

Agilent Technologies U3022AE10

User's Guide

**Use this manual with the following documents:
PNA Series Network Analyzer On-line Help System and
Application Note 1408-12**



Agilent Technologies

Manufacturing Part Number: U3022-90001

Printed in USA

July 2007

© Copyright Agilent Technologies, Inc. 2007

Warranty Statement

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, AGILENT 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. AGILENT 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 AGILENT 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 WILL CONTROL.

DFARS/Restricted Rights Notice

If software is for use in the performance of a U.S. Government prime contract or subcontract, Software is delivered and licensed as “Commercial computer software” as defined in DFAR 252.227-7014 (June 1995), or as a “commercial item” as defined in FAR 2.101(a) or as “Restricted computer software” as defined in FAR 52.227-19 (June 1987) or any equivalent agency regulation or contract clause. Use, duplication or disclosure of Software is subject to Agilent Technologies’ standard commercial license terms, and non-DOD Departments and Agencies of the U.S. Government will receive no greater than Restricted Rights as defined in FAR 52.227-19(c)(1-2) (June 1987). U.S. Government users will receive no greater than Limited Rights as defined in FAR 52.227-14 (June 1987) or DFAR 252.227-7015 (b)(2) (November 1995), as applicable in any technical data.

Safety Notes

The following safety notes are used throughout this document. Familiarize yourself with each of these notes and its meaning before performing any of the procedures in this document.

WARNING	Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.
----------------	---

CAUTION	Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.
----------------	---

Statement of Compliance

This product has been designed and tested in accordance with the standards listed on the Manufacturer's Declaration of Conformity, 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.

Definitions

- *Specifications* describe the performance of parameters covered by the product warranty (temperature -0 to 55 °C, unless otherwise noted.)
- *Typical* describes additional product performance information that is not covered by the product warranty. It is performance beyond specification that 80% of the units exhibit with a 95% confidence level over the temperature range 20 to 30 °C. Typical performance does not include measurement uncertainty.
- *Nominal* values indicate expected performance or describe product performance that is useful in the application of the product, but is not covered by the product warranty.
- *Characteristic Performance* describes performance parameter that the product is expected to meet before it leaves the factory, but is not verified in the field and is not covered by the product warranty. A characteristic includes the same guard bands as a specification.

Contents

U3022AE10

Introduction	2
Description	3
Verifying the Shipment	4
General Specifications	5
Power Requirements	5
Environmental Requirements	6
Environmental Tests	6
Equipment Heating and Cooling	6
Required Conditions for Accuracy Enhanced Measurement	6
Dimensions and Space Requirements	7
Frequency Range and Maximum Power Levels	8
Front and Rear Panel Features	9
Power LED	9
Test Port LEDs	9
Test Ports – 3.5 mm Bulkhead (male)	9
Access Ports – 3.5 mm (female)	10
Line Switch	10
Control Lines and Voltage Adjust	10
Test Set Interface	10
Pass Through Interface	10
Line Module	11
Available Fuses	11
System Setup	12
Preparing the PNA Network Analyzer	12
12-Port and 14-Port RF Cable Connections	14
Operation	17
Controlling the Test Set	17
PNA Multiport Mode for the E8362B Option 551	17
PNA Multiport Mode for the N5230A Option 551	23
Control Lines	28
Operating the DUT Control Interface	29
Setting the DUT Control Interface	29
Pin Assignment	29
Setting the Variable Source Voltage	32
Connecting the DUT to the Rear Panel Control Line Connector	32
Using an External Power Supply	33
Operational Check	34
Verification Limits	34
Equipment Required	35
Operational Check Procedure	36
Prepare the PNA	36
1-Port Calibration Procedure	38
Troubleshooting Operational Check Failures	41
Theory of Operation	42
RF Switch Components	42
S102 - Source to Odd Ports (1-11)	42
S202 - Source to Even Ports (2-12)	42
S302 - Receiver to Odd Ports (1-11)	42
S402 - Receiver to Even Ports (2-12)	42
RF Coupler Components	42
System Block Diagram	43

Contents

Service Information	45
Replaceable Parts	45
Safety and Regulatory Information	46
Introduction	46
Before Applying Power	46
Connector Care and Cleaning	46
Declaration of Conformity	46
Shipping Instructions	46
Compliance with German Noise Requirements	47
EMC Information	47
Safety Information	47
Warnings	48
Cautions	49
Instrument Markings	50
Contacting Agilent Sales and Service Offices	51

U3022AE10

Introduction

This document describes how to use the U3022AE10 Multiport Test Set with the Agilent E8362B 2-Port and the N5230A 2-Port or 4-Port PNA Network Analyzer.

Figure 1 E8362B 2-Port PNA and U3022AE10

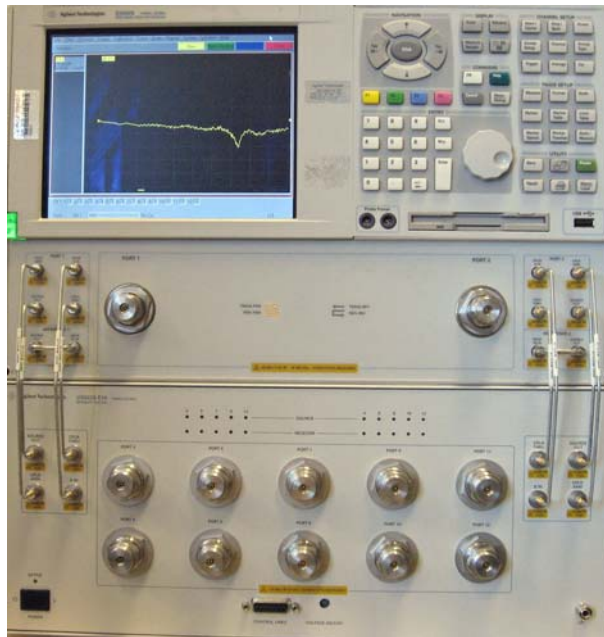
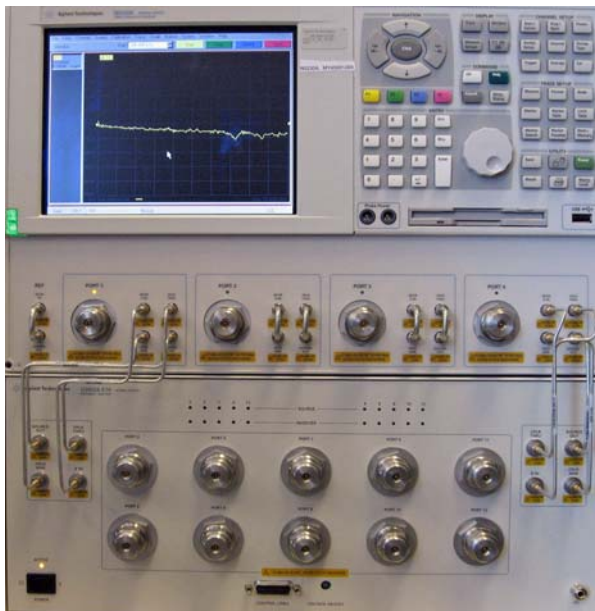


Figure 2 N5230A 4-Port PNA and U3022AE10



Description

The Agilent U3022AE10 is a 10-Port mechanical switching extension test set (10 MHz to 20 GHz). The 10-Port extension test set can be connected to a 12-Port device when configured with the E8362B Option 014 or N5230A Option 225, 2-Port network analyzers. The 10-Port extension test set can also be configured to N5230A 4-Port network analyzer with Option 245 allowing the user to connect to a 14-Port device with special RF jumper cables.

This test set frequency range can also be extended down from 10 MHz to 300 kHz when used with the N5230A PNA-L family. The test set is controlled by the test set I/O connector located on the rear panel of the PNA network analyzer. All PNA and PNA-L network analyzers require Option 551, add n-port error correction and measurement capability.

The U3022AE10 has three available options:

- Option 012 provides the cable set to connect the E8362B Option 014 or the N5230A Option 225 for the 12-Port configuration.
- Option 014 provides the cable set to connect the N5230A Option 245 for the 14-Port configuration.
- Option 063 provides the cable set to connect the E8363B Option 014 or the E8364B Option 014 for the 12-Port configuration.

NOTE The U3022AE10 can be connected to a 12-Port device when configured with the E8363B Option 014 or the E8364B Option 014, but the operation frequency is only up to 20 GHz.

The E8362B, E8363B, and E8364B Performance Network Analyzer and N5230A PNA-L information, data sheets, white papers, or manuals can be viewed or printed by visiting <http://www.agilent.com/find/pna>

Verifying the Shipment

Inspect the shipping container. If the container or packing material is damaged, it should be kept until the contents of the shipment have been checked mechanically and electrically. If there is physical damage refer to “Contacting Agilent” on [Page 51](#). Keep the damaged shipping materials (if any) for inspection by the carrier and an Agilent representative.

Table 1 Content List

Agilent PN	Description	Qty
Common to the following Options		
9320-0333	Envelope-Cal Certificate	1
9320-6636	Functional Test Certificate	1
U3022-90001	User’s Guide	1
8120-6818	Test Set I/O Cable	1
5023-0132	Locking Feet	1
Option 012 (12-Port Configuration, 3.5 to 3.5 mm connector)		
U3022-20001	RF Cable Semi-rigid	4
U3022-20002	RF Cable Semi-rigid	4
Option 014 (14-Port Configuration, 3.5 to 3.5 mm connector)		
U3022-20031	RF Cable Semi-rigid	1
U3022-20032	RF Cable Semi-rigid	1
U3022-20033	RF Cable Semi-rigid	1
U3022-20034	RF Cable Semi-rigid	1
U3022-20035	RF Cable Semi-rigid	1
U3022-20036	RF Cable Semi-rigid	1
U3022-20037	RF Cable Semi-rigid	1
U3022-20038	RF Cable Semi-rigid	1
U3022-80002	Label printed - PORT 13	1
U3022-80003	Label printed - PORT 14	1
U3022-80004	Label printed - PORT 2	1
Option 063 (12-Port Configuration, 3.5 to 2.4 mm connector)		
U3022-20040	RF Cable Semi-rigid	4
U3022-20041	RF Cable Semi-rigid	4

General Specifications

Specifications for the U3022AE10 Multiport Test Set (10 MHz to 20 GHz) are characteristic for the System performance of the PNA and Test Set. Actual performance of the system is based on the customers PNA that is used with the test set.

A functional certificate is supplied for the U3022AE10. The U3022AE10 performance is based on external components such as the calibration kit and network analyzer. There are no internal adjustment in the U3022AE10, therefore an annual calibration is not required.

NOTE When connected to a PNA, this test set will degrade the performance at the test ports. The internal mechanical switch paths reduce test port power and power to the receivers. This affects the test port power of the PNA and also reduces dynamic range. The test port power indicated by the PNA can be reduced as much as 3 dB and power to the receivers can also be reduced by as much as 3 dB. This will decrease the dynamic range (depending on the frequency) by as much as 6 dB.

Power Requirements

Verify that the required ac power is available at all necessary locations before installing the Test Set to the PNA.

- Air conditioning equipment (or other motor-operated equipment) should not be placed on the same ac line that powers the Test Set and PNA.
- [Table 2](#) contains the maximum wattage for all instruments. This table can be use to determine the electrical and cooling requirements.

NOTE Values are based on 120 Vac supplied to each instrument at 60 Hz.

Table 2 Power Requirements

Standard Equipment	
Instrument	Maximum Wattage
E8362B and N5230A	350
U3022AE10	350
Total	700

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

The environmental requirements of the PNA are listed in [Table 3](#). Note that these requirements are the same as those of the E8362B and N5230A PNA-L. The E8362B and N5230A PNA-L provides front panel access to the source outputs, receiver inputs and couplers for use with the Multiport test sets.

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.

Table 3 PNA Operating Environment

Temperature	
Operation	0 °C to 40 °C (32 °F to 104 °F)
Storage	–40 °C to +70 °C (–40 °F to +158 °F)
Measurement Calibration	20 °C to 26 °C (68 °F to 79 °F)
Performance Verification	Temperature must be within 1 °C (1.8 °F) of the temperature at which the measurement calibration was performed.
Pressure Altitude (Operation or Storage)	0 to 4600 meters (~ 15,000 feet)
Enclosure Protection	IP 2 0, according to IEC 529

Environmental Tests

The U3022AE10 complies with all applicable safety and regulatory requirements for the intended location of use and have been evaluated to assure that they are consistent with Agilent quality and reliability goals. On the basis of that evaluation, the following environmental tests have been deemed unnecessary and have not been performed: temperature, humidity, shock, vibration, altitude and power line conditions.

