

Keysight Technologies  
U3042AE12  
Multiport Test Set Extension

User's and  
Service Guide

# Notices

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### WARNING

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

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U3042AE12

## Introduction

This document describes how to use and service the U3042AE12 Multiport Test Set Extension.

Figure 1 4-Port PNA-L with U3042AE12



Figure 2 4-Port PNA or PNA-X with U3042AE12



## Description

The Keysight U3042AE12 is a 12-Port solid-state test set used for multiport applications. The test set can be connected to a 4-port PNA, PNA-L, or PNA-X, providing a 16-port network analyzer solution for full crossbar measurements.

The U3042AE12 has the following key features:

- 12 test ports (3.5 mm male connectors)
- High speed, solid state RF switching  
Frequency range of operation: 10 MHz to 26.5 GHz
- Keysight PNA compatibility with rear panel test set I/O interface for operational control. The PNA Option 551 is required and provides N-Port calibration capabilities.
- The U3042AE12 is directly controlled by the network analyzer; no external personal computer or software is required.

### NOTE

The N5222A/B PNA, N5230A/C and N5232A/B PNA-L and N5242A/B PNA-X Network Analyzer's will be referred to as the PNA, PNA-L and PNA-X throughout this document. Analyzer refers to all series of PNA, PNA-L and PNA-X. The U3042AE12 will be referred to as the Test Set.

## Measurement Application Note

### Low Loss DUT Measurements

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

## 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 95](#). Keep the damaged shipping materials (if any) for inspection by the carrier and a Keysight Technologies representative.

Table 1

U3042AE12 Accessories Supplied

Description	Part Number	Quantity
Short, 3.5 mm (female)	85052-60007	1
User's and Service Guide	U3042-90001	1

## Network Analyzer Requirements

All network analyzers require Option 551 for multiport operation (N-Port error correction and measurement capability). **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 test set files indicated in **Table 2** must be installed into the analyzer's file directory: c:\Program Files\Keysight\Network Analyzer\testsets

Table 2 Network Analyzer Configuration Requirements

4-Port Network Analyzer	Options	Test Set File	System Figure
N5222A/B PNA	401, 417 or 419	u3042ae12_pnax_p4.tsx	Figure 2
N5230A/C PNA-L	245, 145, 246 or 146	u3042ae12_p4.tsx	Figure 1
N5232A/B PNA-L	416	u3042ae12_p4.tsx	Figure 1
N5242A/B PNA-X	400	u304xae12_pnax_p4.tsx	Figure 2

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

- Network Analyzer - <http://www.keysight.com/find/pna>
- U3042AE12 Test Set Files - <http://na.support.keysight.com/multiport/testsetsupport.html>
- Firmware - <http://na.support.keysight.com/pna/firmware/firmware.html>

## Available Options

### Test Set Option

The test set has one available option:

Refer to **“System Block Diagram” on page 72.**

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

#### NOTE

Options 001 and 002 limit the frequency range due to blocking capacitors in the bias tee and amplifier performance. Bias tees degrade the frequencies below 45 MHz, and amplifiers degrade performance below 45 MHz and above 18 GHz.

### Accessory Options

Installation instructions are included in the option package.

- U3042A-1CM - 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 U3042AE12 requires one of the following kits to interface the Test Set with your Analyzer. The interface kit model option includes the hardware lock-link and cable kit.

Table 3 Interface Kit Options

12-Port System	Interface Kit Option	Hardware Lock-link Kit	Cable Kit - Conn. Type
N5230A/C or N5232A/B PNA-L	U3021PL3-430	U3021-60001 <sup>a</sup>	U3021-60045, SMA m/m <sup>b</sup>
N5222A/B PNA or N5242A/B PNA-X	U3021PL3-442	U3021-60002 <sup>c</sup>	U3021-60047, SMA m/m <sup>d</sup>

a. Refer to **“Hardware Lock-Link Kit Installation with N5230C or N5232A/B” on page 19.**

b. Refer to **“PNA-L RF Interface Cable Connections” on page 22.**

c. Refer to **“Hardware Lock-Link Kit Installation with N5222A/B or N5242A/B” on page 24.**

d. Refer to **“PNA and PNA-X RF Interface Cable Connections” on page 27.**

## General Specifications

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

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

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

When connected to a 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 in the **"Cal Kit Operational Check" on page 60** can be subtracted from the analyzers dynamic range to determine the approximate performance of the system.

## Power Requirements

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

- 100/120/220/240 VAC (50/60Hz)
- The instruments can operate with mains supply voltage fluctuations up to  $\pm 10\%$  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 PNA.
- U3042AE12 maximum power is 350 W.

### WARNING

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

---



## Environmental Requirements

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

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

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

### Equipment Heating and Cooling

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

#### CAUTION

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

### Required Conditions for Accuracy Enhanced Measurement

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

### Dimensions and Space Requirements

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

#### CAUTION

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

Table 4

Instrument Dimensions

Model	Weight	Height	Width	Depth
U3042AE12	13 kg (28.6 lb)	19.1 cm (7.5 in)	42.5 cm (16.7 in)	43.2 cm (17 in)

## Maximum 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

Maximum U3042AE12 Test Port Power Levels:	
PORT 5-16	+27 dBm
U3042AE12 Access Ports:	
SOURCE OUT	+20 dBm
CPLR ARM	+20 dBm
CPLR THRU	+20 dBm
RCVR OUT	+20 dBm

### NOTE

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

---

### NOTE

Damage and maximum levels are not necessarily the optimum level.

---

## Typical Reflection Tracking

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

### NOTE

Typical specifications are based on 1 to 2 units performance. Refer to [Table 6](#) and [Table 7](#).

Table 6 Typical Reflection Tracking PNA-L

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

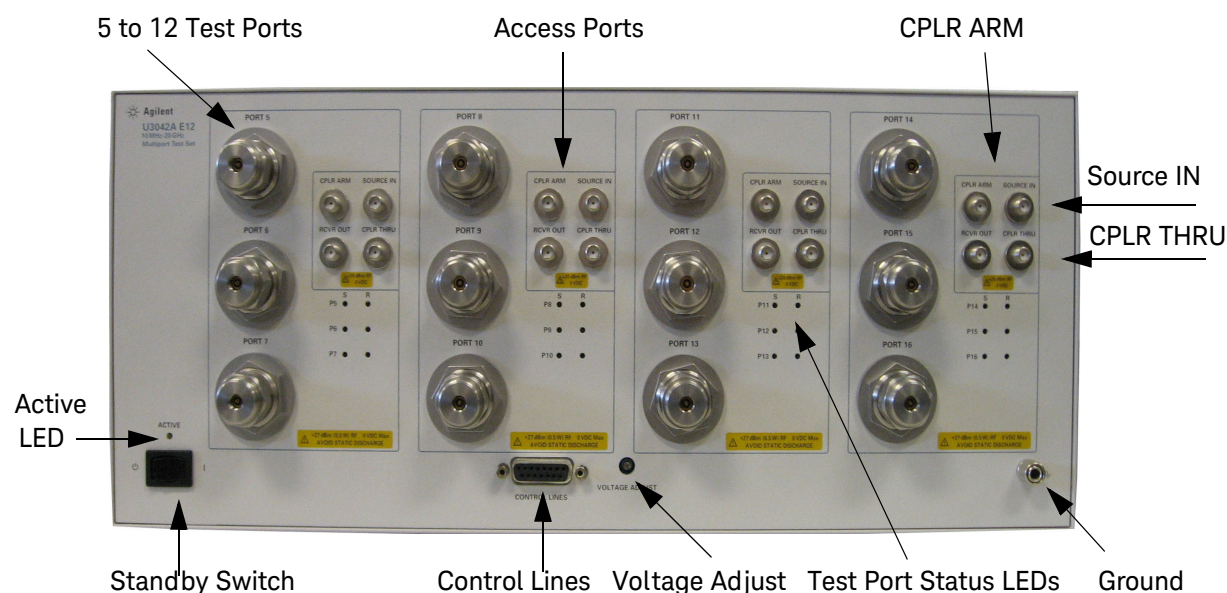
a. Generally improves at 3 MHz to -6 dBm.

Table 7 Typical Reflection Tracking PNA and PNA-X

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

## Front and Rear Panel Features

Figure 3 U3042AE12 Front Panel



**Test Ports 3.5 mm Bulkhead (male)**

Port 5-16

**Access Ports – SMA (female)**

- CPLR ARM
- SOURCE IN
- CPLR THRU
- RCVR OUT

**Ground**

Ground is provided for ESD and safety connection.

**Test Port Status LEDs**

An illuminated LED indicates an active port in Source or Receiver mode. On the front panel, “S” indicates Source test ports and “R” indicates Receiver test ports.

**Control Lines and Voltage Adjust**

For further information pertaining to control lines and voltage adjustments see [“Control Lines” on page 54](#).

**Standby Switch**

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

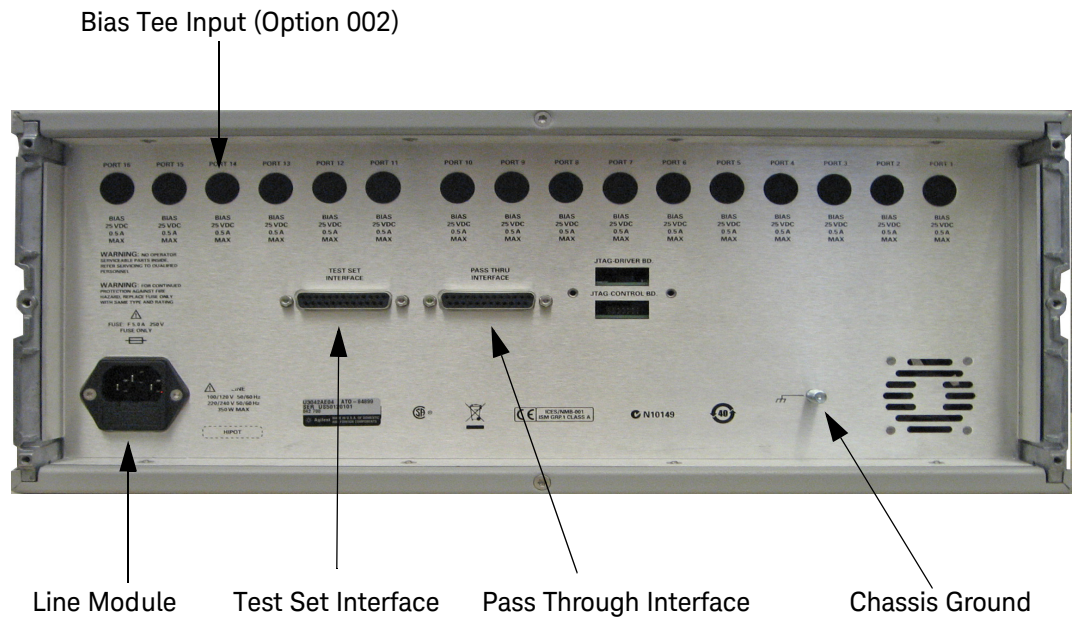
**Active LED**

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

### NOTE

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

Figure 4 U3042AE12 Rear Panel



- Bias Tee Input** BNC Input connectors for Option 002.
- Chassis Ground** A threaded terminal post for connecting the test set to a conductive object, cabinet or structure to ensure a common potential and reduce leakage current in a system. Requires an English 1/4-20 thread nut (2950-0004) and lock washer (2190-0067).
- Pass Through Interface** Connection to another test set.
- Test Set Interface** The test set I/O connector is used to send address and data to the Test Set from the network analyzer.
- Line Module** This assembly houses the line cord connection, line fuse, and line voltage selector. Remove the line module cover to replace or change the fuse. Line voltage selection is automatic and no setting is required.
- Install the instrument so that the detachable power cord is readily identifiable and is easily reached by the operator. The detachable power cord is the instrument disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the instrument. The front panel switch is only a standby switch and is not a LINE switch. Alternatively, an externally installed switch or circuit breaker (which is readily identifiable and is easily reached by the operator) may be used as a disconnecting device.

**Available Fuses**

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

**WARNING**

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

---

Figure 5

Line Module and Fuse

**CAUTION**

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

---

## Hard ware Lock-Link Kit Installation with N5230C or 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.

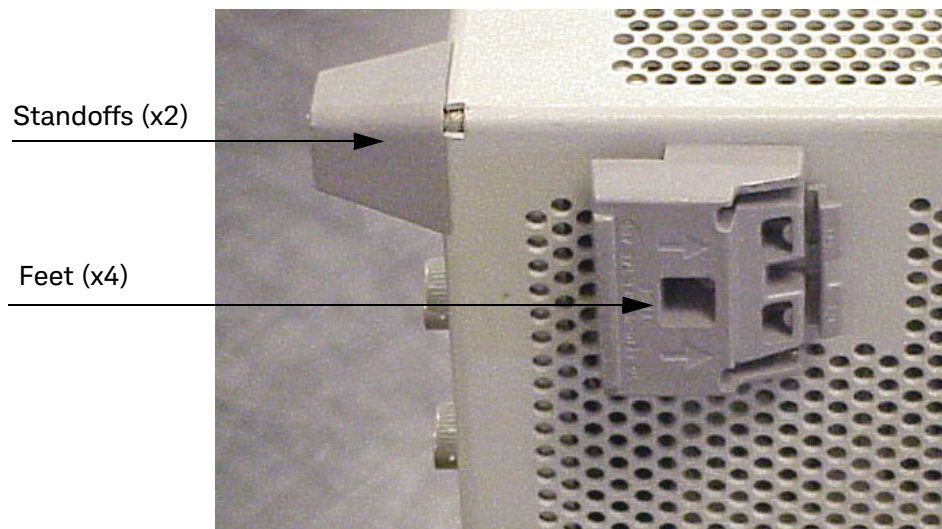
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### Locking the Test Set to the PNA-L

1. The kit (U3021-60001) includes items to interface the test set to the PNA-L.
  - 5023-0132 Lock-link Set, Analyzer
  - 0515-1619 Screw, Analyzer
  - 5063-9253 Lock-link Set, Test Set
  - 0515-1244 Screw, Test Set
2. Remove the feet from the bottom of the PNA-L.
3. Remove the 2 lower standoffs from the rear panel on the analyzer.

Figure 6

Rear Bottom Feet

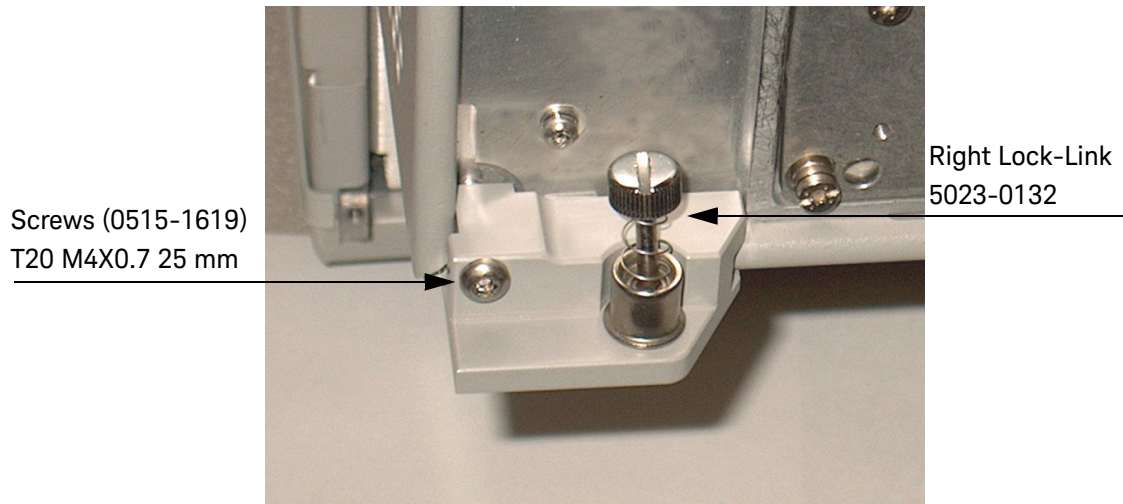




4. Install the two rear lock-Links onto the PNA-L, using the included screws where the standoffs were removed.

Figure 7

Install Lock-links to the Analyzer



5. Remove the top two standoffs from the rear panel on the test set.
6. Install the top left and right rear lock-links from the kit (5063-9253) onto the test set using the screws included with this option.

Figure 8

Install Lock-links to the Test Set

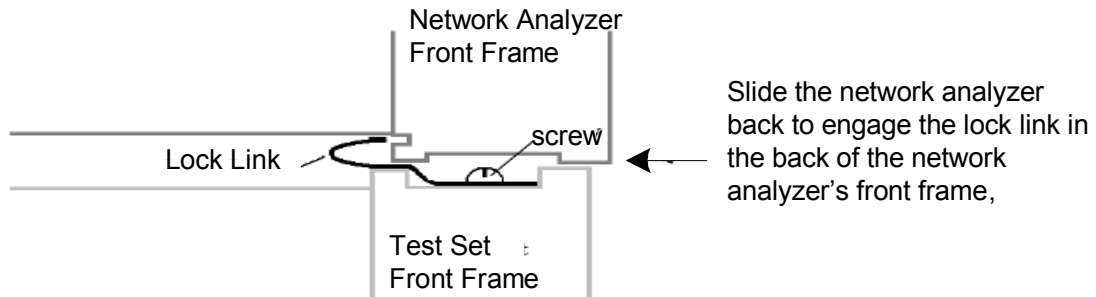




7. Place the PNA-L on top of the test set and ensure that the front frame of the analyzer is positioned slightly forward of the locks that are attached to the test set. Slide the analyzer back so the locks engage the front frame.

Figure 9

Locking the Analyzer



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

Figure 10

Lock-Link Screws



# PNA-L RF Interface Cable Connections

Figure 11 on page 23 illustrates the cable configuration of the test set to the PNA-L. The cables have been supplied with the kit (U3021-60045).

- 1. Remove the SOURCE OUT to CPLR THRU and RCVR IN to CPLR ARM jumpers (x16) on the PNA-L. 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 below and Figure 11 on page 23.

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 the 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	SOURCE OUT	SOURCE OUT
Z5623-20418	CPLR ARM	CPLR ARM
Z5623-20419	CPLR THRU	CPLR THRU
Z5623-20419	RCVR IN	RCVR OUT

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3. Connect the PNA-L Test Set I/O cable (N4011-21002) to the Test Set Interface on the rear panel. Refer to **“System Operational Checks” on page 30** for turn-on verification of the multiport system.
4. Connect the analyzer’s Test Set I/O cable to the Test Set Interface connector on the rear panel. Refer to **“Test Set I/O Cable Installation” on page 29**.

## Hard ware Lock-Link Kit Installation with N5222A/B or N5242A/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.

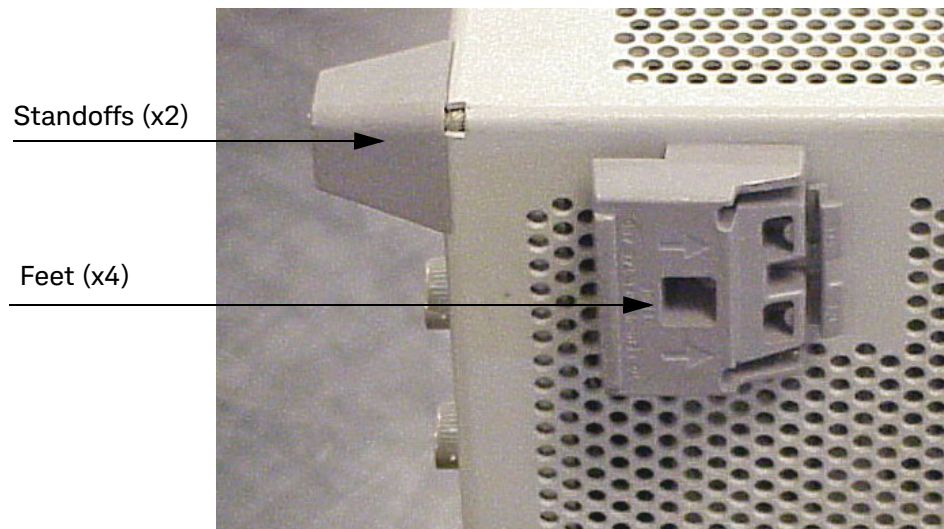
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### Locking the Test Set to the PNA or PNA-X

1. The kit (U3021-60002) includes items to interface the test set to the PNA and PNA-X.
  - 5023-0132 Lock-link Set, Analyzer
  - 0515-1619 Screw, Analyzer
  - N5242-20138 Right Lock-link, Test Set
  - N5242-20139 Left Lock-link, Test Set
  - 0515-2317 Screw, Test Set
2. Remove the feet from the bottom of the analyzer.
3. Remove the two lower standoffs from the rear panel on the analyzer.

