Installation and Reference Guide

Agilent N1900 Series
Physical Layer Test Systems

N1930A Physical Layer Test System Software which supports VNA-Based and TDR-Based Physical Layer Test System Hardware

Agilent Technologies

Manufacturing Part Number: N1930-90005

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Notice

LIMITED WARRANTY

Assistance

Product maintenance agreements and other customer assistance agreements are available for Agilent Technologies products. For any assistance, refer to “Contacting Agilent” on page 237.

Software Licensing

The Physical Layer Test System has two licensing options. The options are:

Node-Locked allows use of PLTS software only on a single personal computer. The license resides on and is tied to the local PC via a hardware address.

Server-Based Floating allows the sharing of a licenses (or multiple licenses) across a network. The PLTS software may be installed on an unlimited number of personal computers. The license(s) reside on a networked drive/folder and are checked out on a first-come, first-served basis.

Refer to Chapter 3, Installing the Physical Layer Test System Software, for the licensing procedure.

Software Compatibility

This document is compatible with Physical Layer Test System software revisions 2.500 and above.

Document Conventions

This document uses a few conventions to make reading easier.

- Menu and dialog box items are shown in bold face type. When described in text, menus and sub-menus are separated by right arrows, as in **File > Open > Data...**
- Window and dialog box names are shown in *italic* font.
- Keyboard entries are shown in `mono-spaced` typeface.
- Network analyzer keys are displayed in **condensed, bold** font.

Embedded Operating System Risk

PNA Network Analyzers

The Agilent PNA-family of network analyzers make use of Embedded Operating Systems (EOS) technology. The EOS is Windows[1] 2000, a standard personal computer-based operating system. The PNA is essentially a network analyzer with a personal computer behind the front panel.

EOS devices, including the PNA may be connected to computer networks. When connected, these devices are open to numerous security exploits, worms, and viruses. In addition, they can become a threat to other EOS devices, servers, end-user PCs, and to the network itself.

Precautions are taken to ensure that the PNA has no security issues, such as worms or viruses, prior to shipping. To maintain the health of the PNA, it is recommended that you install anti-virus software and the latest service packs on the PNA before connecting the PNA to a computer network.

Infiniium DCA Oscilloscopes

On your 86100C, you can access Microsoft Windows XP Professional just as you would on your personal computer. Use Windows XP Professional to manage files and folders, add, remove, and setup printing, configure networking, and install applications. The ability to access the operating system is not available on 86100A/B instruments.

Although the 86100C is an instrument and not a personal computer, the operating system is accessible. This makes it possible for you to install applications such as virus protection software. If the performance of the Infiniium DCA application decreases while running other applications, you may need to close those applications that are demanding processor resources. It is also suggested that you schedule automatic virus scans for times when you are not making measurements. Refer to the 86100C Help for complete information.

1. Windows® and MS Windows® are U.S. registered trademarks of Microsoft Corporation.

Contents

I Installation

Part I guides you through the initial steps of installing the physical layer test system.

Chapter 1, "Installing the VNA-Based Physical Layer Test System Hardware"

Provides you a step-by-step installation procedure for the VNA-based PLTS hardware.

Chapter 2, "Installing the TDR-Based Physical Layer Test System Hardware"

Provides you a step-by-step installation procedure for the TDR-based PLTS hardware.

Chapter 3, "Installing the Physical Layer Test System Software"

Provides you a step-by-step installation procedure for the PLTS software. This chapter also explains the various areas of the main software screen.

1 Installing the VNA-Based Physical Layer Test System Hardware

The Physical Layer Test System (PLTS) consists of the following items:

- Personal computer (PC)
- VNA-based system (Network analyzer and S-parameter test set)
- PLTS software

The installation procedure in this chapter will lead you through setting up the hardware (the PC and the VNA-based system). After that is complete, you will refer to Chapter 3, Installing the Physical Layer Test System Software, to install the software.

NOTE If you have the TDR-based PLTS system, refer to Chapter 2, “Installing the TDR-Based Physical Layer Test System Hardware,” on page 33 for instructions on setting up that system.

This installation procedure will lead you through a series of steps to set up your PLTS hardware. The following is a list of the installation steps:

- Step 1. Set Up the Personal Computer
- Step 2. Verify your System Shipment
- Step 3. Set Up the Network Analyzer
- Step 4. Attach the Test Set to the Network Analyzer (N4420B or N4464A/B Test Set Only)
- Step 5. Install the S-Parameter Test Set on a Bench Top or in an Equipment Rack
- Step 6. Make the Interconnections between the S-Parameter Test Set and the Network Analyzer
- Step 7. Set Up the General Purpose Interface Bus (GPIB)
- Step 8. Power up the Physical Layer Test System

NOTE These installation instructions were written specifically for customers who have just received their PLTS. If you have already been using our S-parameter test set and its corresponding network analyzer, you have probably completed most of these installation steps. Review these installation steps to ensure that your system is currently set up as recommended. Then, begin the software installation process by starting at Chapter 3, “Installing the Physical Layer Test System Software,” on page 41.

Step 1. Set Up the Personal Computer

1. Make sure that your PC meets the following minimum system controller requirements:

Table 1-1 Minimum PC Requirements by PLTS Modes of Operation

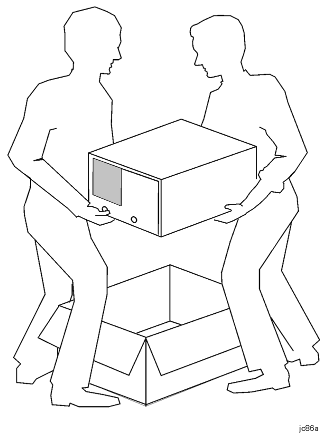
PC Requirement	Measurement Controller Mode	Off-Line Analysis Mode
	In the lab, controlling test equipment and making quick analysis of the results	In your office, performing "What if..." analysis, characterization, cross-domain analysis, filtering, waveform math, and eye diagram simulation
CPU	400 MHz Pentium®[a] II or greater	1 GHz Pentium III compatible PC
Main Memory	256 MB[b]	512 MB
Virtual Memory[c]	512 MB	768 MB
GPIB Interface	Agilent 82357A USB/GPIB Interface for Windows or supported GPIB card (any National Instruments or Agilent 82340/41 or 82350 GPIB card)	No GPIB connection is required to utilize PLTS in the off-line mode. Saved (stored) measurement files can be recalled at any time for analysis.
Operating Systems	Windows 2000 or Windows XP[d]	
Screen Resolution	1024 × 768	
Display Colors	High Color (16 Bit) or greater	

a. Pentium® is a U.S. registered trademark of Intel Corporation.
b. 512 MB of Main Memory is recommended for the Measurement Controller Mode when the measurement is measuring 16,000 points with the PNA B-model network analyzer.
c. As a general rule for optimum PC performance when using PLTS, virtual memory should be 1.5 to 2 times the size of the main memory.
d. Earlier versions of Windows are no longer supported by PLTS.

2. Using the PC documentation, make sure that the PC is operating properly.
3. Make sure the GPIB card is installed in the PC and that it is operating properly.
4. Make sure the PC is located near where you will position the Physical Layer Test System (PLTS). Later in this process, you will connect the GPIB card to the PLTS using a GPIB cable.

Step 2. Verify your System Shipment

1. Unpack your system from the containers in which it was shipped.



WARNING **The test system hardware is heavy. Use proper lifting techniques. The network analyzer can weigh between 53 lb. (24 kg) and 64 lb. (29 kg). The test set can weigh as much as 20 lb. (9 kg).**

2. Carefully inspect the system hardware to make sure that it was not damaged during shipment.

NOTE If your test system was damaged during shipment, contact Agilent Technologies. Refer to "Contacting Agilent" on page 237.

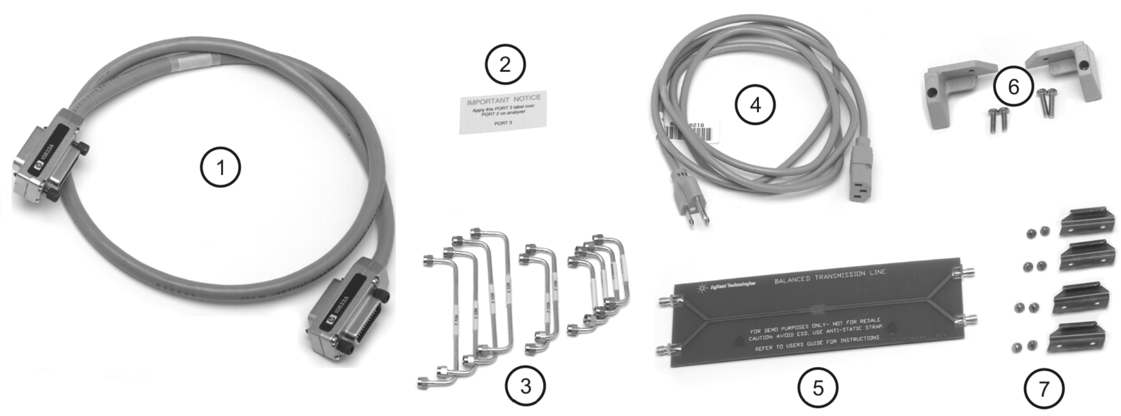
3. Use Table 1-2 to verify that your test set is compatible with your network analyzer and its installed options. "Step 3. Set Up the Network Analyzer" on page 10 has additional network analyzer option information if you have a question. If the installed options are not compatible, contact us before proceeding. Refer to "Contacting Agilent" on page 237.

Table 1-2 Physical Layer Test System Configurations

Test Set Model Number[a]	System Frequency Range	Supported Network Analyzer			
		Model Number	Options[b]		
			Required	Compatible	Incompatible
N4419B	10 MHz to 20 GHz	E8362A[c]/B	014	010, 022, 711, UNL	
		N5230A	225	010	220
N4420B	10 MHz to 40 GHz	E8363A[c]/B	014	010, 022, 711, UNL	
N4421B	10 MHz to 50 GHz	E8364A[c]/B	014	010, 022, 711, UNL	

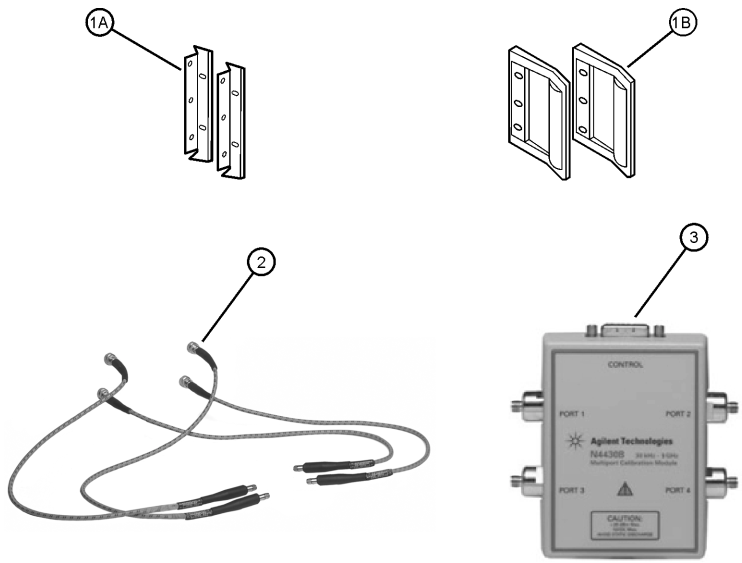
a. For the discontinued test set model numbers (N4415A, N4416A, N4417A, N4418A, N4419A, and N4421A), refer to Table B-2 on page 281 in Appendix B, "Reference Information for Discontinued Physical Layer Test System Hardware."
b. This table lists only the most specifically relevant options. For compatibility with options not listed here, contact the factory.
c. "A" models of this network analyzer have a start frequency of 45 MHz.

4. Check the accessories that were shipped with your system. Your network analyzer accessories will be checked during the network analyzer setup.



Item Nr	Part Number	Part Description
1	8120-3445	GPIB Cable (3 feet)
2	N/A	“Port 3” Label
3	Varies by Test Set Model and Option	Semirigid interconnect cables (refer to Step 6. Make the Interconnections between the S-Parameter Test Set and the Network Analyzer for the appropriate number of cables)
4	Unique to country	AC Power Cord (for the test set)
5	AD00658	Balanced Transmission Line PC Board Device (Sample DUT)
6	Left: Z5823-20239 Right: Z5823-20240	2 Rear Locking Feet (N4420B, N4421A/B only) (With 4 Screws - 2 each - longer: 0515-0686 and shorter: HW00235)
7	1600-1423	4 Lock Links (N4420B, N4421A/B only) with 8 screws (0515-1499)

5. If you ordered any of the following options, check the parts. Option 1CP is shipped in a separate container.



Option Number	Item Number	Part Description
1CP	1A 1B	Rack mount flange kit (For use with handles) Handles (set of 2)
B20	2	Precision 50-ohm cables (4)
060	3	4-Port Electronic Calibration Module/Kit (Not available as an option for the N1951A/53A/53B/55B/57A/57B or N1935A PLTS)
		Other Calibration Kits
N/A	Not Shown	85033E 3.5mm Calibration Kit (0 Hz (dc) - 9 GHz) [1] 85052D 3.5mm Economy Calibration Kit (0 Hz (dc) – 26.5 GHz) [1] 85056A 2.4mm Precision Calibration Kit (0 Hz (dc) – 50 GHz) [1] 85050C 7 mm Precision Calibration Kit (0 Hz (dc) – 18 GHz) [2]

[1] Kit for SOLT Calibration; [2] Kit for TRL Calibration

Step 3. Set Up the Network Analyzer

1. Using Table 1-3, verify that your network analyzer options are compatible with the physical layer test system. Incompatible options are shaded.

Table 1-3 Common Hardware Option Number Descriptions for Network Analyzers

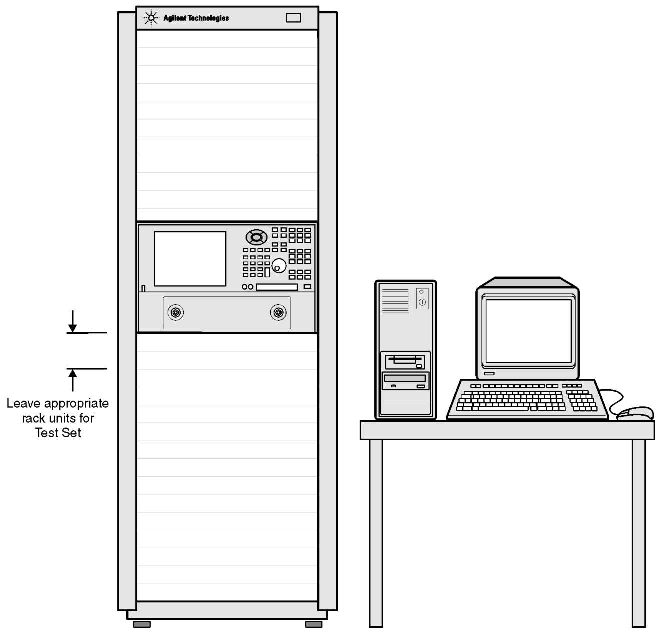
E8362B, E8363B, and E8364B Network Analyzer Options[a]			
010	Time Domain Capability	014	Configurable Test Set
016[b]	Add Receiver Attenuators	022	Extended Memory
080[b]	Frequency Offset	081[b]	External Reference Switch
083[b]	Frequency Converter Measurement Application	711	Standard Power Range
UNL	Extended Power Range with Bias Tees		
N5230A Network Analyzer Options			
010	Time Domain Capability	080[b]	Frequency Offset
220	10 MHz–20 GHz, Standard Test Set	225	10 MHz–20 GHz, Configurable Test Set and Extended Power Range
420	10 MHz–40 GHz, Standard Test Set	425	10 MHz–40 GHz, Configurable Test Set and Extended Power Range
520	10 MHz–50 GHz, Standard Test Set	525	10 MHz–50 GHz, Configurable Test Set and Extended Power Range

a. Network analyzer should have firmware revision A.03.53 or later. Contact the factory for information regarding PLTS support of earlier firmware revisions.
b. This option has not been tested and is not specified with the Physical Layer Test System.

NOTE For option information on the network analyzer model numbers listed below, refer to Table B-3 on page 283 in Appendix B, “Reference Information for Discontinued Physical Layer Test System Hardware.”

8753ES	8720ES/8722ES
E8356A/E8357A/E8358A	E8362A/E8363A/E8364A
E8801A/E8802A/E8803A	

2. Using the network analyzer's Installation and Quick Start Guide, set up the network analyzer.
3. If you are installing your network analyzer in an equipment rack, be sure to leave at least 2 rack units of space *below* the analyzer to install the test set.



NOTE For the N4420B or N4421A/B test set, connect the network analyzer to the test set before placing in the rack as a single unit on one set of rails. Refer to"Step 4. Attach the Network Analyzer to the Test Set" on page 12 for instructions.

Step 4. Attach the Network Analyzer to the Test Set

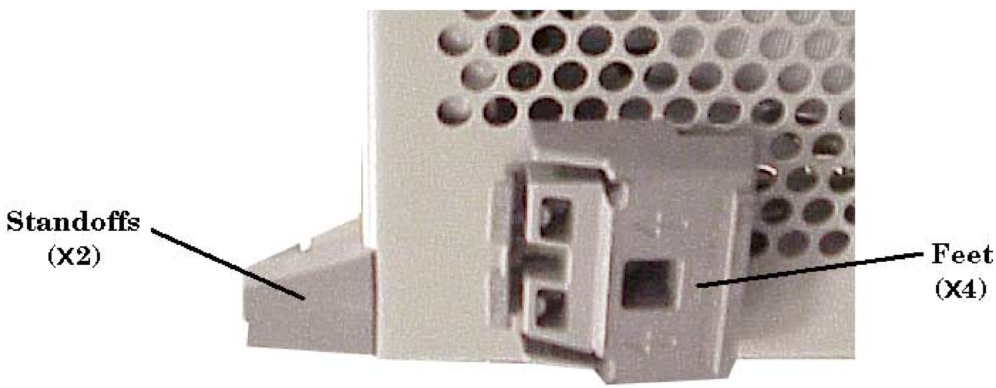
(N4420B or N4421A/B Test Set Only)

If your test set is *not* an N4420B, an N4421A, or an N4421B, continue with "Step 5. Install the Test System on a Bench Top or in an Equipment Rack" on page 15.

The compatible network analyzers are attached to the N4420B and N4421A/B test sets using lock links at the front and locking feet at the rear. This hardware is supplied with the test set. Other network analyzers are ***not*** attached to test sets (N4415A, N4416A, N4417A, N4418A, and N4419A/B) using this hardware.

Preparing the Network Analyzer

1. Remove the four feet from the bottom of the network analyzer.

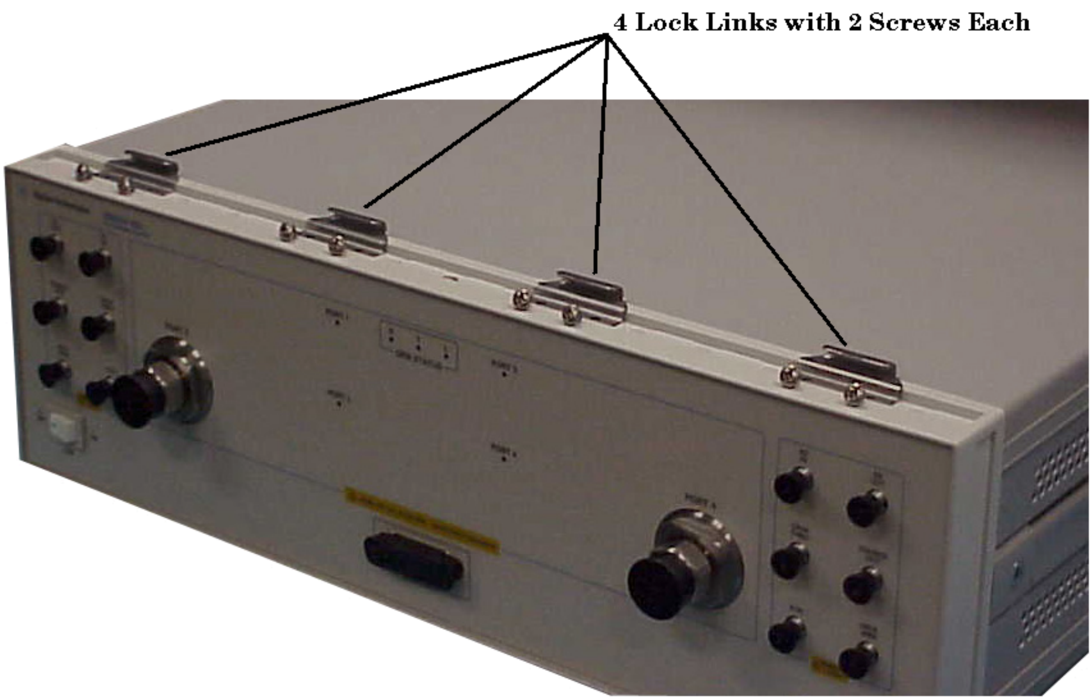


2. Remove the screws from the two lower rear panel standoffs.
3. Install the two rear locking feet where the standoffs were removed. Use part number Z5823-20239 on the left side of the analyzer and part number Z5823-20240 on the right side. Use the two longer screws to secure the feet to the analyzer.

Preparing the Test Set

4. Remove the trim strip from the top of the front frame.
5. Install the four lock links to the top of the front frame using eight screws.

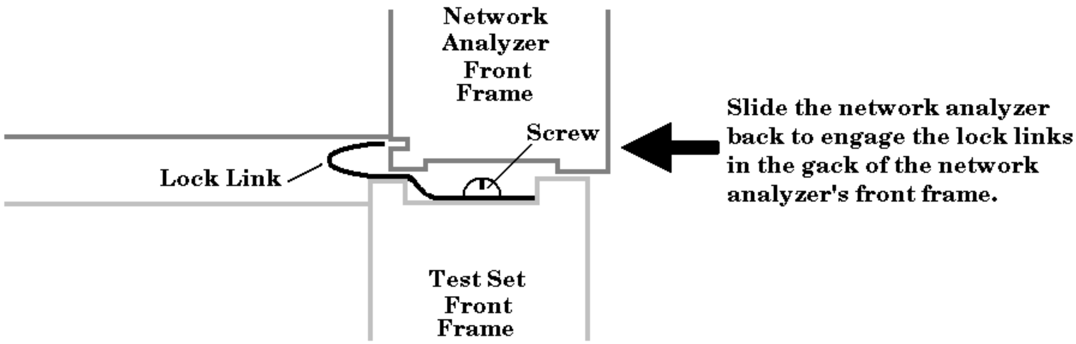
Lock Link Installation



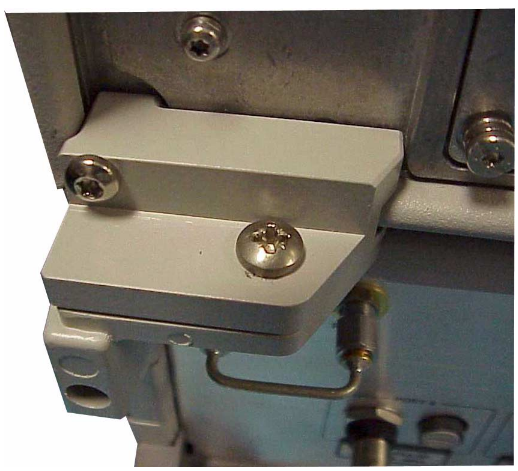
Attaching the Network Analyzer to the Test Set

6. Place the network analyzer on top of the test set ensuring that the front frame of the network analyzer is positioned slightly forward of the lock links that are attached to the the test set. Then slide the network analyzer back so the lock links engage the front frame of the analyzer.

Making the Lock Link Connection



7. Secure the network analyzer's lower locking feet to the test set's upper locking feet by inserting the shorter two screws between the two pairs of locking feet, one on each side of the instrument as shown below.



If the screw holes between the network analyzer's lower locking feet are not aligned with the screw holes in the test set's upper locking feet, loosen the screws securing the feet to the instruments slightly to align.

8. Tighten all screws.

Step 5. Install the Test System on a Bench Top or in an Equipment Rack

The test system can be installed on a bench top or in an equipment rack.

In all installations, consider the following ventilation requirements when deciding where to set up your test system.

CAUTION **Ventilation Requirements:**
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 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, then forced convection must be used.

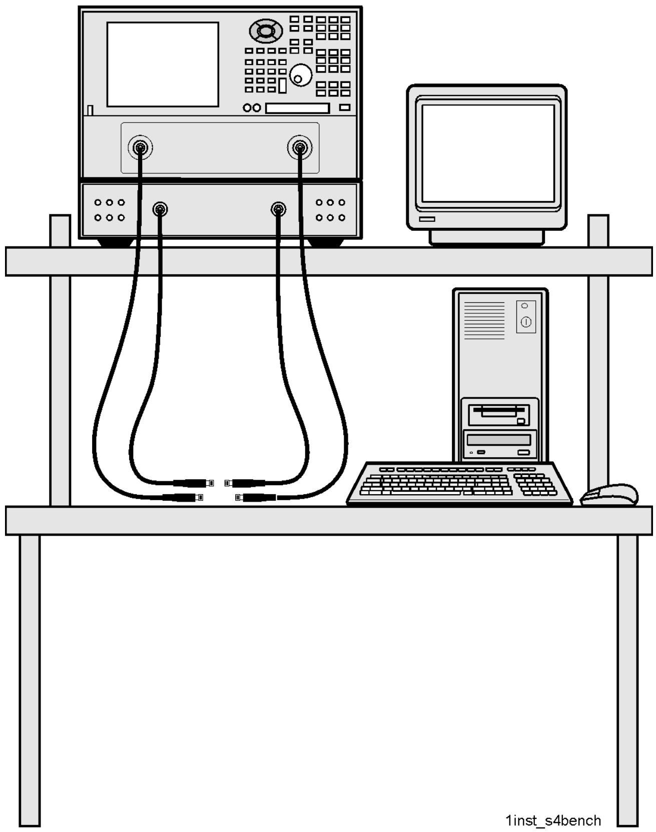
Refer to the section that applies to your installation.

- **For bench top installation**, continue on page 16.
- **For equipment rack installation**, continue on page 17.

To Install on a Bench Top

1. Place the test set and the network analyzer on a bench top. In the example illustration shown below, the system is placed on a riser as an alternative to the bench top. Make sure that there is at least four inches of clearance on the sides and back of the system for adequate ventilation.

   The front panel test cables are shown only as a reminder to make sure they can easily reach the test surface of the bench.



CAUTION Consider the ventilation requirement described on page 15 when selecting the location of your system.

2. Continue with "Step 6. Make the Interconnections between the S-Parameter Test Set and the Network Analyzer" on page 21.

To Install in an Equipment Rack

You may install the PLTS in an equipment rack in one of following two ways:

Removing Feet from VNA	Leaving Feet attached to VNA
1. Install one set of rails into the equipment rack 2. Remove feet from Test Set and VNA 3. Attach mount flanges and the handles to Test Set 4. Attach mount flanges and the handles to VNA 5. Insert test set on rails in equipment rack and screw to rack 6. Place VNA on top of test set and screw VNA into rack 7. Bend Semi rigid interconnect cables to fit between the test set connector and the VNA connector 8. Connect semirigid between test set and VNA	1. Install one set of rails into the equipment rack 2. Remove feet from Test Set only 3. Attach mount flanges and the handles to Test Set 4. Attach mount flanges and the handles to VNA 5. Insert test set on rails in equipment rack and screw to rack 6. Place VNA on top of test set 7. Connect semirigid between test set and VNA

When you install the test set in an equipment rack, you will install rails in the rack to support the weight of the test set, attach the handles and the rack mount flanges to the test set, and secure the test set to the equipment rack.

1. Ensure that the front handle kit, the rack mount flange kit, and the rack mount rail set are complete.

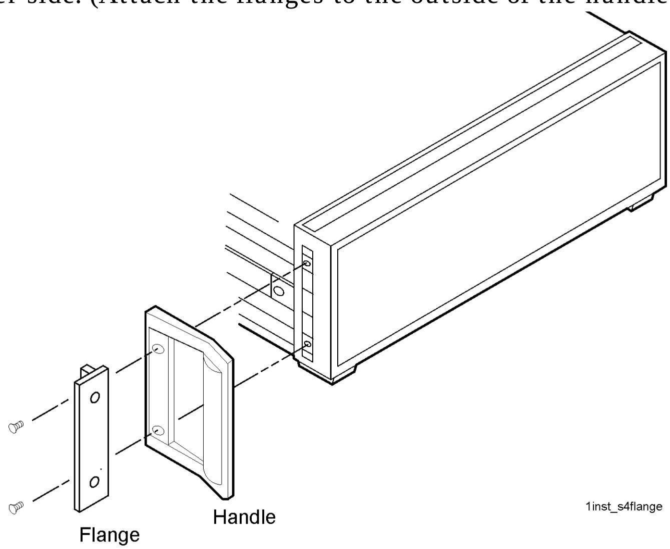
Handle Kit Contents	Flange Kit Contents
• 4 Screws • 2 Side Trim Strip • 2 Handles • Installation Instructions	• 4 Screws (Long) • 4 Screws with Washers • 4 Nuts with Metal Clips • 2 Flanges • Installation Instructions

NOTE If any items are damaged or missing from a kit, contact us (refer to “Contacting Agilent” on page 237) to order a replacement kit. Items within these kits are not individually available.

2. Install the rails into the equipment rack using the instructions provided. Consider that the test set is two rack units high (3.5 inches). Mount the test set immediately below the network analyzer.

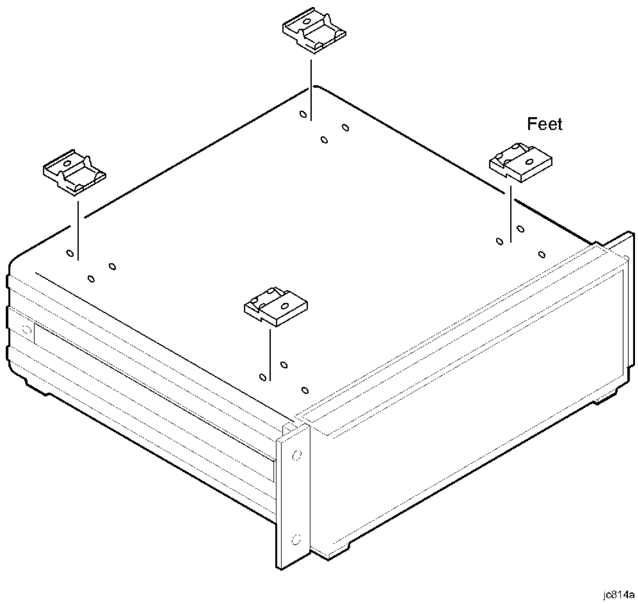
NOTE For the N4420B, N4421A, or N4421B test set, connect the network analyzer to the test set before placing in the rack as a single unit on one set of rails.

3. Attach the cabinet mount flanges and the handles to the sides of the front panel, using two long screws per side. (Attach the flanges to the outside of the handles.)



WARNING **If an instrument handle is damaged, you should replace it immediately. Damaged handles can break while you are moving or lifting the instrument and cause personal injury or damage to the instrument.**

4. Remove the feet before cabinet mounting the analyzer using the directions imprinted on the feet.



5. Ensure there is adequate clearance between the system cabinet and the sides and back of the test system for adequate ventilation.

CAUTION Consider the ventilation requirements described in "Step 5. Install the Test System on a Bench Top or in an Equipment Rack" on page 15 when selecting the location of your system.

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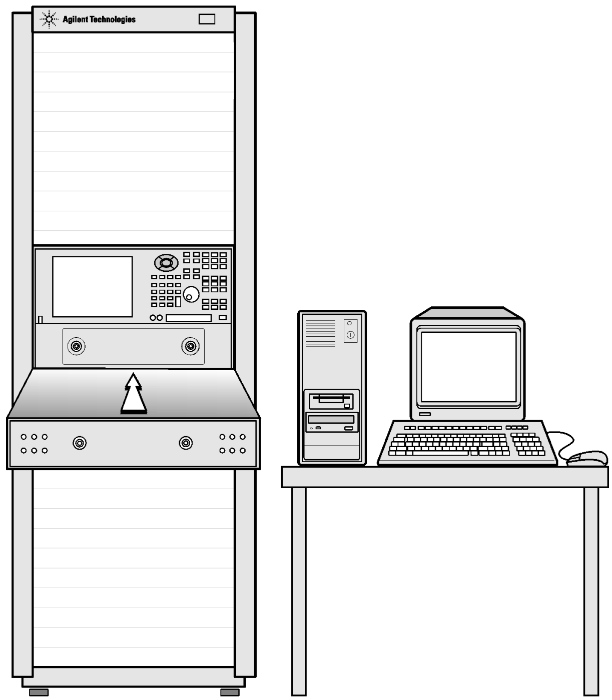
6. Lift the test set and slide it onto the rails that you installed earlier from the front of the equipment rack. Secure the test set to the equipment rack using the screws with washers and metal-clipped nuts provided in the flange kit.



1inst_s4rackts

7. Continue with "Step 6. Make the Interconnections between the S-Parameter Test Set and the Network Analyzer" on page 21.

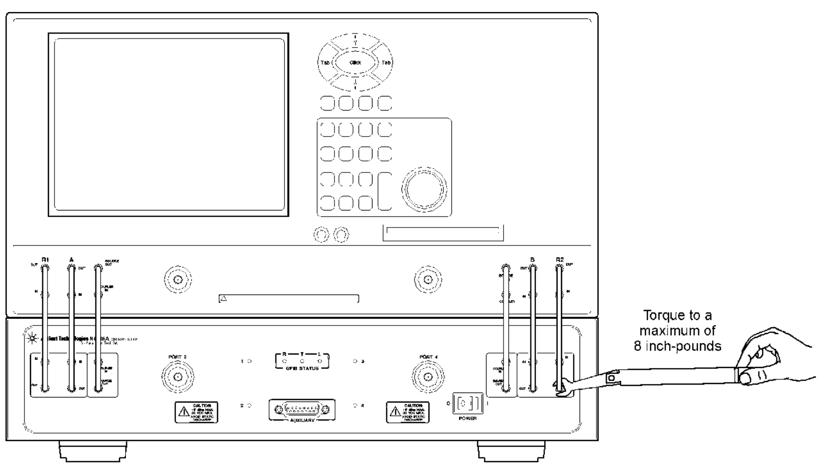
Step 6. Make the Interconnections between the S-Parameter Test Set and the Network Analyzer

1. Locate your system or test set and network analyzer listed below. Refer to the page indicated for information describing the interconnections between the test set and the network analyzer.

Test System Model Number[a]	Test Set Model Number[a]	Network Analyzer Model Number[a]	Refer to:
N1957B	N4421B	E8364B	page 23
N1955B	N4420B	E8363B	page 25
N1935A/N1953B	N4419B	N5230A Option 225/E8362B	page 27

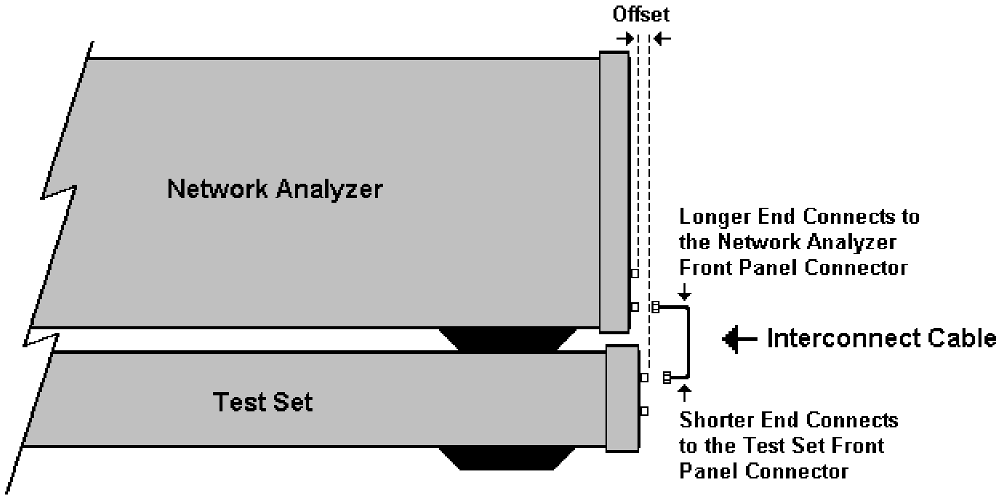
a. For interconnection information for the hardware models listed below, refer to Table B-4 on page 284.
PLTS Systems: N1947A, N1948A, N1951A, N1953A, N1957A
PLTS Test Sets: N4415A, N4416A, N4417A, N4418A, N4419A, N4421A
PLTS Network Analyzers: 8753ES, 8720ES/8722ES, E8356A/E8357A/E8358A, E8362A/E8363A/E8364A, E8801A/E8802A/E8803A

2. Using the illustration and table located on the page referenced above in step 1, connect the interconnect cables between the test set and the network analyzer. Torque the semirigid cable connectors to 8 inch-pounds.



CAUTION When connecting the interconnect cables described in the remaining pages of this section, be careful to install the interconnect cables correctly. The longer end of the interconnect cable connects to the network analyzer front panel connector. Refer to Figure 1-1 for the correct orientation.

Figure 1-1 Interconnect Cable Orientation



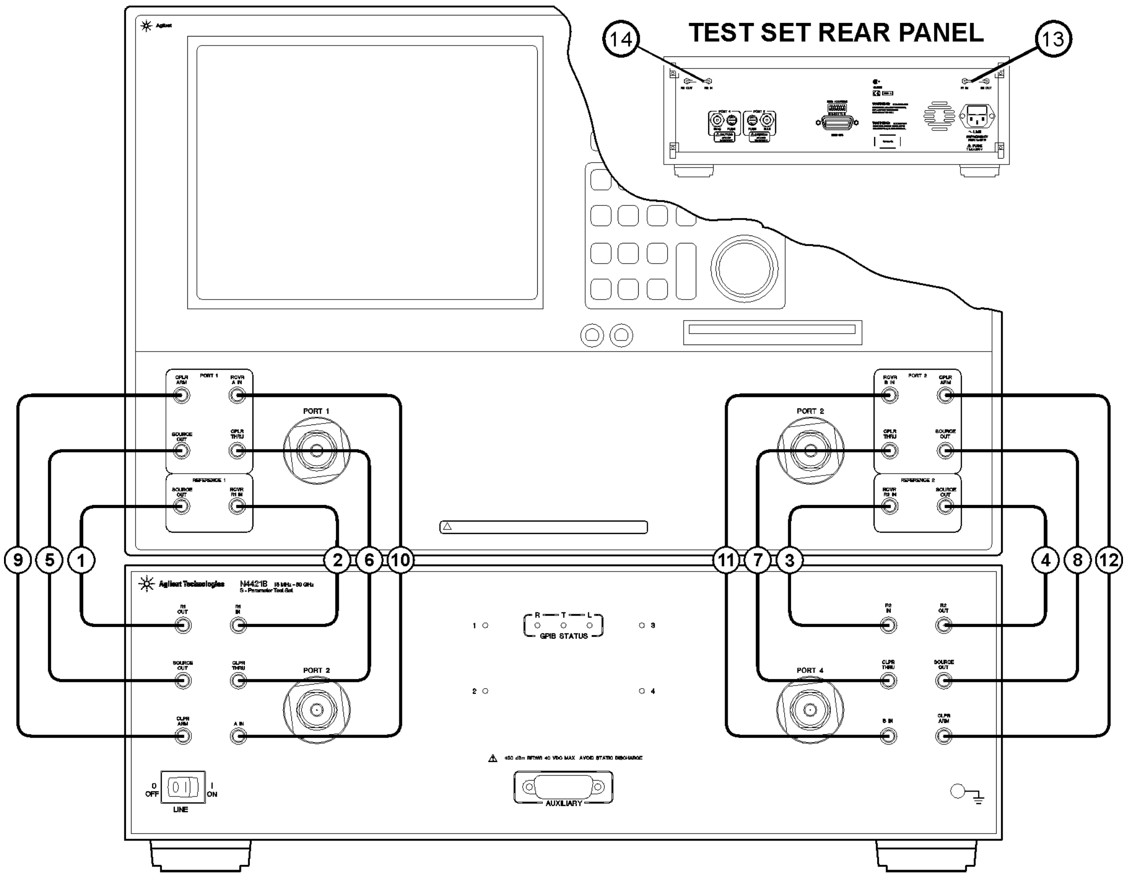
Damage to the interconnect cable can result from improper connection of the cable.

TIP If the test set and the network analyzer are rack mounted, the screws securing the rack mount flanges to the instrument rack may be loosened slightly to allow for minor repositioning of the instruments. Don't forget to retighten the screws when you are done.

3. Continue with “Step 7. Set Up the General Purpose Interface Bus (GPIB)” on page 29.

N1957B Test System Interconnections

(or N4421B Test Set with E8364B Network Analyzer)



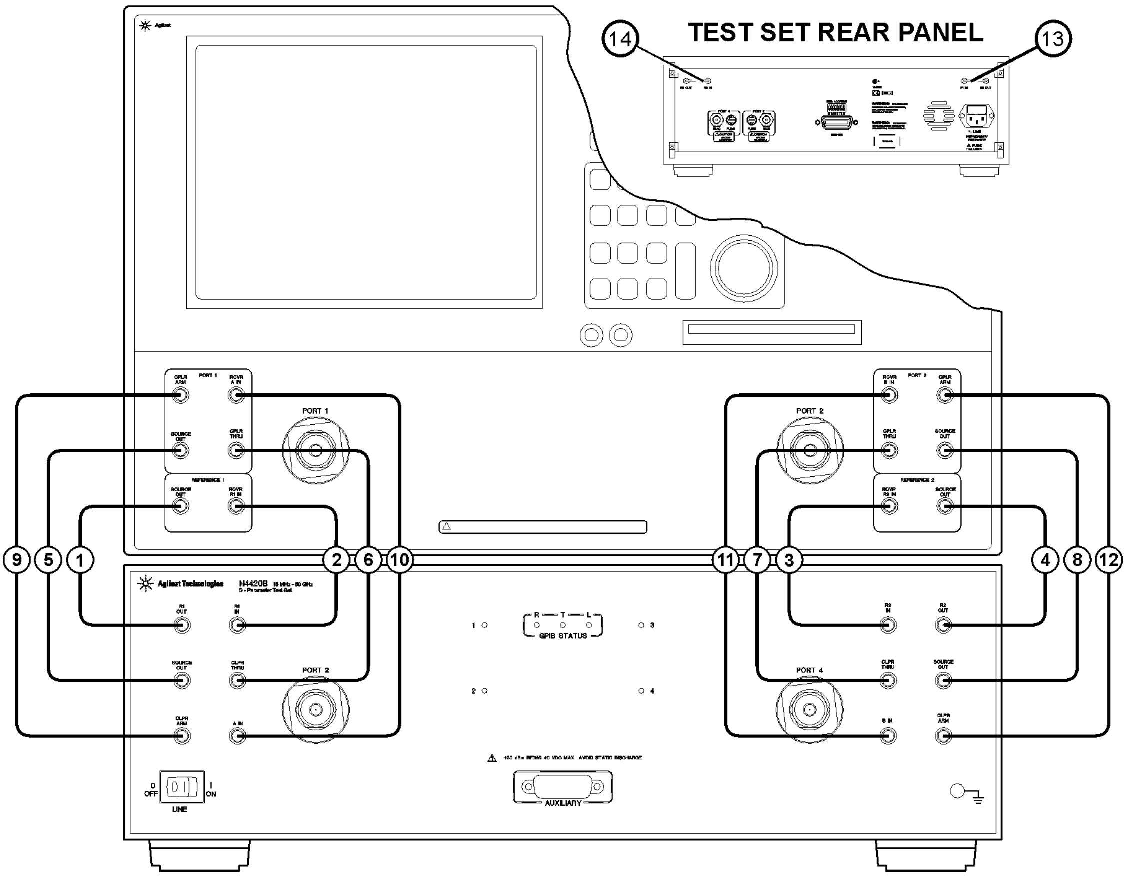
4421_connections

CAUTION Damage to the interconnect cable can result from improper orientation of the cable. Refer to page 22 for detailed information regarding the correct cable orientation.

Call Out Sequence	Cable Part Number	From Network Analyzer	To Test Set
1	Z5623-20215	REF 1 SOURCE OUT	REF 1 R1 OUT
2	Z5623-20215	REF 1 RCVR R1 IN	REF 1 RCVR R1 IN
3	Z5623-20215	REF 2 RCVR R2 IN	REF 2 RCVR R2 IN
4	Z5623-20215	REF 2 SOURCE OUT	REF 2 R2 OUT
5	Z5623-20216	PORT 1 SOURCE OUT	PORT 1 SOURCE OUT
6	Z5623-20216	PORT 1 CPLR THRU	PORT 1 CPLR THRU
7	Z5623-20216	PORT 2 CPLR THRU	PORT 2 CPLR THRU
8	Z5623-20216	PORT 2 SOURCE OUT	PORT 2 SOURCE OUT
9	Z5623-20217	PORT 1 CPLR ARM	PORT 1 CPLR ARM
10	Z5623-20217	PORT 1 RCVR A IN	PORT 1 RCVR A IN
11	Z5623-20217	PORT 2 RCVR B IN	PORT 2 RCVR B IN
12	Z5623-20217	PORT 2 CPLR ARM	PORT 2 CPLR ARM
13	E8364-20059	REF 1 on rear panel of the test set	
14	E8364-20059	REF 2 on rear panel of the test set	

N1955B Test System Interconnections

(or N4420B Test Set with E8363B Network Analyzer)



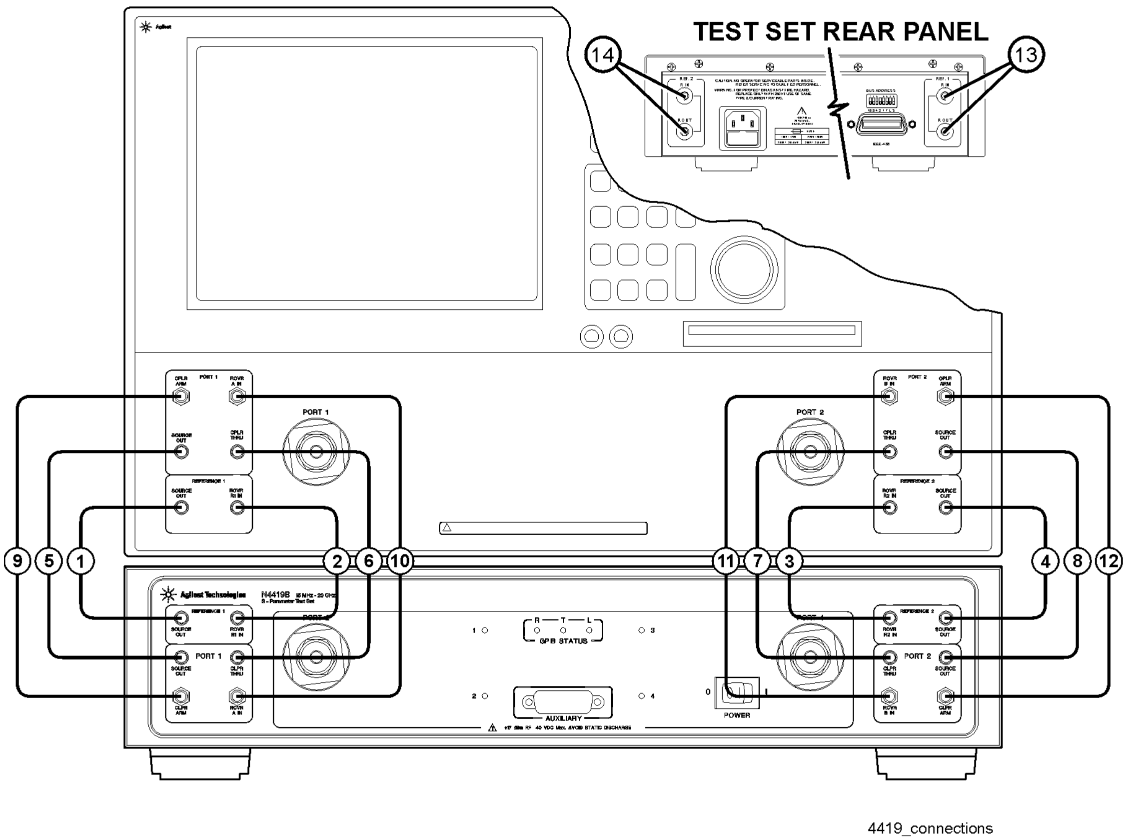
4420_connections

CAUTION Damage to the interconnect cable can result from improper orientation of the cable. Refer to page 22 for detailed information regarding the correct cable orientation.

Call Out Sequence	Cable Part Number	From Network Analyzer	To Test Set
1	Z5623-20215	REF 1 SOURCE OUT	REF 1 R1 OUT
2	Z5623-20215	REF 1 RCVR R1 IN	REF 1 RCVR R1 IN
3	Z5623-20215	REF 2 RCVR R2 IN	REF 2 RCVR R2 IN
4	Z5623-20215	REF 2 SOURCE OUT	REF 2 R2 OUT
5	Z5623-20216	PORT 1 SOURCE OUT	PORT 1 SOURCE OUT
6	Z5623-20216	PORT 1 CPLR THRU	PORT 1 CPLR THRU
7	Z5623-20216	PORT 2 CPLR THRU	PORT 2 CPLR THRU
8	Z5623-20216	PORT 2 SOURCE OUT	PORT 2 SOURCE OUT
9	Z5623-20217	PORT 1 CPLR ARM	PORT 1 CPLR ARM
10	Z5623-20217	PORT 1 RCVR A IN	PORT 1 RCVR A IN
11	Z5623-20217	PORT 2 RCVR B IN	PORT 2 RCVR B IN
12	Z5623-20217	PORT 2 CPLR ARM	PORT 2 CPLR ARM
13	E8364-20059	REF 1 on rear panel of the test set	
14	E8364-20059	REF 2 on rear panel of the test set	

N1935A and N1953B Test System Interconnections

(or N4419B Test Set with E8362B or N5230A Option 225 Network Analyzer)



CAUTION Damage to the interconnect cable can result from improper orientation of the cable. Refer to page 22 for detailed information regarding the correct cable orientation.

Call Out Sequence	Cable Part Number	From Network Analyzer	To Test Set
1	AD00756-1	REF 1 SOURCE OUT	REF 1 SOURCE OUT
2	AD00756-1	REF 1 RCVR R1 IN	REF 1 RCVR R1 IN
3	AD00756-1	REF 2 RCVR R2 IN	REF 2 RCVR R2 IN
4	AD00756-1	REF 2 SOURCE OUT	REF 2 SOURCE OUT
5	AD00756-2	PORT 1 SOURCE OUT	PORT 1 SOURCE OUT
6	AD00756-2	PORT 1 CPLR THRU	PORT 1 CPLR THRU
7	AD00756-2	PORT 2 CPLR THRU	PORT 2 CPLR THRU
8	AD00756-2	PORT 2 SOURCE OUT	PORT 2 SOURCE OUT
9	AD00756-3	PORT 1 CPLR ARM	PORT 1 CPLR ARM
10	AD00756-3	PORT 1 RCVR A IN	PORT 1 RCVR A IN
11	AD00756-3	PORT 2 RCVR B IN	PORT 2 RCVR B IN
12	AD00756-3	PORT 2 CPLR ARM	PORT 2 CPLR ARM
13	AD00756-4	REF 1 on rear panel of the test set	
14	AD00756-4	REF 2 on rear panel of the test set	

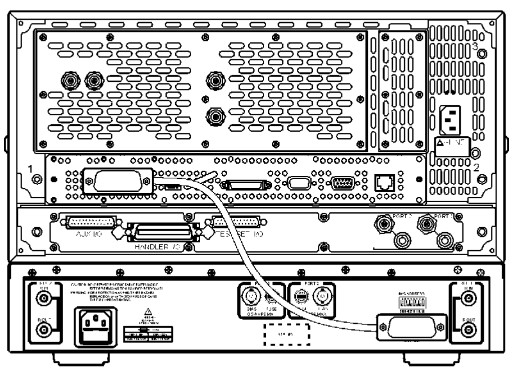
Step 7. Set Up the General Purpose Interface Bus (GPIB)

The PC uses the General Purpose Interface Bus (GPIB) to communicate with the test system hardware. The PLTS software will locate and identify your test system equipment automatically. Each test system device must have a unique GPIB address.

NOTE There are 31 GPIB addresses, numbered 0 to 30. However, there may be the occasion that you need to change the GPIB address for test equipment. GPIB addresses are set either using rear panel switches or using the equipment firmware. Refer to “Setting Up the General Purpose Interface Bus Manually” in the *PLTS User's Guide* for more information.

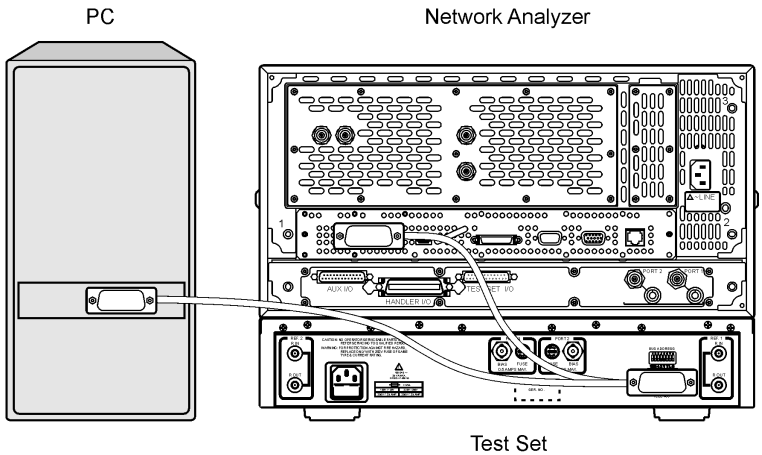
1. Connect a GPIB cable from the rear panel GPIB connector on the network analyzer to the rear panel GPIB connector on the test set.

Network Analyzer



Test Set

2. Connect a second GPIB cable from the PC GPIB card's connector to the GPIB connector on either end of the first cable that was connected.



Step 8. Power up the S-Parameter Test Set

1. Ensure the available ac power supply meets the Power Source Requirements and the operating environment meets the Operating Environment Requirements listed below.

Power Source Requirements			
Input Voltage Range	100 – 120 Vac	- or -	220 – 250 Vac
Frequency Range	47 – 62 Hz / 400 Hz		
Power	40 VA maximum.		
Operating Environment Requirements			
Operating Environment	Indoor use		
Altitude	Operating: Storage:	0 to 2.0 km (6,560 ft.) 0 to 15.24 km (50,000 ft.)	
Temperature	0 °C to 40 °C		
Maximum Relative Humidity	80% for temperatures up to 31 °C; decreasing linearly to 50% for a temperature of 40 °C		

Refer to Chapter 5, “Specifications and Characteristics,” for the complete specifications.

2. Verify that the ac power cable is not damaged, and that the power-source outlet provides a protective earth contact.

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.

3. Turn off the PC and the network analyzer.
4. Connect the ac power cable from the power-source outlet to the ac input on the rear panel of the test set.
5. Turn on the PC, the network analyzer, and the test set by pressing the ON/OFF button on the front panel of each device.

6. If your network analyzer is an E8362A/B, E8363A/B, or E8364A/B, you will need to perform the Phase-Lock IF Gain Adjustment after it has been connected to the test set. This routine adjusts the R Channel receivers ALC gain to ensure phase lock over the entire frequency range. Refer to **Phase-Lock IF Gain Adjustment** in the network analyzer's online help system for details. Use the following steps to perform this adjustment:

    a. On the PNA, from the **System** menu, click **Service**, then **Adjustments**, then **IF Gain Adjustment**.

       If you are unable to find these selections on your E836XA PNA, your analyzer firmware is a revision prior to 3.0. Refer to the "IF Gain Adjustment" section of the "Procedures" appendix in the *PLTS User's Guide* for the adjustment procedure.

    b. Select any special test set options installed.

    c. No connections to the test ports are required.

    d. Click **Begin Adj**. The adjustment takes about a minute to complete.

       The advanced screen is for factory personnel only.

NOTE This adjustment must be performed before using the network analyzer each time the system is assembled or disassembled.

7. The PLTS hardware installation is complete. Continue with the PLTS software installation by referring to Chapter 3, "Installing the Physical Layer Test System Software," on page 41.

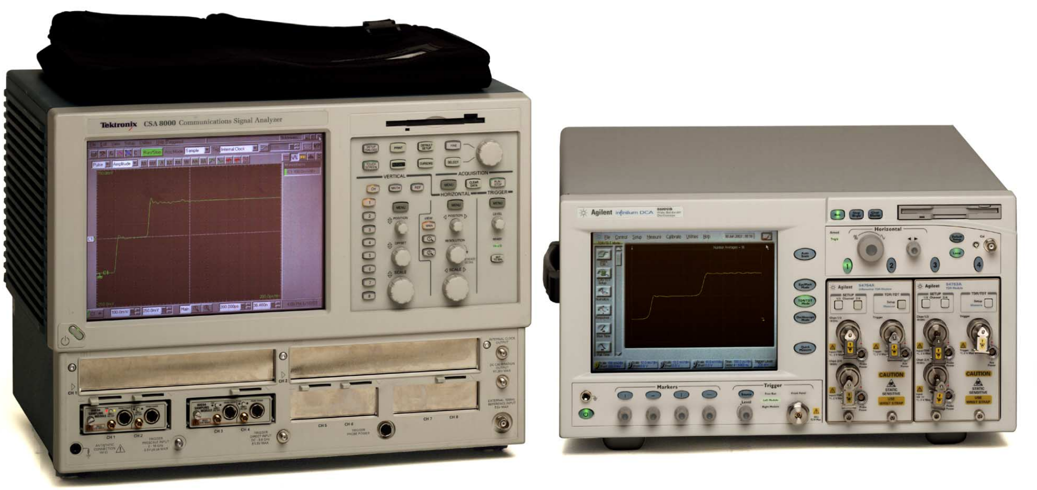
2 Installing the TDR-Based Physical Layer Test System Hardware

To make time domain measurements using the Physical Layer Test System (PLTS) software and a TDR system, you need the following equipment:

- Personal computer (PC)
- PLTS software
- TDR-based PLTS hardware (one of the following systems)
  - — Agilent 86100A/B/C Infiniium DCA Wide-Bandwidth Oscilloscope equipped with one or two 54754A Differential 18 GHz TDR/TDT Plug-in Modules using the following firmware revisions:

    Agilent 86100A/B: Firmware Revision 03.06 or greater
    Agilent 86100C: Firmware Revision 04.00 or greater
  - — Tektronix CSA8000 Communications Signal Analyzer equipped with one or two 80E04 Dual Channel, 20 GHz TDR Sampling Modules using Firmware Revision 1.3.3 or greater
  - — Tektronix TDS8000 Digital Sampling Oscilloscope equipped with one or two 80E04 Dual Channel, 20 GHz TDR Sampling Modules using Firmware Revision 1.3.3 or greater

Figure 2-1 TDR-based Physical Layer Test System Hardware: Tektronix CSA8000 (left) and Agilent 86100A/B/C DCA (right)



This installation procedure leads you through setting up the hardware (the PC and the TDR-based Physical Layer Test System). After you complete this installation, you will refer to Chapter 3, Installing the Physical Layer Test System Software, to install the software.

NOTE If you have the VNA-based Physical Layer Test System, refer to Chapter 1, "Installing the VNA-Based Physical Layer Test System Hardware," on page 3 for instructions on setting up that system.

The following is a list of the installation steps to set up your TDR system hardware:

- Step 1. Set Up the Personal Computer
- Step 2. Set Up the TDR System
- Step 3. Set Up the GPIB
- Step 4. Power up the TDR System

NOTE These installation instructions were written specifically for customers who have just received their TDR system with their PLTS software. If you have already been using your TDR system, you have probably completed most of these installation steps. Briefly review installation these steps to ensure that your system is currently set up as recommended. Then, begin the software installation process by starting at Chapter 3, "Installing the Physical Layer Test System Software," on page 41.

Step 1. Set Up the Personal Computer

1. Make sure that your PC meets the following minimum system controller requirements:

Table 2-1 Minimum PC Requirements by PLTS Modes of Operation

PC Requirement	**Measurement Controller Mode** In the lab, controlling test equipment and making quick analysis of the results	**Off-Line Analysis Mode** In your office, performing "What if..." analysis, characterization, cross-domain analysis, filtering, waveform math, and eye diagram simulation
CPU	400 MHz Pentium II or greater	1 GHz Pentium III compatible PC
Main Memory	256 MB[a]	512 MB
Virtual Memory[b]	512 MB	768 MB
GPIB Interface	Agilent 82357A USB/GPIB Interface for Windows or supported GPIB card (any National Instruments or Agilent 82340/41 or 82350 GPIB card)	No GPIB connection is required to utilize PLTS in the off-line mode. Saved (stored) measurement files can be recalled at any time for analysis.
Operating Systems	Windows 2000 or Windows XP[c]	
Screen Resolution	1024 × 768	
Display Colors	High Color (16 Bit) or greater	

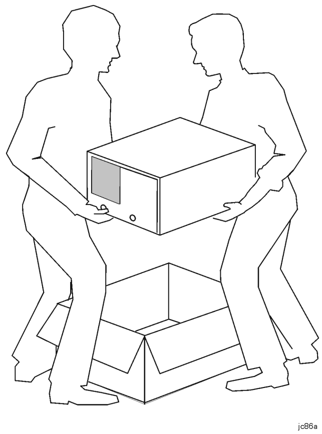
a. 512 MB of Main Memory is recommended for the Measurement Controller Mode when the measurement is measuring 16,000 points with the PNA B-model network analyzer.
b. As a general rule for optimum PC performance when using PLTS, virtual memory should be 1.5 to 2 times the size of the main memory.
c. Earlier versions of Windows are no longer supported by PLTS.

NOTE Memory, both main and virtual, is critical to using PLTS effectively. There is no substitution for not having enough memory. As more applications are added to the PC, more memory is used. If your PC needs more memory, we suggest you take the time to remove unused programs.

