

Agilent Technologies U3045A Option M12

User's and Service Guide

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



Agilent Technologies

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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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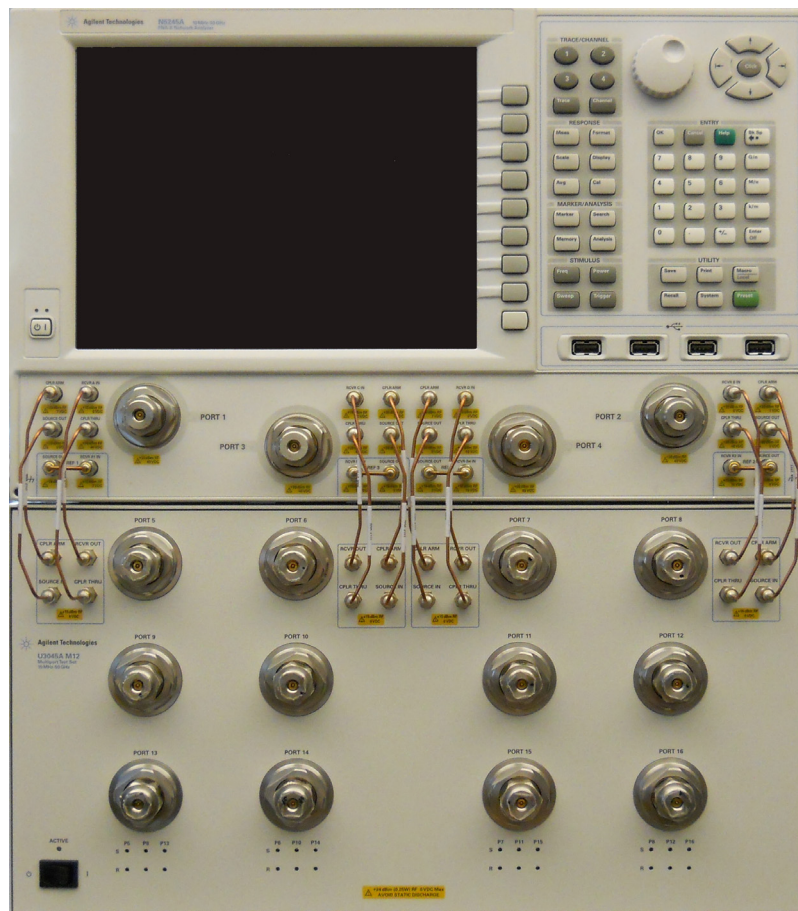
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U3045AM12

Introduction

This document describes how to use and service the U3045AM12 Multiport Extension Test Set with the Agilent N5244A or N5245A 4-Port PNA-X for a 16-Port network analyzer solution.

Figure 1 Front Panel N5245A with U3045AM12



Description

The Agilent U3045AM12 is a 12-Port multiport mechanical switch extension Test Set. The Test Set adds 12 test ports to a 4-Port N5244A (10 MHz to 40 GHz), or the N5245A (10 MHz to 50 GHz) PNA-X Network Analyzer. The PNA-X with Option 551 provides 16-Port calibration and full cross bar measurement capability.

The U3045AM12 mechanical switches provide low insertion loss for the best dynamic range performance, but have slower switching speed and limited life when compared to solid-state switches. The operational frequency range of the extension Test Set is 10 MHz to 50 GHz.

The U3045AM12 requires a network analyzer with Test Set I/O interface for operational control. An external personal computer is not required.

The N5244/45A PNA-X Network Analyzer will be referred to throughout this document as the PNA-X. The U3045AM12 will be referred to as the Test Set.

Network Analyzer Requirements

- The N5244/45A requires Option 551 and test set file u3042am12_pnax_p4.tsx (for N-Port error correction and multiport measurement capability).
- The N5244/45A requires Option 400 to provide the front panel test set interface connections
- PNA-X firmware revision: N5244/45A \geq A.09.22.09

The following test set file must be installed into the PNA-X file directory:
c:\Program Files\Agilent\Network Analyzer\testsets

4-Port PNA-X requires test set: u3042am12_pnax_p4.tsx

More PNA information is available on the following websites:

- Documentation - <http://www.agilent.com/find/pna>
- Network Analyzer Firmware - <http://na.tm.agilent.com/pna/firmware/firmware.htm>
- U3045AM12 Test Set Files - <http://na.tm.agilent.com/multiport> (see Test Set Files)

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

Available Options

Test Set Options

The Test Set has one available Test Set option:
Refer to [Figure 44 on page 54](#).

- Standard - mechanical switches for low loss.

Interface Option

The available Test Set cable options:

- U3021PX2 Option 445 includes two kits to connect the 4-Port N5245A to the Test Set; a Lock Link kit U3021M-045 (U3021-60002), and Cable kit 445 PNX2 (U3021-60089).

Rack Mount Kits

Available options for system cabinet mounting:

- U3045AM12-1CP Rack Mount Kit with Handles (5063-9223)
- U3045AM12-1CM Rack Mount Kit without Handles (5063-9216)
- U3045AM12-1CN Front Handle Kit (5063-9229)

Specifications

Specifications for the Test Set are characteristic for the system performance of the PNA-X and the Test Set. Before using the PNA-X and Test Set a calibration is recommended for best measurement performance. Actual performance of the system is based on the customer's PNA-X and options that are used with the Test Set. A functional certificate is only offered for the Test Set.

When connected to a PNA-X, this Test Set will degrade the performance at the test ports. The internal switch paths reduce test port power and power to the receivers. This affects the test port power of the PNA-X and also reduces dynamic range. The reflection tracking values measured in the [“Operational Cal Kit Check” on page 44](#) can be subtracted from the analyzers dynamic range to determine the approximate performance of the system.

CAUTION The life expectancy of the following switches are 5 million cycles. When making measurements using more than one port, single sweeps are recommended to minimize switch cycles.

- N1811TL (x24, N1811-60023)
-

Power Requirements

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

- 100/120/220/240 VAC (50/60Hz)
- The instruments can operate with mains supply voltage fluctuations up to $\pm 10\%$ of the nominal voltage.
- Air conditioning equipment (or other motor-operated equipment) should not be placed on the same ac line that powers the Test Set and PNA-X.
- [Table 1](#) contains the maximum wattage for all instruments. This table can be use to determine the electrical and cooling requirements.

Table 1 Power Requirements

| Instrument | Maximum Wattage |
|------------|-----------------|
| N5244/45A | 450 |
| U3045AM12 | 350 |

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

Environmental Requirements

Refer to the PNA series standard documentation for environmental requirements.

Environmental Tests

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

- Temperature 0 - 50 °C
- 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. Air conditioning capacity must be consistent with the BTU ratings given in [Table 1](#).

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

Required Conditions for Accuracy Enhanced Measurement

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

Dimensions and Space Requirements

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

Table 2 Instrument Dimensions

| Model | Weight | Height | Width | Depth |
|-----------|-----------------|----------------------|----------------------|----------------------|
| U3045AM12 | 14.9 kg (33 lb) | 23.2 cm (19.3 in) | 42.5 cm (16.7 in) | 52.4 cm (20.6 in) |

Maximum Power Levels

CAUTION It is recommended that you do not operate components near damage levels (+25 dBm). The power levels must be 3 dB below maximum level to ensure no damage, see [Table 3](#).

Table 3 Power Levels

| Maximum U3045AM12 Test Port RF Power Levels: | |
|--|---------------|
| PORT 5-12 | +25 dBm 0 Vdc |
| Maximum U3045AM12 Access Ports: | |
| SOURCE OUT | +15 dBm 0 Vdc |
| CPLR ARM | +15 dBm 0 Vdc |
| CPLR THRU | +15 dBm 0 Vdc |
| RCVR OUT | +15 dBm 0 Vdc |

NOTE Refer to your PNA-X specifications to determine the maximum input power levels for the access and test ports, or to optimize the power levels in the receivers.

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

Reflection Tracking Performance

Specifications for the reflection tracking are typical and are intended as non-warranted information.

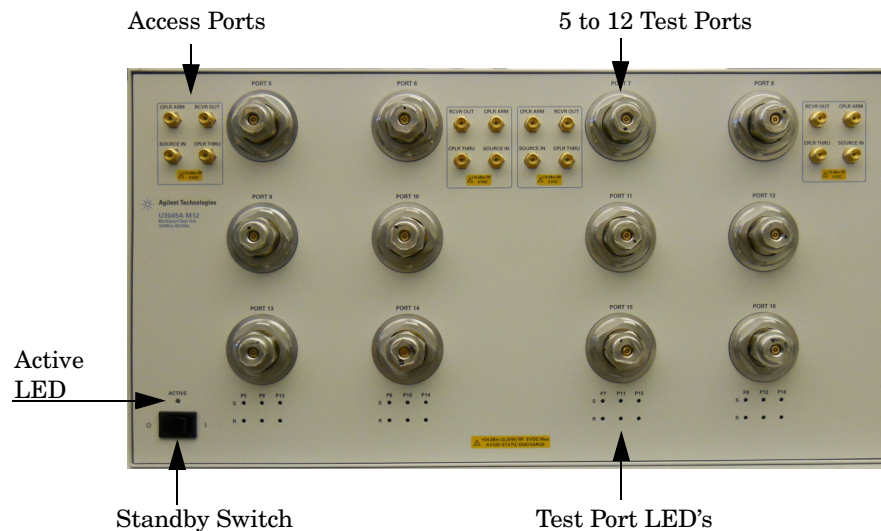
NOTE Typical specifications are based on 1 to 2 units performance, see [Table 4](#).

Table 4 Typical Reflection Tracking PNA-X

| Frequency | Ports 1 to 4 | Ports 5 to 12 | Ports 13 to 16 |
|----------------------|--------------|---------------|----------------|
| 10 MHz to 50 MHz | -0.5 | -0.5 | -0.5 |
| 50 MHz to 200 MHz | -1 | -1 | -1 |
| 200 MHz to 500 MHz | -1.5 | -1.5 | -1.5 |
| 500 MHz to 3.2 GHz | -2.5 | -2 | -1.5 |
| 3.2 GHz to 10 GHz | -4 | -3 | -2.5 |
| 10 GHz to 13.5 GHz | -5 | -3 | -2.5 |
| 13.5 GHz to 16 GHz | -5 | -4 | -2.5 |
| 16 GHz to 20 GHz | -6 | -4 | -3 |
| 20 GHz to 24 GHz | -6 | -5 | -3 |
| 24 GHz to 26.5 GHz | -8 | -7 | -3.5 |
| 26.5 GHz to 43.5 GHz | -10 | -9 | -3.5 |
| 43.5 GHz to 46 GHz | -12 | -11 | -4 |
| 46 GHz to 50 GHz | -14 | -12 | -5 |

Front and Rear Panel Features

Figure 2 U3045AM12 Front Panel



Test Ports – 2.4 mm Bulkhead (male)

- Port 5 – 12

Access Ports – 2.4 mm (female)

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

Test Port's LEDs

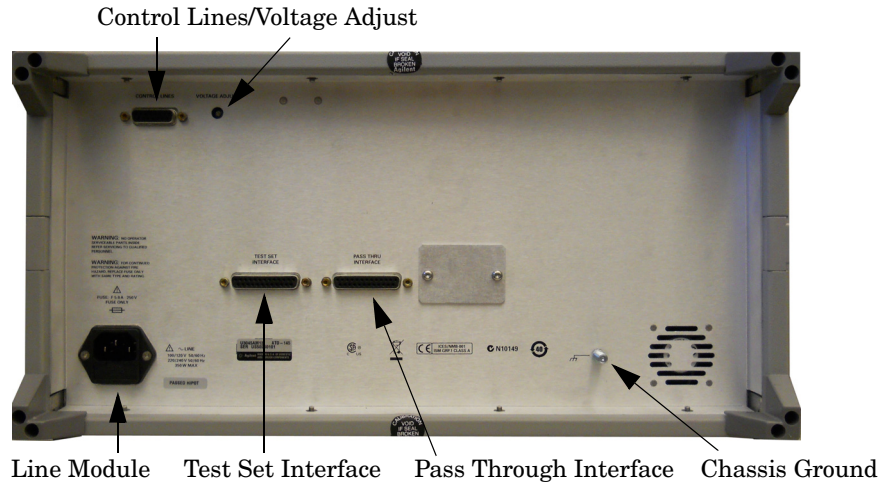
An illuminated LED indicates an active port in Source or Receiver mode. On the front panel “S” indicates Source test ports and “R” indicates Receiver test ports.

Standby Switch

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

Active LED

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

Figure 3 U3045AM12 Rear Panel

Control Lines and Voltage Adjust

For further information pertaining to control lines and voltage adjustments see. Refer to “Control Lines” on page 38.

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

The Pass Through Interface is used to connection to another test set.

Test Set Interface

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

Line Module

The line module contains the power cord receptacle. The line fuse, as well as a spare, reside within the line module. [Figure 4](#) illustrates where the fuses are located and how to access them.

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

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

Power Cords

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

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

Available Fuses

- Fuse (F 5 A/250V, 2110-0709) UL listed and CSA certified.
- Fuse (F 8 A/250V, 2110-0342) UL listed and CSA certified.

WARNING **For continued protection against fire hazard, replace fuses, and or circuit breakers only with same type and ratings. The use of other fuses, circuit breakers or materials is prohibited.**

Figure 4 **Line Fuse**



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

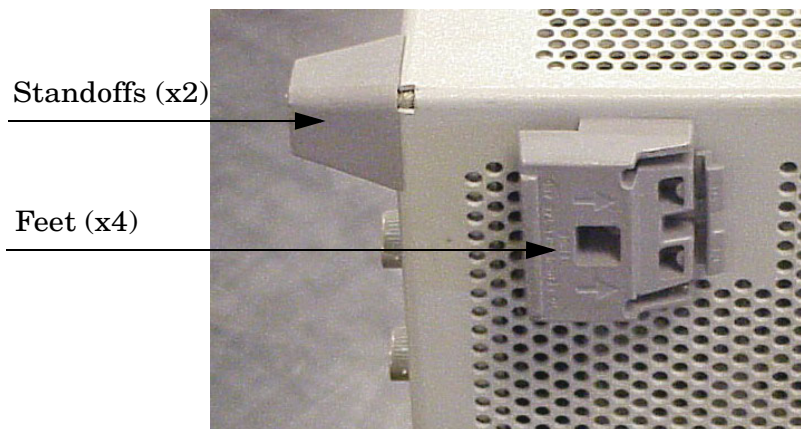
System Setup

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

Preparing the PNA-X

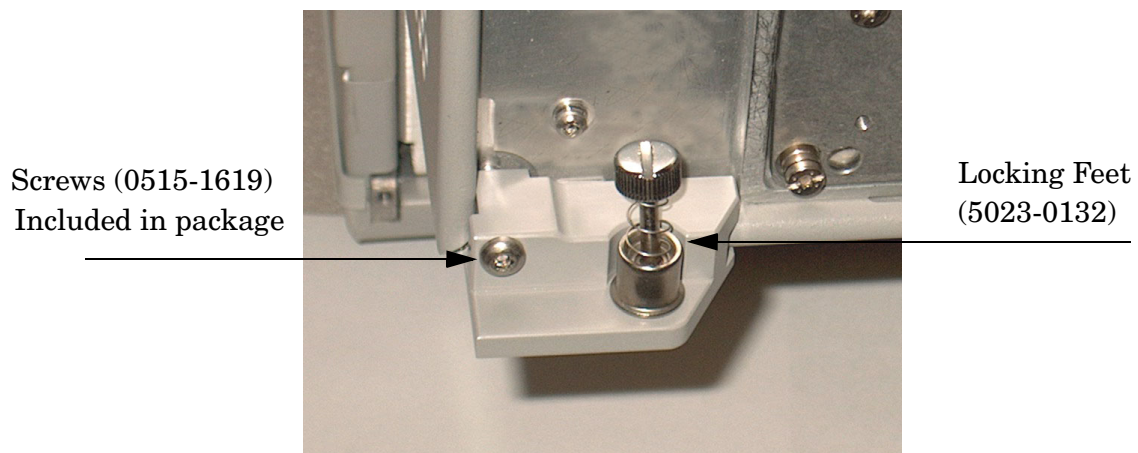
1. Remove the feet from the bottom of the PNA-X.
2. Remove the 2 lower standoffs and screws (0515-1619) from the rear panel on the PNA-X.

Figure 5 Rear Bottom Feet



3. Install the two rear locking feet (5023-0132) onto the PNA-X, using the included screws (0515-1619), where the standoffs were removed.

Figure 6 Install Locking Feet on PNA-X



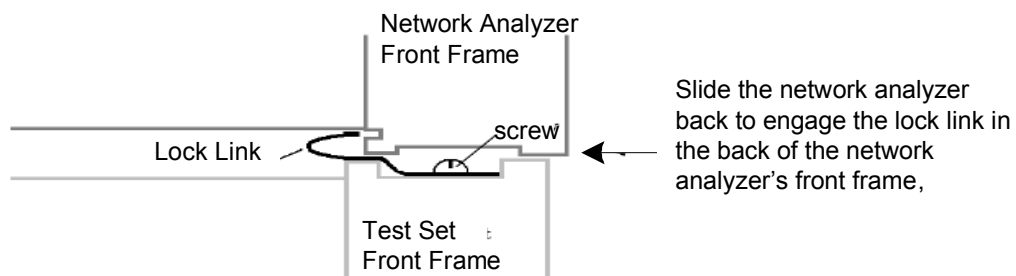
4. Remove the top two standoffs and screws (0515-2317) from the rear panel on the Test Set.
5. Install the two rear locking feet onto the Test Set. The N5242-20138 is the right foot and the N5242-20139 is the left foot. Two screws (0515-2317) are included with this option.