Figure 12

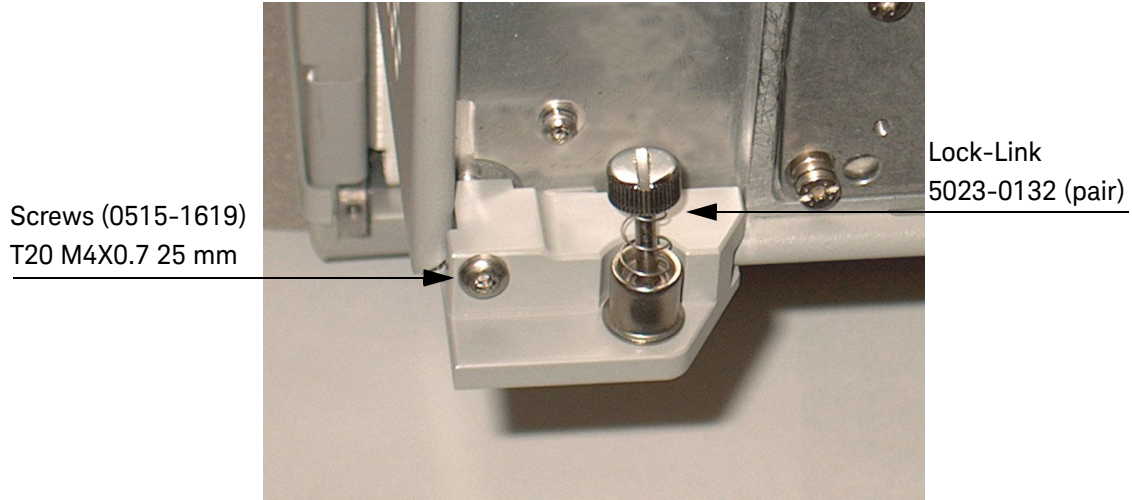
Rear Bottom Feet



4. Install the two rear locking feet onto the PNA or PNA-X, using the included screws where the standoffs were removed.

Figure 13

Install Lock-links on PNA or PNA-X



5. Remove the top two standoffs from the rear panel on the test set.
6. Install the left and right rear lock-links onto the test set, using the screws included with this option.

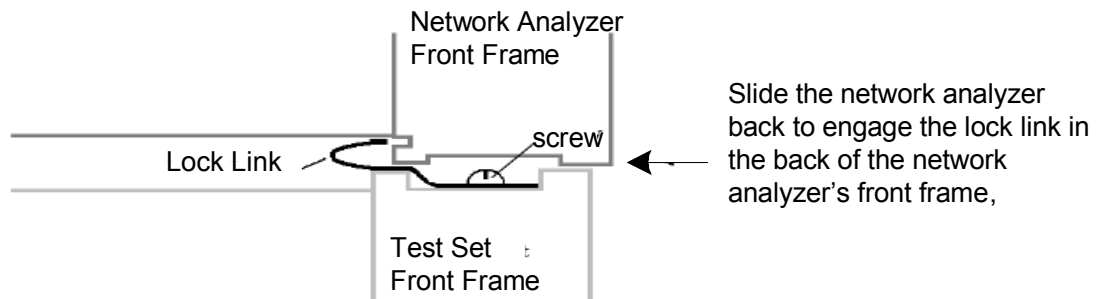
Figure 14

Install Locking Feet on Test Set



7. Place the PNA or PNA-X on top of the Test Set and ensure that the front frame of the analyzer is positioned slightly forward of the locks that are attached to the Test Set. Slide the analyzer back so the locks engage the front frame of the analyzer.

Figure 15 Locking the Analyzer



8. Secure the PNA or PNA-X lower locking feet to the Test Set 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 Lock-Link Screws





## PNA and PNA-X RF Interface Cable Connections

Figure 17 on page 28 illustrates the cable configuration of the Test Set to the analyzer. The cables have been supplied with the kit (U3021-60047).

1. Remove the SOURCE OUT to CPLR THRU and RCVR IN to CPLR ARM jumpers (x8) on the analyzer. The RCVR R1 - R4 to SOURCE OUT reference loop jumpers (x4) remain on the front panel.
2. Connect the RF interconnect cables from the PNA or PNA-X to the Test Set in the order listed. As you are connecting each cable, torque to 8 in-lb. The longer, straight end of each cable is connected to the Test Set. Refer to Table 9 below and Figure 17 on page 28.

### CAUTION

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

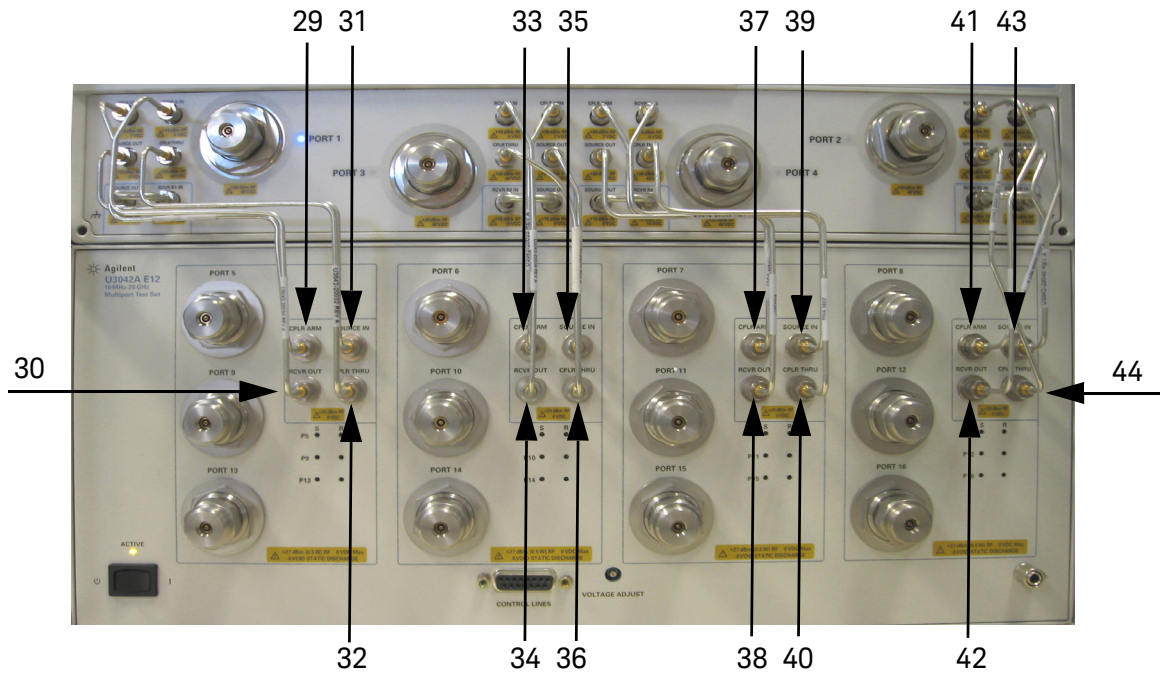
Table 9

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	U3042-20038	Port 4 RCVR D IN	Port 7 RCVR OUT
10	U3042-20037	Port 4 CPLR ARM	Port 7 CPLR ARM
11	U3042-20039	Port 4 SOURCE OUT	Port 7 SOURCE IN
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 17 illustrates the final two digits of the part number for each cable. The cables must be connected in the numeric order listed in Table 9 on page 27.

Figure 17 RF Interface Cable Connections



3. Connect the analyzer's Test Set I/O cable to the Test Set Interface connector on the rear panel. Refer to "Test Set I/O Cable Installation" on page 29.

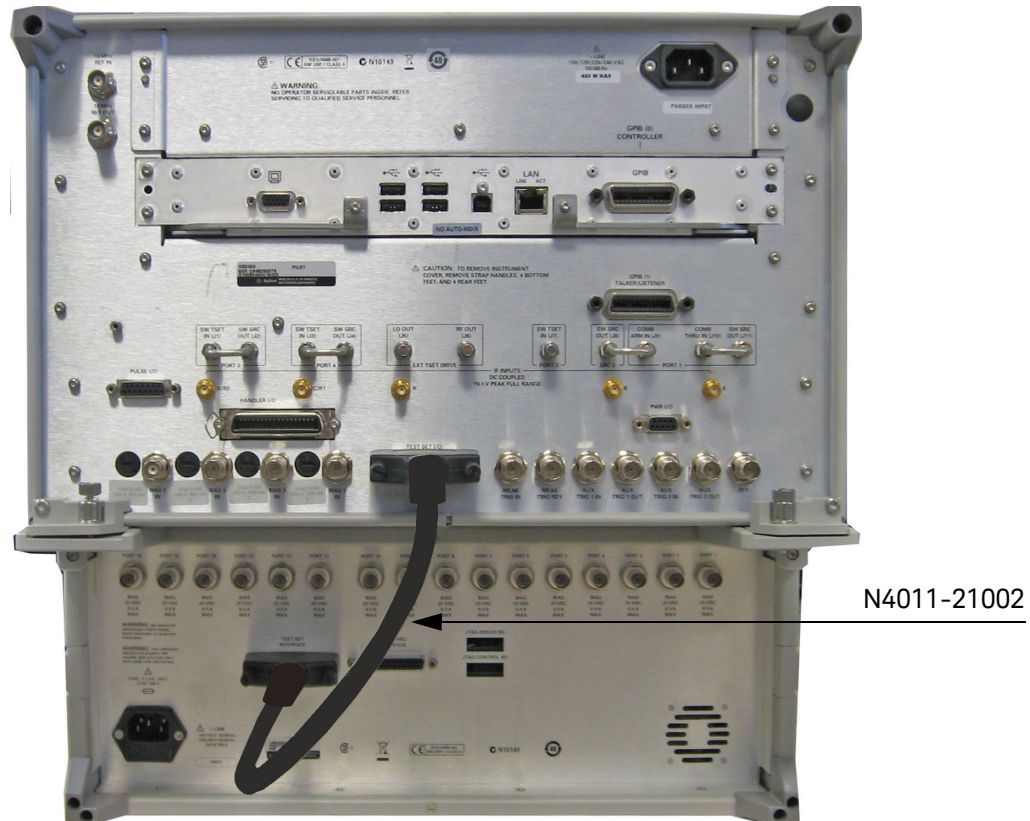


## Test Set I/O Cable Installation

1. Connect the Analyzer's Test Set I/O cable (N4011-21002) to the Test Set Interface connector on the rear panel, similar to **Figure 18**.

Figure 18

PNA or PNA-X Test Set I/O Cable Connection



## Interconnect Cable Verification

1. Perform the **"System Operational Checks"** on page 30.
2. If the problem still exists, perform the **"RF Switching Failures"** on page 80.
3. If a power hole or other failure still exist, refer to **"Contacting Keysight"** on page 95.

# System Operational Checks

The following procedure will confirm that the RF interface cables between the Test Set and PNA-X 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 you should complete the following steps:

- Stack the PNA-X 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 PNA Port 1.

## Equipment Setup

- Turn *on* the Test Set and network analyzer.
- Preset the PNA-X 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 Option 029” on page 41.

## Verify Results

The 3.5 mm short will be relocated to each Test Port and an uncorrected Sxx 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 19 on page 31	Figure 20 on page 31
Ports 5 to 16	Figure 21 on page 32	Figure 22 on page 32

