

Keysight Technologies
U3042AE16
Multiport Test Set Extension

Notices

Copyright Notice

© Keysight Technologies. 2011-2022

No part of this manual may be reproduced in any form or by any means (including electronic storage and retrieval or translation into a foreign language without prior agreement and written consent from Keysight Technologies, Inc. as governed by United States and international copyright laws.

Trademarks

Trademark Acknowledgments

Manual Part Number

U3042-90012

Edition

Edition 5, April 2022

Supersedes: October 2020

Printed in:

Printed in USA

Published by:

Keysight Technologies Inc
1400 Fountaingrove Parkway
Santa Rosa, CA 95403

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

What's Changed

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

U.S. Government Rights

The Software is "commercial computer software," as defined by Federal Acquisition Regulation ("FAR") 2.101. Pursuant to FAR 12.212 and 27.405-3 and Department of Defense FAR Supplement ("DFARS") 227.7202, the U.S. government acquires commercial computer software under the same terms by which the software is customarily provided to the public. Accordingly, Keysight provides the Software to U.S. government customers under its standard commercial license, which is embodied in its End User License Agreement (EULA), a copy of which can be found at <http://www.keysight.com/find/sweula>. The license set forth in the EULA represents the exclusive authority by which the U.S. government may use, modify, distribute, or disclose the Software. The EULA and the license set forth therein, does not require or permit, among other things, that Keysight: (1) Furnish technical information related to commercial computer software or commercial computer software documentation that is not customarily provided to the public; or (2) Relinquish to, or otherwise provide, the government rights in excess of these rights customarily provided to the public to use, modify, reproduce, release, perform, display, or disclose commercial computer software or commercial computer software documentation. No additional government requirements beyond those set forth in the EULA shall apply, except to the extent that those terms, rights, or licenses are explicitly required from all providers of commercial computer software pursuant to the FAR and the DFARS and are set forth specifically in writing elsewhere in the EULA. Keysight shall be under no obligation to update, revise or otherwise modify the Software. With respect to any technical data as defined by FAR 2.101, pursuant to FAR 12.211 and 27.404.2 and DFARS 227.7102, the U.S. government acquires no greater than Limited Rights as defined in FAR 27.401 or DFARS 227.7103-5 (c), as applicable in any technical data.

Warranty

THE MATERIAL CONTAINED IN THIS DOCUMENT IS PROVIDED "AS IS," AND IS SUBJECT TO BEING CHANGED, WITHOUT NOTICE, IN FUTURE EDITIONS. FURTHER, TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, KEYSIGHT DISCLAIMS ALL WARRANTIES, EITHER EXPRESS OR IMPLIED WITH REGARD TO THIS MANUAL AND ANY INFORMATION CONTAINED HEREIN, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. KEYSIGHT SHALL NOT BE LIABLE FOR ERRORS OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE FURNISHING, USE, OR PERFORMANCE OF THIS DOCUMENT OR ANY INFORMATION CONTAINED HEREIN. SHOULD KEYSIGHT AND THE USER HAVE A SEPARATE WRITTEN AGREEMENT WITH WARRANTY TERMS COVERING THE MATERIAL IN THIS DOCUMENT THAT CONFLICT WITH THESE TERMS, THE WARRANTY TERMS IN THE SEPARATE AGREEMENT SHALL CONTROL.

Safety Notices

CAUTION

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

WARNING

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

U3042AE16

Introduction	2
Description	4
Measurement Application Note.	4
Verifying the Shipment	4
Network Analyzer Requirements	5
Available Options	6
Test Set Options.	6
Rack Mounting Kits	6
Network Analyzer Interface Kit Options	6
General Specifications.	7
Power Requirements	7
Environmental Requirements	8
Equipment Heating and Cooling	8
Required Conditions for Accuracy Enhanced Measurement	8
Dimensions and Space Requirements	8
Frequency Range and Power Levels	8
Typical Reflection Tracking	10
Front and Rear Panel Features	11
Hardware Lock-link Installation (U3021-60004)	14
Locking the Test Set to the PNA-L	14
Hardware Lock-link Installation (U3021-60005)	17
Locking the Test Set to the PNA or PNA-X	17
N5232A/B RF Interface Cable Connections (U3021-60075)	20
Cable Connection Procedure.	20
N5222A/42A/B RF Interface Cable Connections (U3021-60077)	22
Cable Connection Procedure.	22
Test Set I/O Cable Installation	24
Interconnect Cable Verification	24
System Operational Check	25
Equipment Setup	25
Verify Results.	26
Controlling the Test Set with N5222/32/42A/B	31
Typeface Key Conventions.	31
Sweep Setup for Multiport and Standalone Modes	31
Multiport Mode for Option 551	33
How to Access Multiport Mode	33
External Test Set Control Feature	34
Trace Measure S-Parameter	35
New Trace Measure S-Parameter	35
Balanced Tab:	36
Receivers Tab:	36
RF Path Configuration with Option 029	37
N-Port Calibration	38
Interface Control	40
Overview of the Interface Control	40
How to Access Interface Control Settings	41
Using Interface Control Mode	42
SCPI Control Mode.	44
Overview of the SCPI Control	44
How to Access the Command Processor	44
SCPI Command Processor Console.	45

Table of Contents

Address and Data Values	47
Setting the Test Port Paths with Address and Data	47
Control Lines	50
Internal Voltage Supply Configuration	52
External Voltage Supply Configuration	53
Setting the Control Lines with Address and Data Values	54
Setting the Analyzer to Standalone Mode	54
Cal Kit Operational Check.	56
Equipment Required	56
Verification Limits	57
Cal Kit Operational Check Procedure	58
Preparing the Network Analyzer	58
1-Port Calibration Procedure	59
Cal Set Verification	60
Verifying a Cal Kit Operational Check Failure.	62
ECal Confidence Check	62
Service Information	63
Replaceable Parts	63
System Block Diagrams	65
Theory of Operation	66
RF Coupler/Bridges	66
RF Switch Components.	66
Troubleshooting the Test Set	67
Electrostatic Discharge Protection	67
Non-RF Failures.	68
RF Switching Failures	70
RF Switching Path Test	70
Equipment Required	70
Equipment Setup	71
Cable Connections.	71
Source Signal Path Insertion Loss Test.	72
RF Performance Fails	77
Safety and Information	80
Introduction	80
Safety Earth Ground	80
Statement of Compliance	80
Before Applying Power	81
Connector Care and Cleaning Precautions.	82
Regulatory Information.	83
Instrument Markings	83
Keysight Support, Services, and Assistance	85
Service and Support Options	85
Contacting Keysight	85
Shipping Your Product to Keysight for Service or Repair.	85

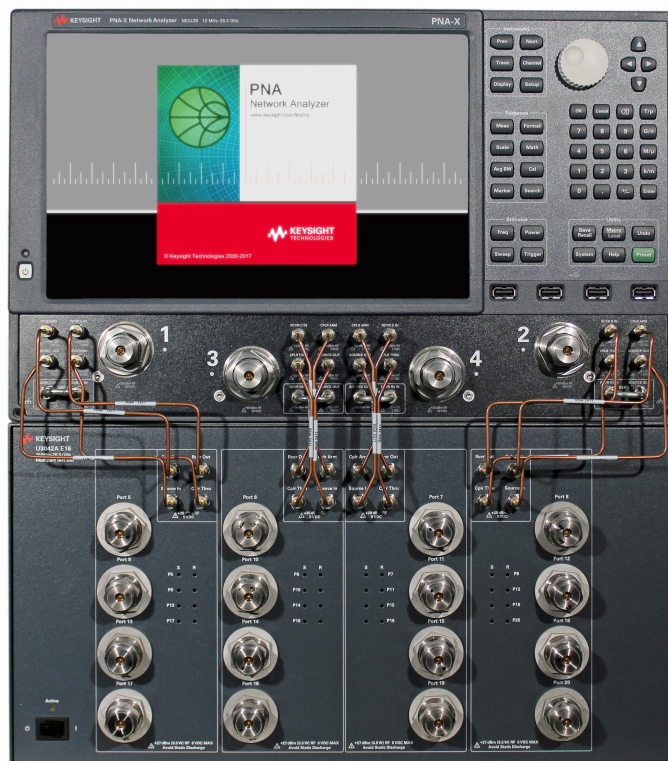
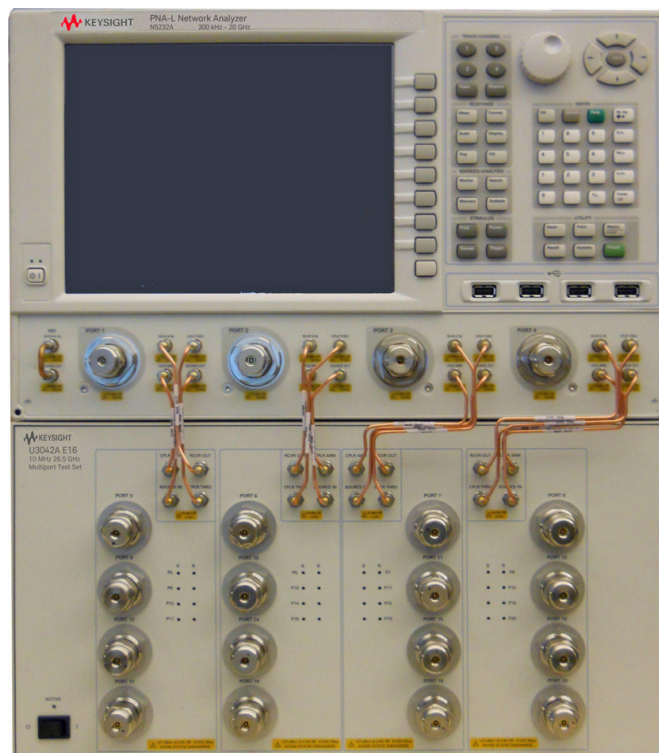
U3042AE16

Introduction

This document describes how to use and service the U3042AE16 Multiport Test Set Extension.

Figure 1 U3042AE16 Multiport Test Set



Figure 2 4-Port N5242B PNA-X with U3042AE16**Figure 3** 4-Port N5232A PNA-L with U3042AE16

Description

The Keysight U3042AE16 is a 16-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 an 20-Port network analyzer solution for full crossbar measurements.

The U3042AE16 has the following key features:

- 16 test ports (3.5 mm male connectors)
- High speed, solid state RF switching
- Frequency range of operation:
 - 10 MHz to 26.50 GHz (Standard Opt 700)
- 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 U3042AE16 is directly controlled by the network analyzer, no external personal computer or software is required.

The N5222A/B PNA, N5232A/B PNA-L and N5242A/B PNA-X Network Analyzers will be referred to throughout this document as the PNA, PNA-L and PNA-X. Analyzer refers to all series of PNA, PNA-L and PNA-X. The U3042AE16 will be referred to as the test set.

NOTE

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

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 shipment. Keep the shipping container and packaging material until you have inspected the contents of the shipment for completeness and have verified the instrument mechanically and electrically. If there is physical damage refer to **“Contacting Keysight” on page 85**. Keep the damaged shipping materials (if any) for inspection by the carrier and an Keysight Technologies representative.

Table 1 U3042AE16 Accessories Supplied

Description	Part Number	Quantity
Short, 3.5 mm (female)	85052-60007	1
User's and Service Guide	U3042-90012	1

Network Analyzer Requirements

For multiport operation (N-Port error correction and measurement capability), all "A" model network analyzers require Option 551, and all "B" model analyzers require Software Application S93551B. For "B" models in which the system is configured with more than 8 test ports, it is recommended to use PLTS Software, N1930B, to manage/control any advanced network analyzer measurement applications and their large data files.

The test set files indicated in Table 2 must be installed into the analyzer's file directory location:

"A" Models: C:\Program Files (x86)\Agilent\Network Analyzer\TestSets

"B" Models: C:\Program Files (x86)\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	u3042ae16_pnax_p4.tsx	Figure 2 on page 3 ¹
N5232A/B PNA-L	416	u3042ae16_p4.tsx	Figure 3 on page 3
N5242A/B PNA-X	400	u3042ae16_pnax_p4.tsx	Figure 2 on page 3

1. This graphic is not a N5222A or N5232A network analyzer, but the port configuration is similar.

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

- Documentation - <http://www.keysight.com/find/pna>
- Network Analyzer Firmware - <http://na.support.keysight.com/pna/firmware/firmware.htm>
- U3042AE16 Test Set Files - <http://na.keysight.com/multiport> (see test set files)

Available Options

Test Set Options

The test set has one available option:

Refer to “**System Block Diagrams**” beginning on [page 65](#).

- Option 700 Standard, Solid-State switches

Rack Mounting Kits

Installation instructions are included in the option package.

- U3042AE16-1CM, Rack Mount Kit without Handles 1CM130A (5063-9216*)
- U3042AE16-1CN, Front Handle Kit 1CN105A (5063-9229*)
- U3042AE16-1CP, Rack Mount Kit with Handles 1CP126A (5063-9236*)

* Previous color (Agilent Palette 2000)

Network Analyzer Interface Kit Options

NOTE

The U3042AE16 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 listed in [Table 3](#).

Table 3 Interface Kit Options

20-Port Network Analyzer System	Interface Kit Option	Hardware Lock-link	Cable Kit, Connector Type
N5222A/B PNA	U3021PX3 Opt 442	U3021-60005 ¹	U3021-60077 ² , SMA m/m
N5232A/B PNA-L	U3021PX3 Opt 430	U3021-60004 ³	U3021-60075 ⁴ , SMA m/m
N5242A/B PNA-X	U3021PX3 Opt 442	U3021-60005 ¹	U3021-60077 ² , SMA m/m

1. “Hardware Lock-link Installation (U3021-60005)” on [page 17](#).
2. “N5222A/B and N5242A/B RF Interface Cable Connections (U3021-60077)” on [page 22](#).
3. “Hardware Lock-link Installation (U3021-60004)” on [page 14](#).
4. “N5232A/B RF Interface Cable Connections (U3021-60075)” on [page 20](#).

General Specifications

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

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

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

When connected to a 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 provided in [Tables 6 or 7 on page 10](#) can be subtracted from the analyzers dynamic range to determine the approximate performance of the system.

CAUTION

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

Power Requirements

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

- 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 analyzer.
- U3042AE16 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.

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

Equipment Heating and Cooling

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

CAUTION

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

Required Conditions for Accuracy Enhanced Measurement

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

Dimensions and Space Requirements

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

CAUTION

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

Table 4 Instrument Dimensions

Model	Weight	Height	Width	Depth
U3042AE16	15 kg (30.8 lb)	23.2 cm (9.1 in)	42.9 cm (16.8 in)	52.4 cm (20.6 in)

Frequency Range and Power Levels

NOTE

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

CAUTION

It is recommended that you do not operate components near damage levels (+30 dBm). The power levels must be 3 dB below maximum level to ensure no damage. Do not apply any DC voltage to the Access or Test Set ports.

Table 5 Maximum Power Levels

U3042AE16 Test Port RF Power Levels:	
PORT 5-20	+27 dBm
U3042AE16 Access Ports:	
SOURCE OUT	+20 dBm
CPLR ARM	+20 dBm
CPLR THRU	+20 dBm
RCVR OUT	+20 dBm
NOISE SOURCE IN/OUT	+20 dBm

NOTE

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

NOTE

Damage and maximum levels are not necessarily the optimum level.

Typical Reflection Tracking

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

NOTE

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

Table 6 Typical Reflection Tracking with PNA-L

Frequency	Ports 1 to 4	Ports 5 to 20
300 kHz to 50 MHz	-4	-10
50 MHz to 500 MHz	-5	-11
500 MHz to 3.2 GHz	-7	-13
3.2 GHz to 10 GHz	-12	-18
10 GHz to 16 GHz	-15	-24
16 GHz to 20 GHz	-17	-28

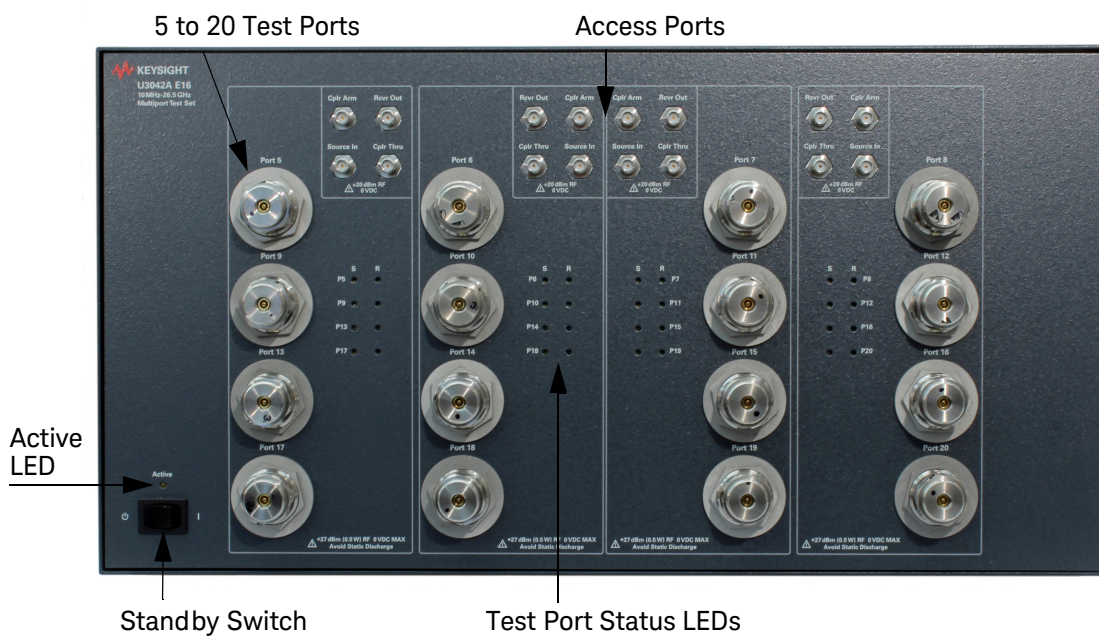
Table 7 Typical Reflection Tracking with PNA or PNA-X

Frequency	Ports 1 to 4	Ports 5 to 20
10 MHz to 50 MHz ¹	-4	+21
50 MHz to 500 MHz ¹	-5	-5
500 MHz to 3.2 GHz	-7	-13
3.2 GHz to 10 GHz	-12	-18
10 GHz to 16 GHz	-15	-24
16 GHz to 20 GHz	-17	-28
20 GHz to 24 GHz	-21	-34
24 GHz to 26.5 GHz	-22	-40

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

Front and Rear Panel Features

Figure 4 U3042AE16 Front Panel



Test Ports – 3.5 mm Bulkhead (male)

- Port 5 - 20

Access Ports – SMA (female)

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

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.

Standby Switch

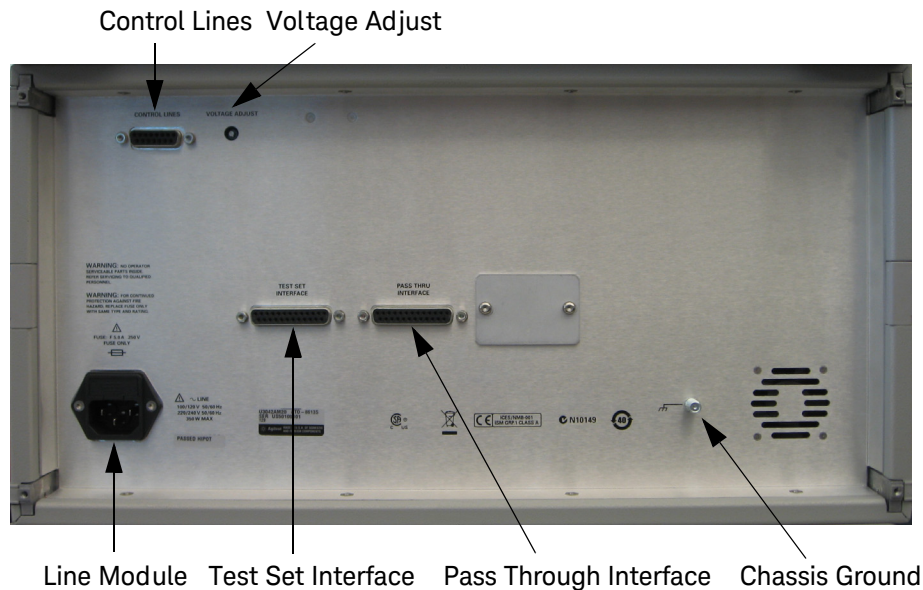
Note that this switch is Standby only, not a line switch. The main power cord can be used as the system disconnecting device. It disconnects the mains circuits from the mains supply.