Figure 7 Install Locking Feet on Test Set



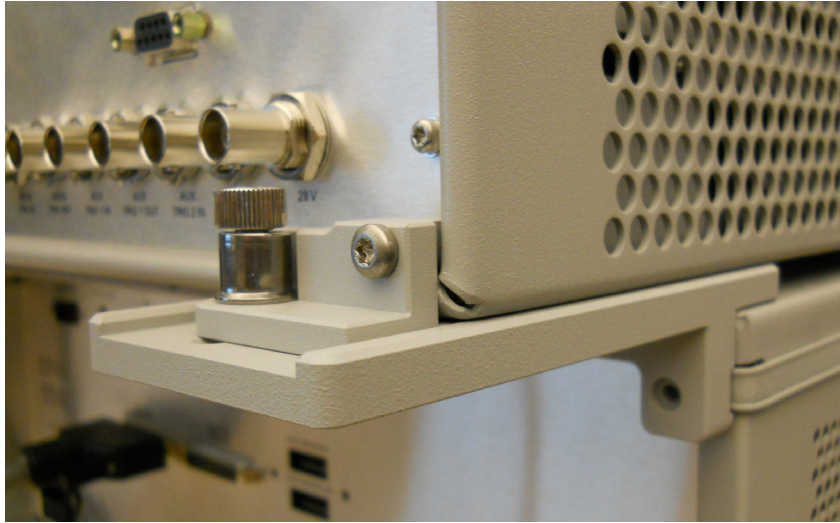
6. Place the PNA-X on top of the Test Set and ensure that the front frame of the PNA-X is positioned slightly forward of the locks that are attached to the Test Set. Slide the PNA-X back so the locks engage the front frame of the analyzer.

Figure 8 Locking the Analyzer



7. Secure the PNA-X's lower locking feet to the Test Set upper locking feet, using the spring-loaded screws on the locking feet. If the PNA-X's lower locking feet are not aligned with the screw holes in the Test Set's upper locking feet, loosen the screws securing the feet to the instrument slightly to align and tighten.

Figure 9 Locking Feet Screws



NOTE There are two Lock-Feet kits available. Refer to [“Contacting Agilent” on page 78](#) for ordering information.

- PNA-X – 5023-0132 (Kit includes locking feet and screws)
 - Test Set – N5242-20138 (right foot) and N5242-20139 (left foot).
 - Screw – 0515-2317
-

RF Interface Cable Connections

Figure 10 on page 15 illustrates the cable configuration of the Test Set to the PNA-X. The cables have been supplied with Cable Kit (U3021-60089).

1. Remove the SOURCE OUT to CPLR THRU and RCVR IN to CPLR ARM jumpers (x8) on the PNA-X. The RCVR R1 to SOURCE OUT reference loop jumpers (x4) remain on the front panel.
2. Connect the RF interconnect cables (N5247-20016 and N5247-20017) from the PNA-X to the Test Set in the order listed. As you are connecting each cable, torque to 8 in-lb. Refer to Table 5 and Figure 10.

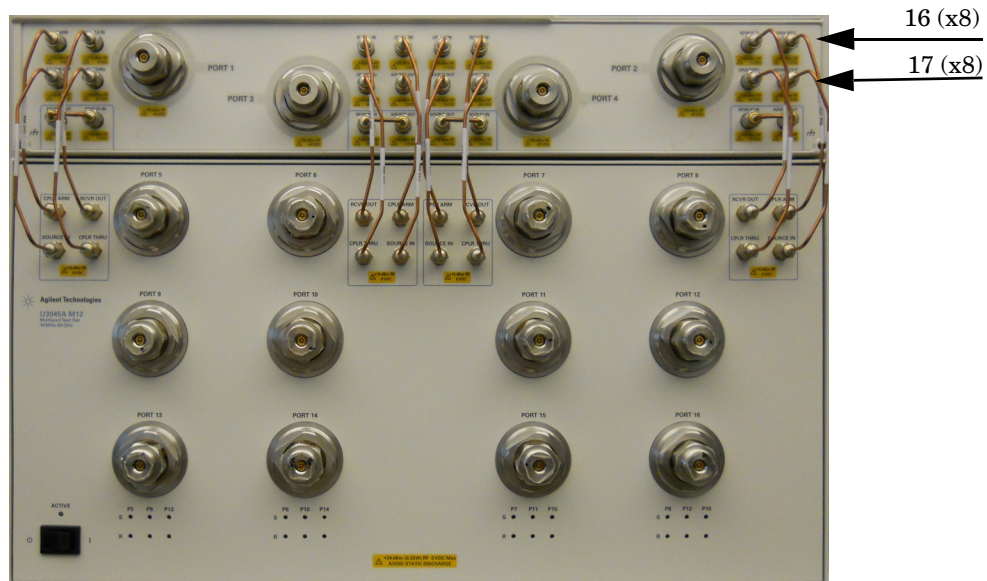
CAUTION Over torque will cause damage to the Test Set and may cause connectors to spin or become loose.

Table 5 N5244/45A RF Interface Cable Connection

| Numeric Order | RF Cables | From PNA-X | To Test Set |
|--|-------------|------------|-------------|
| Cable Kit 445 PNX2 U3021-60089: | | | |
| 1 | U3047-20016 | CPLR ARM | CPLR ARM |
| 2 | U3047-20016 | RCVR IN | RCVR OUT |
| 3 | U3047-20017 | CPLR THRU | CPLR THRU |
| 4 | U3047-20017 | SOURCE OUT | SOURCE IN |

Figure 10 illustrates the final two digits of the part number for each cable. The cables must be connected in the numeric order listed in Table 5.

Figure 10 PNA-X RF Interface Cable Connections



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

Figure 11 Rear Panel N5245A with U3045AM12



System Operational Checks

The following procedure will confirm that the RF interface cables between the Test Set and PNA-X are installed and the system is working correctly. Ensure that your PNA-X is calibrated by measuring the short on each port before connecting the Test Set.

Before beginning this procedure complete the following steps:

1. Stacked the PNA-X on top of the Test Set.
2. Connect the Test Set interface cable on the rear panel.
3. Connect all of the RF interface cables on the front panel.
4. Install the female 2.4 mm short (85056-60021) to PNA-X Port 1.

Equipment Setup

1. Turn On the Test Set and PNA-X.
2. Preset the PNA-X, and set the PNA-X to Multi-Port Mode.
3. Confirm frequency range is set to 10 MHz to 50 GHz.
4. Set the PNA-X to measure S11.

Verify Results

The 2.4 mm short will be relocated to each Test Port and an uncorrected reflection response trace should be displayed that resembles the following plots indicated in 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 6 Reflection Response Results

| Reflection Port | Response Trace | Cable Path Diagram |
|-----------------|--------------------------------------|--------------------------------------|
| Port 1 to 4 | Figure 12 on page 18 | Figure 13 on page 18 |
| Ports 5 to 12 | Figure 14 on page 19 | Figure 15 on page 19 |
| Ports 13 to 16 | Figure 16 on page 20 | Figure 17 on page 20 |

Figure 12 Typical Reflection Response Ports 1 to 4

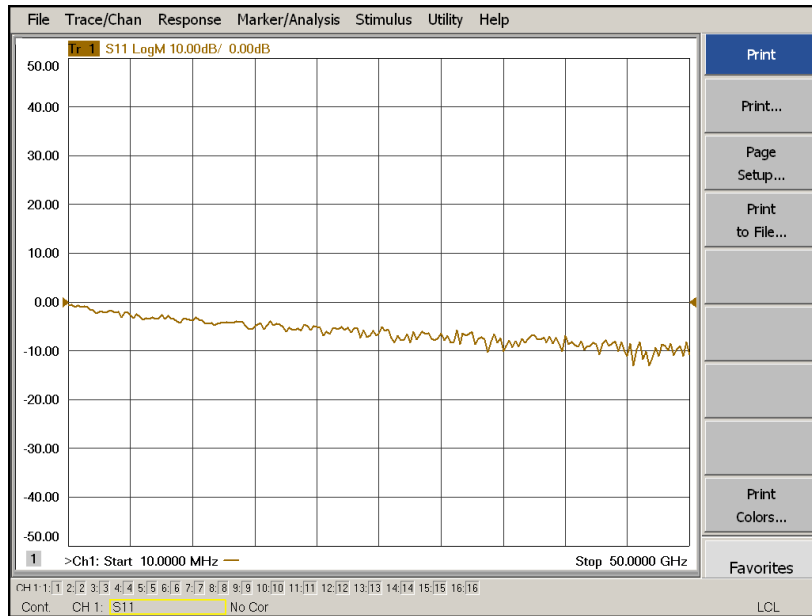


Figure 13 Reflection Response Signal Path Diagram Ports 1 to 4

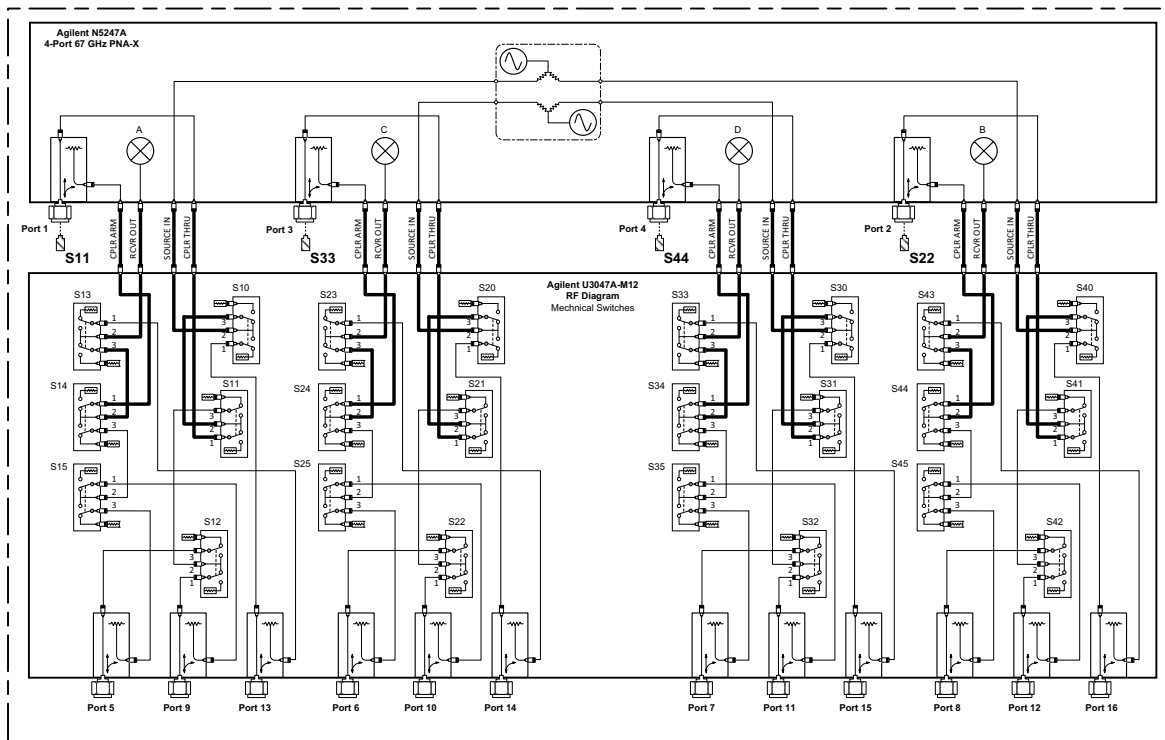


Figure 14 Typical Reflection Response Ports 5 to 12

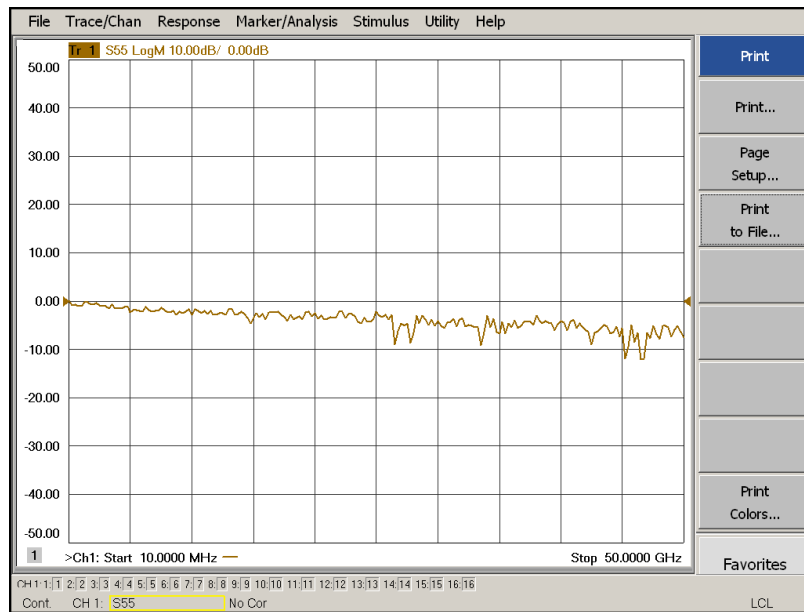


Figure 15 Reflection Response Signal Path Diagram Ports 5 to 12

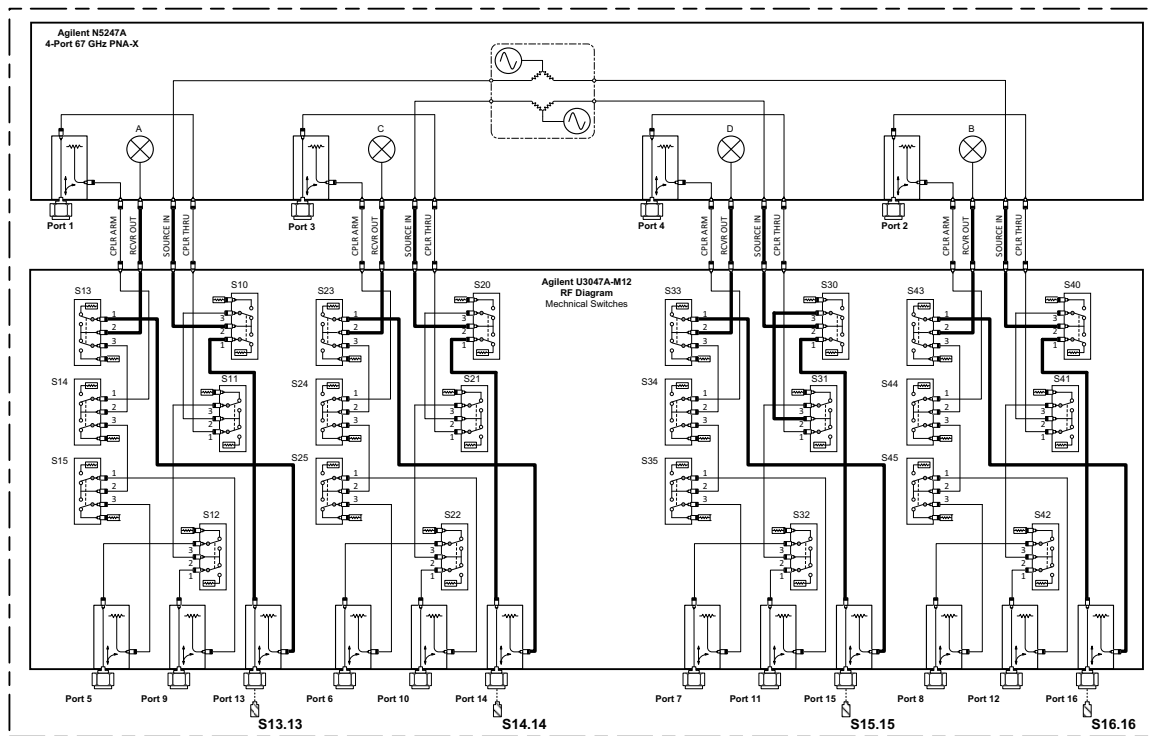


Figure 16 Typical Reflection Response Ports 13 to 16

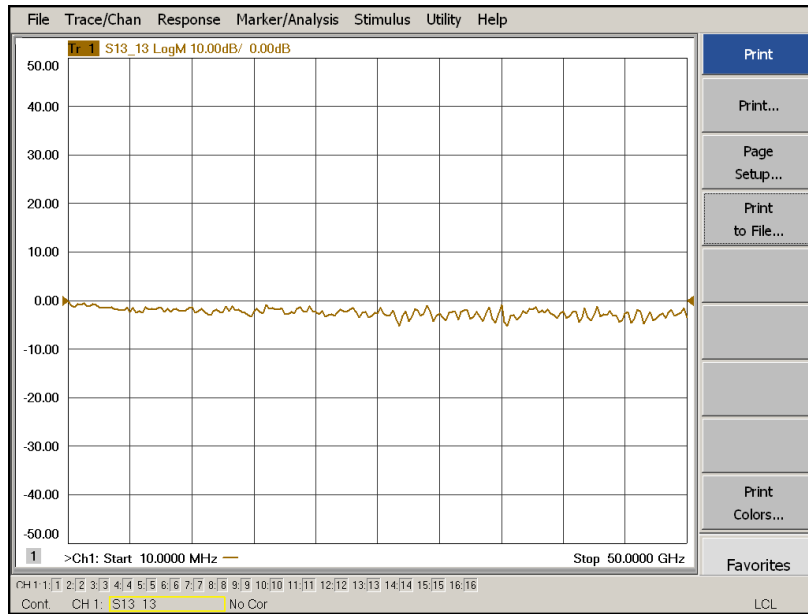
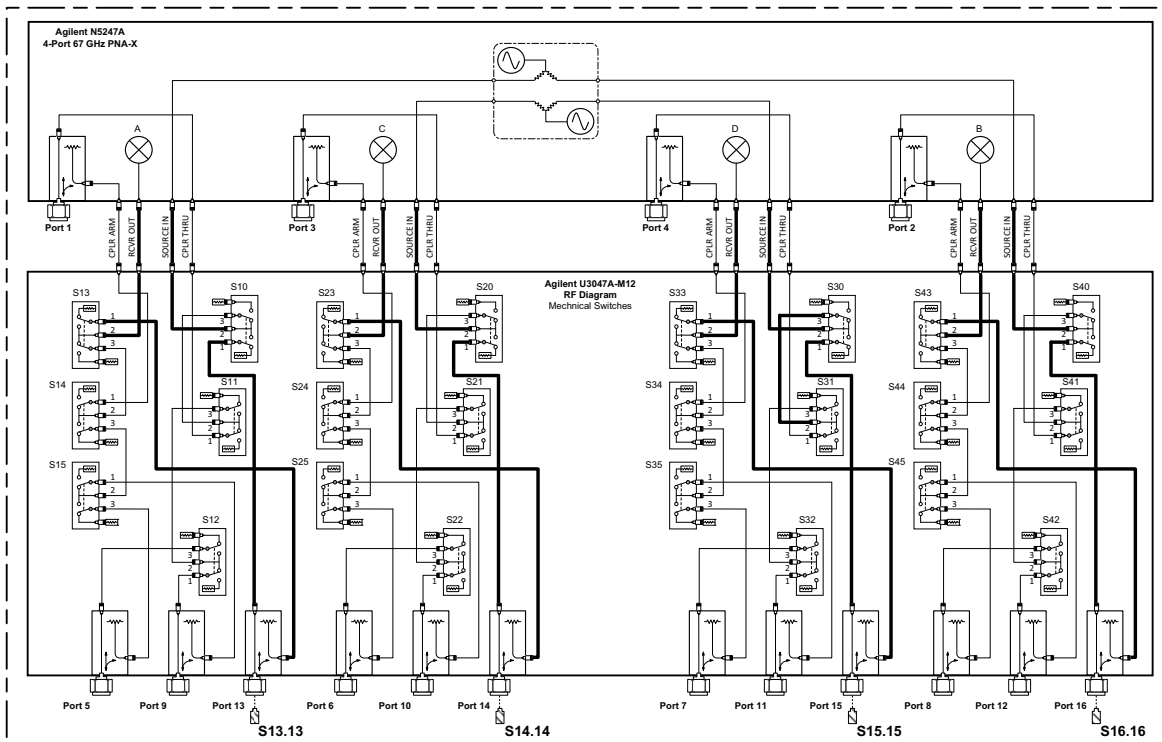


Figure 17 Reflection Response Signal Path Diagram Ports 13 to 16



Controlling the U3045AM12

This section will describe how to operate the Test Set with the PNA-X.

