Agilent Technologies Z5623AK44

User's Guide

Use this manual with the following documents:

PNA Series Network Analyzer On–line Help System

Application Note 1408-12

Agilent Technologies

Manufacturing Part Number: Z5623-90081
Printed in USA
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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.

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.

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Introduction

This document describes how to use the Z5623AK44 Multiport Test Set with the Agilent N5230A 4-Port PNA Series Network Analyzer.

Figure 1 Agilent N5230A and Z5623AK44

Description

The Agilent Z5623AK44 is a 4-Port solid state switching extension test set (10 MHz to 20 GHz) for the N5230A 4-Port PNA-L. The N5230A Option 551 with Options 145, 146, 245 or 246 will be referred to as the N5230A PNA-L throughout this document.

When connected to the N5230A 4-Port PNA-L Series Network Analyzer access ports, the Z5623AK44 expands the N5230A PNA-L to an 8-Port network analyzer. Two Z5623AK44 can be used to expand the N5230A PNA-L to a 12-Port network analyzer. The Z5623AK44 allows full cross bar connection to any port for all of the 64 or 144 S-Parameters.

The additional port connectors are the same as the N5230A, 3.5 mm male. The front panel connectors that mate the N5230A PNA-L to the Z5623AK44 (CPLR Thru, CPLR ARM, Source In and RCVR In) are SMA female connectors. The interconnect cables and hardware to lock the Z5623AK44 to the N5230A are supplied with your instrument.

The N5230A rear panel Test Set I/O connector controls the Agilent Z5623AK44 Multiport Test Set. The Z5623AK44 has a 15 pin female D-Sub connector on the front panel that provides control lines and a adjustable voltage source (+2 to +5 Vdc) for customer use. Refer to “Operating the DUT Control Interface” on page 42.

The Z5623A Option K44 has two options available.

- Option 001 provides internal amplifiers to improve dynamic range.
- Option 002 provides internal amplifiers and bias tee’s to improve dynamic range and enable the customer to apply a voltage bias for each port. The bias voltage BNC input connectors are located on the rear panel.
- Cable sets for the 8-Port and 12-Port network analyzer configuration are available. Refer to Table 1 on page 4.

Z5623AK44

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 Sales and Service Offices" on page 73. Keep the damaged shipping materials (if any) for inspection by the carrier and an Agilent Technologies representative.

Table 1, "Option 012 Content List," and Table 2, "Option 008 Content List,"contain the accessories shipped with your Z5623AK44.

Table 1 Option 012 Content List

Agilent Part Number	Description	Qty
9320-0333	Envelope-Cal Certificate	1
9320-6636	Function Test Certificate	1
Z5623-90081	User's Guide	1
8120-6818	Test Set I/O Cable	1
5063-9253	Lock Feet	1
Z5623-20649	RF Cable Semi-rigid	8
Z5623-20650	RF Cable Semi-rigid	8
Z5623-80075	Label, Do not Use	4
Z5623-80076	Label, Port 9	1
Z5623-80077	Label, Port 10	1
Z5623-80078	Label, Port 11	1
Z5623-80079	Label, Port 12	1
Z5623-80080	Label, Port 9	1
Z5623-80081	Label, Port 10	1
Z5623-80082	Label, Port 11	1
Z5623-80083	Label, Port 12	1

Table 2 Option 008 Content List

Agilent Part Number	Description	Qty
9320-6636	Calibration Certificate (envelope)	1
9320-0333	Envelope-Cal Certificate	
Z5623-90081	User's Guide	1
5023-0132	Locking Feet (set)	1
5063-9253	Lock Feet	1
8120-6818	Test Set I/O Cable	2
Z5623-20418	Interconnect RF Cable (3 inch)	8
Z5623-20419	Interconnect RF Cables (4.5 inch)	8

General Specifications

Specifications for the Z5623AK44 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 only offered for the Z5623AK44.

NOTE When connected to a PNA, this test set will degrade the performance at the test ports. The internal solid–state 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 15 dB, and power to the receivers can also be reduced by as much as 15 dB. This will decrease the dynamic range (depending on the frequency) by as much as 31 dB.

Power Requirements

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

- Three–wire power cables (which provide a safety ground) must be used with all instruments.
- 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 3 contains the maximum VA rating and BTU/hour rating 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 3 Power Requirements

Standard Equipment		
Instrument	**Maximum VA Rating**	**Maximum BTU/Hour**
N5230A	350	1195
Z5623AK44	320	1095
Total	670	2290

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 system are listed in Table 4. Note that these requirements are the same as those of the N5230A PNA-L. 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 4 Operating Environment

Temperature	
Operation	5 °C to 40 °C (41 °F to 104 °F)
Storage	–40 °C to +65 °C (–40 °F to +158 °F)
MeasurementCalibration	20 °C to 26 °C (68 °F to 79 °F)
PerformanceVerification	Temperature must be within 1 °C (1.8 °F) of the temperature at which the measurement calibration was performed.
Relative Humidity	
Operation	5% to 95% at 40 °C or less (non-condensing)
Storage	5% to 95% at 65 °C or less (non-condensing)
Pressure Altitude (Operation or Storage)	Less than 4600 meters (~ 15,000 feet)

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 3.

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 Z5623AK44 and PNA includes configuration and installation on a customer provided lab bench or table top of adequate size and strength.

Table 5 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 6 Instrument Dimensions

Model	Weight	Height	Width	Depth
N5230A	29 kg (75 lb, ±0.5 lb)	26.7 cm (10.5 in)	42.5 cm (16.7 in)	42.6 cm (16.8 in)
Z5623AK44	18.2 kg (40 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 Z5623AK44 frequency range is 10 MHz to 20 GHz, although the standard Z5623AK44 is usable to 300 kHz. The Z5623A Option 001 and 002 are not usable below 10 MHz do to the amplifiers and bias tee's.

CAUTION It is recommend that you do not operate components near damage levels (+27 dBm). The power levels must be 3 dB below maximum level to ensure no damage. See Table 7.

Table 7 Power Levels

Test Setup	Power Level
Maximum Z5623AK44 Multiport Test Set RF Power Levels:	
PORT 5-12	+27 dBm 0 Vdc
SOURCE IN	+20 dBm 0 Vdc
CPLR ARM	+20 dbm 0 Vdc
CPLR THRU	+20 dBm 0 Vdc
RVCR A-D	+20 dBm 0 Vdc
AUX CPLR	+20 dBm 0 Vdc
AUX SOURCE	+20 dBm 0 Vdc
Bias Tee Inputs 1-12	+25 Vdc (0.5 Amps)
Damage Power Levels to Z5623AK44 Access and Test Ports:	
Max Level to Port 1, 2, 3 and 4 Test Ports	+27 dBm (0 Vdc)

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

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

Z5623AK44 Test Set Front and Rear Panel Features

Figure 2 Front Panel (Multiport Test Set)

Front Panel LED

Power On = When the test set is turned On (toggle switch to 1) the LED is illuminated. When the test set is turned Off the LED is Off.

Port 5 – Off indicates PNA Port 1 is the source or receiver.
S – On indicates source Port 5, R – On indicates receiver is Port 5.

Port 6 – Off indicates PNA Port 2 is the source or receiver.
S – On indicates source Port 6, R – On indicates receiver is Port 6.

Port 7 – Off indicates PNA Port 3 is the source or receiver.
S – On indicates source Port 7, R – On indicates receiver is Port 7.

Port 8 – Off indicates PNA Port 4 is the source or receiver.
S – On indicates source Port 8, R – On indicates receiver is Port 8.

AUX1 – On indicates Source connection to SOURCE IN and CPLR Jumper to Port 5, Off indicates Source to CPLR connection Port (amber)

AUX2 – On indicates Source connection to SOURCE IN and CPLR Jumper to Port 8, Off indicates Source to CPLR connection Port (amber)

Test Ports – 3.5 mm Bulkhead (male)

- Port 5–8

AUX – 3.5 mm Bulkhead (female)

- SOURCE
- CPLR

Access Ports – 3.5 mm (female)

- SOURCE IN
- CPLR THRU
- CPLR ARM
- RCVR A – D IN

Line Switch

- **0** – OFF
- **1** – ON (Power LED On)

Figure 3 Rear Panel (Multiport Test Set)

Bias Tee Fuses

- Provides protection for each of the bias tee's. Fast blow (F 0.5 A/250V, 2110-0012).

BNC Inputs

- The rear panel BNC Inputs are bias tee inputs for each port. Maximum recommended DC voltage is 25 Volts due to the 50 Volt capacitor inside of the bias tee's. Each input is fuse protected.

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 4 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 4 Line Fuse

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

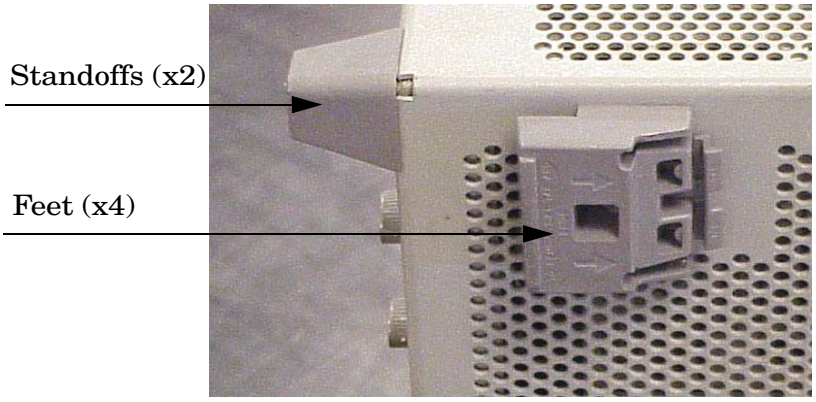
System Setup for 8-Port Configuration

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

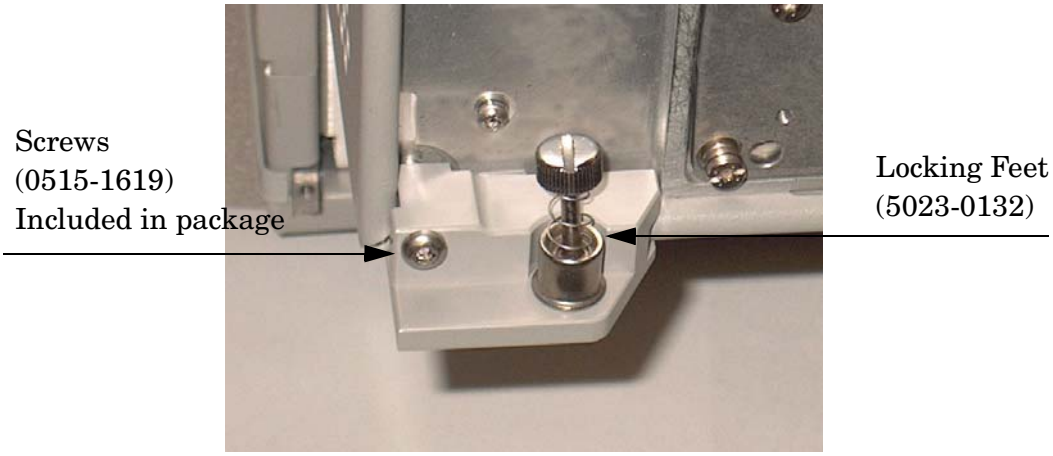
1. Remove the feet from the bottom of the network analyzer. Refer to Figure 5.

Figure 5 Rear Bottom Feet



2. Remove the 2 lower standoffs and screws (0515-1619) from the rear panel on the network analyzer. Refer to Figure 5.
3. Install the two rear locking feet (5023-0132) using the included screws (0515-1619), where the standoffs were removed. Refer to Figure 6.

Figure 6 Installing Lock Feet



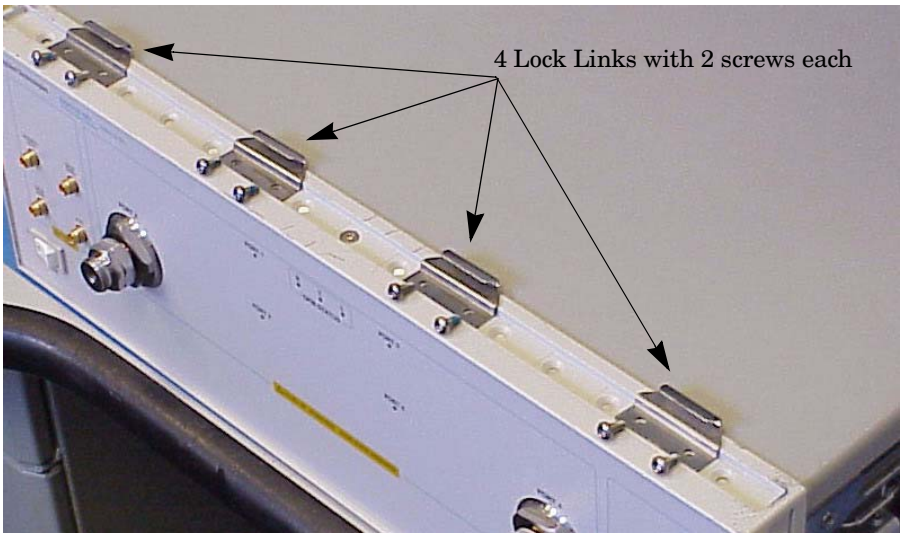
Preparing the Test Set

1. Remove the two standoffs and screws (0515-1619) from the rear panel on the test set. Refer to Figure 7.
2. Install the top left and right rear locking feet from the kit (5063-9253) using screws (0515-1244). The 8-Port configuration does not require the bottom feet.

Figure 7 Rear Locking Feet

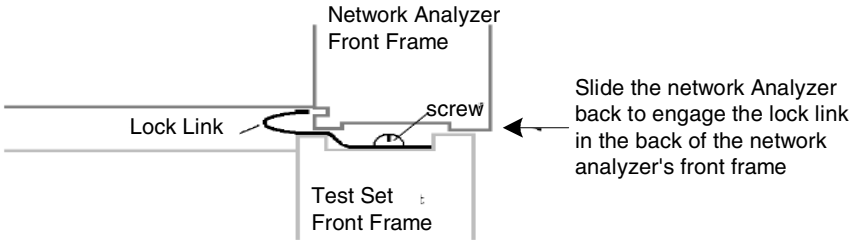
3. Remove the front frame top trim strip from the Test Set.
4. Install the four lock links (1600-1423) included in the kit (5063-9283) on the top of the front frame, using 8 screws (0515-1499). Refer to Figure 8.

