Agilent Technologies U3025AE10

User's Guide

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

Agilent Technologies

Manufacturing Part Number: U3025-90001

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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.

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.

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Introduction

This document describes how to use the U3025AE10 Multiport Test Set with the Agilent E8363C and E8364C 2-Port and the N5230C 2-Port PNA Network Analyzer.

Figure 1   E8364C 2-Port PNA and U3025AE10
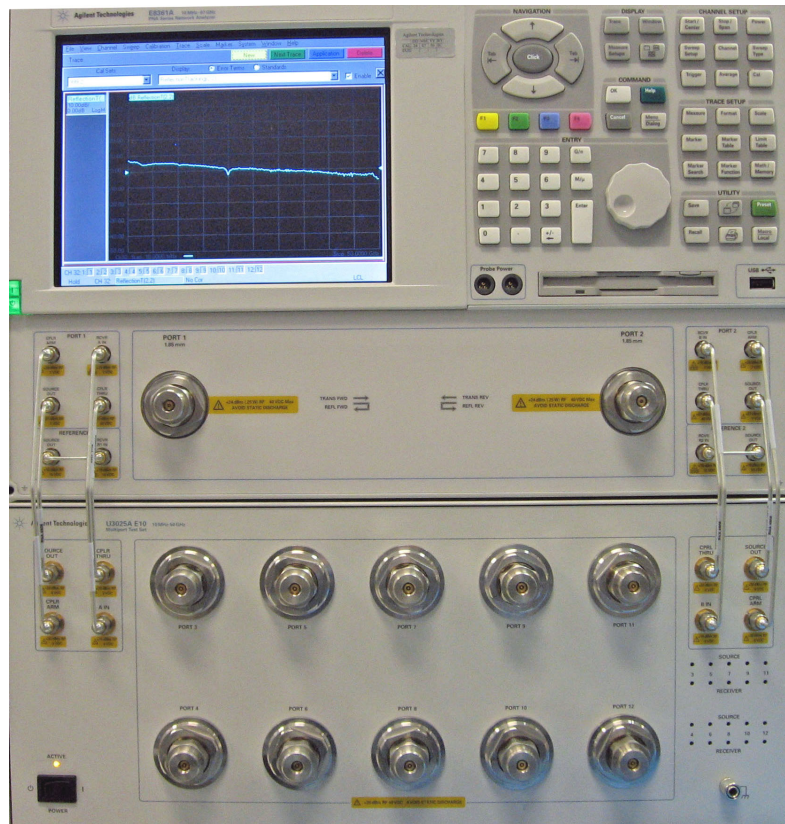
Description

The Agilent U3025AE10 is a 10-Port mechanical switching extension Test Set (10 MHz to 50 GHz). When combined with a E8363/4C Option 014 or N5230C Option 525 or 425 2-Port network analyzer, the U3025AE10 provides a complete solution for 8-Port full crossbar measurements. The U3025AE10 can be used with the E8363C (10 MHz to 40 GHz). The test ports are 2.4 mm male.

The Test Set is controlled by the Test Set I/O connector located on the rear panel of the PNA network analyzer.

The E8363/4C Performance Network Analyzer and N5230C PNA-L information, data sheets, white papers, or manuals can be viewed or printed by visiting http://www.agilent.com/find/pna

Figure 2   System Configuration
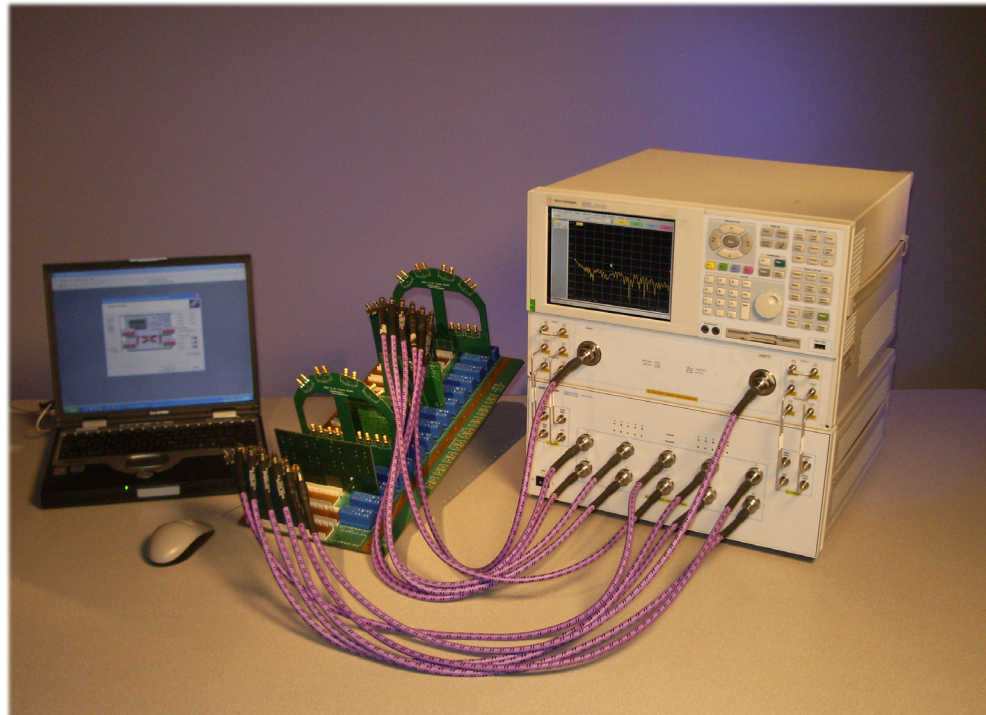
Network Analyzer Requirement

- All PNA, PNA-L Network Analyzers require Option 551, which adds N-Port error correction and full cross-bar measurement capability.

- PNA firmware revision:
  N5230C and E8363/4C Option 551 $\geq$ A.08.04.10

- The N5230C PNA-L requires Option 525 or 425 (40 GHz) to provide the Test Set interface connections and requires Test Set file u302xae10_p2.tsx.

- E8363/4C PNA require Option 014 to provide the Test Set interface connections and requires Test Set file u302xae10_p2.tsx.

More PNA information is available on the following websites:

- Documentation - http://www.agilent.com/find/pna

- Network Analyzer Firmware - http://na.tm.agilent.com/pna/firmware/firmware.htm

- U3025AE10 Test Set Files - http://na.tm.agilent.com/multiport. (see test set files link)

Verifying the Shipment

To verify the contents shipped with your product, refer to the "Box Content List" included with the shipment.

Inspect the shipping container. If the container or packing material is damaged, it should be kept until the contents of the shipment have been checked mechanically and electrically. If there is physical damage refer to "Contacting Agilent" on page 48. Keep the damaged shipping materials (if any) for inspection by the carrier and an Agilent Technologies representative.

Available Options

Test Set Options

The U3025AE10 has two available Test Set options:
Refer to "System Block Diagrams" beginning on page 40.

- Standard - Includes amplifiers.

- Option 001 provides Bias Tee's for the 10-Ports in the Test Set.

Mounting Kits

Installation instructions are included in the option package.

- Option 1CM - Rackmount Kit (5063-9215).

- Option 1CN - Front-Handle Kit (5063-9228).

- Option 1CP - Rackmount with front handle Kit (5063-9222).

Cable Options

The U3025AE10 has one available cable option:

- U3021PN2-263 provides the interface kit to connect the E8363/4C or 2-Port N5230C Option 425 or 525 to the Test Set.

General Specifications

Specifications for the Test Set are characteristic for the system performance of the PNA and Test Set. Actual performance of the system is based on the customer's PNA 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.

NOTE   When connected to a PNA, this Test Set will degrade the performance at the test ports. The internal switch paths reduce test port power and power to the receivers. This affects the test port power of the PNA and also reduces dynamic range. The reflection tracking values measured in the "Operational Check Procedures" on page 32 can be subtracted from the analyzers dynamic range to determine the approximate performance of the system.

Power Requirements

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

- 100/120/220/240 VAC (50/60Hz)

- The instruments can operate with mains supply voltage fluctuations up to ± 10% of the nominal voltage.

- Air conditioning equipment (or other motor–operated equipment) should not be placed on the same ac line that powers the Test Set and PNA.

- Table 1 contains the maximum wattage for all instruments. This table can be use to determine the electrical and cooling requirements.

Table 1   Power Requirements

Standard Equipment	
Instrument	**Maximum Wattage**
U3025AE10	350

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 the PNA-L or PNA-X standard documentation for environmental requirements.

Environmental Tests

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

- Pressure Altitude (Operation)
  3,000 meters (~10,000 feet)

- The instrument can safely operate in a relative humidity of 80% for temperatures to 31 degrees C, decreasing linearly to 50% relative humidity at 40 degrees C.

Equipment Heating and Cooling

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

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

Required Conditions for Accuracy Enhanced Measurement

Accuracy–enhanced (error–corrected) measurements require the ambient temperature of the PNA 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 PNA 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.

Table 2   Instrument Dimensions

Model	Weight	Height	Width	Depth
U3025AE10	12.7 kg (28 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 U3025AE10 frequency range is 10 MHz to 50 GHz.

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 3.

Table 3   Power Levels

Test Setup	Power Level
Maximum U3025AE10 Multiport Test Set RF Power Levels:	
PORT 3-12	+30 dBm 40 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[1]	+15 dBm 0 Vdc
Damage Power Levels to U3025AE10 Access and Test Ports:[2]	
Max Level to Port 1 & 2 Test Ports	+30 dBm 40 Vdc

1. Refer to your PNA specifications to determine the maximum input power levels for the access and test ports.
2. Add the RF signal to the DC component to determine the maximum wattage.

NOTE	Refer to your PNA 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.

The examples shown assumes a 10 dBm (0.01w) RF signal and 7 VDC.