A PNA-X must be used to control the Test Set using the Test Set I/O interface on the rear panel. There are three methods to control the Test Set. Multiport mode is recommended due to ease of use, and multiport calibration capability (N-Port).

- “PNA-X Multiport Mode” on page 22.
- “Interface Control Mode” on page 29.
- “GPIO Control Mode” on page 33.

Typeface Key Conventions

The following key conventions are used throughout this document.

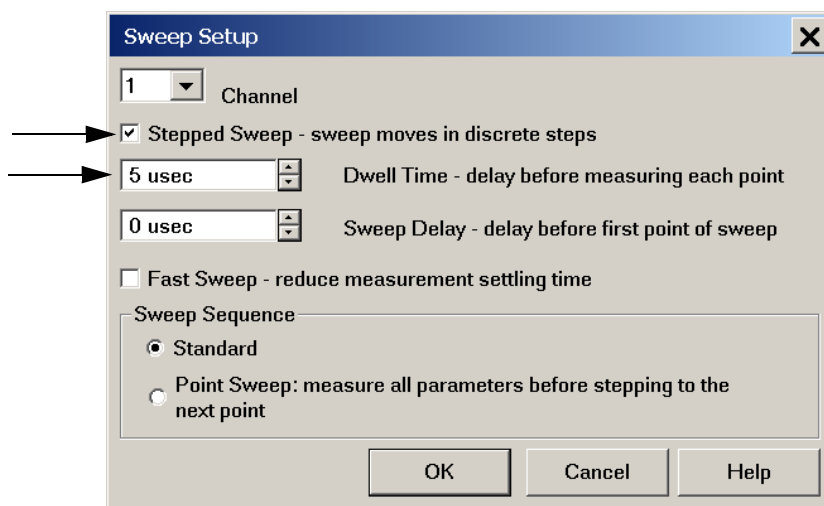
- **[HARDKEYS]** are labeled front panel keys
- **SOFTKEYS** are indicated on the instrument display

Sweep Setup for Multiport and Standalone PNA Modes

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

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

Figure 18 PNA Sweep Setup



PNA-X Multiport Mode

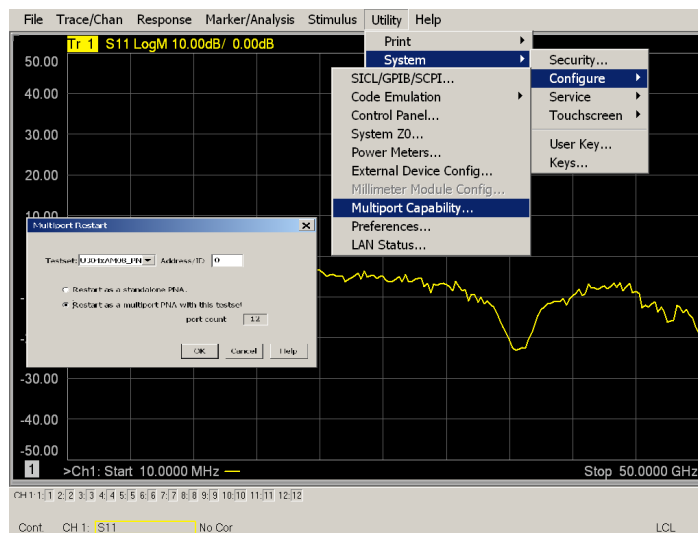
The PNA-X requires Option 551 for multiport mode. The PNA-X must have the Test Set file installed to enable the PNA-X to control the Test Set. The PNA-X multiport mode allows you to select measurement ports, complete an N-Port calibration, operate control lines, and rename test ports. Refer to the Help menu for more information.

Multiport Mode Operation

1. The Option 551 must be installed for multiport capability. To access the multiport application select **Utility > System > Configure > Multiport Capability**.
2. Select **U304xAM12_PNAX_p4** (16-Port System) from the drop-down menu and select **Restart as a multiport PNA with this testset > OK**. The PNA-X 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 PNA-X 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` directory.

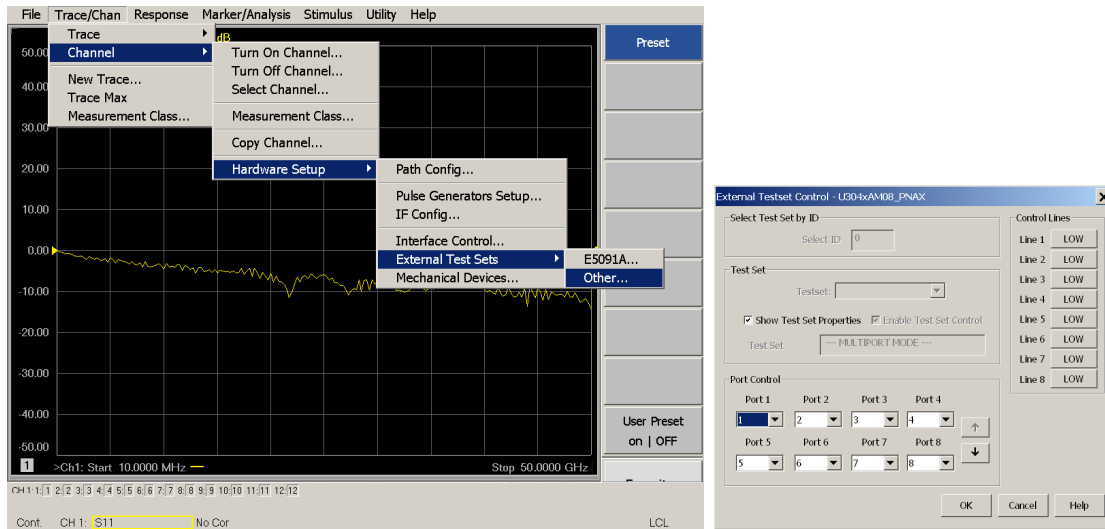
Figure 19 Test Set Selection



External Test Set Control Operation

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-U3045AM12**.

Figure 20 External Test Set Control



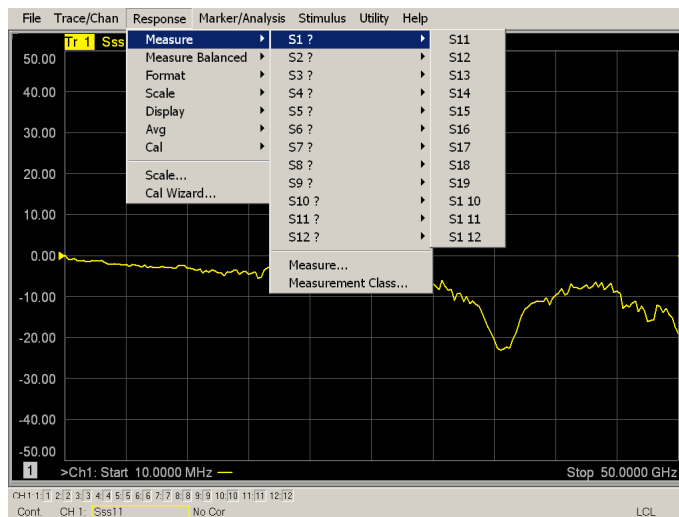
This menu will allow the physical Ports 1 thru 12 to be identified as any port for your convenience. For example; Port 5 can be re-named Port 2.

The **External Test Set Control-U3045AM12** also allows control of the DUT control lines, refer to “[Control Lines](#)” on page 38. To change the state from LOW to HIGH, select the graphical user interface (GUI) for the specific control (LINE 1 thru 12), click **OK**. Each line can be controlled separately. Select the Port Control down arrow for Ports 9 thru 12.

Selecting S-Parameter Measurement

S-Parameter selection can be accomplished using **Response > Measure**. Use the drop-down menu to select 1 of 144 S-Parameters for the 16-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.

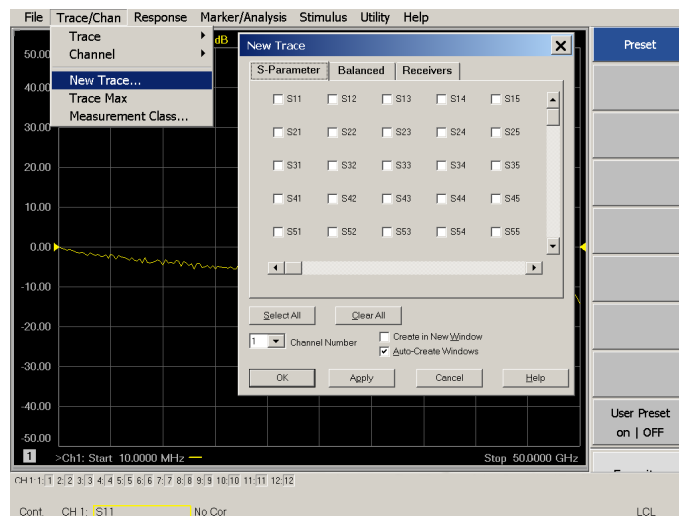
Figure 21 S-Parameter Measurement



Selecting New S-Parameter Measurement

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

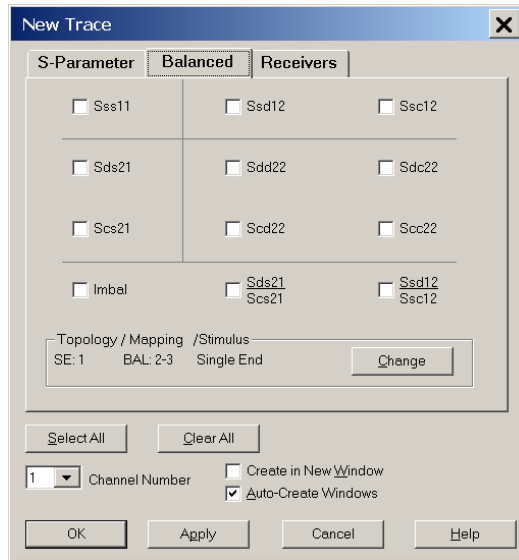
Figure 22 New S-Parameter Measurement



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

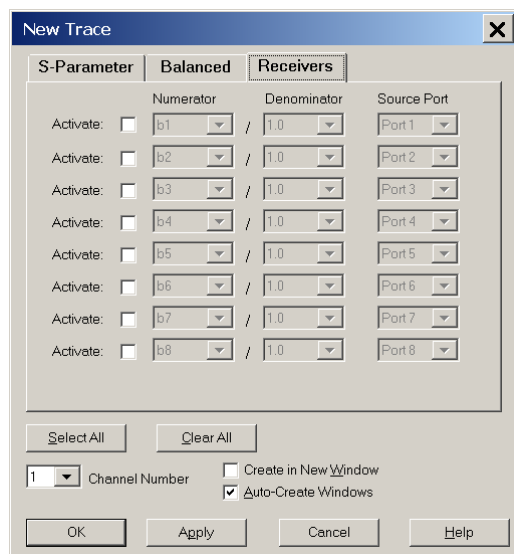
For more information on balanced (differential) component measurement, refer to the Application Note 1373-1 and 1373-2 (5988-5634EN and 5988-5635EN) at <http://www.home.agilent.com>. In the search menu type “Multiport and Balanced.”

Figure 23 Selecting Balanced Measurements



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

Figure 24 Receiver Measurements



N-Port Calibration with N5244/45A

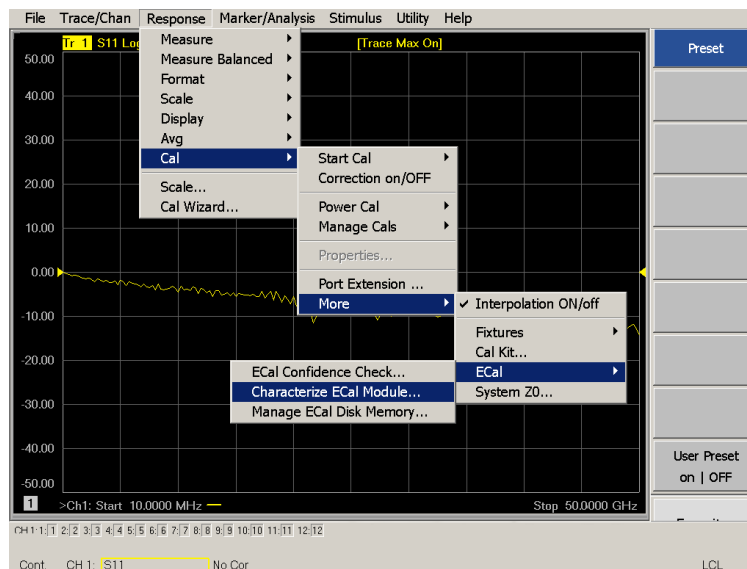
It is recommended that you perform an ECal characterization to minimize the connections required for multiple port calibration. The N4693AB Option M0F is recommended with cable (85133F) if you are calibrating at the PNA-X and Test Set ports.

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.

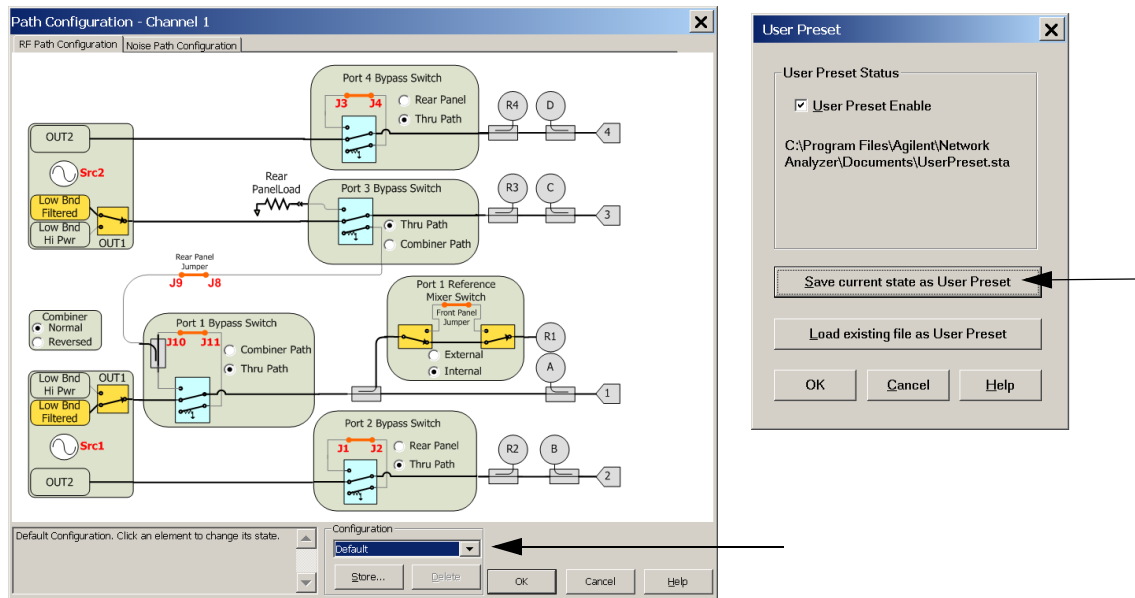
NOTE If measurement errors occur, ensure the newest version of firmware is installed on the PNA-X. Measurement errors can be a result of firmware algorithms. Consult with Agilent Service or firmware web page for the latest PNA-X Option 551 firmware revisions and history.
<http://na.tm.agilent.com/pna/firmware/firmware.htm>.

Figure 25 ECal Characterization



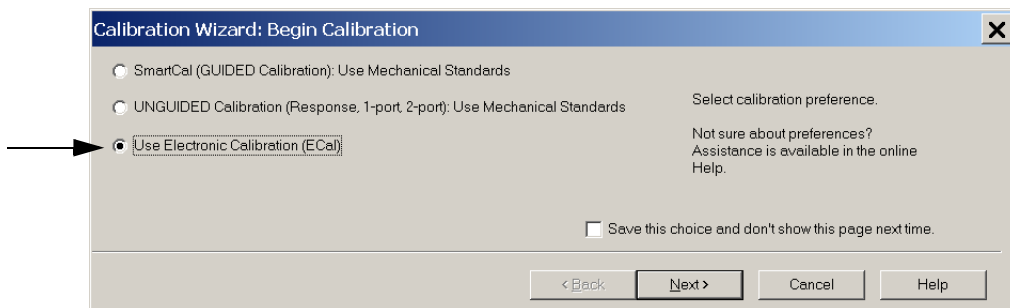
NOTE If the PNA-X has Option 029 or H29 (noise figure capability) verify that the path configuration is set to Default. If the PNA-X is not in Default configuration, ports 5 and 9 will not operate correctly. Select **Trace/Chan > Channel > Hardware Setup > Path Cong...** and in the drop-down menu select **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 PNA-X will return to Option 029 path configuration.