**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 60.

Figure 19 Typical Reflection Response Ports 1-4

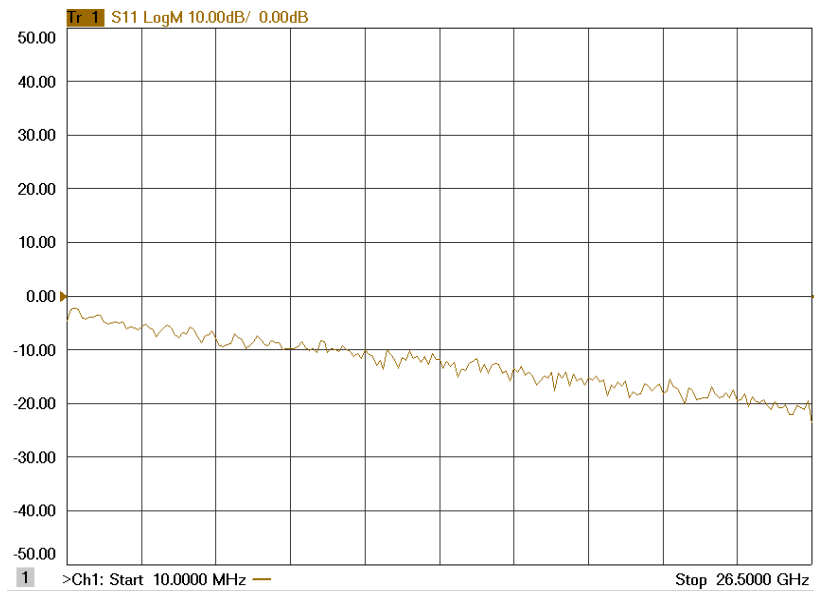


Figure 20 Reflection Response Signal Path Diagram Ports 1-4

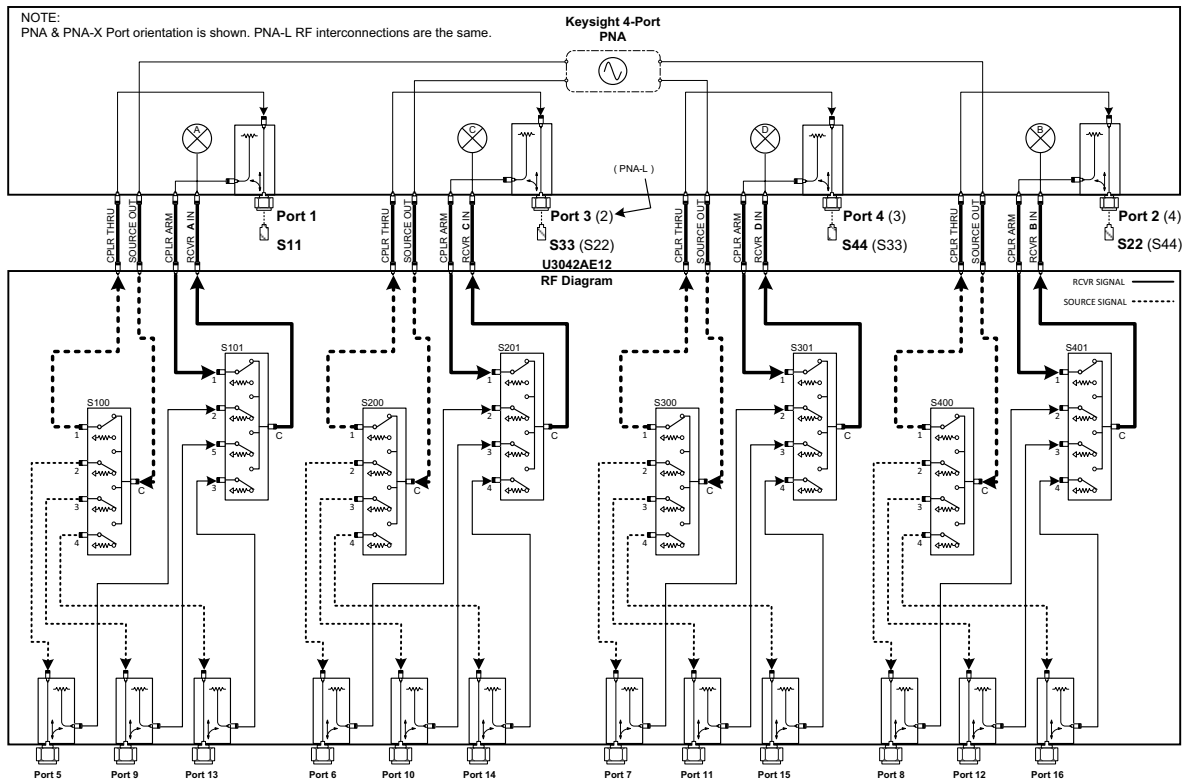


Figure 21

Typical Reflection Response Ports 5-16

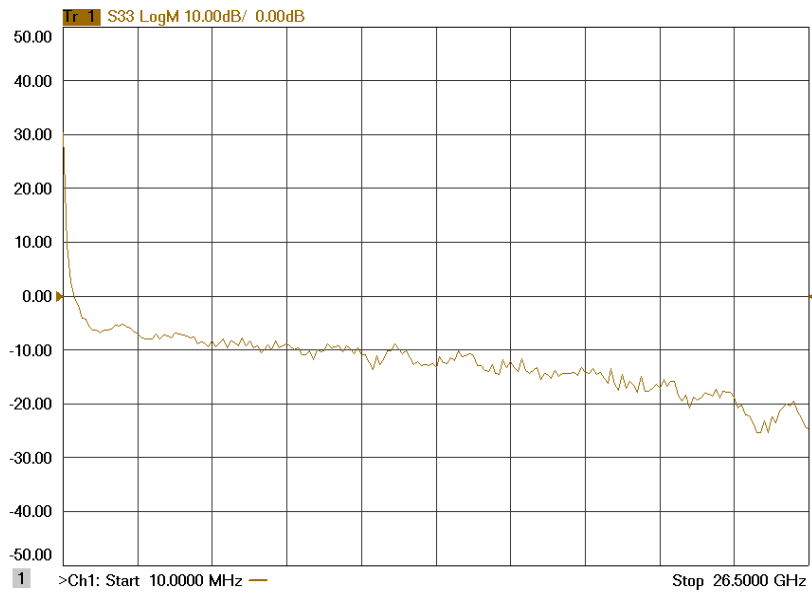


Figure 22

Reflection Response Signal Path Diagram Ports 5-16

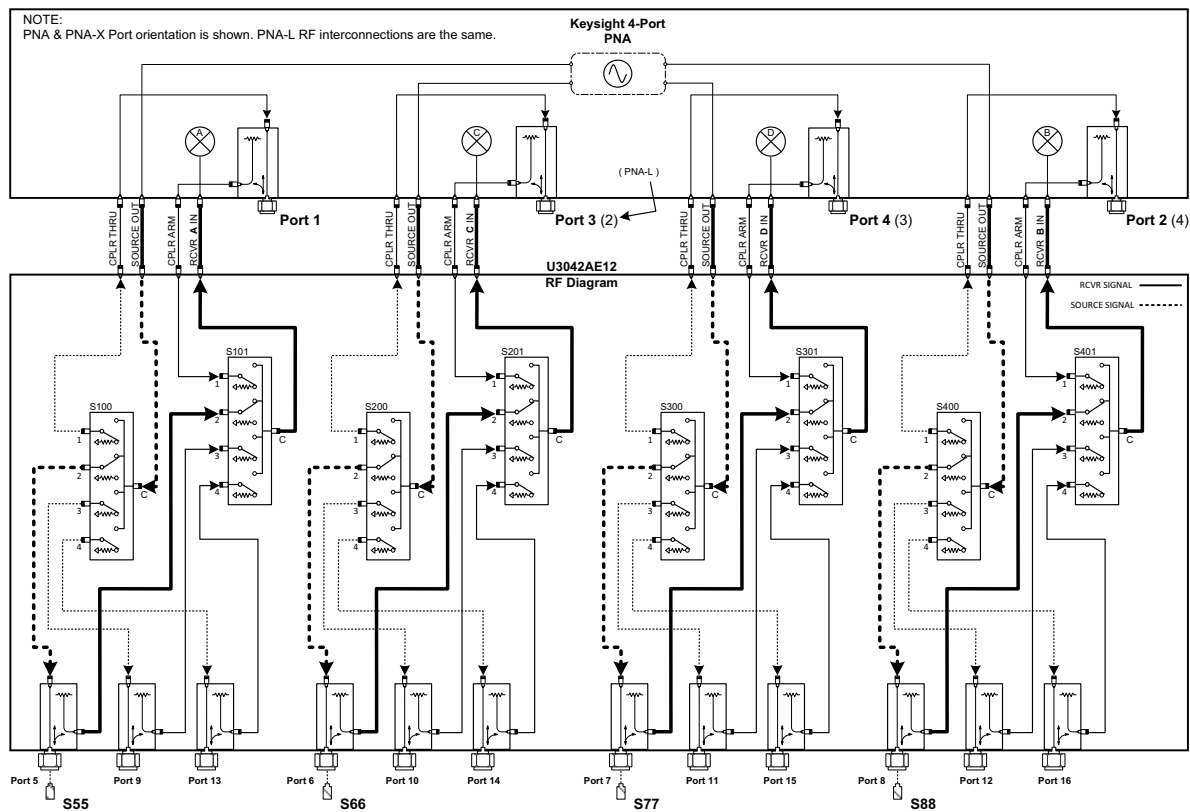


Figure 23 Reflection Response Signal Path Diagram Ports 9-12

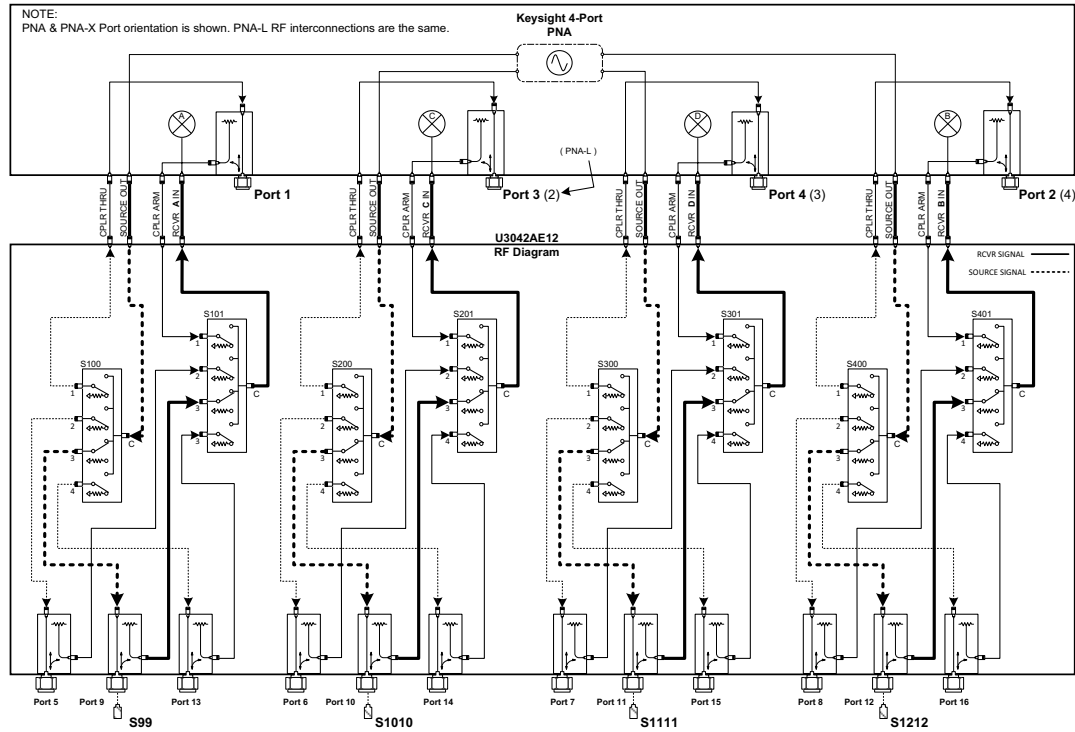
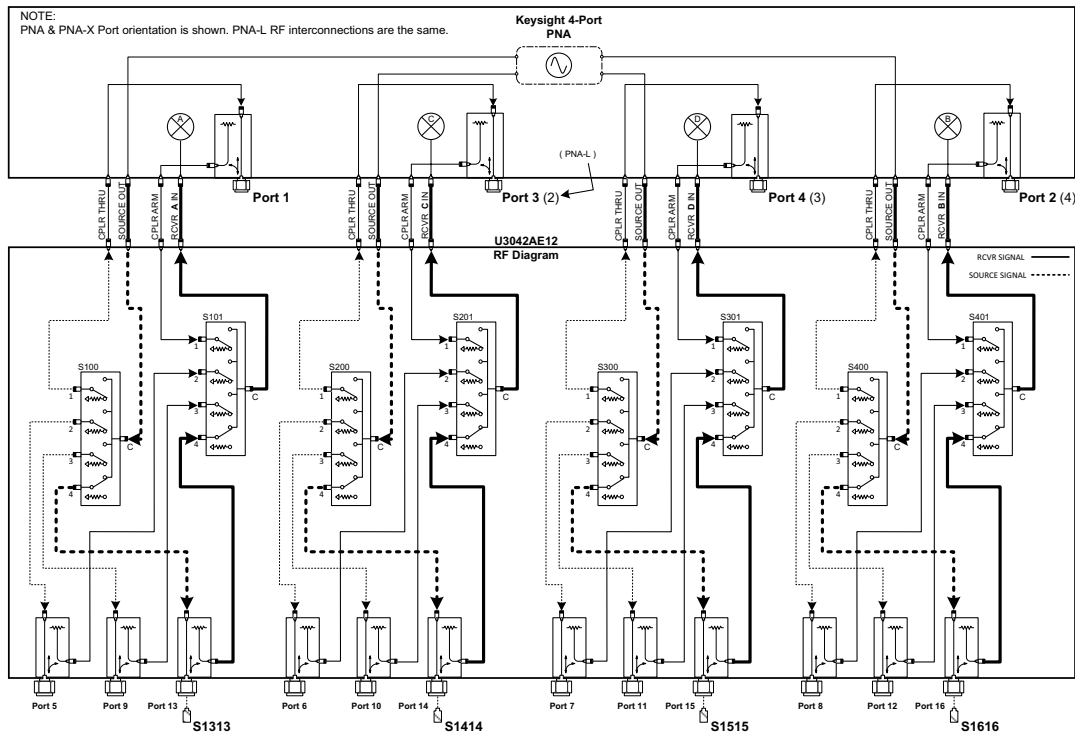


Figure 24 Reflection Response Signal Path Diagram Ports 13-16



## 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, 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 35
- “Interface Control Mode” on page 44
- “SCPI Control Mode” on page 48

### 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.

## Multiport Mode (Option 551)

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

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

4-Port PNA-L requires Test Set: u3042ae12\_p4.tsx

4-Port PNA or PNA-X requires Test Set: u3042ae12\_pnax\_p4.tsx

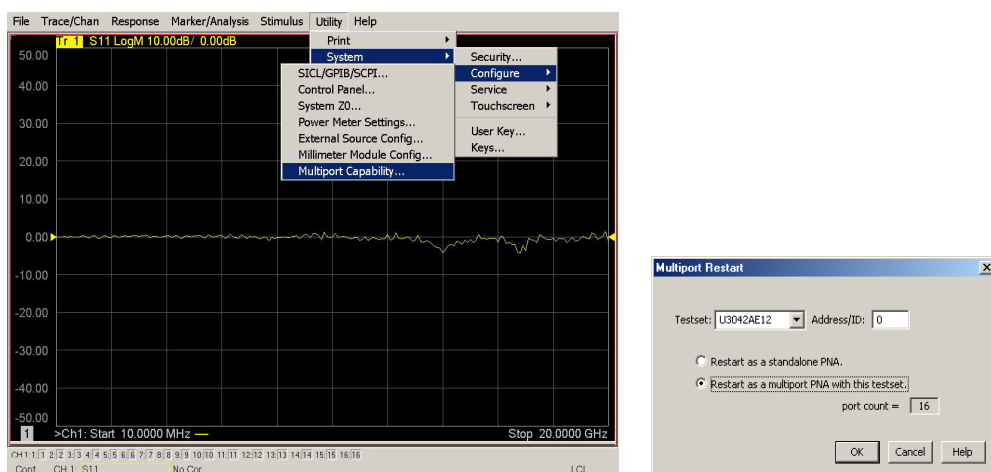
### How to Access Multiport Mode

1. The Option 551 must be installed for multiport capability. To access the multiport application select **Utility > System > Configure > Multiport Capability -OR- (Instrument > Setup > External Hardware > Multiport > Multiport Configuration...)**.
2. Select **U3042AE12** (16-Port System) from the drop-down menu and select **Restart as a multiport PNA with this testset > OK**. The PNA will restart the network application with the Test Set interface features.

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

Figure 25

Selecting Multiport Mode



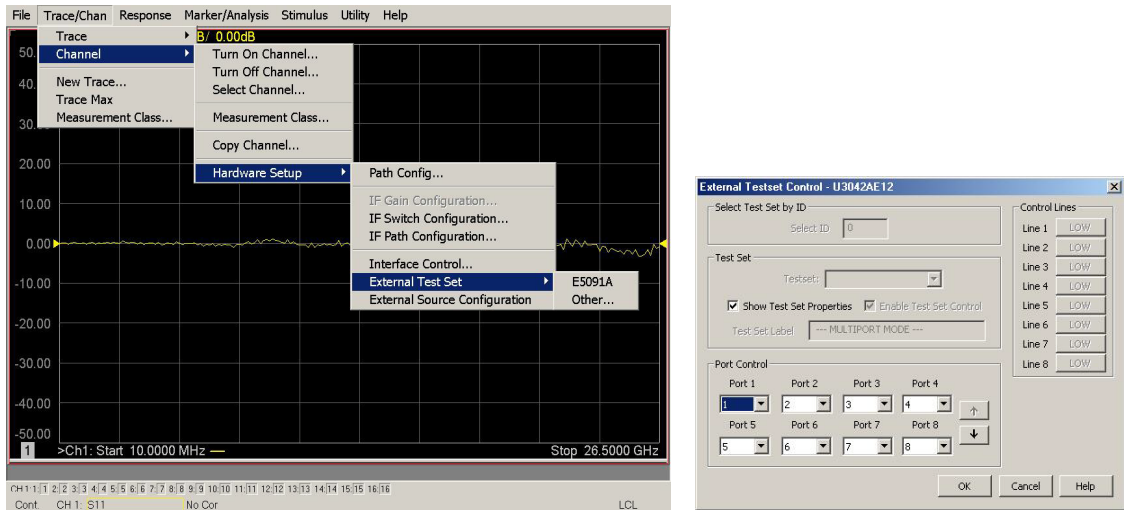
## External Test Set Control Feature

To verify that the network application has the Test Set interface features, select **Trace/Chan > Channel > Hardware Setup > External Test Set > Other -OR- (Instrument > Setup > External Hardware > External Device... > Multiport > Other Test Set Setup...)**.

The Test Set will be displayed as External Test Set Control-U3042AE12.

Figure 26

### External Test Set Control



This menu will allow the physical Ports 1 thru 8 to be identified as any port for your convenience. For example, Port 5 can be re-named Port 2. Select the Port Control down arrow for Ports 9 thru 16.

The External Test Set Control-U3042AE12 also allows control of the DUT control lines, refer to **“Control Lines” on page 54**. To change the state from LOW to HIGH, select the graphical user interface (GUI) for the specific control (LINE 1 thru 16), click OK. Each line can be controlled separately.



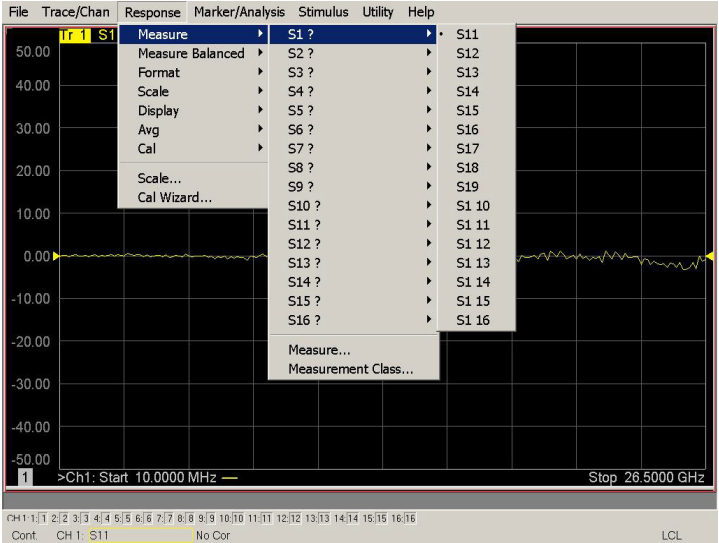
# Trace Measure S-Parameter

S-Parameter selection can be accomplished using **Response > Measure**. Use the drop-down menu to select 1 of 256 S-Parameters for the 16-Port system. The first number in the Sxx selection is the Receiver Port and the second number will be the Source Port. Any port can be selected to be the Receiver, Source or both, as in S11. The front panel R LED indicates the port is the Receiver and the S LED indicates the port is the Source.

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

Figure 27

## S-Parameter Measurement

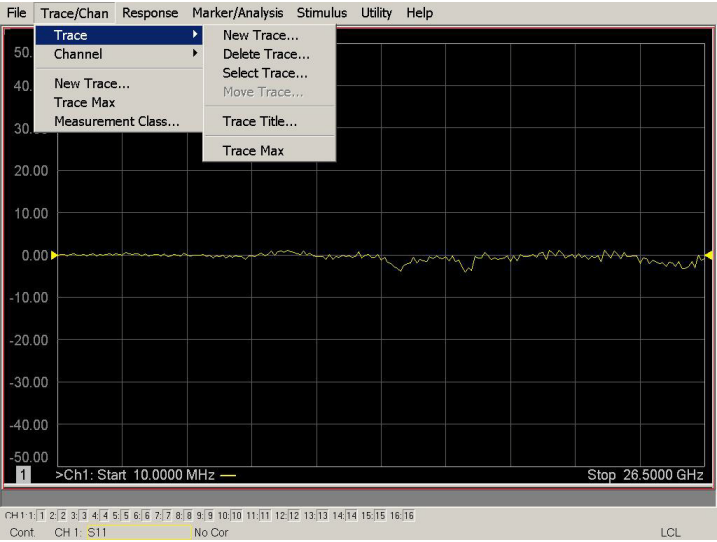


# New Trace Measure S-Parameter

S-Parameter Tab: Multiple S-Parameters can be made from the New Trace menu. In the drop-down menu select **Trace/Chan > Trace > New Trace -OR- (Instrument > Trace > New Trace)**. The dialog box allows the selection of any of the 256 S-Parameters.

Figure 28

## New S-Parameter Measurement

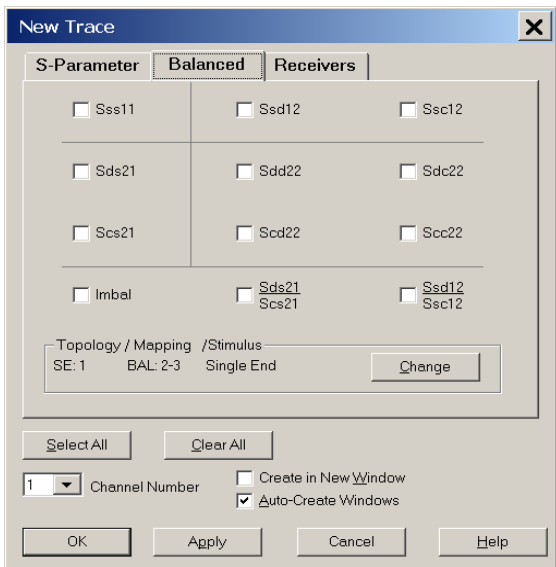


**Balanced Tab**

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

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

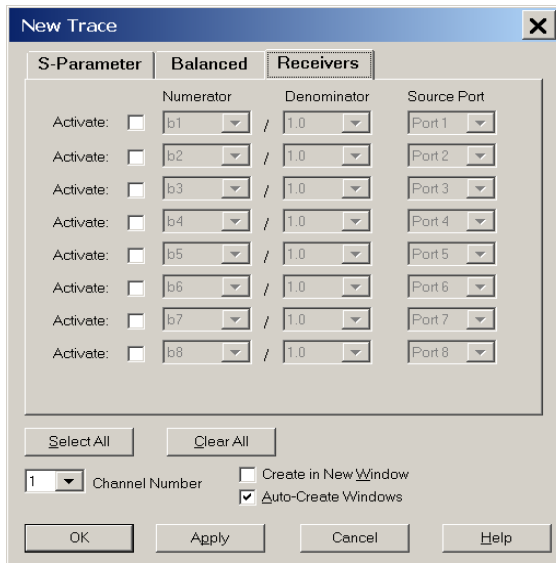
Figure 29 Selecting Balanced Measurements



**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 30 Receiver Measurements

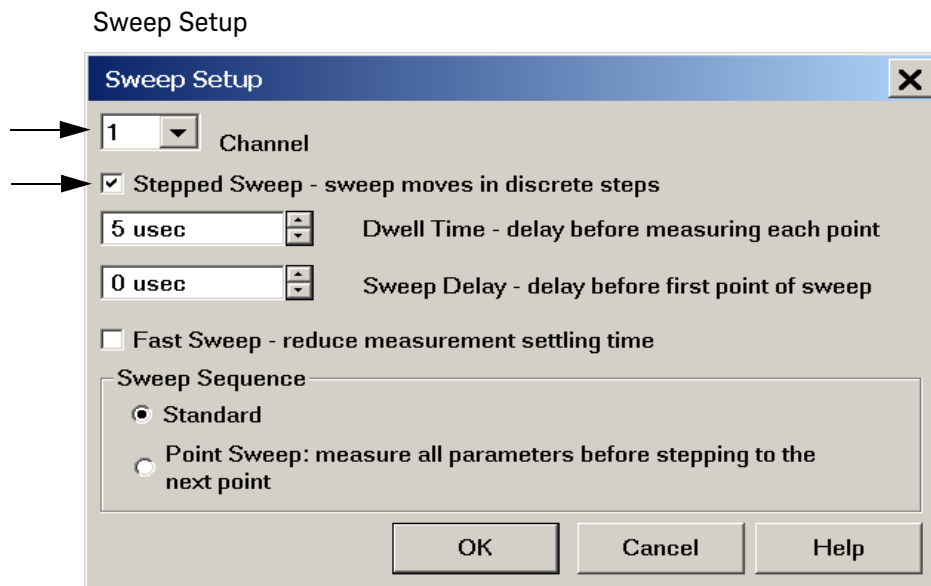


### Sweep Setup for Multiport and Standalone Modes

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

1. On the analyzer select **STIMULUS > Sweep > Sweep Setup**.
2. Select **Stepped Sweep - sweep moves in discrete steps**.
3. Set the **Dwell Time** to 5 ms > **OK**.

Figure 31



## Sweep Setup for PNA-X N52xxB Models

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

Figure 32 Sweep Setup, N52xxB

The screenshot shows the 'Sweep Setup' dialog box for N52xxB models, with the 'Timing' tab selected. The dialog has two main sections: 'Time' and 'Sweep Mode'. In the 'Time' section, 'Sweep Time' is set to 253.069 msec, 'Dwell time' is 1.000 msec, and 'Sweep Delay' is 0 usec. There are checkboxes for 'Auto Sweep Time' and 'Fast Sweep - Reduce settling time', both of which are currently unchecked. In the 'Sweep Mode' section, there are two radio buttons: 'Auto' and 'Stepped'. The 'Stepped' radio button is selected. Below these, there is a 'Sweep Sequence' section with two radio buttons: 'Standard' and 'Point Sweep - measure all data before stepping to next point'. The 'Standard' radio button is selected. At the bottom of the dialog are four buttons: 'OK', 'Cancel', 'Apply', and 'Help'.

