

Agilent Technologies

U3045AM04

User's and Service Guide

Agilent Technologies U3045AM04

User's and Service Guide

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



Agilent Technologies

Manufacturing Part Number: U3045-90003

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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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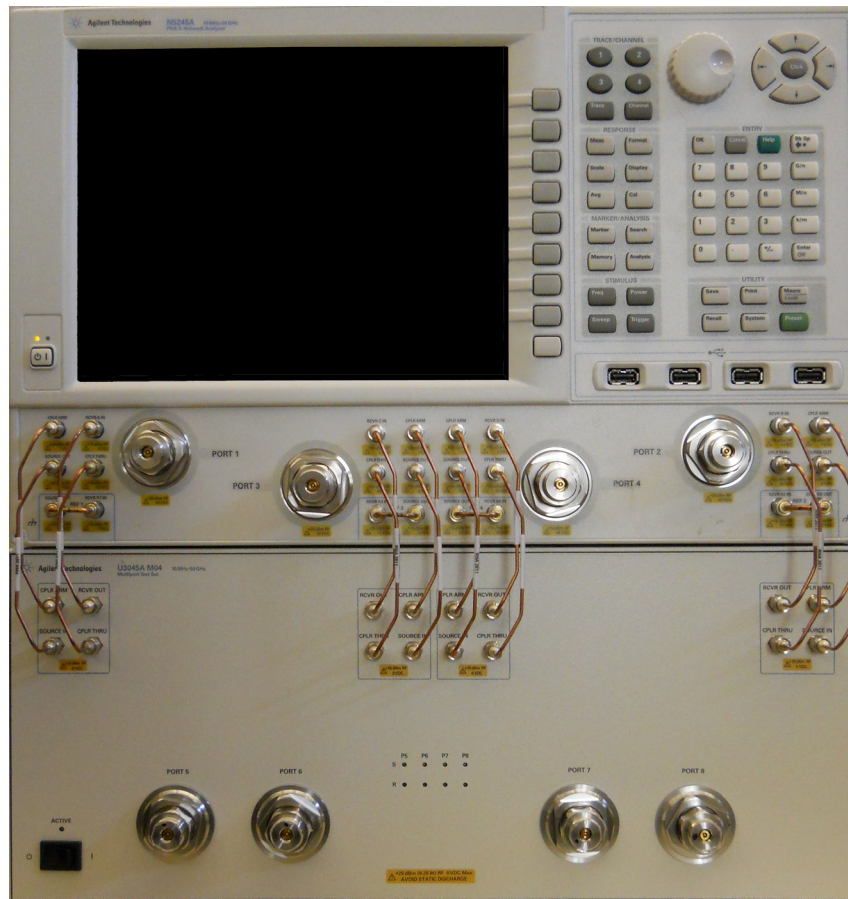
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U3045AM04

Introduction

This document describes how to use and service the U3045AM04 Multiport Extension Test Set with the Agilent 4-Port PNA or PNA-X Network Analyzer for an 8-Port solution.

Figure 1 Front Panel N5245A with U3045AM04



Description

The Agilent U3045AM04 is a 50 GHz, 4-Port mechanical switch multiport extension test set. The test set adds four test ports to a 4-Port N5224A, N5225A & N5227A PNA, and N5244A, N5245A & N5247A PNA-X Network Analyzer. The PNA or PNA-X with Option 551 and 400 provides 8-Port calibration and full cross bar measurement capability.

The U3045AM04 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 U3045AM04 requires a network analyzer with Test Set I/O interface for operational control. An external personal computer is not required.

The N5224/25/27A Network Analyzers will be referred to throughout this document as a PNA. The N5244/45/47A Network Analyzers will be referred to throughout this document as a PNA-X. If it is applicable to both they will be referred to as the analyzer. The U3045AM04 will be referred to as the Test Set.

Network Analyzer Requirements

- Option 400 to provide the Test Set interface connections.
- Analyzer firmware revision: \geq A.09.33.09
- The Option 551 and the following test set file must be installed into the analyzer's file directory for multiport measurement capability and N-Port error correction.

```
c:\Program Files\Agilent\Network Analyzer\testsets  
Test Set file: U3045AM04_PNAX_p4.tsx
```

More network analyzer 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>
- U3045AM04 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 74](#). 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 41 on page 52](#).

- 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 analyzer to the Test Set; a Lock Link kit U3021M-045 (U3021-60002), and Cable kit 445 PNX2 (U3021-60089). The U3021-60002 and U3021-60089 may be ordered separately at SPO, refer to [“Replaceable Parts” on page 50](#).

Front Panel Mounting Kits

- U3045AM04-1CP Rack Mount Kit with Handles (5063-9222)
- U3045AM04-1CM Rack Mount Kit without Handles (5063-9215)
- U3045AM04-1CN Front Handle Kit (5063-9228)

Specifications

Specifications for the Test Set are characteristic for the system performance of the analyzer and the Test Set. Before using the analyzer and Test Set a calibration is recommended for best measurement performance. Actual performance of the system is based on the your analyzer and options that are used with the Test Set. A functional certificate is only provided for the Test Set.

When connected to an analyzer, the 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 analyzer and also reduces dynamic range. The reflection tracking values measured in the [“Operational Check with Cal Kit” on page 43](#) 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 (x8, N1811-60023)
-

Power Requirements

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

- 100/120/220/240 VAC (50/60Hz)
- Air conditioning equipment (or other motor-operated equipment) should not be placed on the same ac line that powers the Test Set and analyzer.
- [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
PNA & PNA-X	450
U3045AM04	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 your analyzer's 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 5 - 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.

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

Required Conditions for Accuracy Enhanced Measurement

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

Dimensions and Space Requirements

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

Table 2 Instrument Dimensions

Model	Weight	Height	Width	Depth
U3045AM04	10.9 kg (24 lb)	17.8 cm (7 in)	43.1 cm (17 in)	50.8 cm (20 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 Maximum Power Levels

Maximum U3045AM04 Test Port RF Power Levels:	
PORT 5-8	+25 dBm 0 Vdc
Maximum U3045AM04 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 analyzer 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.

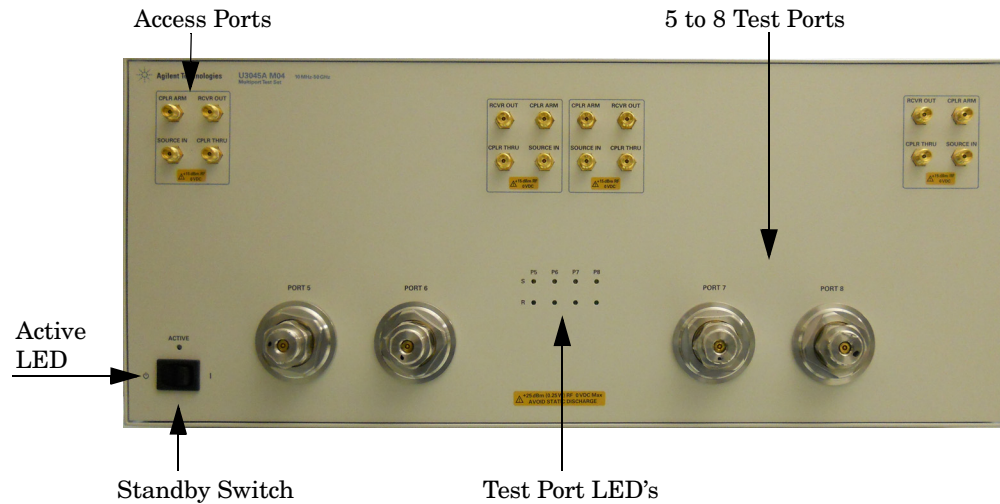
NOTE Typical specifications are based on 1 to 2 units performance. Refer to [Table 4](#).

Table 4 Typical Reflection Tracking

Frequency	Ports 1 to 4	Ports 5 to 8
10 MHz to 2 GHz	-1.5	-0.5
2 GHz to 5 GHz	-2.5	-2.0
5 GHz to 10 GHz	-3.5	-2.0
10 GHz to 15 GHz	-4	-2.5
15 GHz to 20 GHz	-5	-3.0
20 GHz to 25 GHz	-5.5	-3.5
25 GHz to 30 GHz	-6	-4.0
30 GHz to 35 GHz	-6.5	-4.5
35 GHz to 40 GHz	-7	-5
40 GHz to 45 GHz	-7.5	-5.5
45 GHz to 50 GHz	-8.5	-6.0

Front and Rear Panel Features

Figure 2 U3045AM04 Front Panel



Test Ports – 2.4 mm Bulkhead (male)

- Port 5 – 8

Access Ports – 2.4 mm (female)

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

Test Port's LEDs

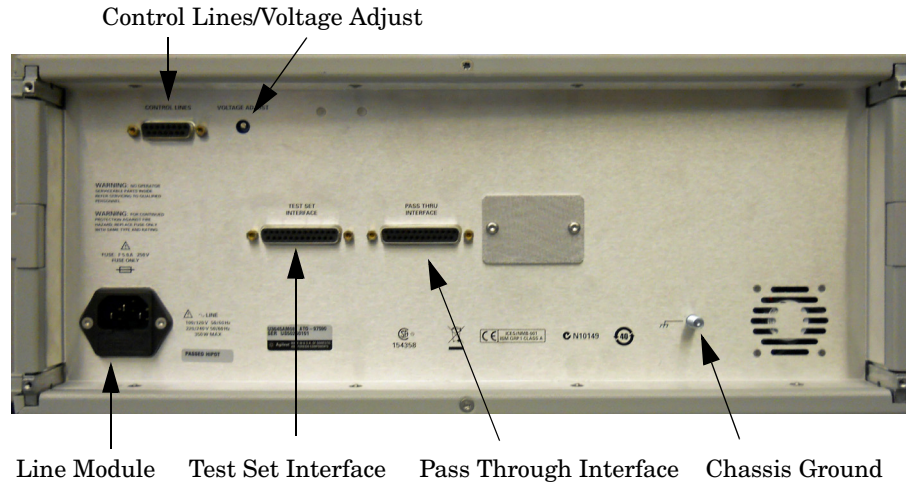
An illuminated LED indicates an active port in Source or Receiver mode. On the front panel “S” indicates Source test ports and “R” indicates Receiver test ports.

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 On and addressed by the analyzer, the LED is illuminated. The LED is Off when the Test Set is in Standby, or not addressed by the analyzer.

Figure 3 U3045AM04 Rear Panel

Control Lines and Voltage Adjust

For further information pertaining to control lines and voltage adjustments see. Refer to [“Control Lines” on page 37](#).

Chassis Ground

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

Pass Through Interface

Connection to another test set.

Test Set Interface

The Test Set Interface connector is used to send address and data to the Test Set from the analyzer.

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.

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**



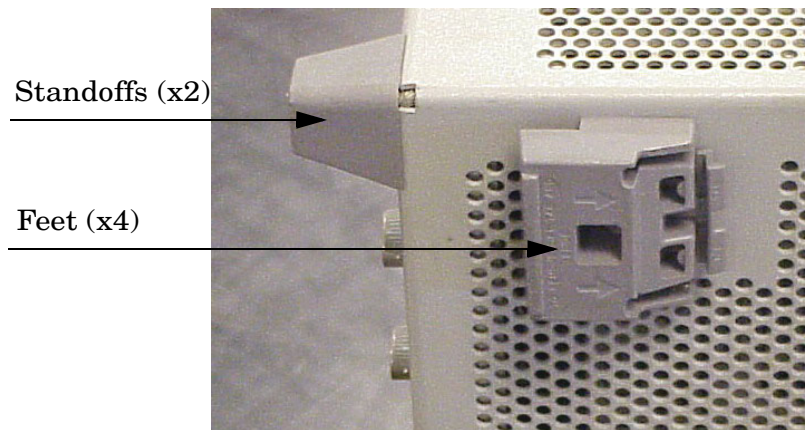
CAUTION Verify that the premise electrical voltage supply is within the range specified on the instrument.

System Setup

Preparing the Analyzer

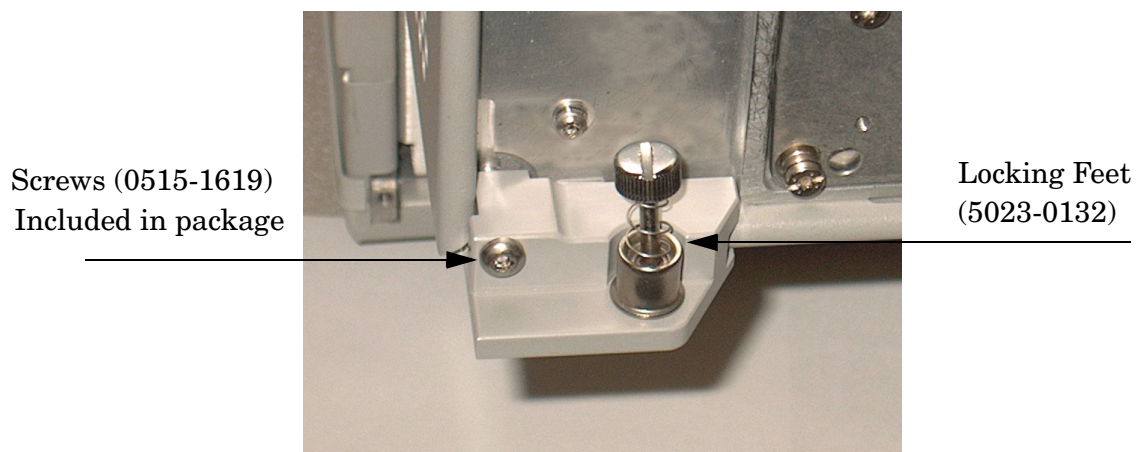
1. Remove the feet from the bottom of the analyzer.
2. Remove the 2 lower standoffs and screws (0515-1619) from the rear panel on the analyzer.

Figure 5 Rear Bottom Feet



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

Figure 6 Install Locking Feet on Analyzer



4. Remove the top two standoffs and screws (0515-2317) from the rear panel on the Test Set.

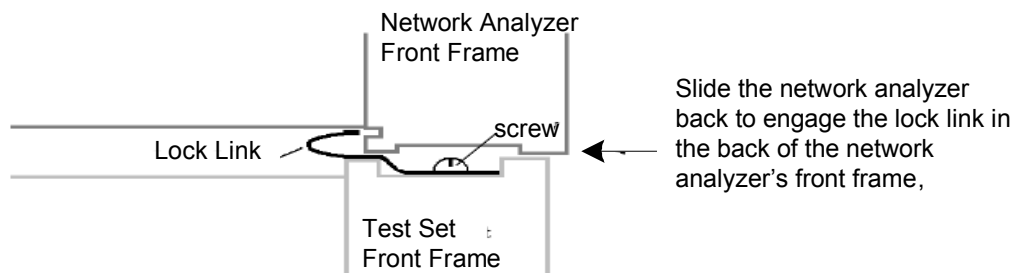
5. Install the two rear locking feet onto the Test Set. The N5242-20138 is the right foot and the N5242-20139 is the left foot. Two screws (0515-2317) are included with this option.