Figure 26 RF Path Configuration



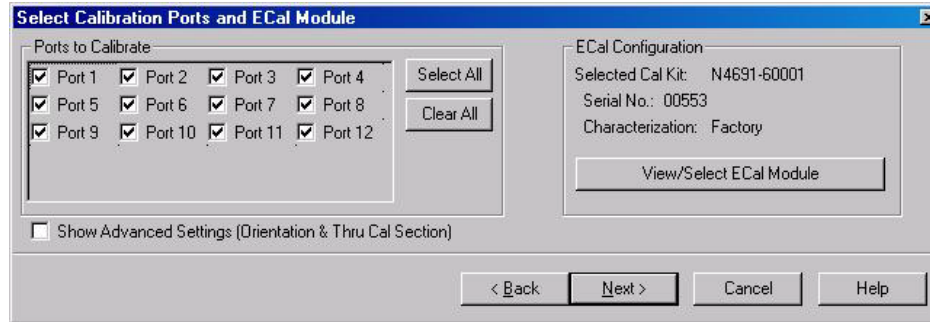
1. On the PNA-X select **Response > Cal Wizard**.
 - a. If using a mechanical cal kit, select **SmartCal (Guided Calibration) > Next**.
 - b. If using an ECal module, connect the ECal to an available PNA-X USB port and select **Use Electronic Calibration (ECal) > Next**.

Figure 27 Begin Calibration



- Continue following the Cal Wizard prompts. In the Select Calibration Ports and ECal Module dialog box click the **Select All**, check box, or select the ports you are calibrating and click **Next**. If an ECal characterization has been done, select **View/Select ECal Module** and select the previously saved user file from [step 1](#).

Figure 28 16-Port Calibration



- 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**.
- At the Calibration Completed prompt, select **Save As User Calset**, type the name and **Save**. See [Figure 37 on page 46](#).
- After calibrating Test Set ports, use a quality load and short to verify the calibration on each port or end of the test cable. Measure reflection and confirm the return loss is as expected. If the result is not as expected, repeat the calibration without the Test Set and ensure that the PNA-X is in standard (non-multiport) mode.

NOTE If measurement errors occur, ensure the newest version of firmware is installed on the PNA. Measurement errors can be a result of firmware algorithms. Consult with Agilent Service or firmware web page for the latest PNA Option 551 firmware revisions and history.
<http://na.tm.agilent.com/pna/firmware/firmware.htm>

Interface Control Mode

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 PNA-X Help menu, “Rear Panel Tour” and “Interface Control.”

This section includes:

- How to Access Interface Control Settings
- Interface Control dialog box

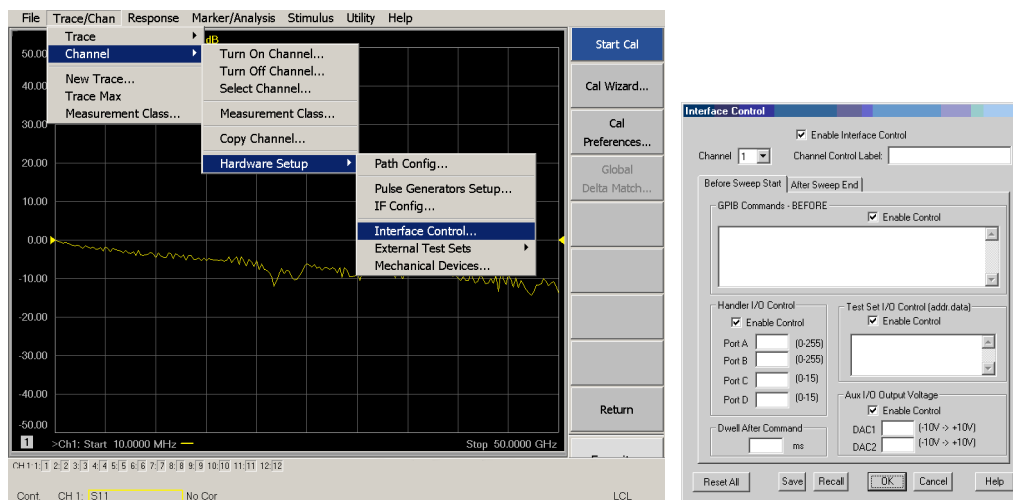
NOTE The interface control mode will not function properly when using multiport mode. The multiport mode will reset the switch path commands of the interface control. It is recommended that the PNA-X be restarted in stand-alone mode if the interface control is being used.

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

How to Access Interface Control Mode

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 PNA-X Series Network Analyzer includes the Interface Control application and rear panel connection. Please review this application before connecting the Test Set to the PNA-X. Information regarding this application can be found in the PNA-X Help menu, Interface Control. The application is shown below.

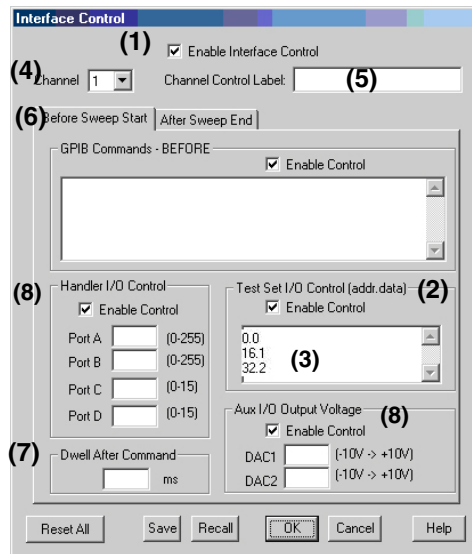


Using Interface Control Mode

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 PNA-X 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 29 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 PNA-X. 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 36](#).

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 PNA-X.

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 PNA-X screen during the channel sweep.

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

Commands (GPIO, I/O's and Dwell) can be sent Before Sweep Start and After Sweep End. However, they are configured and enabled separately on the Interface Control dialog box. For example; to send a command before and after a PNA-X 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-X. Refer to the PNA-X 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-X 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 PNA-X GPIB Command Processor feature allows you to send remote commands and data to the PNA-X rear-panel GPIB connector and Test Set I/O connector. More information regarding the GPIB Command Processor can be found in the PNA-X Help menu.

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

Overview of the GPIB Control

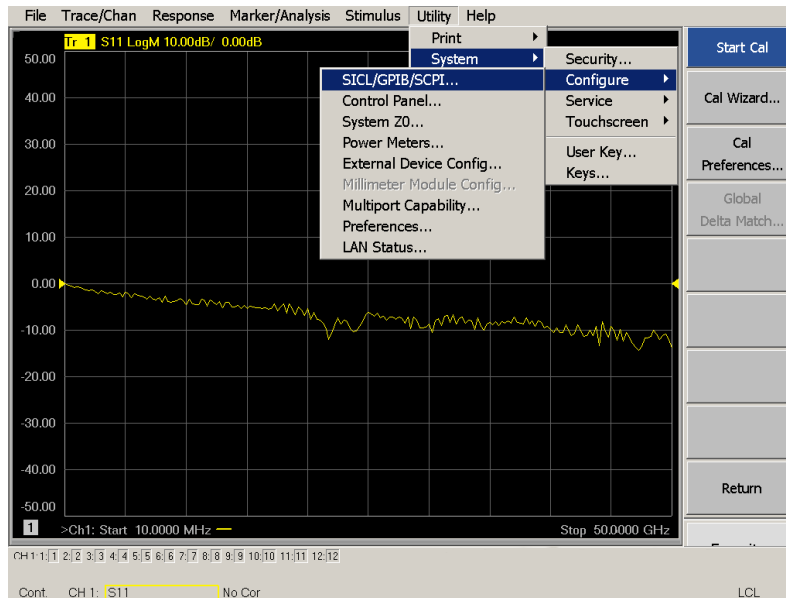
The GPIB Command Processor allows you to send address and data to control an external Test Set, without needing to create a remote program. The user is required to manually input address and data using the GPIB Command Processor Console in the PNA-X Help menu.

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

How to Access GPIB Command Processor

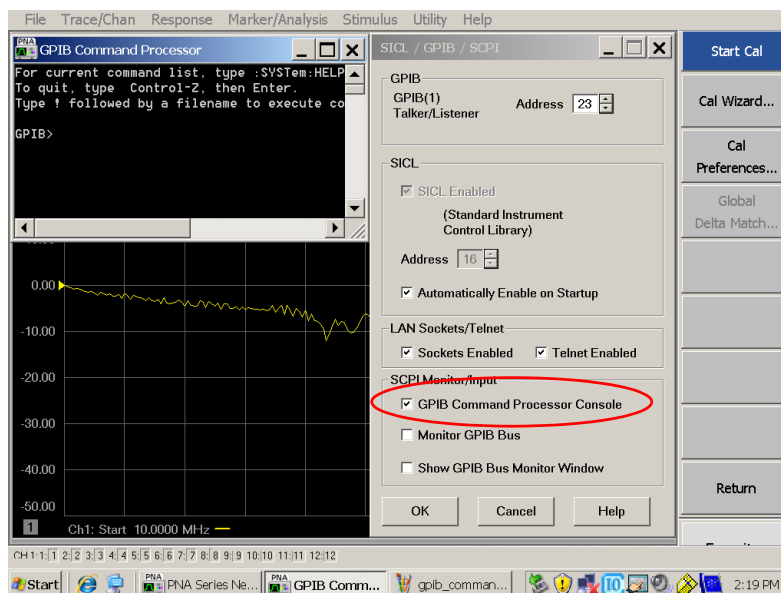
1. To access the GPIB Command Processor select **Utility > System > Configure > SICL/GPIB/SCPI**.

Figure 30 Utility Configure



2. Select **GPIB Command Processor Console > OK**.

Figure 31 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

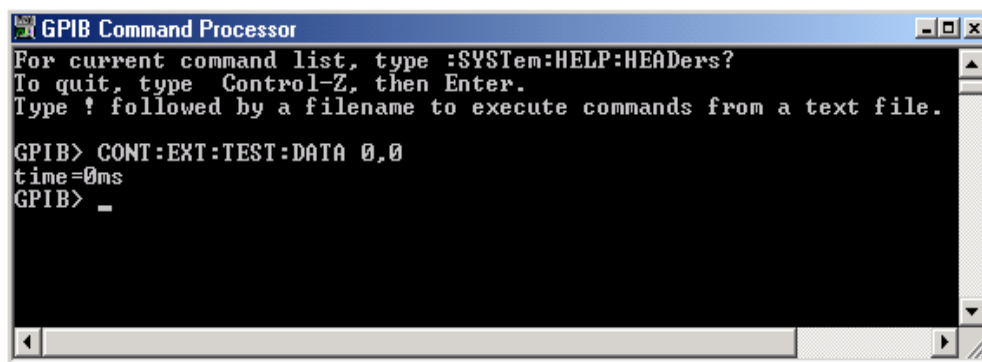
Address and data are separated by a comma. Commands should be separated by a new line, or carriage return.

For example:

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

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

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



```
GPIB Command Processor
For current command list, type :SYSTem:HELP:HEADers?
To quit, type Control-Z, then Enter.
Type ! followed by a filename to execute commands from a text file.

GPIB> CONT:EXT:TEST:DATA 0,0
time=0ms
GPIB> _
```

Refer to [“Address and Data Values”](#) on page 36.

Address and Data Values

Setting the Test Port Paths with Address and Data

Refer to [Table 7](#) and [Figure 32 on page 37](#) 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.

Example 1:

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

Port 5 is the Source and Port 6 is the Receiver.

Source Port 5 = address 0, data 1 and Receiver Port 6 = address 16, data 16.

Two separate commands must be sent, you may use the same dialog box. Send address 0 and data 1 in one command line, and address 16 and data 16 in the second line. Refer to [“Interface Control Mode” on page 29](#) and in [“GPIB Control Mode” on page 33](#).

For further information refer to [“How to Access Interface Control Mode” on page 30](#) and [“How to Access GPIB Command Processor” on page 34](#).

Example 2:

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

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

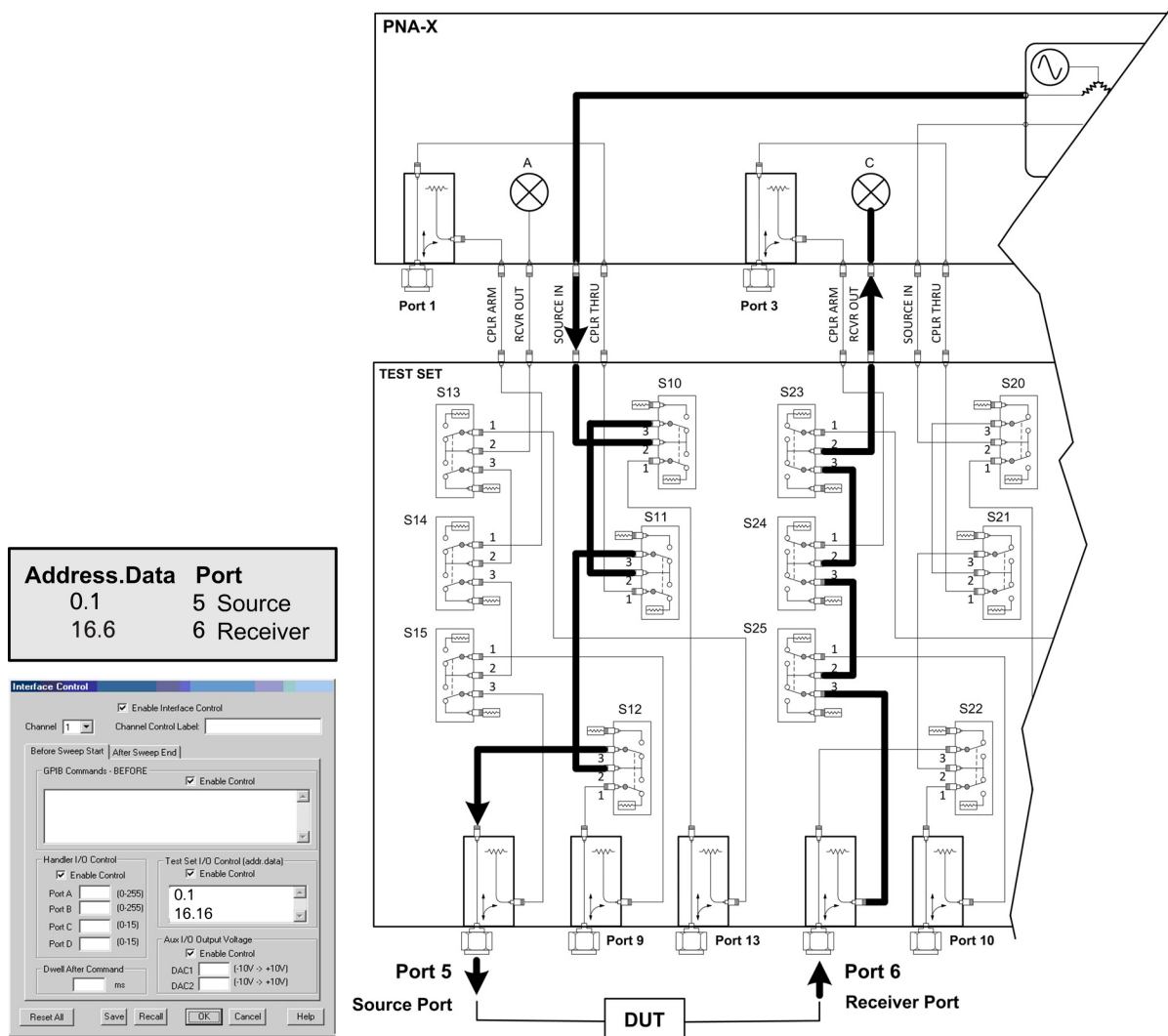
Source Port 5 = address 0, data 1 and Receiver Port 5 = address 0, data 16. The data values are added together, the entry will be 0.17. See [Table 7](#).

Table 7 Test Port Address and Data Values

| Address | Data | Source Path | | | | Receiver Path | | |
|---------|-------|-------------|---|----|----|---------------|----|----|
| | | 0 | 1 | 2 | 3 | 0 | 16 | 32 |
| 0 | Ports | 1 | 5 | 9 | 13 | 1 | 5 | 9 |
| 16 | Ports | 3 | 6 | 10 | 14 | 3 | 6 | 10 |
| 32 | Ports | 4 | 7 | 11 | 15 | 4 | 7 | 11 |
| 64 | Ports | 2 | 8 | 12 | 16 | 2 | 8 | 12 |

Refer to [Figure 44, “U3045AM12 RF Block Diagram,”](#) for in-depth RF path information.

Figure 32 Address and Data Example 1 (Port 5 and 6)



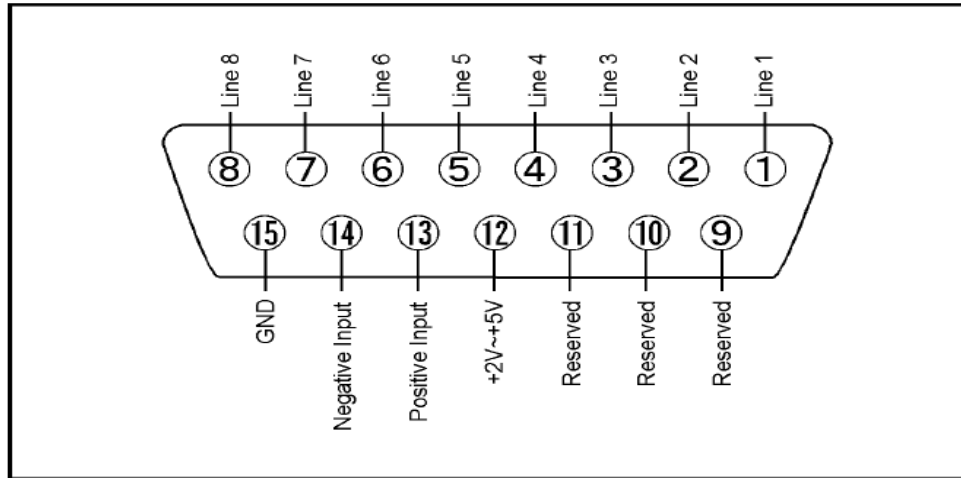
Control Lines

The 15 pin female D-Sub connector on the rear panel provides 8 latched data lines that can be used to control your device under test (DUT). The lines can be controlled with the multiport external test set control, or Test Set I/O commands. Refer to [“External Test Set Control Operation” on page 23](#) and [“Setting the Control Lines with Address and Data Values” on page 42](#). See [Table 8](#) 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 33](#) and [Table 9 on page 39](#) for control line pin location and description. Refer to [“Internal Voltage Supply Configuration” on page 40](#) and [“External Voltage Supply Configuration” on page 41](#) for configurations.