Equation 1   DC Wattage (E^2/R = DC Wattage)

$$7v^2 / 50\Omega = \ 0.98w$$

Equation 2   Maximum Wattage (RF + DC = Maximum Wattage)

$$0.01w + 0.98w \ = \ 0.99w$$

Typical Reflection Tracking

Specifications for the Test Set are typical. System performance for the PNA and Test Set are only characteristic and are intended as non-warranted information.

| NOTE | Typical specifications are based on 1 to 2 units performance, refer to Table 4. |

Table 4   Typical Reflection Tracking Loss[1,2]

Frequency	Standard (dB) *(typical)*	Option 001 (dB) *(typical)*
10 MHz to 45 MHz	+3.0	+2.5
45 MHz to 500 MHz	+6.5	+6.0
500 MHz to 2 GHz	+4.0	+3.5
2 GHz to 10 GHz	+2.0	+1.5
10 GHz to 20 GHz	0	–0.5
20 GHz to 30 GHz	–3.0	–8.0
30 GHz to 40 GHz	–4.5	–9.0
40 GHz to 45 GHz	–7.0	–10.0
45 GHz to 50 GHz	–8.5	–12.0

1. Reflection tracking loss is generally source path loss + receiver path loss.
2. Does not include margin of ± 2 dB, or PNA accuracy ± 1.5 dB up to 40 GHz (± 2 dB 40 to 50 GHz).

Front and Rear Panel Features

Figure 3   **Front Panel (Multiport Test Set)**
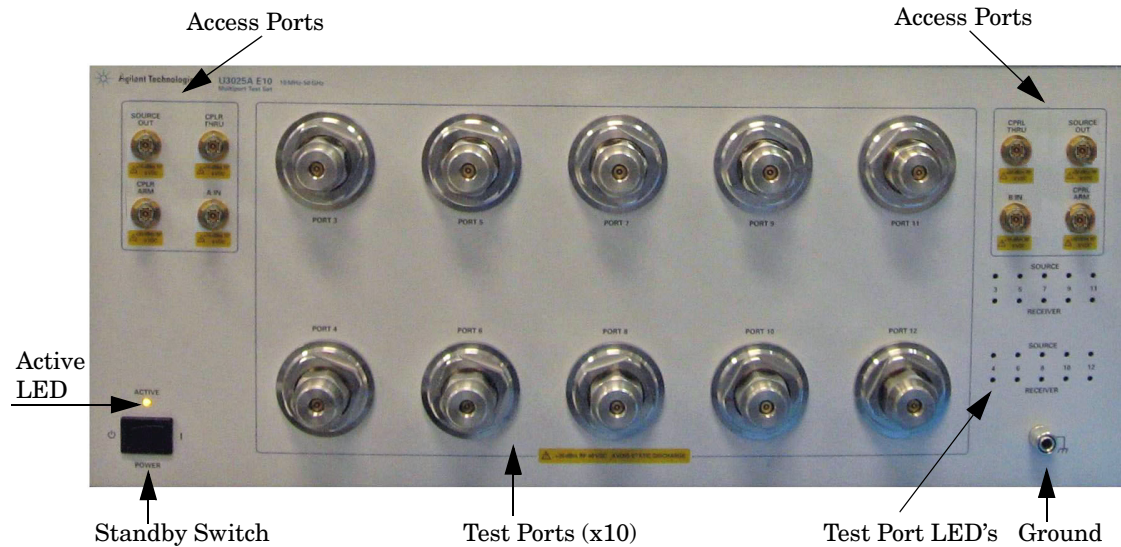
Access Ports - 3.5 mm (female)

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

Ground

Chassis ground is provided for ESD and safety connection.

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 - 2.4 mm Bulkhead (male)

- Port 3–12

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.

Figure 4   U3042AE04 Rear Panel

Bias Tee Input (Option 002)

Line Module   Test Set Interface   Pass Through Interface   Ground
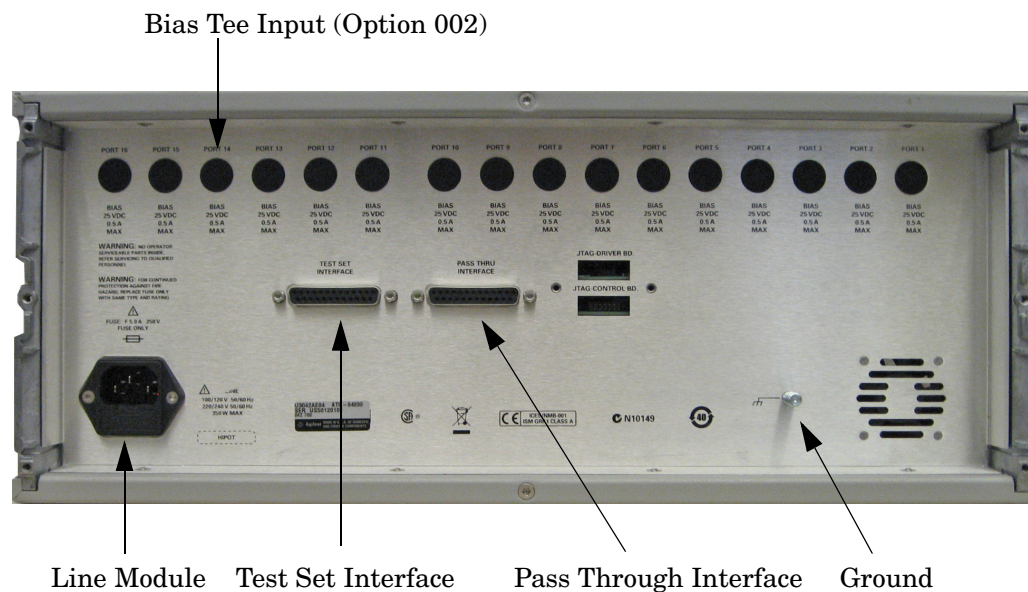
Test Port LEDs

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

Bias Tee Inputs - Option 001 (only)

BNC female Connectors.

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 PNA.

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.

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

Available Fuses

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

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

Figure 5   Line Module and Fuse

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

System Setup E8363C, E8364C or N5230C

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.**

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.

Figure 6   Rear Bottom Feet
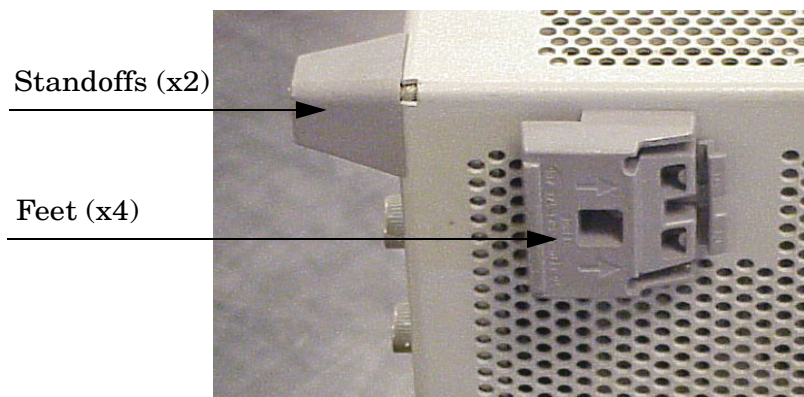
3. Install the two rear locking feet (5023-0132) using the included screws (0515-1619), where the standoffs were removed.

Figure 7   Install Locking Feet

4. Place the network analyzer on top of the Test Set and ensure that the front frame of the network analyzer is positioned slight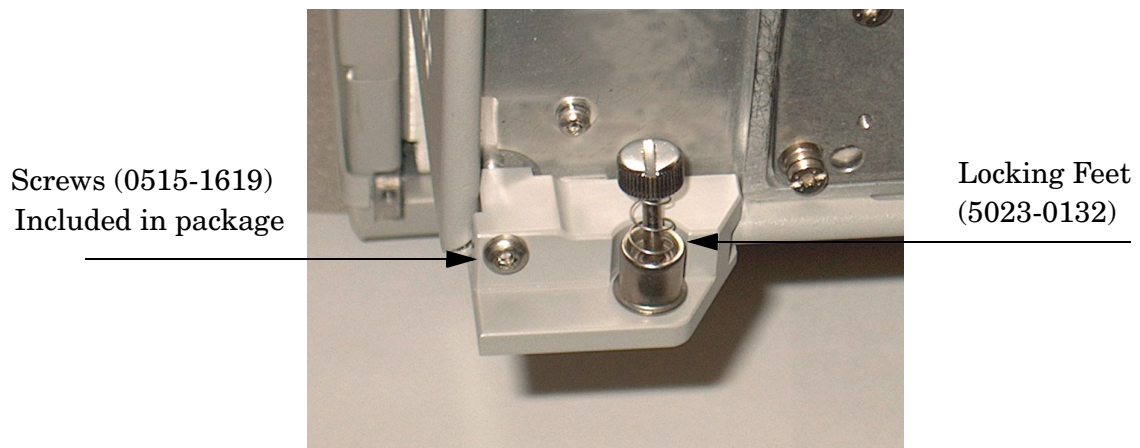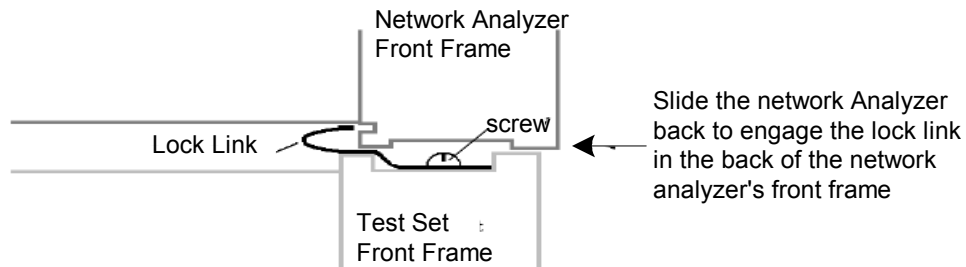ly forward of the locks that are attached to the Test Set. Slide the network analyzer back so the locks engage the front frame of the analyzer.

Figure 8   Locking the Analyzer's

5. 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-Feet kits available. Refer to "Contacting Agilent" on page 48 for ordering information.

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

RF Interface Cable Connections

Figure 10 illustrates the setup configuration of the U3025AE10 Multiport Test Set and how it should be configured to the E8364C 2-Port and N5230C PNA Network Analyzer.

