figure 5 Rear Panel



Control Lines and Voltage Adjust For further information pertaining to control lines and voltage adjustments see "Control Lines" on page 53.

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 The Pass Through Interface is used to connection to another Test Set.

Test Set Interface The Test Set Interface connector is used to send address and data to the Test Set from the analyzer.

Line Module

The line fuse, as well as a spare, reside within the line module. Figure 6 illustrates where the fuses are located and how to access them.

Install the instrument so that the detachable power cord is readily identifiable and is easily reached by the operator. The detachable power cord is the instrument disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the instrument. The front panel switch is only a standby switch and is not a LINE switch. Alternatively, an externally installed switch or circuit breaker (which is readily identifiable and is easily reached by the operator) may be used as a disconnecting device.

Available Fuses

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

WARNING

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

Figure 6 Line Fuse

CAUTION

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

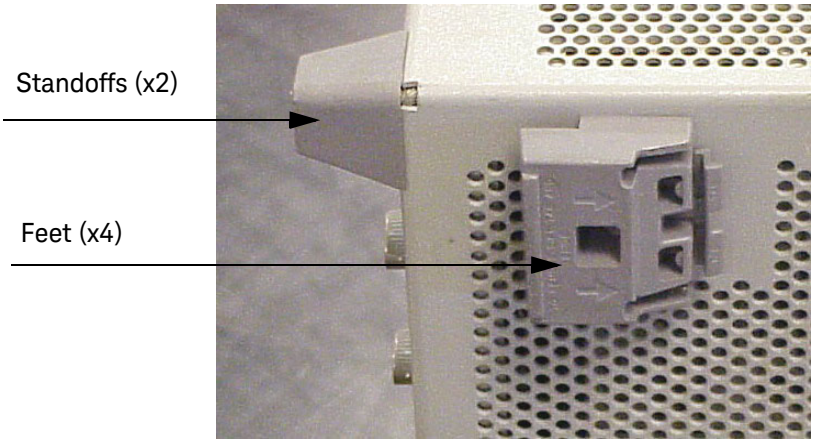
System Setup with N5230C and N5232A/B

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

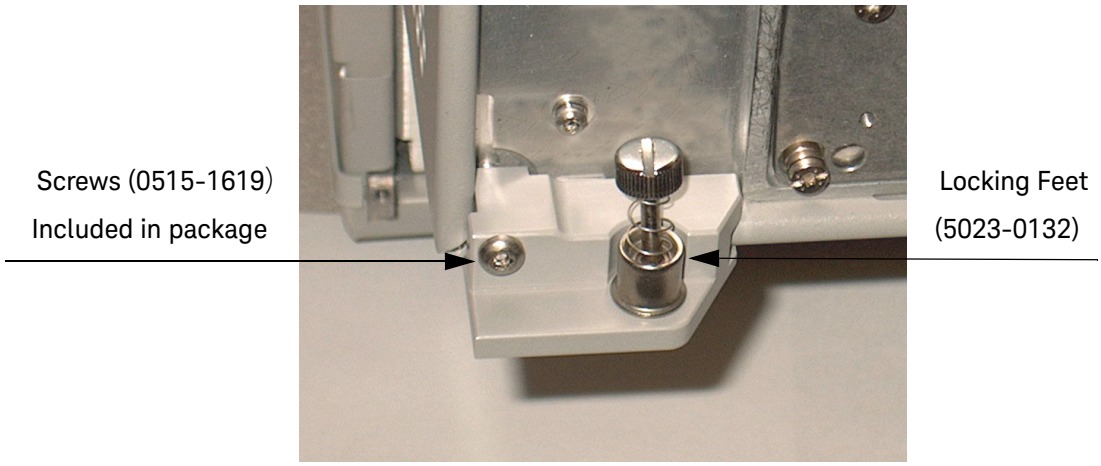
1. The kit (U3021-60001) includes items to interface the Test Set to the analyzer.
2. Remove the feet from the bottom of the analyzer.
3. Remove the 2 lower standoffs and screws (0515-1619) from the rear panel on the analyzer.

Figure 7 Rear Bottom Feet



4. Install the two rear locking feet (5023-0132) onto the PNA-L, using the included screws (0515-1619), where the standoffs were removed.

Figure 8 Install Locking Feet



5. Remove the top two standoffs and screws (0515-1619) from the rear panel on the Test Set.
6. Install the top left and right rear locking feet from the kit (5063-9253) using screws (0515-1244).

Figure 9 Rear Locking Feet

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.
8. Secure the analyzer's lower locking feet to the Test Set's upper locking feet using the spring–loaded screws on the locking feet. If the analyzer's lower locking feet are not aligned with the screw holes in the Test Set's upper locking feet, loosen the screws securing the feet to the instrument slightly to align and tighten.

Figure 10 Locking the Analyzer

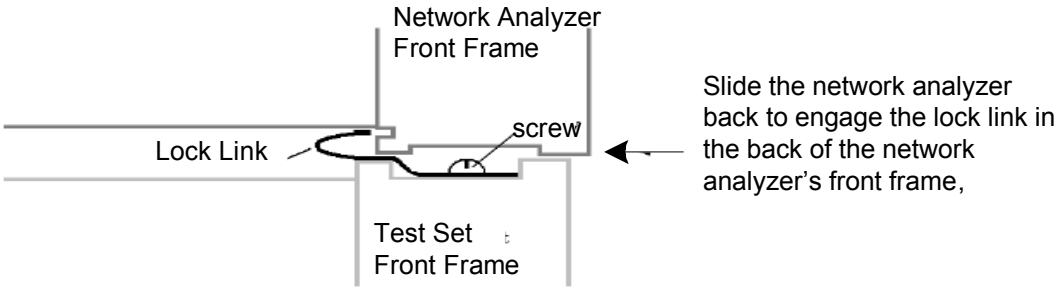


Figure 11 Locking Feet Screws

NOTE

The lock-feet kit (U3021-60001) includes the analyzer and Test Set lock-feet. Refer to "Contacting Keysight" on page 94 for ordering information.

- PNA - 5023-0132 (Kit includes locking feet and screws)
- Test Set - 5063-9253 (Kit includes lock links, locking feet and screws)

PNA-L RF Interface Cable Connections

Figure 12 on page 22 illustrates the cable configuration of the Test Set to the PNA-L, and indicates the final two digits of the part number for each cable. The cables are supplied in the interface cable kit (U3021-60045).

1. Remove the SOURCE OUT to CPLR THRU and RCVR IN to CPLR ARM jumpers (x16) on the PNA. 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. The Z5623-20418 are the short cables and the Z5623-20419 are the long cables. Refer to Table 8 and Figure 12.

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

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

Table 8 PNA-L Interface Cable Connection (U3021-60045)

RF Cables	From PNA-L	To Test Set
Z5623-20418 (short)	SOURCE OUT	SOURCE OUT
Z5623-20418 (short)	CPLR ARM	SOURCE OUT
Z5623-20419 (long)	CPLR THRU	CPLR THRU
Z5623-20419 (long)	RCVR IN	RCVR OUT

Figure 12 indicates the final two digits of the part number for each cable, and the quantity required.

Figure 12 PNA-L RF Interface Connections

3. Connect the 25 pin D-Sub parallel cable (N4011-21002) from the PNA-L Test Set I/O to the Test Set I/O interface connector on the rear panel of the Test Set. Refer to Figure 19 on page 27.

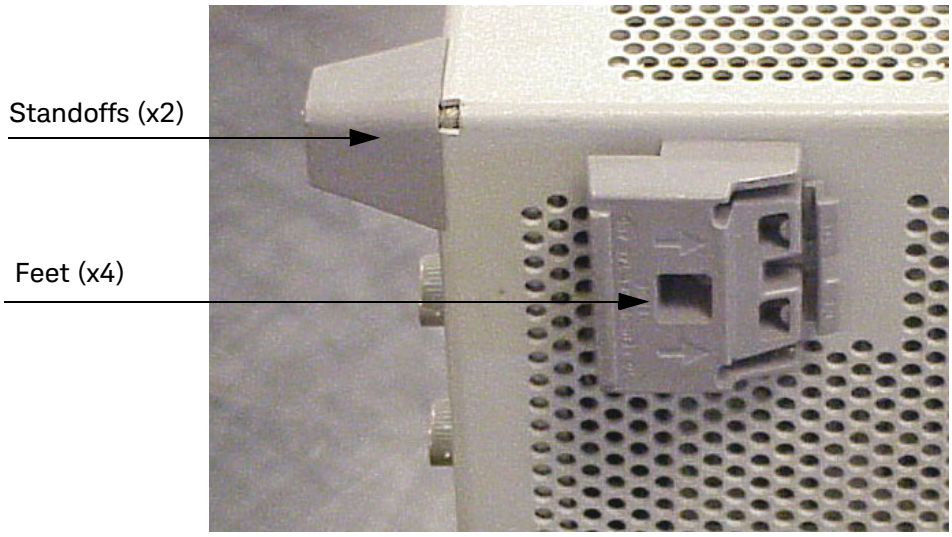
   Refer to “System Operational Checks” on page 28 for turn-on verification of the multiport system.

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 and Test Set to the PNA or PNA-X

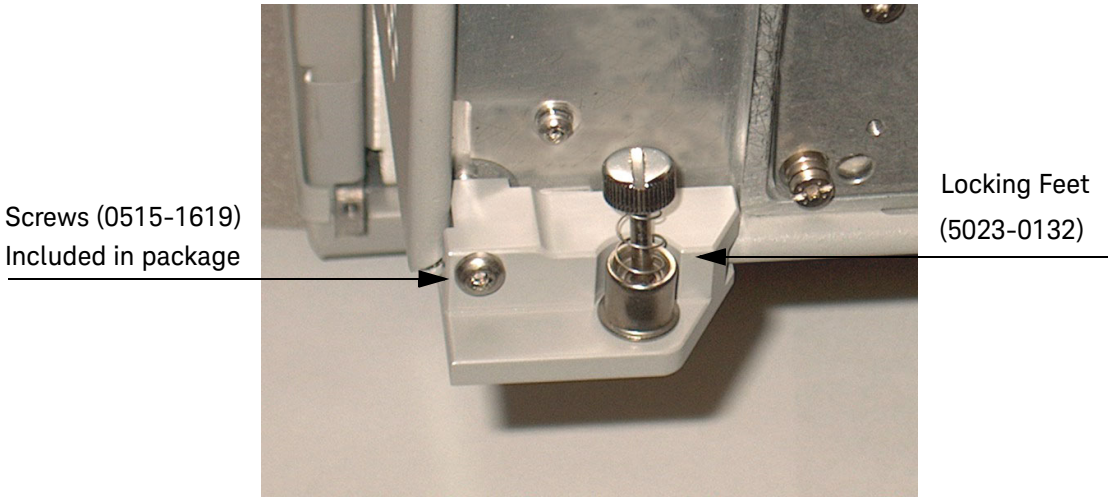
1. The kit (U3021-60002) includes items to interface the Test Set to the analyzer.
2. Remove the feet from the bottom of the analyzer.
3. Remove the 2 lower standoffs and screws (0515-1619) from the rear panel on the analyzer.

Figure 13 Rear Bottom Feet



4. Install the two rear locking feet (5023-0132) onto the PNA-X, using the included screws (0515-1619), where the standoffs were removed.

Figure 14 Install Locking Feet on PNA-X



5. Remove the top two standoffs and screws (0515-1619) from the rear panel on the Test Set.
6. Install the two rear locking feet onto the Test Set. Looking at the front panel, the N5242-20138 is the right foot and the N5242-20139 is the left foot. Two screws (0515-2317) are included with this option.

Figure 15 Install Locking Feet on Test Set

7. Place the analyzer on top of the Test Set and ensure that the front frame of the analyzer is positioned slightly forward of the locks that are attached to the Test Set. Slide the analyzer back so the locks engage the front frame of the analyzer.
8. Secure the analyzer's lower locking feet to the Test Set's upper locking feet using the spring–loaded screws on the locking feet. If the analyzer's lower locking feet are not aligned with the screw holes in the Test Set's upper locking feet, loosen the screws securing the feet to the instrument slightly to align and tighten.

Figure 16 Locking the Analyzer's

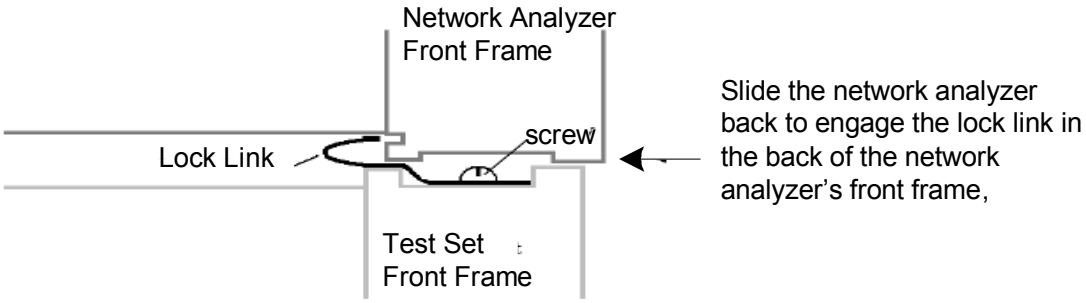


Figure 17 Locking Feet Screws

NOTE

The lock-feet kit (U3021-60002) includes the analyzer and Test Set lock-feet. Refer to "Contacting Keysight" on page 94 for ordering information.

- PNA - 5023-0132 (Kit includes locking feel and screws)
- Test Set - N5242-20138 (right foot) and N5242-20139 (left foot).
- Screw - 0515-2317

N5222A/B or N5242A/B RF Interface Cable Connections

Figure 18 on page 27 illustrates the cable configuration of the Test Set to the analyzer. The cables have been supplied in the interface cable kit (U3021-60047).

1. Remove the SOURCE OUT to CPLR THRU and RCVR IN to CPLR ARM jumpers (x16) on the PNA. The RCVR R1 to SOURCE OUT reference loop jumper (x1) remain on the front panel.
2. Connect the RF interconnect cables from the analyzer to the Test Set in the order listed. As you are connecting each cable, torque to 8 in-lb. The longer, straight end of each cable is connected to the Test Set. Refer to Table 9 and Figure 18 on page 27.

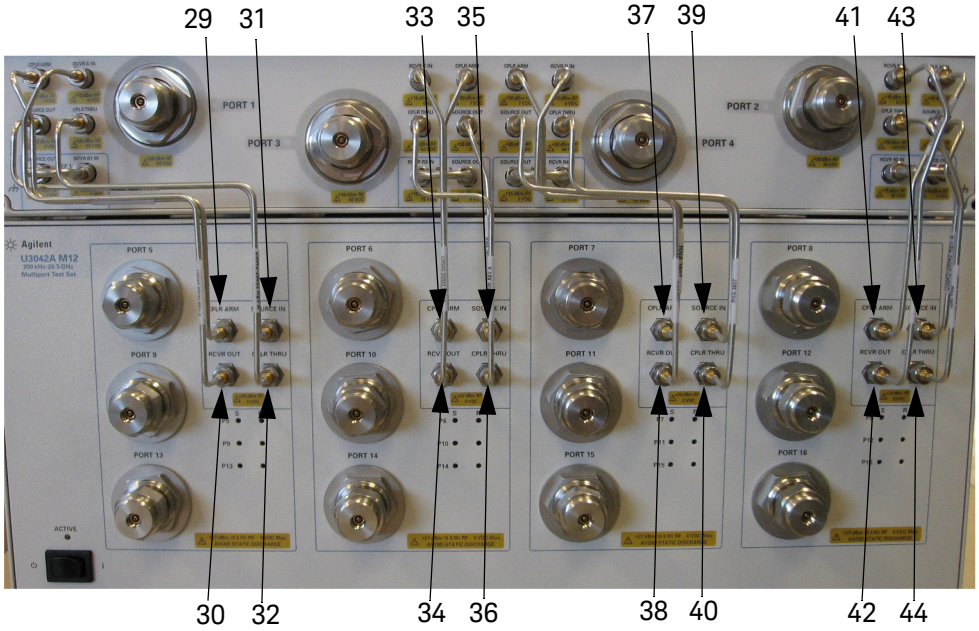
CAUTION Over torque will cause damage to the Test Set and may cause connectors to spin or become loose.

Table 9 PNA or PNA-X RF Interface Cable Connection (U3021-60047)

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

Figure 18 indicates the final two digits of the part number for each cable. The cables must be connected in the numeric order listed in Table 9 on page 26.

Figure 18 PNA-X RF Interface Cable Connections



3. Connect the analyzer Test Set I/O cable (N4011-21002) to the Test Set Interface connector on the rear panel.

Figure 19 Test Set I/O Cable Connection

System Operational Checks

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

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 included female 3.5 mm short (85052-60007) to Port 1 on the analyzer.

Equipment Setup

- Turn on the test set and analyzer.
- Preset the analyzer and make the following settings:
  - Set to Multi-Port Mode
  - Frequency range: 10 MHz to 26.5 GHz
  - IFBW: 1 kHz
  - Scale: 10 dB/Div
  - Set the PNA to measure S11
  - Ensure the RF path of the analyzer is in Default mode. Refer to "RF Path Configuration with Analyzer Option 029" on page 39.