Active LED

When the Test Set is connected and addressed by a PNA-X, the LED is ON (illuminated). The LED is OFF (not illuminated) when the Test Set is in Standby, or not addressed by the PNA-X.

NOTE

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

Figure 5 U3042AE16 Rear Panel

Control Lines and Voltage Adjust

For further information pertaining to control lines and voltage adjustments see [“Control Lines” on page 50](#).

Chassis Ground

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

Pass Through Interface

Connection to another test set.

Test Set Interface

The test set Interface connector is used to send address and data to the test set from the network analyzer.

Line Module

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

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

CAUTION

Always use the three-prong AC power cord supplied with this product. Failure to ensure adequate grounding by not using this cord may cause damage to the product.

Power Cords

A line power cord is supplied in one of several configurations, depending on the destination of the original shipment. Keysight can supply additional certified power cords to meet region electrical supply and receptacle configurations. Please contact Keysight at: www.keysight.com for assistance in power cord selection.

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).

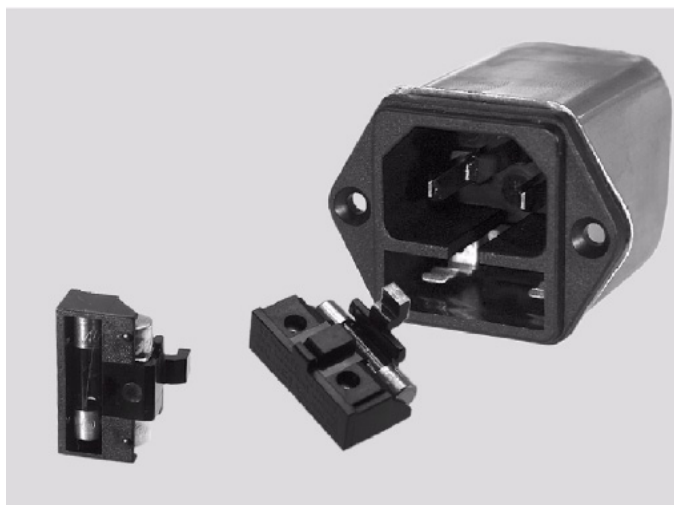
Available Fuse

· 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, circuit breakers or materials is prohibited.

Figure 6 **Line Fuse**

**CAUTION**

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

Hardware Lock-link Installation (U3021-60004)

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

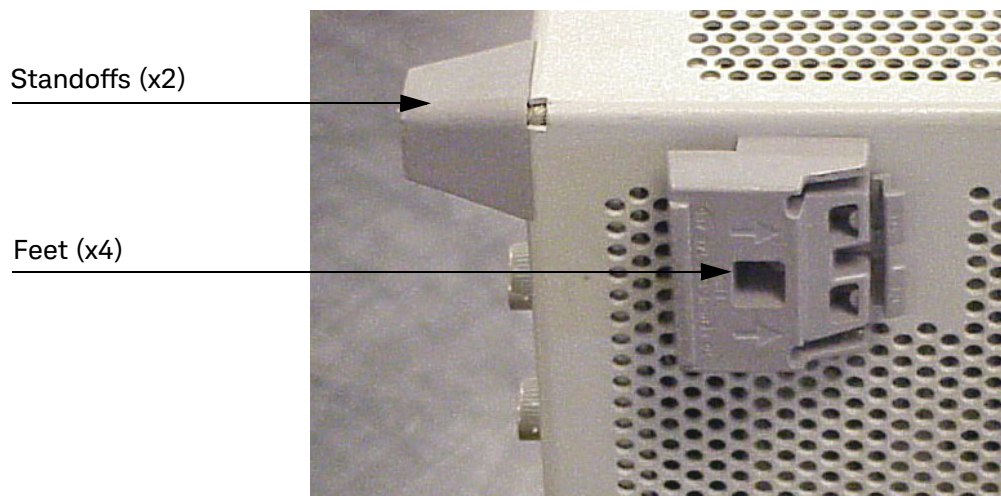
WARNING

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

Locking the Test Set to the PNA-L

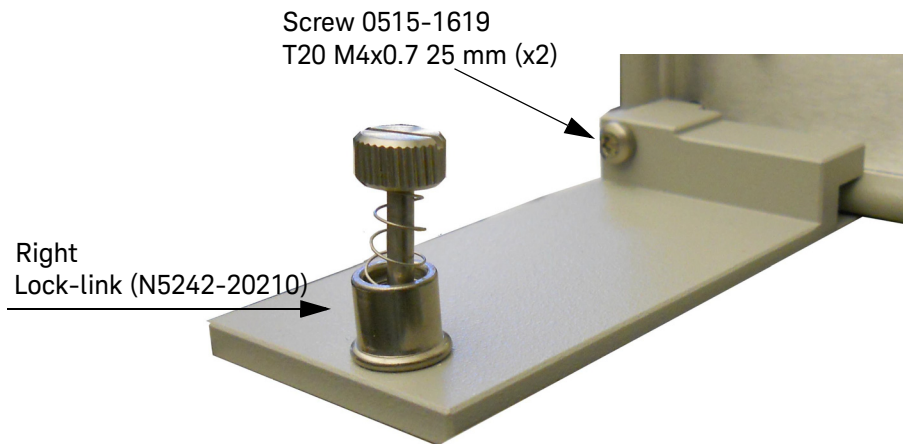
1. The lock-link kit (U3021-60004) includes:
 - 0515-1619 - Screw T20 M4x0.7 25 mm (x2), Analyzer
 - 0515-2317 - Screw T15 M3.5x0.6 12 mm (x2), Test Set
 - N5242-20208 - Right Lock-link, Test Set
 - N5242-20209 - Left Lock-link, Test Set
 - N5242-20210 - Right Lock-link, Analyzer
 - N5242-20211 - Left Lock-link, Analyzer
2. Remove the feet from the bottom of the analyzer.
3. Remove the 2 lower standoffs from the rear panel on the analyzer using a T20 torx driver.

Figure 7 Rear Bottom Feet & Standoffs



4. Install the lower lock-links (N5242-20210, right and N5242-20211, left not shown) onto the analyzer, as shown in **Figure 8**.

Figure 8 Install Lock-links to the Analyzer



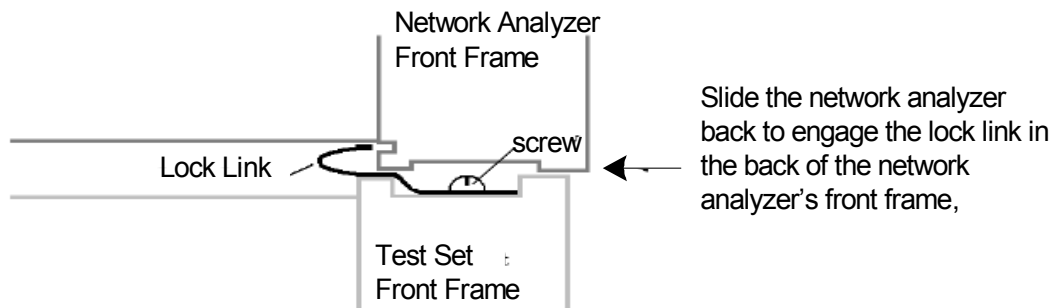
5. Remove the two upper standoffs from the rear panel of the test set using a T20 torx driver.
6. Install the left and right lock-links onto the test set, as shown in **Figure 9**.

Figure 9 Install Lock-links to the Test Set



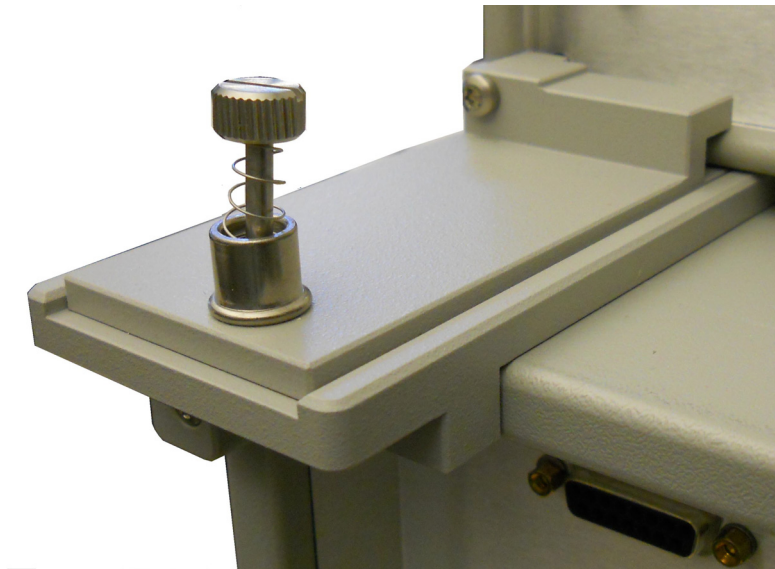
7. Place the analyzer on top of the test set and ensure that the front frame of the analyzer is positioned slightly forward of the locks that are attached to the test set. Slide the analyzer back so the locks engage the front frame.

Figure 10 Locking the Analyzer



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

Figure 11 Secure and Tighten



NOTE

Refer to [“Network Analyzer Interface Kit Options”](#) on page 6.

Hardware Lock-link Installation (U3021-60005)

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

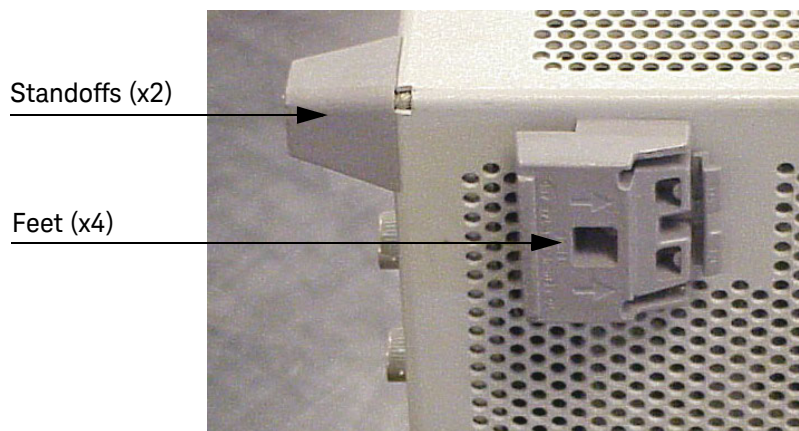
WARNING

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

Locking the Test Set to the PNA or PNA-X

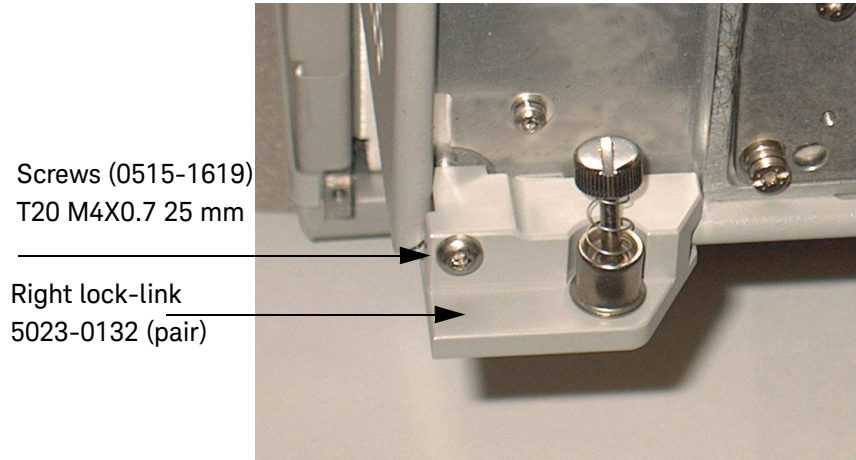
1. The lock-link kit (U3021-60005) includes:
 - 0515-1619 - Screw T20 M4x0.7 25 mm (x2), Analyzer
 - 0515-2317 - Screw T15 M3.5x0.6 12 mm (x2), Test Set
 - 5023-0132 - Lock-links kit (left, right pair and screws), Analyzer
 - N5242-20206 - Right Lock-link, Test Set
 - N5242-20207 - Left Lock-link, Test Set
2. Remove the feet from the bottom of the analyzer.
3. Remove the 2 lower standoffs from the rear panel on the analyzer using a T20 torx driver.

Figure 12 Rear Bottom Feet & Standoffs



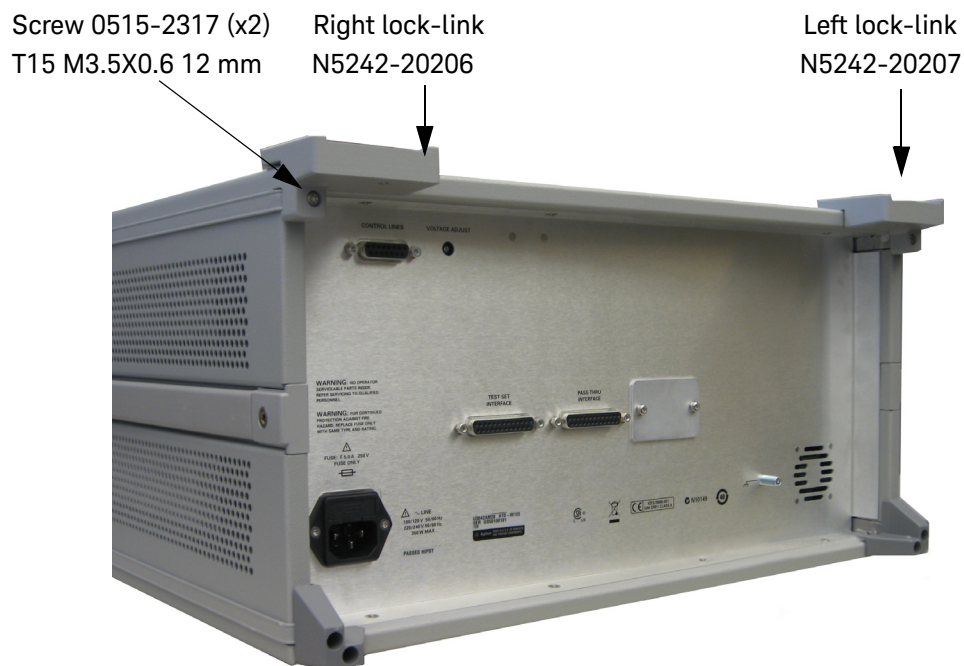
4. Install the lower rear lock-links onto the analyzer, as shown in **Figure 13**.

Figure 13 Install Lock-links to the Analyzer



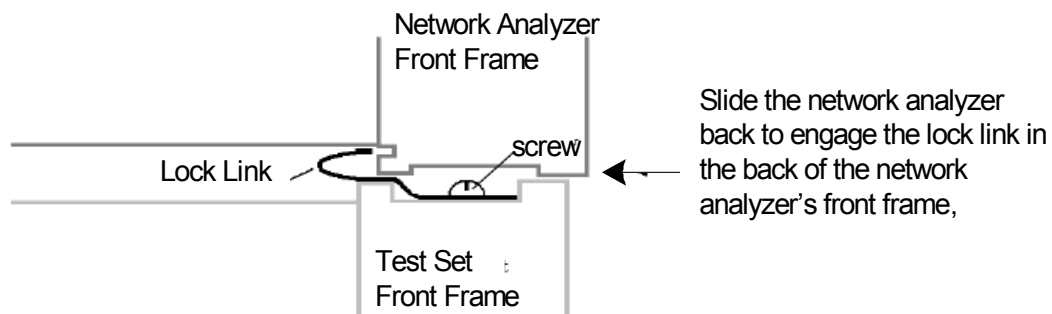
5. Remove the two upper standoffs from the rear panel of the test set using a T20 Torx driver.
6. Install the left and right lock-links onto the test set, as shown in **Figure 14**.

Figure 14 Install Lock-links onto the Test Set



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

Figure 15 Locking the Analyzer



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

Figure 16 Lock-link Secured



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

Figure 17 illustrates the cable configuration of the test set to the PNA-L. The cables have been supplied with the kit (U3021-60075).

Cable Connection Procedure

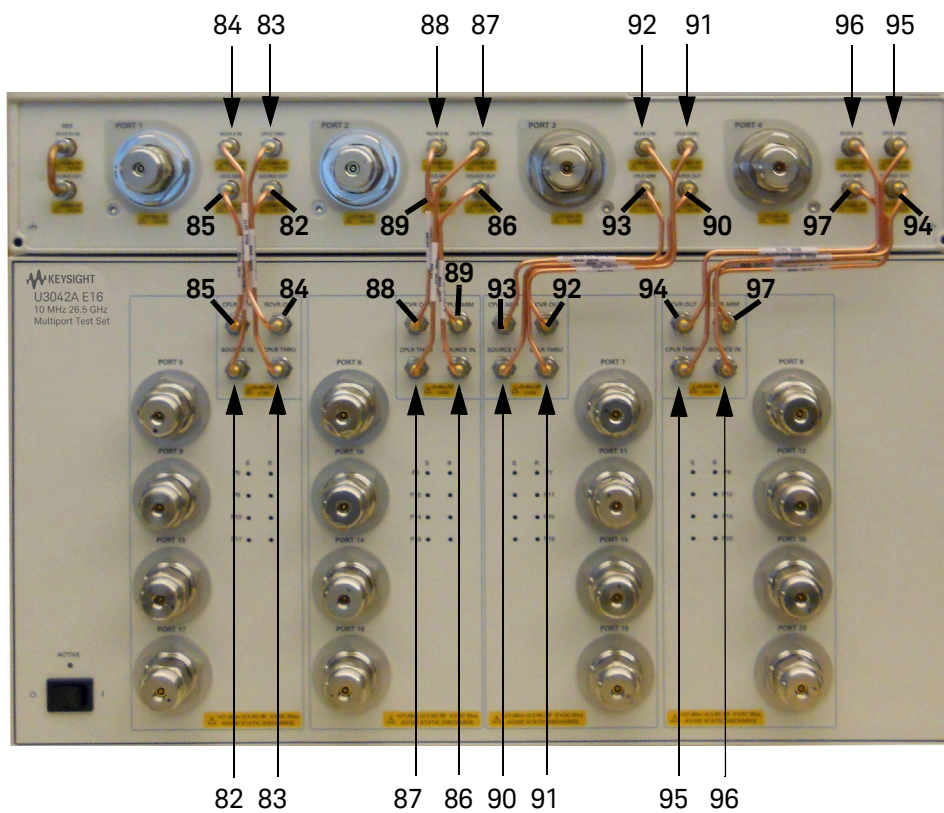
1. Remove the SOURCE OUT to CPLR THRU and RCVR IN to CPLR ARM jumpers (x8) on the analyzer. The RCVR R1 to SOURCE OUT reference loop jumper (x1) remain on the front panel.
2. Connect the RF interconnect cables, supplied with this option, from the PNA-L to the test set. Torque each cable to 8 in-lb. Refer to **Table 8** and **Figure 17**.

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 (U3021-60075)

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

Figure 17 PNA-L RF Interface Connections

3. Connect the Test Set I/O cable (N4011-21002) to the Test Set Interface connector on the rear panel, similar [Figure 19 on page 24](#).

Refer to [“System Operational Check” on page 25](#) for turn-on verification of the multiport system.

N5222/42A/B RF Interface Cable Connections (U3021-60077)

Figure 18 on page 23 illustrates the cable configuration of the test set to the analyzer. The cables have been supplied the kit (U3021-60077).

Cable Connection Procedure

1. Remove the SOURCE OUT to CPLR THRU and RCVR IN to CPLR ARM jumpers (x8) on the analyzer. The RCVR R1 - R4 to SOURCE OUT reference loop jumpers (x4) remain on the front panel.
2. Connect the RF interconnect cables from the PNA or PNA-X to the test set in the order listed. As you are connecting each cable, torque to 8 in-lb. Refer to Table 9 and Figure 18 on page 23.