1. Remove the SOURCE OUT to CPLR THRU and RCVR IN to CPLR ARM jumpers (x8) on the PNA. The RCVR R1 - R2 to SOURCE OUT reference loop jumpers (x2) remain on the front panel.

2. Connect the RF cables supplied with this option between the network analyzer and the U3025AE10 Test Set. Torque each cable to 8 in-lb. Refer to Table 5 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 5   12-Port Cable Connection

RF Cables	From (PNA)	To (Test Set)
U3025-20044	SOURCE OUT	SOURCE OUT
U3025-20044	CPLR THRU	CPLR THRU
U3025-20045	CPLR ARM	CPLR ARM
U3025-20045	RCVR A IN, B IN	A IN, B IN

Figure 10   12-Port Setup Configuration
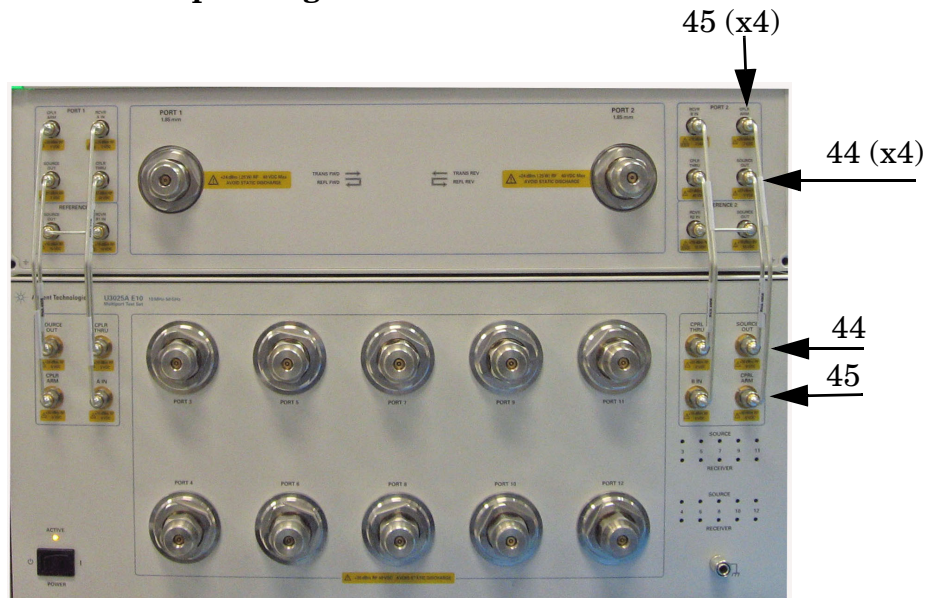
3. Connect the PNA Test Set I/O cable (8120-6818) to the U3025AE10 Test Set Interface on the rear panel.

Figure 11   Test Set I/0 Connections
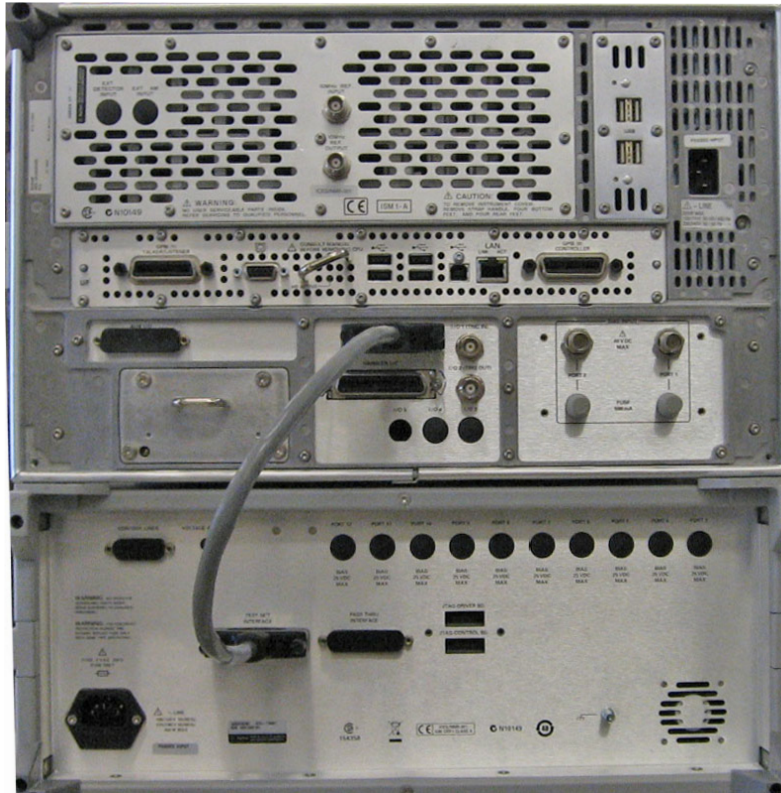
Controlling the System with E8363/4C and N5230C

This section will describe how to setup and operate the U3025AE10 Multiport Test Set with the E8363/4C and N5230C 2-Port PNA Network Analyzer.

NOTE   The internal firmware of the Agilent E8363/4C and N5230C 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.

The U3025AE10 Multiport Test Set is considered a "slave" instrument. A E8363/4C or N5230C must be used to control the Test Set.

• PNA Multiport Mode Option 551 requires firmware revision ≥ A.08.04.10. From the PNA drop-down menu select **Help** > **About Network Analyzer** to see the options installed and the installed firmware revision, refer to Figure 12.

Figure 12   N5230C and E8363/4C Options
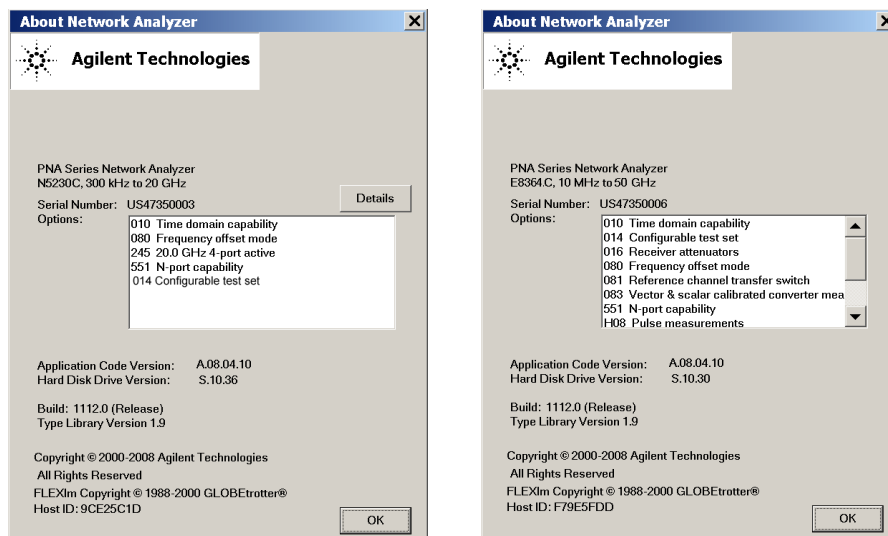
The following Test Set file must be installed into network analyzer file directory: c:\Program Files\Agilent\Network Analyzer\testsets

2-Port PNA-X requires Test Set: u302xae10_pnax_p2.tsx
2-Port PNA or PNA-L requires Test Set: u302xae10_p2.tsx

Visit our website for firmware revision and downloads.http://na.tm.agilent.com/pna/firmware/firmware.htm

PNA Multiport Mode for E8363/4C and N5230C with Option 551

The PNA Multiport Mode selects the Test Set file that will enable the PNA to control the Test Set. 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.

12-Port System with E8363/4C and N5230C

1. The E8363/4C and N5230C Option 551 must be installed for Multiport capability. You may access the multiport application by using the touch screen. Select **Utility > System > Configure > Multiport Capability.**

Figure 13   System Configuration
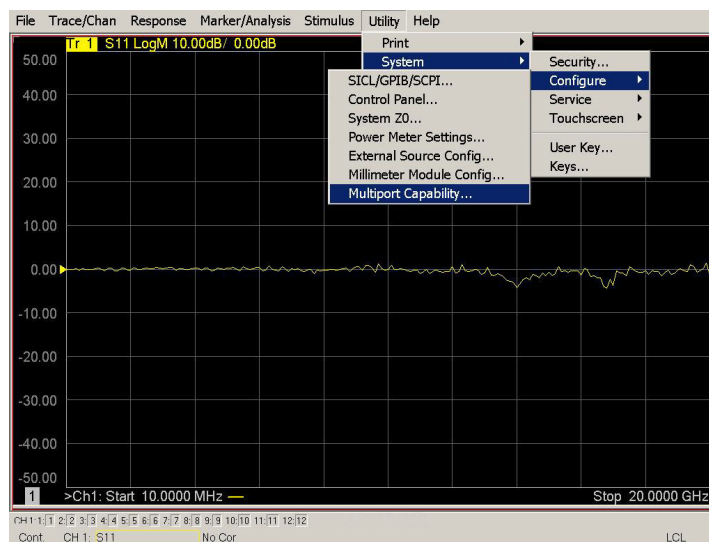
2. Select **U302xAE10** (12-Port system) from the Test Set drop-down menu and select **Restart as a Multiport PNA with this test set** > **OK**. The PNA will restart the network application with the U302xAE10 Multiport Test Set interface features.

Figure 14   U302xAE10 Selection
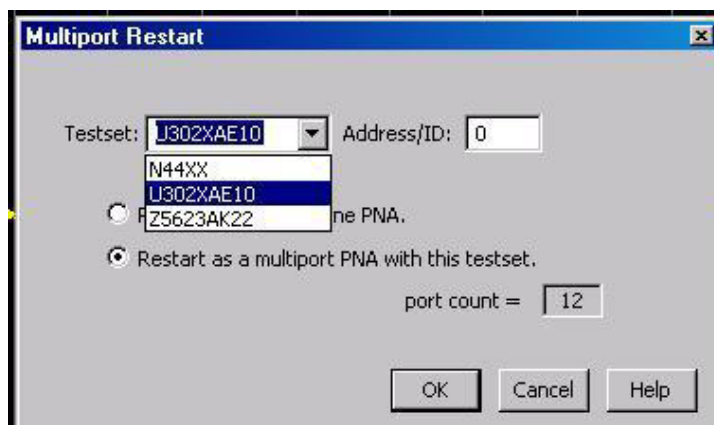
External Test Set Control Feature

To verify that the network application has the U302xAE10 interface features, select **Trace/Chan** > **Channel** > **Hardware Setup** > **External Test Set** > **Other**. The Test Set will be displayed as **External Test Set Control-U302xAE10**.