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 10 Reflection Response Results

Reflection Port	Response Trace	Cable Path Diagram
Port 1 to 4	Figure 20 on page 29	Figure 21 on page 29
Ports 5 to 8	Figure 22 on page 30	Figure 23 on page 30
Ports 9 to 12	Figure 22 on page 30	Figure 24 on page 31
Ports 13 to 16	Figure 22 on page 30	Figure 25 on page 31

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 20 Typical Reflection Response Ports 1 to 4

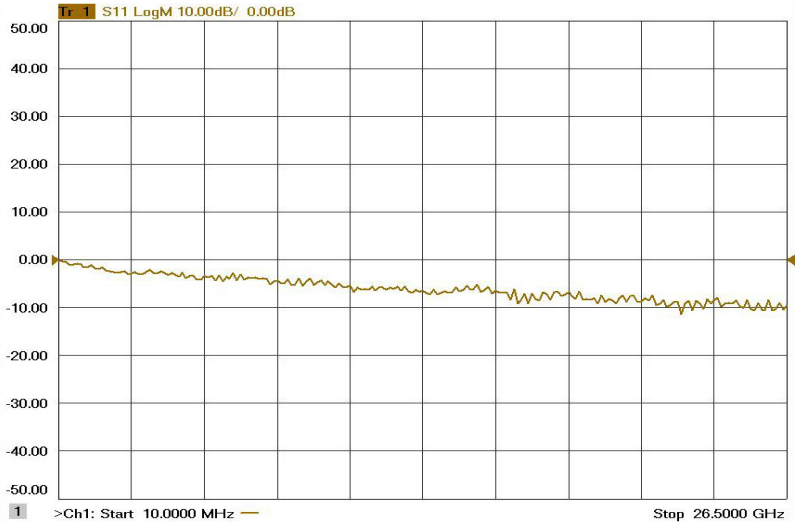


Figure 21 Reflection Response Signal Path Diagram Ports 1 to 4

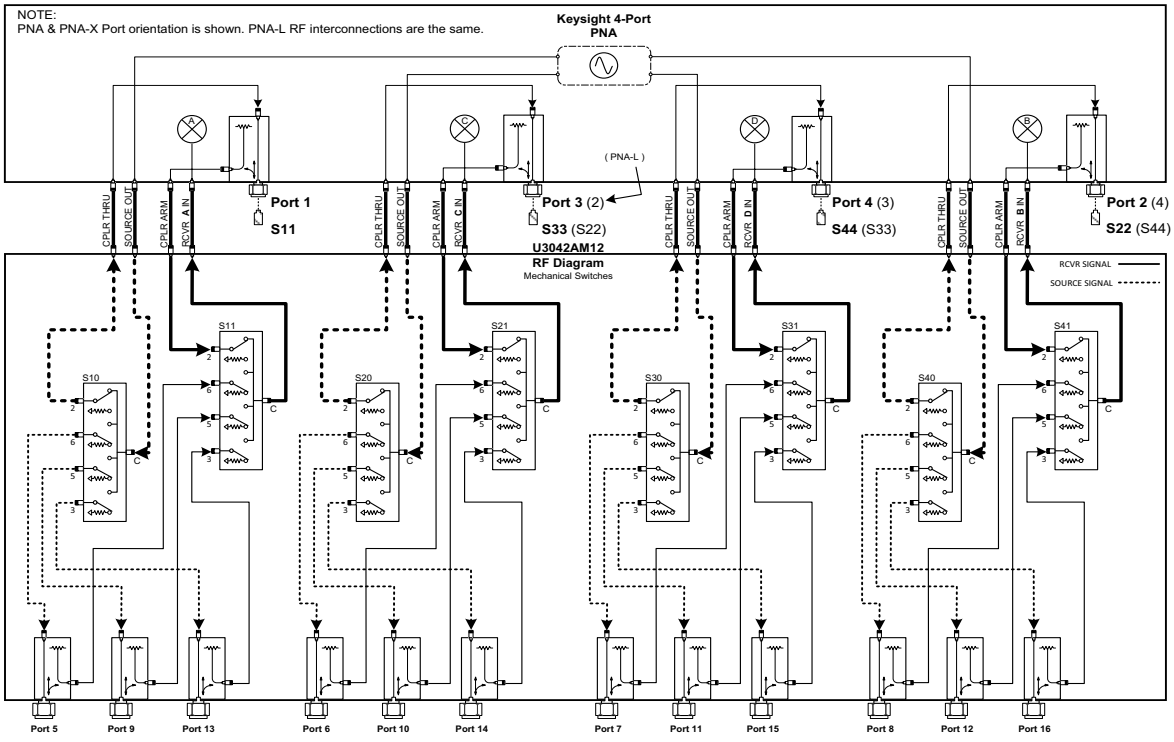


Figure 22 Typical Reflection Response Ports 5 to 16

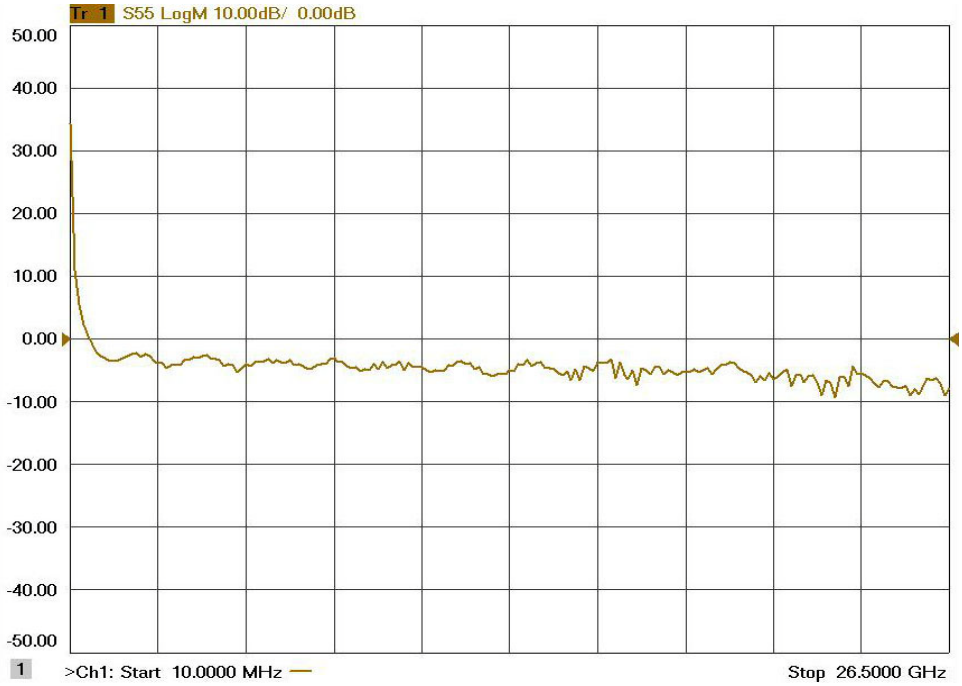


Figure 23 Reflection Response Signal Path Diagram Ports 5 to 8

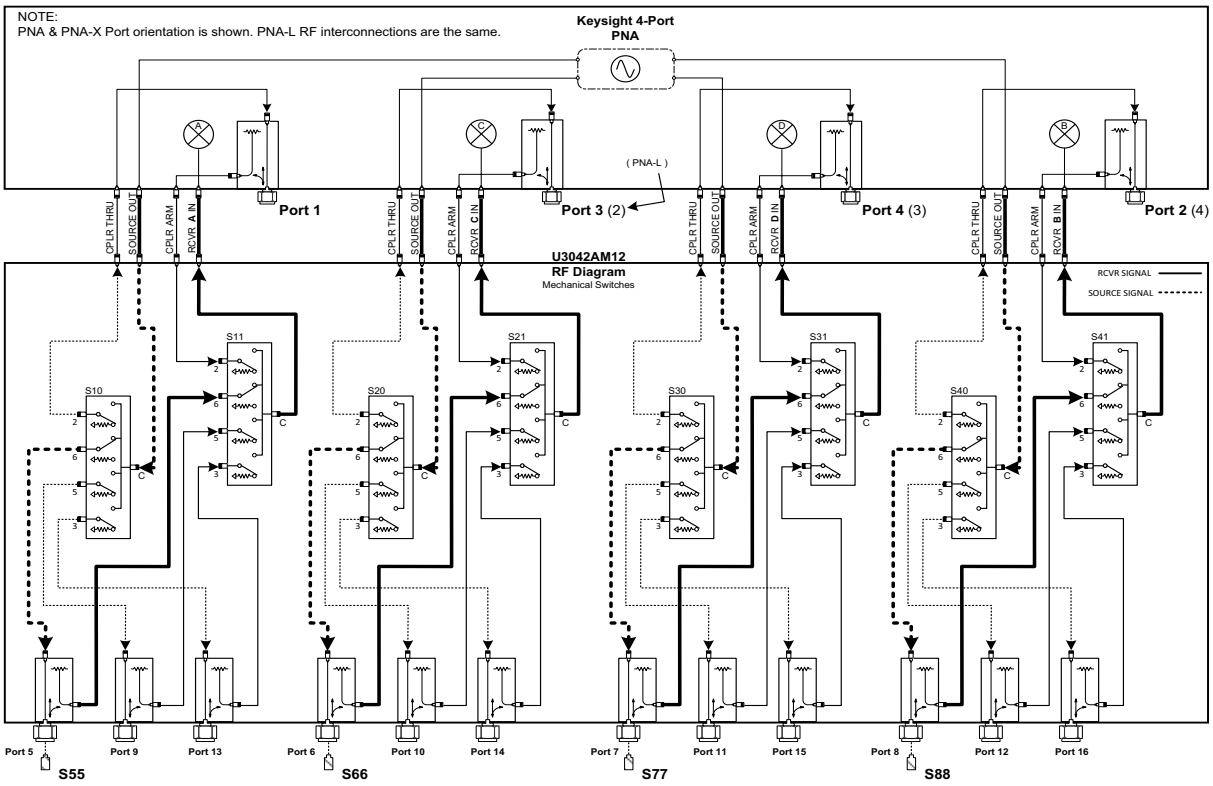


Figure 24 Reflection Response Signal Path Diagram Ports 9 to 12

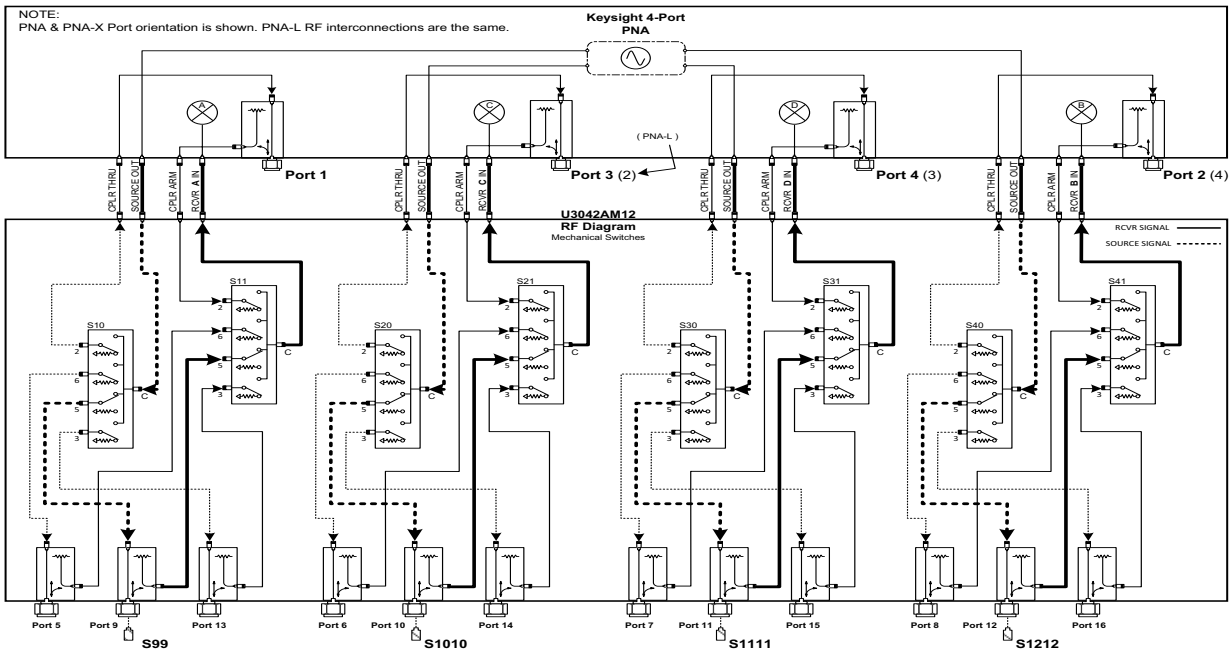
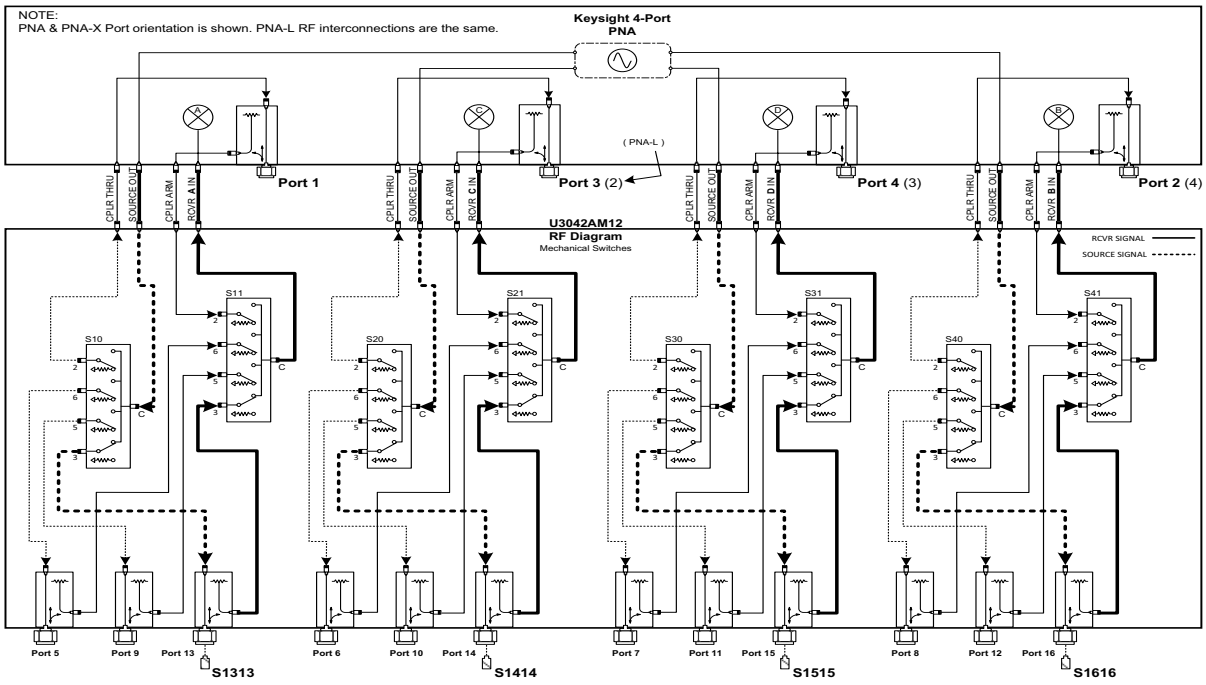


Figure 25 Reflection Response Signal Path Diagram Ports 13 to 16



Controlling the Test Set with N5222A/B, N5230C, N5232A/B or N5242A/B

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-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 33
- “Interface Control” on page 42
- “SCPI Control” on page xx

The U3042AM12 Option 129 (External Source Path Switch) will not operate in multiport mode (Option 551).When changing from multiport mode to standalone mode, send commands 0.0, 16.0, 32.0 and 64.0 to ensure the system is set to a default state.

- Standard - Mechanical switches for low loss. No Option 129 on the serial tag.
- Option 129 - External source path switch ports 1, 5, 9, and 13.

Typeface Key Conventions

The following key conventions are used throughout this document.

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

Definitions for Specifications

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

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

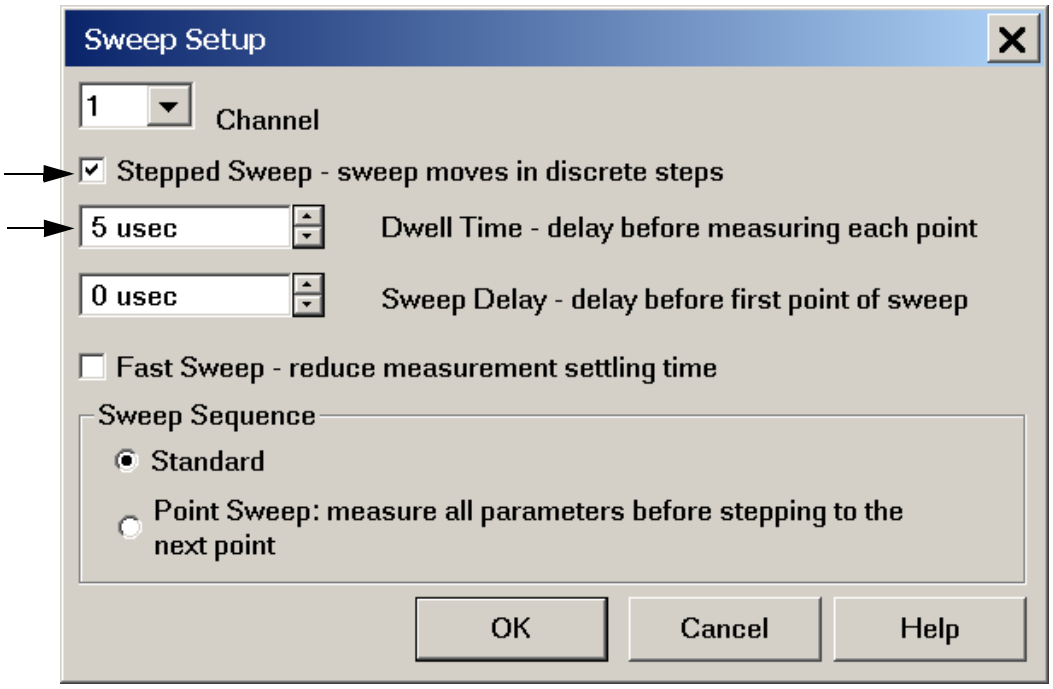
- **Nominal** describes representative performance that is useful in the application of the product when operated over a 20 to 30 °C temperature range. Nominal performance is not warranted.
- **Typical** describes characteristic performance, which 80% of instruments are expected to meet when operated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