Figure 7 Install Locking Feet on Test Set



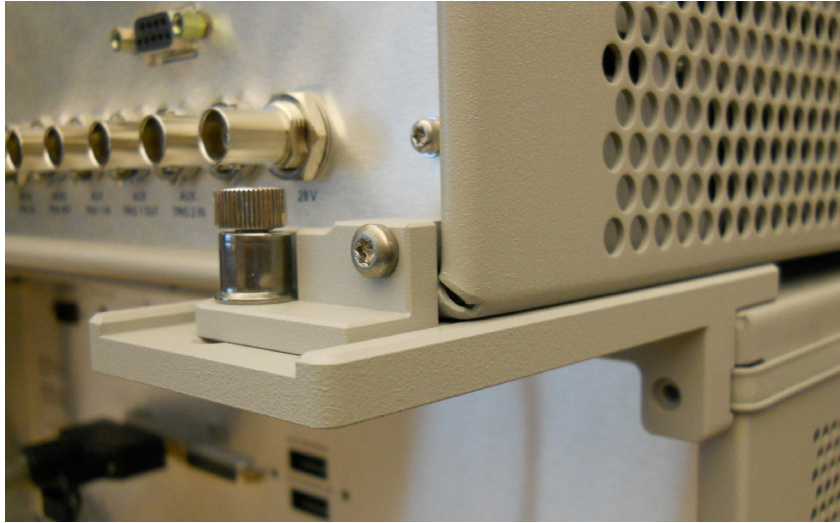
6. Place the analyzer on top of the Test Set and ensure that the front frame of the analyzer is positioned slightly forward of the locks that are attached to the Test Set. Slide the analyzer back so the locks engage the front frame of the analyzer.

Figure 8 Locking the Analyzer



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

Figure 9 Locking Feet Screws



NOTE

There are two rear panel Lock-Fee kits available. Refer to [“Contacting Agilent” on page 74](#) for ordering information.

- Analyzer – 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 analyzer. 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 analyzer. 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 analyzer to the Test Set in the order listed in Table 5. As you are connecting each cable, torque to 8 in-lb. Figure 10 illustrates the final two digits of the part number for each cable.

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

Table 5 RF Interface Cable Connections

Numeric Order	RF Cables	From: Analyzer	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 RF Interface Cable Connections



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

Figure 11 Rear Panel with U3045AM04



System Operational Check

The following procedure will confirm that the RF interface cables between the Test Set and analyzer are installed and the system is working correctly.

Before beginning this procedure you should complete the following steps:

- Stack the analyzer on top of the Test Set.
- Install the Test Set interface cable on the rear panel.
- Install all of the RF interface cables on the front panel.
- Install the included female 2.4 mm short (85056-60021) to analyzer's Port 1.
- Ensure that the connectors are clean.

Equipment Setup

- Turn On the Test Set and analyzer.
- Preset the analyzer and make the following settings:
 - Set to Multi-Port Mode (see [Multiport Mode Operation \(on page 21\)](#))
 - Frequency range: 10 MHz to 50 GHz
 - IFBW: 1 kHz
 - Scale: 20 dB/Div
 - Set the analyzer to measure S11

Check Results

The 2.4 mm short will be moved to each test port and the trace on the analyzer is set to measure the S-parameter of each port. An uncorrected Sxx reflection response trace should be displayed and resemble the plots indicated in the [Table 6 on page 17](#). If you suspect an RF signal path problem, refer to the RF cable diagram and check the interface cables associated with the signal path for proper installation.

NOTE Some trace amplitude ripple is expected on the reflection response due to the use of a short as a test device. Use an ECal to verify reflection tracking.

Table 6 Reflection Response Results

Reflection Port	Response Trace	Cable Path Diagram
Ports 1-4	Figure 12 on page 18	Figure 13 on page 18
Ports 5-8	Figure 14 on page 19	Figure 15 on page 19

Figure 12 Typical Reflection Response Ports 1-4

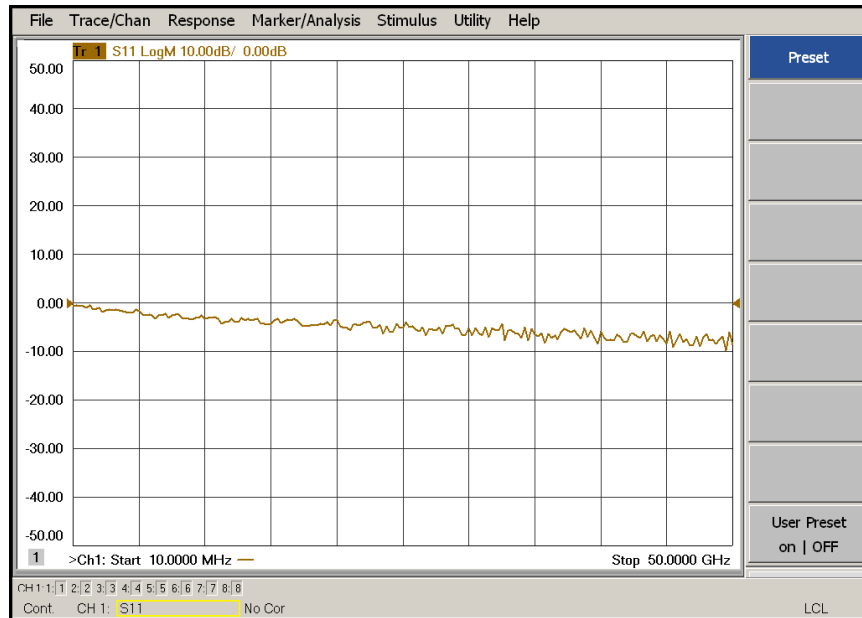


Figure 13 Reflection Response Signal Path Diagram Ports 1-4

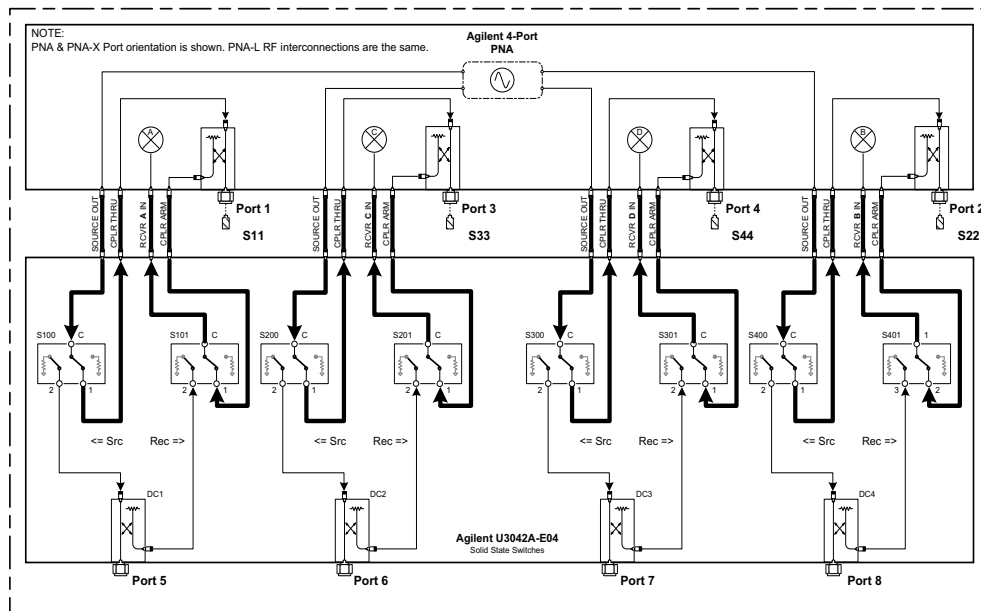


Figure 14 Typical Reflection Response Ports 5-8

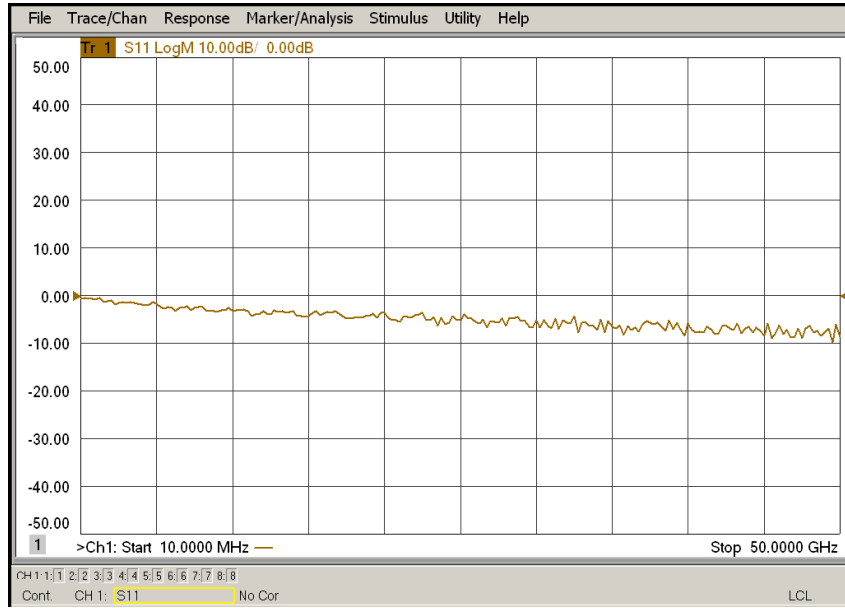
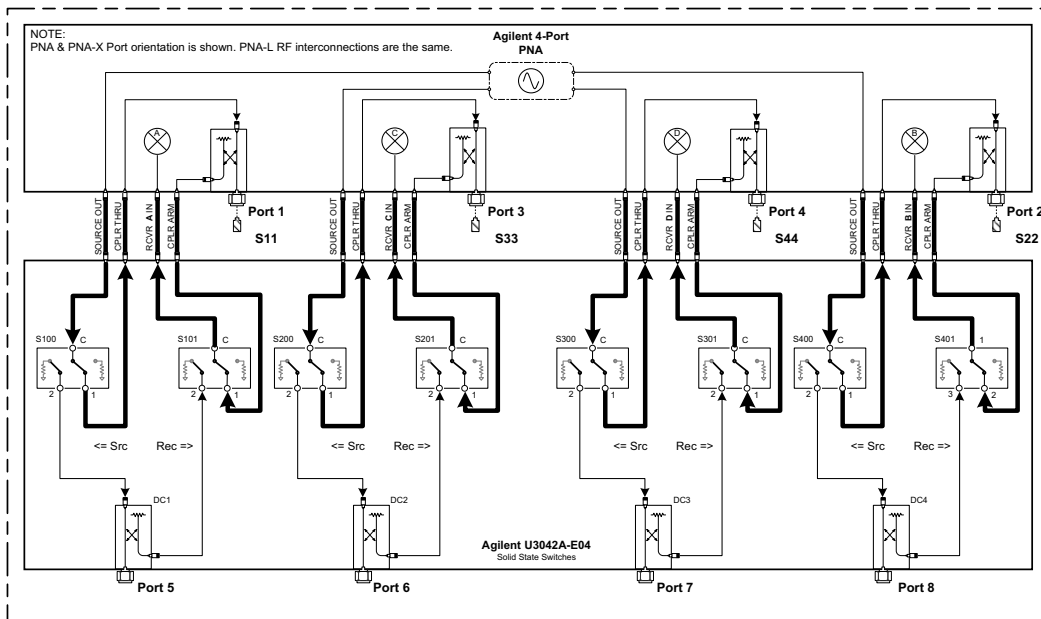


Figure 15 Reflection Response Signal Path Diagram Ports 5-8



Controlling the U3045AM04

This section will describe how to operate the Test Set with the analyzer.

A analyzer 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).

- “Multiport Mode” on page 21.
- “Interface Control Mode” on page 28.
- “GPIB Control Mode” on page 32.

Typeface Key Conventions

The following key conventions are used throughout this document.

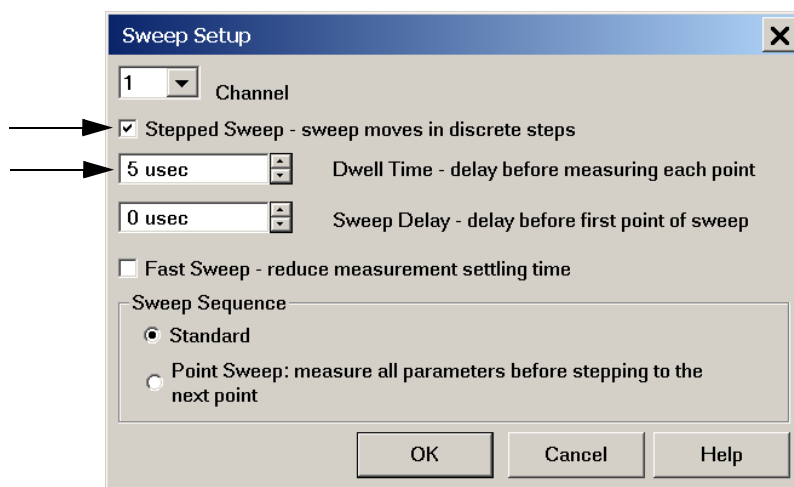
- **[HARDKEYS]** are labeled front panel keys
- **SOFTKEYS** are indicated on the instrument display

Sweep Setup for Multiport and Standalone 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 models.

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

Figure 16 Sweep Setup



Multiport Mode

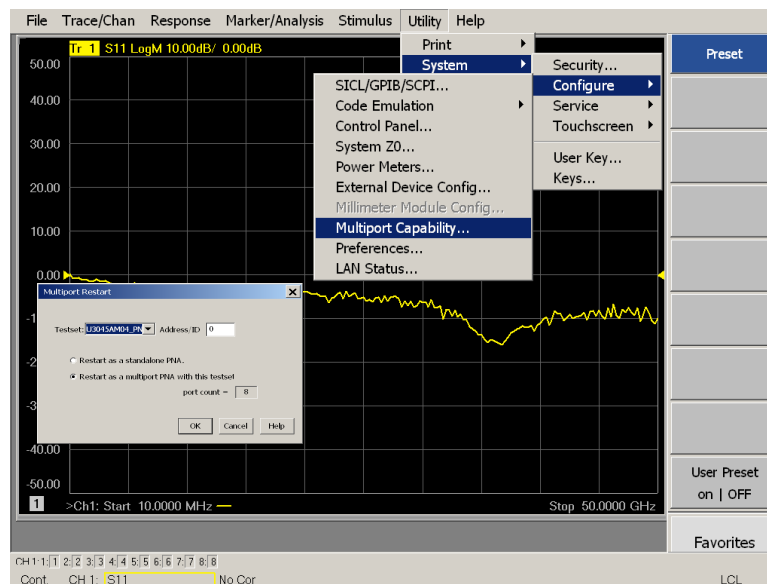
The analyzer requires Option 551 for Multiport mode. The analyzer must have the Test Set file installed to enable the analyzer to control the Test Set. The analyzer multiport mode allows you to select measurement ports, complete an N-Port calibration, operate control lines, and rename test ports. Refer 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 **U3045AM04_PNAX_p4** (8-Port System) from the drop-down menu and select **Restart as a multiport PNA with this testset > OK**. The analyzer will restart the network application with the Test Set interface features.