Equipment Heating and Cooling

If necessary, install air conditioning and heating to maintain the ambient temperature within the appropriate range. Air conditioning capacity must be consistent with the BTU ratings given in [Table 2](#).

Required Conditions for Accuracy Enhanced Measurement

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

Dimensions and Space Requirements

Standard installation of the U3022AE10 and PNA includes configuration and installation on a customer provided lab bench or table top of adequate size and strength.

Table 4 System Dimensions

Item	Weight
Required Bench Top Dimension:	
Clearance above the bench	43 cm (17 in)
Width	127 cm (50 in)
Depth	102 cm (40 in)
Weight	55 kg (110 lb)

Table 5 Instrument Dimensions

Model	Weight	Height	Width	Depth
E8362B	29 kg (64 lb)	26.7 cm (10.5 in)	42.5 cm (16.7 in)	42.6 cm (16.8 in)
N5230A	24.9 kg (55 lb, ±0.5 lb)	26.7 cm (10.5 in)	42.5 cm (16.7 in)	42.6 cm (16.8 in)
U3022AE10	11.4 kg (25 lb)	19.1 cm (7.5 in)	42.5 cm (16.7 in)	42.6 cm (16.8 in)

Frequency Range and Maximum Power Levels

The U3022AE10 frequency range is 10 MHz to 20 GHz and is usable to 300 kHz with the N5230A PNA-L.

CAUTION It is recommend 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. See [Table 6](#).

Table 6 Power Levels

Test Setup	Power Level
Maximum U3022AE10 Multiport Test Set RF Power Levels:	
PORT 3-12	+30 dBm 0 Vdc
SOURCE OUT	+30 dBm 0 Vdc
CPLR ARM	+30 dbm 0 Vdc
CPLR THRU	+30 dBm 0 Vdc
RVCR A IN and B IN	+15 dBm 0 Vdc
Damage Power Levels to U3022AE10 Access and Test Ports:	
Max Level to Port 1 & 2 Test Ports	+30 dBm (0 Vdc)

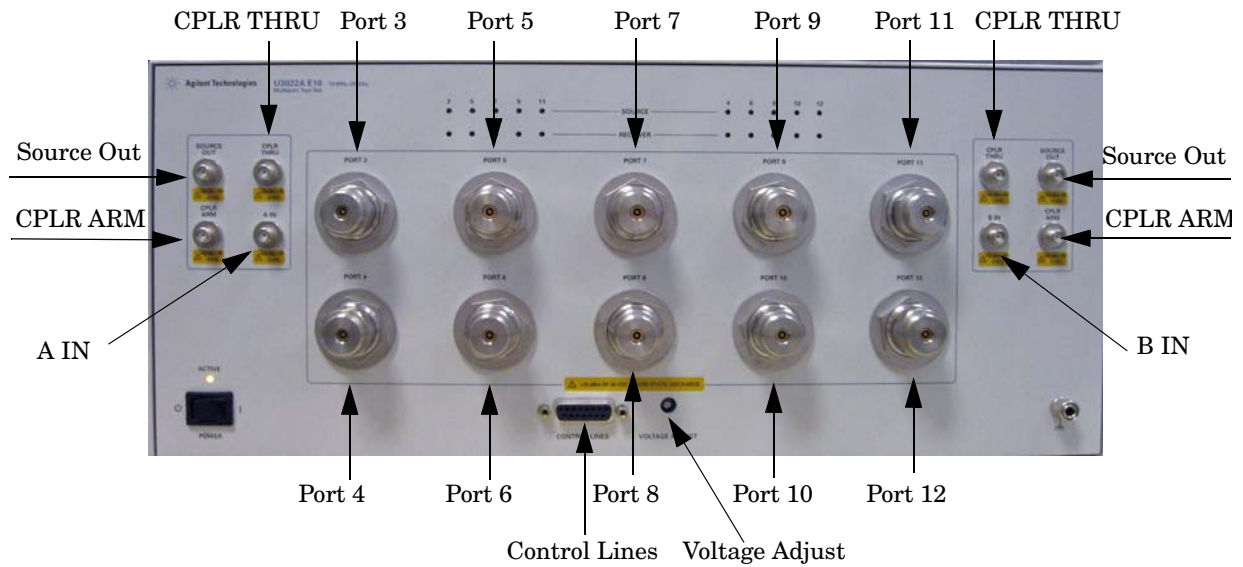
NOTE Refer to your PNA specifications to determine the maximum input power levels for the access and test ports.

NOTE Refer to your PNA specifications to optimize the power levels in the receivers.

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

Front and Rear Panel Features

Figure 3 Front Panel (Multiport Test Set)



Power LED

- When the Power Switch is On, the LED is illuminated.
- When the Power Switch is in Standby, the LED is Off.

Test Port LEDs

- An illuminated LED indicates an active port and if it is in Source or Receiver mode.
- If all of the Source or Receiver LEDs are illuminated, all of the ports are terminated.
- If all of the odd numbered ports are Off, Port 1 of the PNA is active.
- If all of the even numbered ports are Off, Port 2 of the PNA is active.

Test Ports – 3.5 mm Bulkhead (male)

- Port 3–12

Access Ports – 3.5 mm (female)

- SOURCE OUT
- CPLR THRU
- CPLR ARM
- A IN – B IN

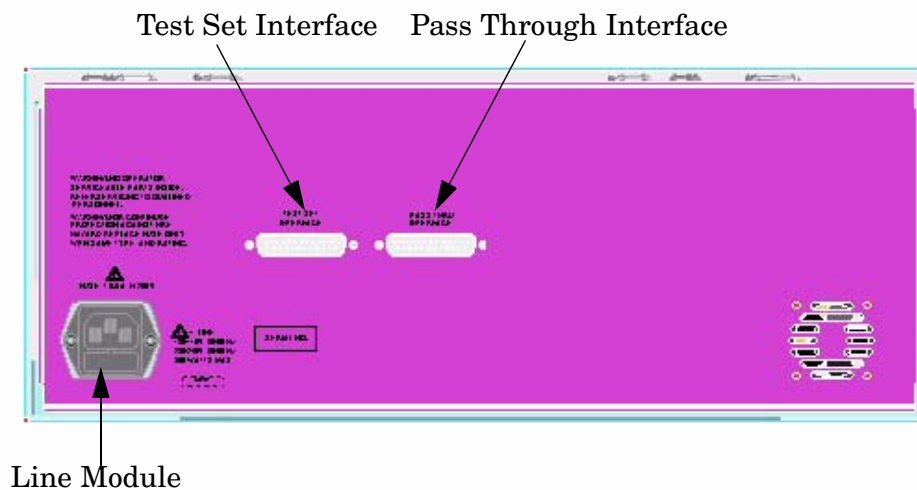
Line Switch

- ☰ – Standby
- 1 – ON (Power LED On)

Control Lines and Voltage Adjust

For further information pertaining to control lines and voltage adjustments see “Control Lines” on page 28.

Figure 4 Rear Panel (Multiport Test Set)



Test Set Interface

The Test Set Interface connector is used to send address and data to the test set from the PNA.

Pass Through Interface

Connection to another test set.

Line Module

The line fuse, as well as a spare, reside within the line module. [Figure 5](#) illustrates where the fuses are located and how to access them.

Available Fuses

- **United States (115 V orientation)**
Fuse (F 5 A/250V, 2110-0709) U.L. listed and CSA certified
- **Europe (230 V orientation)**
Fuse (F 5.0A/250V, 2110-0709) IEC listed and U.L. recognized certified

WARNING For continued protection against fire hazard replace line fuse only with same type and rating:

- United States—F 5A/250V, Part Number 2110-0709
- Europe—F 5A/250V, Part Number 2110-0709

The use of other fuses or material is prohibited.

Figure 5 Line Fuse



CAUTION This instrument has autoranging line voltage input; be sure the supply voltage is within the specified range.

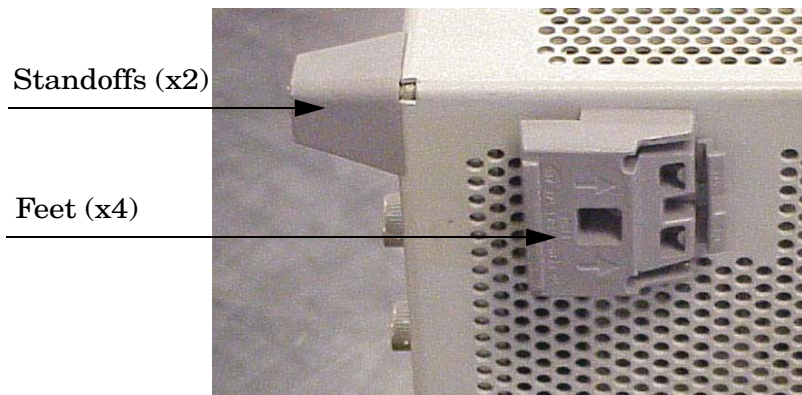
System Setup

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

Preparing the PNA Network Analyzer

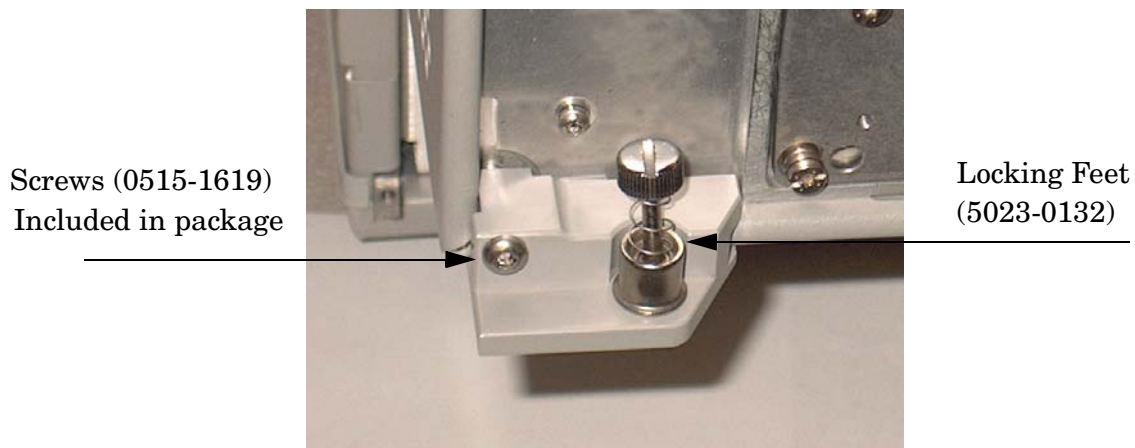
1. Remove the feet from the bottom of the network analyzer. Refer to [Figure 6](#).
2. Remove the 2 lower standoffs and screws (0515-1619) from the rear panel on the network analyzer. Refer to [Figure 6](#).

Figure 6 Rear Bottom Feet



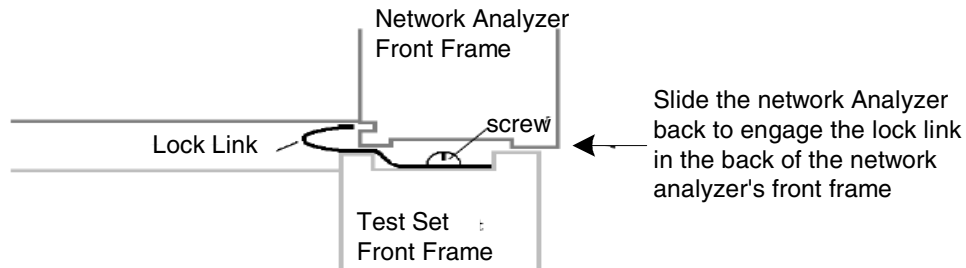
3. Install the two rear locking feet (5023-0132) using the included screws (0515-1619), where the standoffs were removed. Refer to [Figure 7](#).

Figure 7 Install Locking Feet



- Place the network analyzer on top of the Test Set and ensure that the front frame of the network analyzer is positioned slightly forward of the locks that are attached to the Test Set. Slide the network analyzer back so the locks engage the front frame of the analyzer. Refer to [Figure 8](#).

Figure 8 Locking the Analyzer's



- Secure the network analyzer's lower locking feet to the Test Set upper locking feet, using the spring-loaded screws on the locking feet. Refer to [Figure 9](#). If the network analyzer's lower locking feet are not aligned with the screw holes in the Test Set's upper locking feet, loosen the screws securing the feet to the instrument slightly to align.

Figure 9 Locking Feet Screws



NOTE There are two Lock-Foot kits available. Refer to [“Contacting Agilent Sales and Service Offices”](#) on page 51 for ordering information.