Sweep Setup for Multiport and Standalone Modes

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

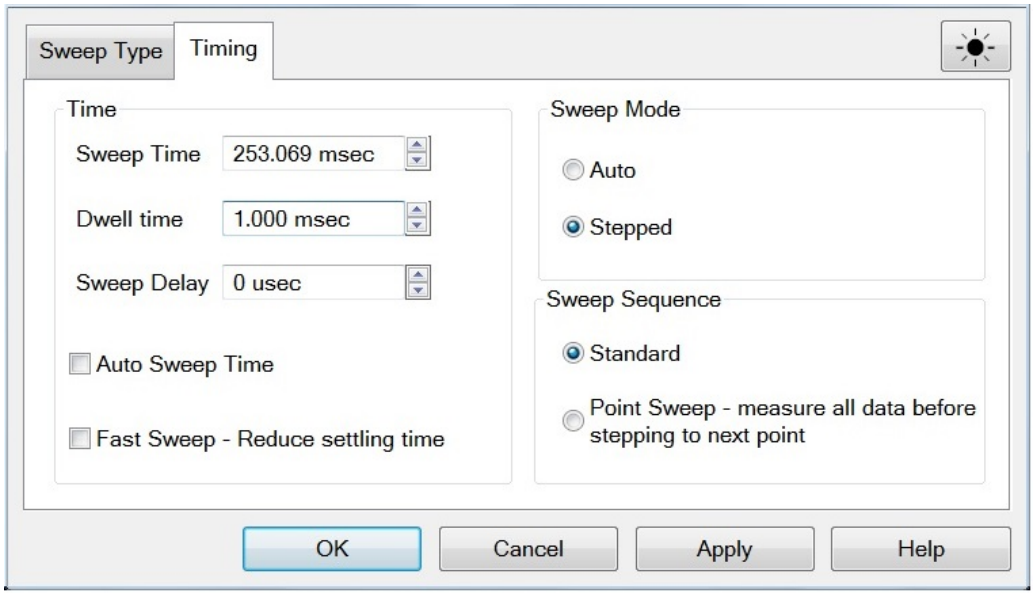
Figure xx **Sweep Setup**



Sweep Setup for PNA-X N524xB Models

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

Figure xx Sweep Setup, N524xB



Multiport Mode (Option 551)

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

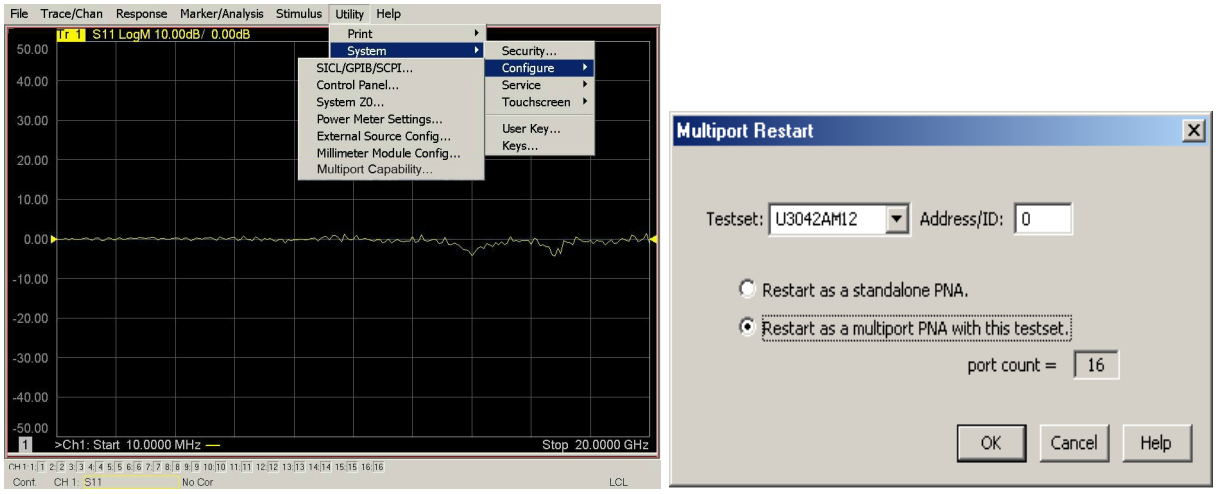
The U3042AM12 Option 129 (External Source Path Switch) will not operate in multiport mode (Option 551).

How to Access Multiport Mode

1. The Option 551 must be installed for Multiport capability. To access the multiport application select **[Utility] > System > Configure > Multiport Capability** -OR- ***(Instrument > Setup > External Hardware > Multiport > Multiport Configuration...)***.
2. Select **U3042M12** from the test set drop-down menu and select **Restart as a multiport PNA with this testset** > **OK**. The analyzer will restart the network application with the test set interface features.

If the U3042M12 is not available in the drop-down list, it will be necessary for you to copy the required test set file to the analyzer's hard drive. The current version of the test set files are available on the web at http://na.support.keysight.com/multiport. Copy the appropriate file to c:\program files\keysight\Network Analyzer\testsets directory.

Figure 26 Selecting Multiport Mode

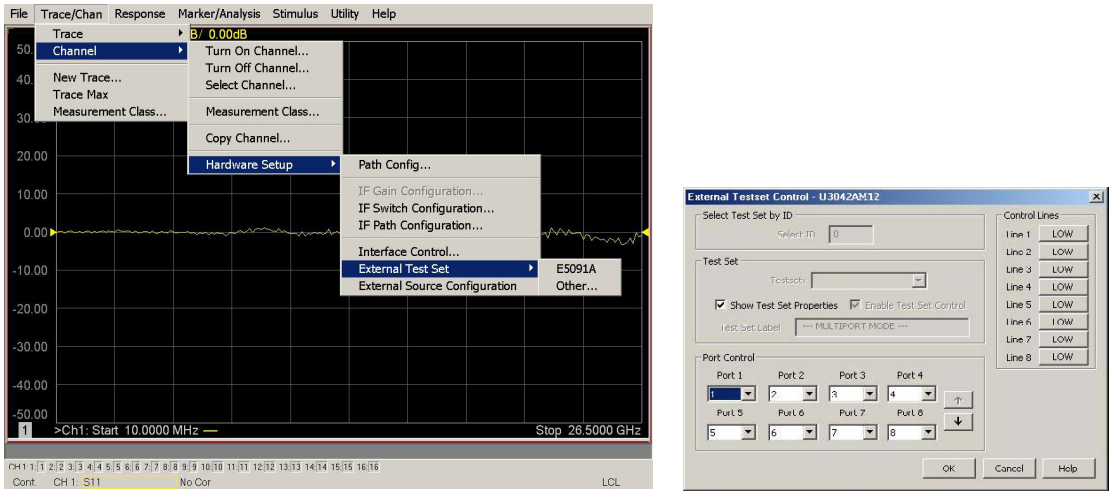


External Test Set Control Feature

To verify that the network application has the test set interface features, select **Trace/Chan** > **Channel** > **Hard ware 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-U3042M12**.

Figure 27 External Test Set Control

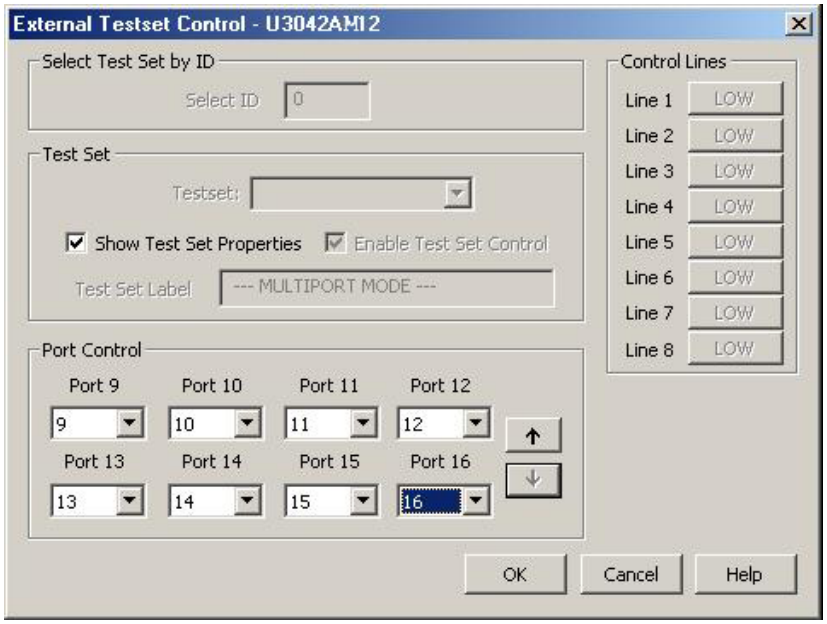


This menu will allow the physical Ports 1 thru 12 to be identified as any port for your convenience. For example; Port 5 can be re-named Port 2.

The **External Test Set Control-U3042M12** also allows control of the DUT control lines, refer to “Control Lines” on page 53. To change the state from LOW to HIGH, select the graphical user interface (GUI) for the specific control (LINE 1 to 8) > **OK**. Each line can be controlled separately.

Select the **Port Control** down arrow for Ports 9 thru 12.

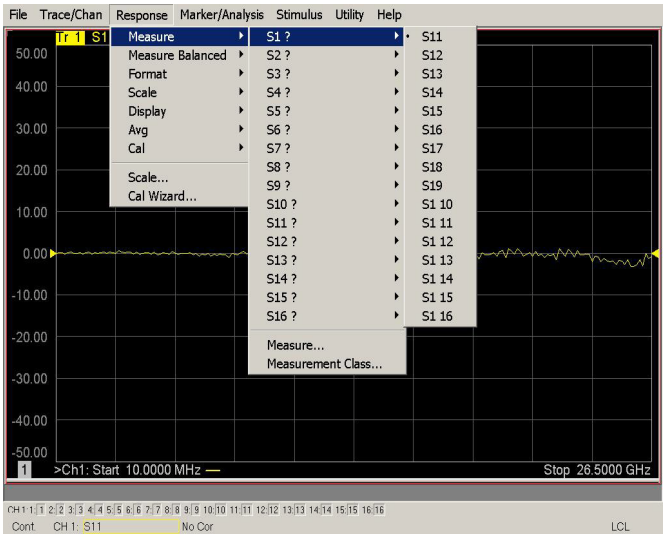
Figure 28 External Test Set U3042M12 (Port 9 - 16)



Trace Measure S-Parameter

S-Parameter selection can be accomplished using **Response** > **Measure**. Use the drop-down menu to select 1 of 144 S-Parameters for the 16-Port system, see Figure 29. 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.

Figure 29 Trace Measure



New Trace Measure S-Parameter

Multiple S-Parameters can be made from selecting **Trace/Chan** > **Trace** > **New Trace** -OR- ***(Instrument*** > ***Trace*** > ***New Trace)***. Use the drop-down menu and select any of the 144 S-Parameters.

Figure 30 New Trace Measure

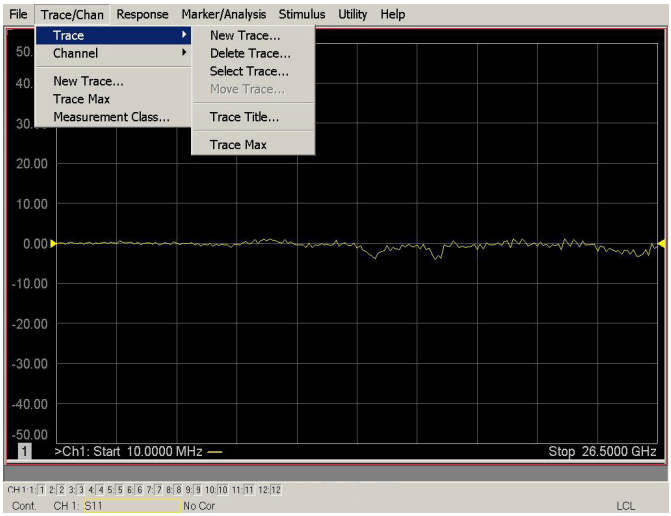


Figure 31 16-Port New Trace Measure (S11-S55)

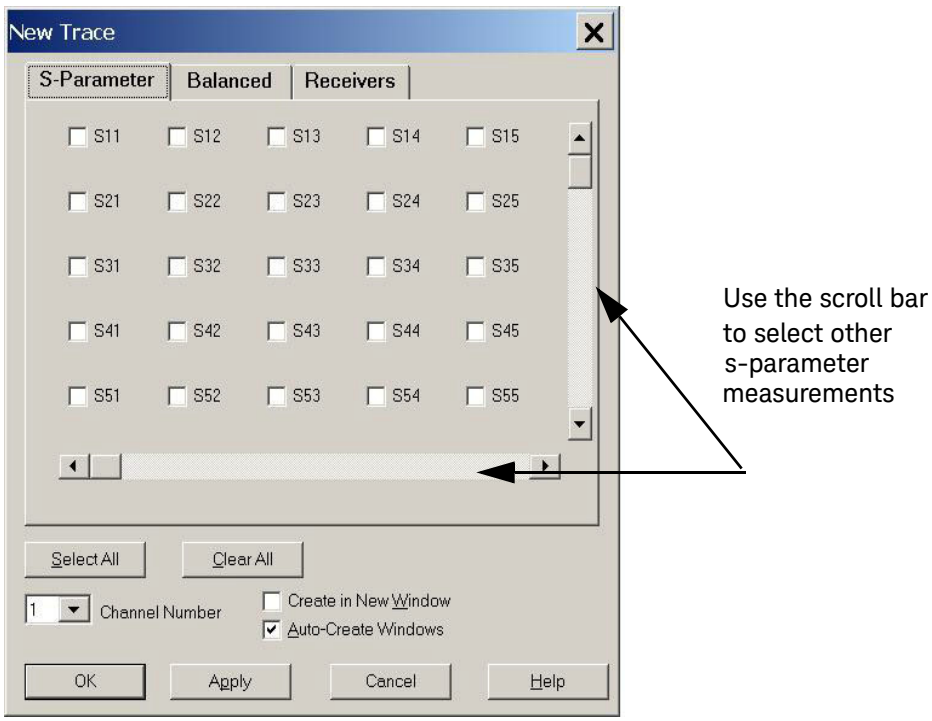
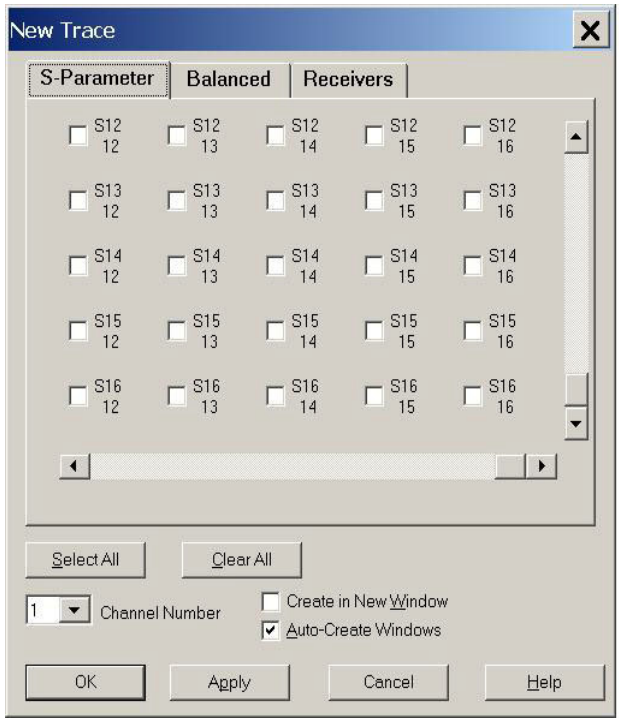


Figure 32 16-Port New Trace Measure (S1212 - S1616)

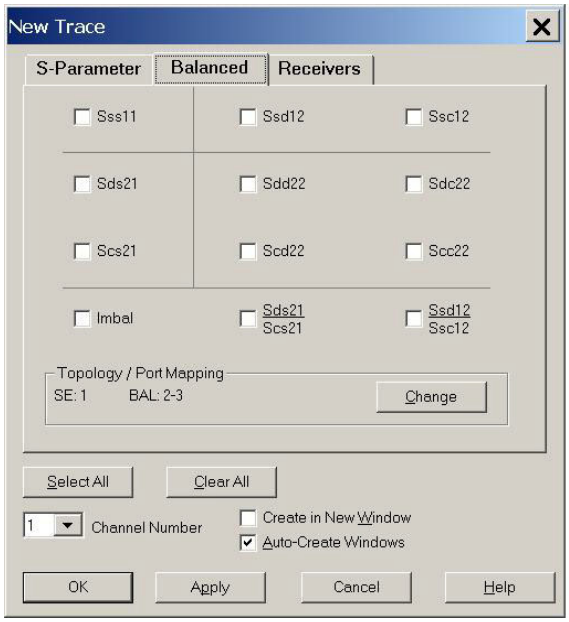


Balanced Tab

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

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

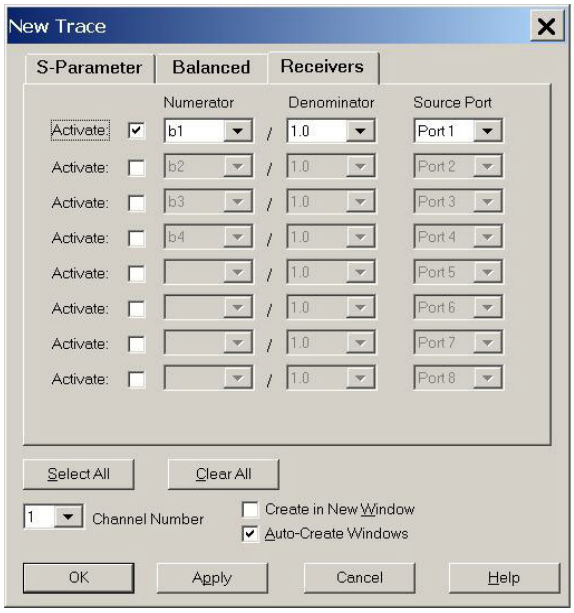
Figure 33 Selecting Balanced Measurements



Receivers Tab

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

Figure 34 Receiver Measurements

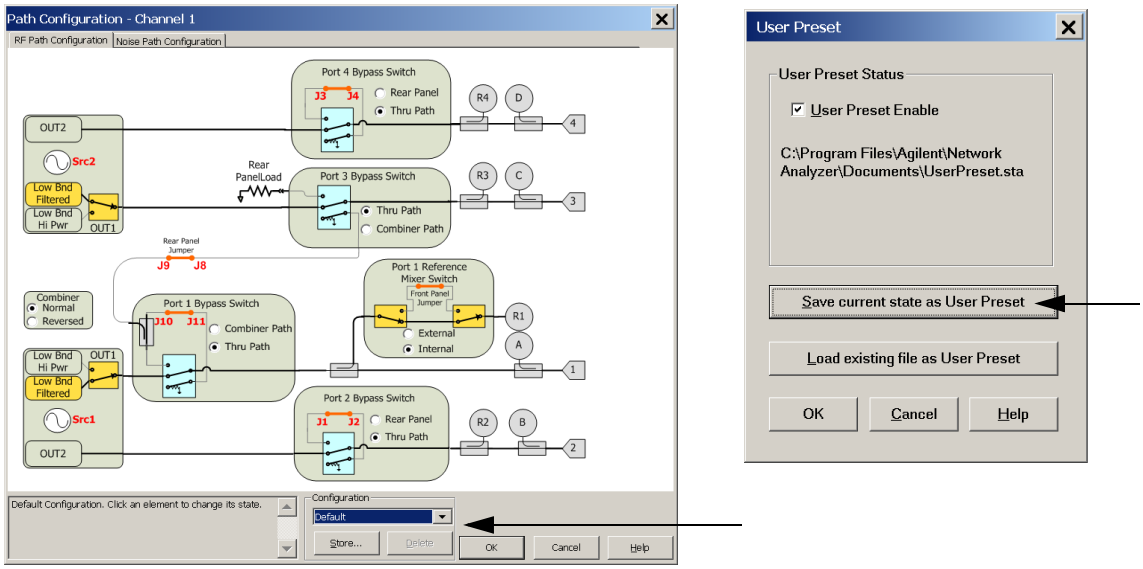


RF Path Configuration with Analyzer Option 029

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

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

Figure 35 RF Path Configuration



N-Port Calibration

It is recommended that you perform an ECal characterization to minimize the connections required for multiple port calibration. The N4691B Option M0F is recommended with cable (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...)***.