Figure 15   External Test Set Control
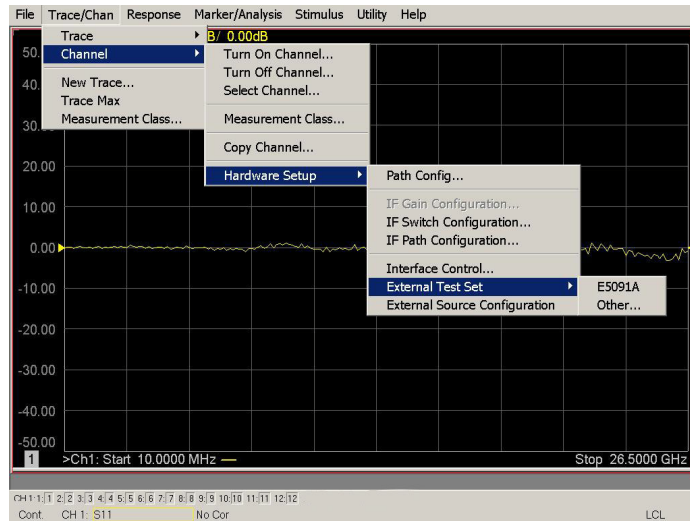
This menu will allow the physical Ports 1 through 12 to be identified as any port for your convenience. For example; Port 5 can be named Port 2.

The **External Test Set Control-U302xAE10** also allows control of the DUT control lines, refer to "DUT Control Lines" on page 27. To change the state from LOW to HIGH, select the graphical user interface (GUI) for the specific control (LINE 1 through 8) and then select **OK**. Each line can be controlled separately.

Figure 16   External Test Set U302xAE10 (Port 1 - 8)
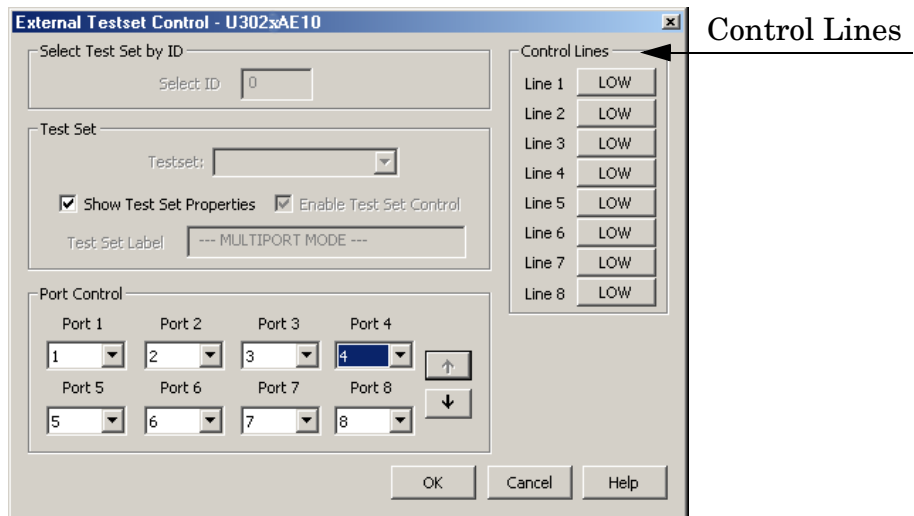
Select the **Port Control** down arrow for Ports 9 through 12.

Figure 17   External Test Set U302xAE10 (Port 9 - 12)
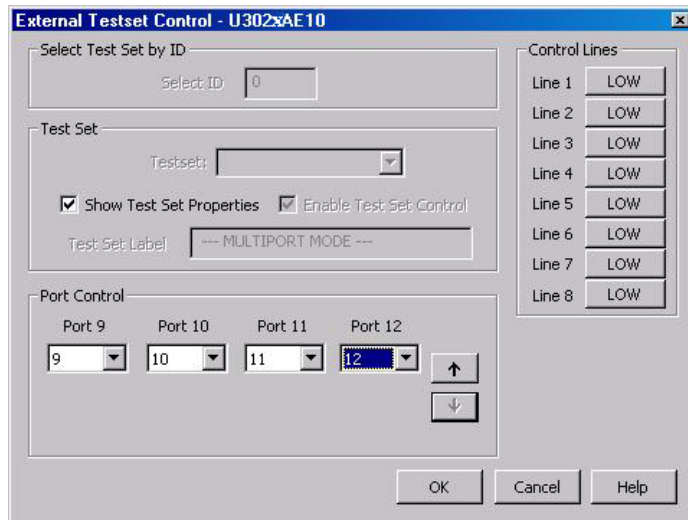
Trace Measure S-Parameter

S-Parameter selection can be accomplished using **Response** > **Measure**. Use the drop-down menus to select 1 of 144 S-Parameters for the 12-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.

Figure 18   12-Port Trace Measure
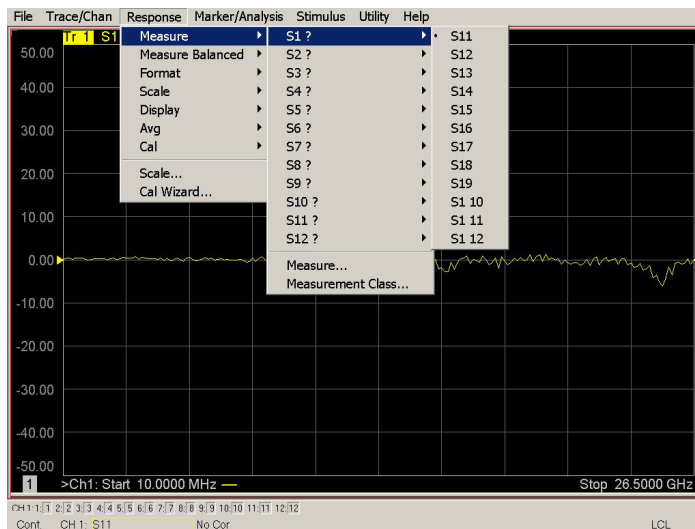
New Trace Measure S-Parameter

S-Parameter Tab: Multiple S-Parameters can be made by selecting **Trace/Chan** > **Trace** > **New Trace**. Use the drop-down menu and select of any of the 144 S-Parameter's.

Figure 19   Selecting PNA New Trace Measure
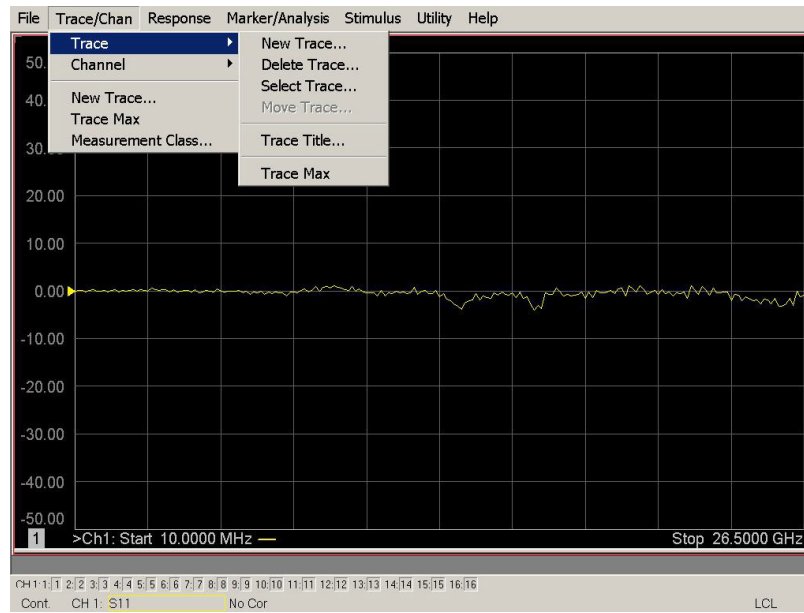
Figure 20   12-Port New Trace Measure (S11 - S88)
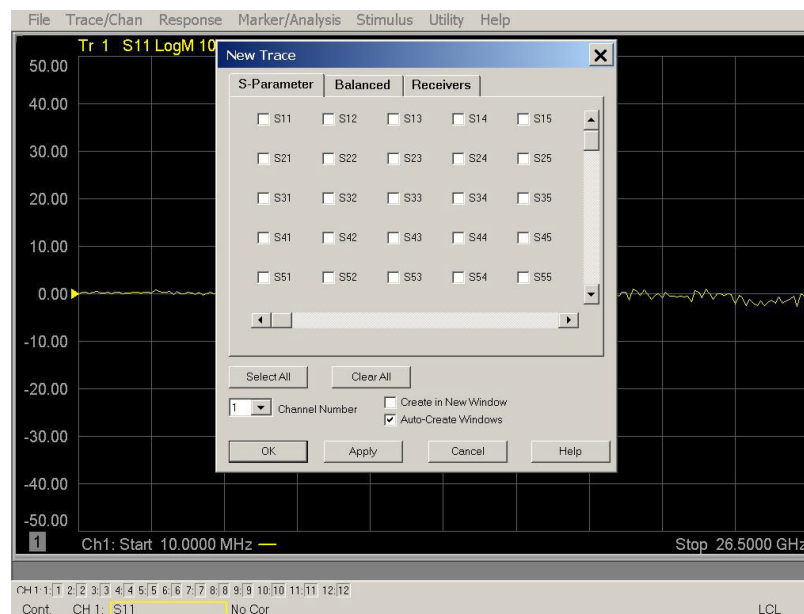
Figure 21   12-Port New Trace Measure (S88 - S12_12)
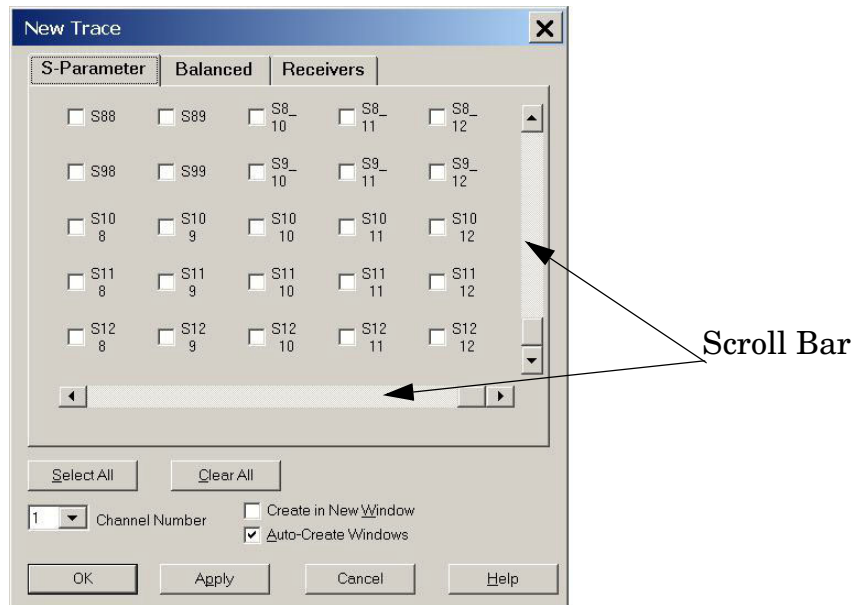
Balanced Tab: Balanced Measurements can be configured by selecting the Balance tab in the New Trace menu.