Table 8 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 33 DUT Control Line Pin Assignment (rear panel view)**Table 9 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

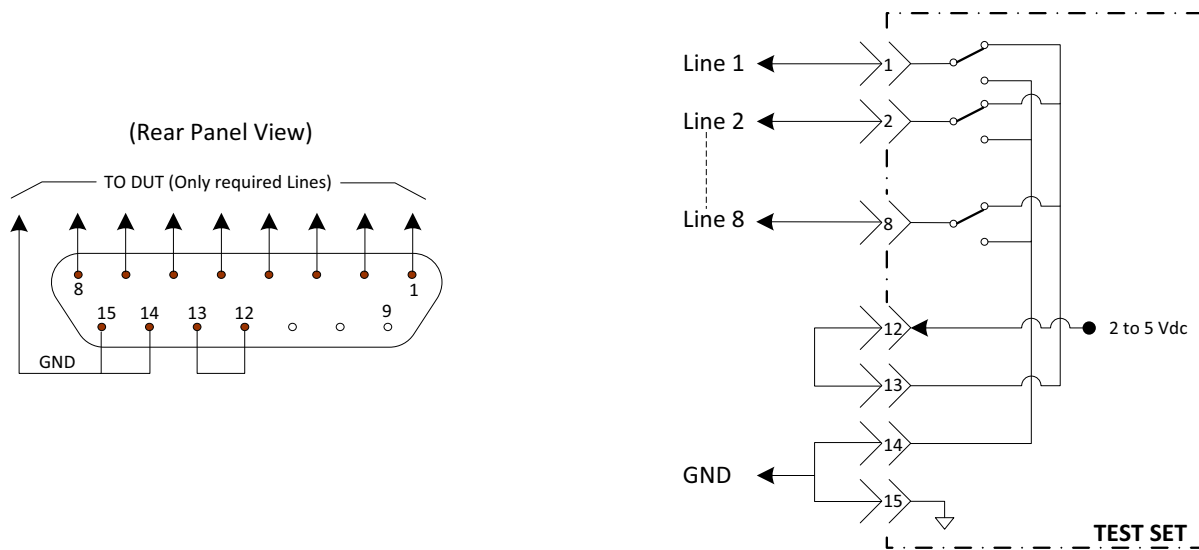
The output voltage of pin 12 can be adjusted from +2 to +5 V. Perform the following procedure to set the voltage:

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 34 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 34 Internal DC Power Configuration (rear panel view)



External Voltage Supply Configuration

Figure 35 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.

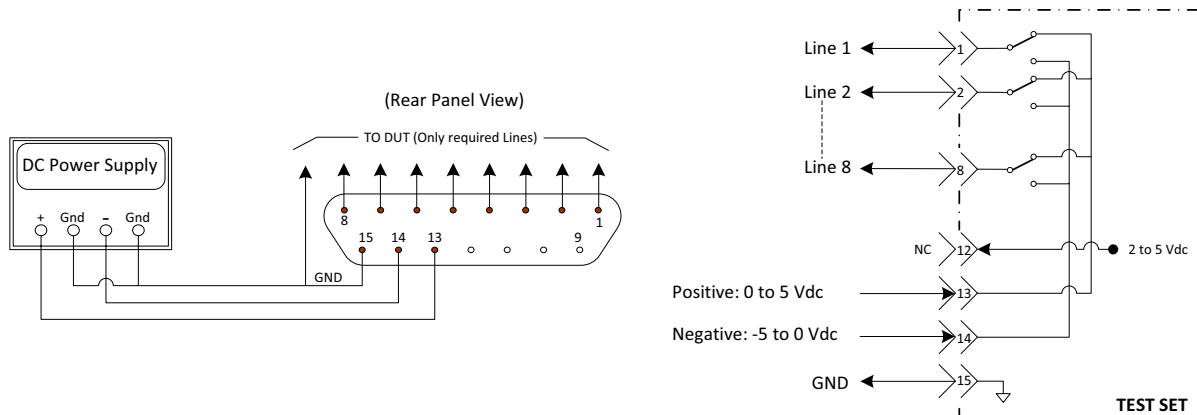
Turning On the Test Set using an External Power Supply

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 35 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 36, the <address>.<data> values are determined in a similar manor, with the following exceptions:

- [Table 10](#) will be used.
- The <address> value is always = 112

Table 10 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 34 on page 40](#). To reset all control lines to logic high, without having to reset the power switch on the Test Set, make the following PNA entry:

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

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

Listed are two examples to illustrate this concept. Refer to Figure 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 PNA 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.

Operational Cal Kit Check

The following procedure can be used to confirm the 1-Port Cal operation of an ECal module or Mechanical Cal Kit with the U3045AM12 Multiport Test Set. The operation verification limits provided ensure that your U3045AM12 and PNA-X are operating properly. Refer to [“Verifying Cal Kit Operational Check Failure” on page 50](#) to ensure the RF interface cables are installed and working correctly before returning the Test Set for repairs.

Verification Limits

Specifications for the Test Set are typical. System performance for the PNA-X 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 PNA-X performance exceed the operational verification limits.

A periodic calibration is not required. The Operators Check should be performed after System Setup, or if performance is in question. An N-Port calibration should be performed before making a measurement. Refer to [Table 4 on page 8](#).

| | |
|-------------|---|
| NOTE | If you suspect that your 16-Port configuration is not operating properly, ensure that all front RF jumper interconnect cables are correctly attached. |
|-------------|---|

Equipment Required

The Agilent U3045AM12 requires that the user be familiar with the equipment listed.

Table 11 Equipment List

| Description | Qty |
|---|-----|
| N4693A 2.4 mm ECal Module 10 MHz - 50 GHz (Option 00F or M0F) <i>or</i> 85057B Verification Kit. | 1 |
| N5244/45A Option 400 and 551 | 1 |
| Set of interconnect cables (PNA-X and Test Set), see “RF Interface Cable Connections” on page 15. | 1 |

Operational Check Procedure

The sequence of this procedure is very important and must be followed or the performance accuracy and results may vary from the reference plots provided. Ensure that the Test Set is not connected to the PNA-X if you are performing a PNA-X Operator’s Check. The PNA-X will indicate false failures if the Test Set is connected.

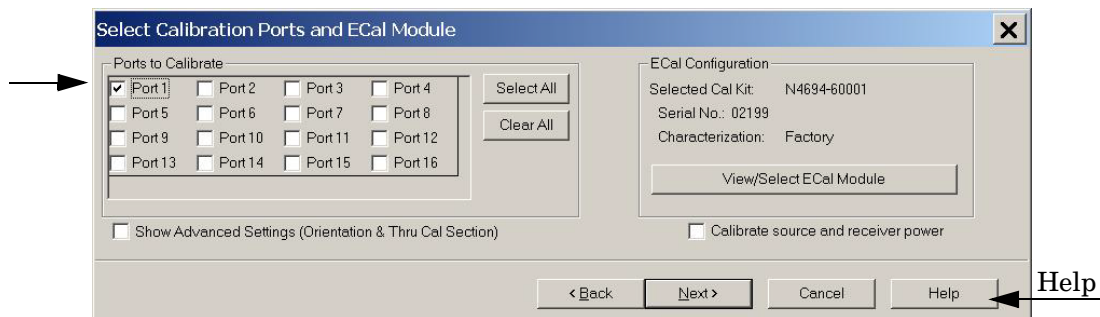
Preparing the N5244/45A

1. Connect the Test Set to the 4-Port PNA-X using the interconnect cables as shown in [Figure 10 on page 15](#) and [Table 5 on page 15](#).
2. Turn On the Test Set.
3. On the PNA-X, select **Response > Cal > Manage Cals > Cal Set**. Delete or Rename any Cal Sets titled “999.1” thru “999.16” (16-Port), although it is unlikely that you will find Cal Sets with these names.
4. Verify that the PNA-X is in 16-Port mode. See the bottom of the measurement window.
 - a. If only four S-Parameters are listed, select **Utility > System > Configure > Multiport Capability**. Select **Restart as multiport PNA with this testset** and select **U3045AM12 (16-Port)** from the drop-down menu > **OK**. Refer to [Figure 19 on page 22](#).
5. Press **Preset**.
6. Verify that the **[Start Frequency]** is set to **[10 MHz]**.
7. Verify that the **[Stop Frequency]** is set to **[50 GHz]**, or **[40 GHz]** for the N5244A.
8. Verify that the **[Power]** is to set to **[-15 dBm]**. If not, select **[Power] > Power Level** and enter **[-15 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 PNA-X USB port on the front or rear panel. Refer to [Figure 10 on page 15](#). This procedure assumes you are using a ECal. If you are not, see [“N5244/45A 1-Port Calibration and Verification Procedure” on page 46, step 2](#).
12. Allow the ECal module, Test Set and PNA-X to warm up for a minimum of 30 minutes.

N5244/45A 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, see [Figure 36](#).
2. Perform a 1-Port Calibration on Port 1. On the PNA-X, select **Response > Cal > Start Cal > Calibration Wizard**.
 - a. If using a mechanical cal kit, select **SmartCal (Guided Calibration) > Next**.
 - b. If using an ECal module, connect the ECal to a PNA-X 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**.

Figure 36 1-Port Calibration



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

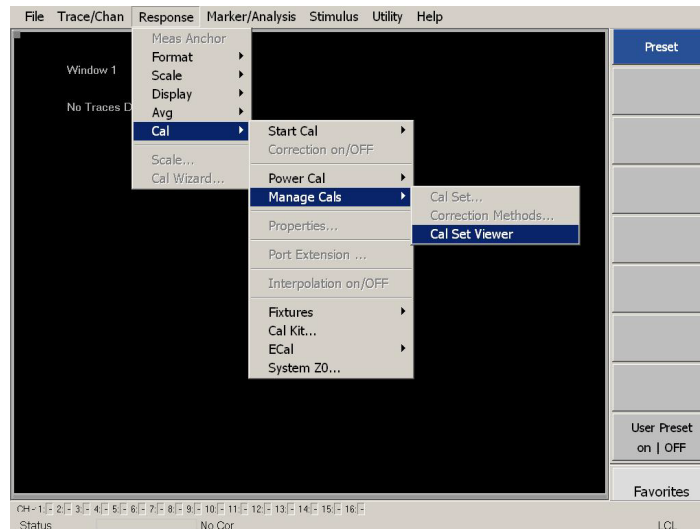
NOTE If you do not have a key board, select **Save As User Calset > Edit Name** and save as **999.x**. X is the port number you are calibrating. See [Figure 37](#). Use the numeric keypad on the PNA-X front panel to enter “999.1.”

Figure 37 Calibration Complete



6. Repeat [step 1](#) thru [step 5](#) for Ports 2 thru 16. When finished, there should be 16 Cal Sets saved with the titles “999.1” thru “999.16” (16-Port).
7. Select **Trace/Chan > Trace > Delete Trace**. There should be no traces on the PNA-X screen.
8. To launch the Cal Set Viewer toolbar. Select **Response > Cal > Manage Cals > Cal Set Viewer**.

Figure 38 Calibration, Cal Set Viewer



9. 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, term in the center drop-down menu and ensure that the **Enable** and **Error Terms** check boxes are selected.
10. Compare the Reflection Tracking (1,1) trace to the appropriate limits in [Table 4 on page 8](#). The trace should be above the limit.
11. Repeat [step 9](#) and [step 10](#) for Cal Sets “999.1” thru “999.16” (16-Port).

Figure 39 Standard Reflection Tracking Trace (Port 1-4) with PNA-X

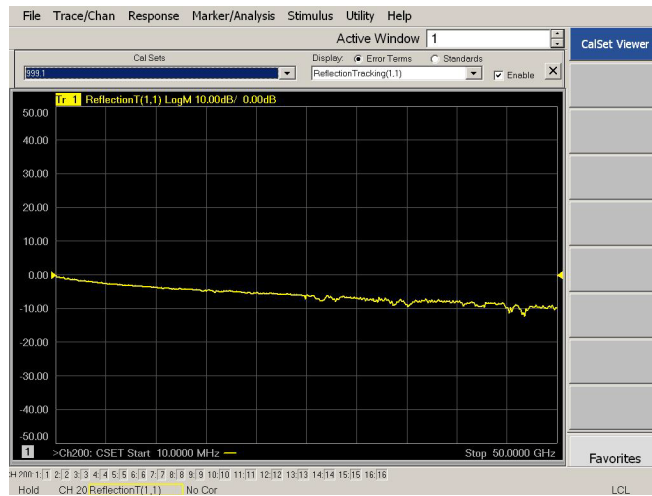


Figure 40 Standard Reflection Tracking Trace (Port 5-12) with PNA-X

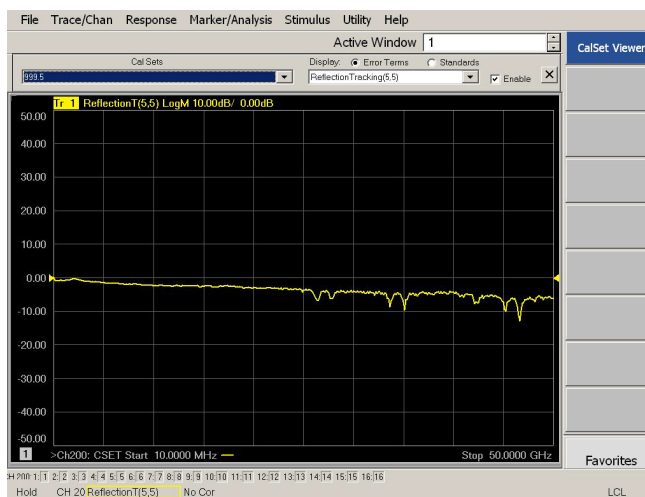
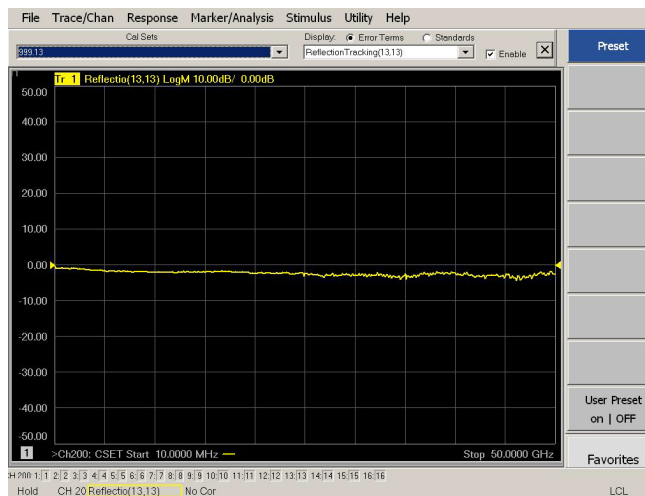


Figure 41 Standard Reflection Tracking Trace (Port 13-16) with PNA-X



If you are using an ECal module you can verify the individual port calibration.

1. Select **Response > Cal > More > ECal > ECal Confidence Check**.
2. Click **Change Measurement** and select the test port S-Parameter > **Apply > OK**.
3. Click **Read Module Data**.

For further information refer to the Help menu.

Verifying Cal Kit Operational Check Failure

If your test results fail the Cal Kit Operational Check limits, see [Table 4 on page 8](#). Verify the following verify following:

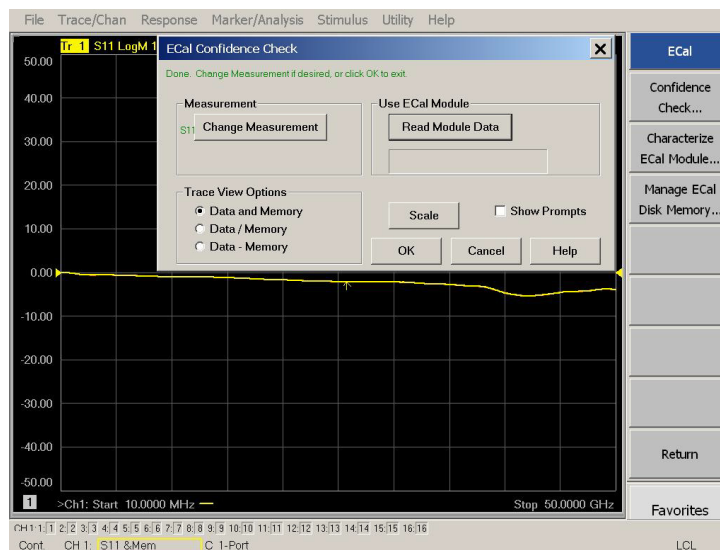
1. Ensure that the Test Set is turned on and connected properly to the PNA-X.
2. Check all appropriate PNA-X and Test Set connectors for damage, cleanliness, and proper torque.
3. Repeat the relevant 1-Port calibrations using another ECal or mechanical standard.
4. Verify that the PNA-X is operating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

ECal Confidence Check

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

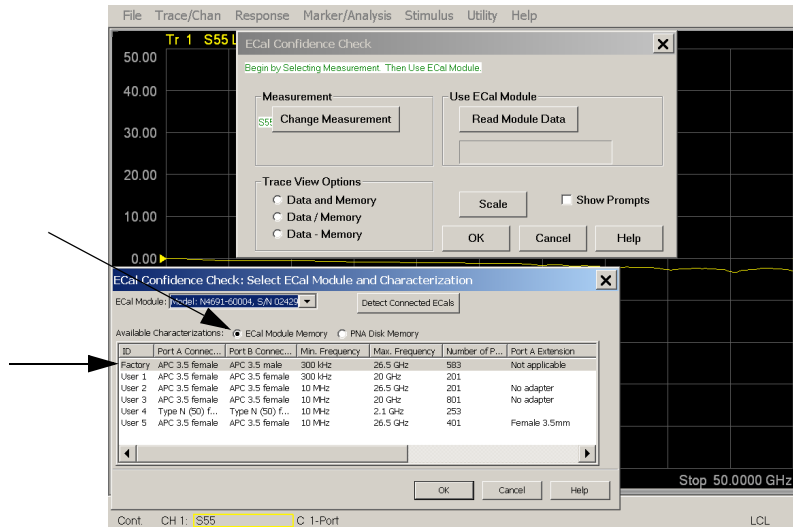
1. Perform a 1-Port calibration on the Test Set port being tested.
2. Connect the ECal Module to the port being tested. Terminate any remaining ports on the ECal Module.
3. Select the Cal Set to be tested. Select **[CAL] > Cal Set > Cal_File > Apply Cal > Close**. If the Choose Stimulus Settings prompt appears, Select **Change the active channel's stimulus.. > OK > Close**.
4. Select **[Response] > Cal > More > ECal > ECal Confidence Check**.