CAUTION

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

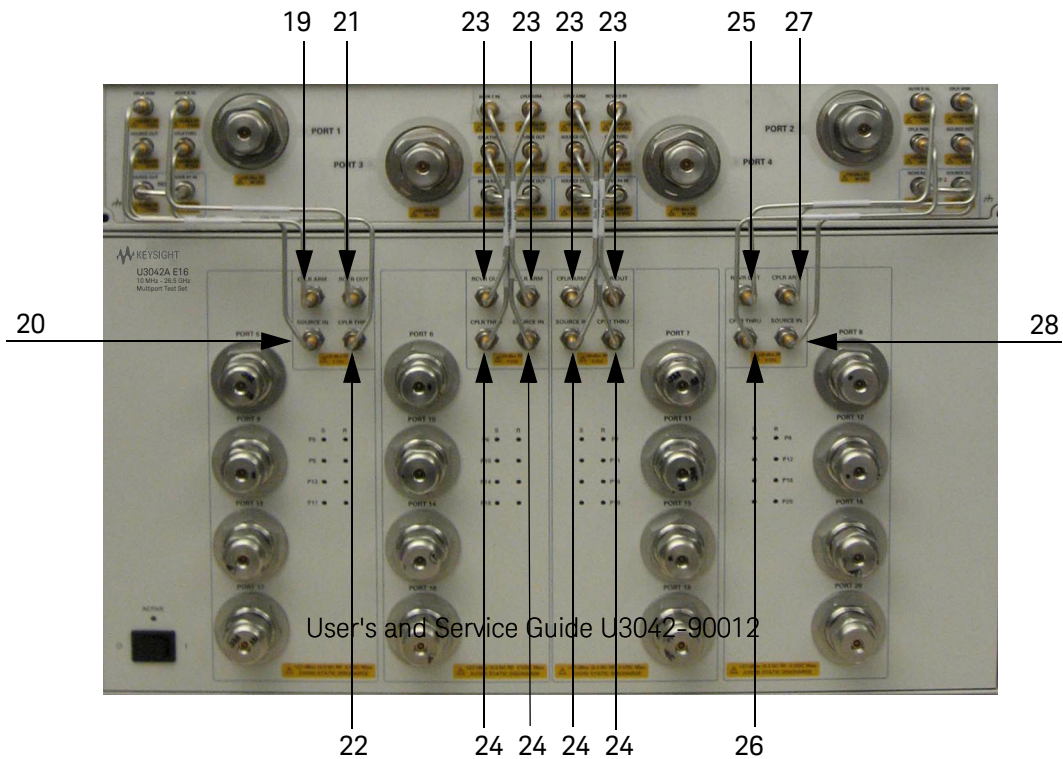
Table 9 PNA or PNA-X RF Interface Cable Connection (U3021-60077)

Numeric Order	RF Cables	From: PNA-X	To: Test Set
1	U3042-20122	Port 1 CPLR THRU	Port 5 CPLR THRU
2	U3042-20120	Port 1 SOURCE OUT	Port 5 SOURCE IN
3	U3042-20119	Port 1 CPLR ARM	Port 5 CPLR ARM
4	U3042-20121	Port 1 RCVR A IN	Port 5 RCVR OUT
5	U3042-20123	Port 3 CPLR ARM	Port 6 CPLR ARM
6	U3042-20123	Port 3 RCVR C IN	Port 6 RCVR OUT
7	U3042-20124	Port 3 SOURCE OUT	Port 6 SOURCE IN
8	U3042-20124	Port 3 CPLR THRU	Port 6 CPLR THRU
9	U3042-20123	Port 4 RCVR D IN	Port 7 RCVR OUT
10	U3042-20123	Port 4 CPLR ARM	Port 7 CPLR ARM
11	U3042-20124	Port 4 SOURCE OUT	Port 7 SOURCE IN
12	U3042-20124	Port 4 CPLR THRU	Port 7 CPLR THRU
13	U3042-20126	Port 2 CPLR THRU	Port 8 CPLR THRU
14	U3042-20128	Port 2 SOURCE OUT	Port 8 SOURCE IN
15	U3042-20125	Port 2 RCVR B IN	Port 8 RCVR OUT
16	U3042-20127	Port 2 CPLR ARM	Port 8 CPLR ARM

Refer to “Interconnect Cable Verification” on page 24.

Figure 18 illustrates the final two digits of the part number for each cable (e.g. 19 is U3042-20119). The cables must be connected in the numeric order listed in **Table 9** on page 22.

Figure 18 PNA-X RF Interface Cable Connections

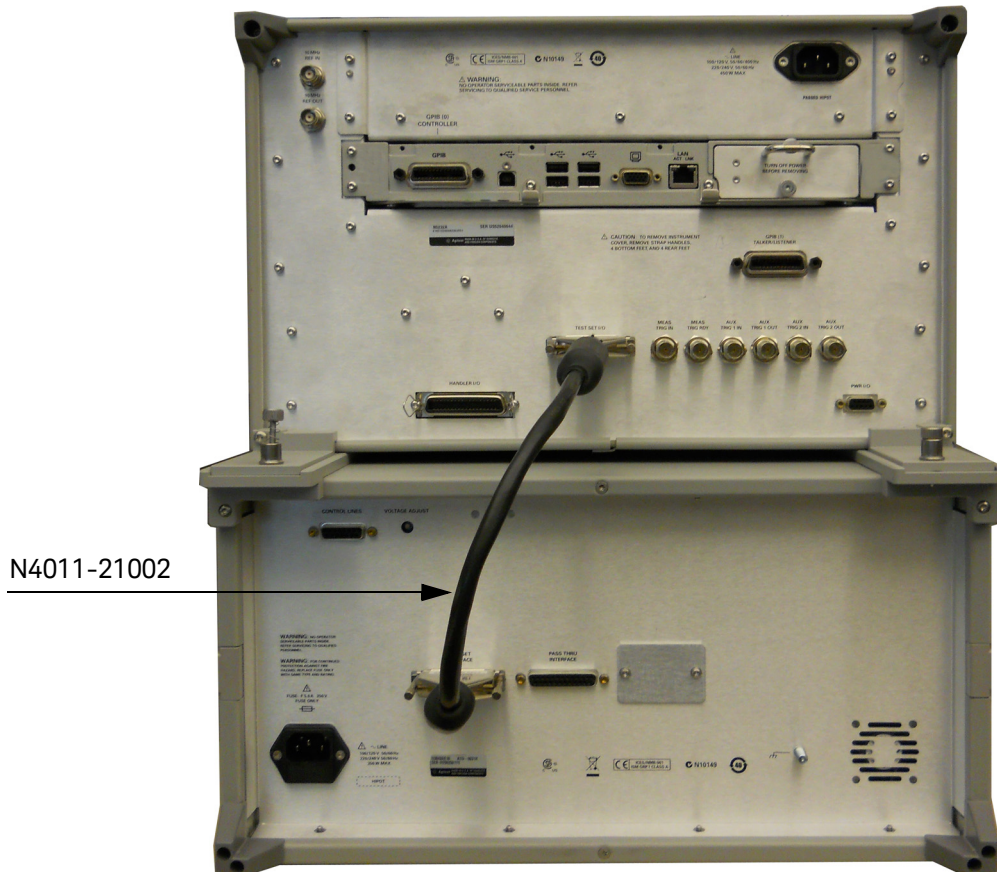


Continue to **“Test Set I/O Cable Installation”** on page 24.

Test Set I/O Cable Installation

1. Connect the Test Set I/O cable (N4011-21002) to the Test Set Interface connector on the rear panel, similar to **Figure 19**.

Figure 19 Test Set I/O Cable Connection



Interconnect Cable Verification

1. Perform the “**System Operational Check**” on page 25.
2. If the problem still exists, perform the “**RF Switching Failures**” on page 70.
3. If a power hole or other failure still exists, refer to “**Contacting Keysight**” on page 85.

System Operational Check

The following procedure will confirm that the RF interface cables between the test set and analyzer are installed and the system is working correctly. Ensure that your analyzer is operational before connecting the test set.

NOTE

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

Complete the following steps before beginning this procedure:

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

Equipment Setup

- Turn on the test set and the analyzer.
- Preset the analyzer and make the following settings:
 - Set to Multi-Port Mode
 - Frequency range: 10 MHz to 26.5 GHz (refer to **“Multiport Mode for Option 551” on page 33**)
 - 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 37**.

Verify Results

The 3.5 mm short will be relocated to each Test Port and an uncorrected reflection response trace should be displayed that resembles the following plots indicated in [Table 10](#). If you suspect an RF signal path problem, refer to the RF cable diagram and check the interface cables associated with this signal path for proper installation.

Table 10 Reflection Response Results

Reflection Port	Response Trace	Cable Path Diagram
Port 1 to 4	Figure 20 on page 27	Figure 21 on page 27
Ports 5 to 8	Figure 22 on page 28	Figure 23 on page 28
Ports 9 to 12	Figure 22 on page 28	Figure 24 on page 29
Ports 13 to 16	Figure 22 on page 28	Figure 25 on page 30
Ports 17 to 20	Figure 22 on page 28	Figure 26 on page 30

NOTE

The trace ripple (peak-peak variation) is normal for this raw uncorrected measurement.

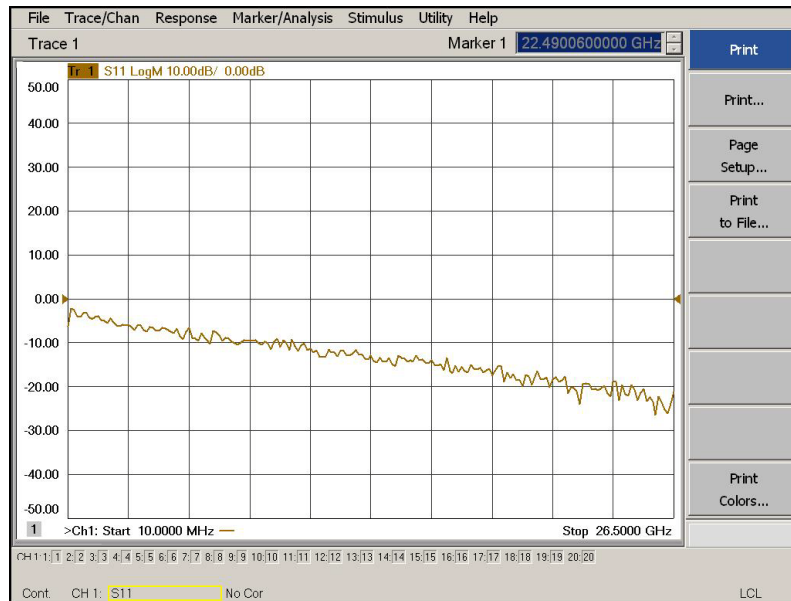
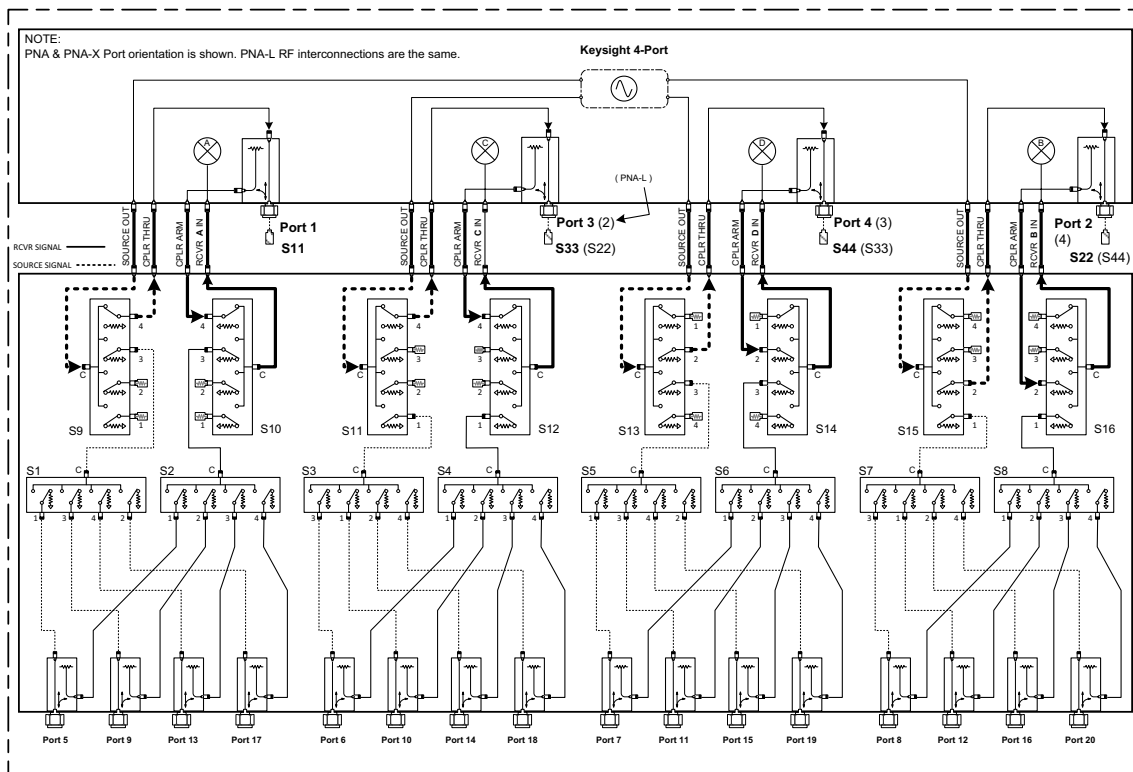
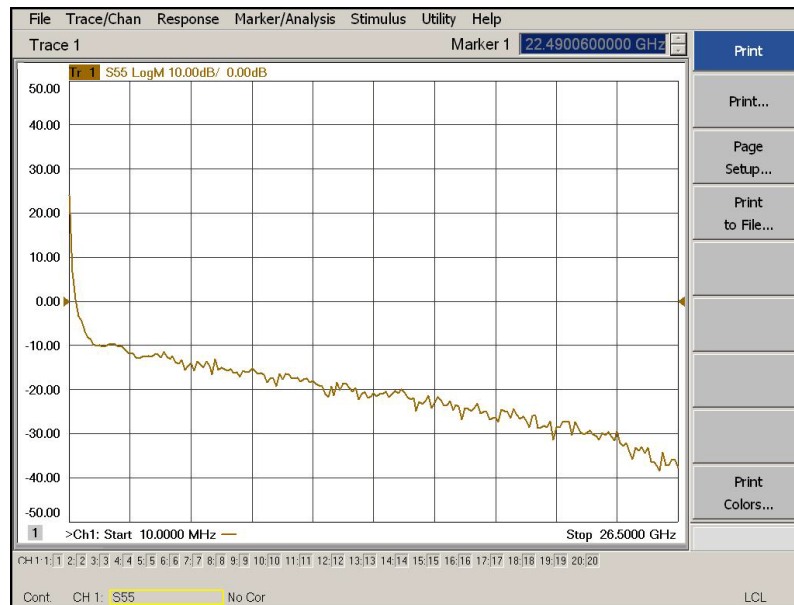
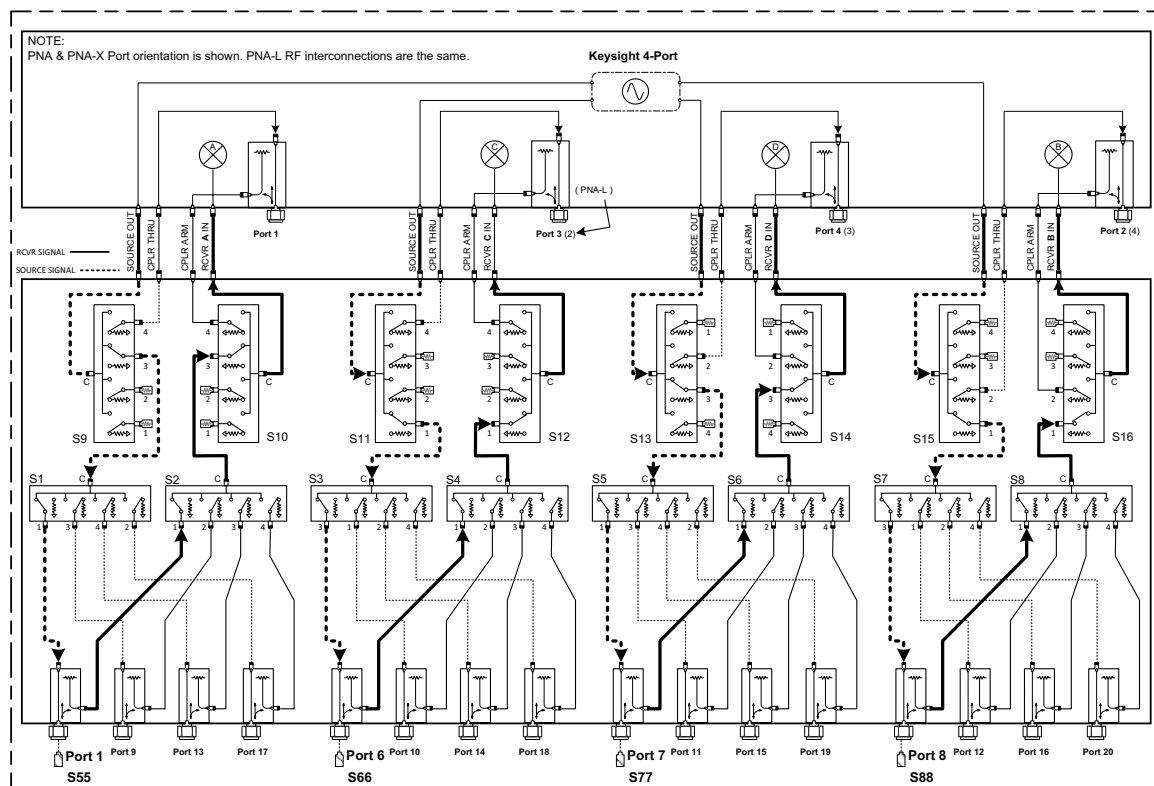
Figure 20 Typical Reflection Response Ports 1 to 4**Figure 21 Reflection Response Signal Path Diagram Ports 1 to 4**

Figure 22 Typical Reflection Response Ports 5 to 20**Figure 23 Reflection Response Signal Path Diagram Ports 5 to 8****NOTE**

Response 10 MHz to 500 MHz is normal for the PNA-X couplers only.