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

12-Port and 14-Port RF Cable Connections

Figure 10 on page 15 and Figure 11 on page 16 illustrates the setup configuration of the U3022AE10 Multiport Test Set and how it should be configured to the E8362B, E8363B and E8364B 2-Port and N5230A 4-Port PNA Network Analyzer.

1. Connect the RF cables supplied with this option between the E8362B, E8363B and E8364B 2-Port PNA Network Analyzer and the U3022AE10 Test Set. Torque each cable to 8 in-lb. Refer to Table 7, Table 8 and Figure 10 on page 15.

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

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

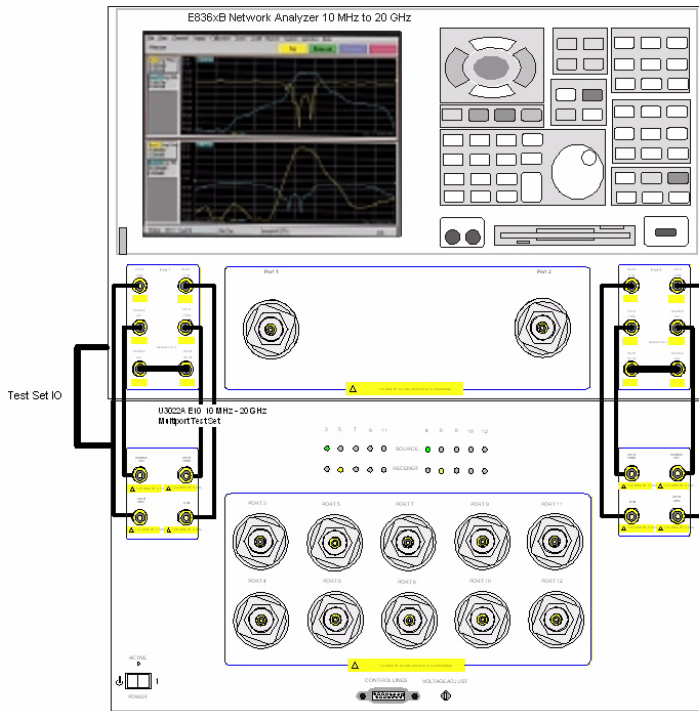
Table 7 E8362B 12-Port Cable Connection

RF Cables	From (PNA)	To (Test Set)
U3022-20001	SOURCE OUT	SOURCE OUT
U3022-20001	CPLR THRU	CPLR THRU
U3022-20002	CPLR ARM	CPLR ARM
U3022-20002	RCVR A IN, B IN	A IN, B IN

Table 8 E8363B or E8364B 12-Port Cable Connection

RF Cables	From (PNA)	To (Test Set)
U3022-20040	SOURCE OUT	SOURCE OUT
U3022-20040	CPLR THRU	CPLR THRU
U3022-20041	CPLR ARM	CPLR ARM
U3022-20041	RCVR A IN, B IN	A IN, B IN

Figure 10 12-Port Setup Configuration



2. Connect the RF cables supplied with this option between the N5230A 4-Port PNA-L Network Analyzer and the U3022AE10 Test Set. Torque each cable to 8 in-lb. Refer [Table 9](#) and [Figure 11](#) on page 16.

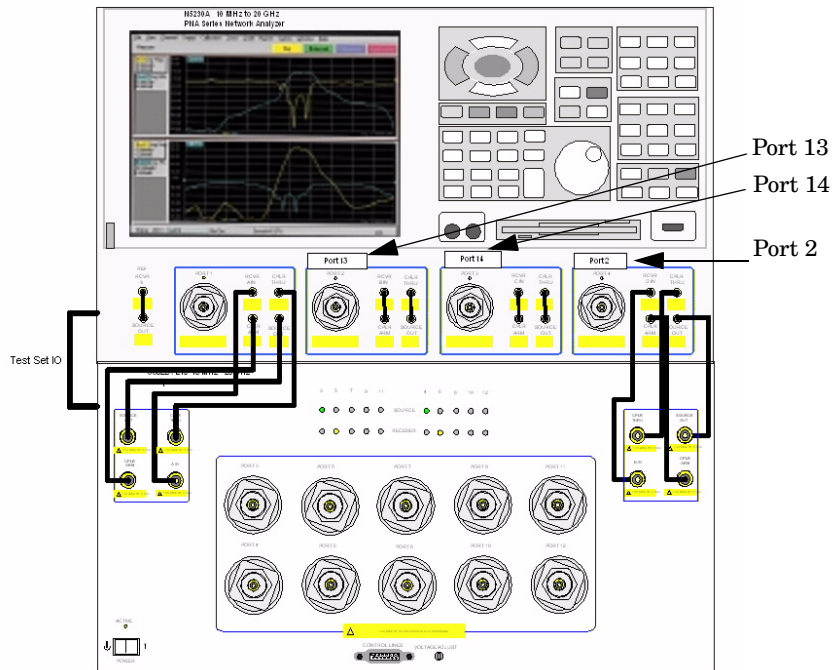
Table 9 N5230A 14-Port Cable Connection

RF Cables	From (PNA)	To (Test Set)
U3022-20031	SOURCE OUT	SOURCE OUT
U3022-20032	CPLR ARM	CPLR ARM
U3022-20033	CPRL THRU	CPLR THRU
U3022-20034	RCVR A IN	A IN
U3022-20035	SOURCE OUT	SOURCE OUT
U3022-20036	CPLR ARM	CPLR ARM
U3022-20037	CPRL THRU	CPLR THRU
U3022-20038	RCVR D IN	B IN

3. Add the front panel port labels to the N5230A PNA.

- Port 13 over Port 2 (U3022-80002)
- Port 14 over Port 3 (U3022-80003)
- Port 2 over Port 4 (U3022-80004)

Figure 11 14-Port Setup Configuration



4. Connect the PNA Test Set I/O cable (8120-6818) to the U3022AE10 Test Set Interface on the rear panel.

Operation

This section will describe how to setup and operate the U3022AE10 Multiport Test Set with the E8362B 2-Port and N5230A 4-Port PNA Network Analyzer.

NOTE The internal firmware of the Agilent E8362B 2-Port and N5230A 4-Port PNA Network Analyzer has not been modified for this test set option. Power levels may differ from those indicated on the PNA when the Test Set is connected.

Controlling the Test Set

The U3022AE10 Multiport Test Set is considered a “slave” instrument. A PNA must be used to control the test set.

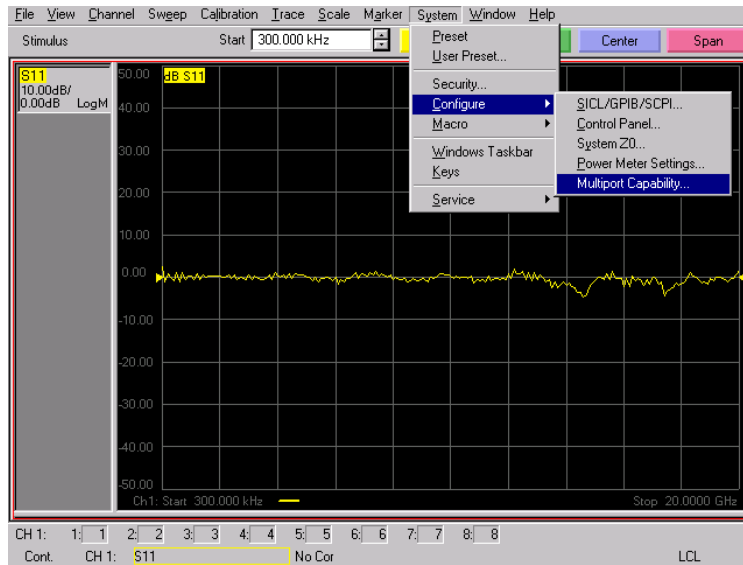
- PNA Multiport Mode:
 - Firmware revision \geq A.06.20.08 for the E8362B Option 551
 - Firmware revision \geq A.06.20.08 for the N5230A Option 551

PNA Multiport Mode for the E8362B Option 551

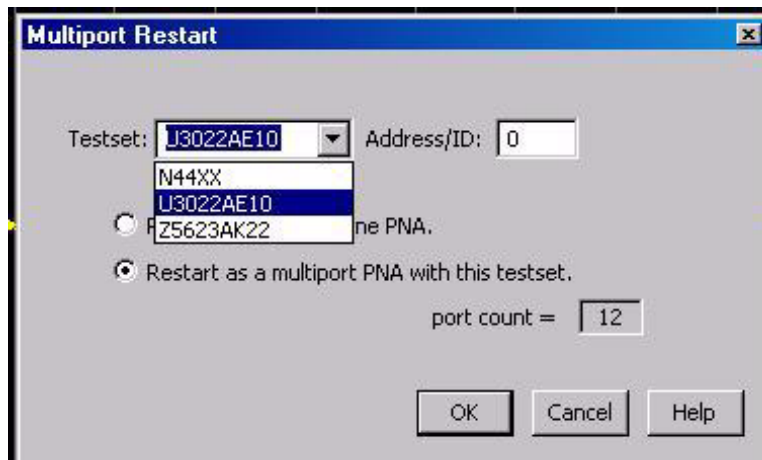
PNA Multiport Mode selects the test set file or PNA to a normal state. The PNA multiport Mode allows you to complete a N-Port calibration using the Cal Wizard application in the PNA. Refer to the PNA Help system for more information.

How to Access Multiport Mode

The E8362B Option 551 must be installed for Multiport capability. To access the multiport application select **System > Configure > Multiport Capability**. See [Figure 12 on page 18](#).

Figure 12 System Configuration

Select **U3022AE10** (12-Port System) from the test set drop-down menu and select **Restart as a Multiport PNA with this test set**. Press OK. The PNA will restart the network application with the U3022AE10 Multiport Test Set interface features. See [Figure 13](#).

Figure 13 U3022AE10 Selection

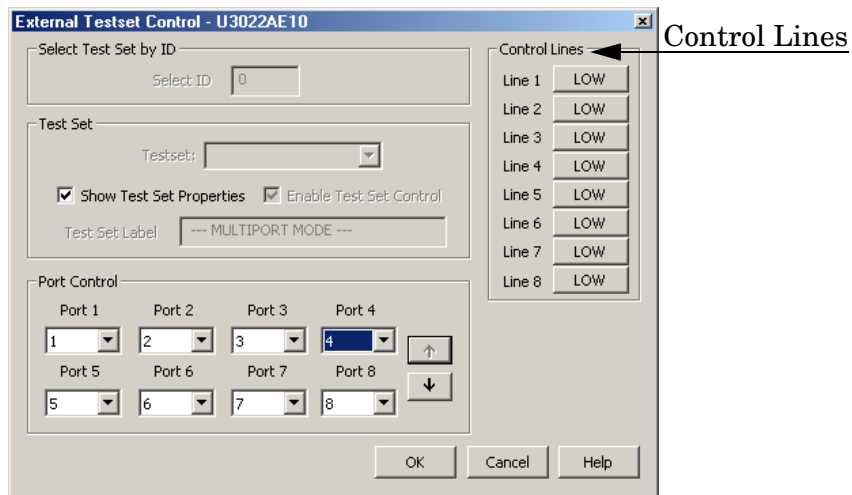
External Test Set Control Feature

To verify that the network application has the U3022AE10 interface features, select **Channel > External Test Set > Other**. The U3022AE10 will be displayed as **External Test Set Control-U3022AE10**. See [Figure 14](#).

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

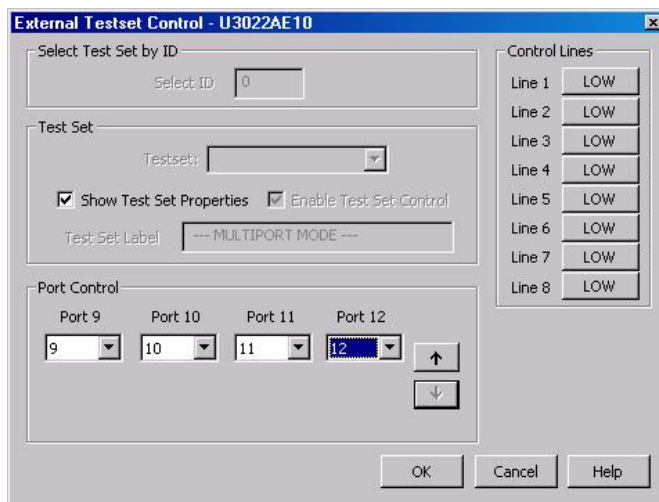
The **External Test Set Control-U3022AE10** also allows control of the DUT control lines, refer to [“Control Lines” on page 28](#). To change the state from LOW to HIGH, select the graphical user interface (GUI) for the specific control (LINE 1 through 8) and then press OK. Each line can be controlled separately, see [Figure 14](#).