Figure 42 ECal Confidence Check



5. ECal Confidence Check dialog box: Click **Change Measurement** and select the test port S-parameter > **Apply** > **OK**. Click **Read Module Data**.
6. Select ECal Module dialog box: Select the ECal Module you are using, and select the **ECal Module Memory and Factor ID** > **OK**.

Figure 43 ECal Confidence Check Trace



Service Information

This section provides information to troubleshoot and repair the U3045AM12 test set. Refer to “[Agilent Support, Services, and Assistance](#)” on page 78 for information on returning your test set to Agilent Technologies.

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 12 Available Replacement Parts (SPO)

| Description | Agilent Part Number |
|--|---------------------|
| Switch, Multiport (50 GHz terminated) | N1811-60023 |
| Fuse (5 A 250 V non-time delay Socket) | 2110-0709 |
| Fuse (8 A 250 V non-time delay 0.0146 Ohm) | 2110-0342 |
| PWR Supply (AC/DC SWG 650W 9- Output) | 0950-4729 |
| Couplers | 5087-7724 |
| PNA-X Locking Feet | 5023-0132 |
| Test Set I/O Cable | 8120-6818 |
| Fan (rear panel) | 87050-60027 |
| DUT Control Board | E5091-66503 |

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 13 Replaceable Parts (M12)

| Description | Agilent Part Number |
|---|---------------------|
| RF Cable, Semi-rigid | U3047-20016 |
| RF Cable, Semi-rigid | U3047-20017 |
| SW Interface Board, programmed | U3025-60062 |
| U3045AM12 User's and Service Guide | U3045-90002 |
| Dress Nut (couplers) | N5230-20081 |
| PNA-X Test Set Rear Lock Feet (right) | N5242-20138 |
| PNA-X Test Set Rear Lock Feet (left) | N5242-20139 |
| Front Panel LED Board (programmed) | N5261-60005 |
| Test Set Control Board (programmed) | N5261-60006 |
| 2.4 mm Short (female) | 85056-60021 |
| Screw-Pan Head Machine with thread patch, Torx-T15 M3.5 with 0.6 thread, 12 mm-LG | 0515-2317 |
| U3045A-M12 User's and Service Guide | U3045-90002 |

System Block Diagram

Figure 44 U3045AM12 RF Block Diagram

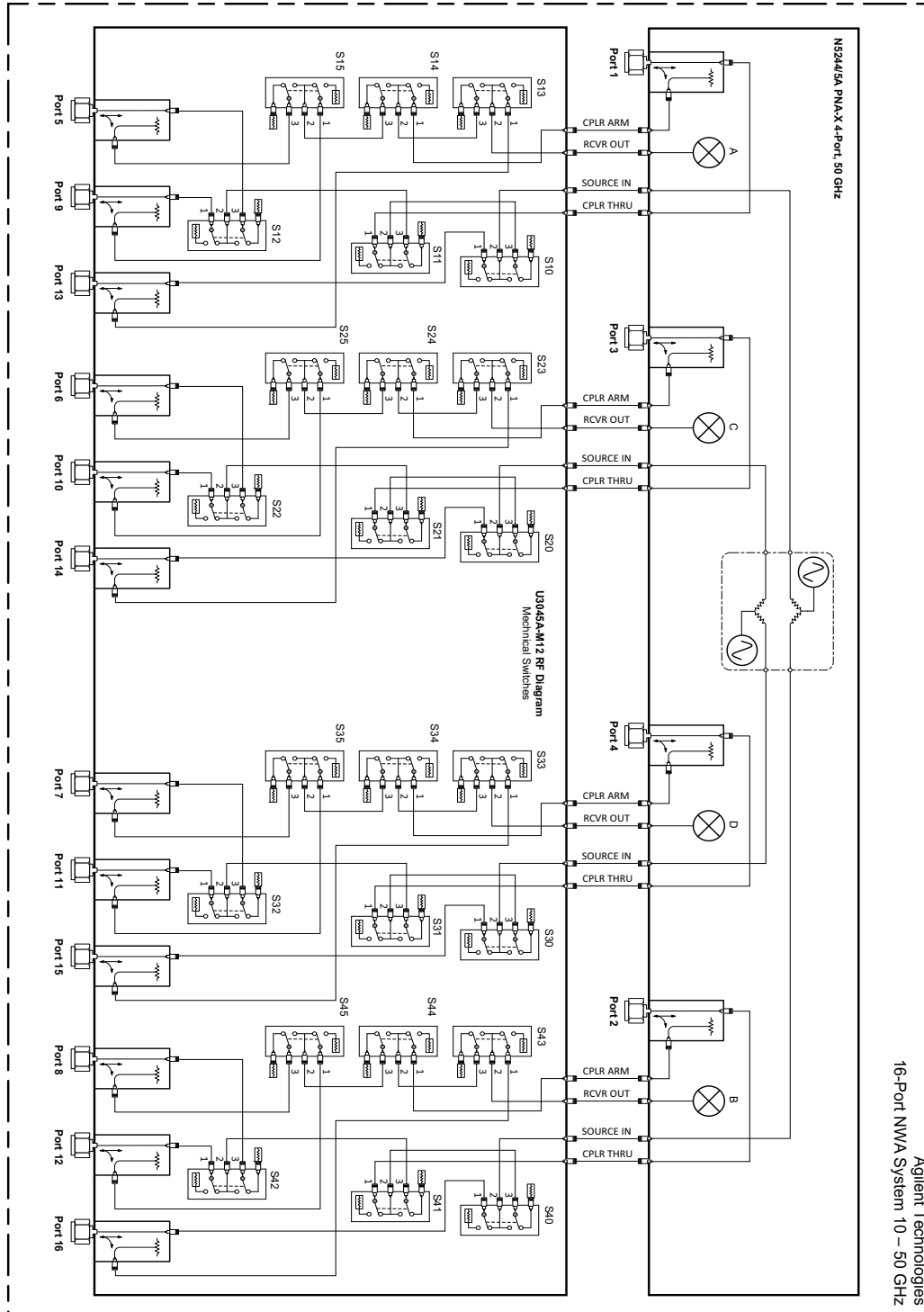
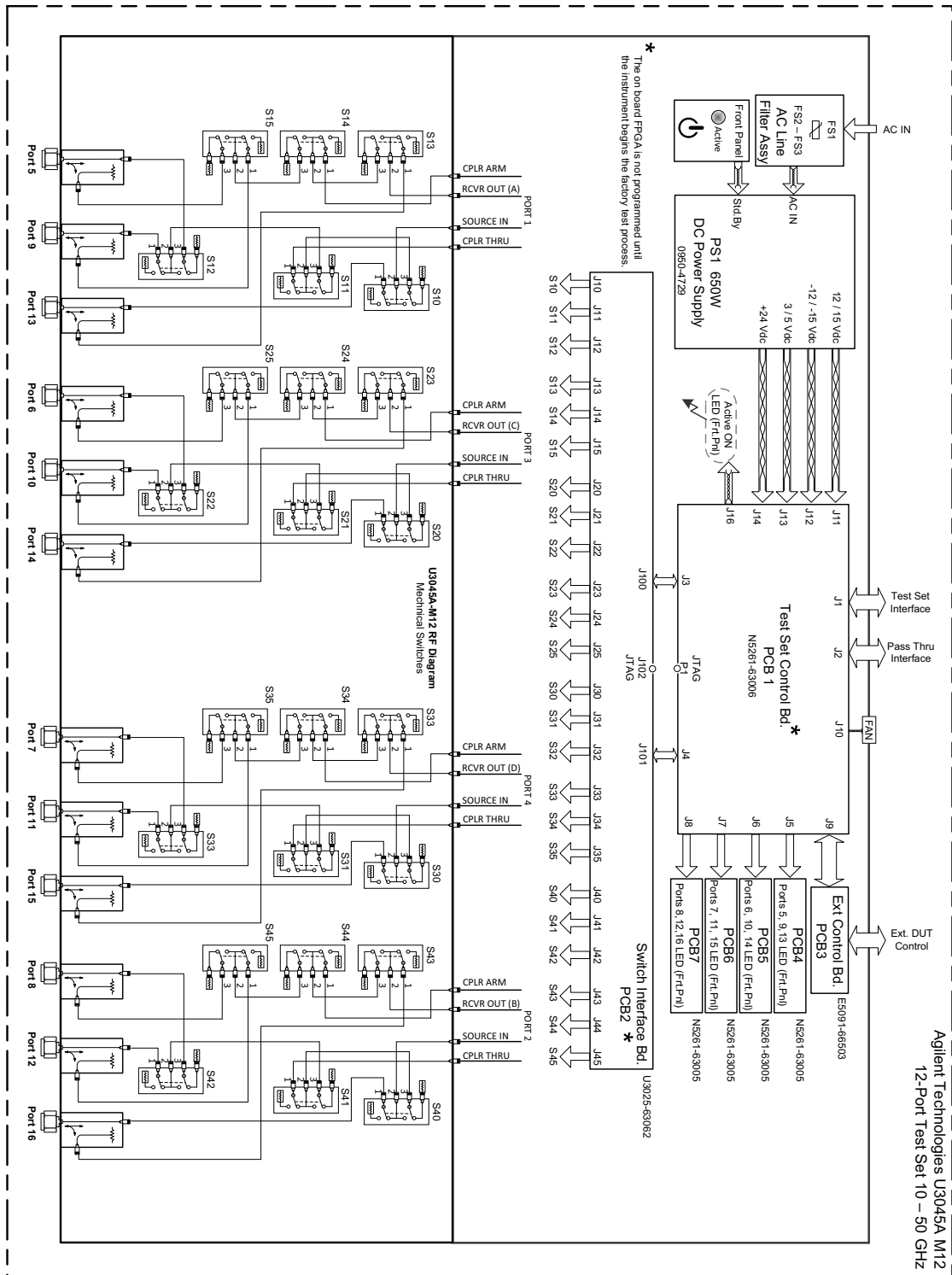


Figure 45 Electrical Block Diagram



Theory of Operation

The following is a description of the operation of the Test Set. Reference the Test Set block diagrams shown in [Figure 44 on page 54](#). This section assumes the user has a general understanding of couplers, switches, and network analyzers.

The Test Set adds 12 test ports to a 4-Port N5244/45A PNA-X Network Analyzer. The internal RF switches direct the source and receiver signals of the PNA-X to the selected measurement test port.

The switches and couplers are arranged in four groups to control the source and receiver paths of the PNA port to the couplers in the column under the PNA port.

Test Set Control Board

The Test Set Control Board (N5261-60006) is a surface mount, printed circuit assembly (PCA). It provides a connection to the power supply, and the PNA Test Set I/O for control of the RF switch paths (through the Switch Interface board (U3025-60062). The front panel “Active” and port LEDs are on only when the PNA has addressed the U3045AM12 test set. The rear panel fan is on when the controller board supplies are operational.

Switch Interface Board

The Switch Interface board (U3025-60062) is installed on top of the Test Set Controller Board and provides connections to the RF switches. This board regulates the DC voltage supply (24 volts), and routes logic signals to the switches through harness cables connected to ports J10-15, J20-25, J30-35 and J40-45.

Front Panel LED Boards

Four LED board assemblies (N5261-60005) are mounted to the front panel. The LED's indicate the Source Path (amber/yellow color), or Receiver Path (green colored) shown as “S” and “R” on the front panel. The LED board assemblies are connected to the test set controller board by ribbon cables to J5, J6, J7 and J8.

DUT Control Board

The DUT Control Board (E5091-66503) provides eight control lines for controlling an external device. The DUT Control Board installed on the rear panel and is connected to the Test Set Control Board through a ribbon cable to J9.

Power Supply

The switching power supply (0950-4729) converts the AC line voltages to DC. This is an automatic line voltage selecting power supply. The DC supplies are connected to the test set control board through four wire harness to J11, J12, J13 and J14. The 9/10 Vdc section of the power supply is not used in this instrument. The AC line voltage (100 to 240 V @ 50/60 Hz) is provided from the line module on the rear panel.

RF Coupler

The Test Set uses 12 couplers (5087-7724) on the front panel for RF Test Ports 5-16. The couplers provide the signal separation of the source and receiver paths. The Test Set ports can receive from or stimulate a signal to the DUT.

The RF Test Port connectors are male 2.4 mm. The coupling factor is approximately -18 dB for the Coupled Arm for frequencies > 1 GHz to 50 GHz (approximately -53 dB < 1 GHz). The insertion loss through the CPLR THRU path is typically < 4 dB at 50 GHz.

RF Switch Components

The Test Set uses 24 mechanical switches that have internal $50\ \Omega$ termination and an external $50\ \Omega$ termination (00901-60003). The switches select the RF paths from the PNA-X source and receiver through interconnect cables to the Test Set.

Source and Receiver Switch Paths

SW10 to 12 - Source to Ports (1, 5, 9 and 13) Switch 10 to 12 provide control of the Source Output path to PNA-X Port 1 and Test Set Ports 5, 9 and 13. In the state shown in the block diagram, switch 10 and 11 route the RF Source back to the PNA-X Port 1, and the Test Set Source path to Port 5, 9 and 13 are terminated.

SW20 to 22 - Source to Ports (3, 6, 10 and 14) Switch 20 to 22 provide control of the Source Output path to PNA-X Port 3 and Test Set Port 6, 10 and 14. In the state shown in the block diagram, switch 20 and 21 route the RF Source back to the PNA-X Port 3, and the Test Set Source path to Ports 10 and 14 are terminated.

SW30 to 32 - Source to Ports (4, 7, 11 and 15) Switch 30 to 32 provide control of the Source Output path to PNA-X Port 4 and Test Set Port 7, 11 and 15. In the state shown in the block diagram, switch 30 and 31 route the RF Source back to the PNA-X Port 4, and the Test Set Source path to Ports 11 and 15 are terminated.

SW40 to 42 - Source to Ports (2, 8, 12 and 16) Switch 40 to 42 provide control of the Source Output path to PNA-X Port 2 and Test Set Port 8, 12 and 16. In the state shown in the block diagram, switch 40 and 41 route the RF Source back to the PNA-X Port 2, and the Test Set Source path to Ports 8, 12 and 16 are terminated.

SW13 to 15 - Receiver to Ports (1, 5, 9 and 13) Switch 13 to 15 provide control of the Receiver Input path to PNA-X Port 1 and Test Set Port 5, 9 and 13. In the state shown in the block diagram, switch 13 and 14 route the Port 1 Coupler Arm to the Receiver, and Test Set Ports 5, 9 and 13 Coupler Arm paths are terminated.

SW23 to 25 - Receiver to Ports (3, 6, 10 and 14) Switch 23 to 25 provide control of the Receiver Input path to PNA-X Port 3 and Test Set Ports 6, 10 and 14. In the state shown in the block diagram, switch 23 and 24 route the Port 3 Coupler Arm to the Receiver, and Test Set Ports 6, 10 and 14 Coupler Arm paths are terminated.

SW33 to 35 - Receiver to Ports (4, 7, 11 and 15) Switch 33 to 35 provide control of the Receiver Input path to PNA-X Port 4 and Test Set Ports 7, 11 and 15. In the state shown in the block diagram, switch 33 and 34 route the Port 4 Coupler Arm to the Receiver, and Test Set Ports 7, 11 and 15 Coupler Arm paths are terminated.

SW43 to 45 - Receiver to Ports (2, 8, 12 and 16) Switch 43 to 45 provide control of the Receiver Input path to PNA-X Port 2 and Test Set Port 8, 12 and 16. In the state shown in the block diagram, switch 43 and 44 route the Port 2 Coupler Arm to the Receiver, and Test Set Ports 8, 12 and 16 Coupler Arm paths are terminated.

Troubleshooting the Test Set

If the U3045AM12 is not operating properly, use the following procedures to isolate and repair the type of failure encountered. It is recommended that a qualified service technician perform the following procedures.

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

Typical malfunctions may be the rear panel fan, control lines or front panel indicator lights.

1. Verify that the front panel Power Switch is operational.
 - a. The rear panel fan and front panel Active LED should operate when the Standby Switch is in the On position.
2. 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. Confirm the instrument AC line module fuse is operational. See [Figure 4 on page 11](#).
 - c. Internal AC line fuses - Remove the bottom cover of the instrument. Near the rear panel are two fuse holders, remove the fuses and verify that they are operational. Refer to [Figure 56 on page 71](#).