Figure 8 Lock Links



5. 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 9.

Figure 9 Locking the Analyzer's



6. 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 10. 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 10 Locking Feet Screws

8-Port RF Cable Connections

Figure 11 on page 17 illustrates the setup configuration of the Z5623AK44 Multiport Test Set and how it should be configured to the N5230A 4–Port PNA–L Series Network Analyzer.

1. Connect the RF cables supplied with this option between the N5230A 4–Port PNA–L Series Network Analyzer and the Z5623AK44 Test Set. Torque each cable to 8 in-lb. Refer to in Table 8 and Figure 11 on page 17.

CAUTION Each end of the interconnect 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. Refer to Figure 11, "8-Port Setup Configuration."

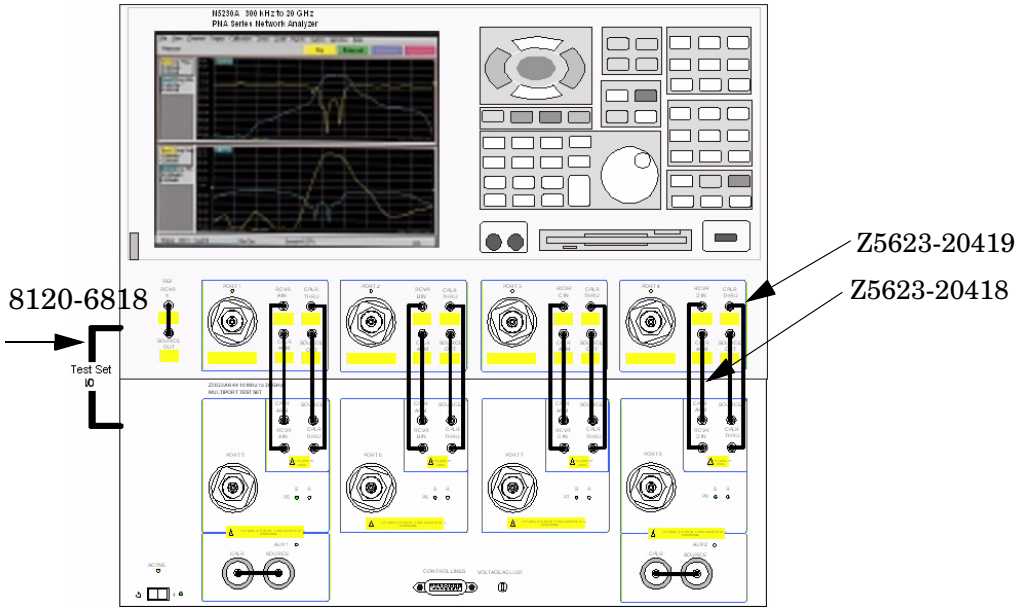
CAUTION Over torque will cause damage to the test set and may cause connectors to spin or become loose.

Table 8 8-Port Cable Connection

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

2. Connect the PNA–L Test Set I/O cable (8120-6818) to the Z5623AK44 Test Set Interface on the rear panel.
   - From the PNA TEST SET I/O connector to the Z5623AK44 Test Set Interface connector on the rear panel.

Figure 11 8-Port Setup Configuration



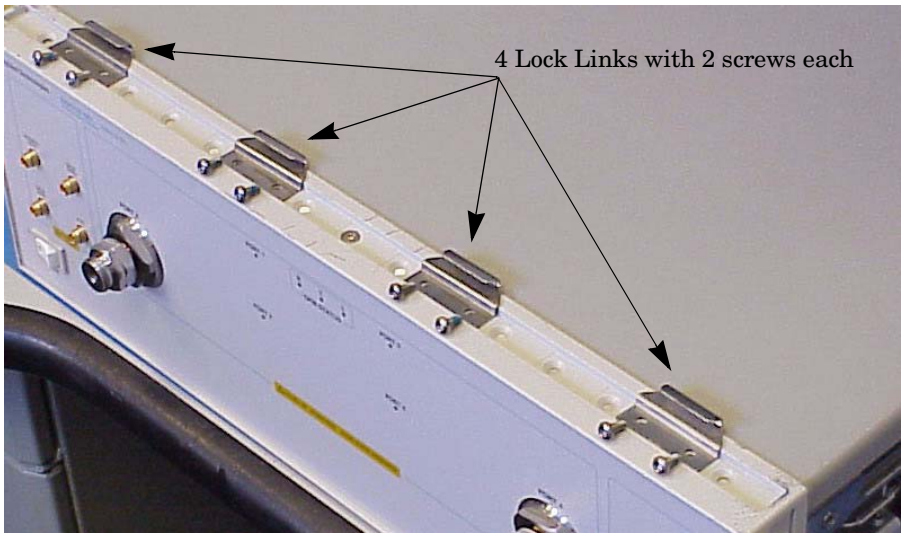
System Setup for 12-Port Configuration

For 12-Port network analyzer configurations, the second Z5623AK44 (located on the bottom of the instrument stack up) bias tee inputs and front panel will be labeled with new port numbers. The bias tee Ports 1-4 are active on the bottom Z5623AK44 and not functional on the top Z5623AK44. The DUT control lines are only active on the bottom test set. The top two Z5623AK44 are to be labeled “DO NOT USE”.

Preparing the Z5623AK44 Test Set (bottom Ports 9-12)

1. Add the rear panel Bias Tee port labels to the bottom Z56544AK44.
   - Port 9 over Port 5 (Z5623-80076)
   - Port 10 over Port 6 (Z5623-80077)
   - Port 11 over Port 7 (Z5623-80078)
   - Port 12 over Port 8 (Z5623-80079)
2. Add the front panel port labels to the bottom Z56544AK44.
   - Port 9 over Port 5 (Z5623-80080)
   - Port 10 over Port 6 (Z5623-80081)
   - Port 11 over Port 7 (Z5623-80082)
   - Port 12 over Port 8 (Z5623-80083)
3. Remove the front frame top trim strip from the Test Set.
4. Install the four lock links (1600-1423) included in the kit (5063-9283) on the top of the front frame, using 8 screws (0515-1499). Refer to Figure 12.

Figure 12 Lock Links

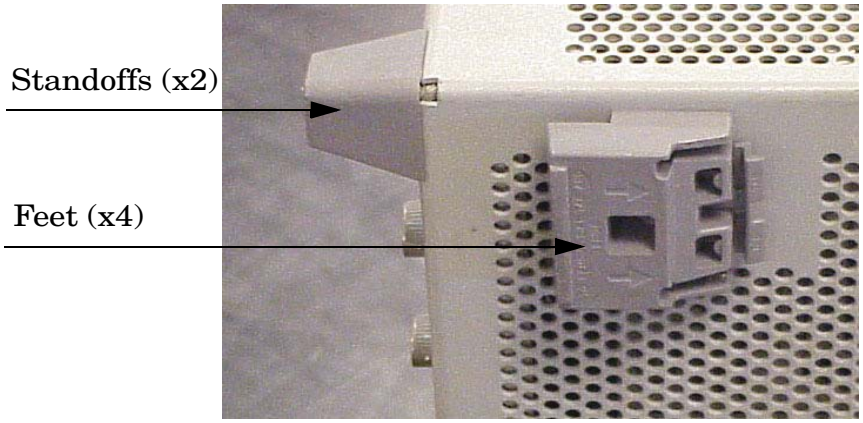


5. Remove the two standoffs and screws (0515-1619) from the rear panel on the test set. Refer to Figure 13.
6. Install the top left and right rear locking feet from the kit (5063-9253) using screws (0515-1244). The 8-Port configuration does not require the bottom feet. Refer to Figure 7 on page 14.

Preparing the Z5623AK44 Test Set (top Ports 5-8)

1. Add four “Do Not Use” labels (Z5623-80075) over the Port 1-4 silk screening on the rear panel of the top Z5623AK44.
2. Remove the feet from the top Z5623AK44 Test Set. Refer to Figure 13.
3. Remove the four standoffs and screws (0515-1619) from the rear panel on the test set.

Figure 13 Preparing the Z5623AK44 Test Set (top Port 5-8)

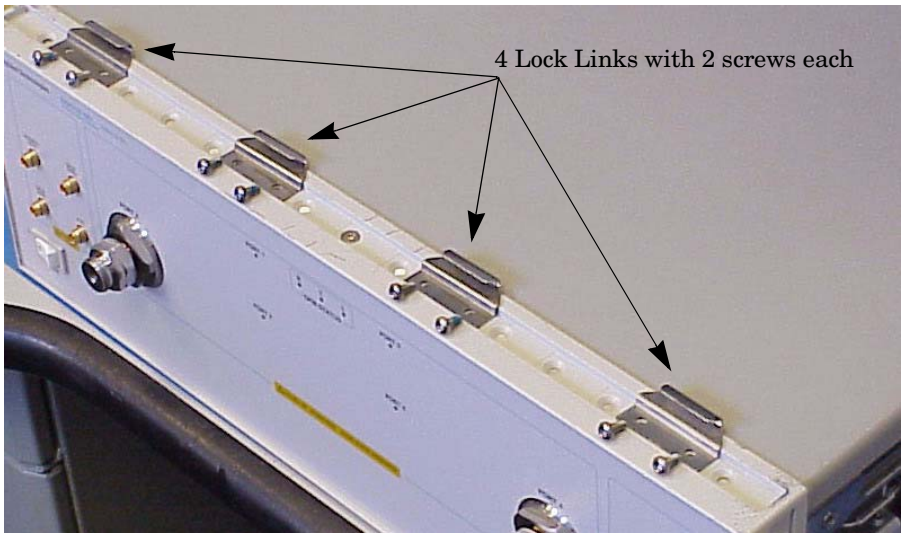


4. Install four rear panel locking feet from the kit (5063-9253) using the screws (0515-1244), where the standoffs were removed. Refer to the instructions inclosed in the kit. See Figure 14.

Figure 14 Installing Lock Feet

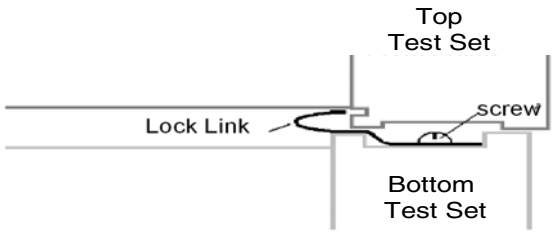
5. Remove the front frame top trim strip from the Test Set.
6. Install the four lock links (1600-1423) on the top of the front frame, using 8 screws (0515-1499). Refer to Figure 15.

Figure 15 Lock Links



7. Place the top Z5623AK44 Test Set on top of the bottom Z5623AK44 Test Set. Ensure that the front frame of the top Z5623AK44 Test Set is positioned slightly forward of the locks that are attached to the bottom Z5623A K44 Test Set. Slide the top test set back so the locks engage the front frame of the bottom test set. Refer to Figure 16.

Figure 16 Locking the Test Sets



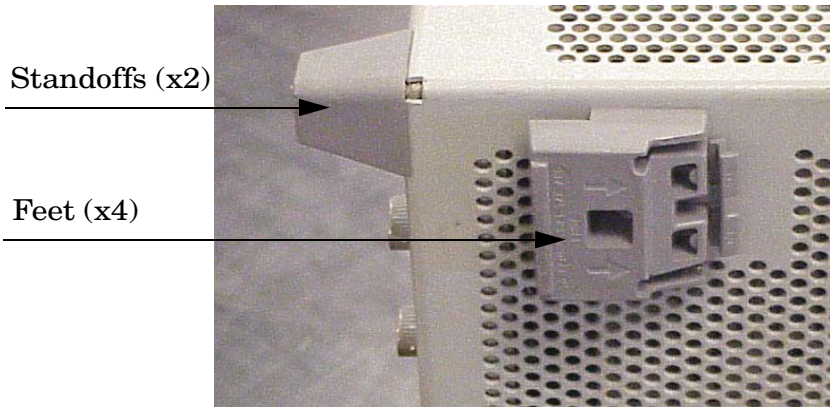
8. Secure the top test sets lower locking feet to the bottom test set upper locking feet, using the spring–loaded screws on the locking feet. Refer to Figure 17. If the network analyzer's lower locking feet are not aligned with the screw holes in the Test Set's upper locking feet, loosen the screws securing the feet to the instrument slightly to align.

Figure 17 Locking Feet Screws

Preparing the PNA Network Analyzer

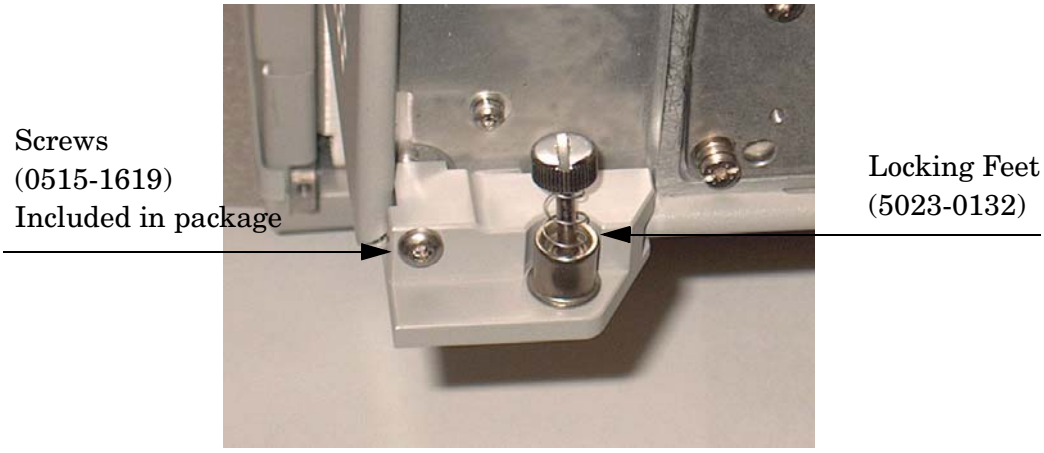
1. Remove the feet from the bottom of the network analyzer. Refer to Figure 18.
2. Remove the 2 lower standoffs and screws (0515-1619) from the rear panel on the network analyzer. Refer to Figure 18.