2. Using the PC documentation, make sure that the PC is operating properly.
3. Make sure the GPIB card is installed in the PC and that it is operating properly.
4. Make sure the PC is located near where you will position the oscilloscope-based TDR system. Later in this process, you will connect the GPIB card to the TDR system using a GPIB cable.

Step 2. Set up the TDR System

1. Unpack your system from the containers in which it was shipped.



WARNING **The TDR system hardware can be heavy. Use proper lifting techniques. Refer to the TDR system's documentation for information regarding the equipment weight.**

2. Carefully inspect the system to make sure that it was not damaged during shipment.

   If your TDR system was damaged during shipment, refer to the system's documentation to contact the manufacturer. If the manufacturer is Agilent, refer to "Contacting Agilent" on page 237.

3. Using the TDR system's documentation, set up the system as instructed, ensuring that the system's permanent location is near the PC that was set up in Step 1 on page 36.

CAUTION Both the Agilent and Tektronix TDR systems, although not required, may be connected to a computer network. Connecting to a computer network may present security risks to your TDR system. For the Agilent TDR system, refer to "Embedded Operating System Risk" on page iv for additional information. For the Tektronix TDR systems, refer to your system documentation for additional information.

4. Ensure that your TDR system is one of the following:

   - Agilent 86100A/B/C Infiniium Digital Communications Analysis Wide-Bandwidth Oscilloscope with:

     — Firmware: 86100A/B revision 03.06 or later / 86100C: revision 04.00 or later
     — 1 or 2 Agilent 54754A 18 GHz Differential TDR/TDT Plug-In Modules installed

   - Tektronix CSA8000 Communications Signal Analyzer Oscilloscope with:

     — Firmware revision 1.3.3 (check with your Tektronix representative for firmware)
     — 1 or 2 Tektronix 80E04 Dual Channel, 20 GHz TDR Sampling Modules installed in slot 1/2 and/or slot 3/4 only (no support for channels 5, 6, 7, or 8)

   - Tektronix TDS8000 Digital Sampling Oscilloscope with:

     — Firmware revision 1.3.3 (check with your Tektronix representative for firmware)
     — 1 or 2 Tektronix 80E04 Dual Channel, 20 GHz TDR Sampling Modules installed in slot 1/2 and/or slot 3/4 only (no support for channels 5, 6, 7, or 8)

CAUTION **Avoiding ESD Damage to TDR Plug-In Modules**

The input connectors are very sensitive to electrostatic discharge (ESD). When you connect a device or cable that is not fully discharged to the input connector, you risk damage to the module and expensive instrument repairs. Refer to your TDR documentation for detailed information regarding ESD susceptibility.

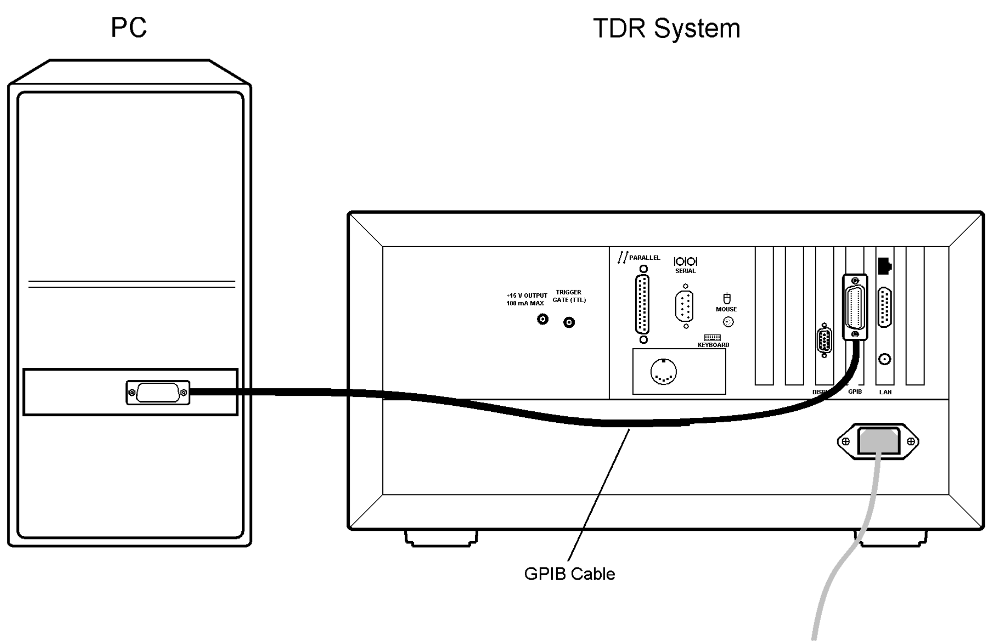
Step 3. Set Up the General Purpose Interface Bus (GPIB)

The PC uses the General Purpose Interface Bus (GPIB) to communicate with the test system hardware. The PLTS software will locate and identify your test system equipment automatically. Each test system device must have a unique GPIB address.

Check the GPIB address of your Agilent TDR system by selecting **Remote Interface** from the **Utilities** menu on the TDR display. To check the GPIB address of your Tektronix TDR system, refer to the programming manual for information.

NOTE There are 31 GPIB addresses, numbered 0 to 30. However, there may be the occasion that you need to change the GPIB address for test equipment. GPIB addresses are set using the equipment firmware. Refer to "Setting Up the General Purpose Interface Bus Manually" in the *PLTS User's Guide* for more information.

1. Connect a GPIB cable from the PC GPIB card's connector to the rear-panel GPIB connector on the TDR system.



Step 4. Power up the TDR System

If you have not previously powered on your TDR system, start with step 1. If you have already powered on your TDR system, just review steps 1, 2, and 3 before continuing with step 4.

1. Ensure the available ac power supply meets the power source requirements and the operating environment meets the operating environment requirements for the TDR system. Refer to the TDR system documentation for the environmental specifications.
2. Verify that the ac power cable is not damaged, and that the power-source outlet provides a protective earth contact.

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.

3. Connect the ac power cable from the power-source outlet to the ac input on the rear panel of the test set.
4. Turn on the PC and the TDR system.
5. The TDR system hardware installation is complete. Continue with the PLTS software installation by referring to Chapter 3, “Installing the Physical Layer Test System Software,” on page 41.

3 Installing the Physical Layer Test System Software

This chapter guides you through installing the Physical Layer Test System (PLTS) software. The software can be used 1) in the lab to control test equipment making measurements and make a quick analysis of the results, and it can be used 2) in your office to perform “What if...” analysis, characterization, cross-domain analysis, filtering, waveform math, and eye diagram simulation.

- If you are making measurements in the lab, you should have already installed one of the following hardware systems:
  - — VNA-based system (Network analyzer and S-parameter test set) described in Chapter 1, “Installing the VNA-Based Physical Layer Test System Hardware”
  - — TDR-based system (Agilent TDR or Tektronix TDR) described in Chapter 2, “Installing the TDR-Based Physical Layer Test System Hardware”

NOTE Steps 1 and 2 of this chapter were performed during the hardware installation procedures described in Chapter 1 and Chapter 2. You may skip these steps if you already performed them.

- If you are performing analysis in your office, you will only need a PC to use the software.

This software installation chapter will lead you through a series of steps to install the PLTS software. The following is a list of the installation steps:

- Step 1. Set Up the Personal Computer
  (Skip this step if you already performed it during hardware installation.)
- Step 2. Verify your System Shipment
  (Skip this step if you already performed it during hardware installation.)
- Step 3. Install the Physical Layer Test System Software
- Step 4. License the Physical Layer Test System Software
- Step 5. Start the Physical Layer Test System Software
- Step 6. Familiarize Yourself with the PLTS Software Screen

Step 1. Set Up the Personal Computer

This procedure describes the steps that need to be performed if you plan to use PLTS in your office, performing "What if..." analysis, characterization, cross-domain analysis, filtering, waveform math, and eye diagram simulation and you ***do not*** plan to use this software to control test equipment and make measurements.

NOTE If you plan to control test equipment with the software, refer to "Set Up the Personal Computer" step in the appropriate chapter, either Chapter 1, "Installing the VNA-Based Physical Layer Test System Hardware," or Chapter 2, "Installing the TDR-Based Physical Layer Test System Hardware."

1. Make sure that your PC meets the following minimum system controller requirements:

Table 3-1 Minimum PC Requirements for Off-Line Analysis Mode of Operation

CPU	1 GHz Pentium III compatible PC
Main Memory	512 MB
Virtual Memory[a]	768 MB
GPIB Interface	No GPIB connection is required to utilize PLTS in the off-line mode. Saved (stored) measurement files can be recalled at any time for analysis.
Operating Systems	Windows 2000 or Windows XP[b]
Screen Resolution	1024 × 768
Display Colors	High Color (16 Bit) or greater

a. As a general rule for optimum PC performance when using PLTS, virtual memory should be 1.5 to 2 times the size of the main memory.

b. Earlier versions of Windows are no longer supported by PLTS.

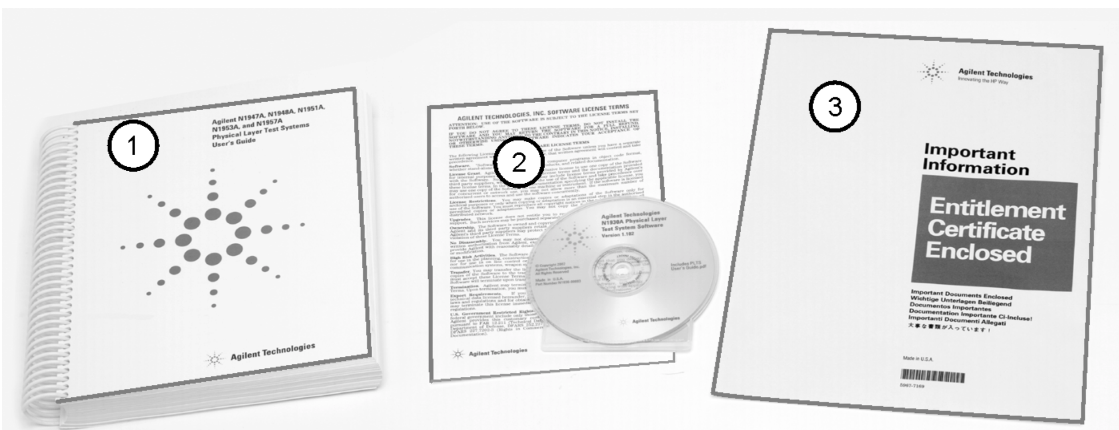
2. Using the PC documentation, make sure that the PC is operating properly.

Step 2. Verify your System Shipment

NOTE This procedure describes the steps that need to be performed if you only purchased the N1930A PLTS Software.

If you purchased a PLTS with the software, refer to “Verify your System Shipment” step in the appropriate chapter, either Chapter 1, “Installing the VNA-Based Physical Layer Test System Hardware.”

1. Unpack and carefully inspect the package to make sure that it was not damaged during shipment.



Item Nr	Part Nr	Part Description
1	N1930-90003	User’s Guide (this document)
2	N1930A	Physical Layer Test System Software CD-ROM (in envelope with Agilent Software License Terms printed on exterior)
3	N/A	Software Entitlement Certificate (in envelope)
Not Shown	N/A	Agilent 86100 firmware upgrade on LM-120 and CD-ROM

NOTE If the contents of your package were damaged during shipment, contact Agilent Technologies. Refer to “Contacting Agilent” on page 237.

Step 3. Install the Physical Layer Test System Software

CAUTION Before beginning the PLTS software installation, close any other applications that you computer is running. Not closing other applications could result in the loss of data because a reboot of the PC is required during the PLTS installation.

In addition to loading PLTS files, PLTS installs other supported software programs that it requires. As part of the installation, PLTS may also install:

- Microsoft .NET Framework versions 1.03 and 1.1
- Microsoft Direct X
- Agilent IO Driver Libraries & VisaCom
- Agilent T&M Programmers Toolkit Redistributable Package 1.0
- Crystal Reports 9.0 Runtime Engine (embedded components)
- Adobe®[1] Acrobat®[1] Reader 6.0 (if needed)

NOTE If you already have of these software packages installed on your PC, you will be asked if you want to upgrade to this version. If this version is newer than your version, please upgrade your software.

However, if your version is newer than the version PLTS wants to install, decline to load the PLTS version.

Use the following instructions to install PLTS depending on whether you have installed PLTS on your PC previously:

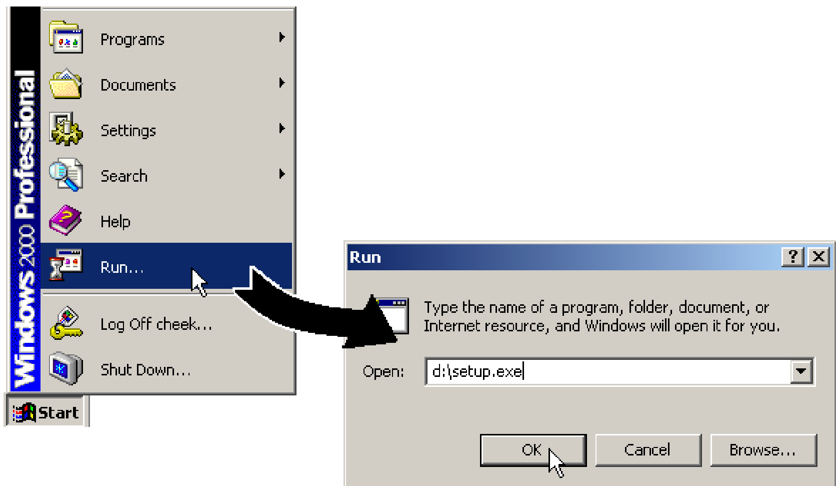
- If you have not installed PLTS on your PC previously, follow the instructions in "Installation of PLTS for the First Time on your PC" on page 46.
- If you are upgrading your computer with a new version of PLTS or just reinstalling PLTS after it was removed earlier, refer to "Installation of PLTS as a Software Upgrade" on page 56.

1. Adobe and Acrobat are trademarks of Adobe Systems Incorporated.

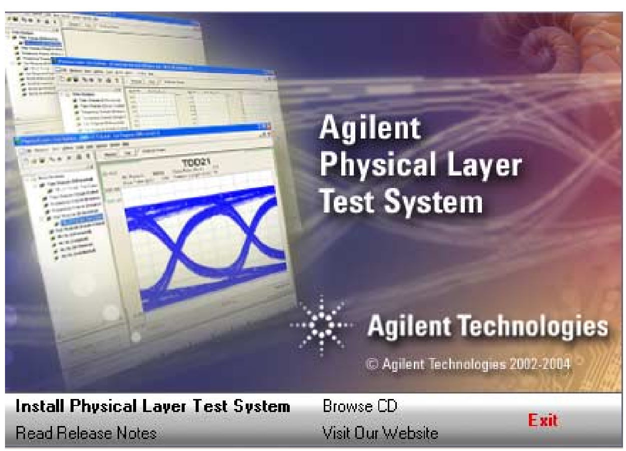
Installation of PLTS for the First Time on your PC

1. Insert the PLTS software CD-ROM in your PC. The software should begin the installation process automatically.

   If the software does not start the automatic installation process, select **Start** > **Run...** in Windows as shown below. With the *Run* dialog box displayed, enter your CD-ROM drive letter followed by "\:Setup.exe". For example, `D\:Setup.exe`. Then click **OK** and follow the onscreen instructions.

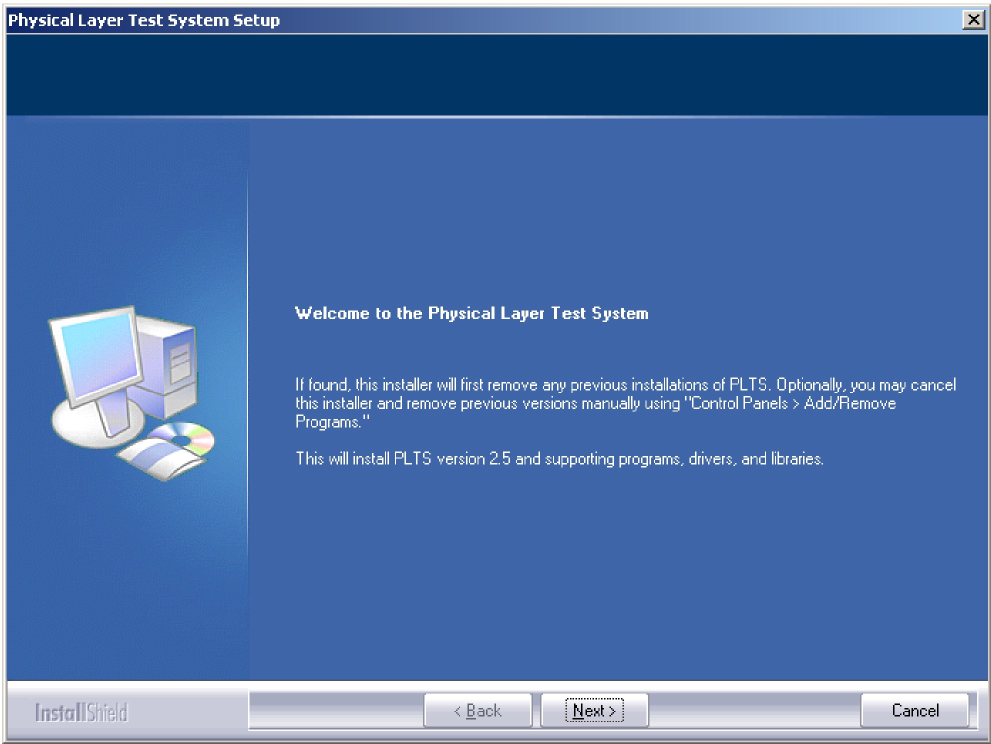


2. After the PLTS CD-ROM is started, the initial *Agilent Physical Layer Test System Install Wizard* screen is displayed. **Select the Install Physical Layer Test System** selection.

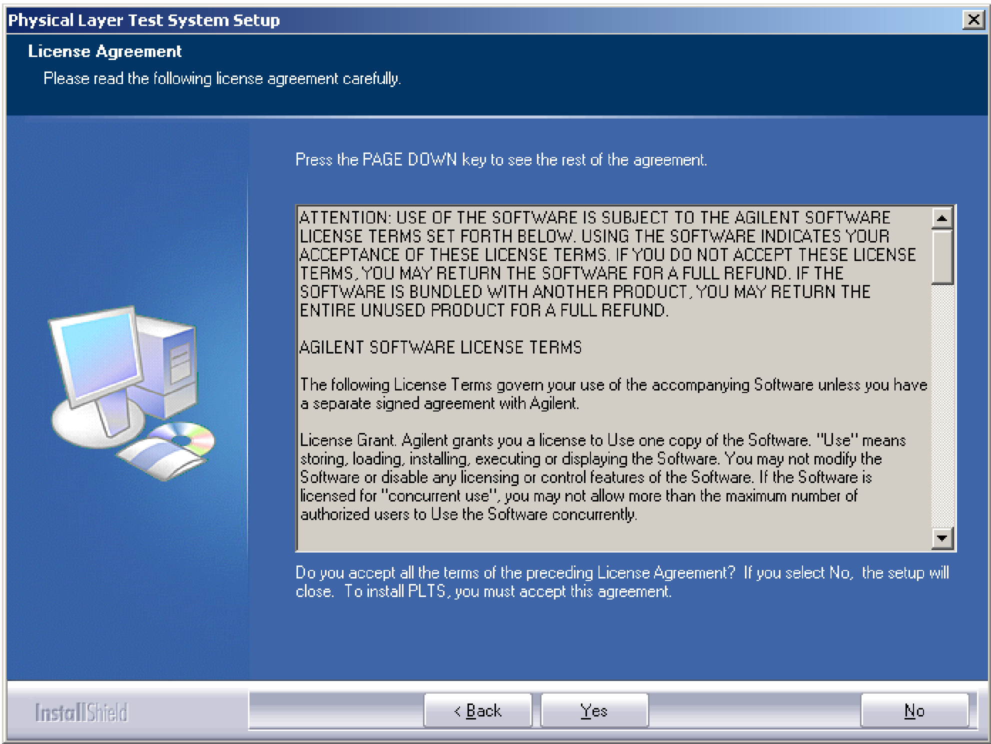


The *Agilent Physical Layer Test System Install Wizard* screen also has selections that allow you to browse the CD, read the release notes, and visit the PLTS web site.

3. After you select the **Install Physical Layer Test System** selection, the *Welcome to the Physical Layer Test System* screen is displayed. Click the **Next >** button to continue the installation.

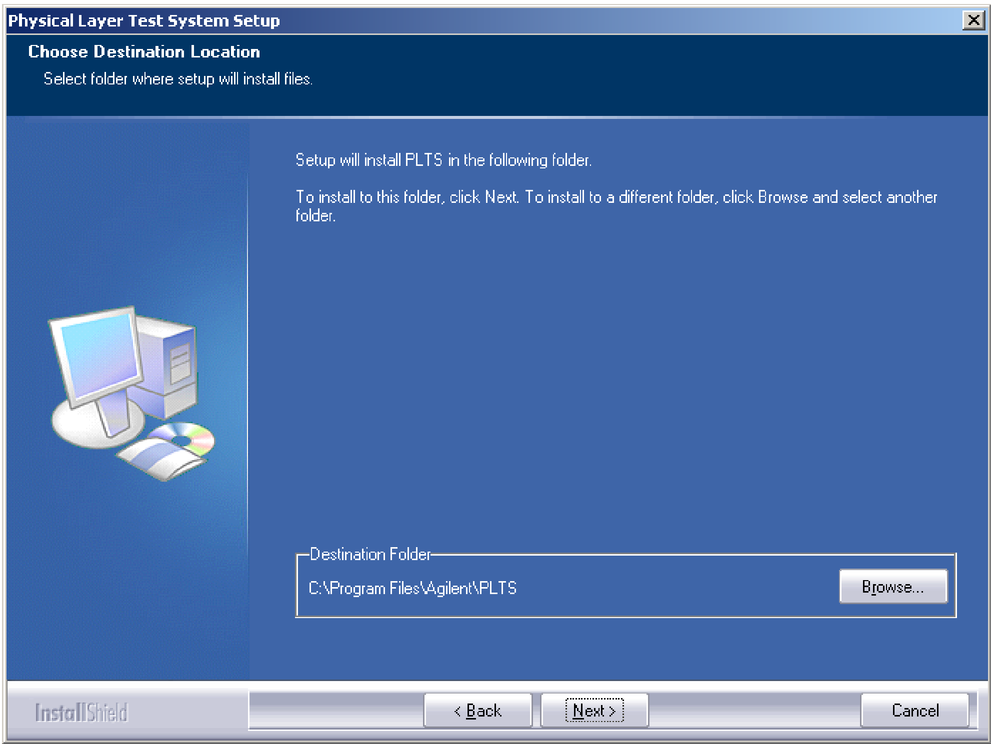


4. Before installing PLTS, a license agreement is displayed. Read the agreement. You will be asked if you accept the terms of the license agreement. If you click **No**, the PLTS setup will close. To install PLTS, you must accept this agreement by clicking **Yes**.

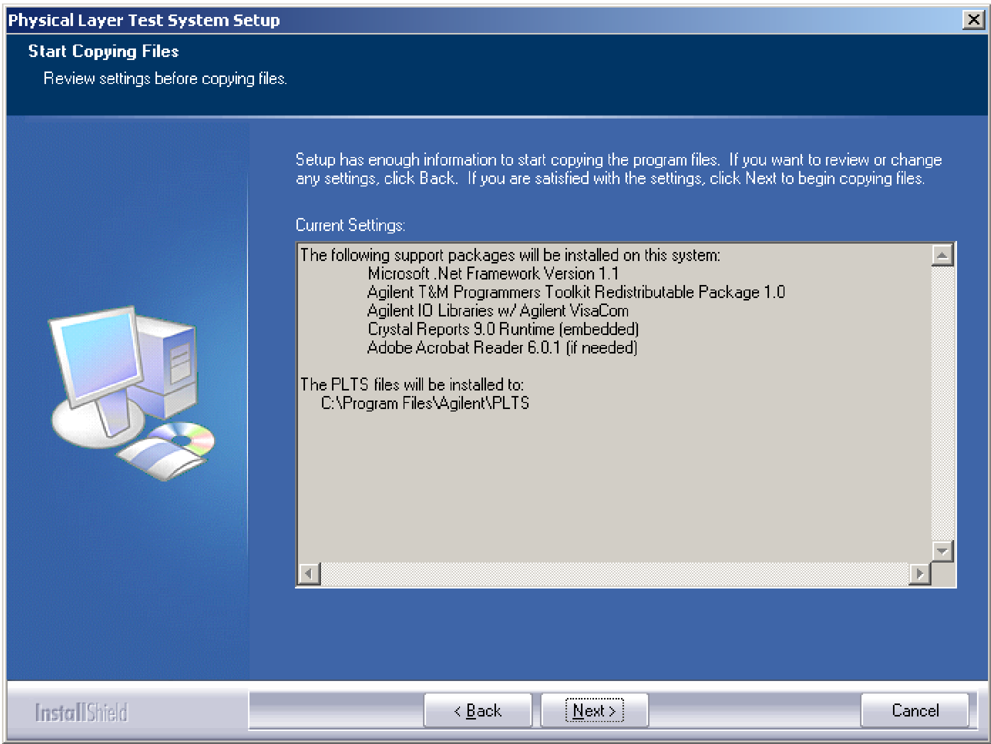


5. When asked to choose a destination location, you may use the default settings (recommended) or you may choose another directory. To use the default directory, just click the **Next >** button and continue with the installation.

   If you want to choose another directory, you may find and select the directory using the **Browse**... button.

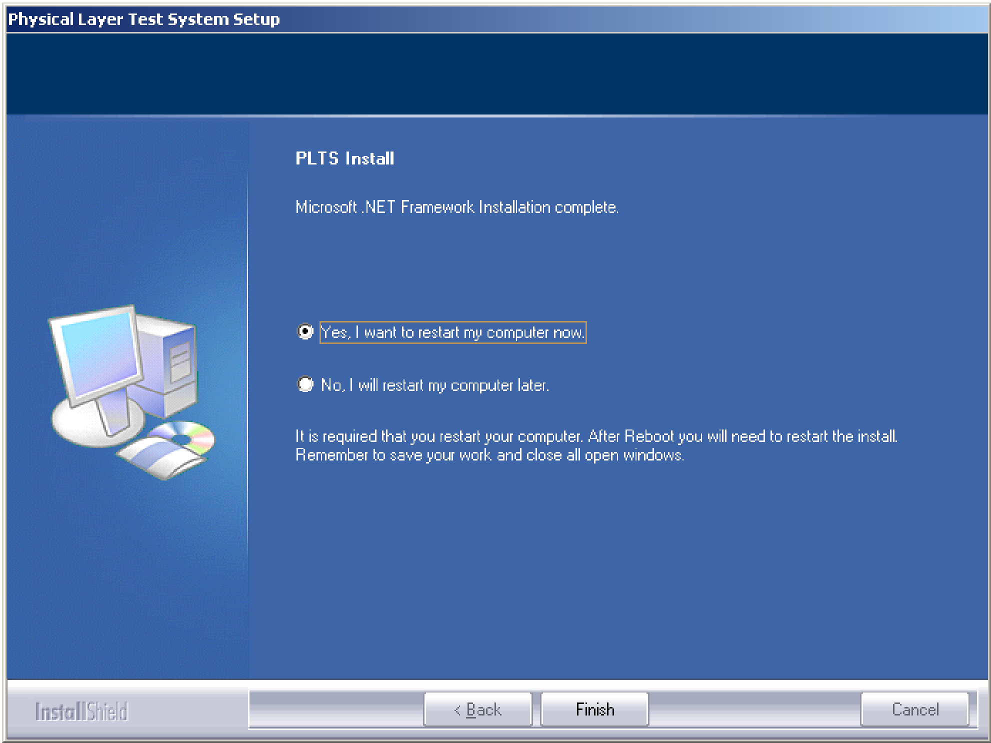


6. The PLTS InstallShield wizard asks you to review the settings. Use the default settings. Click **Next >** to continue copying the PLTS files to your PC.



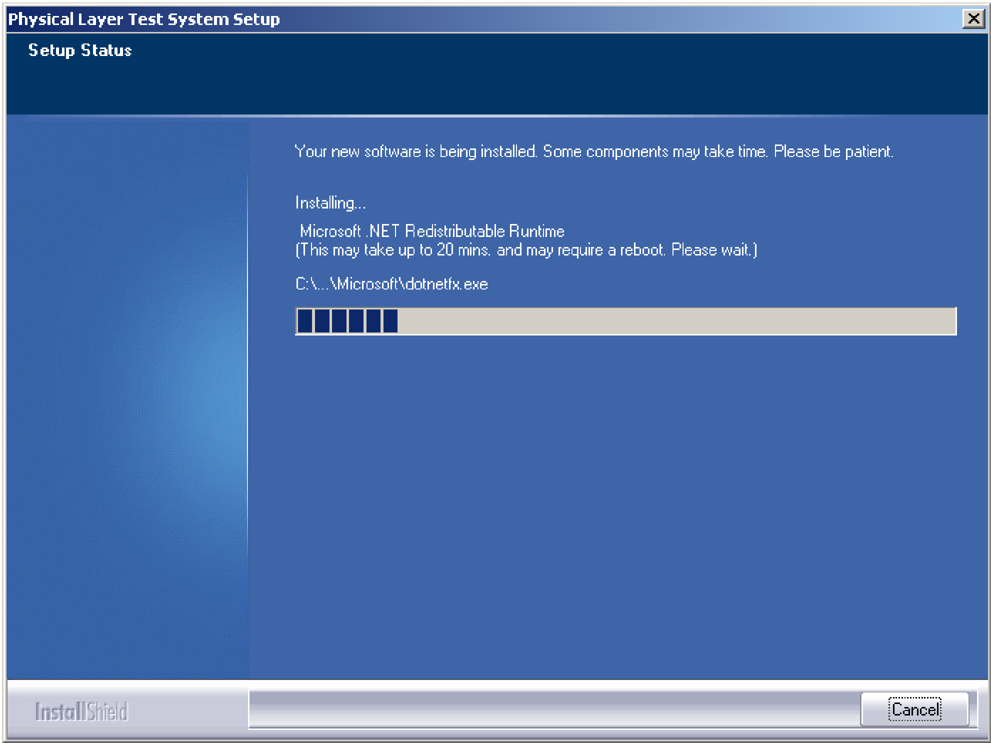
7. The PLTS InstallShield wizard begins to install Microsoft.NET.

8. After the Microsoft.NET installation is complete, you are prompted to restart your computer. Select **Yes, I want to restart my computer now**.



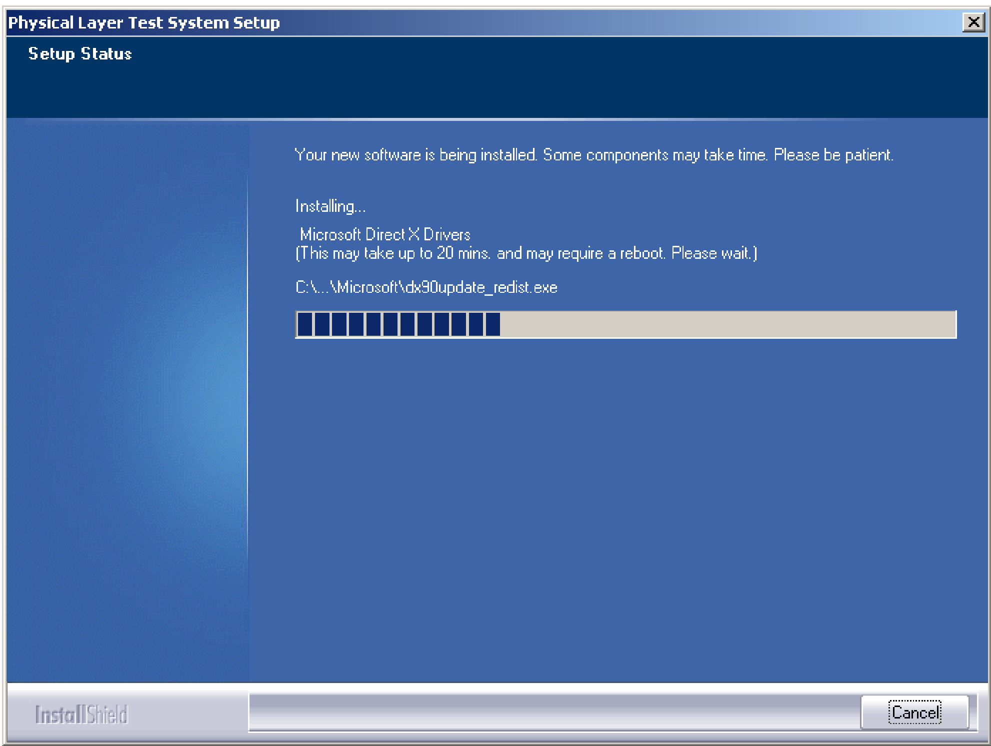
9. After restarting your computer, restart the PLTS installation as described in step 1. You also need to repeat steps 2 through 7.

10. The PLTS InstallShield wizard begins the installation procedure again with Microsoft .Net program.

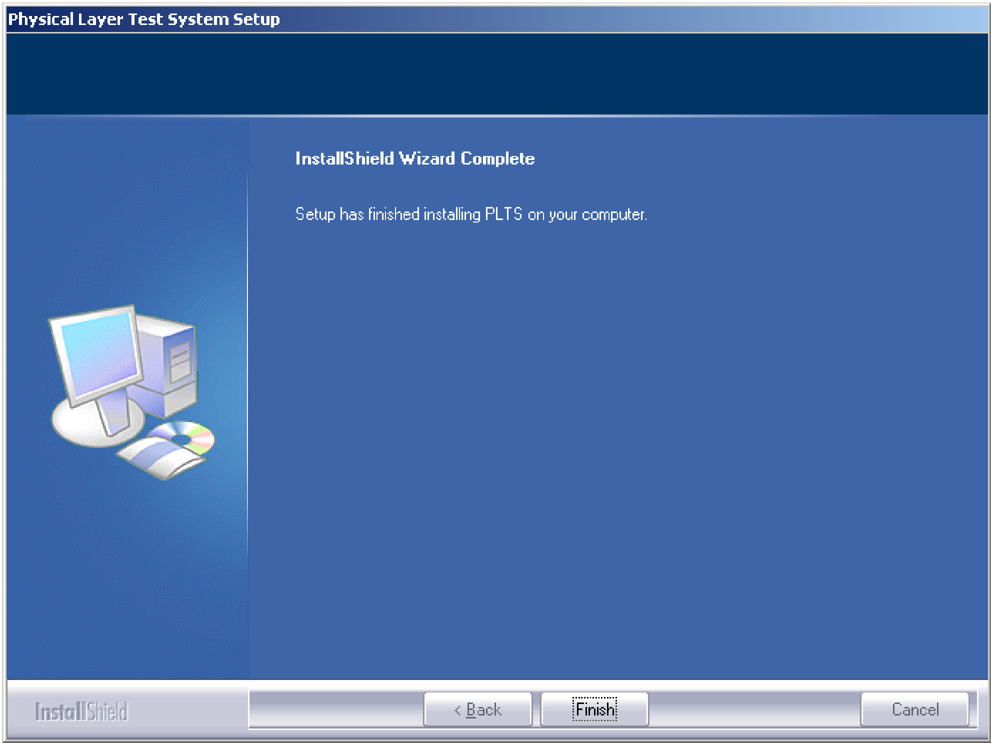


11. After the Microsoft.NET Framework installation is complete, the PLTS InstallShield wizard begins to load the following support packages:

- Microsoft Direct X
- Agilent IO Driver Libraries & VisaCom
- Agilent T&M Programmers Toolkit Redistributable Package 1.0
- Crystal Reports 9.0 Runtime Engine (embedded components)
- Adobe Acrobat Reader 6.0 (if needed)

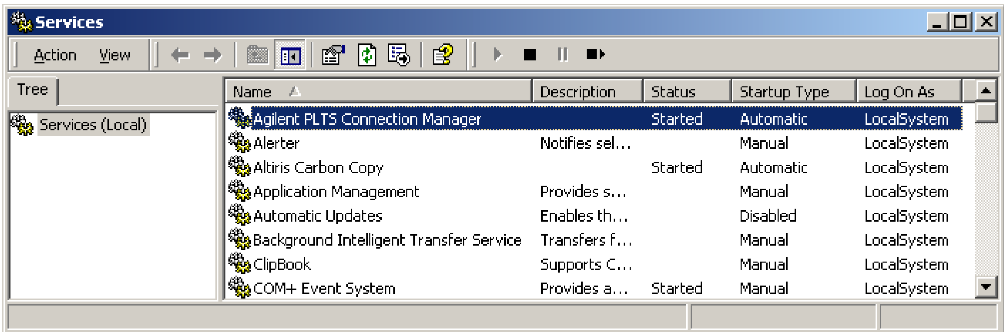


12. When the PLTS InstallShield wizard is complete, click the **Finish** button. The PLTS software installation is complete.

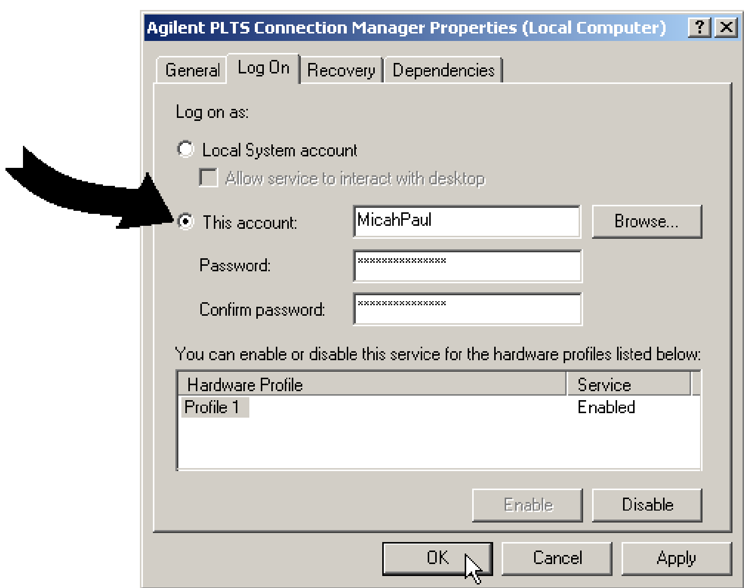


13. PLTS communicates with instruments using a Microsoft Service, the PLTS Connection Manager. The log on for this service needs to be changed to from a local system account to a specific account.

    To make this change, select **Start** > **Settings** > **Control Panel**. From the *Control Panel*, select **Administrative Tools** and then **Services**. Double-click the **Agilent PLTS Connection Manager** selection.



14. In the *Agilent PLTS Connection Manager Properties* dialog box window under the **Log On** tab, select the **This account** selection. Enter your user name with administrative privileges. Enter and confirm the password. Then click **OK** to save the change.

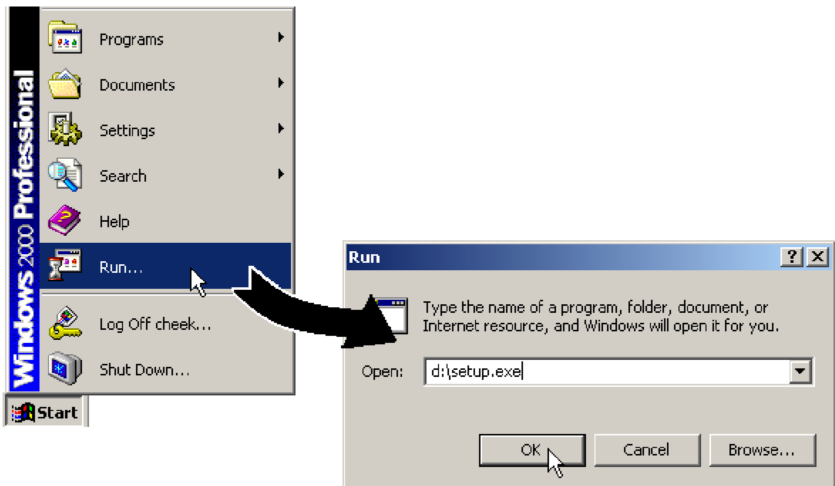


15. Continue with “Step 4. License the Physical Layer Test System Software” on page 68.

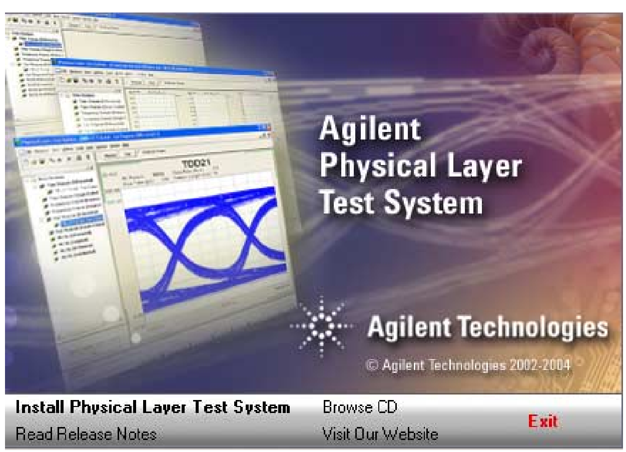
Installation of PLTS as a Software Upgrade

1. Insert the PLTS software CD-ROM in your PC. The software should begin the installation process automatically.

   If the software does not start the automatic installation process, select **Start** > **Run...** in Windows as shown below. With the *Run* dialog box displayed, enter your CD-ROM drive letter followed by "\:Setup.exe". For example, `D\:Setup.exe`. Then click **OK** and follow the onscreen instructions.

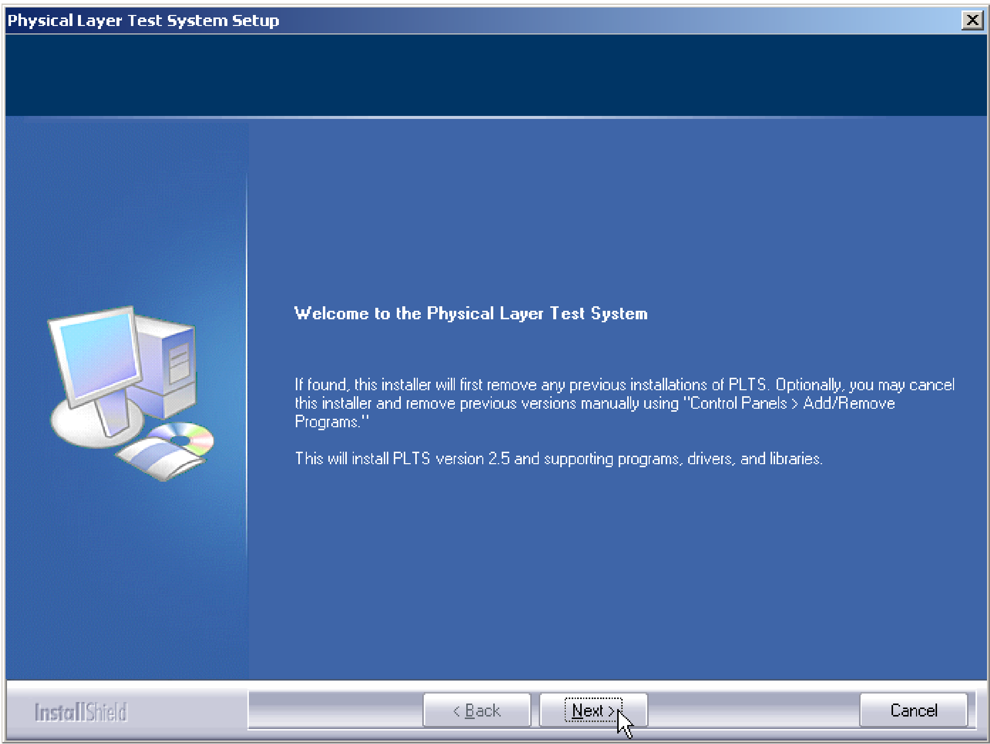


2. After the PLTS CD-ROM is started, the initial *Agilent Physical Layer Test System Install Wizard* screen is displayed. **Select the Install Physical Layer Test System** selection.

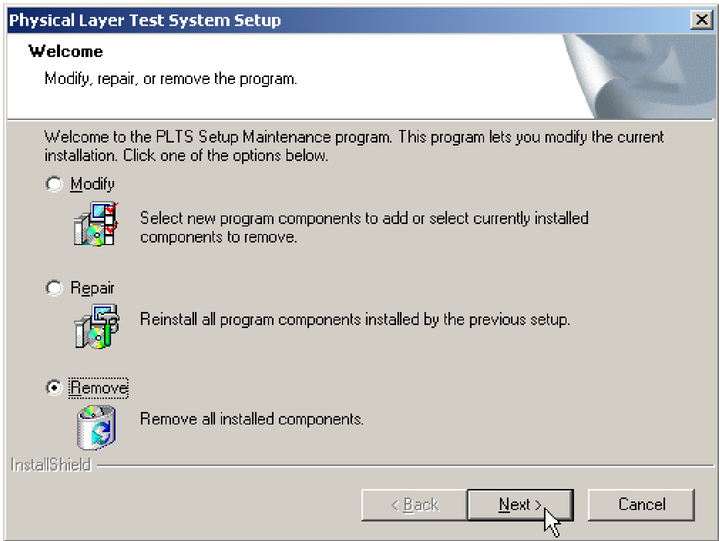


The *Agilent Physical Layer Test System Install Wizard* screen also has selections that allow you to browse the CD, read the release notes, and visit the PLTS web site.

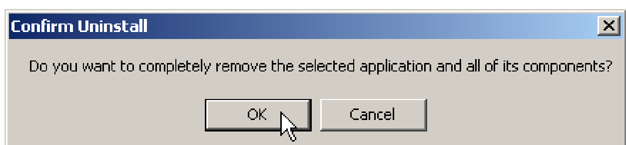
3. After you select the **Install Physical Layer Test System** selection, the *Welcome to the Physical Layer Test System* screen is displayed. Click the **Next >** button to continue the installation.



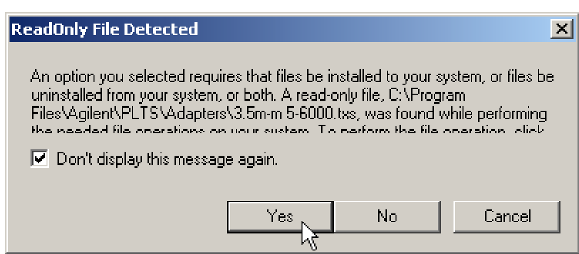
4. The installation window for the PLTS version that is currently installed is displayed. Select the **Remove** selection and then click the **Next >** button.



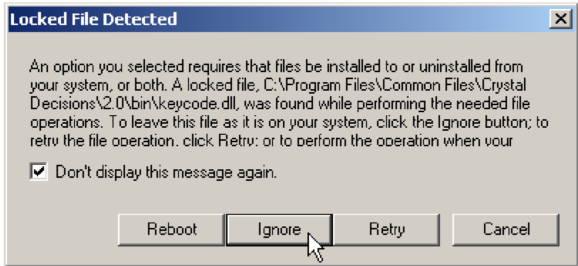
5. Select the **OK** button to confirm the removal of the current PLTS version.



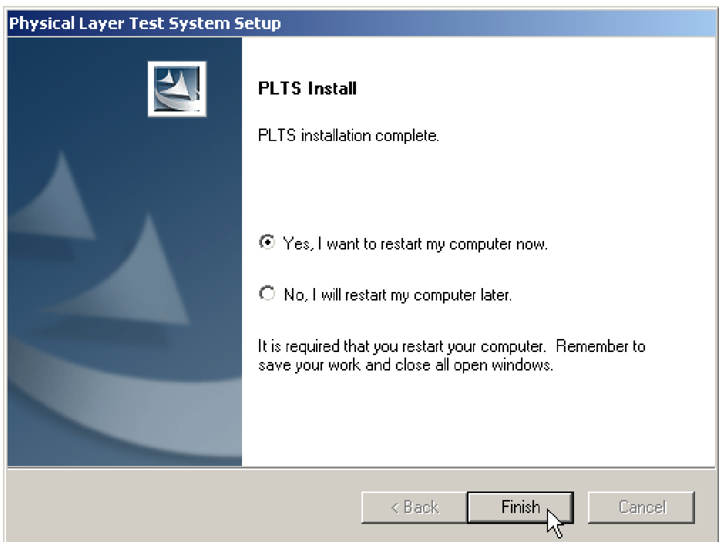
6. If you get the following dialog box, click the **Don't display this message again** box and then click the **Yes** button.



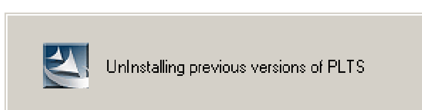
7. In some cases, the following dialog box may be displayed. If the dialog box is displayed, click the **Don't display this message again** box and then click the **Ignore** button.



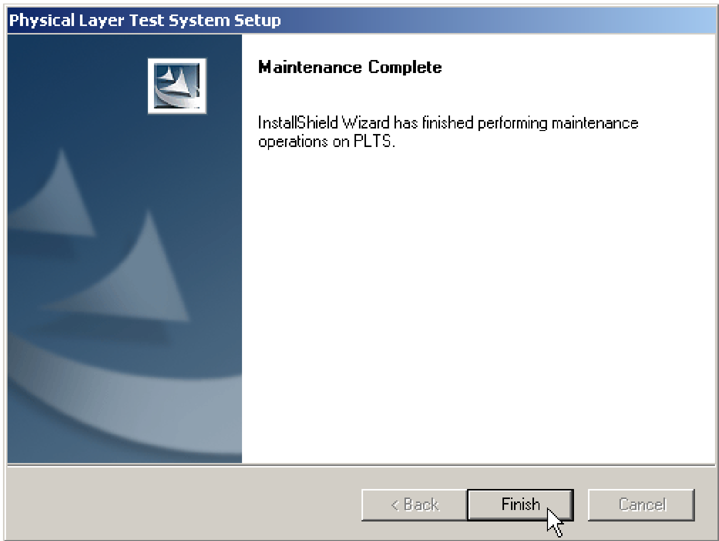
8. In some cases the following dialog box is displayed. If it is displayed, select the **Yes, I want to restart my computer now** selection. Then click the **Finish** button.



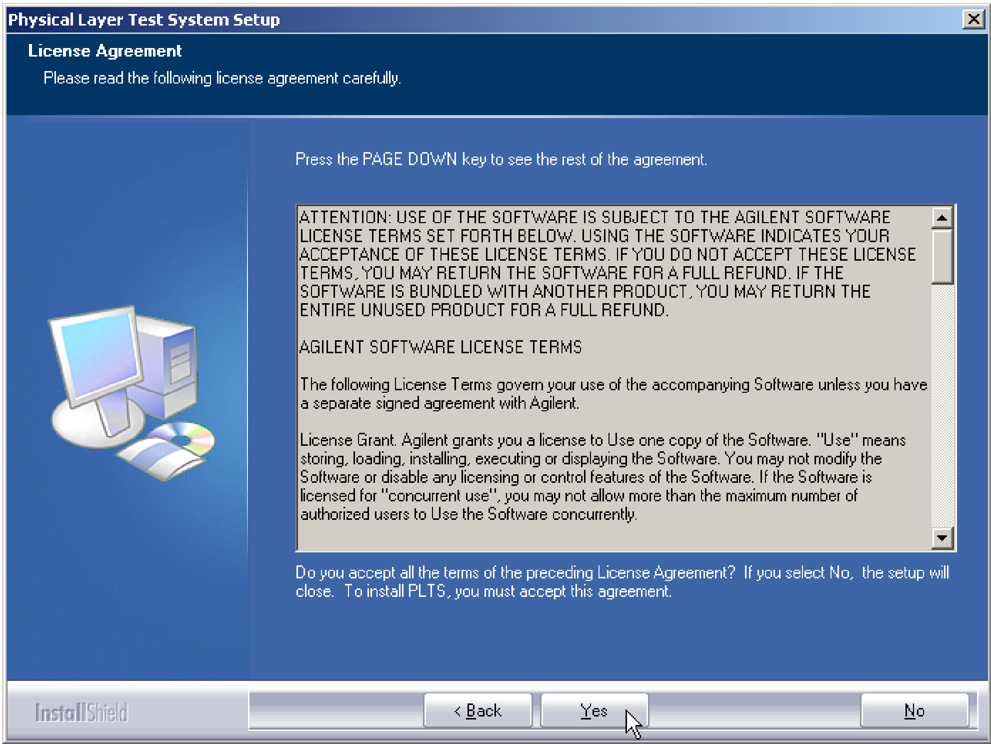
The following message is displayed notifying you that a previous version of PLTS is being uninstalled (removed).



9. When the program has finished removing the original PLTS version and the following dialog box is displayed, click the **Finish** button.

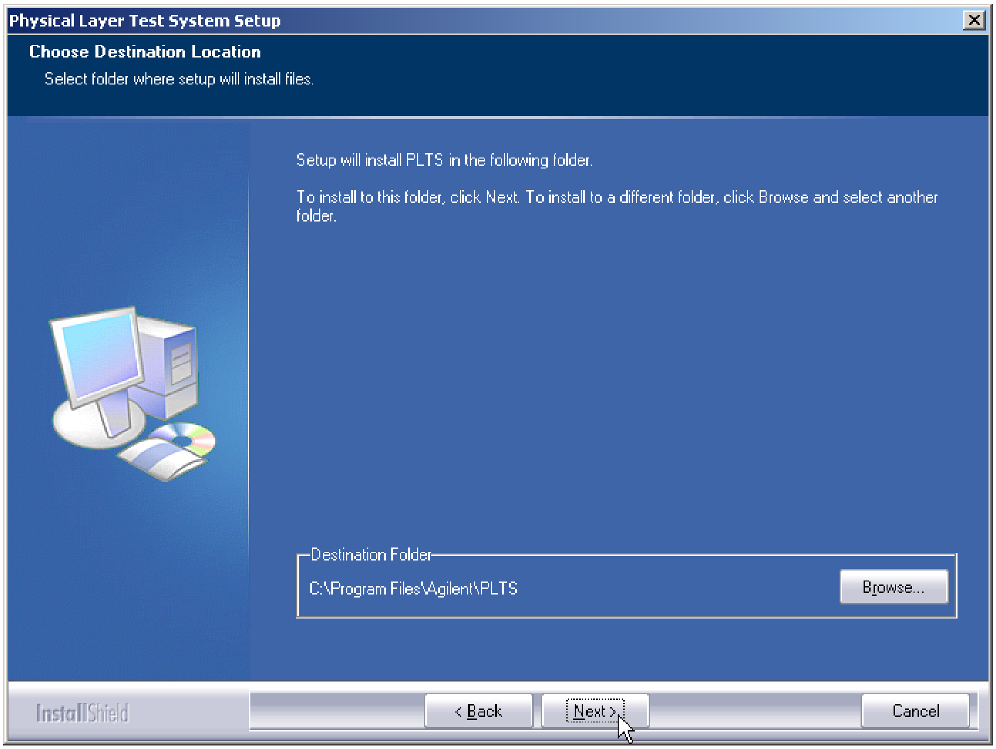


10. Before installing PLTS, a license agreement is displayed. Read the agreement. You will be asked if you accept the terms of the license agreement. If you click **No**, the PLTS setup will close. To install PLTS, you must accept this agreement by clicking **Yes**.

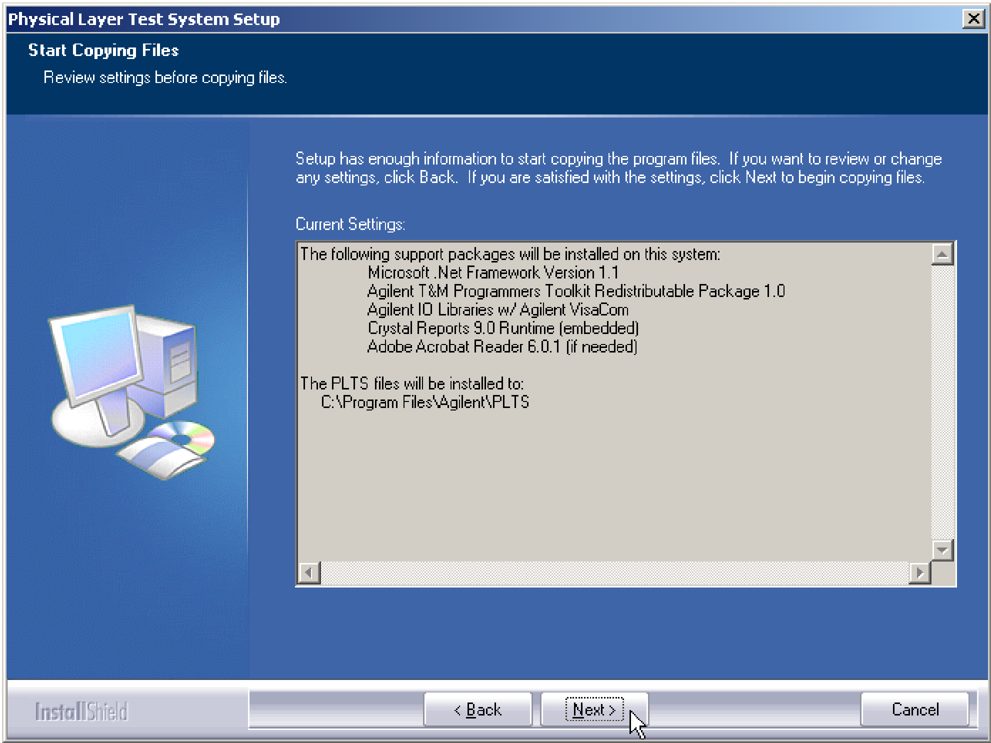


11. When asked to choose a destination location, you may use the default settings (recommended) or you may choose another directory. To use the default directory, just click the **Next >** button and continue with the installation.

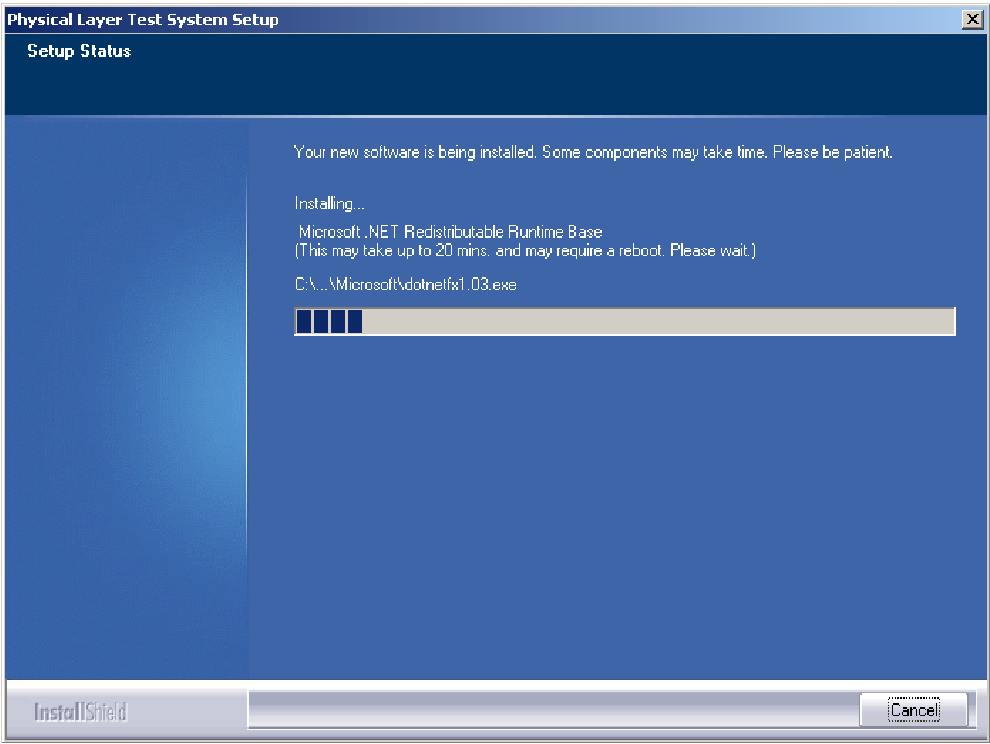
If you want to choose another directory, you may find and select the directory using the **Browse**... button.



12. The PLTS InstallShield wizard asks you to review the settings. Use the default settings. Click **Next >** to continue copying the PLTS files to your PC.

