Agilent Technologies
U3022AE10

User's and Service Guide

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

Agilent Technologies

Manufacturing Part Number: U3022-90001

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Safety Notes

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

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

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

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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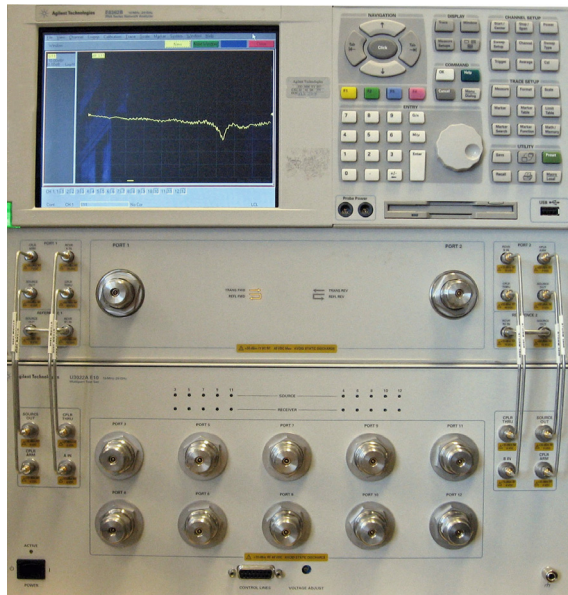
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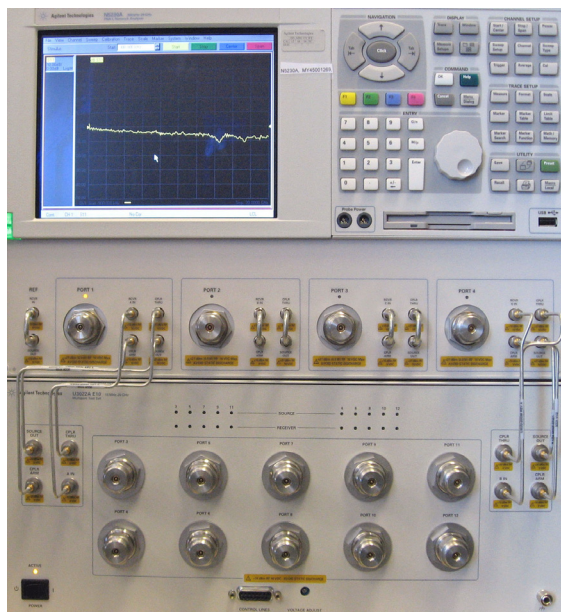
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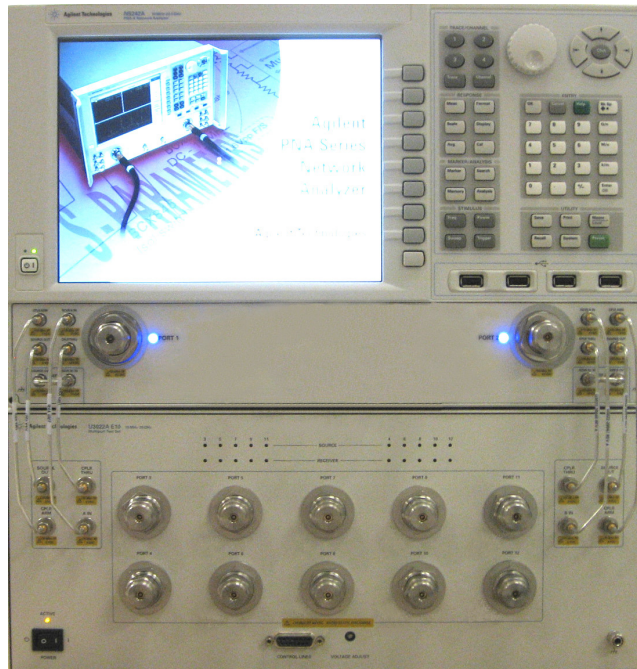
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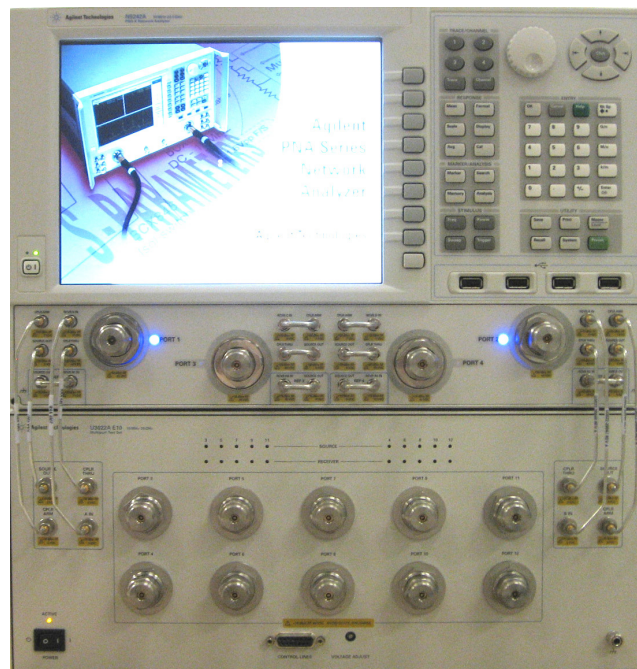
Description

The U3022AE10 is a Multiport Test Set designed to be configured with a 2 or 4-Port PNA, PNA-L or PNA-X for a 12 or 14-Port network analyzer measurement system.

- 10 Test Ports (3.5 mm male connectors)

- Low Loss Mechanical RF switching

- Frequency Range of Operation:

    — 300 kHz - 20 GHz (Standard Opt 700)

    — 10 MHz - 20 GHz (Opt 001 or 002)

    — 300 kHz - 26.5 GHz (Opt 026)

    — Test Set I/O interface for operational control. An external personal computer is not required.

The network analyzers will be referred to throughout this document as the PNA, PNA-L or PNA-X. Analyzer will be used for general information that pertains to all of the network analyzers. The U3022AE10 will be referred to as the test set.

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 91. Keep the damaged shipping materials (if any) for inspection by the carrier and an Agilent Technologies representative.

Network Analyzer Requirements

All network analyzers require Option 551 for multiport operation (N-Port error correction and measurement capability). Table 1 provides a listing of additional network analyzer option requirements.

The test set files indicated in Table 1 must be installed into the network analyzer file directory: C: Program Files\Agilent\Network Analyzer\testsets

Table 1   Configuration Requirements

2-Port Network Analyzer	Series	Options	Test Set File	System Figures
E8362/3/4B/C	PNA	014	U3022ae10_p2.tsx	Figure 1 on page 2
N5222A	PNA	201, 217 or 219	U3022ae10_pnax_p2.tsx	Figure 3 on page 3
N5230A/C	PNA-L	025, 125, 425 or 525	U3022ae10_p2.tsx	–
N5232A	PNA-L	216	U3022ae10_p2.tsx	–
N5242A	PNA-X	200	U3022ae10_pnax_p2.tsx	Figure 3 on page 3
4-Port Network Analyzer	**Series**	**Options**	**Test Set File**	**System Figures**
E8362/3/4B/C	PNA	014	U3022ae10_p2.tsx	Figure 1 on page 2
N5222A	PNA	401, 417 or 419	U3022ae10_pnax_p4.tsx	Figure 4 on page 3
N5230A/C	PNA-L	125, 125, 225 or 246	U3022ae10_p4.tsx	Figure 2 on page 2
N5232A	PNA-L	416	U3022ae10_p4.tsx	Figure 2 on page 2[1]
N5242A	PNA-X	400	U3022ae10_pnax_p4.tsx	Figure 4 on page 3

1. Figure 2 on page 2 does not show the actual analyzer, but the port configuration similar.

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

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

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

• U3022AE10 Test Set Files - *http://na.tm.agilent.com/multiport* (see test set files)

Available Options

Test Set Options

The test set has four available options:
Refer to "System Block Diagrams" beginning on page 65.

- Option 001   Adds RF amplifiers to improved dynamic range (10 MHz to 20 GHz).

- Option 002   Adds RF amplifiers and bias-tees for each of the 10 test ports
                 (10 MHz to 20 GHz).

- Option 700   Standard, 300 kHz to 20 GHz frequency range.

- Option 026   Extended frequency range from 300 kHz to 26.5 GHz.

Accessory Options

Installation instructions are included in the option package.

- Option 1CM - Rackmount Kit without Handles (5063-9215)

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

- Option 1CP - Rackmount with Front Handle Kit (5063-9222)

Network Analyzer Interface Kit Options

The U3022AE10 requires one of the following kits to interface the test set with your network analyzer. The interface kit model option includes the hardware lock-link and cable kit listed in Table 2.

Table 2   Interface Kit Options

12-Port System	Interface Kit Option	Hardware Lock-link Kit	Cable Kit - Conn. Type
E8362B/C Opt 014 (PNA)	U3021PN3-262	U3021-60001[1]	U3021-60013, SMA m/m[2]
E8363B/C Opt 014 (PNA)	U3021PN3-263	U3021-60001[1]	U3021-60014, SMA(m)/2.4(m)[2]
E8364B/C Opt 014 (PNA)	U3021PN3-263	U3021-60001[1]	U3021-60014, SMA(m)/2.4(m)[2]
N5222A Opt 201, 217 or 219 (PNA)	U3021PN3-242	U3021-60002[3]	U3021-60016, SMA m/m[4]
N5230A/C Opt 025, 125, 145, 146, 225, 245 or 246 (PNA)	U3021PN3-262	U3021-60001[1]	U3021-60013, SMA m/m[2]
N5230A/C Opt 425 or 525 (PNA-L)	U3021PN3-263	U3021-60001[1]	U3021-60014, SMA(m)/2.4(m)[2]
N5242A Opt 200 (PNA-X)	U3021PN3-242	U3021-60002[3]	U3021-60016, SMA m/m[4]
14-Port System	**Interface Kit Option**	**Hardware Lock-link Kit**	**Cable Kit - Conn. Type**
N5222A Opt 401, 417 or 419 (PNA)	U3021PN3-242	U3021-60002[3]	U3021-60016, SMA m/m[4]
N5230A/C Opt 245 (PNA-L)	U3021PN3-430	U3021-60001[1]	U3021-60015, SMA m/m[2]
N5242A Opt 400 (PNA-X)	U3021PN3-242	U3021-60002[3]	U3021-60016, SMA m/m[4]

1. Refer to "Hardware Lock-link Kit Installation (U3021-60001)" on page 15.
2. Refer to "E8362/3/4B/C & N5230A/C RF Interface Cable Connections" on page 21.
3. Refer to "Hardware Lock-link Kit Installation (U3021-60002)" on page 18.
4. Refer to "N5222A and N5242A RF Interface Cable Connections" on page 24.

General Specifications

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

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

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

When connected to a analyzer, the test set will degrade the performance at the test ports. The internal switch paths reduce test port power to the receivers. This affects the test port power of the analyzer and also reduces dynamic range. The reflection tracking values measured in the "Cal Kit Operational Check" on page 53 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 analyzer.

- U3022AE10 maximum power is 350 W.

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

Environmental Requirements

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

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

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

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

Equipment Heating and Cooling

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

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

Required Conditions for Accuracy Enhanced Measurement

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

Dimensions and Space Requirements

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

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

Table 3   Instrument Dimensions

Model	Weight	Height	Width	Depth
U3022AE10	11.4 kg (25 lb)	19.1 cm (7.5 in)	42.5 cm (16.7 in)	43.2 cm (17 in)

Power Levels

CAUTION	It is recommended that you do not operate components near damage levels (+30 dBm). The power levels must be 3 dB below maximum level to ensure no damage.

Table 4   Recommended Maximum Power Levels

U3022AE10 Test Port RF Power Levels:	
PORT 3-10	+27 dBm 0 Vdc
U3022AE10 Access Ports:	
SOURCE OUT	+27 dBm 0 Vdc
CPLR ARM	+27 dBm 0 Vdc
CPLR THRU	+27 dBm 0 Vdc
RCVR A IN and B IN	+12 dBm 0 Vdc
Damage Power Levels to U3022AE10 Access and Test Ports:	
Max Level to Port 1 & 2 Test Ports	+30 dBm (0 Vdc)

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

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

Typical Reflection Tracking

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

NOTE   Typical specifications are based on 1 to 2 units performance. Refer to Table 5 and Table 6.

Table 5   Typical Reflection Tracking PNA-L

Frequency	Standard 700	Option 001 and 002[1]	
		PNA Ports	Test Set Ports
300 kHz to 10 MHz	-1^2	+5	+6
10 MHz to 4 GHz	−3	+4	+6
4 GHz to 6 GHz	−4	+3	+6
6 GHz to 10.5 GHz	−5	+3	+6
10.5 GHz to 13.5 GHz	−6	+3	+6
13.5 GHz to 15 GHz	−7	+4	+6
15 GHz to 20 GHz	−8	−2	0

1. Low end is limited to 10 MHz
2. Generally improves a 3 MHz to –6 dB.

Table 6   Typical Reflection Tracking PNA and PNA-X

Frequency	Standard 700	Option 001 and 002[1]	
		PNA Ports	Test Set Ports
10 MHz to 50 MHz	−1	+7	+8
50 MHz to 500 MHz	−2	+7	+8
500 MHz to 3.2 GHz	−3	+5	+3
3.2 GHz to 10 GHz	−5	+3	+2
10 GHz to 16 GHz	−7	+3	+2
16 GHz to 20 GHz	−8	−2	−3
20 GHz to 24 GHz	−10	–	–
24 GHz to 26.5 GHz	−12	–	–

1. Upper end is limited to 20 GHz.

Front and Rear Panel Features

Figure 5   U3022AE10 Front Panel
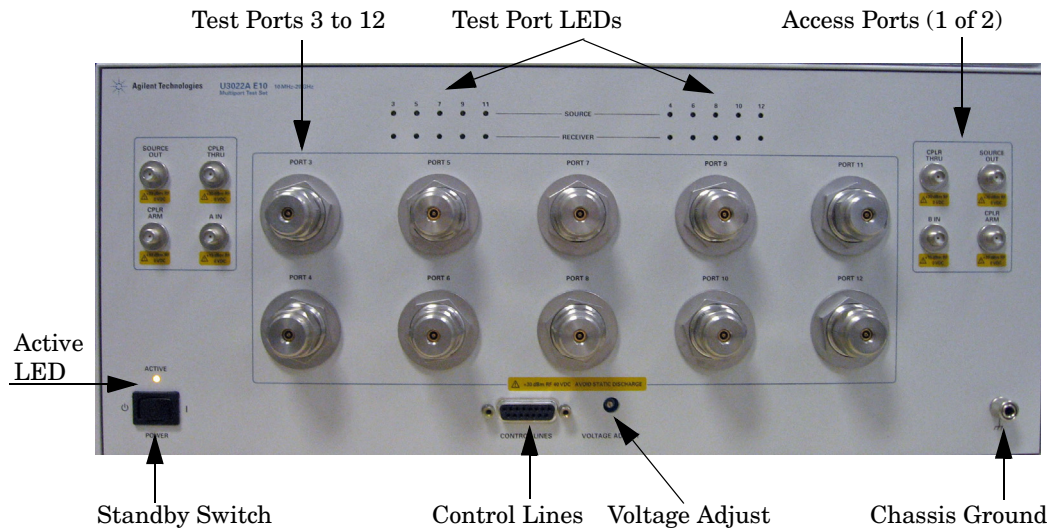
Test Ports - 3.5 mm (male)

• Port 3 – 12

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.

Access Ports – SMA Bulkhead (female)

• CPLR ARM

• SOURCE OUT

• CPLR ARM

• A IN

• B IN

Chassis Ground

A threaded terminal post for connecting the test set to a conductive object, cabinet or structure to ensure a common potential and reduce leakage current in a system. Requires an English 1/4-20 thread nut (2950-0004) and lock washer (2190-0067).

Control Lines and Voltage Adjust

For further information pertaining to control lines and voltage adjustments see "Control Lines" on page 47.

Standby Switch

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

Active LED

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

Figure 6   U3022AE10 Rear Panel

Control Lines   Voltage Adjust
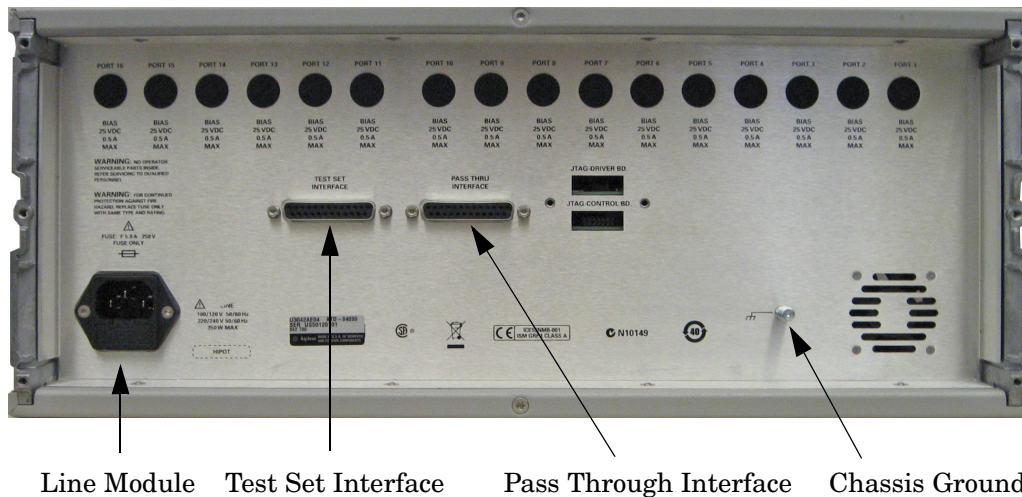
Line Module   Test Set Interface   Pass Through Interface   Chassis Ground

Chassis Ground

A threaded terminal post for connecting the test set to a conductive object, cabinet or structure to ensure a common potential and reduce leakage current in a system. Requires an English 1/4-20 thread nut (2950-0004) and lock washer (2190-0067).

Pass Through Interface

Connection to another test set.

Test Set Interface

The Test Set I/O connector is used to send address and data to the test set from the network analyzer.

Line Module

This assembly houses the line cord connection, line fuse, and line voltage selector. Remove the line module cover to replace or change the fuse. Line voltage selection is automatic and no setting is required.

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

Available Fuses

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

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

Figure 7   Line Module and Fuse

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

Hardware Lock-link Kit Installation (U3021-60001)

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

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

Locking the Test Set to the PNA-L

1. The lock-link kit (U3021-60001) includes items to mechanically interface the test set to the analyzer.

2. Remove the feet from the bottom of the analyzer.

3. Remove the 2 lower standoffs from the rear panel on the analyzer.

Figure 8   Rear Bottom Feet

Standoffs (x2)

Feet (x4)
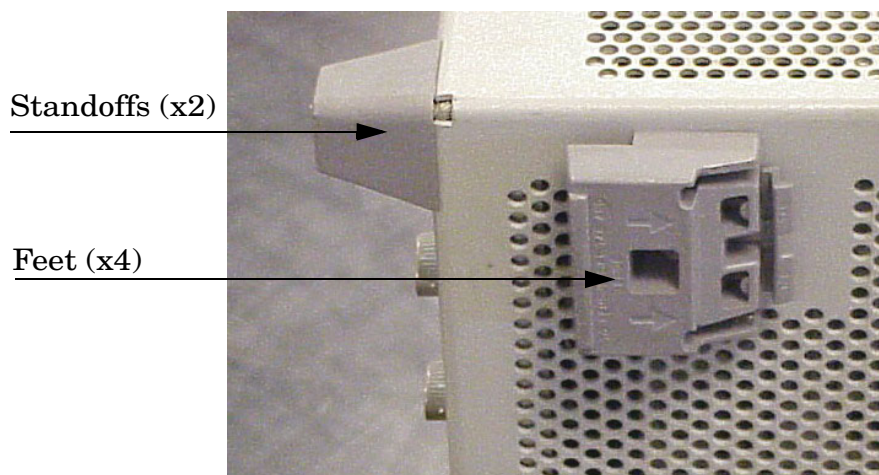
4. Install the two rear lock-links (5023-0132) onto the PNA-L, where the standoffs were removed.

Figure 9   Install Lock-links to PNA-L

Screw 0515-1619

Lock-link (5023-0132)

5. Remove the top two standoffs from the rear panel on the test set.

6. Install the top left and right rear lock-links from the kit (5063-9253) using screws (0515-1244).

Figure 10   Install Rear Lock-links to the Test Set

5022-2816

5022-2818
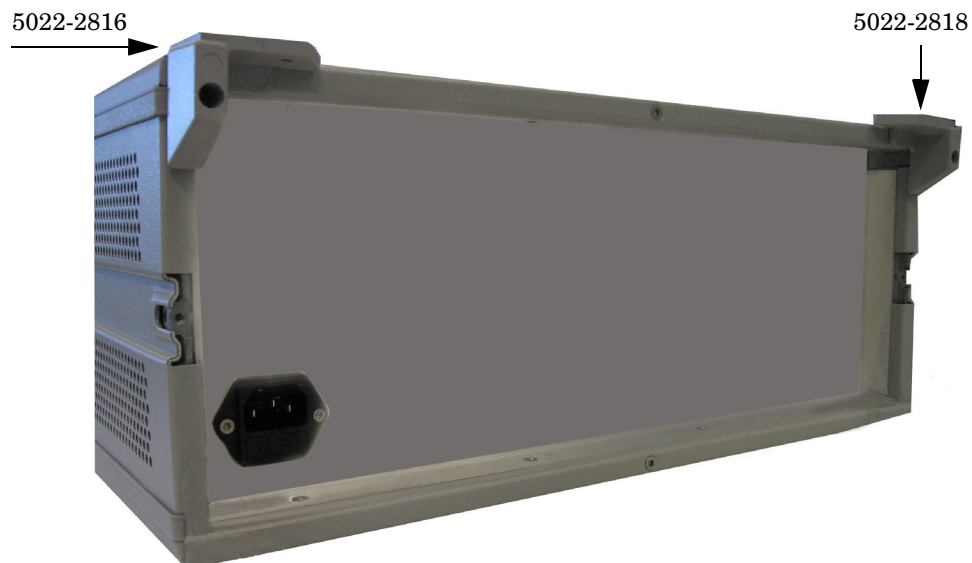
7. Place the PNA-L on top of the test set and ensure that the front frame of the analyzer is positioned slightly forward of the locks that are attached to the test set. Slide the analyzer back so the locks engage the front frame.