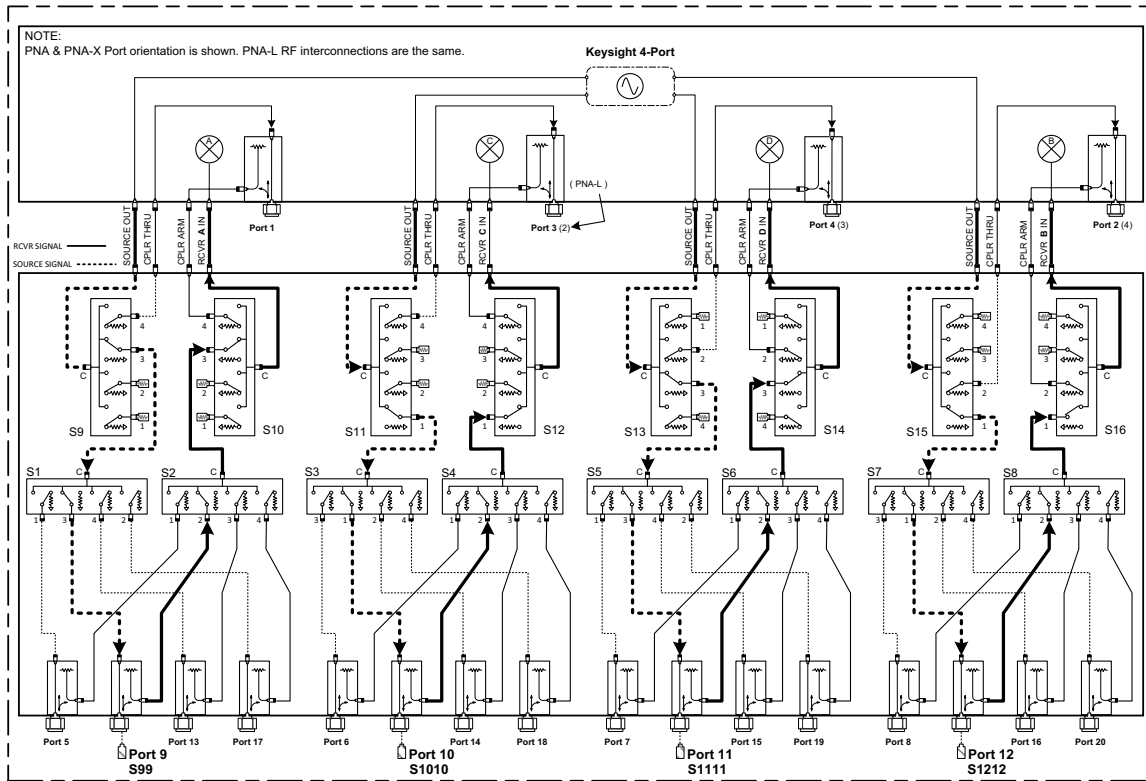
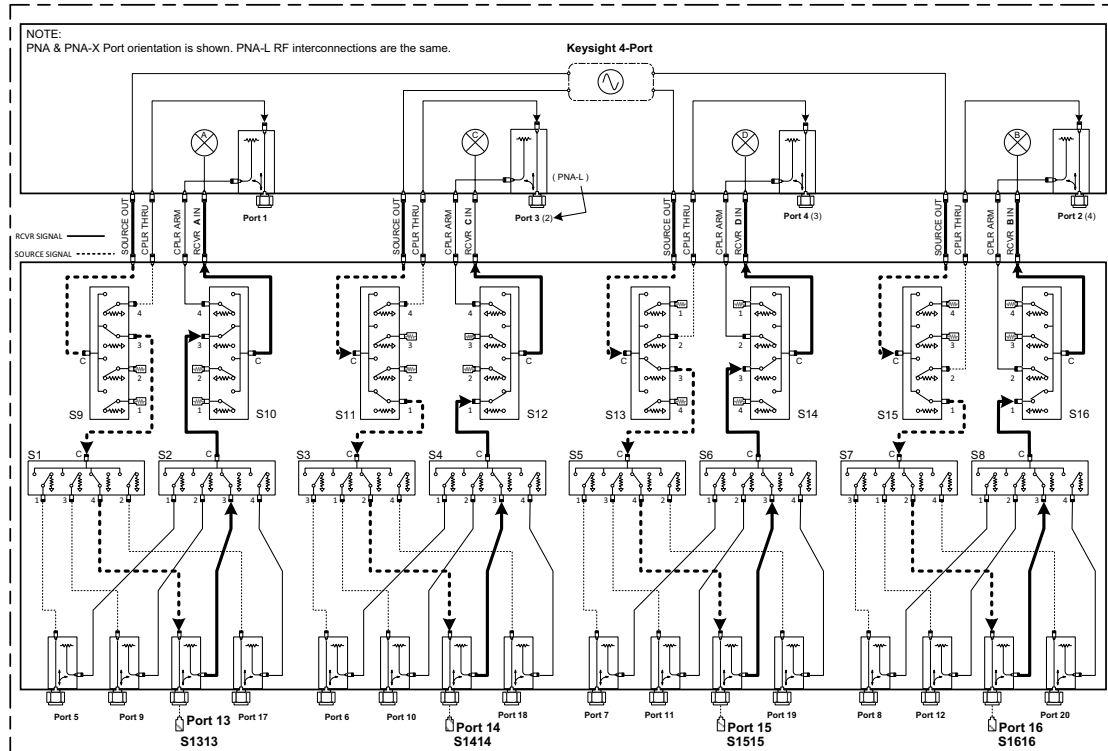
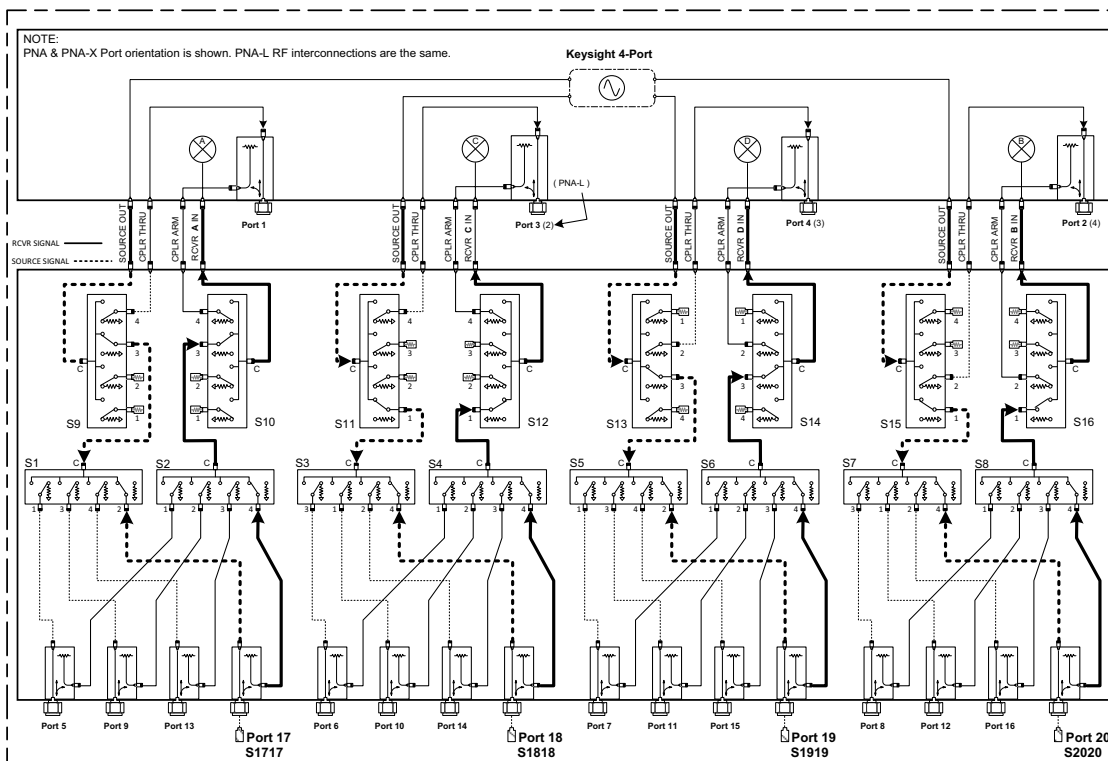
Figure 24 Reflection Response Signal Path Diagram Ports 9 to 12

Figure 25 Reflection Response Signal Path Diagram Ports 13 to 16**Figure 26 Reflection Response Signal Path Diagram Ports 17 to 20**

Controlling the Test Set with N5222/32/42A/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 for Option 551” on page 33.
- “Interface Control” on page 40.
- “SCPI Control Mode” on page 44.

Typeface Key Conventions

The following key conventions are used throughout this document.

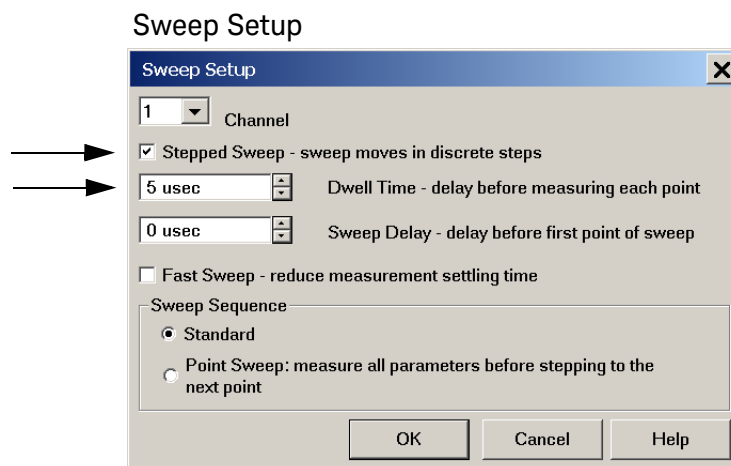
- **[HARDKEYS]** are labeled front panel keys
- **SOFTKEYS** are indicated on the instrument display
- (*Italicized in parenthesis*) are menu paths for the 'B' model analyzer.

Sweep Setup for Multiport and Standalone Modes

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

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

Figure 27



Sweep Setup for PNA-X N52xxB Models

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

Figure 28 **Sweep Setup, N52xxB**

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 two checkboxes: 'Auto Sweep Time' (unchecked) and 'Fast Sweep - Reduce settling time' (unchecked). In the 'Sweep Mode' section, 'Auto' is unchecked and 'Stepped' is selected. Below this is the 'Sweep Sequence' section, where 'Standard' is selected and 'Point Sweep - measure all data before stepping to next point' is unchecked. At the bottom 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	Unchecked
	Stepped	Checked
Sweep Sequence	Standard	Checked
	Point Sweep - measure all data before stepping to next point	Unchecked

Multipoint Mode for Option 551

Multipoint mode selects the test set file that will enable the network analyzer to control the test set. Multipoint 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: u3042ae16_p4.tsx

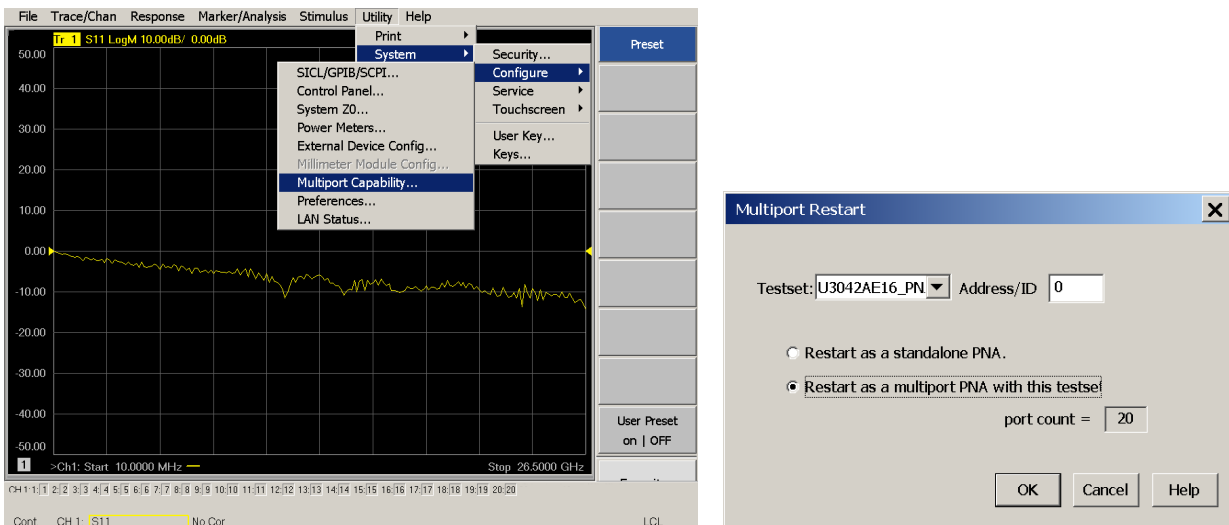
4-Port PNA or PNA-X requires Test Set: u3042ae16_pnax_p4.tsx

How to Access Multipoint Mode

1. The Option 551 must be installed for multipoint capability. To access the multipoint application select **Utility > System > Configure > Multipoint Capability -OR- (Instrument > Setup > External Hardware > Multipoint > Multipoint Configuration...)**.
2. Select **U3042AE16 (20-Port System)** from the drop-down menu and select **Restart as a multipoint PNA with this testset > OK**. The analyzer will restart the network application with the test set interface features.

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

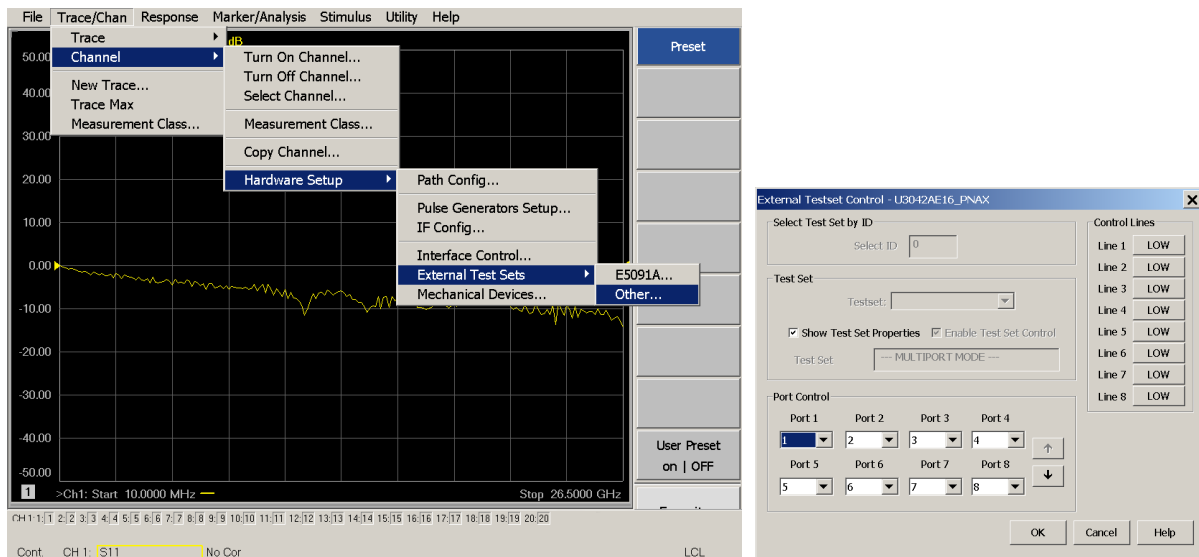
Figure 29 Selecting Multipoint Mode



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... > Multipoint > Other Test Set Setup...)**. The test set will be displayed as External Test Set Control-U3042AE16.

Figure 30 External Test Set Control



This menu will allow the physical Ports 1 thru 20 to be identified as any port for your convenience. For example; Port 5 can be named Port 2.

The **External Test Set Control-U3042AE16** also allows control of the DUT control lines, refer to **“Control Lines” on page 50**. To change the state from LOW to HIGH, select the graphical user interface (GUI) for the specific control (LINE 1 thru 8) click **OK**. Each line can be controlled separately.

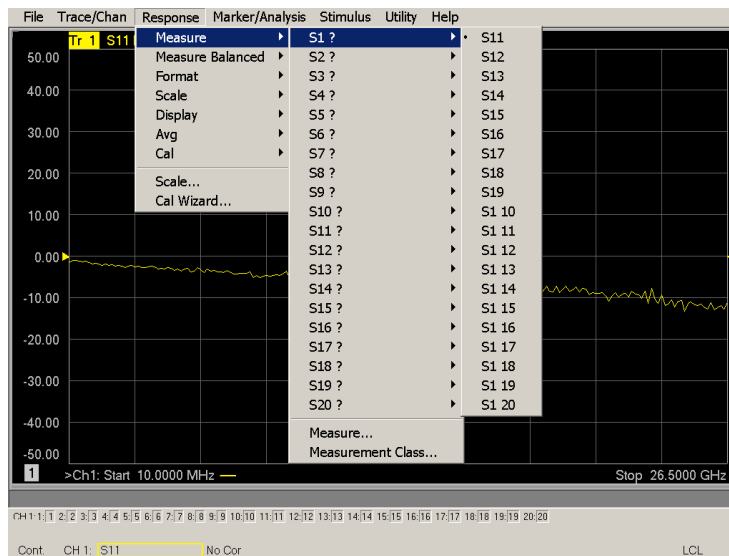
Select the Port Control down-arrow for Ports 9 thru 16.

Trace Measure S-Parameter

S-Parameter selection can be accomplished using **Response > Measure**. Use the drop-down menu to select 1 of 400 S-Parameters for the 20-Port system. The first number in the Sxx selection is the Receiver Port and the second number will be the Source Port. Any port can be selected to be the Receiver, Source or both, as in S11. The front panel R LED indicates the port is the Receiver and the S LED indicates the port is the Source.

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

Figure 31 S-Parameter Measurement ('A' Model Analyzers Only)

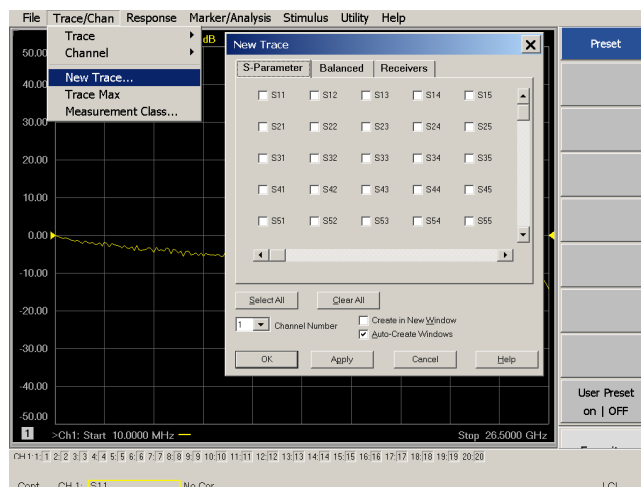


New Trace Measure S-Parameter

S-Parameter Tab: Multiple S-Parameters can be made from the New Trace menu. In the drop-down menu select **Trace/Chan > New Trace -OR- (Instrument > Trace > New Trace)**.

The dialog box allows the selection of any of the 400 S-Parameters.

Figure 32 New S-Parameter Measurement

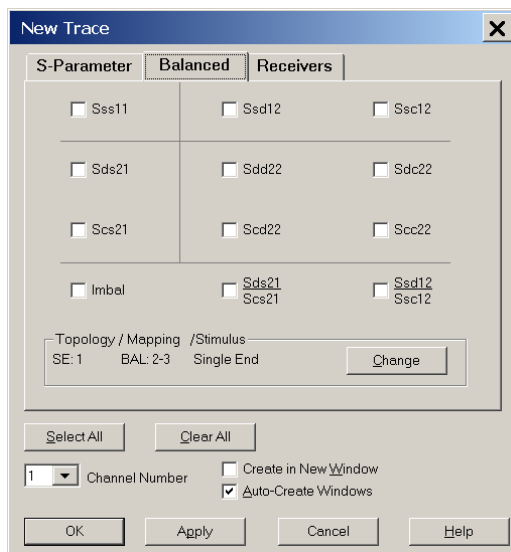


Balanced Tab:

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

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

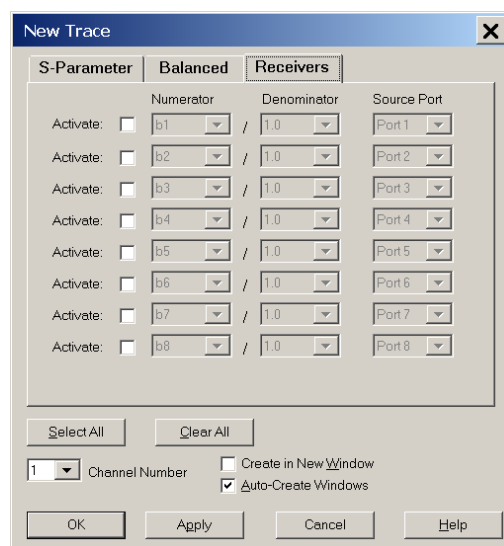
Figure 33 Selecting Balanced Measurements



Receivers Tab:

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

Figure 34 Receiver Measurements



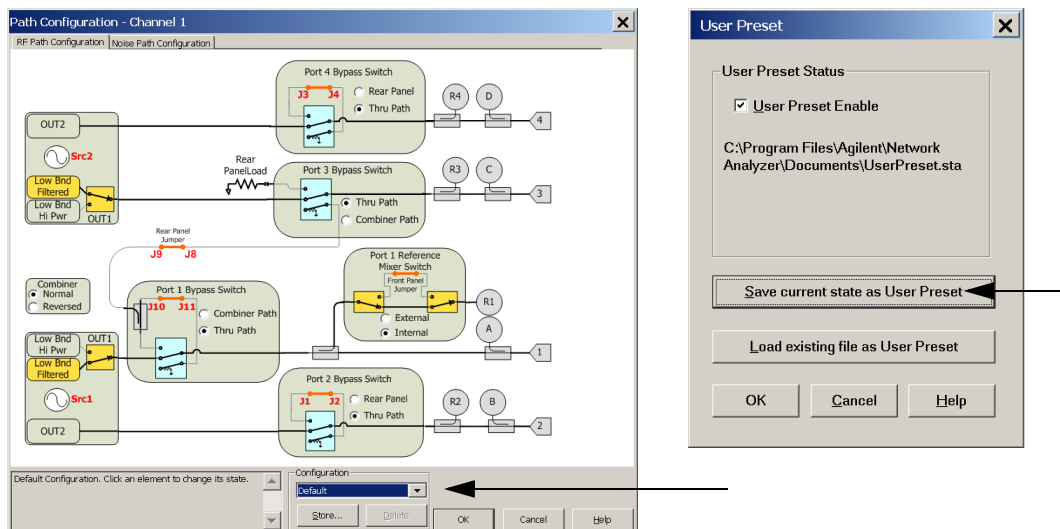
RF Path Configuration with Option 029

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

1. Select **Trace/Chan > Channel > Hardware Setup > Path 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 35 RF Path Configuration



N-Port Calibration

It is recommended that you perform an ECal characterization to minimize the connections required for multiple port calibration. The N4691A/B 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...).**

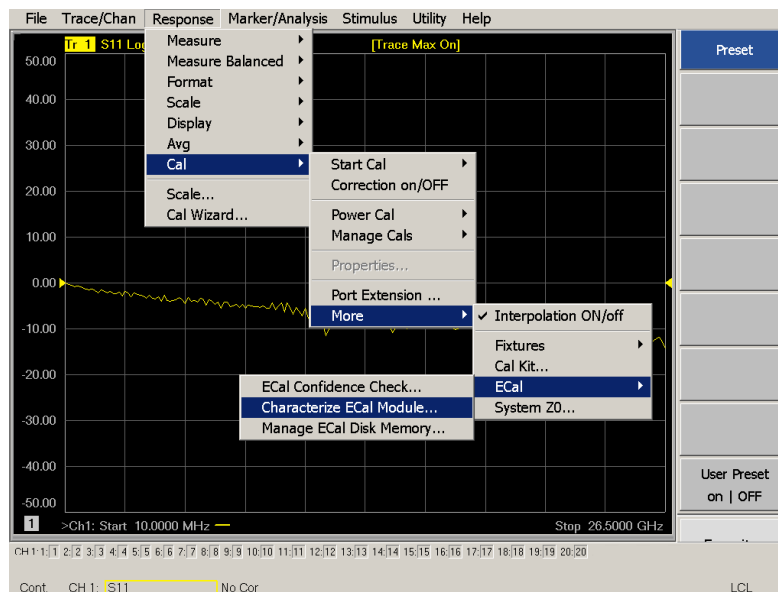
Calibrate at the end of the test port RF cables and any adapters that are used to connect the DUT. This removes the effect on the measurement of the DUT. Failure to do this will create ripple and other measurement errors.