Figure 18 Rear Bottom Feet



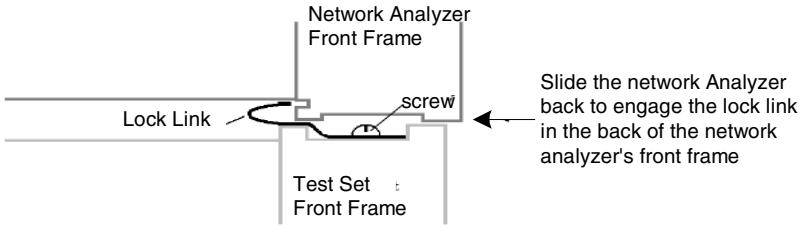
3. Install the two rear locking feet (5023-0132) using the included screws (0515-1619), where the standoffs were removed. Refer to Figure 19.

Figure 19 Installing Lock Feet



4. 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 20.

Figure 20 Locking the PNA to the Top Test Set



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 10 on page 15. 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.

12-Port RF Cable Connections

Figure 21 on page 26 illustrates the setup configuration of the Z5623AK44 Multiport Test Set and how it should be configured to the N5230A 4-Port PNA–L Series Network Analyzer for a 12-Port.

1. The RF cables supplied with this option connect between the N5230A 4-Port PNA–L Series Network Analyzer and the Z5623AK44 test set. Torque each cable to **8 in-lb**. Connect the cables as listed in Table 9.

CAUTION Each end of the interconnect 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. Refer to Figure 21, "12-Port Setup Configuration."

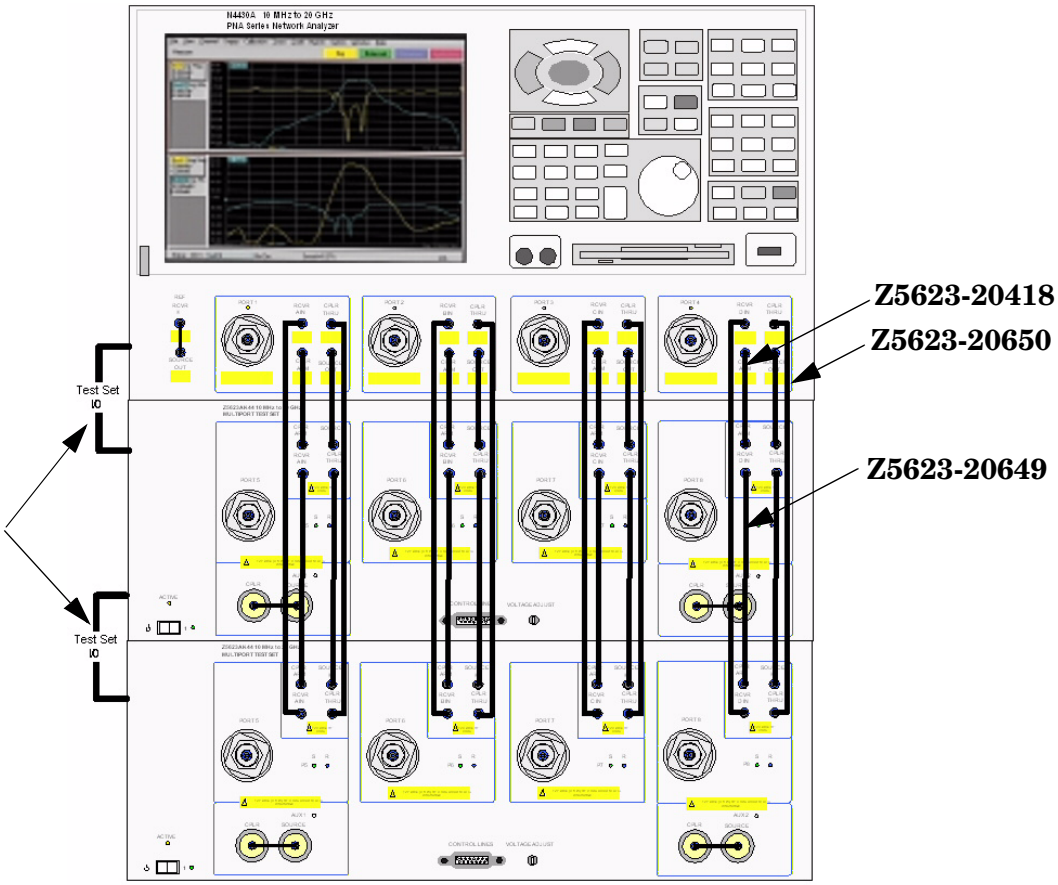
CAUTION Over torque will cause damage to the test set and may cause connectors to spin or become loose.

Table 9 12-Port Cable Connection

RF Cables	From	To
Z5623-20418	CPLR ARM PNA	CPLR ARM (top test set)
Z5623-20418	SOURCE OUT PNA	SOURCE IN (top test set)
Z5623-20649	RCVR A thru D (top test set)	CPLR ARM (bottom test set)
Z5623-20649	CPLR THRU (top test set)	SOURCE IN (bottom test set)
Z5623-20650	RCVR A thru D IN (PNA)	RCVR A thru D IN (bottom test set)
Z5623-20650	CPLR THRU PNA	CPLR THRU (bottom test set)

2. Connect the PNA–L test set with two I/O cables (8120-6818) to the Z5623AK44 Test Set Interface on the rear panel. Refer to Figure 21 on page 26.
   - From the PNA TEST SET I/O connector to the Z5623AK44 (top box) TEST SET INTERFACE connector on the rear panel.
   - From the Z5623AK44 (top box) PASS THRU INTERFACE to the TEST SET INTERFACE connectoron the Z5623AK44 (bottom box) rear panel.

Figure 21 12-Port Setup Configuration



Operation

This section will describe how to setup and operate the Z5623A Option K44 Multiport Test Set with the N5230A 4-Port Series Network Analyzer.

NOTE The internal firmware of the Agilent N5230A 4-Port PNA–L Series 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 Z5623AK44 Multiport Test Set is considered a “slave” instrument. A PNA–L must be used to control the test set or a personal computer with GPIB interface. There are three methods to control the Test Set. Multiport mode is recommended due to calibration and ease of use.

- PNA Multiport Mode (firmware revision ≥ A.06.20.08) and N5230A Option 551
- PNA Interface Control
- PNA GPIB Command Processor

PNA Multiport Mode

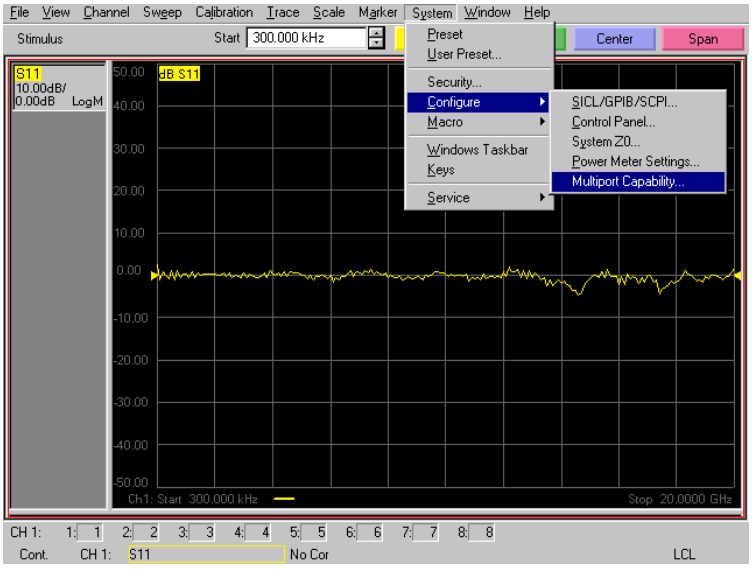
Use the PNA System to identify the network application code revision.

The Z5623AK44 can be controlled with software that is built into the PNA Network application. Multiport Capability can be selected from the System menu to enable control and calibration of the Z5623AK44 in a manner similar to the N5230A Ports 1 thru 4, enabling easy use of the “full cross bar” feature of the Z5623AK44 installed with the PNA. Measurements between any port can be selected from several menus, which will be covered in this section. When using Multiport mode, the Interface Control will not always operate correctly due to the Multiport mode changing switch states. To use the Interface Control, it is recommended to restart and operate the N5230A PNA in Standalone Mode.

How to Access Multiport Mode

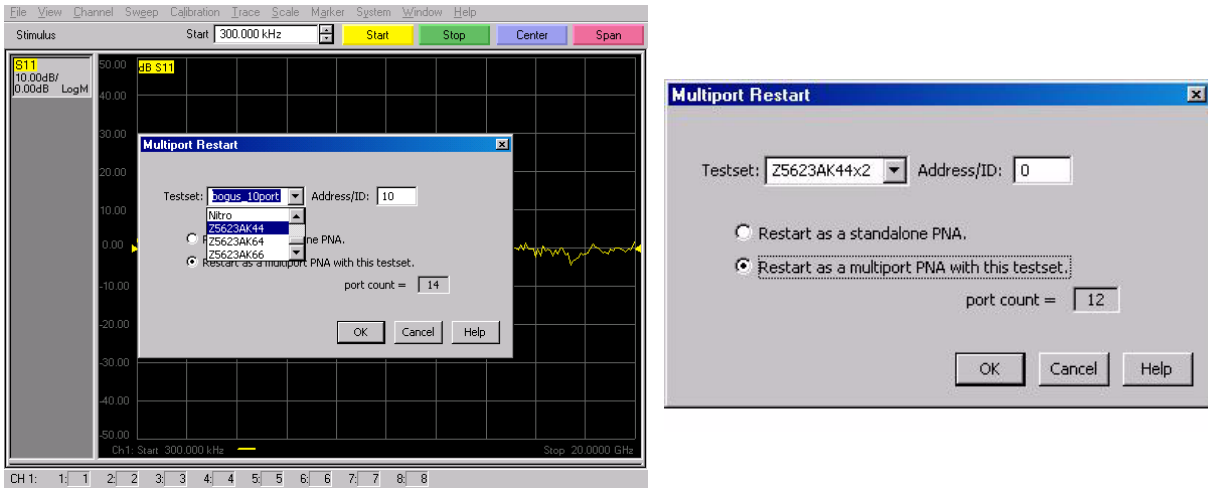
The N5230A Option 551 must be installed for Multiport capability. To access the multiport application select **System** > **Configure** > **Multiport Capability**. See figure Figure 22.

Figure 22 System Configuration



Select **Z5623AK44** (8-Port System) or **Z5623AK44x2** (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 Z5623AK44 Multiport Test Set interface features. See Figure 23.

Figure 23 Z5623AK44 or Z5623AK44x2 Selection



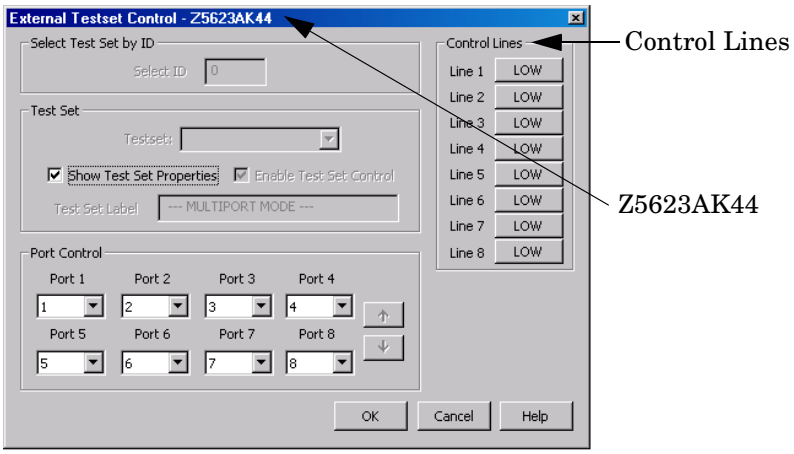
External Test Set Control Feature

To verify that the network application has the Z5623AK44 interface features, select > **Channel menu** > **External Test Set Control** > **other**. The Z5623AK44 will be displayed as **External Test Set Control-Z5623AK44**. See Figure 24.

This menu will allow the physical Ports 1 through 8 to be identified as any port for your convenience. For example; Port 5 can be named Port 2.

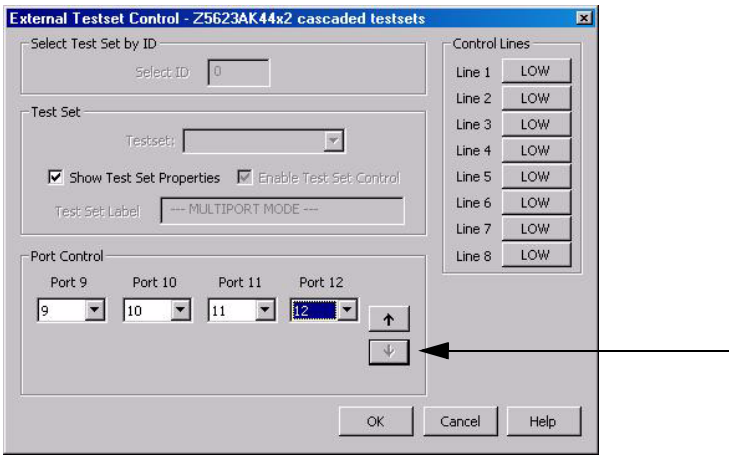
The **External TestSet Control-Z5623AK44 menu** also allows control of the DUT control lines, refer to "Control Lines" on page 41. To change the state from LOW to HIGH, select the graphical user interface (GUI) for the specific control (LINE 1 through 8) and then press OK. Each line can be controlled separately, see Figure 24.

Figure 24 External Test Set Z5623AK44



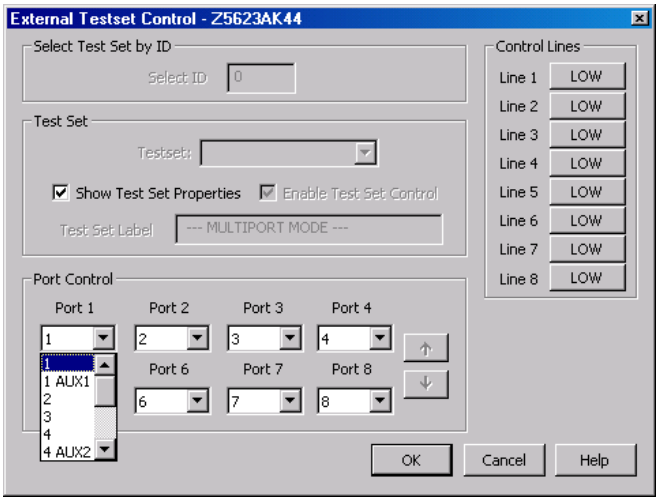
For 12-Port configuration select the **Port Control** down arrow for Ports 9 through 12, see Figure 25.