Figure 11   Locking the Analyzer
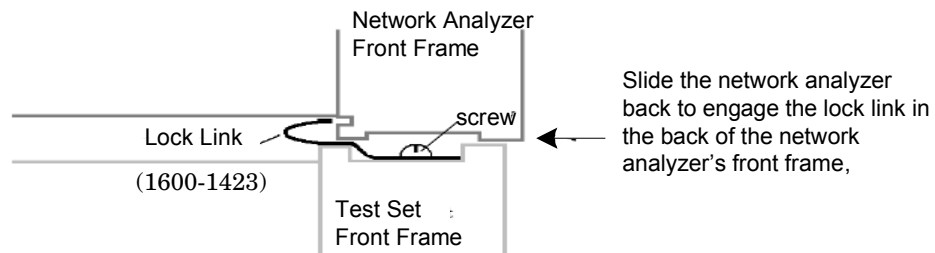
8. Secure the PNA-L's lower lock-links to the test set's upper lock-links, using the spring–loaded screws. If the analyzer's lock-links are not aligned with the screw holes, loosen the screws securing the lock-links to the instrument slightly to align and tighten.

Figure 12   Lock-link Screws

NOTE   The Lock-link kit (U3021-60001) includes hardware to attach the PNA-L to the test set. Refer to "Network Analyzer Interface Kit Options" on page 7 and "Contacting Agilent" on page 91 for ordering information.

- PNA-L – 5023-0132 (Kit includes lock-links and screws)
- Test Set – 5063-9253 (Kit includes lock-links and screws).

Hardware Lock-link Kit Installation (U3021-60002)

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

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

Locking the Test Set to the PNA or PNA-X

1. The lock-link kit (U3021-60002) includes items to interface the Test Set to the PNA or PNA-X.

2. Remove the feet from the bottom of the analyzer.

3. Remove the 2 lower standoffs from the rear panel on the analyzer.

Figure 13   Rear Bottom Feet

Standoffs (x2)

Feet (x4)
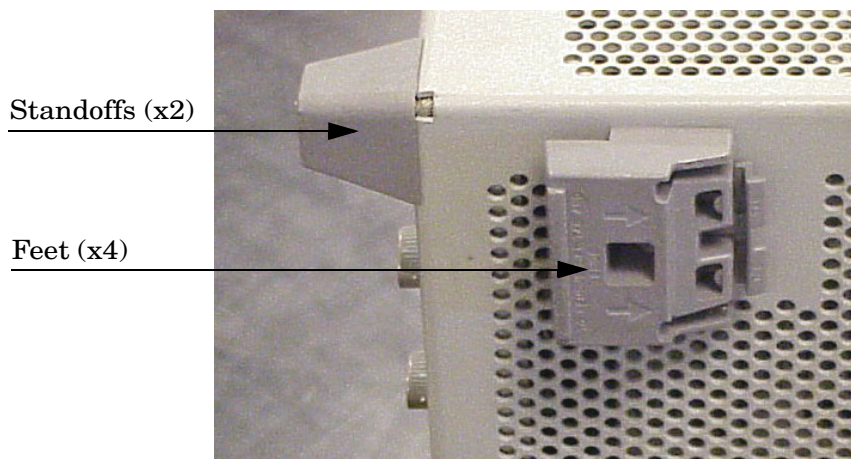
4. Install the two rear lock-links (5023-0132) onto the PNA or PNA-X, where the standoffs were removed.

Figure 14   Install Lock-links on PNA or PNA-X
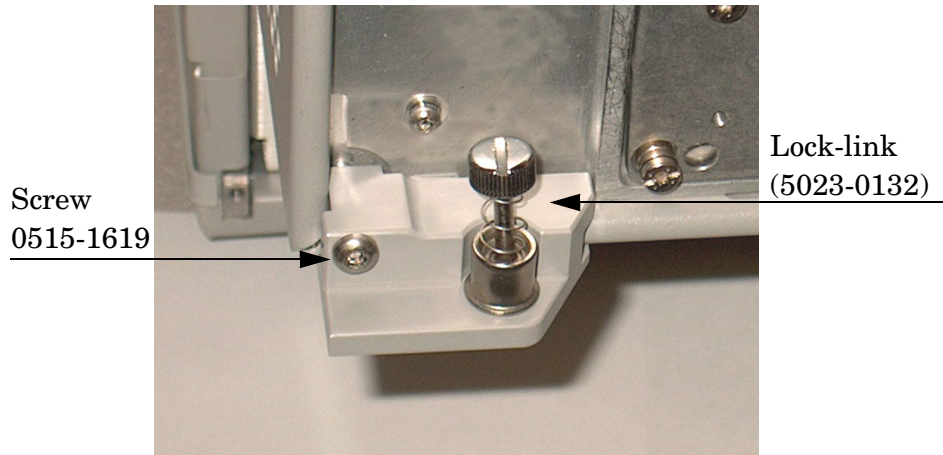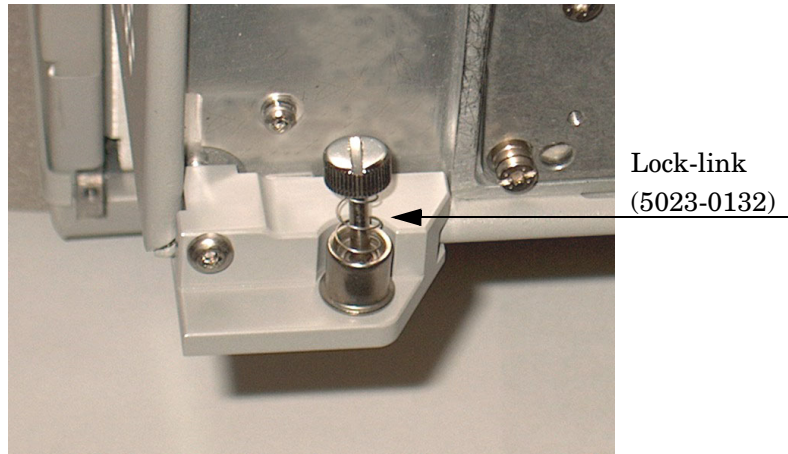
Lock-link
(5023-0132)

5. Remove the top two standoffs from the rear panel on the test set.

6. Install the two rear lock-links onto the Test Set. Looking at the front panel, the N5242-20138 is the right foot and the N5242-20139 is the left foot. Two screws (0515-2317) are included with this option.

Figure 15   Install Lock-link on Test Set

N5242-20139

N5242-20138

0515-2317

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

Figure 16   Locking the Analyzer

Network Analyzer
Front Frame

screw

Slide the network analyzer
back to engage the lock link in
the back of the network
analyzer's front frame,

Lock Link

Test Set
Front Frame
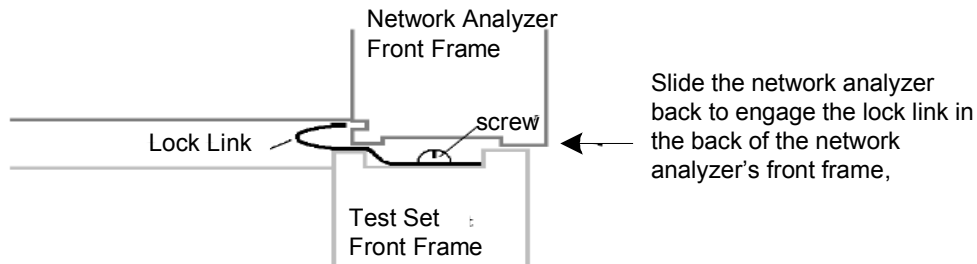
8. Secure the PNA or PNA-X lower lock-links to the Test Set upper lock-link, using the spring–loaded screws. If the analyzer's lock-link are not aligned with the screw holes, loosen the screws securing the lock-link to the instrument slightly to align and tighten.

Figure 17   Lock-link Screws

NOTE	The lock-links kit (U3021-60002) includes hardware to attach the PNA or PNA-X to the test set. Refer to "Network Analyzer Interface Kit Options" on page 7 and "Contacting Agilent" on page 91 for ordering information.

- PNA or PNA-X– 5023-0132 (Kit includes lock-links and screws)
- Test Set – N5242-20138 (right foot) and N5242-20139 (left foot) and screw (0515-2317) for use with the PNA or PNA-X.

E8362/3/4B/C & N5230A/C RF Interface Cable Connections

2 and 4-Port Analyzer

Figure 18 on page 22 illustrates the cable configuration of the 2-Port analyzer. The cables are supplied with the kits (U3021-60013 or 60014). Refer to Table 7, Table 8. Figure 19 on page 23 illustrates the cable configuration of the 4-Port analyzer. The cables have been supplied with kit (U3021-60015), see Table 9 on page 23.

Cable Connection Procedure

1. Remove the SOURCE OUT to CPLR THRU and RCVR IN to CPLR ARM jumpers (x4) on the PNA-L. The RCVR R1 to SOURCE OUT reference loop jumper (x1) remain on the front panel.

2. Connect the RF interconnect cables, supplied with this option, from the analyzer to the test set. Torque each cable to 8 in-lb. Refer to Table 7 and Figure 18 on page 22.

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

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 analyzer.

Table 7   12-Port RF Cable Connections (U3021-60013, SMA m/m)

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

Table 8   12-Port RF Cable Connections (U3021-60014, SMA m/2.4 m)

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

NOTE   The 2.4 mm male connector end of the cable mates to the 2.4 mm female connector on the analyzer.

Figure 18 indicates the final two digits of the part number for each cable.

Figure 18   12-Port Interface Connections

3. Add the front panel port labels from the cable kit (U3021-60015) over the analyzer's port numbers.

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

Table 9   14-Port RF Cable Connections (U3021-60015)

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

Figure 19 indicates the final two digits of the part number for each cable.

Figure 19   14-Port Interface Connections

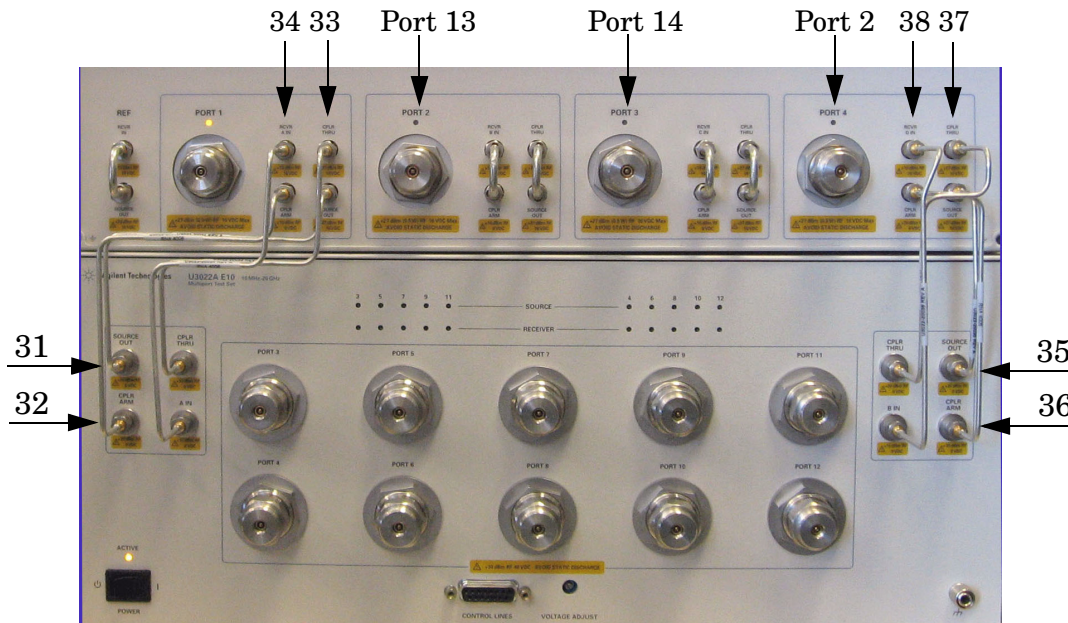# N5222A and N5242A RF Interface Cable Connections

Figure 20 and Figure 20 on page 25 illustrates the cable configuration of the test set to the analyzer. The cables have been supplied with the kit (U3021-60016).

1. Remove the SOURCE OUT to CPLR THRU and RCVR IN to CPLR ARM jumpers on the analyzer. The RCVR R1 - R4 to SOURCE OUT reference loop jumpers remain on the front panel.

2. Add the front panel port labels to the analyzer. Refer to Figure 21 on page 25.

   - Port 13 over Port 3 (U3022-80002)

   - Port 14 over Port 4 (U3022-80003)

3. Connect the RF interconnect cables from the analyzer to the test set in the order listed. As you are connecting each cable, torque to 8 in-lb. The longer, straight end of each cable is connected to the test set. Refer to Table 10 and Figure 21 on page 25.

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 10   RF Interface Cable Connections (U3021-60016)

Numeric Order	RF Cables	From: Analyzer	To: Test Set
1	U3022-20042	Port 1, CPLR ARM	CPLR ARM
2	U3022-20043	Port 1, SOURCE OUT	SOURCE OUT
3	U3022-20044	Port 1, RCVR A IN	A IN
4	U3022-20045	Port 1, CPLR THRU	CPLR THRU
5	U3022-20046	Port 2 CPLR THRU	CPLR THRU
6	U3022-20047	Port 2, RCVR B IN	B IN
7	U3022-20048	Port 2, SOURCE OUT	SOURCE OUT
8	U3022-20049	Port 2, CPLR ARM	CPLR ARM

Figure 20 and Figure 21 illustrates the final two digits of the part number for each cable. The cables must be connected in the numeric order listed in Table 10 on page 24.

Figure 20   12 Port RF Interface Cable Connections
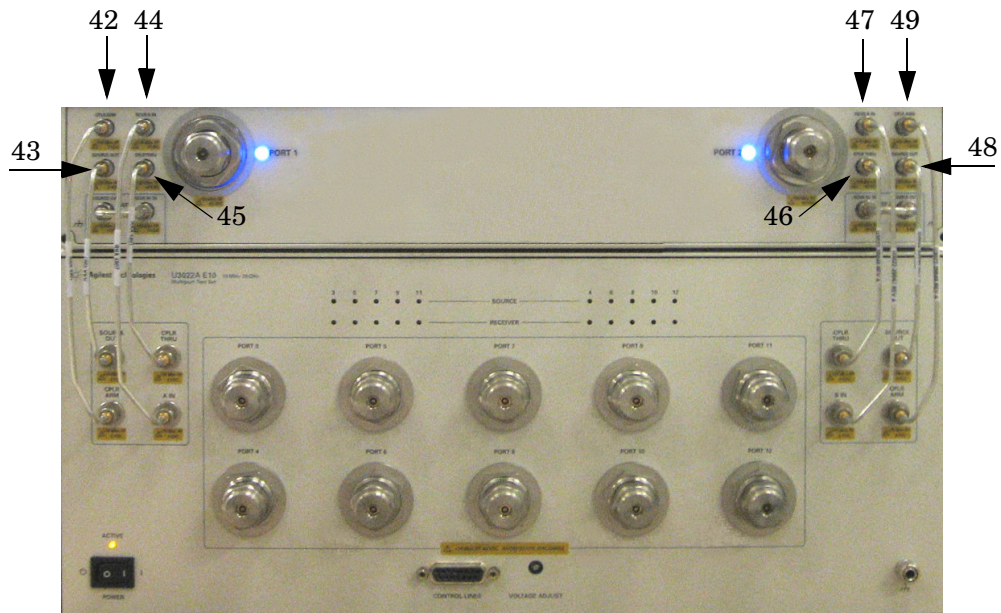

Figure 21   14 Port RF Interface Cable Connections
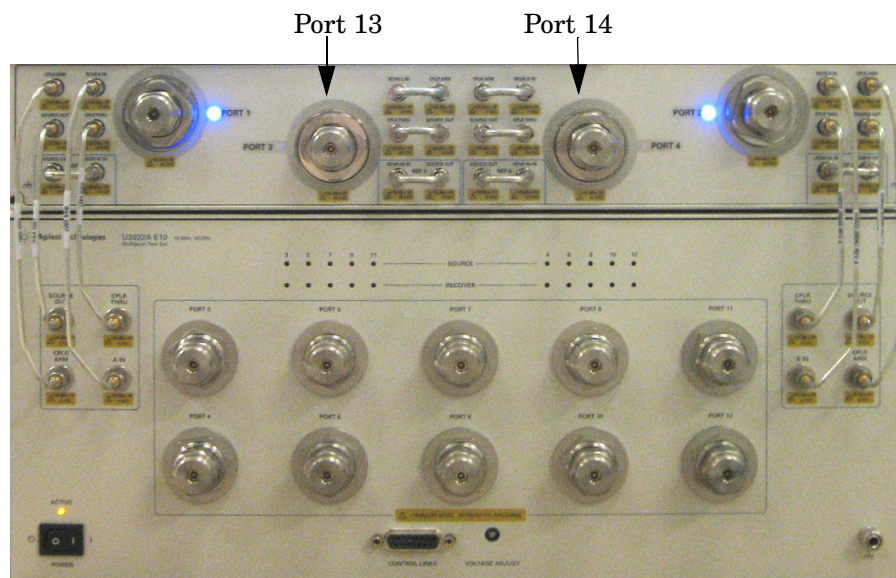
Test Set I/O Cable Installation

1. Connect the analyzer's Test Set I/O cable (N4011-21002) to the Test Set Interface
   connector on the rear panel, similar to Figure 22.

Figure 22   Test Set I/O Cable Connection
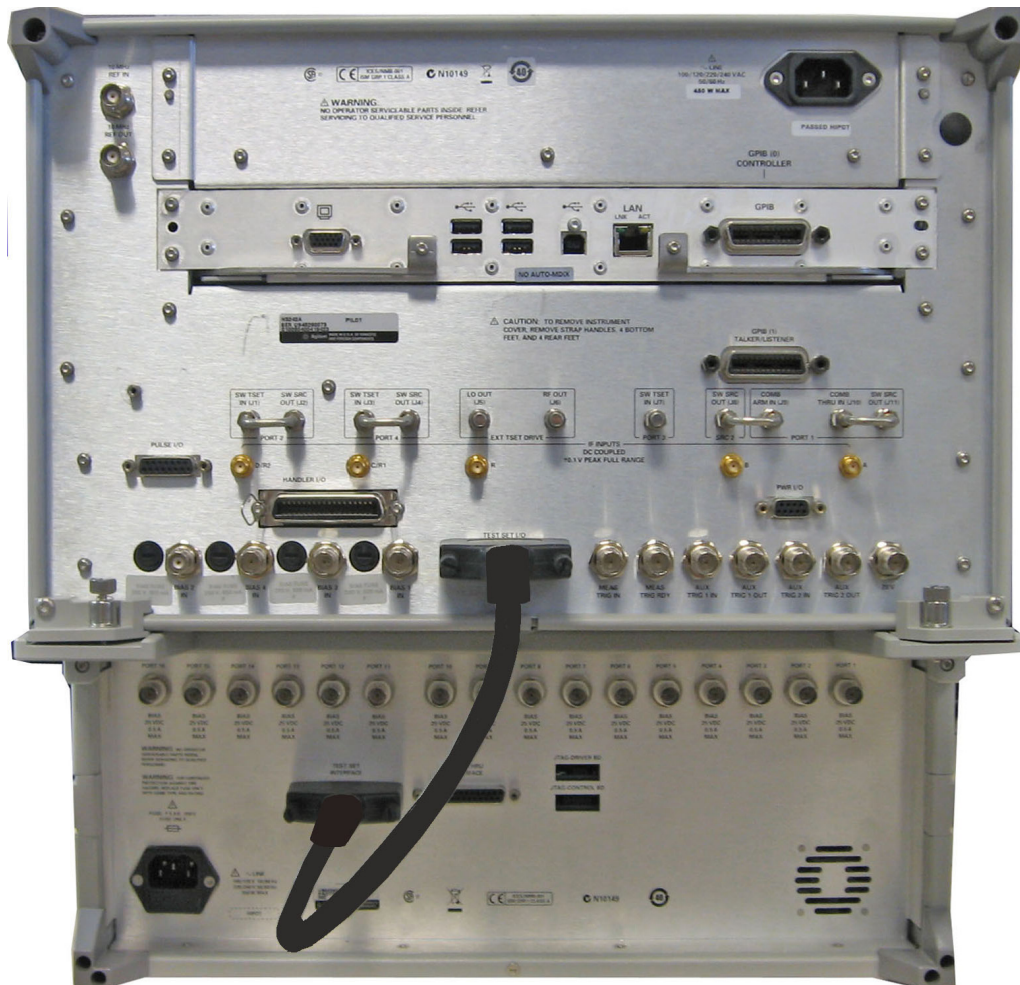
System Operational Check

The following procedure will confirm that the RF interface cables between the test set and analyzer are installed and the system is working correctly. Ensure that your analyzer is calibrated by measuring the short on each port before connecting the test set.