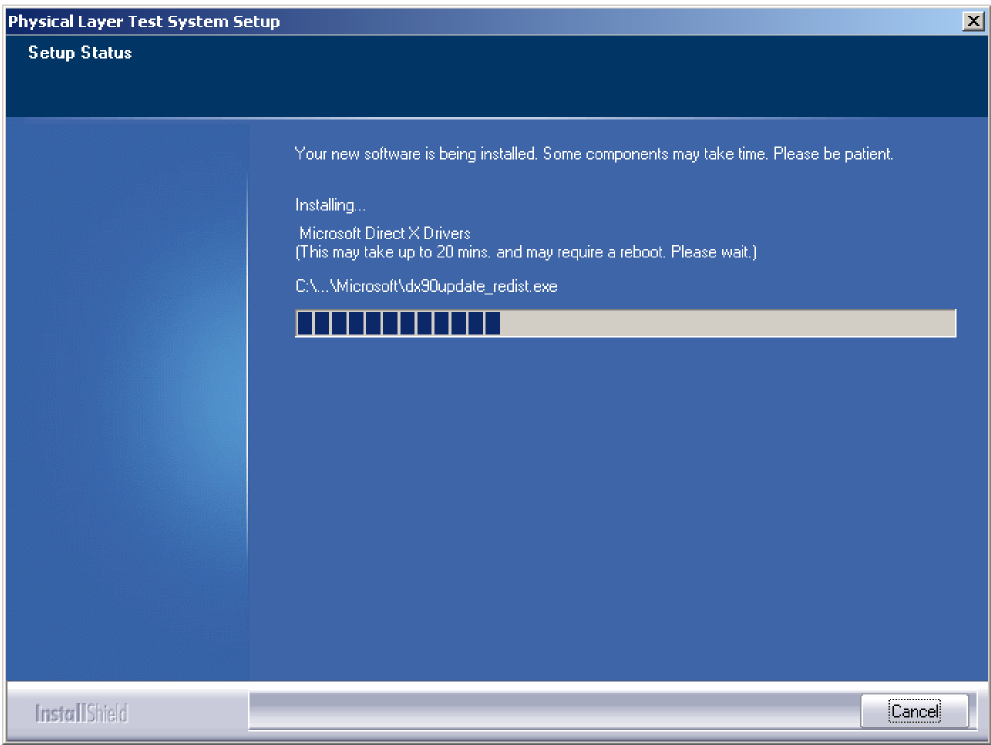


13. The PLTS InstallShield wizard begins the installation procedure by installing the Microsoft .Net program.

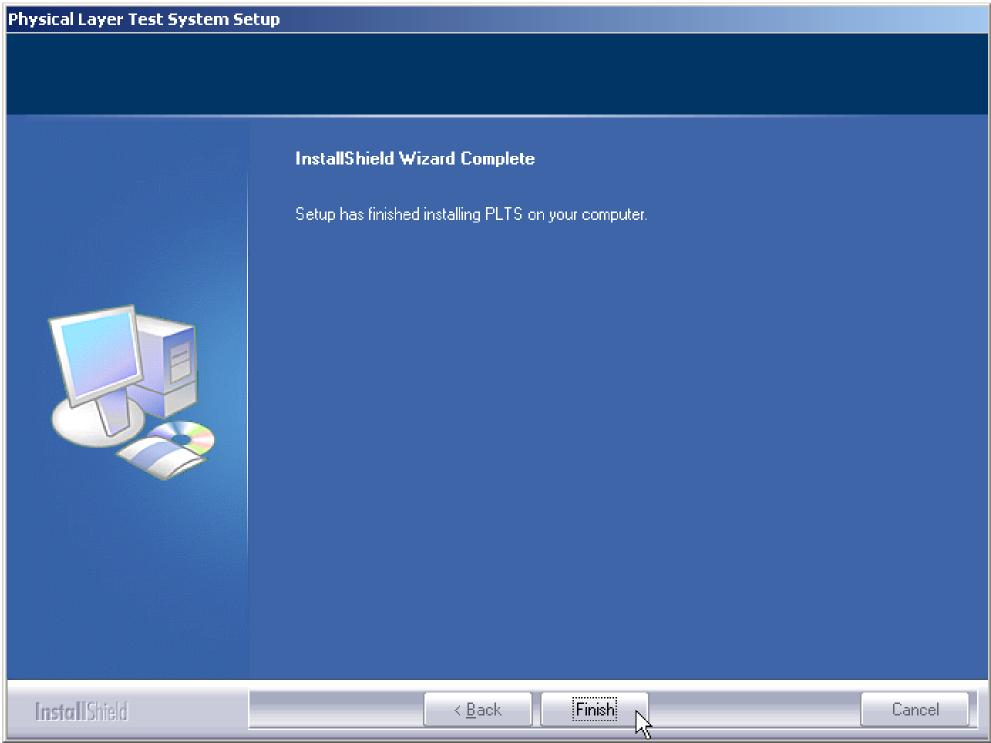


14. After the Microsoft.NET Framework installation is complete, the PLTS InstallShield wizard begins to load the following support packages:

- Microsoft Direct X
- Agilent IO Driver Libraries & VisaCom
- Agilent T&M Programmers Toolkit Redistributable Package 1.0
- Crystal Reports 9.0 Runtime Engine (embedded components)
- Adobe Acrobat Reader 6.0 (if needed)

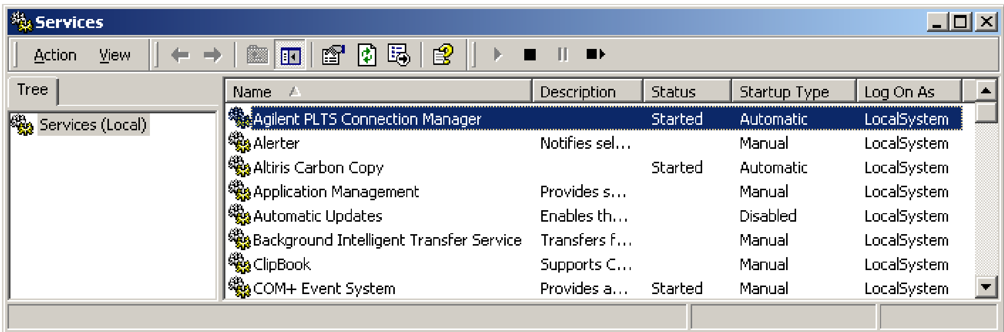


15. When the PLTS InstallShield wizard is complete, click the **Finish** button. The PLTS software installation is complete.

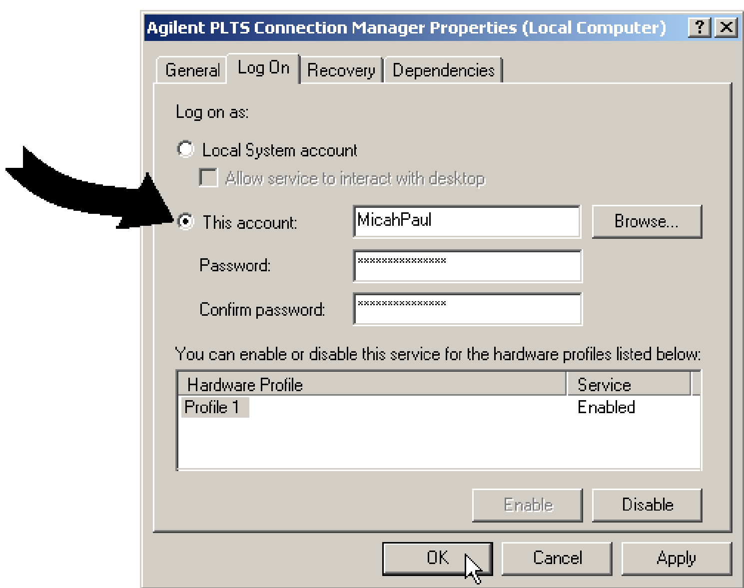


16. PLTS communicates with instruments using a Microsoft Service, the PLTS Connection Manager. The log on for this service needs to be changed to from a local system account to a specific account.

    To make this change, select **Start** > **Settings** > **Control Panel**. From the *Control Panel*, select **Administrative Tools** and then **Services**. Double-click the **Agilent PLTS Connection Manager** selection.



17. In the *Agilent PLTS Connection Manager Properties* dialog box window under the **Log On** tab, select the **This account** selection. Enter your user name with administrative privileges. Enter and confirm the password. Then click **OK** to save the change.



18. Continue with "Step 4. License the Physical Layer Test System Software" on page 68.

Step 4. License the Physical Layer Test System Software

PLTS is sold with one of two type of licenses, either node-locked or network-server floating. The type of license that you have was decided when the software was purchased.

A **node-locked license** entitles you to use the software on only one personal computer and the software enforces that restriction.

A **network-server floating license** entitles you to install the software license on only one server and check the license out to any personal computer on the server network that has PLTS installed. The software enforces the restriction that a license can checked out to one user at a time unless multiple PLTS network-server floating licenses are owned.

Stop! Determine the type of license that you own. Do not proceed until you have determined the type of license you own.

- If you own a node-locked license, continue with "Setting Up the Node-locked License" on page 68.
- If you own a network-server floating license, continue with "Setting Up the Network-Server Floating License" on page 70.

Setting Up the Node-locked License

This procedure instructs you how to license your Physical Layer Test System Software which is required before it can be used. The software is node-locked which means that license entitles you to use the software on only one personal computer (PC) and the software enforces that restriction.

CAUTION The software is node-locked which means that license entitles you to use the software on only one personal computer and the software enforces that restriction. Make sure that you license the software to the correct PC.

During this procedure, you will identify the Host ID of that PC. The host ID is a unique identifier for that computer. Then, you will use the host ID to license the software to that unique identifier of your PC. Therefore, it is very important to affirm that you have loaded and are licensing the software to the correct PC.

1. In Windows, select **Start > Programs** and locate the **Command Prompt** selection on your PC. Open the *Command Prompt* window by clicking the **Command Prompt** selection.

2. In the *Command Prompt* window, change the directory to the **License** subdirectory in the PLTS subdirectory using the following command:

   cd x:\dddd\ssss\PLTS\License

where,	x	is the letter of the drive the software was installed on.
	dddd	is the directory name the software was installed on.
	ssss	is any subdirectories the software was installed on.

   The default directory that the software is loaded on is: C:\Program Files\Agilent. Therefore, enter the following command to change to the default directory:

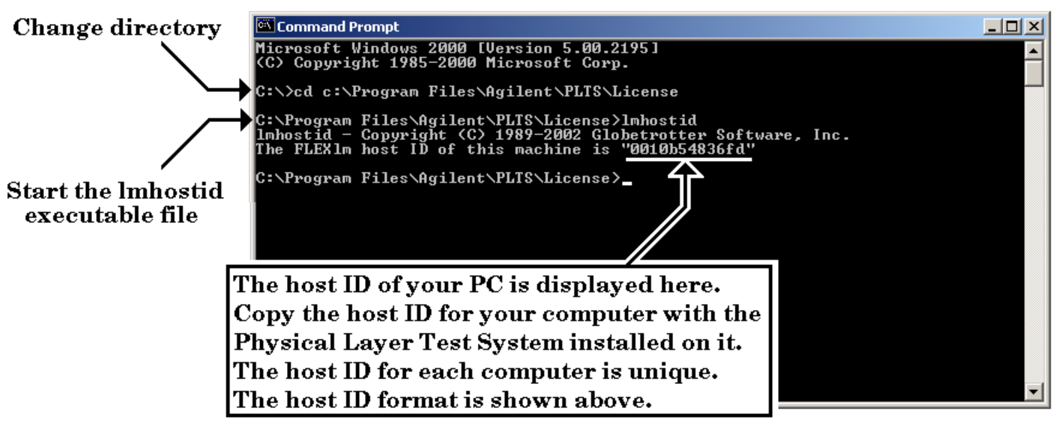
   ```
   cd c:\Program Files\Agilent\PLTS\License
   ```

   Refer to the illustration in step 4 on page 69.

3. Run the lmhostid executable file that will display the host ID for the PC that you have installed the software on by entering the following command as shown in the following figure:

   ```
   lmhostid
   ```

4. The host ID of the computer is displayed in window opened by the **lmhostid.exe** file. Write the host ID for your computer in the space provided below. You will need the host ID to license the software.



Record the host ID for your computer here:	

5. Locate the **Software Entitlement Certificate** that was shipped with your software.

   The certificate lists the **Order Number** and the **Certificate Number** for your software. These two numbers will also be used to license your software. It also lists the web site where you must register your software.

6. Go to the Agilent web site listed on the **Software Entitlement Certificate**. Follow the instructions at the web site to receive your license file for the software. You will need to provide the following information:
   - **Order Number**
   - **Certificate Number**
   - **Host ID for your computer that will run the PLTS Software**

   The web site will also ask you provide your e-mail address. The license file will be e-mailed to you promptly.
7. Once you receive the E-mail with the attached license file, save the file to the “License” directory (the same directory that you used earlier to identify the host ID).
8. Make a back up of the license file and store in a safe location.

   This back up file is very important! You may need this back up file if you encounter problems with your computer or if the license file is lost or erased.
9. Continue with “Step 5. Start the Physical Layer Test System Software” on page 76.

Setting Up the Network-Server Floating License

This procedure instructs you how to set up PLTS with a *Network License Server/Floating* type of license. This type of license allows you use PLTS on one of many PCs (or clients), utilizing a single license on a common server. The server issues the license to any of the clients that attempt to run PLTS. If the license is already being used by another client, notification is provided that the license is in use. If you have multiple licenses of this type, multiple clients can be issued a license at the same time, up to the number of licenses installed.

CAUTION During this procedure, you will identify the Host ID of the server. The host ID is a unique identifier for a computer. Then, you will use the host ID to obtain a software license for that unique identifier of your server. Therefore, it is very important to affirm that you have loaded and are licensing the software to the correct server.

To use PLTS, the client PC must be on the same network as the license server.

NOTE With this type of license, a PC can be both a server and a client. This allows the PC to use the PLTS software or issue the license for other PCs on the network to use PLTS.

PLTS supports servers operating the Windows 2000 or Windows XP operating system.

Preparing the License Server

To install Network License Server/Floating type of license after you have installed PLTS on your PC (one of the client machines):

1. Copy the following files from your PC that has PLTS installed to the server:

   agilent.exe   lmgrd.exe   lmhostid.exe   lmtools.exe   lmgrd.dl

   You will find these files in the license directory of the PLTS software. If you used the default path to set up PLTS on your PC, that path is:.

   C:/Program Files/Agilent/PLTS/License

   While you could save these files to any directory on your server, we recommend that you create a similar directory structure on your server.

Obtaining the License

2. On your license server, in Windows, select **Start > Programs** and locate the **Command Prompt** selection. Open the ***Command Prompt*** window by clicking the **Command Prompt** selection.
3. In the *Command Prompt* window, change the directory to the **License** directory that you created to save the five files (the servers PLTS License directory):

   cd x:\dddd\License

   where, x is the letter of the drive where you created a directory for the 5 files.

   dddd is all directory names between the drive letter and the License directory you created.

4. In the *Command Prompt* window, run the lmhostid executable file to display the host ID for the license server by typing:

   ```
   lmhostid
   ```

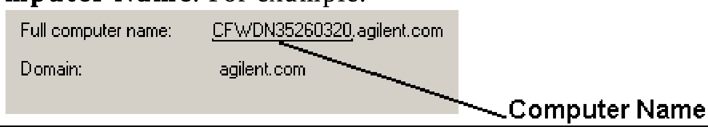
5. The host ID of the server is displayed in the *Command Prompt* window. Write the host ID for your computer in the space provided below. You will need the host ID to license the software.

Record the host ID for your server here:	

CAUTION This software license is locked to a specific server that you provide information for when obtaining the license. Make sure that you obtain and provide the Host ID for the correct server when obtaining your license.

---

6. You also need the network computer name of the server to redeem license. To locate the network name of your server: From Windows *Control Panel*, double-click the **System** icon to open the *System Properties* dialog box. On the **Network Identification** tab, locate the **Full Computer Name** entry. The network computer name of the server is the first portion of the **Full Computer Name**. For example:



Record the network computer name of your server here:	

7. Locate the **Software Entitlement Certificate** that was shipped with your software.

   The certificate lists the **Order Number** and the **Certificate Number** for your software. These two numbers will also be needed to license your software.

   The certificate also lists the web site where you must register your software.

8. Go to the Agilent web site listed on the **Software Entitlement Certificate**. Follow the instructions at the web site to receive your license file for the software. You will need to provide the following information:

   - **Order Number**
   - **Certificate Number**
   - **Host ID for your PLTS license server**
   - **Network Computer Name for your PLTS license server**

   The web site will also ask you provide your e-mail address. The license file will be e-mailed to you promptly.

Setting Up the License Server

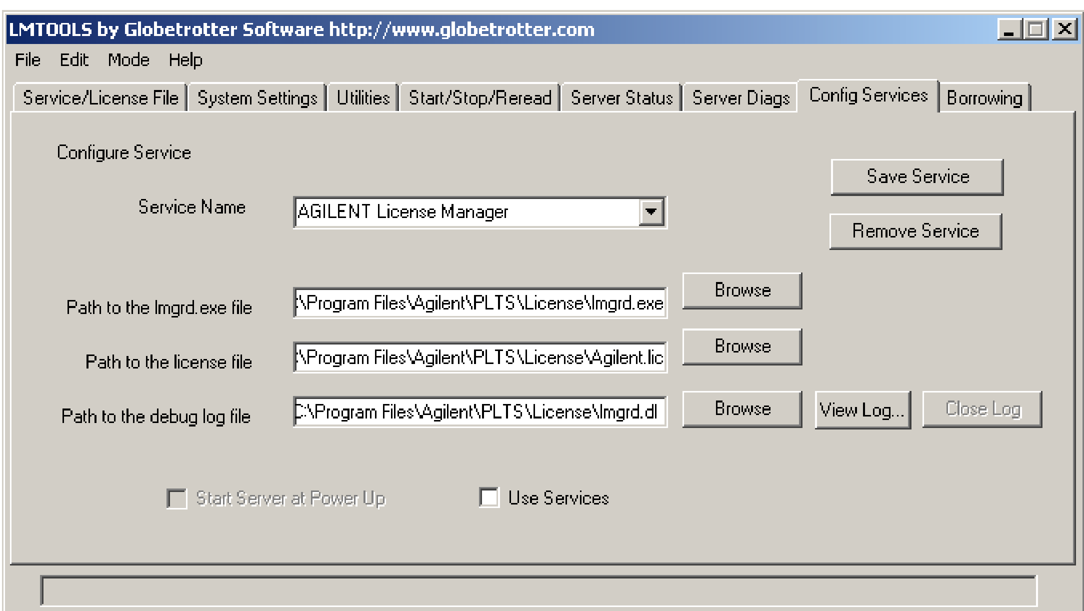
9. Once you receive the E-mail with the attached license file, save the license file to the server's PLTS License directory (the same directory that you created on your server to save the five files to earlier).

10. Make a back up of the license file and store in a safe location.

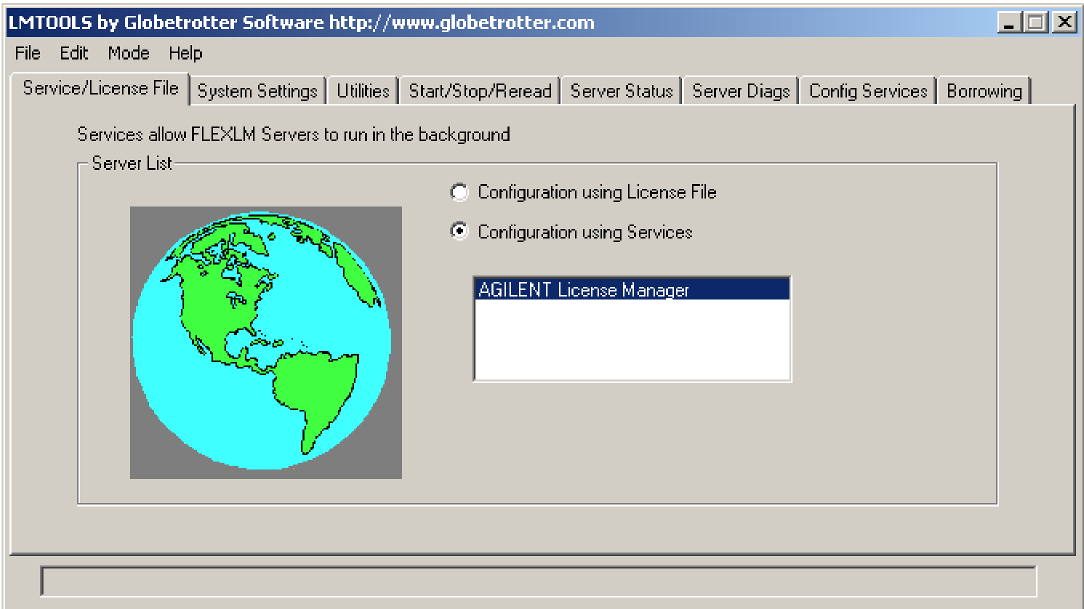
    This back up file is very important! You may need this back up file if you encounter problems with your computer or if the license file is lost or erased.

11. In the server's PLTS License directory, double click the **lmtools.exe** file to open the *LMTools* dialog box. Select the **Config Services** tab. On this tab:

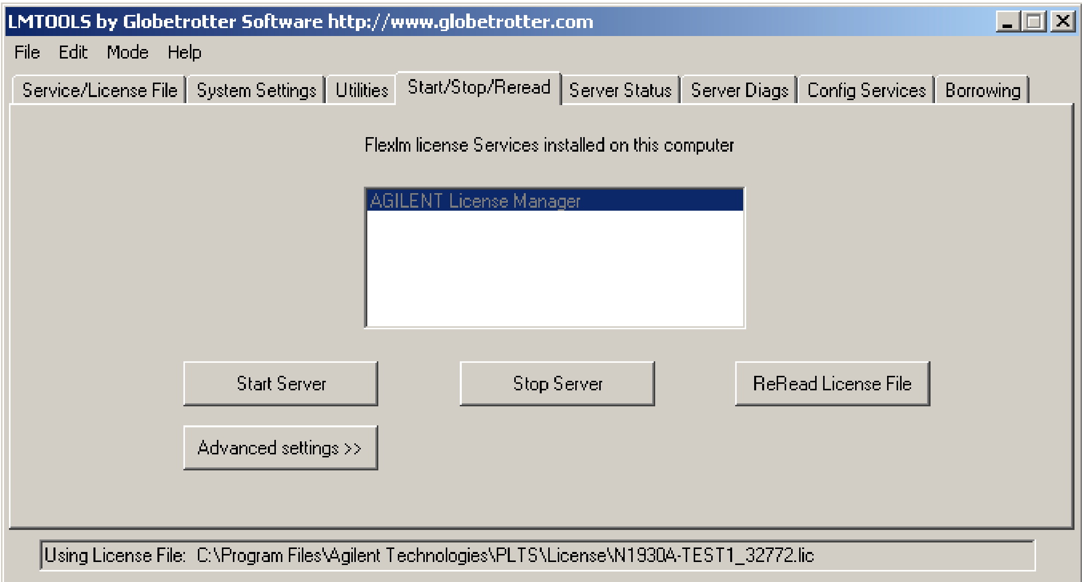
    a. In the **Service Name** list, select or enter **AGILENT License Manager**.
    b. In the **Path to the LMgrd.exe file** text box, enter the path to the server's PLTS license directory followed by the **lmgrd.exe** file name.
    c. In the **Path to the license file** text box, enter the path to the server's PLTS license directory followed by the file name of the license that you copied to the directory.
    d. In the **Path to the debug log file** text box, enter the path to the server's PLTS license directory followed by the **lmgrd.dl** file name.
    e. Click the **Use Services** check box and then click the **Start Server at Power Up** check box to make the PLTS license available for PLTS on restart of the server.
    f. Click the **Save Service** button to save the changes.



12. In the *LMTools* dialog box, select the **Service/License File** tab. On this tab, highlight **AGILENT License Manager** and click the **Configuration using Services** selection.



13. In the *LMTools* dialog box, select the **Start/Stop/Reread** tab. On this tab, highlight **AGILENT License Manager** and click the **Start Server** button.

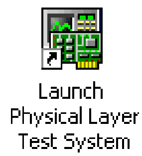


This step must be repeated each time the server is powered up if you did not click the **Start Server at Power Up** check box earlier in this procedure.

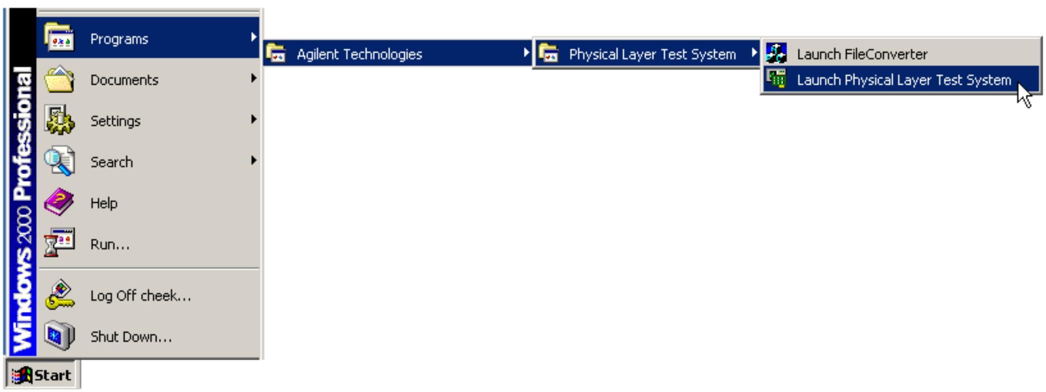
14. Continue with “Step 5. Start the Physical Layer Test System Software” on page 76.

Step 5. Start the Physical Layer Test System Software

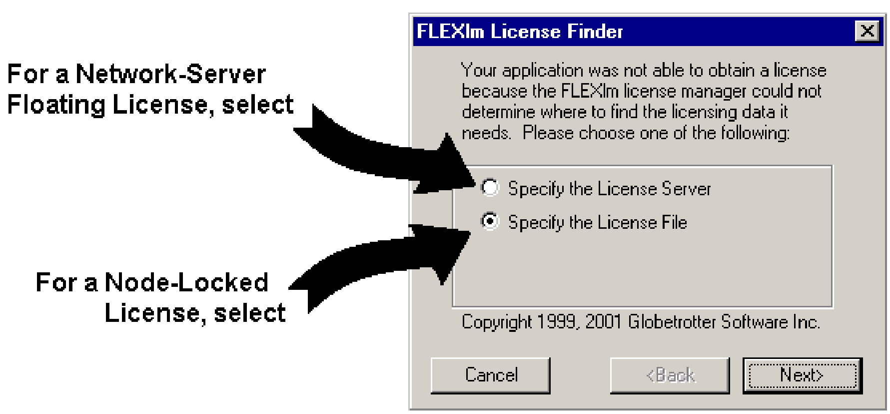
1. Start the PLTS software by double-clicking the **Launch Physical Layer Test System** icon on the PC desktop.



You may also run the program by selecting **Start**, **Programs, Agilent Technologies**, **Physical Layer Test System**, **Launch Physical Layer Test System**.



2. The first time you start the software, you will be asked to identify the license type of the software.



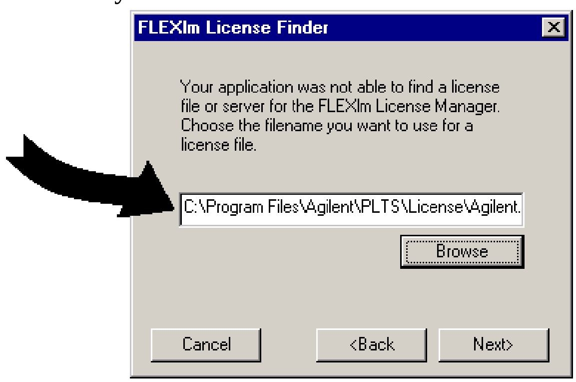
When the dialog box is displayed:

- **If you own a node-locked license:**
  Select **Specify the License File** and then click the **Next >** button.
- **If you own a network-server floating license:**
  Select **Specify the License Server** and then click the **Next >** button.

3. Based on the type of license you own:

- **If you own a node-locked license:**

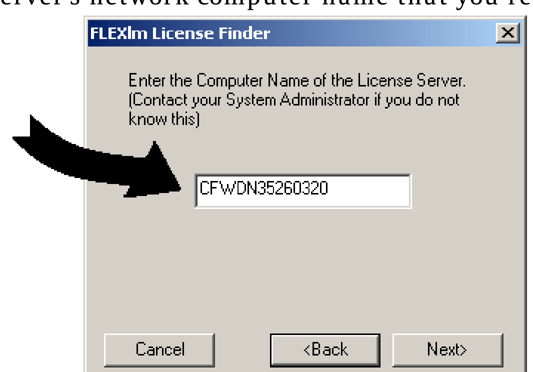
  When this *FLEXlm License Finder* dialog box is displayed asking you to choose the license filename, click the **Browse** button and select the license file in the License directory.



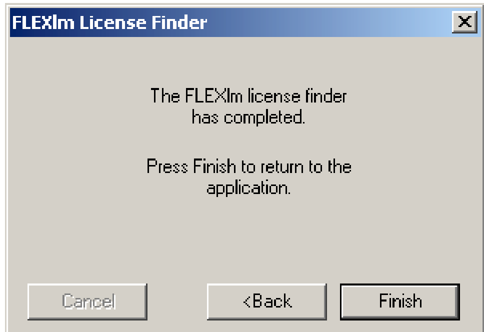
  Once the directory and the license file is identified, the directory path is displayed in the FLEXlm License Finder dialog box. Select the **Next>** button.

- **If you own a network-server floating license:**

  The client PC needs to be configured to look for the PLTS license on the Server. Enter the server's network computer name that you recorded earlier.



4. When the license is found and identified, select the Finish button to continue starting the software.



NOTE Make a back-up copy of the license file if you have not already done so.

5. After the licensing is completed, the software scans the GPIB bus to find the PLTS systems that are available to use.

The PLTS software looks for the following VNA-based and TDR-based PLTS systems:

VNA-Based Systems:		**TDR-Based Systems:**
N1957B (E8364B & N4421B)	N1951A (8720ES & N4418A)	Agilent 86100A/B/C
N1955B (E8363B & N4420B)	N1948A (E8358A & N4417A)	Tektronix CSA8000
N1953B (E8362B & N4419B)	N1947A (E8803A & N4417A)	Tektronix TDS8000
N1935A (N5230A Option 225 & N4419B)		

- If the software recognizes one of the systems, it sets your software to make a measurement using the measurement wizard. You should review "Step 6. Familiarize Yourself with the PLTS Software Screen" on page 82.

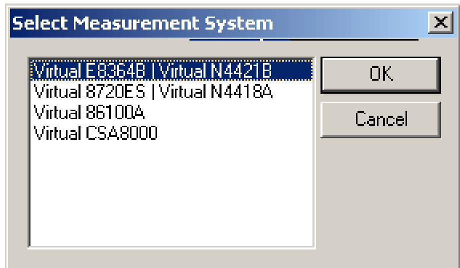
  Then, based on your PLTS system hardware, continue with either:

  — Chapter 1 "Setting Up and Making Measurements using the VNA-Based PLTS" in the *PLTS User's Guide*
  — Chapter 3 "Setting Up, Calibrating, and Making Measurements using the TDR-Based PLTS" in the *PLTS User's Guide*

- If the software does not recognize one of the systems, it notifies you: "No instruments were detected. PLTS will operate in analysis-only mode." This may be because:

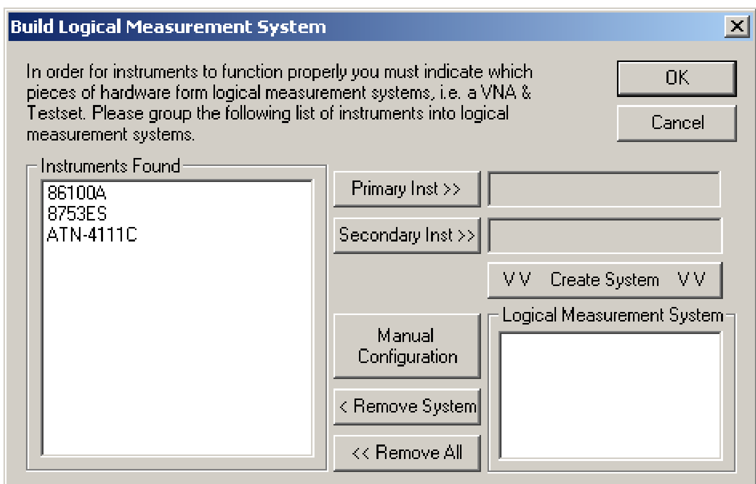
  You want to perform analysis only and do not have any PLTS system hardware connected to the GPIB. In this case, select the virtual instrument that be matches

your PLTS system or if known, the system that was used to measure the data. Continue at "Step 6. Familiarize Yourself with the PLTS Software Screen" on page 82.



— PLTS does not recognize your system hardware or PLTS finds more than one system connected to your GPIB. Continue with the next step.

6. If the PLTS software does not recognize your system hardware or if it finds more than one system on the GPIB, it displays the *Build Logical Measurement System* dialog box. This dialog box allows you to identify your PLTS system hardware for the PLTS software.



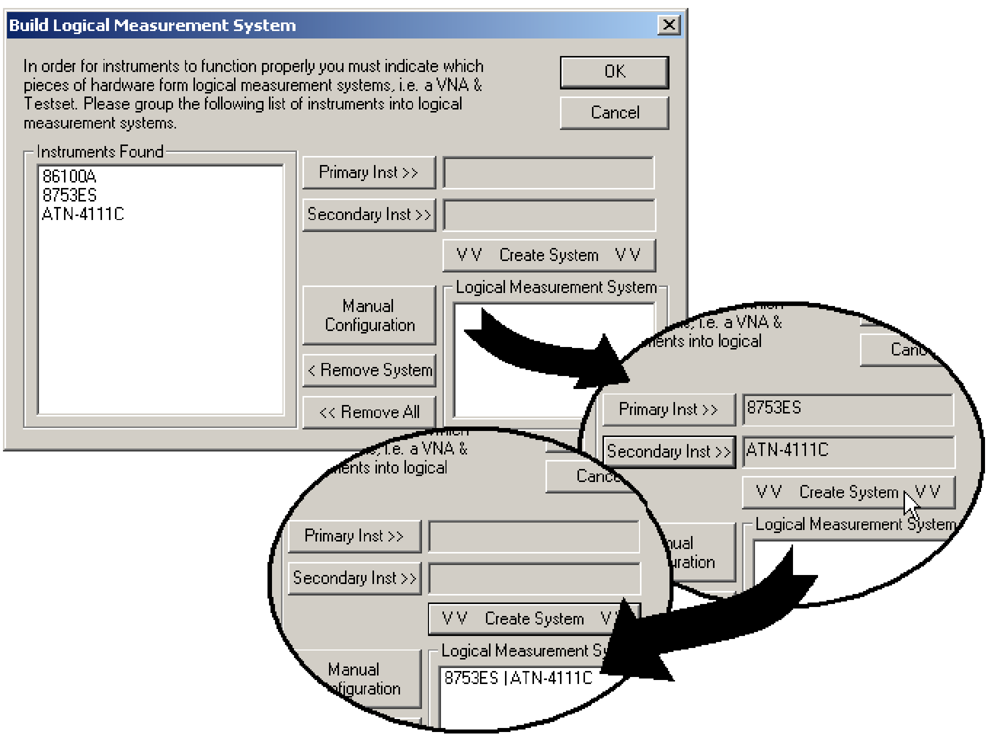
- To identify your VNA-based system (VNA with a test set) for the software:

  a. In the **Instruments Found** list, click the model number of your network analyzer to highlight it. Then click the **Primary Inst >>** button which moves the model number to the text box at the right of the button.

  b. In the **Instruments Found** list, click the model number of your test set to highlight it. Then click the **Secondary Inst >>** button which moves the model number to the text box at the right of that button.

  c. Click the **Create System** button which moves the combination of the devices to the **Logical Measurement System** box.

  d. Click the **OK** button to save the system so the software identifies the PLTS system.



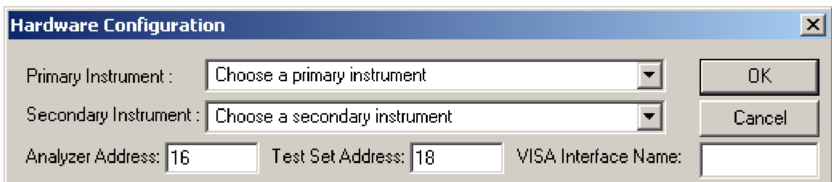
- To identify your TDR-based (or single-instrument) system for the software:

  a. In the **Instruments Found** list, click the model number of your network analyzer to highlight it. Then click the **Primary Inst >>** button which moves the model number to the text box at the right of the button.

b. Click the **Create System** button which moves the device to the **Logical Measurement System** box. (Note that this step may be omitted for single-instrument systems, such as the TDR systems.)

c. Click the **OK** button to save the system so the software identifies the PLTS system.

NOTE If you can not get your system identifies, you can manually configure your system by selecting the **Manual Configuration** button to display the Hardware Configuration dialog box.



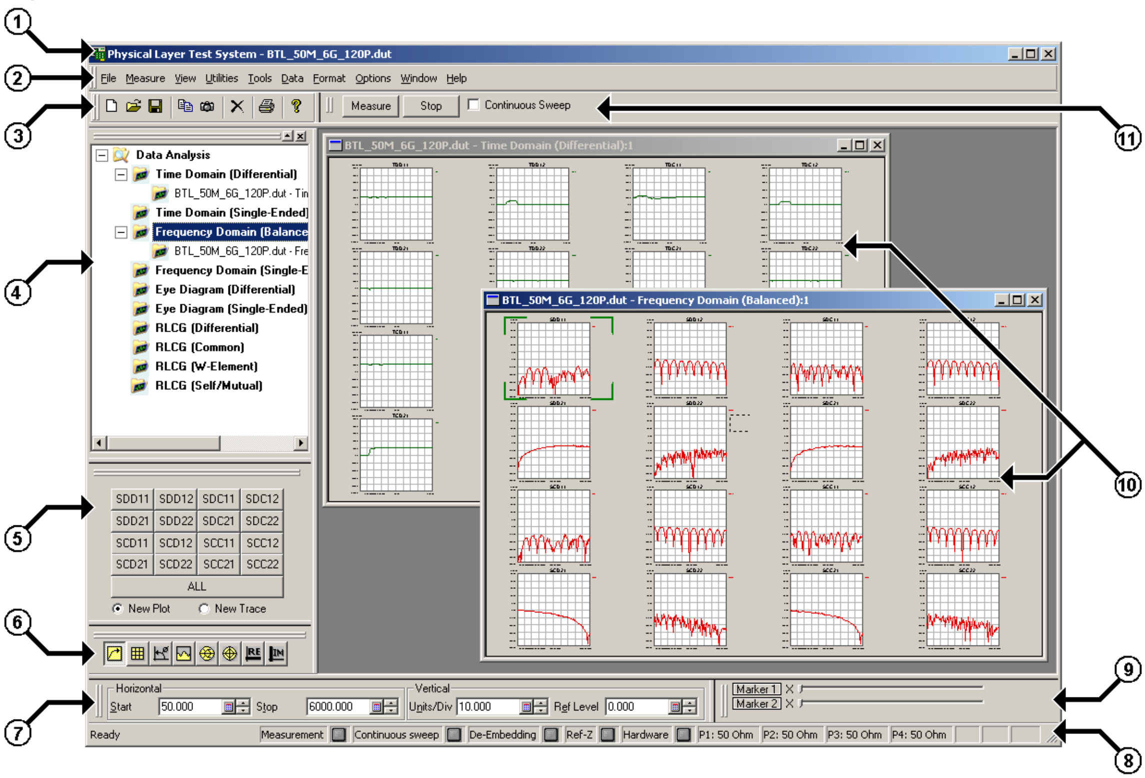
Select the primary instrument (typically at VNA or a TDR) from the **Primary Instrument** list. If necessary, select a secondary instrument (typically at test set) from the **Secondary Instrument** list.

Enter the address for the primary instrument in the **Analyzer Address** text box and the secondary instrument in the **Test Set Address** text box. Also, enter the **VISA Interface Name**.

Step 6. Familiarize Yourself with the PLTS Software Screen

This section describes the features of the Physical Layer Test System software. Refer to Figure 3-1, Main Window, for the locations of each of the software's main features.

Figure 3-1 Main Window



1. **Title Bar**
2. **Menu Bar**
3. **Toolbar**
4. **Browser**
5. **Parameter Bar**
6. **Format Bar**
7. **Scaling Bar**
8. **Status Bar**
9. **Marker Bar**
10. **Plots Area**
11. **Measure Bar**

Each of these areas are described in the remainder of this section.

The software was designed with an informal flow down the left edge of the window in mind. It is an informal flow because with the flexibility of the software, this is an easy way, not the

only way to setup many of the features. For example, you may open a device file from areas 2 and 3. Then you will select a data analysis that shows the open file in area 4. You will need to select parameters to display from area 5. If you need to change the format of the display, you change the format in area 6. Then you can adjust the scaling of the plots in area 7.

1. Title Bar

The title bar (Figure 3-2) displays the title of the software. In the brackets, it also displays the file name of the data in the active plot window if the data has been saved. The data analysis type of the active plot window is also displayed. At the right side of the title bar, buttons are also provided quickly perform tasks at the program level.

Figure 3-2 Title Bar

Clicking:	Performs:
	Minimizes the program window to the Windows task bar.
	Toggles the program window to full screen mode.
	Toggles the program window to partial screen mode.
	Closes the program.

2. Menu Bar

The menu bar (shown in Figure 3-3) lists each of the drop down menu names currently available. When you click a menu name, the menu is displayed. The menu names and menus change to reflect appropriate choices for the data analysis type of the active plot window. Refer to Chapter 4, “Menu Reference,” for detailed information about each of the menu bar selections.

When the active plot window is maximized, completely filling the plot area, the menu bar also displays three buttons to control the plot window.

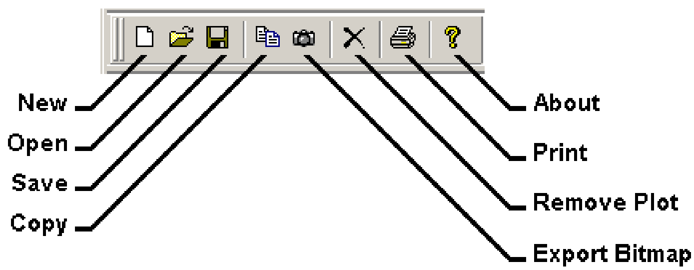
Figure 3-3 Menu Bar

Clicking:	Performs:
	Minimizes the plot window within the plot windows display area.
	Toggles the plot window to partially fill the plot windows display area.
	Closes the plot window.

3. Toolbar

The toolbar (Figure 3-4) provides buttons for beginning a new measurement, opening existing files, saving current data, copying current data, exporting data, removing plots, and printing.

Figure 3-4 Toolbar



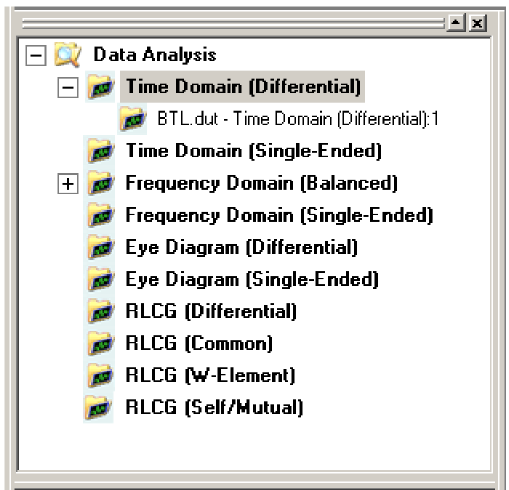
Clicking:		Performs:
	New	Starts the setup wizard so that a new measurement may be made.
	Open	Opens the *Open* dialog box so that an existing file may be opened.
	Save	Opens the *Save As* dialog box so that a file may be saved.
	Copy	Copies the active plot to the clipboard.
	Export Bitmap	Saves the active plot as a bitmap file (bmp).
	Remove Plot	Deletes the active plots.
	Print	Prints the active plots.
	About	Opens the *About PLTS* information.

4. Browser

The browser (Figure 3-5) provides access to each measurement and data analysis type. Selecting a new Data Analysis type from the browser opens up a corresponding plot window. Each Data Analysis type may view multiple sets of data.

- Clicking a bold label opens a new window in the plots area with that data analysis type.
- Clicking a non-bold label displays that plot and makes it the active plot in the plots area.
- Clicking the minus sign (–)hides the data selections for a given data analysis type.
- Clicking the plus sign (+) shows the data selections.

Figure 3-5 Browser



5. Parameter Bar

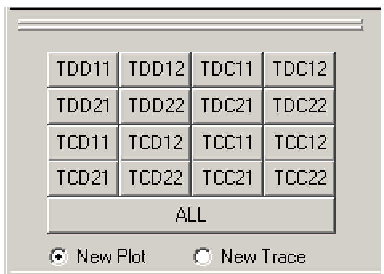
The parameter bar (Figure 3-6) allows you to open a new plot, or add a new trace to an existing plot. Figure 3-6 shows the parameter bar for the balanced time domain plots. Each analysis type has a unique parameter bar specific to that type of analysis. Refer to Figure 4-23, “Parameter Bars for Each Data Analysis Type” on page 114 to see all parameter bars.

Select **New Plot** and then click a parameter to display a new plot.

- or -

Select **New Trace** and then click a parameter to overlay a new trace to an existing plot. Clicking the parameter a second time removes the added trace from the plot.

Figure 3-6 Parameter Bar for Balanced Time Domain Plots



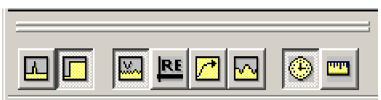
6. Format Bar

The format bar (Figure 3-7) is only available when the active plot window is a time domain or frequency domain selection. The format bars allow you to format the parameters for the active time domain or frequency domain plot window. To display the format bar, select **Format Bar** from the **View** menu. It is hidden with the same selection.

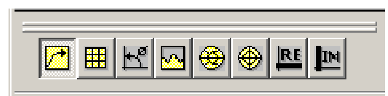
The time domain format bar differs from the frequency domain format bar. It has different format selections and it is divided into three areas. Therefore, the time domain format bar has three selections while the frequency domain format bar has one selection. Each format bar matches its corresponding **Format** menu (selected in the **Menu** bar.) The format bar and the title of each button for both time and frequency domain are shown below.

Figure 3-7 Format Bars

Time Domain



Frequency Domain

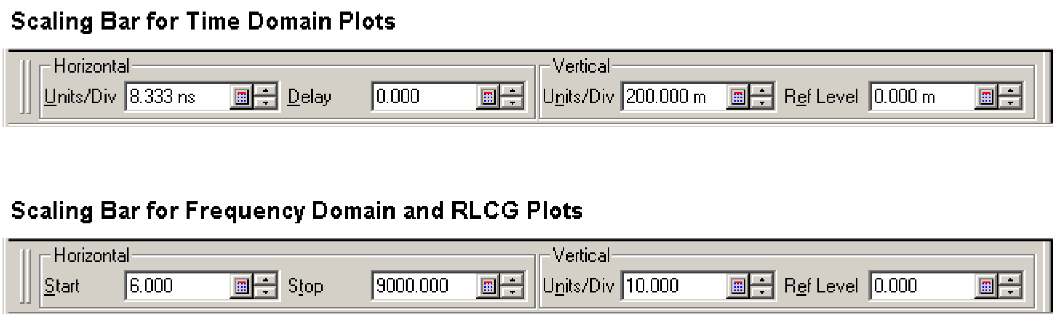


For detailed information about each selection, refer to "Selecting Time Domain Display Formats" in the "Analyzing Data in the Time Domain" chapter of the *PLTS User's Guide*.	For detailed information about each selection, refer to "Selecting Frequency Domain Display Formats" in the "Analyzing Data in the Frequency Domain" chapter of the *PLTS User's Guide*.
Impulse	Log Mag (default selection)
Step (default selection)	Linear Mag
Volts (default selection)	Phase
Real	Group Delay
Log Mag	Smith Chart
Impedance	Polar Chart
ns (default selection)	Real
cm	Imaginary

7. Scaling Bar

The scaling bar (see Figure 3-8) allows you to change the scale on both the horizontal and vertical axis.

Figure 3-8 Scaling Bars



For time domain, the horizontal axis entries are units/division and delay. The vertical axis units are units/division and reference level.

For frequency domain and RLCG, the horizontal axis entries are the start frequency and the stop frequency. The vertical axis units are the units/division and the reference level.

NOTE When the time domain horizontal units per division is changed, the **Delay** value is reset to zero.

---

8. Status Bar

The status bar (Figure 3-9) provides a visual indication of when conditions are happening within the software and the impedance associated with each system channel.

When any of the conditions listed below are active, an indicator adjacent to the condition title is displayed in a bright color. If the condition is not active, the color of the indicator is gray. The conditions are:

Measurement is bright when a measurement is being performed by the software.

Continuous sweep is bright when the measurement is being continuously swept.

De-Embedding is bright when the active plot has de-embedding data applied.

Port Rotation is bright when the active plot has reference impedance applied.

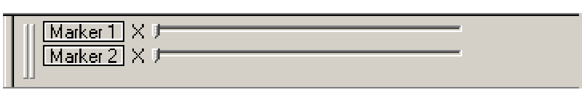
Hardware is bright when the hardware has been identified by the software.

Figure 3-9 Status Bar

9. Marker Bar

The marker bar (Figure 3-10) allows you to add and display up to two markers to the active plot. The X-Y values of each cursor and the delta (the value of their difference) is displayed at the right edge of the plot. The eye diagram marker bar and the frequency domain polar and Smith chart marker bars differ slightly. Refer to “Markers” in the “Using Analysis Tools and Utilities” chapter of the *PLTS User’s Guide* for complete marker bar information.

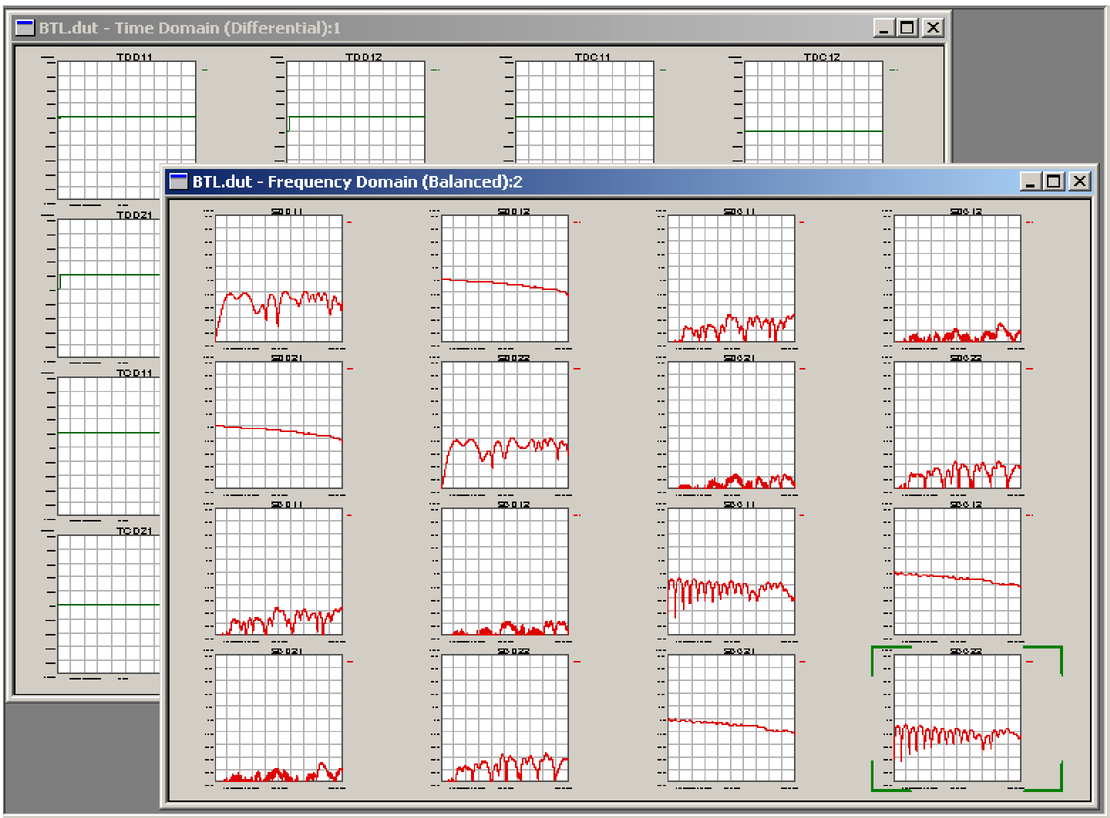
Figure 3-10 Marker Bar



10. Plots Area

The plot windows (Figure 3-11) display the measurement results in the data analysis type selected. You select the data analysis type when you make a measurement, open existing data files, or make a selection in the browser. The **Parameter Bar** or the **Data** menu on the **Menu** bar allows you to display plots for all of the parameters or just the parameters you want to view. Multiple plot windows can be displayed in the plot window display area at the same time as shown in the figure.

Figure 3-11 Plot Windows in the Plots Area



11. Measure Bar

The measure bar allows you to make measurements on your DUT without using the wizard. With a valid calibration file loaded, you may measure a single sweep or measure continuous sweeps.

Figure 3-12 Measure Bar

II Reference

Part II provides reference information related to operating the physical layer test system.

Chapter 4, “Menu Reference”

Provides you with descriptions of each menu bar selection in the test system software.

Chapter 5, “Specifications and Characteristics”

Provides you with the specifications and characteristics of the physical layer test system.

Chapter 6, “Test Set Front Panel and Rear Panel”

Provides you with specific information regarding each test set front panel and rear panel connector, switch, fuse, and LED indicator.

Chapter 7, “Troubleshooting and Maintenance”

Provides you with information about troubleshooting the test system, contacting Agilent for assistance, care of test cables and coaxial connectors, and electrostatic discharge.

Chapter 8, “Safety and Regulatory Information”

Provides you with information that will allow you to operate the test system safely. This chapter also lists the appropriate information required by regulatory agencies.

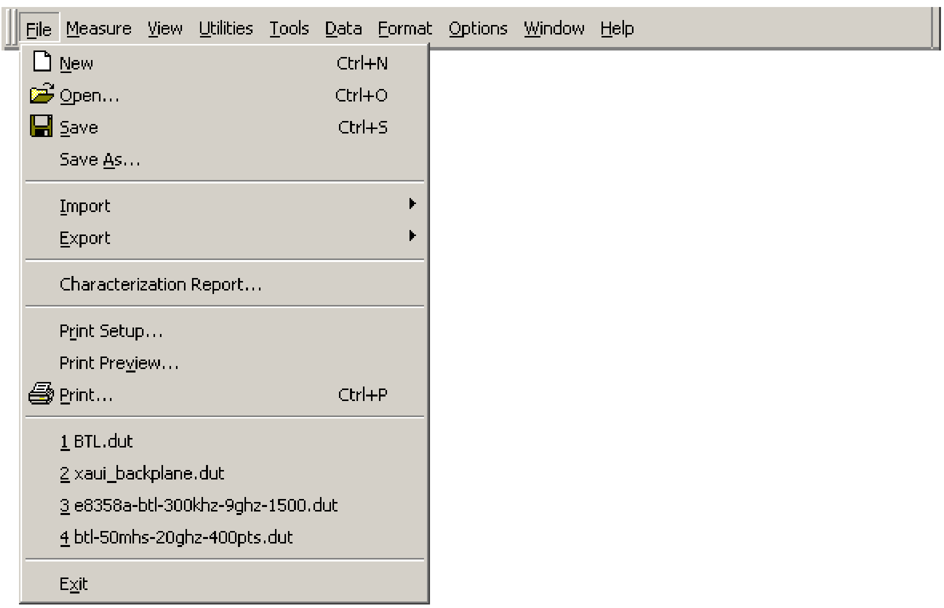
4 Menu Reference

The following menus and each of their selections are described in detail in this chapter. Many of these menus are displayed only under specific measurement conditions. Refer to each specific menu on the pages listed for selections and conditions.

File Menu

The **File** menu provides access to many standard software functions such as creating, opening, and saving data, importing and exporting files, creating a characterization report, printing, and exiting the software.

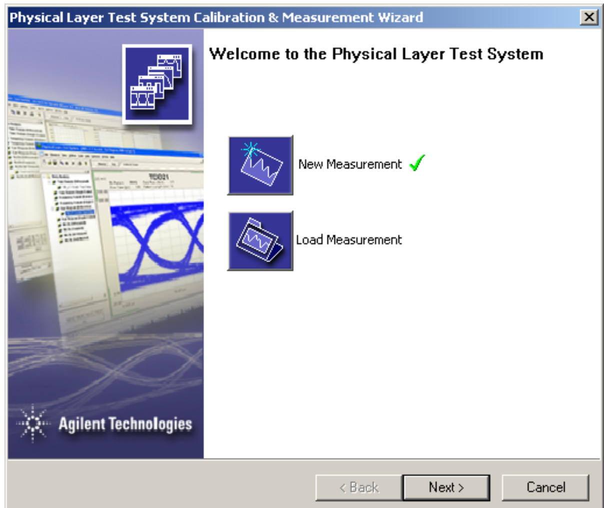
Figure 4-1 File Menu



New

Select **New** from the **File** menu to start a new measurement process and open the *Startup Wizard* window.

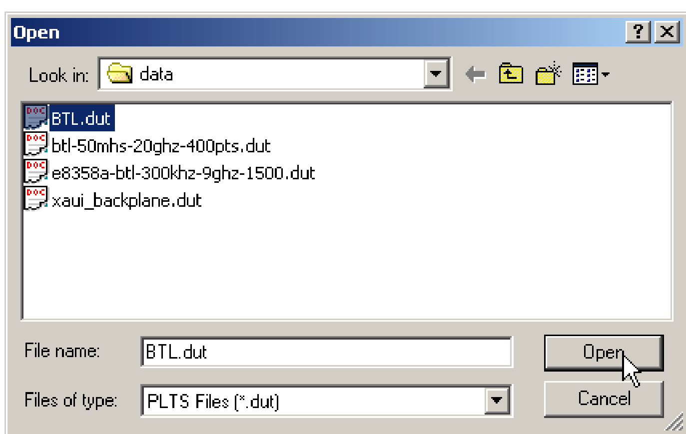
Figure 4-2 Startup Wizard Window



Open

Select **Open** from the **File** menu to load a previously saved file.

Figure 4-3 Open Dialog Box

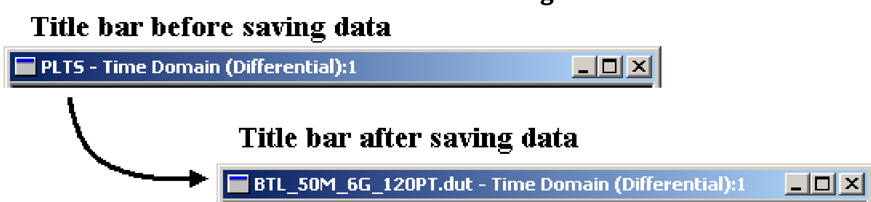


Save

Select **Save** from the **File** menu to save the current measurement or calibration data. New data or imported data may be saved.

Until measurement data is saved, the plot window title bar is labeled PLTS along with the analysis type of the plot window and the sequential plow window number. Once the data is saved, the PLTS label is replaced with the name of the saved file. Figure 4-4 shows the plot window title bar before the data was saved and how it changes to match the file name (BTL_50M_6G_120PT.dut) after it is saved.

Figure 4-4 Plot Window Title Bar Changes After Data is Saved

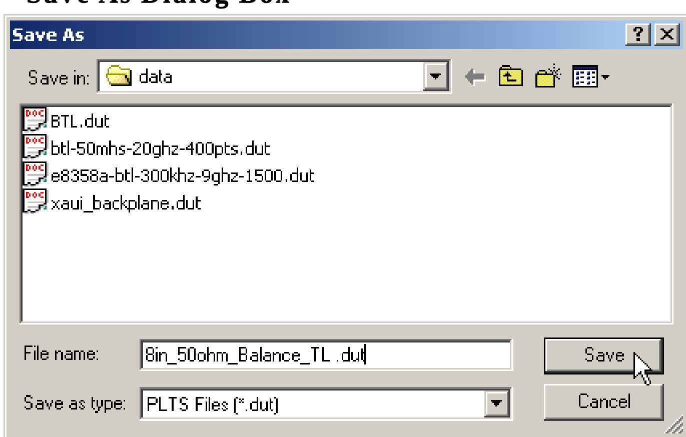


Only one unsaved plot window may be open at a time. If you have one unsaved plot window, you must either save the data or delete the window before you can open another plot window with unsaved data.

Save As...

Select **Save As**... from the **File** menu to save new measurement or calibration data or existing data as a new file.

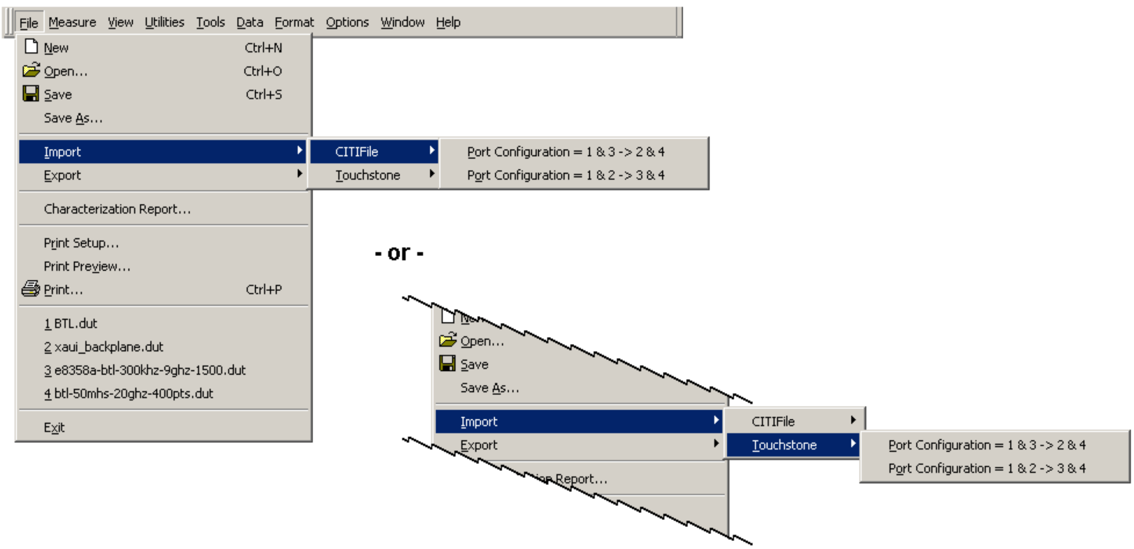
Figure 4-5 Save As Dialog Box



Import

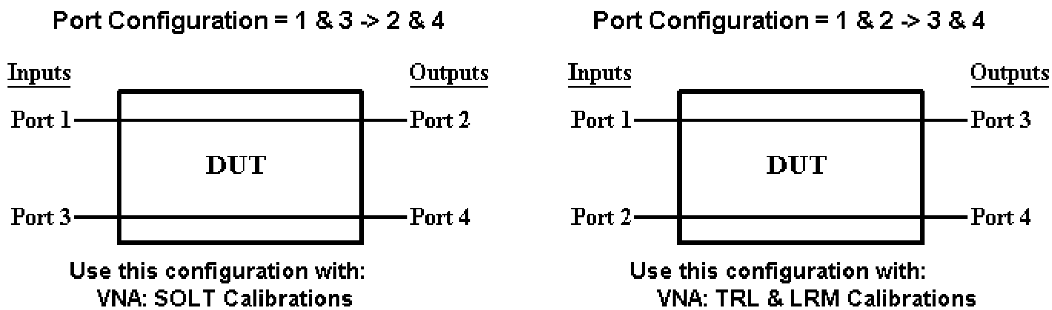
Select **Import** from the **File** menu to import a single-ended measurement data file. Then select either **CITIFile** to import a file in CITIfile format or **Touchstone** to import a file in Touchstone format. Then select from one of the port selections (either **Port Configuration = 1 & 3 -> 2 & 4** or **Port Configuration = 1 & 2 -> 3 & 4**) based on the system and calibration type used with the original measurement.