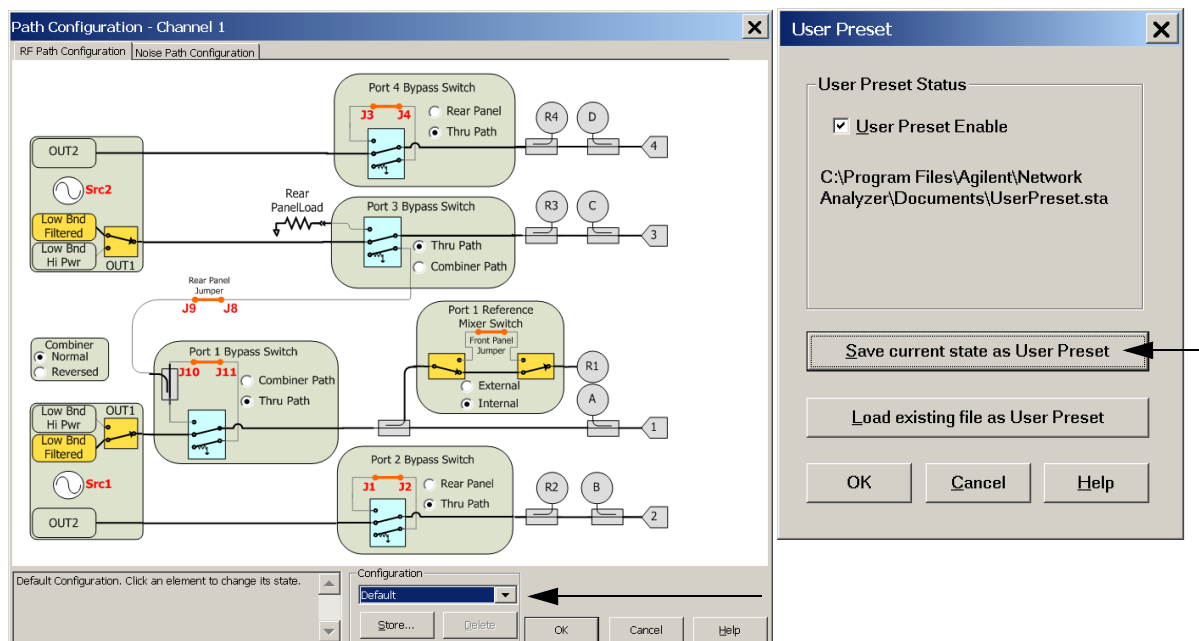
Section	Parameter	Value
Time	Sweep Time	253.069 msec
	Dwell time	1.000 msec
	Sweep Delay	0 usec
Sweep Mode	Auto	<input type="radio"/>
	Stepped	<input checked="" type="radio"/>
Sweep Sequence	Standard	<input checked="" type="radio"/>
	Point Sweep - measure all data before stepping to next point	<input type="radio"/>

## RF Path Configuration with Option 029

If the analyzer has Option 029 or H29 (noise figure capability) verify that the path configuration is set to Default. If it is not in Default configuration, ports 5 and 9 will not operate correctly.

1. Select **Trace/Chan > Channel > Hardware Setup > Path Cong...** -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 33 RF Path Configuration



## N-Port Calibration with PNA

It is recommended that you perform an ECal characterization to minimize the connections required for multiple port calibration. The N4691B Option M0F is recommended with cable (85131F) if you are calibrating at the analyzer and Test Set ports.

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

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

### NOTE

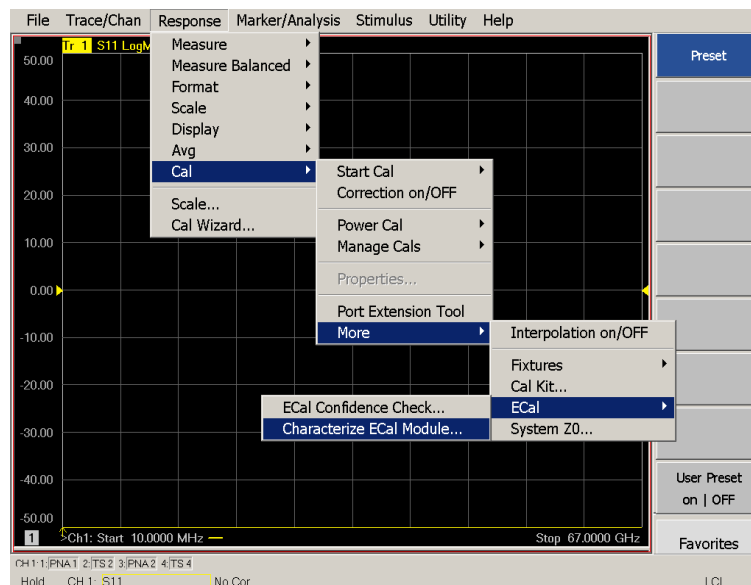
If measurement errors occur, ensure the newest version of firmware is installed on the network analyzer. Measurement errors can be a result of firmware algorithms. Consult with Keysight Service or firmware web page for the latest PNA, PNA-L or PNA-X Option 551 firmware revisions and history.

<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...)** and follow the prompts.
2. Save the ECal characterization file. Refer to the Help menu for characterizing information.

Figure 34

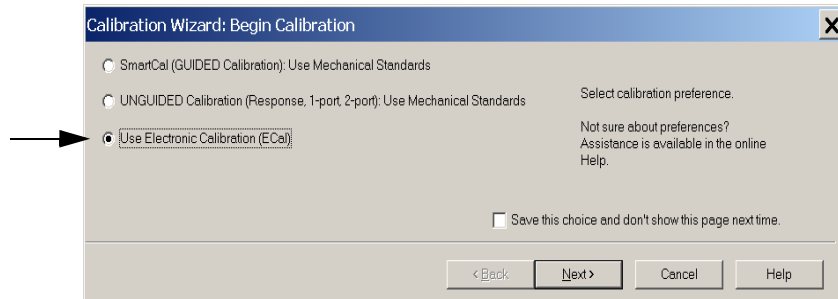
### ECal Characterization and Calibration Wizard



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...)**.

Figure 35

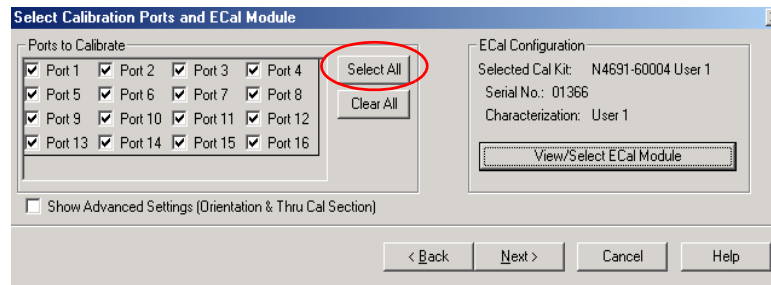
#### Begin Calibration



3. Continue following the Cal Wizard prompts. In the “Select Calibration Ports and ECal Module” dialog box press **Select All**, or select the ports you are calibrating and press **Next**. If an ECal characterization has been done, select **View/Select ECal Module** and select the previously saved user file from **step 2**.

Figure 36

#### 8-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. The electrical delay value may be shown in the dialog box after the last measurement, click **OK**.
5. At the Calibration Completed prompt, select **Save As User Calset** and type the name desired and **Save**. See **Figure 48 on page 63**.
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 network analyzer is in standard (non-multiport) mode.

#### NOTE

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

## Interface Control Mode

### NOTE

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 the need of an external computer. Refer to analyzer's Help menu, "Rear Panel Tour" and "Interface Control."

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



## How to Access Interface Control Mode

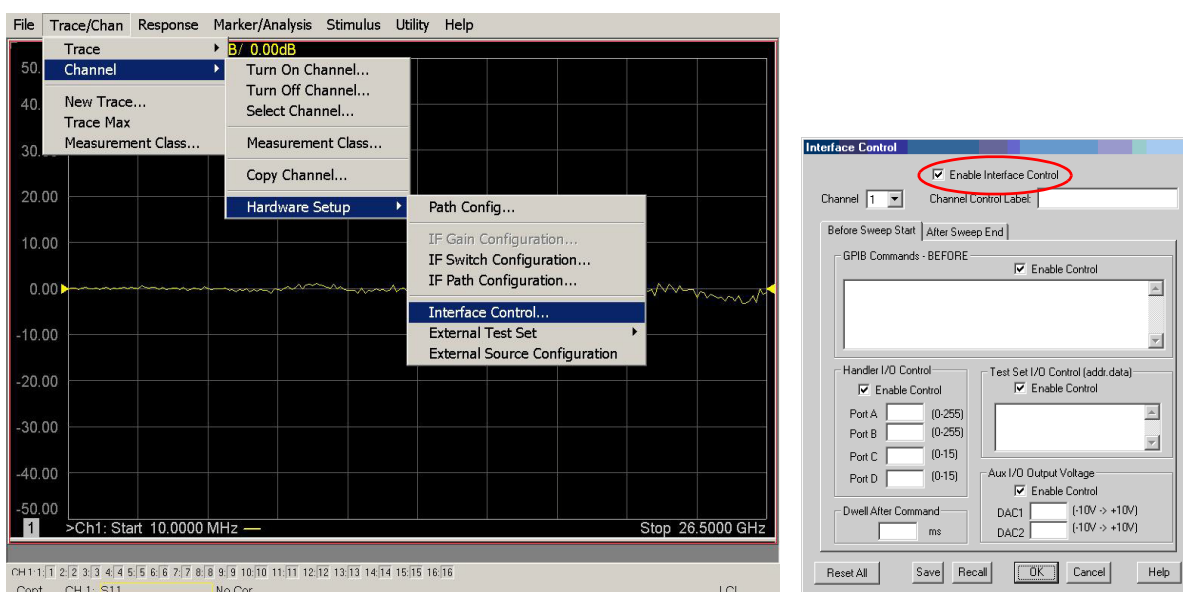
This section will describe how to setup and operate the test set with the analyzer.

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

### NOTE

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

Figure 37 Enable Interface Control



# Using Interface Control Mode

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

## NOTE

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

Figure 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 PNA. 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 52.**
- 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 PNA.
- Address and Data example: **addr.data (3)**
- 0.0  
16.1  
32.2

<b>Channel: (4)</b>	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.
<b>Channel Control Label: (5)</b>	Specifies the label to be displayed on the analyzer's screen during the channel sweep.
<b>Before Sweep Start – After Sweep End Tabs: (6)</b>	Commands (GPIB, I/O's and Dwell) can be sent Before Sweep Start and After Sweep End. However, they are configured and enabled separately on the "Interface Control" dialog box. For example; to send a command before and after a PNA sweep, the "Enable Interface Control" check box must be selected and commands entered in both the Before Sweep Start and After Sweep End tabs. The <b>Before Sweep Start</b> data is sent before the first trace on the channel begins sweeping. The <b>After Sweep Start</b> data is sent after the last trace on the channel sweep is completed.
<b>Dwell After Command: (7)</b>	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.
<b>Handler I/O Control and Aux I/O Output Voltage: (8)</b>	Provides I/O interface control through the rear panel of the PNA. Refer to the PNA Help menu for further information.
<b>Reset All:</b>	Sets all fields on all channels to their default values.
<b>Save and Recall:</b>	Saves and recalls the contents of the dialog box. If the "Interface Control" dialog box is populated with settings during an Instrument State Save, the settings are automatically recalled with the instrument state settings. Interface control uses an *.xml file type. An example file is stored on the PNA hard drive. You can recall it into the dialog, or you can open and edit it with a word processor, such as Word Pad.
<b>OK:</b>	Applies the settings and closes the dialog box.
<b>Cancel:</b>	Does not apply changes that were made and closes the dialog box.
<b>Help:</b>	Provides additional information for using the interface control application.

## SCPI Control Mode

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

### Overview of the SCPI Control

The Command Processor allows you to send address and data to control an external test set, without 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 > System Setup > Remote Interface > SCPI Monitor Input > Show SCPI Parser Console).**
2. Check the **SCPI Command Processor Console** box.

Figure 39 Command Console for 'A' Model Analyzers

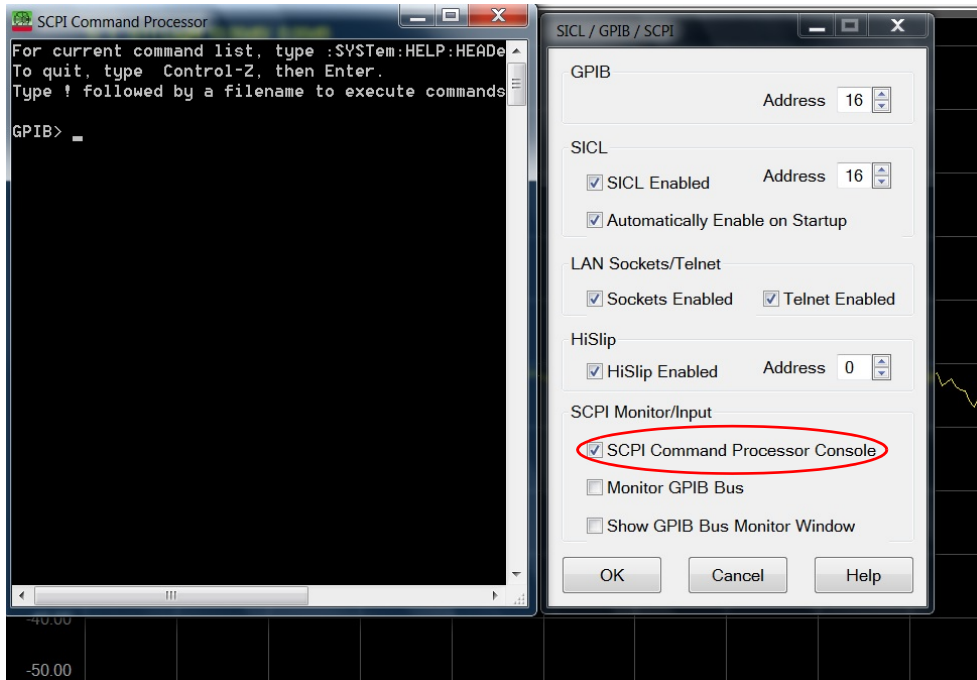
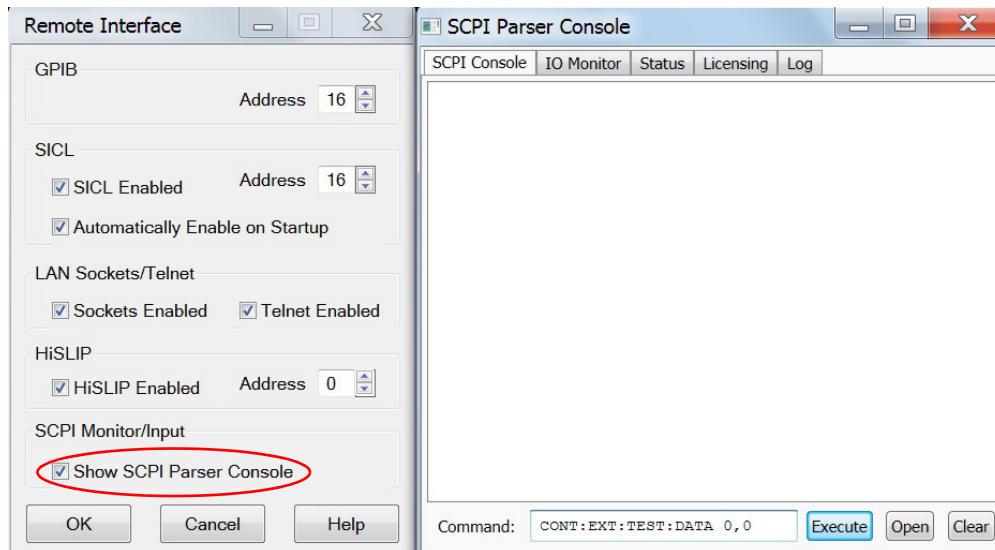


Figure 40 Command Console for 'B' Model Analyzers



## 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.

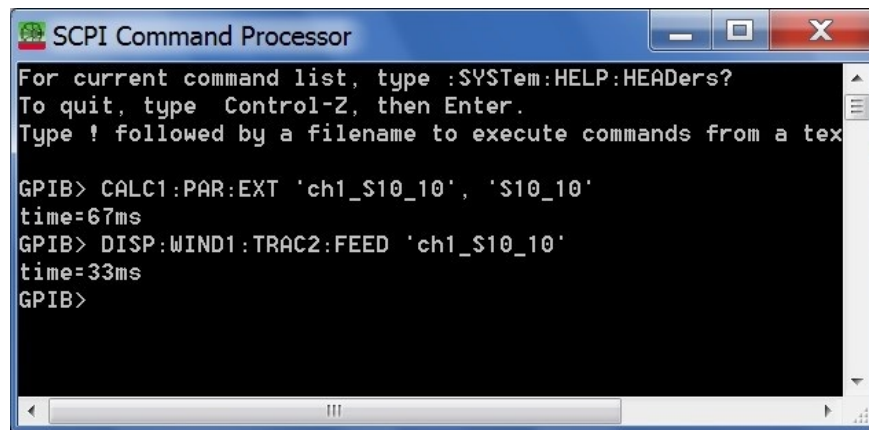
### Method 1 - Using GPIB/SCPI Command Values

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 41 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 52](#).

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:

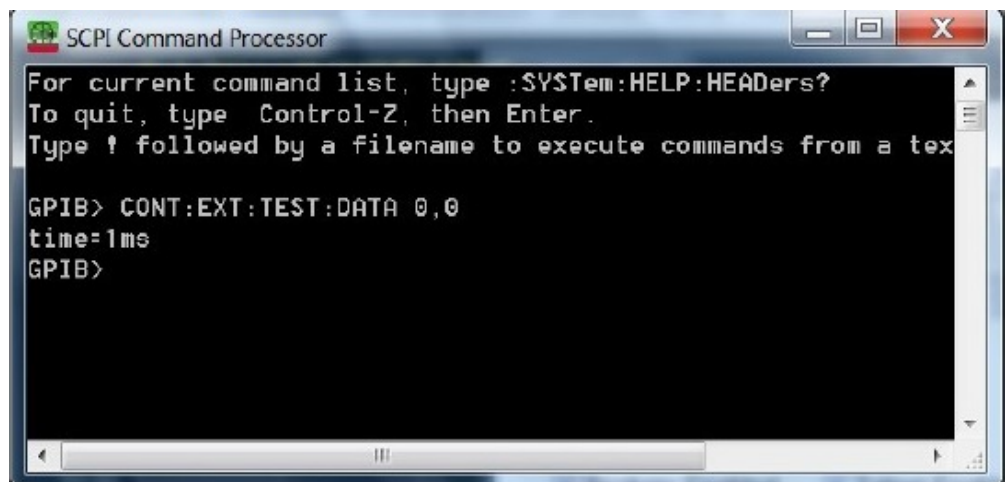
```
CONT:EXT:TEST:DATA <address>,<data>
```

```
CONT:EXT:TEST:DATA 0,0
```

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

Figure 42

Method 2 - Using Test Set Address and Data Values



## Address and Data Values

### Setting the Test Port Paths with Address and Data

Refer to [Table 11 below](#), [Table 12 on page 53](#) and [Figure 43 on page 53](#) for information to set the internal switch paths of the test set.

The address is the first value in the test set I/O control or GPIB data command. The second value controls the source and receiver paths of the ports. To select a test set port configuration both switches must be set to complete the source and receiver paths. To do this you must add the data values together to determine the data command value for each port, which is the second number in the test set I/O or GPIB command. Refer to [“Interface Control Mode” on page 44](#) and in [“SCPI Control Mode” on page 48](#).

#### Example 1:

Refer to [Figure 43 on page 53](#).

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

Port 5 is the Source and Port 14 is the Receiver.

Source Port 5 = address 0, data 1 and Receiver Port 14 = address 16, data 128. Two separate commands must be sent, you may use the same dialog box. The entry will be 0.1 in one command line, and 16.128 in the second line.