Before beginning this procedure you should complete the following steps:

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

Equipment Setup

- Turn *on* the test set and network analyzer.
- Preset the analyzer and make the following settings:
  — Set to Multi-Port Mode
  — Frequency range: 10 MHz to 20 or 26.5 GHz
  — IFBW: 1 kHz
  — Scale: 10 dB/Div
  — Set the PNA to measure S11
  — Ensure the RF path of the analyzer is in Default mode. Refer to "RF Path Configuration with Option 029" on page 36.

Verify Results

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

Table 11   Reflection Response Results

Reflection Port	Response Trace	Cable Path Diagram
Ports 1-2	Figure 22 & Figure 24 on page 28	Figure 24 on page 28
Ports 3-12	Figure 25 on page 29 & Figure 26 on page 29	Figure 27 on page 30

NOTE   The trace ripple (peak-peak variation) will be higher than when using an ECal Module due to variation in your Short's performance. If response is in question perform "Cal Kit Operational Check" on page 53.

Figure 23   Typical Reflection Response Ports 1-2 (Standard)
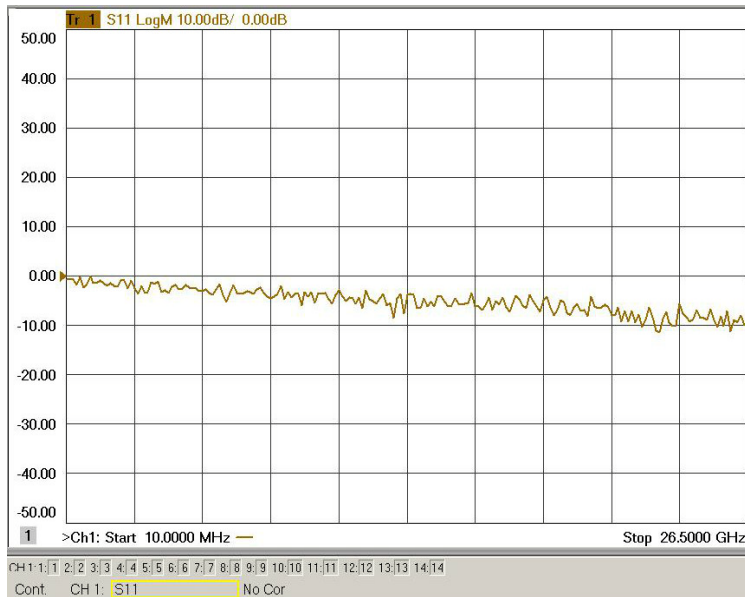
Figure 24   Typical Reflection Response Ports 1-2 (Option 001)

Figure 25   Reflection Response Signal Path Diagram Ports 1-2
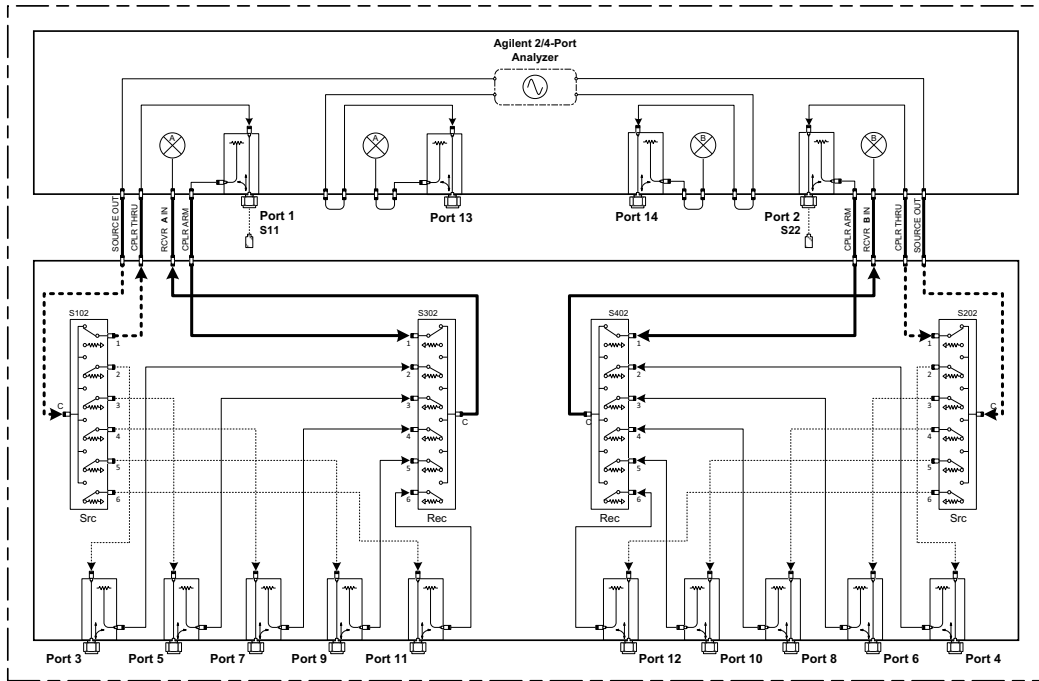
Figure 26   Typical Reflection Response Ports 3-12 (Standard)
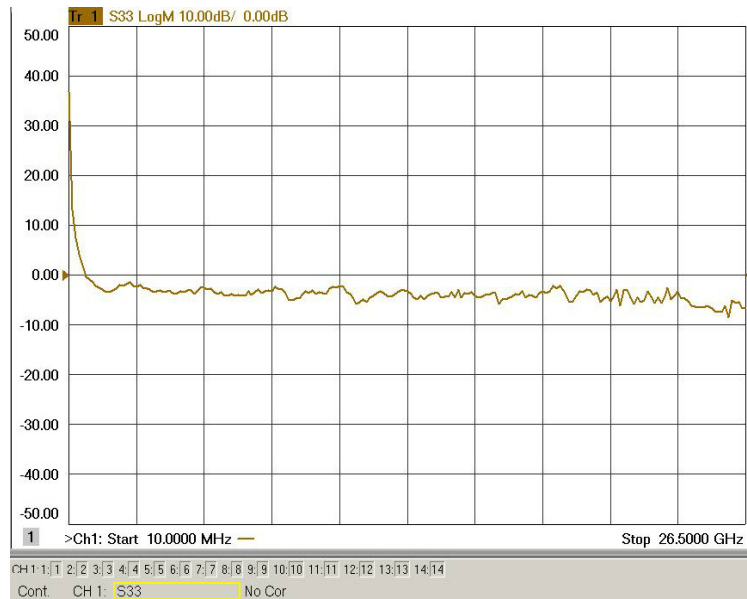
Figure 27   Typical Reflection Response Ports 3-12 (Option 001)
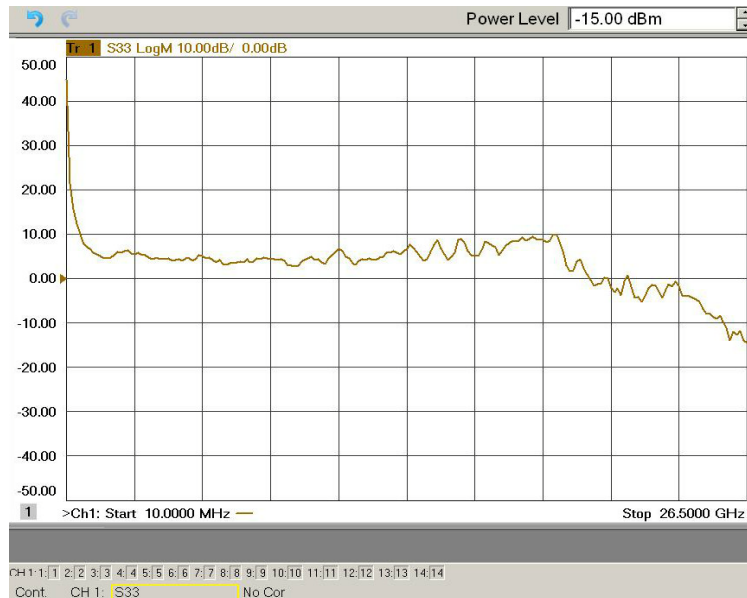
Figure 28   Reflection Response Signal Path Diagram Ports 3-12
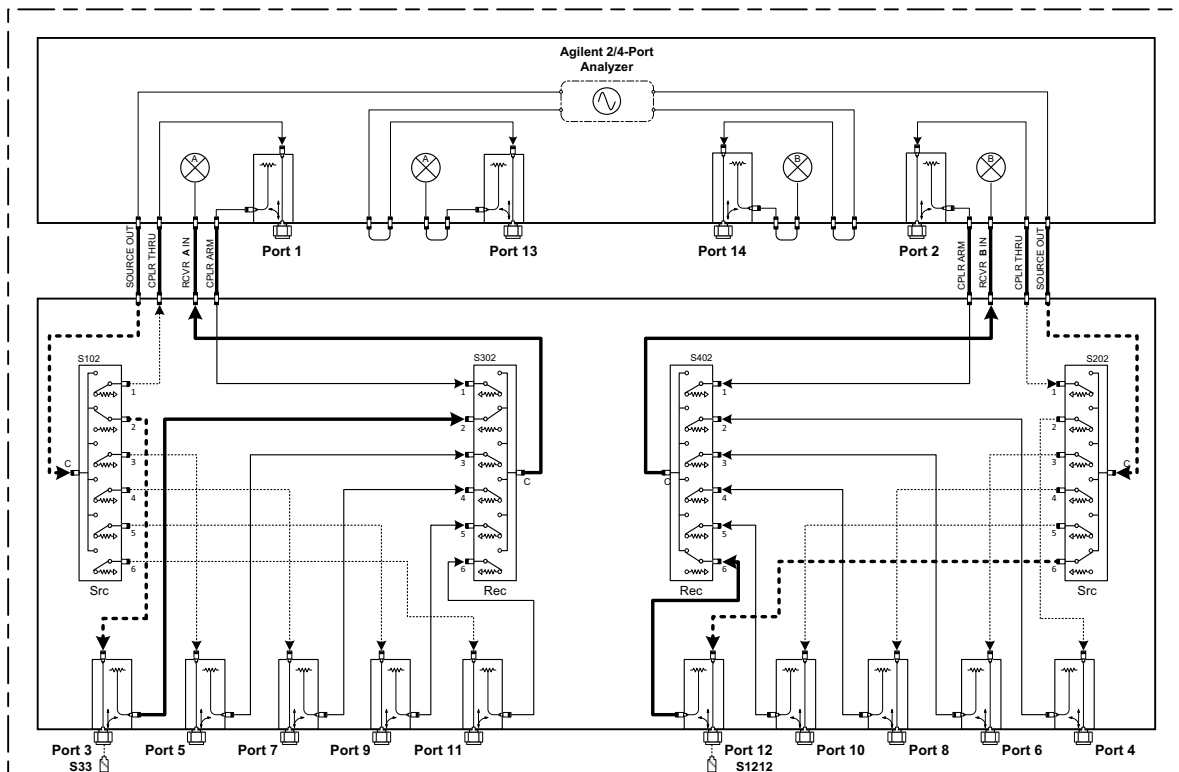
Controlling the Test Set with N5222A, N5230C or N5242A

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

NOTE	The internal firmware of the analyzer has not been modified for this test set option. Power levels may differ from those indicated on the network analyzer when the test set is connected.

The test set is considered a "slave" instrument. A PNA, PNA-X or PNA-L must be used to control the test set. There are three methods to control the test set. Multiport mode is recommended due to calibration and ease of use.

-
-
-

Typeface Key Conventions

The following key conventions are used throughout this document.

- **[HARDKEYS]** are labeled front panel keys
- **SOFTKEYS** are indicated on the instrument display

Multiport Mode (Option 551)

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

Ensure the test set file needed for your analyzer are installed into network analyzer file directory: C:\Program Files\Agilent\Network Analyzer\testsets

Refer to "Network Analyzer Requirements" on page 5.

How to Access Multiport Mode

1. The Option 551 must be installed for multiport capability. To access the multiport application select **Utility** > **System** > **Configure** > **Multiport Capability**.

2. Select **U3022AE10** (12-Port System) from the drop-down menu and select **Restart as a multiport PNA with this testset** > **OK**. The analyzer will restart the network application with the test set interface features.

If the test set is not available in the drop-down list, it will be necessary for you to copy the required test set file to the analyzer's hard drive. The current version of the test set files are available on the web at *http://na.tm.agilent.com/multiport*. Copy the appropriate file to C:\Program Files\Agilent\Network Analyzer\testsets.

Figure 29   Selecting Multiport Mode
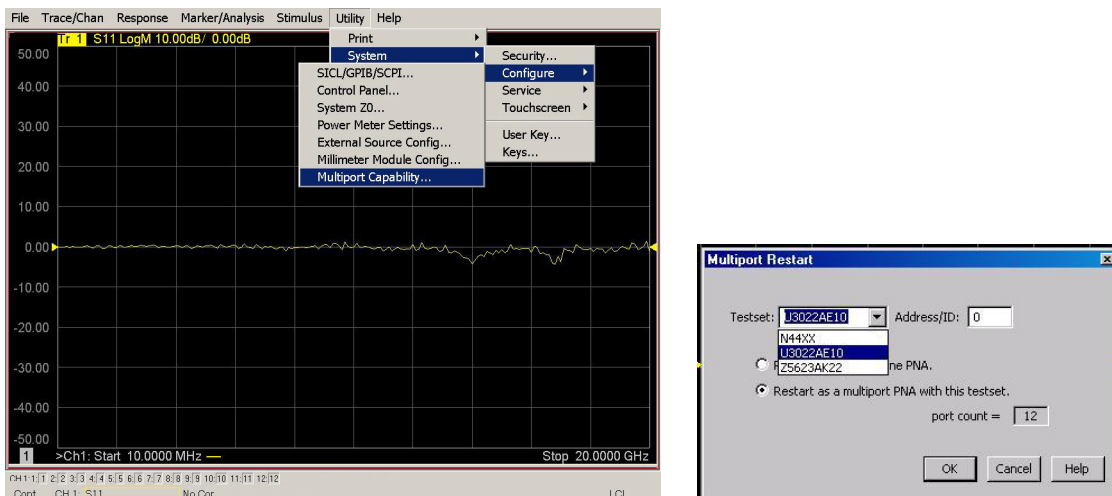
External Test Set Control Feature

To verify that the network application has the test set interface features, select
Trace/Chan > **Channel** > **Hardware Setup** > **External Test Set** > **Other.** The test set will be
displayed as **External Test Set Control-U3022AE10**.

Figure 30   External Test Set Control
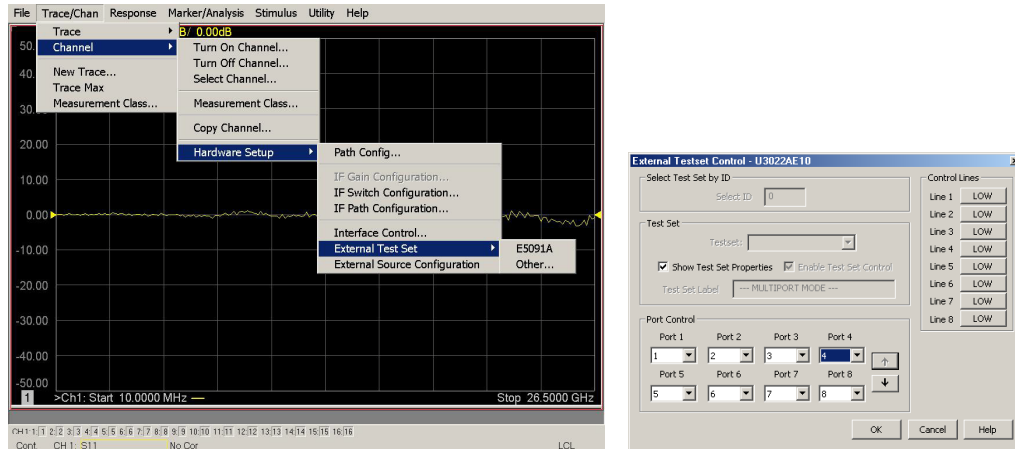
This menu will allow the physical Ports 1 thru 8 to be identified as any port for your
convenience. For example; Port 5 can be re-named Port 2.

The **External Test Set Control-U3022AE10** also allows control of the DUT control lines,
refer to "Control Lines" on page 47. To change the state from LOW to HIGH, select the
graphical user interface (GUI) for the specific control (LINE 1 thru 8), click **OK**. Each line
can be controlled separately.

Select the port control down arrow for Ports 9 thru 12.

Trace Measure S-Parameter

S-Parameter selection can be accomplished using **Response** > **Measure**. Use the drop-down menu 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 31   S-Parameter Measurement
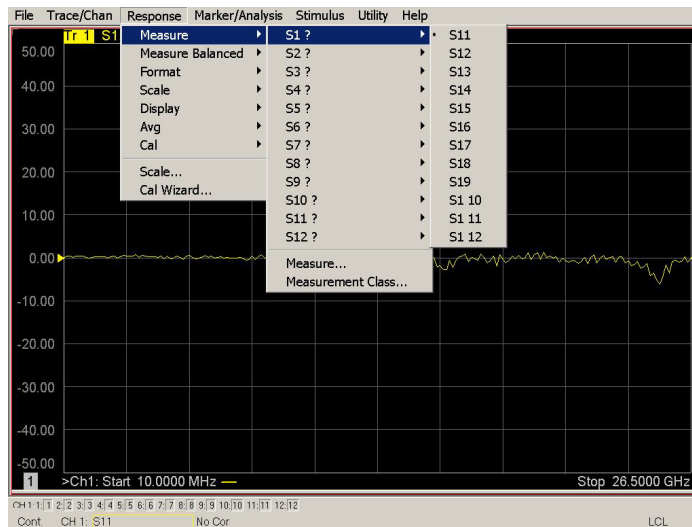
New Trace Measure S-Parameter

S-Parameter Tab: Multiple S-Parameters can be made from the **New Trace** menu. In the drop-down menu select **Trace/Chan** > **Trace** > **New Trace**. The dialog box allows the selection of any of the 144 S-Parameters.

Figure 32   New S-Parameter Measurement
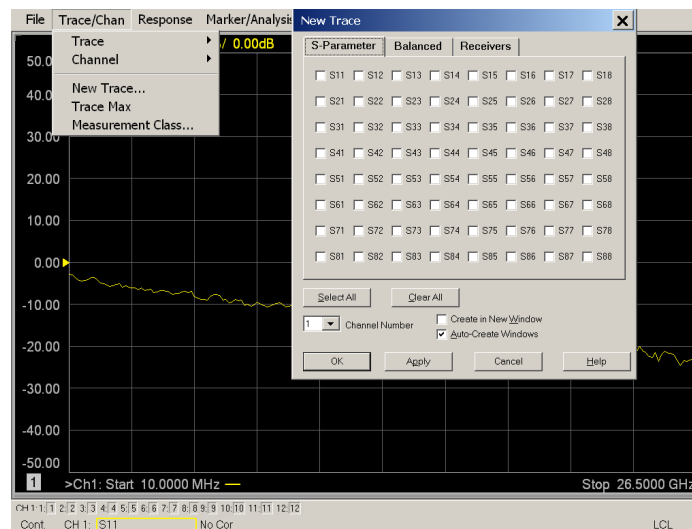
Balanced Tab: Balanced Measurements can be configured by selecting the Balance tab in the New Trace menu.

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

Figure 33   Selecting Balanced Measurements
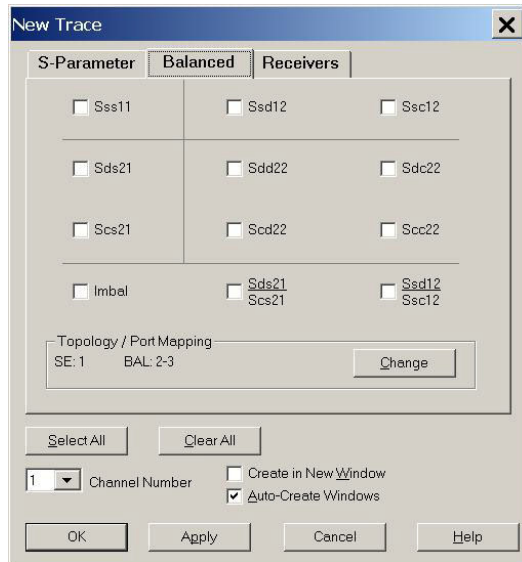
Receivers Tab: The S-Parameter measurements can be ratioed with selectable Denominators for each port and receiver. Refer to the standard documentation for more information.