Figure 4-6 File Menu with Import and CITIFile Expanded



CAUTION PLTS will not import files with Power Sweep data. Attempting to import files with Power Sweep data could cause PLTS to close without notice.

Figure 4-7 Balanced Transform Port Configuration Diagram



CITIFile

CITIFile imports data previously saved in CITIfile (*.cit) format. CITIfiles imported in this fashion can be used for comparison with other data sets using trace memory and math functions. Refer to Figure 4-7 and choose from one of the following port selections.

Port Configuration = 1 & 3 -> 2 & 4 is used to import single-ended measurement data taken with a VNA-based system calibrated using the SOLT calibration.

Port Configuration = 1 & 2 -> 3 & 4 is used to import single-ended measurement data taken with a VNA-based system calibrated using a TRL or LRM calibration or for all TDR measurements.

Touchstone

Touchstone imports data previously saved in Touchstone (*.S4P) format. Refer to Figure 4-7 and choose from one of the following port selections.

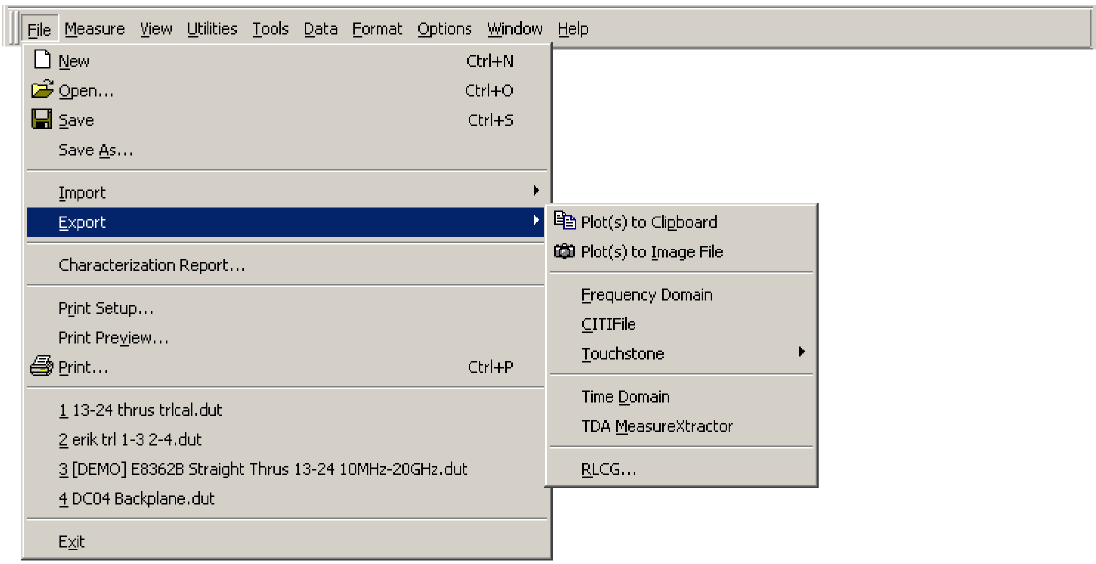
Port Configuration = 1 & 3 -> 2 & 4 is used to import single-ended measurement data taken with a VNA-based system calibrated using the SOLT calibration.

Port Configuration = 1 & 2 -> 3 & 4 is used to import single-ended measurement data taken with a VNA-based system calibrated using a TRL or LRM calibration or for all TDR measurements.

Export

Select **Export** from the **File** menu to export a file. Then select from the following choices to select a specific format: **Plots to Clipboard**, **Plots to Image File**, **Frequency Domain**, **CITIFile**, **Touchstone**, **Time Domain**, **TDA MeasureXtractor**, and **RLCG**....

Figure 4-8 File Menu with Export Expanded



Select **Export** from the **File** menu to export a file. Then select from the following choices to select a specific format: **Plots to Clipboard**, **Plots to Image File**, **Frequency Domain**, **CITIFile**, **Touchstone**, **Time Domain**, **TDA MeasureXtractor**, and **RLCG**....

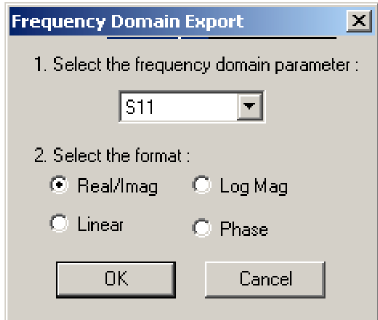
Plot(s) to Clipboard exports the contents of the current plot window to the Windows clipboard.

Plot(s) to Image File exports the contents of the current plot window as an image file. When you export it, you may choose from Windows Bitmap (*.BMP), JPEG Bitmap (*.JPG), or Targa Bitmap (*.TGA) formats.

Frequency Domain exports the data of a single S-parameter (either single-ended or balanced) in one of four frequency domain formats: Real/Imaginary, Log Magnitude, Linear Magnitude, or Phase. All four formats are exported in tabular format as a text file, each with a header. The measured data is bounded by a `BEGIN` and an `END` message. The Real/Imaginary data of each measured point is exported as comma-separated values.

Use the *Frequency Domain Export* dialog box shown in to select the S-parameter (all single-ended and balanced S-parameters are listed). Then click **OK** to export the data.

Figure 4-9 Frequency Domain Export Dialog Box

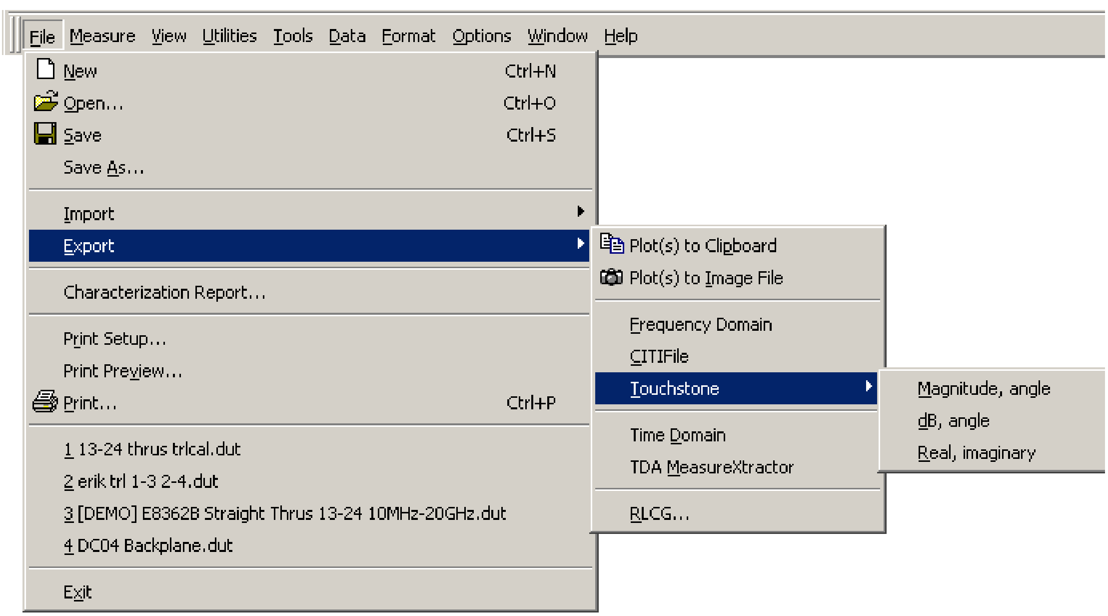


CITIFile exports the current data in CITIfile format (*.cit).

Touchstone exports the current data in the S4P format which also has the following data format choices in which the data may be saved:

- **Magnitude, angle**
- **dB, angle** (power, angle)
- **Real, imaginary**

Figure 4-10 File Menu with Export and Touchstone Expanded



Time Domain exports the current time domain data in text format (*.txt). It saves a name, the parameter and format information in a header. In the body, each X and Y measurement coordinate is displayed separated by a comma. These coordinates are bounded by a BEGIN and END message.

TDA MeasureXtractor exports measured data into the TDA MeasureXtractor format. Refer to the “TDA MeasureXtractor” section in the “Importing and Exporting” chapter of the user’s guide.

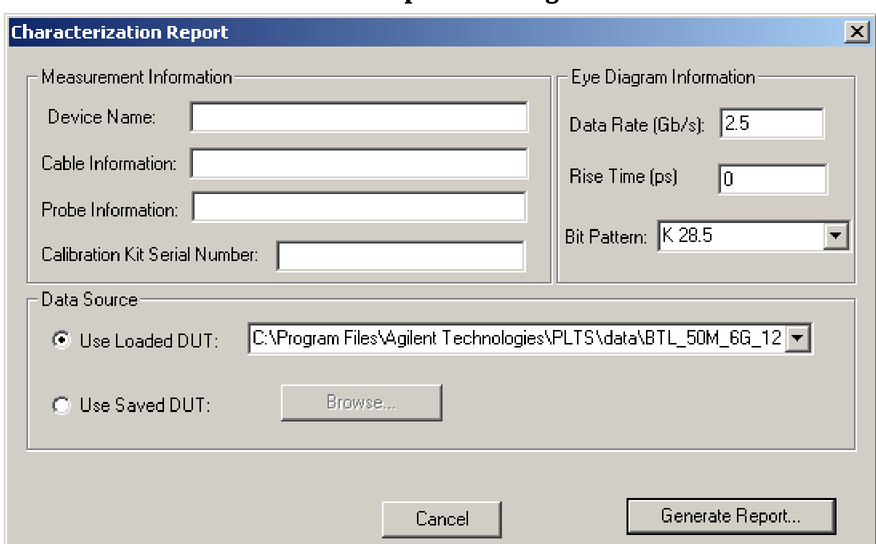
RLCG... exports the current W-element RLCG data into formats that can be used with either HSPICE or ADS applications.

Refer to the “RLCG” section in the “Importing and Exporting” chapter of the user’s guide for detailed information.

Characterization Report...

Click the **File** menu and then click **Characterization Report**... to start creating the characterization report. The *Characterization Report* dialog box is displayed.

Figure 4-11 Characterization Report Dialog Box

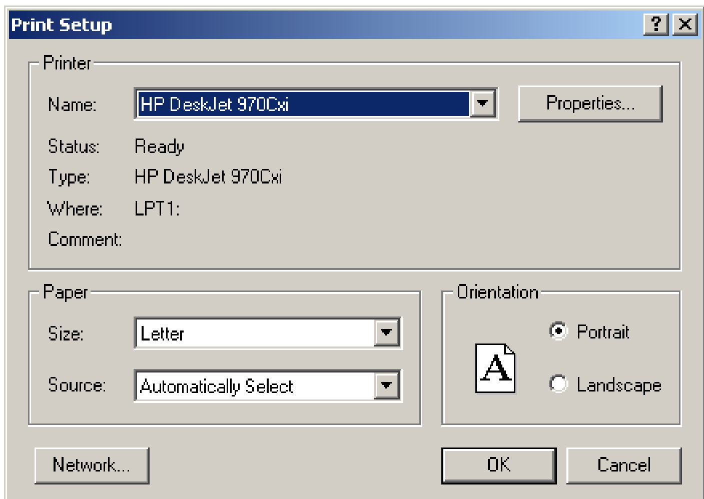


For more information, refer to the “Characterization Report Generator” section in the “Using Analysis Tools and Utilities” chapter of the user’s guide.

Print Setup...

Click the **File** menu and then click **Print Setup**... to review the printer settings. The *Print Setup* dialog box is displayed. The *Print Setup* dialog box allows you to select the destination printer and its properties, the paper size and printer paper source, additional network printers, and choose the orientation of the paper when printed.

Figure 4-12 Print Setup Dialog Box



If you are connected to other networks, click **Network...** to find additional printers.

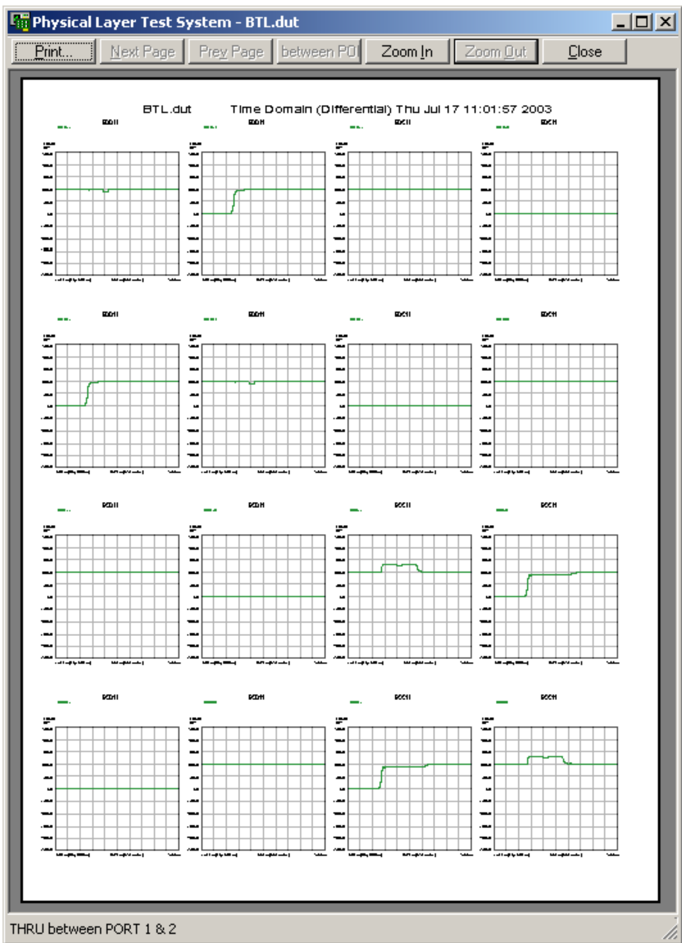
Click **OK** to print the selected plots and return to the program.

Click **Cancel** to close the dialog box and return to the program without printing.

Print Preview…

Click the **File** menu and then click **Print Preview**… to review the active plot window prior to printing. The data is displayed in the preview window. The preview window allows you to move between multiple pages of data, zooming in and zooming out on displayed data, printing the data, and closing the window.

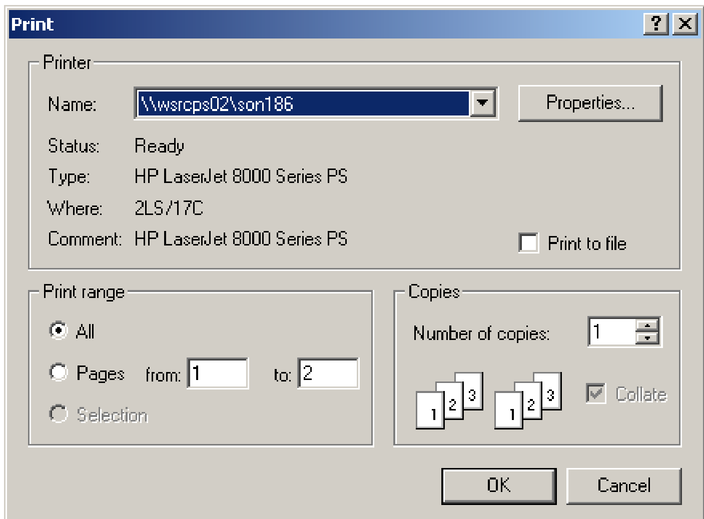
Figure 4-13 Displayed Data when Print Preview… is Selected



Print...

Click **Print**... from the **File** menu to print the selected plots and display the *Print* dialog box. The *Print* dialog box allows you to select the destination printer and its properties, the range of pages to be printed, and the number of copies you wish to print.

Figure 4-14 Print Dialog Box



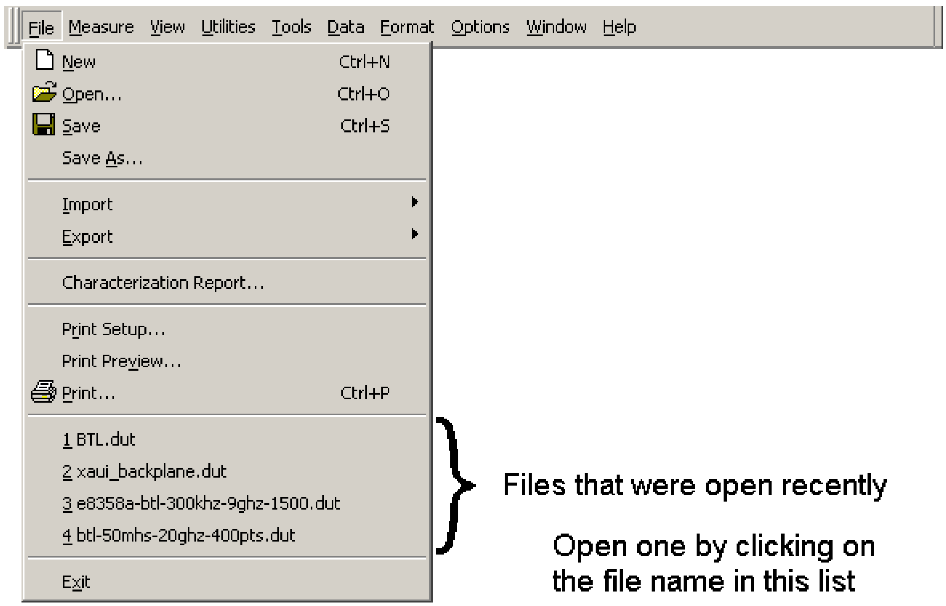
Click **OK** to print the selected plots and return to the program.

Click **Cancel** to close the dialog box and return to the program without printing.

Recent Files

Open any of the four most recently accessed files by clicking the name of the file from this list. Only the four most recently accessed files are displayed.

Figure 4-15 Opening Recently Accessed Files



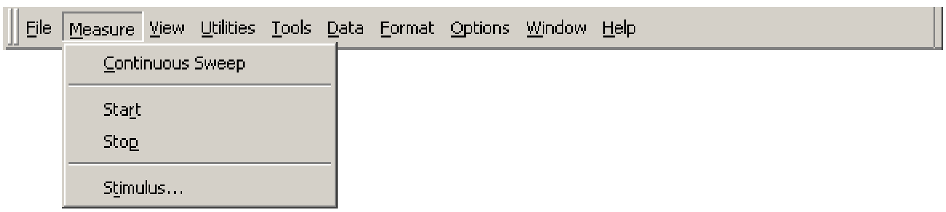
Exit

Click **Exit** from the **File** menu to quit this program.

Measure Menu

The Measure menu allows you to start a measurement, start and stop a continuous sweep measurement, and change the stimulus.

Figure 4-16 Measure Menu



Continuous Sweep

Continuous Sweep sets the system to make measurements as the selected frequency span is swept continuously. After each measurement, the displayed data is updated.

To perform a continuous sweep measurement, select **Continuous Sweep** so that it has a check mark on its left side on the Measure menu. With **Continuous Sweep** active, the **Start** and **Stop** menu selections control continuous sweep. Select **Start** to begin a continuous measurement and select **Stop** to stop the measurement.

The **Continuous sweep** indicator on status bar means that system is currently in the continuous sweep mode. See Figure 4-17.

Figure 4-17 Continuous Sweep Indicator on the Status Bar

Start

Start begins a measurement when it is selected. When **Continuous Sweep** has a check mark, **Start** begins a continuous sweep measurement; otherwise it begins a single sweep measurement.

Stop

Stop stops a continuous sweep measurement.

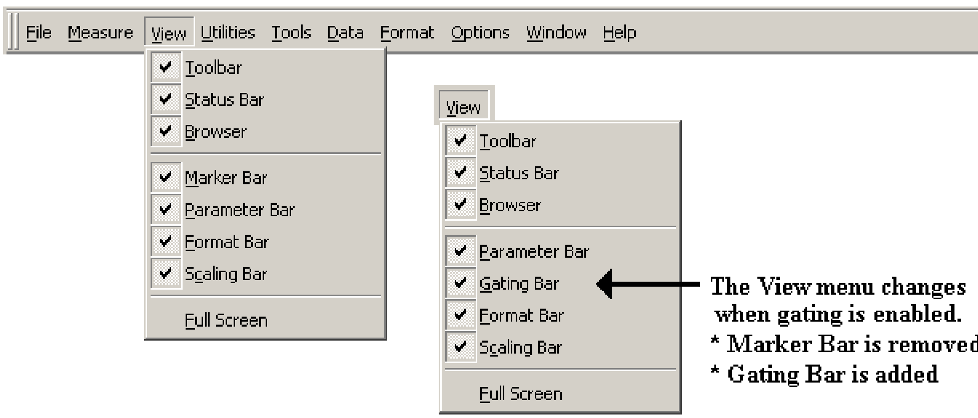
Stimulus...

Stimulus... opens the *Modify Time and Frequency Parameters* dialog box so that you can change the parameters. For detailed information regarding changing the stimulus parameters, refer to the stimulus information of the “Setting Up the Calibration and Measurement Parameters” section in the “Setting Up and Making Measurements using the VNA-Based PLTS” chapter of the user’s guide.

View Menu

The **View** menu opens and closes the various tool bars.

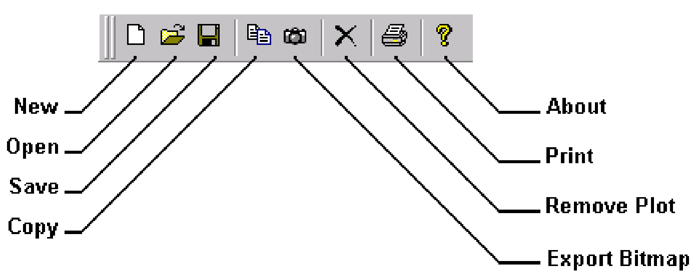
Figure 4-18 View Menu



Toolbar

The **Toolbar** provides quick access to several File menu features as well as two others. The features that are available on the **Toolbar** are **New**, **Open**, **Save**, **Copy**, **Export Bitmap**, **Remove Plot**, **Print**, and **About**.

Figure 4-19 Toolbar



Status Bar

The **Status Bar** provides a graphic display of when several features are active. Each feature has a label on the left and an indicator just to the right side of the label. When a feature is active, the indicator is changed to a bright color. When the feature in not active, the indicator is gray. The impedance of each test system channel is displayed at the right side of this bar.

Figure 4-20 Status Bar

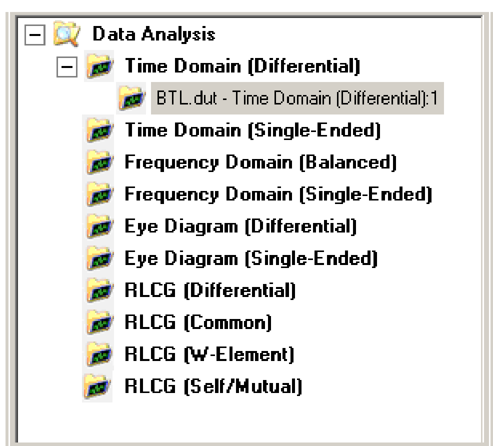
Measurement	is bright when a measurement is being performed
Continuous sweep	is bright when a continuous sweep measurement is being performed
De-Embedding	is bright when de-embedding is applied to the data
Port Rotation	is bright when port rotation/extension is applied to the data
Hardware	is bright when the software recognizes the GPIB-connected hardware

Browser

The **Browser** allows selection of data analysis type and the selection of plots to view. Selecting a data analysis type (a bold selection) opens a blank plot window for that analysis type. Selecting an existing plot (a non-bold selection) makes that plot active and displays it in the front of the plot window.

Data analysis types that have a plot opened have either a “+” or a “–” to the left of the label. Select the “+” to display all plots of that type or the “–” to collapse and hide all plots.

Figure 4-21 Browser



Marker Bar

The **Marker Bar** allows you to add up to 2 markers to a plot. Simply select the plot, select the marker button, and click and drag the horizontal scroll bar in the window to move the marker in the plot. The marker X and Y values are displayed to the right of the plot. The frequency domain Smith Chart and Polar Chart formats allow you to choose between magnitude/phase and impedance styles. This is *not* available when time-domain gating is enabled.

Figure 4-22 Marker Bar

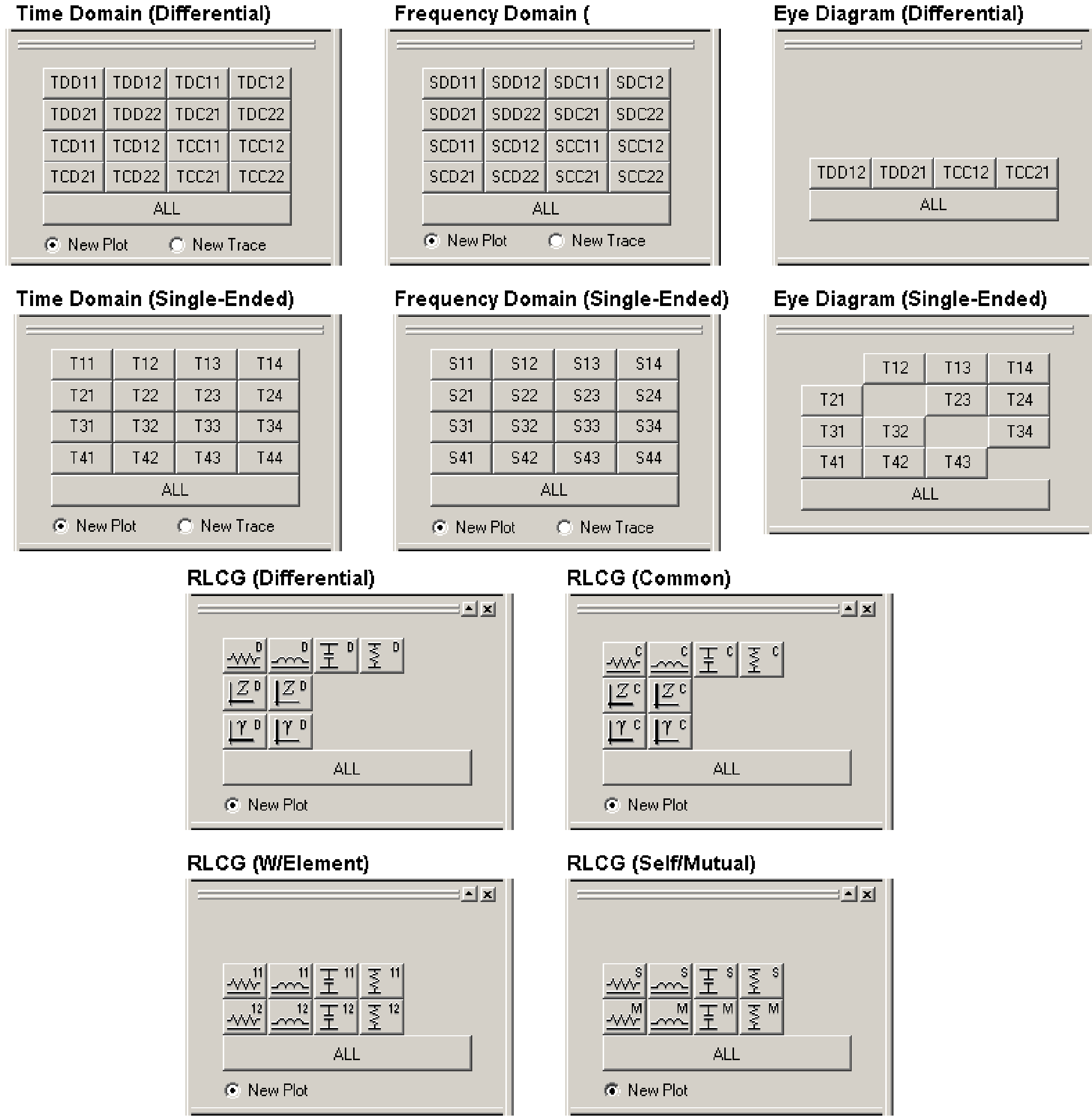
For marker information, refer to the “Markers” section in the “Using Analysis Tools and Utilities” chapter of the user’s guide.

Parameter Bar

The **Parameter Bar** displays each individual parameter for each specific data analysis type as well as the capability to display all of the parameters. See Figure 4-23 on page 114.

The time domain, frequency domain, and RLCG data analysis types also have the option to allow you to display multiple plots on the same plot or separate plots. For Time Domain, Frequency Domain, and Eye Diagram, refer to “Data Menu” on page 133 for detailed information. For RLCG, refer to “RLCG Menu” on page 138 for detailed information.

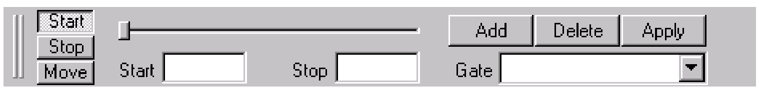
Figure 4-23 Parameter Bars for Each Data Analysis Type



Gating Bar

The **Gating Bar** allows you to add up to 10 gates to a time domain plot. Select **Gating** from the **Utilities** menu to display this bar. After the time domain plot is displayed, slide the horizontal control to set the gate's stop and start position and then press **Add** to add the gate to the plot. Gates may also be deleted and moved from this window. Refer to the "Gating" section in the "Removing Unwanted Effects from the Measurement" chapter of the user's guide. This is only available when time domain Gating is enabled.

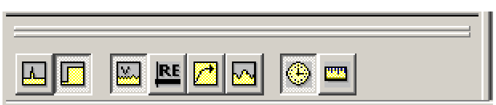
Figure 4-24 **Gating Bar**



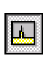
Format Bar

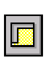
The **Format Bar** displays the plot using the format selected from the bar. **Format Bar** is only available for Time Domain and Frequency Domain plots. As shown below, the Time Domain Format Bar differs from the Frequency Domain Format Bar. Refer to "Format Menu" on page 136 for a detailed description of each format item.

Time Domain Format Bar



For detailed information about each of the selections, refer to the "Selecting Time Domain Formats" section in the "Analyzing Data in the Time Domain" chapter of the user's guide.

 Impulse

 Step

 Volts

 Real

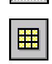
 Log Mag

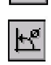
 Impedance

Frequency Domain Format Bar

For detailed information about each of the selections, refer to the "Selecting Frequency Domain Formats" section in the "Analyzing Data in the Frequency Domain" chapter of the user's guide.

 Log Mag

 Linear Mag

 Phase

 Group Delay

 Smith Chart

 Polar Chart

Time Domain Format Bar


ns (nanoseconds)


cm (centimeters)

Frequency Domain Format Bar


Real

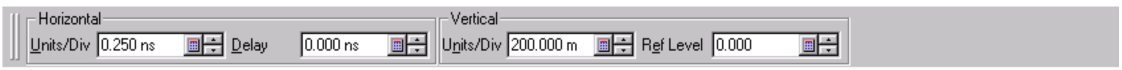

Imaginary

Scaling Bar

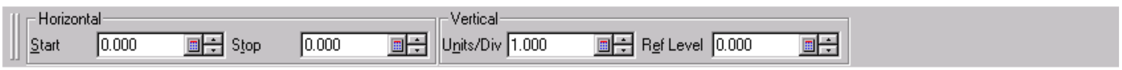
Scaling Bar allows you to change the scale of the active plot. There are two different scaling bars available. The analysis type determines the scaling bar that is displayed. Eye diagrams do not have an associated scaling bar.

Figure 4-25 Scaling Bar

Parameter Bar for Time Domain Plots



Parameter Bar for Frequency Domain and RLCG Plots



Full Screen

Full Screen enlarges the **Plot** area to full screen by:

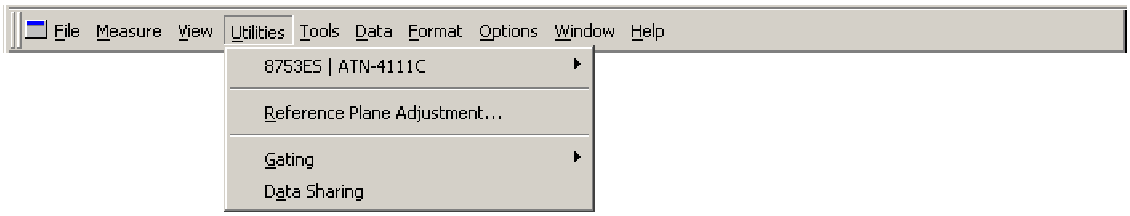
- Removing the **Browser**. The **Browser** may be turned on and off by selecting the **View** menu.
- Making the Parameter Bar, Scaling Bar, Format Bar, and Marker Bar free floating over the PLTS window. These tool bars may be turned on and off through the **View** menu.

Clinking the **Full Screen** selection again, turns of the Full Screen feature, returning the Plot area, Browser, and the tool bars back to normal.

Utilities Menu

The **Utilities** menu provides access to calibration resources and several enhancement tools that you can use to provide a realistic analysis result.

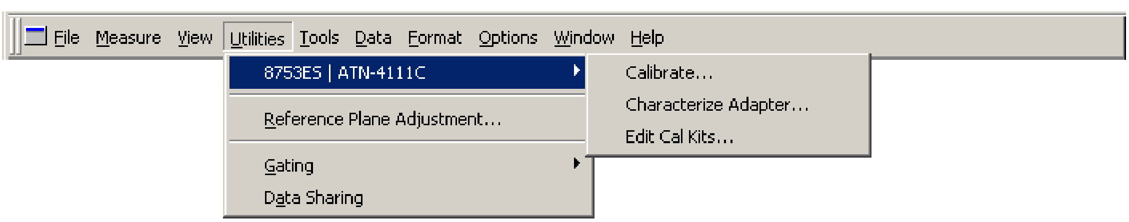
Figure 4-26 Utilities Menu



Calibration

The **Calibration** selection allows you to start a calibration, characterize an adapter used for calibration, or edit the definition of mechanical calibration kits.

Figure 4-27 Utilities Menu with Calibration Expanded



Calibrate

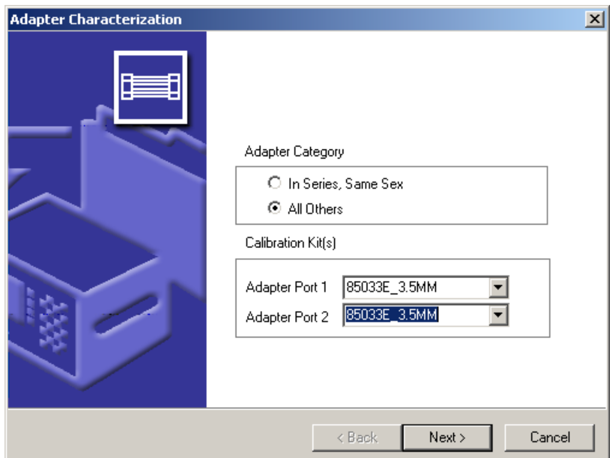
Selecting **Calibrate** opens the wizard so that you may begin your calibration. Refer to the "Performing Error Correction on the VNA-Based PLTS" chapter of the user's guide for detailed calibration information.

Figure 4-28 Calibration Wizard

Characterize Adapter

Adapters used in measurements and calibration must be characterized to ensure accurate results. The Physical Layer Test System software has a wizard that steps you through this adapter characterization process. Select **Characterize Adapter** from the **Utilities** menu to start the *Custom Adapter Characterization Wizard*. This selection is available only when a network analyzer is the selected PLTS-based hardware.

Figure 4-29 Custom Adapter Characterization Wizard



A short/open/load calibration is performed directly at the network analyzer front panel test port with out any cables. Then the calibration is repeated with the adapter inserted. The resulting adapter S-parameters are saved in CITIfile format, which can later be de-embedded from the device measurement.

To allow for best interpolation of adapters used in broadband measurements, characterize the adapter over the entire frequency range of the system with as many points as possible.

Your adapters must have an orientation, forward and reverse directions. Mark the connectors on the adapter as ports 1 and 2. Forward orientation has the lower-numbered adapter port connected to the test-set port.

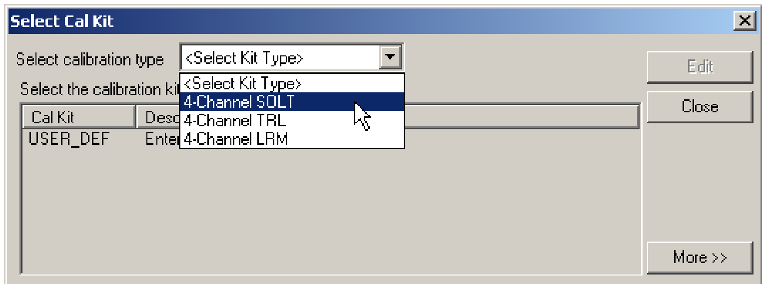
Refer to the “Characterizing Adapters” section in the “Performing Error Correction on the VNA-Based PLTS” chapter of the user’s guide for detailed instructions on performing adapter characterization.

Edit Cal Kit

The **Edit Cal Kit** feature gives you flexibility to make changes to your calibration kit

definition or to add new calibration kits. First, select the calibration type from the **Select Calibration Type** list. Then, from the **Cal Kit** column, select your calibration kit model number to edit an existing kit or select **USER_DEF** to define a new calibration kit.

Figure 4-30 Select Cal Kit Dialog Box



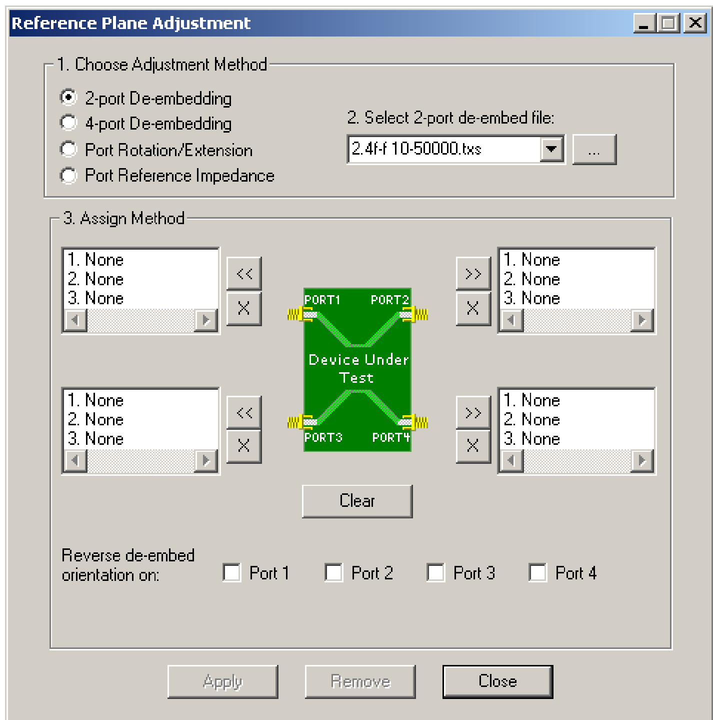
An *Edit Calibration Kit* dialog box is displayed allowing you to change the calibration kit parameters. The **USER_DEF** selection provides a blank dialog box that you can enter new parameter values. Refer to the list below for an illustration showing each of the *Edit Calibration Kit* dialog boxes and the location of detailed instructions for completing the calibration kit definitions.

Calibration Type	To define the calibration kit, refer to the following sections
SOLT	Refer to the "Defining a SOLT Calibration Kit" section in the "Performing Error Correction on the VNA-Based PLTS" chapter of the user's guide.
TRL	Refer to the "Defining a TRL Calibration Kit" section in the "Performing Error Correction on the VNA-Based PLTS" chapter of the user's guide.
LRM	Refer to the "Defining a LRM Calibration Kit" section in the "Performing Error Correction on the VNA-Based PLTS" chapter of the user's guide.
4-Channel TDR	Refer to the "To Define a Calibration Kit" section in the "Setting Up, Calibrating, and Making Measurements using the TDR-Based PLTS" chapter of the user's guide.

Reference Plane Adjustment...

Select **Reference Plane Adjustment**... from the **Utilities** menu to open the *Reference Plane Adjustment* dialog box. Use the *Reference Plane Adjustment* dialog box to add de-embedding, perform port rotation/extension, and change port impedances.

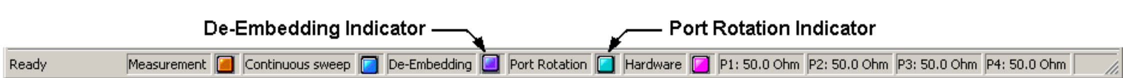
Figure 4-31 Reference Plane Adjustment Dialog Box



Refer to the “To Use Port Reference Adjustment” section in the “Removing Unwanted Effects from the Measurement” chapter of the user’s guide.

One of two indicators can be lit when Port Reference Adjustments features are used. The De-Embedding indicator and the Port Rotation indicators are accessed in this dialog box.

Figure 4-32 De-Embedding and Port Rotation Indicators on the Status Bar

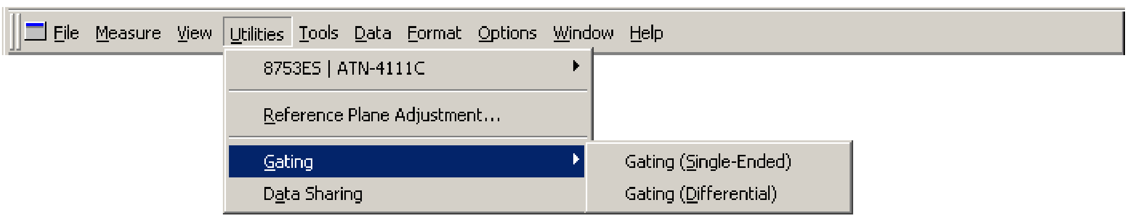


Gating

Gating the time domain response provides the ability to mathematically remove the effect of a particular circuit element. By observing the original frequency domain response and the transformed frequency domain response, the effect of the gating operation on the S-parameter data can be seen. Refer to the “Gating” section in the “Removing Unwanted Effects from the Measurement” chapter of the user’s guide for additional information.

Click **Gating** from the **Utilities** menu. Then click either **Gating (Single-Ended)** or **Gating (Differential)** depending on whether your Time Domain plot is single-ended or differential.

Figure 4-33 Utilities Menu with Gating Expanded



Gating (Single-Ended)

Select **Gating (Single-Ended)** when you are planning to gate a single-ended Time Domain plot.

Gating (Differential)

Select **Gating (Differential)** when you are planning to gate a differential Time Domain plot.

Data Sharing

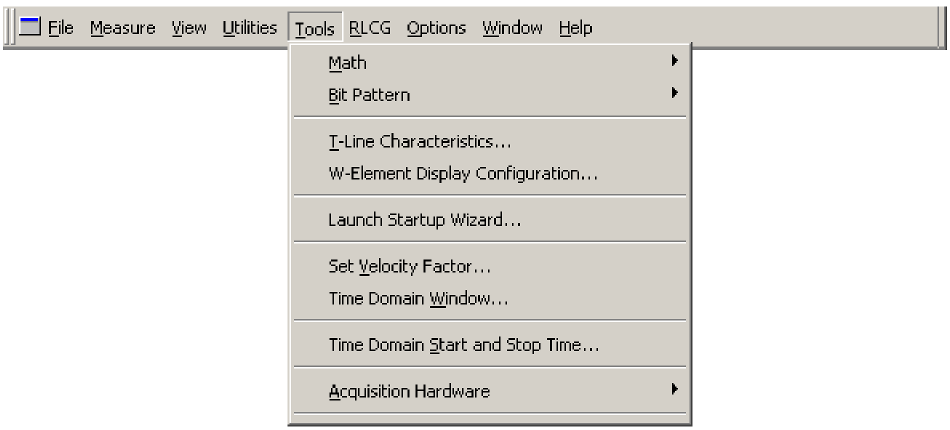
Data Sharing is used to overlay the plot of one measurement over the plot of another so that differences and similarities between the two plots can easily be viewed.

Refer to the “Data Sharing” section in the “Using Analysis Tools and Utilities” chapter of the user’s guide for additional information.

Tools Menu

The **Tools** menu allows access to the Math, Bit Pattern, and T-Line Characteristics features. It also allows you to launch the startup wizard, set the velocity factor, change the time domain windowing, set the time domain start and stop times, and scan or select new data acquisition hardware.

Figure 4-34 Tools Menu



Math

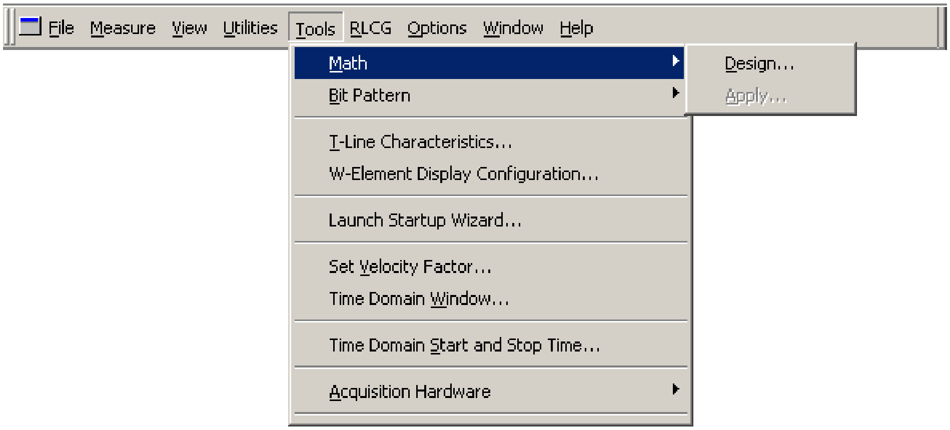
The **Math** feature allows you to design and save a mathematical formula and to apply that formula to compare measured parameters. For example, you could use the math feature to determine noise immunity on a balanced line by calculating the common mode rejection ratio (CMRR) using the following equation:

$$CMRR = (SDD21)/(SCC21)$$

You could also characterize the loss of a single-ended frequency domain measurement using the following equation:

$$Loss = \frac{1}{\sqrt{2}}(S21 + jS31)$$

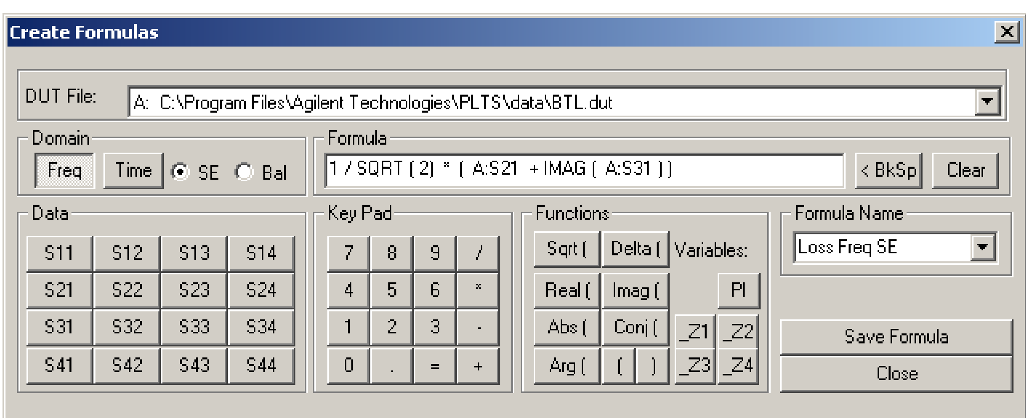
Figure 4-35 Tools Menu with Math Expanded



Design

To create a formula for use with the measured data, select **Design** from the **Math** choice of the **Tools** menu. Select the domain, either **Freq** or **Time** and either **SE** (single-ended), **Diff** (differential for time domain) or **Bal** (balanced for frequency domain) in the **Domain** area. Click the **Formula** box and begin entering the equation using the buttons in the **Data**, **Key Pad**, and **Functions** areas. Enter your equation from left to right. When you have finished, enter a name in the **Formula Name** box and click the **Save Formula** button. When you have finished inputting equations, click the **Close** button. For more details, refer to the “Creating a Math Formula” section in the “Using Analysis Tools and Utilities” chapter of the user’s guide.

Figure 4-36 Create Formulas Dialog Box

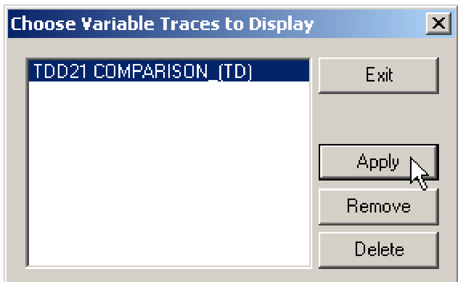


Apply

To apply a formula to the active data, display the *Choose Variable Traces to Display* dialog box by selecting **Apply** from the **Math** choice of the **Tools** menu. Then select the formula name from those displayed in the list. Click the **Apply** button to apply the formula to the active data and display a trace showing the data with the formula applied.

Remove removes the selected formula from the active data and removes the trace shown when **Apply** was clicked. **Delete** removes the selected variable from the list in the dialog box. **Exit** closes the dialog box.

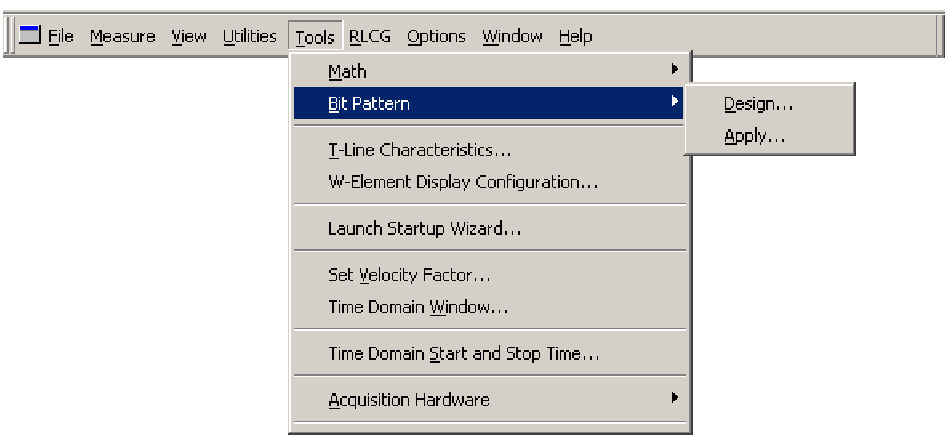
Figure 4-37 Choose Variable Traces to Display Dialog Box



Bit Pattern

The **Bit Pattern** feature allows you to design a digital pattern and save the pattern. Then you can apply the digital pattern to eye diagram plots.

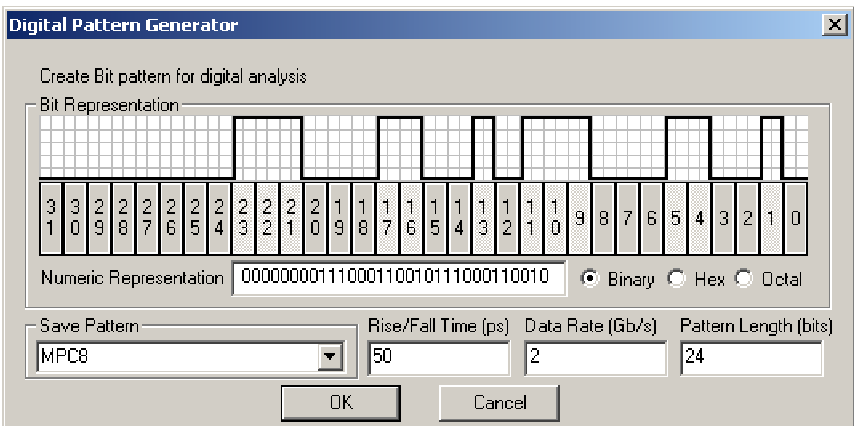
Figure 4-38 Tools Menu with Bit Pattern Expanded



Design

Select **Design** from the **Bit Pattern** choice in the **Tools** menu to design a digital pattern using the *Digital Pattern Generator*. The *Digital Pattern Generator* allows you to create a pattern of between 8 and 32 bits. You may create the pattern in one of two ways, either clicking the numbered keys (0 to 31) or by typing the numeric value in either Binary (base 2), Octal (base 8), or Hexadecimal (base 16) formats. As you enter the pattern inputs, the pattern is displayed in the upper portion of the **Bit Representation** area.

Figure 4-39 Digital Pattern Generator

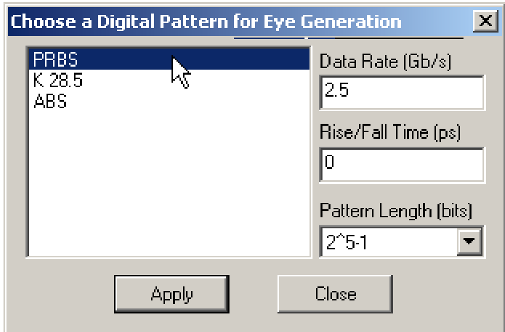


After the pattern has been created and is displayed correctly, save the pattern by entering a pattern name in the **Save Pattern** box and values in the **Rise/Fall Time (pS)**, **Data Rate (Gb/s)**, and **Pattern Length** boxes. Then select **OK** to save the digital pattern.

Apply

Apply a digital pattern to an eye diagram using the *Choose a Digital Pattern for Eye Generation* dialog box. This dialog box also allows you to change the values for the rise/fall time, data rate, pattern length, and number of patterns (arbitrary bitstream only). A digital pattern must be applied to view data using the eye diagram data analysis type.

Figure 4-40 Choose a Digital Pattern for Eye Generation Dialog Box



After clicking a digital pattern in the *Choose a Digital Pattern for Eye Generation* dialog box list, review the digital pattern parameter entries on the right side of the dialog box and enter the desired parameter values.

- **Rise/Fall Time (pS)** is the time that it takes a signal to transition from a low to a high condition (or the time that it takes a signal to transition from a high to a low condition). Refer to the illustration titled "Rise/Fall Time and Data Rate" of the "Designing a Bit Pattern for Eye Diagrams" section in the "Analyzing Data using Eye Diagrams" chapter of the user's guide for additional information regarding transition time.
- **Data Rate (Gb/s)** is the speed that data is transferred over a circuit or a communications line. Refer to the illustration titled "Rise/Fall Time and Data Rate" of the "Designing a Bit Pattern for Eye Diagrams" section in the "Analyzing Data using Eye Diagrams" chapter of the user's guide for additional information regarding data rate.
- **Pattern Length (bits)** is the number of bits in the digital pattern used to create the eye diagram. This value is the limiting factor in creating unique digital patterns.

Then, click **OK** to view the eye diagram in the plot window. **Cancel** closes the dialog box without making any changes.

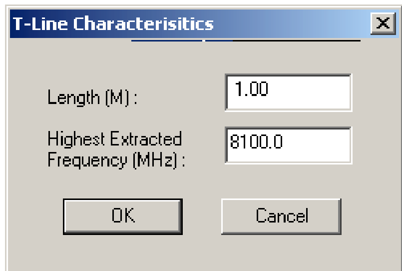
For additional information, refer to the "Viewing Data using Eye Diagrams" section in the "Analyzing Data using Eye Diagrams" chapter of the user's guide.

NOTE You may change the digital pattern using the dialog box shown in Figure 4-40 by selecting **Bit Pattern** then **Apply**... from the **Tools** menu.

T-Line Characteristics

T-Line Characteristics displays the RLCG data analysis *T-Line Characteristics* dialog box. This is the same dialog box that is displayed when any RLCG analysis is selected. Enter the length of the transmission line (in meters) and the highest frequency (in megahertz) in this dialog box to change the existing transmission line characteristics.

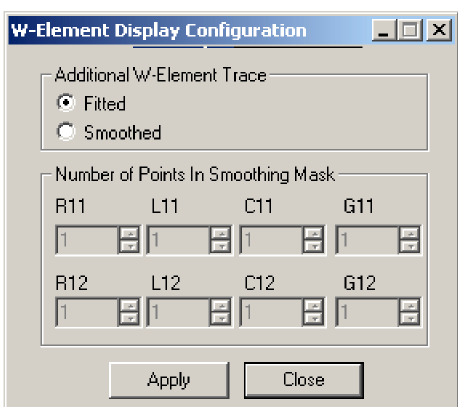
Figure 4-41 T-Line Characteristics



W-Element Display Configuration...

W-Element Display Configuration... displays the RLCG data analysis *W-Element Display Configuration* dialog box. This dialog box allows you to select either **Fitted** or **Smoothed** data traces to compare against the RLCG (W-Element) extracted data traces. When **Smoothed** data traces is selected, you may enter an odd-numbered integer to set the number of traces used in the smoothing mask.

Figure 4-42 W-Element Display Configuration Dialog Box

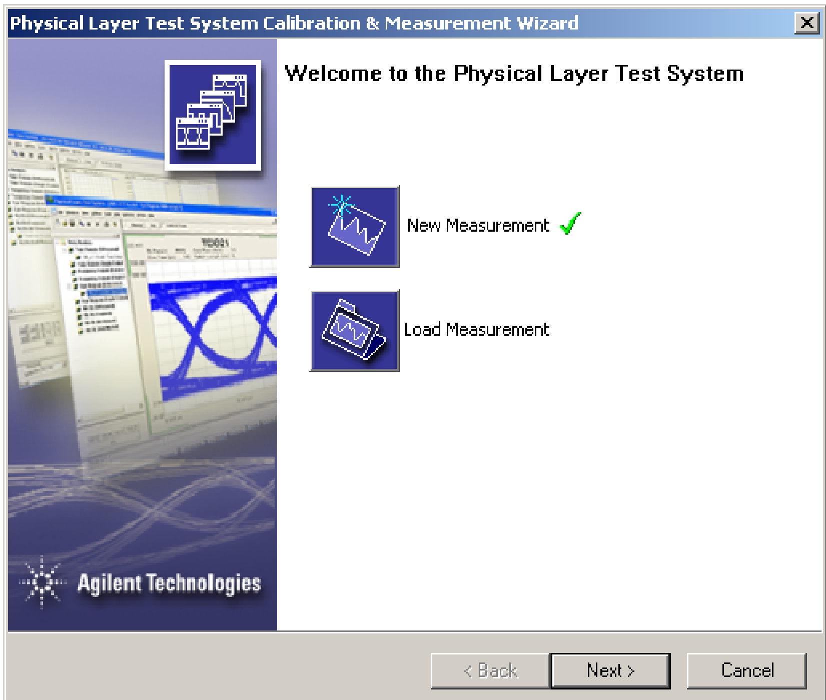


For additional information, refer to the “Viewing Fitted and Smoothed RLCG W-Element Traces” section in the “Analyzing Transmission Line Parameters” chapter of the user’s guide.

Launch Startup Wizard

When **Launch Startup Wizard** is selected, this menu choice starts the **Physical Layer Test System Startup Wizard**. See Figure 4-43.

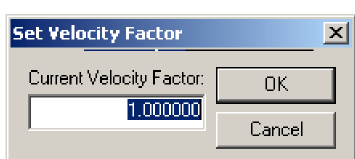
Figure 4-43 Startup Wizard



Set Velocity Factor

When **Set Velocity Factor** is selected from the **Tools** menu, the dialog box shown in Figure 4-44 is displayed. Enter the new velocity factor in the **Current Velocity Factor** box and click **OK**. The maximum allowable value is 1.000000.

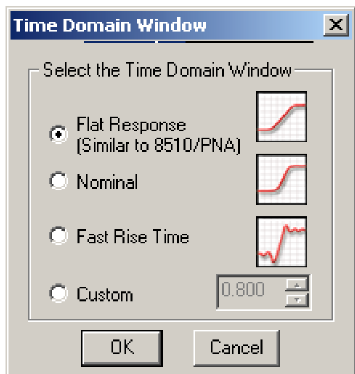
Figure 4-44 Set Velocity Factor Dialog Box



Time Domain Window...

When **Time Domain Window**... is selected from the **Tool** menu, the *Time Domain Window* dialog box is displayed (see Figure 4-45). This dialog box allows you to set the Time Domain Window setting to one of three defined levels, **Flat Response**, **Nominal** (the default value), and **Fast Rise Time** or to a level you define. Refer to the “Time Domain Windowing” section in the “Analyzing Data in the Time Domain” chapter of the user’s guide for additional information.

Figure 4-45 Time Domain Window Dialog Box

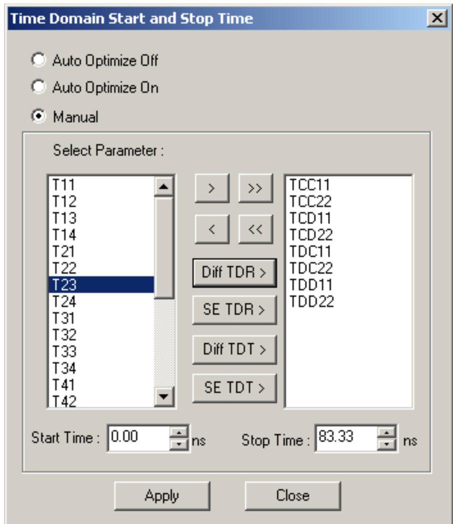


- **Flat Response** gives the minimum side lobes and this provides the greatest dynamic range.
- **Nominal** gives reduced side lobes and is normally the most useful. This is the default setting.
- **Fast Rise Time** is essentially no window and therefore gives the highest side lobes.
- **Custom** allows you to create your own time domain window by selecting the spinner or entering a value in the box.

Time Domain Start and Stop Time...

When **Time Domain Start and Stop Time**... is selected, you can change the start and stop time values for your time domain plots that were converted from frequency domain parameters (S-parameters). The *Time Domain Start and Stop Time* dialog box is opened. See Figure 4-46. You can have these plots displayed in their full time range, automatically optimized, or you may change the start and stop time values manually. Refer to the “Optimizing the Time Domain Scale for Viewing” section in the “Analyzing Data in the Time Domain” chapter of the user’s guide for additional information.