#### Example 2:

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

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

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

Table 11

N5230C Test Port and Data Values

Address		Source Path				Receiver Path			
	Data	1	2	4	8	16	32	64	128
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 12

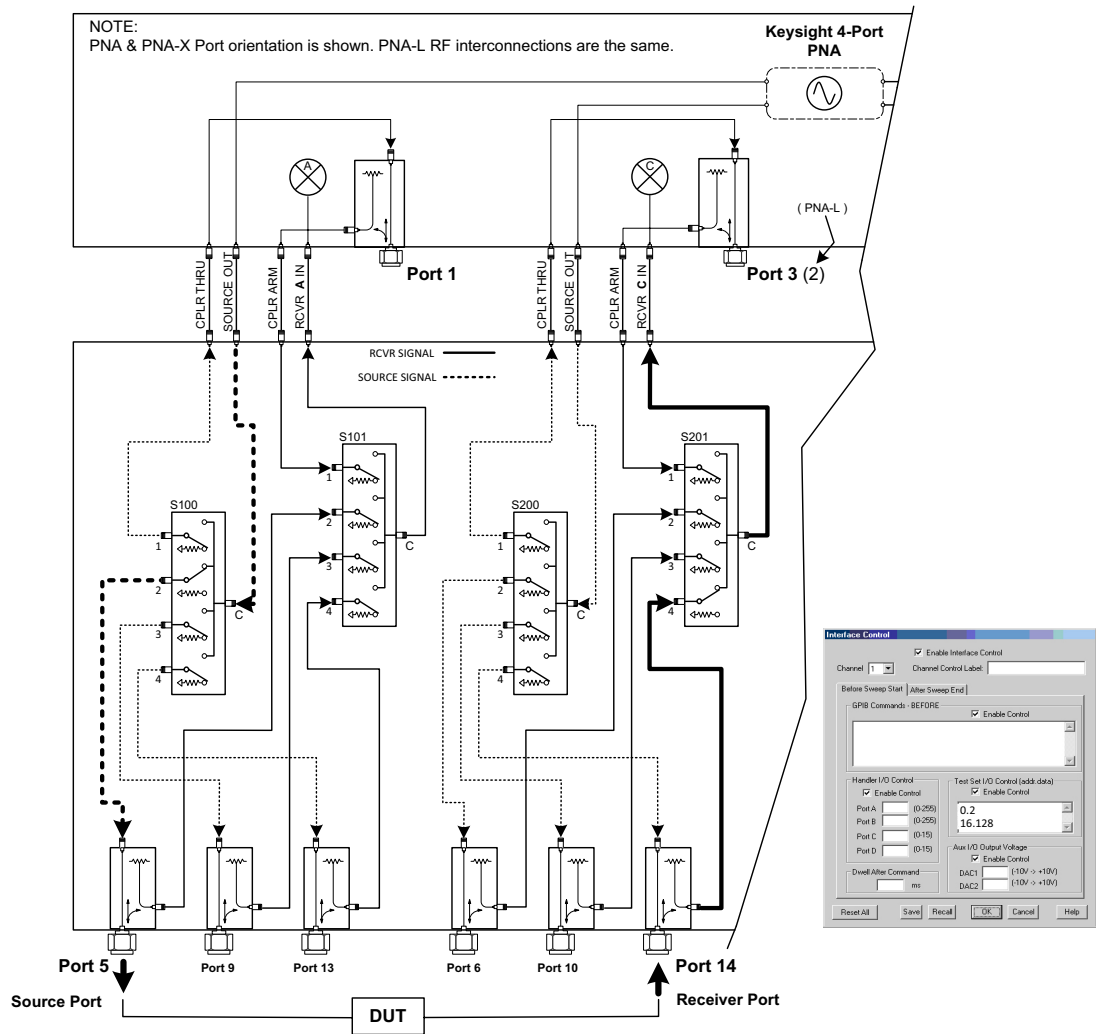
N5242A/B Test Port and Data Values

Address		Source Path				Receiver Path			
	Data	1	2	4	8	16	32	64	128
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

Refer to “System Block Diagram” on page 72 for in-depth RF path information

Figure 43

Address and Data Example 1 (Port 5 and 14)



## Control Lines

The 15 pin female D-Sub connector on the front panel provides 8 latched data lines that can be used to control your device under test (DUT). The lines can be controlled with the multiport external test set control, or test set I/O commands. Refer to [“External Test Set Control Feature” on page 36](#) and [“Setting the Control Lines with Address and Data Values” on page 58](#). See [Table 13](#) for DUT control line specification.

The output voltage of the lines can be from the internal adjustable voltage source (+2 to +5 Vdc), or an external DC power supply depending on how the connection to the control line is configured. When using an external power supply a positive or negative voltage can be used. Refer to [Figure 44](#) and [Table 14 on page 55](#) for control line pin location and description. Refer to [“Internal Voltage Supply Configuration” on page 56](#) and [“External Voltage Supply Configuration” on page 57](#) for configurations.

Table 13 DUT Control Specifications

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

Figure 44 DUT control Line Pin Assignment (rear panel view)

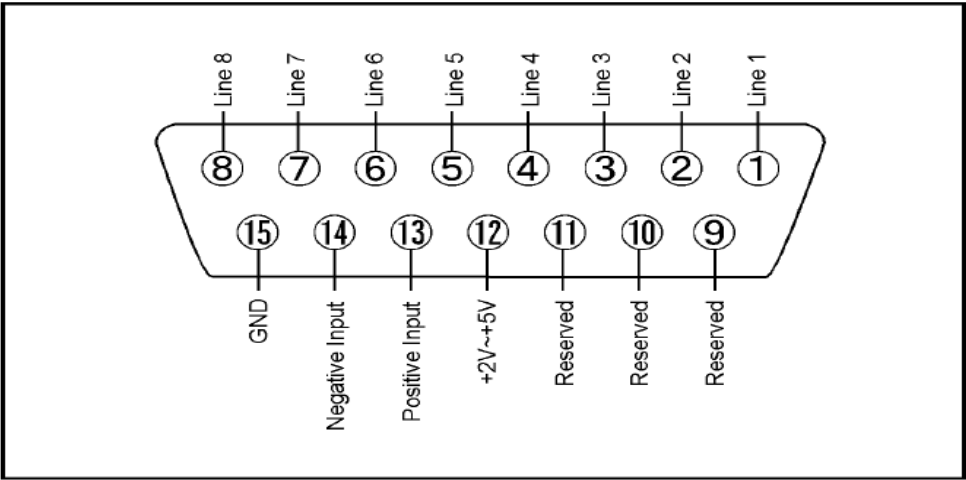


Table 14 DUT Control specifications

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

## Internal Voltage Supply Configuration

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

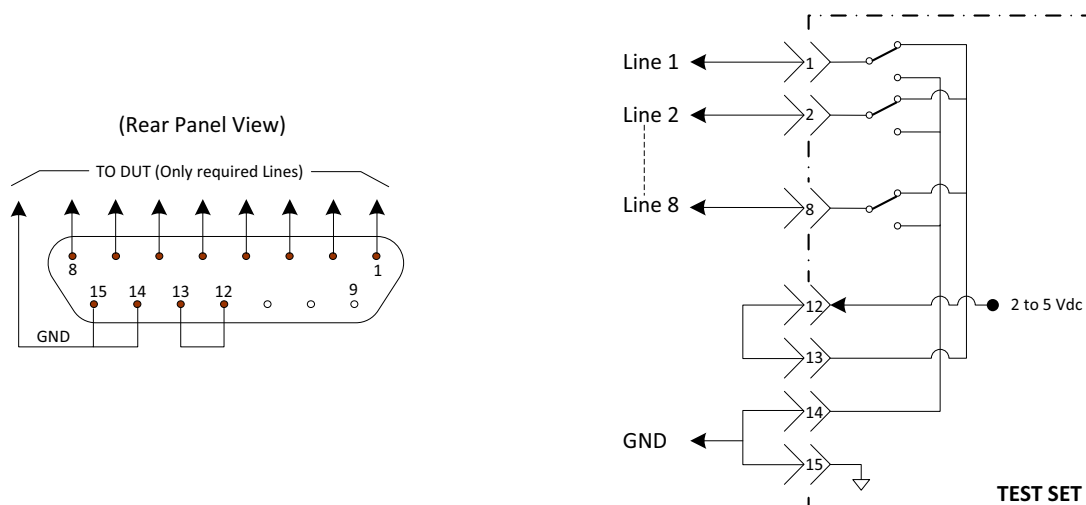
1. Turn on the test set.
2. Measure the voltage between pin 12 and 15 using a multimeter.
3. Rotate the voltage adjustment trimmer on the rear panel until the multimeter indicates the selected voltage.

**Figure 45** illustrates an example of the connection between the DUT and the test set using the internal DC power supply. Connect pin 12 to pin 13 and pin 14 to pin 15 to provide the ground path. Connect the control lines to the external DUT.

### CAUTION

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

Figure 45 Internal DC Power Configuration (rear panel view)



## External Voltage Supply Configuration

**Figure 46** illustrates an example of the connection with an external DC power supply. Connect the positive and negative voltage supply from the external power supply to the positive input (pin 13) and the negative input (pin 14). Connect the power supply DC ground to pin 15.

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

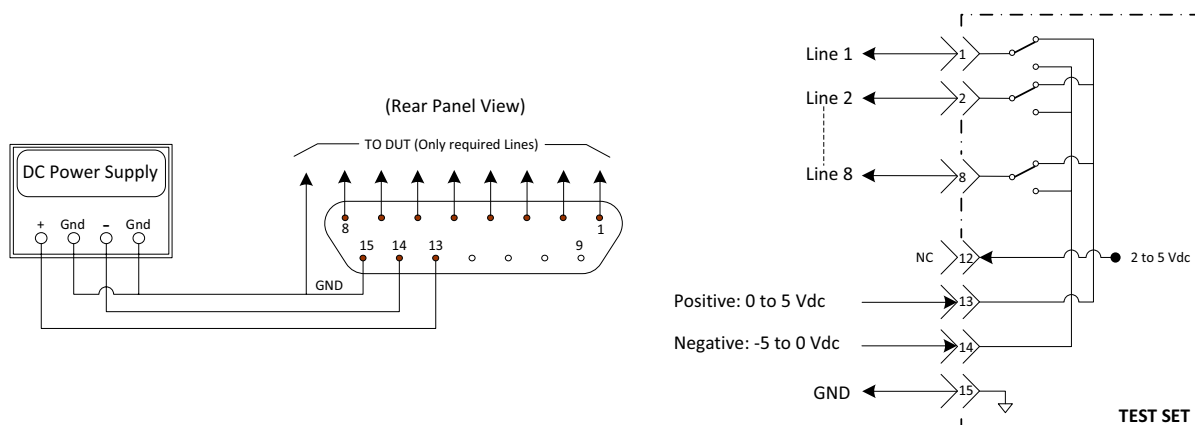
1. Turn on the test set.
2. Connect the DUT.
3. Turn on the external power supply.

### Turning Off the Test Set using an External Power Supply

1. Turn off the power supply.
2. Turn off the test set.
3. Disconnect the DUT.

Figure 46

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 PNA to Standalone Mode

1. Select **Utility > System > Configure > Multiport Capability -OR- (Instrument > Setup > External Hardware > Multiport > Multiport Configuration...)**. In the dialog box, select **Restart as a standalone PNA > OK**.
2. **Access Interface Control Mode** (see page 45).

As described in “**Setting the Test Port Paths with Address and Data**” on page 52, the <address>.<data> values are determined in a similar manner, with the following exceptions:

- **Table 15** will be used.
- The <address> value is always = 112

Table 15 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 45 on page 56](#). To reset all control lines to logic high, without having to reset the power switch on the test set, make the following 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 45 on page 56](#), shown with all lines = logic high.

#### Example 1

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

1. Line 1 (<address> = 112 and <data> = 1)
2. Line 8 (<address> = 112 and <data> = 128)
3. The SUM of the <data> values = 129
4. Front panel 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

The following procedure can be used to confirm that the test set and network analyzer are operational. The operation verification limits provided ensure that your test set and network analyzer is operating properly.

### Equipment Required

The U3042AE12 requires that the user be familiar with the equipment and components listed in [Table 16](#).

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

Table 16 Equipment List

Description	Qty
N4691A 3.5 mm ECal Module 10 MHz to 26.5 GHz (Option 00F or M0F) <i>or</i> N4691B 3.5 mm ECal Module 300 kHz to 26.5 GHz (Option 00F or M0F) <i>or</i> Mechanical cal kit 85052B <i>or</i> 85052D	1
N5230C 4-Port Network Analyzer (Option 245 and 551) <i>or</i> N5222A/B, N5232A/B <i>or</i> N5242A/B Option 400 and 551	1
Set of interconnect cables (PNA and test set), see <a href="#">“PNA-L RF Interface Cable Connections” on page 22</a> <i>or</i> <a href="#">“PNA and PNA-X RF Interface Cable Connections” on page 27</a> .	1



## Verification Limits

Specifications for the test set are typical. System performance for the network analyzer and test set are only characteristic and intended as non-warranted information. Only a functional certificate is provided for the test set.

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

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

### NOTE

Typical specifications are based on 1 to 2 units performance. Refer to [Table 17](#) and [Table 18](#) below.

Table 17 PNA-L Reflection Tracking Limits<sup>a</sup>

Frequency	Standard Port 1- 16 <sup>b</sup>	Option 001 or 002 Port 1-16
10 MHz to 4 GHz	-10 dB	0 dB
4 GHz to 6 GHz	-13 dB	-2.5 dB
6 GHz to 10 GHz	-16 dB	-5.0 dB
10 GHz to 15 GHz	-17 dB	-7.5 dB
15 GHz to 20 GHz	-25 dB	-15 dB

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

b. A standard unit is one without Options 001 or 002

Table 18 PNA or PNA-X Reflection Tracking Limits<sup>a</sup>

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

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

b. A standard unit is one without Options 001, 002.

## 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 analyzer if you are performing the analyzer's Operator's Check. The analyzer will indicate false failures if the test set is connected.

### Preparing the Network Analyzer

1. Connect the test set to the analyzer using the interconnect cables as shown in [“Hardware Lock-Link Kit Installation with N5230C or N5232A/B” on page 19](#) and [“Hardware Lock-Link Kit Installation with N5222A/B or N5242A/B” on page 24](#).
2. Turn on the test set.
3. Select **Response > Cal > Manage Cals > Cal Set -OR- (Cal Sets & Cal Kits > Cal Set...)**. Delete or rename any Cal Sets titled “999.1” thru “999.16” (16-Port), although it is unlikely that you will find Cal Sets with these names.
4. Verify that the network 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 -OR- (Instrument > Setup > External Hardware > Multiport > Multiport Configuration...)**. Select **Restart as Multiport PNA with this Test Set** and select **U3042AE12** (16-Port) from the drop-down menu > **OK**. Refer to [Figure 25 on page 35](#).
5. Press **Preset**.
6. Verify that the **[Start Frequency]** is set to **[300 kHz or 10 MHz]**.
7. Set **[Stop Frequency]** to **[20 GHz or 26.5 GHz]**.
8. Select **[Power] > Power Level** and enter **[0 dBm]**.
9. Select **Response > Avg > IF Band width > 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 a ECal. If you are not, see [“1-Port Calibration and Verification Procedure” on page 63, step 2](#).

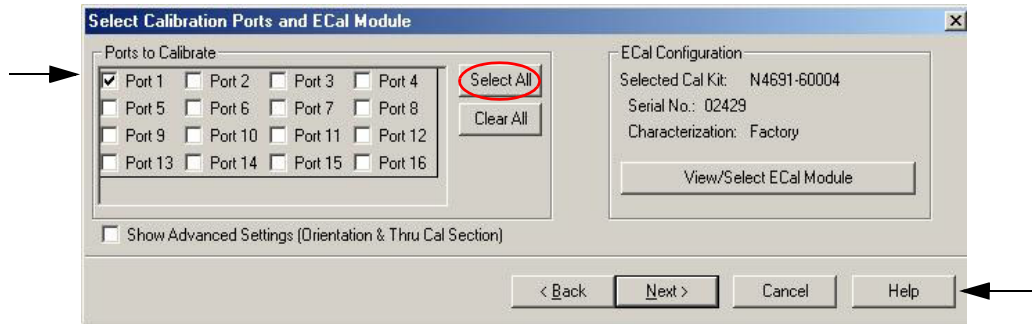
Allow the ECal module, test set and analyzer to warm up for a minimum of 30 minutes.

## 1-Port Calibration and Verification Procedure

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

Figure 47

### 1-Port Calibration



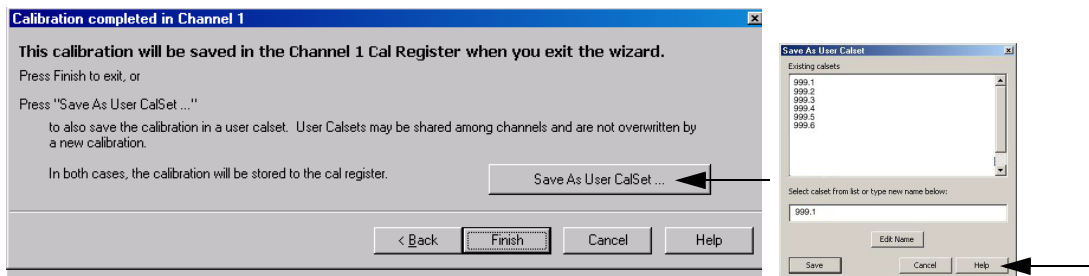
5. Continue to follow the prompts until the "Calibration Completed" dialog box appears.
6. At the Calibration Completed prompt, select **Save As User Calset**, type the name **999.1**. Overwrite the Calset if it already exists and **Save**.

### 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 48

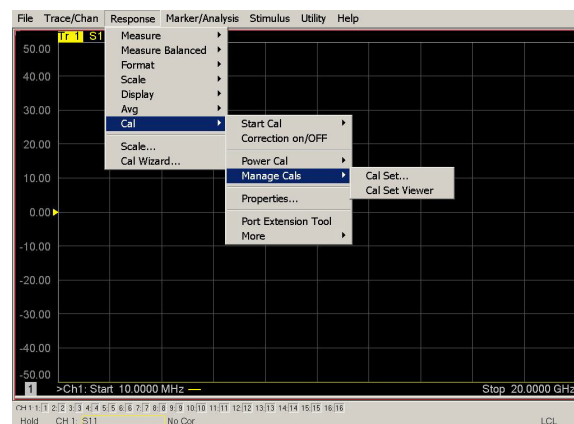
### Calibration Complete



7. Repeat **step 1** thru **step 6** (1-Port Calibration Procedure) for Ports 2 thru 16. When finished, there should be 16 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 -OR- (Response > Cal > Cal Sets & Cal Kits > ECAL Confidence Check)**. Select Change Measurement and select the test port S-Parameter > **Apply > OK > Read Module Data**.
8. Select **Trace/Chan > Trace > Delete Trace -OR- (Instrument > Trace > Delete Trace)**. There should be no traces on the screen.
9. To launch the Cal Set Viewer tool bar. Select **Response > Cal > Manage Cals > Cal Set Viewer -OR- (Response > Cal > Cal Sets & Cal Kits > Cal Set Viewer [On/Off])**.