If the Test Set is not available in the drop-down list, it will be necessary for you to copy the required Test Set file to the analyzer 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.

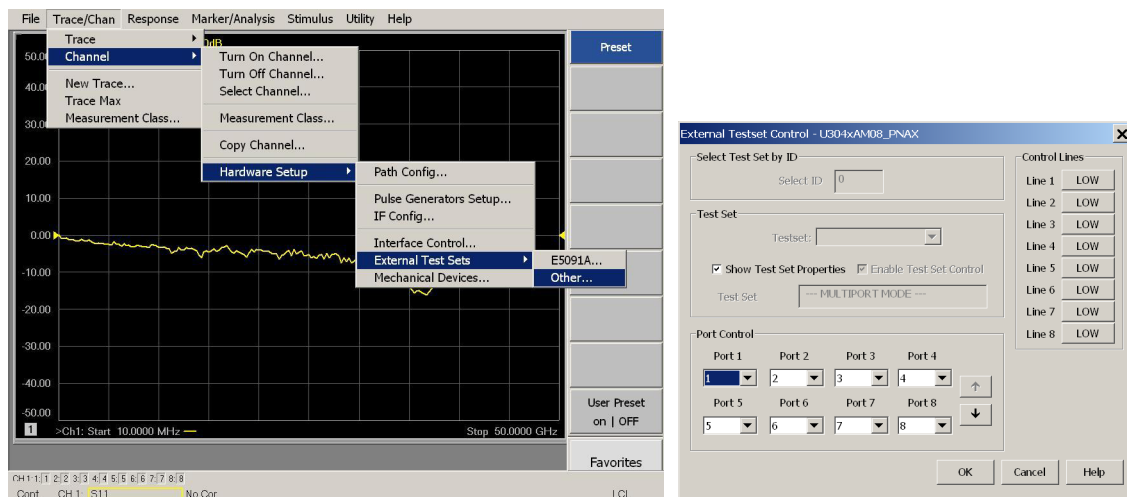
Figure 17 Selecting Multiport Mode



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-U3045AM04**.

Figure 18 External Test Set Control



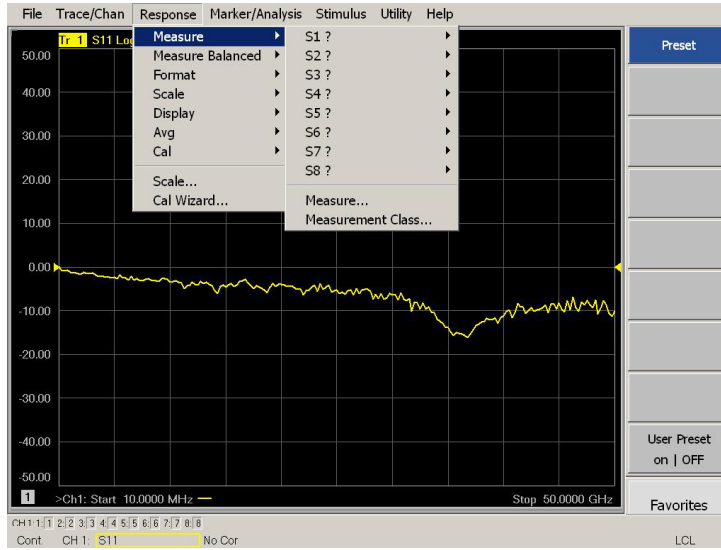
This menu will allow the physical Ports 1 thru 8 to be identified as any port for your convenience. For example; Port 5 can be re-named Port 2.

The **External Test Set Control-U3045AM04** also allows control of the DUT control lines, refer to [“Control Lines” on page 37](#). To change the state from LOW to HIGH, select the graphical user interface (GUI) for the specific control (LINE 1 thru 8), click **OK**. Each line can be controlled separately.

Selecting S-Parameter Measurement

S-Parameter selection can be accomplished using **Response > Measure**. Use the drop-down menu to select 1 of 64 S-Parameters for the 8-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.

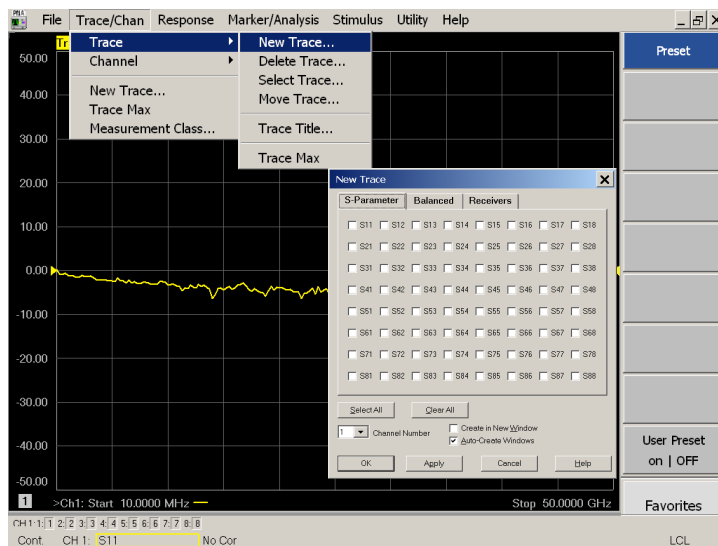
Figure 19 S-Parameter Measurement



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 64 S-Parameter's.

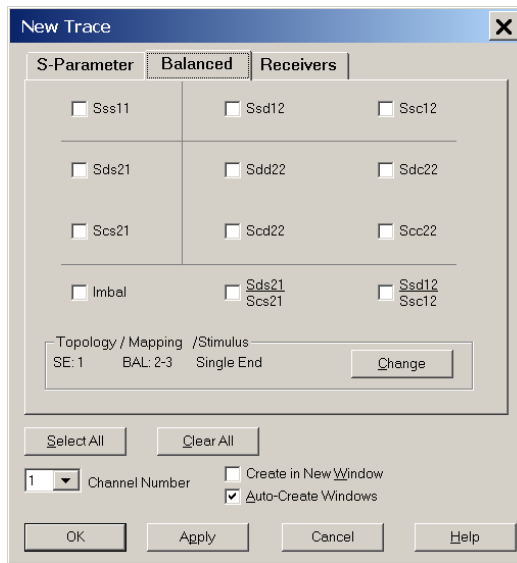
Figure 20 New S-Parameter Measurement



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

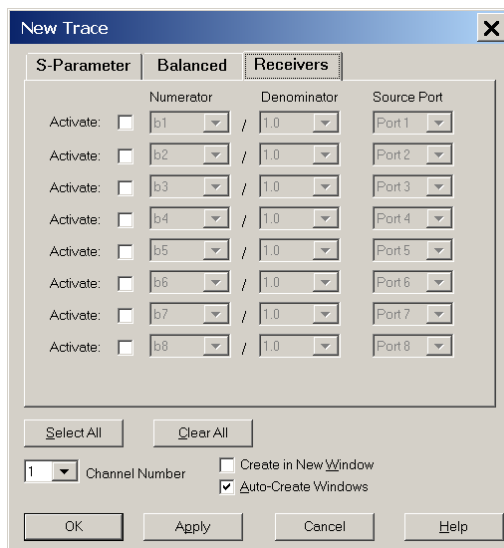
For more information on balanced (differential) component measurement, refer to the Application Note 1373-1 and 1373-2 (5988-5634EN and 5988-5635EN) at <http://www.home.agilent.com>. In the search menu type “**Multiport and Balanced.**”

Figure 21 Selecting Balanced Measurements



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

Figure 22 Receiver Measurements



N-Port Calibration with the Analyzer

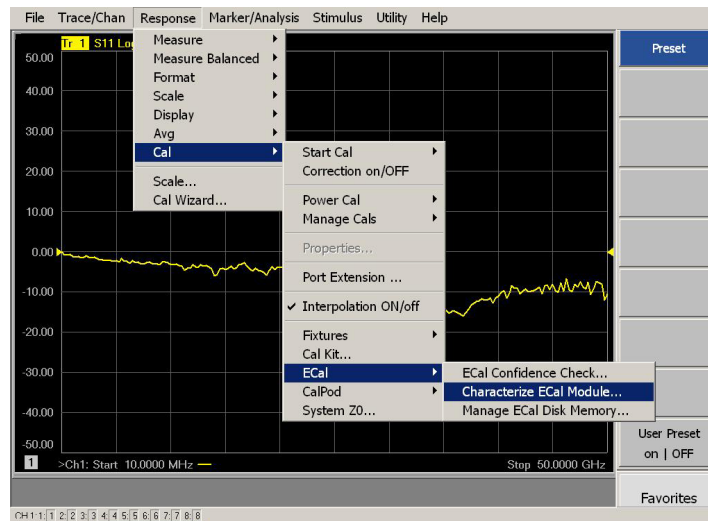
It is recommended that you perform an ECal characterization to minimize the connections required for multiple port calibration. The N4693A Option M0F is recommended with cable (85133F) if you are calibrating at the analyzer and Test Set ports.

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

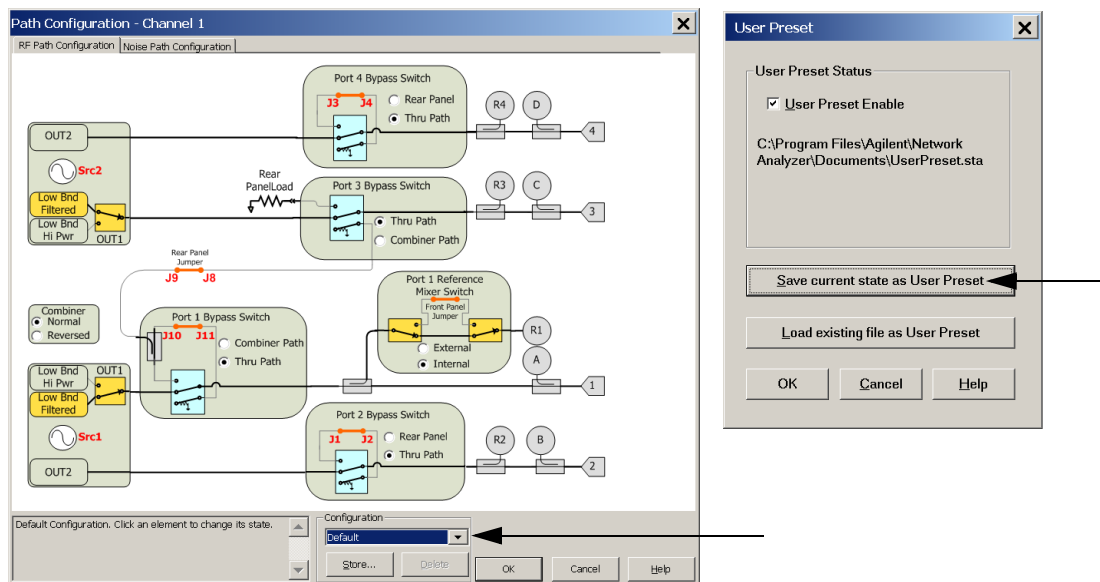
NOTE If measurement errors occur, ensure the newest version of firmware is installed on the analyzer. Measurement errors can be a result of firmware algorithms. Consult with Agilent Service or firmware web page for the latest analyzer Option 551 firmware revisions and history.
<http://na.tm.agilent.com/pna/firmware/firmware.htm>

Figure 23 ECal Characterization



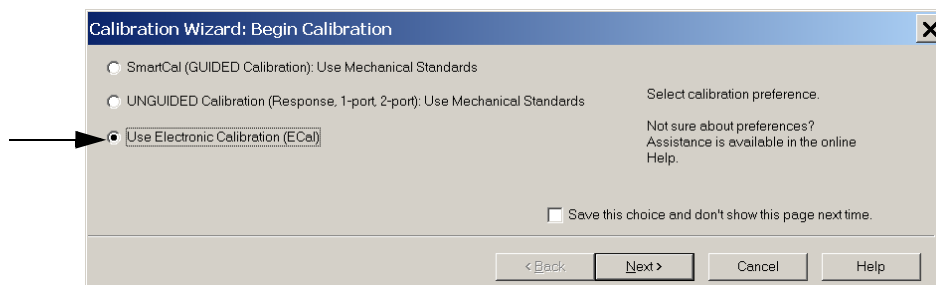
NOTE If the PNA-X has Option 029 or H29 (noise figure capability) verify that the path configuration is set to Default. If the PNA-X is not in Default configuration, ports 5 and 9 will not operate correctly. Select **Trace/Chan > Channel > Hardware Setup > Path Cong...** and in the drop-down menu select **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 24 RF Path Configuration



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

Figure 25 Calibration Wizard



- Continue following the Cal Wizard prompts. In the Select Calibration Ports and ECal Module dialog box click **Select All**, or select the ports individually that 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](#). Refer to the analyzer Help system for calibration information using an ECal module.

Figure 26 Select Calibration Ports

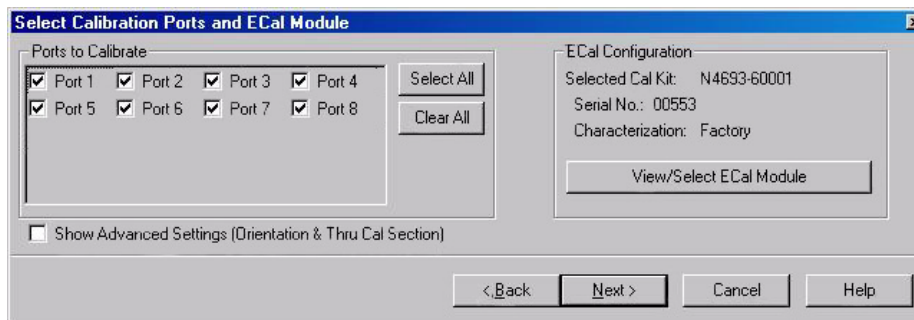
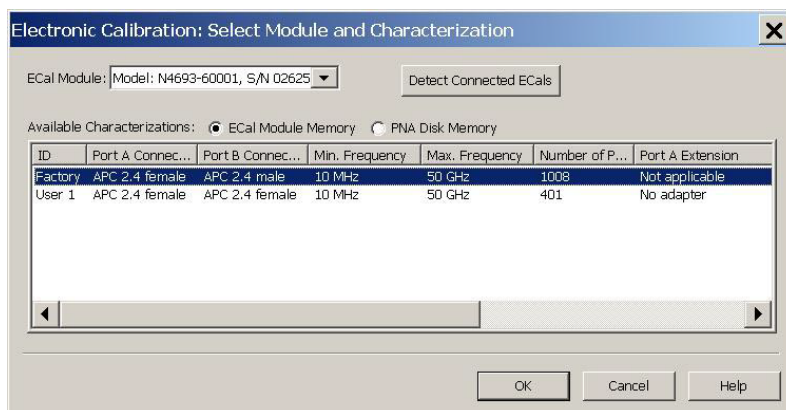


Figure 27 Factory Calibration



- 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 36 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 analyzer is in Standard mode (not multiport mode).