Figure 34   Receiver Measurements
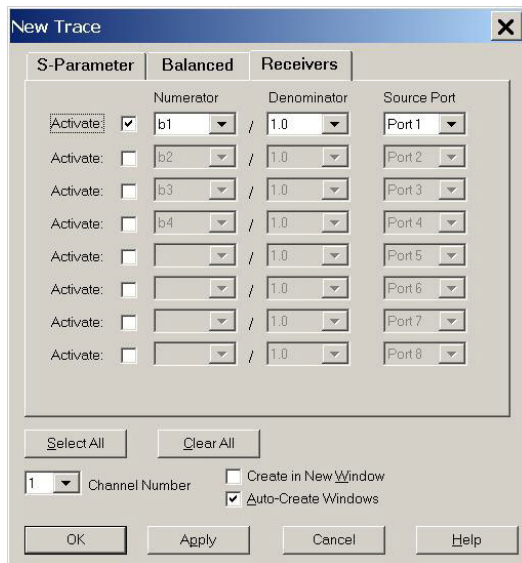
Sweep Setup for Multiport and Standalone Modes

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

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

2. Select **Stepped Sweep-sweep moves in discrete steps**.

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

Figure 35　Sweep Setup
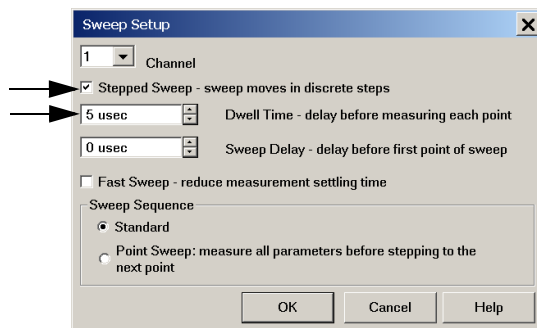
RF Path Configuration with Option 029

NOTE　　　If the analyzer has Option 029 or H29 (noise figure capability) verify that the path configuration is set to Default. If it is not in Default configuration, ports 5 and 9 will not operate correctly. Select **Trace/Chan > Channel** > **Hardware Setup > Path Cong**... and in the drop-down menu select **Default** > **OK**. Save this configuration as a User Preset by selecting **Save** > **User Preset** > **Save current state as User Preset**. Do not use the factory Preset (User Preset Off), the analyzer will return to Option 029 path configuration.

Figure 36　RF Path Configuration
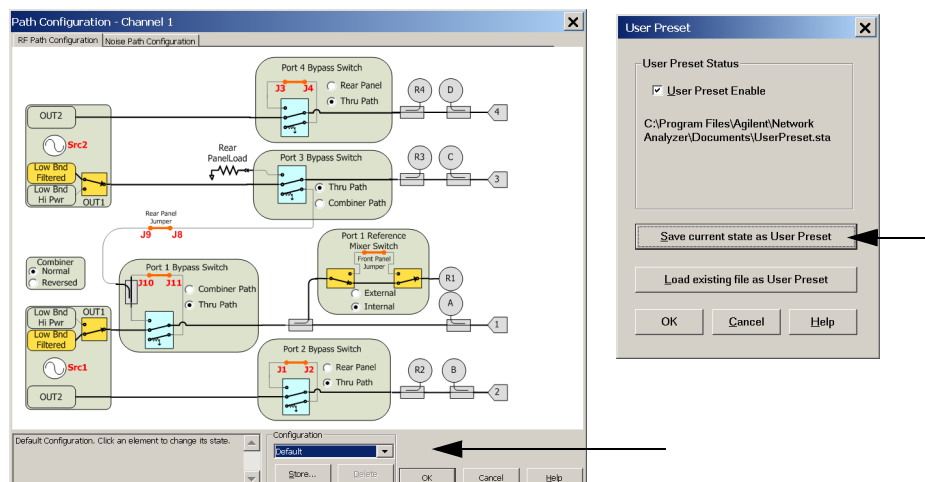
N-Port Calibration

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

Characterize the ECal module with adapters that will not be used in the measurement of the DUT. To characterize the ECal module select **Response > Cal > More > ECal > Characterize ECal Module**.

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

NOTE   If measurement errors occur, ensure the newest version of firmware is installed on the network analyzer. Measurement errors can be a result of firmware algorithms. Consult with 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*

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1. To perform an ECal characterization select **Response** > **Cal Wizard** > **Characterize ECal Module**.

2. Follow the prompts and save the ECal characterization file. Refer to the Help menu for characterizing information.

Figure 37   ECal Characterization and Calibration Wizard
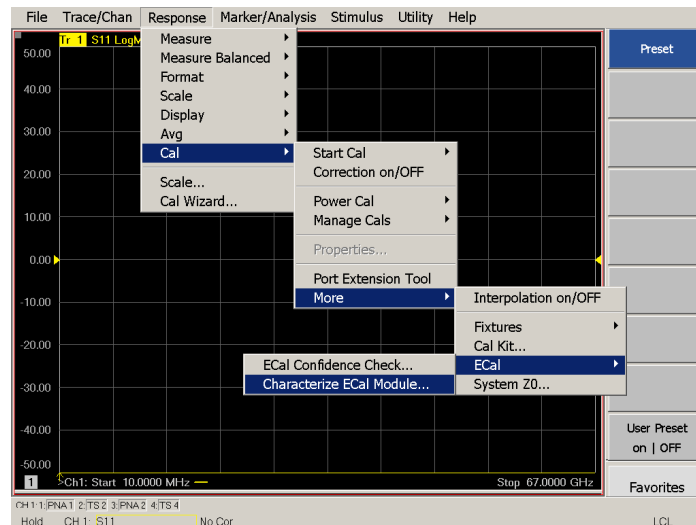
3. On the analyzer select **Response** > **Cal Wizard**.

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

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

Figure 38   Begin Calibration
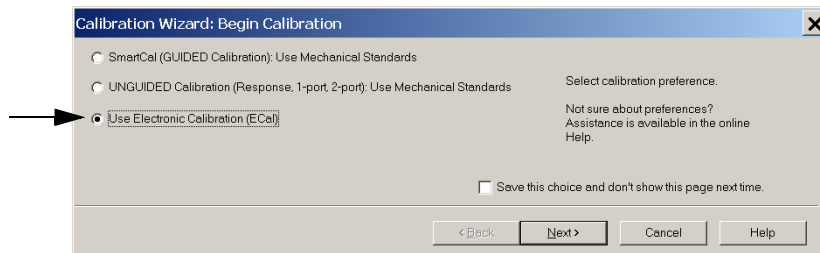
4. Continue following the Cal Wizard prompts. In the "Select Calibration Ports and ECal Module" dialog box press **Select All**, or select the ports you are calibrating and press **Next**. If an ECal characterization has been done, select **View/Select ECal Module** and select the previously saved user file from step 3.

Figure 39   12-Port Calibration
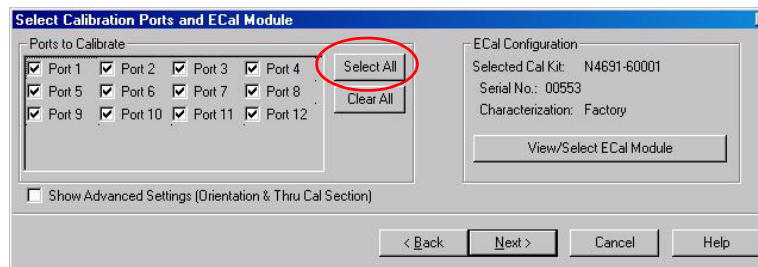
5. Connect the ECal or the mechanical cal kit to the ports you are calibrating following the Cal Wizard prompts and click **Measure** after each connection. The electrical delay value may be shown in the dialog box after the last measurement, click **OK**.

6. At the Calibration Completed prompt, select **Save As User Calset and** type the name desired and **Save**. See Figure 48 on page 57.

7. After calibrating test set ports, use a quality load and short to verify the calibration on each port or end of the test cable. Measure reflection and confirm the return loss is as expected. If the result is not as expected, repeat the calibration without the test set and ensure that the analyzer is in standard (non-multiport) mode.

**NOTE**   If measurement errors occur, ensure the newest version of firmware is installed on the analyzer. Measurement errors can be a result of firmware algorithms. Consult with Agilent Service or firmware web page for the latest firmware revisions and history.
http:\\na.tm.agilent.com\pna\firmware\firmware.htm

Interface Control Mode

NOTE	Interface Control mode will not function properly when using multiport mode. Multiport mode will reset the switch path commands of the interface control. It is recommended that the network analyzer be restarted in stand-alone mode if the interface control is being used. Select **Utility** > **System** > **Configure** > **Multiport Capability**. In the dialog box select **Restart as a standalone PNA** > **OK.**

Overview of the Interface Control

The Interface Control feature allows you to send data and remote commands to control external equipment using the GPIB, Material Handler I/O, Test Set I/O, and Auxiliary I/O without the need of an external computer. Refer to analyzer's Help menu, "Rear Panel Tour" and "Interface Control."

- A unique set of control data can be sent for each channel. In addition, a unique set of control data can be sent before the channel sweep starts and after the sweep ends.

- Interface Control settings can be saved and recalled from the "Interface Control" dialog box or with Instrument State Save and Recall.

- Interface Control settings can be copied to other channels using Copy Channels.

- Control data can only be WRITTEN to the interfaces, NOT READ from the interfaces.

- Control data is sent in the following order and this order cannot be changed:
  Refer to the Help menu.

  1. GPIB Interface

  2. Material Handler Interface

  3. Test Set Interface

  4. Dwell Time

How to Access Interface Control Settings

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

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

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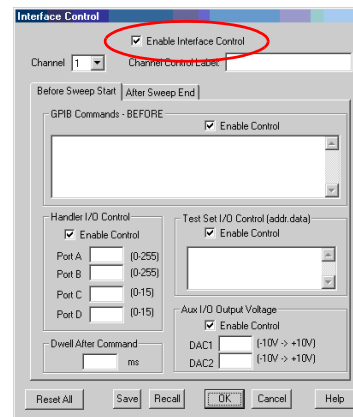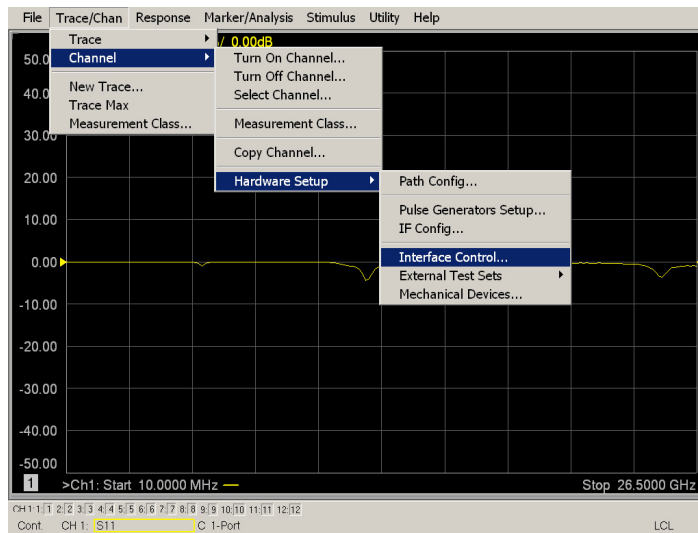
Using Interface Control Mode

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

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

Figure 40   Interface Control
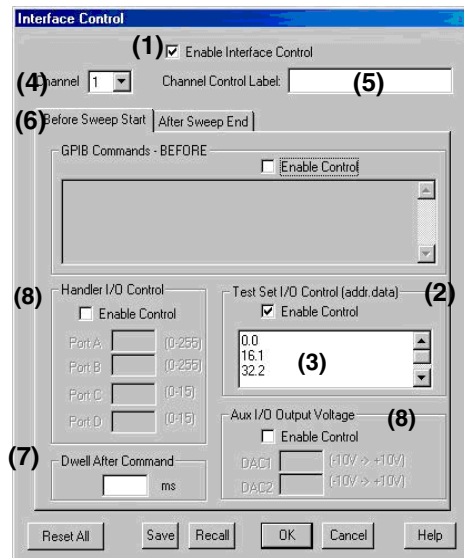
Enable Interface Control: (1)

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

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

Provides control of the Test Set I/O Interface on the rear panel of the analyzer. Used to control your test set.

Only positive integers are allowed to select switch positions or states of DUT control interface lines. Refer to "Address and Data Values" on page 45.

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

Address and Data example: **addr.data (3)**

0.0
16.1
32.2

Channel: (4)

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

Channel Control Label: (5)

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

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

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

Dwell After Command: (7)

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

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

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

Reset All:

Sets all fields on all channels to their default values.

Save and Recall:

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

OK:

Applies the settings and closes the dialog box.

Cancel:

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

Help:

Provides additional information for using the interface control application.

GPIB Control Mode

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

Overview of the GPIB Control

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

- GPIB Command Processor settings can not be saved or recalled.

- Address and data can be *written* from the GPIB Command Processor in Standalone mode only, and is not usable in Multiport mode.

How to Access GPIB Command Processor

1. To access the GPIB Command Processor select **Utility** > **System** > **Configure** > **SICL/GPIB/SCPI**.

Figure 41   **Utility Configure**
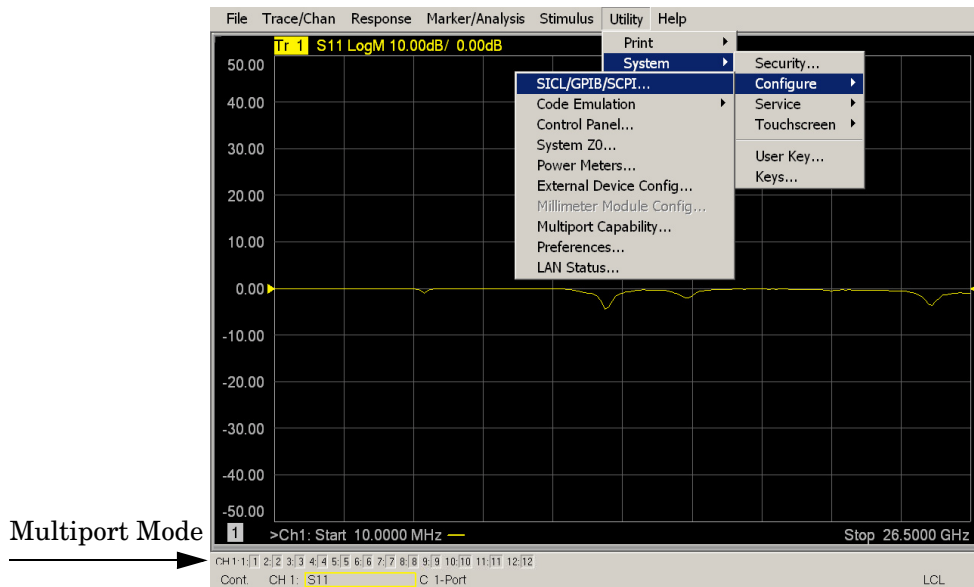
2. Select **GPIB Command Processor Console** > **OK**.

Figure 42   GPIB Command Processor
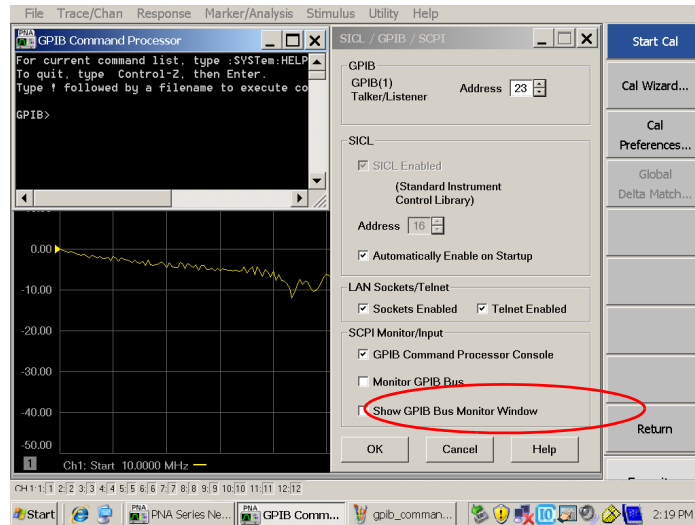
GPIB Command Processor Console

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
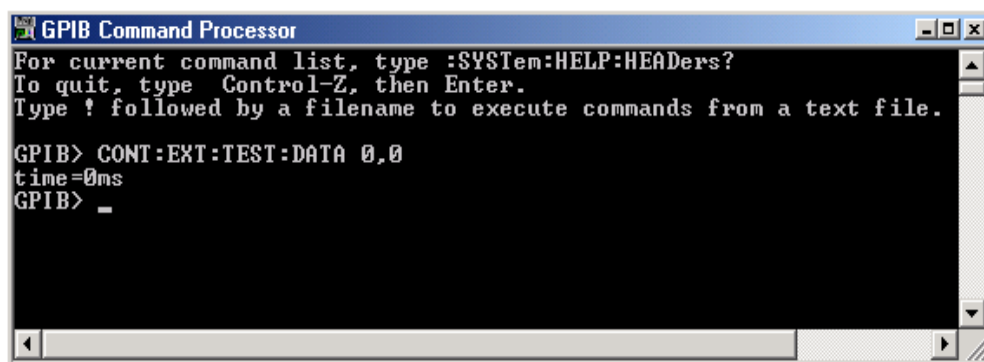
Address and Data Values

Setting the Test Port Paths with Address and Data

Refer to Table 12 and Figure 43 on page 46 for information to set the internal switch paths of the test set.

The address is the first value in the Test Set I/O control or GPIB data command. The second value controls the source and receiver paths of the ports. To select a test set port configuration both switches must be set to complete the source and receiver paths. To do this you must add the data values together to determine the data command value for each port, which is the second number in the Test Set I/O or GPIB command. Refer to "Interface Control Mode" on page 39 and in "GPIB Control Mode" on page 43.

Example 1:

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

Port 3 is the Source and Ports 11 is the Receiver.

Source Port 3 = address 0, data 1 and Receiver Port 11 = address 0, data 80. The data values are added together, the entry will be 0.81.

Example 2: Refer to Figure 43 on page 46.

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

Port 7 is the Source and Port 8 is the Receiver.

Source Port 7 = address 0, data 3 and Receiver Port 8 = address 16, data 48.
Two separate commands must to be sent, you may use the same dialog box. The entry will be 0.3 in one command line, and 16.48 in the second line.

Table 12   Test Port Address and Data Values

Address		Source Path						Receiver Path					
	Data	0	1	2	3	4	5	0	16	32	48	64	80
0	Ports	1	3	5	7	9	11	1	3	5	7	9	11
16	Ports	2	4	6	8	10	12	2	4	6	8	10	12

Figure 43   Address and Data Example 1 (Port 3 and 11)
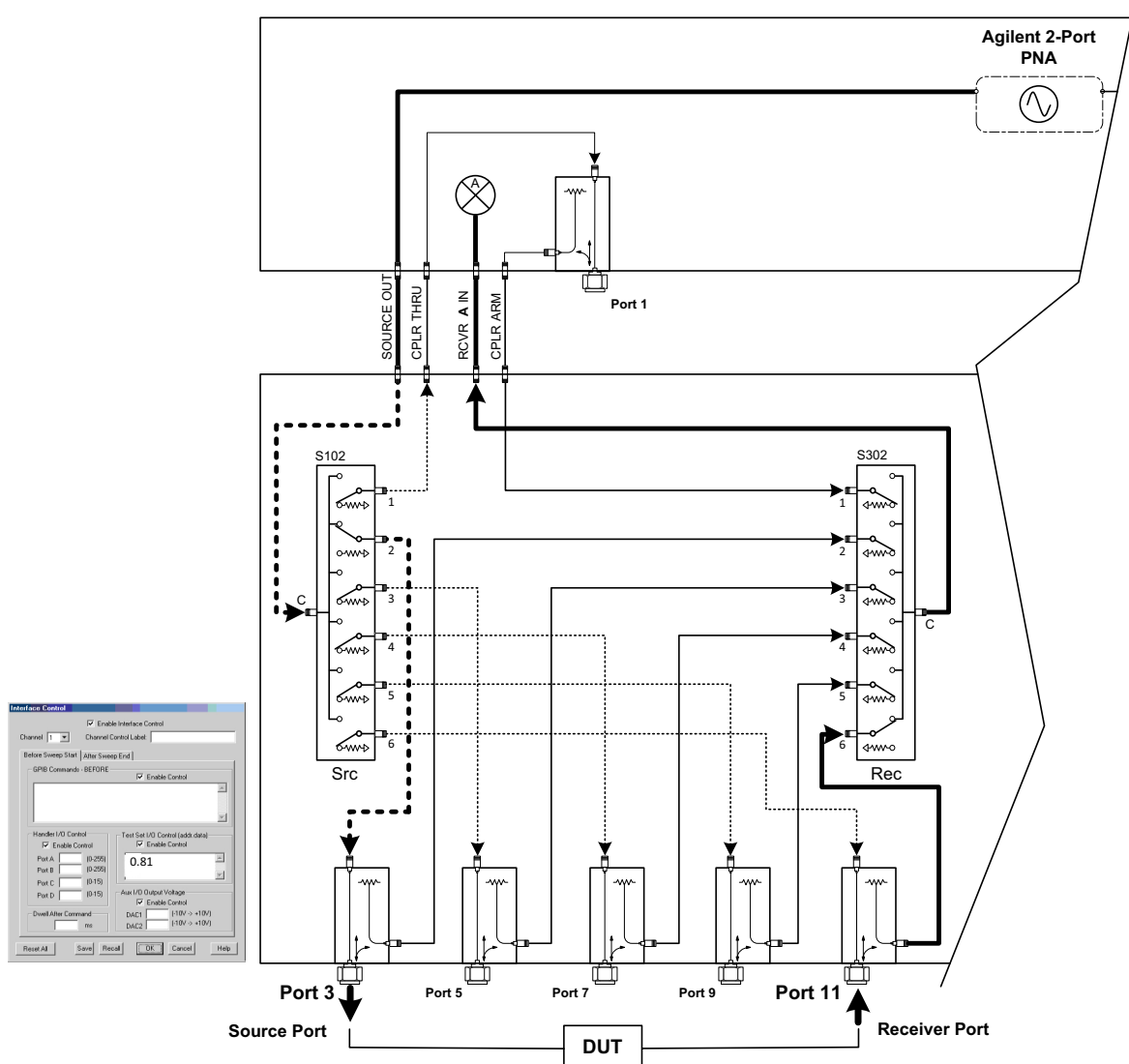
Control Lines

The 15 pin female D-Sub connector on the front panel provides 8 latched data lines that can be used to control your device under test (DUT). The lines can be controlled with the Multiport External Test Set control, or Test Set I/O commands. Refer to "External Test Set Control Feature" on page 33 and "Setting the Control Lines with Address and Data Values" on page 51. See Table 13 for DUT control line specification.