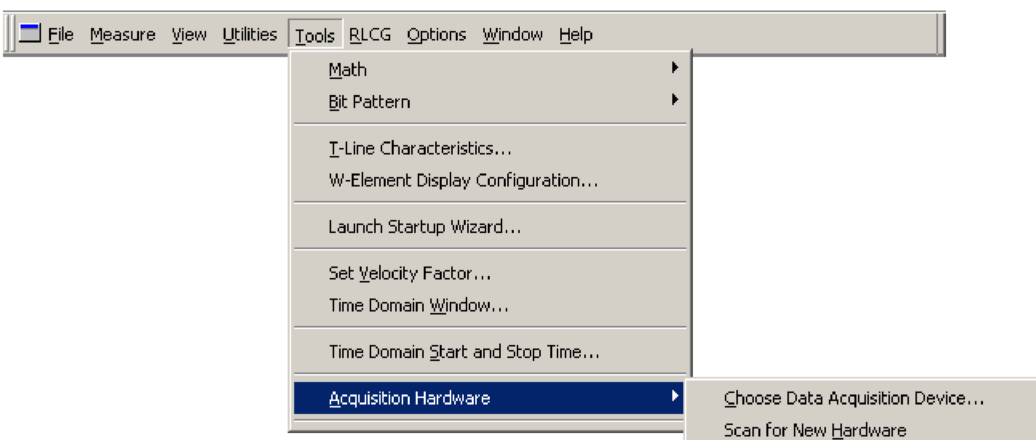
Figure 4-46 Time Domain Start and Stop Time Dialog Box



Acquisition Hardware

Acquisition Hardware allows you to select **Choose Data Acquisition Device**… or **Scan for New Hardware**.

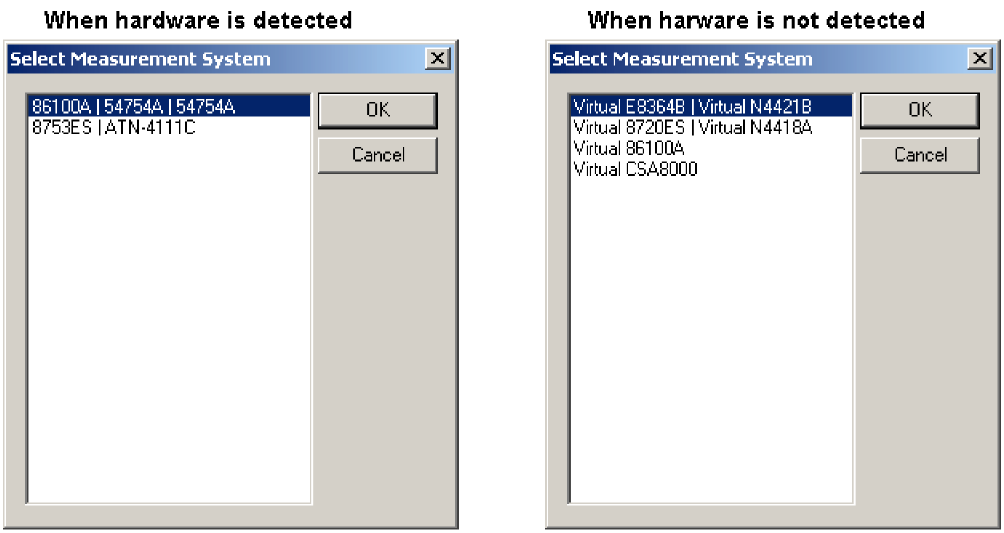
Figure 4-47 Tools Menu with Acquisition Hardware Expanded



Choose Data Acquisition Device...

The **Choose Data Acquisition Device**... selection displays all of the hardware that is detected in the *Select Measurement System* dialog box. See Figure 4-48. For example, the left dialog box shown in shows both an 86100A TDR-based PLTS, as well as an 8753ES VNA-based PLTS. When no hardware is detected, the software displays virtual PLTS hardware systems (two VNA-based and two TDR-based systems). A virtual PLTS hardware system allows you to use the software just like you would while using actual PLTS hardware with the exception of making a measurement.

Figure 4-48 Select Measurement System Dialog Box



Select your hardware and click the **OK** button to change your hardware.

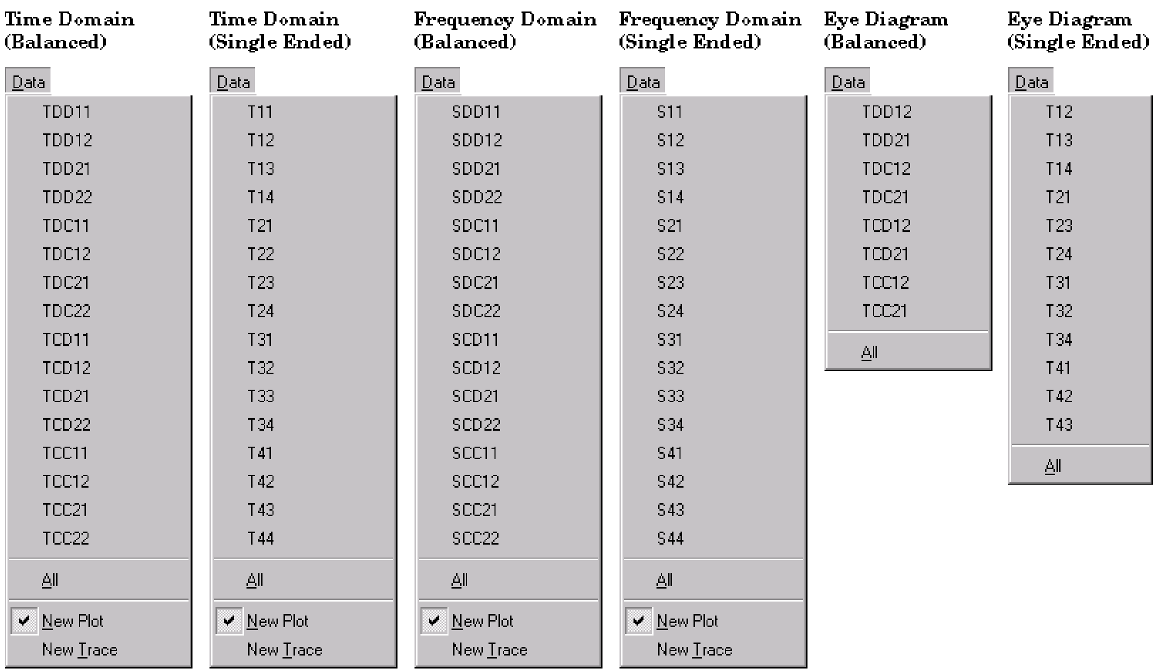
Scan for New Hardware

The **Scan for New Hardware** selection causes the PLTS software to check the GPIB bus for connected hardware. After the bus has been scanned, the *Select Measurement System* dialog box that is shown in Figure 4-48 is displayed.

Data Menu

The **Data** menu displays each individual parameter for each specific data analysis type as well as the capability to display all of the parameters. The time domain and frequency domain data analysis types also have the option to allow you to display multiple plots on the same plot or separate plots. Figure 4-49 shows each of the data menus and their selections. See also "Parameter Bar" on page 113.

Figure 4-49 Data Menu



Individual Parameter Selections

The individual parameter selections are based on the specific data analysis type. The following lists each data analysis type and its associated parameters:

- **Time Domain (Differential)**

  TDD11, TDD12, TDD21, TDD22, TDC11, TDC12, TDC21, TDC22, TCD11, TCD12, TCD21, TCD22, TCC11, TCC12, TCC21, TCC22

- **Time Domain (Single-Ended)**

  T11, T12, T13, T14, T21, T22, T23, T24, T31, T32, T33, T34, T41, T42, T43, T44

- **Frequency Domain (Balanced)**

  SDD11, SDD12, SDD21, SDD22, SDC11, SDC12, SDC21, SDC22,
  SCD11, SCD12, SCD21, SCD22, SCC11, SCC12, SCC21, SCC22

- **Frequency Domain (Single-Ended)**

  S11, S12, S13, S14, S21, S22, S23, S24, S31, S32, S33, S34, S41, S42, S43, S44

- **Eye Diagram (Differential)**

  TDD12, TDD21, TDC12, TDC21, TCD12, TCD21, TCC12, TCC21

- **Eye Diagram (Single-Ended)**

  T12, T13, T14, T21, T23, T24, T31, T32, T34, T41, T42, T43

All

Selecting **All** displays:

- All 16 of the time domain parameters if the active plot window is a time domain window.
  - If **New Plot** is chosen, selecting **All** displays all 16 of the parameters on individual plots in one window.
  - If **New Trace** is chosen, selecting **All** displays all 16 of the parameters on a single plot.
- All 16 of the frequency domain parameters if the active plot window is a frequency domain window.
  - If **New Plot** is chosen, selecting **All** displays all 16 of the parameters on individual plots in one window.
  - If **New Trace** is chosen, selecting **All** displays all 16 of the parameters on a single plot.
- 4 of the eye diagram parameters if the active plot window is a differential eye diagram window.
- All 12 of the eye diagram parameters if the active plot window is a single-ended eye diagram window.

New Plot

When **New Plot** is chosen, selecting any of the time or frequency domain parameters will display a new plot with that parameter within the active plots window. If **New Plot** is chosen, selecting **All** displays all 16 of the time or frequency domain parameters on individual plots in one window.

New Trace

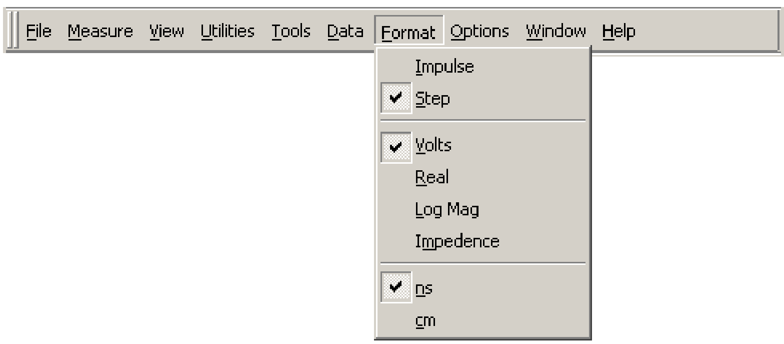
When **New Trace** is chosen, selecting any of the time or frequency domain parameters will display a new trace within the active plot. If **New Trace** is chosen, selecting **All** displays all 16 of the time or frequency domain parameters on a single plot.

Format Menu

There are two versions of the **Format** menu, one for active displays in the time domain and another for active displays in the frequency mode. The **Format** menu is not displayed for displays in other modes. See also "Format Bar" on page 115.

Time Domain Format Menu

Figure 4-50 Format Menu for Time Domain Measurements



Impulse Sets the active time domain plot to show the response with an impulse stimulus.

Step Sets the active time domain plot to show the response with a step-voltage stimulus. This is the default setting.

Volts Sets the active time domain plot's vertical axis to Volts mode. This is the default setting.

Real Sets the active time domain plot's vertical axis to Real mode.

Log Mag Sets the active time domain plot's vertical axis to Log Mag mode.

Impedance Sets the active time domain plot's vertical axis to impedance mode. Active only for reflection plots with a step stimulus.

ns Sets the active time domain plot's horizontal axis to nanoseconds (ns). This is the default setting.

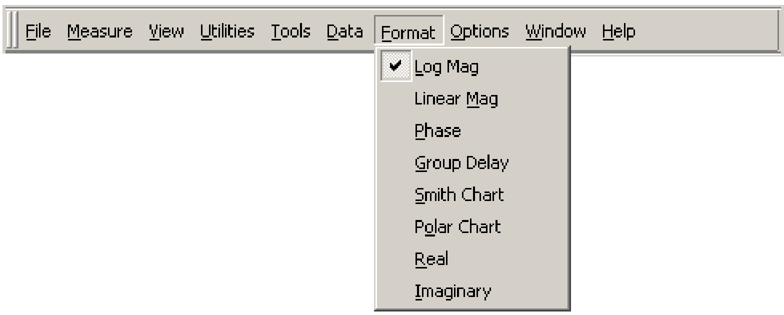
cm Sets the active time domain plot's horizontal axis to centimeters (cm).

Refer to the "Selecting Time Domain Display Formats" section in the "Analyzing Data in the

Time Domain" chapter of the user's guide for more information.

Frequency Domain Format Menu

Figure 4-51 Format Menu for Frequency Domain Measurements



Log Mag Displays the active frequency domain plot in Log Magnitude format. This is the default setting.

Linear Mag Displays the active frequency domain plot in Linear Magnitude format.

Phase Displays the active frequency domain plot in Phase format.

Group Delay Displays the active frequency domain plot in Group Delay format.

Smith Chart Displays the active frequency domain plot in Smith Chart format.

Polar Chart Displays the active frequency domain plot in Polar Chart format.

Real Displays the active frequency domain plot in Real format.

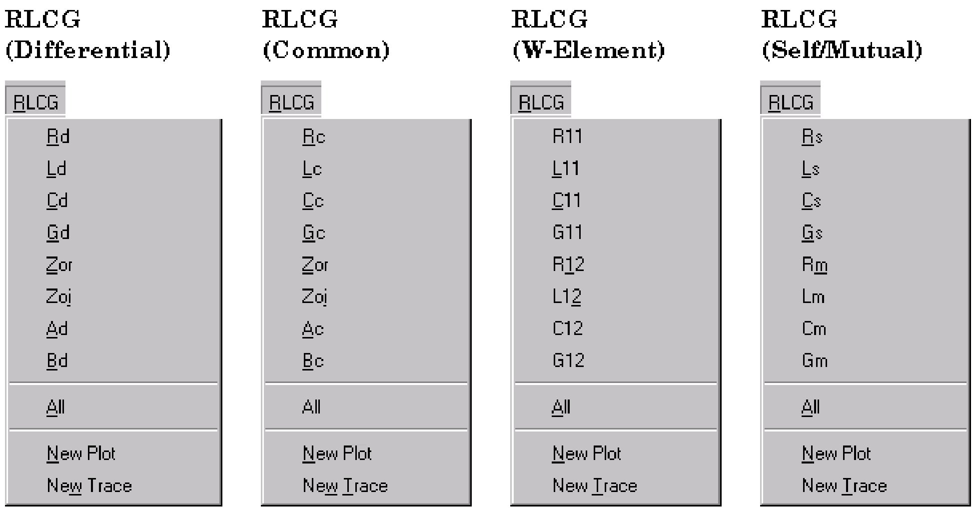
Imaginary Displays the active frequency domain plot in Imaginary format.

Refer to the "Selecting Frequency Domain Display Formats" section in the "Analyzing Data in the Frequency Domain" chapter of the user's guide for more information.

RLCG Menu

When any of the RLCG data analysis types are selected, the **RLCG** menu is displayed. Each of the four RLCG data analysis types has its own menu. Refer to Figure 4-52.

Figure 4-52 RLCG Menus



Individual Parameter Selections

The individual parameter selections are based on the specific RLCG data analysis type. The following lists each data analysis type and its associated parameters.

RLCG (Differential):	Rd, Ld, Cd, Gd, Zor, Zoi, Ad, Bd
RLCG (Common):	Rc, Lc, Cc, Gc, Zor, Zoi, Ac, Bc
RLCG (W-Element):	R11, L11, C11, G11, R12, L12, C12, G12
RLCG (Self/Mutual):	Rs, Ls, Cs, Gs, Rm, Lm, Cm, Gm

where,	**A** represents the Attenuation Constant (α)	**B** represents the Phase Constant (β)
	C represents Capacitance	**G** represents Conductance
	L represents Inductance	**R** represents Resistance
	Z represents Impedance	

All

If **New Plot** is chosen, selecting **All** displays all eight parameters on individual plots in one window. If **New Trace** is chosen, selecting **All** displays all eight parameters on a single plot.

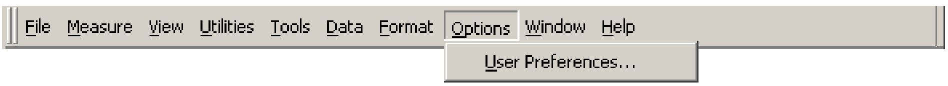
New Plot

When **New Plot** is chosen, selecting any of the RLCG parameters will display a new plot with that parameter within the active plots window. If **New Plot** is chosen, selecting **All** displays all eight parameters on individual plots in one window.

Options Menu

The **Options** menu provides access to the *User Preferences* dialog box

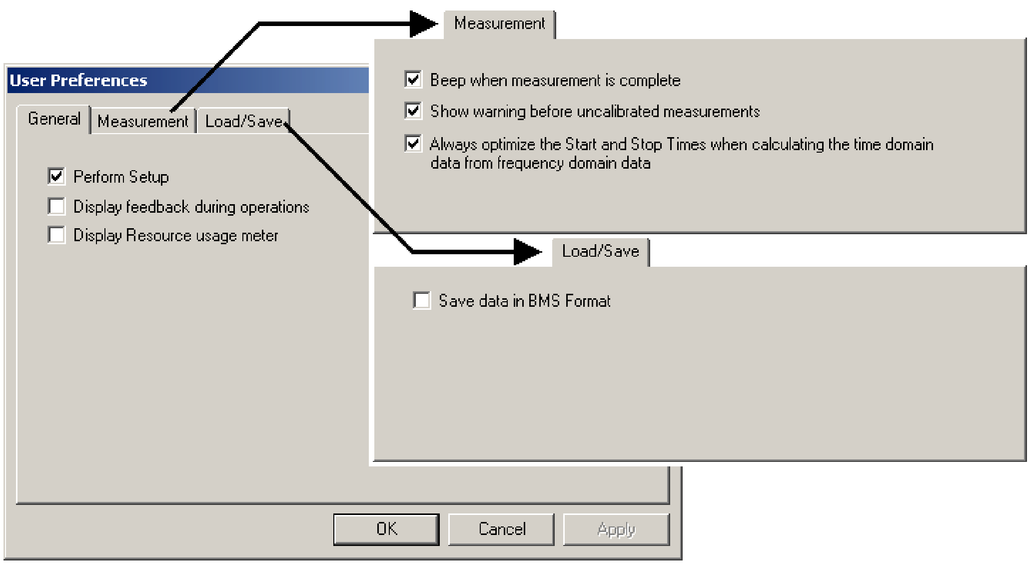
Figure 4-53 Options Menu



User Preferences

The *User Preferences* dialog box allows you to customize your Physical Layer Test System software. This dialog box has the following three tabs to choose from: **General**, **Measurement**, and **Load/Save**.

Figure 4-54 User Preferences Dialog Box



General

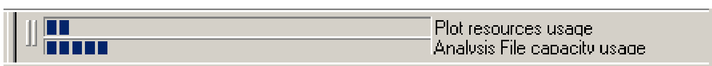
The **General** tab (see Figure 4-54) has the following choices:

- **Perform Setup -** when selected, the PLTS software, when it is next started, will operate

as if it has just been installed and go through a complete setup routine. At the conclusion of this routine, the **Perform Setup** option is automatically turned off.

- **Display feedback during operations -** controls the display of informational and progress windows for various operations, such as the file conversion summary window and the measurement post-processing progress window. When selected, these windows are displayed; otherwise, these windows are hidden. This option's default setting is ON.
- **Display Resource usage meter -** controls the display of resource use meter in the tool bar above the plot windows. The resource usage meter displays the current plot usage and the analysis file capacity usage. This meter is turned ON when the usage reaches a critical stage. This option's default setting is OFF.

Figure 4-55 Resource Usage Meter



Measurement

The **Measurement** tab (see Figure 4-54) has the following choices:

- **Beep when measurement is complete -** when checked, the PC emits a beep to indicate that the measurement is complete.
- **Show warning before uncalibrated measurements -** when checked, a message is displayed confirming that you are making an uncalibrated measurement.
- **Always optimize the Start and Stop Times when calculating the time domain data from frequency domain data -** when checked, the time domain start and stop times are optimized for best viewing. This selection affects the *Time Domain Start and Stop Time* dialog box default optimize selection. Refer to the "Automated Start and Stop Settings in the Time Domain" section in the "Analyzing Data in the Time Domain" chapter of the user's guide.

Load/Save

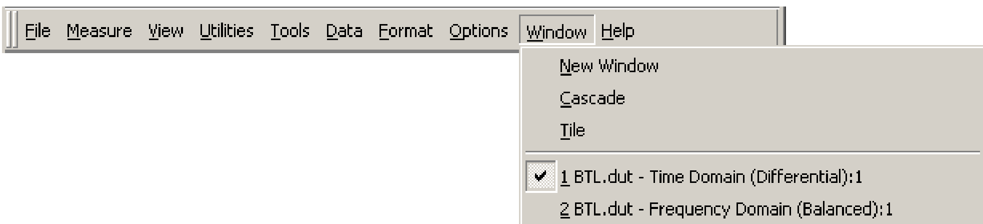
The **Load/Save** tab (see Figure 4-54) has the following choices:

- **Save data in BMS Format -** when checked, data is saved in Balanced Measurement System format.

Window Menu

The **Window** menu provides an efficient method of working with analysis windows. It gives you the ability to add new analysis windows, arrange open analysis windows for optimum viewing, arrange the minimized analysis window icons, and select/display individual analysis windows.

Figure 4-56 Window Menu



New Window

New Window adds a new analysis window to the display area. The new window will display the analysis type that is currently selected.

Cascade

Cascade arranges all of the open plot windows to optimum and equal size with the active window arranged on top so that is fully displayed. Any window may be accessed by a single click.

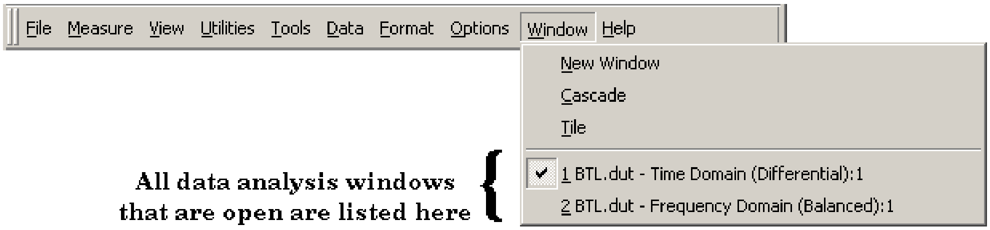
Tile

Tile displays all open plot windows completely in the plot window area. Each plot window is reduced in size to accommodate new plot windows.

List of Open Analysis Windows

The **Window** menu also lists the open analysis windows below the standard **Window** menu selections. Each open analysis window is listed in the order they were opened with the most recent window listed at the bottom. The active analysis window is shown with a check mark displayed at its left side. Selecting a window from the list displays the window in the display area.

Figure 4-57 List of Open Data Analysis Windows



Help Menu

The **Help** menu provides access to information about the software.

Figure 4-58 Help Menu

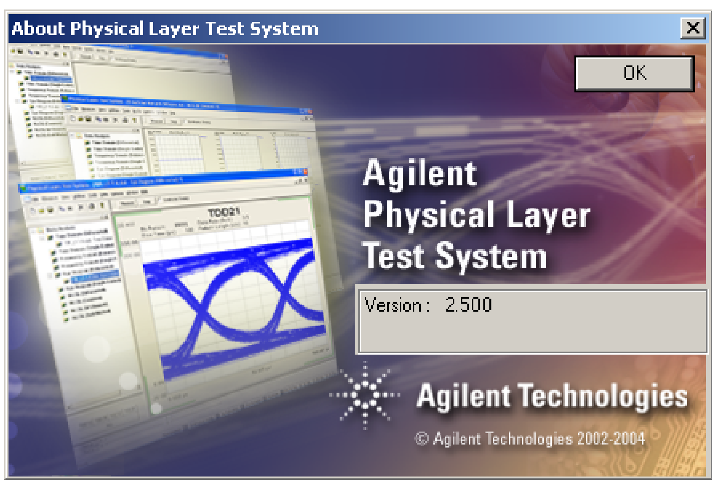
Help...

The **Help**... selection displays the user’s guide in pdf format.

About PLTS...

The *About PLTS*... window displays the software version information.

Figure 4-59 About PLTS... Window



5 Specifications and Characteristics

NOTE For specifications and characteristics on the Physical Layer Test System model numbers listed below, refer to page 301 in Appendix B, "Reference Information for Discontinued Physical Layer Test System Hardware."

N1947A, N1948A, N1951A, N1953A, N1957A

Definitions

All specifications and characteristics apply over a 25 °C ±5 °C range (unless otherwise stated) and 90 minutes after the instrument has been turned on.

Specification (spec.)	Warranted performance. Specifications include guard bands to account for the expected statistical performance distribution, measurement uncertainties, and changes in performance due to environmental conditions.
Characteristic (char.)	A performance parameter that the product is expected to meet before it leaves the factory, but that is not verified in the field and is not covered by the product warranty. A characteristic includes the same guard bands as a specification.
Typical (typ.)	Expected performance of an average unit which does not include guard bands. It is not covered by the product warranty.
Nominal (nom.)	A general, descriptive term that does not imply a level of performance. It is not covered by the product warranty.
Calibration	The process of measuring known standards to characterize the system's systematic (repeatable) errors.
Corrected (residual)	Indicates performance after error correction (calibration). It is determined by the quality of calibration standards and how well "known" they are, plus system repeatability, stability, and noise.
Uncorrected (raw)	Indicates instrument performance without error correction. The uncorrected performance affects the stability of a calibration.

N1935A Electrical Specifications and Characteristics

The following specifications are applicable for a system in the following configurations:

Network Analyzer:	Agilent E5230A Option 225
Test Set:	Agilent N4419B
Calibration Kit:	Agilent 85052D 3.5 mm
Test Port Cables:	Agilent N4419B Option B20
Calibration Technique:	Four-Port SOLT

System Dynamic Range

The test port transmission measurements are valid at 10 Hz IF bandwidth with four-port error correction and –5 dBm default maximum output power. The dynamic range is the difference between rms noise floor and the output power.

Table 5-1 System Dynamic Range

Frequency Range	Specification	Supplemental Information
10 MHz to 45 MHz		60 dB (char.)
45 MHz to 500 MHz	70 dB	
500 MHz to 2.0 GHz	100 dB	
2.0 GHz to 10.0 GHz	100 dB	
10.0 GHz to 20.0 GHz	70 dB	

Measurement Port

Residual uncertainties for corrected data using four-port error correction. These apply for 25 °C with less than 1 °C variation from calibration.

Table 5-2 Measurement Port Characteristics

Description	**Characteristic**		
	45 MHz to 2.0 GHz	**2.0 GHz to 10.0 GHz**	**10.0 GHz to 20.0 GHz**
Directivity	56 dB	42 dB	40 dB
Source Match	42 dB	36 dB	33 dB
Load Match	56 dB	42 dB	40 dB
Reflection Tracking	± 0.0025 dB	± 0.009 dB	± 0.013 dB
Transmission Tracking	± 0.020 dB	± 0.032 dB	± 0.050 dB

Measurement Uncertainties

The following graphics show the worst case transmission and reflection magnitude and phase uncertainty for the system.

Figure 5-1 3.5 mm Transmission Magnitude and Phase Uncertainty

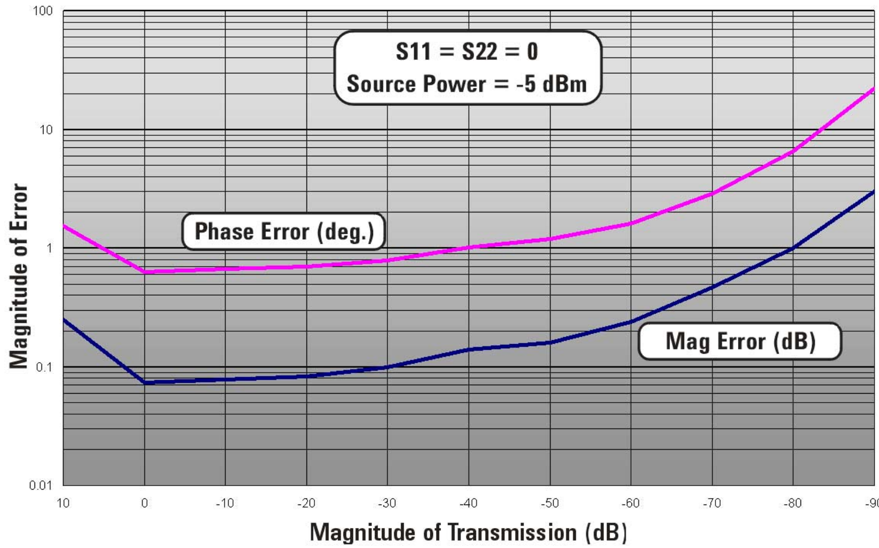
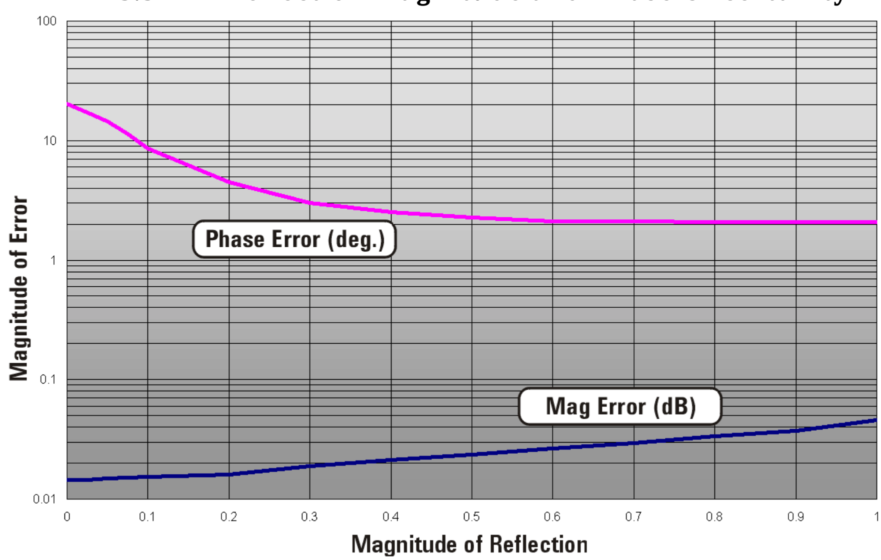


Figure 5-2 3.5 mm Reflection Magnitude and Phase Uncertainty



Test Set Performance

Table 5-3 Test Set Performance

Description	Characteristics	Supplemental Information
Frequency Range	10 MHz to 20.0 GHz	
Impedance		50 Ohms (nom.)
Insertion Loss		
Source Out to Coupler Thru	5.0 dB maximum	
Port 2 to Rcvr A In and Port 4 to Rcvr B In		
45 MHz to 1.0 GHz		18 to 45 dB (typical)
1.0 GHz to 20.0 GHz		18 to 25 dB (typical)
Rcvr A In to Cplr Arm and Rcvr B In to Cplr Arm	8.0 dB maximum	
Isolation (port to port)		
45 MHz to 200 MHz	≥ 70 dB	
200 MHz to 20 GHz	≥ 90 dB	
Maximum Operating Level	+20 dBm	
Damage Level		+30 dBm (typical)
Test Port Connectors		50 Ohms (nom.) 3.5 mm Connectors

Power Supply

The power supply requirements for the test sets are listed below.

Table 5-4 Test Set Power Supply Specifications

Description	Specification
Input Voltage Range	100 to 240 Volts
Frequency Range	47 to 63 Hertz
Power	40 VA

N1953B Electrical Specifications and Characteristics

The following specifications are applicable for a system in the following configurations:

Network Analyzer:	Agilent E8362B Options 014 and UNL
Test Set:	Agilent N4419B
Calibration Kit:	Agilent 85052D 3.5 mm
Test Port Cables:	Agilent N4419B Option B20
Calibration Technique:	Four-Port SOLT

System Dynamic Range

The test port transmission measurements are valid at 10 Hz IF bandwidth with four-port error correction and –5 dBm default maximum output power. The dynamic range is the difference between rms noise floor and the output power.

Table 5-5 System Dynamic Range

Frequency Range	Specification	Supplemental Information
10 MHz to 45 MHz		60 dB (char.)
45 MHz to 500 MHz	70 dB	
500 MHz to 2.0 GHz	100 dB	
2.0 GHz to 10.0 GHz	100 dB	
10.0 GHz to 20.0 GHz	85 dB	

Measurement Port

Residual uncertainties for corrected data using four-port error correction. These apply for 25 °C with less than 1 °C variation from calibration.

Table 5-6 Measurement Port Characteristics

Description	Characteristic		
	45 MHz to 2.0 GHz	**2.0 GHz to 10.0 GHz**	**10.0 GHz to 20.0 GHz**
Directivity	56 dB	42 dB	40 dB
Source Match	42 dB	36 dB	33 dB
Load Match	56 dB	42 dB	40 dB
Reflection Tracking	± 0.0025 dB	± 0.009 dB	± 0.013 dB
Transmission Tracking	± 0.020 dB	± 0.032 dB	± 0.050 dB

Measurement Uncertainties

The following graphics show the worst case transmission and reflection magnitude and phase uncertainty for the system.

Figure 5-3 3.5 mm Transmission Magnitude and Phase Uncertainty

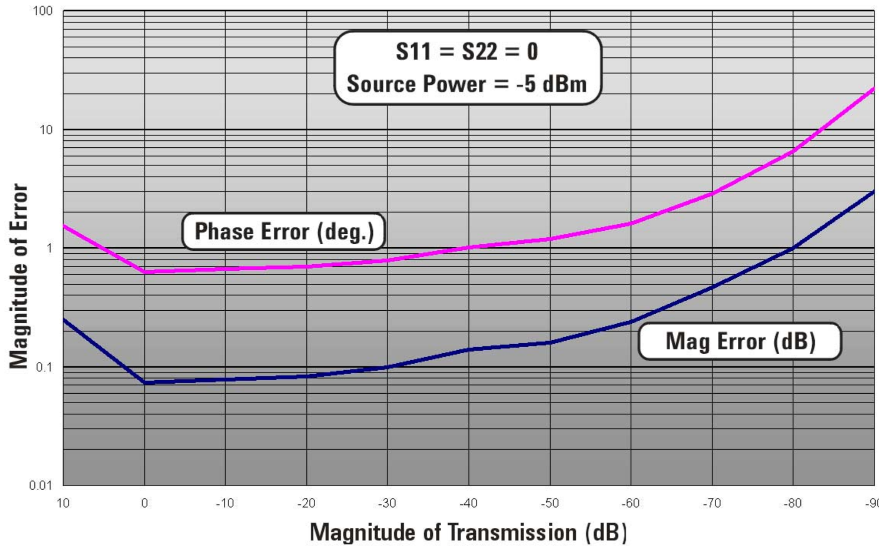
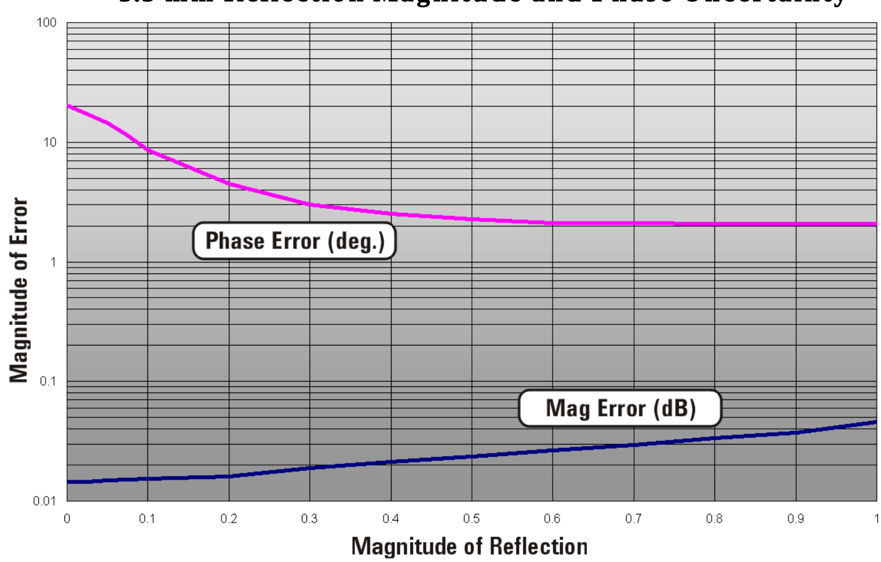


Figure 5-4 3.5 mm Reflection Magnitude and Phase Uncertainty



Test Set Performance

Table 5-7 Test Set Performance

Description	Characteristics	Supplemental Information
Frequency Range	10 MHz to 20.0 GHz	
Impedance		50 Ohms (nom.)
Insertion Loss		
Source Out to Coupler Thru	5.0 dB maximum	
Port 2 to Rcvr A In and Port 4 to Rcvr B In		
45 MHz to 1.0 GHz		18 to 45 dB (typical)
1.0 GHz to 20.0 GHz		18 to 25 dB (typical)
Rcvr A In to Cplr Arm and Rcvr B In to Cplr Arm	8.0 dB maximum	
Isolation (port to port)		
45 MHz to 200 MHz	≥ 70 dB	
200 MHz to 20 GHz	≥ 90 dB	
Maximum Operating Level	+20 dBm	
Damage Level		+30 dBm (typical)
Test Port Connectors		50 Ohms (nom.) 3.5 mm Connectors

Power Supply

The power supply requirements for the test sets are listed below.

Table 5-8 Test Set Power Supply Specifications

Description	Specification
Input Voltage Range	100 to 240 Volts
Frequency Range	47 to 63 Hertz
Power	40 VA

N1955B Electrical Specifications and Characteristics

The following specifications are applicable for a system in the following configurations:

Network Analyzer:	Agilent E8363B Options 014 and UNL
Test Set:	Agilent N4420B
Calibration Kit:	Agilent 85056A 2.4 mm
Test Cables:	Agilent N4420B Option B20
Calibration Technique:	Four-Port SOLT

System Dynamic Range

The test port transmission measurements are valid at 10 Hz IF bandwidth with four-port error correction and –17 dBm default maximum output power. The dynamic range is the difference between rms noise floor and the output power.

Table 5-9 System Dynamic Range

Frequency Range	Specification	Supplemental Information
10 MHz to 45 MHz		55 dB (char.)
45 MHz to 500 MHz	55 dB	
500 MHz to 10.0 GHz	70 dB	
10.0 GHz to 20.0 GHz	70 dB	
20.0 GHz to 40.0 GHz	55 dB	

Measurement Port

Residual uncertainties for corrected data using four-port error correction. These apply for 25 °C with less than 1 °C variation from calibration.

Table 5-10 Measurement Port Characteristics

Description	Characteristic			
	45 MHz to 0.5 GHz	0.5 GHz to 10.0 GHz	10.0 GHz to 20.0 GHz	20.0 GHz to 40.0 GHz
Directivity	43 dB	39.5 dB	39 dB	33 dB
Source Match	38 dB	34 dB	34 dB	27 dB
Load Match	43 dB	39.5 dB	39 dB	33 dB
Reflection Tracking	± 0.001 dB	± 0.002 dB	± 0.008 dB	± 0.026 dB
Transmission Tracking	± 0.015 dB	± 0.020 dB	± 0.040 dB	± 0.20 dB

Measurement Uncertainties

The following graphics show the worst case transmission and reflection magnitude and phase uncertainty for the system.

Figure 5-5 **2.4 mm Transmission Magnitude and Phase Uncertainty**

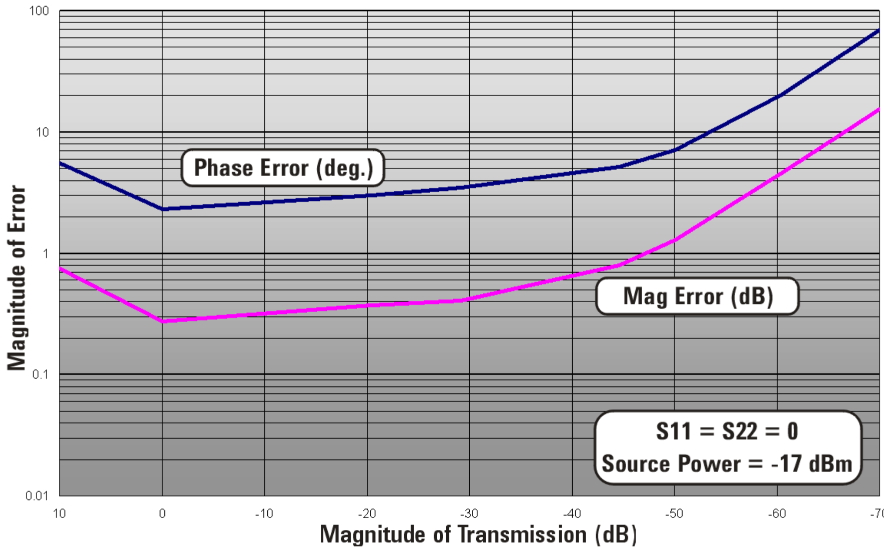
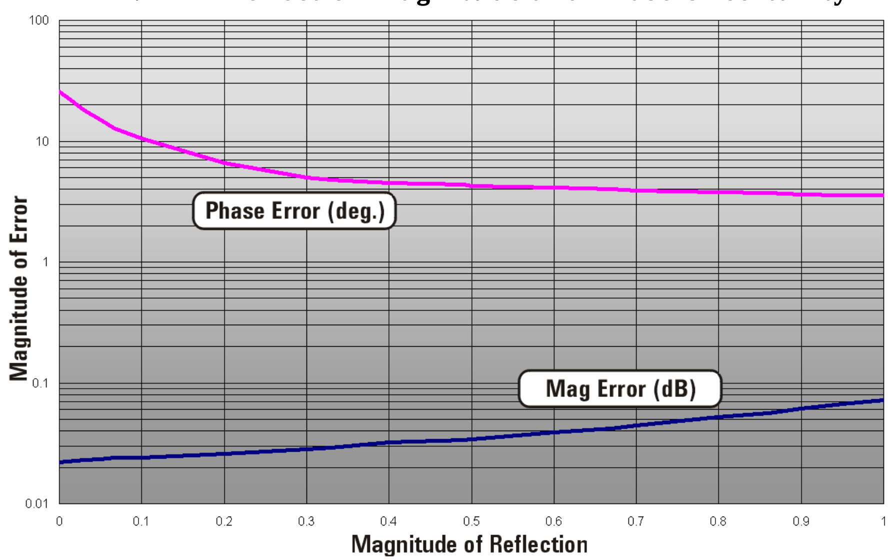


Figure 5-6 **2.4 mm Reflection Magnitude and Phase Uncertainty**



Test Set Performance

Table 5-11 Test Set Performance

Description	Characteristics	Supplemental Information
Frequency Range	10 MHz to 40.0 GHz	
Transition Time (10 to 90%, TR=.72/BW)	18 ps	
Impedance		50 Ohms (nom.)
Insertion Loss		
Source Out to Coupler Thru	12.0 dB maximum	
Port 2 to Rcvr A In and Port 4 to Rcvr B In		
45 MHz to 1.0 GHz		18 to 45 dB (typical)
1.0 GHz to 40.0 GHz		16 to 26 dB (typical)
Rcvr A In to Cplr Arm and Rcvr B In to Cplr Arm	15.0 dB maximum	
Isolation (port to port)		
45 MHz to 200 MHz	≥ 70 dB	
200 MHz to 40 GHz	≥ 90 dB	
Maximum Operating Level	+20 dBm	
Damage Level		+30 dBm (typical)
Test Port Connectors		50 Ohms (nom.) 2.4 mm (m) Connectors

Power Supply

The power supply requirements for the test sets are listed below.

Table 5-12 Test Set Power Supply Specifications

Description	Specification
Input Voltage Range	100 to 240 Volts
Frequency Range	47 to 63 Hertz
Power	40 VA

N1957B Electrical Specifications and Characteristics

The following specifications are applicable for the systems in the following configurations:

Network Analyzer:	Agilent E8364B Options 014 and UNL
Test Set:	Agilent N4421B
Calibration Kit:	Agilent 85056A 2.4 mm
Test Cables:	Agilent N4421B Option B20
Calibration Technique:	Four-Port SOLT

System Dynamic Range

The test port transmission measurements are valid at 10 Hz IF bandwidth with four-port error correction and –17 dBm default maximum output power. The dynamic range is the difference between rms noise floor and the output power.

Table 5-13 System Dynamic Range

Frequency Range	Specification	Supplemental Information
10 MHz to 45 MHz		55 dB (char.)
45 MHz to 500 MHz	55 dB	
500 MHz to 10.0 GHz	70 dB	
10.0 GHz to 20.0 GHz	70 dB	
20.0 GHz to 50.0 GHz	55 dB	

Measurement Port

Residual uncertainties for corrected data using four-port error correction. These apply for 25 °C with less than 1 °C variation from calibration.

Table 5-14 Measurement Port Characteristics

Description	Characteristic			
	45 MHz to 0.5 GHz	0.5 GHz to 10.0 GHz	10.0 GHz to 20.0 GHz	20.0 GHz to 50.0 GHz
Directivity	43 dB	39.5 dB	39 dB	33 dB
Source Match	38 dB	34 dB	34 dB	27 dB
Load Match	43 dB	39.5 dB	39 dB	33 dB
Reflection Tracking	± 0.001 dB	± 0.002 dB	± 0.008 dB	± 0.026 dB
Transmission Tracking	± 0.015 dB	± 0.020 dB	± 0.040 dB	± 0.20 dB

Measurement Uncertainties

The following graphics show the worst case transmission and reflection magnitude and phase uncertainty for the system.

Figure 5-7 2.4 mm Transmission Magnitude and Phase Uncertainty

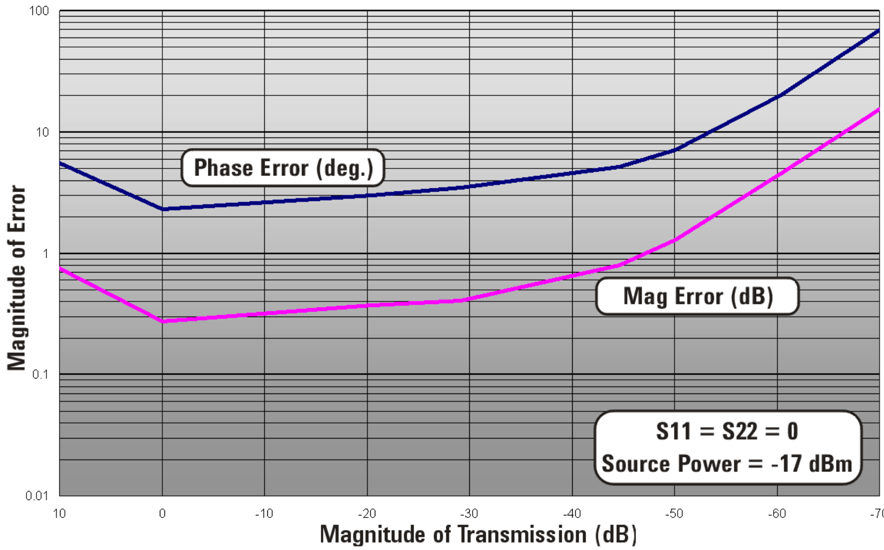
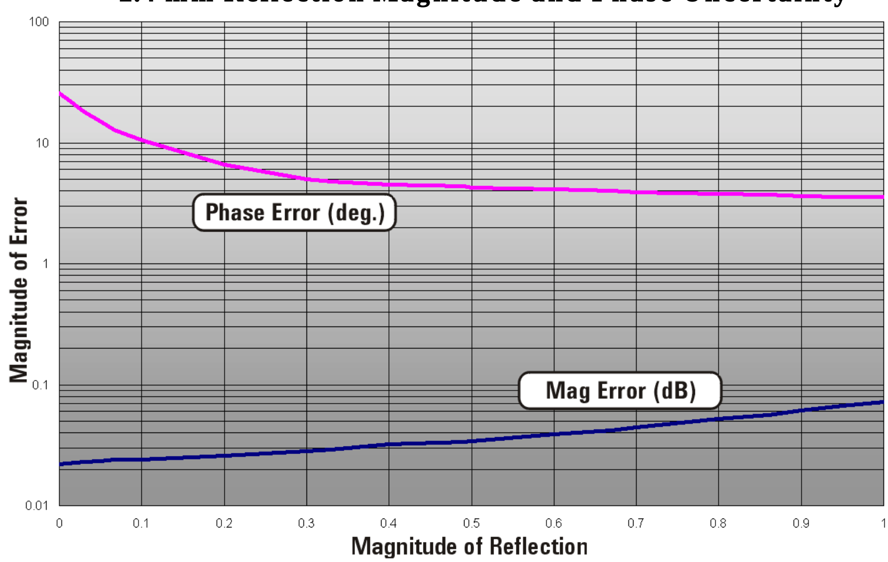


Figure 5-8 2.4 mm Reflection Magnitude and Phase Uncertainty



Test Set Performance

Table 5-15 Test Set Performance

Description	Characteristics	Supplemental Information
Frequency Range	10 MHz to 50.0 GHz	
Transition Time (10 to 90%, TR=.72/BW)	14 ps	
Impedance		50 Ohms (nom.)
Insertion Loss		
Source Out to Coupler Thru	12.0 dB maximum	
Port 2 to Rcvr A In and Port 4 to Rcvr B In		
45 MHz to 1.0 GHz		18 to 45 dB (typical)
1.0 GHz to 50.0 GHz		16 to 26 dB (typical)
Rcvr A In to Cplr Arm and Rcvr B In to Cplr Arm	15.0 dB maximum	
Isolation (port to port)		
45 MHz to 200 MHz	≥ 70 dB	
200 MHz to 50 GHz	≥ 90 dB	
Maximum Operating Level	+20 dBm	
Damage Level		+30 dBm (typical)
Test Port Connectors		50 Ohms (nom.) 2.4 mm (m) Connectors

Power Supply

The power supply requirements for the test sets are listed below.

Table 5-16 Test Set Power Supply Specifications

Description	Specification
Input Voltage Range	100 to 240 Volts
Frequency Range	47 to 63 Hertz
Power	40 VA

General Characteristics

The test set environmental operating conditions and physical characteristics are displayed on the following pages.

Environmental Operating Conditions

The environmental operating conditions for the test set are listed below.

Table 5-17 Test Set Environmental Operating Conditions

Description	Conditions
Operating Environment	Indoor use
Altitude	
Operating:	0 to 2.0 km (6,560 ft)
Storage:	0 to 15.24 km (50,000 ft)
Temperature	0 °C to 40 °C
Maximum Relative Humidity	80% for temperatures up to 31 °C decreasing linearly to 50% for a temperature of 40 °C

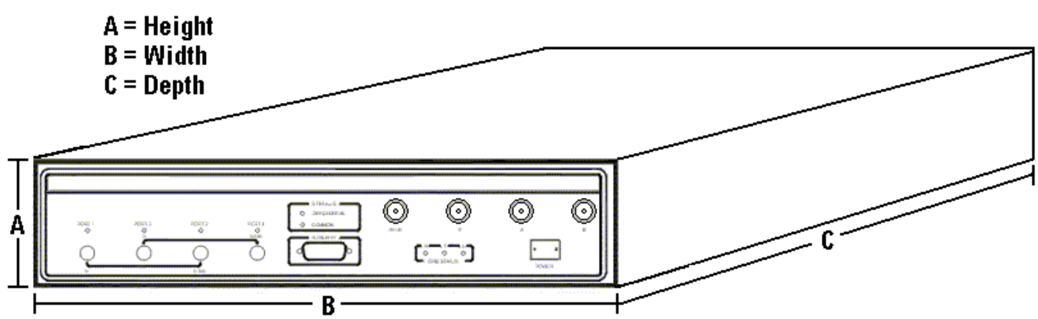
This product is designed for use in INSTALLATION CATEGORY II and POLLUTION DEGREE 2, per IED 61010-1 and 664, respectively.

Physical Characteristics

The weight and dimensions for the test sets are listed below.

Weight and Dimensions

Table 5-18 Test Set Weight and Dimensions



Model Number	Weight	Dimensions		
		Height (A)	Width (B)	Depth (C)
N4419B	9.0 kilograms (19.9 pounds)	3.0 in (7.62 cm)	16.75 in (42.55 cm)	19.25 in (48.90 cm)
N4420B and N4421B	9.0 kilograms (19.9 pounds)	5.5 in (13.97 cm)	16.75 in (42.55 cm)	16.75 in (42.55 cm)

6 Test Set Front Panel and Rear Panel

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This chapter provides a graphical overview of the test sets used as part of the physical layer test system. This chapter also illustrates the front and rear panels of the S-parameter test sets separately. The features of each front and rear panel (such as connectors, switches, LEDs, and fuses) are identified and briefly described.

The individual network analyzer features are described in the network analyzer documentation. They are not be described in this document!

The front and rear panel of each S-parameter test set model is illustrated and described. Refer to the page number listed below for your test set model number.

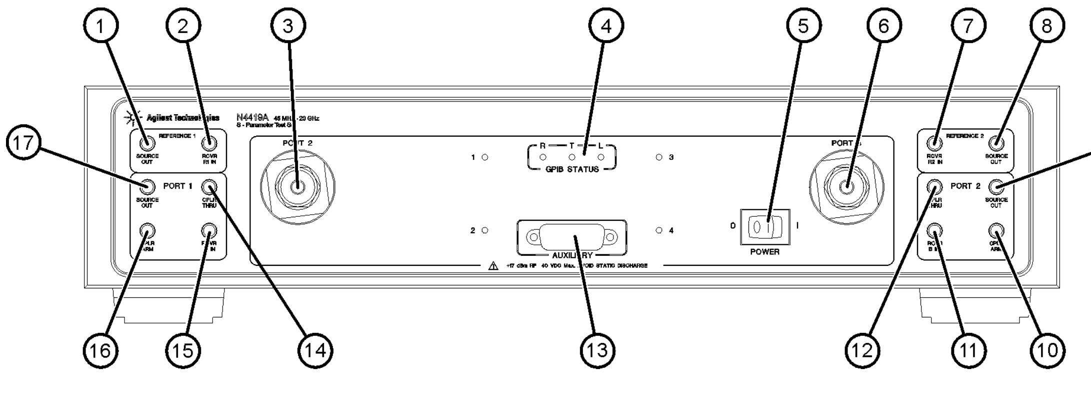
For Model Number:	Refer to:
N4419B	page 172
N4420B	page 176
N4421B	page 180

NOTE For front and rear panel information on the test set model numbers listed below, refer to page 322 in Appendix B, "Reference Information for Discontinued Physical Layer Test System Hardware."

N4415A, N4416A, N4417A, N4418A, N4419A, N4421A

N4419B

N4419B Front Panels

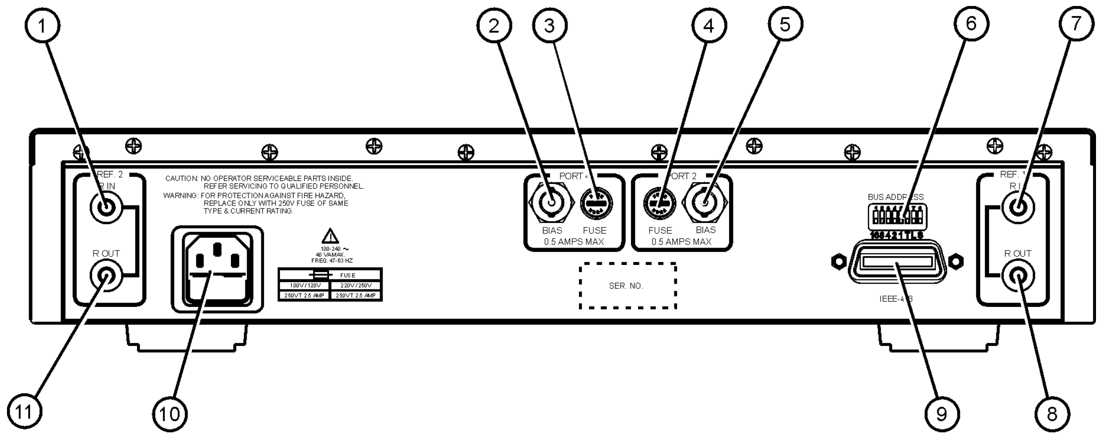


4419frnpnl

ID Number	Front Panel Feature	Feature Description
1	REFERENCE 1 SOURCE OUT	SMA (f) connector that is connected to the network analyzer REFERENCE 1 SOURCE OUT connector using a semirigid cable.
2	REFERENCE 1 RCVR R1 IN	SMA (f) connector that is connected to the network analyzer REFERENCE 1 RCVR R1 IN connector using a semirigid cable.
3	PORT 2	*PORT 2 - APC-3.5 (m) connector with 20 mm nut that is connected to the DUT or fixture. (+17 dBm maximum operating level)*
4	GPIB STATUS	Three LEDs (R, T, and L) that display the GPIB status of the test set when it is communicating with the network analyzer. R = Remote Operation, T = Talk mode, L = Listen mode.
5	POWER	ON/OFF switch that disconnects the mains circuits from the mains supply before other parts of the test set. The front panel POWER switch disconnects the mains circuits from the mains supply after the EMC filters and before other parts of the instrument.
6	PORT 4	*PORT 4 - APC-3.5 (m) connector with 20 mm nut that is connected to the DUT or fixture. (+17 dBm maximum operating level)*

ID Number	Front Panel Feature	Feature Description
7	REFERENCE 2 RCVR R2 IN	SMA (f) connector that is connected to the network analyzer REFERENCE 2 RCVR R2 IN connector using a semirigid cable.
8	REFERENCE 2 SOURCE OUT	SMA (f) connector that is connected to the network analyzer REFERENCE 2 SOURCE OUT connector using a semirigid cable.
9	PORT 2 SOURCE OUT	SMA (f) connector that is connected to the network analyzer PORT 2 SOURCE OUT connector using a semirigid cable.
10	PORT 2 CPLR ARM	SMA (f) connector that is connected to the network analyzer PORT 2 CPLR ARM connector using a semirigid cable.
11	PORT 2 RCVR B IN	SMA (f) connector that is connected to the network analyzer PORT 2 RCVR B IN connector using a semirigid cable.
12	PORT 2 CPLR THRU	SMA (f) connector that is connected to the network analyzer PORT 2 CPLR THRU connector using a semirigid cable.
13	AUXILIARY	15-pin ribbon (f) connector that may be connected to the Agilent N4430A/B ECal module to provide ECal capability.
14	PORT 1 CPLR THRU	SMA (f) connector that is connected to the network analyzer PORT 1 CPLR THRU connector using a semirigid cable.
15	PORT 1 RCVR A IN	SMA (f) connector that is connected to the network analyzer PORT 1 RCVR A IN connector using a semirigid cable.
16	PORT 1 CPLR ARM	SMA (f) connector that is connected to the network analyzer PORT 1 CPLR ARM connector using a semirigid cable.
17	PORT 1 SOURCE OUT	SMA (f) connector that is connected to the network analyzer PORT 1 SOURCE OUT connector using a semirigid cable.

N4419B Rear Panel



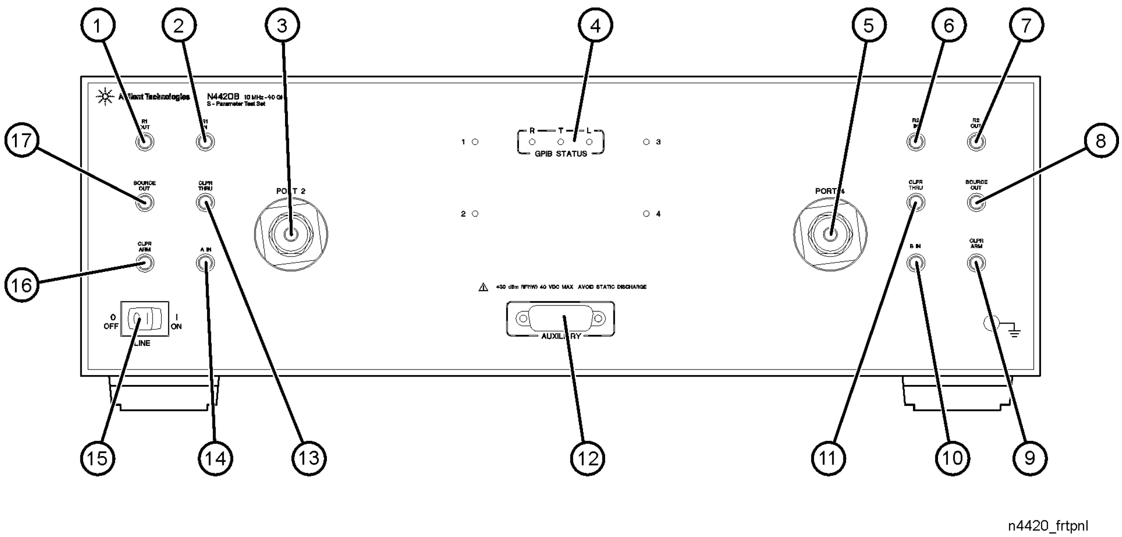
hy407a

ID Number	Rear Panel Feature	Feature Description
1	REF 2 R IN	SMA (f) connector, used as an input reference signal
2	PORT 4 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.
3	PORT 4 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
4	PORT 2 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
5	PORT 2 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.
6	BUS ADDRESS	Switch that is used to set the GPIB address. Refer to “Step 7. Set Up the General Purpose Interface Bus (GPIB)” on page 29 for further information.
7	REF 1 R IN	SMA (f) connector, used as an input reference signal
8	REF 1 R OUT	SMA (f) connector, used as an output reference signal
9	IEEE-488	24-pin IEEE-488/PCB (f) connector. The GPIB is the communication bus with the PC and the network analyzer.