NOTE If measurement errors occur, ensure the newest version of firmware is installed on the analyzer. Measurement errors can be a result of firmware algorithms. Consult with Agilent Service or firmware web page for the latest 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 analyzer Help menu, “Rear Panel Tour” and “Interface Control.”

This section includes:

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

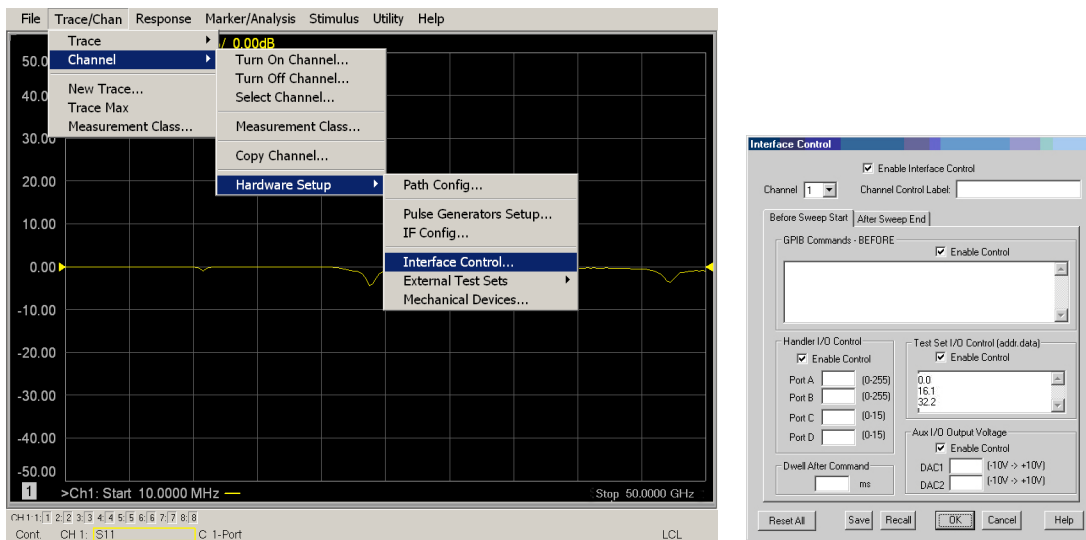
NOTE The interface control mode will not function properly when using multiport mode. The multiport mode will reset the switch path commands of the interface control. It is recommended that the analyzer be restarted in stand-alone mode if the interface control is being used.

- 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 analyzer’s Help menu.
1. GPIB Interface
 2. Material Handler Interface
 3. Test Set Interface
 4. Dwell Time

How to Access Interface Control Mode

1. Place the analyzer in start or Standalone mode. The interface control will not work in multipoint mode. See [Figure 25 on page 26](#).
2. To access the Interface Control mode, select **Trace/Chan > Channel > Hardware Setup > Interface Control** in the drop-down menu, and select **Enable Interface Control**.

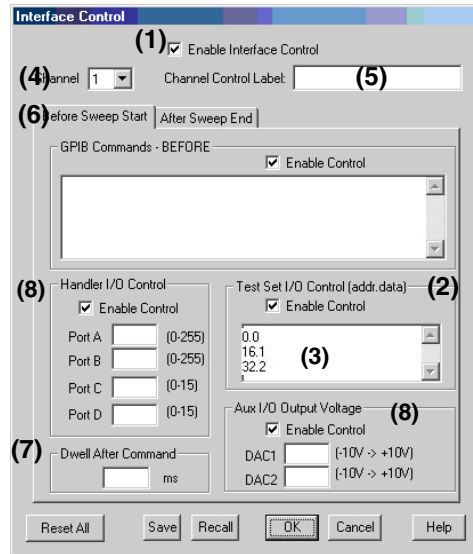
NOTE The analyzer Series Network Analyzer includes the Interface Control application and rear panel connection. Please review this application before connecting the Test Set to the analyzer. Information regarding this application can be found in the analyzer Help menu, Interface Control. The application 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 analyzer 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 28 Interface Control**Enable Interface Control: (1)**

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

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

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

Only positive integers are allowed to select switch positions or states of DUT control interface lines. Refer to [“Address and Data Values” on page 35](#).

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

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

0.0
16.1
32.2

Channel: (4)

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

Channel Control Label: (5)

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

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

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

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

Overview of the GPIB Control

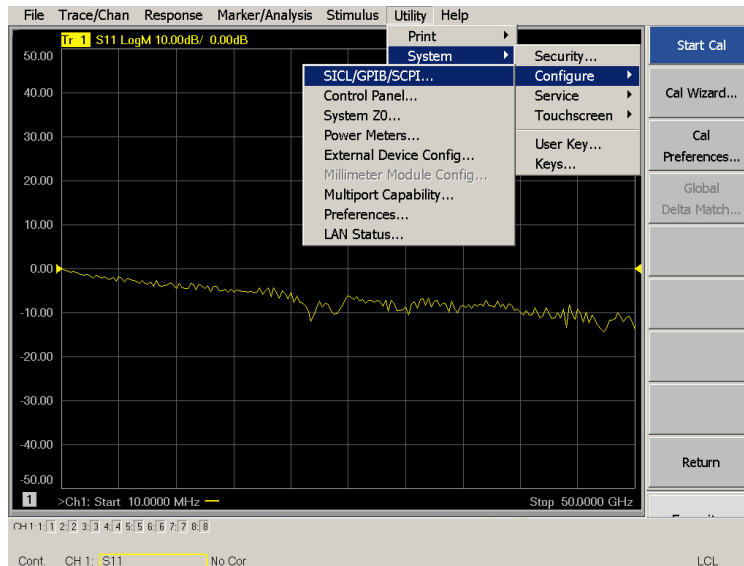
The GPIB Command Processor allows you to send address and data to control an external Test Set, without needing to create a remote program. The user is required to manually input address and data using the GPIB Command Processor Console in the analyzer's Help menu.

- 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

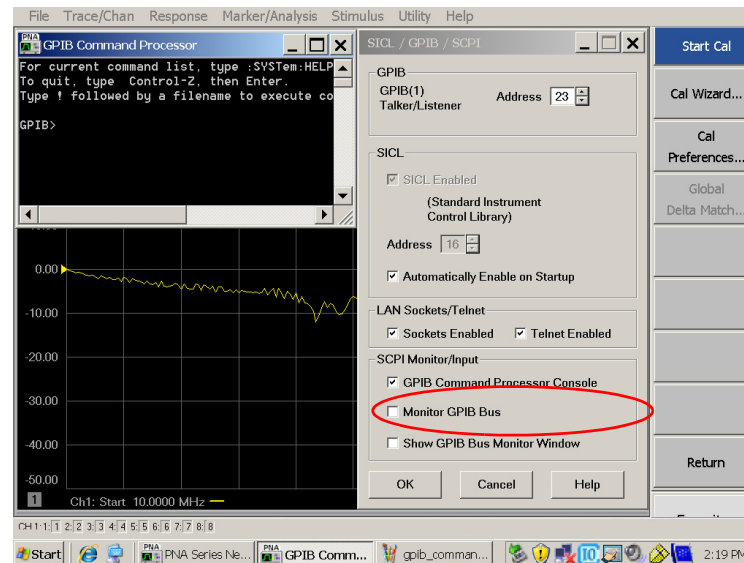
1. Turn Off Interface Control.
2. Place the analyzer in Start or Standalone mode. The GPIB Command Processor will not work in Multiport mode. See [Figure 17 on page 21](#).
3. To access the GPIB Command Processor select **Utility > System > Configure > SICL/GPIB/SCPI**.

Figure 29 Utility Configure



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

Figure 30 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

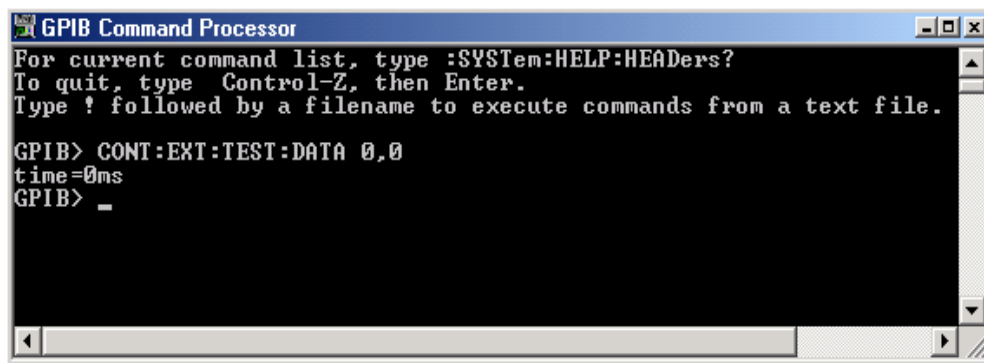
Address and data are separated by a comma. Commands are executed by a carriage return or the Enter key.

For example:

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

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

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



Refer to [“Address and Data Values”](#) on page 35.

Address and Data Values

Setting the Test Port Paths with Address and Data

Refer to [Table 7](#) and [Figure 31 on page 36](#) for information to set the internal switch paths of the Test Set.

The address is the first value in the Test Set I/O control or GPIB data command. The second value controls the source and receiver paths of the ports. To select a Test Set port configuration both switches must be set to complete the source and receiver paths. To do this you must add the data values together to determine the data command value for each port, which is the second number in the Test Set I/O or GPIB command. Refer to [“Interface Control Mode” on page 28](#) and in [“GPIB Control Mode” on page 32](#).

Example 1: Refer to [Figure 31 on page 36](#).

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. The entry will be 0.1 in one command line, and 16.16 in the second line.

Example 2:

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

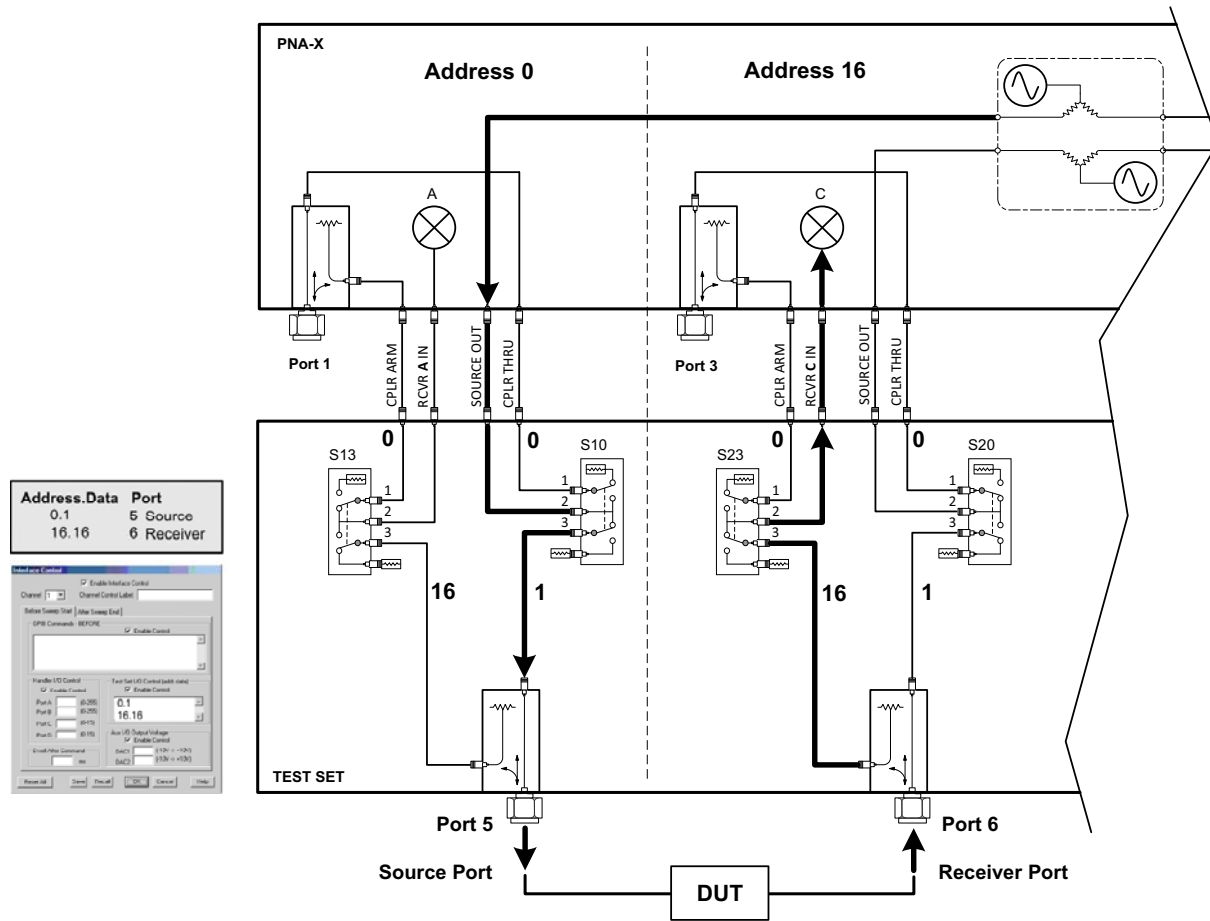
Port 1 is the Source and Ports 5 is the Receiver.

Source Port 1 = address 0, data 0 and Receiver Port 5 = address 0, data 16. The data values are added together, the entry will be 0.16.