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.home.agilent.com. In the search menu type in "Multiport and Balanced."

Figure 22   Balance
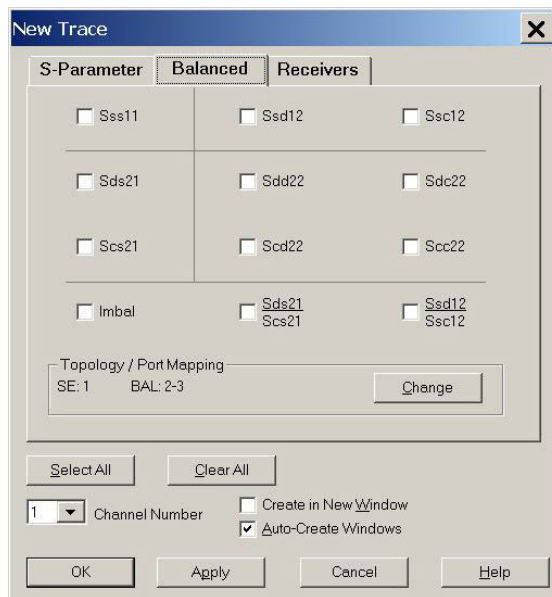
Receivers Tab: The S-Parameter measurements can be ratioed with selectable Denominators for each port and receiver. Refer to the standard PNA-X documentation for more information.

Figure 23 Receiver Ports

Sweep Setup for Multiport and Standalone PNA Modes

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

1. On the PNA select **STIMULAS** > **Sweep** > **Sweep Setup**.

2. Select **Stepped Sweep**.

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

Figure 24   ECal Characterization
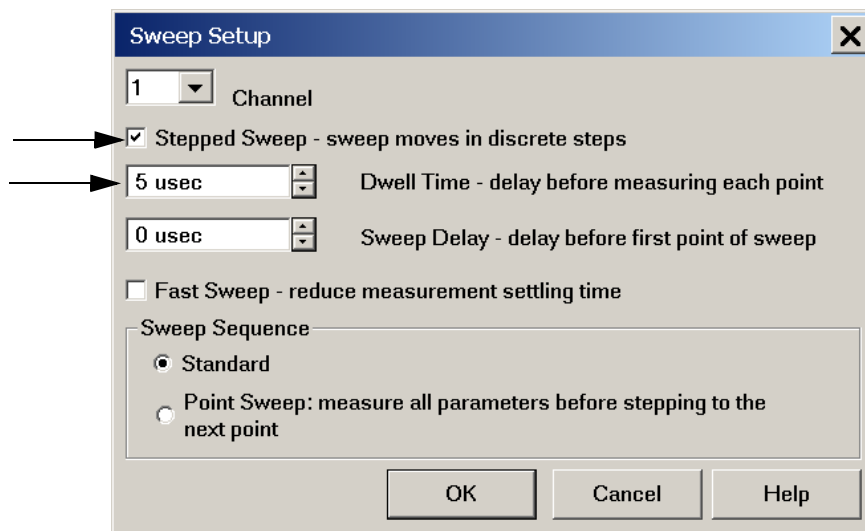
N-Port Calibration with E8363/4C and N5230C

It is recommended that you perform an ECal characterization to minimize the connections required for multiple port calibration. The N4693A Option M0F is recommended with cable (85133F) if you are calibrating at the PNA 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**.

Calibrate at the end of the test port RF cables and any adapters that are used to connect the DUT. This removes the effect on the measurement of the DUT. Failure to do this will create ripple and other measurement errors. Refer to the PNA Help menu, Ecal > user-characterization.

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 Agilent Service or firmware web page for the latest PNA, PNA-L or PNA-X Option 551 firmware revisions and history. http:\\na.tm.agilent.compna\firmware\firmware.htm.

Figure 25   ECal Characterization
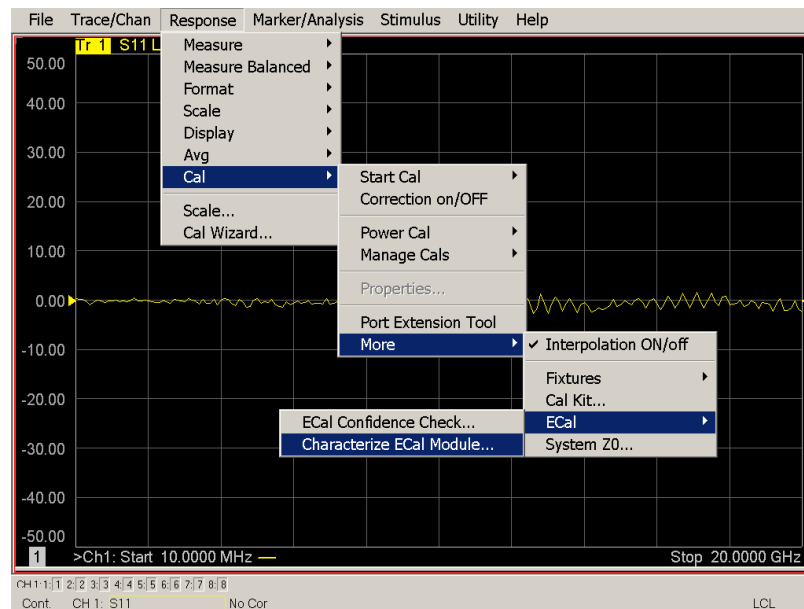
1. On the network analyzer select **Response** > **Cal Wizard**.

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

   b. If using an ECal module, connect the ECal to an available PNA USB port and select **Use Electronic Calibration (ECal)** > **Next**.

2. Continue following the Cal Wizard prompts. In the Select Calibration Ports and ECal Module dialog box press **Select All**, or select the ports you are calibrating and select **Next**.

Figure 26   12-Port Calibration
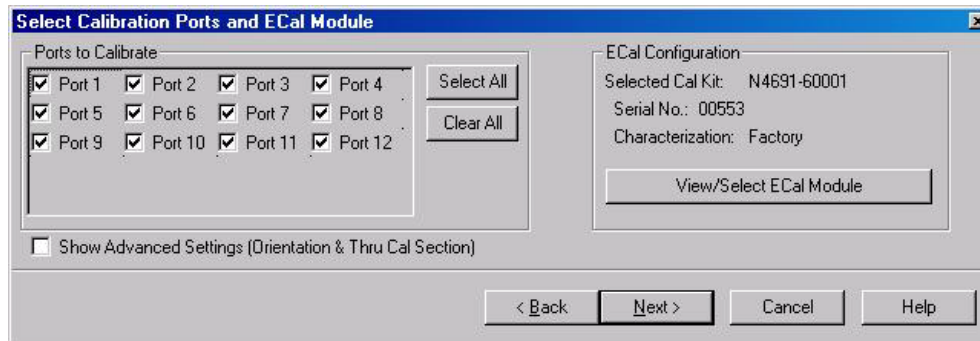
3. Connect the ECal or the mechanical cal kit to the ports you are calibrating following the Cal Wizard prompts and press **Measure** after each connection.

4. At the Calibration Completed prompt select **Save As User Calset,** type the name and **Save**. See Figure 32 on page 34.

5. After calibrating Test Set ports, use a quality load and short to verify the calibration on each port or end of the test cable. Measure reflection and confirm the return loss is as expected. If the result is not as expected, repeat the calibration without the Test Set and ensure that the PNA 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 Agilent Service or firmware web page for the latest PNA Option 551 firmware revisions and history.
http:\\na.tm.agilent.compna\firmware\firmware.htm.

DUT Control Lines

The 15 pin female D-Sub connector on the rear 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 8 and Figure 30 on page 31.

Setting the DUT Control Interface

This section describes how to control the DUT control lines. Refer to "Controlling the System with E8363/4C and N5230C". For more information regarding the control lines, see Table 6 on page 27 and Table 7 on page 28.