NOTE

If measurement errors occur, ensure the newest version of firmware is installed on the PNA. 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>

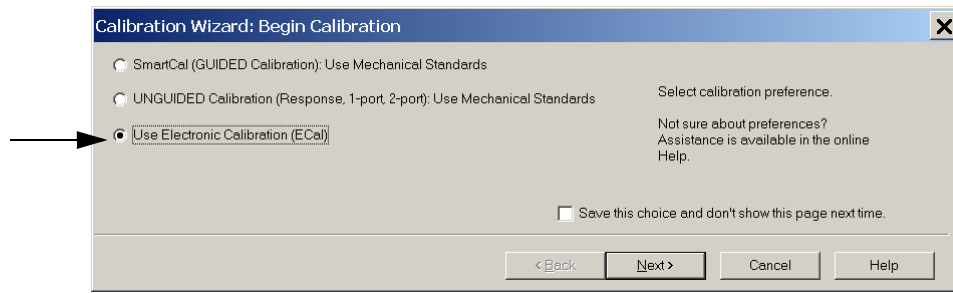
1. To perform an ECal characterization select
**Response > Cal Wizard > Characterize ECal Module -OR-
(Response > Cal > Other Cals > ECal...)** and follow the prompts.
2. Save the ECal characterization file. Refer to the Help menu for characterizing information.

Figure 36 ECal Characterization



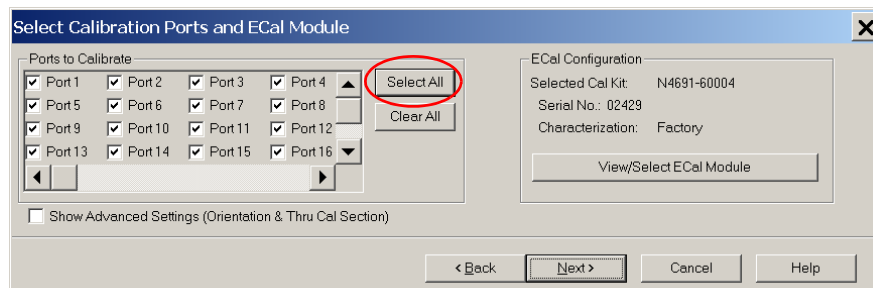
3. On the analyzer select **Response > Cal Wizard -OR- (Response > Cal > Other Cals...)**.
 - a. If using a mechanical cal kit, select **SmartCal (Guided Calibration) > Next**.
 - b. If using an ECal module, connect the ECal to an available USB port and select **Use Electronic Calibration (ECal) > Next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

Figure 37 Begin Calibration



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

Figure 38 20-Port Calibration



5. Connect the ECal or the mechanical cal kit to the ports you are calibrating following the Cal Wizard prompts and click **Measure** after each connection. The electrical delay value may be shown in the dialog box after the last measurement, click **OK**.
6. At the Calibration Completed prompt click **Save As User Cal Set**, type the name and **Save**. See **Figure 50 on page 59**.
7. After calibrating test set ports, use a quality load and short to verify the calibration on each port or end of the test cable. Measure reflection and confirm the return loss is as expected. If the result is not as expected, repeat the calibration without the test set and ensure that the analyzer is in standard (non-multiport) mode.

NOTE

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

<http://na.support.keysight.com/pna/firmware/firmware.htm>

Interface Control

NOTE

Interface Control mode will not function properly when using multiport mode. Multiport mode will reset the switch path commands of the interface control. It is recommended that the analyzer be restarted in stand-alone mode if the interface control is being used.

Overview of the Interface Control

The Interface Control feature allows you to send data and remote commands to control external equipment using the GPIB, Handler I/O, Test Set I/O, Dwell After Command and Aux I/O without needing to create a remote program. Refer to PNA Help menu, "Rear Panel Tour."

- A unique set of control data can be sent for each channel. In addition, a unique set of control data can be sent before the channel sweep starts and after the sweep ends.
- Interface Control settings can be saved and recalled from the Interface Control dialog box or with Instrument State Save and Recall.
- Interface Control settings can be copied to other channels using Copy Channels.
- Control data can only be WRITTEN to the interfaces, NOT READ from the interfaces.
- Control data is sent in the following order and this order cannot be changed:
Refer to the PNA Help menu.
 1. GPIB Commands - BEFORE
 2. Handler I/O Control
 3. Test Set I/O Control (addr.data)
 4. Dwell After Command
 5. Aux I/O Output Voltage

How to Access Interface Control Settings

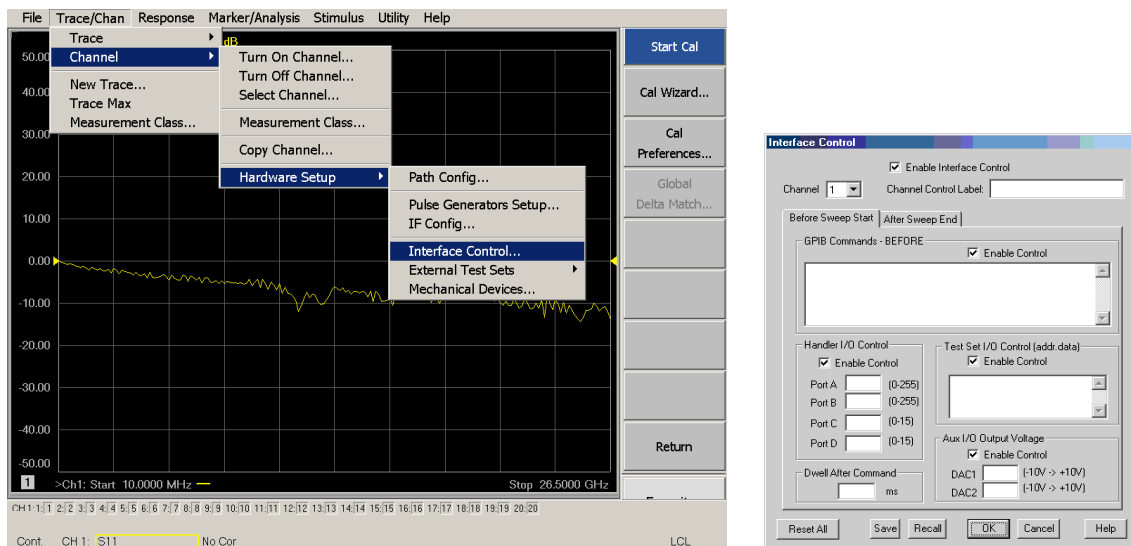
This section describes how to configure and operate the test set with the PNA.

- 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 PNA Series Network Analyzer comes with the Interface Control application. Please review this application before connecting the test set to the PNA. Information regarding this application can be found in the PNA Help menu, Interface Control. The application is shown in **Figure 39** below.

Figure 39 Interface Control Application



Using Interface Control Mode

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

NOTE

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

Figure 40 Interface Control

The screenshot shows the 'Interface Control' dialog box. It has a title bar 'Interface Control' and a tabbed interface with 'Before Sweep Start' and 'After Sweep End' tabs. The 'Before Sweep Start' tab is active. Inside, there's a 'GPIB Commands - BEFORE' section with an 'Enable Control' checkbox. Below that are 'Handler I/O Control' and 'Test Set I/O Control (addr.data)' sections, each with an 'Enable Control' checkbox and several input fields. The 'Handler I/O Control' section has 'Port A', 'Port B', 'Port C', and 'Port D' fields. The 'Test Set I/O Control' section has a large text area for 'addr.data' and 'Aux I/O Output Voltage' section with 'DAC1' and 'DAC2' fields. At the bottom are 'Reset All', 'Save', 'Recall', 'OK', 'Cancel', and 'Help' buttons. Numbered callouts (1) through (8) point to: (1) 'Enable Interface Control' checkbox, (2) 'Test Set I/O Control (addr.data)' label, (3) the 'addr.data' text area, (4) 'Channel' dropdown, (5) 'Channel Control Label' text field, (6) 'Before Sweep Start' tab, (7) 'Dwell After Command' field, and (8) 'Aux I/O Output Voltage' label.

Enable Interface Control: (1)

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

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

Provides control of the Test Set I/O Interface on the rear panel of the analyzer. Used to control your test set. Only positive integers are allowed to select switch positions or states of DUT control interface lines. Refer to [“Address and Data Values” on page 47](#).

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

Address and Data example: addr.data (3)

```
0.0
16.1
32.2
```

Channel: (4)

Specifies the channel number for dialog settings. Each channel is configured individually. The drop-down list illustrates the channels that currently have measurements. There must be at least one displayed trace for the test set I/O Interface to function.

Channel Control Label: (5)

Specifies the label to be displayed on the analyzer's screen during the channel sweep.

Before Sweep Start – After Sweep End Tabs: (6)

Commands (GPIO, I/O's and Dwell) can be sent Before Sweep Start and After Sweep End. However, they are configured and enabled separately on the "Interface Control" dialog box. For example; to send a command before and after a PNA sweep, the "Enable Interface Control" check box must be selected and commands entered in both the Before Sweep Start and After Sweep End tabs. The **Before Sweep Start** data is sent before the first trace on the channel begins sweeping. The **After Sweep Start** data is sent after the last trace on the channel sweep is completed.

Dwell After Command: (7)

Specifies a wait time, in milliseconds, after all commands to all interfaces are sent. Any positive integer is allowed. This is used to allow all external devices to settle before beginning a measurement. An erratic trace could indicate that more settling time is necessary.

Handler I/O Control and Aux I/O Output Voltage: (8)

Provides I/O interface control through the rear panel of the PNA. Refer to the PNA Help menu for further information.

Reset All:

Sets all fields on all channels to their default values.

Save and Recall:

Saves and recalls the contents of the dialog box. If the "Interface Control" dialog box is populated with settings during an Instrument State Save, the settings are automatically recalled with the instrument state settings. Interface control uses an *.xml file type. An example file is stored on the PNA hard drive. You can recall it into the dialog, or you can open and edit it with a word processor, such as Word Pad.

OK:

Applies the settings and closes the dialog box.

Cancel:

Does not apply changes that were made and closes the dialog box.

Help:

Provides additional information for using the interface control application.

SCPI Control Mode

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

Overview of the SCPI Control

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

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

How to Access the Command Processor

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

Figure 41 Command Console for 'A' Model Analyzers

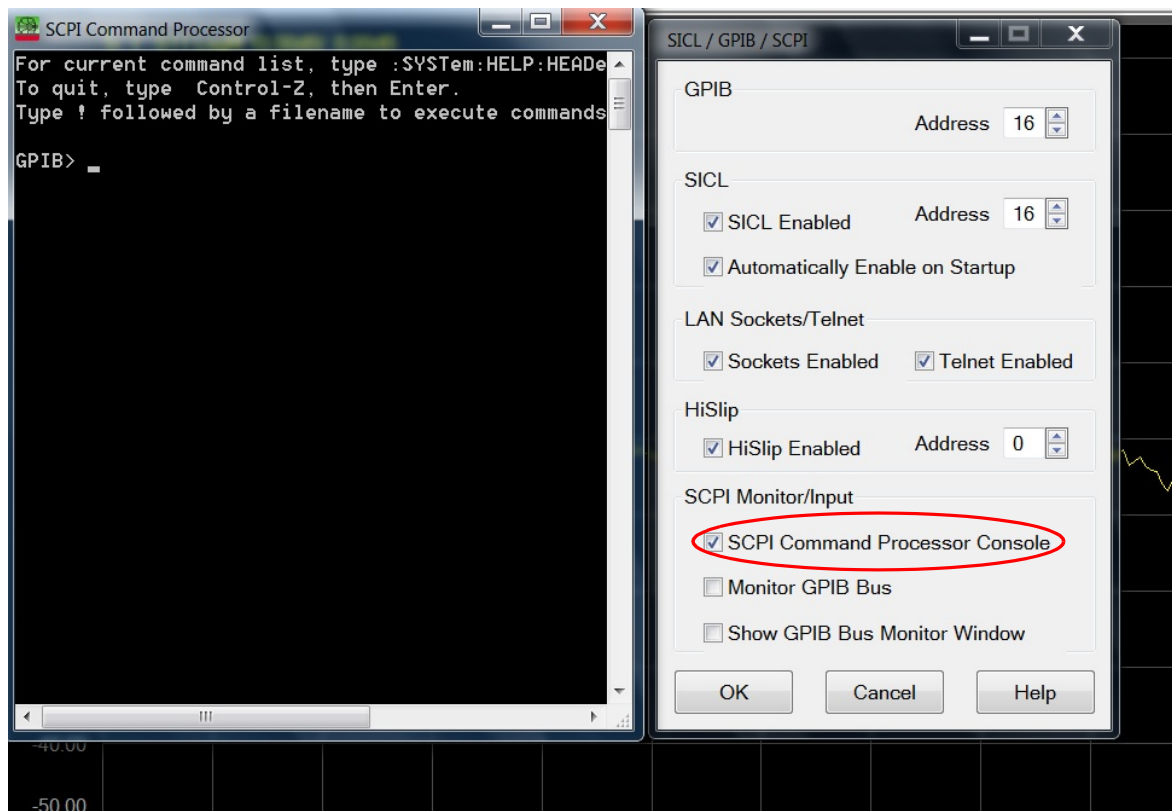
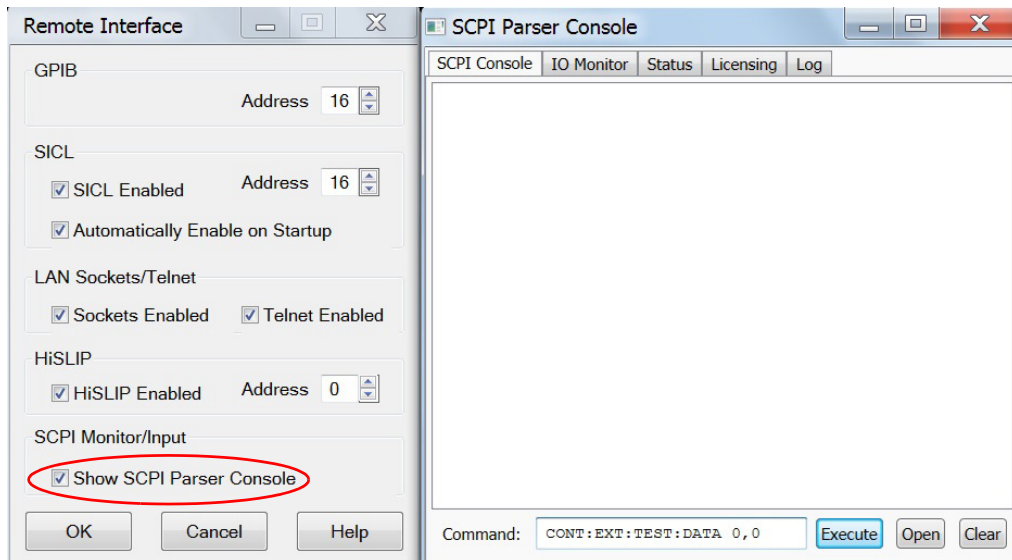


Figure 42 Command Console for 'B' Model Analyzers

SCPI Command Processor Console

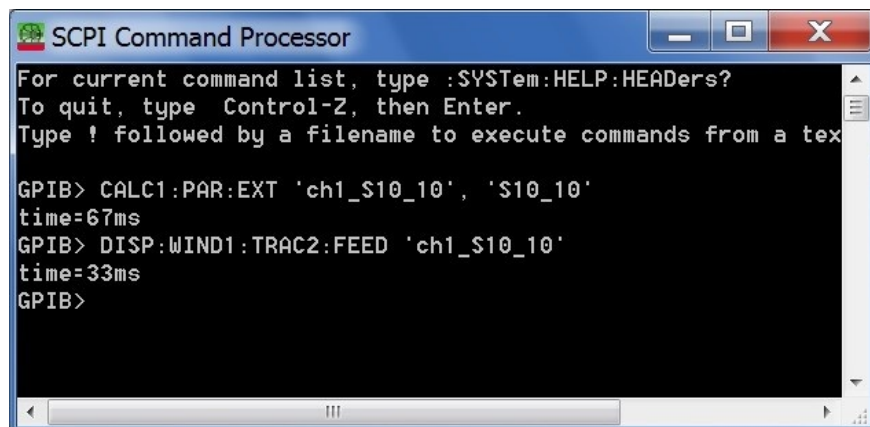
There are two methods in which the PNA-X Command Processor Console can be used to control the Test Set internal switches to configure the Multiport system for S-Parameter measurements.

Method 1 - Using GPIB/SCPI Command Values

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

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

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

Figure 43 Method 1 - Using GPIB/SCPI Command Values

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

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

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

```
DISP:WIND1:TRAC2:FEED 'ch1_S10_10'
```

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

```
'ch1_S99'      'ch1_S22'      'ch1_S9_10'  'ch1_S10_9'
```

Method 2 - Using the Test Set Address and Data Values

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

The Address and Data values for the Test Set can be found in the [“Address and Data Values” section on page 47](#).

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

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

For example:

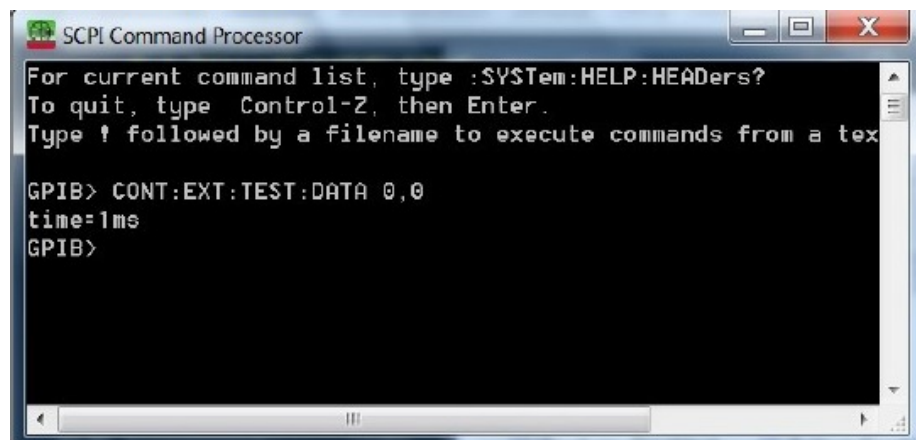
```
CONT:EXT:TEST:DATA <address>,<data>
```

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

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

Figure 44

Method 2 - Using Test Set Address and Data Values



Address and Data Values

Setting the Test Port Paths with Address and Data

Refer to [Table 11](#) and [Table 12](#) and [Figure 45 on page 49](#) to set the internal switch paths of the test set.