Table 7 Test Port Address and Data Values

Address		Source Path		Receiver Path	
		0	1	0	16
0	Ports	1	5	1	5
16	Ports	3	6	3	6
32	Ports	4	7	4	7
64	Ports	2	8	2	8

Figure 31 Address and Data Example 1 (Port 5 and 6)



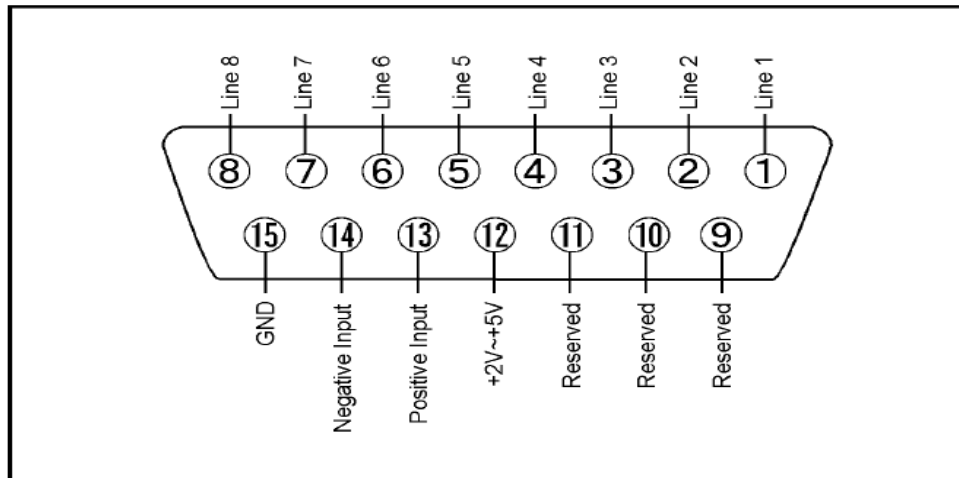
Control Lines

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 22](#) and [“Setting the Control Lines with Address and Data Values” on page 41](#). 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 32](#) and [Table 9 on page 38](#) for control line pin location and description. Refer to [“Internal Voltage Supply Configuration” on page 39](#) and [“External Voltage Supply Configuration” on page 40](#) 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 32 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

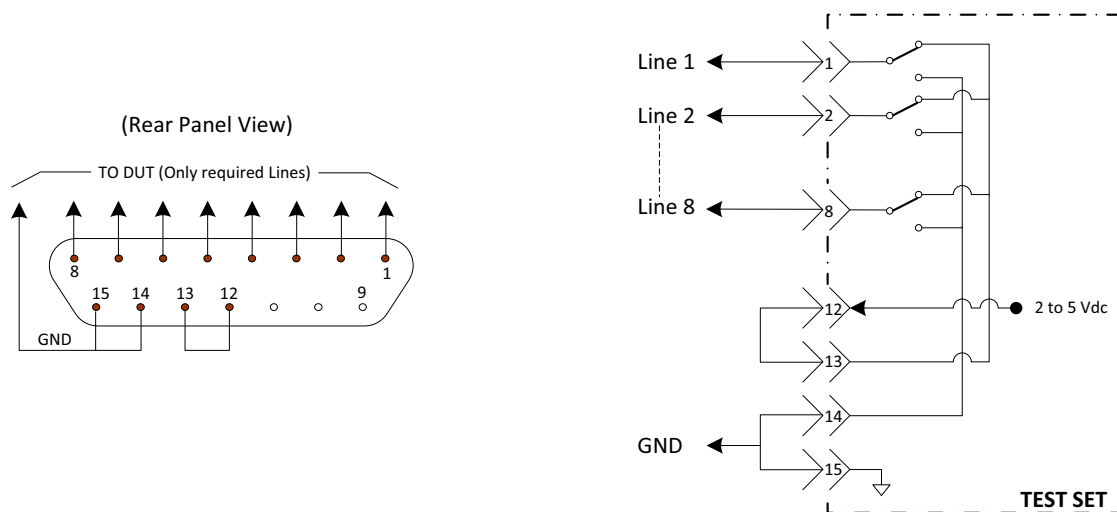
The output voltage of pin 12 can be adjusted from +2 to +5 V. Perform the following procedure to set the voltage:

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 33 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 33 Internal DC Power Configuration (rear panel view)



External Voltage Supply Configuration

Figure 34 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.

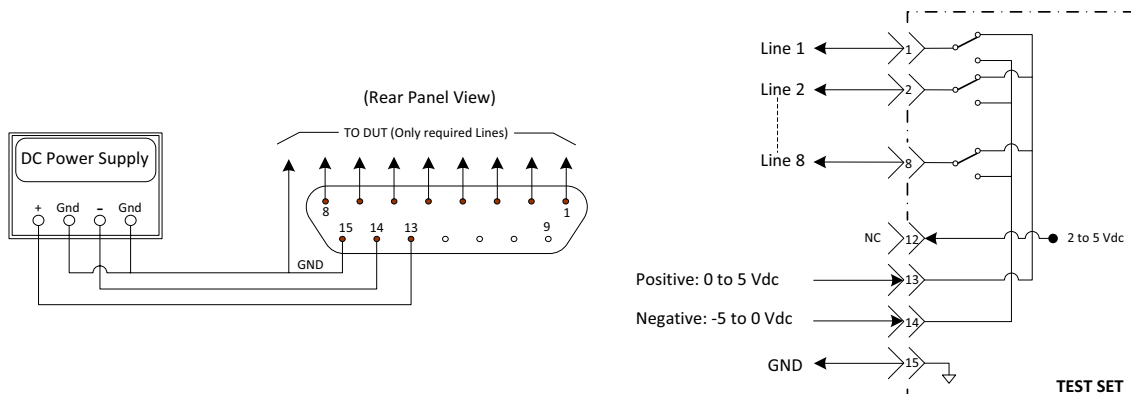
Turning On the Test Set using an External Power Supply

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 34 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 analyzer is in Standalone mode.

Setting the Analyzer 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 35, 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 33 on page 39](#). To reset all control lines to logic high, without having to reset the power switch on the Test Set, make the following analyzer entry:

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

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

1. Line 2 (<address> = 112 and <data> = 2)
2. Line 3 (<address> = 112 and <data> = 4)
3. The SUM of the <data> values = 6
4. Front panel analyzer Interface Control Mode line entry = 112.6 > OK.

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

Operational Check with Cal Kit

The following procedure can be used to confirm 1-Port Cal performance of an ECal Module or Mechanical Cal Kit. The operation verification limits provided ensure that your U3045AM04 and analyzer are operating properly. Refer to [“Verifying a Cal Kit Operational Check Failure” on page 48](#) 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 analyzer and Test Set are only characteristic and intended as non-warranted information. Only a functional certificate is provided for the Test Set.

It is recommended that you return your instrument to Agilent Technologies for servicing or repair if the Test Set and analyzer 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 3 on page 7](#).

NOTE If you suspect that your 8-Port configuration is not operating properly, ensure that all front RF jumper interconnect cables are correctly attached.

Table 11 Operation Verification Limits for Reflection Tracking¹

Frequency	Port 1-12
10 MHz to 5 GHz	-5 dB
5 GHz to 15 GHz	-7 dB
15 GHz to 25 GHz	-10 dB
25 GHz to 35 GHz	-12 dB
35 GHz to 50 GHz	-15 dB

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

Equipment Required

The Agilent U3045AM04 requires that the user be familiar with the equipment listed.

Table 12 Equipment List

Description	Qty
N4693A 2.4 mm ECal Module 10 MHz to 50 GHz (Option 00F or M0F) <i>or</i> Mechanical cal kit 85056A or 85056D	1
4-Port Network Analyzer with Options 400 and 551	1
Set of interconnect cables (Analyzer and Test Set) Table 5 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 analyzer if you are performing a analyzer Operational Check. The analyzer will indicate false failures if the Test Set is connected.

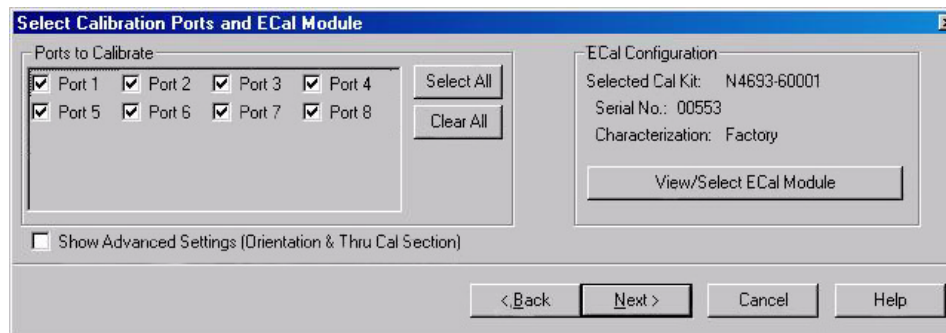
Preparing the Analyzer

1. Connect the Test Set to the 4-Port analyzer 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 analyzer, select **Response > Cal > Manage Cals > Cal Set**. Delete or Rename any Cal Sets titled “999.1” thru “999.8” (8-Port), although it is unlikely that you will find Cal Sets with these names.
4. Verify that the analyzer is in 8-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 **U3045AM04 (8-Port)** from the drop-down menu > **OK**. Refer to [Figure 17 on page 21](#).
5. Press **Preset**.
6. Verify that the **[Start Frequency]** is set to **[10 MHz]**.
7. Set **[Stop Frequency]** to **[50 GHz]**, or upper frequency limit for your analyzer.
8. Select **[Power] > Power Level** and enter **[0 dBm]**.
9. Select **Response > Avg > IF Bandwidth > 100 Hz > OK**.
10. Select **Stimulus > Sweep > Number of Points > 401**.
11. Connect the ECal module to an available USB port on the front or rear panel. This procedure assumes you are using a ECal. If you are not, see “[1-Port Calibration and Verification Procedure](#)” on page 45, step 2.
12. Allow the ECal module, Test Set and Analyzer to warm up for a minimum of 30 minutes.

1-Port Calibration and Verification Procedure

1. Connect the ECal or the mechanical cal kit to Port 1 or the port you are testing. Torque to 8 in-lb. For further information refer to the Help menu, see [Figure 35](#).
2. Perform a 1-Port Calibration on Port 1. On the analyzer, select **Response > Cal > Start Cal > Calibration Wizard**.
 - a. If using a mechanical cal kit, select **SmartCal (Guided Calibration) > Next**.
 - b. If using an ECal module, connect the ECal to a analyzer USB port. Select **Use Electronic Calibration (ECal) > Next**.
3. Continue following the Cal Wizard prompts. In the Select Calibration Ports and ECal Module dialog box click **Clear All**, then select **Port 1 > Next > Measure**.
4. Ensure the Cal Kit you are using is indicated on the right side of the window.

Figure 35 1-Port Calibration

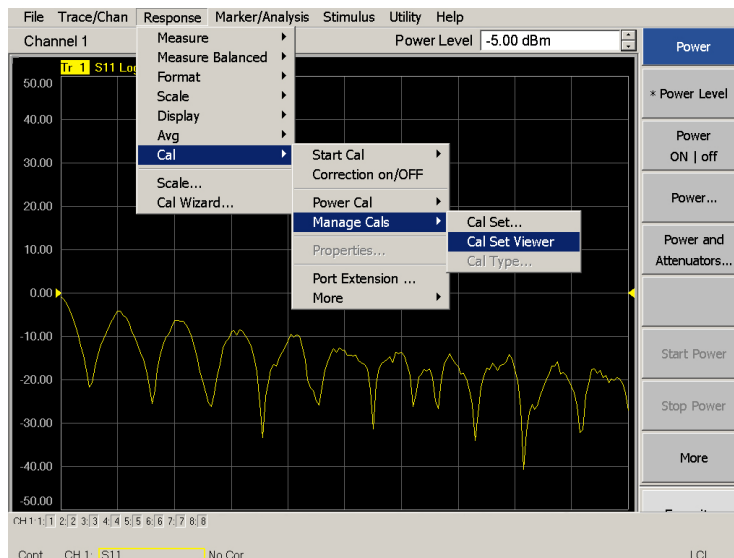


5. Continue to follow the prompts until the Calibration Completed dialog box appears.
6. At the Calibration Completed prompt, select **Save As User Calset**, type the name **999.1**. Overwrite the Calset if it already exists and **Save**.

NOTE If you do not have a key board, select **Save As User Calset > Edit Name** and save as **999.x**. X is the port number you are calibrating. See [Figure 36](#). Use the numeric keypad on the analyzer's front panel to enter "999.1."

Figure 36 Calibration Complete

7. Repeat [step 1](#) thru [step 6](#) for Ports 2 thru 8. When finished, there should be 8 Cal Sets saved with the titles “999.1” thru “999.8” (8-Port).
8. Select **Trace/Chan > Trace > Delete Trace**. There should be no traces on the analyzer’s screen.
9. To launch the Cal Set Viewer toolbar. Select **Response > Cal > Manage Cals > Cal Set Viewer**.

Figure 37 Calibration, Cal Set Viewer

10. 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. See [Figure 38](#).
11. Compare the Reflection Tracking (1,1) trace to the appropriate limits in [Table 3 on page 7](#). The trace should be above the limit.
12. Repeat [step 10](#) and [step 11](#) for Cal Sets “999.1” thru “999.8” (8-Port).

Figure 38 Reflection Tracking Trace (Port 1-4)

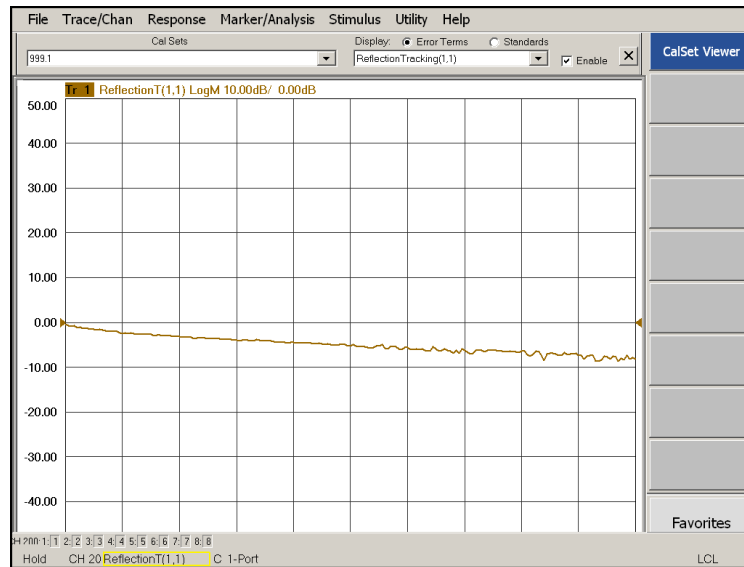
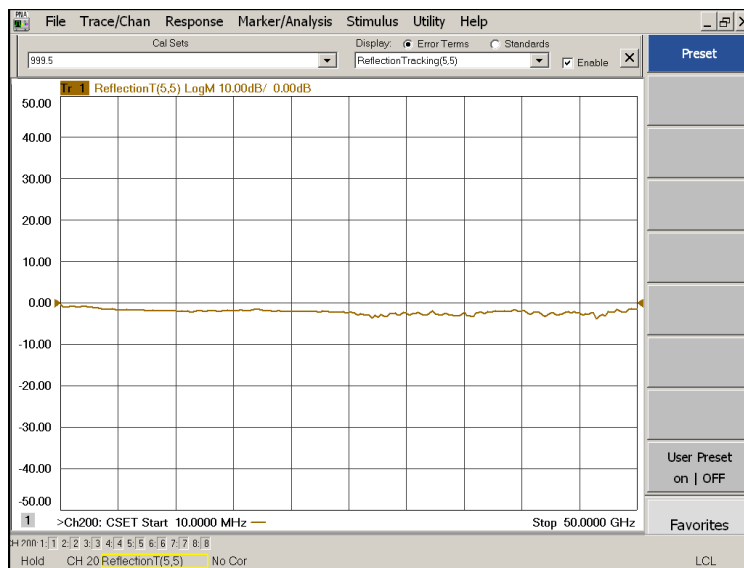


Figure 39 Reflection Tracking Trace (Port 5-8)



NOTE Response from 10 MHz to 500 MHz is normal due to the analyzer's couplers in comparison to the Test Set bridges. The bridges have more gain in the coupled RF path.