Table 6   Test Set DUT Control Address and Data

Address	Data	Data AD12–AD0	Description								Bit Data 0= +Voltage 1= –Voltage
112	0	0000000000000	ALL DUT Control Lines set to 0 or + voltage								
112	255	0000001111111	ALL DUT Control Lines set to 0 or – voltage								
112	1	00000xxxxxxxB	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											
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   All DUT control lines must be set with each command sent. Logic 0 = high

---

Figure 27   DUT Control Line Pin Assignment
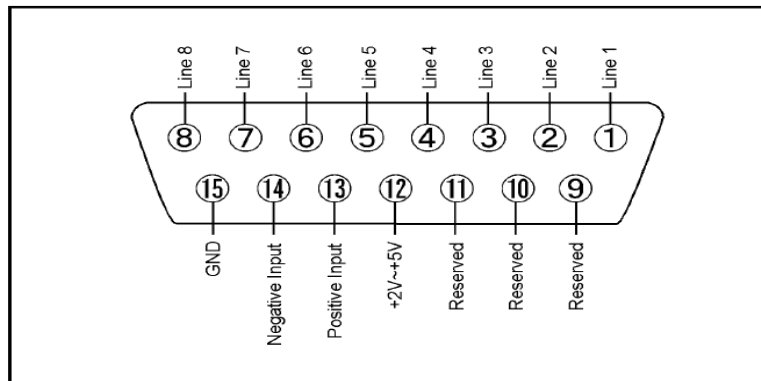
Table 7   DUT Control Line Pin Assignment

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 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

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 U3025AE10.

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 to the DUT Control Lines

Figure 28 illustrates an example of the connection between the DUT and the U3025AE10 *without* an external dc power supply. Connect pin 12 to pin 13 for +5 V, and pin 14 to pin 15 to provide the ground path. Connect each DUT control line to the external device under test.

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

Figure 28   Control Line Connector
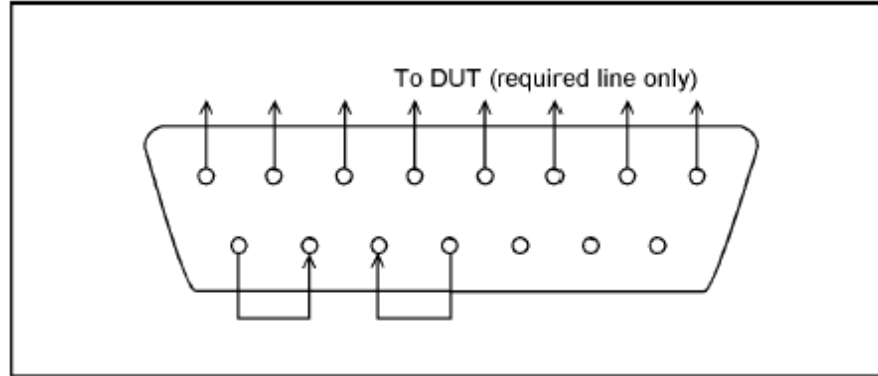
Using an External Power Supply

Figure 29 illustrates an example of the connection between the DUT and the U3025AE10 *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.

Turning On the U3025AE10 using an External Power Supply.

1. Turning On the U3025AE10.

2. Connect the DUT.

3. Turn On the external power supply.

Turning Off the U3025AE10 using an External Power Supply.

1. Turning Off the Power Supply.

2. Turning Off the U3025AE10.

3. Disconnect the DUT.

Figure 29   U3025AE10 to the DUT and External DC Power Supply
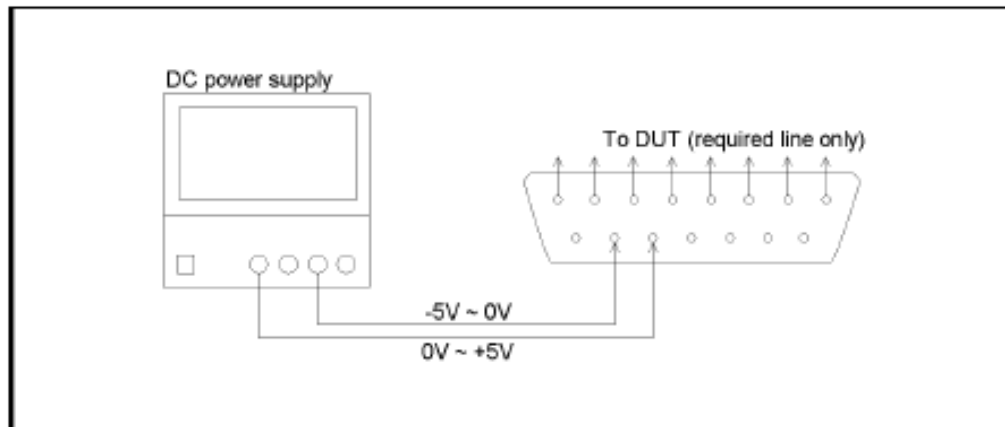
Table 8   **DUT Control Specifications**

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 30   Block Diagram of DUT Control
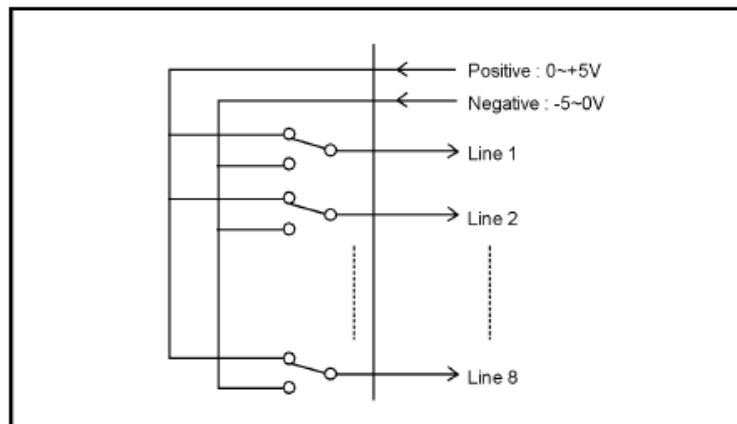
Operational Check Procedures

This section provides the test calibration procedure to confirm the U3025AE10 and PNA operational performance. The operation verification limits provided ensure that your U3025AE10 and PNA are operating properly.

Verification Limits

Specifications for the U3025AE10 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 U3025AE10 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 9   Operational Check Reflection Tracking Loss

Frequency	Standard (dB)	Option 001 (dB)
10 MHz to 45 MHz	−0.5	−1.0
45 MHz to 500 MHz	+3.0	+2.5
500 MHz to 2 GHz	+0.5	0
2 GHz to 10 GHz	−1.5	−2.0
10 GHz to 20 GHz	−3.5	−4.0
20 GHz to 30 GHz	−6.5	−11.5
30 GHz to 40 GHz	−8.0	−12.5
40 GHz to 45 GHz	−10.5	−14.0
45 GHz to 50 GHz	−12.5	−16.0

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

Equipment Required

The Agilent U3025AE10 requires that the user be familiar with the equipment and components listed in Table 10.

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

Table 10   Equipment List

Description	Qty
E8364C 2-Port Network Analyzer (Option 014 or 551) *or* N5230C 2-Port Network Analyzer (Option 525 or 551)	1
N4693A ECal Module with a female connector, or a 2.4 mm Cal kit (85056B, 85057D, etc.)	1
Set of interconnect cables (PNA and Test Set), see "RF Interface Cable Connections" on page 15.	1

E8363/4C and N5230C Procedure

1. Connect the Test Set to the 2-Port E8363/4C or N5230C 2-Port PNA as shown in Figure 10 on page 15, and Table 5 on page 15.

2. Turn On the Test Set.

3. On the E8363/4C and N5230C, select **Response** > **CAL** > **Manage Cals** > **Cal Set**. Delete or Rename any Cal Sets titled "999.1" thru "999.12" (12-Port), although it is unlikely that you will find Cal Sets with these names.

4. Verify that the PNA is in 12-Port. See the bottom of the measurement window.

    a.   If only four S-Parameters are listed, select **Utility** > **System** > **Configure** > **Multiport Capability**. Select **Restart as multiport PNA with this test set** and select **U302xAE10** (12-Port).

5. Press **Preset.**

6. Verify that the **[Stop Frequency]** is set to **[50 GHz]**.

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

8. Verify that the **[Power]** is to set to **[−17 dBm]**. If not, press **[Power]** > **Power Level** and enter **[−17 dBm].**

9. Select **Response** > **Avg > IF Bandwidth** > **100 Hz**.

10. Select **Stimulus** > **Sweep** > **Number of Points** > **401**.

11. Connect the ECal module to the network analyzer 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" step 2 on page 34.

12. 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. Refer to Figure 1 on page 2. For more information refer to the system Help menu.

2. Perform a 1-Port Calibration on Port 1. On the PNA, select **Response** > **Cal > Start Cal > Calibration Wizard**.

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

   b. If using an ECal module, connect the ECal to a PNA USB port. Select **Use Electronic Calibration (ECal)** > **Next**.

3. Continue following the Cal Wizard prompts. In the Select Calibration Ports and ECal Module dialog box press **Clear All** and select **Port 1** > **Next** and select **Measure**.

Figure 31   1-Port Calibration
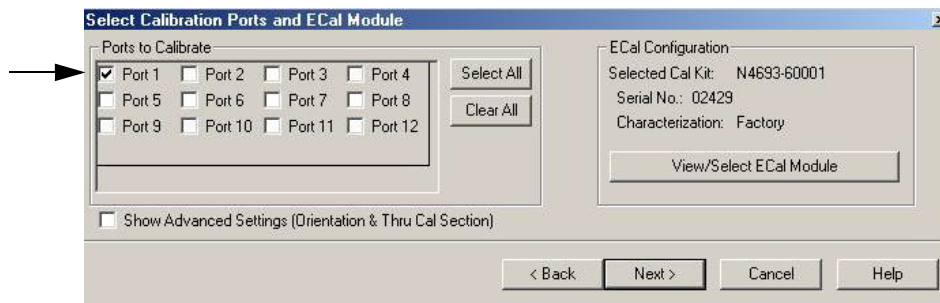
4. Continue to follow the prompts until the "Calibration Completed" window appears.