The output voltage of the lines can be from the internal adjustable voltage source (+2 to +5 Vdc), or an external dc power supply depending on how the connection to the control line is configured. When using an external power supply a positive or negative voltage can be used. Refer to Figure 44 and Table 14 on page 48 for control line pin location and description. Refer to "Internal Voltage Supply Configuration" on page 49 and "External Voltage Supply Configuration" on page 50 for configurations.

Table 13   DUT Control Specifications

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

Figure 44   DUT Control Line Pin Assignment (rear panel view)
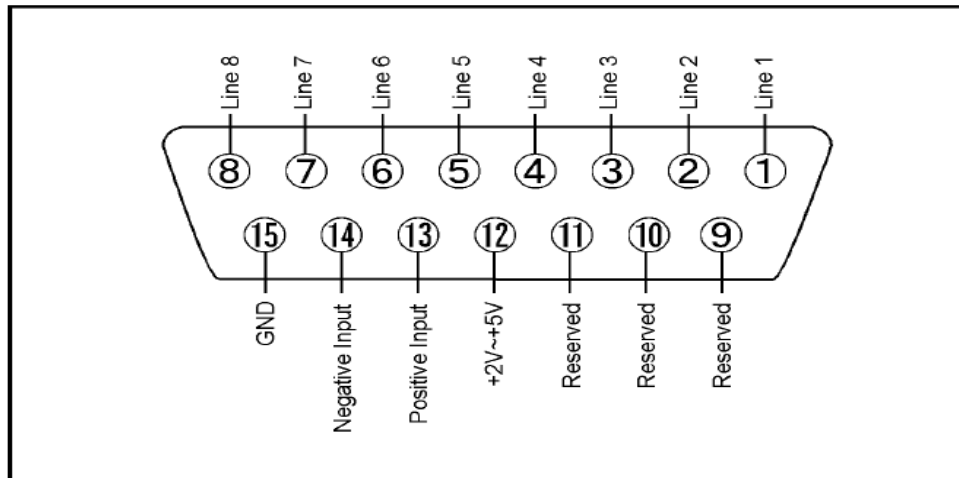
Table 14   DUT Control Line Interface Connector Pin Assignment

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

Internal Voltage Supply Configuration

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

1. Turn *on* the test set.

2. Measure the voltage between pin 12 and 15 using a multimeter.

3. Rotate the voltage adjustment trimmer on the rear panel until the multimeter indicates the selected voltage.

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

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

Figure 45   Internal DC Power Configuration (rear panel view)
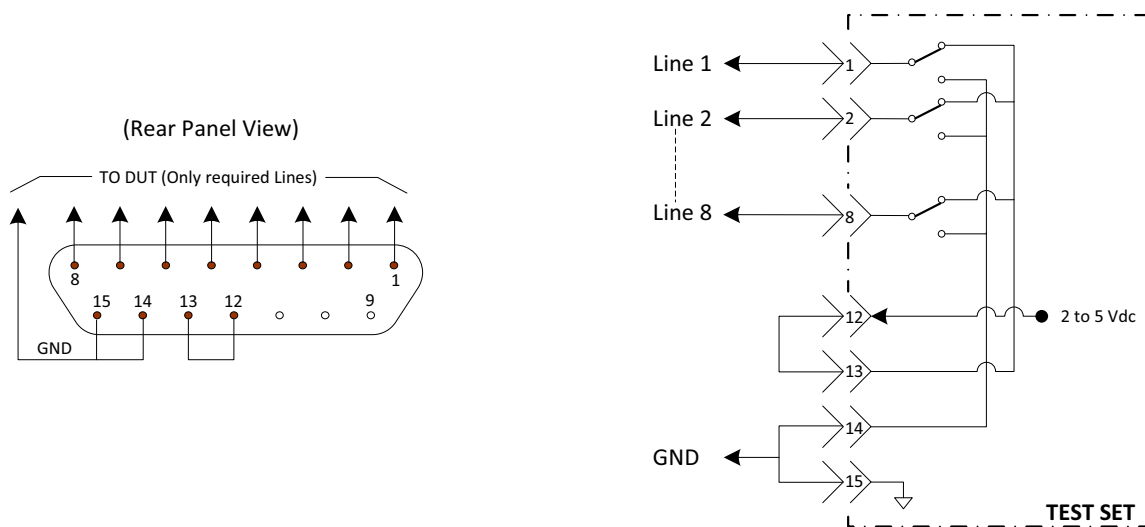
External Voltage Supply Configuration

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

Turning On the Test Set using an External Power Supply

1. Turn *on* the test set.

2. Connect the DUT.

3. Turn *on* the external power supply.

Turning Off the Test Set using an External Power Supply

1. Turn *off* the power supply.

2. Turn *off* the test set.

3. Disconnect the DUT.

Figure 46   Test Set to the DUT and External DC Power Supply
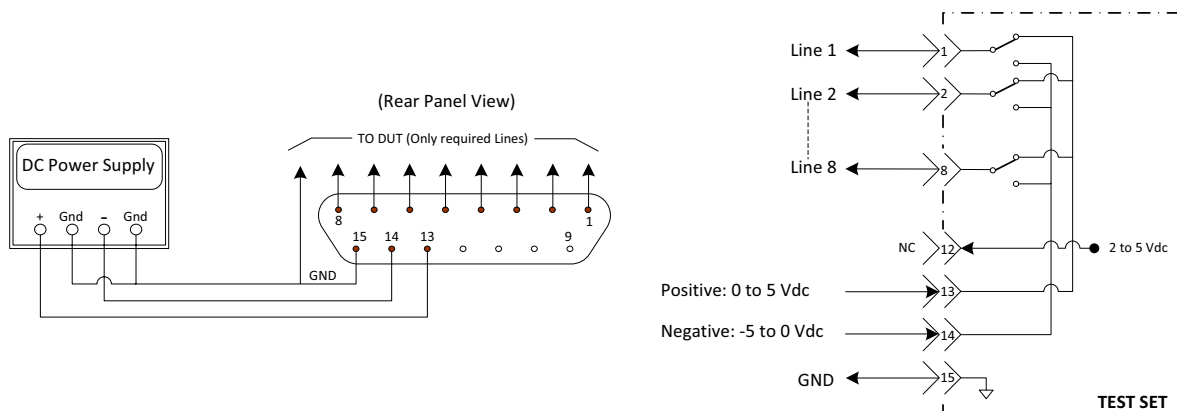
Setting the Control Lines with Address and Data Values

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

NOTE	The following control feature will function only while the PNA is in its Standalone Mode.

Setting the PNA to Standalone Mode

1. Select **Utility** > **System** > **Configure** > **Multiport Capability**. In the dialog box select **Restart as a standalone PNA** > **OK.**

As described in "Setting the Test Port Paths with Address and Data" on page 45, the <address>.<data> values are determined in a similar manor, with the following exceptions:

- Table 15 will be used.

- The <address> value is always = 112

Table 15   Test Set DUT Control Address and Data Logic Table

<Address>	<Data>	Description	Line/Pin
112	0	ALL DUT Control Lines set to logic high or connected to Pin 13	1-8
112	255	ALL DUT Control Lines set to logic low or connected to Pin 14	1-8
112	1	DUT Control Line 1 set to logic low or connected to Pin 14	1
112	2	DUT Control Line 2 set to logic low or connected to Pin 14	2
112	4	DUT Control Line 3 set to logic low or connected to Pin 14	3
112	8	DUT Control Line 4 set to logic low or connected to Pin 14	4
112	16	DUT Control Line 5 set to logic low or connected to Pin 14	5
112	32	DUT Control Line 6 set to logic low or connected to Pin 14	6
112	64	DUT Control Line 7 set to logic low or connected to Pin 14	7
112	128	DUT Control Line 8 set to logic low or connected to Pin 14	8

After a power reset all DUT control lines are initially configured to a logic high state or connected to Pin 13, refer to Figure 45 on page 49. To reset all control lines to logic high, without having to reset the power switch on the test set, make the following entry:

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

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

Listed are two examples to illustrate this concept. Refer to Figure 28, shown with all lines = logic high.

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

1. Line 1 (<address> = 112 and <data> = 1)

2. Line 8 (<address> = 112 and <data> = 128)

3. The SUM of the <data> values = 129

4. Front panel PNA Interface Control Mode line entry = 112.129 > OK.

Example 2: From Example 1 to only change Lines 2 & 3 to equal logic low, all others logic high.

1. Line 2 (<address> = 112 and <data> = 2)

2. Line 3 (<address> = 112 and <data> = 4)

3. The SUM of the <data> values = 6

4. Front panel analyzer Interface Control Mode line entry = 112.6 > OK.

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

Cal Kit Operational Check

The following procedure can be used to confirm that the test set and network analyzer are operational. The operation verification limits provided ensure that your test set and network analyzer are operating properly. Refer to "General Specifications" on page 8.

Equipment Required

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

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

Table 16   Equipment List

Description	Qty
N4693A 2.4 mm ECal Module 10 MHz - 50 GHz (Option 00F or M0F) *or* N4691A 3.5 mm ECal Module 10 MHz to 26.5 GHz (Option 00F or M0F) *or* N4691B 3.5 mm ECal Module 300 kHz to 26.5 GHz (Option 00F or M0F) *or* Mechanical cal kit 85052B or 85052D	1
E8362/3/4B/C 2-Port Network analyzer (Option 014 and 551) *or* N5230A/C 2-Port Network Analyzer (Option 225 and 551) *or* N5230A/C 4-Port Network Analyzer (Option 245 and 551) *or* N5242A 4-Port Network Analyzer (Option 400 and 551) *or* N5242A 2-Port Network Analyzer (Option 200 and 551)	1
Set of interconnect cables (analyzer to test set), see Table 2 on page 7.	1

Verification Limits

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

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

Table 17   Typical Verification Limit for Reflection Tracking[1] (Ports 1-12)

Frequency	N5230A/C or E8362B/C		N5242A or E8363/4B/C	
	Standard	Option 001	Standard	Option 001
10 MHz to 4 GHz	−3 dB	+4 dB	−3 dB	+3 dB
4 GHz to 6 GHz	−4 dB	+3 dB	−5 dB	+2 dB
6 GHz to 10 GHz	−5 dB	+3 dB	−5 dB	+2 dB
10 GHz to 15 GHz	−7 dB	+3 dB	−7dB	+2 dB
15 GHz to 20 GHz	−8 dB	0 dB	−8 dB	−3 dB
20 GHz to 26.5 GHz	−	−	−12 dB	−

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

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

Cal Kit Operational Check Procedure

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

NOTE	In this procedure (when using with the 4-Port PNA-L or PNA-X System) Ports 13 and 14 are not connected to the test set, therefore not verified.

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

Preparing the Network Analyzer

1. Connect the test set to the analyzer using the interconnect cables as shown in "Hardware Lock-link Kit Installation (U3021-60001)" on page 15 and "Hardware Lock-link Kit Installation (U3021-60002)" on page 18.

2. Turn *on* the test set.

3. 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 network analyzer is in Multiport mode. See the bottom of the measurement window, similar to Figure 49 on page 58.

   a. If only four S-Parameters are listed, select **Utility** > **System** > **Configure** > **Multiport Capability**. Select **Restart as multiport PNA with this testset** and select **U3022AE10** (12-Port) from the drop-down menu > **OK**. Refer to Figure 29 on page 32.

5. Press **Preset.**

6. Verify that the **[Start Frequency]** is set to **[300 kHz or 10 MHz]**.

7. Set the **[Stop Frequency]** to **[20 GHz or 26.5 GHz]**.

8. Select **[Power]** > **Power Level** and enter **[0 dBm]**.

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

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

11. Connect the ECal module to an available USB port on the front or rear panel. This procedure assumes you are using a ECal. If you are not, see "1-Port Calibration and Verification Procedure" on page 56, step 2.

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

1-Port Calibration and Verification Procedure

1. Connect the ECal or the mechanical cal kit to Port 1 or the port you are testing. Torque to 8 in-lb. For further information refer to the Help menu.

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

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

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

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

4. Ensure the Cal Kit you are using is indicated on the right side of the window.

Figure 47   1-Port Calibration
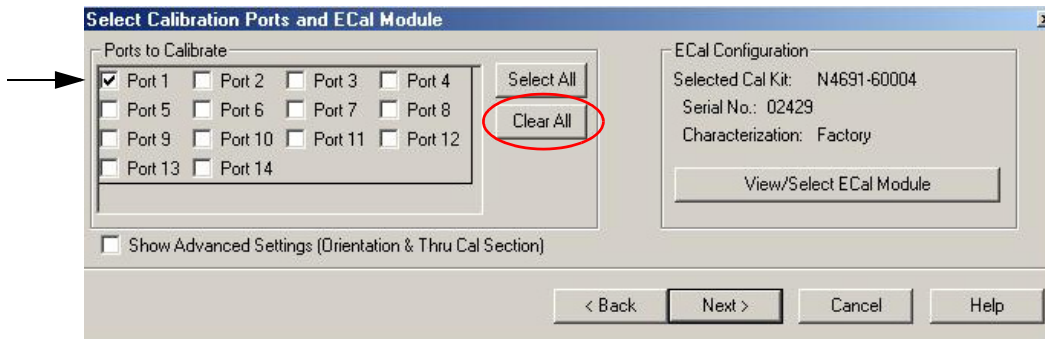
5. Continue to follow the prompts until the "Calibration Completed" dialog box appears.

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

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

Figure 48   Calibration Complete
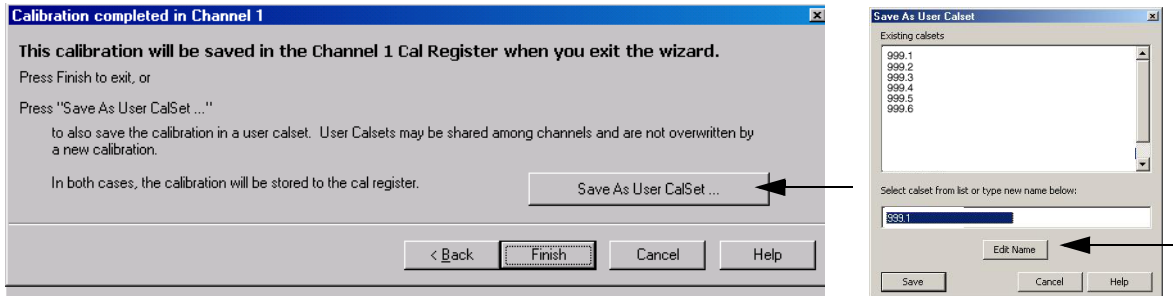
7. Repeat step 1 thru step 6 (1-Port Calibration Procedure) for Ports 2 thru 8. When finished, there should be 8 Cal Sets saved with the titles "999.1" thru "999.12" (12-Port).

CalSet Verification

1. Select **Trace/Chan** > **Trace** > **Delete Trace**. There should be no traces on the screen.

2. To launch the Cal Set Viewer toolbar. Select **Response** > **Cal** > **Manage Cals** > **Cal Set Viewer**.

Figure 49   Calibration Cal Set Viewer
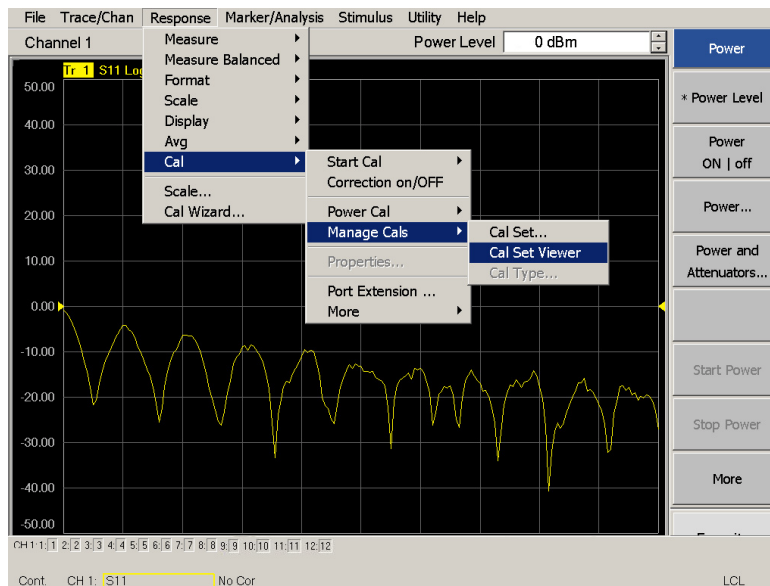
3. From the Cal Sets drop-down menu, select **999.1** and select **Enable**. Select the **Reflection Tracking(x,x)**, where x,x is the port being tested. Ensure that the **Enable** and **Error Terms** check boxes are selected.

4. Compare the Reflection Tracking (1,1) trace to the appropriate limits in Table 17 on page 54. This can be done using Markers.

5. Repeat step 3 and step 4 for Cal Sets "999.1" thru "999.12" (12-Port).

Figure 50   PNA or PNA-X Port 1 & 2 and PNA-L Ports 1-12
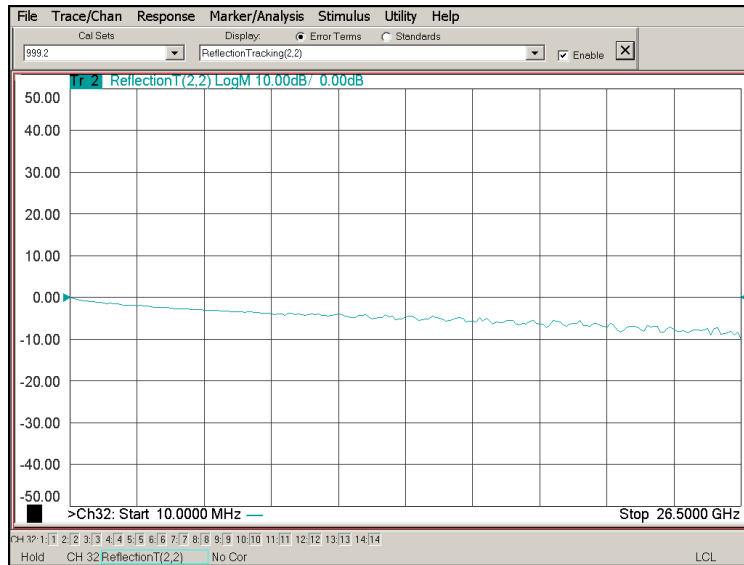
Figure 51   PNA or PNA-X Port 1& 2 and PNA-L Ports 1-12 (Option 001)

Figure 52   PNA or PNA-X Port 3-12
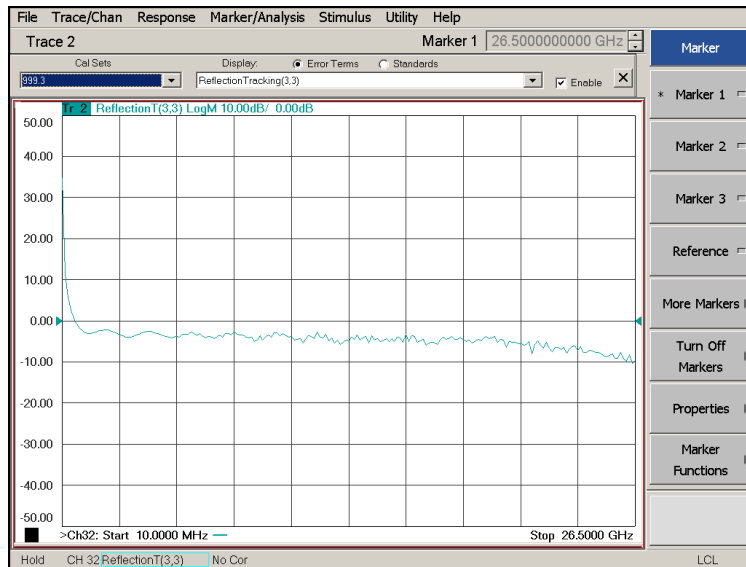
Figure 53   PNA or PNA-X Port 3-12 (Option 001)
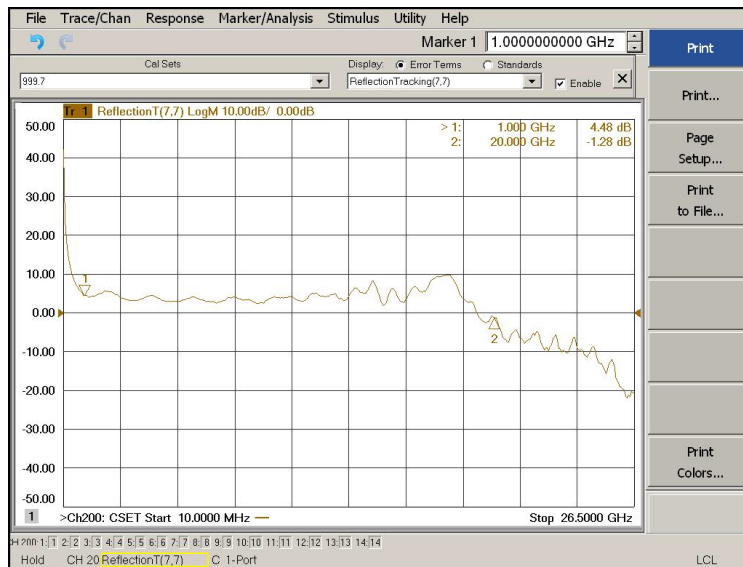
NOTE   Response from 10 MHz to 500 MHz is normal due to the PNA or PNA-X couplers in comparison to the test set bridges. The bridges have more gain in the coupled RF path.