Figure 25 External Test Set Z5623AK44



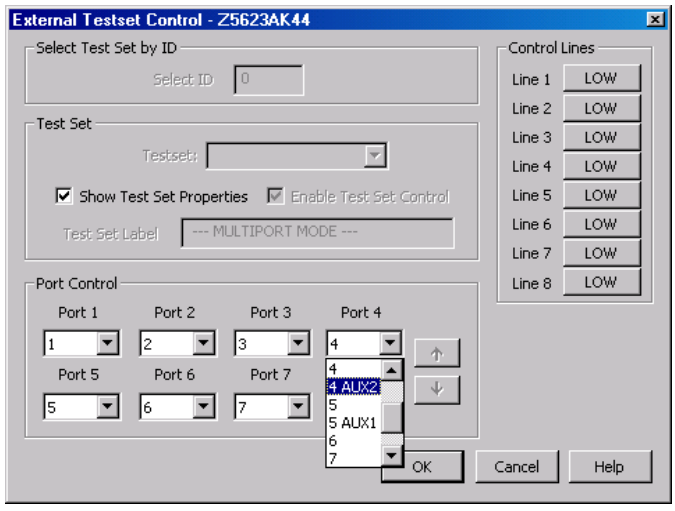
The **External TestSet Control-Z5623AK44** menu will allow you to control the AUX 1 and AUX 2 paths. The AUX paths provide external access to the PNA Source Out and Port 5 or Port 8 Coupler Thru. To select AUX 1 for Port 5 use the drop-down menu and select Port 1 as 1 AUX1 and Port 5 as 5 AUX1. Press OK, you will hear the transfer switch activate and the front panel AUX 1 LED will illuminate. Both 1 AUX1 for Port 1 and 5AUX1 for Port 5 must be selected to enable the OK button. See Figure 26.

Figure 26 AUX 1 for Ports 1 and 5



To select AUX 2 for Port 4 and Port 8, use the drop-down menu and select Port 4 as 4 AUX2 and Port 8 as 8 AUX2. Press OK, you will hear the transfer switch activate and the front panel AUX 2 LED will illuminate. Both 4 AUX2 and 8 AUX2 must be selected to enable the OK button. See Figure 27.

Figure 27 AUX 2 for Ports 4 and 8



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 64 S-Parameters for the 8-Port system, see Figure 28 or select 1 of 144 S-Parameters for the 12-Port system, see Figure 29. The first number in the Sxx selection is the Receiver Port and the second number will be the Source Port. Any port can be selected to be the Receiver, Source or both, as in S11. The front panel R LED indicates the port is the Receiver and the S LED indicates the Port is the Source.

Figure 28 8-Port Trace Measure

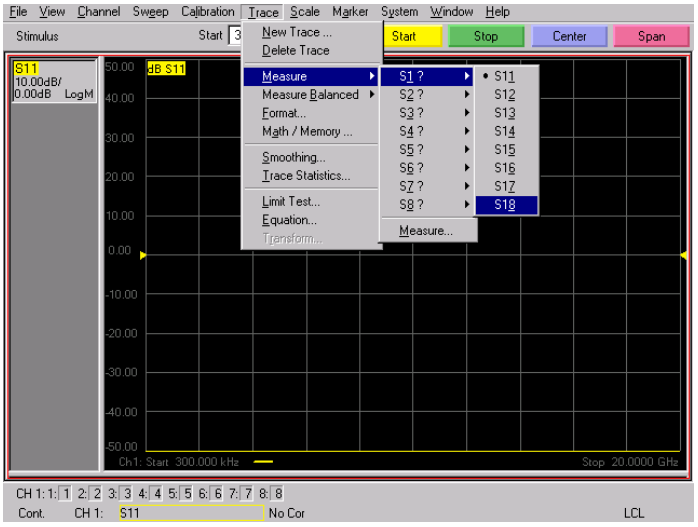


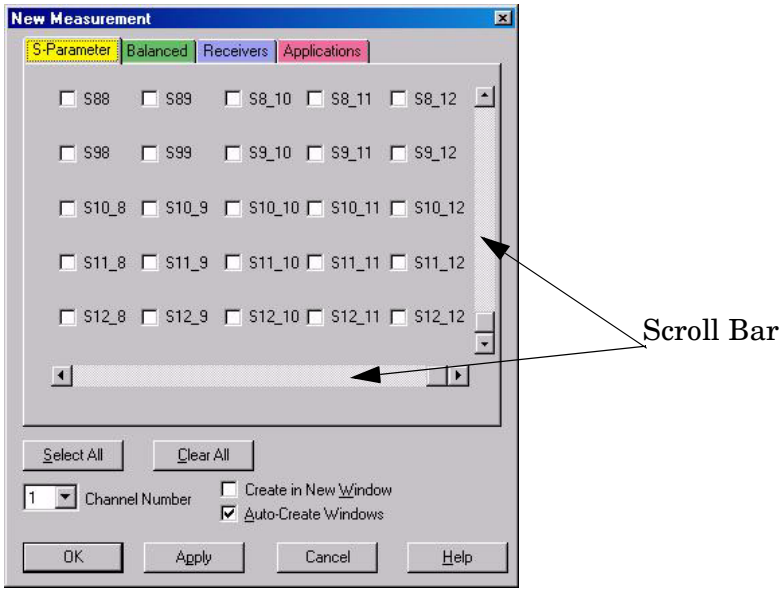
Figure 29 12-Port Trace Measure

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. SeeFigure 30 and Figure 31.

Figure 30 8-Port New Trace Measure

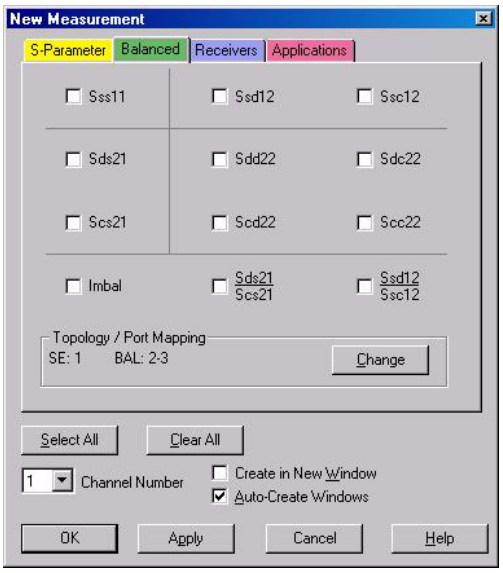
Figure 31 12-Port New Trace Measure



Balanced Tab: Balanced Measurements can be configured by selecting the Balance tab in the **New Measurement** menu. Refer to Figure 32.

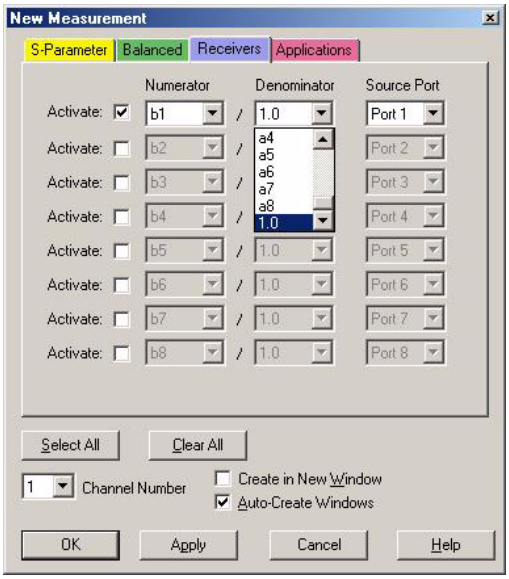
For more information on balanced (differential) component measurement, refer to the Application Note 1373-1 and 1373-2 (5988-5634EN and 5988-5635EN) at http://www.home.agilent.com. In the search menu type in “Multiport and Balanced.”

Figure 32 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 33 Receiver Ports



PNA Interface Control

NOTE The interface control will not function properly when using the mutliport mode. The multiport mode will reset the switch path commands of the interface control. It is recommended that the PNA be restarted in stand-alone mode if the interface control is being used.

This section includes only the features required in the Interface Control for the Z5623AK44 Multiport Test Set. Applications and feature information can be found in the PNA's Help System Menu, "Interface Control."

- Overview
- How to Access Interface Control Settings
- Interface Control Dialog Box

Other connectivity topics can be found in the PNA Series Network Analyzer's Help System Menu.

Overview of the Interface Control

The Interface Control feature allows you to send data and remote commands to control external equipment using the GPIB, Material Handler I/O, Test Set I/O, and Auxiliary I/O without needing to create a remote program. Refer to PNA Series Network Analyzer's Help System Menu, "Rear Panel Tour."

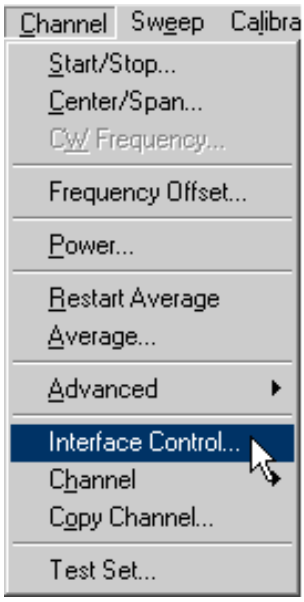
- A unique set of control data can be sent for each channel. In addition, a unique set of control data can be sent before the channel sweep starts and after the sweep ends.
- Interface Control settings can be saved and recalled from the Interface Control Dialog Box or with Instrument State Save and Recall.
- Interface Control settings can be copied to other channels using Copy Channels.
- Control data can only be WRITTEN to the interfaces, NOT READ from the interfaces.
- Control data is sent in the following order and this order cannot be changed:

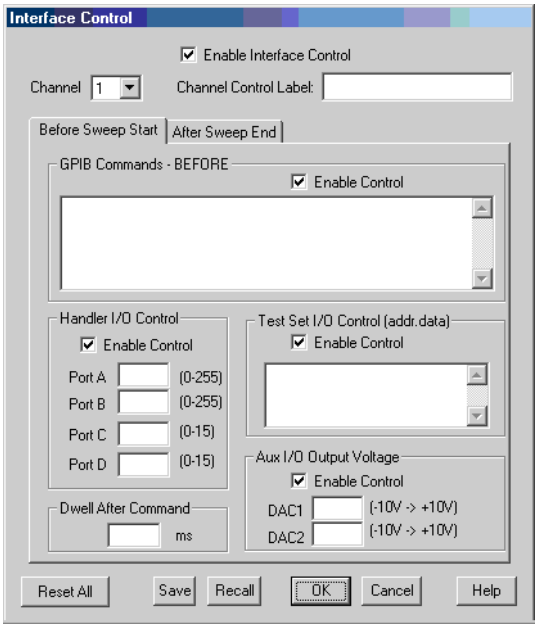
    1. GPIB Interface
    2. Material Handler Interface (not covered in this manual)
    3. Test Set Interface (not covered in this manual)
    4. Dwell Time (not covered in this manual)

How to Access Interface Control Settings

This section will describe how to setup and operate the Z5623AK44 Multiport Test Set with the N5230A 4-Port Series Network Analyzer. To access the **Interface Control** application select **Channel** > **Interface Control** in the drop-down menu.

NOTE The Agilent N5230A 4-Port PNA–L Series Network Analyzer comes with the Interface Control application. Please review this application before connecting the Z5623AK44 Test Set to the PNA. Information regarding this application can be found in the PNA's Help System Menu, "InterfaceControl." The application is shown below.





NOTE While using Interface Control, the PNA must be in GPIB System Controller mode. Once this is complete you must restart the PNA application to go back to Talker/Listener.

Test Set I/O Address and Data using Control Interface

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

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

Enable Interface Control:

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

Channel:

Specifies the channel number for dialog settings. Each channel is configured individually. The list box illustrates the channels that currently have measurements. There must be at least one measurement present in order to make the settings.

Channel Label:

Specifies the label to be displayed on the PNA screen during the channel sweep.

Before Sweep Start– After Sweep End Tabs:

Commands /data for all four interfaces can be sent Before Sweep Start and After Sweep End. However, they are configured and enabled on separate tabs of the Interface Control Dialog Box. For example; to send GPIB commands Before and After a PNA sweep, the Enable Control check box must be selected and commands entered on both the Before Sweep Start and After Sweep End tabs.

Before Sweep Start:

The data is sent before the first trace on the channel begins sweeping.

After Sweep End:

The data is sent after the last trace on the channel completes sweeping.

Address:

Positive integer is used to specify switch path to be controlled. Address also specifies output on specific ports. DUT control interface =112, 0 = Port 5, 16 = Port 6, 32 = Port 7 and 65 = Port 8. Refer to Table 13 on page 47 through Table 20 on page 52.

NOTE For 12-Port configuration add 1 to address. Port 9=1, Port 10=17, Port 11=33 and Port 12=65.

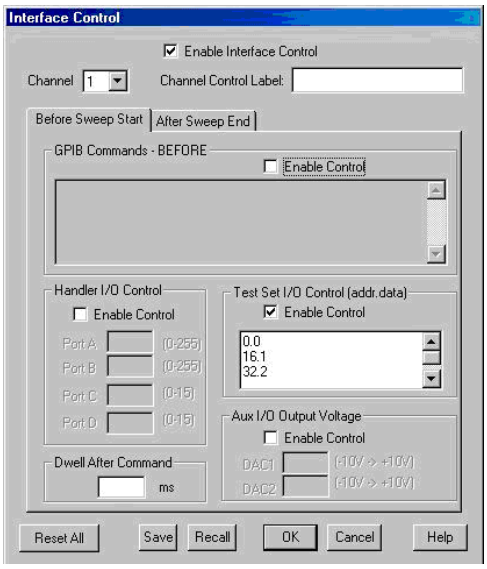
Data:

Positive integer is used to select switch position or state of DUT control interface line. Refer to Table 13 on page 47 through Table 20 on page 52.