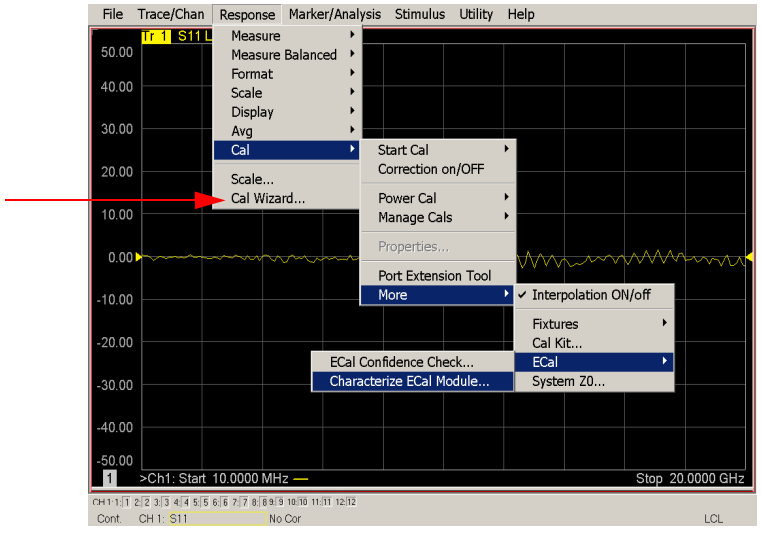
Calibrate at the end of the test port RF cables and any adapters that are used to connect the DUT. This removes the effect on the measurement of the DUT. Failure to do this will create ripple and other measurement errors. Refer to **ECal** > **User-Characterization.**

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 PNA, PNA-L or PNA-X Option 551 firmware revisions and history.
http://na.support.keysight.com/pna/firmware/firmware.html.

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

Figure 36 ECal Characterization and Calibration Wizard



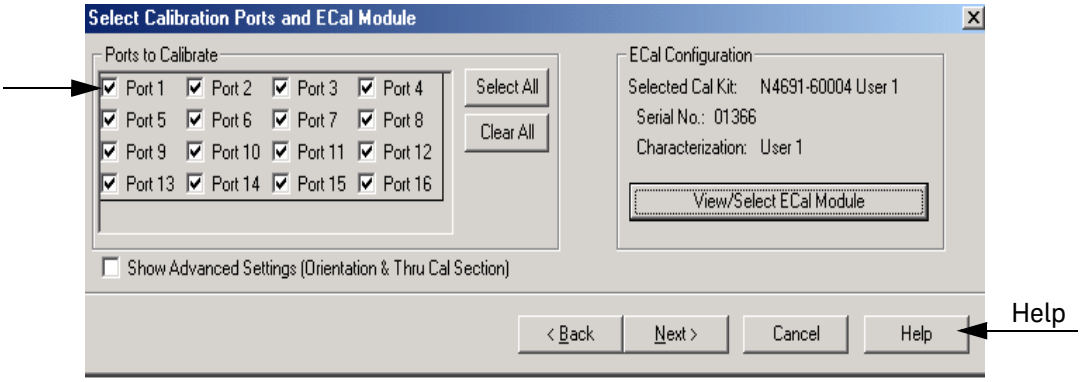
2. On the analyzer select **Response** > **Cal Wizard** -OR- ***(Response > Cal > Other Cals...)***

   a. If using a mechanical cal kit, select **SmartCal (Guided Calibration)** > **Next**.

   b. If using an ECal module, connect the ECal to an available USB port and select **Use Electronic Calibration (ECal)** > **Next** -OR- ***(Response > Cal > Other Cals > ECal...)***.

3. On the "Select Calibration Ports and ECal Module" dialog box press **Select All**, or select the ports you are calibrating and press **Next**. If an ECal characterization has been done, select **View/Select ECal Module** and select the previously saved user file from step 1.

Figure 37 16-Port Calibration



4. 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.

5. At the Calibration Completed prompt, select **Save As User Calset** and enter the name desired and **Save**.

6. 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 at http://na.support.keysight.com/pna/firmware/firmware.html.

NOTE

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

Overview of the Interface Control

The Interface Control feature allows you to send data and remote commands to control external equipment using the GPIB, Material Handler I/O, Test Set I/O, and Auxiliary I/O without needing to create a remote program. Refer to 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:
  1. GPIB Interface
  2. Material Handler Interface
  3. Test Set Interface
  4. Dwell Time

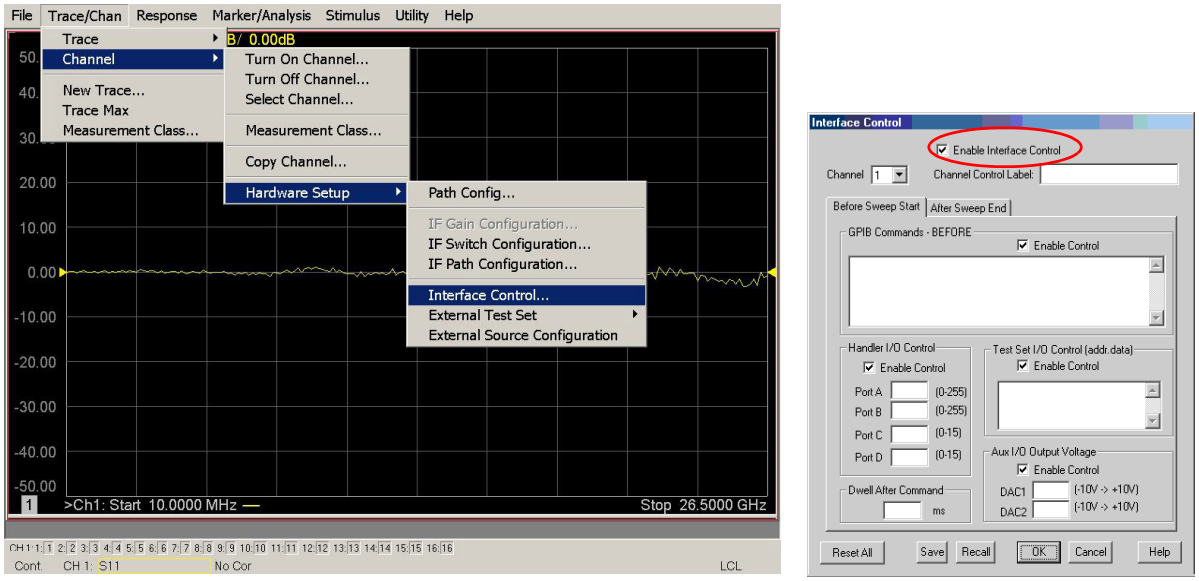
How to Access Interface Control Settings

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

NOTE

The network analyzer comes with the Interface Control application. Please review this application before connecting the test set to the analyzer. Information regarding this application can be found in the analyzer's Help menu, Interface Control.

Figure xx Interface Control



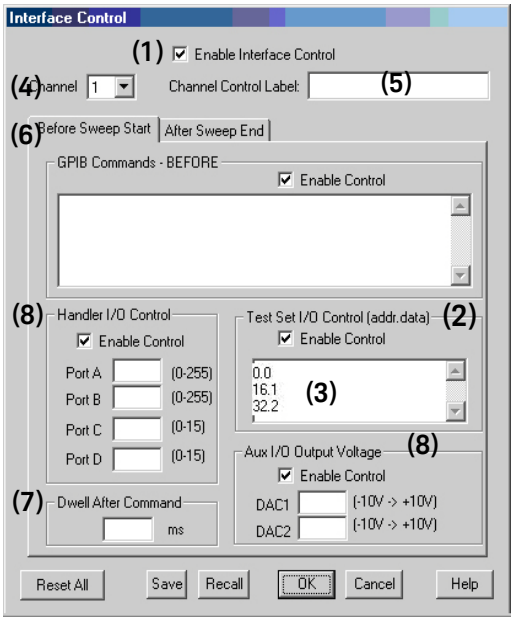
Using Interface Control Mode

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

NOTE

If an error is encountered when sending Interface Control data, an error message is displayed 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 38 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 51.

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 an analyzer 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 analyzer. Refer to the 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 analyzer's 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

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

Overview of the SCPI Control

The Command Processor allows you to send address and data to control an external test set without needing to create a remote program. The user is required to manually input address and data using the Command Processor Console in the PNA Help menu.

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

How to Access the Command Processor

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

2. Check the **SCPI Command Console** box.

Figure xx Command Console for 'A' Model Analyzers

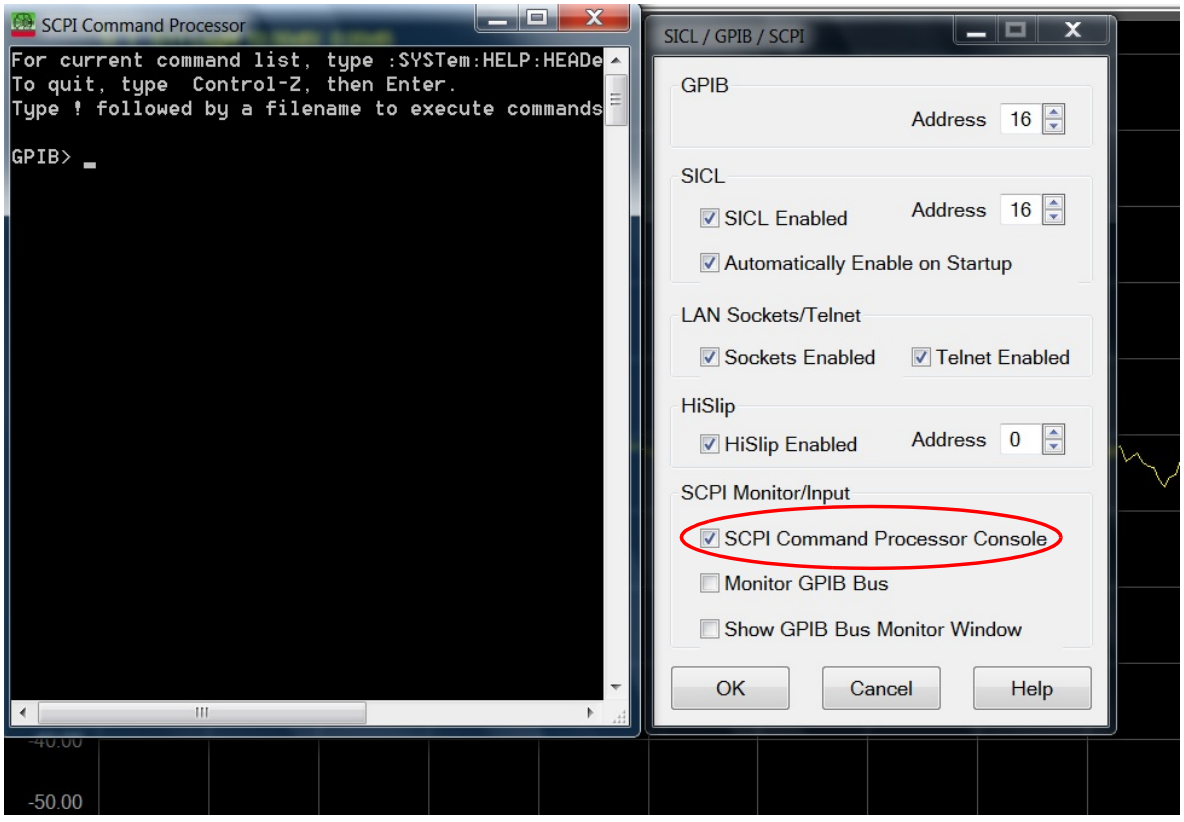
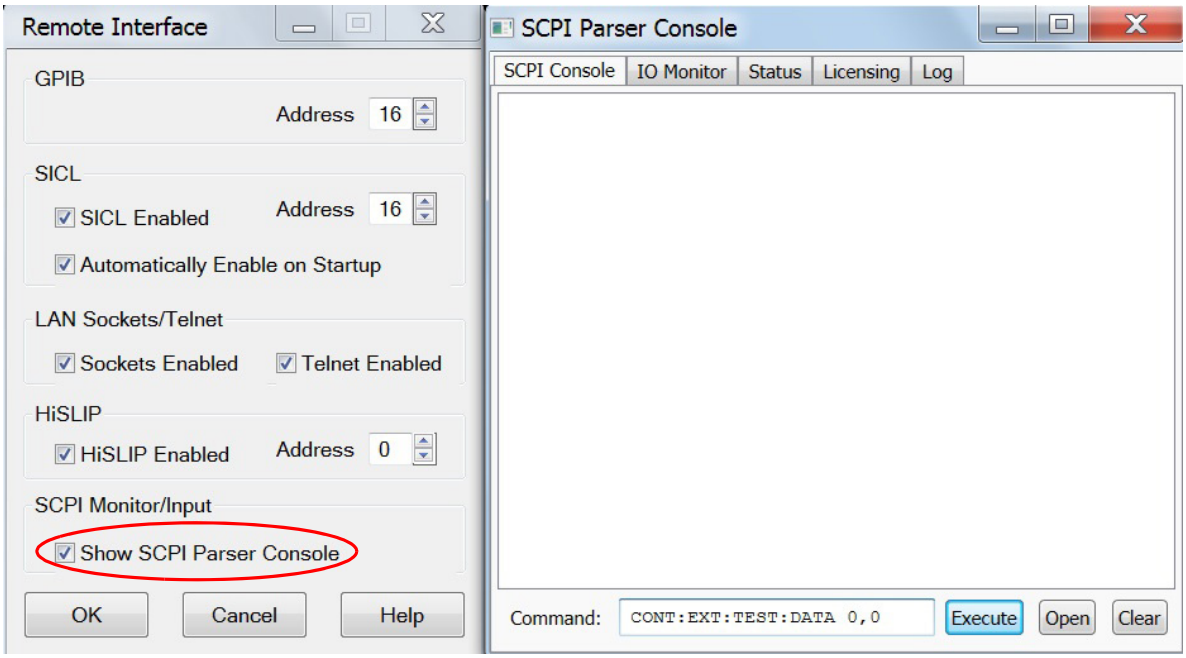


Figure 42 Command Console for 'B' Model Analyzers



SCPI Command Processor Console

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

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

Method 1 - Using GPIB/SCPI Command Values

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

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

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

Figure 43 Method 1 - Using GPIB/SCPI Command Values

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

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

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

DISP:WIND1:TRAC2:FEED 'ch1_S10_10'

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

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

Method 2 - Using the Test Set Address and Data Values

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

The Address and Data values for the Test Set can be found in the “Address and Data Values” section on page 56.