Verifying a Cal Kit Operational Check Failure

If your test results fail the Cal Kit Operational Check Reflection Tracking limits, see Table 5 and Table 6 on page 11. Verify the following verify following:

1. Ensure the test set is turned *on* and connected properly to the analyzer.

2. Check all appropriate connectors for damage, cleanliness, and proper torques.

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

4. Verify that the PNA is operating properly and meeting its published specifications. If the PNA is connected to the test set it will fail the Operational Check. Refer to "Network Analyzer Requirements" on page 5.

ECal Confidence Check

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

1. Perform an 1-Port Cal of the test set port being tested.

2. Connect the ECal Module to the Port being verified. Terminate any remaining ports on the ECal module.

3. Select the Cal Set to be verified. Select **[Cal]** > **Cal Set...** > **Cal_File** > **Apply Cal** > **Close.** If the "Choose Stimulus Settings..." prompt appears, select **Change the active channel's stimulus...** > **OK** > **Close**.

4. Select **Response > Cal** > **More** > **ECal** > **ECal Confidence Check**.

5. Click **Change Measurement** and select the test port S-parameter **Apply** > **OK.** Click **Read Module Data**.

6. Select the ECal module you are using, and select **ECal Module Memory** > **Factory** > **OK**.

Figure 54   ECal Confidence Check
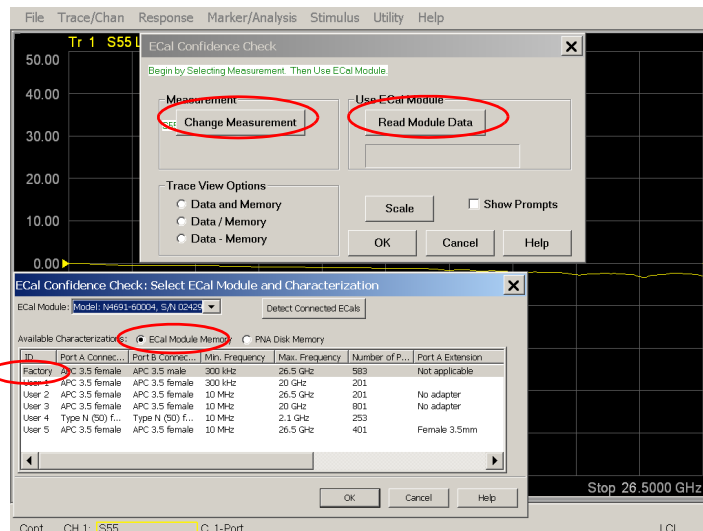
Service Information

Refer to "Contacting Agilent" on page 91.

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

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

Replaceable Parts

The following replaceable parts are available from Agilent Technologies "Find-A-Part" system on the web at *www.parts.agilent.com*.

Table 18   Available Replacement Parts (SPO)

Description	Agilent Part Number
PNA-X Test Set Rear Lock-link (right)	N5242-20138
PNA-X Test Set Rear Lock-link (left)	N5242-20139
PNA-L Test Set Lock-links	5063-9253
Coupler/Bridge	5087-7716
Coupler/Bridge (RoHS)	5087-7752
Amplifier (Option 001 & 002)	5087-7790
Amplifier (Option 001 & 002), (RoHS)	5087-7750
Bias Tee (Option 002)	5087-7239
Fuse (5 A 250 V non-time delay (20 mm)	2110-0709
Fuse (8 A 250 V non-time delay (1.25 inch)	2110-0342
DUT Control Board	E5091-66503
Fan (rear panel)	87050-60027

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

Table 19   Available Factory Replaceable Parts (E10)

Description	Agilent Part Number
Screw (lock-links)	0515-2317
PWR Supply (AC/DC SWG 650W 9- Output	0950-4729
Lock-link for a PNA & PNA-X	5023-0132
Test Set I/O Cable	N4011-21002
U3042AE10 User's and Service Guide	U3022-90001
Fan (Deck)	U3022-60005
Label printed - Port 13	U3022-80002
Label printed - Port 14	U3022-80003
Label printed - Port 2	U3022-80004
LED Status Board	Z5623-63463
LED Status Ribbon Cable	Z5623-60213
Switch Interface Board	Z5623-63647
Controller Board	Z5623-63646
Power Switch and LED	Z5623-60221
12-Port Configuration Interface Cables with SMA Connectors	
RF Cable, Semi-rigid (E8362B/C *or* N5230A/C Option 225	U3022-20001
RF Cable, Semi-rigid (E8362B/C *or* N5230A/C Option 225	U3022-20002
12-Port Configuration Interface Cables with SMA to 2.4 mm Connectors	
RF Cable, Semi-rigid (E8363B/C *or* E8364B/C)	U3022-20040
RF Cable, Semi-rigid (E8363B/C *or* E8364B/C)	U3022-20041
14-Port Configuration Interface Cables with SMA Connectors	
RF Cable, Semi-rigid (N5230A/C Option 245)	U3022-20031
RF Cable, Semi-rigid (N5230A/C Option 245)	U3022-20032
RF Cable, Semi-rigid (N5230A/C Option 245)	U3022-20033
RF Cable, Semi-rigid (N5230A/C Option 245)	U3022-20034
RF Cable, Semi-rigid (N5230A/C Option 245)	U3022-20035
RF Cable, Semi-rigid (N5230A/C Option 245)	U3022-20036
RF Cable, Semi-rigid (N5230A/C Option 245)	U3022-20037
RF Cable, Semi-rigid (N5230A/C Option 245)	U3022-20038

Table 19   Available Factory Replaceable Parts (E10)

Description	Agilent Part Number
14-Port Configuration Interface Cables with SMA Connectors	
RF Cable, Semi-rigid (N5242A)	U3022-20042
RF Cable, Semi-rigid (N5242A)	U3022-20043
RF Cable, Semi-rigid (N5242A)	U3022-20044
RF Cable, Semi-rigid (N5242A)	U3022-20045
RF Cable, Semi-rigid (N5242A)	U3022-20046
RF Cable, Semi-rigid (N5242A)	U3022-20047
RF Cable, Semi-rigid (N5242A)	U3022-20048
RF Cable, Semi-rigid (N5242A)	U3022-20049

System Block Diagrams

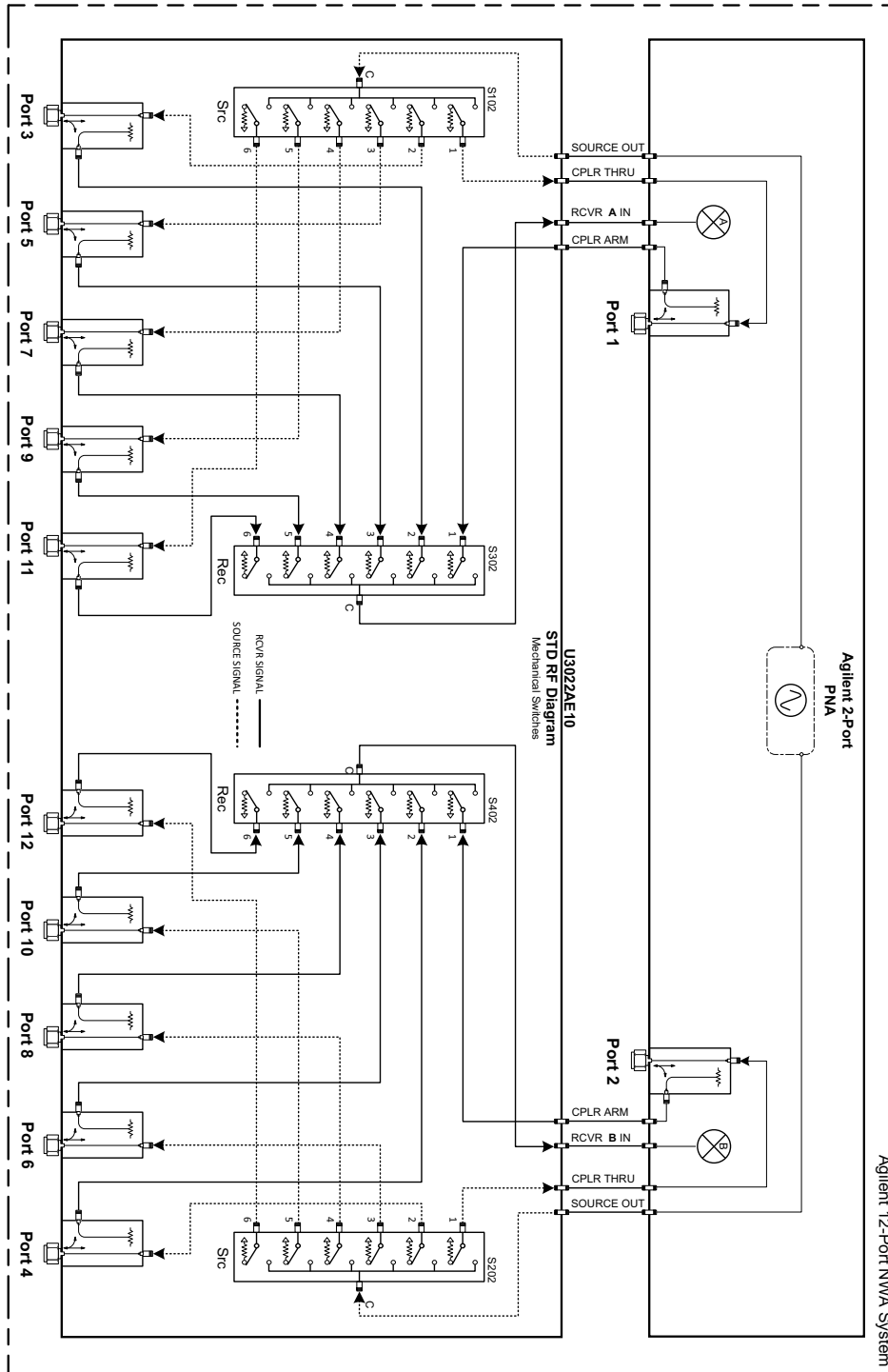**Figure 55   U3022AE10 RF Block Diagram (12-Port)**

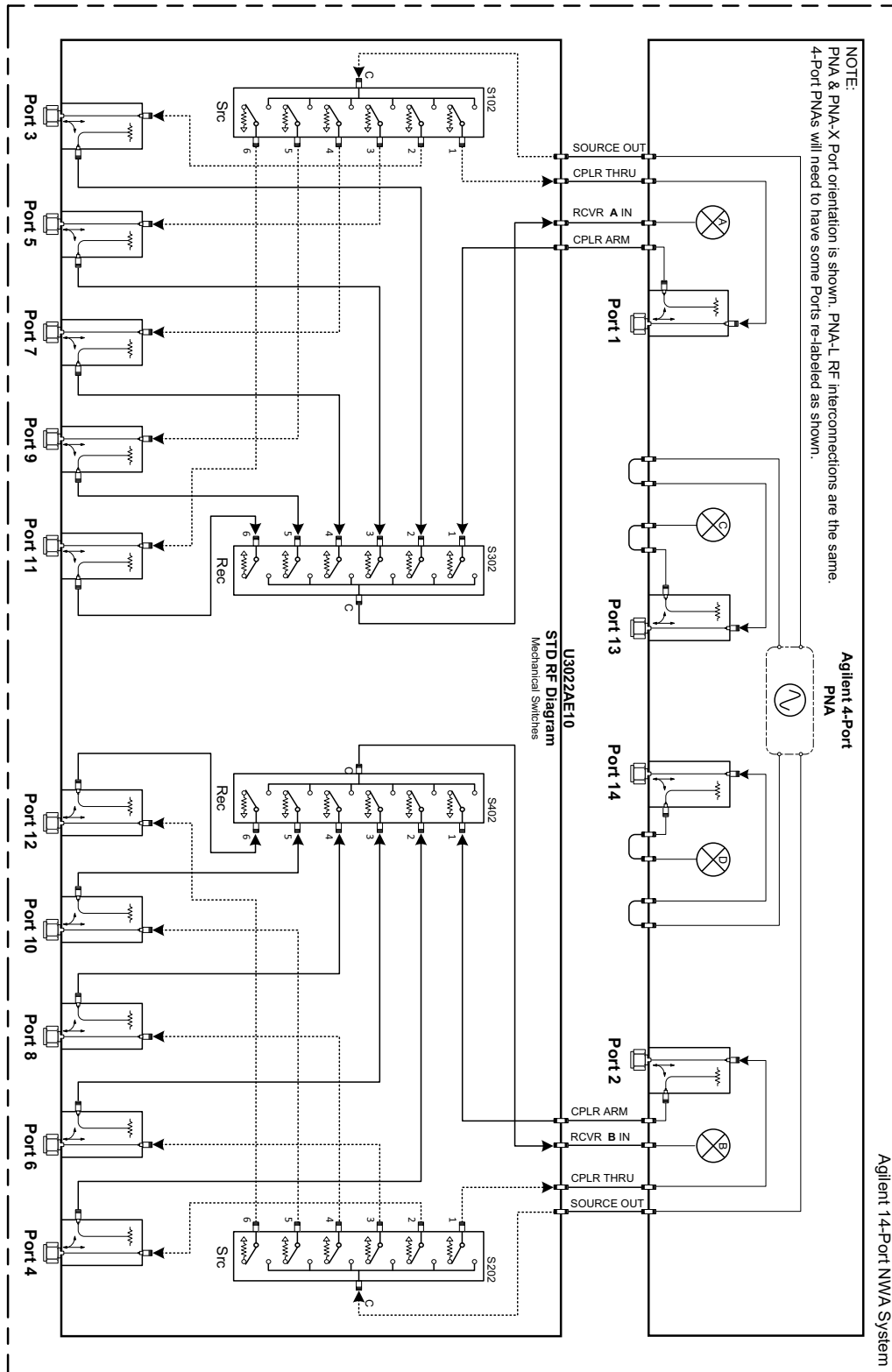**Figure 56   U3022AE10 RF Block Diagram (14-Port)**

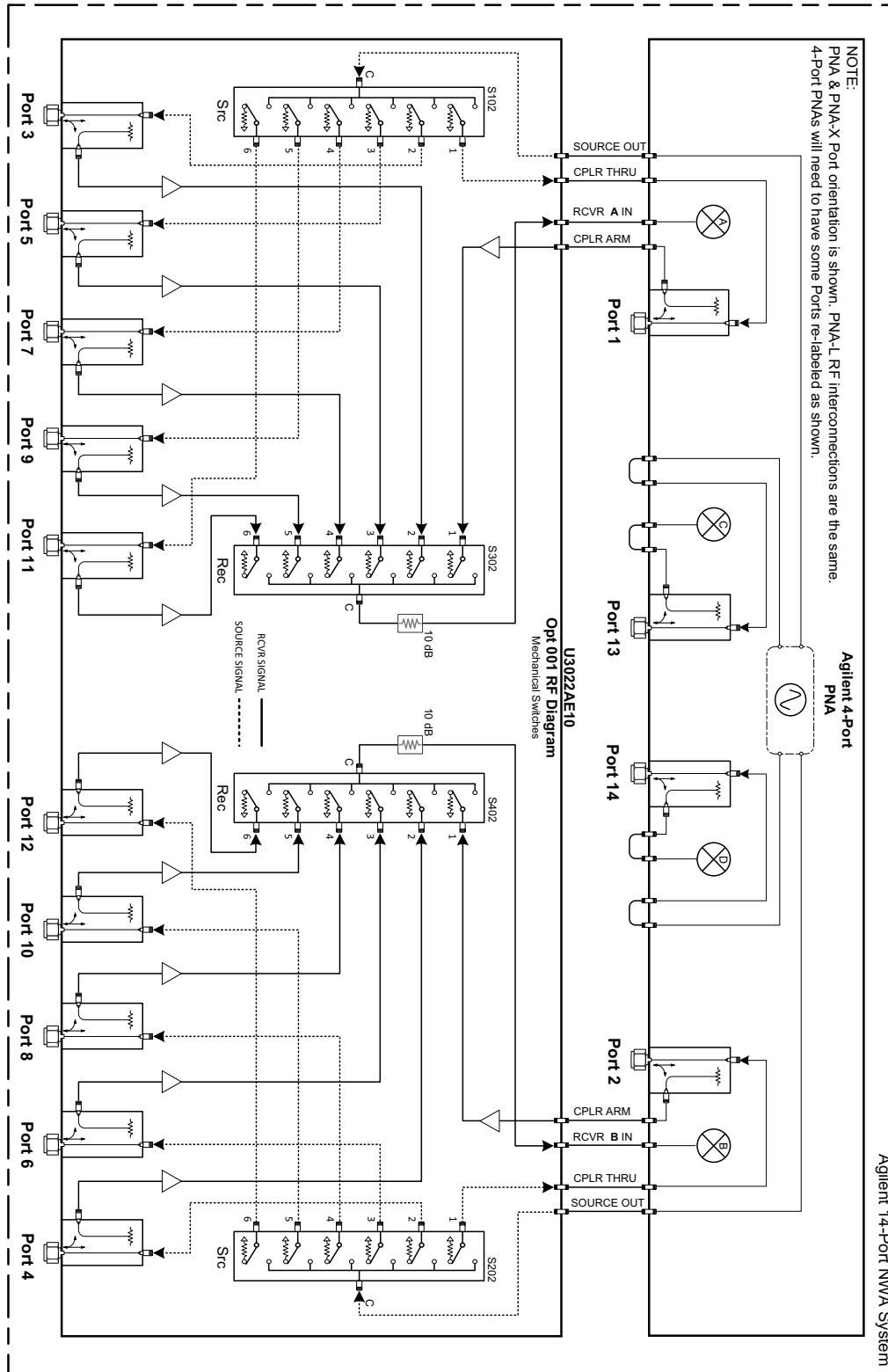**Figure 57   U3022AE10 RF Block Diagram (12-Port, Option 001)**