ID Number	Rear Panel Feature	Feature Description
10	Power Cord Connector	Connector, 100-120 Vac or 220-250Vac input and Fuse, T 2.5 A 250 V (Agilent part number 2110-0681)
11	REF 2 R OUT	SMA (f) connector, used as an output reference signal

N4420B

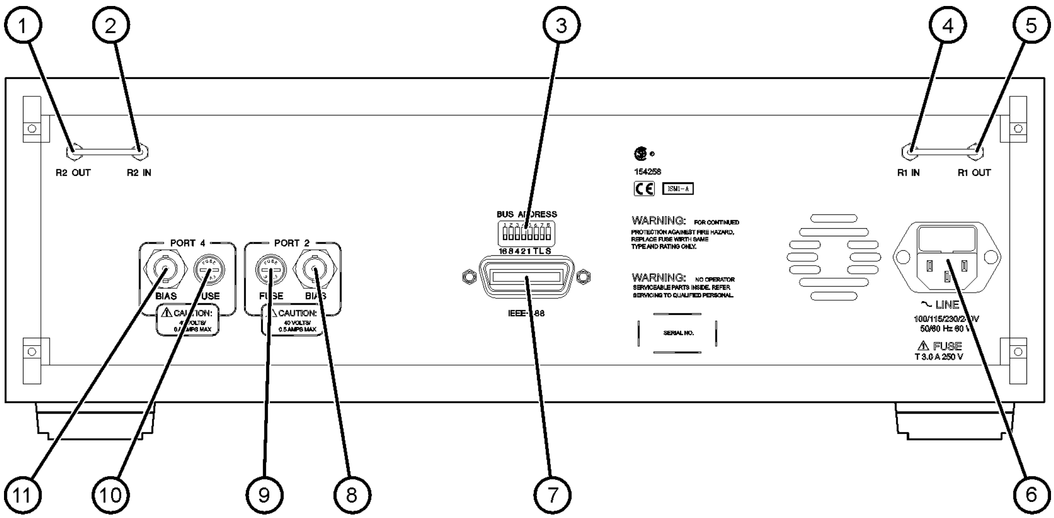
N4420B Front Panel



ID Number	Front Panel Feature	Feature Description
1	R1 OUT	2.4 mm (f) connector that connects to the network analyzer REFERENCE 1 OUT connector using a semirigid cable.
2	R1 IN	2.4 mm (f) connector that connects to the network analyzer REFERENCE 1 RCVR R1 connector using a semirigid cable.
3	PORT 2	2.4 mm bulkhead test port connector that is connect to the DUT or fixture. (+17 dBm maximum operating level)
4	GPIB STATUS	Three LEDs (R, T, and L) that display the GPIB status of the test set when it is communicating with the network analyzer. R = Remote Operation, T = Talk mode, L = Listen mode.
5	PORT 4	2.4 mm bulkhead test port connector that is connect to the DUT or fixture. (+17 dBm maximum operating level)

ID Number	Front Panel Feature	Feature Description
6	R2 IN	2.4 mm (f) connector that connects to the network analyzer REFERENCE 2 RCVR R2 connector using a semirigid cable.
7	R2 OUT	2.4 mm (f) connector that connects to the network analyzer REFERENCE 2 OUT connector using a semirigid cable.
8	SOURCE OUT	2.4 mm (f) connector that connects to the network analyzer PORT 2 SOURCE OUT connector using a semirigid cable.
9	CPLR ARM	2.4 mm (f) connector that connects to the network analyzer PORT 2 CPLR ARM connector using a semirigid cable.
10	B IN	2.4 mm (f) connector that connects to the network analyzer PORT 2 B IN connector using a semirigid cable.
11	CPLR THRU	2.4 mm (f) connector that connects to the network analyzer PORT 2 CPLR THRU connector using a semirigid cable.
12	AUXILIARY	15-pin ribbon (f) connector. Not currently used.
13	CPLR THRU	2.4 mm (f) connector that connects to the network analyzer PORT 1 CPLR THRU connector using a semirigid cable.
14	A IN	2.4 mm (f) connector that connects to the network analyzer PORT 1 A IN connector using a semirigid cable.
15	LINE	ON/OFF switch that disconnects the mains circuits from the mains supply before other parts of the test set. The front panel POWER switch disconnects the mains circuits from the mains supply after the EMC filters and before other parts of the instrument.
16	CPLR ARM	2.4 mm (f) connector that connects to the network analyzer PORT 1 CPLR ARM connector using a semirigid cable.
17	SOURCE OUT	2.4 mm (f) connector that connects to the network analyzer PORT 1 SOURCE OUT connector using a semirigid cable.

N4420B Rear Panel



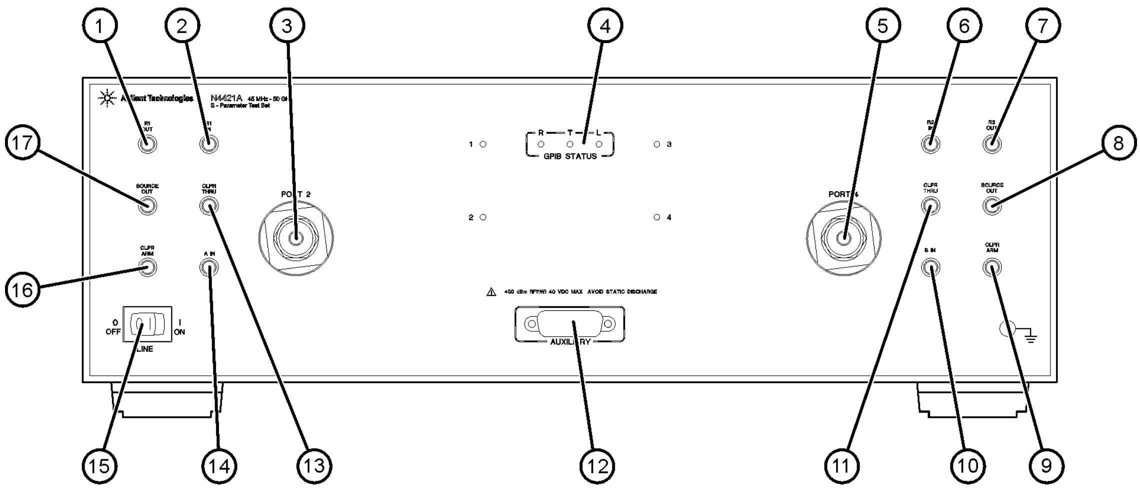
4421_rearpnl

ID Number	Rear Panel Feature	Feature Description
1	REF 2 R OUT	2.4 mm (f) connector, used as an output reference signal
2	REF 2 R IN	2.4 mm (f) connector, used as an input reference signal.
3	BUS ADDRESS	Switch that is used to set the GPIB address. Refer to "Step 7. Set Up the General Purpose Interface Bus (GPIB)" on page 29 for further information.
4	REF 1 R IN	2.4 mm (f) connector, used as an input reference signal
5	REF 1 R OUT	2.4 mm (f) connector, used as an output reference signal
6	Power Cord Connector	Connector, 100-120 Vac or 220-250 Vac input and Fuse, T 2.5 A 250 V (Agilent part number 2110-0681)
7	IEEE-488	24-pin IEEE-488/PCB (f) connector. The GPIB is the communication bus with the PC and the network analyzer.
8	PORT 2 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.

ID Number	Rear Panel Feature	Feature Description
9	PORT 2 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
10	PORT 4 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
11	PORT 4 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.

N4421B

N4421B Front Panel

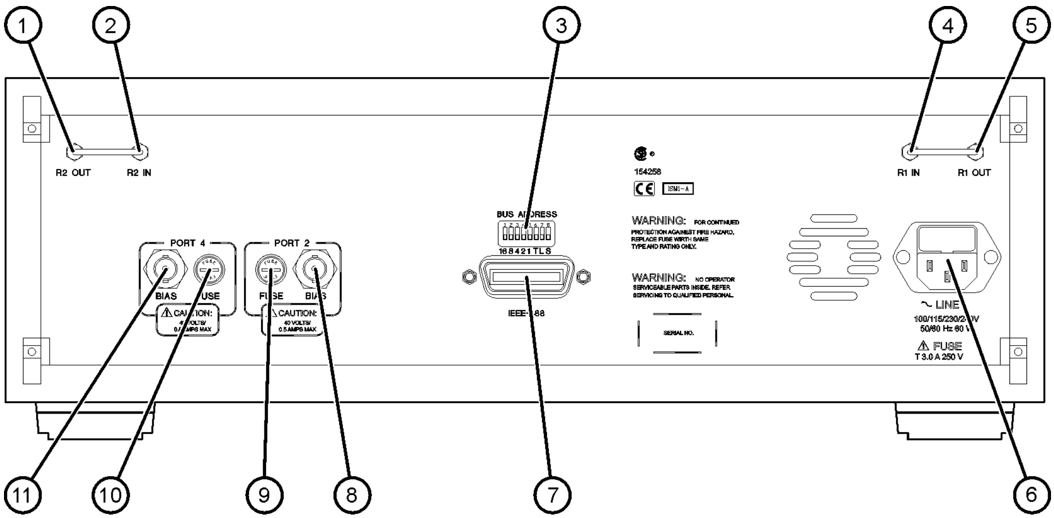


n4421_frtpnl

ID Number	Front Panel Feature	Feature Description
1	R1 OUT	2.4 mm (f) connector that connects to the network analyzer REFERENCE 1 OUT connector using a semirigid cable.
2	R1 IN	2.4 mm (f) connector that connects to the network analyzer REFERENCE 1 RCVR R1 connector using a semirigid cable.
3	PORT 2	2.4 mm bulkhead test port connector that is connect to the DUT or fixture. (+17 dBm maximum operating level)
4	GPIB STATUS	Three LEDs (R, T, and L) that display the GPIB status of the test set when it is communicating with the network analyzer. R = Remote Operation, T = Talk mode, L = Listen mode.
5	PORT 4	2.4 mm bulkhead test port connector that is connect to the DUT or fixture. (+17 dBm maximum operating level)

ID Number	Front Panel Feature	Feature Description
6	R2 IN	2.4 mm (f) connector that connects to the network analyzer REFERENCE 2 RCVR R2 connector using a semirigid cable.
7	R2 OUT	2.4 mm (f) connector that connects to the network analyzer REFERENCE 2 OUT connector using a semirigid cable.
8	SOURCE OUT	2.4 mm (f) connector that connects to the network analyzer PORT 2 SOURCE OUT connector using a semirigid cable.
9	CPLR ARM	2.4 mm (f) connector that connects to the network analyzer PORT 2 CPLR ARM connector using a semirigid cable.
10	B IN	2.4 mm (f) connector that connects to the network analyzer PORT 2 B IN connector using a semirigid cable.
11	CPLR THRU	2.4 mm (f) connector that connects to the network analyzer PORT 2 CPLR THRU connector using a semirigid cable.
12	AUXILIARY	15-pin ribbon (f) connector. Not currently used.
13	CPLR THRU	2.4 mm (f) connector that connects to the network analyzer PORT 1 CPLR THRU connector using a semirigid cable.
14	A IN	2.4 mm (f) connector that connects to the network analyzer PORT 1 A IN connector using a semirigid cable.
15	LINE	ON/OFF switch that disconnects the mains circuits from the mains supply before other parts of the test set. The front panel POWER switch disconnects the mains circuits from the mains supply after the EMC filters and before other parts of the instrument.
16	CPLR ARM	2.4 mm (f) connector that connects to the network analyzer PORT 1 CPLR ARM connector using a semirigid cable.
17	SOURCE OUT	2.4 mm (f) connector that connects to the network analyzer PORT 1 SOURCE OUT connector using a semirigid cable.

N4421B Rear Panel



4421_rearpnl

ID Number	Rear Panel Feature	Feature Description
1	REF 2 R OUT	2.4 mm (f) connector, used as an output reference signal
2	REF 2 R IN	2.4 mm (f) connector, used as an input reference signal.
3	BUS ADDRESS	Switch that is used to set the GPIB address. Refer to “Step 7. Set Up the General Purpose Interface Bus (GPIB)” on page 29 for further information.
4	REF 1 R IN	2.4 mm (f) connector, used as an input reference signal
5	REF 1 R OUT	2.4 mm (f) connector, used as an output reference signal
6	Power Cord Connector	Connector, 100-120 Vac or 220-250 Vac input and Fuse, T 2.5 A 250 V (Agilent part number 2110-0681)
7	IEEE-488	24-pin IEEE-488/PCB (f) connector. The GPIB is the communication bus with the PC and the network analyzer.
8	PORT 2 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.

ID Number	Rear Panel Feature	Feature Description
9	PORT 2 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
10	PORT 4 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
11	PORT 4 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.

7 Troubleshooting and Maintenance

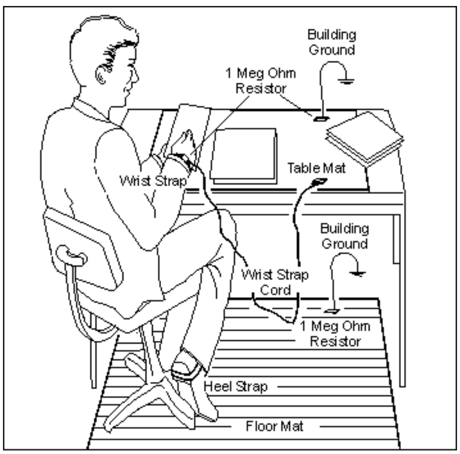
Electrostatic Discharge

Although protected internally, test systems are sensitive to electrostatic discharge (ESD). Static discharges too small to feel can damage or degrade the test equipment or your devices.

Use standard precautions to protect against ESD before using the test system for calibration or measurement.

Use the following illustration and list of equipment to set up a static-safe workstation.

Figure 7-1 Static-Safe Workstation



- static-control table mat and earth ground wire: part number 9300-0797
- wrist-strap cord: part number 9300-0980
- wrist-strap: part number 9300-1367
- heel-straps: part number 9300-1308
- floor mat: not available through Agilent Technologies

PLTS Installation Troubleshooting

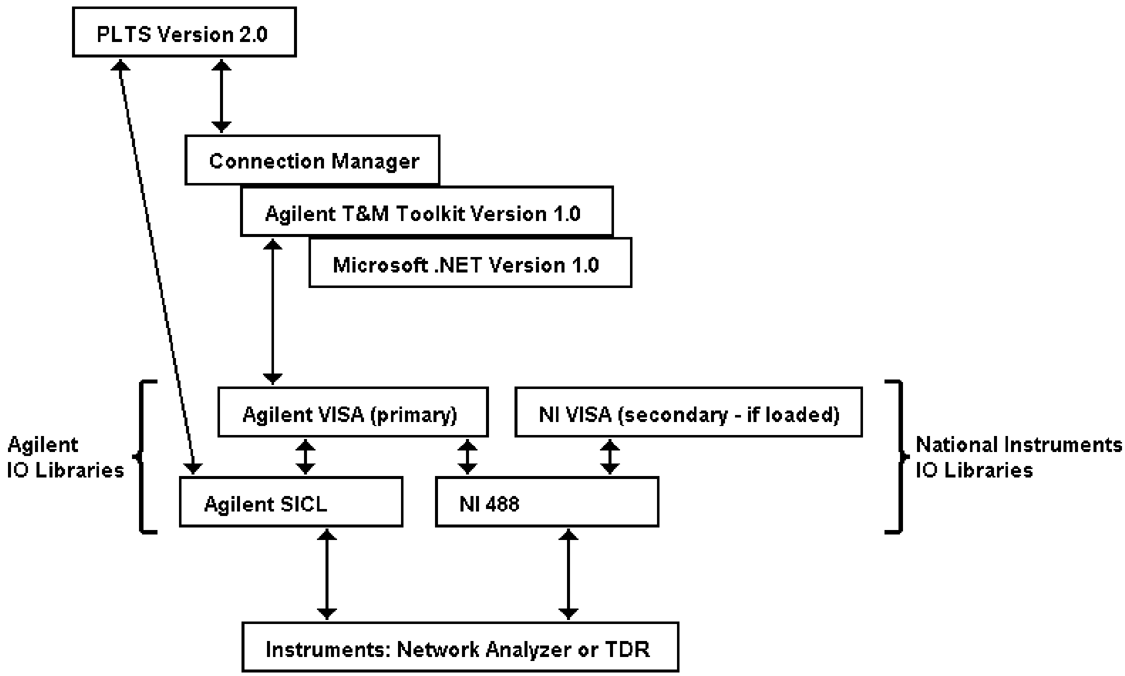
This troubleshooting section is included to help you correct a variety of issues that you may encounter when you install PLTS. This section provides some background and gives solutions for correcting these PLTS installation problems. The issues that are covered in this section are:

- "Issues with .NET and the T&M Toolkit Versions" on page 188
- "Problems with the Agilent USB to GPIB Adapter" on page 190
- "Problems with the VISA Layer" on page 191
- "Problems with VISA COM (SOAP Error)" on page 191
- "Problems with using National Instruments I/O Devices" on page 194
- "I/O Troubleshooting Steps" on page 196
- "Upgrading from PLTS 1.102" on page 210
- "Missing Microsoft Component" on page 210

Issues with .NET and the T&M Toolkit Versions

PLTS v2.*x* contains new functionality called the PLTS Connection Manager, that is designed to communicate with instruments and to scan for instruments connected to the bus. The PLTS Connection Manager is built on Agilent's Test and Measurement Programmers Tool Kit (T&M Toolkit), which requires Microsoft's .NET package. Figure 7-2 shows PLTS and it's dependencies on other software products and how it communicates with instruments.

Figure 7-2 PLTS v2.*x* Instrument Communication Hierarchy



- **Microsoft .NET:**

  Microsoft .NET V1.0 ***must*** be installed on your PC. There are two revisions of .NET. They are 1.0 and 1.1. NET can be installed three ways.

  1. Load the runtime libraries (redistribution package) as with the PLTS installation.
  2. Install the .NET Framework (downloadable from Microsoft).
  3. Install a purchased version of Visual Studio .NET.

  Multiple versions of the runtime libraries (in our redistribution package or downloaded from Microsoft) can be loaded at the same time. The studio version and the runtime libraries can also be loaded at the same time and may be different versions.

- **Agilent T&M Toolkit:**

  Agilent T&M Toolkit Version 1.0 ***must*** be installed on your PC. There are two versions of the T&M Toolkit. They are versions 1.0 and 1.1. T&M Toolkit can be installed two ways.

  1. Load the redistribution package as with the PLTS installation.
  2. Install a purchased version of the T&M Toolkit Development Environment product.

  Only one version of the T&M Toolkit Development Environment can be loaded at the same time. However, one version of the development environment can be loaded with one or more redistribution packages.

- **PLTS Connection Manager:**

  PLTS Connection Manager is automatically installed with PLTS v2.*x*. The PLTS Connection Manager is compiled against T&M Toolkit 1.0 and .NET 1.0. This means that some version of T&M Toolkit 1.0 and .NET 1.0 MUST be loaded on the computer for PLTS v2.*x* to work. T&M Toolkit was built such that it does not migrate forward, meaning that applications, like PLTS Connection Manager, that are built on T&M Toolkit 1.0 will not work on newer T&M Toolkit versions unless they are recompiled. The same is true of the .NET. PLTS requires .NET 1.0; T&M Toolkit will not work with .NET 1.1. Depending on what products have been previously installed, there may be different versions of these tools loaded. This means that a version of both .NET 1.0 and T&M Toolkit 1.0 ***must*** be loaded! See Table 7-1 for different supported configuration cases.

Table 7-1 .Net – T&M Toolkit Configuration Matrix

Application	Case					Case			
	1	2	3	4	5	6	7	8	9
.NET runtime version	1.0	N/A	1.0	N/A	1.0	N/A	1.1	N/A, 1.0, or 1.1	N/A, 1.0, or 1.1
.NET Visual Studio or Framework version	N/A	1.0	N/A	1.0	1.0 or 1.1	1.1	N/A or 1.1	N/A, 1.0, or 1.1	N/A, 1.0, or 1.1
T&M Toolkit redistribution version	1.0	N/A	N/A	1.0	1.0	1.0 or 1.1	1.0 or 1.1	1.1, or 1.2	N/A, 1.1, or 1.2
T&M Toolkit product version	N/A	1.0	1.0	N/A	1.0, 1.1, or 1.2	1.0, 1.1, or 1.2	1.0, 1.1, or 1.2	N/A, 1.1, or 1.2	1.1, or 1.2
PLTS Connection Manager works	Yes	Yes	Yes	Yes	Yes	No	No	No	No

N/A - Not Available (or Not Loaded)

Case Descriptions:

- **Cases 1, 2, 3, 4, and 5:** PLTS Connection Manager works because some version of .Net 1.0 *and* T&M Toolkit 1.0 are loaded.
- **Cases 6 and 7:** PLTS Connection Manager does *not* work because no version of .Net 1.0 is loaded.
- **Cases 8 and 9:** PLTS Connection Manager does *not* work because no version of T&M Toolkit 1.0 is loaded.

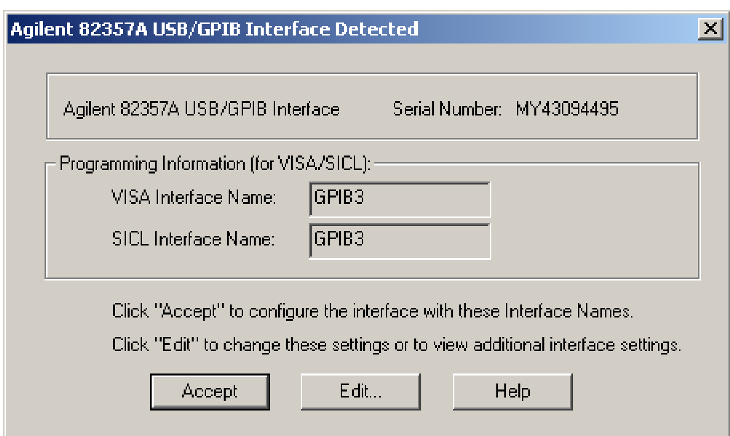
Problems with the Agilent USB to GPIB Adapter

Several problems can occur with the Agilent USB to GPIB adapter (Agilent 82357A). The Microsoft driver that was written for the adapter has some limitations.

1. If the computer goes into hibernation with the adapter connected, the adapter will not work when the computer comes out of hibernation.
2. If the adapter is connected to a docking station and the laptop is powered up (or rebooted), sometimes the adapter will not work.

To get the adapter to work for either case, make sure the PC is fully powered up and Windows is functional, then unplug the USB connection and reconnect the adapter. The Microsoft Operating System will find the new hardware and a dialog box similar to Figure 7-3 will be displayed. It should remember your previous settings for the interface names, so click the **Accept** button and the adapter should operate correctly.

Figure 7-3 Agilent 82357A USB/GPIB Interface Detected Dialog Box



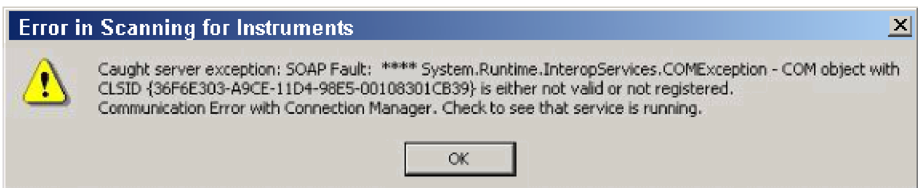
Problems with the VISA Layer

For PLTS Connection Manager to operate correctly and consistently, the Agilent VISA needs to be the primary (or the only) VISA installed. If the NI VISA is installed first, it usually assumes the primary position. When loading the Agilent I/O libraries second (as with PLTS), the Agilent VISA should be set as the primary VISA. Problems may occur leaving the Agilent VISA as secondary VISA. Refer to Figure 7-5 through Figure 7-8 for more details. To quickly check the VISA status, see "I/O Troubleshooting Steps" on page 196 for directions.

Problems with VISA COM (SOAP Error)

The error message shown in Figure 7-4 may be displayed when running PLTS. This error is generated because the VISA COM was not loaded with the Agilent IO libraries.

Figure 7-4 Scanning for Instruments Error Message

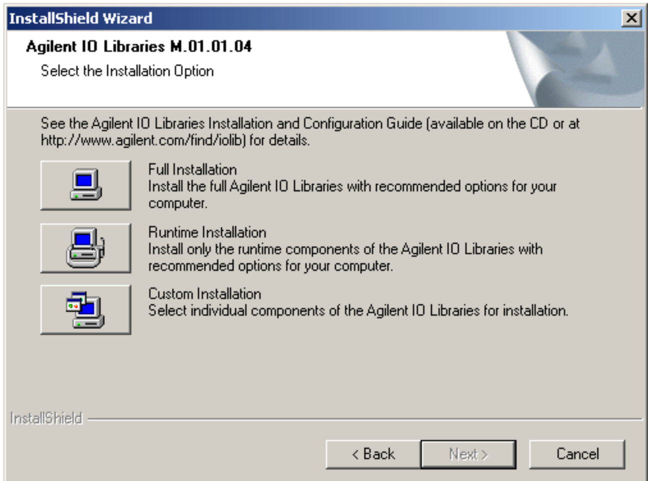


The VISA COM must be loaded for PLTS Connection Manager to work. If the IO libraries are already installed, uninstall then re-install the IO libraries. This can be done by re-installing PLTS or by down loading the IO libraries from the Agilent ADN web page:

http://www.agilent.com/find/iolib

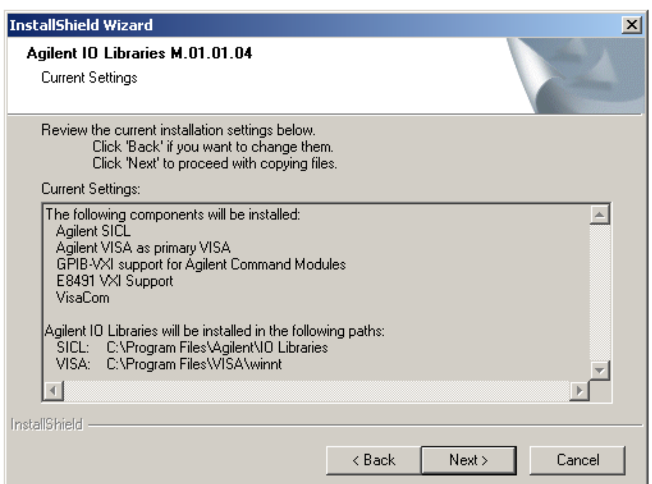
Choose the **Full Installation** selection during the PLTS installation. See Figure 7-5.

Figure 7-5 Agilent IO Libraries M.01.01.04 Select Installation Option Screen



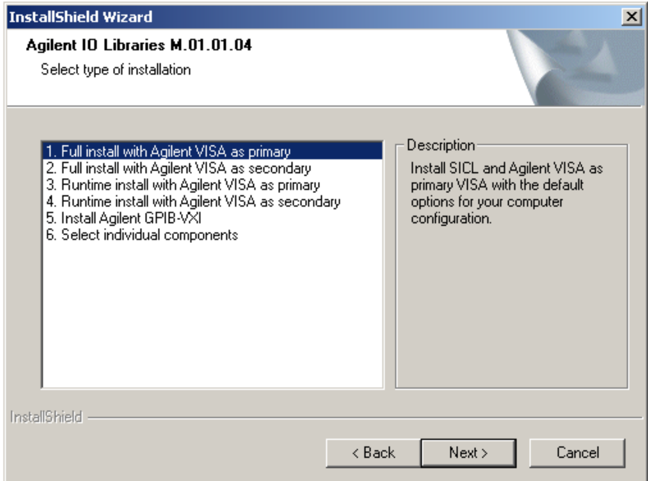
The **Full Installation** selection automatically loads the Agilent VISA COM and sets it as the primary VISA. See Figure 7-6.

Figure 7-6 Agilent IO Libraries M.01.01.04 Current Settings Screen



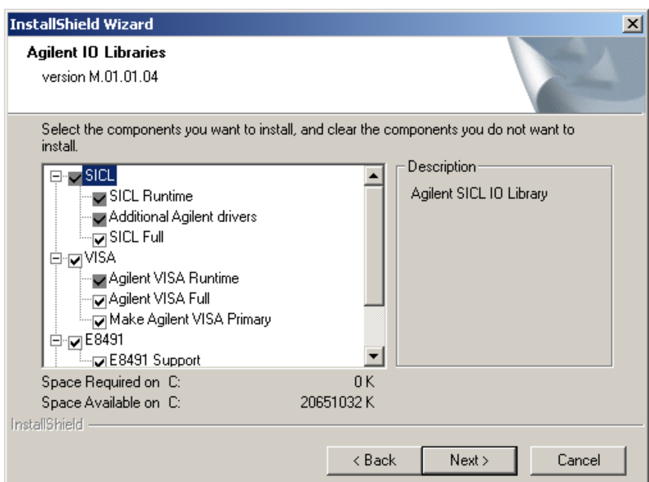
If you chose the **Custom Installation** selection, you must now choose how to install the VISA. Choose Option 1 **Full install with Agilent VISA as primary** (this method is used when loaded with PLTS) or Option 3 **Runtime install with Agilent VISA as primary**. See Figure 7-7.

Figure 7-7 Agilent IO Libraries M.01.01.04 Select Type of Installation Screen



If you chose Option 6 **Select individual components** or reinstallation from the PLTS disk, you may get the display shown in Figure 7-8.

Figure 7-8 Agilent IO Libraries version M.01.01.04 Screen



If so, make sure that the **VISA** and **Make Agilent VISA Primary** selections are selected.

A VISA COM only loader is available on the ADN web page:

http://www.agilent.com/find/iolib

Problems with using National Instruments I/O Devices

If you are using a PCMCIA or PCI NI GPIB, card, the NI software drivers should be loaded first before loading PLTS. There have been occasions where loading the NI software has been problematic. The installation may complete without any apparent errors. However, when running the National Instruments/NI488.2/Getting Started, an error is displayed indicating that the software was not loaded correctly and must be reloaded. Occasionally, getting past this problem has been difficult. Reloading does not seem to help. Sometimes there is a problem identifying the I/O card and getting it to work. In all cases, contact National Instruments technical support representative.

With the NI GPIB-USB-B adapter shown in Figure 7-9, use the latest NI drivers.

Figure 7-9 National Instruments GPIB-GPIB Adapter

The latest NI drivers can be downloaded from:

ftp://ftp.ni.com/support/gpib/ni488221/ni488221.exe (104 MB)

The NI VISA code can be downloaded from:

ftp://ftp.ni.com/support/visa/drivers/win32/3.0.1/visa301full.exe (68 MB)

If problems occur when trying to use the NI GPIB-USB-B interface, it may be necessary to force a clean installation by performing the following steps:

1. Uninstall PLTS v2.*x*.
2. Uninstall “all” NI products using **Start**, **Settings**, **Control Panel**, and **Add/Remove Programs**.
3. Reboot your computer.
4. Uninstall Agilent IO Libraries using **Start**, **Settings**, **Control Panel**, and **Add/Remove Programs**.
5. Uninstall Agilent VISA Com using **Start**, **Settings**, **Control Panel**, and **Add/Remove Programs**.
6. Uninstall the Agilent T&M Toolkit using **Start**, **Settings**, **Control Panel**, and **Add/Remove Programs**.

7. Reboot your computer.
8. Install the new NI driver.

   Reboot your computer if prompted.
9. Install NI VISA.

   Reboot your computer if prompted.
10. Install PLTS v2.*x*. Ensure that the Agilent VISA Layer is the primary VISA. See Figure 7-18 on page 200.
11. For NI Labview code to run properly, you will need to enable **TULIP Passport** in NI Labview.

I/O Troubleshooting Steps

This section provides some steps to troubleshooting the I/O section of the PLTS system. The steps include:

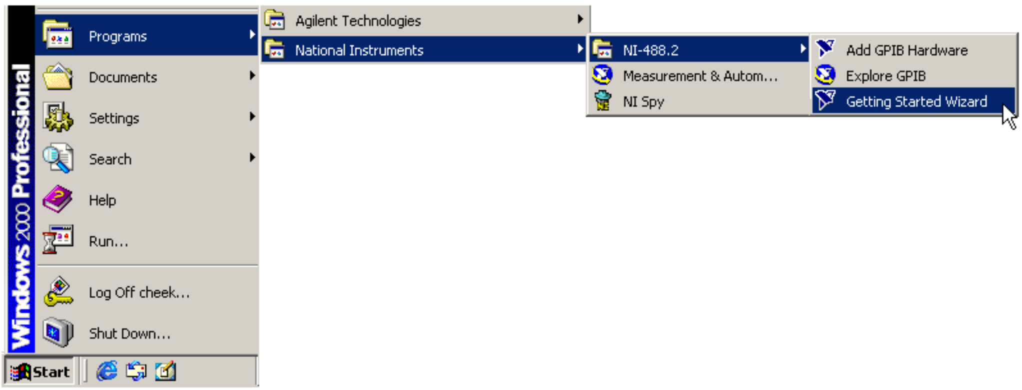
1. Troubleshooting the National Instruments (NI) software, hardware, and connections on page 197
2. Troubleshooting the Agilent I/O libraries on page 200
3. Verifying that the PLTS Connection Manager Service is configured correctly on page 205

Troubleshooting the NI Software, Hardware, and Connections

If you are using a National Instruments (NI) GPIB card, troubleshoot the NI software, hardware, and connection by doing the following:

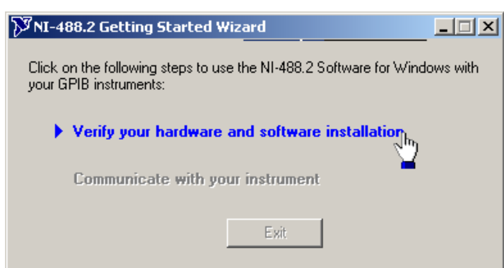
1. Click **Start**, **Programs**, **National Instruments**, **NI-488.2**, **Getting Started Wizard** to run the NI-488.2 Getting Started Wizard. See Figure 7-10.

Figure 7-10 National Instrument Getting Started Menu Selection



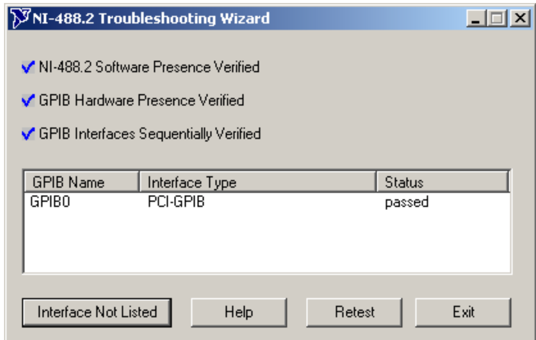
2. The *NI-488.2 Getting Started Wizard* (shown in Figure 7-11) is displayed. This wizard checks the status of the NI software and GPIB card. Click the **Verify your hardware and software installation** selection.

Figure 7-11 NI-488.2 Getting Started Wizard



A dialog box similar to Figure 7-12 is displayed, indicating if the software and cards are working properly. If errors are identified, they must be resolved before continuing to the next step.

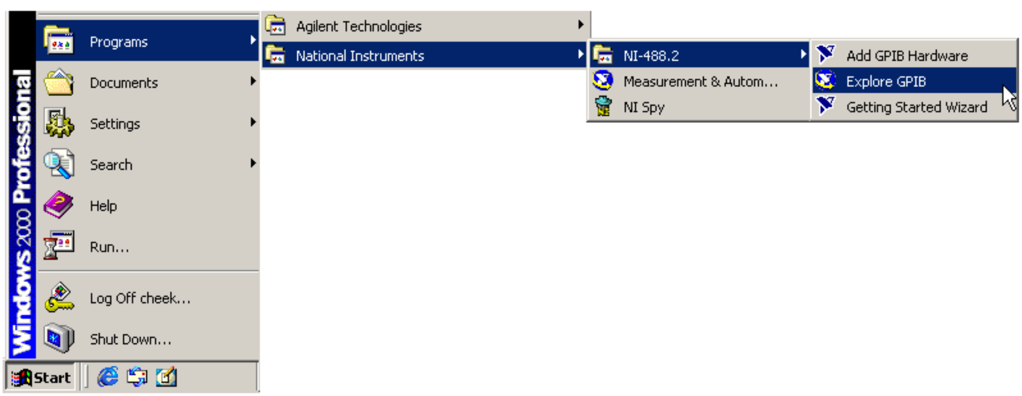
Figure 7-12 NI-488.2 Troubleshooting Wizard



3. Click **Start**, **Programs**, **National Instruments**, **NI-488.2**, **Explore GPIB** as shown in Figure 7-13 to verify the NI driver and card can communicate with the instruments.

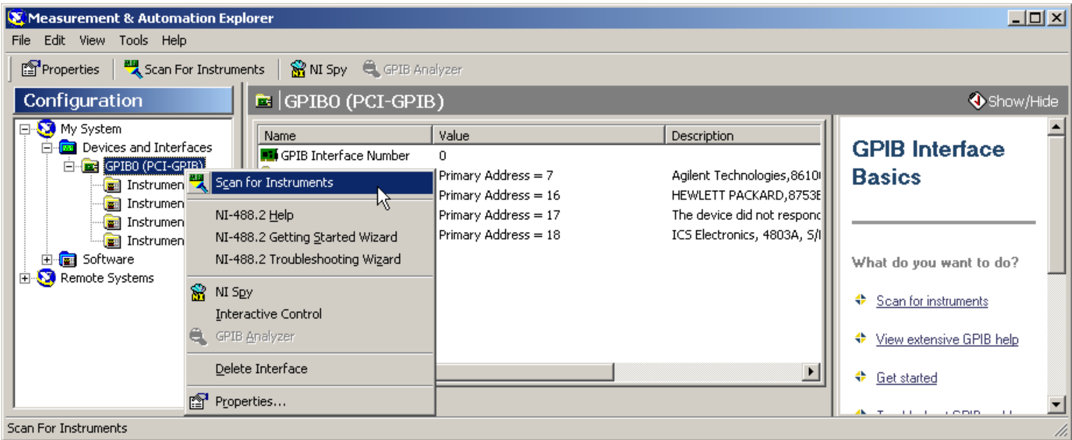
NOTE Make sure the GPIB interface cable is connected to the instruments.

Figure 7-13 National Instrument Explore GPIB Menu Selection



4. When the *Measurement & Automation Explorer* window is displayed (Figure 7-14), click the “+” on the **Devices and Interfaces** item to show the configured interface cards. Right-click the interface and select **Scan for Instruments**. This starts a scan to detect all instruments connected to that interface card.

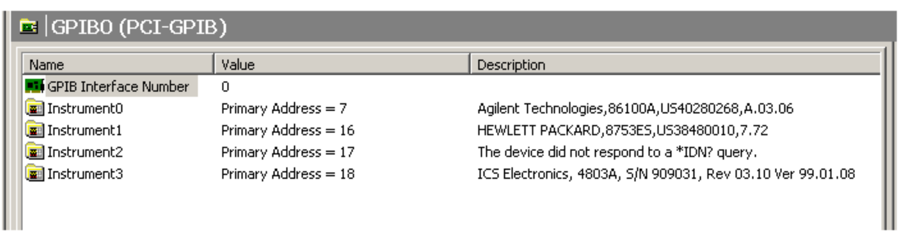
Figure 7-14 NI Measurement & Automation Explorer Window



The detected instruments are shown in the center pane of the window. See Figure 7-15.

If the connected instruments are correctly listed, then the National Instruments software, driver, GPIB card, and connection to the instruments are all properly working. If not, resolve the problem before continuing to the next step.

Figure 7-15 Center Pane of NI Measurement & Automation Explorer Window



Troubleshooting the Agilent I/O Libraries

Troubleshoot the Agilent I/O libraries by doing the following:

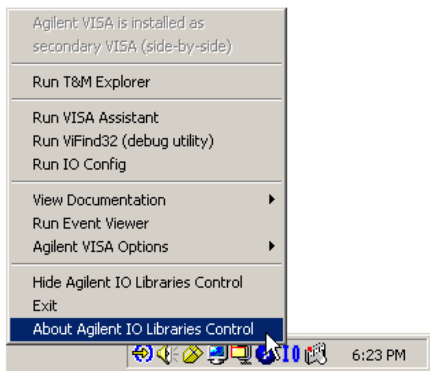
1. When the **Agilent IO Control** is running, a blue **IO** icon is displayed in the task bar as shown in Figure 7-16. Right-click the **IO** icon.

Figure 7-16 Agilent IO Control Icon

If the **Agilent IO Control** is not already running, start run it by clicking **Start**, **Programs**, **Agilent IO Libraries**, and **IO Control**.

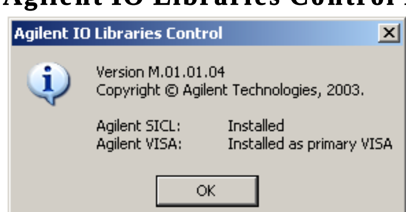
2. Select **About Agilent IO Libraries Control** to verify that the Agilent libraries are installed and Agilent VISA is set as the primary VISA.

Figure 7-17 About Agilent IO Libraries Control Menu Selection



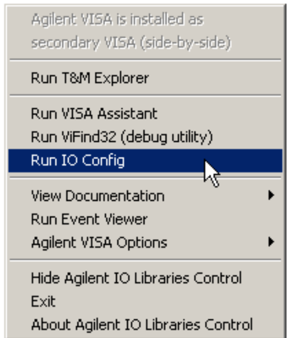
The displayed *Agilent IO Libraries Control* dialog box should indicate that the Agilent SICL libraries are installed and the Agilent VISA is set as the primary VISA. This is required for PLTS to work correctly. If either of these is not correct, reload the Agilent IO libraries.

Figure 7-18 Agilent IO Libraries Control Dialog Box



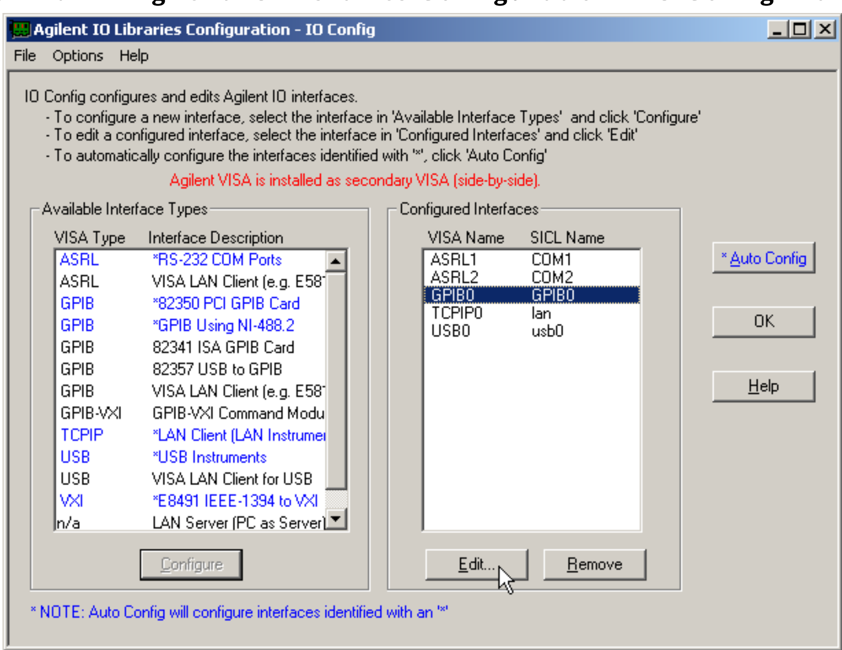
3. Right-click the **IO** icon and select **Run IO Config** to run the IO Libraries Configuration. See Figure 7-19.

Figure 7-19 Run IO Config Menu Selection



This displays the *Agilent IO Libraries Configuration – IO Config* dialog box shown in Figure 7-20. Check that the desired GPIB interface is configured. If it is not, configure the interface by either selecting **Auto Config** or manually configure the interface by selecting the interface and clicking the **Edit**... button.

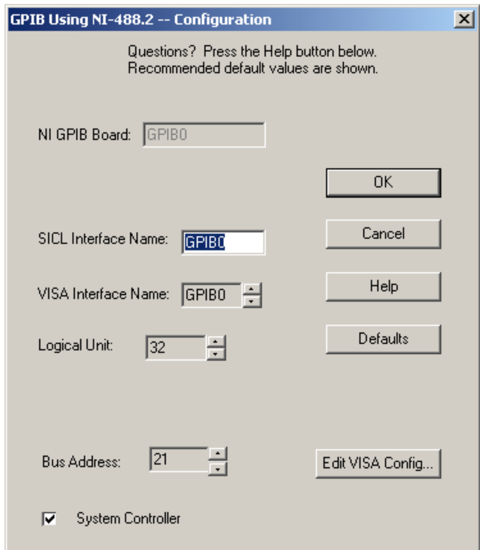
Figure 7-20 Agilent IO Libraries Configuration – IO Config Dialog Box



4. For all GPIB interfaces used with PLTS, the **VISA Interface Name** and **SICL Interface Name** must be the same (including the case). For NI GPIB interfaces, the **NI GPIB Board** name must also be the same as shown in Figure 7-21.

   Click **OK** to complete the manual configuration and return to the **Agilent IO Libraries Configuration – IO Config** dialog box.

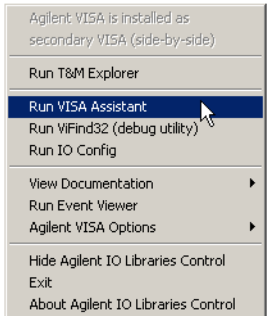
Figure 7-21 GPIB Using NI-488.2 -- Configuration Dialog Box



5. Close the *Agilent IO Libraries Configuration – IO Config* dialog box by clicking the **OK** button.

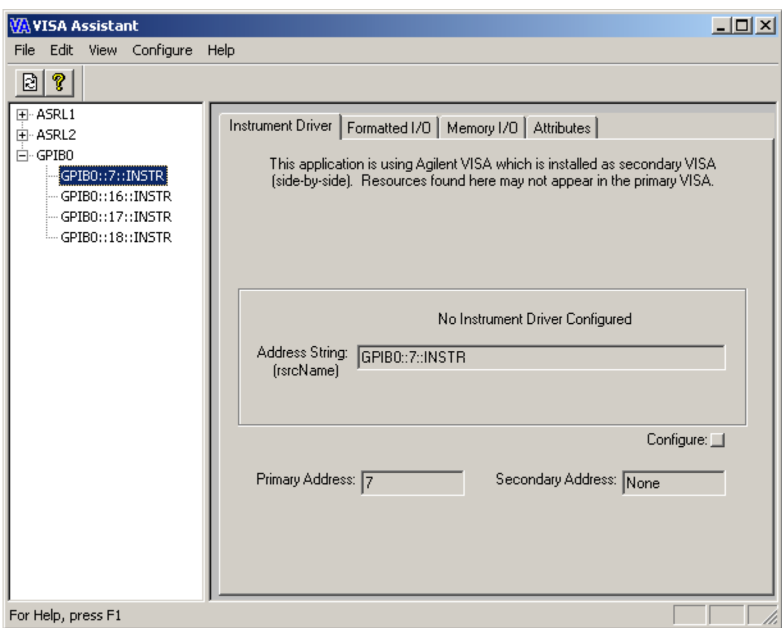
6. Right-click the **IO** icon and select **Run VISA Assistant** to confirm the GPIB card controls the instruments.

Figure 7-22 Run VISA Assistant Menu Selection



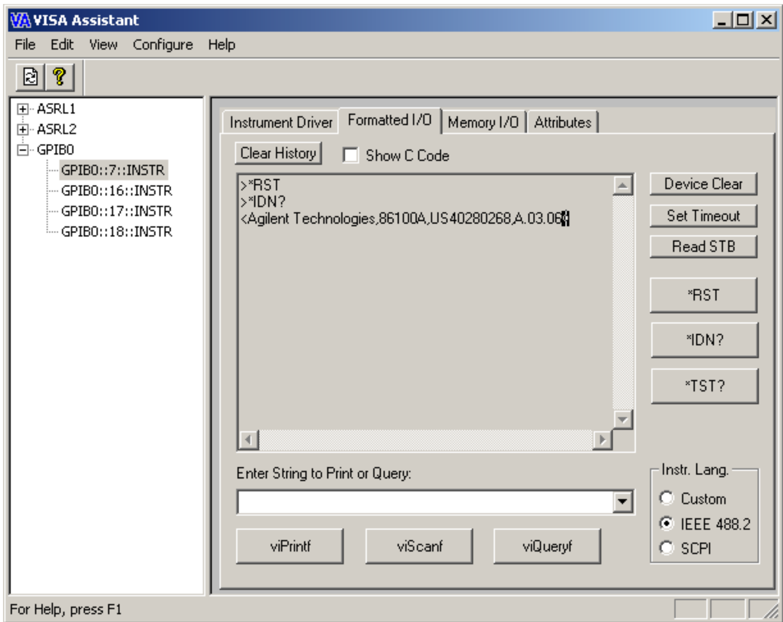
When the VISA Assistant is started, the instruments connected to the GPIB interface should be displayed in the *VISA Assistant* dialog box. See the right side of the *VISA Assistant* dialog box in Figure 7-23.

Figure 7-23 VISA Assistant Dialog Box -- Instrument Driver Tab



7. To send a command to the instrument, select the **Formatted I/O** tab shown in Figure 7-24.

Figure 7-24 VISA Assistant Dialog Box - Formatted I/O Tab



8. In the *VISA Assistant* dialog box, select a GPIB address in the right pane, and then select **IEEE 488.2** in the **Instr. Lang.** area.

9. Click the ***RST** button to send a reset command to the instrument. Then click the ***IDN?** button to query the instrument for its ID string.

   The instrument information is displayed which verifies that the GPIB interface, driver and libraries are properly loaded and working, as well as the NI card, if it is being used.

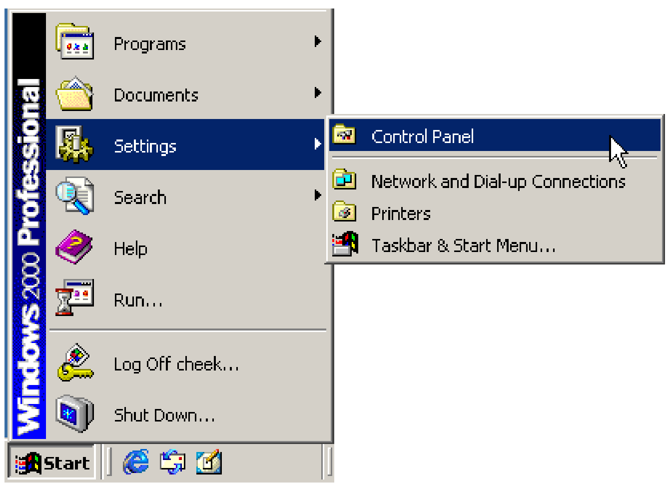
Verify that the PLTS Connection Manager Service is Configured Correctly

PLTS uses a program that runs as a service to communicate with instruments using the GPIB interface standard. When PLTS is installed the service is automatically installed and started. When using HP or Agilent GPIB cards everything works fine and nothing needs to be done. A defect in the VISA library can cause potential problems when using National Instruments GPIB cards. It is recommended that the “Logon as” for the service be changed from the default “Local System account” to a valid user on the network. Any user with administrator privileges will work. There are no registry entries for “Local System account”. Normal users have registry entries. To change to a valid network user, follow the instructions below. This only needs to be done once after PLTS is installed.

Check that the PLTS Connection Manager Service is configured correctly and running by doing the following:

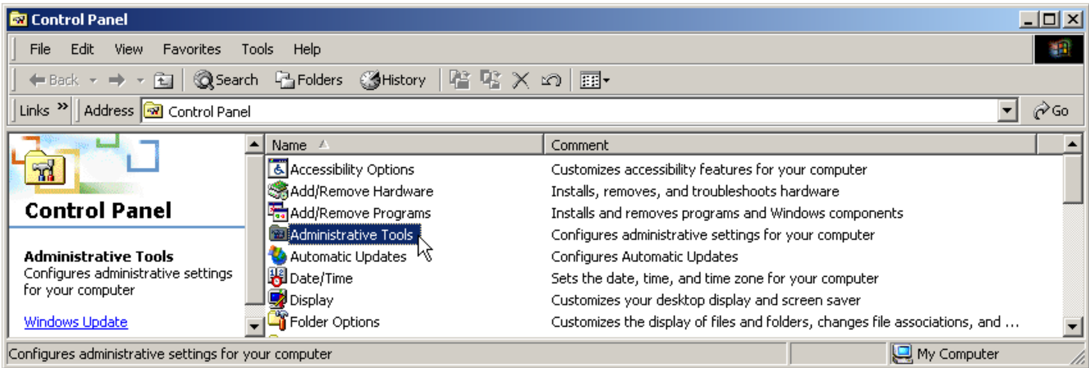
1. Click the **Start** button then click **Settings**, **Control Panel**. See Figure 7-25.

Figure 7-25 Control Panel Menu Selection



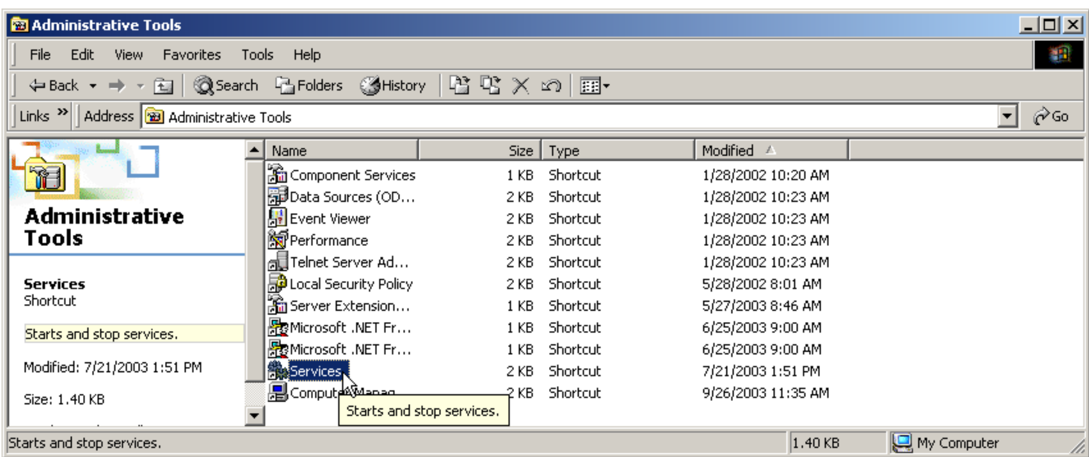
2. Double-click **Administrative Tools** in the *Control Panel*. See Figure 7-26.

Figure 7-26 Administrative Tools Menu Selection in Control Panel



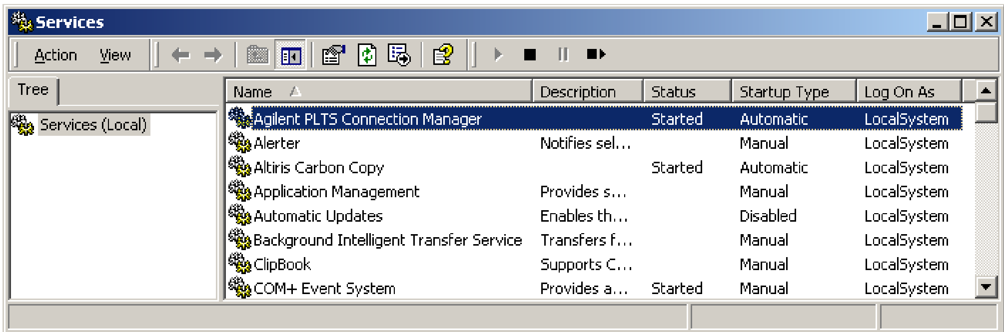
3. Double-click **Services** in the *Administrative Tools* dialog box. See Figure 7-27.

Figure 7-27 Services Menu Selection in Services Dialog Box



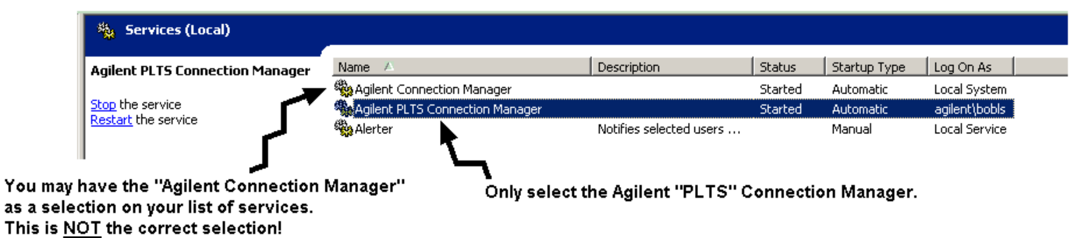
4. In the *Services* dialog box, double-click **Agilent PLTS Connection Manager** to display its properties. See Figure 7-28.

Figure 7-28Agilent PLTS Connection Manager Selection - Services Dialog Box



CAUTION If you have an **Agilent Connection Manager** selection as shown in Figure 7-29, do *not* change that service because it is not used by PLTS.

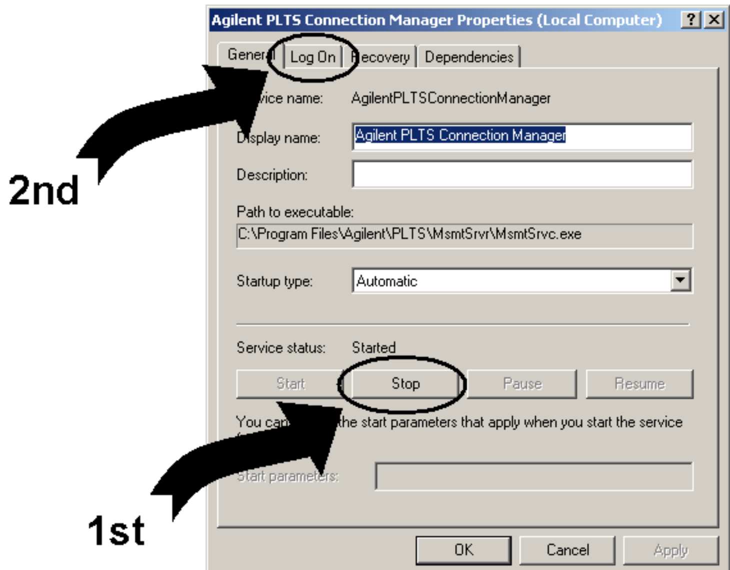
Figure 7-29Beware of Similar Connection Manager Selections



Agilent Connection Manager is used with other applications.

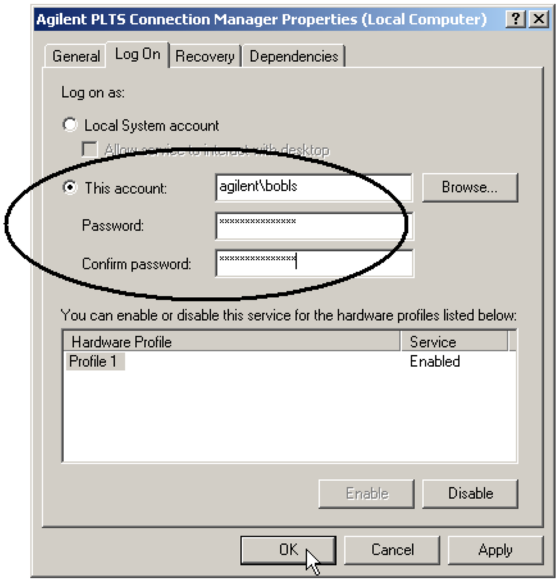
5. First, click the **Stop** button to stop the running service and then select the **Log On** tab. See Figure 7-30.

Figure 7-30 Agilent PLTS Connection Manager Properties - General Tab



6. Change the "Logon As" to a valid user on the network by selecting **This account** choice and then entering a valid user name (including the domain name followed by a backslash) and password as shown in Figure 7-31.

Figure 7-31 Agilent PLTS Connection Manager Properties - Log On Tab



7. Then click the **OK** button.

8. When the warning dialog box that is displayed, click the **OK** button.

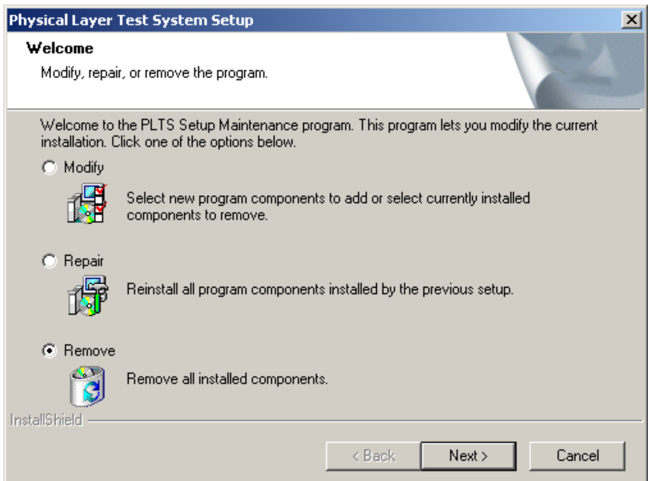
9. Select the **General** tab and then click **Start** button to restart the service.

10. Click the **OK** button to close the *Agilent PLTS Connection Manager Properties* dialog box for the service.

Upgrading from PLTS 1.102

If version 1.102 of PLTS is loaded on the computer, it must be removed ***before*** installing PLTS v2.*x*. This can be done by starting the PLTS installation process using the PLTS v1.102 disk and selecting the **Remove** option as shown in Figure 7-32:

Figure 7-32 PLTS Installation Wizard - Remove Selection



CAUTION Any previously loaded PLTS versions must be removed before PLTS v2.*x* will load properly.

Be sure to reboot the computer after removing PLTS.

Start the PLTS v2.*x* installation process again. This time PLTS v2.*x* will load correctly.

Missing Microsoft Component

When installing PLTS, if the following error is displayed, comctl32.ocx has to be installed and registered.

'Component 'comctl32' or one of its dependencies not correctly registered: a file is missing or invalid'

PLTS Hardware Troubleshooting

Use Table 7-2 to help troubleshoot your Physical Layer Test System VNA-based hardware.

Table 7-2 Troubleshooting the PLTS VNA-Based Hardware

Symptom	Cause	Cure
One or more biases not applied.	Bias fuse blown.	Check bias fuses. Replace blow fuse with fuse of the same type and rating. Refer to the test set rear-panel information in Chapter 6.
Control computer can't communicate with the test set.	Accidental change to GPIB switch settings.	Set the GPIB address as needed. Restart the test system. See "Step 7. Set Up the General Purpose Interface Bus (GPIB)" on page 29.
The test set does not come on the first time you use it.	Line fuse not installed, or incorrect line fuse installed.	Install the line fuse. Refer to "Replacing the Test Set Line Fuse" on page 219.
Excessive ripple in data.	Load termination damaged by excessive RF power.	Contact Agilent Technologies. See "Contacting Agilent" on page 237 for more information.
	Loose connections between VNA and test set and/or between test set and DUT.	Check and torque the connectors.
	Poor test cable repeatability.	Replace test cables as needed. You can replace a single cable, without replacing the entire set.
High loss on one path with poor raw data match (as seen during analyzer sweep) or inability to make a good calibration.	Possible signal channel damage.	Contact Agilent Technologies. See "Contacting Agilent" on page 237 for more information.