Figure 14 External Test Set U3022AE10 (Port 1 - 8)



Select the **Port Control** down arrow for Ports 9 through 12, see [Figure 15](#).

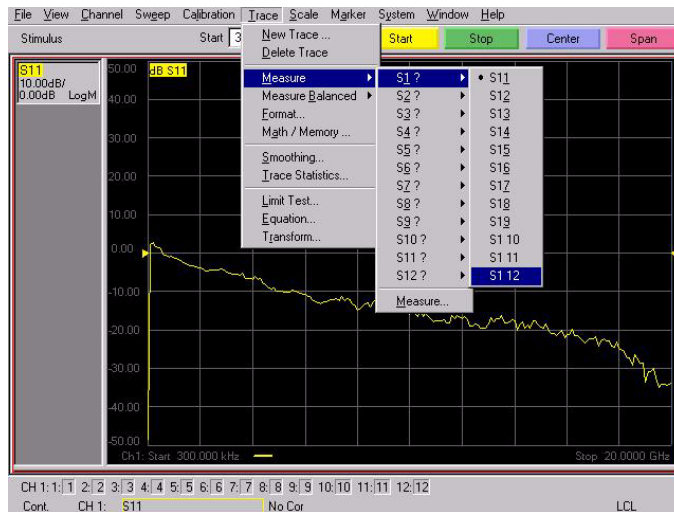
Figure 15 External Test Set U3022AE10 (Port 9 - 12)



Trace Measure S-Parameter

S-Parameter selection can be accomplished using **Trace Measure** menu. Select **TRACE > Measure**. Use the drop-down menus to select 1 of 144 S-Parameters for the 12-Port system, see [Figure 16](#). The first number in the Sxx selection is the Receiver Port and the second number will be the Source Port. Any port can be selected to be the Receiver, Source or both, as in S11. The front panel R LED indicates the port is the Receiver and the S LED indicates the port is the Source.

Figure 16 12-Port Trace Measure



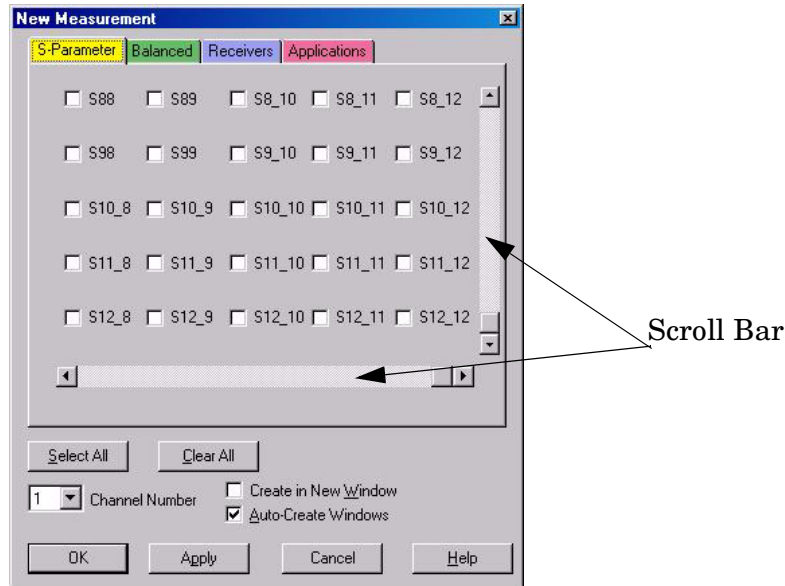
New Trace Measure S-Parameter

S-Parameter Tab: Multiple S-Parameters can be made from the **New Measurement** menu. In the drop-down menu select **Trace > New Trace**. The **New Measurement** window allows the selection of any of the 144 S-Parameter's. See [Figure 17](#) and [Figure 18](#).

Figure 17 12-Port New Trace Measure (S11 - S88)



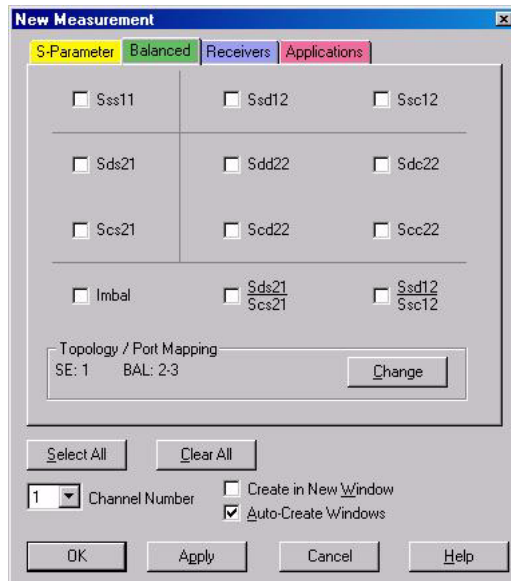
Figure 18 12-Port New Trace Measure (S88 - S12_12)



Balanced Tab: Balanced Measurements can be configured by selecting the Balance tab in the **New Measurement** menu. Refer to [Figure 19](#).

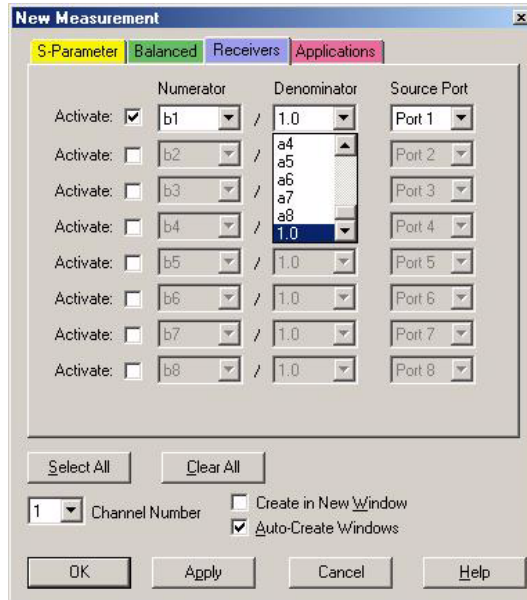
For more information on balanced (differential) component measurement, refer to the Application Note 1373-1 and 1373-2 (5988-5634EN and 5988-5635EN) at <http://www.home.agilent.com>. In the search menu type in “Multiport and Balanced.”

Figure 19 Balance



Receiver Tab: The S-Parameter measurements can be ratioed with selectable Denominators for each port and receiver. Refer to the standard E8362B PNA documentation for more information.

Figure 20 Receiver Ports

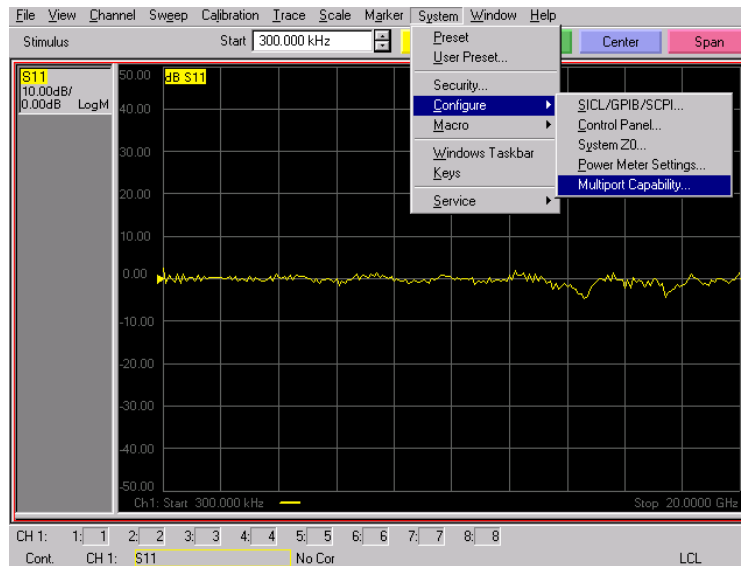


PNA Multiport Mode for the N5230A Option 551

How to Access Multiport Mode

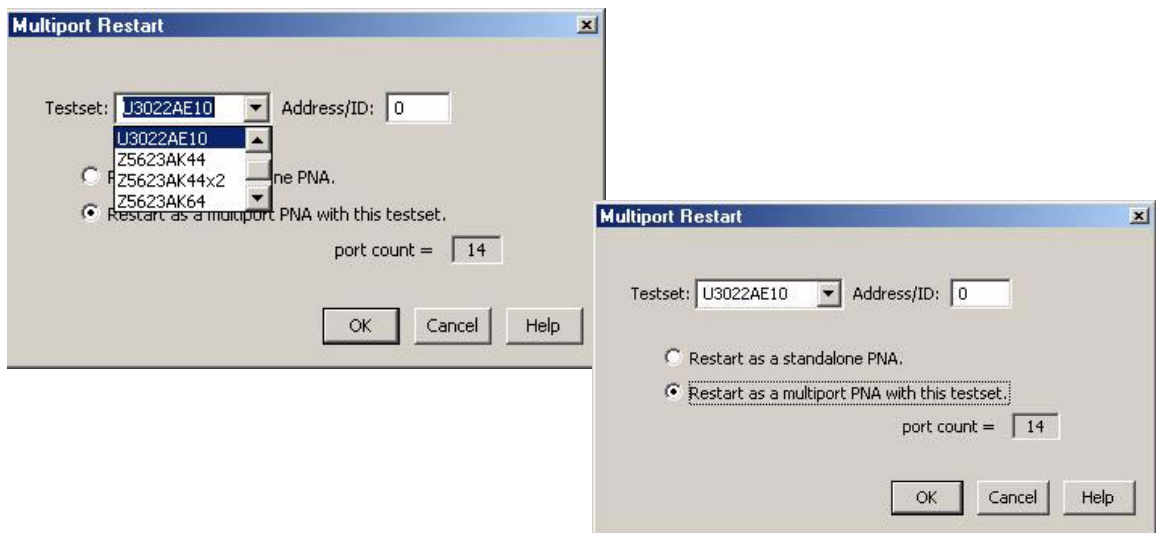
The N5230A Option 551 must be installed for Multiport capability. To access the multiport application select **System > Configure > Multiport Capability**. See [Figure 21](#).

Figure 21 System Configuration



Select **U3022AE10** (14-Port System) from the test set drop-down menu and select **Restart as a Multiport PNA with this test set**. Press OK. The PNA will restart the network application with the U3022AE10 Multiport Test Set interface features. See [Figure 22](#).

Figure 22 U3022AE10 Selection



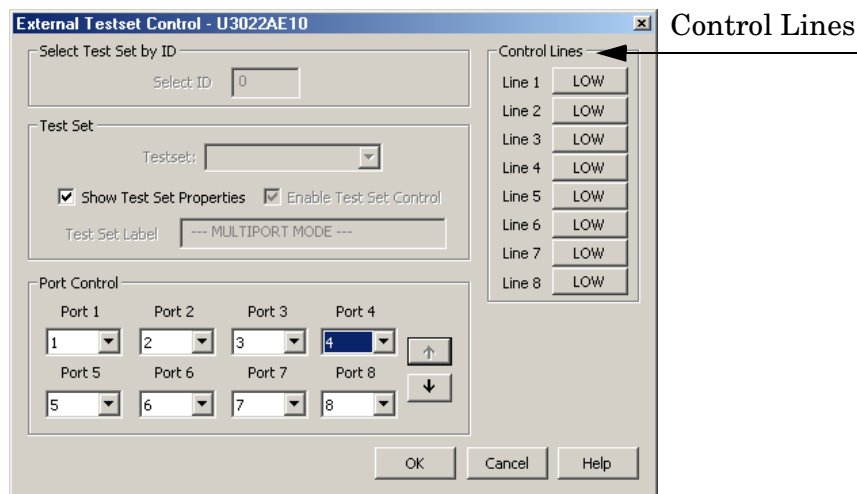
External Test Set Control Feature

To verify that the network application has the U3022AE10 interface features, select **Channel > External Test Set > Other**. The U3022AE10 will be displayed as **External Test Set Control-U3022AE10**. See [Figure 23](#).

This menu will allow the physical Ports 1 through 14 to be identified as any port for your convenience. For example; Port 5 can be named Port 2.