Figure 58   U3022AE10 RF Block Diagram (14-Port, Option 001)
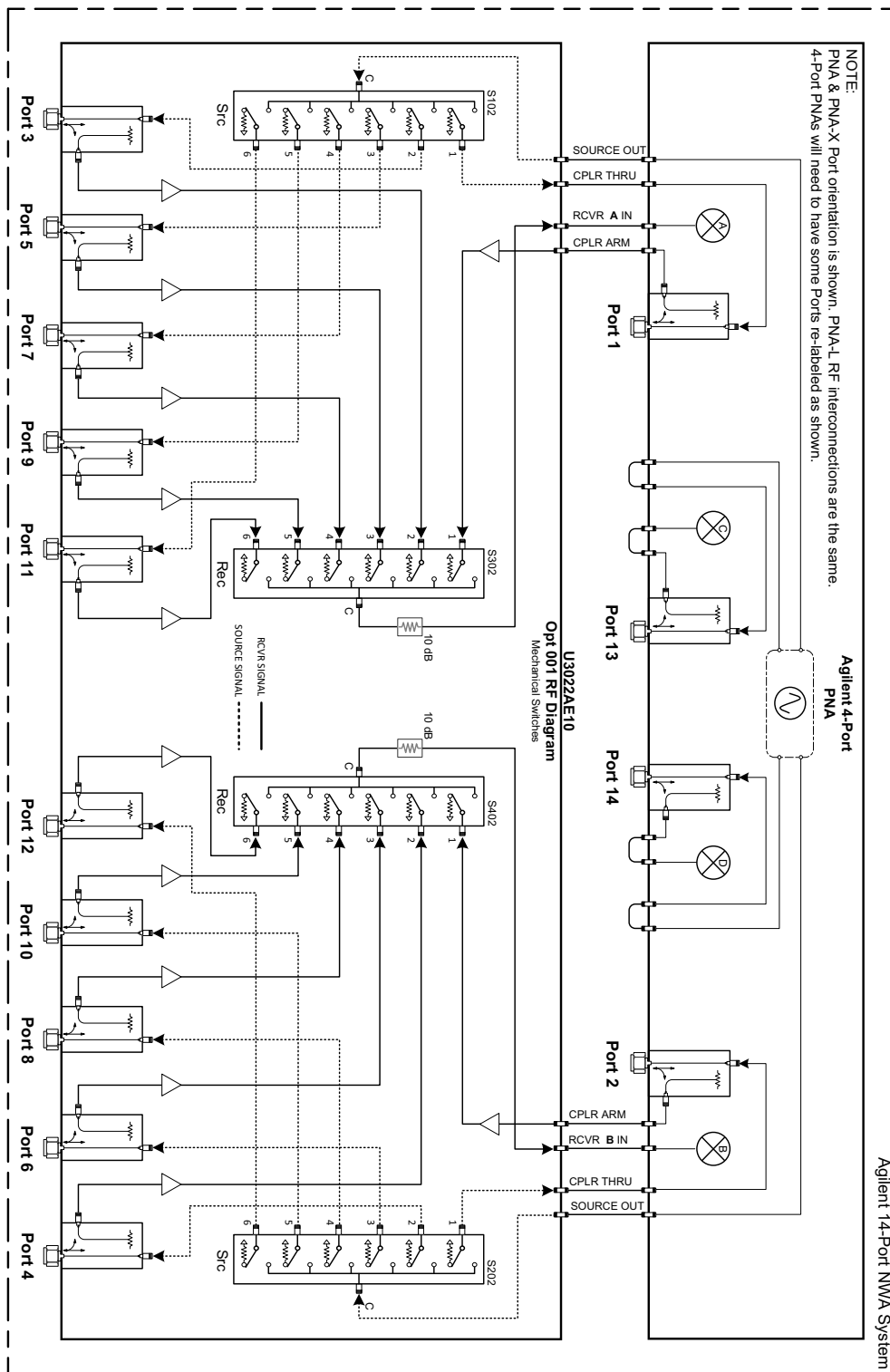
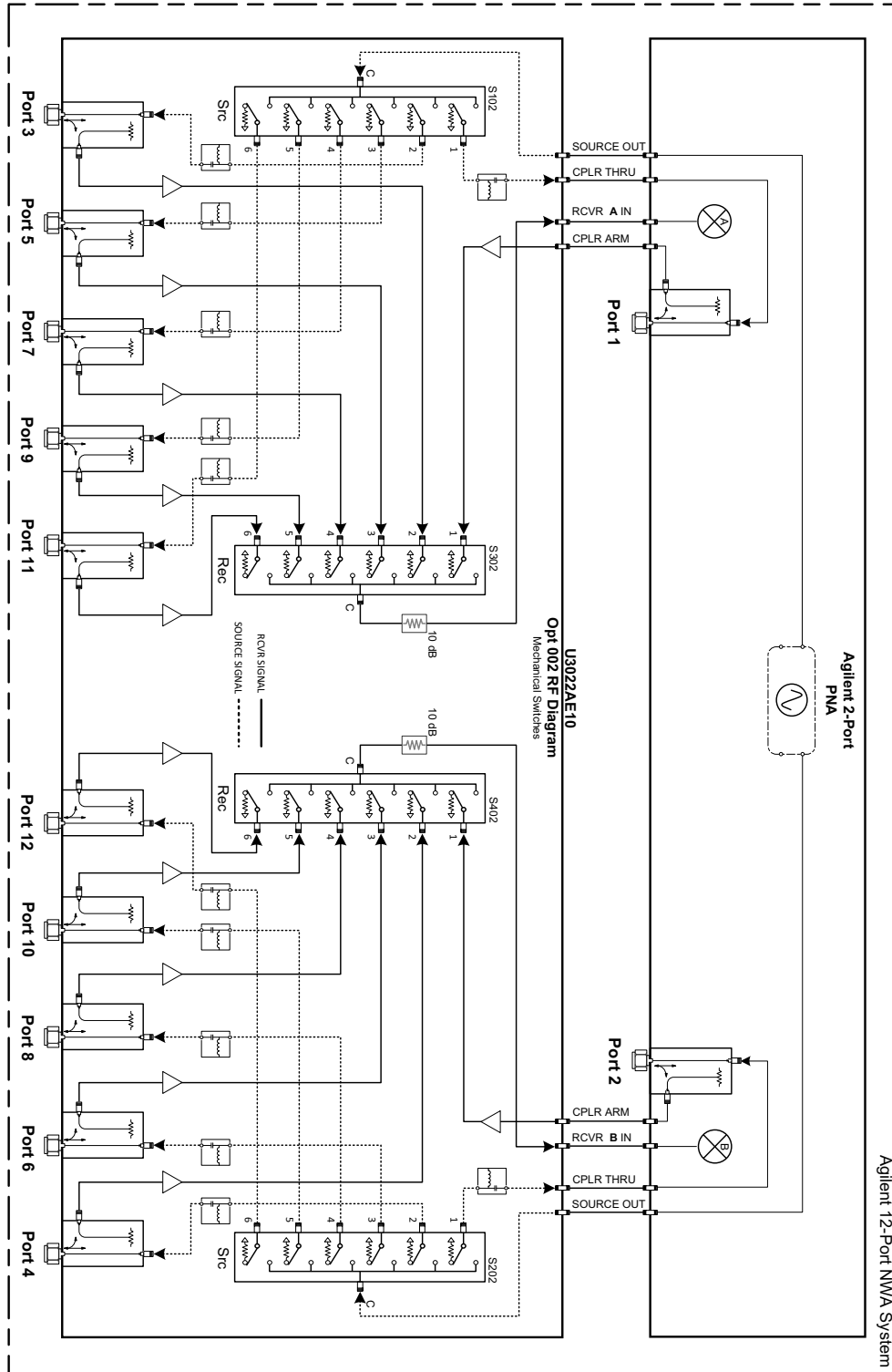**Figure 59   U3022AE10 RF Block Diagram (12-Port, Option 002)**

Figure 60   U3022AE10 RF Block Diagram (14-Port, Option 002)
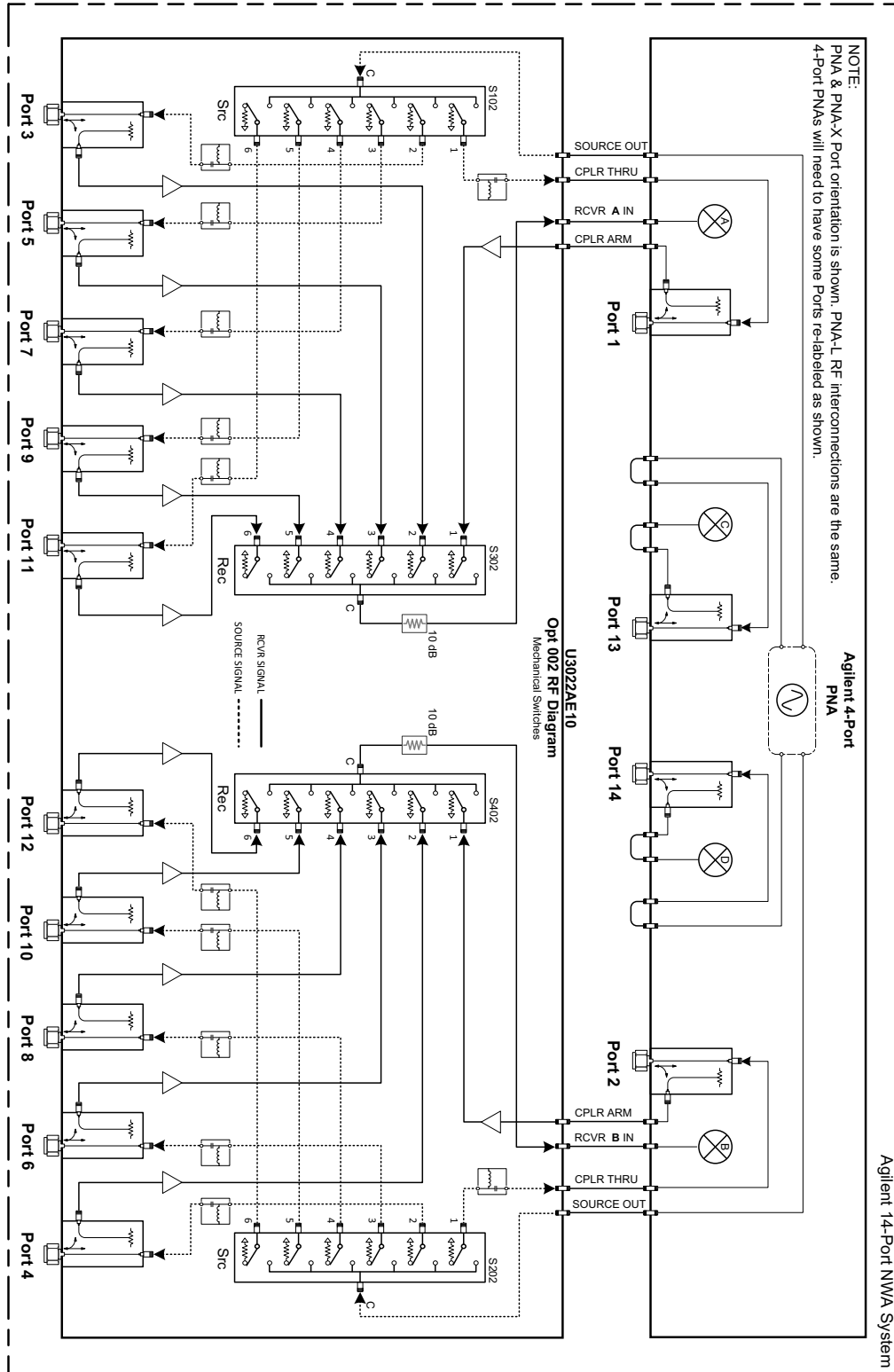
Theory of Operation

The following is a description of the operation of the test set. Reference the test set block diagrams shown in "System Block Diagrams" on page 65. This section assumes the user has a general understanding of couplers, switches, and network analyzers.

RF Coupler/Bridges

The test set uses ten coupler/bridges (5087-7752) on the front panel for RF Test Ports 3 - 12. The coupler/bridges provide the signal separation of the source and receiver paths, using resistor networks. The test set ports can receive from or stimulate a signal to the DUT.

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

RF Switch Components

The test set uses four mechanical switches (87106-60009) that have internal 50 Ohm termination for each path. The switches select the RF paths from the analyzer's source and receiver through interconnect cables to the test set. Network analyzer Ports 1 thru 2 and test set ports paths 3 thru 12.

RF Amplifiers, Option 001 & 002

Twelve RF amplifiers are installed in the receiver signal paths to improve the dynamic range of the system. The amplifiers reduce the operational frequency range of the system to 10 MHz - 20 GHz. A cooling fan (U3022-60005) was added internally to assist in maintaining cooling air flow of the RF amplifiers.

S102 - Source to Odd Ports (1-11)

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

S202 - Source to Even Ports (2-12)

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

S302 - Receiver to Odd Ports (1-11)

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

S402 - Receiver to Even Ports (2-12)

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

Troubleshooting the Test Set

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

Refer to the Agilent PNA Series: Service & Support Home Page at: *http://na.tm.agilent.com/pna* for further information.

To request service, please contact your local service center. In the US, call 800-829-4444. For a listing of service centers worldwide, please visit us at *www.agilent.com/find/service*.

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

Non-RF Failures

Non RF failures are; Power Supply, Fans, Control Lines, Status LEDs or Interface not operating. Refer to Figure 62 on page 74.

1. Verify that the front panel Power Switch is operational.The front panel Active LED will be *off* unless the test set interface cable is connected and the test set is addressed by the network analyzer.

2. Turn *on* the Standby Switch.

   a. The rear panel and internal power supply fans should be operational. If not, continue with step 3.

3. AC Line voltage checks (remove AC power from the instrument).

   a. Ensure the proper AC Line voltage is present at the instrument line cord.

   b. Remove the AC power cord from the instrument. Verify the instrument AC Line Module fuse (2119-0709) and replace if necessary. Refer to Figure 7 on page 14.

   c. Verify the Internal AC lines fuse (2110-0342). Remove the instrument bottom cover. Near the rear panel are two fuse holders, verify the fuses and replace if necessary. See Figure 70 on page 84.

4. Internal DC Power checks.

   a. Set the front panel switch to the Standby position. No fans or indicator lights should be operational.

   b. Remove the top cover.

   c. Set the Standby switch to the *on* position. Both the rear panel and internal power supply fans should be operational. Verify that the DC indicator LEDs are *on* as shown in Figure 61 on page 74.

| NOTE | The +9 Vdc and −10 Vdc indicator are not used, they will be off. |

Figure 61   DC Power Status LEDs
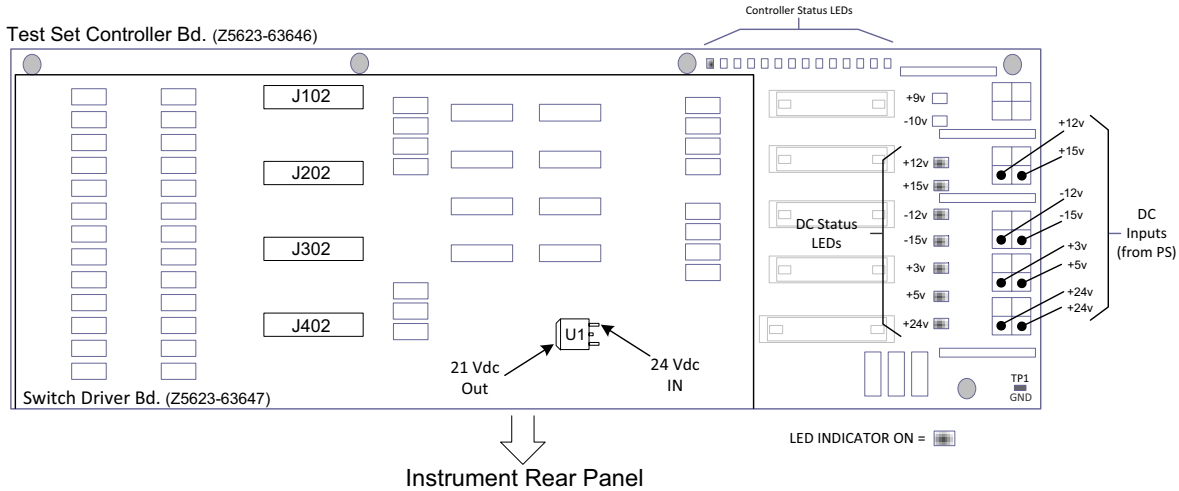
d. If the DC Indicator LEDs are not on, suspect the main power supply module or front panel switch. The power supply(0950-4729) terminal connections should also be verified with a DVM. Verify the voltages on the power supply label.

e. If rear panel fan is not operating and the DC Indicator LEDs are *on*; replace fan.

Figure 62   Test Set Diagram
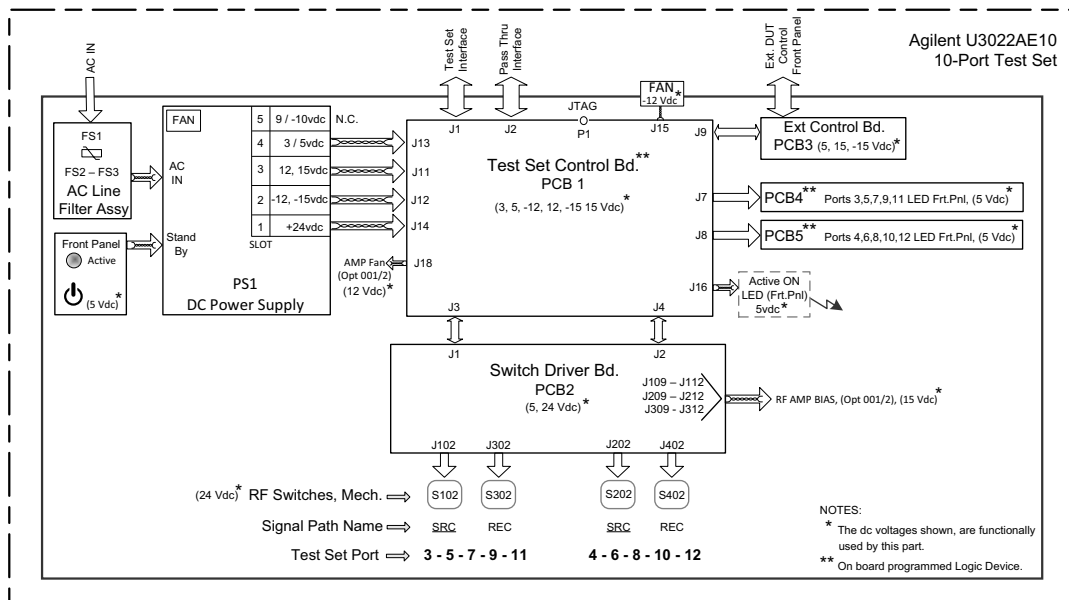
5. Front Panel R and S indicator LED Check.

   a. Verify the test set Controller board Controller Status LEDs, shown in Figure 61 on page 74.

   b. If none are *on* remove the Switch Driver board and recheck, if still no indication, replace the Controller board.

   c. If the Controller Status LEDs are *on* and the front panel Active LED is *on*, suspect the front panel LED boards or the ribbon cables. Replace as needed.

6. Control Lines are not working.

   a. Verify that the control voltage pin connections to the DUT control lines are connected properly. Refer to "Control Lines" on page 47.

   b. Verify that the rear panel DC voltage control adjustment can be set to 5 Vdc. Refer to Figure 6 on page 13.

   c. Remove the instrument top cover. Using a DVM, verify that the three DC voltage inputs are present on the DUT control board (E5091-66503). Refer to Figure 63.

   d. If the DC voltages are normal, then replace the DUT control board. If the voltages are not present, check the ribbon cable and its connections at both ends. Suspect the test set Control board as the possible problem.

Figure 63   DUT Control Board DC Voltage Locations

E5091-66503
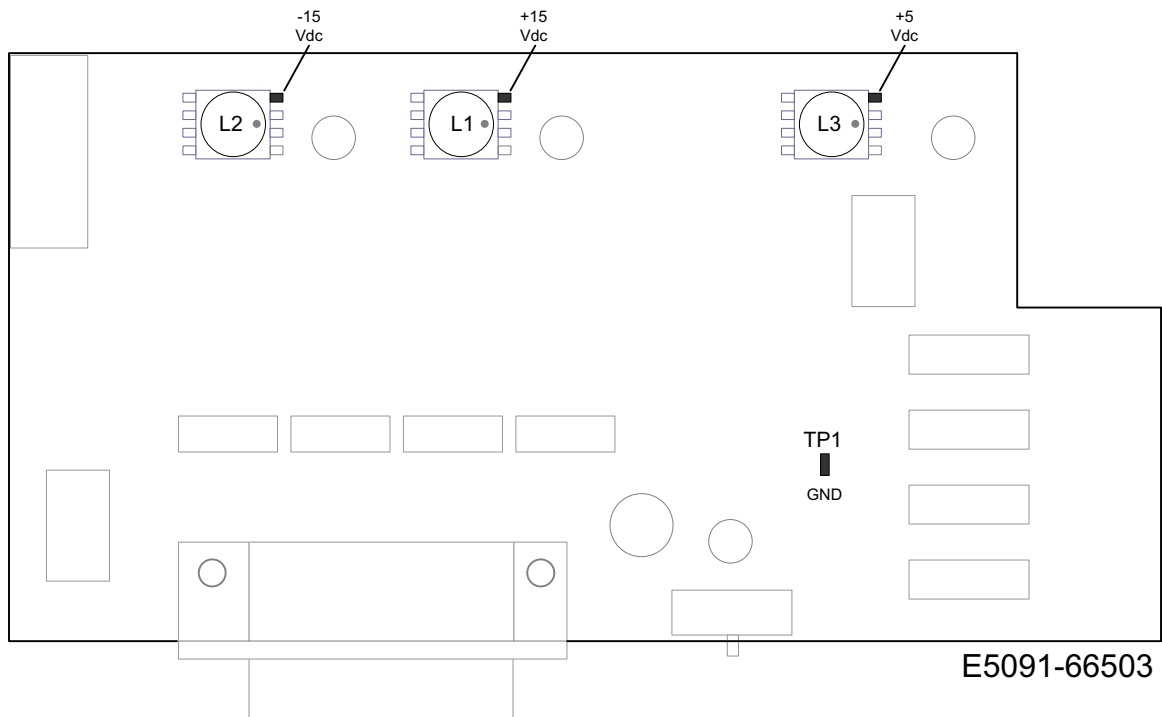
RF Switching Failures

If the test set's RF signal functionality is not operating properly, use the following procedure to aid in isolating the source of problem. The internal RF mechanical switches used in this instrument are biased with the +21 Vdc supply voltage from the Switch Interface board.

1. Follow the "Non-RF Failures" on page 73, if you have not done so.

2. Place the network analyzer and test set side by side (not stacked) and connect the I/O cable (N4011-21002). See Figure 22 on page 26.

3. Ensure that the network analyzer is *not* in Multiport Mode.

4. Using the test set I/O Data command values, confirm the correct address and data values are used, refer to "Address and Data Values" on page 45.

RF Switching Path Test

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

- Install the Test Set I/O cable from the analyzer to the test set's rear panel.

- Remove the front panel RF interface cables and reinstall the analyzer's original front panel semi-rigid "U" shaped jumper cables.

Equipment Required

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

Equipment Setup

1. Turn *on* the test set and the analyzer.

2. **Preset** the analyzer and set it to **Standalone Mode**. Select **Utility** > **System** > **Configure** > **Multiport Capability**. In the dialog box select **Restart as a standalone PNA** > **OK**.

3. Connect the RF cables to the analyzer's Ports 1 and 2. Connect the cables together using a 3.5 mm adapter.

4. Configure the analyzer to measure S21 and normalize the response trace.

5. Set the analyzer to **Interface Control Mode**: Select **Channel > Hardware Setup > More > Interface Control…** and click **Enable Interface Control box**.