Troubleshooting PLTS Using a Tektronix CSA8000 or TDS8000

PLTS is designed to use the following Tektronix equipment.

- Tektronix CSA8000 Communications Signal Analyzer equipped with one or two 80E04 Dual Channel, 20 GHz TDR Sampling Modules using Firmware Revision 1.3.3 or greater
- Tektronix TDS8000 Digital Sampling Oscilloscope equipped with one or two 80E04 Dual Channel, 20 GHz TDR Sampling Modules using Firmware Revision 1.3.3 or greater

If you are having problems getting PLTS to work with this equipment, the following is a basic troubleshooting procedure that should help you isolate the problem.

1. First, this procedure instructs you how to make sure the Tektronix equipment has basic operational functions.
2. Then, this procedure instructs you how to make sure your PC has basic communication functions with the Tektronix equipment.
3. Finally, this procedure instructs you how to make sure PLTS is communicating with the Tektronix equipment.

Verifying the Tektronix System is Operational

The first step is verifying that the Tektronix instrument is operational. The first part of this step is to check that the instrument's stimulus and receiver for each channel is operating. Then, the next part of this step is performing the compensation utility on the instrument and verifying the main frame and both channels of each 80E04 TDR sampling module pass.

Check each Channel's Stimulus and Receivers are Operational

Perform this procedure with nothing (no cables, connectors, or standards) connected to the TDR sampling module channel connectors.

1. Using the mouse, from the **Setup** menu, click **Display** for the *Disp* tab on the *Setups* window. With **Normal** selected, click the **Show Vectors** check box.
2. Select the **TDR** tab on the *Setups* window.
3. On **TDR** tab, for **C1**:
   a. In the **TDR Step** area:
      - Click the **On** check box
      - Make sure the waveform is positive going 

   b. In the **ACQ** area:
      - Click the **On** check box

- Set the **Units** to volts (**V**)

c. In the **Preset** area:

- Click the **C1** button

4. On the TDR sampling module, verify that the red **TDR** LED and the yellow **SELECT ON/OFF** LED for channel 1 (CH 1) is lit.
5. Verify that the display shows Channel 1 with an initial step 250 mV and a subsequent step of 250 mV because of the open circuit response.
6. Repeat for steps 3, 4, and 5 for each of the other channels to verify that each channel is operational.
7. If the instrument does not match these results, contact your Tektronix representative.

Perform the Compensation

Perform this procedure to verify that the instrument is operating with the instrument's Compensation utility. The firmware will only allow you to start this utility after the instrument is sufficiently warmed. Typically, the longer the instrument has been powered on; the stability of the instrument is increased and results in better performance.

1. Under **Utilities** menu, select **Compensation**...
2. Make sure that **Compensate** in the **Select Action** area is selected. Then, select **All** from the list below. Choose **Execute** button to start the compensation utility on the mainframe and of all the TDR sampling module channels.
3. When the Compensation utility has finished (after approximately five minutes), make sure that the mainframe and each of the four module channels has passed.
4. Save the compensation data by selecting **Save** in the **Select Action** area and then choosing the **Execute** button.
5. Click the **Close** button to exit the Compensation utility.
6. If the Compensation utility fails, contact your Tektronix representative.

Verifying the GPIB Communication between the PC and the Tektronix System

The next step is verifying that the PC and the Tektronix instrument have two-way communication over the GPIB. To check the GPIB communication:

1. Check the GPIB address of the Tektronix instrument:

   a. Select **User Preferences** on the **Utilities** menu.

   b. Select the **GPIB Configuration** tab on the *User Preferences* window.

c. Locate the address in the **GPIB Address** box.

d. Make sure that **GPIB Talk/Listen** is selected in the **GPIB Mode** area.

2. Click the **Start** button in the lower left corner of the PC. Then select **Programs**, **Agilent IO Libraries**, then **VISA Assistant** to open the *Visa Assistant* dialog box.

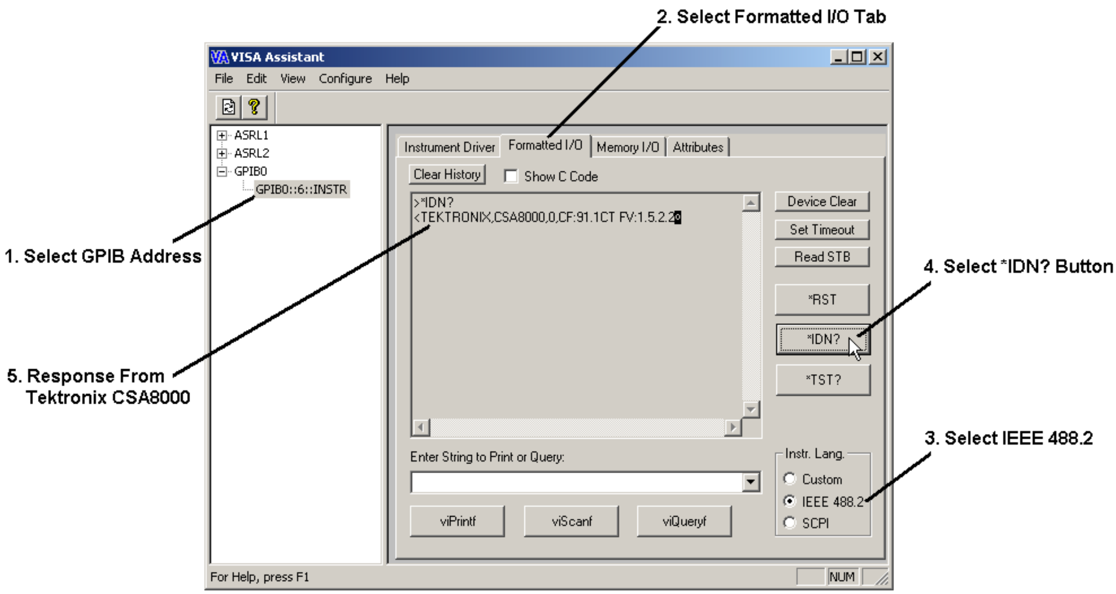
3. In *Visa Assistant* dialog box, make sure the Tektronix instrument's GPIB address found in step 1 is listed the window. See Figure 7-33.

Figure 7-33 Instrument GPIB Address Displayed in VISA Assistant

4. Verify the PC and the Tektronix instrument have two-way communication over the GPIB:

a. Select the GPIB address listed in step 3, and then select the **Formatted I/O** tab. See Figure 7-34.

Figure 7-34 Tektronix CSA8000 Response to *IDN? Button



b. Select **IEEE 488.2** in the **Inst. Lang.** area.

c. Click the ***IDN?** button.

The PC queries the instrument at the address requesting instrument information. The Tektronix instrument should reply with a response that lists the manufacturer, the model number, and some additional information that includes the firmware version (FV).

If this response is received, two-way communication over the GPIB between the PC and the instrument is occurring.

5. If communication is not occurring, investigate your GPIB for problems.

Verifying PLTS is Operating with the Tektronix System

The first step is verifying that PLTS recognizes the Tektronix instrument. The next part is performing a basic PLTS calibration and measurement with the Tektronix instrument.

Verify PLTS Recognizes the Tektronix Instrument

Start PLTS to ensure that PLTS finds and identifies the Tektronix instrument. This section does not go into detail with each PLTS step. Locate specific PLTS information in the PLTS User’s Guide.

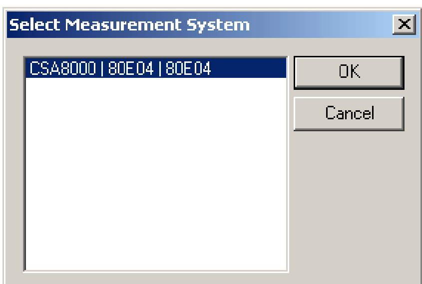
1. Start the PLTS software. PLTS scans for possible PLTS hardware on the GPIB.

    - If the Tektronix instrument is found and displayed in the *Select Measurement System* dialog box (Figure 7-35) upon PLTS startup, skip the remaining steps and continue with "Verify the Tektronix Instrument Makes a PLTS Measurement".
    - If the Tektronix instrument is not found and displayed in the *Select Measurement System* dialog box upon PLTS startup:

        a. From the PLTS **Tools** menu, select **Acquisition Hardware**, and then choose **Choose Data Acquisition Device**... to display the *Select Measurement System* dialog box manually.

        b. If the Tektronix instrument is found and displayed in the *Select Measurement System* dialog box, skip the remaining steps and continue with "Verify the Tektronix Instrument Makes a PLTS Measurement".

Figure 7-35 Select Measurement System Dialog Box



2. If the Tektronix instrument is not displayed in step 1:

    a. From the PLTS **Tools** menu, select **Acquisition Hardware**, and then choose **Scan for New Hardware** to force PLTS to rescan for PLTS hardware on the GPIB.

    b. After the scan is complete, from the PLTS **Tools** menu, select **Acquisition Hardware**, and then choose **Choose Data Acquisition Device**... to display the *Select Measurement System* dialog box manually.

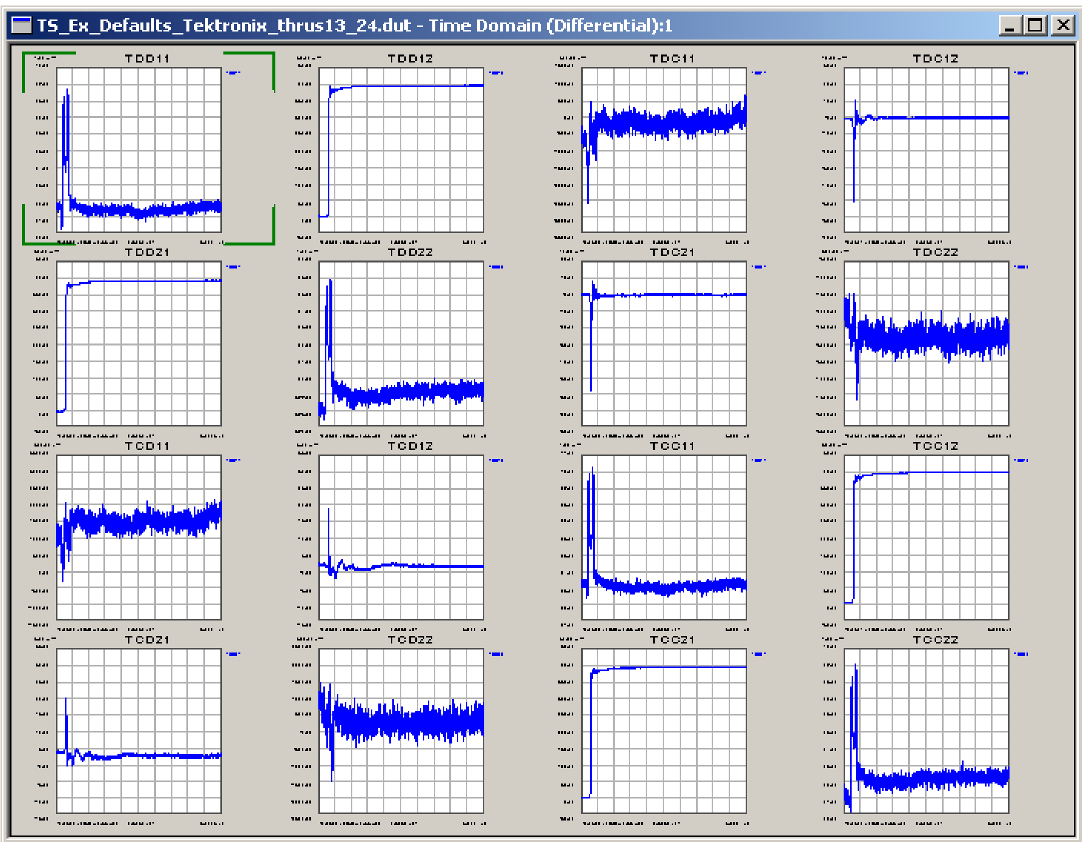
    c. Check for the Tektronix instrument in the *Select Measurement System* dialog box. If it is found, continue with "Verify the Tektronix Instrument Makes a PLTS Measurement". If it is not found, contact Agilent for assistance.

Verify the Tektronix Instrument Makes a PLTS Measurement

After PLTS has found and identified the Tektronix instrument, make a basic measurement using the following instructions. This section does not go into detail with each PLTS step. Locate specific PLTS information in the PLTS User's Guide.

1. Select the Tektronix instrument in the *Select Measurement System* dialog box.
2. Start the PLTS measurement process. Use the default parameters for the **TDR Setup** and **Calibration and Measurement Parameters** wizard windows. Use the **Generic 3.5mm** calibration kit for the calibration.
3. For the measurement, connect a thru device between channel 1 and channel 3 and another thru device between channel 2 and channel 4.
4. Compare the Time Domain Differential results with the measurement plots shown in Figure 7-36. Each measurement plot has been autoscaled.

Figure 7-36 PLTS-Tektronix Measurement Example Plots



5. If your measurement results are similar to the measurement results shown above, your Tektronix instrument operates with the PLTS software. If it is not found, contact Agilent for assistance.

Maintenance

This section provides basic maintenance information such as cleaning, fuse replacement, cable care, and connector care.

Cleaning

Clean the cabinet, using a dry or damp cloth only.

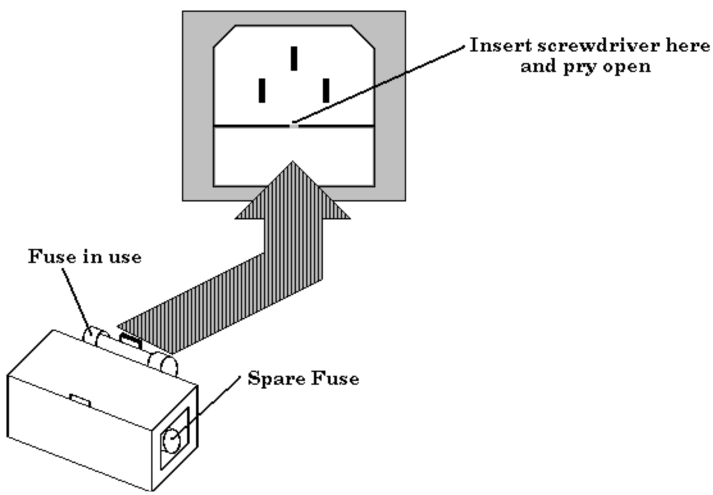
WARNING **To prevent electrical shock, disconnect the Agilent Technologies (N4415A, N4416A, N4417A, N4418A, N4419A/B, N4420B, and N4421A/B) S-parameter test set from mains before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.**

Replacing the Test Set Line Fuse

To replace the line fuse, disconnect the power cord from the rear of the test set, use a small screwdriver to pry open the line fuse holder and slide it open until it reaches its stop. Replace the fuse in use with the spare fuse and slide the fuse holder back into the instrument.

WARNING **For continued protection against fire hazard replace the test set line fuse only with same type and rating (115V and 230V operation: T2.5A 250V). The use of other fuses or material is prohibited.**

Figure 7-37 Line Fuse Replacement



Care of Test Cable Assemblies

Proper use and care of your test cable assemblies will yield positive results including:

- longer life
- higher performance
- better repeatability

Performing the routine inspection and cleaning of the test cable assemblies, especially the connectors, is very important to making the best possible measurements.

Connector Mating

Alignment of the center lines of the connectors of the test cables with the test set and DUT connectors before mating is important. It is possible to start the threads on the connector nuts without good alignment, but this will result in bent pins and damaged inserts. Resistance encountered while turning the connector nut may be due to one of the following:

- The pins are not aligned.
- The coupling nut is cross-threaded.
- The connector (or its mate) has been damaged by excessive torque.

Stop and determine the reason. To proceed without doing so risks the destruction of the assembly and the mating connector.

Holding a connector nut stationary while screwing the socket into the connector will wear away the connector plating and score the connector parts. If the pins lock up, serious damage can be caused.

Connector Torque

Make sure to grasp the body of the connector before applying final torque. If the connector body is allowed to rotate with the nut, the connector plating, outer interface rim, or pin assembly may be damaged. Excess torque applied to the connector will be transferred to the cable assembly. Refer to "Care of RF and Microwave Coaxial Connectors" on page 222 for more information.

Depending on the connector, over-torque can cause damage to connectors in a variety of ways:

- mushroomed outer interface shells
- mushroomed pin shoulders
- recessed or protruding pins
- recessed or protruding dielectrics
- bent pins
- chipped plating
- coupling nut retaining ring damage
- damage to coupling threads

Cable Handling

The test cables have a 1 inch minimum bend radius. Exceeding this radius can result in poor measurements and poor repeatability. Be alert to tight bends where they are not necessarily obvious — like at the end of connector strain relief tubing.

Swept 90° adapters may be used (typically, at the test set front panel) to minimize cable bending. However, if the adapters are used, they must be in place during the calibration.

Cables are often stored in a coiled configuration. Coiled cable “set” (the tendency to stay coiled) can occur if the cables are left coiled. Use large coil diameters (one or two feet) to minimize cable set. Unroll coiled cables prior to use – never just pull out the loops.

Avoid pinching, crushing, or dropping objects on cable assemblies. Dragging a cable over a sharp edge will tend to flatten one side, and it is highly likely that the minimum bend radius will be exceeded.

Care of RF and Microwave Coaxial Connectors

Proper connector care is critical for accurate and repeatable measurements. The following information will help you preserve the precision and extend the life of your connectors - saving both time and money. Prior to making connections to your test system, review the connector care information within this section.

This section is made up of three main subjects:

- **Connector Care Reference**
  which contains information about:
  - ❏ Safety Reminders
  - ❏ Connector Cleaning Supplies
  - ❏ Connector Care Quick Reference
- **Connector Care Concepts**
  which contains information about:
  - ❏ Connector Service Life
  - ❏ Connector Grades and Performance
  - ❏ Adapters as Connector Savers
  - ❏ Connector Mating Plane Surfaces
  - ❏ Gaging Fundamentals
  - ❏ Handling and Storing Connectors
- **Connector Care Procedures**
  which contains information about:
  - ❏ Inspecting Connectors
  - ❏ Cleaning Connectors
  - ❏ Making Connections
  - ❏ Separating Connections
  - ❏ Gaging Connectors
  - ❏ Using a Torque Wrench

Connector Care Reference

This section includes the following information:

- Safety Reminders
- Connector Cleaning Supplies
- Connector Care Quick Reference

Safety Reminders When cleaning connectors:

- Always use protective eyewear when using compressed air or nitrogen.
- Keep isopropyl alcohol away from heat, sparks and flame. Use with adequate ventilation. Avoid contact with eyes, skin and clothing.
- Avoid electrostatic discharge (ESD). Wear a grounded wrist strap (having a 1 MΩ series resistor) when cleaning device, cable or test port connectors.

Connector Cleaning Supplies Products commonly used to clean connectors are listed below. To order these and other connector care products, contact Agilent Technologies.

Table 7-3 Connector Cleaning Supplies

Cleaning Supplies Description	Agilent Part Number
Lint-Free Swabs, small 100 ct.	9301-1243
IPA 99.5% alcohol, 30 ml bottle	8500-5344
Compressed Air, 235 ml can	8500-6659

Connector Care Quick Reference Use the following table as a quick guide for connector care:

Table 7-4 Connector Care Quick Reference

Handling and Storage			
Do	Keep connectors clean Extend sleeve or connector nut Use plastic end-caps during storage	**Do Not**	Touch mating-plane surfaces Set connectors contact-end down
Visual Inspection			
Do	Inspect all connectors carefully Look for metal particles, scratches, and dents	**Do Not**	Use a damaged connector - ever
Connector Cleaning			
Do	Try compressed air first Use isopropyl alcohol Clean connector threads	**Do Not**	Use any abrasives Get liquid into plastic support beads
Gaging Connectors			
Do	Clean and zero the gage before use Use the correct gage type Use correct end of calibration block Gage all connectors before first use	**Do Not**	Use an out-of-spec connector
Making Connections			
Do	Align connectors carefully Make preliminary connection lightly Turn only the connector nut Use a torque wrench for final connect	**Do Not**	Apply bending force to connection Over tighten preliminary connection Twist or screw any connection Tighten past torque wrench “break” point

Connector Care Concepts

This section includes the following concepts:

- Connector Service Life
- Connector Grades and Performance
- Adapters as Connector Savers
- Connector Mating Plane Surfaces
- Gaging Fundamentals
- Handling and Storing Connectors

Connector Service Life Even though calibration standards, cables, and test set connectors are designed and manufactured to the highest standards, all connectors have a limited service life. This means that connectors can become defective due to wear during normal use. For best results, all connectors should be inspected and maintained to maximize their service life.

Visual Inspection should be performed each time a connection is made. Metal particles from connector threads often find their way onto the mating surface when a connection is made or disconnected. See Inspection procedure.

Cleaning the dirt and contamination from the connector mating plane surfaces and threads can extend the service life of the connector and improve the quality of your calibration and measurements. See Cleaning procedure.

Gaging connectors not only provides assurance of proper mechanical tolerances, and thus connector performance, but also indicate situations where the potential for damage to another connector may exist. See “Gaging Fundamentals” on page 228.

Proper connector care and connection techniques yield:

- Longer Service Life
- Higher Performance
- Better Repeatability

Connector Grades and Performance The three connector grades (levels of quality) for the popular connector families are listed below. Some specialized types may not have all three grades.

- **Production grade** connectors are the lowest grade and the least expensive. It is the connector grade most commonly used on the typical device under test (DUT). It has the lowest performance of all connectors due to its loose tolerances. This means that production grade connectors should always be carefully inspected before making a connection to the analyzer. Some production grade connectors are not intended to mate with metrology grade connectors.
- **Instrument grade** is the middle grade of connectors. It is mainly used in and with test instruments, most cables and adapters, and some calibration standards. It provides long life with good performance and tighter tolerances. It may have a dielectric supported interface and therefore may not exhibit the excellent match of a metrology grade connector.
- **Metrology grade** connectors have the highest performance and the highest cost of all connector grades. This grade is used on calibration standards, verification standards, and precision adapters. Because it is a high precision connector, it can withstand many connections and disconnections and, thus, has the longest life of all connector grades. This connector grade has the closest material and geometric specifications. Pin diameter and pin depth are very closely specified. Metrology grade uses an air dielectric interface and a slotless female contact which provide the highest performance and traceability.

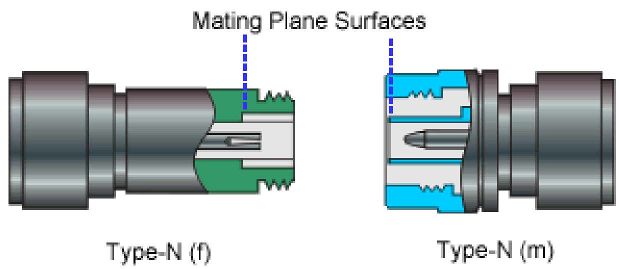
NOTE In general, Metrology grade connectors should not be mated with Production grade connectors.

Adapters as Connector Savers Make sure to use a high quality (Instrument grade or better) adapter when adapting a different connector type to the analyzer test ports. It is a good idea to use an adapter even when the device under test is the same connector type as the analyzer test ports. In both cases, it will help extend service life, and protect the test ports from damage and costly repair.

The adapter must be fully inspected before connecting it to the analyzer test port and inspected and cleaned frequently thereafter. Because calibration standards are connected to the adapter, the adapter should be the highest quality to provide acceptable RF performance and minimize the effects of mismatch.

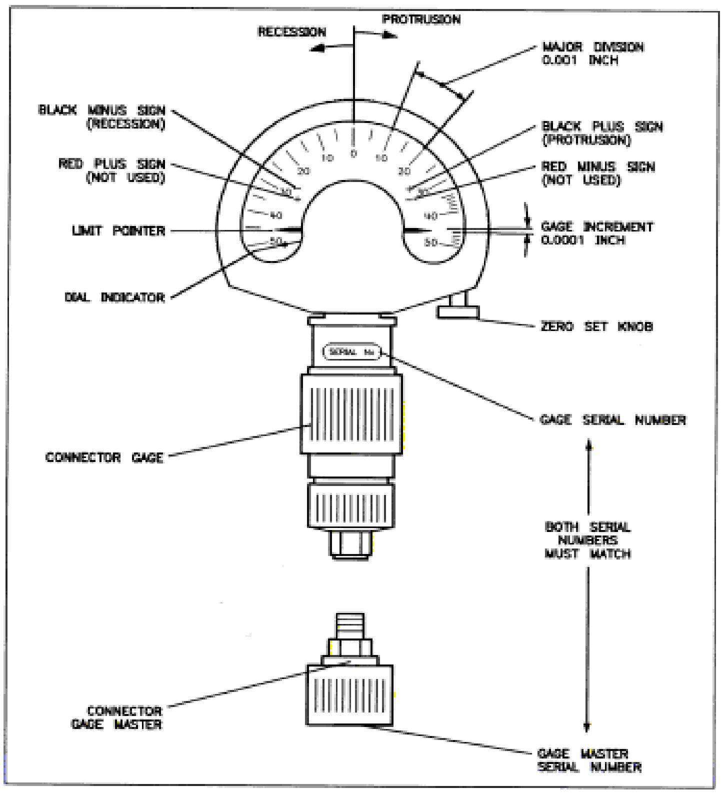
Connector Mating Plane Surfaces An important concept in RF and microwave measurements is the reference plane. For a network analyzer, this is the surface or point that measurements are referenced to at calibration. In connectors, the reference plane is defined as the plane where the mating plane surfaces meet. Good connections require perfectly flat contact between connectors at all points on the mating plane surfaces (see Figure 7-38).

Figure 7-38 Connector Mating Surfaces (Reference Plane)



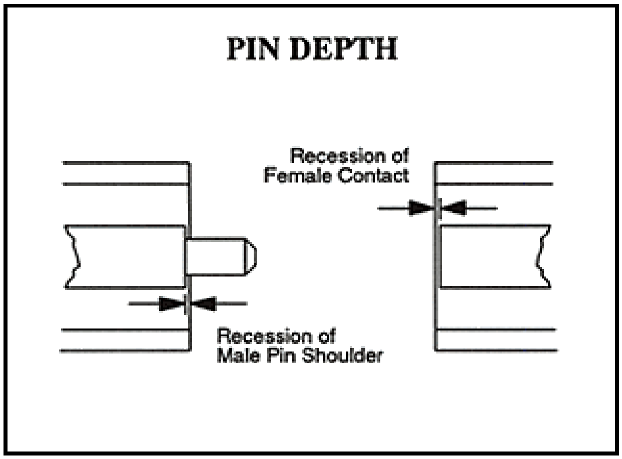
Gaging Fundamentals Connector gages are important tools used to measure center conductor pin depth in connectors. See Figure 7-39. Connector pin depth is generally the distance between the mating plane of the outer conductor and the end of the center conductor, or the shoulder of the center conductor for a stepped male pin.

Figure 7-39 Typical Connector Gage



Recession and Protrusion Pin depth is negative (recession) if the center conductor is recessed below the outer conductor mating plane, usually referred to as the “reference plane”. Pin depth is positive (protrusion) if the center conductor projects forward from the connector reference plane. See Figure 7-40.

Figure 7-40 Connector Pin Depth



1. Recession of female contact
2. Recession of male pin shoulder

Some connectors, like Type-N connectors, have the mating plane of the center conductors offset from the connector reference plane. In this case the zero setting “gage masters” generally offset the nominal distance between the center conductor mating plane and the connector reference plane.

When to Gage Connectors Connectors should be gaged at each of the following events:

- Before using a connector or adapter the first time.
- When visual inspection or electrical performance suggests the connector interface may be out of range.
- After every 100 connections, depending on use.

Connector Gage Accuracy Connector gages (those included with calibration and verification kits), are capable of performing coarse measurements only. This is due to the repeatability uncertainties associated with the measurement. It is important to recognize that test port connectors and calibration standards have mechanical specifications that are extremely precise. Only special gaging processes and electrical testing (performed in a calibration lab) can accurately verify the mechanical characteristics of these devices. The pin depth specifications in the Agilent calibration kit manuals provide a compromise between the pin depth accuracy required, and the accuracy of the gages. The gages shipped with calibration and verification kits allow you to measure connector pin depth and avoid damage from out-of-specification connectors.

NOTE Before gaging any connector, the mechanical specifications provided with that connector or device should be checked.

Handling and Storing Connectors Use the following precautions when handling or storing connectors.

- Install protective end caps when connectors are not in use.
- Never store connectors, airlines, or calibration standards loose in a box. This is a common cause of connector damage.
- Keep connector temperature the same as analyzer. Holding the connector in your hand or cleaning connector with compressed air can significantly change the temperature. Wait for connector temperature to stabilize before using in calibration or measurements.
- Do not touch mating plane surfaces. Natural skin oils and microscopic particles of dirt are difficult to remove from these surfaces.
- Wear a grounded wrist strap and work on a grounded, conductive table mat. This helps protect the analyzer and devices from electrostatic discharge (ESD).
- Wear a grounded wrist strap and work on a grounded, conductive table mat. This helps protect the analyzer and devices from electrostatic discharge (ESD).

Connector Care Procedures

This section includes the following procedures:

- Inspecting Connectors
- Cleaning Connectors
- Making Connections
- Separating Connections
- Gaging Connectors
- Using a Torque Wrench

Inspecting Connectors Use the following procedures when inspecting connectors.

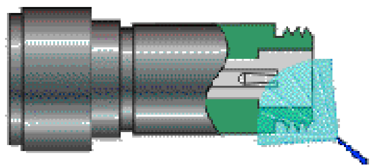
1. Wear a grounded wrist strap (having a 1 MΩ series resistor) when cleaning device, cable or test port connectors.
2. Use a magnifying glass (>10×) and inspect the connector for the following conditions:
    - Badly worn plating or deep scratches
    - Deformed threads
    - Metal particles on threads and mating plane surfaces
    - Bent, broken, or misaligned center conductors
    - Poor connector nut rotation

CAUTION A damaged or out-of-specification device can destroy a good connector attached to it even on the first connection. Any connector with an obvious defect should be marked for disposal or sent out for repair.

Cleaning Connectors Use the following procedures when cleaning connectors.

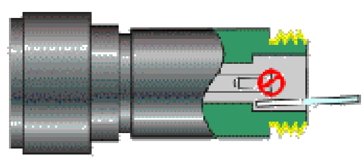
1. Wear a grounded wrist strap (having a 1 MΩ series resistor) when cleaning device, cable or test port connectors.
2. Use clean, low-pressure air to remove loose particles from mating plane surfaces and threads (see Figure 7-41). Inspect connector thoroughly. If additional cleaning is required, continue with the following steps.

Figure 7-41 Removing Loose Particles using Clean, Low Pressure Air



3. Moisten-do not saturate-a lint-free swab with isopropyl alcohol. See Cleaning Supplies for recommended type.
4. Clean contamination and debris from mating plane surfaces and threads. When cleaning interior surfaces, avoid exerting pressure on center conductor and keep swab fibers from getting trapped in the female center conductor. See Figure 7-42.

Figure 7-42 Cleaning Surfaces using a Lint-Free Swab



5. Let alcohol evaporate-then use compressed air to blow surfaces clean.
6. Inspect connector. Make sure no particles or residue remains.
7. If defects are still visible after cleaning, the connector itself may be damaged and should not be used. Determine the cause of damage before making further connections.

Gaging Connectors Use the following procedures when gaging connectors.

1. Wear a grounded wrist strap (having a 1 MΩ series resistor) when cleaning device, cable or test port connectors.
2. Select proper gage for device under test (DUT).
3. Inspect and clean gage, gage master, and DUT.
4. Zero the connector gage.
   a. While holding gage by the barrel, carefully connect gage master to gage. Finger-tighten connector nut only.
   b. Use proper torque wrench to make final connection. If needed, use additional wrench to prevent gage master (body) from turning.
   c. The gage pointer should line up exactly with the zero mark on gage. If not, adjust “zero set” knob until gage pointer reads zero. On gages having a dial lock screw and a movable dial, loosen the dial lock screw and move the dial until the gage pointer reads zero. Gages should be zeroed before each set of measurements to make sure zero setting has not changed.
   d. Remove gage master.
5. Gage the DUT.
   a. While holding gage by the barrel, carefully connect DUT to gage. Finger-tighten connector nut only.
   b. Use proper torque wrench to make final connection and, if needed, use additional wrench to prevent DUT (body) from turning.
   c. Read gage indicator dial for recession or protrusion and compare reading with device specifications.

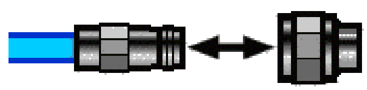
CAUTION If the gage indicates excessive protrusion or recession, the connector should be marked for disposal or sent out for repair.

6. For maximum accuracy, measure the device a minimum of three times and take an average of the readings. After each measurement, rotate the gage a quarter-turn to reduce measurement variations.
7. If there is doubt about measurement accuracy, be sure the temperatures of the parts have stabilized. Then perform the cleaning, zeroing, and measuring procedure again.

Making Connections Use the following procedures when making connections.

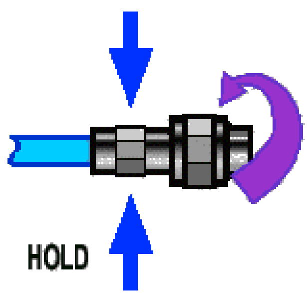
1. Wear a grounded wrist strap (having a 1 MΩ series resistor) when cleaning device, cable or test port connectors.
2. Inspect, clean, and gage connectors. All connectors must be undamaged, clean, and within mechanical specification.
3. Carefully align center axis of both devices. The center conductor pin-from the male connector-must slip concentrically into the contact finger of the female connector. See Figure 7-43.

Figure 7-43 Aligning the Center Axis of Both Connectors



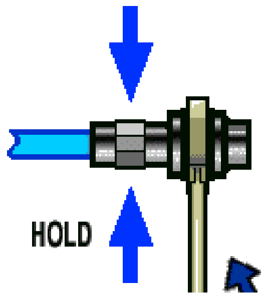
4. Carefully push the connectors straight together so they can engage smoothly. Rotate the connector nut (not the device itself) until finger-tight, being careful not to cross the threads. See Figure 7-44.

Figure 7-44 Pushing the Connectors Together and Rotating the Nut



5. Use a torque wrench to make final connection. Tighten until the “break” point of the torque wrench is reached. Do not push beyond initial break point. Use additional wrench, if needed, to prevent device body from turning. See Figure 7-45.

Figure 7-45 Using a Torque Wrench to Make the Final Connection



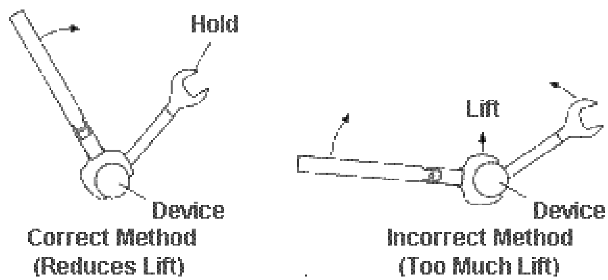
Separating Connections Use the following procedures when separating connections.

1. Support the devices to avoid any twisting, rocking or bending force on either connector.
2. Use an open-end wrench to prevent the device body from turning.
3. Use another open-end wrench to loosen the connector nut.
4. Complete the disconnection by hand, turning only the connector nut.
5. Pull the connectors straight apart.

Using a Torque Wrench Use the following procedures when using a torque wrench.

1. Make sure torque wrench is set to the correct torque setting.
2. Position torque wrench and a second wrench (to hold device or cable) within 90° of each other before applying force. Make sure to support the devices to avoid putting stress on the connectors. See Figure 7-46.

Figure 7-46 Positioning the Wrenches



3. Hold torque wrench lightly at the end of handle-then apply force perpendicular to the torque wrench handle. Tighten until the "break" point of the torque wrench is reached. Do not push beyond initial break point. See Figure 7-47.

Figure 7-47 Torquing with the Torque Wrench

Contacting Agilent

You may use the following table to contact Agilent Technologies for assistance with any Agilent product.

Table 7-5 Contacting Agilent

`Online assistance: www.agilent.com/find/assist`

United States *(tel)* 1 800 452 4844	**Latin America** *(tel)* (305) 269 7500 *(fax)* (305) 269 7599
New Zealand *(tel)* 0 800 738 378 *(fax)* (+64) 4 495 8950	**Japan** *(tel)* (+81) 426 56 7832 *(fax)* (+81) 426 56 7840
Malaysia *(tel)* 1 800 828 848 *(fax)* 1 800 801 664	**India** *(tel)* 1-600-11-2929 *(fax)* 000-800-650-1101
Taiwan *(tel)* 0800-047-866 *(fax)* (886) 2 25456723	**Hong Kong** *(tel)* 800 930 871 *(fax)* (852) 2506 9233
Canada *(tel)* 1 877 894 4414 *(fax)* (905) 282-6495	**Europe** *(tel)* (+31) 20 547 2323 *(fax)* (+31) 20 547 2390
Australia *(tel)* 1 800 629 485 *(fax)* (+61) 3 9210 5947	**Singapore** *(tel)* 1 800 375 8100 *(fax)* (65) 836 0252
Thailand *(tel) outside Bangkok:* (088) 226 008 *(tel) within Bangkok:* (662) 661 3999 *(fax)* (66) 1 661 3714	**People's Republic of China** *(tel) (preferred):* 800-810-0189 *(tel) (alternate):* 10800-650-0021 *(fax)* 10800-650-0121
Philippines *(tel)* (632) 8426802 *(tel) (PLDT subscriber only):* 1 800 16510170	 *(fax)* (632) 8426809 *(fax) (PLDT subscriber only):* 1 800 16510288

Make sure have the following information readily available when you call:

- the serial number of the test set
- a list of any options or accessories installed in or in use with the test set
- the type of GPIB board in your computer
- any information you can supply about the DUT
- the nature of the problem
- the version number of software

Shipment for Service

If you are sending the instrument to Agilent Technologies for service, ship the test set to the nearest service center for repair, including a description of any failed test and any error message. Ship the instrument using the original or comparable antistatic packaging materials.

Refer to "Contacting Agilent" on page 237 for additional information.

8 Safety and Regulatory Information

Safety Information

Review to the safety information in this section before operating your physical layer test system.

Safety Symbols

The following safety symbols are used throughout this manual. Familiarize yourself with each of the symbols and its meaning before operating the physical layer test system.

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

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.**

Instrument Markings

Familiarize yourself with each of the markings and its meaning before operating the physical layer test system.

	The ON symbol. The ON symbol is used to mark the positions of the instrument line switch.
	The OFF symbol. The OFF symbol is used to mark the positions of the instrument line switch.
	The ON symbol. The ON symbol is used to mark the positions of the instrument line switch.
	The OFF symbol. The OFF symbol is used to mark the positions of the instrument line switch.
	The AC symbol. The AC symbol is used to indicate the required nature of the line module input power.
	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.
	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 Canadian Standards Association.
ISM1-A	This is a symbol of an Industrial Scientific and Medical Group 1 Class A product.
ICES / NMB-001	This is a marking to indicate product compliance with the Canadian Interference-Causing Equipment Standard (ICES-001).
N10149	The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency.

Safety Considerations

Familiarize yourself with each of the safety considerations before operating the physical layer test system.

NOTE Positioning the Test System for Use

When setting up the physical layer test system for use, position the equipment so that the front panel power switch is easy to reach.

NOTE This instrument has been designed and tested in accordance with the standards listed on the Manufacturer's Declaration of Conformity and has been supplied in a safe condition. This instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the instrument in a safe condition.

Safety Earth Ground

WARNING **This is a Safety Class 1 product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited.**

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.

Before Applying Power

CAUTION Install the instrument so that the ON/OFF switch is readily identifiable and is easily reached by the operator. The ON/OFF switch or the detachable power cord is the instrument disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the instrument. Alternately, 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 Before switching on this instrument, make sure that the correct fuse is installed and the supply voltage is in the specified range.

Servicing

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.**

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

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

WARNING **For continued protection against fire hazard replace line fuse only with same type and rating (115V and 230V operation: T2.5A 250V). The use of other fuses or material is prohibited.**

General

WARNING **To prevent electrical shock, disconnect the Agilent Technologies (N4415A, N4416A, N4417A, N4418A, N4419A/B, N4420B, and N4421A/B) S-parameter test set from mains before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.**

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 This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and 664 respectively.

CAUTION VENTILATION REQUIREMENTS: 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 that 800 watts, then forced convection must be used.

Regulatory Information

The Agilent Technologies S-Parameter test system complies with the regulatory requirements listed in this section.

Compliance with Canadian EMC Requirements

This ISM device complies with Canadian ICES-001.

Cet appareil ISM est conforme a la norme NMB du Canada.

Compliance with German Noise Requirements

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

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

Declaration of Conformity

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014

Manufacturer's Name:	Agilent Technologies, Inc.
Manufacturer's Address:	40 Shatttuck Road Andover, MA 01810 USA

Declares that the products

Product Name:	Multiport Test Sets & Calibration Modules
Model Number:	N4413A, N4414A, N4415A, N4416A, N4417A, N4418A, N4419A, N4421A, N4425A, N4430A, N4430B, N4419B, N4420B, N4421B
Product Options:	This declaration covers all options of the above products.

Conform to the following product standards:

EMC: EN 61326:1998

Standard	Limit
EN 55011/A-1999	Group 1, Class A
EN 61000-4-2:1995	4 kV CD, 8 kV AD
EN 61000-4-3:1998+AMD1	3 V/m, 80 - 1000 MHz
EN 61000-4-4:1995	0.5 kV sig., 1 kV power
EN 61000-4-5:1995	0.5 kV L-L, 1 kV L-G
EN 61000-4-6:1996	3 V, 0.15 – 80 MHz
EN 61000-4-11:1994	1 cycle, 100%

Safety: EN 61010-1:1993 +A2:1995

Supplementary Information:
The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carry the CE-marking accordingly.

Andover, MA, USA [0917/03]

Peter Rienzo/Order Fulfillment Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor.

Rev. A

III Appendix

Part III is a collection of supplementary information that you may find useful.

Appendix A, "Glossary"

Defines terms that you may encounter while performing measurements using the physical layer test system.

Appendix B, "Reference Information for Discontinued Physical Layer Test System Hardware"

Provide general information, interconnection diagrams, specifications and characteristics, and front and rear panel information for discontinued PLTS hardware.

A Glossary

– Symbols –	
.SnP	.SnP data format creates component data files that describe frequency dependent linear network parameters for n port components. This format is used to import/export S-parameter data. Also see “Touchstone” on page 276.
γ **(Gamma)**	Gamma is the complex propagation constant. $\gamma = \alpha + j\beta$ where α is the attenuation per length and β is related to the wave velocity.
Γ **(Gamma)**	In network analysis, Γ (Gamma) is the ratio of the reflected voltage signal level to the incident signal voltage level (Γ = Vreflected/Vincident). It is the complex reflection coefficient that consists of magnitude (ρ) and phase (Φ) components.
δ **(delta)**	Skin depth. A measure of the depth of current penetration towards the center of a conductor from the perimeter at a particular frequency.
Tan δ	Loss tangent of a material. This is mostly a measure of the ease at which electric fields penetrate (or propagate through) a material. Typical values in electronic materials are in the 0.001 – 0.025 range.
ε_r	ε_r is the relative permittivity of a material (also referred to as dielectric constant), which is mostly a measure of a material's density. Most insulators used in electronics are in the range of 3 to 10. ε_o is the permittivity of air, which is $8.85e^{-12}$.
μ **(mu)**	μ (mu) is the relative permeability of a material. A measure of how easily a material is magnetized. Most all non-magnetic materials have a value of 1. μ_o is the permeability of a vacuum, which is $4\pi e^{-7}$.
μ**W**	1. Microwave. See “Microwave” on page 264. 2. Microwatts (one-millionth of a watt)
ρ **(rho)**	1. (Material properties) Bulk resistivity of a material (e.g. Cu = $1.7e^{-8}$ ohm-meters). A measure of a materials resistance to current flow. 2. (Network analysis) Magnitude portion of the complex reflection coefficient (Γ). The magnitude of the ratio between the reflected and the incident voltages.

σ (sigma)	1. (Material properties) Bulk conductivity of a material (the inverse of resistivity). 2. (Statistics) Standard deviation, which is the measure of the dispersion or spread of the statistical average of all results for a particular measurement. See “Standard Deviation” on page 273.
τ (tau)	In network analysis, τ (tau) is the magnitude portion of the complex transmission coefficient (T). The magnitude of the ratio between the transmitted and the incident voltages.
T **(Tau)**	T (Tau) is the ratio of the transmitted voltage signal level to the incident signal voltage level (T = Vtransmitted/Vincident). It is the complex transmission coefficient that consists of magnitude (τ) and phase (ø) components.
ø (phi)	In network analysis, ø (phi) is the phase angle portion of the complex transmission coefficient (the ratio between the transmitted and the incident voltages).
Φ (Phi)	In network analysis, Φ (Phi) is the phase angle portion of the complex reflection coefficient (the ratio between the reflected and the incident voltages).
– Numeric –	
2-Level (PAM2)	A 2-level data signal generates 1 bit per symbol.
4-Level (PAM4)	A 4-level data signal generates 2 bits per symbol consuming half the bandwidth of a 2-level signal.
– A –	
Active Device	An active device is a device that requires a source of energy to add gain to a signal or control a circuit. Examples of active device are LEDs, transistors, and integrated circuits.
American Wire Gauge (AWG)	AWG is the standard for determining wire size. The gauge number varies inversely with the diameter of the wire.
Analog	Analog is a method of transmitting information. Analog is characterized by adding data of continuously varying frequency or amplitude to carrier waves. Digital transmissions depend on the varying between two discrete levels. An analog signal responds to changes in light, sound, heat and pressure.

Arbitrary Bitstream (ABS)	Arbitrary Bitstream is a random-like bit stream used to generate eye diagrams. The "number of bits" and the "number of patterns" user inputs is used to create the ABS. The "number of bits" entry identifies the number of unique bit patterns that are available. The "number of patterns" identifies the number of these unique bit patterns that are used to create the eye diagram. Using both of these values, a random number generator selects unique bit patterns until the appropriate number of bit patterns is identified. Each of these unique bit patterns are then used to create the eye diagram, one bit pattern at a time.
Attenuation	Attenuation is a reduction in signal amplitude. The difference between transmitted and received power due to loss through equipment, lines, or other transmission devices; usually expressed in decibels.
Averaging	Averaging is a waveform acquisition mode in which the instrument acquires waveforms from multiple data acquisitions and then averages the waveforms together, point by point. Averaging significantly reduces noise and improves resolution of the displayed waveform. The noise sources can average to zero over time while the underlying waveform is preserved. The effective resolution of the displayed waveform increases as more acquisitions are averaged together. This improves the stability of both the display and waveform measurements.
– B –	
Backplane	A backplane is a circuit board that has sockets and circuitry and serves as an interconnection between other cards (circuit boards) that are plugged into the sockets. Typically refers to a special, heavy-duty printed or discrete wired circuit board. In terms of PCs, this circuit board is synonymous with the motherboard. Typically the backplane is designed for a longer life than the daughter cards and has improved signal integrity. It is often manufactured out of more expensive PCB materials. Backplanes are either active (also called intelligent) or passive. Active backplanes also contain a microprocessor or circuitry that performs computing functions. Passive backplanes have no computing circuitry.
Balanced Device	A balanced device is composed of two nominally identical halves. Practically speaking, the signals on each side of the device can have any relative amplitude and phase relationship, but they can be decomposed into a differential-mode (anti-phase) component, and a common-mode (in-phase) component.

Balanced Measurement System (BMS)	The BMS is the predecessor to the Physical Layer Test System. The BMS acquires 2-, 3-, or 4-port frequency domain test data using a network analyzer and multiport test set and displays the data in either frequency or time domain. ATN Microwave originally developed this product before being acquired by Agilent Technologies.
Balun	A balun (balanced-unbalanced) is an impedance matching device used to connect a balanced line or device with an unbalanced coaxial line or device.
Bandwidth	In analog terms, bandwidth is the difference between the maximum and minimum frequency. It is measured in hertz (Hz). In digital terms, bandwidth is the data transmission capacity of an electronic circuit or system. It is measured in bits (or bytes) per second.
Baud	Baud refers to the number of level transitions through a device in a one second period. One baud is one state-transition or level-transition per second. In the past, baud was the accepted units for data transmission rate. However, bits per second (bps) is replacing baud as a more accepted unit of measure.
Bit	Bit is an abbreviation of the term "Binary Digit". A bit is the smallest unit of computer data. It is a single digit number, either a one or a zero. A collection of bits makes up a group called a "byte" or a "word" which is equivalent to one alphanumeric character.
Bit Pattern	A bit pattern is a series of bits that are convolved with a time domain impulse response of a system to create an eye diagram.
Bits Per Second (bps)	Bits per second (bps) is the unit of measure for the rate or speed of data transfer. Refer to “Data Transfer Rate” on page 256.
Bit Rate	Bit rate is the number of bits that are sent through a circuit per second, calculated as inverse of the bit period (1/bit period). The bit period is a measure of the horizontal opening of an eye diagram at the crossing points of the eye.
Broadband	Broadband is high-speed transmission. Although not a standard, it commonly refers to computer data and telecommunication rates in excess of 1.544 Mbps, the rate of T1 lines. Broadband often refers to Internet access using cable modems and DSL. A broadband network can carry voice, video and data all at the same time.

Bus	A collection of wires in a cable (or copper traces on a circuit board) that serve as a common data path between multiple devices. The bus is used to transmit signals (data, status, and control) between the devices that share the bus. Bus typically refers to a parallel data transmission structure (1 clock, multiple data channels). As designs transition from parallel to serial with data rates in excess of 1 Gbps barrier, the terms "Channel" or "Lane" may become more commonly used than "Bus".
Byte	A byte is a unit of data that is eight bits in length. A byte represents a single character, such as a letter, number, or symbol. "Byte" may be preceded with Kilo (Kilobyte) for 1 thousand bytes, Mega (Megabyte) for 1 million bytes, or Giga (Gigabyte) for 1 billion bytes.
– C –	
C (capacitance)	Capacitance (farads) is a measure of stored electric charge.
Calibration	In network analyzer systems, calibration is the process of removing systematic errors from measurements (also known as accuracy enhancement or error correction). See “SOLT Calibration” on page 272 and “Thru Reflect Line (TRL) Calibration” on page 275.
Calibration Kit	A calibration kit contains hardware and software required to perform error correction on a network analyzer for a specific measurement and/or test set.
Characteristic Impedance (Zo)	Characteristic impedance is the impedance looking into the end of an infinitely long lossless transmission line.
Coaxial Cable (Coax)	Coaxial cable is a cable with the inner solid or stranded wire acting as the primary conductor wire that is surrounded by a solid or braided metallic shield serving as the ground with an insulating medium between the two.

Common Instrumentation Transfer and Interchange File (CITIfile)	CITIfile is an ASCII data format that is useful when exchanging data between different computers and instruments. CITIfile is a data storage convention designed to be independent of the operating system, and therefore may be implemented by any file system that has the ability to transfer ASCII files. A typical CITIfile package is divided into two sections, the header and the data. The header section contains information about the data that will follow. It may also include information about the setup of the instrument that measured the data. The Data is a numeric array of data that is arranged with one data element per line. The data section may contain more than one array of data. Arrays of data start after the BEGIN keyword, and the END keyword follows the last data element in an array.
Common Mode	Common mode is the in-phase mode of a balanced measurement.
Continuous Sweep Mode	Continuous sweep mode is the vector network analyzer condition where traces are automatically updated each time trigger conditions are met.
Crossing Percentage (Eye)	Crossing percentage (eye) is a measure of the amplitude of an eye diagram crossing points relative to the one level and zero level. Crossing percentage = 100 $(V_{cross} - V_{zero\ level}) / (V_{one\ level} - V_{zero\ level})$)
Crossing Point (Eye)	Crossing point (eye) is the point in time, in an eye diagram, where the rising edge of a waveform intersects with the falling edge.
Crosssstalk	Crosstalk is the occurrence of a signal at one port of a device being affected by a signal in any other path. Isolation is a description of each signal path (or channel's or lane's) immunity from noise from other channels or outside sources.
– D –	
Data Sharing	Data Sharing is a Physical Layer Test System utility that is used to overlay the plot of one measurement parameter over the plot of the same measured parameter from a different data set so that differences and similarities can be readily seen.

Data Transfer Rate	The number of bits that are sent during a one second period. This is generally associated with high-speed serial data transfer systems. The base unit of measure is bits per second (bps). "bps" may be preceded with K (Kbps) for 1000 bits per second, M (Mbps) for 1,000,000 bits per second, or G (Gbps) for 1,000,000,000 bits per second.
De-embedding	De-embedding eliminates the effects (loss, phase shift, mismatch) of the test fixture, connectors, cables and other equipment. De-embedding combines these effects with the errors determined during a coaxial calibration to account for errors of all of the equipment required to measure the DUT. This characterized data is mathematically removed from the measured data, thus ensuring that only the effects of the DUT are displayed. This technique is very useful for measuring DUTs that require fixtures, such as wafers and packages.
Deterministic Jitter	Deterministic jitter is the deviation of a transition from its ideal time caused by reflections relative to other transitions or events happening on neighboring lines. It is pattern dependent, occurring in a predictable, systematic manner due to the varying data patterns. It adds linearly and is measured in peak-to-peak means.
Differential Mode	Differential mode is the anti-phase mode of a balanced measurement.
Direct Current (DC)	Direct Current is electron flow at zero hertz.
DUT	DUT is an acronym commonly used for the device under test.
Dynamic Range	Dynamic range specifies the amplitude (size) of a signal that can be input into the instrument at a particular vertical scale without overdriving the front end, resulting in an inaccurate acquisition of data.
– E –	
Electromagnetic Interference (EMI)	Any electromagnetic energy created by an outside source that interrupts, degrades, or limits the performance of electronics equipment or systems. It can result from unintentional sources, such as spurious emissions and responses, or it can be induced intentionally, as a form of electronic warfare.

Electronic Calibration (ECal)	Electronic calibration performs a SOLT (Short-Open-Load-Thru) calibration on the Physical Layer Test System using an ECal module controlled by the N1930A software. The ECal module is a state-of-the-art, solid-state device with programmable and highly repeatable impedance states that provide consistent calibrations and eliminate operator errors while bringing convenience and simplicity to your calibration routine. The PLTS uses the N4430A and N4430B ECal modules to calibrate to maximum frequencies of 6 GHz and 9 GHz, respectively.
Ethernet	Ethernet is a network that adheres to the IEEE 802.3 Local Area Network standard.
Extinction Ratio	Extinction ratio is the ratio of the one level and the zero level of an eye diagram. This measurement is made in a section of the eye referred to as the eye window.
Eye Amplitude	Eye amplitude is the difference between the logic 1 level and the logic 0 level histogram mean values of an eye diagram.
Eye Diagram or Pattern	An eye diagram is a waveform display that has a specific number of bits sliced and folded on top of one another to produce an overlaid display. In PLTS, the eye diagram is produced by convolving the time domain impulse response of SDD21 with a repetitive bit pattern, which is wrapped.
Eye Height	Eye height is a measure of the vertical opening of an eye diagram.
Eye Opening Factor	Eye Opening Factor is a measure of the vertical opening of an eye diagram.
Eye Width	Eye width is a measure of the horizontal opening of an eye diagram.
Eye Window	The eye window provides the time boundaries within which signal parameters for eye diagrams are measured.
– F –	
Fall Time	Fall time is the transition time for the falling edge of a pulse to decrease from 90% of its peak value to 10% of its peak value.
Fast Fourier Transform (FFT)	The Fast Fourier Transform is an algorithm for transforming data from the time domain to the frequency domain.

Fixturing	Fixturing is the process of using a test fixture as an interface between your test equipment and your device under test (DUT). See “Test Fixture” on page 275.
Forward Orientation	Forward orientation is the direction an adapter is inserted into the Physical Layer Test System equipment setup. An adapter is "forward oriented" when the end labeled "1" at the PLTS test cable and the end labeled "2" will be connected to the DUT. See “Orientation” on page 266.
FR-4	FR-4 is a common epoxy resin glass laminate that is used as substrate for PC boards.
Frequency	Frequency is the number of periodic oscillations, vibrations, or waves per unit of time, usually expressed in cycles per second, or Hertz (Hz).
Frequency Accuracy	Frequency accuracy is the uncertainty with which the frequency of a signal or spectral component is indicated, either in an absolute sense or relative to another signal or spectral component. Absolute and relative frequency accuracies are specified independently.
Frequency Band	Frequency band is a term that identifies a range of frequencies in the electromagnetic spectrum.
Frequency Range	Frequency range is the range of frequencies over which a device or instrument performance is specified.
Frequency Response	In frequency mode, frequency response is the peak-to-peak variation in the displayed amplitude response over a specified center frequency range. Frequency response is typically specified in terms of dB, relative to the value midway between the extremes.
Frequency Span	Frequency span is represented by the horizontal axis of the display. Generally, frequency span is given as the total span across the full display. Sometimes frequency span (scan width) is represented as a per-division value.
Functions (Math)	Functions (Math) are mathematical operations (such as Add, Subtract, Multiply, Integrate, Versus for XY plots) that can be performed on input waveforms, stored waveform memories, or even other functions.
– G –	
G (conductance)	Conductance is the resistive component in shunt impedance from a signal to ground or across transmission lines.

Gating	Gating enables a network analyzer to remove displayed data between specific intervals. This function is used in the time domain mode to separate device connector and coupling effects.
General Purpose Interface Bus (GPIB)	The GPIB bus provides an easy and reliable interface between GPIB instruments and a computer GPIB interface card using GPIB cables. These cables are available in various lengths. Multiple cables can be daisy-chained together to simplify the system interconnection.
Gigabits per Second (Gbps)	Gigabits per second or one billion bits per second. Refer to “Data Transfer Rate” on page 256.
Gigabyte	Gigabyte is generally defined as either 1,000 or 1,024 megabytes. See “Byte” on page 254.
Gigahertz (GHz)	One billion cycles per second. Refer to “Frequency” on page 258.
Golden Device	A device under test that is measured and its test results are saved for comparison against future measurements as a metric of calibration quality and repeatability.
Graticule	Graticules are the horizontal and vertical grid lines making up the plot area. Graticules allow for easier, more accurate viewing of the waveform data and markers.
Group Delay	A measure of the transit time of a signal through a DUT versus frequency. Group delay can be calculated by differentiating the DUT's insertion-phase response versus frequency. $-\Delta \text{ Phase} / (\Delta f)\ (360)$ where, Δ Phase is the phase difference between two adjacent frequencies, Δf.
– H –	
Hertz (Hz)	One cycle per second. Refer to “Frequency” on page 258.
Horizontal Scale	Horizontal scale is an instrument control that controls the x-axis (time or frequency per division) of displayed waveforms. Horizontal scale is often referred to as sweep speed in some instruments.
HSPICE	HSPICE is a circuit simulation tool based on SPICE (Simulation Program for Integrated Circuits Emphasis). Physical Layer Test System data can be exported in an HSPICE format. HSPICE is a product of Synopsys, Inc.

Hub	A hub is a central connection point for devices in a network. It receives a signal from one device and retransmits the signal to one or more devices. Passive hubs are data conduits that just connect devices, adding nothing to the data passing through them. Active hubs regenerate the data bits in order to maintain a strong signal. Intelligent hubs have additional features that monitor traffic. Switching hubs read the destination address of each packet of information and then forward the information to the proper destination.
– I –	
IEEE 802	IEEE 802 is a series of documents that define the standards for Local and Metropolitan Area Networks. The Institute of Electrical and Electronics Engineers, Inc. (IEEE) publish these standards. The following is a list of subjects that the standards define: IEEE Std 802: Overview and Architecture IEEE Std 802.1: Bridging and Management IEEE Std 802.2: Logical Link Control IEEE Std 802.3: CSMA/CD Access Method IEEE Std 802.5: Token Ring Access Method IEEE Std 802.6: DQDB Access Method IEEE Std 802.7: Broadband LAN IEEE Std 802.10: Security IEEE Std 802.11: Wireless LANs IEEE Std 802.12: Demand Priority Access Method IEEE Std 802.15: Wireless Personal Area Networks IEEE Std 802.16: Broadband Wireless Metropolitan Area Networks
Imaginary	Imaginary is a format that displays the reactive portion of the measured data on a Cartesian format. This is the corollary to the Real format where the resistive portion is displayed.
Impedance	Impedance is the ratio of voltage to current at a port of a circuit, expressed in ohms.
Insertion Loss	Insertion loss is the difference between the power measured before and after the insertion of a device or the attenuation between the input and output of a device.

Inverse Fast Fourier Transform	The Inverse Fast Fourier Transform is an algorithm for transforming data from the frequency domain to the time domain.
Isolation	Isolation is the specification or measure of the immunity that one signal has to being affected by another adjacent signal. Low isolation in digital systems manifests itself as crosstalk or noise on the victim channel.
– J –	
Jitter	Jitter is the measure of the time variances of the rising and falling edges of an eye diagram as these edges affect the crossing points of the eye.
– K –	
K28.5	K28.5 is an industry standard, finite length, specific bit sequence than includes a comma character and 8B/10B encoding.
Kilobits per Second (Kbps)	Kilobits per second or one thousand bits per second. Refer to “Data Transfer Rate” on page 256.
Kilobyte	Kilobyte is generally defined as either 1,000 or 1,024 bytes. See “Byte” on page 254.
Kilohertz (kHz)	One thousand cycles per second. Refer to “Frequency” on page 258.
– L –	
L (inductance)	Inductance (henries) is stored magnetic charge.
Line Reflect Match (LRM) Calibration	LRM calibration is a calibration type that utilizes three simpler, more convenient standards to define the error terms to be removed from the measurement. The measured parameters of the Line, Reflect, and Match standards in a LRM calibration kit provides the same information as a SOLT calibration via a different algorithm. A calibration at the coaxial ports of the test system removes the effects of the system and any cables or adapters before the fixture; however, the effects of the fixture itself are not accounted for. An in-fixture calibration is preferable, but SOLT standards may not be readily available to allow a conventional full 4-port calibration at the desired measurement port of the device.