Verifying a Cal Kit Operational Check Failure

If your test results fail the Cal Kit Operational Check Reflection Tracking limits, verify the following:

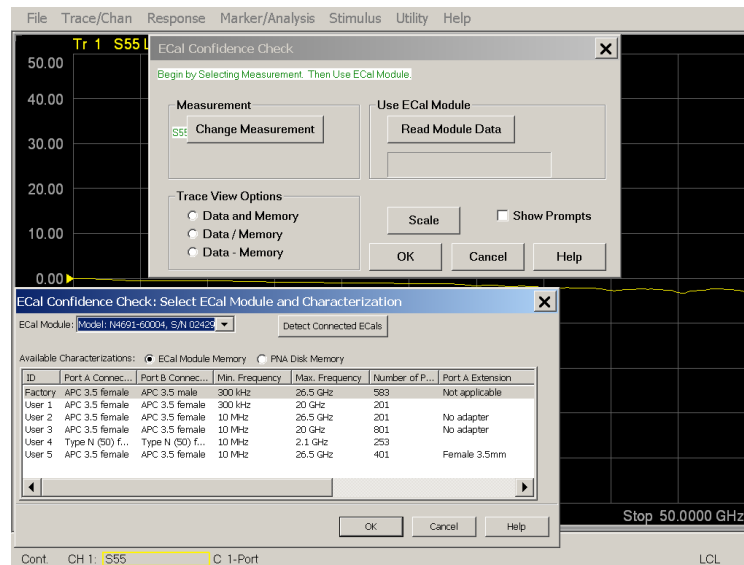
1. Ensure the Test Set is On and connected properly to the analyzer.
2. Check all appropriate analyzer and Test Set connectors for damage, cleanliness, and proper torques.
3. Repeat the relevant 1-Port calibrations using another ECal or mechanical standard.
4. Verify that the analyzer is operating properly and meeting its published specifications. If the analyzer 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 verify the accuracy of a 1-Port calibration performed with mechanical standards or an ECal module. To perform this check, the test port of the ECal module must connect directly to the Test Port being verified (without adapters).

Procedure

1. Perform an 1-Port Cal of the Test Set port being verified.
2. Connect the ECal Module to the Port being verified. Terminate any remaining ports on the ECal module.
3. Select the Cal Set to be verified. Select **[Cal] > Cal Set... > Cal_File > Apply Cal > Close**. If the "Choose Stimulus Settings..." prompt appears, select **Change the active channel's stimulus... > OK > Close**.
4. Select **Response > Cal > More > ECal > ECal Confidence Check**.
5. In the ECal Confidence Check window, click **Change Measurement** and select the test port S-parameter **Apply > OK > Read Module Data**.
6. When the "Select ECal Module" prompt appears, select the ECal module you are using and the ECal Module Memory and Factor ID **> OK**.

Figure 40 ECal Confidence Check

Interconnect Cable Verification

1. Perform the “[System Operational Check](#)” on page 17.
2. If the problem still exists, perform the “[Source and Receiver Path Test](#)” on page 58.
3. If a power hole or other failure still exists, refer to “[Contacting Agilent](#)” on page 74.

Service Information

This section provides information to troubleshoot and repair the U3045AM04 test set. Refer to “[Agilent Support, Services, and Assistance](#)” on page 74 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 13 Available Replacement Parts (SPO)

Description	Agilent Part Number
Switch, Multiport (50 GHz terminated), N1811TL Opt 050, 124,201 &301	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
Locking Feet	5023-0132
Test set I/O Cable	8120-6818
Fan (rear panel)	87050-60027
DUT Control Board	E5091-66503
Load (2.4 mm male)	00901-60003
Short (2.4 mm female)	85056-60021

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

Table 14 Replaceable Parts (M04)

Description	Agilent Part Number
RF Cable, Semi-rigid	U3047-20016
RF Cable, Semi-rigid	U3047-20017
SW Interface Board, programmed	U3025-60062
U3045AM04 User's and Service Guide	U3045-90003
Dress Nut (couplers)	N5230-20081
Rear Lock Feet (right)	N5242-20138
Rear Lock Feet (left)	N5242-20139
Front Panel LED Board	N5261-60005
Test Set Control Board (programmed)	N5261-60006
Screw-Pan Head Machine with thread patch, Torx-T15 M3.5 with 0.6 thread, 12 mm-LG	0515-2317
Lock-link Kit (N5242 PNA-X to a 421.6 mm or a N5245 PNA-X to a 497.8 mm instrument)	U3021-60002
Cable Kit, Interface	U3021-60089

System Block Diagram

Figure 41 U3045AM04 RF Block Diagram

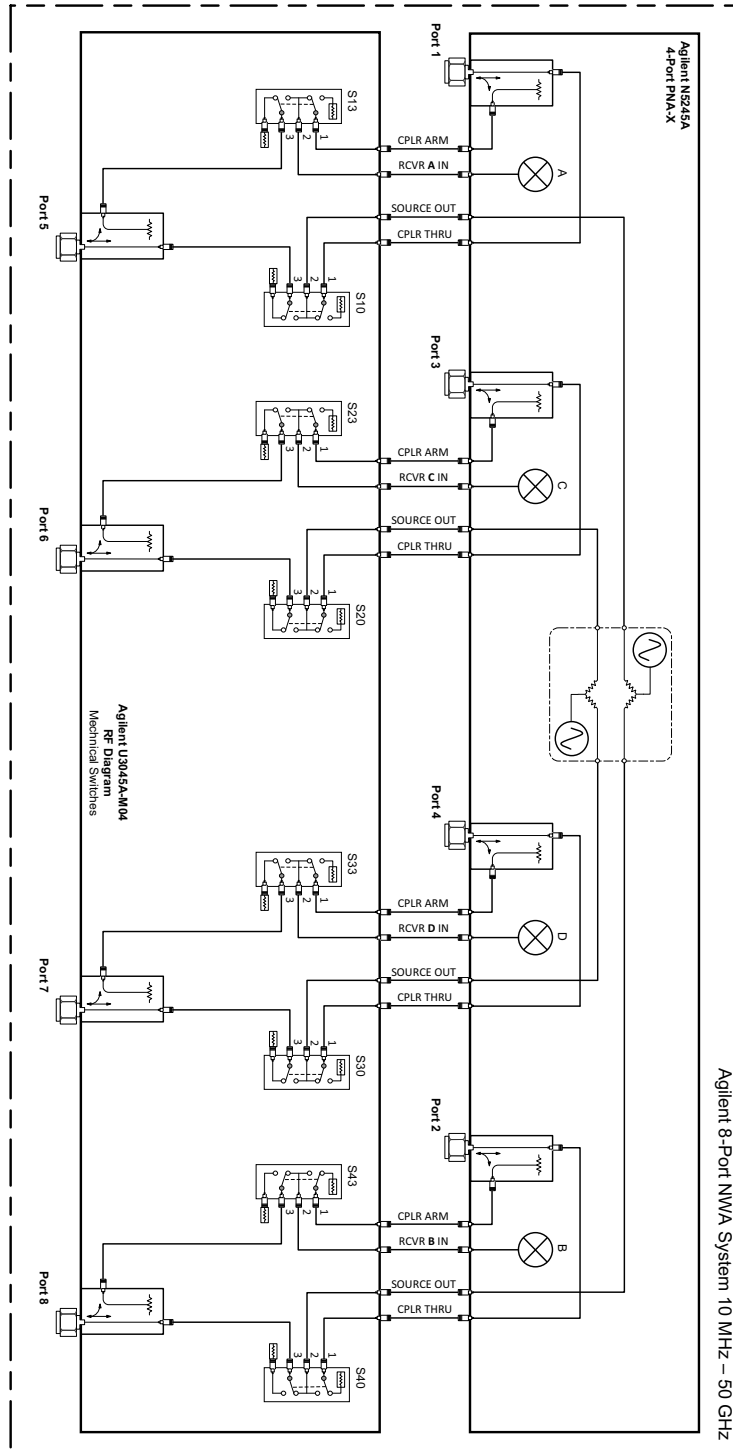
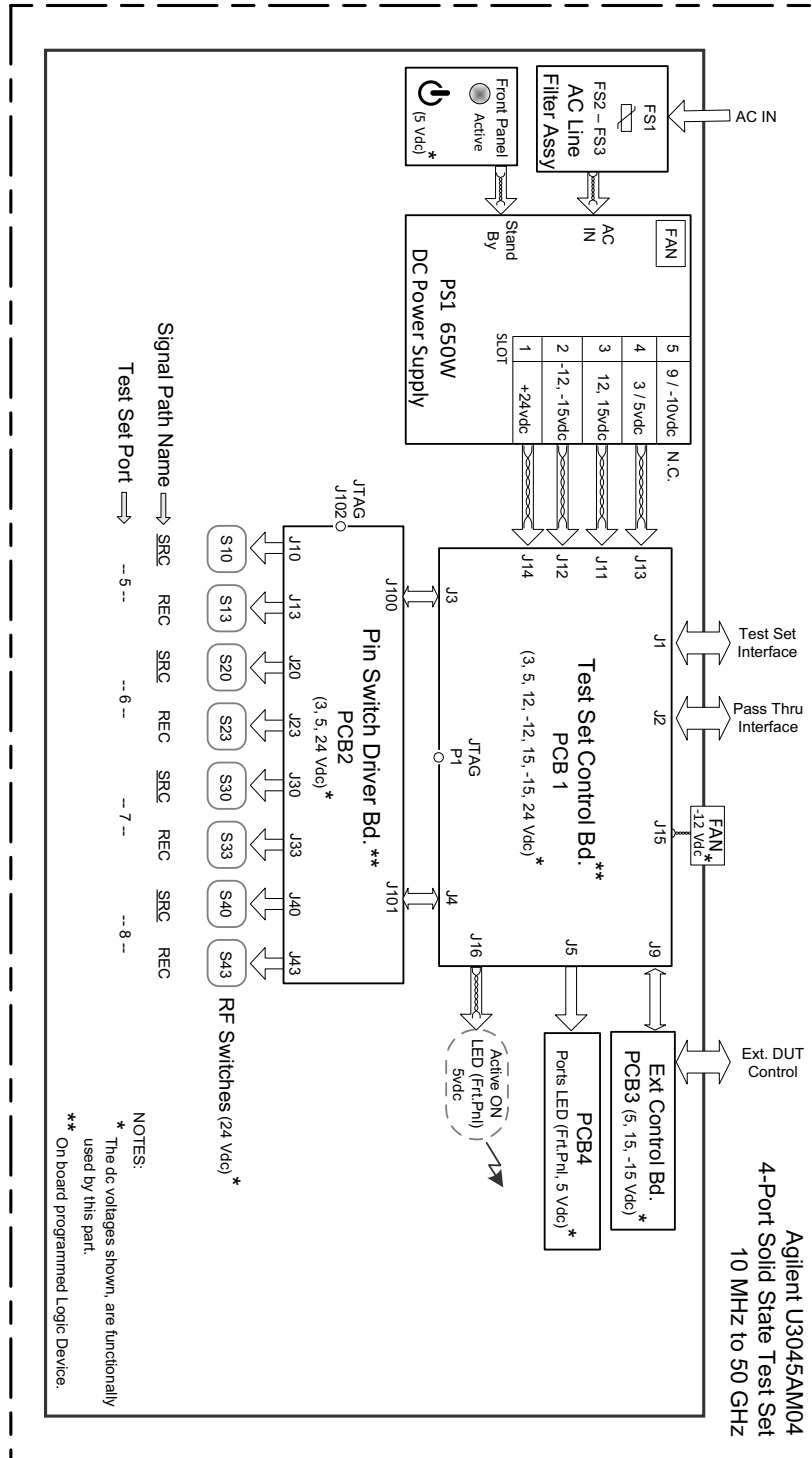


Figure 42 U3045AM04 Electrical Diagram



Theory of Operation

The following is a description of the operation of the Test Set. Reference the Test Set block diagrams shown in [Figure 41 on page 52](#) and [Figure 42 on page 53](#). This section assumes the user has a general understanding of couplers, switches, and network analyzers.

The Test Set adds four test ports to a 4-Port network analyzer. The internal RF switches direct the source output and receiver input to the selected port coupler.

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

RF Coupler

The Test Set uses four couplers (5087-7724) on the front panel for RF Test Ports 5 - 8. 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. See [Figure 47 on page 63](#) that includes cable losses to the coupler.

RF Switch Components

The Test Set uses eight mechanical switches (N1811-60023) that have internal 50Ω termination and an external 50Ω termination (00901-60003). The switches select the RF paths from the analyzer source and receiver through interconnect cables to the Test Set.

Source and Receiver Switch Paths

SW10 - Source to Ports (1 and 5) Switch 10 provides control of the Source Output path to analyzer Port 1 and Test Set Port 5. In the state shown in the block diagram, switch 10 routes the RF Source back to the analyzer Port 1, and Test Set Source path to Port 5 is terminated.

SW20 - Source to Ports (3 and 6) Switch 20 provides control of the Source Output path to analyzer Port 3 and Test Set Port 6. In the state shown in the block diagram, switch 20 routes the RF Source back to the analyzer Port 3, and Test Set Source path to Port 6 is terminated.

SW30 - Source to Ports (4 and 7) Switch 30 provides control of the Source Output path to analyzer Port 4 and Test Set Port 7. In the state shown in the block diagram, switch 30 routes the RF Source back to the analyzer Port 4, and Test Set Source path to Port 7 is terminated.

SW40 - Source to Ports (2 and 8) Switch 40 provides control of the Source Output path to analyzer Port 2 and Test Set Port 8. In the state shown in the block diagram, switch 40 routes the RF Source back to the analyzer Port 2, and Test Set Source path to Port 8 is terminated.

SW13 - Receiver to Ports (1 and 5) Switch 13 provides control of the Receiver Input path to analyzer Port 1 and Test Set Port 5. In the state shown in the block diagram, switch 13 routes Port 1 Coupler Arm to the Receiver, and Test Set Port 5 Coupler Arm path is terminated.

SW23 - Receiver to Ports (3 and 6) Switch 23 provides control of the Receiver Input path to analyzer Port 3 and Test Set Port 6. In the state shown in the block diagram, switch 23 routes Port 3 Coupler Arm to the Receiver, and Test Set Port 6 Coupler Arm path is terminated.

SW33- Receiver to Ports (4 and 7) Switch 33 provides control of the Receiver Input path to analyzer Port 4 and Test Set Port 7. In the state shown in the block diagram, switch 33 routes Port 4 Coupler Arm to the Receiver, and Test Set Port 7 Coupler Arm path is terminated.

SW43 - Receiver to Ports (2 and 8) Switch 43 provides control of the Receiver Input path to analyzer Port 2 and Test Set Port 8. In the state shown in the block diagram, switch 43 routes Port 2 Coupler Arm to the Receiver, and Test Set Port 8 Coupler Arm path is terminated.

Troubleshooting the Test Set

If the U3045AM04 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.