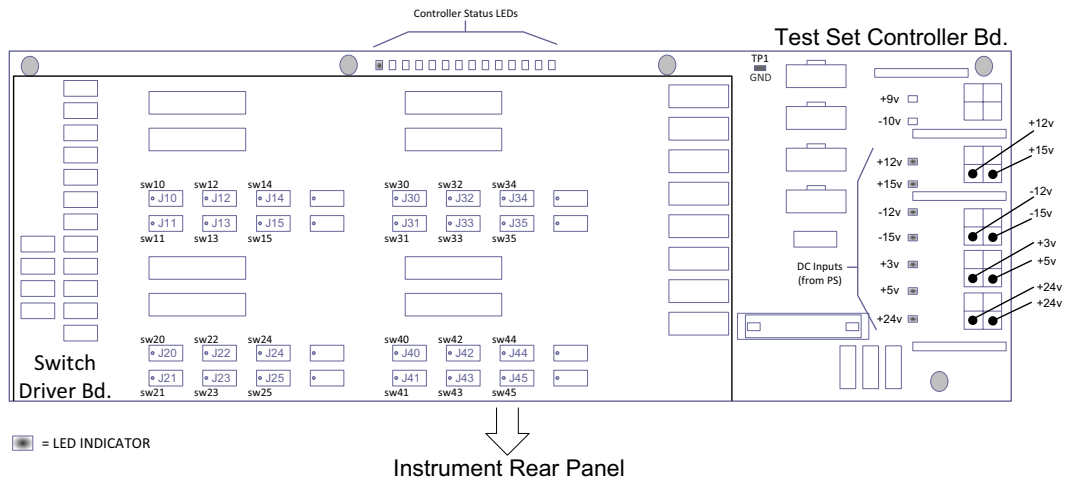
WARNING **The opening of covers or removal of parts is likely to expose the user to dangerous voltages. Disconnect the instrument from all voltage sources before being opened.**

3. Internal DC Power - During this check you will apply AC power to the instrument with the top cover removed. Connect the AC power cord to the Test Set.
 - a. Set the front panel switch to the Standby position. The fans and indicator lights should be Off.
 - b. Set the standby switch to the On position. The rear panel and internal power supply fans should be operational. The Active LED will be On when Test Set is connected to an active PNA-X and is addressed by the PNA-X
 - c. Verify that the DC LEDs indicators are On.
Note: The LEDs only indicate the presence of a DC voltage, not the DC voltage level. Use the indicated wire locations for voltage measurements, TP1 is your common. Refer to [Figure 46 on page 59](#).

- d. If there is no DC power, suspect the power supply module. The actual power supply terminal connection should also be confirmed with a DVM by removing the bottom cover and using the power supply label to identify the terminal voltage values.
- e. If all of the DC Input LEDs are On and the fan is not working, replace fan.

NOTE The +9 and -10 Vdc indicators are not used in this instrument (Off is normal).

Figure 46 DC Power Status LEDs

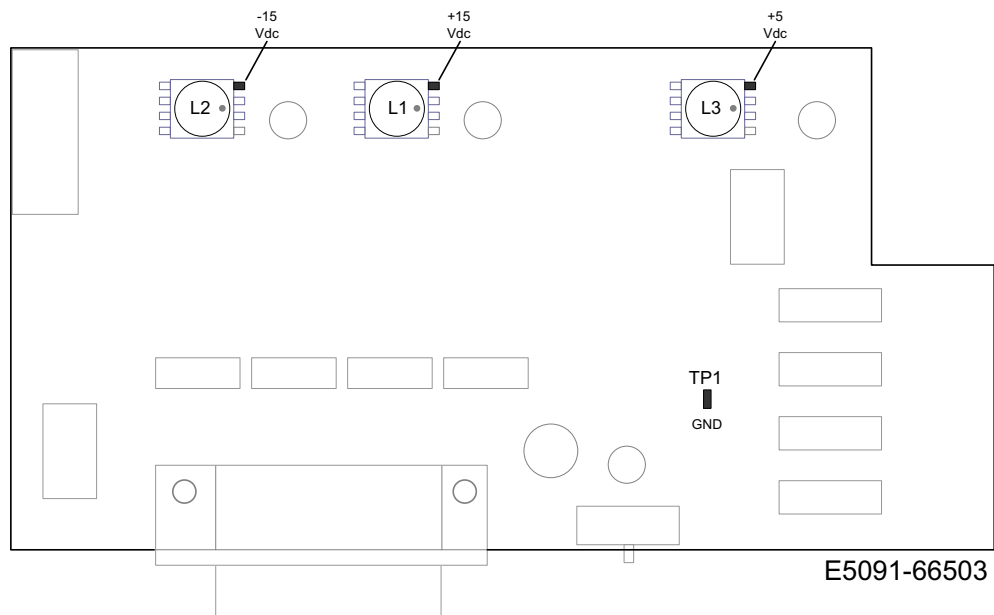


4. Front panel R and S indicator LED check.

- a. If the indicators are not operating, continue to [“RF Switching Failures”](#), [step 1](#) and [step 2](#).

5. 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 38.
 - b. Verify that the rear panel DC voltage control adjustment can be set to 5 Vdc. Refer to Figure 3 on page 10.
 - 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 47.
 - 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 47 DUT Control Board DC Voltage Locations

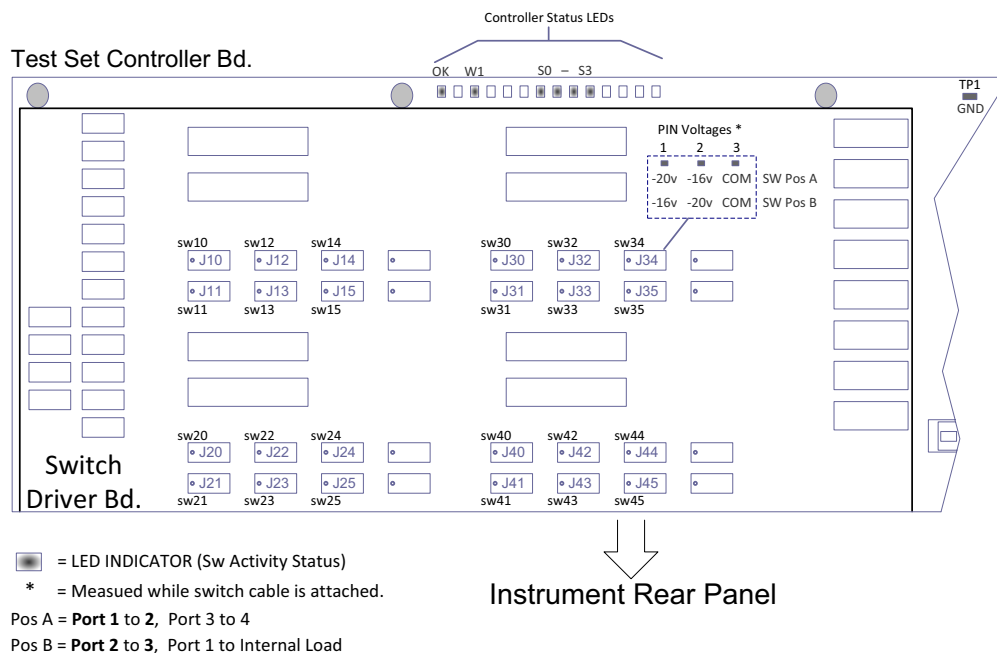


RF Switching Failures

Typical failures may be the loss of RF switch control failure or a non RF failure as outlined in the prior section. The internal RF switches used in this instrument are controlled by the +21 Vdc from the Switch Driver board.

1. Confirm that the PNA and Test Set are properly connected using the Test Set I/O cable (8120-6818). See [Figure 11 on page 16](#).
2. Using Multiport Mode (Option 551), verify that the PNA-X firmware is correct, and that the Test Set file is loaded into the PNA-X. Refer to [“Network Analyzer Requirements” on page 3](#).
3. Using the I/O command values, confirm that the correct address and data values are used. Refer to [“Address and Data Values” on page 36](#).
4. Follow the [“Non-RF Failures” on page 58](#) procedure (if not already done so).
5. Front Panel R and S indicator LED Check.
 - a. Confirm that the Test Set Controller Board Status LED's are On. Refer to [Figure 46 on page 59](#). If the LED's are Off remove the Switch Driver board, if the LED's are remain Off replace the Controller board.
 - b. If the Status LED's are On and the front panel Active LED is On, suspect the front panel LED board or the ribbon cable (replace as needed).
6. Confirm the DC +21 Vdc switch drive voltages on the Switch Driver Bd by connecting a voltmeter to one of the Jxx locations as shown in [Figure 47 on page 60](#). Do not disconnect the RF Switch connector, this will keep the switch in place as a load for the following voltage measurement.

Figure 48 Switch Drive Voltage Check



Test Set and RF Switching Path

If you suspect an RF signal path problem with the Test Set and have verified that the problem is not the front panel RF interface cables, the following procedure will check all of the RF signal paths through the Test Set. Path checks 1 thru 4 are from the front panel Test Port to the PNA source and receiver interconnect ports. Path checks 5 and 6 are Test Set bypass signal paths for of PNA ports 1 to 4.

- Install the Test Set interface cable from the PNA-X to the Test Set rear panel.
- Remove the front panel RF interface cables and reinstall the PNA-X front panel jumper cables.

Equipment Required

- N5244/45A PNA-X
- Two 50 GHz, 2.4 mm RF Flex Cables
- 2.4 mm Adapters (female to female)
- Test Set Interface Cable

Equipment Setup

1. Turn on the Test Set and the PNA-X.
2. **Preset** the PNA-X and set it to **Standalone Mode**. Select **Utility > System > Configure > Multipoint Capability**. In the dialog box select **Restart as a standalone PNA > OK**.
3. Confirm the frequency range is set to 10 MHz to 50 GHz.
4. Connect the RF flexible cables to PNA Ports 1 and 2. Connect the cables together using a 2.4 mm adapter.
5. Configure the PNA-X to measure S21 and normalize the response trace.
6. Set the PNA-X to **Interface Control Mode**: Select **Channel > Hardware Setup > More > Interface Control...** and click **Enable Interface Control box**.

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

Cable Connections

The RF flex cables will be connect to the designated Test Set front panel ports and an uncorrected response trace should be displayed that resembles the figures indicated in [Table 14](#).

Table 14 RF Signal Path Insertion Loss (S21) Summery

| RF Path Description | Signal | Insertion Loss (typical) |
|--------------------------|----------|--------------------------------------|
| Source IN to Ports 5-12 | Source | Figure 49 on page 64 |
| Source IN to Ports 13-16 | Source | Figure 50 on page 64 |
| RCVR OUT to Ports 5-12 | Receiver | Figure 51 on page 66 |
| RCVR OUT to Ports 13-16 | Receiver | Figure 52 on page 66 |
| Source IN to CPLR THRU | Source | Figure 53 on page 67 |
| RCVR OUT to CPLR ARM | Receiver | Figure 54 on page 68 |

Source Signal Path Insertion Loss Test

Connect the RF Flex cables to the Test Port and Source IN port indicated in [Table 15](#), the expected results should be similar to [Figure 49](#) and [Figure 50 on page 64](#).

Table 15 Source Signal Path Test Instructions

| Path # | RF Path Description | Control Mode <Address>.<Data> | Path Components | Insertion Loss (typical) |
|--------|-----------------------------------|-------------------------------|-----------------------|--------------------------------------|
| 1 | Source IN to Ports 5 ¹ | 0.1 | P5 CPLR, S10, 11, 12 | Figure 49 on page 64 |
| 2 | Source IN to Ports 9 | 0.2 | P9 CPLR, S10, 11, 12 | |
| 3 | Source IN to Ports 13 | 0.3 | P13 CPLR, S10 | Figure 50 on page 64 |
| 4 | Source IN to Ports 6 | 16.1 | P6 CPLR, S20, 21, 22 | Figure 49 on page 64 |
| 5 | Source IN to Ports 10 | 16.2 | P10 CPLR, S20, 21, 22 | |
| 6 | Source IN to Ports 14 | 16.3 | P14 CPLR, S20 | Figure 50 on page 64 |
| 7 | Source IN to Ports 7 | 32.1 | P7 CPLR, S30, 31, 32 | Figure 49 on page 64 |
| 8 | Source IN to Ports 11 | 32.2 | P11 CPLR, S30, 31, 32 | |
| 9 | Source IN to Ports 15 | 32.3 | P15 CPLR, S30 | Figure 50 on page 64 |
| 10 | Source IN to Ports 8 | 64.1 | P8 CPLR, S40, 41, 42 | Figure 49 on page 64 |
| 11 | Source IN to Ports 12 | 64.2 | P12 CPLR, S40, 41, 42 | |
| 12 | Source IN to Ports 16 | 64.3 | P16 CPLR, S40 | Figure 50 on page 64 |

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

Figure 49 Source IN to Ports 5-12 Path Response

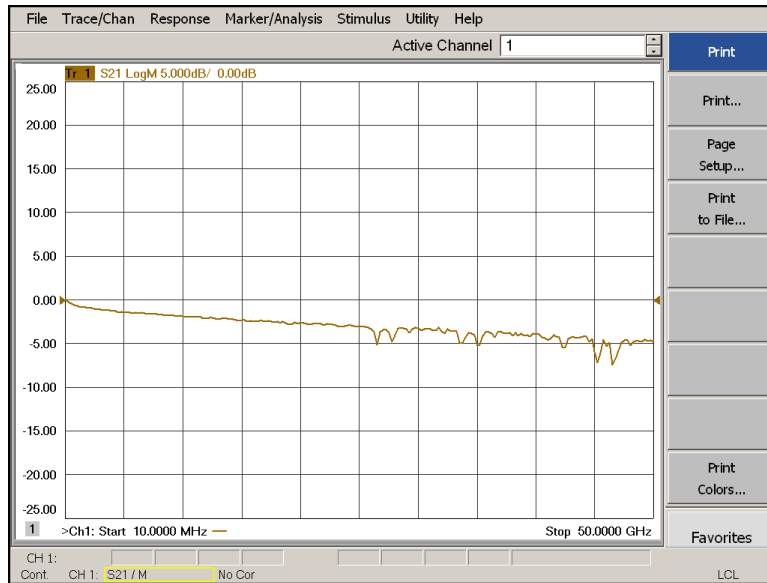
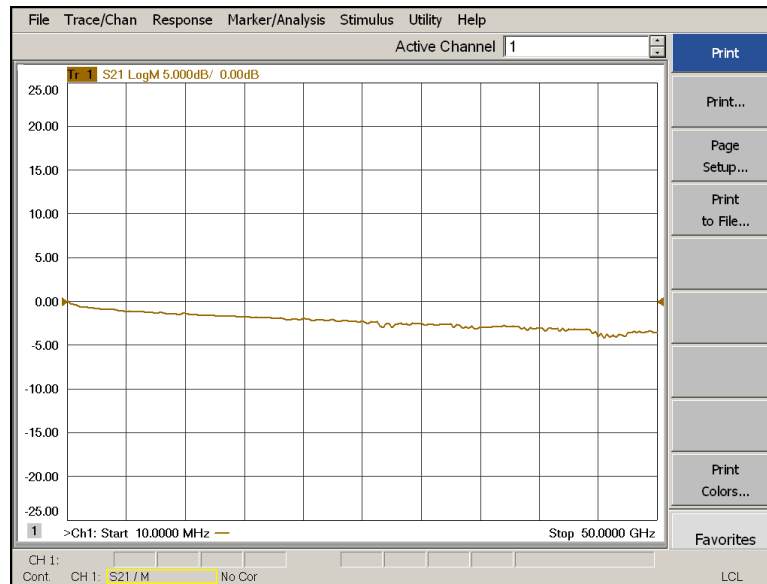


Figure 50 Source IN to Ports 13-16 Path Response



Connect the RF Flex cables to the Test Port and RCVR OUT port indicated in [Table 16](#), the expected results should be similar to [Figure 51](#) and [Figure 52](#) on page 66.

Table 16 Receiver Signal Path Test Instructions

| Path # | RF Path Description | Control Mode <Address>.<Data> | Path Components | Insertion Loss (typical) |
|--------|----------------------------------|----------------------------------|-----------------------|--------------------------------------|
| 1 | RCVR OUT to Ports 5 ¹ | 0.16 | P5 CPLR, S13, 14, 15 | Figure 51 on page 66 |
| 2 | RCVR OUT to Ports 9 | 0.32 | P9 CPLR, S13, 14, 15 | |
| 3 | RCVR OUT to Ports 13 | 0.48 | P13 CPLR, S13 | Figure 52 on page 66 |
| 4 | RCVR OUT to Ports 6 | 16.16 | P6 CPLR, S23, 24, 25 | Figure 51 on page 66 |
| 5 | RCVR OUT to Ports 10 | 16.32 | P10 CPLR, S23, 24, 25 | |
| 6 | RCVR OUT to Ports 14 | 16.48 | P14 CPLR, S23 | Figure 52 on page 66 |
| 7 | RCVR OUT to Ports 7 | 32.16 | P7 CPLR, S33, 34, 35 | Figure 51 on page 66 |
| 8 | RCVR OUT to Ports 11 | 32.32 | P11 CPLR, S33, 34, 35 | |
| 9 | RCVR OUT to Ports 15 | 32.48 | P15 CPLR, S33 | Figure 52 on page 66 |
| 10 | RCVR OUT to Ports 8 | 64.16 | P8 CPLR, S43, 44, 45 | Figure 51 on page 66 |
| 11 | RCVR OUT to Ports 12 | 64.32 | P12 CPLR, S43, 44, 45 | |
| 12 | RCVR OUT to Ports 16 | 64.48 | P16 CPLR, S43 | Figure 52 on page 66 |