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

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

Figure 32   Calibration Complete
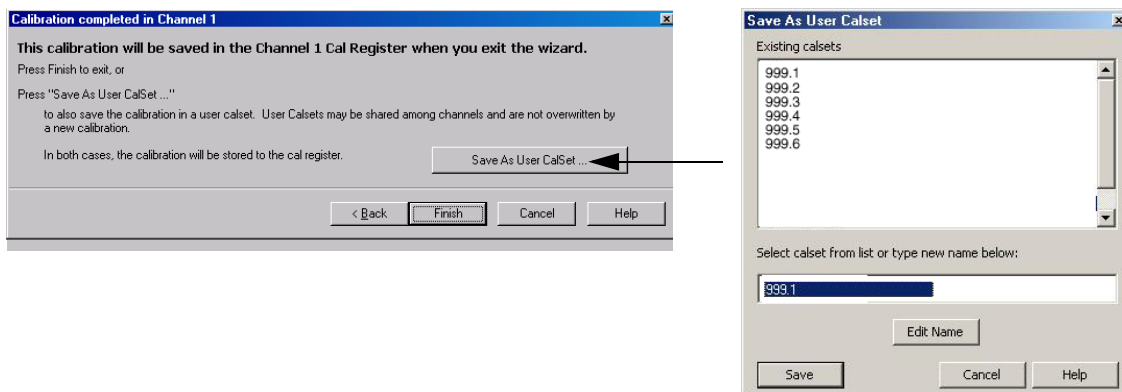
6. Repeat step 1 thru step 5 (1-Port Calibration Procedure) for Ports 2 thru 12. When finished, there should be twelve Cal Sets saved with the titles "999.1" thru "999.12" (12-Port).

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

Figure 33   ECal Confidence Check
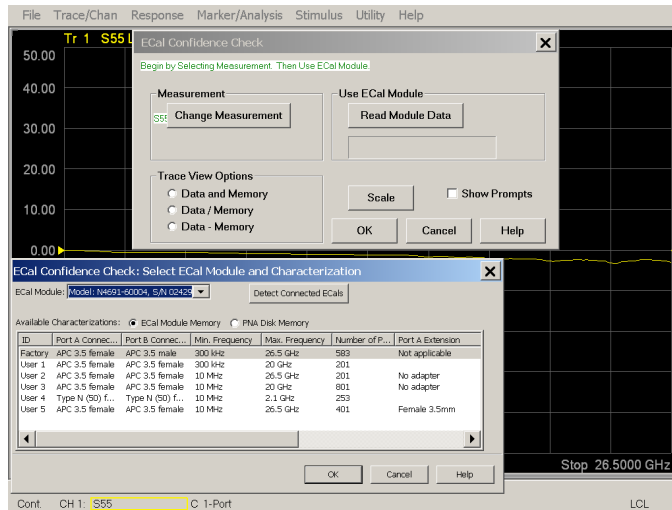
7. Press **Trace/Chan** > **Trace** > **Delete Trace**. There should be no traces on the PNA screen.

8. To launch the Cal Set Viewer toolbar select **Response** > **Cal** > **Manage Cals** > **Cal Set Viewer**.

Figure 34   Calibration, Cal Set Viewer
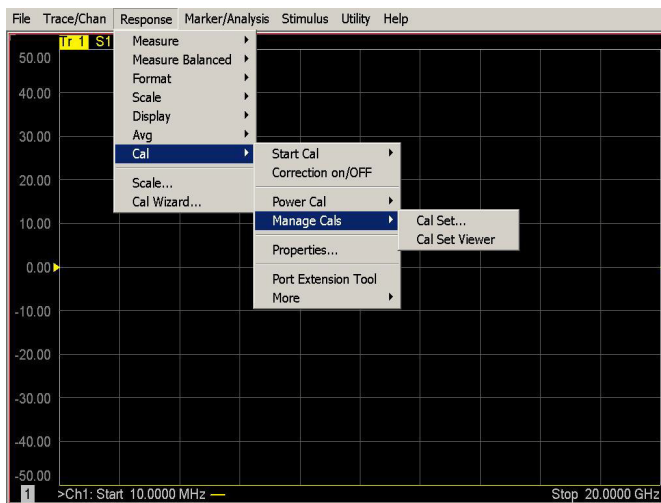
9. From the Cal Sets drop-down menu, select **999.1** and check **Enable**. Select the **Reflection Tracking(1,1)** term in the center drop-down menu and ensure that the **Enable** and **Error Terms** are selected.

NOTE   You may also create a table on the PNA and enter the limit line stimulus and response values. Select **Marker/Analysis** > **Analysis> Limit Test** > **Limit Test ON** and **Limit Line ON** > **Global pass/fail display ON**, select **Show Table**.

Figure 35   PNA-X Setting the Test Limits
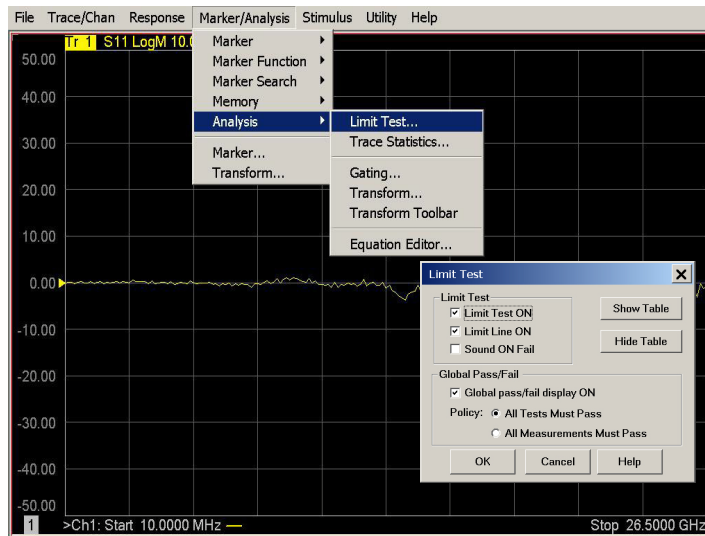
Figure 36   Reflection Tracking Trace (Port 1-12)

10.Compare the Reflection Tracking (1,1) trace to the appropriate limits in Table 9 on page 32. This can be done using Limit Lines, select **Marker/Analysis** > **Analysis** > **Limit Test** > **Limit Test ON** and **Limit Line ON** > **Global pass/fail display ON**, select **Show Table.** The trace should be above the limit. PASS will be displayed on the screen if the limit lines are used.

11.Repeat step 9 and step 10 for Cal Sets "999.1" thru "999.12" (12-Port).

NOTE   For Ports 3-12 the response from 10 MHz to 500 MHz is normal due to the PNA-X Couplers in comparison to the U3022AE10 bridges. The bridges have more gain in the coupled RF path.

Troubleshooting Operational Check Failures

If your test results fail the Operational Check limits, verify following:

1. Ensure that the Test Set is turned on and connected properly to the PNA.

2. Check all appropriate network analyzer and Test Set connectors for damage, cleanliness, and proper torque.

3. Repeat the relevant 1-Port calibrations using another ECal or mechanical standard.

4. Verify that the stand-alone network analyzer is operating properly and meeting its published specifications. Refer to "Network Analyzer Requirement" on page 4.

Interconnect Cable Verification

1. Connect the Test Set to the PNA and select Multiport mode.

2. Verify the Source Interconnect RF cables (Source Out and CPLR THRU).

   a. Remove the Receiver and CPLR ARM interconnect cables and install the standard PNA jumpers.

   b. Connect an RF cable from Port 1 to Port 2 on the PNA.

   c. Set the PNA to measure Trace S12 and S21 and verify that there are no power holes. If S12 has a power hole check the Port-2 Source interconnect cables and Test Set connectors for damage. If S21 has a power hole check the Port-1 Source interconnect cables and Test Set connectors for damage.

3. Verify the Receiver Interconnect RF cables (Receiver A IN or B IN and CPLR ARM).

   a. Re-install the Receiver and CPLR ARM interconnect cables.

   b. Remove the Source Out and CPLR THRU interconnect cables and install the standard PNA jumpers.

   c. Connect an RF cable from Port 1 to Port 2 on the PNA.

   d. Set the PNA to measure Trace S12 and S21, and verify that there are no power holes. If S12 has a power hole check the Port-1 Receiver Interconnect cables and Test Set connectors for damage. If S21 has a power hole check the Port-2 Receiver Interconnect cables and Test Set connectors for damage.

4. If the problem still exists, connect the standard jumpers to the PNA (Source and Receiver) and verify the Source Out to CPLR THRU and A/B IN to CPLR ARM switch paths.

   a. Set the PNA to measure trace S12.

   b. Connect Port-1 to Source Out and Port-2 to CPLR THRU connectors on the Test Set. If a power hole still exists refer to "Contacting Agilent" on page 48.

   c. Connect Port-1 to Receiver A IN or B IN and Port-2 to CPLR ARM connectors on the Test Set. If a power hole still exists refer to "Contacting Agilent" on page 48.

Theory of Operation

The following is a description of the operation of the U3025AE10. Reference the U3025AE10 block diagrams shown in Figure 37 on page 40. This section assumes the user has a general understanding of couplers, switches, and network analyzers.

RF Switch Components

All RF switches are mechanical. The switches select the RF paths from the PNA Source and Receiver through interconnect cables to Test Set port paths 3 through 12.

Source to Odd Ports (1-11)

The Port 1 Source Output from the PNA is routed into a matrix of switches in the Test Set. This matrix routes the Source to one of the 6 odd ports and terminates the other odd ports.

Source to Even Ports (2-12)

The Port 2 Source Output from the PNA is routed into a matrix of switches in the Test Set. This matrix routes the Source to one of the 6 even ports and terminates the other even ports.

Receiver to Odd Ports (1-11)

The Port 1 Receiver Input from the PNA is routed into a matrix of switches in the Test Set. This matrix routes one of the signals from the 6 odd ports to the PNA "A Receiver" and terminates the other odd ports.

Receiver to Even Ports (2-12)

The Port 2 Receiver Input from the PNA is routed into a matrix of switches in the Test Set. This matrix routes one of the signals from the 6 even ports to the PNA "B Receiver" and terminates the other even ports.