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

Table 20   RF Signal Path Insertion Loss (S21)

RF Path Description	Signal	Insertion Loss (typical)
Source Out to Ports 3-12	Source	Figure 64 on page 78
A/B IN to Ports 3-12	Receiver	Figure 65 on page 79 *or* Figure 66 on page 80
Source Out to CPLR THRU	Source	Figure 67 on page 81
A/B IN to CPLR ARM	Receiver	Figure 67 on page 81 *or* Figure 68 on page 82

Source Signal Path Insertion Loss Test

Connect the RF Flex cables to the Test Port and Source Out port indicated in Table 21, the expected results should be similar to Figure 64.

Table 21   Source Signal Path Test Instructions

Path #	RF Path Description	Control Mode <Address>.<Data>	Path Components	Insertion Loss (typical)
1	Source Out to Port 3[1]	0.1	P3 CPLR, S102	Figure 64 on page 78
2	Source Out to Port 5	0.2	P5 CPLR, S102	
3	Source Out to Port 7	0.3	P7 CPLR, S102	
4	Source Out to Port 9	0.4	P9 CPLR, S102	
5	Source Out to Port 11	0.5	P11 CPLR, S102	
6	Source Out to Port 4	16.1	P4 CPLR, S202	
7	Source Out to Port 6	16.2	P6 CPLR, S202	
8	Source Out to Port 8	16.3	P8 CPLR, S202	
9	Source Out to Port 10	16.4	P10 CPLR, S202	
10	Source Out to Port 12	16.5	P12 CPLR, S202	

1. Use the Source Out port (on the left) associated with the odd test ports.
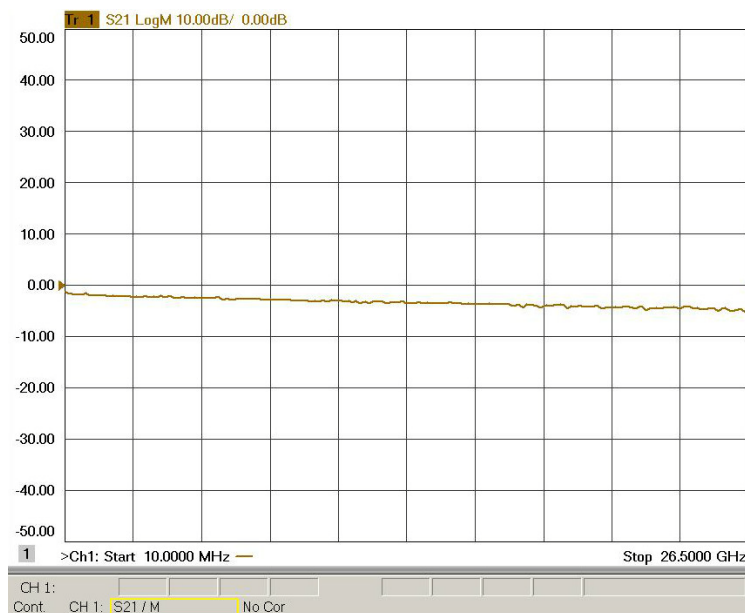
Figure 64   Source Out to Ports 3-12 Path Response

Connect the RF Flex cables to the Test Port and A/B IN port indicated in Table 22 The expected results should be similar to Figure 65.

Table 22   Receiver Signal Path Test Instructions

Path #	RF Path Description	Control Mode <Address>.<Data>	Path Components	Insertion Loss (typical)
1	A IN to Port 3	0.16	P3 CPLR, S302	
2	A IN to Port 5	0.32	P5 CPLR, S302	
3	A IN to Port 7	0.48	P7 CPLR, S302	
4	A IN to Port 9	0.64	P9 CPLR, S302	
5	A IN to Port 11	0.80	P11 CPLR, S302	Figure 64 on page 78
6	B IN to Port 4	16.16	P4 CPLR, S402	
7	B IN to Port 6	16.32	P6 CPLR, S402	
8	B IN to Port 8	16.48	P8 CPLR, S402	
9	B IN to Port 10	16.64	P10 CPLR, S402	
10	B IN to Port 12	16.80	P12 CPLR, S402	

Figure 65   A or B IN to Ports 3-12 Path Response, Standard
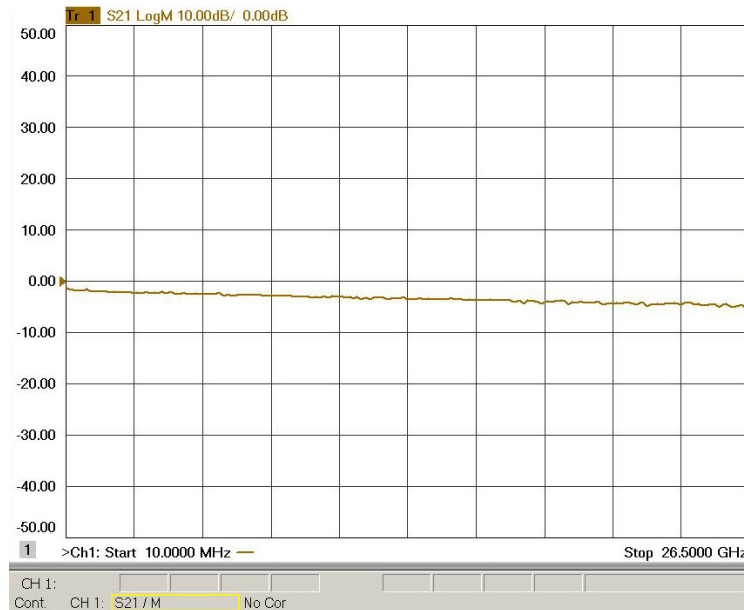
Figure 66   A or B IN to Ports 3-12 Path Response, Option 001
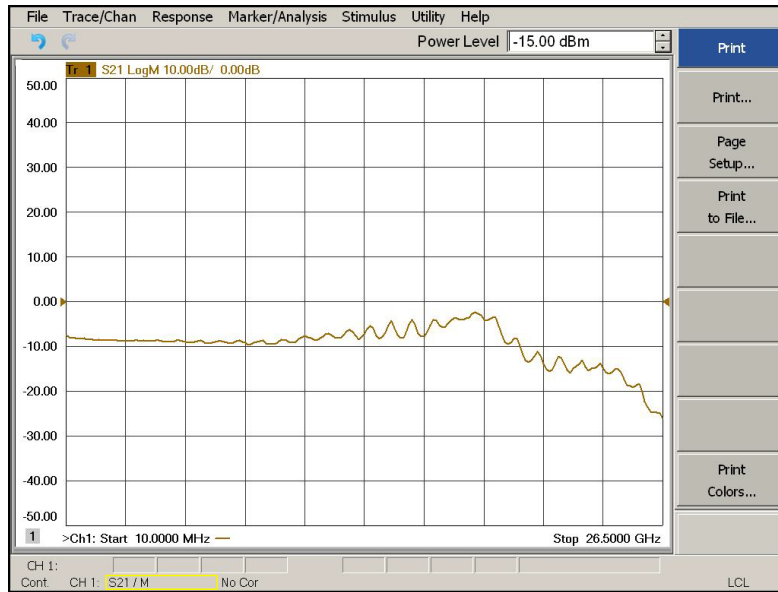
Connect the RF Flex cables to the Source Out and CPLR THRU port indicated in Table 23 and Table 24, the expected results should be similar to Figure 67.

Table 23   Source Bypass Signal Path Test Instructions

Path #	Test Port Group	RF Path Description	Control Mode <Address>.<Data>	Insertion Loss (typical)
1	Left Side	Source Out to CPLR THRU	0.0	Figure 66 on page 80
2	Right side	Source Out to CPLR THRU	16.0	

Table 24   Receiver Bypass Signal Path Test Instructions

Path #	Test Port Group	RF Path Description	Control Mode <Address>.<Data>	Path Components	Insertion Loss (typical)
1	Left Side	A IN to CPLR ARM	0.0	S302	Figure 66 on page 80 or Figure 67 on page 81
2	Right side	B IN to CPLR ARM	16.0	S402	

Figure 67   Source Out to CPLR THRU or A/B IN to CPLR ARM, Standard
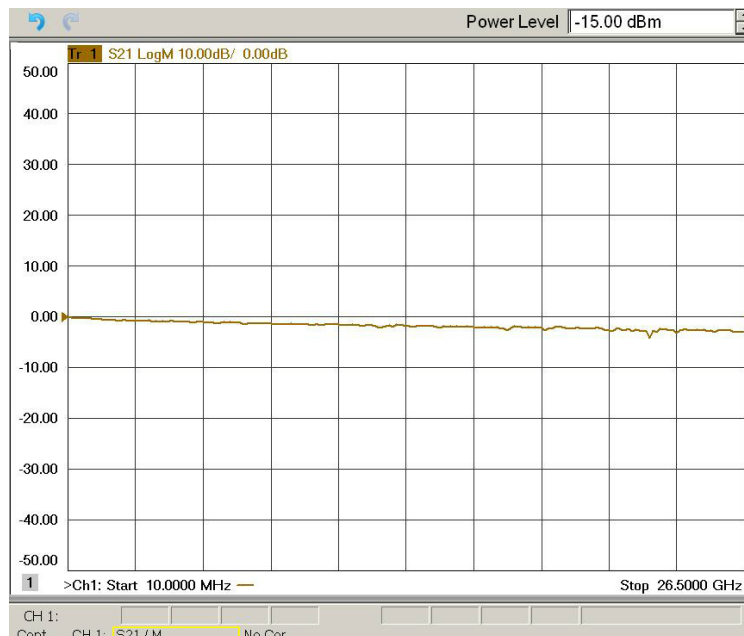
Figure 68   A/B IN to CPLR THRU, Option 001

Figure 69   Top View

Coupler/
Bridge (x10)

10

Amp Fan

RF Switch
(x4)

202   402

Switch
Interface Bd.
(top Bd.)

Test Set Control Bd (bottom)

Figure 70   Bottom View

DUT Control Bd.

RF
Switch (x4)

Fuse (x2)

Fan   Power Supply   Line Module
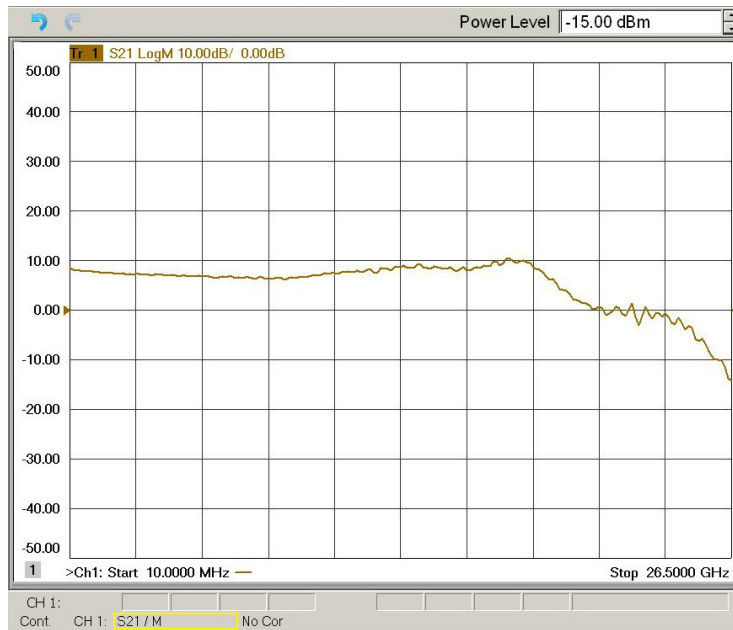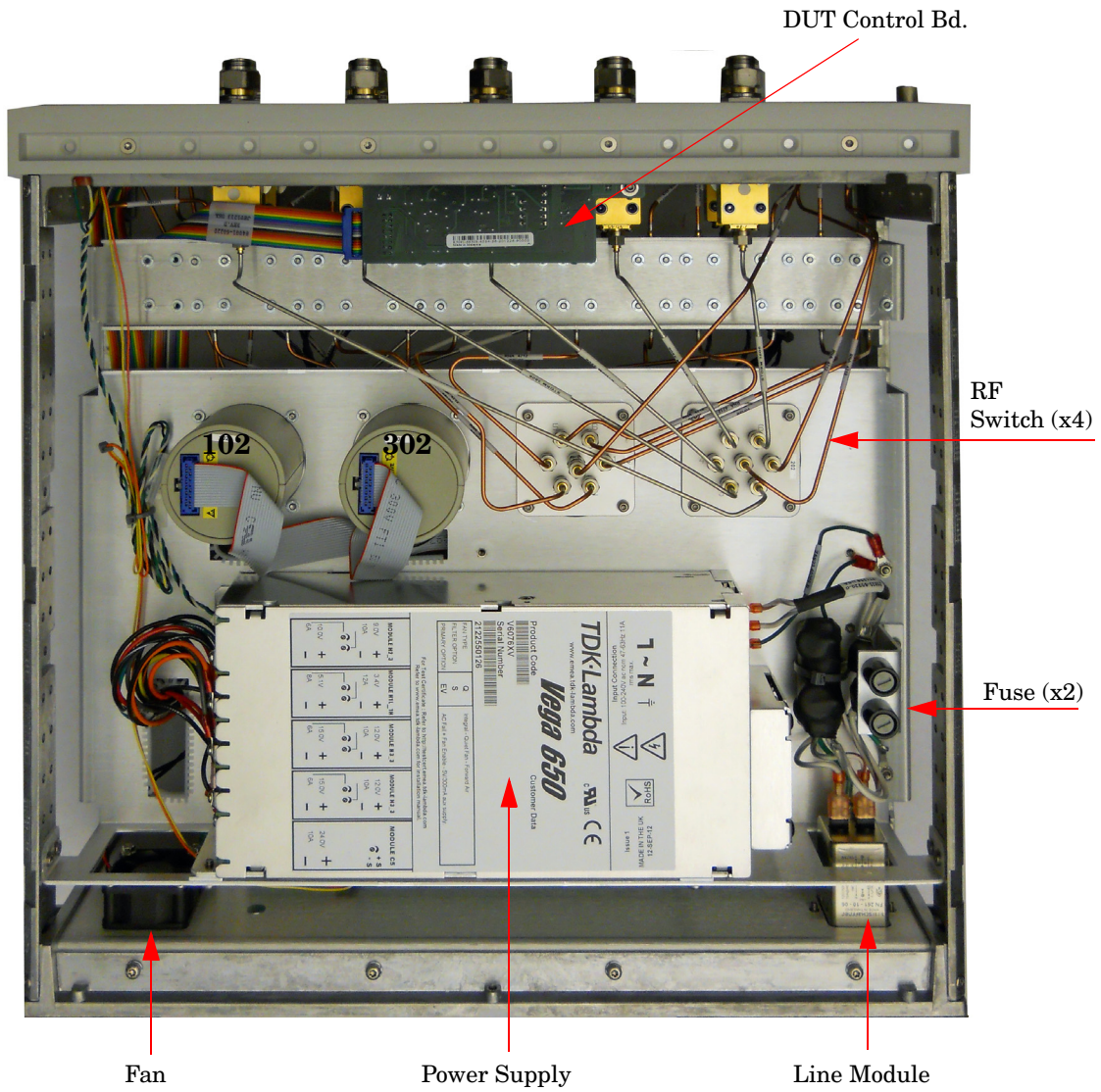
Safety and Regulatory Information

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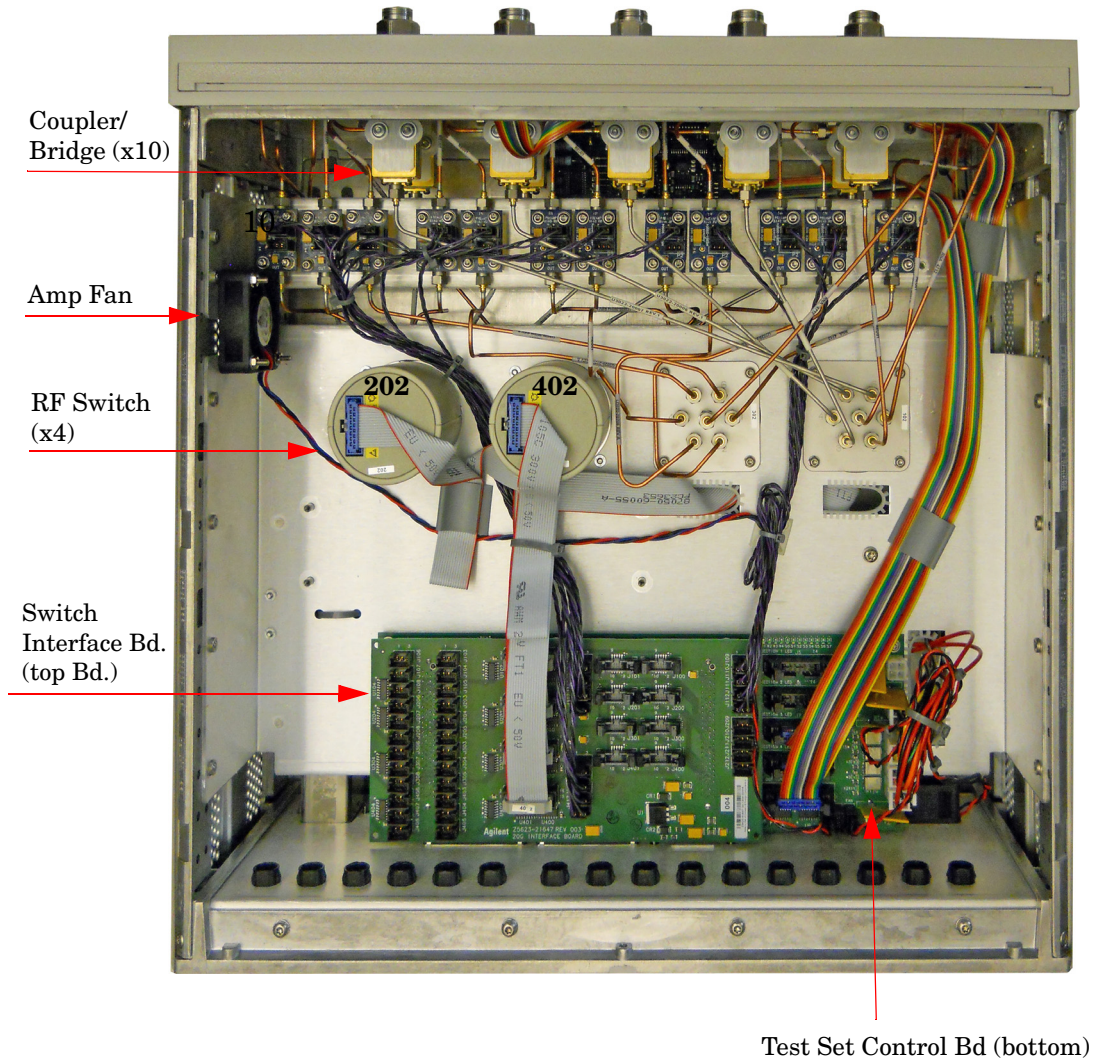
CAUTION   Always use the three prong AC power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause product damage and the risk of electrical shock.

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 U3022AE10" 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.**

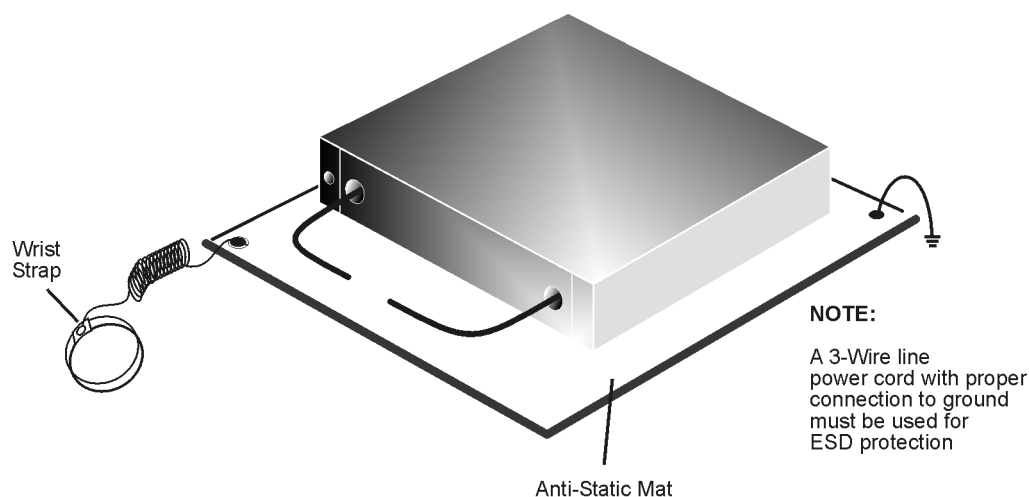|	
WARNING	**If flammable cleaning materials are used, the material shall not be stored, or left open in the area of the equipment. Adequate ventilation shall be assured to prevent the combustion of fumes, or vapors.**

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 71   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.

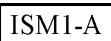|	
⚠	The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the documentation.
🗑	This symbol indicates separate collection for electrical and electronic equipment, mandated under EU law as of August 13, 2005. All 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.
I	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.
CE	The CE mark is a registered trademark of the European Community. (If accompanied by a year, it is when the design was proven.)
CSA ® C US	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.
40	Indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.
♲	This symbol on all primary and secondary packaging indicates compliance to China standard GB 18455-2001.

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 91 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, return the analyzer 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.