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

Figure 51 RCVR OUT to Ports 5-12 Path Response

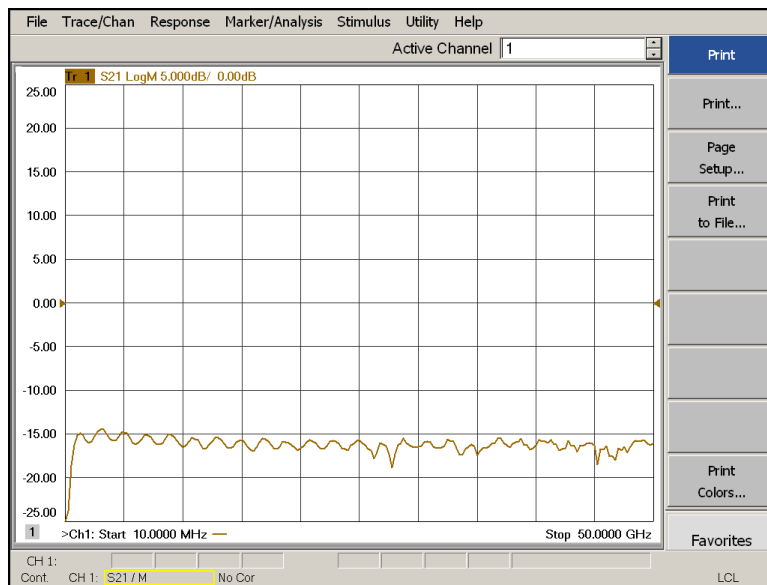
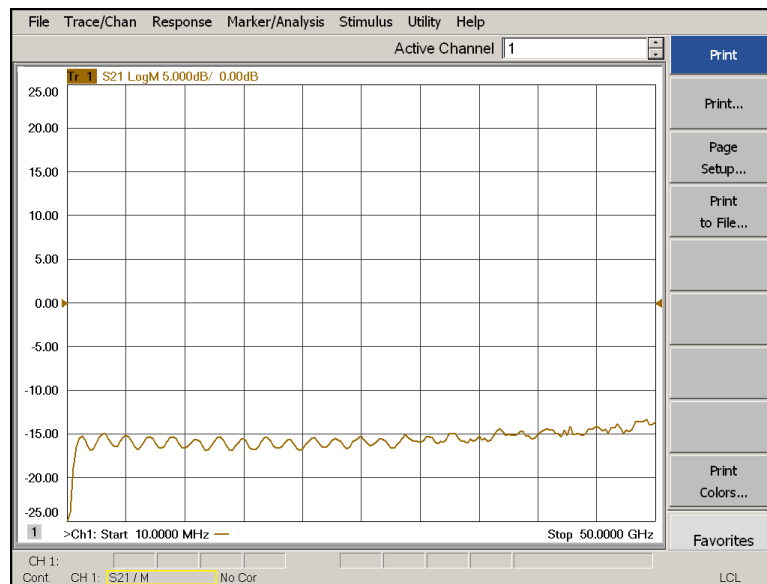


Figure 52 RCVR OUT to Ports 13-16 Path Response

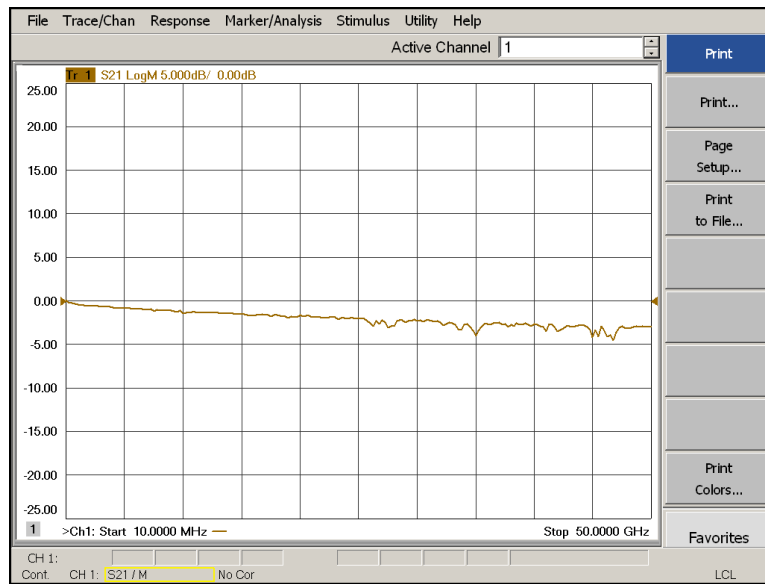


Connect the RF Flex cables to the Source IN and CPLR THRU port indicated in [Table 17](#), the expected results should be similar to [Figure 53](#).

Table 17 Source Signal Path Test Instructions

| Path # | Test Port Group | RF Path Description | Control Mode <Address>.<Data> | Path Components |
|--------|-----------------|------------------------|-------------------------------|-----------------|
| 1 | Port 5, 9, 13 | Source IN to CPLR THRU | 0.0 | S10, 11 |
| 2 | Port 6, 10, 14 | Source IN to CPLR THRU | 16.0 | S20, 21 |
| 3 | Port 7, 11, 15 | Source IN to CPLR THRU | 32.0 | S30, 31 |
| 4 | Port 8, 12, 16 | Source IN to CPLR THRU | 64.0 | S40, 41 |

Figure 53 Source IN to CPLR THRU Path Response

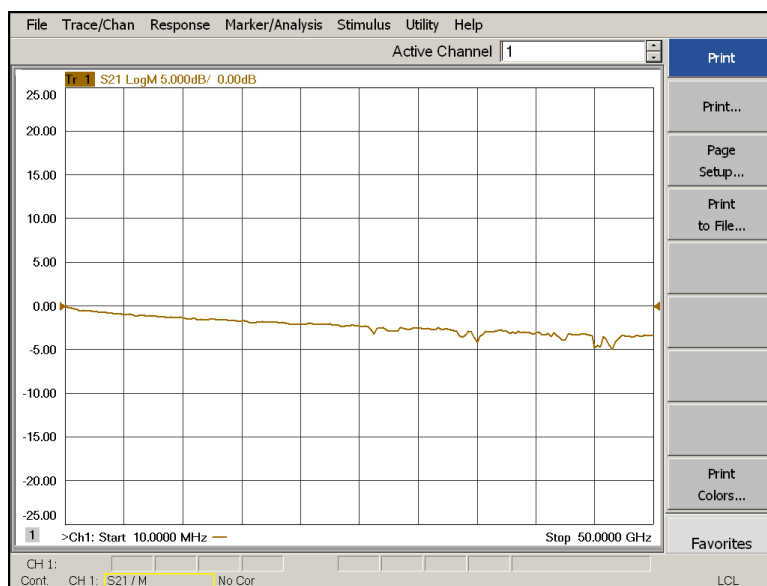


Connect the RF Flex cables to the Source IN and CPLR ARM port indicated in [Table 18](#), the expected results should be similar to [Figure 54](#).

Table 18 Receiver Bypass Signal Path Test Instructions

| Path # | Test Port Group | RF Path Description | Control Mode <Address>.<Data> | Path Components |
|--------|-----------------|----------------------|-------------------------------|-----------------|
| 1 | Port 5, 9, 13 | RCVR OUT to CPLR ARM | 0.0 | S13, 14 |
| 2 | Port 6, 10, 14 | RCVR OUT to CPLR ARM | 16.0 | S23, 24 |
| 3 | Port 7, 11, 15 | RCVR OUT to CPLR ARM | 32.0 | S33, 34 |
| 4 | Port 8, 12, 16 | RCVR OUT to CPLR ARM | 64.0 | S43, 44 |

Figure 54 RCVR OUT to CPLR ARM Path Response



RF Performance Fails

If the U3045AM12 operates correctly, but RF performance fails the operational test. The following procedures can be used to isolate the failed component. Suspect the coax switches (N1811-60023), RF cables, or coupler (5087-7724).

NOTE The RF performance of the U3045AM12 depends on the performance of the PNA. Ensure the PNA is meeting specification before continuing.

1. Verify that the test set and PNA SOURCE, RCVR, CPLR THRU, and CPLR ARM connectors are clean and that the center pins are not damaged.
2. Verify the interface and internal RF cables are cleaned and not damaged. [“Verifying Cal Kit Operational Check Failure” on page 50.](#)
3. Review the [“Operational Cal Kit Check” on page 44](#) and verify the results for the port that is failing.
4. Reflection tracking trace shows a power hole, or is below the test limit line, perform the switch path test for the port that is failing.
5. Directivity trace fails (above -10dB), replace the couplers (5087-7724).
6. Source or load match fails (above -10 dB), replace the coax switch (N1811-60023).
7. Isolation is poor between ports, inspect the RF connections. If it continues to fail replace the coax switch (N1811-60023). The RF cables require proper torque (10 in-lb) and can be damaged by over tightening.

Figure 55 Test Set Top View

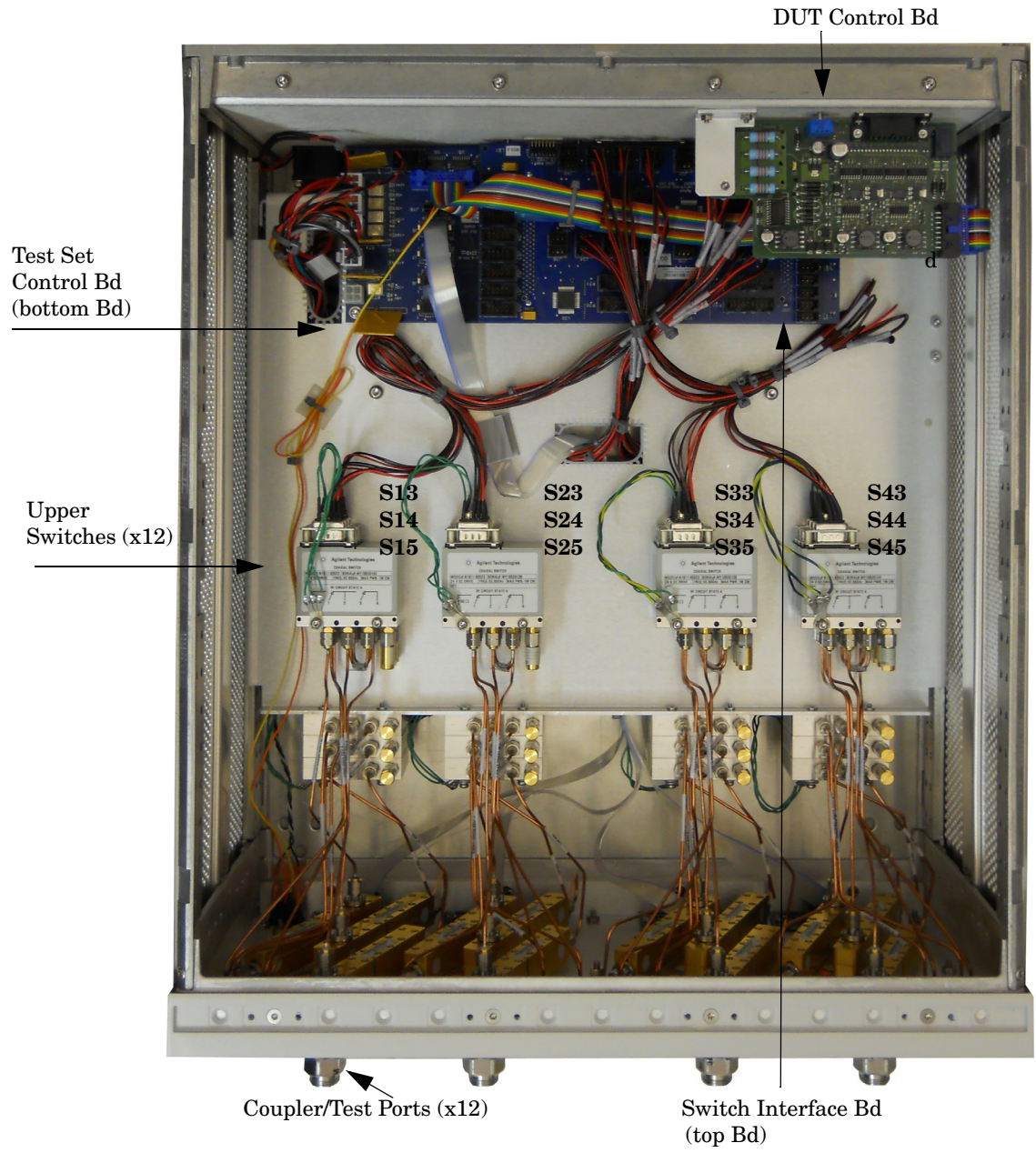
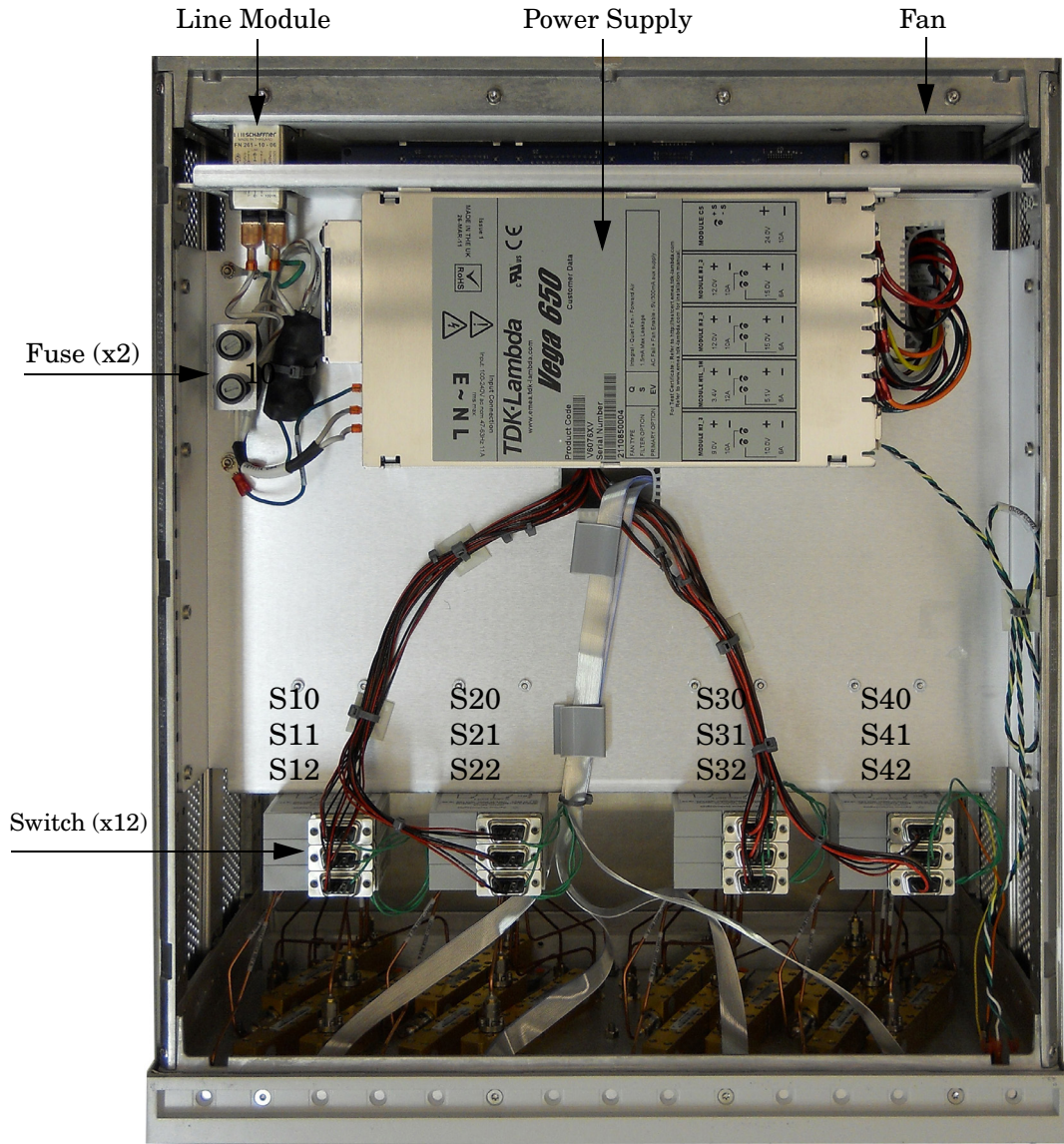


Figure 56 Test Set Bottom View



Safety and Regulatory Information

Introduction

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

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

Safety Earth Ground

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

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

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).

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, per IEC 61010 Second Edition.

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

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

CAUTION This instrument has auto-ranging line voltage input, be sure the supply voltage is within the specified range and voltage fluctuations do not to exceed 10 percent of the nominal supply voltage.

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 U3045A Option M12](#) 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.**

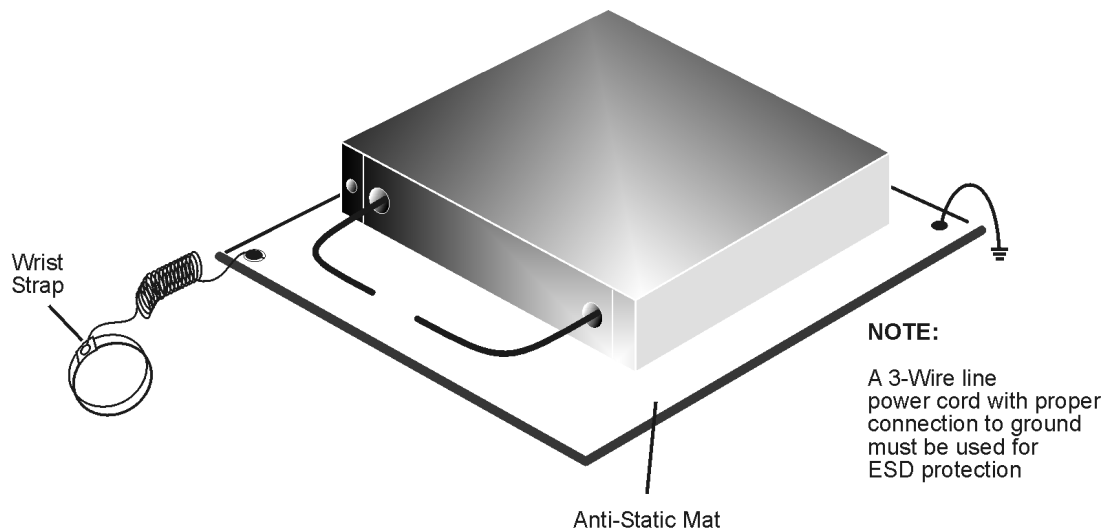
WARNING **If flammable cleaning materials are used, the material shall not be stored, or left open in the area of the equipment. Adequate ventilation shall be assured to prevent the combustion of fumes, or vapors.**

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 57 ESD Protection Setup



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 power line switch is ON.



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



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



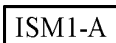
This symbol is used to identify a terminal which is internally connected to the product frame or chassis.



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



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



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



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 ingress and operational environment.



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.



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 78](#) 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 Maschinenlaermrrerordnung-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 your Test Set along with your PNA-X and cables to Agilent so that we may verify the 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.