When sending the Test Set in for repair, please also send your PNA and cables. This will allow us to verify proper operation of the complete system, and speed your repair turn-around time. Refer to [“Agilent Support, Services, and Assistance” on page 74](#).

Refer to the following procedures for troubleshooting. It is recommended that a qualified service technician perform the following procedures.

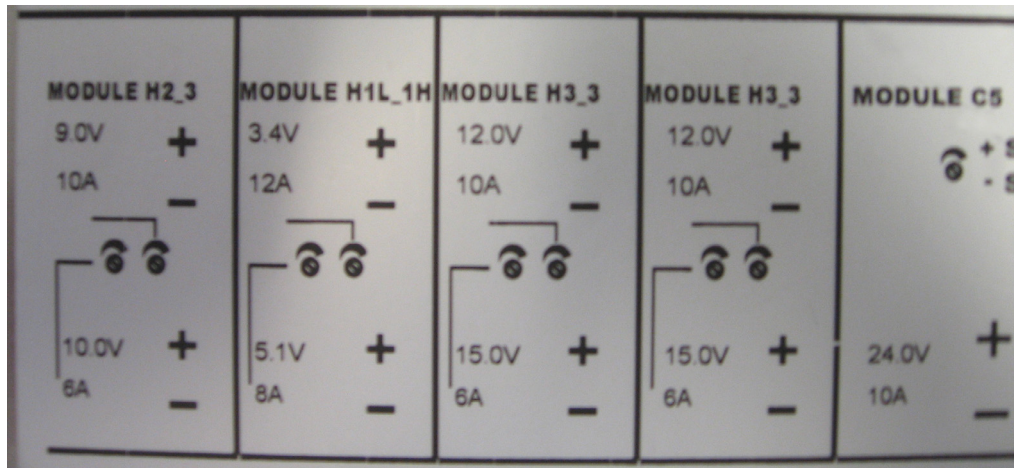
WARNING **No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.**

Fan is not Operating

Suspect a power supply problem or failed fan, and perform the following troubleshooting.

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.**

1. Verify the front panel power switch (3101-4058) is operational.
2. Verify that the AC line voltage is correct (100/120/220/240 VAC, 50/60 Hz) and that the power cord is not damaged.
 - a. If the power cord is damaged, replace it.
 - b. If the AC line voltage is incorrect, use another receptacle.
3. Verify that the fuse (2110-0709) in line module is not blown. There is a spare fuse in the line module. Refer to [Figure 4 on page 11](#). If the fuse is working, continue to step 4.
4. Remove the top cover. Verify that the supply LED indicators, on the test set control board (N5261-60006) are illuminated. The +9 and +10 V supplies will not be on. If the LED's are illuminated, replace the fan (87050-60027). Refer to [Figure 48 on page 66](#).
5. If the LED's are off, verify the voltages (+24, +5, +3, -15, -12, +15, +12, +9 and -10 Volts) on the Test Set Controller board. If the voltages are not correct, verify that J10 - J14 cables are connected correctly on both the power supply and controller board. Refer to [Figure 48 on page 66](#).
6. If the J10 - J14 cables are connected properly, measure the voltages on the power supply screw terminals. See the power supply voltages in [Figure 43 on page 57](#).

Figure 43 Test Set Power Supply

7. If power supply voltages are not present, verify and/or replace the two 8 amp fuses (2110-0342) in the line fuse assembly. Refer to [Figure 48 on page 66](#).
 - a. If the fuses are correct, replace the power supply (0950-4729).

Front Panel LEDs (R, S or Active) are not Illuminated

If the U3045AM04 fan and power supplies are operating the following procedures can be used to verify the failure. Suspect the Test Set Controller Board (N5261-60006) or Front Panel LED Assembly (N5261-60005).

1. Verify the Test Set I/O cable (8120-6818) is installed correctly. See [Figure 11 on page 16](#).
2. Using multiport mode (Option 551), verify the PNA firmware is correct, and the test set file is loaded into the PNA, refer to [“Network Analyzer Requirements” on page 3](#).
3. Using the I/O command values, confirm the correct address and data values are used. Refer to [“Address and Data Values” on page 35](#).
4. Remove the top cover. Verify that the supply LED indicators, on the test set control board (N5261-60006), are illuminated.
5. If the LED's are off, verify the voltages(+24, +5, +3, -15, -12, +15, +12, +9 and -10 Volts) on the Test Set Controller board. If the voltages are not correct, verify that J10 - J14 cables are connected correctly on both the power supply and controller board. Refer to [“Fan is not Operating” on page 56](#).
6. Verify at least one of the status LEDs is on. If not, replace the controller board (N5261-60006).
7. If the controller board status LEDs are on, and the Active LED is on, suspect the front panel LED boards (N5261-60005) or the ribbon cables (N5261-60001). If only one set of front panel LEDs are not working, connect the ribbon cable from one of the working front panel LED boards to the front panel LED board assembly that is not working. Replace if necessary.

Test Ports are not Switching

If the test ports are not switching, the following procedures can be used to verify the failure. The procedures assume power supplies, controller board and front panel LEDs are working. Suspect the switch interface board (U3025-60062), ribbon cable connection or coax switch (N1811-60023).

1. Inspect the ribbon cable connections from the test port switches to the Switch Interface board (U3025-60062). Refer to [Table 16 on page 65](#).
2. Send a test set I/O command and verify that the mechanical switches are make a clicking sound. If there is no sound, replace the Switch Interface board (U3025-60062) or the suspected switch (N1811-60023).
3. If the switches are operating, send a test set I/O command to verify the path for each port. See [“Source and Receiver Path Test” on page 58](#).
4. Substitute a known good switch, or connect a known good ribbon cable to a suspect switch and retest. Replace if necessary.

Source and Receiver Path Test

This section provides information for testing the RF paths.

Equipment Required

- N5224/25/27/44/45/47A Network Analyzer
- Two Flex Cable (8121-1072 or equivalent)
- One 2.4 mm Adapters (female to female), (11900B or equivalent)
- Test Set I/O Cable (8120-6818)

Equipment Setup

1. Connect the Test Set I/O cable (8120-6818) from the analyzer to Test Set. Refer to [Figure 11 on page 16](#).
2. Set analyzer to “Standalone mode” (test can not be performed in Multiport mode). Refer to [Figure 17 on page 21](#).
3. Connect the flexible cables to the analyzer's Ports 1 and 2. Connect the cables together using a 2.4 mm adapter.
4. Set the frequency range to 10 MHz to 50 GHz, or the frequency range of the analyzer you are using.
5. Select [Ref Level] 0 dB > [Scale] 2 dB (or Autoscale).
6. Select measure S21 trace, and perform a Response Cal. Select [Memory] > Normalize.

Source Path Trace

The S21 trace should be approximately -0 to -3.5 dB (± 1 dB) for all CPLR THRU to SOURCE IN paths. Refer to the individual port path to be tested. Refer to [Figure 2 on page 9](#) for the connector locations, and [Figure 45 on page 62](#) for example path response.

The S21 trace should be approximately -0 to -7 dB (± 1 dB) for test Ports 5 thru 8 to SOURCE IN paths. Refer to [Figure 46 on page 63](#) for example path response.

Port 1 Source

- Set Test I/O addr.data 0.0
- Connect PNA Port 1 flex cable to Test Set Port 5 CPLR THRU.
- Connect PNA Port 2 flex cable to Test Set Port 5 SOURCE IN.

Port 3 Source

- Set Test I/O addr.data 16.0
- Connect PNA Port 1 flex cable to Test Set Port 6 CPLR THRU.
- Connect PNA Port 2 flex cable to Test Set Port 6 SOURCE IN.

Port 4 Source

- Set Test I/O addr.data 32.0
- Connect PNA Port 1 flex cable to Test Set Port 7 CPLR THRU.
- Connect PNA Port 2 flex cable to Test Set Port 7 SOURCE IN.

Port 2 Source

- Set Test I/O addr.data 64.0
- Connect PNA Port 1 flex cable to Test Set Port 8 CPLR THRU.
- Connect PNA Port 2 flex cable to Test Set Port 8 SOURCE IN.

Port 5 Source

- Set Test I/O addr.data 0.1
- Connect PNA Port 1 flex cable to Test Set Port 5.
- Connect PNA Port 2 flex cable to Test Set SOURCE IN.

Port 6 Source

- Set Test I/O addr.data 16.1
- Connect PNA Port 1 flex cable to Test Set Port 6.
- Connect PNA Port 2 flex cable to Test Set SOURCE IN.

Port 7 Source

- Set Test I/O addr.data 32.1
- Connect PNA Port 1 flex cable to Test Set Port 7.
- Connect PNA Port 2 flex cable to Test Set SOURCE IN.

Port 8 Source

- Set Test I/O addr.data 64.1
- Connect PNA Port 1 flex cable to Test Set Port 8
- Connect PNA Port 2 flex cable to Test Set SOURCE IN.

Receiver Path Trace

The S21 trace should be approximately -0 to -3.5 dB (± 1 dB) for all RCVR OUT to CPLR ARM paths. Refer to the individual port path to be tested. Refer to [Figure 2 on page 9](#) for the connector locations, and [Figure 44 on page 62](#) for example path response.

The S21 trace should be approximately -18 dB (± 1 dB) for frequencies > 1 GHz, and -50 dB for frequencies < 1 GHz. This is due to the couplers low frequency response for test Ports 5 thru 8 to RCVR OUT paths. Refer to [Figure 47 on page 63](#) for example path response.

Port 1 RCVR

- Set Test I/O addr.data 0.0
- Connect PNA Port 1 flex cable to Test Set Port 5 CPLR ARM.
- Connect PNA Port 2 flex cable to Test Set Port 5 RCVR OUT.

Port 3 RCVR

- Set Test I/O addr.data 16.0
- Connect PNA Port 1 flex cable to Test Set Port 6 CPLR ARM.
- Connect PNA Port 2 flex cable to Test Set Port 6 RCVR OUT.

Port 4 RCVR

- Set Test I/O addr.data 32.0
- Connect PNA Port 1 flex cable to Test Set Port 7 CPLR ARM.
- Connect PNA Port 2 flex cable to Test Set Port 7 RCVR OUT.

Port 2 RCVR

- Set Test I/O addr.data 64.0
- Connect PNA Port 1 flex cable to Test Set Port 8 CPLR ARM.
- Connect PNA Port 2 flex cable to Test Set Port 8 RCVR OUT.

Port 5 RCVR

- Set Test I/O addr.data 0.16
- Connect PNA Port 1 flex cable to Test Set Port 5.
- Connect PNA Port 2 flex cable to Test Set Port 5 RCVR OUT.

Port 6 RCVR

- Set Test I/O addr.data 16.16
- Connect PNA Port 1 flex cable to Test Set Port 6.
- Connect PNA Port 2 flex cable to Test Set Port 6 RCVR OUT.

Port 7 RCVR

- Set Test I/O addr.data 32.16
- Connect PNA Port 1 flex cable to Test Set Port 7.
- Connect PNA Port 2 flex cable to Test Set Port 7 RCVR OUT.

Port 8 RCVR

- Set Test I/O addr.data 64.16
- Connect PNA Port 1 flex cable to Test Set Port 8.
- Connect PNA Port 2 flex cable to Test Set Port 8 RCVR OUT.