Address and data are separated by a period. Entries should be separated by a new line, or carriage return.

For example:

0.0
16.1
32.2



The front-panel Enter key inserts a new line into the field. The number of Test Set I/O entries that can be entered is limited only by the available memory of the PNA. See "Test Set I/O Interface Commands" on page 47.

Dwell After Command:

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

Reset All:

Sets all fields on all channels to their default values.

Save and Recall:

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

OK:

Applies the settings and closes the dialog box.

Cancel:

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

NOTE Z5623AK44 Test Set I/O Commands can be found in Table 13 on page 47 through Table 10 on page 41. The Address and Data commands can be entered into the Test Set I/O control.

PNA GPIB Control

The GPIB Command Processor feature allows you to send remote commands and data to the PNA rear-panel GPIB connector and test set I/O connector. More information regarding the GPIB Command Processor can be found in the PNA Series Network Analyzer Help System Menu.

- Overview
- How to Access GPIB Command Processor
- GPIB Command Processor Console

Overview

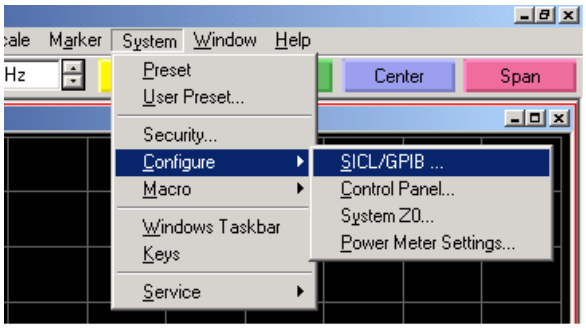
The GPIB Command Processor allows you to send address and data to control an external test set, without needing to create a remote program. The user is required to manually input address and data using the GPIB Command Processor Console in the PNA Series Network Analyzer Help System Menu.

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

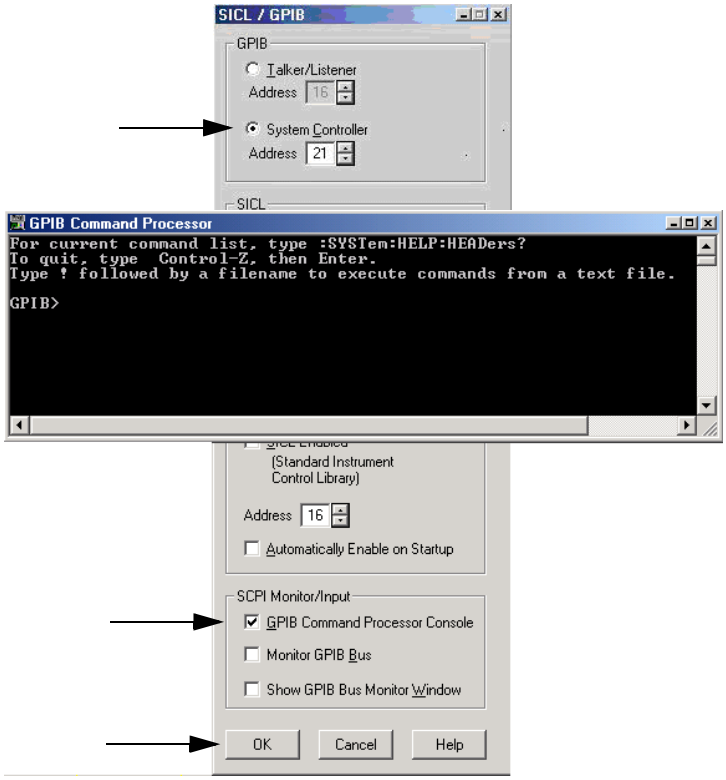
How to Access GPIB Command Processor

1. To access the GPIB Command Processor press:

   [Menu/Dialog] then tab to **System**, select **Configure** > **SICL/GPIB**



2. Select System Controller and GPIB Command Processor Console and select OK.



NOTE If the PNA is not in System Controller mode, an error message appears and the GPIB Command Processor is disabled. To correct this situation, place the PNA in System Controller mode and restart the GPIB Command Processor Console.

GPIB Command Processor Console

Write Commands Once the GPIB Command Processor Console is open, commands can remotely control the external Test Set I/O connector by sending the following:

address: a integer number

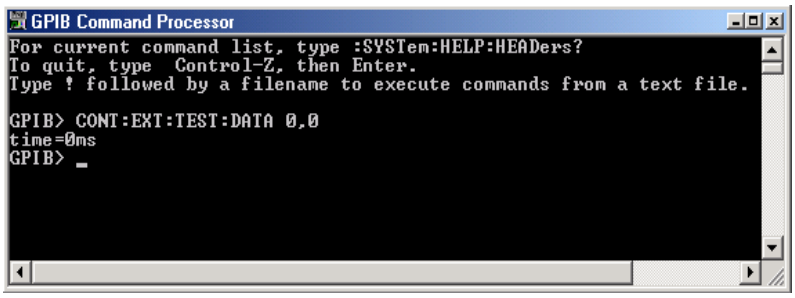
data: a integer number

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

For example:

CONT:EXT:TEST:DATA <address>,<data>
CONT:EXT:TEST:DATA 0,0

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



Read Commands

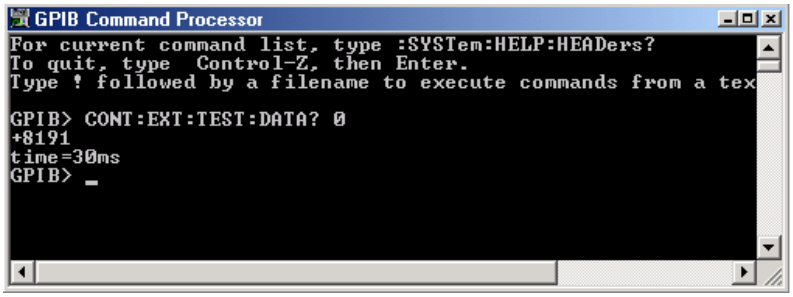
address: a integer number

Address is entered, data value will be returned. Commands should be executed with a carriage return (enter).

For example:

CONT:EXT:TEST:DATA? <address>
CONT:EXT:TEST:DATA? 0

Example: CONT:EXT:TEST:DATA? 0



This command reads the decimal equivalent of the binary data from the specified address. The example shown above illustrates address is 0 and the returned data is 8191. Refer to Table 13 on page 47.

Control Lines

Table 10 contains the information to set the control lines of the Z5623AK44 Test Set. Refer to "Operating the DUT Control Interface" on page 42.

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	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

There are 256 individual switch combinations for the Z5623AK44. 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 Z5623AK44 DUT control lines will function in a 12-Port configuration. The top Z5623AK44 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 44.

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 41.

Pin Assignment

Figure 34 Control Line Pin Assignment

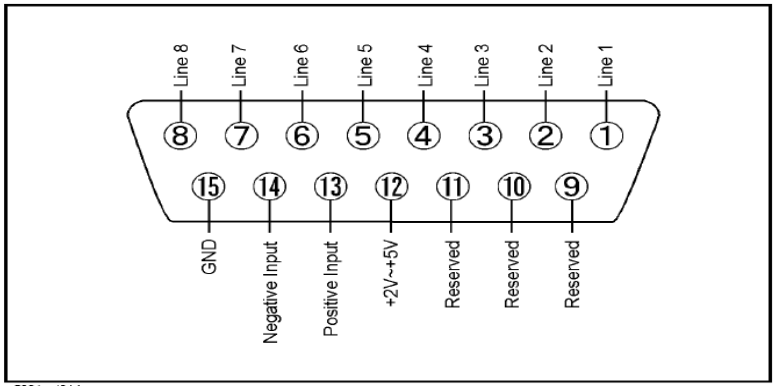


Table 11 Pin Assignment

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 35 Block Diagram of DUT Control

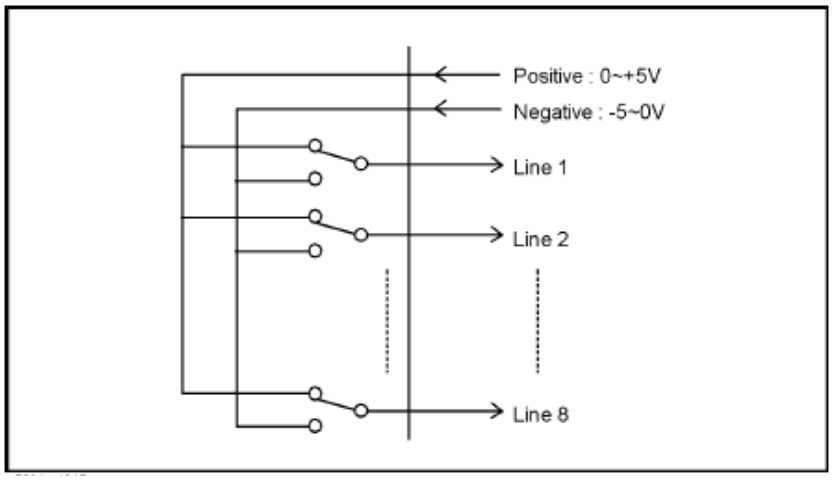


Table 12 DUT Control Specifications

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:

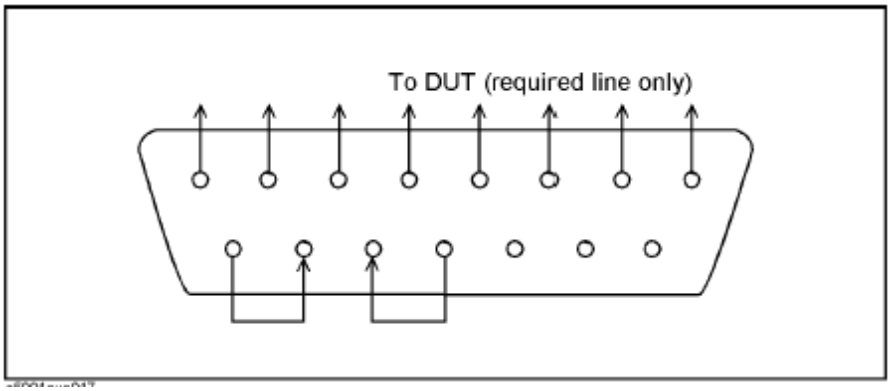
1. Turn On Z5623AK44.
2. Measure the voltage between pin 12 and 15 using a multimeter.
3. Rotate the voltage adjustment trimmer on the front panel until the multimeter indicates the appropriate voltage.

Connecting to the DUT

Figure 36 illustrates an example of the connection between the DUT and the Z5623AK44 *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 36 Connecting to the DUT



Using an External Power Supply

Figure 37 illustrates an example of the connection between the DUT and the Z5623AK44 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 Z5623AK44 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.

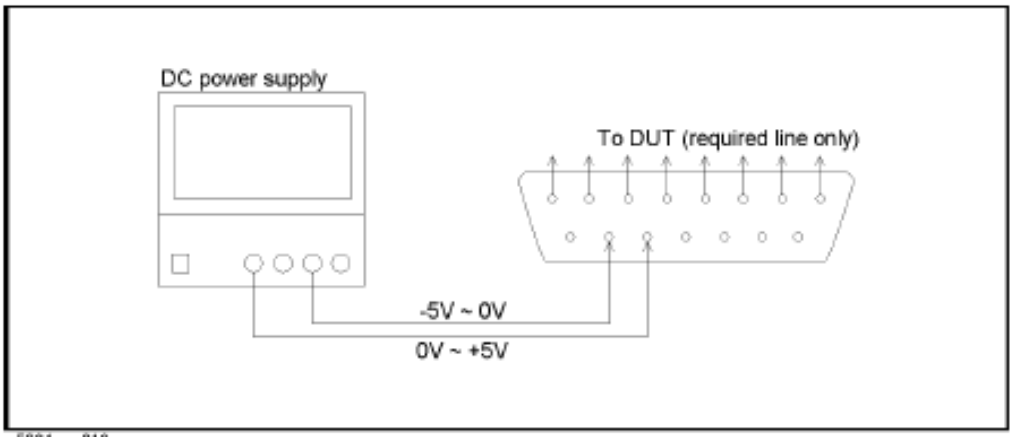
Turning On the Z5623AK44 with Using an External Power Supply.

1. Turning On the Z5623AK44.
2. Connect the DUT.
3. Turn On the external power supply.

Turning Off the Z5623AK44 with Using an External Power Supply.

1. Turning Off the Power Supply.
2. Turning Off the Z5623AK44.
3. Disconnect the DUT.

Figure 37 Z5623AK44 to the DUT and External DC Power Supply



Test Set I/O Interface Commands

Switch Address and Data

Table 13 and Table 14 contain the information to set the internal switch paths of the Z5623AK44 Test Set. Additional information regarding the operation and descriptions for the internal switches can be found in "Theory of Operation" on page 57.

NOTE All switches must be set with each command sent to complete a measurement path.

Table 13 PNA Port 1 and Test Set Ports 5

Address	Data	Data AD7–AD0	Description	Bit Data
0	1	00000xxB	Bit 0 controls S101; Source to PNA Port 1 or Test Set Port 5; 0=PNA; 1=Test Set	0,1
0	2	00000xBx	Bit 1 controls S102; Receiver to PNA Port 1 or Test Set Port 5; 0=PNA; 1=Test Set	0,1
0	4	00000Bxx	Bit 2 controls S103; Access to AUX 1 ports; 0 = Normal; 1 = Aux access	0,1

Switch Number						S103	S102	S101
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 = 5	0	0	0	0	0	1	0	1

X indicates unknown user bit state

B indicates bit of interest

There are 8 individual switch combinations for the Z5623AK44 Port 5 of the Test Set and Port 1 of the PNA. To select a test set port configuration all 3 switches must be set. To do this you must add AD7 to AD0 binary number and convert this to a decimal equivalent.

NOTE Add 1 to the address value to operate the switches in the bottom test set in a 12-Port configuration. (Ports 9 through 12)

NOTE The highlighted areas are the strategic commands.