Figure 49

#### 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 17 on page 61**. 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 50

#### Setting the Test Limits

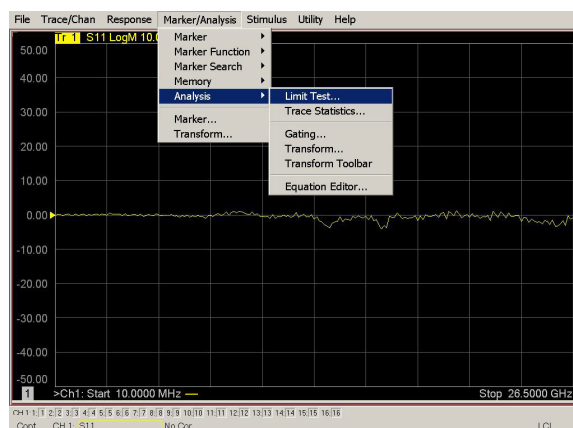


Figure 51 Option 001 or 002 Reflection Tracking (Port 1-4) with PNA or PNA-X

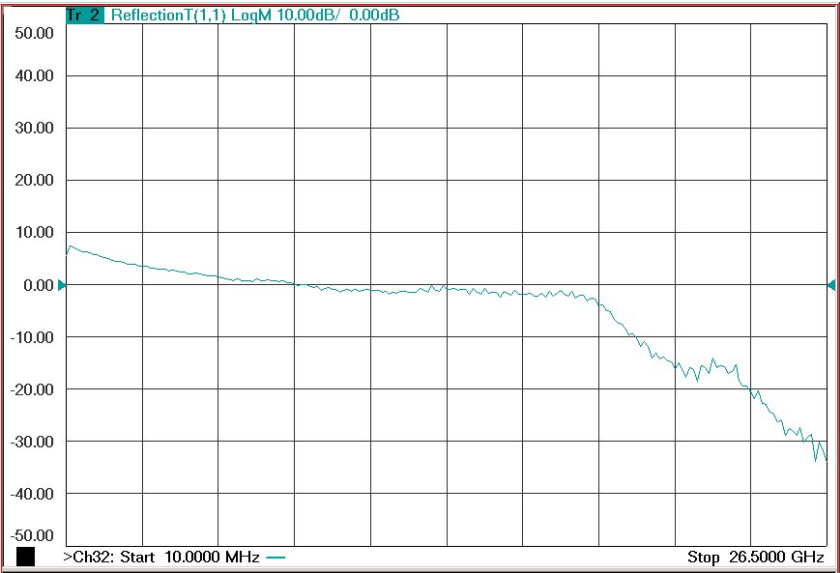
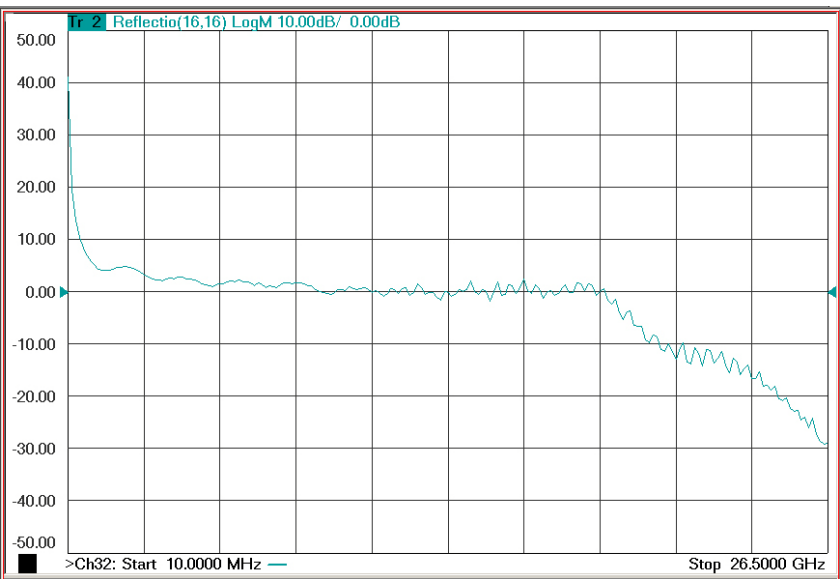


Figure 52 Option 001 or 002 Reflection Tracking (Port 5-16) with PNA or PNA-X



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

Figure 53

Reflection Tracking Trace (Port 1-4) with PNA or PNA-X

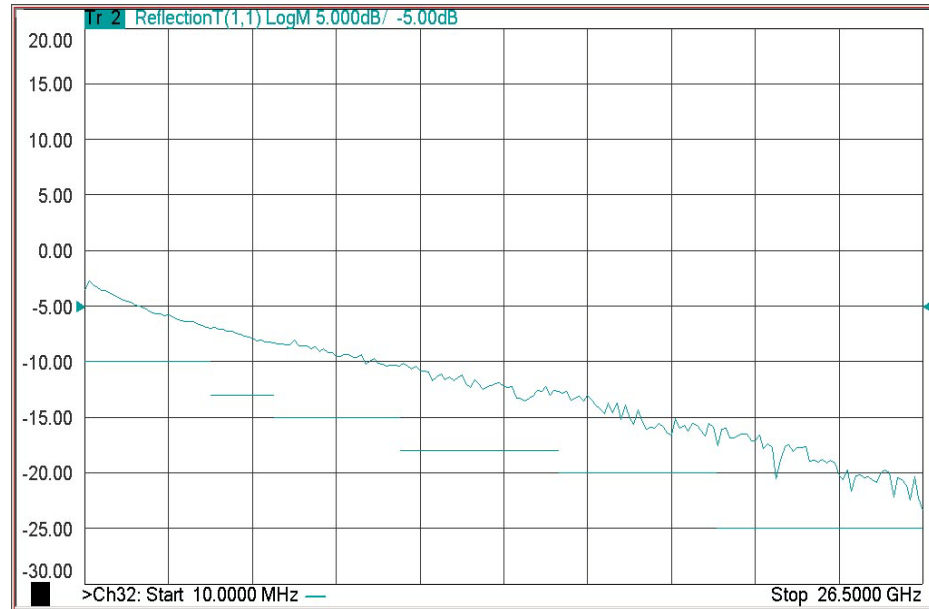
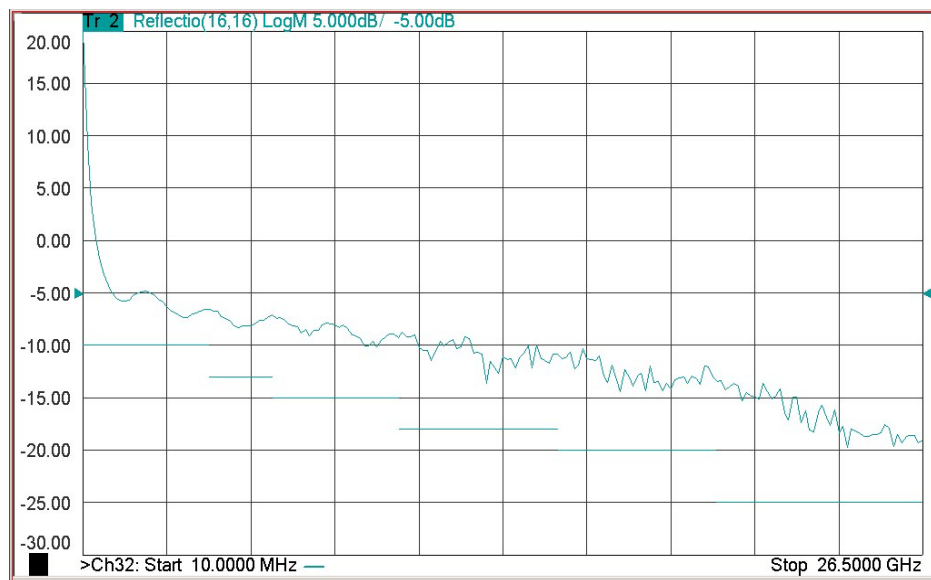


Figure 54

Reflection Tracking Trace (Port 5-16) with PNA or PNA-X



**NOTE**

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

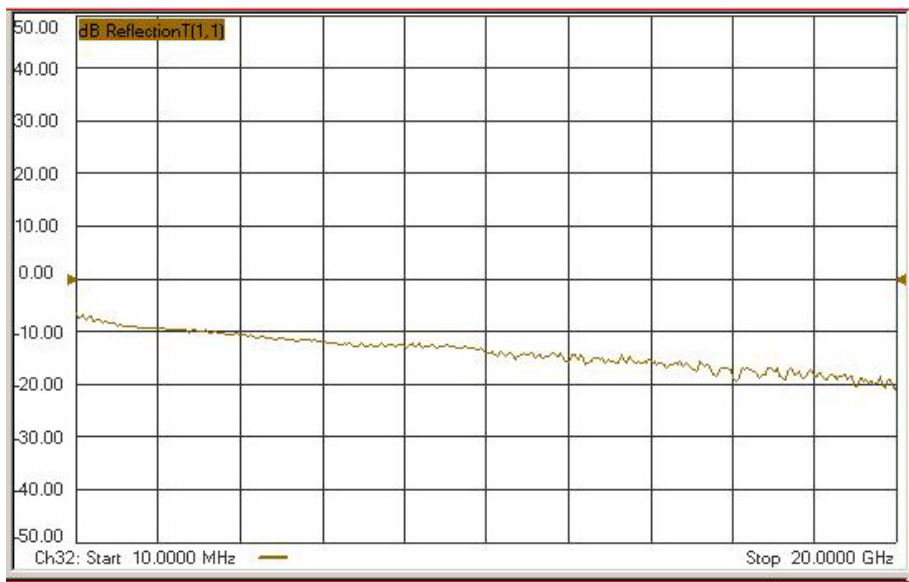
Figure 55

Option 001 or 002 Reflection Tracking (Port 1-16) with PNA-L



Figure 56

Standard Reflection Tracking (Port 1-16) with PNA-L



## Verifying Cal Kit Operational Check Failure

If your test results fail the Cal Kit Operational Check Reflection Tracking limits, see [Table 6](#) and [Table 7](#) on [page 15](#). Verify the following:

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

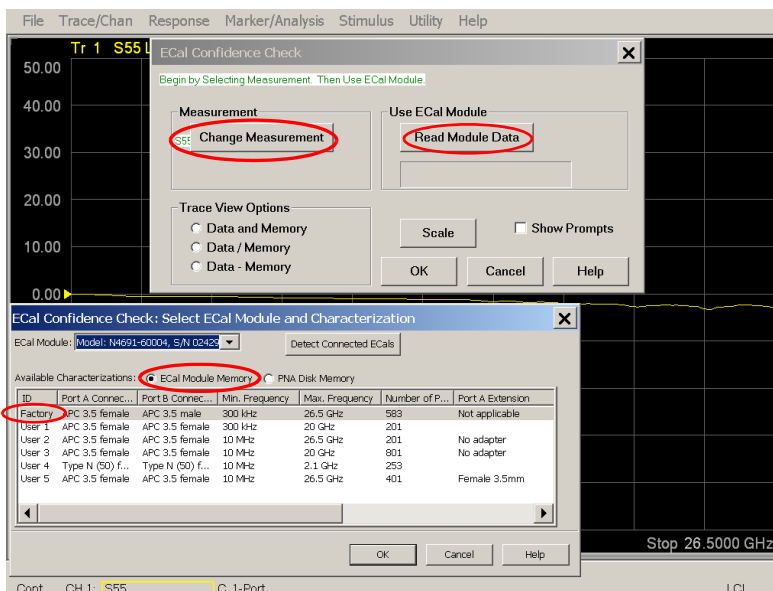
### ECal Confidence Check

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

1. Perform an 1-Port Cal of the test set port being tested.
2. Connect the ECal Module to the Port being verified. Terminate any remaining ports on the ECal module.
3. Select the Cal Set to be verified. Select **[Cal] > Cal Set... > Cal\_File > Apply Cal > Close -OR- ([CAL] Cal Set & Cal Kits > Cal Set... > Apply Cal)**.  
If the “Choose Stimulus Settings...” prompt appears, select **Change the active channel's stimulus... > OK > Close**.
4. Select **Response > Cal > More > ECal > ECal Confidence Check -OR- (Response > Cal > ECal Confidence Check...)**.
5. Click **Change Measurement** and select the test port S-parameter **Apply > OK**. Click **Read Module Data**.
6. Select the ECal module you are using, and select **ECal Module Memory > Factory > OK**.

Figure 57

### ECal Confidence Check





## Service Information

Refer to “Contacting Keysight” on page 95.

### 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.

## Electrostatic Discharge Protection

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

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

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

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

### WARNING

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

## Replacement Parts

The following replaceable parts are available from Keysight Technologies at <https://www.keysight.com/my/faces/fapHomePage.jspx>.

Table 19 Available Replacement Parts (SPO)

Description	Keysight Part Number
Quad Switch	5087-7306 or 5087-7751 (RoHS)
Coupler/Bridge	5087-7716 or 5087-7752 (RoHS)
Amplifier (Option 001 & 002)	5087-7290 or 5087-7750 (RoHS)

(Continued on next page)

Table 19 Available Replacement Parts (SPO) (Continued from previous page)

Fuse (5 A 250 V non-time delay (20 mm)	2110-0709
Fuse (8 A 250 V non-time delay (1.25 inch)	2110-0342
Screw	0515-2317
PWR Supply (AC/DC SWG 650W 9- Output	0950-4729
Port 1 CPLR ARM	U3042-20029
Port 1 RCVR A IN	U3042-20030
Port 1 SOURCE OUT	U3042-20031
Port 1 CPLR THRU	U3042-20032
Port 3 CPLR ARM	U3042-20033
Port 3 RCVR C IN	U3042-20034
Port 3 SOURCE OUT	U3042-20035
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 RCVR B	U3042-20042
Port 2 SOURCE OUT	U3042-20043
Port 2 CPLR THRU	U3042-20044
PNA-X Test Set Rear Lock Feet (right)	N5242-20138
PNA-X Test Set Rear Lock Feet (left)	N5242-20139
RF Cable, Semi-rigid	Z5623-20418
RF Cable, Semi-rigid	Z5623-20419
Locking Feet for a PNA & PNA-X	5023-0132
Test Set Locking Feet to a PNA-L	5063-9253
Test Set I/O Cable	N4011-21002
Fan (rear panel)	87050-60027
Fan (Deck)	87075-60021

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

Table 20 Replacement Parts (E12)

Description	Keysight Part Number
Bias Tee (Option 002)	5087-7239
DUT Control Board	U3020-63223
U3042AE12 User's and Service Guide	U3042-90001
LED Status Board	N5261-63005
LED Status Ribbon Cable	N5261-60001
Switch Interface Board	Z5623-63647 or Z5623-63998 (RoHS)
Controller Board	N5261-63006
Power Switch and LED	Z5623-60221