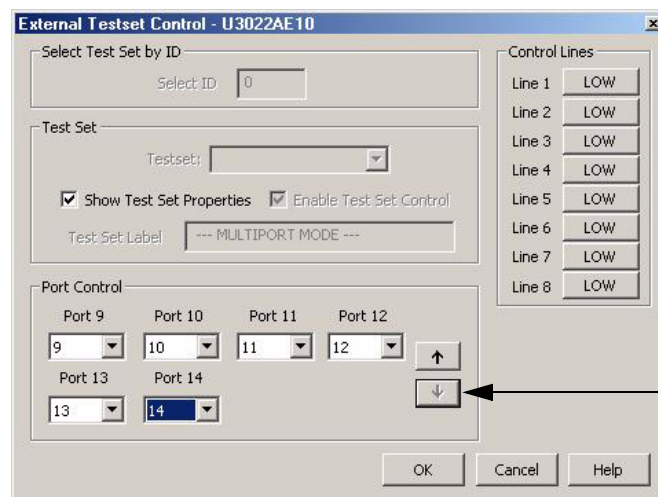
The **External Test Set Control-U3022AE10** menu also allows control of the DUT control lines, refer to [“Control Lines” on page 28](#). To change the state from LOW to HIGH, select the graphical user interface (GUI) for the specific control (LINE 1 through 8) and then press OK. Each line can be controlled separately, see [Figure 23](#).

Figure 23 External Test Set U3022AE10 (Port 1 - 8)



Select the **Port Control** down arrow for Ports 9 through 14, see [Figure 24](#).

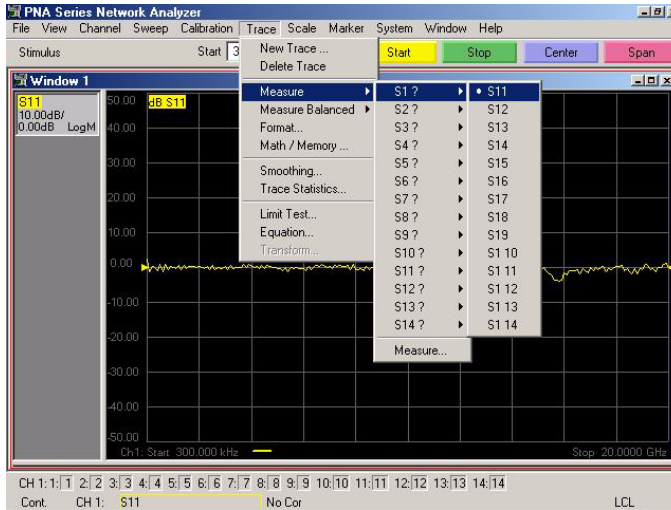
Figure 24 External Test Set U3022A E10 (Port 9 - 14)



Trace Measure S-Parameter

S-Parameter selection can be accomplished using the **Trace Measure** menu. Select **TRACE > Measure**. Use the drop-down menus to select 1 of 196 S-Parameters for the 14-Port system, see [Figure 25](#). The first number in the Sxx selection is the Receiver Port and the second number will be the Source Port. Any port can be selected to be the Receiver, Source or both, as in S11. The front panel R LED indicates the port is the Receiver and the S LED indicates the Port is the Source.

Figure 25 14-Port Trace Measure



New Trace Measure S-Parameter

S-Parameter Tab: Multiple S-Parameters can be made from the **New Measurement** menu. In the drop-down menu select **Trace > New Trace**. The **New Measurement** window allows the selection of any of the 196 S-Parameter's. See [Figure 26](#) and [Figure 27](#).

Figure 26 14-Port New Trace Measure (S11 - S88)

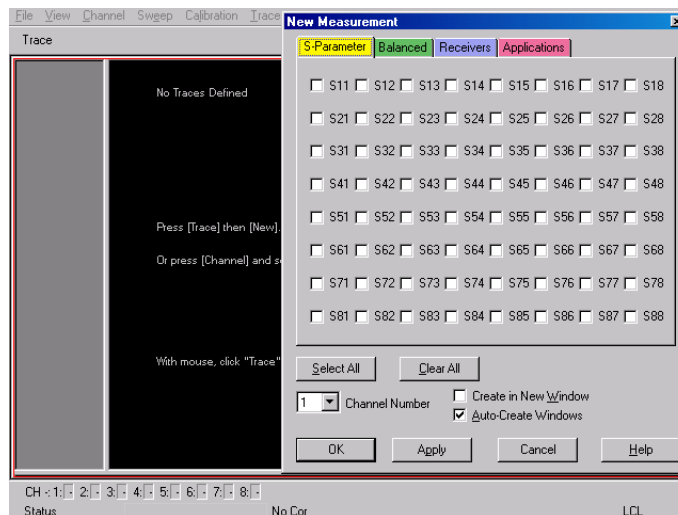
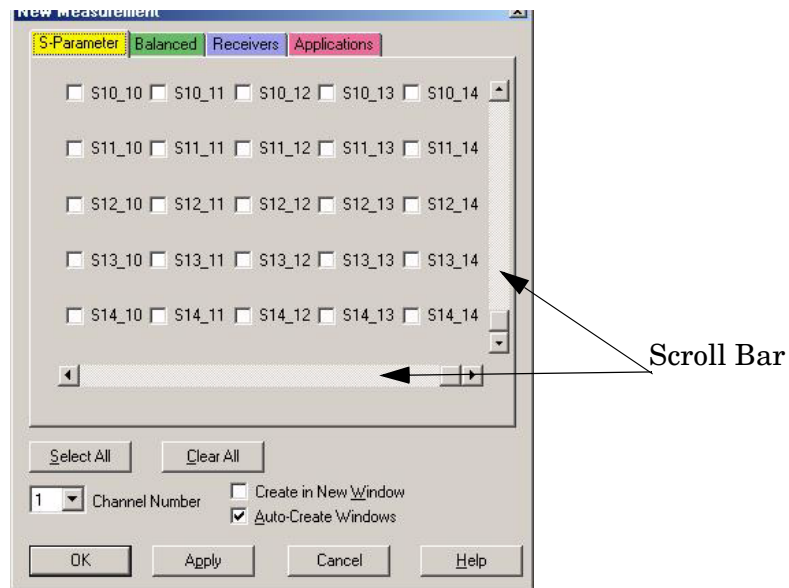


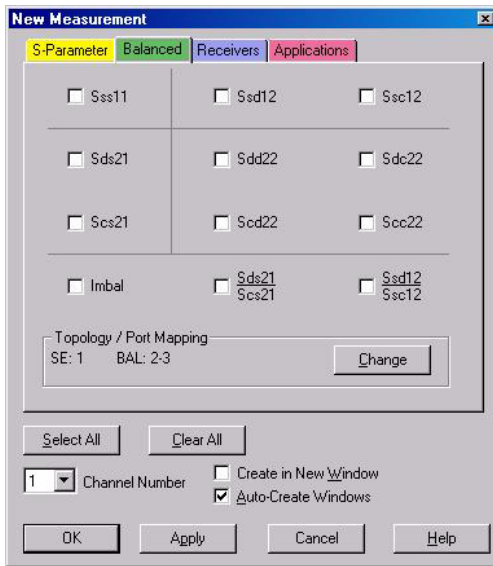
Figure 27 14-Port New Trace Measure (scroll down to S14_14)



Balanced Tab: Balanced Measurements can be configured by selecting the Balance tab in the **New Measurement** menu. Refer to [Figure 28](#).

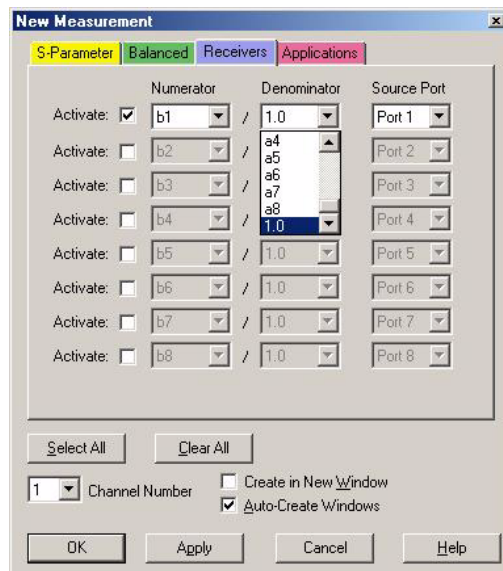
For more information on balanced (differential) component measurement, refer to the Application Note 1373-1 and 1373-2 (5988-5634EN and 5988-5635EN) at <http://www.home.agilent.com>. In the search menu type in “Multiport and Balanced.”

Figure 28 Balance



Receiver Tab: The S-Parameter measurements can be ratioed with selectable Denominators for each port and receiver. Refer to the standard N5230A PNA-L documentation for more information.

Figure 29 Receiver Ports



Control Lines

Table 10 contains the information to set the control lines of the U3022AE10 Test Set. Refer to “Operating the DUT Control Interface” on page 29.

NOTE All DUT control lines must be set with each command sent. Logic 0 = high

Table 10 Test Set DUT Control Address and Data

Address	Data	Data AD12-AD0	Description						Bit Data 0= +Voltage 1= -Voltage	
112	0	000000000000	ALL DUT Control Lines set to 0 or + voltage							
112	255	000001111111	ALL DUT Control Lines set to 0 or – voltage							
112	1	00000xxxxxxB	DUT Control Line 1						0,1	
112	2	00000xxxxxxBx	DUT Control Line 2						0,1	
112	4	00000xxxxxBxx	DUT Control Line 3						0,1	
112	8	00000xxxxBxxx	DUT Control Line 4						0,1	
112	16	00000xxxBxxxx	DUT Control Line 5						0,1	
112	32	00000xxBxxxxx	DUT Control Line 6						0,1	
112	64	00000xBxxxxxx	DUT Control Line 7						0,1	
112	128	00000Bxxxxxxx	DUT Control Line 8						0,1	
Control Lines			Line 8	Line 7	Line 6	Line 5	Line 4	Line 3	Line 2	Line 1
Test Set I/O Bits			AD7	AD6	AD5	AD4	AD3	AD2	AD1	AD0
Bit Decimal Equivalent			128	64	32	16	8	4	2	1
Example 1 Data = 0			0	0	0	0	0	0	0	0
Example 2 Data = 21			0	0	0	1	0	1	0	1
X indicates unknown user bit state										
B indicates bit of interest										
There are 256 individual switch combinations for the U3022AE10. To select a test set DUT control line configuration, all 8 DUT control lines must be set. To do this you must add AD7 to AD0 binary number and convert this to a decimal equivalent.										

NOTE The bottom U3022AE10 DUT control lines will function in a 12-Port configuration. The top U3022AE10 DUT control lines will not operate.

Operating the DUT Control Interface

The 15 pin female D-Sub connector on the front panel provides 8 latched data connections that can be used to control your DUT. An adjustable voltage source (+2 to +5 Vdc) is provided on the front panel. A positive or negative external source can be used. Refer to [Table 12, “DUT Control Specifications,” on page 31.](#)

Setting the DUT Control Interface

This section describes the electrical characteristics of the control line, connection to a DUT and an external dc power supply. For more information regarding the control lines refer to [Table 10, “Test Set DUT Control Address and Data,” on page 28.](#)

Pin Assignment

Figure 30 Control Line Pin Assignment

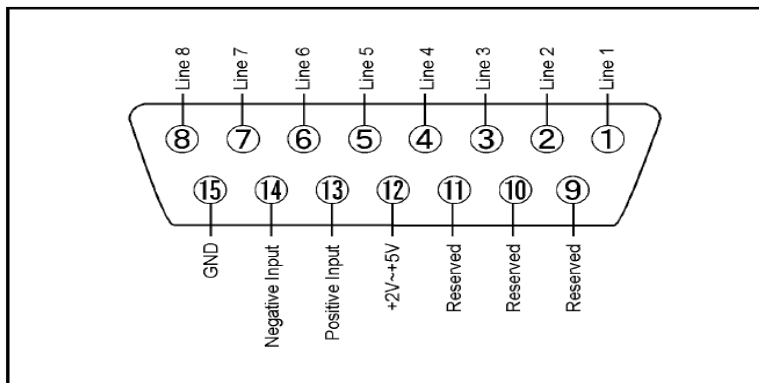
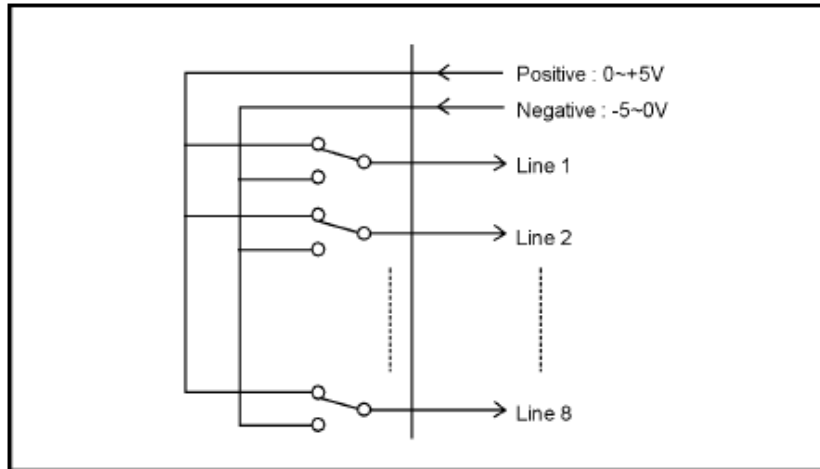