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

Example 1: Refer to [Figure 45 on page 49](#).

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 48.

Two separate commands must be sent, you may use the same dialog box. Send address 0 and data 1 in one command line, and address 16 and data 48 in the second line. Refer to [“Interface Control” on page 40](#) and in [“SCPI Control Mode” on page 44](#).

Example 2:

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

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

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

Table 11 PNA-L Port Address and Data Values for Std

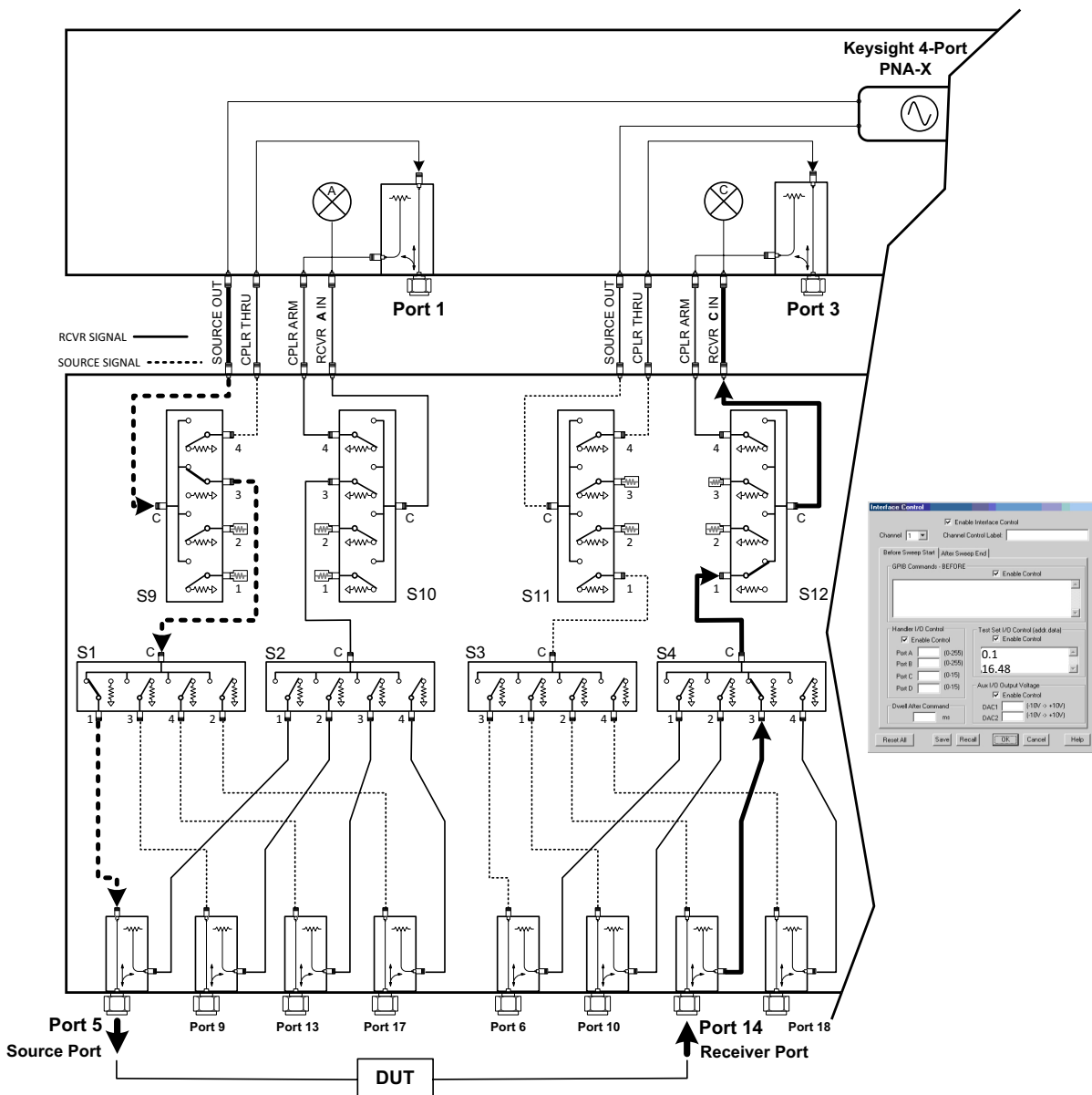
Address		Source Path					Receiver Path				
	Data	0	1	2	3	4	0	16	32	48	64
0	Ports	1	5	9	13	17	1	5	9	13	17
16	Ports	2	6	10	14	18	2	6	10	14	18
32	Ports	3	7	11	15	19	3	7	11	15	19
64	Ports	4	8	12	16	20	4	8	12	16	20

Table 12 PNA or PNA-X Port Address and Data Values for Std¹

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

1. Data 7 will terminate Source Paths for the address selected.
 Data 112 will terminate Receiver Paths for the address selected.
 Data 119 will terminate Source and Receiver Paths for the address selected.

Refer to “**System Block Diagrams**” on page 65 for in-depth RF path information.

Figure 45 Address and Data Example 1 (Port 5 to 14)

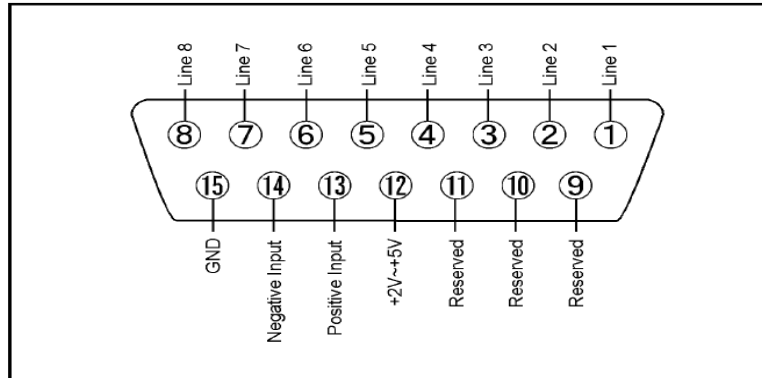
Control Lines

The 15 pin female D-Sub connector on the rear panel provides 8 latched data lines that can be used to control your device under test (DUT). The lines can be controlled with the Multiport External Test Set control, or Test Set I/O commands. Refer to [“External Test Set Control Feature” on page 34](#) and [“Setting the Control Lines with Address and Data Values” on page 54](#). 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 46 on page 51](#) and [Table 14 on page 51](#) for control line pin location and description. Refer to [“Internal Voltage Supply Configuration” on page 52](#) and [“External Voltage Supply Configuration” on page 53](#) for configurations.

Table 13 **DUT Control Specifications**

Item	Specifications
Connector Shape	15-pin female D-Sub
Voltage Range:	
Positive Input	0 to +5 V
Negative Input	–5 to 0 V
Maximum Current	100 mA (in total of each line)
Impedance	< 10 Ω
Range of Variable Voltage	+2 to +5 V

Figure 46 DUT Control Line Pin Assignment**Table 14 DUT Control Line Pin Assignment**

Pin Number	Signal Name	Description
1	Line 1	Output port of line 1
2	Line 2	Output port of line 2
3	Line 3	Output port of line 3
4	Line 4	Output port of line 4
5	Line 5	Output port of line 5
6	Line 6	Output port of line 6
7	Line 7	Output port of line 7
8	Line 8	Output port of line 8
9		Not used
10		Not used
11		Not used
12	+2 V to +5 V	The voltage input to pin 13. (The voltage can be varied by rotating the voltage adjustment trimmer on the rear panel).
13	Positive Input	Input a signal that is outputted when each line is high from pin 12 or external DC power supply.
14	Negative Input	Input a signal that is outputted when each line is low from the external DC power supply. Able to output 0 V as low from the each line by connecting to pin 15.
15	Gnd	ground terminal

Internal Voltage Supply Configuration

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

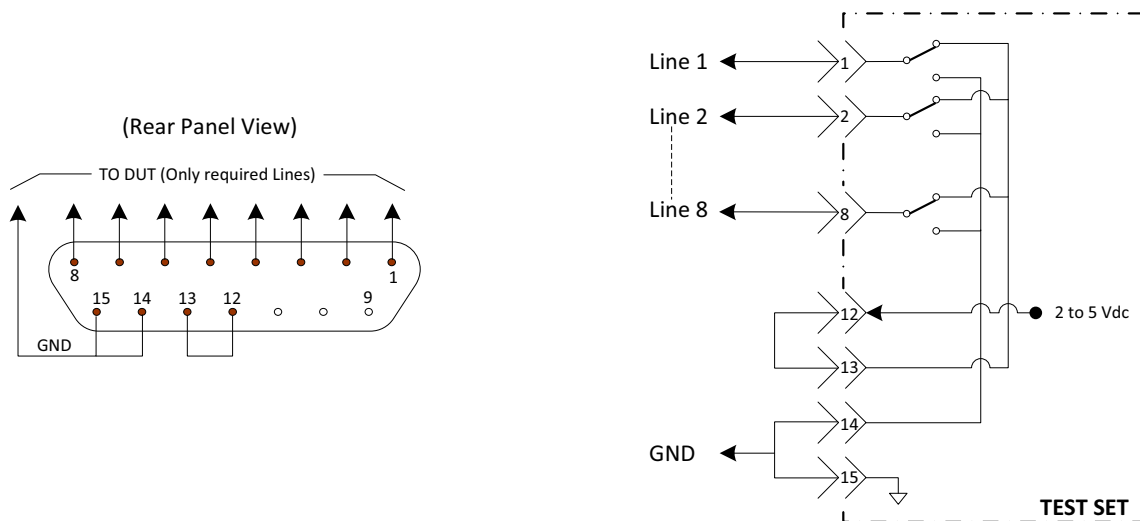
1. Turn on the test set.
2. Measure the voltage between pin 12 and 15 using a multimeter.
3. Rotate the voltage adjustment trimmer on the rear panel until the multimeter indicates the appropriate voltage.

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

CAUTION

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

Figure 47 Internal DC Power Configuration (rear panel view)



External Voltage Supply Configuration

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

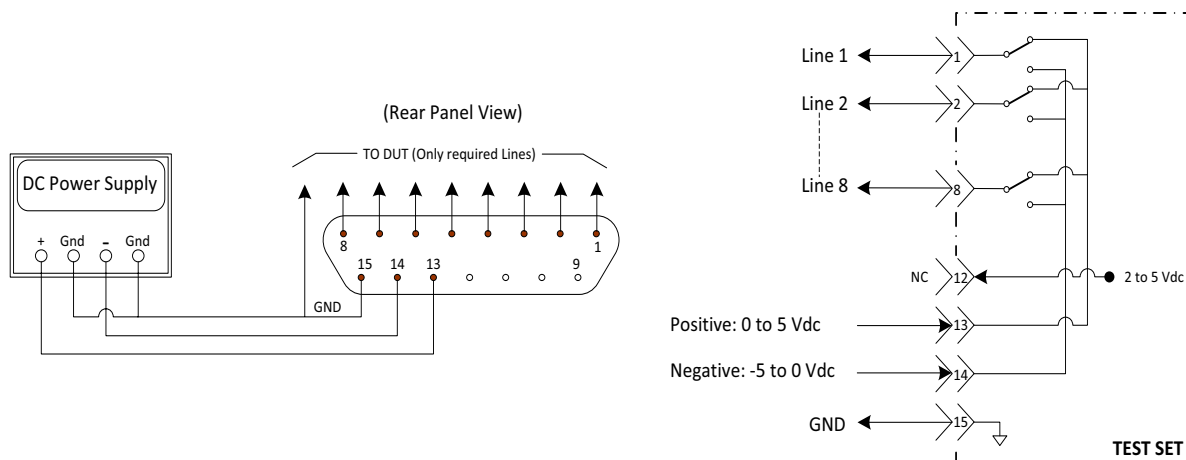
Turning On the Test Set using an External Power Supply

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

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



Setting the Control Lines with Address and Data Values

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

NOTE

The following control feature will function only while the analyzer is in its Standalone mode.

Setting the Analyzer to Standalone Mode

1. Select **Utility > System > Configure > Multiport Capability -OR- (Instrument > Setup > External Hardware > Multiport > Multiport Configuration...)**.
In the dialog box select **Restart as a standalone PNA > OK**.
2. **Access Interface Control Mode (see [page 41](#))**

As described in “[Setting the Test Port Paths with Address and Data](#)” on [page 47](#), 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 low or connected to Pin 14	1-8
112	1	DUT Control Line 1 set to logic low or connected to Pin 14	1
112	2	DUT Control Line 2 set to logic low or connected to Pin 14	2
112	4	DUT Control Line 3 set to logic low or connected to Pin 14	3
112	8	DUT Control Line 4 set to logic low or connected to Pin 14	4
112	16	DUT Control Line 5 set to logic low or connected to Pin 14	5
112	32	DUT Control Line 6 set to logic low or connected to Pin 14	6
112	64	DUT Control Line 7 set to logic low or connected to Pin 14	7
112	128	DUT Control Line 8 set to logic low or connected to Pin 14	8

After a power reset all DUT control lines are initially configured to a logic high state or connected to Pin 13, refer to [Figure 47 on page 52](#). To reset all control lines to logic high, without having to reset the power switch on the test set, make the following PNA entry:

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

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

Listed are two examples to illustrate this concept. Refer to [Figure 46 on page 51](#), 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 analyzer Interface Control Mode line entry = 112.6 > OK.

NOTE

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

Cal Kit Operational Check

The following procedure can be used to confirm that the test set and analyzer are operational. The operation verification limits provided ensure that your test set and analyzer are operating properly within the limits. Refer to **“General Specifications” on page 7**.

Equipment Required

The test set requires that the user be familiar with the equipment and components listed in **Table 16**.

This section provides an equipment list and configuration of the 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 or 85052D	1
N5232A 4-Port Network Analyzer (Option 245 and 551) <i>or</i> N5222A, N5232A or N5242A Option 400 and 551	1
Set of interconnect cables (PNA and test set), see “N5232A RF Interface Cable Connections (U3021-60075)” on page 20 <i>or</i> “N5222A and N5242A RF Interface Cable Connections (U3021-60077)” on page 22 .	1

Verification Limits

Specifications for the test set are typical. System performance for the analyzer and test set are only characteristic and intended as non-warranted information. Only a functional certificate is provided for the 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 performance is based on 1 to 2 units. Refer to [Table 17](#) and [Table 18](#).

Table 17 PNA-L Reflection Tracking Limits

Frequency	Ports 1 - 4	Ports 5 - 20
300 kHz to 50 MHz	-9	-15
50 MHz to 500 MHz	-10	-16
500 MHz to 3.2 GHz	-12	-18
3.2 GHz to 10 GHz	-17	-23
10 GHz to 16 GHz	-20	-29
16 GHz to 20 GHz	-22	-33

Table 18 PNA or PNA-X Reflection Tracking Limits

Frequency	Ports 1 - 4	Ports 5 - 20
10 MHz to 50 MHz ¹	-9	+16
50 MHz to 500 MHz ¹	-10	-10
500 MHz to 3.2 GHz	-12	-18
3.2 GHz to 10 GHz	-17	-23
10 GHz to 16 GHz	-22	-29
16 GHz to 20 GHz	-27	-33
20 GHz to 24 GHz	-32	-39
24 GHz to 26.5 GHz	-37	-45

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

NOTE

If you suspect that your 20-Port configuration is not operating properly, ensure that all front RF jumper interconnect cables are correctly connected.

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 a PNA-X Operator's Check. The PNA-X will indicate false failures if the test set is connected.

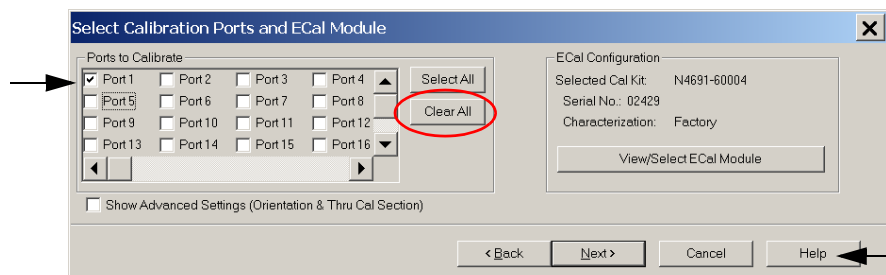
Preparing the Network Analyzer

1. Connect the test set to the analyzer using the interconnect cables as shown in [“Hardware Lock-link Installation \(U3021-60004\)” on page 14](#) and [“Hardware Lock-link Installation \(U3021-60005\)” on page 17](#).
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 “999.20” (20-Port), although it is unlikely that you will find Cal Sets with these names.
4. Verify that the analyzer is in Multiport mode. See the bottom of the measurement window.
 - a. If only four S-Parameters are listed, select **Utility > System > Configure > Multiport Capability -OR- (Instrument > Setup > External Hardware > Multiport > Multiport Configuration...)**. Select **Restart as Multiport PNA with this Test Set** and select **U3042AE16 (20-Port)** from the drop-down menu > **OK**. Refer to [Figure 29 on page 33](#).
5. Press **Preset**.
6. Verify that the **[Start Frequency]** is set to **[300 kHz or 10 MHz]**.
7. Set the **[Stop Frequency]** to **[20 GHz or 26.5 GHz]**.
8. Select **[Power] > Power Level** and enter **[0 dBm]**.
9. Select **Response > Avg BW > IF Bandwidth > 100 Hz > OK**.
10. Select **Stimulus > Sweep > Number of Points > 401**.
11. Connect the ECal module to an available USB port on the front or rear panel. This procedure assumes you are using a ECal. If you are not, see [“1-Port Calibration Procedure” on page 59, step 2](#).
12. Allow the ECal module, test set and analyzer to warm up for a minimum of 30 minutes.

1-Port Calibration 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** and select **Port 1 > Next > Measure**.
4. Ensure the Cal Kit you are using is indicated on the right side of the window.

Figure 49 1-Port Calibration



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

NOTE

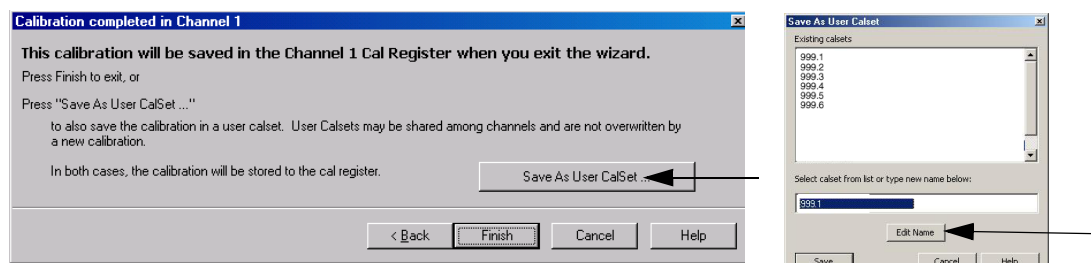
If you do not have a keyboard, select **Save As User Calset > Edit Name** and save as **999.x**. X is the port number you are calibrating. Use the numeric keypad on the analyzer's front panel to enter "999.1."

7. Repeat **step 1** thru **step 6** for Ports 2 thru 20. When finished, there should be 20 Cal Sets saved with the titles "999.1" thru "999.20" (20-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. For further information refer to the Help menu.