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

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

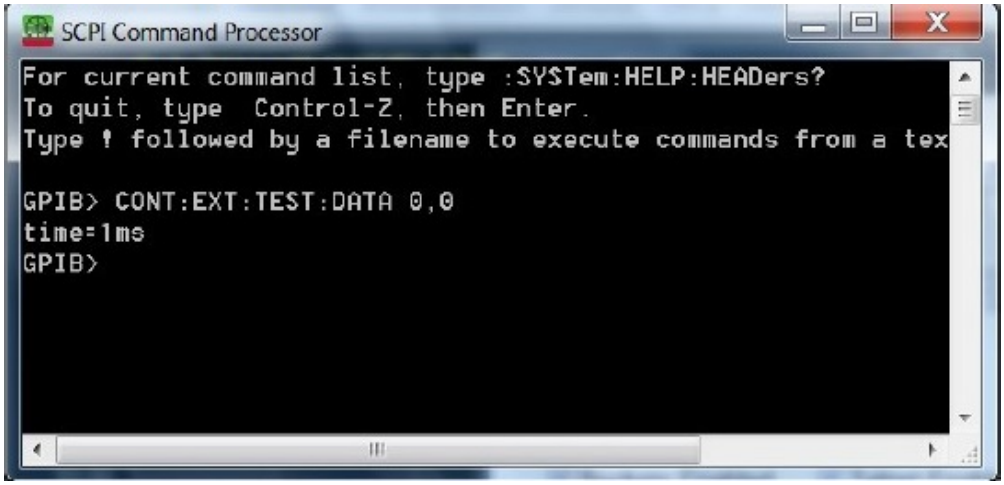
For example:

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

CONT:EXT:TEST:DATA 0,0

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

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



Option 129 External Source Path

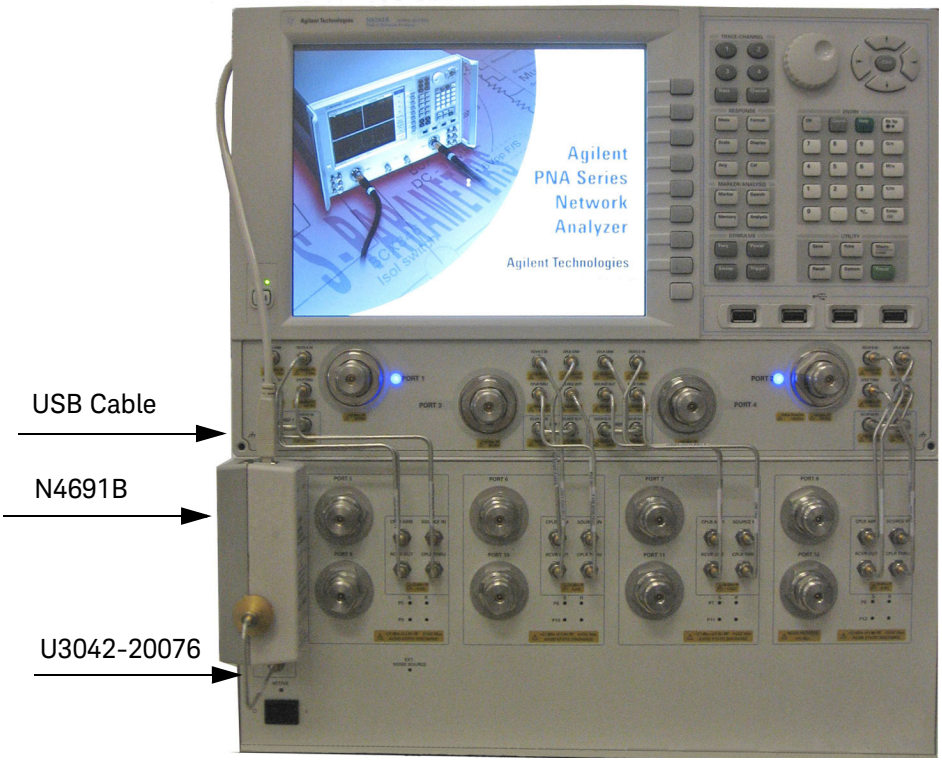
The U3042AM12 with Option 129 allows an external ECal module, or noise source to be switched into the Source path of Ports 1, 5, 9, or 13. Only one port can be the source at a time.

System Configuration

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 NOISE SOURCE IN on the test set.
2. Connected the cable (U3042-20076) from the NOISE SOURCE OUT on the test set to the ECal module.
3. Connect the ECal modules USB cable to one of the PNA-X USB ports.

Figure 41 N5242A System with ECal Module



Setting Option 129 Source Path

1. Restart the PNA to Standalone Mode, if it is in Multiport Mode. Refer to Figure 26 on page 33.
2. Refer to "Interface Control" on page 42, use the values listed in Table 11 to set Port 1, 5, 9 or 13 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 11 Option 129 Source Path Test Set I/O Commands

Address Data	Source Path
0.0	Standard Port 1
0.8	Noise Source Port 1
0.25	Noise Source Port 5
0.42	Noise Source Port 9
0.59	Noise Source Port 13

NOTE The Noise Source path is active when the front panel LED is On.

Address and Data Values

Setting the Test Port Paths with Address and Data

Refer to Table 12, Table 13 on page 52 and Figure 42 on page 52 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.

Example 1: If the ports have different addresses, two separate address data commands must be used. Refer to Figure 42 on page 52.

Port 5 is the Source and Port 8 is the Receiver.

Source Port 5 = address 0, data 1 and Receiver Port 8 = address 16, data 16.
Two separate commands must to be sent, you may use the same dialog box. Send address 0 and data 1 in one command line, and address 16 and data 16 in the second line. Refer to "Interface Control" on page 42 and "GPIB Control" on page 46.

For further information refer to "How to Access Interface Control Settings" on page 43 and "How to Access GPIB Command Processor" on page 46.

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

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

Source Port 5 = address 0, data 1 and Receiver Port 9 = address 0, data 32. The data values are added together, the entry will be 0.33.

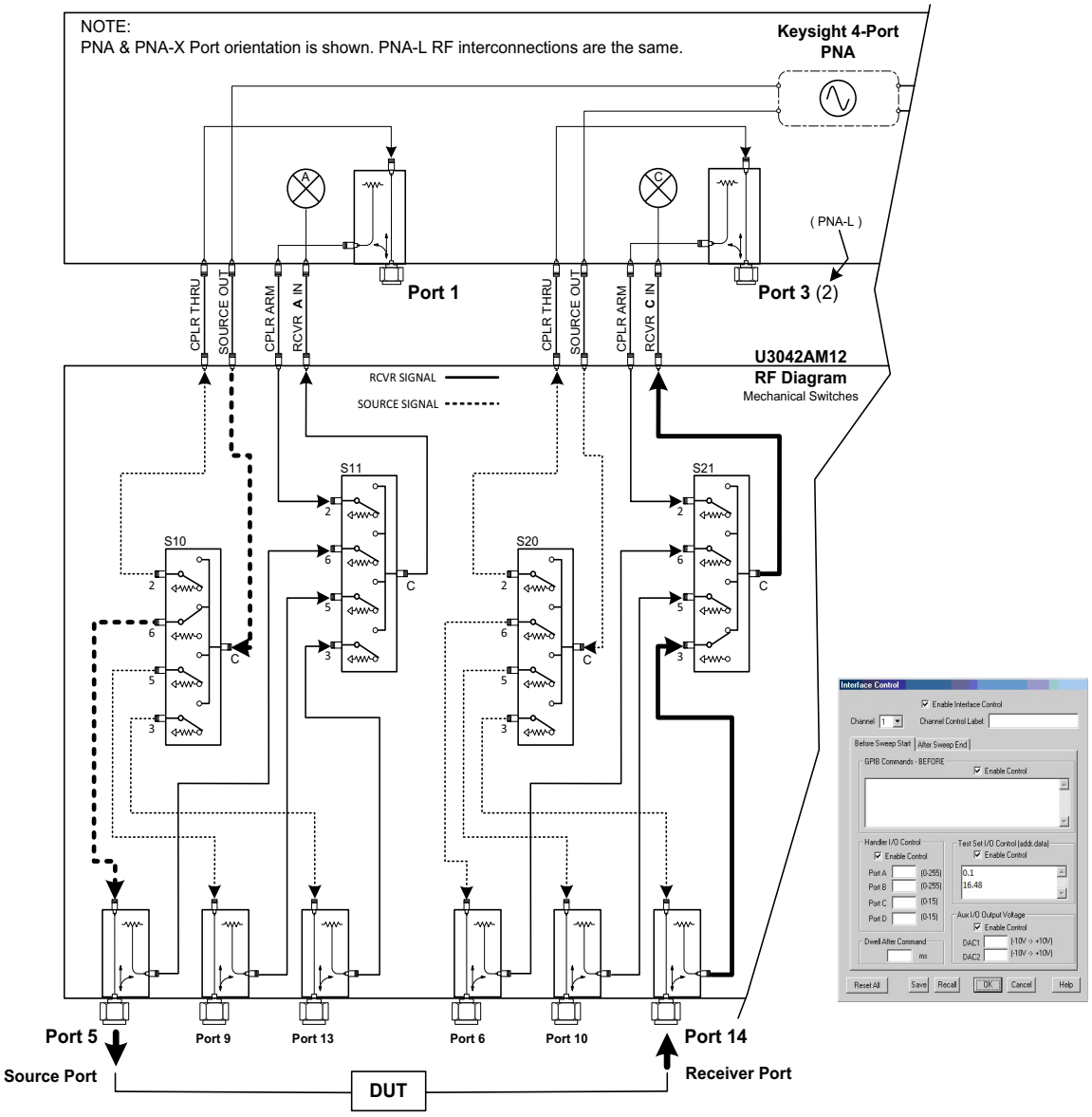
Table 12 PNA-L Port Value Select

Address		**Source Path**				**Receiver Path**			
	Data	0	1	2	3	0	16	32	48
0	Ports	1	5	9	13	1	5	9	13
16	Ports	2	6	10	14	2	6	10	14
32	Ports	3	7	11	15	3	7	11	15
64	Ports	4	8	12	16	4	8	12	16

Table 13 PNA or PNA-X Port Value Select

Address		Source Path				Receiver Path			
	Data	0	1	2	3	0	16	32	48
0	Ports	1	5	9	13	1	5	9	13
16	Ports	3	6	10	14	3	6	10	14
32	Ports	4	7	11	15	4	7	11	15
64	Ports	2	8	12	16	2	8	12	16

Figure 42 Address and Data Example 1 (Port 7 and 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 Voltage Supply Configuration” on page 56 and “Setting the Control Lines with Address and Data Values” on page 57. See Table 14 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 43 on page 54 and Table 15 on page 54 for control line pin location and description. Refer to “Internal Voltage Supply Configuration” on page 55 and “External Voltage Supply Configuration” on page 56 for configurations.

Table 14 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 43 DUT control Line Pin Assignment

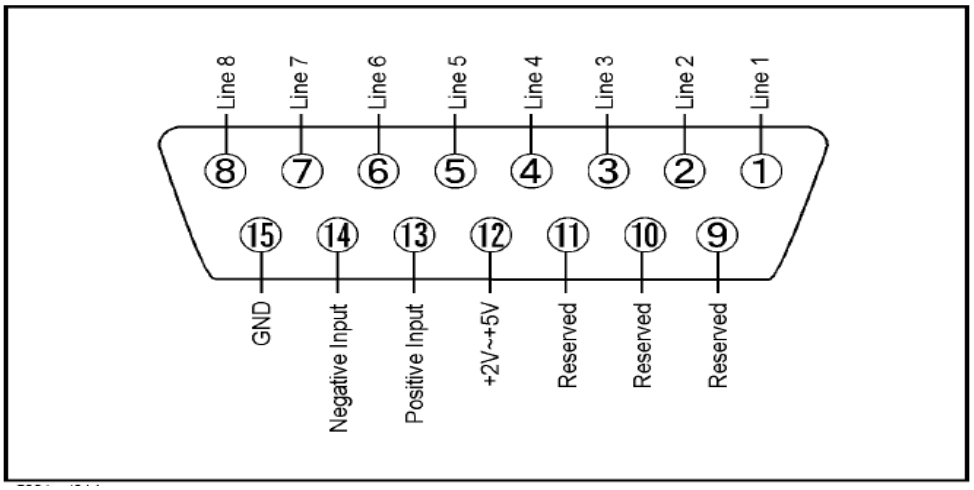


Table 15 DUT Control Line Interface Connector Pin Assignment

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

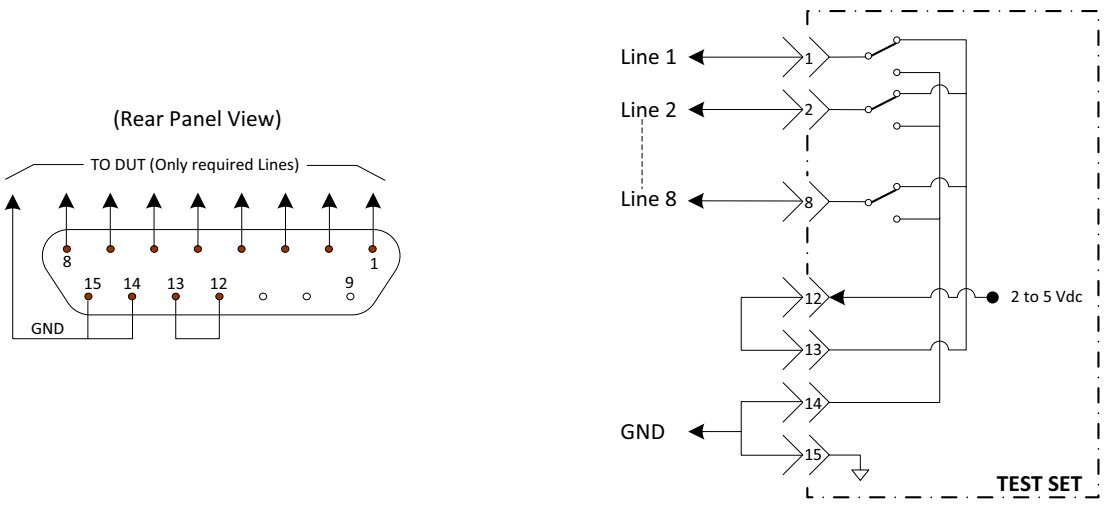
The output voltage of pin 12 can be varied from +2 to +5 V. Perform the following procedure to set the voltage:

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 front panel until the multimeter indicates the appropriate voltage

Figure 44 illustrates an example of the connection between the DUT and the test set *without* an external DC power supply. Connect pin 12 to pin 13, for +5 V, and pin 14 to pin 15 to provide the ground path. Connect each DUT control line to the external device under test.

CAUTION You may only connect pin 12–13, and pin 14–15. Damage may result if any other path is short-circuited.

Figure 44 Internal DC Power Configuration (rear panel view)



External Voltage Supply Configuration

Figure 45 illustrates an example of the connection between the DUT and the test set *with* an external DC power supply. Input the Hight and Low signals from the external power supply to the Positive Input and Negative Input respectively, and connect each line to the control terminal of the DUT.

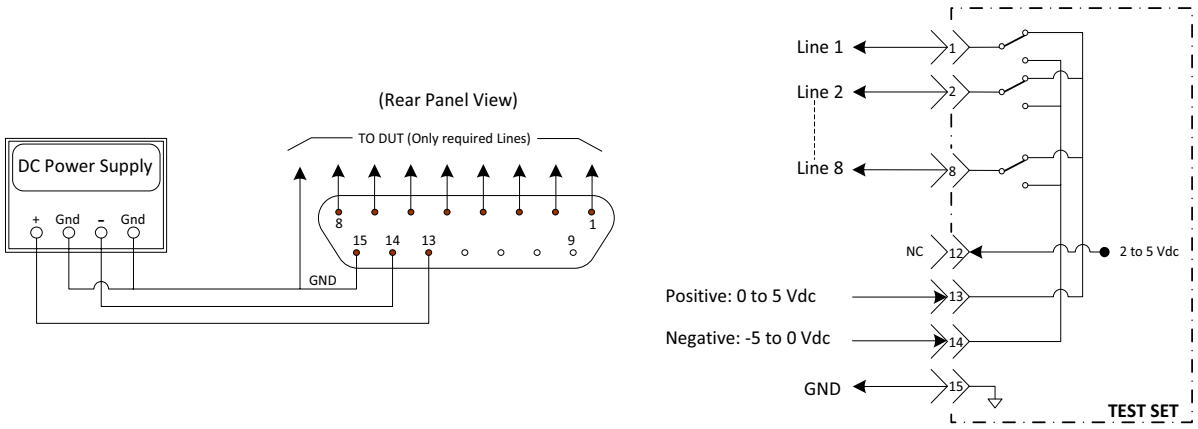
Turning *On* the Test Set using an External Power Supply.

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 45 Test Set to the DUT and External DC Power Supply



Setting the Control Lines with Address and Data Values

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

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

Setting the Analyzer to Standalone Mode

1. **Select Utility > System > Configure > Multiport Capability**. In the dialog box select **Restart as a standalone PNA > OK**.

As described in "Address and Data Values" on page 51, the <address>.<data> values are determined in a similar manor, with the following exceptions:

- Table 16 will be used.
- The <address> value is always = 112

Table 16 Test Set DUT Control Address and Data Logic Table

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

After a power reset all DUT control lines are initially configured to a logic high state or connected to Pin 13, refer to Figure 44 on page 55. To reset all control lines to logic high, without having to reset the power switch on the test set, make the following PNA entry:

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

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

Listed are two examples to illustrate this concept. Refer to Figure 31 on page 37 shown with all lines = logic high.

Example 1

To change lines 1 & 8 to equal logic Low, all others logic high.

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

Example 2

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

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

NOTE

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

Cal Kit Operational Check

This section provides operational check to confirm the test set and analyzer operational performance. The operation verification limits provided ensure that your test set and analyzer are operating properly.

Equipment Required

The test set requires that the user be familiar with the equipment and components listed in Table 17.

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

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
N5230C 4-Port Network Analyzer (Option 245 and 551) *or* N5222A, N5232A or N5242A Option 400 and 551	1
Set of interconnect cables (PNA and test set), see “PNA-L RF Interface Cable Connections” on page 21 or “N5222A or N5242A RF Interface Cable Connections” on page 26.	1

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 U3042AM12.

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

NOTE Typical specifications are based on 1 to 2 units performance. Refer to Table 18 and Table 19 on page 60.

Table 18 Reflection Tracking with PNA-L[a]

Frequency	Port 1-16
10 MHz to 4 GHz	-5 dB
4 GHz to 6 GHz	-6 dB
6 GHz to 10 GHz	-8 dB
10 GHz to 15 GHz	-12 dB
15 GHz to 20 GHz	-14 dB

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

Table 19 Reflection Tracking with PNA or PNA-X[a]

Frequency	Port 1-16
10 MHz to 4 GHz	-5 dB
4 GHz to 6 GHz	-6 dB
6 GHz to 10 GHz	-8 dB
10 GHz to 15 GHz	-12 dB
15 GHz to 20 GHz	-14 dB
20 GHz to 26.5 GHz	-15 dB

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

NOTE If you suspect that your 16-Port configuration is not operating properly, ensure that all front RF jumper interconnect cables are correctly attached.