Table 11 Pin Assignment

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 front 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

Figure 31 Block Diagram of DUT Control**Table 12** 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

Setting the Variable Source Voltage

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

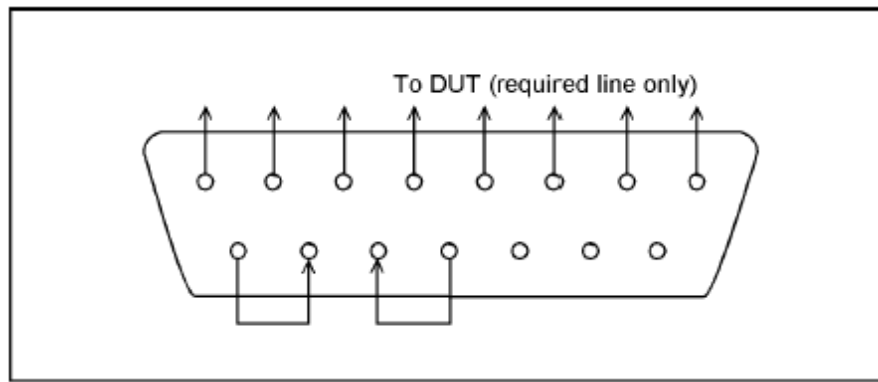
1. Turn On U3022AE10.
2. Measure the voltage between pin 12 and 15 using a multimeter.
3. Rotate the voltage adjustment trimmer on the front panel until the multimeter indicates the appropriate voltage.

Connecting the DUT to the Rear Panel Control Line Connector

Figure 32 illustrates an example of the connection between the DUT and the U3022AE10 *without* an external dc power supply. Input the signals from pin 12 and 15 to the Positive Input and Negative Input respectively and connect each line to the control terminal of the DUT.

CAUTION The path that can be shorted is between pin 12–13 and the pin 14–15 only. Damage may result if any other path is short-circuited.

Figure 32 Control Line Connector



Using an External Power Supply

Figure 33 illustrates an example of the connection between the DUT and the U3022AE10 with an external dc power supply. Input the High and Low signals from the external power supply to the Positive Input and Negative Input respectively, and connect each line to the control terminal of the DUT.

CAUTION The U3022AE10 may be damaged if a dc current is passed through it when it is turned Off. See the steps below.

CAUTION Do not short-circuit between the pins, it may cause damage.

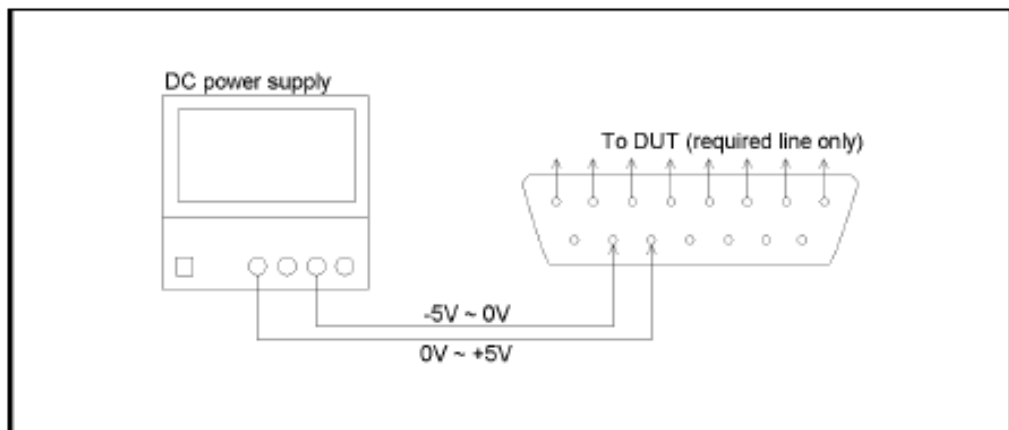
Turning On the U3022AE10 with Using an External Power Supply.

1. Turning On the U3022AE10.
2. Connect the DUT.
3. Turn On the external power supply.

Turning Off the U3022AE10 with Using an External Power Supply.

1. Turning Off the Power Supply.
2. Turning Off the U3022AE10.
3. Disconnect the DUT.

Figure 33 U3022AE10 to the DUT and External DC Power Supply



Operational Check

This section provides the test calibration procedure to confirm the U3022AE10 and PNA operational performance. The operation verification limits provided ensure that your U3022AE10 and PNA are operating properly.

Verification Limits

Specifications for the U3022AE10 Multiport Test Set are typical. System performance for the PNA and Test Set are only characteristic and intended as non warranted information. A functional certificate is provided for the U3022AE10 only.

It is recommended that you return your instrument to Agilent Technologies for servicing or repair if the Test Set and PNA performance exceed the operational verification limits.

NOTE Typical specifications are based on 1 to 2 units performance.

Table 13 Operation Verification Limit for Reflection Tracking¹
(12-Port or 14-Port)

Frequency ²	N5230A and Test Set Port 1-12	E8362B and Test Set Port 1-12
10 MHz to 4 GHz	-5.0 dB	-5.5 dB
4 GHz to 6 GHz	-5.5 dB	-6.0 dB
6 GHz to 10 GHz	-6.5 dB	-7.0 dB
10 GHz to 15 GHz	-8.5 dB	-8.5 dB
15 GHz to 20 GHz	-10.0 dB	-10.0 dB

1. Reflection Tracking takes into account Source Loss, Receiver Loss, Margin, and PNA Mixer Cal.
2. If using an E8362B, the start frequency is 500 MHz due to the E8362B mixer calibration and Port 1 & Port 2 coupler roll off.

NOTE When using with the N5230A 4-Port PNA, System Ports 13 and 14 are not verified.

NOTE If you suspect that your 12 or 14-Port configuration is not operating properly, ensure that all front RF jumper interconnect cables are correctly attached.

Equipment Required

The Agilent U3022AE10 requires that the user be familiar with the equipment and components listed in [Table 14](#).

This section provides an equipment list and setup of the PNA and Test Set.

Table 14 **Equipment List**

Description	Qty
E8362B 2-Port Network analyzer (Option 014 and 551) <i>or</i> N5230A 2-Port Network Analyzer (Option 225 and 551) <i>or</i> N5230A 4-Port Network Analyzer (Option 245 and 551)	1
N4694A/B ECal module with a female connector or a 3.5 mm Cal kit (85052B, 85052D, etc.)	1
Set of interconnect cables (PNA and Test Set), see “12-Port and 14-Port RF Cable Connections” on page 14.	1

Operational Check Procedure

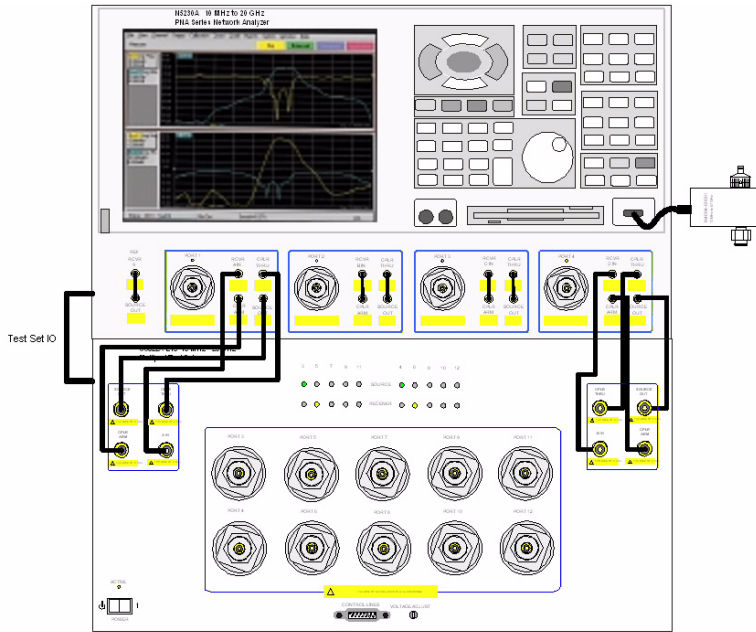
The sequence of this procedure is very important and must be followed or the performance accuracy and results may vary from the reference plots provided.

NOTE The 4-Port PNA is required for the 14-Port System. Ports 13 and 14 are not required.

Prepare the PNA

1. Connect the Test Set to the N5230A 4-Port PNA using the interconnect cables as shown in [Figure 11 on page 16](#) and [Table 9 on page 15](#).
2. On the PNA, press **Calibration > Cal Sets**. Delete or Rename any Cal Sets titled “999.1” thru “999.12” (12-Port), although it is unlikely that you will find Cal Sets with these names.
3. Verify that the PNA is in 14-Port mode by selecting **Trace > New Trace**.
 - a. If only four S-Parameters are listed, press **System > Configure > Multiport Capability**. On the Multiport Restart dialog, select **Restart as multiport PNA with this test set**. Select **U3022AE10** (14-Port).
4. Press **System > Preset**.
5. Verify that the [**Stop Frequency**] is set to the maximum of the PNA and test set.
6. Verify that the [**Start Frequency**] is set to [**10 MHz**]. If not, press **Channel > Start/Stop** and enter [**10 MHz**].
7. Verify that the [**Power**] is to set to [**-8 dBm**]. If not, press [**Power**] > **Power Level** and enter [**-8 dBm**].
8. Select **Sweep > IF Bandwidth > 100 Hz**.
9. Select **Sweep > Number of Points > 401**.
10. Connect the ECal module to the PNA USB port on the front or rear panel, refer to [Figure 34 on page 37](#). This procedure assumes you are using a ECal. If you are not, see “1-Port Calibration Procedure”, [step 2](#).

Figure 34 Test Set to PNA Connections

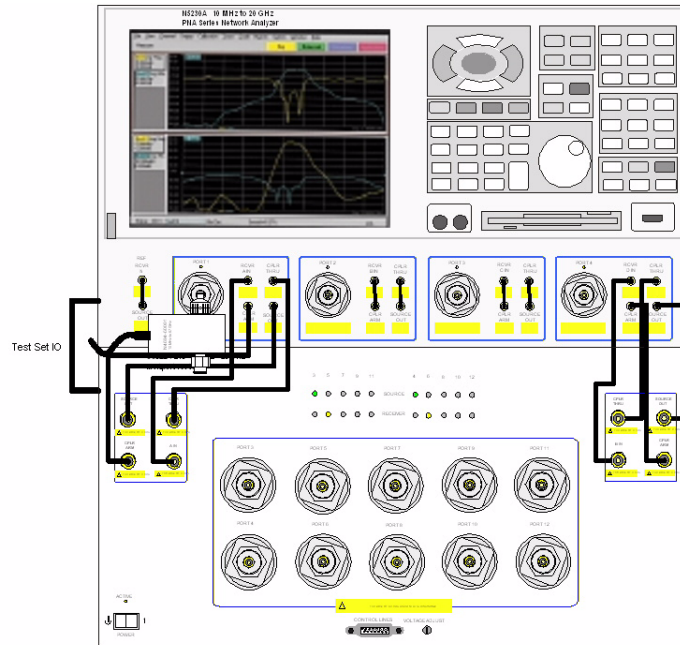


11. Allow the ECal module, Test Set and PNA to warm up for a minimum of 30 minutes.

1-Port Calibration Procedure

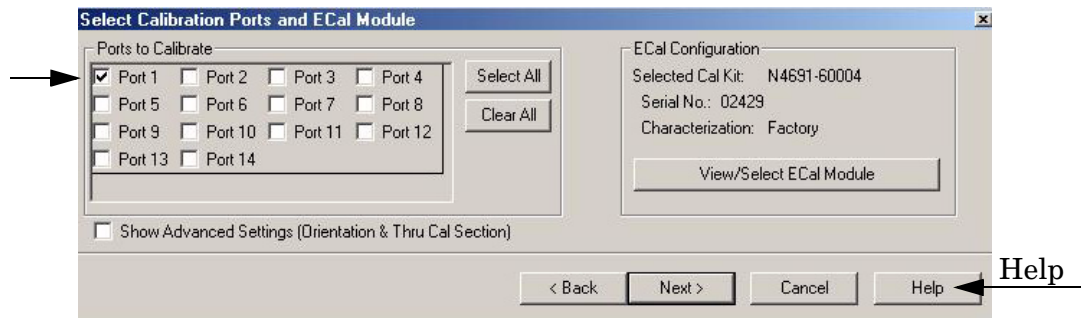
1. Connect the ECal or the mechanical cal kit to Port 1 or the port you are testing. Torque to 8 in-lb. For more information press the **Help** button, see [Figure 36](#).