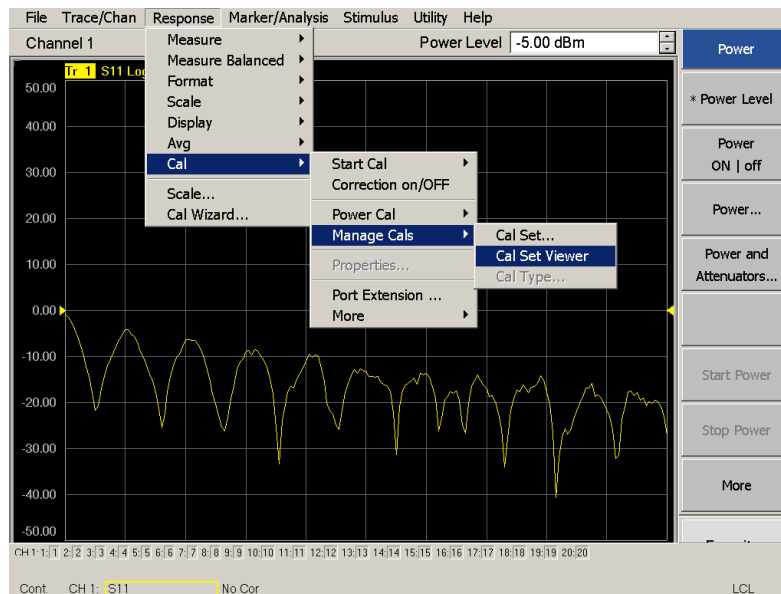
Figure 50 Calibration Complete



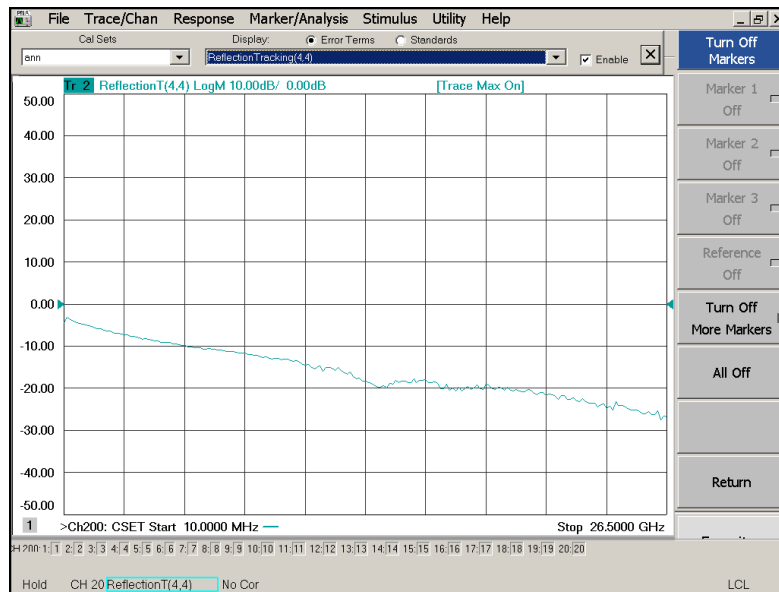
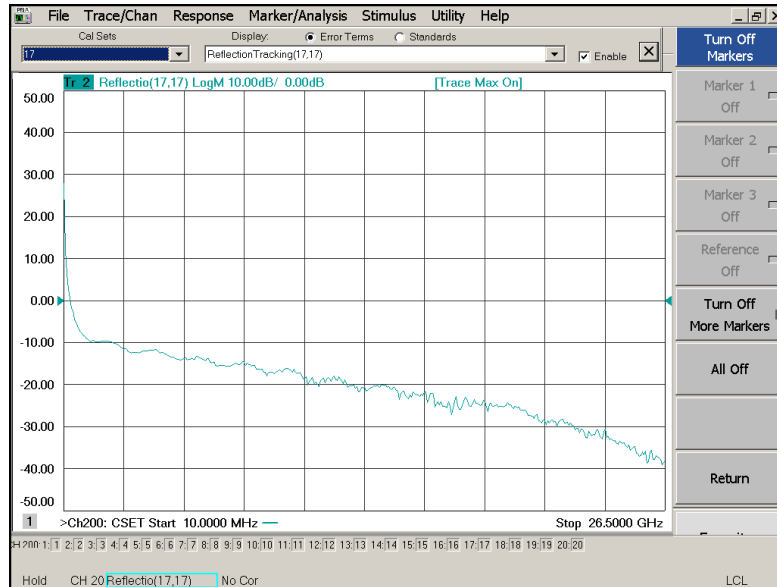
Cal Set Verification

1. Select **Trace/Chan > Trace > Delete Trace**
-OR-
(**Instrument > Trace > Delete Trace**).
There should be no traces on the screen.
2. To launch the Cal Set Viewer toolbar. Select **Response > Cal > Manage Cals > Cal Set Viewer**
-OR-
(**Response > Cal > Cal Sets & Cal Kits > Cal Set Viewer [On/Off]**).

Figure 51 Calibration Cal Set Viewer



3. From the Cal Sets drop-down menu, select **999.1** and select **Enable**. Select the **Reflection Tracking(x,x)**, where x,x is the port being tested. Ensure that the **Enable** and **Error Terms** check boxes are selected.
4. Compare the Reflection Tracking (1,1) trace to the appropriate limits in [Table 17 on page 57](#) or [Table 18 on page 57](#). Use the Markers function to measure the trace values.
5. Repeat [step 3](#) and [step 4](#) for Cal Sets “999.1” thru “999.20” (20-Port).

Figure 52 Reflection Tracking Trace with PNA-X (Port 1 to 4)**Figure 53** Standard Reflection Tracking Trace with PNA or PNA-X (Port 5 to 20)**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.

Verifying a 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 10](#). Verify the following verify following:

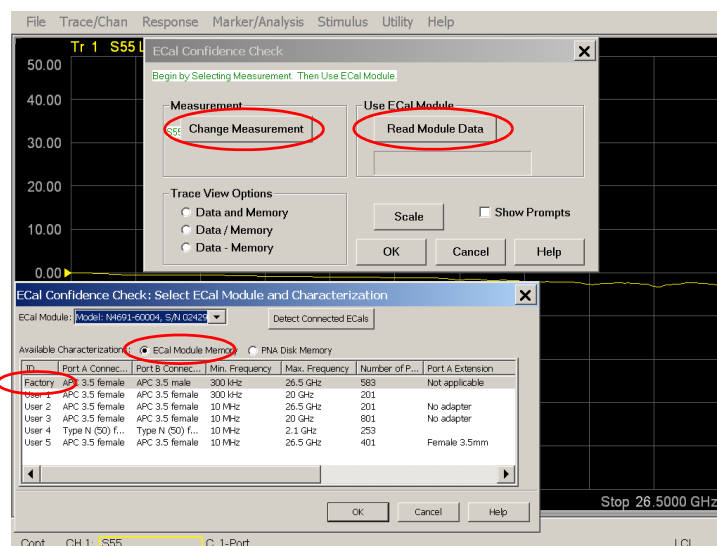
1. Ensure the test set is turned on and connected properly to the analyzer.
2. Check all appropriate connectors for damage, cleanliness, and proper torques.
3. Repeat the relevant 1-Port calibrations using another ECal or mechanical standard.
4. Verify that the PNA is operating properly and meeting its published specifications. If the PNA is connected to the test set it will fail the Operational Check. Refer to [“Network Analyzer Requirements”](#) on [page 5](#).

ECal Confidence Check

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

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

Figure 54 ECal Confidence Check



Service Information

Refer to “Contacting Keysight” on page 85.

WARNING

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

WARNING

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

Replaceable Parts

The following replaceable parts are available from Keysight Technologies “Find-A-Part” system on the web at <http://www.keysight.com/my/faces/fapHomePage.jspx>.

Table 19 Available Replacement Parts (SPO)

Description	Keysight Part Number
Solid State Switch	5087-7306 or 5087-7751 (Rohs)
Coupler/Bridge	5087-7716 or 5087-7752 (Rohs)
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, Torx-T15 M3.5X0.6 12mm	0515-2317
Screw, Torx-T20 M4X0.7 25 mm	0515-1619
PWR Supply (AC/DC SWG 650W 9- Output	0950-4729
Test Set I/O Cable	N4011-21002
DUT Control Board	U3020-63223
Fan (rear panel)	87050-60027

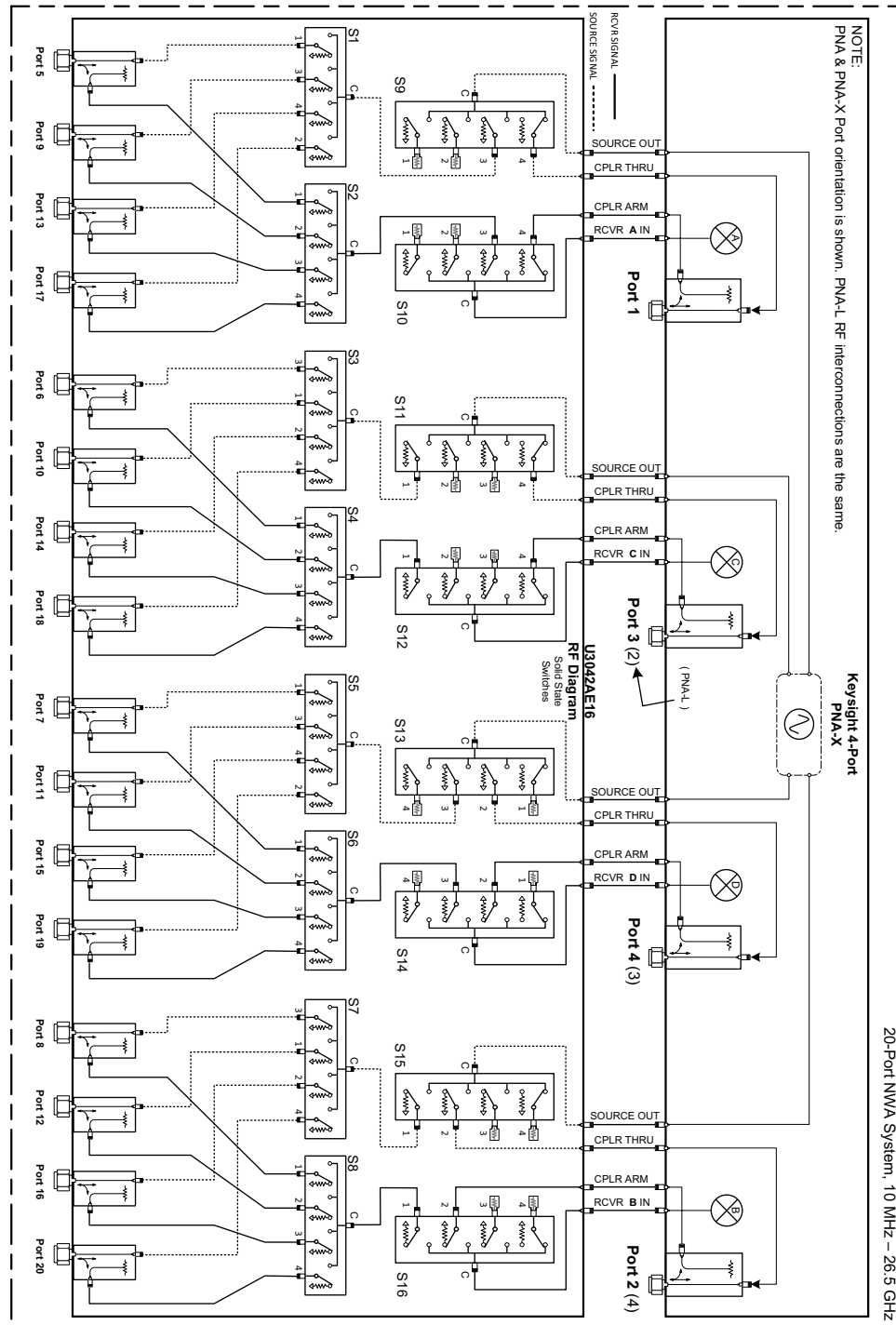
The following replaceable parts may be ordered by sending an e-mail request to ctd-soco_support@keysight.com. Be sure to include test set model, options and serial number. Some parts may have long lead times.

Table 20 Available Replaceable Parts (E16)

Description	Keysight Part Number
U3042AE16 User's Guide	U3042-90012
LED Status Board	N5261-60005
Switch Interface Board	U3042-63130
Controller Board	N5261-60006
Power Switch and LED	Z5623-60221
PNA-L Lock-link kit	U3021-60004
PNA or PNA-X Lock-link kit	U3021-60005
PNA-L Cable kit	U3021-60075
PNA or PNA-X Cable kit	U3021-60077

System Block Diagrams

Figure 55 U3042AE16 with PNA-X Block Diagram



Theory of Operation

The following is a description of the operation of the test set. Reference the test set block diagrams shown in [Figure 55 on page 65](#). This section assumes the user has a general understanding of couplers, switches, and network analyzers.

RF Coupler/Bridges

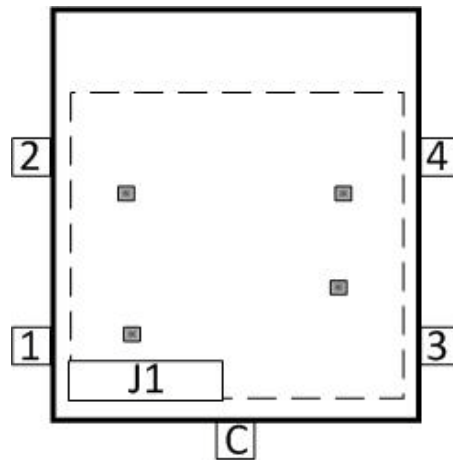
The test set uses sixteen coupler/bridges (5087-7716) on the front panel for RF Test Ports 5 to 20. The coupler/bridges provide the signal separation of the source and receiver paths, using resistor networks. The test set ports can receive from or stimulate a signal to the DUT.

The RF Test Ports are 3.5 mm male connectors. 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 for the coupler. Do not use excessive RF power or DC voltage, or damage may occur to the internal resistors.

RF Switch Components

The test set uses sixteen solid-state switches that have internal 50 Ohm terminations for each path. The switches select the RF paths from the analyzer's source and receiver through interconnect cables to the test set. Network analyzer Ports 1 to 4 and test set port paths 5 thru 20.

Figure 56 Switch



Troubleshooting the Test Set

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

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

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

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.

Electrostatic Discharge Protection

Electrostatic discharge (ESD) can damage or destroy electronic components. The instrument 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

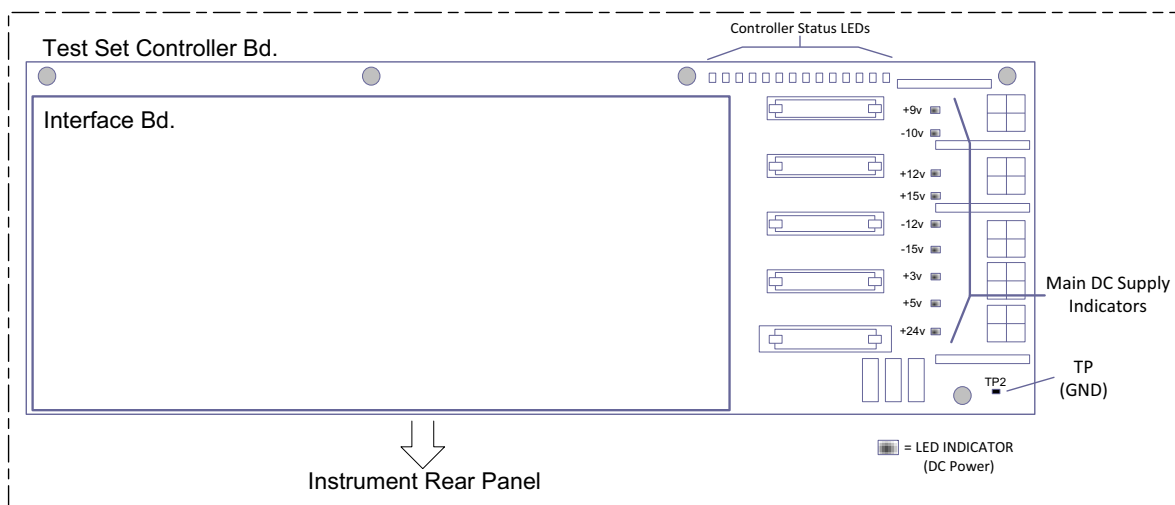
Both types, when used together, provide a significant level of ESD protection. To ensure user safety, static-safe accessories must provide at least 1 M Ω of isolation from ground.

Non-RF Failures

Non RF failures are; Power Supply, Fans, Control Lines, Status LEDs or Interface not operating. Refer to [Figure 58 on page 69](#).

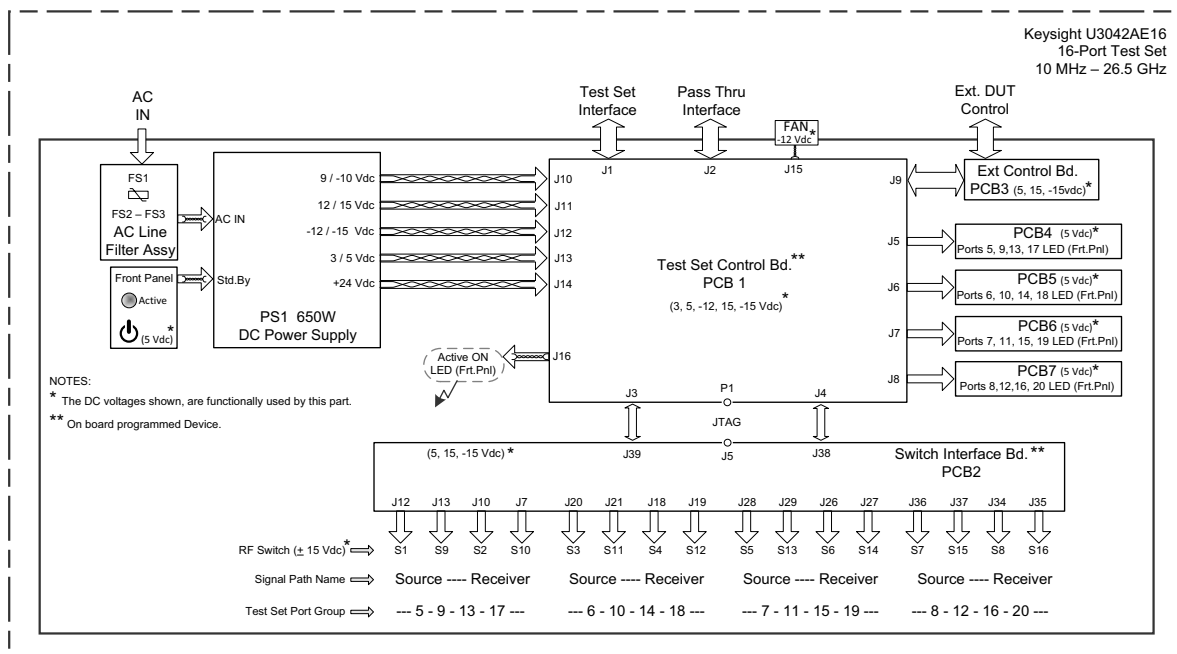
1. Verify that the front panel Power Switch is operational. The front panel Active LED will be *off* unless the test set interface cable is connected and the test set is addressed by the network analyzer.
2. Turn on the Standby Switch.
3. The rear panel, Deck and Internal power supply fans should be operational. If not continue with [step 4](#).
4. AC Line voltage checks (remove AC power from the instrument).
 - a. Ensure the proper AC Line voltage is present at the instrument line cord.
 - b. Remove the AC power cord from the instrument. Verify the instrument AC Line Module fuse (2119-0709) and replace if necessary. Refer to [Figure 6 on page 13](#).
 - 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 63 on page 79](#).
5. Internal DC Power checks.
 - a. Set the front panel switch to the Standby position. No fans or indicator lights should be operational.
 - b. Remove the top cover.
 - c. Set the Standby switch to the *on* position. Both the rear panel and internal power supply fans should be operational. Verify that the DC indicator LEDs are *on* as shown in [Figure 57](#).

Figure 57 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 fan is not operating and the DC Indicator LEDs are on; replace fan.

Figure 58 Test Set Diagram



6. Front Panel R and S indicator LED Check.

- a. Verify the test set Controller board Controller Status LEDs, shown in [Figure 57 on page 68](#).
- 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.

7. Control Lines are not working.

- a. Verify that the control voltage pin connections to the DUT control lines are connected properly. Refer to [“Address and Data Values” on page 47](#).
- b. Verify that the rear panel DC voltage control adjustment can be set to 5 Vdc. Refer to [Figure 5 on page 12](#).