## System Block Diagram

Figure 58

U3042AE12 Standard Configuration

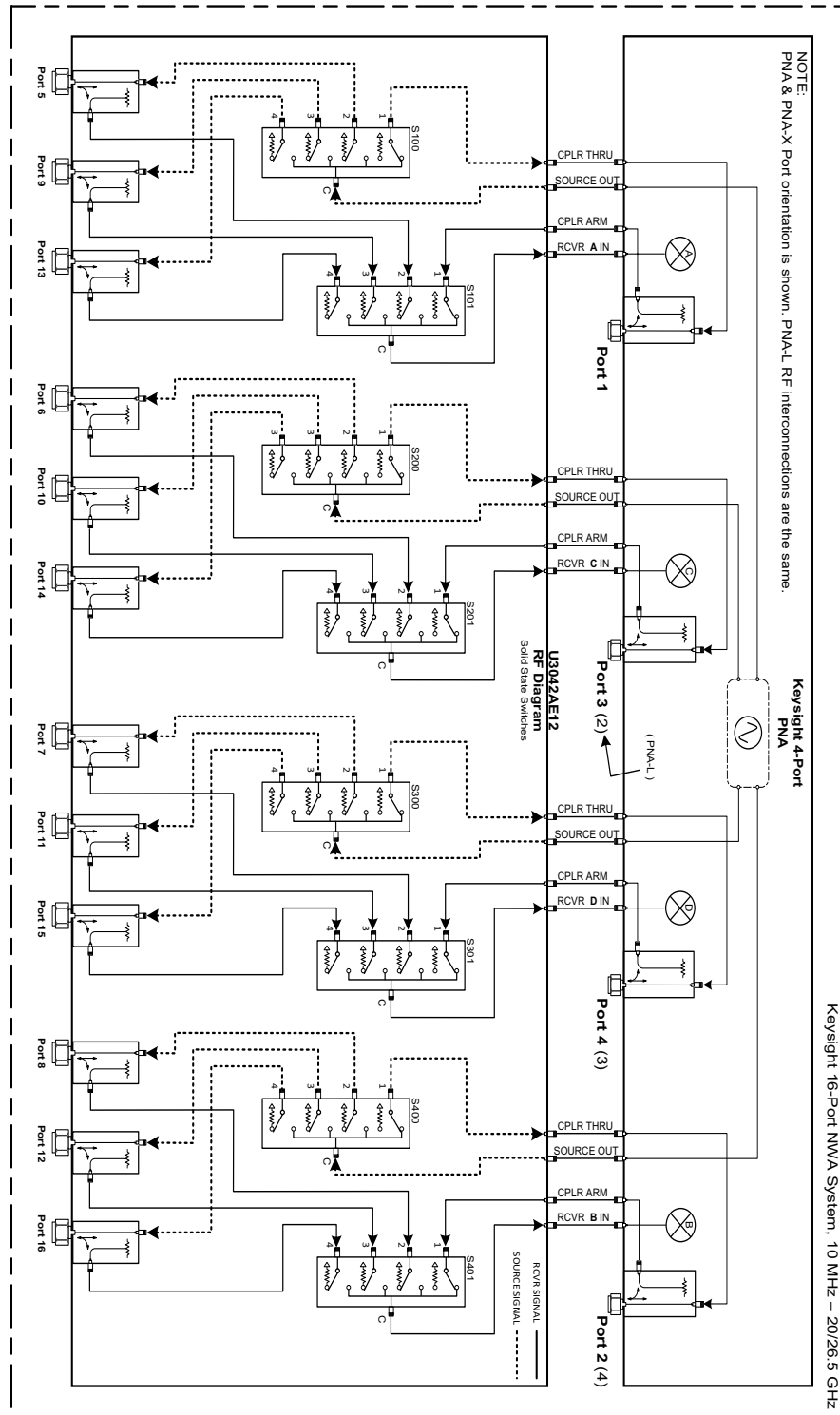


Figure 59 U3042AE12 Option 001 Configuration

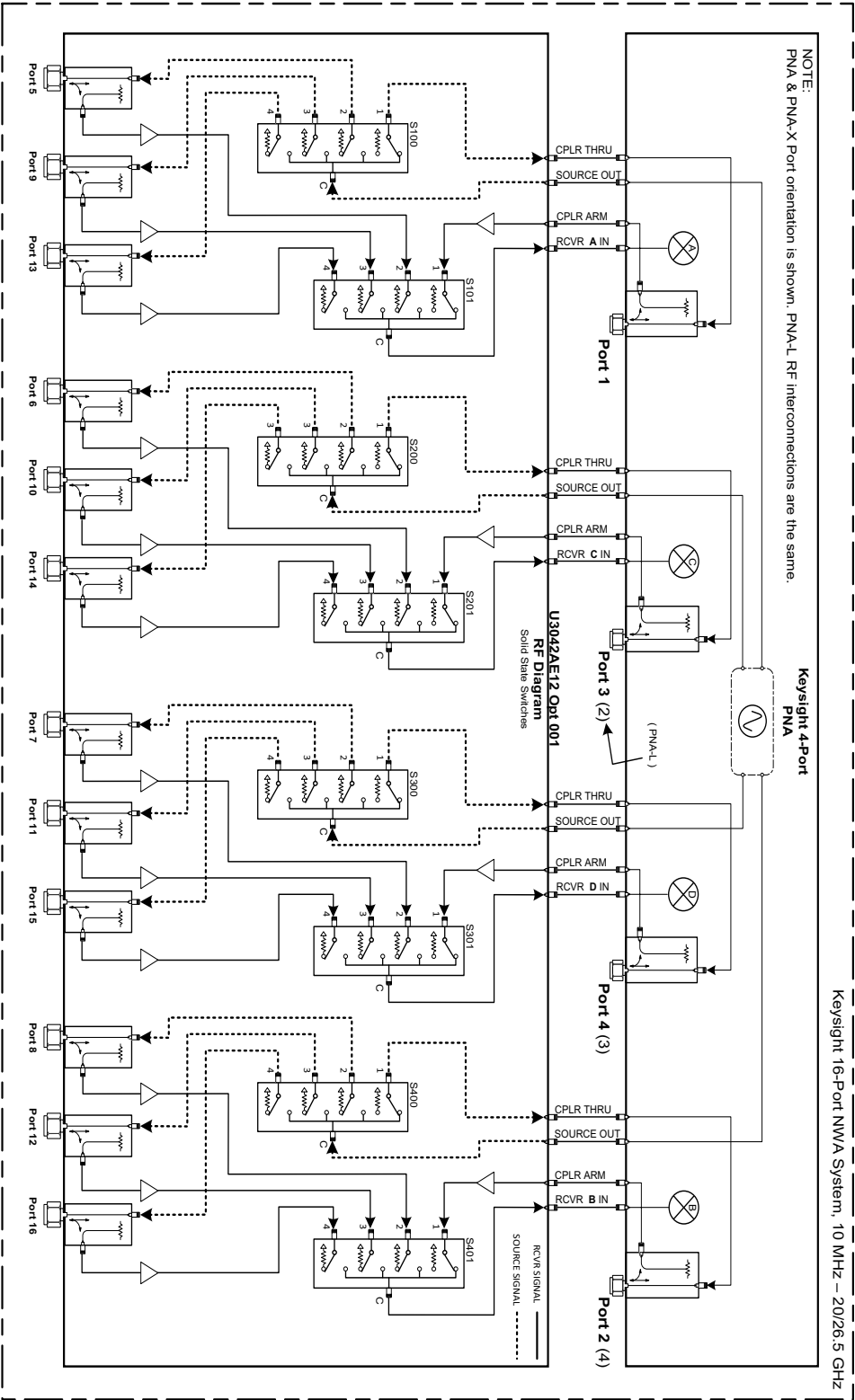
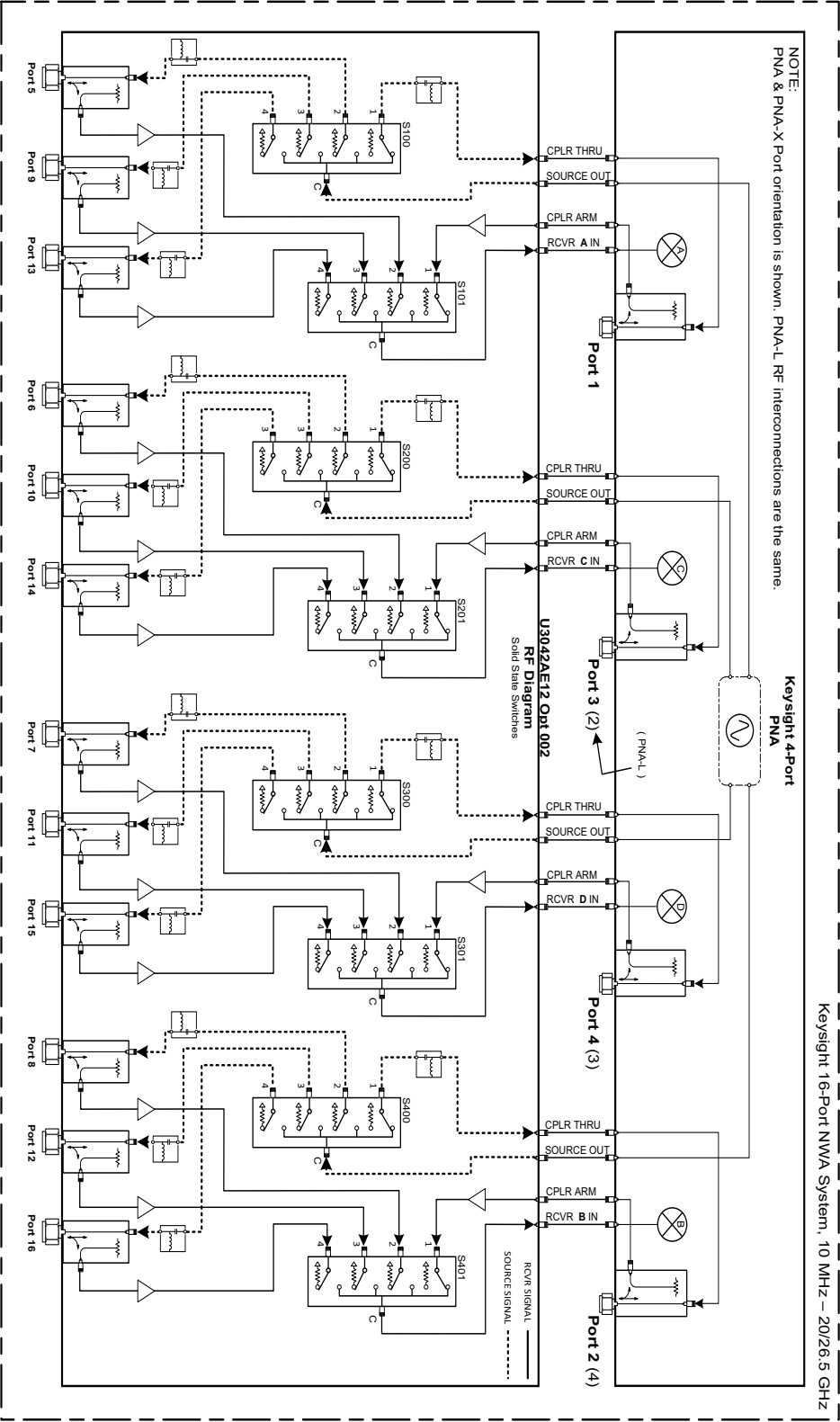


Figure 60 U3042AE12 Option 002 Configuration



## Theory of Operation

The following is a description of the operation of the test set. Reference the test set block diagrams shown in “[System Block Diagram](#)” on page 72. This section assumes the user has a general understanding of couplers, switches, and network analyzers.

### RF Coupler/Bridges

The test set uses 12 coupler/bridges (5087-7716 or 5087-7752) on the front panel for RF Test Ports 5 - 16. The coupler/bridges provide the signal separation of the source and receiver paths, using resistor networks. The test set ports can receive from or stimulate a signal to the DUT.

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

### Test Set Control Board

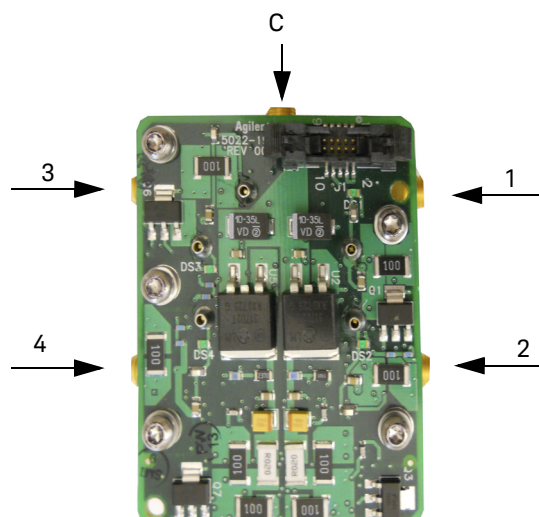
The Test Set Control Board (N5261-63006) is a surface mount, printed circuit assembly (PCA). It provides a connection to the power supply, and the PNA Test Set I/O for control of the RF switch paths (through the Switch Interface board (Z5623-63647 or Z5623-63998). The front panel “Active” and port LEDs are on only when the PNA has addressed the U3042AE12 Test Set. The rear panel fan is on when the controller board supplies are operational.

### RF Switch Components

The test set uses 12 solid-state switches (5087-7306 or 5087-7751) that have internal 50 Ohm termination for each path. The switches select the RF paths from the PNA source and receiver through interconnect cables to the test set. Network analyzer Ports 1 thru 4 and test set Ports 5 thru 16.

Figure 61

Switch



## Source Switch Paths

<b>S100 - Source to Ports (1, 5, 9 and 13)</b>	Switch 100 provides control of the PNA Source path to Port 1, 5, 9 and 13. In the state shown in the block diagram, switch 100 routes the RF Source to Port 1 and the Test Set Source paths to ports 5, 9 and 13 are terminated.
<b>S200 - Source to Ports (2 or 3, 6, 10 and 14)</b>	Switch 200 provides control of the PNA Source path to PNA-L Port 2 or PNA-X Port 3 and the Test Set Ports 6, 10 and 14. In the state shown in the block diagram, switch 200 routes the RF Source back to the PNA Port and unused Test Set ports (6, 10 and 14) are terminated.
<b>S300 - Source to Ports (3 or 4, 7, 11 and 15)</b>	Switch 300 provides control of the PNA Source path to PNA-L Port 3 or PNA-X Port 4 and Test Set Ports 7, 11 and 15. In the state shown in the block diagram, switch 300 routes the RF Source back to the PNA Port and unused Test Set ports (7, 11 and 15) are terminated.
<b>S400 - Source to Ports (2 or 4, 8, 12 and 16)</b>	Switch 400 provides control of the PNA Source path to PNA-L Port 4 or PNA-X Port 2 and the Test Set Ports 8, 12 and 16. In the state shown in the block diagram, switch 400 routes the RF Source back to the PNA Port and unused Test Set ports (8, 12 and 16) are terminated.

## Receivers Switch Paths

<b>S101 - Receiver to Ports (1, 5, 9 and 13)</b>	Switch 101 provides control of the Receiver path to Port 1, 5, 9 and 13. In the state shown in the block diagram, switch 101 routes the Coupler Arm from the PNA Port 1 to the A Receiver and all unused Test Set ports (5, 9 and 13) Coupler Arm paths are terminated.
<b>S201 - Receiver to Ports (2 or 3, 6, 10 and 14)</b>	Switch 201 provides control of the Receiver path to PNA-L Port 2 or PNA-X Port 3 and Test Set Ports 6, 10 and 14. In the state shown in the block diagram, switch 201 routes the Coupler Arm from the PNA Port 2 to the A Receiver and all unused Test Set ports (2, 6, 10 and 14) Coupler Arm paths are terminated.
<b>S301 - Receiver to Ports (3 or 4, 7, 11 and 15)</b>	Switch 301 provides control of the Receiver path to PNA-L Port 3 or PNA-X Port 4 and Test Set Ports 7, 11 and 15. In the state shown in the block diagram, switch 301 routes the Coupler Arm from the PNA Port 3 to the A Receiver and all unused Test Set ports (3, 7, 11 and 15) Coupler Arm paths are terminated.
<b>S401 - Receiver to Ports (2 or 4, to 8, 12 and 16)</b>	Switch 401 provides control of the Receiver path to PNA-L Port 4 or PNA-X Port 2 and Test Set Ports 8, 12 and 16. In the state shown in the block diagram, switch 401 routes the Coupler Arm from the PNA Port 4 to the B Receiver and all unused Test Set ports (2, 8, 12 and 16) Coupler Arm paths are terminated.



## Troubleshooting the Test Set

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

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

To request service, please contact your local service center. In the US, call 800-829-4444. For a listing of service centers world wide, please visit us at <http://keysight.com/find/service>.

### WARNING

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

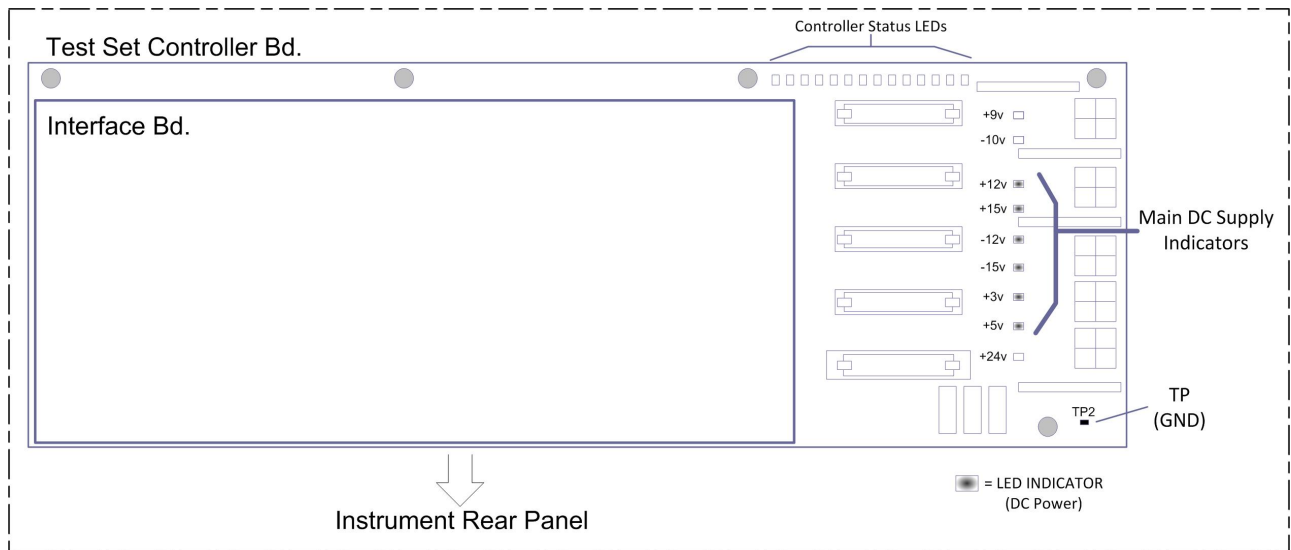
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### Non-RF Failures

Non RF failures are: Power Supply, Fans, Control Lines, Status LEDs or Interface not operating. Refer to [Figure 63 on page 78](#).

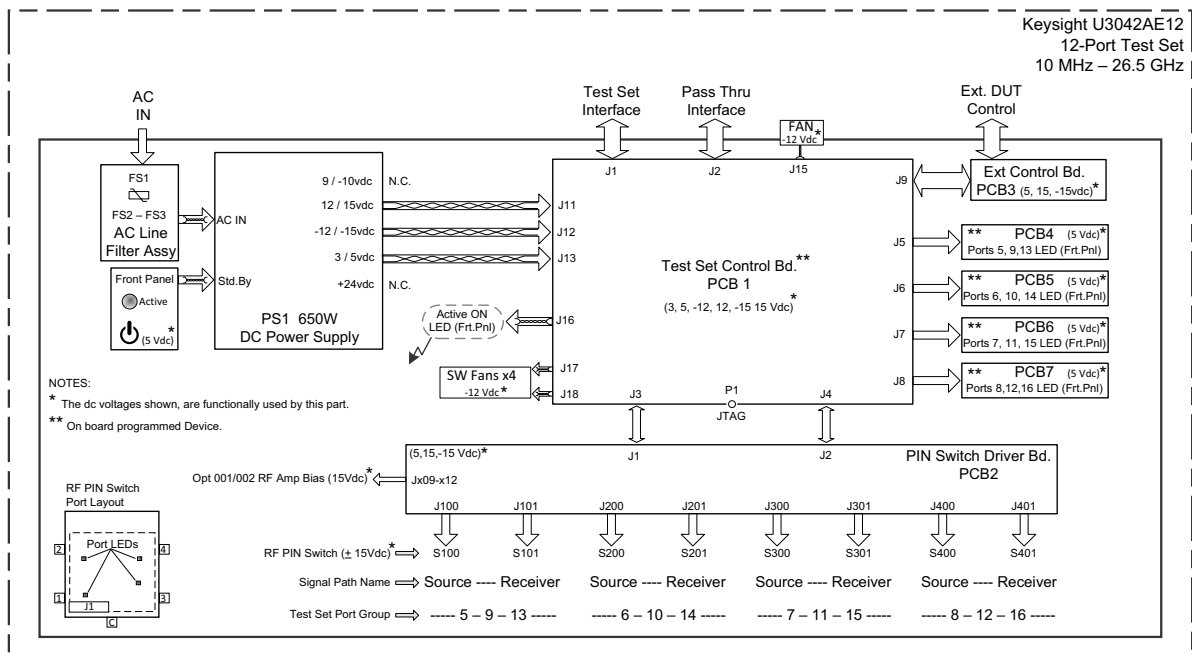
1. Verify that the front panel Power Switch is operational. The front panel Active LED will be *off* unless the test set interface cable is connected and the test set is addressed by the network analyzer.
2. Turn *on* the Standby Switch.
  - a. The rear panel, Deck and Internal power supply fans should be operational. If not, continue with [step 3](#).
3. AC Line voltage checks (remove AC power from the instrument).
  - a. Ensure the proper AC Line voltage is present at the instrument line cord.
  - b. Remove the AC power cord from the instrument. Verify the instrument AC Line Module fuse (2119-0709) and replace if necessary. Refer to [Figure 5 on page 18](#).
  - c. Verify the Internal AC lines fuse (2110-0342). Remove the instrument bottom cover. Near the rear panel are two fuse holders, verify the fuses and replace if necessary. See [Figure 68 on page 88](#).
4. Internal DC Power checks.
  - a. Set the front panel switch to the Standby position. No fans or indicator lights should be operational.
  - b. Remove the top cover.
  - c. Set the Standby switch to the *on* position. Both the rear panel and internal power supply fans should be operational. Verify that the DC indicator LEDs are *on* as shown in [Figure 62 on page 78](#).

Figure 62 DC Power Status LEDs



- d. If the DC Indicator LEDs are not on, suspect the main power supply module or front panel switch. The power supply (0950-4729) terminal connections should also be verified with a DVM. Verify the voltages on the power supply label.
- e. If rear panel or deck fans is are not operating and the DC Indicator LEDs are on; replace fan.

Figure 63 Test Set Diagram



5. Front Panel R and S indicator LED Check.
  - a. Verify the test set Controller board Controller Status LEDs, shown in [Figure 62 on page 78](#).
  - b. If none are on remove the Switch Driver board and recheck, if still no indication, replace the Controller board.
  - c. If the Controller Status LEDs are *on* and the front panel Active LED is *on*, suspect the front panel LED boards or the ribbon cables. Replace as needed.
6. Control Lines are not working.
  - a. Verify that the control voltage pin connections to the DUT control lines are connected properly. Refer to [“Control Lines” on page 54](#).
  - b. Verify that the rear panel DC voltage control adjustment can be set to 5 Vdc. Refer to [Figure 4 on page 17](#).

## RF Switching Failures

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

1. Place the network analyzer and test set side by side (not stacked) and connect the I/O cable (N4011-21002). See [Figure 4 on page 17](#).
2. Ensure that the network analyzer is *not* in Multiport Mode.
3. Using the test set I/O Data command values, confirm the correct address and data values are used, refer to ["Address and Data Values" on page 52](#).
  - a. Each RF solid state switch has a Bias/Logic control board. This board has four port status LEDs. When a switch control signal is created, the switch port status LED will indicate which switch port is being selected. Refer to ["RF Switching Path Test"](#) below.
  - b. If the LEDs *on* the Switch are *off* when that switch is selected, verify that the ribbon cable is installed on the correct connector on the Switch Interface board. If the connection is correct, substitute a working switch or ribbon cable. Swapping can be performed in this situation. Refer to [Figure 63 on page 78](#).

### RF Switching Path Test

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

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

### Equipment Required

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

Equipment Setup

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

NOTE

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

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 21**.

Table 21

RF Signal Path Insertion Loss (S21

RF Path Description	Signal	Insertion Loss (typical)
Source IN to Ports 5-16	Source	Figure 64 on page 82
RCVR OUT to Ports 5-16	Receiver	Figure 65 on page 83
Source IN to CPLR THRU	Source	Figure 66 on page 84
RCVR OUT to CPLR ARM	Receiver	Figure 66 on page 84

## Source Signal Path Insertion Loss Test

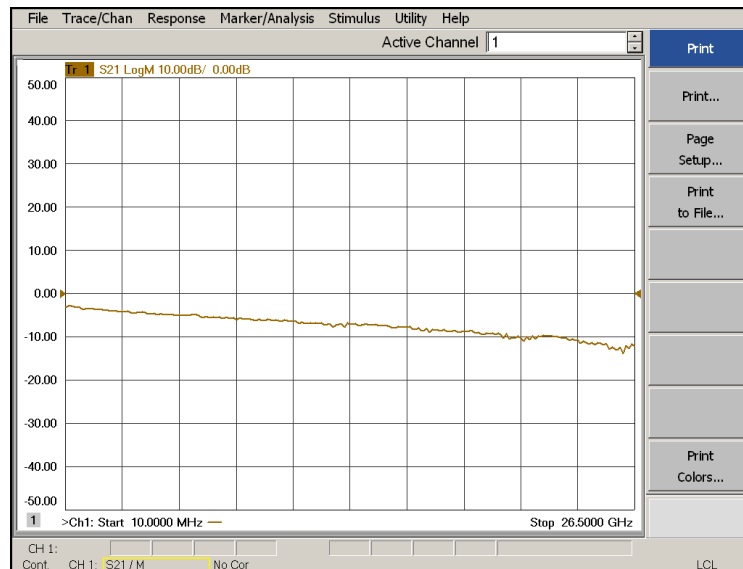
1. Connect the RF Flex cables to the Test Port and RCVR OUT port indicated in [Table 23 on page 83](#). The expected results should be similar to [Figure 65 on page 83](#) and [Figure 66 on page 84](#).