Figure 35 ECal at Port 1



2. Perform a 1-Port Calibration on Port 1. On the PNA, press **Calibration** > **Calibration Wizard**.
 - a. If using a mechanical cal kit, select **SmartCal**.
 - b. If using an ECal module, select **ECal**.
3. Continue following the Cal Wizard prompts. On the “Select Calibration Ports and ECal Module” window, press **Clear All** and select **Port 1**, then press **Next**.

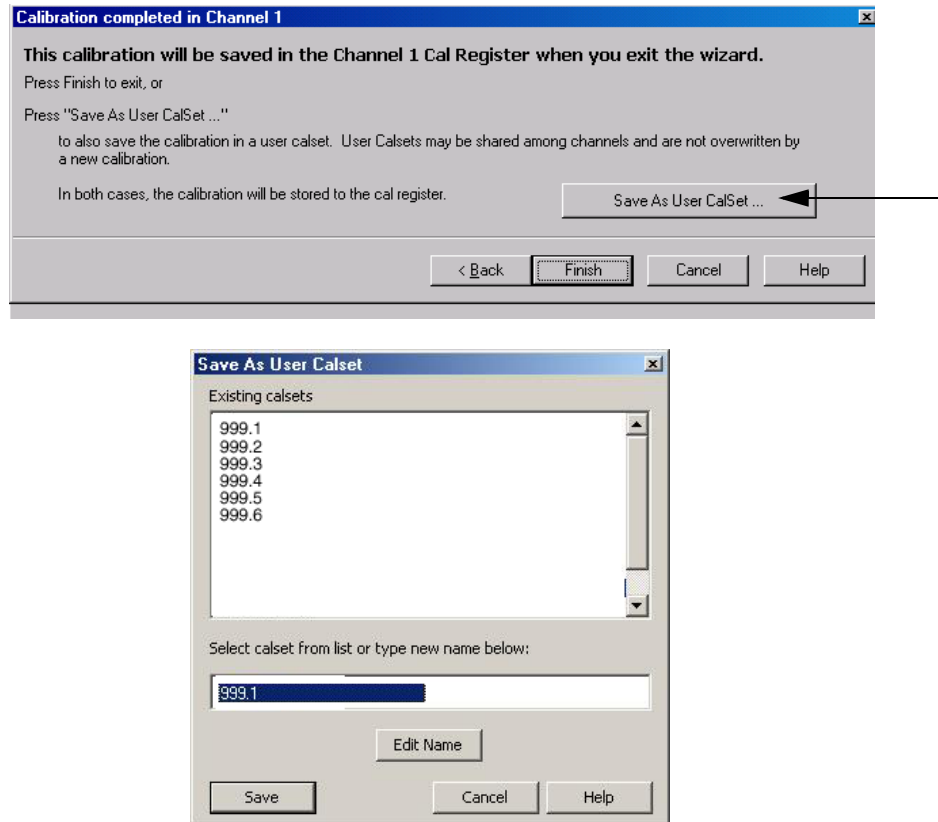
Figure 36 1-Port Calibration



4. In the “Electronic Calibration Step 1 of 1” window, press **Measure**.
5. At the Calibration Completed prompt, select **Save As User Calset** and type the name **999.1**. Overwrite the Calset if it already exists. Press **Save**.

NOTE If you do not have a key board, select **Save As User Calset > Edit Name** and save as **999.x**. X is the port number you are calibrating. See [Figure 37](#).

Figure 37 Calibration Complete



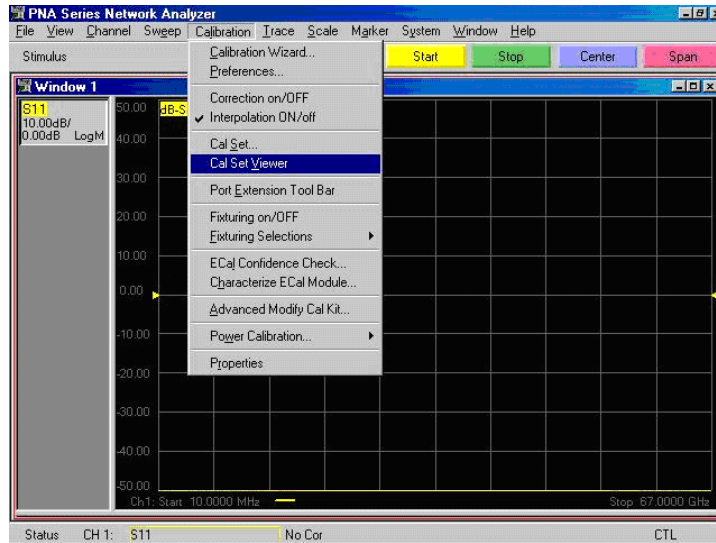
6. Repeat [step 1](#) thru [step 5](#) (1-Port Calibration Procedure) for Ports 2 thru 12. When finished, there should be twelve Cal Sets saved with the titles “999.1” thru “999.12” (12-Port).

If you are using an ECal module you can verify the individual port calibration by selecting **Calibration > ECal Confidence Check**. For further information refer to the system **Help** menu.

7. Press **Trace > Delete Trace**. There should be no traces on the PNA screen.

8. Select **Calibration > Cal Set Viewer** to launch the Cal Set Viewer toolbar.

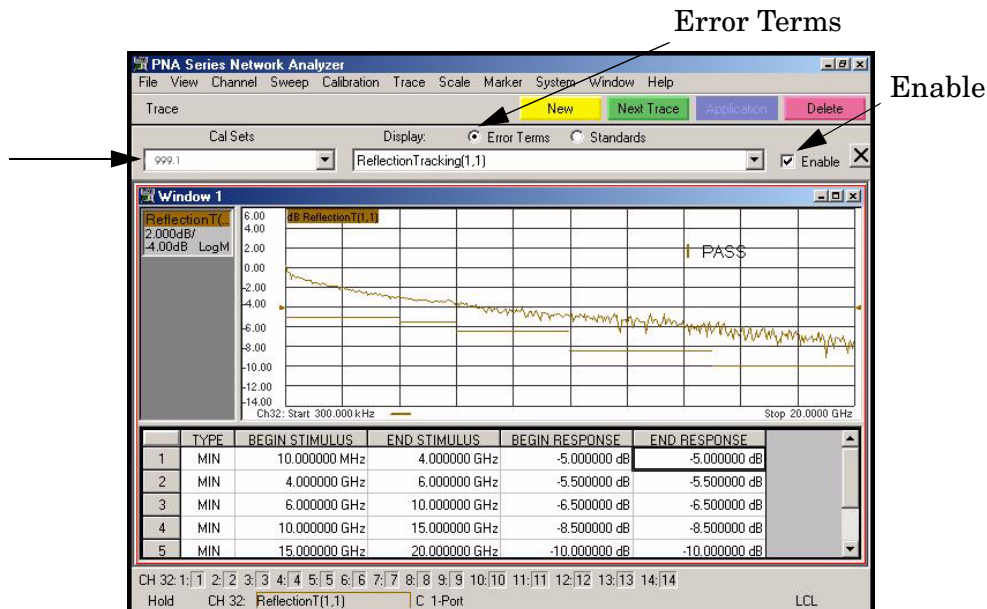
Figure 38 Calibration, Cal Set Viewer



9. From the Cal Sets drop-down menu, select **999.x** (the next sequential number). Select the **Reflection Tracking(1,1)** term in the center drop-down menu and ensure that the **Enable** and **Error Terms** are selected as shown in Figure 39.

NOTE You may also create a table on the PNA and enter the limit line stimulus and response values. Select **Limit Test ON** and **Limit Line ON**, and press **Show Table**. See Figure 39.

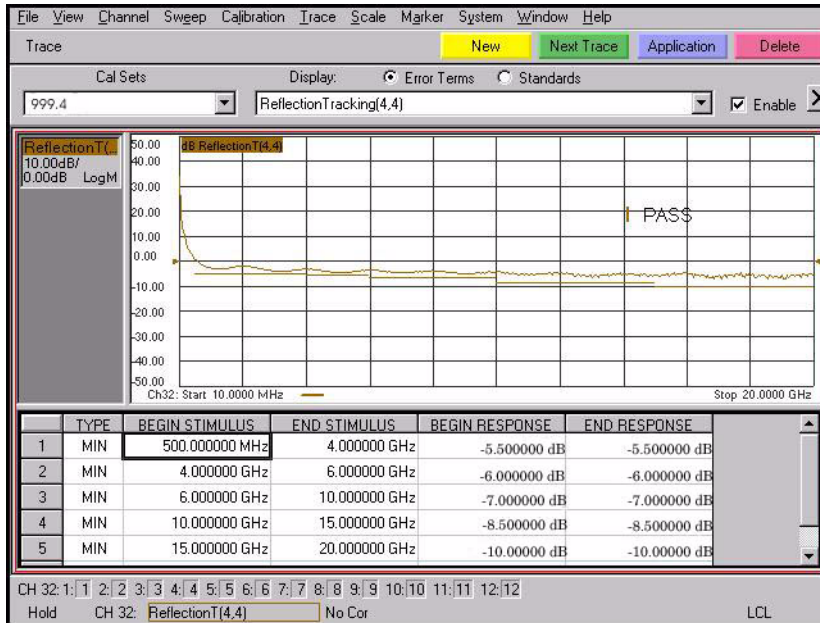
Figure 39 N5230A and Test Set Reflection Tracking Trace (Port 1-12)



10. Compare the Reflection Tracking (1,1) trace to the appropriate limits in [Table 13 on page 34](#). This can be done using Limit Lines (press **Trace > Limit Test**) or **Marker**. The trace should be above the limit line and **PASS** will be displayed on the screen. Refer to [Figure 39 on page 40](#).

11. Repeat [step 9](#) and [step 10](#) for Cal Sets “999.1” thru “999.12” (12-Port).

Figure 40 E8362B and Test Set Reflection Tracking Trace (Port 1-12)



Troubleshooting Operational Check Failures

If your test results fail the Operational Check limits, check the following before contacting Agilent:

1. Check all appropriate PNA and test set connectors for damage, cleanliness, and proper torque.
2. Repeat the relevant 1-Port calibrations.
3. Make sure the stand-alone PNA is operating properly and meeting its published specifications. See http://na.tm.agilent.com/pna/pna_testing.html for more information.

Theory of Operation

The following is a description of the operation of the U3022AE10. Reference the U3022AE10 block diagrams shown in [Figure 41 on page 43](#). This section assumes the user has a general understanding of couplers, switches, and network analyzers.

RF Switch Components

S102, S202, S302 and S401 are all mechanical switches. The frequency range is DC to 26.5 GHz. The switches select the RF paths from the PNA source and receiver through interconnect cables to test set port paths 3 through 12.

S102 - Source to Odd Ports (1-11)

Switch 102 provides control of the Source path to PNA Port 1 and the test set odd ports (3 - 11). In the state shown in the block diagram, switch 102 routes the RF source back to the PNA Port 1 and all unused test set odd ports (3 - 11) source paths are terminated.

S202 - Source to Even Ports (2-12)

Switch 202 provides control of the Source path to PNA Port 2 and the test set even ports (4 - 12). In the state shown in the block diagram, switch 202 routes the RF source back to the PNA Port 2 and all unused test set even ports (4 - 12) source paths are terminated.

S302 - Receiver to Odd Ports (1-11)

Switch 302 provides control of the A Receiver path to PNA Port 1 and the test set odd ports (3 - 11). In the state shown in the block diagram, switch 302 routes the coupler arm from the PNA Port 1 to the A Receiver and all unused test set odd ports (3 - 11) coupler arm paths are terminated.

S402 - Receiver to Even Ports (2-12)

Switch 402 provides control of the B Receiver path to PNA Port 2 and the test set even ports (4 - 12). In the state shown in the block diagram, switch 402 routes the coupler arm from the PNA Port 2 to the B Receiver and all unused test set even ports (4 - 12) coupler arm paths are terminated.