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 5 on page 12](#).
2. Ensure that the network analyzer is *not* in Multiport Mode.
3. Using the test set I/O Data command values, confirm the correct address and data values are used, refer to ["Address and Data Values" on page 47](#).
 - a. Each RF solid state switch has a Bias/Logic control board. This board has four port status LEDs. When a switch control signal is created, the switch port status LED will indicate which switch port is being selected. Refer to ["RF Switching Path Test" on page 70](#).
 - 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.

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 analyzer and set it to **Standalone Mode**. Select **Utility > System > Configure > Multiport Capability**. In the dialog box select **Restart as a standalone PNA > OK**.
3. Confirm the frequency range is set to 10 MHz to 20 GHz or 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 5-20	Source	Figure 55 on page 71
RCVR OUT to Ports 5-20	Receiver	Figure 56 on page 73
Source IN to CPLR THRU	Source	Figure 57 on page 74
RCVR OUT to CPLR ARM	Receiver	Figure 57 on page 74

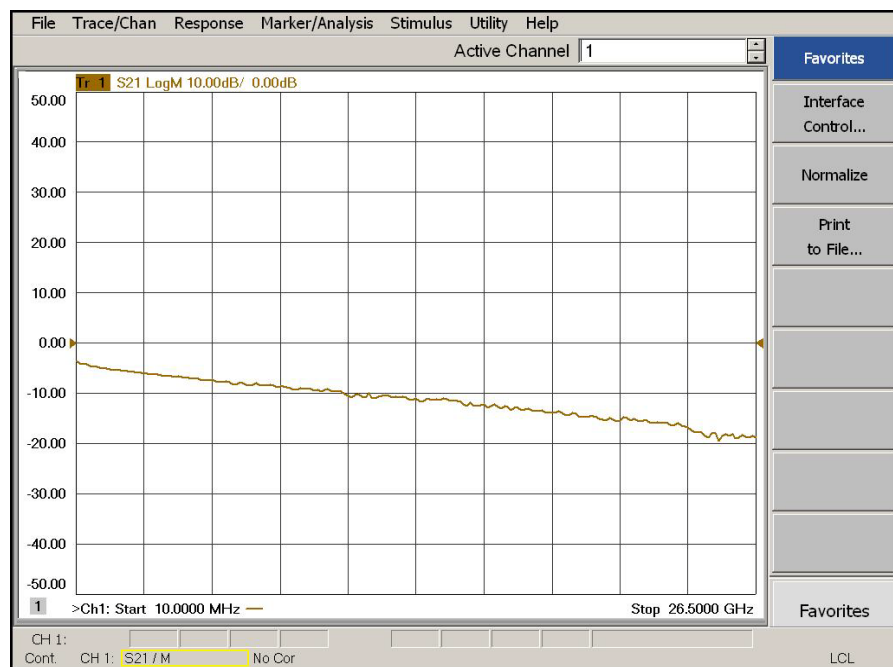
Source Signal Path Insertion Loss Test

Connect a RF Flex cable between the Test Port and Source IN port indicated in [Table 22](#), the expected results should be similar to [Figure 59 on page 73](#).

Table 22 Source Signal Path Test Instructions

Path #	RF Path Description	Control Mode <Address>.<Data>	Path Components	Insertion Loss (typical)
1	Source IN to Port 5 ¹	0.1	P5 CPLR, S1 & 9	Figure 59 on page 73
2	Source IN to Ports9	0.2	P9 CPLR, S1 & 9	
3	Source IN to Port 13	0.3	P13 CPLR, S1 & 9	
4	Source IN to Port 17	0.4	P17 CPLR, S1 & S9	
5	Source IN to Port 6	16.1	P6 CPLR, S3& 11	
6	Source IN to Port10	16.2	P10 CPLR, S11	
7	Source IN to Port 14	16.3	P14 CPLR, S11	
8	Source IN to Port 18	16.4	P18 CPLR, S3 & S11	
9	Source IN to Port 7	32.1	P7 CPLR, S5 & 13	
10	Source IN to Port 11	32.2	P11 CPLR, S11	
11	Source IN to Port 15	32.3	P15 CPLR, S11	
12	Source IN to Port 19	32.4	P19 CPLR, S9 & S13	
13	Source IN to Port 8	64.1	P8 CPLR, S7 & 15	
14	Source IN to Port 12	64.2	P12 CPLR, S11	
15	Source IN to Port 16	64.3	P16 CPLR, S11	
16	Source IN to Port 20	64.4	P20 CPLR, S7 & S15	

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

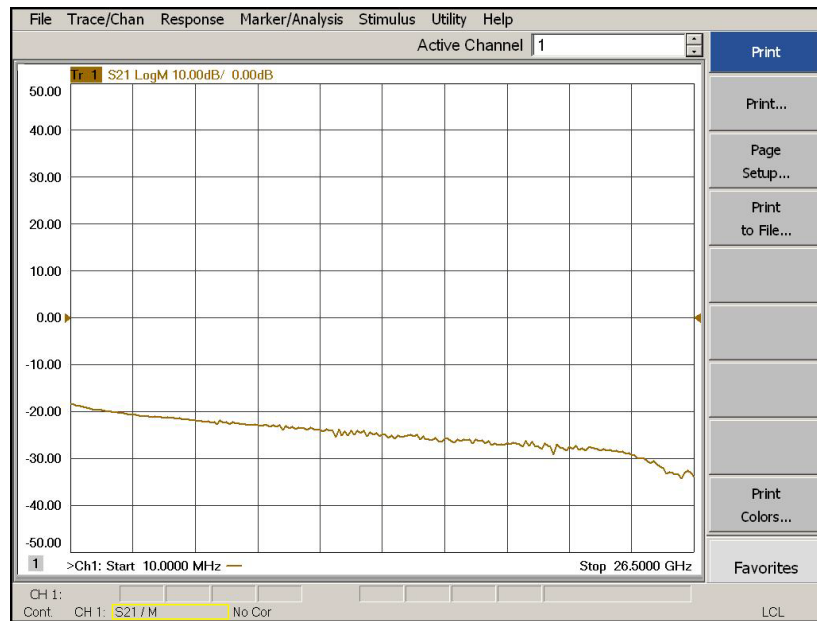
Figure 59 Source IN to Ports 5-20 Path Response

Connect a RF Flex cable between the Test Port and RCVR OUT port indicated in [Table 23](#). The expected results should be similar to [Figure 60 on page 75](#).

Table 23 Receiver Signal Path Test Instructions

Path #	RF Path Description	Control Mode <Address>.<Data>	Path Components	Insertion Loss (typical)
1	RCVR OUT to Ports 5 ¹	0.16	P5 CPLR, S2 & S10	Figure 60 on page 75
2	RCVR OUT to Ports 9	0.32	P9 CPLR, S2 & S10	
3	RCVR OUT to Ports 13	0.48	P13 CPLR, S2 & S10	
4	RCVR OUT to Ports 17	0.64	P17 CPLR, S2 & S10	
5	RCVR OUT to Ports 6	16.16	P6 CPLR, S4 & S12	
6	RCVR OUT to Ports 10	16.32	P10 CPLR, S4 & S12	
7	RCVR OUT to Ports 14	16.48	P14 CPLR, S4 & S12	
8	RCVR OUT to Ports 18	16.64	P18 CPLR, S4 & S12	
9	RCVR OUT to Ports 7	32.16	P7 CPLR, S6 & S14	
10	RCVR OUT to Ports 11	32.32	P11 CPLR, S6 & S14	
11	RCVR OUT to Ports 15	32.48	P15 CPLR, S6 & S14	
12	RCVR OUT to Ports 19	32.64	P19 CPLR, S6 & S14	
13	RCVR OUT to Ports 8	64.16	P8 CPLR, S8 & S16	
14	RCVR OUT to Ports 12	64.32	P12 CPLR, S8 & S16	
15	RCVR OUT to Ports 16	64.48	P16 CPLR, S8 & S16	
16	RCVR OUT to Ports 20	64.64	P16 CPLR, S8 & S16	

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

Figure 60 RCVR OUT to Ports 5-20 Path Response

Connect a RF Flex cable between the Source IN and CPLR THRU port indicated in [Table 24](#), the results should be similar to [Figure 61](#).

Table 24 Source Bypass Signal Path Test Instructions

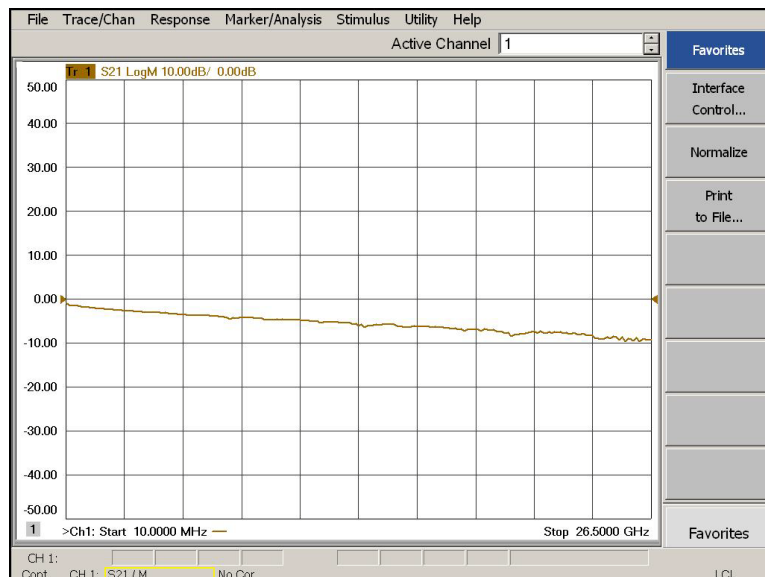
Path #	Test Port Group	RF Path Description	Control Mode <Address>.<Data>	Path Components
1	Port 5, 9, 13 & 17	Source IN to CPLR THRU	0.0	S9
2	Port 6, 10, 14 & 18	Source IN to CPLR THRU	16.0	S11
3	Port 7, 11, 15 & 19	Source IN to CPLR THRU	32.0	S13
4	Port 8, 12, 16 & 20	Source IN to CPLR THRU	64.0	S15

Connect a RF Flex cable between the RCVR OUT and CPLR ARM port indicated in [Table 25](#), the results should be similar to [Figure 61](#).

Table 25 Receiver Bypass Signal Path Test Instructions

Path #	Test Port Group	RF Path Description	Control Mode <Address>.<Data>	Path Components
1	Port 5, 9, 13 & 17	RCVR OUT to CPLR ARM	0.0	S10
2	Port 6, 10, 14 & 18	RCVR OUT to CPLR ARM	16.0	S12
3	Port 7, 11, 15 & 19	RCVR OUT to CPLR ARM	32.0	S14
4	Port 8, 12, 16 & 20	RCVR OUT to CPLR ARM	64.0	S16

Figure 61 Source IN to CPLR THRU & RCVR OUT to CPLR ARM Path Response



RF Performance Fails

If the U3042AE16 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 U3042AE16 depends on the performance of the analyzer. Ensure the PNA 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. [“Verifying a Cal Kit Operational Check Failure” on page 62.](#)
3. Review the [“Cal Kit Operational Check” on page 56](#) 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.

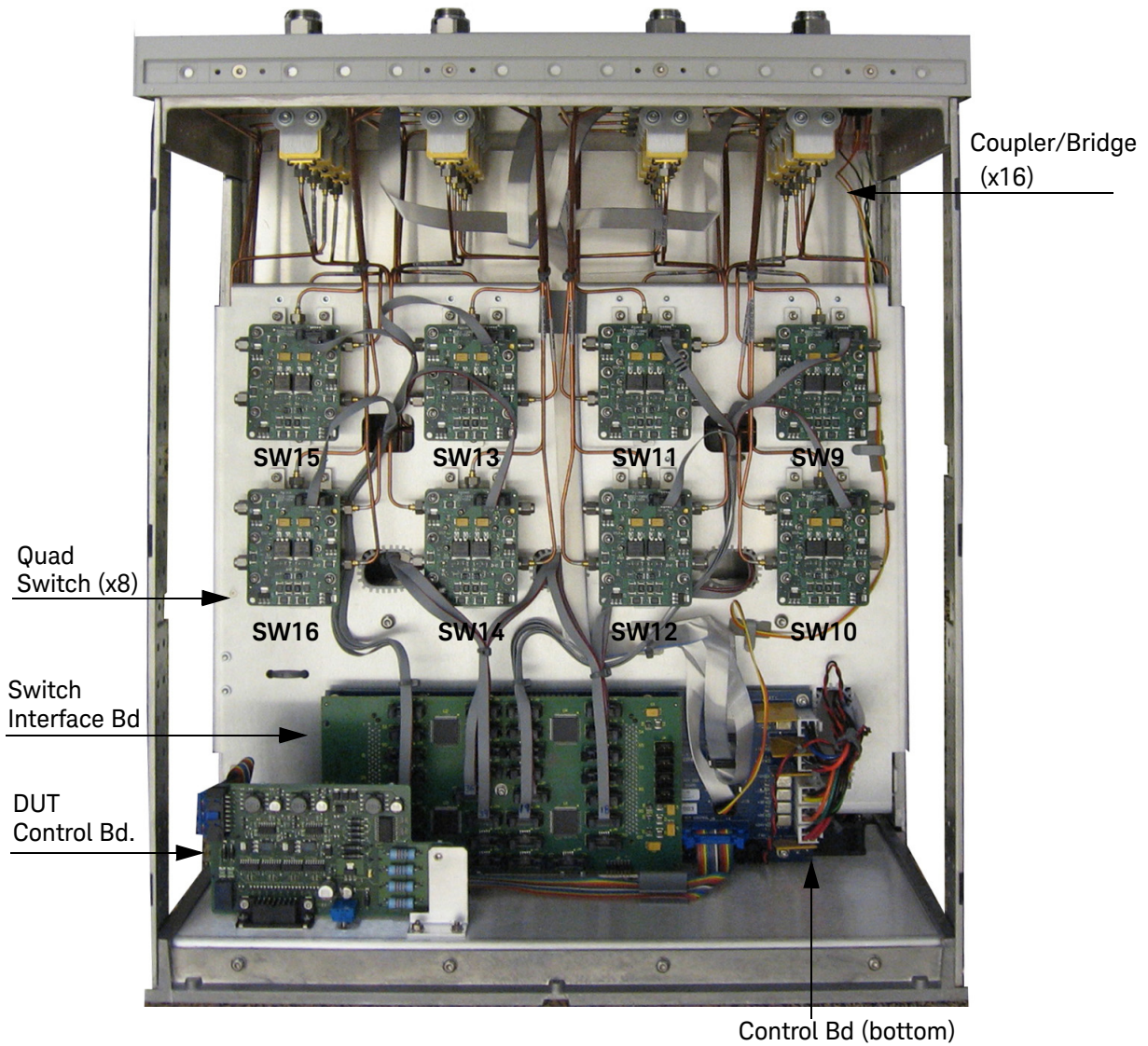
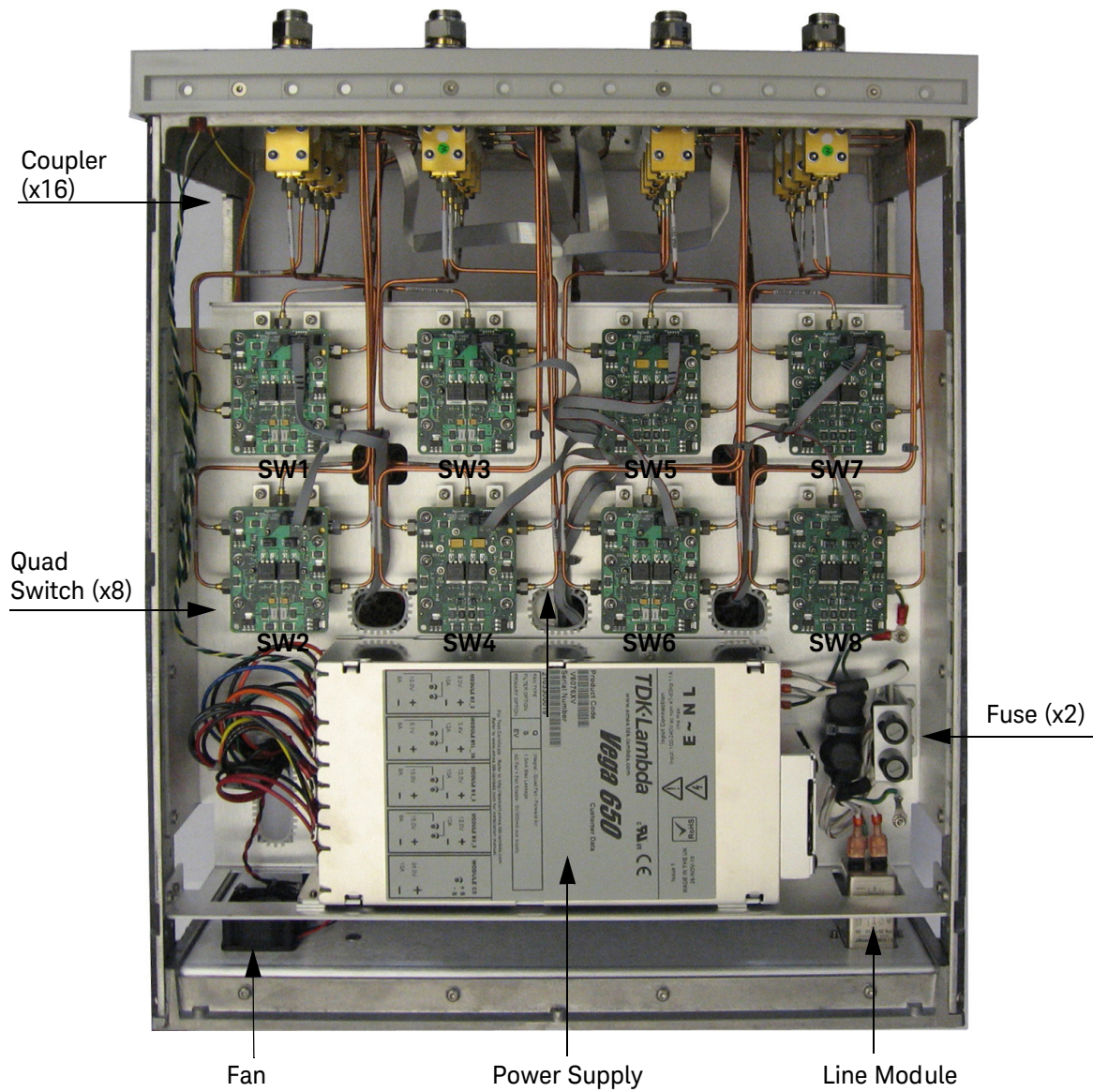
Figure 62 Top View

Figure 63 **Bottom View**

Safety and Information

Introduction

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

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

Safety Earth Ground

WARNING

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

CAUTION

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

Statement of Compliance

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

Before Applying Power

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

WARNING

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

CAUTION

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

CAUTION

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

CAUTION

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

CAUTION

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

CAUTION

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

CAUTION

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

WARNING

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

WARNING

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

WARNING

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

WARNING

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

WARNING

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

WARNING

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

Connector Care and Cleaning Precautions

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

WARNING

To prevent electrical shock, disconnect the Keysight **U3042AE16** from mains electrical supply before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.

WARNING

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

Regulatory Information

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

Instrument Markings

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 20 for egress and operational environment.



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



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



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



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

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 85** 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-001

This ISM device complies with Canadian ICES-001.

Cet appareil ISM est conforme a la norme NMB-001 du Canada.

South Korean Class A EMC Declaration

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

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

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

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

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

<http://www.keysight.com/find/assist>

You can also purchase accessories or documentation items on the Internet at:

<http://www.keysight.com/find>

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

NOTE

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

Shipping Your Product to Keysight for Service or Repair

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

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

- Include a complete description of the service requested or of the failure and a description of any failed test and any error message.
- Remove and retain the front handles and all rack mount hardware. The analyzer should be sent to Keysight in the same configuration as it was originally shipped.
- Remove and retain the front handles and all rack mount hardware. The analyzer should be sent to Keysight in the same configuration as it was originally shipped.
- Contact Keysight for instructions on where to ship your analyzer.



This information is subject to change without notice.

© Keysight Technologies 2011-2022

Edition 5, April 2022

Supersedes: October 2020



www.keysight.com