Table 14 Test Set I/O Address and Data for PNA Port 1, Test Set Ports 5 and AUX 1 Access Ports

Address	Data	Data AD7–AD0	Description	Port LED's
0	0	00000000	Selects the PNA Port 1 as the Source and Receiver port. Test Set Port 5 term in S101.	All Off
0	1	00000001	Selects the PNA Port 1 as the Receiver and Test Set Port 5 as the Source. PNA Port 1 term in S101.	Port 5 S ON
0	2	00000010	Selects the PNA Port 1 as the Source Port. Test Set Port 5 as the Receiver and term in S101.	Port 5 R ON
0	3	00000011	Selects the Test Set Port 5 as the Source and Receiver. PNA Port 1 term in S101.	Port 5 S&R ON
0	4	00000100	Selects the Aux 1 access ports. PNA Port 1 as the Source and Receiver Port.	AUX 1 ON
0	5	00000101	Selects the Aux 1 access ports. PNA Port 1 as the Receiver and Test Set Port 5 as the Source. PNA Port 1 term in S101.	AUX 1 ON, Port 5 S ON
0	6	00000110	Selects the Aux 1 access ports. PNA Port 1 as the Source Port. Test Set Port 5 as the Receiver and term in S101.	AUX 1 ON, Port 5 R ON
0	7	00000111	Selects the Aux 1 access ports. Test Set Port 5 as the Source and Receiver. PNA Port 1 term in S101.	AUX 1 ON, Port 5 S&R ON

Table 15 PNA Port 2 and Test Set Port 6

Address	Data	Data AD7–AD0	Description						Bit Data	
16	1	000000xB	Bit 0 controls S201; Source to PNA Port 2 or Test Set Port 6; 0=PNA; 1=Test Set						0,1	
16	2	000000Bx	Bit 1 controls S202; Receiver to PNA Port 2 or Test Set Port 6; 0=PNA; 1=Test Set						0,1	
Switch Number									S202	S201
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 = 3			0	0	0	0	0	0	1	1
X indicates unknown user bit state										
B indicates bit of interest										
There are 4 individual switch combinations for the Z5623AK44 Port 6 of the Test Set and Port 2 of the PNA. To select a test set port configuration, both switches must be set. To do this you must add AD7 to AD0 binary number and convert this to a decimal equivalent.										

Table 16 Test Set I/O Address and Data for PNA Port 2 and Test Set Port 6

Address	Data	Data AD7–AD0	Description	Port of LEDs
16	0	00000000	Selects the PNA Port 2 as the Source and Receiver Port. Test Set Port 6 term in S201.	All Off
16	1	00000001	Selects the PNA Port 2 as the Receiver and Test Set Port 6 as the Source. PNA Port 1 term in S201.	Port 6 S ON
16	2	00000010	Selects the PNA Port 2 as the Source Port. Test Set Port 6 as the Receiver and term in S201.	Port 6 R ON
16	3	00000011	Selects the Test Set Port 6 as the Source and Receiver. PNA Port 2 term in S201.	Port 6 S&R ON

Table 17 PNA Port 3 and Test Set Ports 7

Address	Data	Data AD7–AD0	Description	Bit Data
32	1	000000xB	Bit 0 controls S301; Source to PNA Port 3 or Test Set Port 7; 0=PNA; 1=Test Set	0,1
32	2	000000Bx	Bit 1 controls S302; Receiver to PNA Port 3 or Test Set Port 7; 0=PNA; 1=Test Set	0,1

Switch Number							S302	S301
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 = 3	0	0	0	0	0	0	1	1

X indicates unknown user bit state

B indicates bit of interest

There are 4 individual switch combinations for the Z5623AK44 Port 7 of the Test Set and Port 3 of the PNA. To select a test set port configuration, both switches must be set. To do this you must add AD7 to AD0 binary number and convert this to a decimal equivalent.

Table 18 Test Set I/O Address and Data for PNA Port 3 and Test Set Port 7

Address	Data	Data AD7–AD0	Description	Port of LEDs
32	0	00000000	Selects the PNA Port 3 as the Source and Receiver Port. Test Set Port 7 term in S301.	All Off
32	1	00000001	Selects the PNA Port 3 as the Receiver and Test Set Port 7 as the Source. PNA Port 1 term in S301.	Port 7 S ON
32	2	00000010	Selects the PNA Port 3 as the Source Port. Test Set Port 7 as the Receiver and term in S301.	Port 7 R ON
32	3	00000011	Selects the Test Set Port 7 as the Source and Receiver. PNA Port 3 term in S301.	Port 7 S&R ON

Table 19 PNA Port 4 and Test Set Port 8

Address	Data	Data AD7–AD0	Description						Bit Data	
64	1	000000xB	Bit 0 controls S401; Source to PNA Port 4 or Test Set Port 8; 0=PNA; 1=Test Set						0,1	
64	2	00000xBx	Bit 1 controls S402; Receiver to PNA Port 4 or Test Set Port 8; 0=PNA; 1=Test Set						0,1	
64	4	00000Bxx	Bit 2 controls S403; Access to AUX 2 ports; 0=Normal; 1=AUX 2 access						0,1	
Switch Number							S403	S402	S401	
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 = 5			0	0	0	0	0	1	0	1
X indicates unknown user bit state										
B indicates bit of interest										
There are 8 individual switch combinations for the Z5623AK44 Port 8 of the Test Set and Port 4 of the PNA. To select a test set port configuration, all three switches must be set. To do this you must add AD7 to AD0 binary number and convert this to a decimal equivalent.										

Table 20 Address and Data for PNA Port 4 and Test Set Port 8

Address	Data	Data AD7–AD0	Description	Port of LEDs
64	0	00000000	Selects the PNA Port 4 as the Source and Receiver port. Test Set Port 8 term in S401.	All Off
64	1	00000001	Selects the PNA Port 4 as the Receiver and Test Set. Port 8 as the Source. PNA Port 1 term in S401.	Port 8 S ON
64	2	00000010	Selects the PNA Port 4 as the Source port. Test Set Port 8 as the Receiver and term in S401.	Port 8 R ON
64	3	00000011	Selects the Test Set Port 8 as the Source and Receiver. PNA Port 4 term in S401.	Port 8 S&R ON
64	4	00000100	Selects the AUX 2 access ports. PNA Port 4 as the Source and Receiver port.	AUX 1 ON
64	5	00000101	Selects the AUX 2 access ports. PNA Port 4 as the Receiver and Test Port 8 as the Source. PNA Port 4 and term in S401.	AUX 1 ON, Port 8 S ON
64	6	00000110	Selects the AUX 2 access ports. PNA Port 4 as the Source port. Test Set Port 8 as the Receiver and term in S401.	AUX 1 ON, Port 8 R ON
64	7	00000111	Selects the AUX 2 access ports. Test Set Port 8 as the Source and Receiver. PNA Port 4 term in S401.	AUX 1 ON, Port 8 S&R ON

Operational Check

This section provides the test calibration procedure to confirm the Z5623AK44 and PNA operational performance. The operation verification limits provided ensure that your Z5623AK44 and PNA are operating properly.

Verification Limits

Specifications for the Z5623AK44 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 Z5623AK44 only.

Table 21 8-Port Limit for Reflection Tracking[1]

Frequency	Standard	Option 001 or 002
10 MHz to 4 GHz	–15 dB	–7 dB
4 GHz to 6 GHz	–19 dB	–11 dB
6 GHz to 10 GHz	–21 dB	–13 dB
10 GHz to 15 GHz	–26 dB	–15 dB
15 GHz to 20 GHz	–31 dB	–24 dB

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

NOTE If you suspect that your 12-Port configuration is not operating properly, ensure that all front RF jumper interconnect cables are correctly attached. If the problem persists, disable the 12-Port configuration and test each test set individually to the option operational verification limits.

Table 22 Standard 12-Port Limit for Reflection Tracking

Frequency	PNA 1-4	Top 5-8	Bottom 9-12
10 MHz to 4 GHz	–27 dB	–22 dB	–22 dB
4 GHz to 6 GHz	–32 dB	–27 dB	–27 dB
6 GHz to 10 GHz	–38 dB	–30 dB	–30 dB
10 GHz to 15 GHz	–45 dB	–35 dB	–35 dB
15 GHz to 20 GHz	–50 dB	–40 dB	–40 dB

NOTE 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.

Table 23 12-Port Option 001 and 002 Limit for Reflection Tracking

Frequency	PNA 1-4	Top 5-8	Bottom 9-12
10 MHz to 4 GHz	–11 dB	–5 dB	–15 dB
4 GHz to 6 GHz	–13 dB	–6 dB	–16 dB
6 GHz to 10 GHz	–19 dB	–9 dB	–19 dB
10 GHz to 15 GHz	–22 dB	–12 dB	–24 dB
15 GHz to 20 GHz	–42 dB	–30 dB	–38 dB

Equipment Required

The Agilent Z5623AK44 requires that the user be familiar with the equipment and components listed in Table 24. 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.

This section provides an Equipment List and setup of the PNA and Test Set.

Table 24 Equipment List

Description	Qty
N5230A Network Analyzer (Opt 145, 146, 245 or 246 and 551) Option 245 or 246 is required for a complete check of the test set.	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 page 13.	1

Operational Check Procedure

The system maybe configured as an 8-Port or 12-Port. Refer to “System Setup for 8-Port Configuration” on page 13 or “System Setup for 12-Port Configuration” on page 18.

Prepare the PNA

1. Ensure that the interconnect the cables between the PNA and test set are configured correctly.
2. On the PNA, press **Calibration** > **Cal Sets**. Delete or Rename any Cal Sets titled "999.1" thru "999.8" (8_Port) or 999.12 (12-Port) configuration although it is unlikely that you will find Cal Sets with these names.
3. Verify that the PNA is in 8-Port mode by selecting **Trace**, then **New Trace**.
   a. If only sixteen S-Parameters are listed, press **System** > **Configure** > **Multiport Capability**. On the Multiport Restart dialog, select **Restart as multiport PNA with this test set**. Select **Z5623AK44** (8-Port) or **Z5623AK44x2** (12-Port) as the test set, Press **OK**.
   b. If 64 or 144 S-Parameters are available, press **System** > **Preset**.
4. Verify that the **Stop Frequency** is set to the maximum of the PNA and test set.
5. Verify that the **Start Frequency** to set to **10 MHz**. If not, press **Channel** > **Start/Stop** and enter **10 MHz**.
6. Press **Sweep** > **IF Bandwidth** > **100 Hz**.
7. Press **Sweep** > **Number of Points** > **401**.
8. Connect the ECal module to the PNA USB port, if an ECal module is used.
9. Allow the ECal module (if used), Test Set, and PNA to warm up for a minimum of a 30 minutes.

Procedure

1. Perform a 1-Port Calibration on Port 1. On the PNA, press **Calibration > Cal Wizard**.
   a. If using a mechanical cal kit, select **SmartCal.**
   b. If using an ECal module, select **ECal**.
2. Continue following the Cal Wizard prompts. On the “Ports to Calibrate” page, select only **Port 1.** For further instructions during the cal, press the Cal Wizard page **Help** button.
3. At the **Calibration Completed** prompt, select **Save As User CalSet** and type the name **999.1**
4. Repeat step 1 through step 3 for Ports 2, thru 8. When finished, there should be eight Cal Sets saved with the titles "999.1" thru "999.8" (8_Port) or 999.12 (12-Port).
5. On the PNA, click **Trace**, then **Delete Trace**. There should be no traces on the PNA screen.

6. On the PNA click **Calibration**, then **Cal Set Viewer** to launch the Cal Set Viewer toolbar.
7. On the toolbar, click **Error Terms** and select **Enable.**
8. In the Cal Sets box, select **999.1**. Then in the Error Terms box, select **Reflection Tracking(1,1)**.
9. Compare the Reflection Tracking (1,1) trace to the appropriate limits in Table 1-2. This can be done using Limit Lines (click **Trace**, then **Limit Test**) or Markers. The trace should be above the limit values. Refer to page 56.

Figure 38 Port 1 Reflection Tracking Trace

10. Repeat step 8 and step 9 for Cal Sets "999.1" thru "999.8" (8_Port) or 999.12 (12-Port) configuration.

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 Z5623AK44. Reference the Z5623AK44 block diagrams shown in Figure 39, Figure 40 and Figure 41 on page 63. This section assumes the user has a general understanding of Couplers, Bias Tees, Amplifiers and network analyzers. The Z5623AK44 is installed with a PNA 4-Port Network Analyzer (N5230A PNA-L) I/O interface cable and interconnect RF cables to provide 8 functioning ports as one network analyzer. Two Z5623AK44 can be used together to create 12 functioning ports, each capable of being a source or receiver port.

Z5623AK44 uses eight solid state coax switches (101, 102, 201, 202, 301, 302, 401 and 402) to select RF paths from the PNA SOURCE and RECIEVER thru interconnect cables (Z5623-20418 and Z5623-20419) to new K44 PORT paths 5, 6, 7, 8. Two mechanical transfer switches (103 and 403) are used to allow selection of the SOURCE to COUPLER path of PORTS 5 and 8, allowing the user to condition the source output of the PNA or use another source (customer supplied) on PORT 5 or 8 if desired. For added dynamic range the Z5623AK44 Option 001 provides amplifiers in the receiver paths (eight total). Z5623AK44 Option 002 installs a Bias Tee into each SOURCE path (eight total) to provide a DC bias to each port (PORT 1 thru 8) by the customer, BNC inputs on the rear panel.

The Switch paths can be controlled discretely using the Test Set I/O Interface or GPIB commands found in the tables 10, 11,12,13,14 15, 16 and 17, or by the Multiport Mode of the PNA which allows N port calibration and selection of the PORT paths in the same way as the PNA standard ports are controlled. Refer to Z5623AK44 Operation, Multiport Mode, PNA Interface control and PNA GPIB Command Processor sections in this manual for more information.

Switch 101 provides control of the Source path of PORT 1 or PORT 5. With Switch 101 in the state shown in the Block diagrams, PORT 1 will be the source, with the RF of the PNA Source going through the Switch 101 and to the PORT 1 coupler through path. For Z5623AK44 units with Option 002, the SOURCE RF will go through the PORT 1 Bias Tee before going into the PORT 1 Coupler. With Switch 101 in the opposite state, PORT 5 will be the source, with the RF of the PNA Source going through the Switch 101 and to through transfer switch 103 to PORT 5 coupler. If the Z5623K44 has Option 002 the SOURCE RF will go through the PORT 5 Bias Tee before going into the PORT 1 Coupler.