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 Diagrams

Figure 37   Standard Configuration
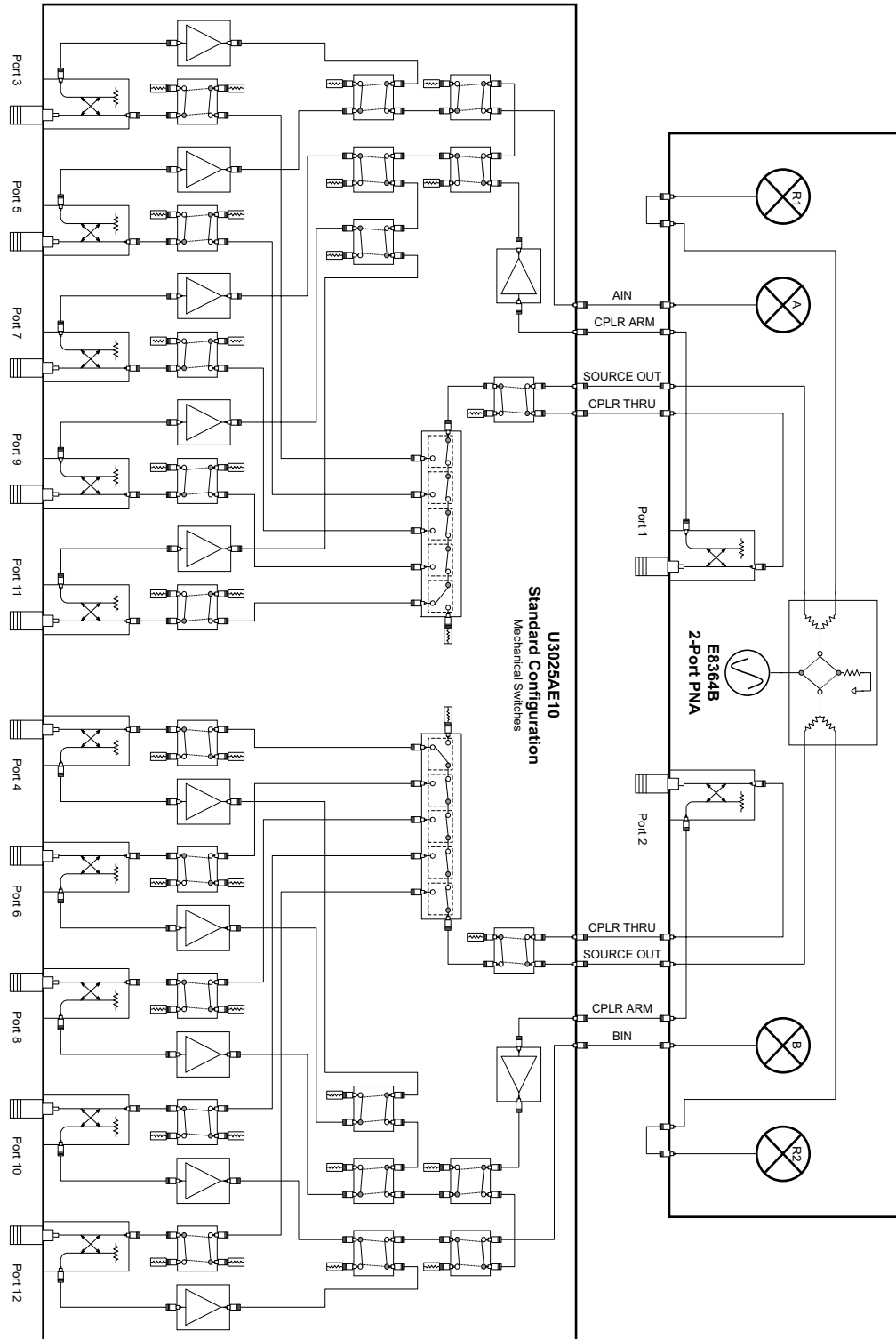
Service Information

Refer to .

| 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	U3025-20044
RF Cable, Semi-rigid	U3025-20045
Lock Feet	5023-0132
Lock Feet Kit	5063-9253
Screw	0515-1619

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.

Safety Earth Ground

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

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

Declaration of Conformity

A copy of the Declaration of Conformity is available upon request, or a copy is available on the Agilent Technologies web site at
http://regulations.corporate.agilent.com/DoC/search.htm

Statement of Compliance

This instrument has been designed and tested in accordance with CAN/CSA 22.2 No. 61010-1-04, UL Std. 61010-1 (2nd Edition), and IEC 61010-1 (Second Edition).

Before Applying Power

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

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

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

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

CAUTION	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.

CAUTION	This instrument has auto-ranging line voltage input, be sure the supply voltage is within the specified range.

Servicing

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

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

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

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

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

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

Connector Care and Cleaning Precautions

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

WARNING	**To prevent electrical shock, disconnect the "Agilent Technologies U3025AE10" 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.**

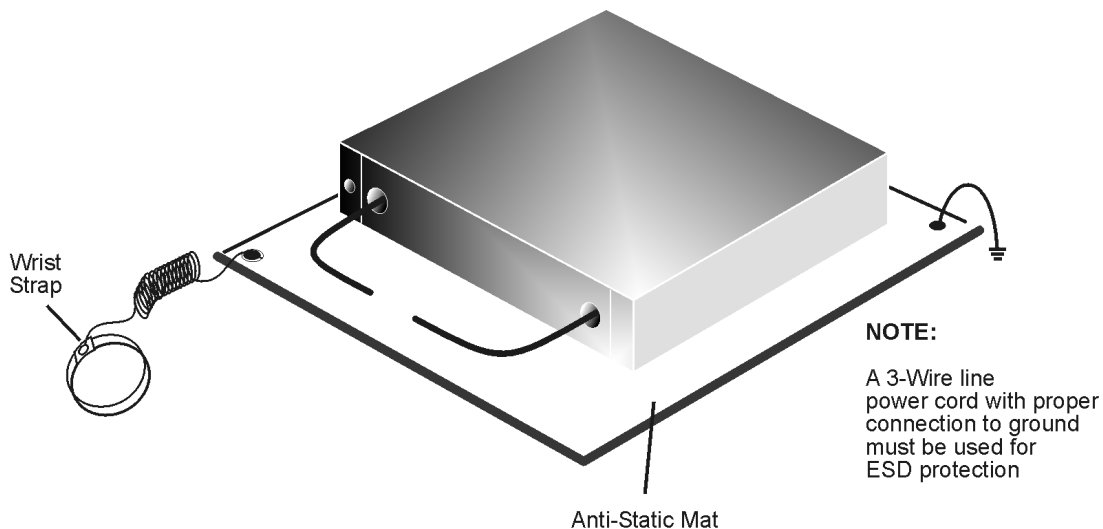|	
WARNING	**If flammable cleaning materials are used, the material shall not be stored, or left open in the area of the equipment. Adequate ventilation shall be assured to prevent the combustion of fumes, or vapors.**

Electrostatic Discharge Protection

Protection against electrostatic discharge (ESD) is essential while removing assemblies from or connecting cables to the instrument. Static electricity can build up on your body and can easily damage sensitive internal circuit elements when discharged. Static discharges too small to be felt can cause permanent damage. To prevent damage to the instrument:

- *always* have a grounded, conductive table mat in front of your test equipment.
- *always* wear a grounded wrist strap with grounding cord, connected to a grounded conductive table mat, having a 1 MΩ resistor in series with it, when handling components and assemblies or when making connections.
- *always* wear a heel strap (9300-1126) when working in an area with a conductive floor. If you are uncertain about the conductivity of your floor, wear a heel strap.
- *always* ground yourself before you clean, inspect, or make a connection to a static-sensitive device or test port. You can, for example, grasp the grounded outer shell of the test port or cable connector briefly.
- *always* ground the center conductor of a test cable before making a connection to the analyzer test port or other static-sensitive device. This can be done as follows:
  1. Connect a short to one end of the cable to short the center conductor to the outer conductor.
  2. While wearing a grounded wrist strap, grasp the outer shell of the cable connector.
  3. Connect the other end of the cable to the test port and remove the short from the cable.

Figure 11   ESD Protection Setup

Wrist Strap

NOTE:

A 3-Wire line power cord with proper connection to ground must be used for ESD protection

Anti-Static Mat

ku310b

Regulatory Information

Instrument Markings

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

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.

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 instrument requires alternating current (ac) input.

This symbol indicates that the power line switch is ON.

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

This symbol indicates that the power line switch is in the OFF position.
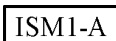
This symbol is used to identify a terminal which is internally connected to the product frame or chassis.

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

The CSA mark is a registered trademark of the CSA International. This instrument complies with Canada: CSA 22.2 No. 61010-1-04.

ISM1-A   This is a symbol of an Industrial Scientific and Medical Group 1 Class A product.

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

Direct Current.

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

N10149   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.

China RoHS regulations include requirements related to packaging, and require compliance to China standard GB18455-2001.

This symbol indicates compliance with the China RoHS regulations for paper/fiberboard packaging.

Battery Collection

Do not throw batteries away but collect as small chemical waste, or in accordance with your country's requirements. You may return the battery to Agilent Technologies for disposal. Refer to "Contacting Agilent" on page 48 for assistance.

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 Maschinenlaermrerordnung-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 2004/108/EC

- IEC/EN 61326-1

- CISPR Pub 11 Group 1, class A

- AS/NZS CISPR 11

- This ISM device complies with Canadian ICES-001.
  Cet appareil ISM est conforme a la norme NMB du Canada.

Agilent Support, Services, and Assistance

Service and Support Options

The standard product warranty is a *one-year return to Agilent Technologies* service warranty.

NOTE   There are many other repair and calibration options available from the Agilent Technologies support organization. These options cover a range of service agreements with varying response times. Contact Agilent for additional information on available service agreements for this product.

Contacting Agilent

Assistance with test and measurements needs and information or finding a local Agilent office are available on the Web at:
http://www.agilent.com/find/assist

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

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

Shipping Your Product to Agilent for Service or Repair

IMPORTANT   Agilent 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 Agilent for repair.

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

- To improve turn-around time, send the PNA and cables used with your Test Set to Agilent to verify operation of the complete system.

- Include a complete description of the service requested or of the failure and a description of any failed test and any error message.

- Remove and retain the front handles and all rack mount hardware. The analyzer should be sent to Agilent in the same configuration as it was originally shipped.

- Ship the analyzer using the original or comparable antistatic packaging materials.

- Contact Agilent for instructions on where to ship your analyzer.