Table 22 Source Signal Path Connections and Commands

Path #	RF Path Description	Control Mode <Address>.<Data>	Path Components	Insertion Loss (typical)
1	Source IN to Port 5 <sup>a</sup>	0.2	P5 CPLR, S100	See Figure 64 below
2	Source IN to Ports 9	0.4	P13 CPLR, S100	
3	Source IN to Port 13	0.8	P5 CPLR, S100	
4	Source IN to Port 6	16.2	P6 CPLR, S200	
5	Source IN to Port10	16.4	P10 CPLR, S200	
6	Source IN to Port 14	16.8	P14 CPLR, S200	
7	Source IN to Port 7	32.2	P7 CPLR, S300	
8	Source IN to Port 11	32.4	P11 CPLR, S300	
9	Source IN to Port 15	32.8	P15 CPLR, S300	
10	Source IN to Port 8	64.2	P8 CPLR, S400	
11	Source IN to Port 12	64.4	P12 CPLR, S400	
12	Source IN to Port 16	64.8	P16 CPLR, S400	

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

Figure 64 Source IN to Ports 5-16 Path Response



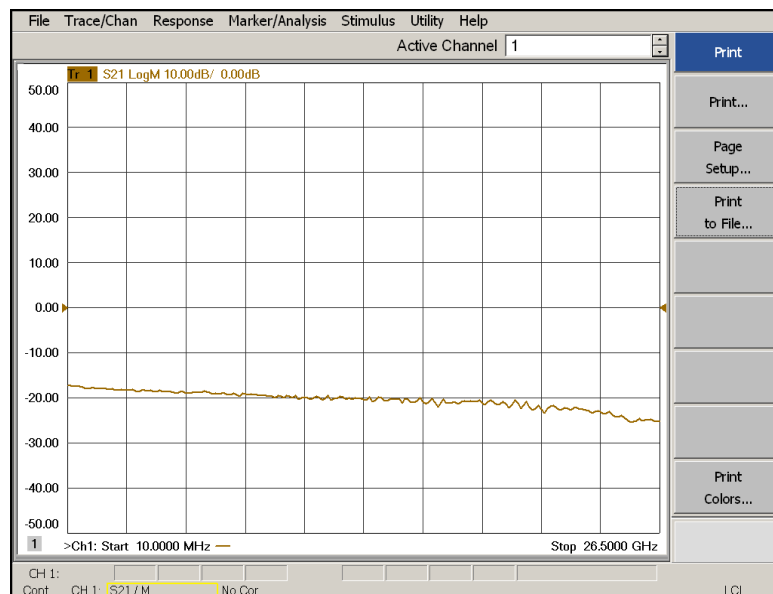
2. Connect the RF Flex cables to the Test Port and RCVR OUT port indicated in **Table 23**. The expected results should be similar to **Figure 65** below and **Figure 66** on page 84.

Table 23 Receiver Signal Path Connections and Commands

Path #	RF Path Description	Control Mode <Address>.<Data>	Path Components	Insertion Loss (typical)
1	RCVR OUT to Port 5 <sup>a</sup>	0.32	P5 CPLR, S101	Figure 65 below
2	RCVR OUT to Ports 9	0.64	P9 CPLR, S101	
3	RCVR OUT to Port 13	0.128	P13 CPLR, S101	
4	RCVR OUT to Port 6	16.32	P6 CPLR, S201	
5	RCVR OUT to Port10	16.64	P10 CPLR, S201	
6	RCVR OUT to Port 14	16.128	P14 CPLR, S201	
7	RCVR OUT to Port 7	32.32	P7 CPLR, S301	
8	RCVR OUT to Port 11	32.64	P11 CPLR, S301	
9	RCVR OUT to Port 15	32.128	P15 CPLR, S301	
10	RCVR OUT to Port 8	64.32	P8 CPLR, S401	
11	RCVR OUT to Port 12	64.64	P12 CPLR, S401	
12	RCVR OUT to Port 16	64.128	P16 CPLR, S401	

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

Figure 65 RCVR OUT to Ports 5-16 Path Response

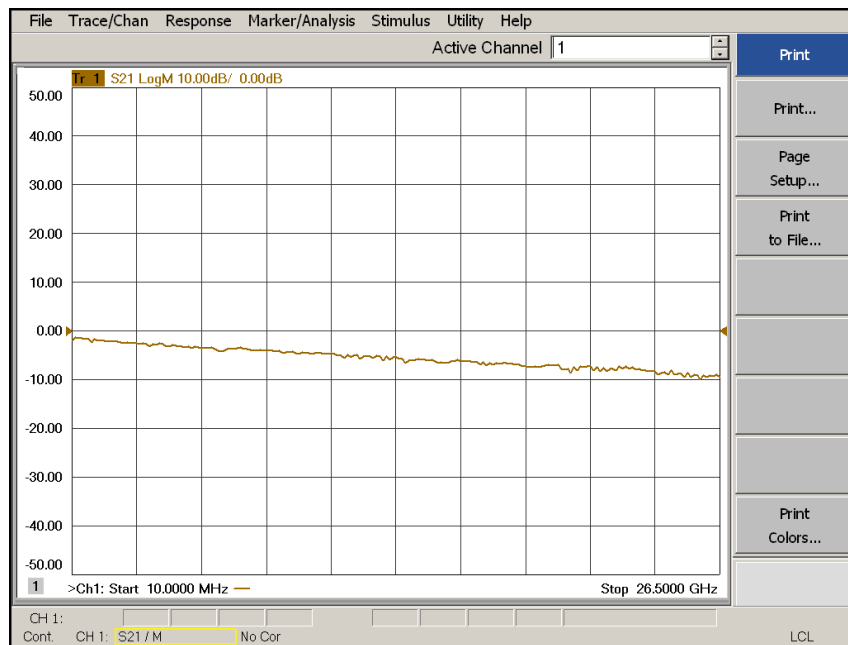


3. Connect the RF Flex cables to the Source IN and CPLR THRU port as indicated in [Table 24](#). The expected results should be similar to [Figure 66](#) as shown below.

Table 24 Source Bypass Signal Path Connections and Commands

Path #	Test Port Group	RF Path Description	Control Mode <Address>.<Data>	Path Components
1	Port 5, 9, 13	Source IN to CPLR THRU	0.1	S100
2	Port 6, 10, 14	Source IN to CPLR THRU	16.1	S200
3	Port 7, 11, 15	Source IN to CPLR THRU	32.1	S300
4	Port 8, 12, 16	Source IN to CPLR THRU	64.1	S400

Figure 66 Source IN to CPLR THRU & RCVR OUT to CPLR ARM Path Response





4. Connect the RF Flex cables to the RCVR OUT and CPLR ARM port indicated in [Table 25](#). The expected results should be similar to [Figure 66 on page 84](#).

Table 25 Receiver Bypass Signal Path Connections and Commands

Path #	Test Port Group	RF Path Description	Control Mode <Address>.<Data>	Path Components
1	Port 5, 9, 13	RCVR OUT to CPLR ARM	0.16	S101
2	Port 6, 10, 14	RCVR OUT to CPLR ARM	16.16	S201
3	Port 7, 11, 15	RCVR OUT to CPLR ARM	32.16	S301
4	Port 8, 12, 16	RCVR OUT to CPLR ARM	64.16	S401

### RF Performance Fails

If the U3042AE12 operates correctly, but RF performance fails the operational test. The following procedures can be used to isolate the failed component. Suspect the coax switches, RF cables, or coupler.

#### NOTE

The RF performance of the U3042AE12 depends on the performance of the analyzer. Ensure the analyzer is meeting specification before continuing.

1. Verify that the test set and PNA 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. Refer to [“Verifying Cal Kit Operational Check Failure” on page 68](#).
3. Review the [“Cal Kit Operational Check Procedure” on page 62](#) and verify the results for the port that is failing.
4. Reflection tracking trace shows a power hole, or is below the test limit line, perform the switch path test for the port that is failing.

## Connection Tables and Diagrams

Refer to [Figure 63, “Test Set Diagram,”](#) on [page 78](#).

Table 26 Controller Board Connection

Controller Board	Connections
<b>LED Ribbon Cables from the LED Board:</b>	
J5	Port 5, 9 and 13
J6	Port 6, 10 and 14
J7	Port 7, 11 and 15
J8	Port 8, 12 and 16
<b>Wire Harness Active LED:</b>	
P1	Active LED
<b>DUT Control Ribbon Cable:</b>	
J9	DUT Controller Board
<b>Power Supply Wire Harness:</b>	
J11-14	Power Supply

Table 27 Switch Interface Board

Switch Interface Board	Connection
<b>Switch Interface Board Connection:</b>	
J100	Port 5, 9 and 13 (Source)
J101	Port 5, 9 and 13 (Receiver)
J200	Port 6, 10 and 14 (Source)
J201	Port 6, 10 and 14 (Receiver)
J300	Port 7, 11 and 15 (Source)
J301	Port 7, 11 and 15 (Receiver)
J400	Port 8, 12 and 16 (Source)
J401	Port 8, 12 and 16 (Receiver)

Figure 67

Top View

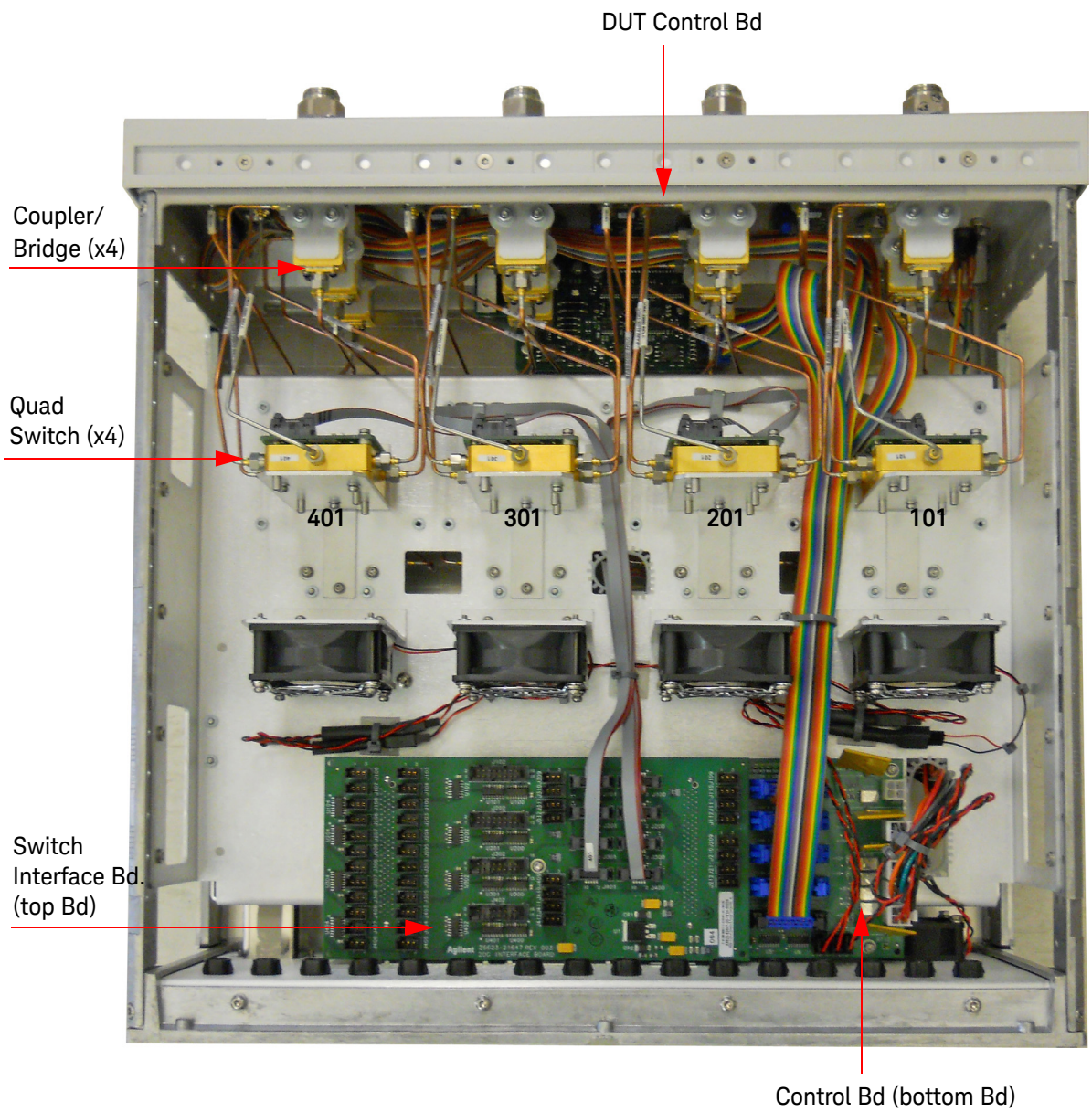
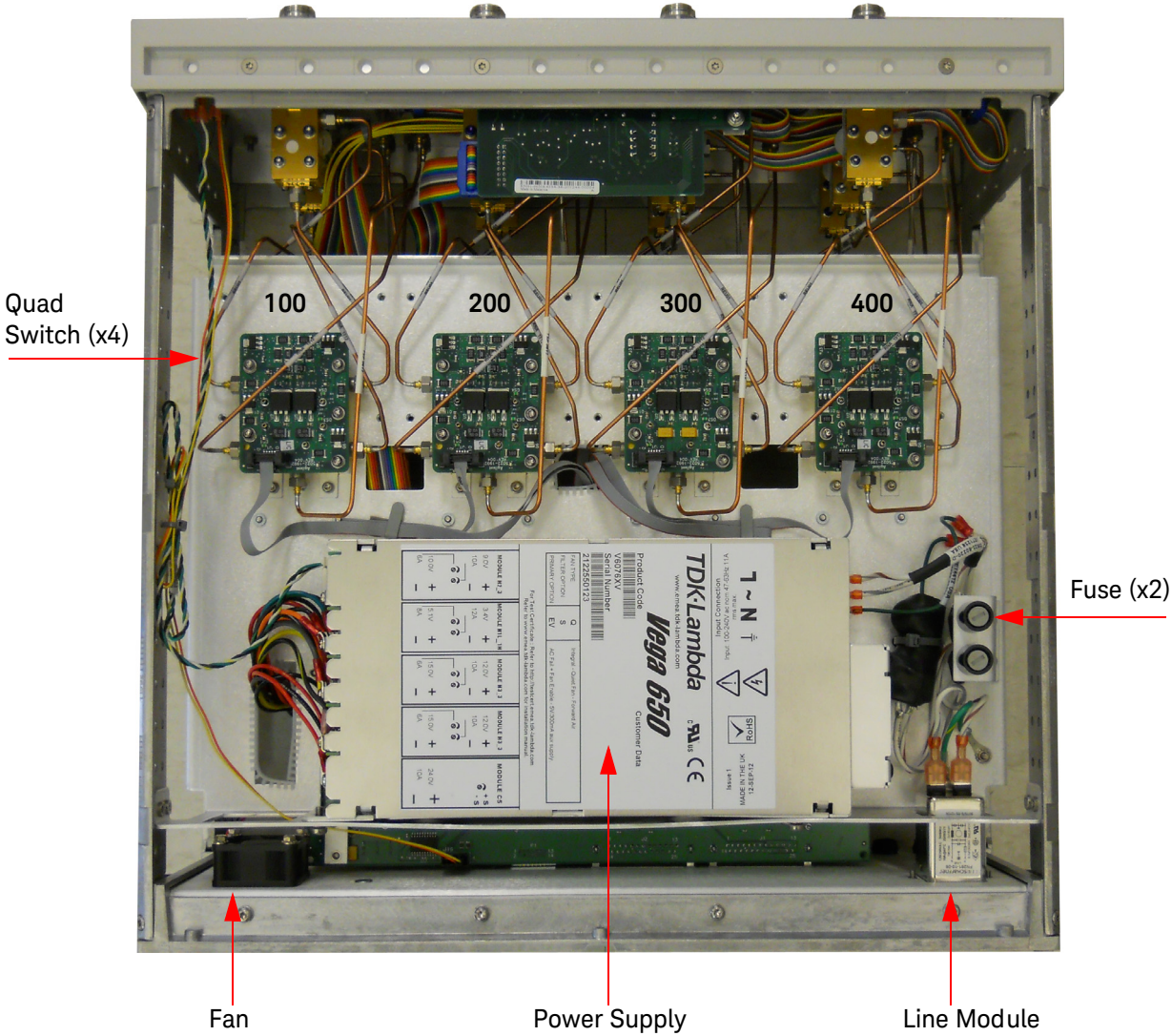


Figure 68 Bottom View





## Safety Information

### Introduction

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

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

### Safety Earth Ground

#### **WARNING**

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

---

#### **CAUTION**

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

---

### Statement of Compliance

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

## Before Applying Power

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

### WARNING

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

---

### CAUTION

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

---

### CAUTION

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

---

### CAUTION

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

---

### CAUTION

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

---

### CAUTION

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

---

### WARNING

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

---

### WARNING

These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.

---

**WARNING**

The opening of covers or removal of parts is likely to expose the user to dangerous voltages. Disconnect the instrument from all voltage sources before opening.

---

**WARNING**

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

---

**WARNING**

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

---

**WARNING**

The power cord is connected to internal capacitors that may remain live for 5 seconds after disconnecting the plug from its power supply.

---

## Connector Care and Cleaning Precautions

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

### **WARNING**

To prevent electrical shock, disconnect the U3042AE12 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

## Instrument Markings

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



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



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



This symbol indicates separate collection for electrical and electronic equipment, mandated under EU law. All electric and electronic equipment are required to be separated from normal waste for disposal (Reference WEEE Directive).



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.

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 is a symbol of an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 5).



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



Direct Current.



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



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



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



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



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

**Battery:** Do not throw batteries away but collect as small chemical waste, or in accordance with your country's requirements. You may return the battery to Keysight Technologies for disposal. Refer to **"Contacting Keysight" on page 95** for assistance.

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

- IEC/EN 61326-1
- CISPR Pub 11 Group 1, class A
- AS/NZS CISPR 11
- ICES/NMB-00 1  
This ISM device complies with Canadian ICES-001.  
Cet appareil ISM est conforme a la norme NMB-001 du Canada.

#### South Korean Class A EMC Declaration

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

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

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

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

※ 사용자 안내문은 "업무용 방송통신기자재"에만 적용한다.

**SAFETY:** Complies with the essential requirements of the European Low Voltage Directive as well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity):

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

**Acoustic Statement:** (European Machinery Directive):

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

**Declarations of Conformity:** To find a current Declaration of Conformity for specific Keysight product, go to: <http://regulations.about.keysight.com/DoC/search.htm>

# 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 measurements needs and information or finding a local Keysight office are available at: <http://www.keysight.com/find/assist>

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

### NOTE

In any correspondence or telephone conversation, refer to the Keysight product by its model number and full serial number. With this information, the Keysight representative can determine the warranty status of your unit.

## Shipping Your Product to Keysight for Service or Repair

### IMPORTANT

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

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

- To improve turn-around time, return your test set along with your analyzer and cables to Keysight so that we may verify the operation of the complete system.
- Include a complete description of the service requested or of the failure and a description of any failed test and any error message.
- Remove and retain the front handles and all rack mount hardware. The analyzer should be sent to Keysight in the same configuration as it was originally shipped.
- Ship the analyzer using the original or comparable antistatic packaging materials.
- Contact Keysight for instructions on where to ship your analyzer.

This information is subject to change without notice.

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[www.keysight.com](http://www.keysight.com)