Switch 102 provides control of Receiver A path of PORT 1 or PORT 5. With Switch 102 in the state shown in the Block diagrams, PORT 1 will be the Receiver A, with the RF to PORT 1 coupler arm going through Switch 102 to the PORT 1 Receiver A (RCVR IN) path. With Switch 102 in the opposite state, PORT 5 will be Receiver A, with the RF of the PNA Source going through the Switch 102 to the PORT 1 Receiver A (RCVR IN) path. If the Z5623K44 has Option 001 or 002 RF will go through an amplifier before going into Receiver A, to improve dynamic range.

Switch 103 provides selection of the AUX1 SOURCE to COUPLER path of PORT 5. Access to the network analyzer source output (SOURCE), and coupler through path (CPLR) of PORT 5, is available with jumper removed on front panel.

Switch 201 provides control of the Source path of PORT 2 or PORT 6. With Switch 201 in the state shown in the Block diagrams, PORT 2 will be the source, with the RF of the PNA Source going through the Switch 201 and to the PORT 2 coupler through path. For Z5623AK44 units with Option 002, the SOURCE RF will go through the PORT 2 Bias Tee before going into the PORT 2 Coupler. With Switch 201 in the opposite state, PORT 6 will be the source, with the RF of the PNA Source going through the Switch 201 to PORT 6 coupler. If the Z5623K44 has Option 002 the SOURCE RF will go through the PORT 6 Bias Tee, before going into the PORT 6 Coupler.

Switch 202 provides control of Receiver B path of PORT 2 or PORT 6. With Switch 202 in the state shown in the Block diagrams, PORT 2 will be the Receiver B, with the RF to PORT 2 coupler arm going through Switch 202 to Receiver B (RCVR IN). With Switch 202 in the opposite state, the RF to PORT 6 coupler arm will go through Switch 202 to the Receiver B (RCVR IN). If the Z5623K44 has Option 001 or 002, the RF will go through an amplifier before going into Receiver B, to improve dynamic range.

Switch 301 provides control of the Source path of PORT 3 or PORT 7. With Switch 301 in the state shown in the Block diagrams, PORT 3 will be the source, with the RF of the PNA Source going through the Switch 301 and to the PORT 3 coupler through path. For Z5623AK44 units with Option 002, the SOURCE RF will go through the PORT 3 Bias Tee before going into the PORT 3 Coupler. With Switch 301 in the opposite state, PORT 7 will be the source, with the RF of the PNA Source going through the Switch 301 to PORT 7 coupler. If the Z5623K44 has Option 002 the SOURCE RF will go through the PORT 7 Bias Tee, before going into the PORT 7 Coupler.

Switch 302 provides control of Receiver C path of PORT 3 or PORT 7. With Switch 302 in the state shown in the Block diagrams, PORT 3 will be the Receiver C, with the RF to PORT 3 coupler arm going through Switch 302 to Receiver C (RCVR IN). With Switch 302 in the opposite state, the RF to PORT 7 coupler arm will go through Switch 302 to the Receiver C (RCVR IN). If the Z5623K44 has Option 001 or 002, the RF will go through an amplifier before going into Receiver B, to improve dynamic range

Switch 401 provides control of the Source path of PORT 4 or PORT 8. With Switch 401 in the state shown in the Block diagrams, PORT 4 will be the source, with the RF of the PNA Source going through the Switch 401 and to the PORT 4 coupler through path. For Z5623AK44 units with Option 002, the SOURCE RF will go through the PORT 4 Bias Tee before going into the PORT 4 Coupler. With Switch 401 in the opposite state, PORT 8 will be the source, with the RF of the PNA Source going through the Switch 401 and to through transfer switch 103 to PORT 8 coupler. If the Z5623K44 has Option 002 the SOURCE RF will go through the PORT 8 Bias Tee before going into the PORT 8 Coupler.

Switch 402 provides control of Receiver A path of PORT 4 or PORT 8. With Switch 102 in the state shown in the Block diagrams, PORT 4 will be the Receiver A, with the RF to PORT 4 coupler arm going through Switch 402 to the PORT 4 Receiver D (RCVR IN) path. With Switch 402 in the opposite state, PORT 8 will be Receiver D, with the RF to PORT 4 coupler arm going through Switch 402, to the Receiver D (RCVR IN) path. If the Z5623K44 has Option 001 or 002 RF will go through an amplifier before going into Receiver D, to improve dynamic range.

Switch 403 provides selection of the AUX2 SOURCE to COUPLER path of PORT 8. Access to the network analyzer source output (SOURCE), and coupler through path (CPLR) of PORT 8, is available with the jumper removed on front panel.

12-Port Theory of Operation

The following is additional information for the operation of two Z5623AK44 configured as a 12-Port network analyzer. Reference the 12-Port block diagram.

The two Z5623AK44 are installed with a N5230A PNA-L, using I/O interface cables and interconnect RF cables Z5623-20418 (short), Z5623-20649 (medium) and Z5623-20650 (long) to provide 12 functioning ports in one network analyzer.

The N5230A Network Analyzer provides Port 1 thru 4. The top Z5623AK44 provides PORT 5 thru 8, the bottom provides Port 9 thru 12 and the Switch numbers for both top and bottom Z5623AK44 products are 101, 102, 103, 201, 202, 301, 302, 401, 402, and 403. Both Z5623AK44 switch paths can be controlled discretely using the Test Set I/O Interface or GPIB commands found in the tables 10, 11,12,13,14 15, 16 and 17 (add 1 to each address for the Bottom Z5623AK44), or by the Multiport Mode of the PNA.

NOTE Only the bottom Z5623AK44 DUT control lines will function in the 12-Port configuration.

Ports 6 and 7 have the least Source Loss and Ports 1 through 4 have the most Source Loss, due to the amount of the RF interconnect cables and switch path losses. Refer to Table 25 on page 60.

Table 25 Port Source Loss or Receiver Loss

Ports	Cables[1]	Switches Paths[2]
PORT 1-4 Source	Z5623-20418 (short) Z5623-20649 (medium) Z5623-20650 (long)	Top - S101/201/301/401 Bottom S101/201/301/401
PORT 1-4 Receiver	Z5623-20418 (short) Z5623-20649 (medium) Z5623-20650 (long)	Top - S102/202/302/402 Bottom - S102/202/302/402
PORT 5 Source PORT 8 Source	Z5623-20418 (short)	Top - S101/103 Top - S401/403
PORT 5 Receiver PORT 8 Receiver	Z5623-20649 (medium) Z5623-20650 (long)	Top & Bottom - S102 Top & Bottom - S402
PORT 6 Source PORT 7 Source	Z5623-20418 (short)	Top - S201 Top - S301
PORT 6 Receiver PORT 7 Receiver	Z5623-20649 (medium) Z5623-20650 (long)	Top & Bottom - S202 Top & Bottom - S302
PORT 10 Source PORT 11 Source	Z5623-20418 (short) Z5623-20649 (medium)	Top & Bottom - S201 Top & Bottom - S301
PORT 10 Receiver PORT 11 Receiver	Z5623-20650 Long	Bottom - S202 Bottom - S302
PORT 9 Source PORT 12 Source	Z5623-20418 (short) Z5623-20649 (medium)	Top - S101 Bottom - S101/103 Top - S401 Bottom - S401/403
PORT 9 Receiver PORT 12 Receiver	Z5623-20650 Long	Bottom - S102 Bottom - S402

1. Z5623-20418 (75 mm) cable loss 0.5 dB.
   Z5623-20649 (150 mm) cable loss 1 dB.
   Z5623-20650 (300 mm) cable loss 2 dB.
2. Path Loss of the Switch is 6 dB.

Switch 101, 201, 301 and 401 provides the selection of SOURCE paths, as shown in the block diagram.

NOTE Option 002 provides a bias tee in the source path of each port. For Ports 1 thru 4, both top and bottom K44 bias tees are in the source path. Only the bottom bias tee inputs for Port 1 thru 4 should be used.

Switch 103, 403 provides the selection of AUX 1 or AUX2 SOURCE paths, as shown in the block diagram.

Switch 102, 202, 302, 402 provide selection of RECEIVER paths as shown in the block diagram.

NOTE Z5623A Option 001 or Option 002 will improve dynamic range.

PORT 1, 2, 3 and 4

- PNA SOURCE OUT (RF cable Z5623-20418) to the top Z5623AK44 SOURCE IN.
- Top Z5623AK44 CPLR THRU (RF cable Z5623-20649) to the bottom Z5623AK44 SOURCE IN.
- From the bottom Z5623AK44 CPRL THRU (RF cable Z5623-20650) to the PNA CPLR THRU.

PORT 6 & 7

- PNA SOURCE OUT (RF cable Z5623-20418) to the top Z5623AK44 SOURCE IN.

PORT 10 & 11 SOURCE

- PNA SOURCE OUT (RF cable Z5623-20418) to the top Z5623AK44 SOURCE IN.
- Top Z5623AK44 CPLR THRU (RF cable Z5623-20649) to the bottom Z5623AK44 SOURCE IN.

PORT 5 & 8 SOURCE

- PNA SOURCE OUT (RF cable Z5623-20418) to the top Z5623AK44 SOURCE IN. Port 5 uses switch 103 and Port 8 403.

PORT 9 & 12 SOURCE

- PNA SOURCE OUT (RF cable Z5623-20418) to the top Z5623AK44 SOURCE IN. Port 9 uses switch 103 and Port 12 403.
- Top Z5623AK44 CPLR THRU (RF cable Z5623-20649) to the bottom Z5623AK44 SOURCE IN.

PORT 1, 2, 3 and 4 RCVR

- PNA CPLR ARM through the (RF cable Z5623-20418) to the top Z5623AK44 CPLR ARM.
- Top Z5623AK44 RCVR IN through the (RF cable Z5623-20649) to the bottom Z5623AK44 CPLR ARM.
- Bottom Z5623AK44 RCVR IN through the (RF cable Z5623-20650) to the PNA RCVR IN.

PORT 5, 6, 7 and 8) RCVR

- Top Z5623AK44 RCVR IN through the (RF cable Z5623-20649) to the bottom Z5623AK44 CPLR ARM.
- Bottom Z5623AK44 RCVR IN through the (RF cable Z5623-20650) to the PNA RCVR IN.

PORT 9, 10, 11 and 12) RCVR

- Bottom Z5623AK44 RCVR IN through the (RF cable Z5623-20650) to the PNA RCVR IN.

Note:

NOTE Option 001 or option 002 will improve dynamic range. RF will go through an amplifier before going into the PNA RCVR IN.