Figure 44 CPLR ARM to RCVR OUT

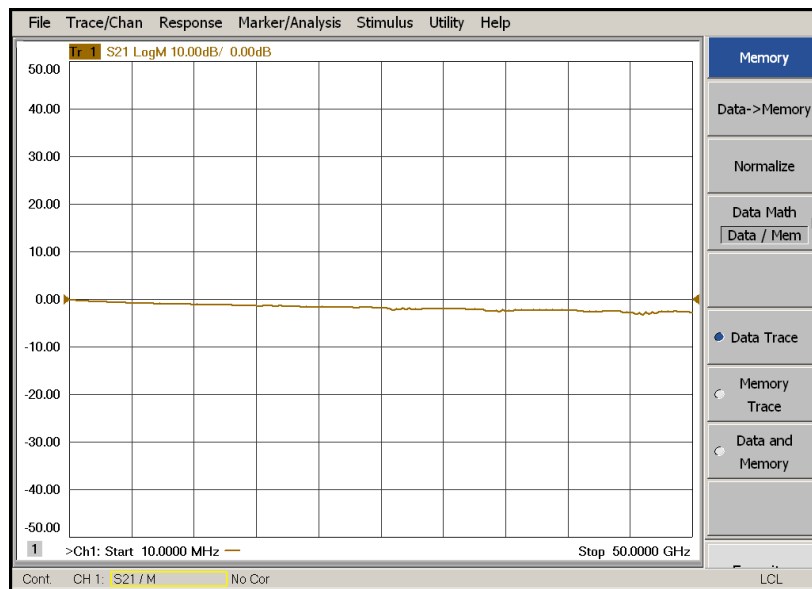


Figure 45 CPLR THRU to SOURCE IN

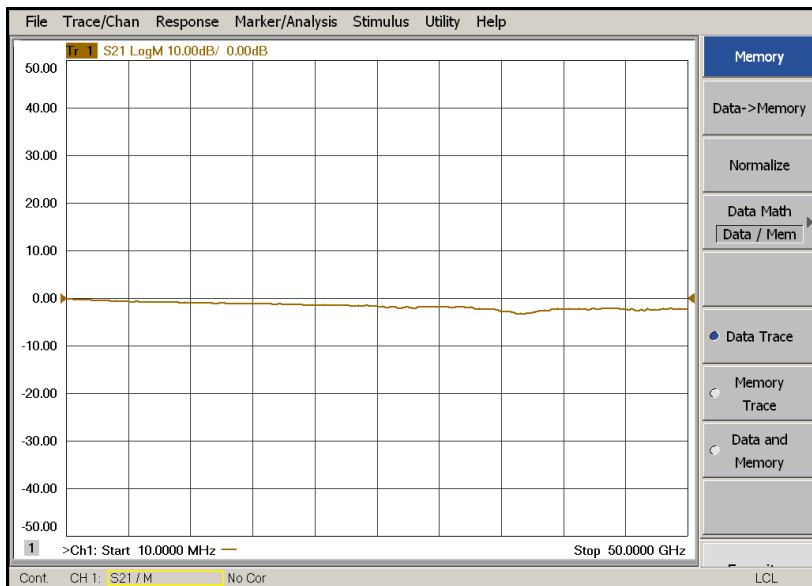


Figure 46 Test Port CPLR THRU to SOURCE IN

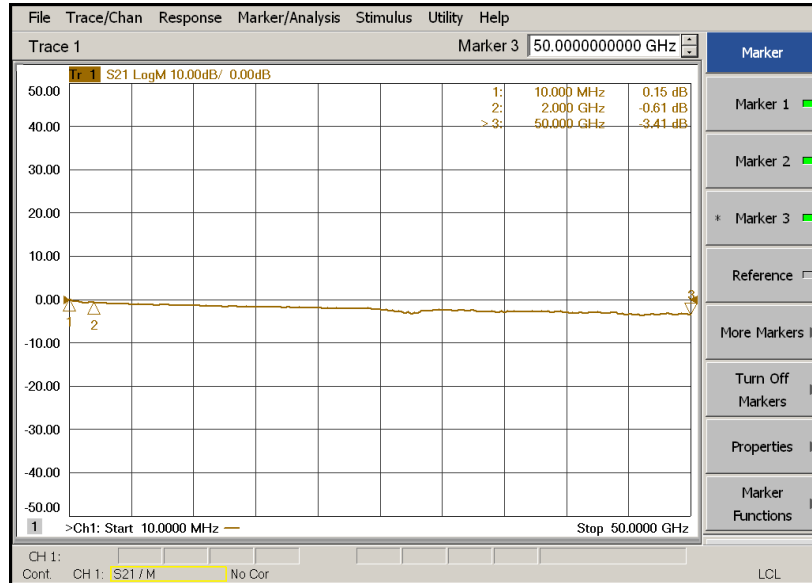
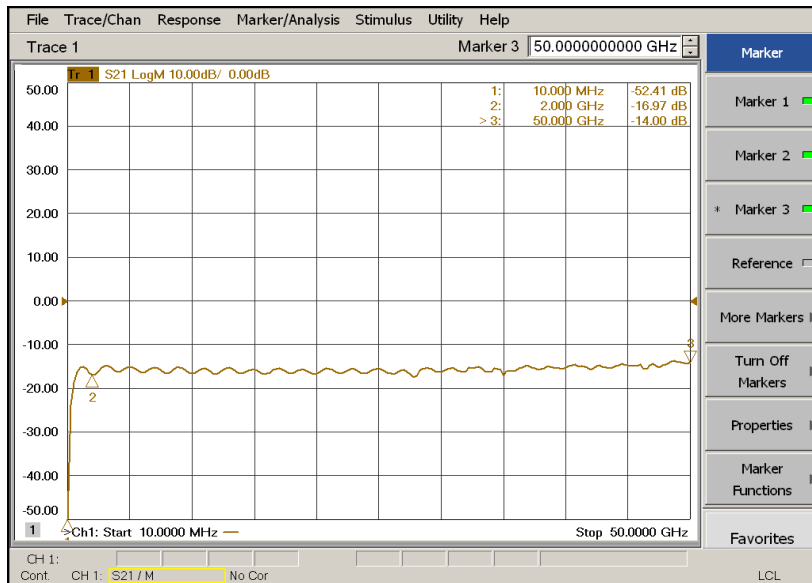


Figure 47 Test Port CPLR ARM to RCVR OUT



RF Performance Fails

If the U3045AM04 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 U3045AM04 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 a Cal Kit Operational Check Failure” on page 48.](#)
3. Review the [“Operational Check with Cal Kit” on page 43](#) 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. Refer to [“Source and Receiver Path Test” on page 58.](#)
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.

Control Lines are not Working

If the U3045AM04 operates correctly but the control lines are not functioning, the following procedures can be used to verify the component failure. Suspect the DUT CONTROL BD (E5091-66503).

1. Verify that the control voltage pins on the DUT control are connected correctly. Refer to [“Control Lines” on page 37.](#)
2. Verify that the control pot is centered (5V). Refer to [Figure 3 on page 10.](#)
3. Verify the ribbon cable connection.
4. Replace the DUT control board (E5091-66503).
5. Replace the test set control board (N5261-60006).

Troubleshooting Diagrams and Tables

Table 15 Controller Board Connections

Controller Bd Connection	Connection
LED Ribbon Cables From the LED Board	
J5	Ports 5, 6, 7 and 8
Wire harness Active LED	
J16	Active LED
DUT Control Ribbon Cable	
J9	DUT Controller Board
Power Supply Wire Harness	
J10	Power Supply -10 V
J11	Power Supply +15 V
J12	Power Supply -15 V
J13	Power Supply +5 V
J14	Power Supply +24 V
J18	Fan

Table 16 Switch Interface Board

SW #	Interface Bd Connection	Ports	Path
1	J10	1 and 5	Source
3	J13	1 and 5	Receiver
5	J20	2 and 6	Source
7	J23	2 and 6	Receiver
9	J30	3 and 7	Source
11	J33	3 and 7	Receiver
13	J40	4 and 8	Source
15	J43	4 and 8	Receiver

Figure 48 Test Set Top View

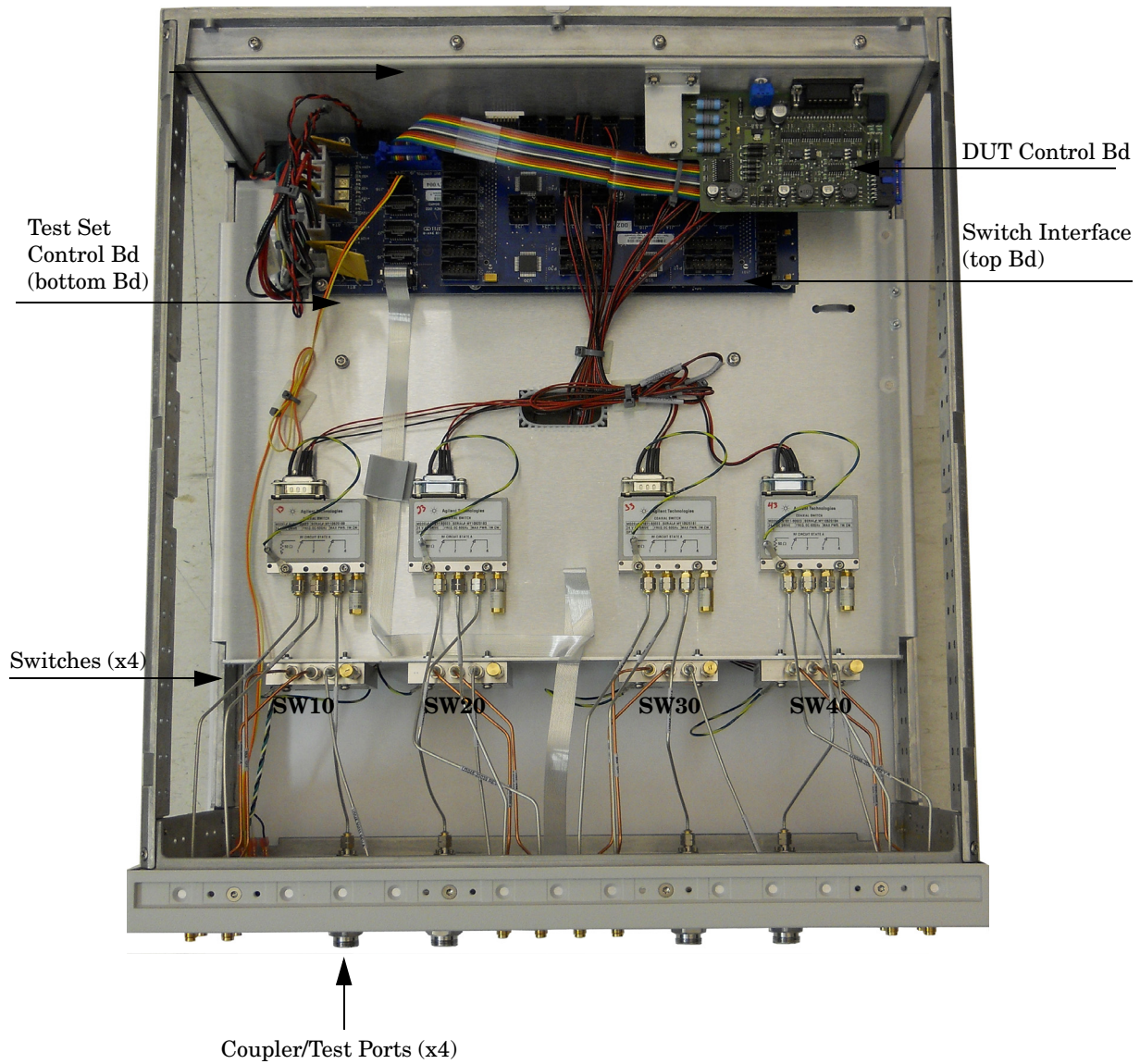
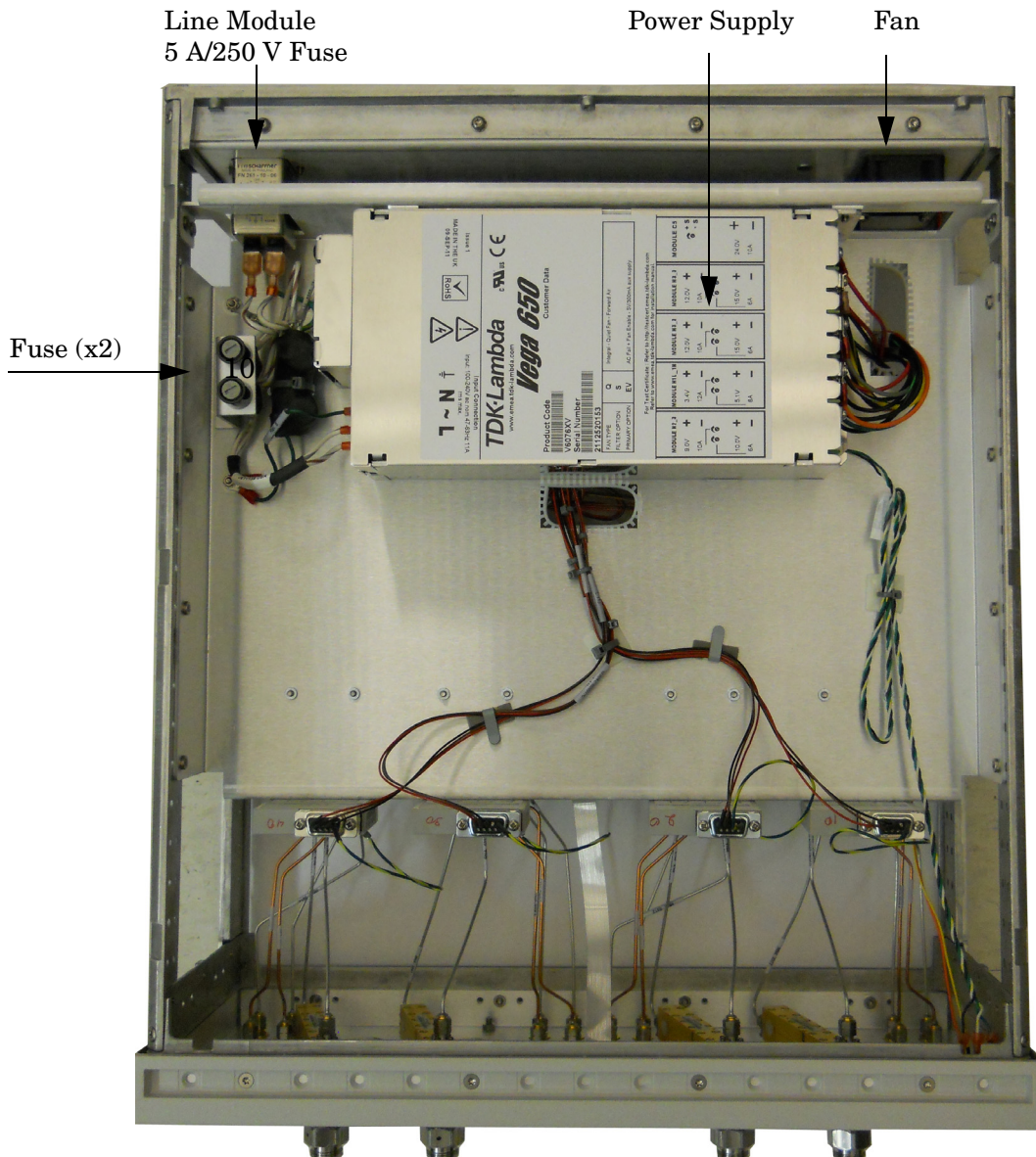


Figure 49 Test Set Bottom View



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.

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.

Servicing

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).

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 U3045AM04](#) 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.

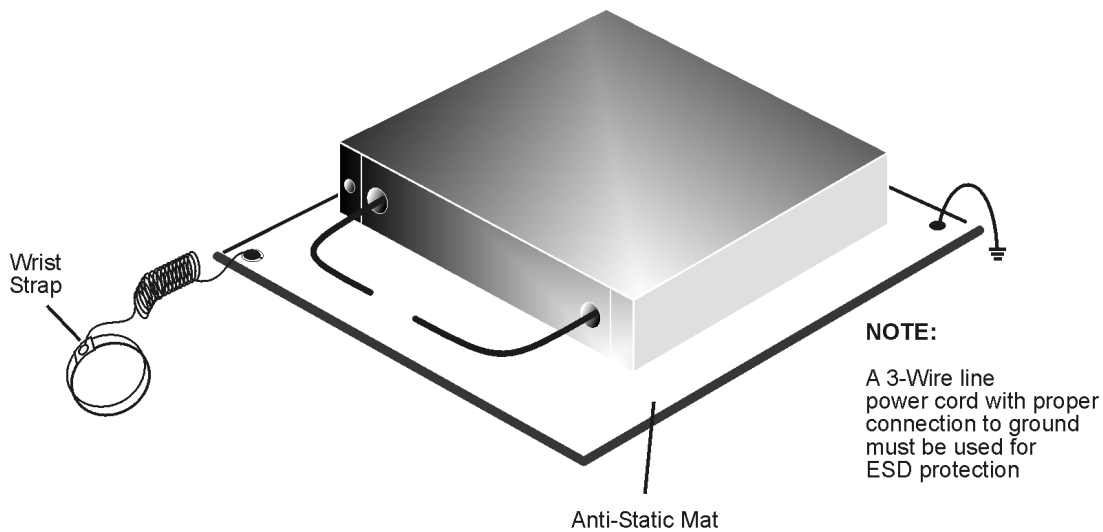
WARNING If flammable cleaning materials are used, the material shall not be stored, or left open in the area of the equipment. Adequate ventilation shall be assured to prevent the combustion of fumes, or vapors.

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 M Ω 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 50 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).



The AC symbol indicates the required nature of the line module input power.



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.



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



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

Compliance with German Noise Requirements

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

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

EMC Information

Complies with European EMC Directive 2004/108/EC

- IEC/EN 61326-1
- CISPR Pub 11 Group 1, class A
- AS/NZS CISPR 11
- This ISM device complies with Canadian ICES-001.
Cet appareil ISM est conforme a la norme NMB du Canada.

Agilent Support, Services, and Assistance

Service and Support Options

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

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

Contacting Agilent

Assistance with test and measurements needs and information or finding a local Agilent office are available on the Web at:

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

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

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

Shipping Your Product to Agilent for Service or Repair

IMPORTANT Agilent Technologies reserves the right to reformat or replace the internal hard disk drive in your analyzer as part of its repair. This will erase all user information stored on the hard disk. It is imperative, therefore, that you make a backup copy of your critical test data located on the analyzer's hard disk before shipping it to Agilent for repair.

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

- To improve turn-around time, return your Test Set along with your analyzer 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.