Table 20 Option 129 Noise SOURCE OUT to CPLR THRU

Frequency	Loss
10 MHz to 4 GHz	-1 dB
4 GHz to 6 GHz	-1.5 dB
6 GHz to 10 GHz	-2 dB
10 GHz to 15 GHz	-3 dB
15 GHz to 20 GHz	-4 dB
20 GHz to 26.5 GHz	-5 dB

Table 21 Option 129 Noise SOURCE IN to Port 1, 5, 9, or 13

Frequency	Port
10 MHz to 4 GHz	-4 dB
4 GHz to 6 GHz	-5 dB
6 GHz to 10 GHz	-6 dB
10 GHz to 15 GHz	-7 dB
15 GHz to 20 GHz	-8 dB
20 GHz to 26.5 GHz	-10 dB

Cal Kit Operational Check Procedure

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

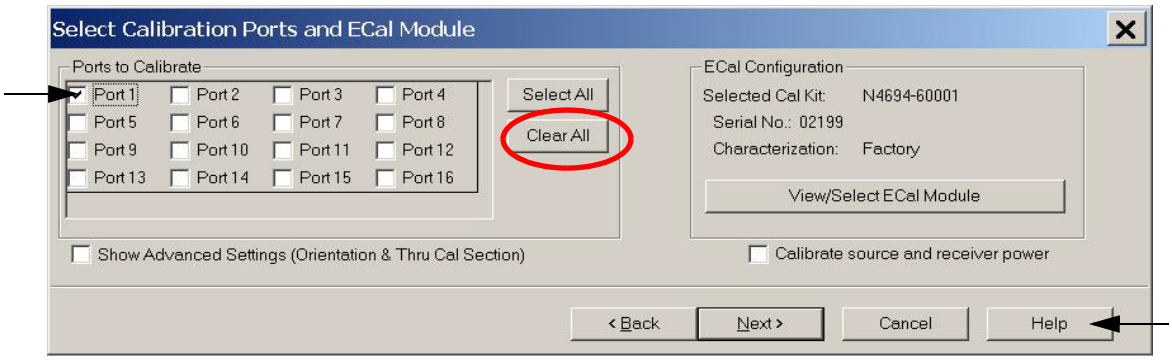
Preparing the Network Analyzer

1. Configure the test set to the analyzer using the interconnect cables as shown in "System Setup with N5230C and N5232A" on page 18 or "System Setup with N5222A and N5242A" on page 23.
2. Turn *on* the test set.
3. Select **Response** > **Cal** > **Manage Cals** > **Cal Set**. Delete or rename any Cal Sets titled "999.1" thru "999.12" (12-Port), although it is unlikely that you will find Cal Sets with these names.
4. Verify that the analyzer is in Multiport mode. See the bottom of the measurement window.
   a. If only four S-Parameters are listed, select **Utility** > **System** > **Configure** > **Multiport Capability**. Select **Restart as multiport PNA with this testset** and select **U3042M08** (12-Port) from the drop-down menu > **OK**. Refer to Figure 26 on page 33.
5. Press [**Preset**].
6. Verify that the [**Start Frequency**] is set to [**300 kHz or 10 MHz**].
7. Set the [**Stop Frequency**] is set to [**20 GHz or 26.5 GHz**].
8. Select [**Power**] > **Power Level** and enter [**0 dBm**].
9. Select **Response** > **Avg** > **IF Bandwidth** > **100 Hz** > **OK**.
10. Select **Stimulus** > **Sweep** > **Number of Points** > **401**.
11. Connect the ECal module to an available PNA USB port on the front or rear panel. This procedure assumes you are using an ECal. If you are not, see "1-Port Calibration and Verification Procedure" on page 63, step 2.
12. Allow the ECal module, test set, and analyzer to warm up for a minimum of 30 minutes.

1-Port Calibration and Verification Procedure

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

Figure 46 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**, type the name **999.1**. Overwrite the Calset if it already exists and **Save**.

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

Figure 47 Calibration Complete

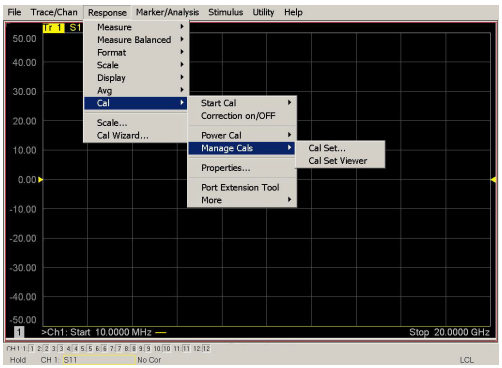
7. Repeat step 1 thru step 5 (1-Port Calibration Procedure) for Ports 2 thru 12. When finished, there should be 12 Cal Sets saved with the titles “999.1” thru “999.16” (16-Port).

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

8. Select **Trace/Chan** > **Trace** > **Delete Trace**. There should be no traces on the screen.

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

Figure 48 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. Ensure that the **Enable** and **Error Terms** check boxes are selected.

11. Compare the Reflection Tracking (1,1) trace to the appropriate limits in Table 19 on page 60. This can be done using Limit Lines (press **Marker/Analysis** > **Analysis** > **Limit Test**). The trace should be above the limit. PASS will be displayed on the screen if the limit lines are used.

12. Repeat step 10 and step 11 for Cal Sets "999.1" thru "999.16" (16-Port).

Figure 49 Setting the Test Limits

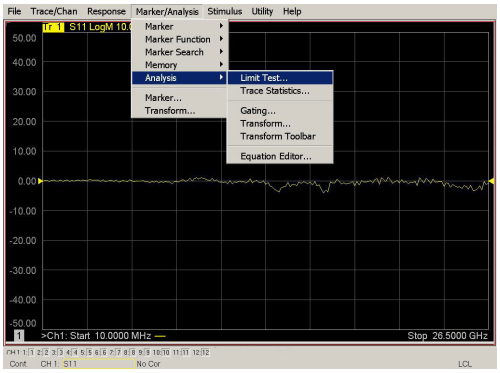


Figure 50 Reflection Tracking PNA or PNA-X (Ports 1 to 4) & PNA-L (Port 1-16)

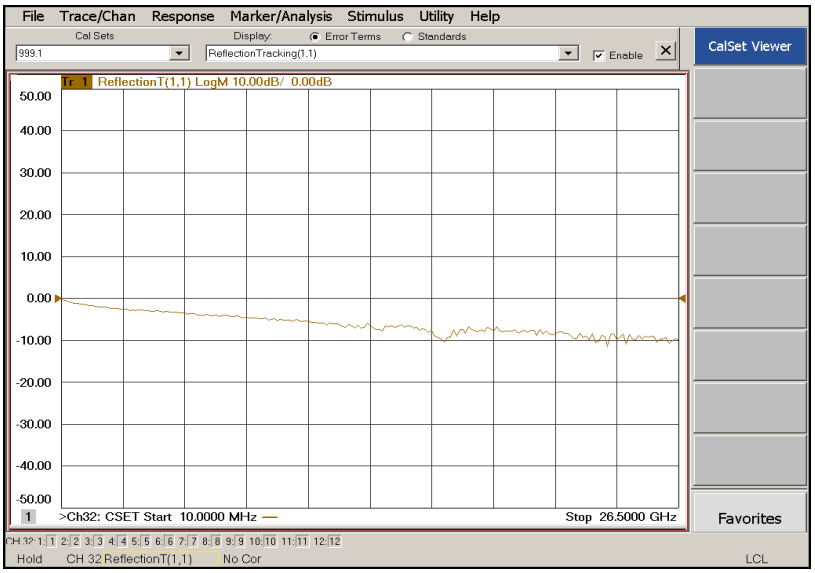
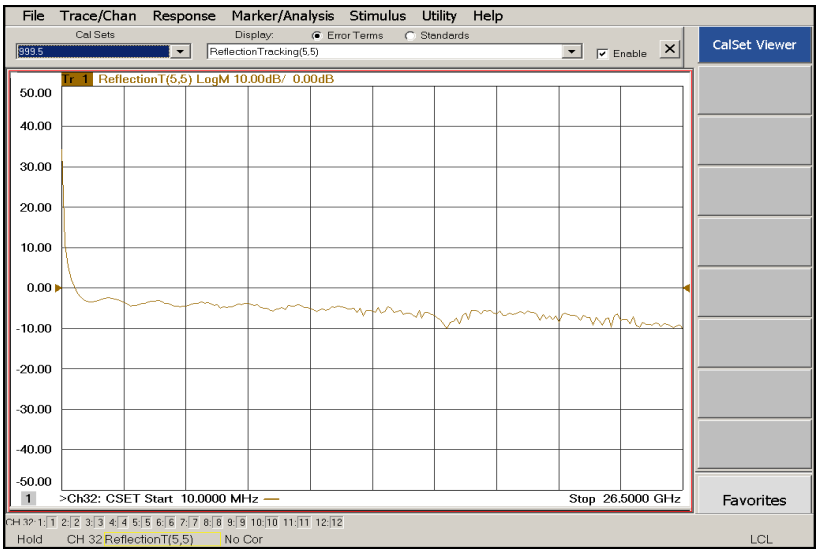


Figure 51 Reflection Tracking (Ports 5 to 16) with PNA or PNA-X



NOTE

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

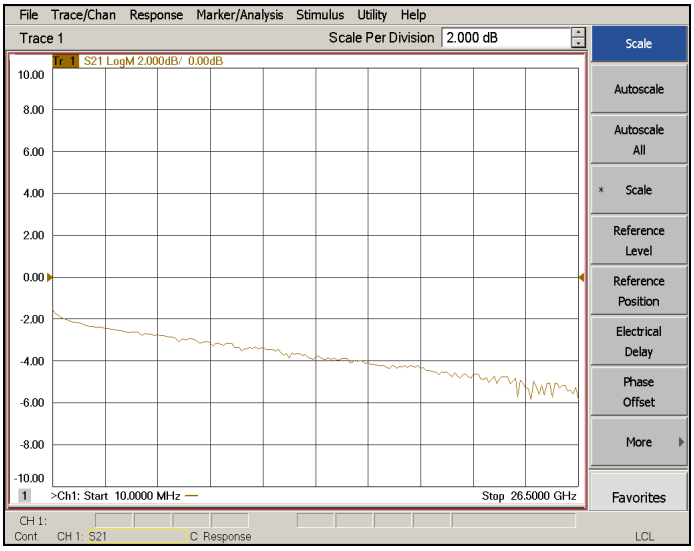
Option 129 Operational Check

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, or 13 and the Noise Source Out to the CPLR THRU.

Noise Source In Test

1. Set the PNA to Standalone Mode.
2. Connect the interface cables, as shown in Figure 12 on page 22 or Figure 18 on page 27.
3. Connect two RF test cables to the PNA Ports 3 and 4. Connect the two cables together using an adapter.
4. Perform a response calibration to normalize and remove the loss created the test cables.
5. Move the adapter to Port 1.
6. Connect the cable from Port 3 to Noise Source In.
7. Connect the cable from Port 4 to the adapter on Port 1.
8. Send the Test Set I/O command 0.8. Verify that the Ext Noise Source front panel LED is On.
9. Set trace S34 and verify that the trace is approximately -3 to -7 dB.
10. Repeat for Port 5 (Test Set I/O command 0.25).
11. Repeat for Port 9 (Test Set I/O command 0.42).

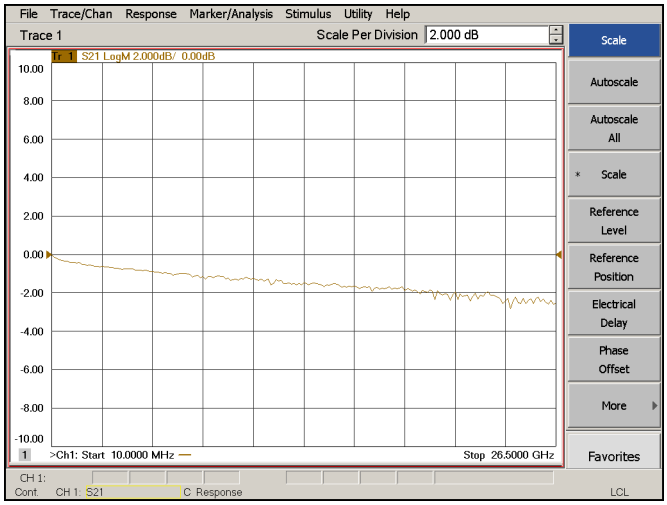
Figure 52 Noise Source In Trace



Noise Source Out Test

1. Set the PNA to Standalone Mode.
2. Remove the jumper from Port 1 CPLR THRU to test set CPLR THRU. Figure 12 on page 22 or Figure 18 on page 27.
3. Connect two RF test cables to the PNA Ports 3 and 4. Connect the two cables together using an adapter.
4. Perform a response calibration to normalize and remove the loss created the test cables.
5. Remove the adapter.
6. Connect the cable from Port 3 to Noise Source Out.
7. Connect the cable from Port 4 to the CPLR THRU on the test set.
8. Send the Test Set I/O command 0.8. Verify that the Ext Noise Source front panel LED
   is On.
9. Set trace S34 and verify that the trace is approximately -0 to -3 dB.

Figure 53 Noise Source Out Trace



Verifying Cal Kit Operational Check Failure

If your test results fail the Cal Kit Operational Check limits, see Table 6 and Figure 4 on page 14 and verify the following:

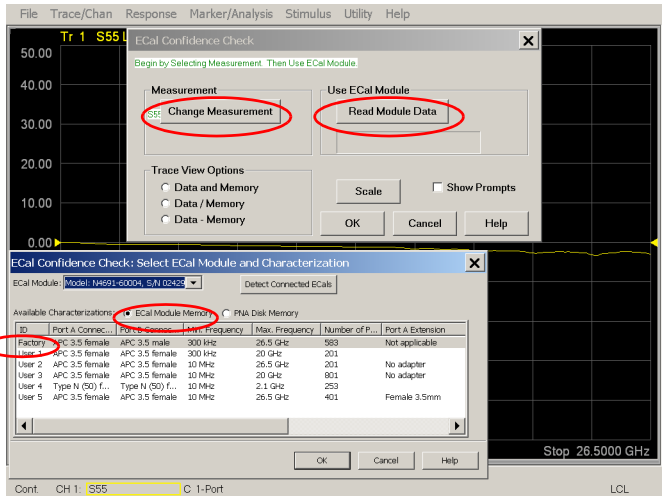
1. Ensure that the test set is turned on and connected properly to the analyzer.
2. Check all appropriate analyzer and test set connectors for damage, cleanliness, and proper torque.
3. Repeat the relevant 1-Port calibrations using another ECal or mechanical standard.
4. Verify that the analyzer is operating properly and meeting its published specifications. If the analyzer is connected to the test set it will fail the Operational Check. Refer to “Network Analyzer Requirements” on page 8.

ECal Confidence Check

The following ECal Confidence Check is a method to check the accuracy of a 1-Port calibration performed with mechanical standards or an ECal module. In order to perform this check, the test port of the ECal module must connect directly to the test port being verified (without adapters).

1. Perform a 1-Port calibration on the test set port being tested.
2. Connect the ECal Module to the port being tested. Terminate any remaining ports on the ECal Module.
3. Select the Cal Set to be tested. Select **[CAL] > Cal Set > Cal_File > Apply Cal > Close**. 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**.
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 the **ECal Module Memory > Factory > OK**.

Figure 54 Ecal Confidence Check



Interconnect Cable Verification

1. Perform the “System Operational Checks” on page 28.
2. If the problem still exists, perform the “RF Switching Failures” on page 80.

If a power hole or other failure still exists, refer to “Contacting Keysight” on page 94.

Service Information

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. Refer to “Contacting Keysight” on page 94 for additional information on available service agreements for this product.

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 Keysight.com.

Table 22 Available Replacement Parts (SPO)

Description	Keysight Part Number
4-Port Terminated Latching Coax Switch with Opt 124, 026, 201, 302 and 403	N1811-60027
Switch, Multiport, SP4T, DC-26.5 GHz	87104-60045
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
Couplers, Bridge	5087-7752
Analyzer’s Locking Feet	5023-0132
PNA-L Test Set Locking Feet	5063-9253
Test Set I/O Cable	N4011-21002
Fan (rear panel)	87050-60027
DUT Control Board	U3020-63223 (RoHS)
RF Cable, Semi-rigid	Z5623-20418
RF Cable, Semi-rigid	Z5623-20419

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 23 Replacement Parts (M12)

Description	Keysight Part Number
Port 1 SOURCE OUT	U3042-20031
Port 1 CPLR THRU	U3042-20032
Port 1 CPLR ARM	U3042-20029
Port 1 RCVR A IN	U3042-20030
Port 3 SOURCE OUT	U3042-20035
Port 3 CPLR ARM	U3042-20033
Port 3 RCVR C IN	U3042-20034
Port 3 CPLR THRU	U3042-20036
Port 4 CPLR ARM	U3042-20037
Port 4 RCVR D IN	U3042-20038
Port 4 SOURCE OUT	U3042-20039
Port 4 CPLR THRU	U3042-20040
Port 2 CPLR ARM	U3042-20041
Port 2 SOURCE OUT	U3042-20043
Port 2 RCVR B IN	U3042-20042
Port 2 CPLR THRU	U3042-20044
SW Interface Board, programmed	U3025-60062
User's Guide (Option M12)	U3042-90006
Dress Nut (coupler/bridge)	N5230-20081
PNA-X Test Set Rear Lock Feet (right)	N5242-20138
PNA-X Test Set Rear Lock Feet (left)	N5242-20139
10 LED Board	N5261-60005
Test Set Control Board (programmed)	N5261-60006