System Block Diagrams

Figure 39 Standard Configuration

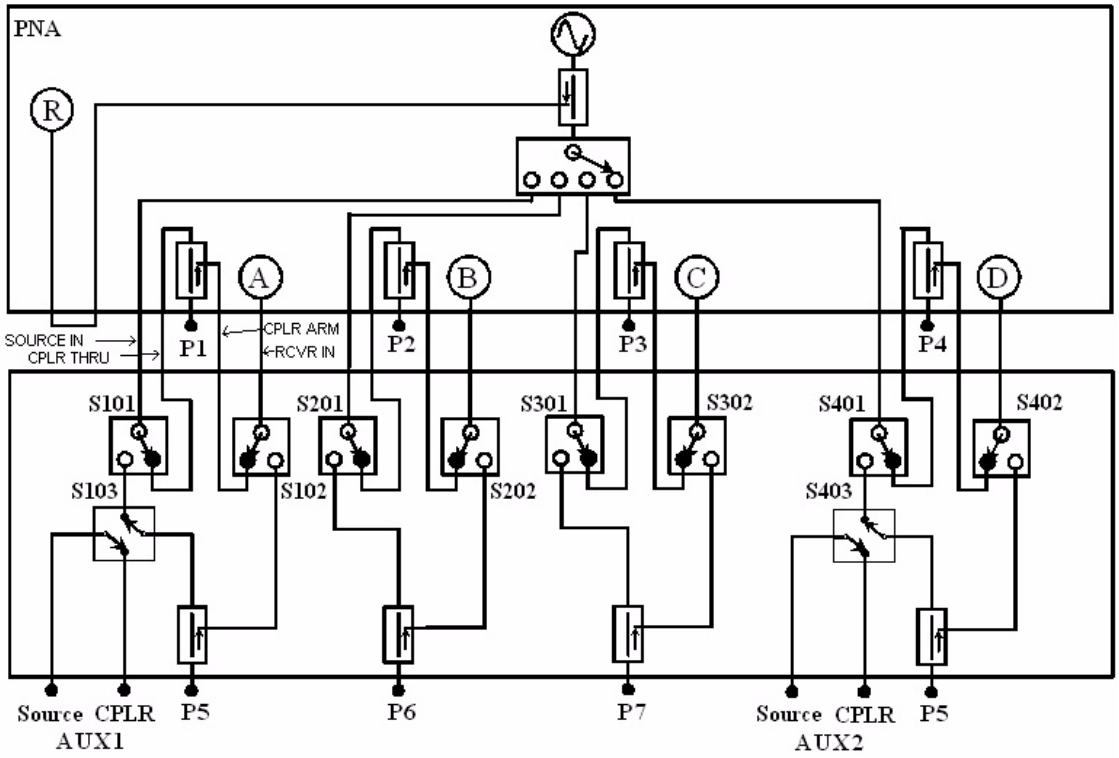


Figure 40 Option 002

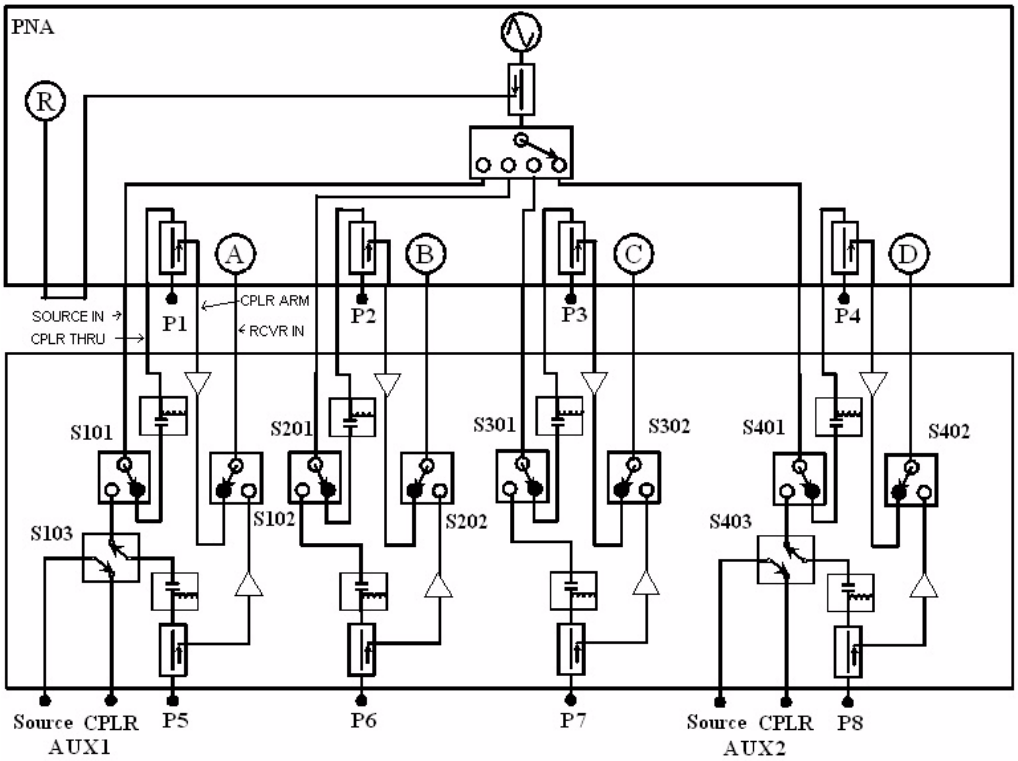


Figure 41 Option 001

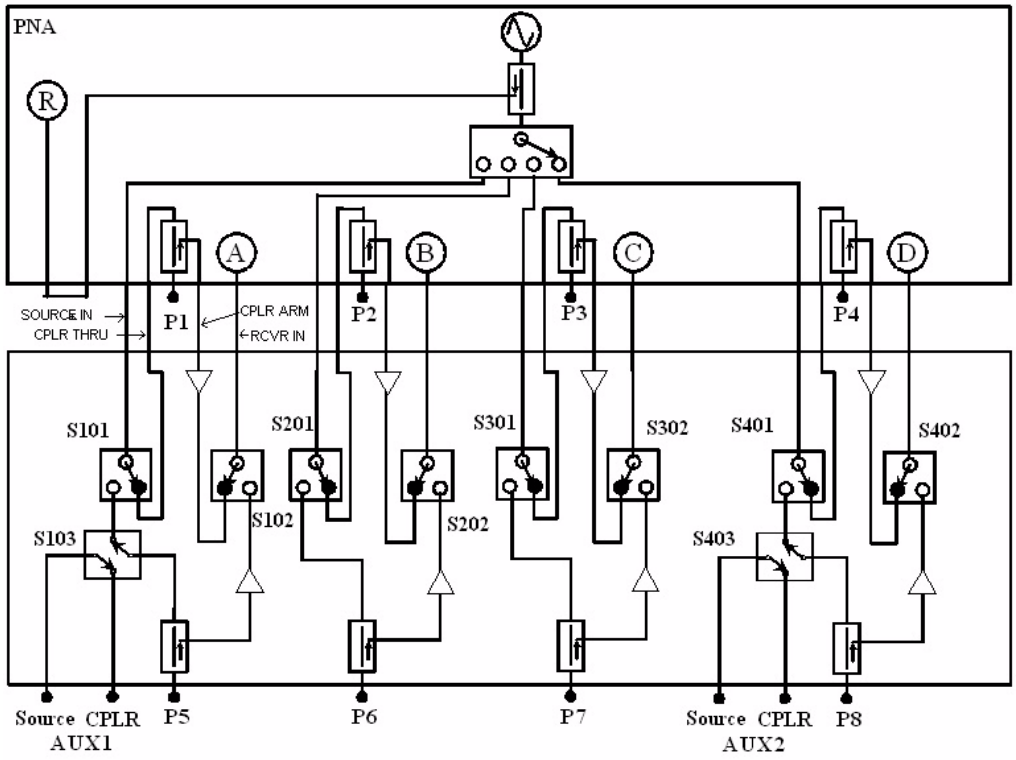


Figure 42 Standard 12-Port Block Diagram

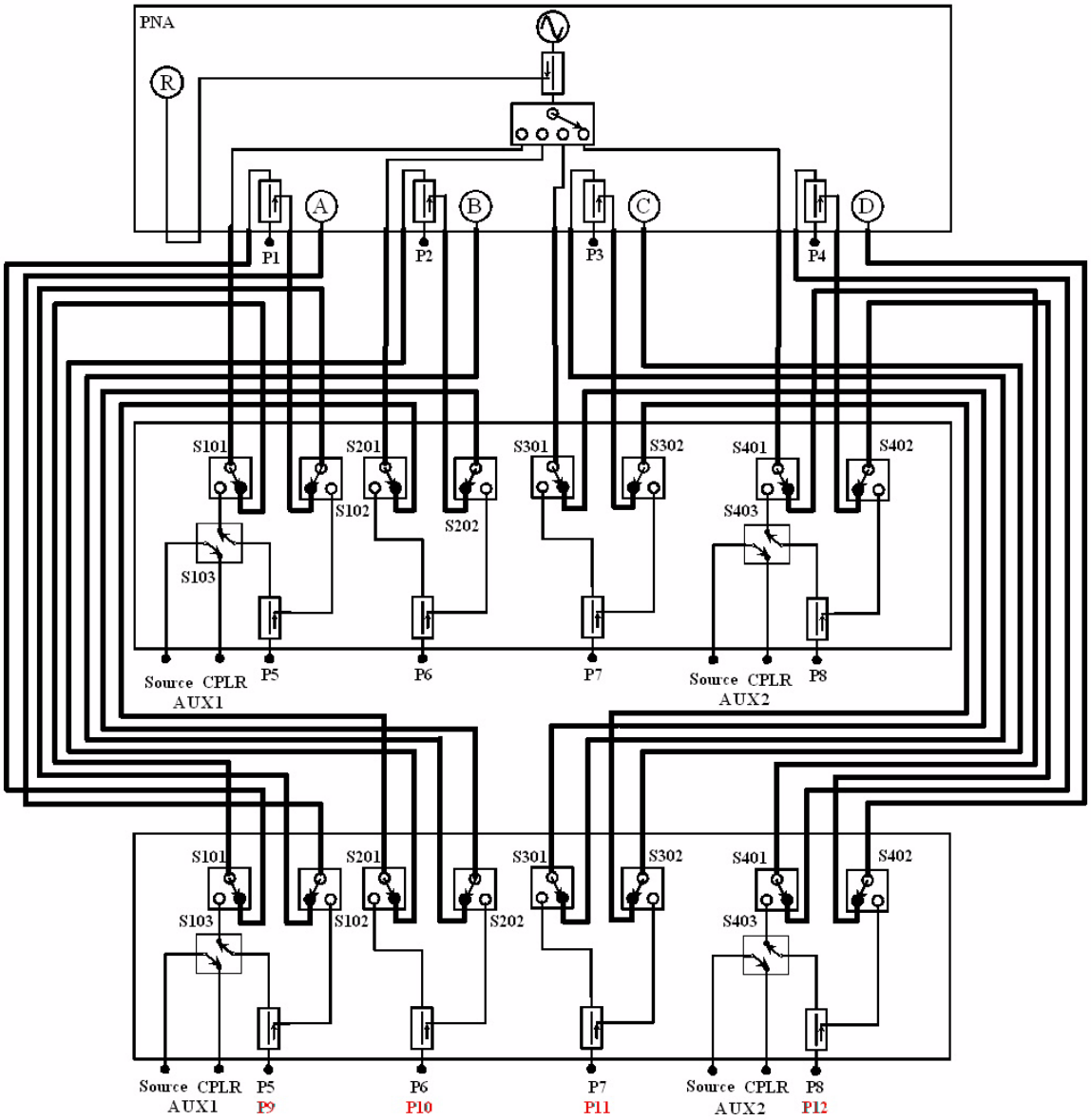
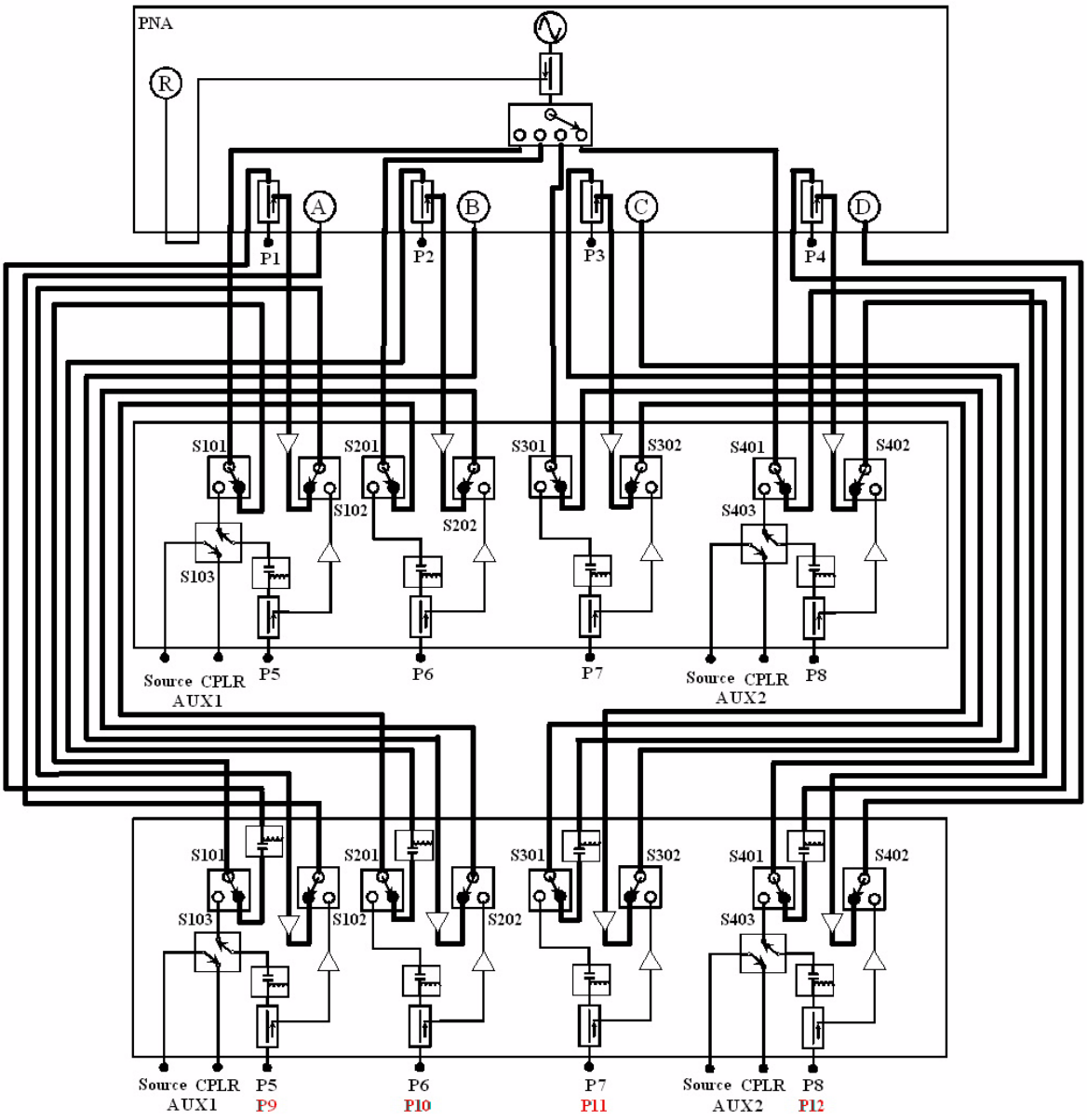


Figure 43 12-Port Block Diagram with Operational Bias Tee's



CAUTION Test set 1 bias tee's 1 thru 4 should be considered non-operational, damage can occur to the test set if bias is applied to the Port 1 thru 4 bias tee's. Test set 2 should be used to bias Port 1 thru 4 of the PNA.

Z5623AK44

Service Information

Refer to "Contacting Agilent Sales and Service Offices" on page 73.

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
Z5623AK44-ICM Rack Mount Kit (without handles)	5063-9215
Z5623AK44-ICP Rack Mount Kit (with handles)	5063-9222
Z5623AK44-ICN (front handles)	5063-9228
Bias Tee Fuse (inch 0.5A 250 V NTD FE UL-LST)	2110-0012
Line Fuse (metric 0.5A 250 V NTD FE IEC)	2110-0709
Locking Feet (tsunami to SYS2 test set)	5023-0132
Foot (FM, 1/2m)	5041-9167
Handle Strap Assembly	5063-9209
Lock Feet Kit	5063-9253
Interconnect Cable	8120-6818
RF Cable (Semi-rigid)	Z5623-20418
RF Cable (Semi-rigid)	Z5623-20419
RF Cable, Semi-rigid (12-Port)	Z5623-20649
RF Cable, Semi-rigid (12-Port)	Z5623-20650

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

For a copy of the manufacturer's Declaration of Conformity for this apparatus, contact your local Agilent Technologies office or sales representative. Refer to "Contacting Agilent Sales and Service Offices" on page 73.

Statement of Compliance

This instrument 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 which must be followed by the user to ensure safe operation and to maintain the instrument in a safe condition.

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 73. 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 Canadian EMC Requirements

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

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

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 Z5623AK44 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 **The power cord is connected to internal capacitors that may retain dangerous electrical charges for 5 seconds after disconnecting the plug from its power supply.**

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:

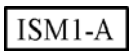
CAUTION Always use the three-prong ac power cord supplied with this instrument. Failure to ensure adequate earth grounding (by not using this cord) can cause instrument damage.

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.
	The laser radiation symbol is marked on products that have a laser output.
	This symbol indicates that the instrument requires alternating current (ac) input.
	The CE mark is a registered trademark of the European Community. If it is accompanied by a year, it indicates the year the design was proven.
	The CSA mark is a registered trademark of the Canadian Standards Association.
	This symbol indicates the product meets the Australian Standards.
	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 text indicates that the instrument is an Industrial Scientific and Medical Group 1 Class A product (CISPR 11, Clause 4).
	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.

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.