RF Coupler Components

Test set ports (3 - 12) provide the signal separation of the source and receiver paths. The test set ports can either stimulate or receive a signal to the DUT.

System Block Diagram

Figure 41 12 Port Standard Configuration

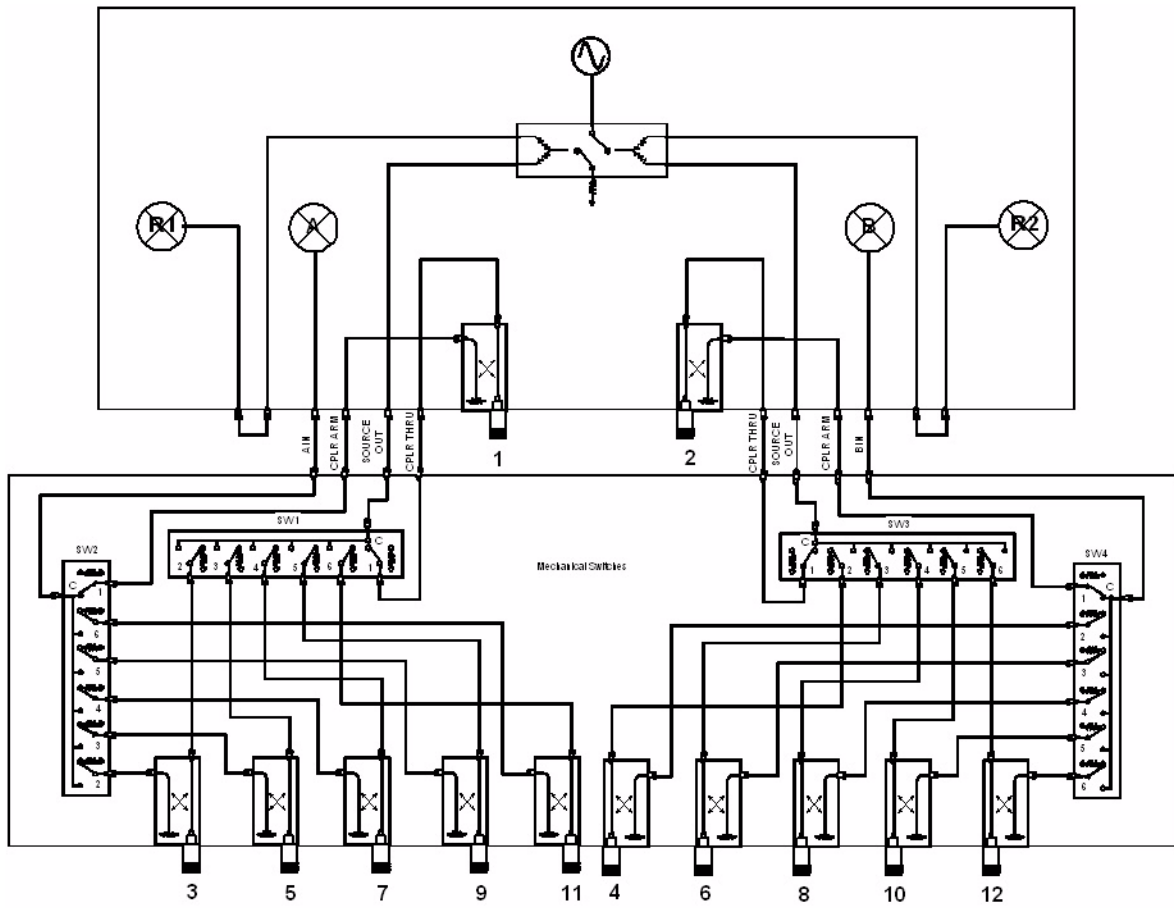
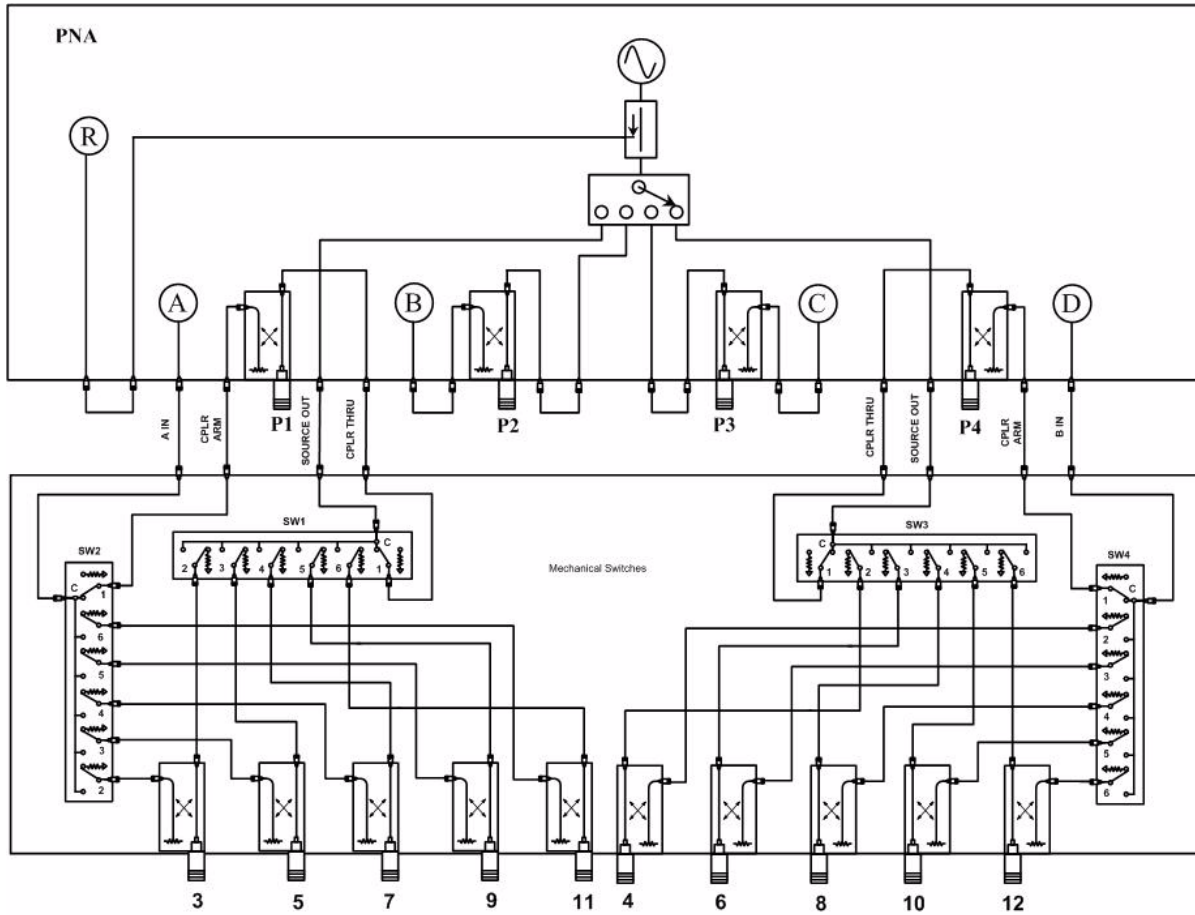


Figure 42 14 Port Standard Configuration



Service Information

Refer to [“Contacting Agilent Sales and Service Offices”](#) on page 51.

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

NOTE Special options are built to order, so long lead times may be encountered when ordering replacement parts.

Description	Agilent Part Number
Interconnect Cable	8120-6818
RF Cable, Semi-rigid (E8362B, 12-Port)	U3022-20001
RF Cable, Semi-rigid (E8362B, 12-Port)	U3022-20002
RF Cable, Semi-rigid (E8363B or E8364B 12-Port)	U3022-20040
RF Cable, Semi-rigid (E8363B or E8364B 12-Port)	U3022-20041
RF Cable, Semi-rigid (N5230A 14-Port)	U3022-20031
RF Cable, Semi-rigid (N5230A 14-Port)	U3022-20032
RF Cable, Semi-rigid (N5230A 14-Port)	U3022-20033
RF Cable, Semi-rigid (N5230A 14-Port)	U3022-20034
RF Cable, Semi-rigid (N5230A 14-Port)	U3022-20035
RF Cable, Semi-rigid (N5230A 14-Port)	U3022-20036
RF Cable, Semi-rigid (N5230A 14-Port)	U3022-20037
RF Cable, Semi-rigid (N5230A 14-Port)	U3022-20038

Safety and Regulatory Information

Introduction

Review this product and related documentation to familiarize yourself with safety markings and instructions before you operate the instrument. 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 product is configured to match the available main power source. If this product is to be powered by autotransformer, make sure the common terminal is connected to the neutral (grounded) side of the ac power supply.

Connector Care and Cleaning

If alcohol is used to clean the connectors, the power cord to the instrument must be removed. All cleaning should take place in a well ventilated area. Allow adequate time for the fumes to disperse and moist alcohol to evaporate prior to energizing the instrument.

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

Declaration of Conformity

A declaration of conformity is on file for the PNA models, and a copy is available upon request.

Shipping Instructions

You must always call the Agilent Technologies Instrument Support Center to initiate service before retuning your instrument to a service office. See [“Contacting Agilent Sales and Service Offices” on page 51](#). Always transport or ship the instrument using the original packaging if possible. If not, comparable packaging must be used. Attach a complete description of the failure symptoms.

Compliance with German Noise Requirements

This is to declare that this instrument is in conformance with the German Regulation on Noise Declaration for Machines (Laermangabe nach der Maschinenlaermrrordnung-3. GSGV Deutschland).

Acoustic Noise Emission/Geraeuschemission	
LpA<70 dB	Lpa<70 dB
Operator Position	am Arbeitsplatz
Normal Operation	normaler Betrieb
per ISO 7779	nach DIN 45635 t. 19

EMC Information

Complies with European EMC Directive 89/336/EEC, amended by 93/68/EEC

- IEC/EN 61326

This product complies with the radiated electromagnetic field immunity requirement in IEC/EN 61326 using performance criterion B. Degradation of some product specifications can occur in the presence of ambient electromagnetic fields. The product self-recovers and operates as specified when the ambient field is removed.

- CISPR Pub 11 Group 1, class A
- AS/NZS CISPR 11:2002
- This ISM device complies with Canadian ICES-001.
Cet appareil ISM est conforme a la norme NMB du Canada.

Safety Information

Complies with European Low Voltage Directive 2006/95/EC

- IEC/EN 61010-1:2001
- Canada: CSA C22.2 No. 61010-1:2001
- USA: UL 61010-1

Warnings

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

Warnings applicable to this instrument are:

WARNING To prevent electrical shock, disconnect the [Agilent Technologies U3022AE10](#) from the mains 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 For continued protection against fire hazard replace line fuse only with same type and rating:

- United States—F 5A/250V, Part Number 2110-0709
- Europe—F 5A/250V, Part Number 2110-0709

The use of other fuses or material is prohibited.

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.

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

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

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.

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).

Cautions

CAUTION The CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like, which 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.

Cautions applicable to this instrument are:











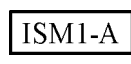

CAUTION Always use the three-prong ac power cord supplied with this instrument. Failure to ensure adequate earth grounding (by not using this cord) can cause instrument damage.

CAUTION This instrument has autoranging line voltage input; be sure the supply voltage is within the specified 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.

CAUTION This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 61010-1:2000, and 664 respectively.

Instrument Markings

	When you see this symbol on your instrument, you should refer to the instrument's instruction manual for important information.
	This symbol indicates hazardous voltages.
	This symbol indicates that the instrument requires alternating current (ac) input.
	This symbol indicates separate collection for electrical and electronic equipment, mandated under EU law as of August 13, 2005. All electric and electronic equipment are required to be separated from normal waste for disposal (Reference WEEE Directive, 2002/96/EC).
	This symbol indicates that the power line switch is ON.
	This symbol indicates that the power line switch is OFF or in STANDBY position.
	Safety Earth Ground. This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and secured against any unintended operation.
	The CE mark is a registered trademark of the European Community. (If accompanied by a year, it is when the design was proven.)
	The CSA mark is a registered trademark of the Canadian Standards Association.
	This is a marking to indicate product compliance with the Canadian Interference-Causing Equipment Standard (ICES-001).
	This is a symbol of an Industrial Scientific and Medical Group 1 Class A product.
	This is a required mark signifying compliance with an EMC requirement. The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency.

Contacting Agilent Sales and Service Offices

Assistance with test and measurement needs, and information on finding a local Agilent office are available on the Internet at:

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

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

<http://www.agilent.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 product by its model number and full serial number. With this information, the Agilent representative can determine whether your unit is still within its warranty period.