System Block Diagram

Figure 55 U3042M12 Block Diagram

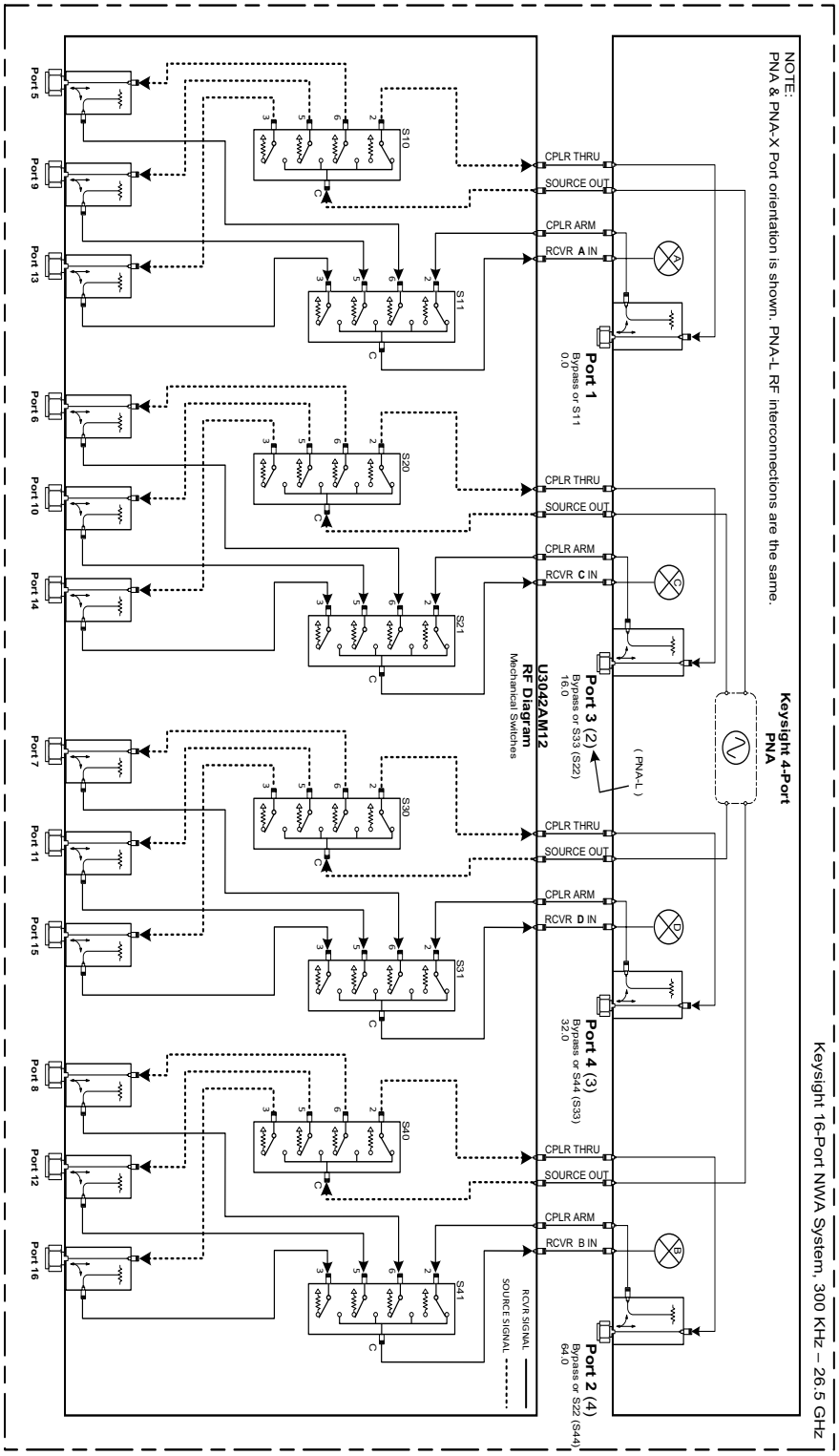


Figure 56 U3042M08 Option 129 Configuration

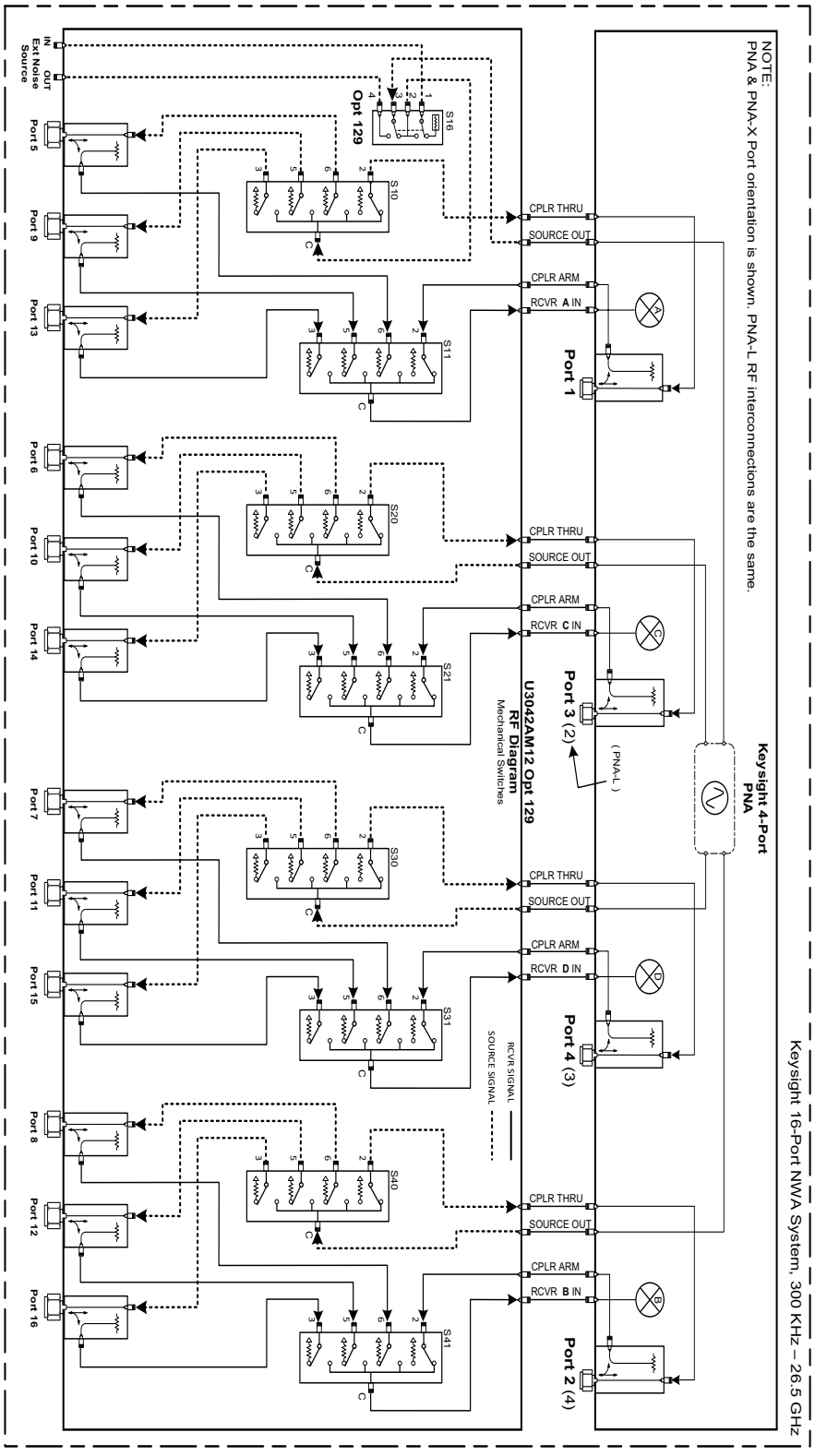
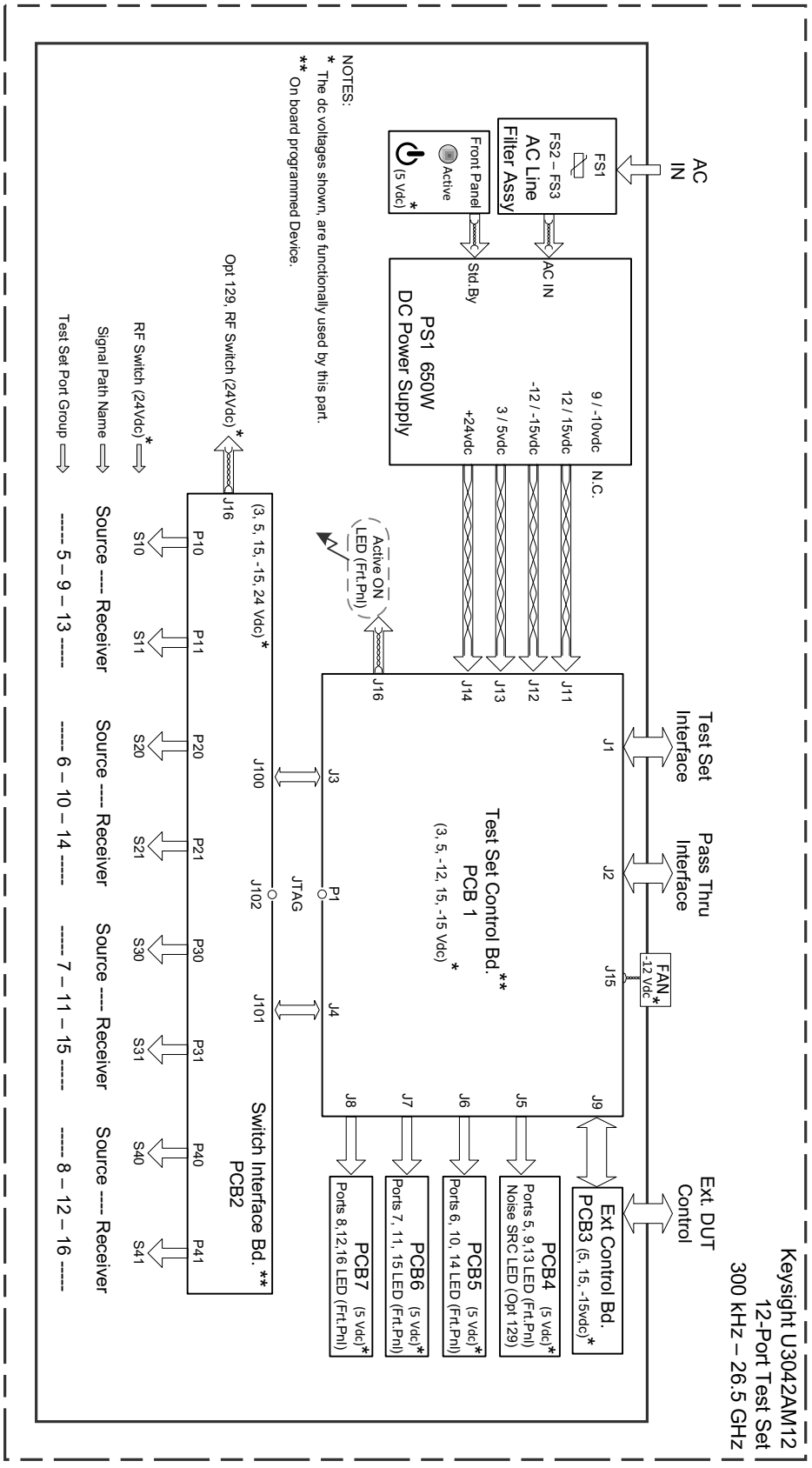


Figure 57 Electrical Block Diagram



Theory of Operation

The following is a description of the operation of the test set. Reference the test set block diagrams shown in Figure 55 on page 72. This section assumes the user has a general understanding of couplers, switches, and network analyzers.

The test set adds 12 test ports to a 4-Port network analyzer. The internal RF switches direct the source and receiver signals of the analyzer to the selected measurement test port.

The switches and couplers are arranged in four groups to control the source and receiver paths of the analyzer port to the couplers in the column under the analyzer port.

Test Set Control Board

The test set Control Board (N5261-60006) is a surface mount, printed circuit assembly (PCA). It provides a connection to the power supply, and the analyzer's Test Set I/O for control of the RF switch paths (through the Switch Interface board (U3025-60062). The front panel "Active" and port LEDs are on only when the analyzer has addressed the test set. The rear panel fan is on when the controller board supplies are operational.

Switch Interface Board

The Switch Interface board (U3025-60062) is installed on top of the test set Controller Board and provides connections to the RF switches. This board regulates the DC voltage supply (24 volts), and routes logic signals to the switches.

Front Panel LED Boards

Four LED board assemblies (N5261-60005) are mounted to the front panel. The LED's indicate the Source Path (amber/yellow color), or Receiver Path (green colored) shown as "S" and "R" on the front panel. The LED board assemblies are connected to the test set controller board.

DUT Control Board

The DUT Control board (U3020-63223) provides eight control lines for controlling an external device. The DUT Control Board installed on the rear panel and is connected to the test set Control board through a ribbon cable to J9.

Power Supply

The switching power supply (0950-4729) coverts the AC line voltages to DC. This is an automatic line voltage selecting power supply. The DC supplies are connected to the test set control board through four wire harness to J11, J12, J13 and J14. The 9/10 Vdc section of the power supply is not used in this instrument. The AC line voltage (100 to 240 V @ 50/60 Hz) is provided from the line module on the rear panel.

RF Coupler/Bridges

The test set uses 12 couplers (5087-7752) on the front panel for RF Test Ports 5 to 16. The couplers provide the signal separation of the source and receiver paths. 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.

RF Switch Components

The test set uses 12 SP4T mechanical, DC to 26.5 GHz, switches (87104-60045). The switches select the RF paths from the analyzer's source and receiver through interconnect cables to the test set. Option 129 installed a Transfer Switch (N1811-60027) in the Source Out path for ports 1, 5, 9, and 13.

Source and Receiver Switch Paths

Refer to the RF Block Diagrams, Figure 55 on page 72 and Figure 56 on page 73 for source and receiver switch path details.

Test Set Control Board

The test set Control board (N5261-60006) is a surface mount, printed circuit assembly (PCA). It provides a connection to the power supply, and the PNA Test Set I/O for control of the RF switch paths (through the Switch Interface board (U3025-60062). The front panel "Active" and port LEDs are on only when the PNA has addressed the test set. The rear panel fan is on when the controller board supplies are operational.

Troubleshooting the Test Set

If the test set is not operating properly, use the following procedures to isolate and repair the type of failure encountered. It is recommended that a qualified service technician perform the following procedures.

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

To request service, please contact your local service center. In the US, call 800-829-4444. For a listing of service centers worldwide, please visit us at http://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

Typical malfunctions may be the rear panel fan, DUT control lines or front panel indicator lights.

1. Verify that the front panel Power Switch is operational.
   a. The rear panel fan and front panel Active LED should operate when the Standby Switch is in the On position.
2. 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. Confirm the instrument AC line module fuse is operational. See Figure 6 on page 17.
   c. Internal AC line fuses - Remove the bottom cover of the instrument. Near the rear panel are two fuse holders, remove the fuses and verify that they are operational. Refer to Figure 58 on page 78.

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.**

3. Internal DC Power - During this check you will apply AC power to the instrument with the top cover removed. Connect the AC power cord to the test set.
   a. Set the front panel switch to the Standby position. The fans or indicator lights should be Off.
   b. Set the standby switch to the On position. The rear panel and internal power supply fans should be operational. The Active LED will be On when test set is connected to an active the analyzer and is addressed by the analyzer.
   c. Verify that the DC LEDs indicators are On.

NOTE The LEDs only indicate the presence of a DC voltage, not the DC voltage level. Use the indicated wire locations for voltage measurements, TP1 is your common. Refer to Figure 58 on page 78.

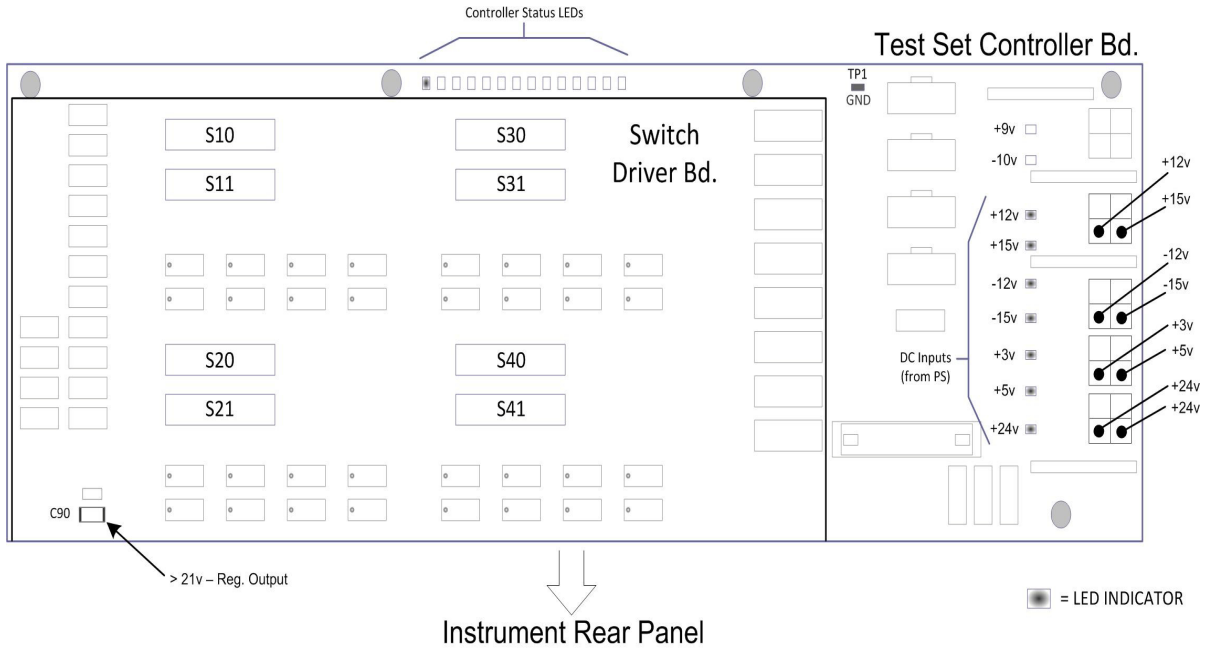
d. If there is no DC power, suspect the power supply module. The actual power supply terminal connection should also be confirmed with a DVM by removing the bottom cover and using the power supply label to identify the terminal voltage values.

e. If all of the DC Input LEDs are On and the fan is not working, replace fan.

f. Using a DVM confirm that the RF Switch power regulator output (> 21 Vdc) is present on the Switch Driver board, at the side of the SMT Cap (C90) as shown in Figure 58 on page 78.

NOTE The +9 and -10 Vdc indicators are not used in this instrument (Off is normal).

Figure 58 DC Power Status LEDs



4. Front Panel R and S indicator LED Check.

   a. If the indicators are not operating, continue to "RF Switching Failures" step 1 and step 2.

5. 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 53.
    b. Verify that the rear panel DC voltage control adjustment can be set to 5 Vdc. Refer to Figure 5 on page 16.

RF Switching Failures

Typical failures may be the loss of RF switch control or a non RF failure as outlined in the prior section. The internal RF switches used in this instrument are controlled by the +21 Vdc from the Switch Driver board.

1. Confirm that the analyzer and test set are properly connected using the Test Set I/O cable (N4011-21002). See Figure 19 on page 27.
2. Using Multiport Mode (Option 551), verify that the analyzer's firmware is correct, and that the test set file is loaded into the analyzer. Refer to "Network Analyzer Requirements" on page 8.
3. Using the I/O command values, confirm that the correct address and data values are used. Refer to "Address and Data Values" on page 51.
4. Follow the "Non-RF Failures" on page 77 procedures (if not already done so).
5. Front Panel R and S indicator LED Check.
    a. Confirm that the test set Controller board Status LED's are On. Refer to Figure 58 on page 78. If the LED's are Off remove the Switch Driver board, if the LED's are remain Off replace the Controller board.
    b. If the Status LED's are On and the front panel Active LED is On, suspect the front panel LED board or the ribbon cable (replace as needed).

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. Path checks 1 thru 4 are from the front panel Test Port to the analyzer source and receiver interconnect ports. Path checks 5 and 6 are test set bypass signal paths for of analyzer Ports 1 to 4.

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

Equipment Required

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

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

Equipment Setup

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

NOTE

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

Cable Connections

The RF flex cables will be connect to the designated test set front panel ports and an uncorrected response trace should resemble the figures indicated in Table 24.

Table 24 RF Signal Path Insertion Loss (S21)

RF Path Description	Signal	Insertion Loss (typical)
Source IN to Ports 5-16	Source	Figure 59 on page 83
RCVR OUT to Ports 5-16	Receiver	Figure 60 on page 83
Source IN to CPLR THRU	Source	Figure 61 on page 83
RCVR OUT to CPLR ARM	Receiver	Figure 61 on page 83

Source Signal Path Insertion Loss Test

Connect the RF Flex cables to the Test Port and Source IN port indicated in Table 25, the expected results should be similar to Figure 59 on page 83.

Table 25 Source Signal Path Test Instructions

Path #	RF Path Description	Control Mode <Address>.<Data>	Path Components
1	Source IN to Port 5[a]	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 6	16.1	P6 CPLR, S20
5	Source IN to Port 10	16.2	P10 CPLR, S20
6	Source IN to Port 14	16.3	P14 CPLR, S20
7	Source IN to Port 7	32.1	P7 CPLR, S30
8	Source IN to Port 11	32.2	P11 CPLR, S30
9	Source IN to Port 15	32.3	P15 CPLR, S30
10	Source IN to Port 8	64.1	P8 CPLR, S40
11	Source IN to Port 12	64.2	P12 CPLR, S40
12	Source IN to Port 16	64.3	P16 CPLR, S40

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

Figure 59 Source IN to Ports 5-16 Path Response

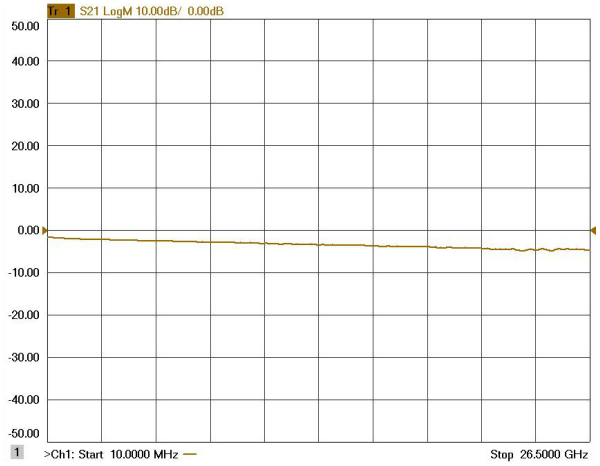


Figure 60 RCVR OUT to Ports 5-16 Path Response

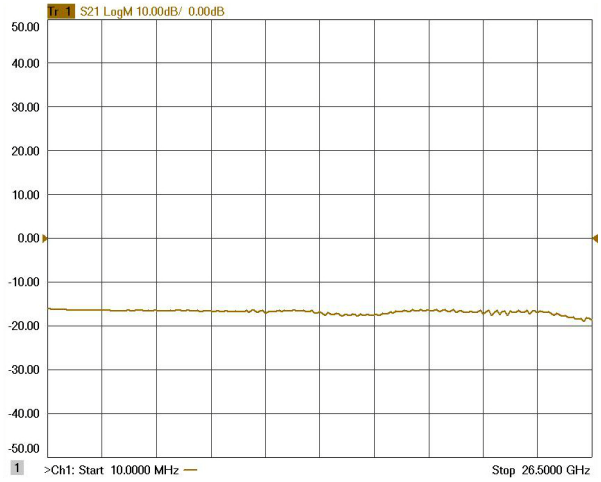
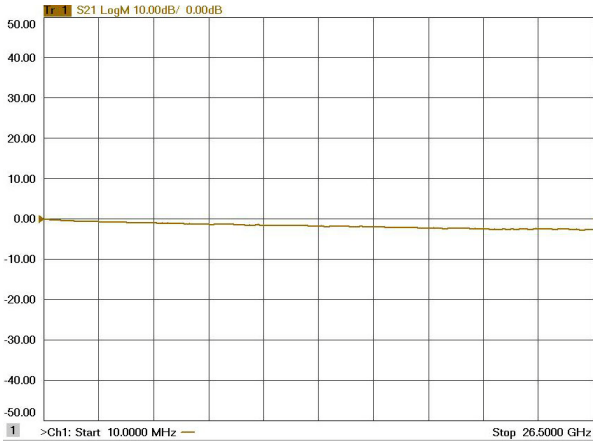


Figure 61 Source & Receiver Bypass Signal Path Response



Connect the RF Flex cables to the Test Port and RCVR OUT port indicated in Table 26. The expected results should be similar to Figure 60 on page 83.

Table 26 Receiver Signal Path Test Instructions

Path #	RF Path Description	Control Mode <Address>.<Data>	Path Components
1	RCVR OUT to Ports 5[a]	0.16	P5 CPLR, S11
2	RCVR OUT to Ports 9	0.32	P9 CPLR, S11
3	RCVR OUT to Ports 13	0.48	P13 CPLR, S11
4	RCVR OUT to Ports 6	16.16	P6 CPLR, S21
5	RCVR OUT to Ports 10	16.32	P10 CPLR, S21
6	RCVR OUT to Ports 14	16.48	P14 CPLR, S21
7	RCVR OUT to Ports 7	32.16	P7 CPLR, S31
8	RCVR OUT to Ports 11	32.32	P11 CPLR, S41
9	RCVR OUT to Ports 15	32.48	P15 CPLR, S41
10	RCVR OUT to Ports 8	64.16	P8 CPLR, S41
11	RCVR OUT to Ports 12	64.32	P12 CPLR, S41
12	RCVR OUT to Ports 16	64.48	P16 CPLR, S41

a. Use the RCVR OUT port associated with this group of test ports.

Connect the RF Flex cables to the Source IN and CPLR THRU port indicated in Table 27, the expected results should be similar to Figure 61 on page 83.

Table 27 Source Bypass Signal Path Test Instructions

Path #	Test Port Group	RF Path Description	Control Mode <Address>.<Data>	Path Components
1	Port 5, 9, 13	Source IN to CPLR THRU	0.0	S10
2	Port 6, 10, 14	Source IN to CPLR THRU	16.0	S20
3	Port 7, 11, 15	Source IN to CPLR THRU	32.0	S30
4	Port 8, 12, 16	Source IN to CPLR THRU	64.0	S40

Connect the RF Flex cables to the Source IN and CPLR ARM port indicated in Table 28, the expected results should be similar to Figure 61 on page 83.

Table 28 Receiver Bypass Signal Path Test Instructions

Path #	Test Port Group	RF Path Description	Control Mode <Address>.<Data>	Path Components
1	Port 5, 9, 13	RCVR OUT to CPLR ARM	0.0	S11
2	Port 6, 10, 14	RCVR OUT to CPLR ARM	16.0	S21
3	Port 7, 11, 15	RCVR OUT to CPLR ARM	32.0	S31
4	Port 8, 12, 16	RCVR OUT to CPLR ARM	64.0	S41

RF Performance Fails

If the U3042AM12 operates correctly, but RF performance fails the Signal Path test. Refer to the "U3042M12 Block Diagram" on page 72 to determine the components that will need to be inspected further. The following procedures can be used to isolate the failed component. Suspect the internal coax switches, RF cables, or coupler.

NOTE The RF performance of the U3042AM12 depends on the performance of the analyzer. Ensure the analyzer is meeting specification before continuing.

1. Verify that the test set and analyzer SOURCE, RCVR, CPLR THRU, and CPLR ARM connectors are clean and that the center pins are not damaged.
2. Verify the interface and internal RF cables are cleaned and not damaged. "Verifying Cal Kit Operational Check Failure" on page 68.

Table 29 Controller Board Connections

Controller Board Connection	**Connection**
LED Ribbon Cables From the LED Board	
J5	Ports 5 and 9
J6	Ports 6 and 10
J7	Ports 7 and 11
J8	Ports 8 and 12
Wire harness Active LED	
P1	Active LED
DUT Control Ribbon Cable	
J9	DUT Controller Board
Power Supply Wire Harness	
J11- 14	Power Supply

Table 30 Switch Interface Board

Switch Interface Board	**Connection**
Switch Interface Board Connection	
P10	Ports 5, 9, and 13 (Source)
P11	Ports 5, 9, and 13 (Receiver)
P20	Ports 6, 10, and 14 (Source)
P21	Ports 6, 10, and 14 (Receiver)
P30	Ports 7, 11, and 15 (Source)
P31	Ports 7, 11, and 15 (Receiver)
P40	Ports 8, 12, and 16 (Source)
P41	Ports 8, 12, and 16 (Receiver)
P16	Option 129 (Source)

Figure 62 Top View

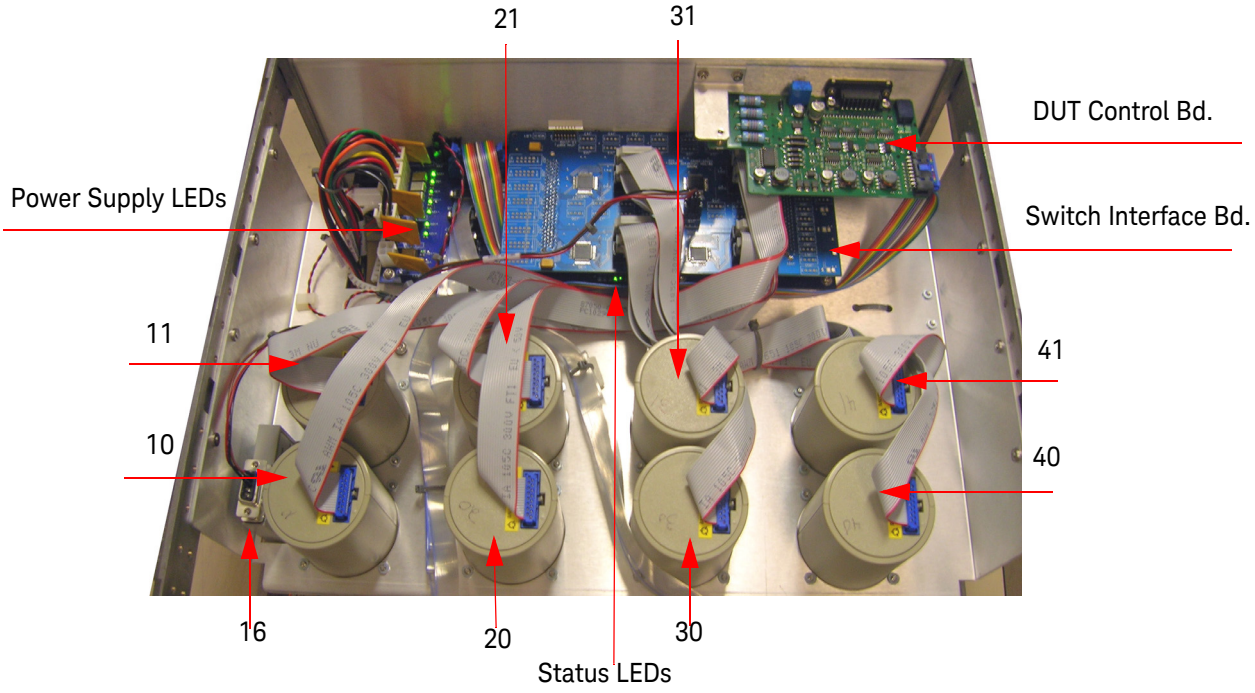
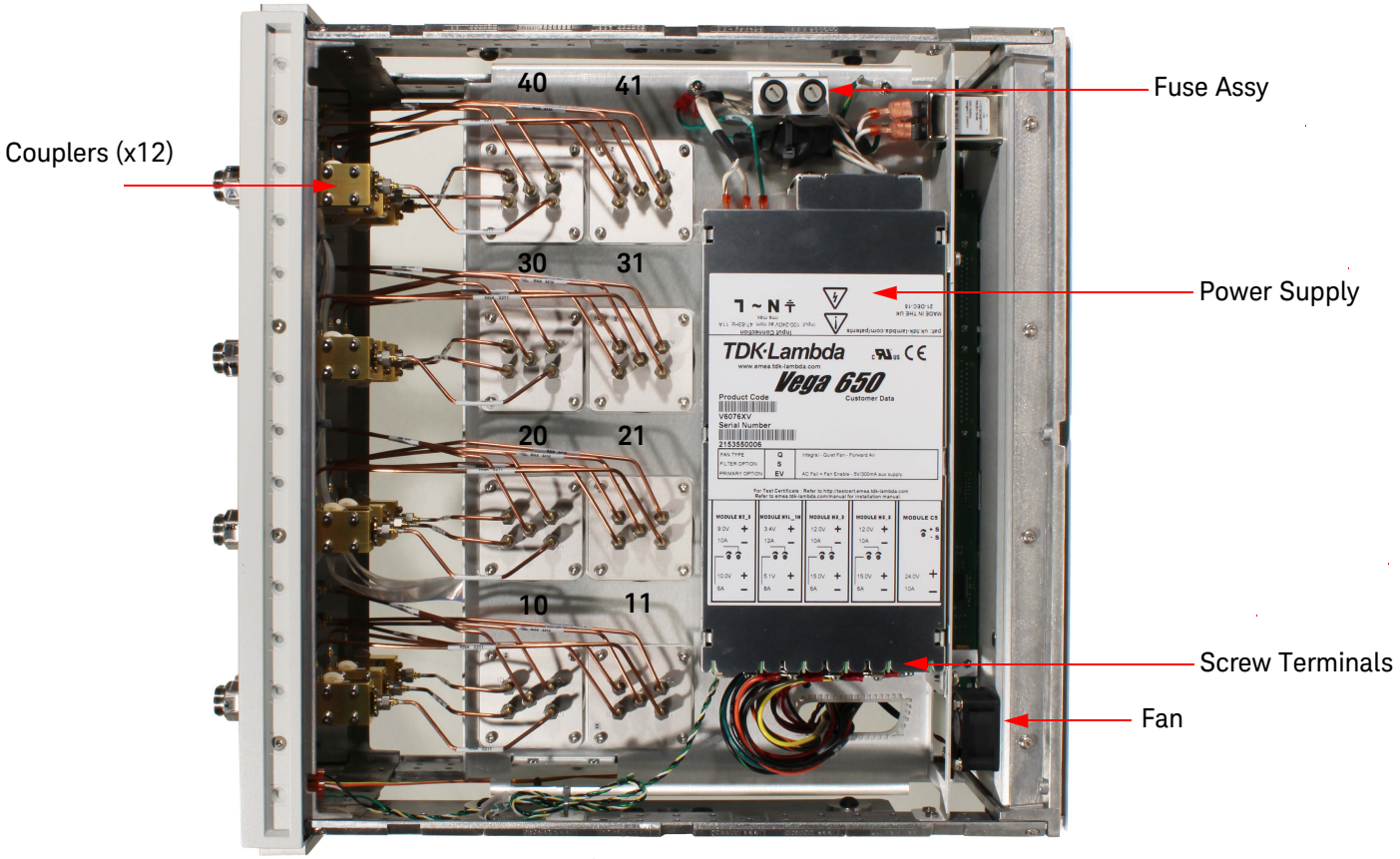


Figure 63 Bottom View



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.

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 http://regulations.keysight.com/DoC.htm.

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 U3042AM12 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.

Regulatory Information

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

Instrument Markings

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

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

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

This symbol indicates that the power line switch is ON.

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

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

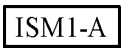
This symbol is used to identify a terminal which is internally connected to the product frame or chassis.

The CE mark is a registered trademark of the European Community. (If accompanied by a year, it is when the design was proven.)

ccr.keysight@keysight.com

The Keysight email address is required by EU directives applicable to our product.

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



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

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

Direct Current.

IP 2 0

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

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

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

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

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

Battery Collection

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 94 for assistance.

Electrical Safety Compliance

SAFETY

Complies with European Low Voltage Directive 2014/35/EU

- IEC/EN 61010-1:2010, 3rd Edition
- Canada: CSA C22.2 No. 61010-1-12
- USA: UL std no. 61010-1, 3rd Edition
- Acoustic statement (European Machinery Directive 2022/42/EC, 1.7.4.2U)
  Accoustical noise emission
  LpA<70 dB
  Operator position
  Normal operation mode
  Per ISO 7779

EMI and EMC Compliance

EMC

Complies with European EMC Directive 2014/30/EU

- IIEC 61326-1:2012/EN 61326-1:2013
- CISPR Pub 11 Group 1, class A
- AS/NZS CISPR 11:2011
- ICES/NMB-001
  This ISM device complies with Canadian ICES-001.
  Cet appareil ISM est conforme a la norme NMB du Canada.
- South Korean Class A EMC declaration: This equipment is Class A suitable for professional use and is for use in electromagnetic environments outside of the home.

A 급 기기 (업무용 방송통신기자재) 이 기기는 업무용 (A 급) 전자파적합기기로서 판 매자 또는 사용자는 이 점을 주 의하시기 바라 며 , 가정외의 지역에서 사용하는 것을 목적으 로 합니다 .

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

You can also purchase accessories or documentation items on the Internet at:
http://www.keysight.com/find

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

This information is subject to change without notice.
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KEYSIGHT TECHNOLOGIES

www.keysight.com