Line Reflect Match (LRM) Calibration (continued)	LRM calibration is convenient because calibration standards can be fabricated for the specific measurement environment. The characteristic impedance of these fabricated transmission lines can be determined from the physical dimensions and substrate's dielectric constant. The LRM calibration relies on the characteristic impedance of simple transmission lines.
Linear Device	A linear device is a device that only modifies phase or magnitude of frequency components present on the input signal.
Linear Mag	Linear Mag is the display mode in which the vertical deflection is presented in linear function (vertical divisions are uniformly space). This format is used for unit-less measurements, such as reflection coefficient magnitude and for linear measurement units. It is used to display conversion parameters and time domain transform data.
Load	1) A load is a one-port microwave device used to terminate a path in its characteristic impedance. 2) A load is a calibration standard that is an actual line that terminates a path with the path's characteristic impedance. See “SOLT Calibration” on page 272.
Load Match	Load match is a measure of how close the device's terminating load impedance is to the ideal transmission line impedance. Match is usually measured as return loss or standing wave ratio (SWR) of the load.
Log Display	Log display (logarithmic display) is the display mode in which vertical deflection is a logarithmic function of the input signal amplitude. The display calibration is set by selecting the value of the reference level position and scale factor in dB per division.
Log Mag	Log Mag is the display mode in which vertical deflection is a logarithmic function of the input signal amplitude. Log Mag is also called logarithmic display.

Low Voltage Differential Signals (LVDS)	LVDS is a high-speed (gigabits per second), low-noise, low-power, low voltage method of transmitting digital information. The differential signals are transmitted over two traces or over balanced cable using a very low voltage swing between high (binary 1) and low (binary 0). The low swing voltage means that data can switched very quickly which provides the higher data transfer rate. LVDS uses the two traces (cables) for two signals, which are 180 degrees out of phase from each other. Thus, the noise travels at the same level making filtering very effective. This mode of transmission is often used with SCSI hardware.
– M –	
Magnitude	Magnitude is the amplitude of a signal measured in its characteristic impedance without regard to phase.
Markers	Marker lines are used to determine the position or amplitude of the selected point on the display graticule. Marker lines can be positioned on either: • A selected waveform source (input channel, waveform memory, or waveform function) • Independently, anywhere on the display graticule
Mask	A mask is a template consisting of numbered, shaded regions on the instrument display screen. The input waveform must remain within these regions in order to comply with industry standards. The waveforms that intrude these regions are mask violations.
Masking	Time domain responses are most accurate closest to the location of the source. A discontinuity in the DUT will reflect some power back to the source, meaning less power is transmitted to the rest of the DUT. This loss of power going away from the source is referred to as masking, and allows the true impedance of the next discontinuity to be misrepresented.
Mask Test	A mask test is a test process used to verify that waveforms generated by a test device conform to industry standards.

Measurement Uncertainty	Measurement uncertainty is the quantified amount of error in a measurement situation. Calibrations are intended to reduce the amount of uncertainty. The following are sources of measurement errors that lead to uncertainty: • Systematic errors (imperfections in calibration standards, connectors, cables, and instrumentation) • Random errors (noise, connector repeatability) • Drift (source and instrumentation)
Megabits per Second (Mbps)	Megabits per second or one million bits per second. Refer to “Data Transfer Rate” on page 256.
Megabyte	Megabyte is generally defined as either 1,000 or 1,024 kilobytes. See “Byte” on page 254.
Megahertz (MHz)	One million cycles per second. Refer to “Frequency” on page 258.
Microprocessor Unit (MPU)	A microprocessor is a computer (central processing unit, CPU) on a single digital semiconductor chip. It performs math and logic operations and executes instructions from memory. A microprocessor requires a power supply, clock and memory to function as a computer.
Microstrip	Microstrip is a planar transmission line that consists of a thin conductive trace (or traces) printed or etched on the top side of an insulating substrate with a parallel ground plane on the other side of the substrate. Microstrips are also used for antennas and antenna arrays.
Microwave	Microwave is the frequency band where radio waves are very short. This band ranges from approximately 1 GHz to 40 GHz, within the UHF, SHF, and EHF frequency bands.
Mixed Mode S-parameters	Mixed-mode S-parameters describe the performance of a device when measuring a balanced device. Each balanced port will support both a common-mode and a differential-mode signal.

Mode Conversion	Mode conversion is a measure of isolation when making balanced S-parameter measurements where there is a: • Differential-mode stimulus with a common-mode response (SCDXX). Mode conversion in this configuration can result in device asymmetry and generation of electromagnetic interference (EMI). • Common-mode stimulus with a differential-mode response (SDCXX). Mode conversion in this configuration can result in device asymmetry and susceptibility to EMI.
– N –	
Near End Crosstalk (NEXT)	Signal distortion as a result of signal coupling from one wire pair to another wire pair at various frequencies. When measuring the NEXT, it is usually the resultant voltage excursion expressed as a percentage of the incident voltage swing of the culprit line.
Network Analysis	Network analysis is the characterization of a device, circuit, or system derived by comparing a signal input going into the device to a signal or signals coming out from the device.
Noise	Noise is an unwanted disturbance (voltage or current) superimposed on a useful waveform.
Non-insertable Calibration	A non-insertable calibration is one in which the test port connectors are of the same gender (male-to-male or female-to-female).
Non-linear Device	A non-linear device is a device in which frequency components are added or deleted (not just modified) from the original signal.
Non-Return to Zero (NRZ) Signaling	NRZ signaling is used in differential signaling to describe that swing about some offset voltage do no return to 0 volts.
Normalize	To normalize is to subtract one trace from another to eliminate calibration data errors or to obtain relative information.
– O –	
Offset	Offset is used to move or set off a determined amount. Used in instruments for offsetting frequencies, limits, delay, loss, impedance, etc.

One Level	One level is a measure of the mean value of the logical 1 of an eye diagram.
Open	An Open is a calibration standard that is an actual line that terminates a path with an electrical open. See “SOLT Calibration” on page 272.
Orientation	Orientation is the direction that an adapter is inserted between the Physical Layer Test System port's coaxial test cable and the DUT. Each end of the adapter should be labeled: either "1" or "2". Identifying the adapter orientation is important when calibrating the test system. An adapter is "forward oriented" when the end labeled "1" at the test cable and the end labeled "2" will be connected to the DUT. An adapter is "reverse oriented" when the end labeled "2" at the test cable and the end labeled "1" will be connected to the DUT.
– P –	
Passive Device	A passive device is a device that requires only a signal to perform its function. It does not require a source of power for its operation and it provides no gain to a circuit. Examples of passive devices are resistors, inductors, capacitors, cables, and filters.
Pattern Length	Pattern length is the number of bits that are used to create a bit pattern used to create an eye diagram in the Physical Layer Test System. Bit patterns may be between 8 and 32 bits long.
Phase	The fractional part of a cycle through which an oscillation has advanced, measured from an arbitrary starting point; usually measured in radians or degrees. In network analysis, the phase response of the device under test is the change in phase as a function of frequency between the input stimulus and the measured response. In network analysis, the phase response of the device under test is the change in phase as a function of frequency between the input stimulus and the measured response.
Phase Rotation	See “Phase Skew” on page 267.
Phase Shift	Phase shift is the change in phase of a signal between two points of time. Phase shift is expressed in degrees of lead or lag.

Phase Skew	Phase skew is a technique to remove the time delay caused by a fixture. Since the SOLT calibration only calibrates to the end of the test cables, the effects added by the test fixture can be removed mathematically. Phase skew moves the reference plane from the end of the test cables to the connection between the fixture and the DUT by accounting for the electrical length of each fixture path. Other terms for phase skew are phase rotation, port extension, port rotation, and reference plane rotation.
Physical Layer	The physical layer is layer 1, the lowest layer, of the seven-layer Open System Interconnection model. In broad terms, the physical layer is responsible for activating and using physical connections for transfer of electronic bits (zeros and ones) between a device and its transmission medium. The physical layer defines the electrical, mechanical, and handshaking protocols that govern transmission media and signals over the interface connecting a device to the transmission medium. In doing so, the physical layer insulates the data link layer (layer 2) from the physical characteristics of the transmission medium, such as baseband, broadband, or fiber-optic transmission. The physical layer is subdivided into the physical medium-dependent sublayer and the transmission convergence sublayer. Physical layer has three basic mediums: electrical (where SIO is focused), wireless/over air, and optical. All three are used in today's communications systems.
Polar Chart	The Polar chart is a format where each point corresponds to a particular value of both magnitude and phase. Quantities are read vectorally: the magnitude at any point is determined by its displacement from the center (which has zero value), and the phase by the angle counterclockwise from the positive x-axis. Magnitude is scaled in a linear fashion, with the value of the outer circle set to a ratio value of 1. Since there is no frequency axis, frequency information is read from the markers. The default marker readout for the polar format is in linear magnitude and phase.
Port	Port is a network-analysis term for the path that sends/received data to/from the DUT. In logic analysis and oscilloscope terminology a port is more like a channel. A channel in a logic analyzer or an oscilloscope is usually unidirectional (acquisition only) where as a port in a network analyzer is bi-directional. A port is also equivalent to the "pin" of an IC or board tester, which is usually bi-directional as well. So a port is similar to a pin on a package or connector.

Port Extension	See “Phase Skew” on page 267.
Port Rotation	See “Phase Skew” on page 267.
Power Level	Power level (dBm) is the stimulus level at the test port required for the measurement of the device under test.
Probe	A probe is the test device is connected to the Physical Layer Test System (or some other electronic device) that is used to make contact with a DUT to deliver or detect a signal for the purpose of on-circuit measurements. It is often a stylus-like device having multiple conductors for signal and ground paths. The tip is also often spring loaded to apply a constant pressure to the DUT.
Probing	In the frequency domain, probing is the process of using a probe to perform on-circuit measurements. In the time domain, probing typically refers to the technique of either browsing (single probe) or attaching (multiple probes, as in a logic analyzer) to the DUT and attempting to be non-intrusive with respect to the signal. Oscilloscope or logic analyzer-based measurements probing is designed to be as non-intrusive to the active electrical signal as possible while retaining the high bandwidth required to make accurate measurements.
Pseudo-Random Binary Sequence (PRBS)	Pseudo-Random Binary Sequence is a fixed length, somewhat random, digital signal pattern.
Pulse Width	Pulse width is the difference in time between the rising and falling edges of a signal that is transitioning, away from and then back to, its steady state.
– R –	
R (resistance)	Resistance (ohms) is the opposition to the flow of current in a conductor.
Rack Units	A rack unit (U) is the vertical distance (height) between screw holes in an equipment rack. One rack unit (1U) equals 1.75 inches (44.45 mm) of rack space for equipment. 2U provides 3.5 inches of rack space for equipment, and so forth.

Radio Frequency (RF)	RF is the frequency band where radio waves are below the microwave band. The RF band ranges from approximately 50 kHz to 3 GHz, within the LF, MF, HF, VHF, and UHF frequency bands.
Range Resolution	Range resolution is defined as the ability to locate a single response in the time domain. If only one response is present, range resolution is a measure of how closely you can pinpoint the peak of that response. The range resolution is equal to the digital resolution of the display, which is the time domain span divided by the number of points on the display. The range resolution is always much finer than the response resolution.
Real	Real is a format that displays the resistive portion of the measured data on a Cartesian format. This is the corollary to the Imaginary format where the reactive portion is displayed.
Record Length	In frequency domain, record length refers to number of frequency points measured by the network analyzer. A longer record length (number of points) in a VNA implies either more resolution (closer points in the frequency domain) or a wider bandwidth measurement. In time domain, record length refers to the number of time points or instances acquired by the scope or logic analyzer. A longer record length (also occasionally called "points") means greater resolution for any given time duration.
Reference Level	Reference level is an instrument function that allows the user to set the amplitude value at the reference position. On network analyzers, the reference position is also selectable.
Reference Plane	A reference plane is the electrical location at which a network analyzer assumes the system connectors and fixturing ends and the device under test (DUT) begins. The reference plane is set by using calibration standards with known electrical lengths. The closer the reference plane is to the DUT, the better the characterization of the device because of the elimination of test system uncertainties.
Reference Plane Rotation	See “Phase Skew” on page 267.
Reflection	Reflection is the phenomenon in which a traveling wave strikes a discontinuity and returns to the original medium.

Reflection Coefficient	The reflection coefficient is the ratio of the reflected voltage to the incident voltage into a transmission line or circuit. If a transmission line is terminated in its characteristic impedance, the reflection coefficient is zero. If the line is shorted or open, the coefficient is 1.
Reflection Measurements	Reflection measurements characterize the input and output behavior of the device under test. Measured as the ratio of the reflected signal to the incident signal as a function of frequency. Parameters are called return loss, reflection coefficient, impedance match, and standing wave ratio (SWR), all as a function of frequency.
Response	The Physical Layer Test System applies reference signals that are transmitted through the DUT or are reflected from the DUT's input. The transmitted or reflected signal is then detected and compared against the reference signal. A detected signal is called the "response". A reference signal is called the stimulus.
Response Resolution	Response resolution is defined as the ability to resolve two closely spaced responses, or a measure of how close two responses can be to each other and still be distinguished from each other in the time domain.
Reverse Orientation	Reverse orientation is the direction an adapter is inserted into the Physical Layer Test System equipment setup. An adapter is "reverse oriented" when the end labeled "2" at the PLTS test cable and the end labeled "1" will be connected to the DUT. See “Orientation” on page 266.
Rise Time	Rise time is the transition time for the leading edge of a pulse to rise from 10% of its peak value to 90% of its peak value.
RMS	RMS is the root-mean-square (rms) of the voltage values of a waveform. Typically, the rms is taken over the first period of the displayed waveform.

Router (Networking)	A router is an electronic device that links local and wide area networks (LANs and WANs), allowing them to talk to one another even though the networks may be based on different standards. Using routing tables and protocols, routers read the network address in each transmitted frame and decide how to send it based on the most expedient route. Gateway is a generic term for a router. Most routers are specialized computers that are optimized for communications; however, router functions can also be implemented by adding routing software to a file server.
– S –	
S-parameters (Scattering Parameters)	A convention used to characterize the way a device modifies signal flow. A four-port device has sixteen S-parameters: four forward transmission parameters, four reverse transmission parameters, four forward reflection parameters, and four reverse reflection parameters.
Scale (horizontal)	Horizontal scale is an instrument control that controls the x-axis or time per division of displayed waveforms. Horizontal scale is often referred to as sweep speed in some instruments.
Scale (vertical)	Vertical scale is an instrument control that controls the y-axis or volts per division for the selected channel. This control allows you to adjust the sensitivity of the instrument.
Serializer-Deserializer (SERDES)	SERDES is a term applied to the serialization (conversion from parallel to serial) and deserialization (conversion from serial to parallel) of data. The serialization portion usually merges clock and data and performs encoding while the deserialization typically performs decoding and clock/data recovery. SERDES are commonly used in high-speed serial links.
Short	A Short is a calibration standard that is an actual line that terminates a path with a precision electrical short. See “SOLT Calibration” on page 272.
Signal-to-Noise Ratio	Signal-to-noise is the ratio of the amplitude of a signal relative to the amplitude of the noise on the signal.
Signal Integrity Engineering	Signal Integrity Engineering is using digital design and analog circuit theory along with accurate models and simulation to design circuits correctly the first time to save time and cost. When problems do occur signal integrity engineering quickly finds the root cause of signal distortions and fixes them.

Single-ended	A singled-ended or unbalanced device, having all of its signals referenced to a common ground potential.
Single-ended Device	A single-ended device has all of its signals referenced to a common ground potential.
Single-Ended Mode (SEM)	Single-ended mode is a method of sending SCSI signals along a cable. Single-ended mode uses one wire for the signal, which is compared to a common ground. The signal is the voltage difference between the two wires. Cable lengths for single-ended mode are restricted to between 6 and 1.5 meters (20 to 5 ft.) with the length decreasing as the data speed increases.
Skew	Skew changes the horizontal position of a waveform on the display independent of any other waveforms on the display. Skew is typically used for overlaying waveforms, or eliminating timing difference caused by different cable and probe lengths. The time base position control moves all of the waveforms on the display at the same time, whereas skew moves individual waveforms.
Skin Effect	Skin effect is the tendency of high-frequency currents to flow close to the surface of the conductor restricting the flow to a small part of the conductor's cross-sectional area. As frequency increases, so does the resistance and thus the loss also increases due to skin effect.
Small Computer System Interface (SCSI)	SCSI (pronounced "skuzzy") is a standardized hardware interface for a computer that acts as an I/O bus that can be used to connect the computer to several peripheral devices, such as printers, disk drives, CD-ROM, CD-R, Zip drives, and scanners.
SOLT Calibration	SOLT is a calibration using four known standards: Short-Open-Load-Thru.

Smith Chart	The Smith chart is the most common way to display complex impedance. The Smith chart is a circular chart with a bisecting horizontal line. The amount of reflection that occurs when characterizing a device depends on the impedance the incident signal sees. Since any impedance can be represented as a real and imaginary part (R+jX or G+jB), these quantities can be plotted on a rectilinear grid (known as the complex impedance plane). All values of reactance and all positive values of resistance from 0 to infinity fall within the outer circle of the Smith chart. Impedances on the chart are always normalized to the characteristic impedance of the test system. A perfect termination (Zo) appears in the center of the chart. A pure open appears at the left end of the bisecting horizontal line (infinity on the x-axis), while a pure short appears at the right end of the same line (zero on the x-axis). Loci of constant resistance now appear as circles, and loci of constant reactance appear as arcs. Inductance (positive reactance) is displayed in the upper half of the Smith chart, while capacitance (negative reactance) is displayed in the lower half.
Source	The source (input channel, function, waveform memory, or constant) used when performing tasks, such as measurements, math, or mask tests.
Standard Deviation	Standard deviation, represented by the Greek letter sigma (σ), is the measure of the dispersion or spread of the statistical average of all results for a particular measurement. In a Gaussian distribution, two sigma, or within ±1σ of the mean is where 68.3 percent of the data points reside. Six sigma, or within ±3σ of the mean is where 99.7 percent of the data points reside.
Start Frequency	Start frequency is the start point of the frequency domain measurement range, or the lowest frequency measured. Together with the stop frequency, they determine the span of the measurement range.
Stimulus	The Physical Layer Test System applies reference signals that are transmitted through the DUT or are reflected from the DUT's input. The transmitted or reflected signal is then detected and compared against the reference signal. A reference signal is called the "stimulus". A detected signal is called the response.

Stop Frequency	Stop frequency is the stop point of the frequency domain measurement range, or the highest frequency measured. Together with the start frequency, they determine the span of the measurement range.
Stripline	A stripline is a planar transmission line structure that consists of a thin conductive trace (or traces) printed or etched within an insulating substrate with parallel ground planes on both sides of the substrate.
Sweep	A sweep is the ability of the source to provide a specified signal level over a specified frequency range in a specified time period.
Sweep Cycle Time	Sweep cycle time is the time required for making a complete sweep and preparing for the next sweep. It can be measured as the time from the start of one sweep to the start of the next sweep.
Sweep Mode	Sweep mode is the way in which a sweep is initiated or selected.
Sweep Type	Sweep type is the method of sweeping the source, e.g., linear, log, or frequency step.
– T –	
T-carrier	T-carrier is a full-duplex digital transmission type that uses four wire cables. One pair is used to transmit; the other pair is used to receive. The cable types were originally twisted pairs, but now include coaxial cable, digital microwave, optical fiber, and other media. Other T-carrier characteristics are: • Symmetry: the same amount of bandwidth is provided in each direction. • Time Division Multiplexing: multiple transmissions can be supported over multiple channels by interleaving the signals over a given carrier frequency. • Unbiasing: all applications and data types are treated the same. Every bit of each transmission is treated the same, regardless of whether it's a voice bit, a data bit, or a video bit.
T1	T1 lines are a standard for broadband digital transmission over telephone lines. T3 lines consist of 24 channels at 1.544 Mbps. These lines are generally used by Internet Service Providers. See “T-carrier” on page 274.

T3	T3 lines consist of 672 channels at 44.736 Mbps. These lines are generally used by Internet Service Providers and are also referred to as DS3 lines. See "T-carrier" on page 274.
Termination	A termination is a load connected to a transmission line or other device.
Test Fixture	A test fixture is a fixture used to hold the DUT, route signals to and from the DUT, and to apply bias voltages and ground paths to the DUT.
Test Set	A test set is the arrangement of hardware (switches, couplers, connectors and cables) that connect a test device input and output to the network analyzer's source and receiver to make S-parameter measurements.
Thru	A Thru (through) is a calibration standard that is an actual through line. See "SOLT Calibration" on page 272.
Thru Reflect Line (TRL) Calibration	TRL calibration is a calibration type that utilizes three simpler, more convenient standards to define the error terms to be removed from the measurement. The measured parameters of the Thru, Reflect, and Line standards in a TRL calibration kit provides the same information as a SOLT calibration via a different algorithm. A calibration at the coaxial ports of the test system removes the effects of the system and any cables or adapters before the fixture; however, the effects of the fixture itself are not accounted for. An in-fixture calibration is preferable, but SOLT standards may not be readily available to allow a conventional full 4-port calibration at the desired measurement port of the device. TRL calibration is convenient because calibration standards can be fabricated for the specific measurement environment. The characteristic impedance of these fabricated transmission lines can be determined from the physical dimensions and substrate's dielectric constant. The TRL calibration relies on the characteristic impedance of simple transmission lines.
Time Domain Network Analysis (TDNA)	TDNA includes both time domain reflectometry (TDR) and time domain transmission (TDT) measurements to characterize a network.

Time Domain Reflectometry (TDR)	TDR gives an intuitive measurement of any discontinuities in a circuit. It measures the location, electrical length, nature of the circuit (resistive, capacitive, inductive), and amount of reflection from discontinuities.
Time Domain Transmission (TDT)	TDT is a measurement technique that measures both attenuation and propagation delay of your device under test.
Topology	Topology is the way that circuits are connected to link the network nodes together. Several network topologies are listed: • Bus topology: A topology in which all nodes, i.e., stations, are connected together by a single bus. • Fully connected topology: A topology in which every node has a direct path to every other node. • Hybrid topology: A combination of any two or more other topologies. • Mesh topology: A topology in which there is a minimum of two nodes with each having a minimum of two (often more) paths. • Ring topology: A topology in which every node has exactly two branches connected to it forming a ring when all connections are made. • Star topology: A topology in which peripheral nodes are connected to a central node. The central node rebroadcasts all transmissions received from any peripheral node to all peripheral nodes on the network. • Tree topology: A topology in which multiple star topologies are connected together when their central nodes are connected to a higher level central node. In turn, this central node may be connected to other higher-level central nodes.
Touchstone	Touchstone data files, also known as .Snp files, are ASCII text files used to import and export S-parameter data. This file format displays the data line-by-line, one line per data point, in increasing order of frequency. Each line of data consists of a frequency value and one or more pairs of values for the magnitude and phase of each S-parameter at that frequency. Values are separated by one or more spaces. Comments are preceded by an exclamation mark (!). Comments can appear on separate lines, or after the data on any line or lines.

Trace	A series of data points containing frequency/time and amplitude information on a plot. In the Physical Layer Test System, a plot may have only one trace or it may be defined to have multiple traces.
Transition Time	Transition time is the time duration that a pulse takes to rise from the 10% level to the 90% level when turning on (the rise time) or the time duration that a pulse takes to fall from the 90% level to the 10% level when turning off (the fall time).
Transmission Measurements	The characterization of the transfer function of a device, that is, the ratio of the output signal to the incident signal. Most common measurements include gain, insertion loss, transmission coefficient, insertion phase, and group delay, all measured over frequency.
Twisted Pair	A twisted pair is a cable that is made up of one or more separately insulated twisted-wire pairs which reduces susceptibility to RF noise.
– U –	
Uncorrected Measurements	Uncorrected measurements are measurements made without performing calibration (error correction).
uW	See “Microwave” on page 264.
– V –	
Velocity Factor	Velocity factor is a numerical value related to the speed of energy through transmission lines with different dielectrics (.66 for polyethylene). In making time domain measurements, a velocity factor of 1 = speed of light = 299.7925×10^6 m/s.
Vertical Resolution	Vertical resolution is the degree to which an instrument can differentiate amplitude between two signals.
Via	A via is a hole filled or lined with a conducting material which is used to link two or more conducting layers of a PC board. There are blind vias (a via that connects two or more layers including the top or bottom layer), buried vias (a via that connects two or more layers that does not include the top or bottom layer), and through-hole vias (a via that connects all layers).
– W –	
Waveform	A waveform is a representation of a signal plotting amplitude versus time.

Wavelength	Wavelength is the physical distance that an electromagnetic wave travels during the time it completes one cycle. The distance between points of corresponding phase of two consecutive cycles of a wave. The wavelength (l) is related to the propagation velocity (v) and the frequency (f) by l = v / f.
Windowing	Windowing is a time domain feature that smooths (filters) overshoot and ringing displayed in time domain plots. Overshoot and ringing are caused by the abrupt transitions of start and stop frequencies used in frequency domain measurements.
– **Z** –	
Zero Level	Zero level is a measure of the mean value of the logical 0 of an eye diagram.
Zo	Zo is the characteristic impedance of a transmission line.

B Reference Information for Discontinued Physical Layer Test System Hardware

The following hardware has been discontinued. However, if you are using any of this equipment, it is still documented in this chapter.

Table B-1 Discontinued PLTS Hardware Model Numbers

PLTS Systems:	N1947A, N1948A, N1951A, N1953A, N1957A
PLTS Test Sets:	N4415A, N4416A, N4417A, N4418A, N4419A, N4421A
PLTS Network Analyzers:	8753ES 8720ES/8722ES E8356A/E8357A/E8358A E8362A/E8363A/E8364A E8801A/E8802A/E8803A

Discontinued System Information for Chapter 1. Installing the VNA-Based Physical Layer Test System Hardware

Table B-2 Physical Layer Test System Configurations

Test Set Model Number	System Frequency Range	Supported Network Analyzer			
		Model Number	Options[a]		
			Required	Compatible	Incompatible
N4415A	30 kHz to 6.0 GHz	8753ES	006[b], 014	002, 004, 010, 1D5	011, 075, H16
N4416A	300 kHz to 6.0 GHz	E8356A[c]/7A/8A	015	010, 1D5	
N4417A[d]	300 kHz to 9.0 GHz	E8356A[c]/7A[e]/8A	015	010	
		E8801A[c]/2A[e]/3A	014	010, 1E1, 1E5	
N4418A	50 MHz to 20 GHz	8720ES	H32 or H42	010, 012, 400	007, 085, 089
		8722ES[f]	H32 or H44		
N4419A	45 MHz to 20 GHz	E8362A	014	010, 022, 711, UNL	
N4420B	45 MHz to 40 GHz	E8363A	014	010, 022, 711, UNL	
N4421A	45 MHz to 50 GHz	E8364A	014	010, 022, 711, UNL	

a. This table lists only the most specifically relevant options. For compatibility with options not listed here, contact the factory.
b. Option 006 required only for operation above 3 GHz.
c. Using this network analyzer, the maximum operating frequency is limited to 3 GHz.
d. E8356A family requires N4417A Option 103; E8801A family requires N4417A Option 104.
e. Using this network analyzer, the maximum operating frequency is limited to 6 GHz.
f. When an 8722ES is used with an N4418A, the N4418A requires Option 302. The system's maximum operating frequency is limited to 20.0 GHz.

NOTE For PNA models E8356A/E8357A/E8358A: If the rear panel USB port is oriented horizontally, then you have an older CPU board. We strongly recommend that you install 128 MB of memory if any firmware revision above 2.62 is desired. While this is not an absolute necessity, performance will be very sluggish without this extra memory. Even with this extra memory, using more than 1601 points will slow the responsiveness of the analyzer. The memory type needed is: 128MB SDRAM SODIMM, PC66 or PC100.

Using Table B-3, verify that your network analyzer options are compatible with the physical layer test system. Incompatible options are shaded.

Table B-3 Common Hardware Option Number Descriptions for Network Analyzers

8753ES Network Analyzer Options			
002	Harmonic-Measurement Upgrade	004	Step Attenuator Upgrade
006	6 GHz Upgrade for Standard Units	010	Time Domain Capability
011	Receiver Configuration	014	Configurable Test Set
075	75 Ohm Impedance	1D5	High Stability Frequency Reference
H16	Low Noise Floor		
8720ES and 8722ES Network Analyzer Options			
007	Mechanical Transfer Switch	010	Time Domain Capability
012	Direct Sampler Access	085	High-Power Test System
089	Frequency Offset Mode	1D5	High Stability Frequency Reference
400	Four-Sampler Test Set	H32	Front panel access to A and B samplers and Port 1 and Port 2 switch and coupler
H42	8719/8720 only: Front panel access to all samplers and Port 1 and Port 2 switch and coupler (installs options 400 & 012)	H44	8722 only: Front panel access to R1, R2, A, and B samplers, and Port 1 and Port 2 switch and coupler ports (installs options 400 & 012)
E8356A, E8357A, and E8358A Network Analyzer Options[a]			
010	Time Domain Capability	015	Configurable Test Set
E8801A, E8802A, and E8803A Network Analyzer Options[a]			
010	Time Domain Capability	014	Configurable Test Set
1E1	Extended Power Range	1E5	High Stability Timebase
E8362A, E8363A, and E8364A Network Analyzer Options[a]			
010	Time Domain Capability	014	Configurable Test Set
016[b]	Add Receiver Attenuators	022	Extended Memory
080[b]	Frequency Offset	081[b]	External Reference Switch
083[b]	Frequency Converter Measurement Application	711	Standard Power Range
UNL	Extended Power Range with Bias Tees		

a. Network analyzer should have firmware revision A.03.53 or later. Contact the factory for information regarding PLTS support of earlier firmware revisions.
b. This option has not been tested and is not specified with the Physical Layer Test System.

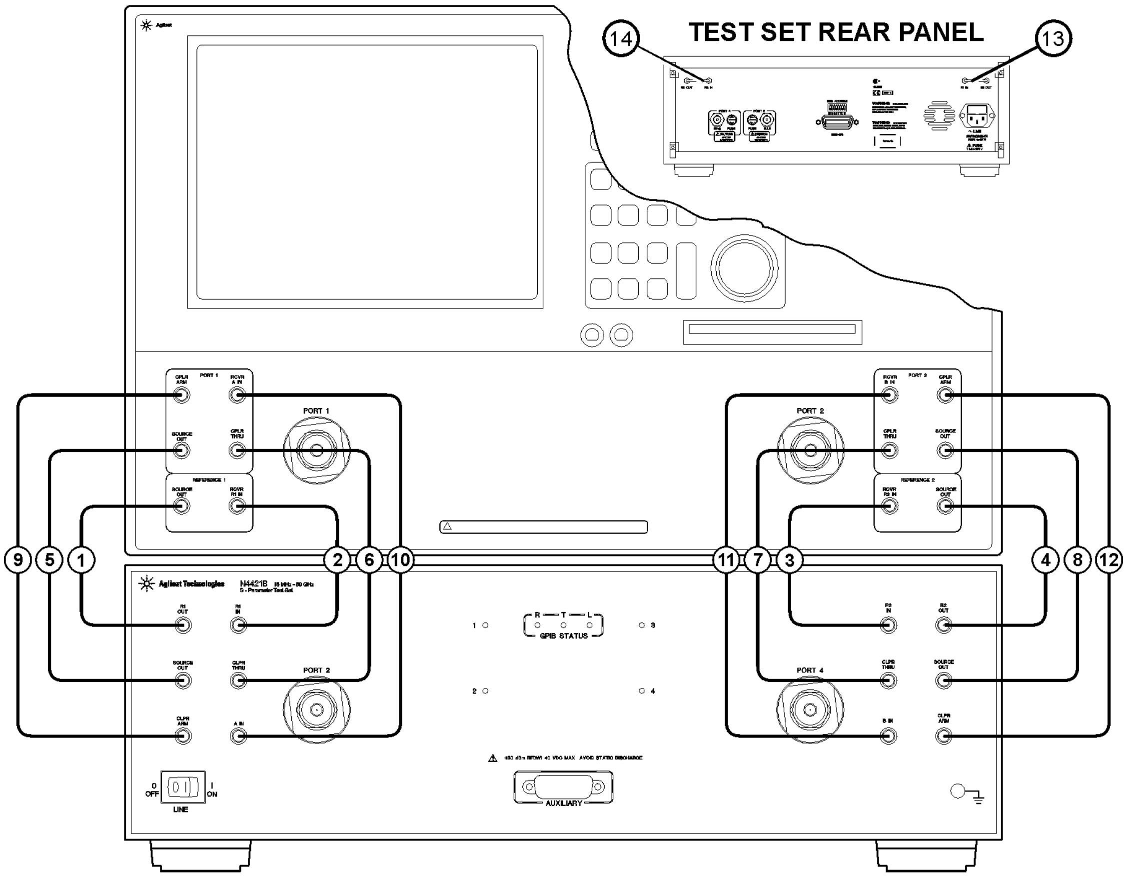
PLTS System Interconnection Diagrams between the S-Parameter Test Set and the Network Analyzer

Locate your system or test set and network analyzer listed below. Refer to the page indicated for information describing the interconnections between the test set and the network analyzer.

Table B-4 PLTS Interconnection Diagrams List for Discontinued Hardware

Test System Model Number	Test Set Model Number	Network Analyzer Model Number	Refer to:
N1957A	N4421A	E8364A	page 285
N/A	N4420B	E8363A	page 287
N1953A	N4419A	E8362A	page 289
N1951A	N4418A	8720ES, 8722ES	page 291
N1948A	N4417A	E8356A, E8357A, E8358A	page 293
N1947A	N4417A	E8801A, E8802A, E8803A	page 295
N/A	N4416A	E8356A, E8357A, E8358A	page 297
N/A	N4415A	8753ES	page 299

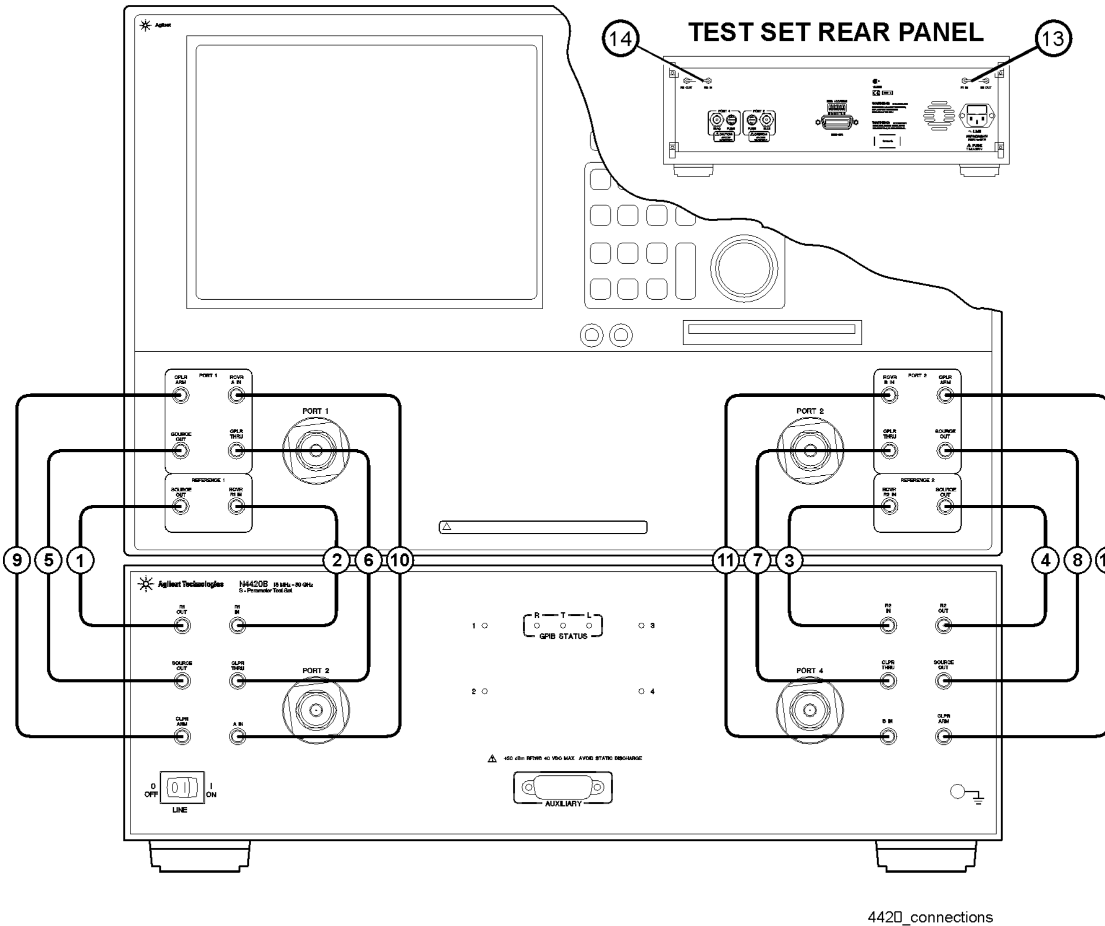
N1957A Test System or N4421A Test Set with E8364A Network Analyzer



CAUTION Damage to the interconnect cable can result from improper orientation of the cable. Refer to page 22 for detailed information regarding the correct cable orientation.

Call Out Sequence	Cable Part Number	From Network Analyzer	To Test Set
1	Z5623-20215	REF 1 SOURCE OUT	REF 1 R1 OUT
2	Z5623-20215	REF 1 RCVR R1 IN	REF 1 RCVR R1 IN
3	Z5623-20215	REF 2 RCVR R2 IN	REF 2 RCVR R2 IN
4	Z5623-20215	REF 2 SOURCE OUT	REF 2 R2 OUT
5	Z5623-20216	PORT 1 SOURCE OUT	PORT 1 SOURCE OUT
6	Z5623-20216	PORT 1 CPLR THRU	PORT 1 CPLR THRU
7	Z5623-20216	PORT 2 CPLR THRU	PORT 2 CPLR THRU
8	Z5623-20216	PORT 2 SOURCE OUT	PORT 2 SOURCE OUT
9	Z5623-20217	PORT 1 CPLR ARM	PORT 1 CPLR ARM
10	Z5623-20217	PORT 1 RCVR A IN	PORT 1 RCVR A IN
11	Z5623-20217	PORT 2 RCVR B IN	PORT 2 RCVR B IN
12	Z5623-20217	PORT 2 CPLR ARM	PORT 2 CPLR ARM
13	E8364-20059	REF 1 on rear panel of the test set	
14	E8364-20059	REF 2 on rear panel of the test set	

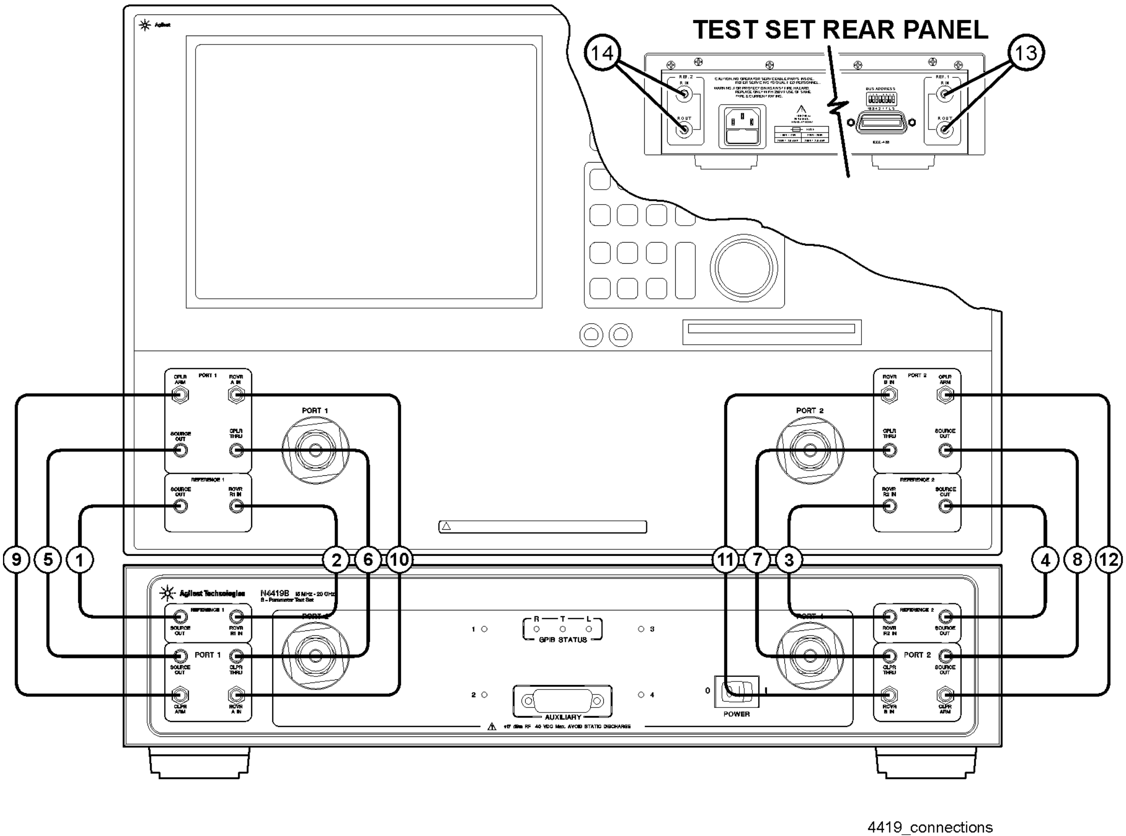
N4420B Test Set with E8363A Network Analyzer Interconnections



CAUTION Damage to the interconnect cable can result from improper orientation of the cable. Refer to page 22 for detailed information regarding the correct cable orientation.

Call Out Sequence	Cable Part Number	From Network Analyzer	To Test Set
1	Z5623-20215	REF 1 SOURCE OUT	REF 1 R1 OUT
2	Z5623-20215	REF 1 RCVR R1 IN	REF 1 RCVR R1 IN
3	Z5623-20215	REF 2 RCVR R2 IN	REF 2 RCVR R2 IN
4	Z5623-20215	REF 2 SOURCE OUT	REF 2 R2 OUT
5	Z5623-20216	PORT 1 SOURCE OUT	PORT 1 SOURCE OUT
6	Z5623-20216	PORT 1 CPLR THRU	PORT 1 CPLR THRU
7	Z5623-20216	PORT 2 CPLR THRU	PORT 2 CPLR THRU
8	Z5623-20216	PORT 2 SOURCE OUT	PORT 2 SOURCE OUT
9	Z5623-20217	PORT 1 CPLR ARM	PORT 1 CPLR ARM
10	Z5623-20217	PORT 1 RCVR A IN	PORT 1 RCVR A IN
11	Z5623-20217	PORT 2 RCVR B IN	PORT 2 RCVR B IN
12	Z5623-20217	PORT 2 CPLR ARM	PORT 2 CPLR ARM
13	E8364-20059	REF 1 on rear panel of the test set	
14	E8364-20059	REF 2 on rear panel of the test set	

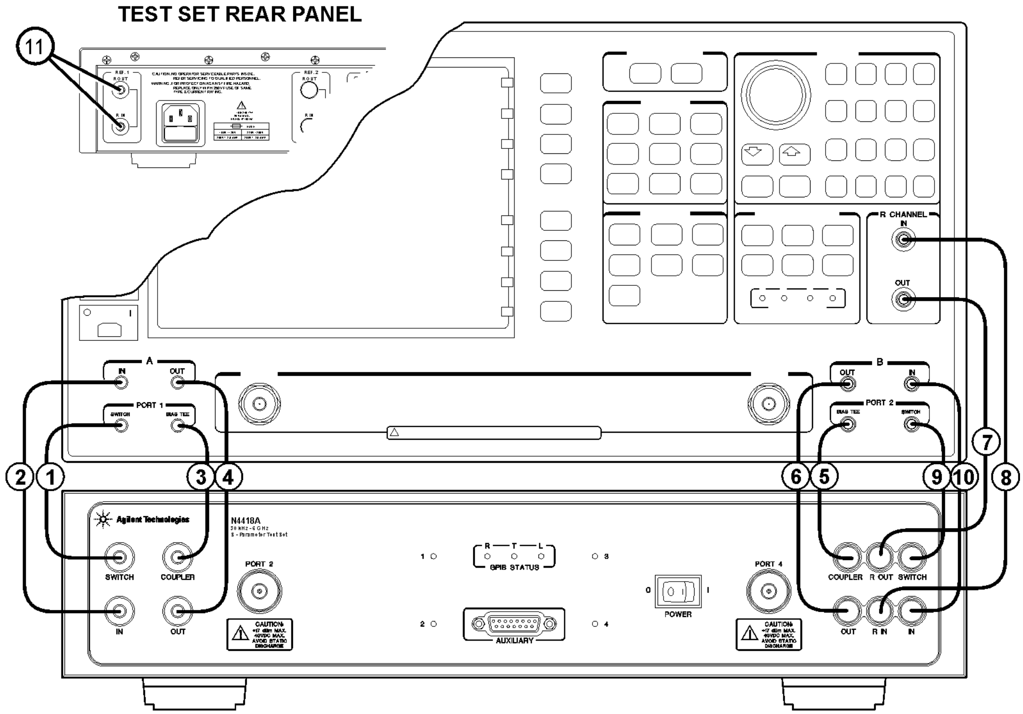
N1953A Test System or N4419A Test Set with E8362A Network Analyzer



CAUTION Damage to the interconnect cable can result from improper orientation of the cable. Refer to page 22 for detailed information regarding the correct cable orientation.

Call Out Sequence	Cable Part Number	From Network Analyzer	To Test Set
1	AD00756-1	REF 1 SOURCE OUT	REF 1 SOURCE OUT
2	AD00756-1	REF 1 RCVR R1 IN	REF 1 RCVR R1 IN
3	AD00756-1	REF 2 RCVR R2 IN	REF 2 RCVR R2 IN
4	AD00756-1	REF 2 SOURCE OUT	REF 2 SOURCE OUT
5	AD00756-2	PORT 1 SOURCE OUT	PORT 1 SOURCE OUT
6	AD00756-2	PORT 1 CPLR THRU	PORT 1 CPLR THRU
7	AD00756-2	PORT 2 CPLR THRU	PORT 2 CPLR THRU
8	AD00756-2	PORT 2 SOURCE OUT	PORT 2 SOURCE OUT
9	AD00756-3	PORT 1 CPLR ARM	PORT 1 CPLR ARM
10	AD00756-3	PORT 1 RCVR A IN	PORT 1 RCVR A IN
11	AD00756-3	PORT 2 RCVR B IN	PORT 2 RCVR B IN
12	AD00756-3	PORT 2 CPLR ARM	PORT 2 CPLR ARM
13	AD00756-4	REF 1 on rear panel of the test set	
14	AD00756-4	REF 2 on rear panel of the test set	

N1951A Test System or N4418A Test Set with 8720ES or 8722ES Network Analyzer

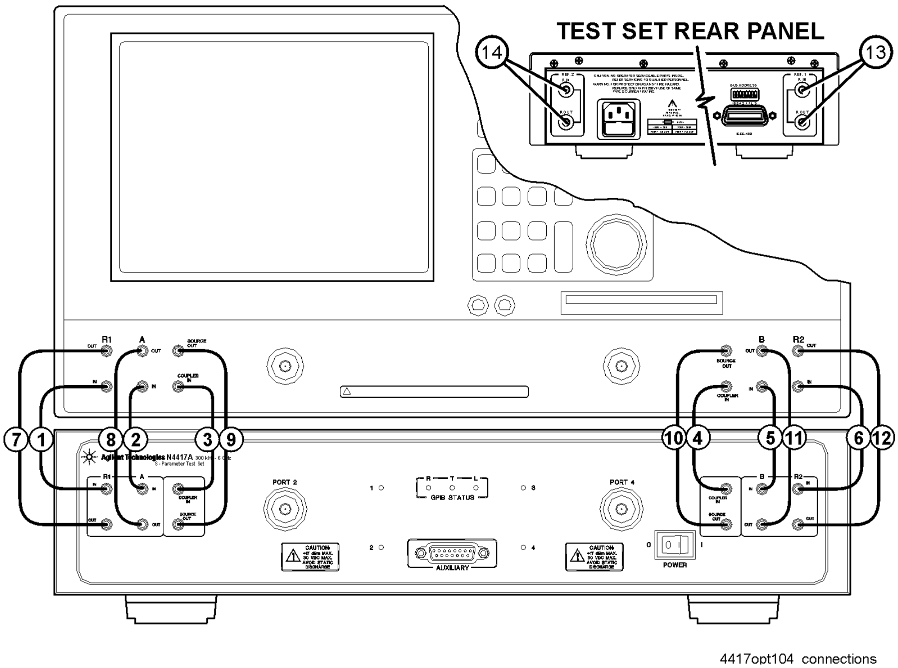


CAUTION	Damage to the interconnect cable can result from improper orientation of the cable. Refer to page 22 for detailed information regarding the correct cable orientation.

Call Out Sequence	Cable Part Number	From Network Analyzer	To Test Set
1	AD00599-2	PORT 1 SWITCH	PORT 1 SWITCH
2	AD00599-1	A IN	A IN
3	AD00599-2	PORT 1 BIAS TEE	PORT 1 COUPLER
4	AD00599-1	A OUT	A OUT
5	AD00599-2	PORT 2 BIAS TEE	PORT 2 COUPLER
6	AD00599-1	B OUT	B OUT
7	AD00599-4	R CHANNEL OUT	R OUT
8	AD00599-3	R CHANNEL IN	R IN
9	AD00599-2	PORT 2 SWITCH	PORT 2 SWITCH
10	AD00599-1	B IN	B IN
11	AD00599-5	REF 1 on rear panel of the test set	

N1948A Test System Interconnections

(or N4417A Option 104 Test Set with E8356A, E8357A, or E8358A Network Analyzer)

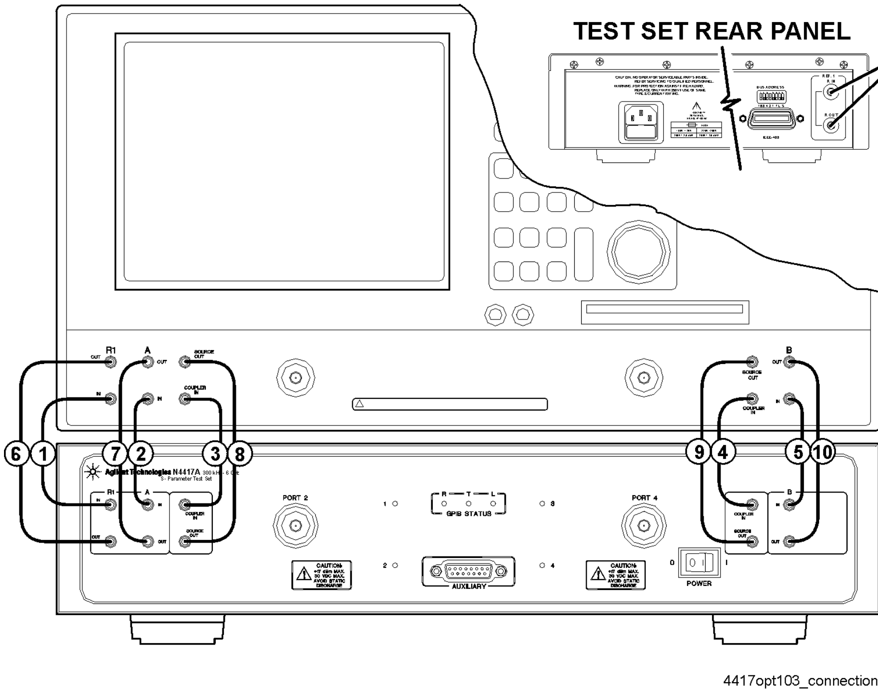


CAUTION Damage to the interconnect cable can result from improper orientation of the cable. Refer to page 22 for detailed information regarding the correct cable orientation.

Installation Sequence	Cable Part Number	From Network Analyzer	To Test Set
1	AD00653-2	R1 IN	R1 IN
2	AD00653-2	A IN	A IN
3	AD00653-2	COUPLER IN	COUPLER IN
4	AD00653-2	COUPLER IN	COUPLER IN
5	AD00653-2	B IN	B IN
6	AD00653-2	R2 IN	R2 IN
7	AD00653-1	R1 OUT	R1 OUT
8	AD00653-1	A OUT	A OUT
9	AD00653-1	SOURCE OUT	SOURCE OUT
10	AD00653-1	SOURCE OUT	SOURCE OUT
11	AD00653-1	B OUT	B OUT
12	AD00653-1	R2 OUT	R2 OUT
13	AD00653-3	REF 1 on rear panel of the test set	
14	AD00653-3	REF 2 on rear panel of the test set	

N1947A Test System Interconnections

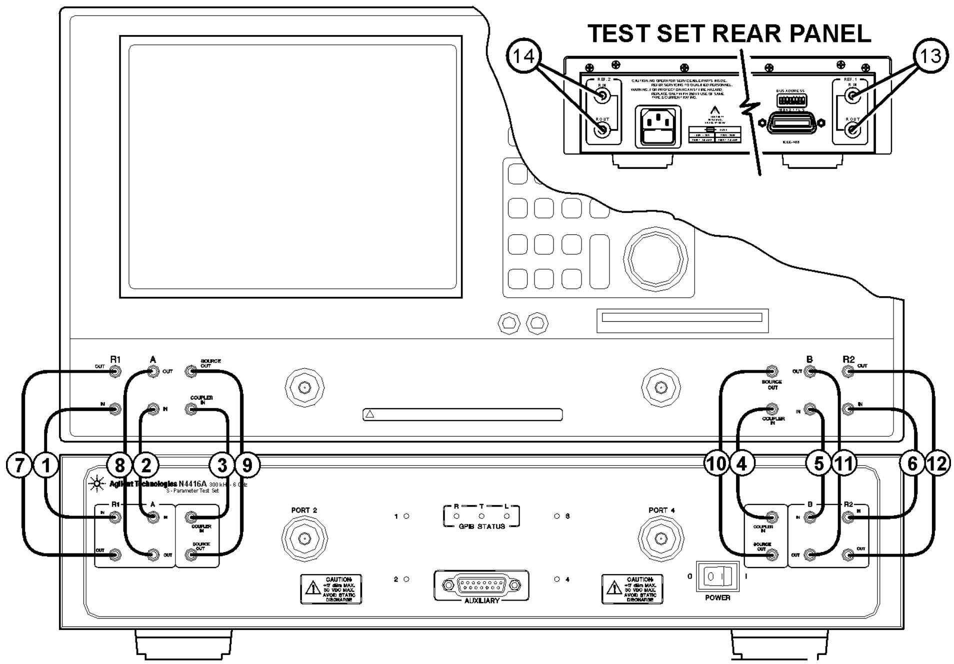
(or N4417A Option 103 Test Set with E8801A, E8802A, or E8803A Network Analyzer)



CAUTION Damage to the interconnect cable can result from improper orientation of the cable. Refer to page 22 for detailed information regarding the correct cable orientation.

Installation Sequence	Cable Part Number	From Network Analyzer	To Test Set
1	AD00653-2	R1 IN	R1 IN
2	AD00653-2	A IN	A IN
3	AD00653-2	COUPLER IN	COUPLER IN
4	AD00653-2	COUPLER IN	COUPLER IN
5	AD00653-2	B IN	B IN
6	AD00653-1	R1 OUT	R1 OUT
7	AD00653-1	A OUT	A OUT
8	AD00653-1	SOURCE OUT	SOURCE OUT
9	AD00653-1	SOURCE OUT	SOURCE OUT
10	AD00653-1	B OUT	B OUT
11	AD00653-3	REF 1 on rear panel of the test set	

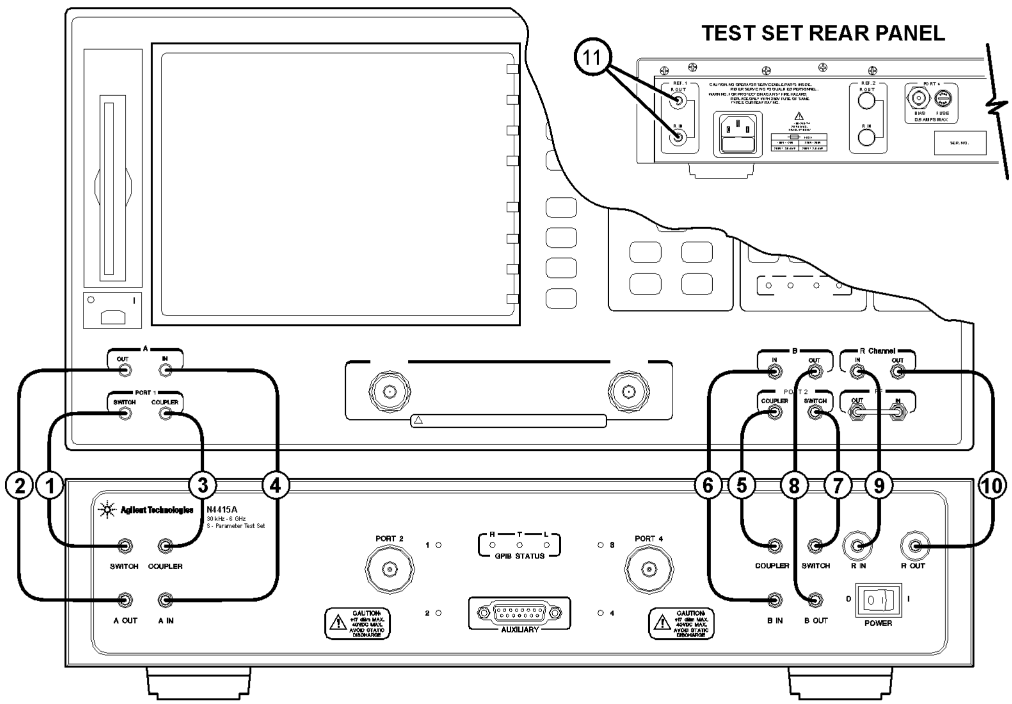
N4416A Test Set with the E8356A, E8357A, or E8358A Network Analyzer



CAUTION Damage to the interconnect cable can result from improper orientation of the cable. Refer to page 22 for detailed information regarding the correct cable orientation.

Installation Sequence	Cable Part Number	From Network Analyzer	To Test Set
1	AD00653-2	R1 IN	R1 IN
2	AD00653-2	A IN	A IN
3	AD00653-2	COUPLER IN	COUPLER IN
4	AD00653-2	COUPLER IN	COUPLER IN
5	AD00653-2	B IN	B IN
6	AD00653-2	R2 IN	R2 IN
7	AD00653-1	R1 OUT	R1 OUT
8	AD00653-1	A OUT	A OUT
9	AD00653-1	SOURCE OUT	SOURCE OUT
10	AD00653-1	SOURCE OUT	SOURCE OUT
11	AD00653-1	B OUT	B OUT
12	AD00653-1	R2 OUT	R2 OUT
13	AD00653-3	REF 1 on rear panel of the test set	
14	AD00653-3	REF 2 on rear panel of the test set	

N4415A Test Set with the 8753ES Network Analyzer



4415_frtpnl_connections

CAUTION Damage to the interconnect cable can result from improper orientation of the cable. Refer to page 22 for detailed information regarding the correct cable orientation.

Installation Sequence	Cable Part Number	From Network Analyzer	To Test Set
1	AD00632-2	Port 1 Switch	Switch
2	AD00632-1	A OUT	A OUT
3	AD00632-2	Port 1 Coupler	Coupler
4	AD00632-1	A IN	A IN
5	AD00632-2	Port 2 Coupler	Coupler
6	AD00632-1	B IN	B IN
7	AD00632-2	Port 2 Switch	Switch
8	AD00632-1	B OUT	B OUT
9	AD00632-3	R Channel In	R IN
10	AD00632-3	R Channel Out	R OUT
11	AD00632-4	REF 1 on rear panel of the test set	

Discontinued System Information for Chapter 5. Specifications and Characteristics

N1947A and N1948A Electrical Specifications and Characteristics

The following specifications are applicable for a system in the following configurations:

Network Analyzer:	Agilent E8803A Option 014 (N1947A System)
	Agilent E8358A Option 015 (N1948A System)
Test Set:	Agilent N4417A Option 103 (N1947A System)
	Agilent N4417A Option 104 (N1948A System)
Calibration Kit:	Agilent 85052C Precision 3.5 mm
Test Port Cables:	Agilent N4417A Option B20
Calibration Technique:	Four-Port SOLT

System Dynamic Range

The test port transmission measurements are valid at 10 Hz IF bandwidth with four-port error correction and +10 dBm maximum output power. The dynamic range is the difference between the rms noise floor and the maximum output power.

Table B-5 System Dynamic Range

Frequency Range	Specification
300 kHz to 1.3 GHz	120 dB[a]
1.3 GHz to 3.0 GHz	120 dB
3.0 GHz to 6.0 GHz	108 dB
6.0 GHz to 9.0 GHz	103 dB

a. May be limited to 100 dB at particular frequencies below 750 MHz due to spurious receiver residuals.

Measurement Port

Residual uncertainties for corrected data using four-port error correction. These apply for 25 °C with less than 1 °C variation from calibration.

Table B-6 Measurement Port Characteristics

Description	Characteristic			
	300 kHz to 1.3 GHz	1.3 GHz to 3.0 GHz	3.0 GHz to 6.0 GHz	6.0 GHz to 9.0 GHz
Directivity	50 dB	47 dB	42 dB	40 dB
Source Match	42 dB	42 dB	38 dB	35 dB
Load Match	50 dB	47 dB	42 dB	40 dB
Reflection Tracking	± 0.006 dB	± 0.007 dB	± 0.009 dB	± 0.015 dB
Transmission Tracking	± 0.012 dB	± 0.015 dB	± 0.040 dB	± 0.060 dB

Measurement Uncertainties

The following graphics show the worst case transmission and reflection magnitude and phase uncertainty for the N1947A and N1948A systems.

Figure B-1 3.5 mm Transmission Magnitude and Phase Uncertainty

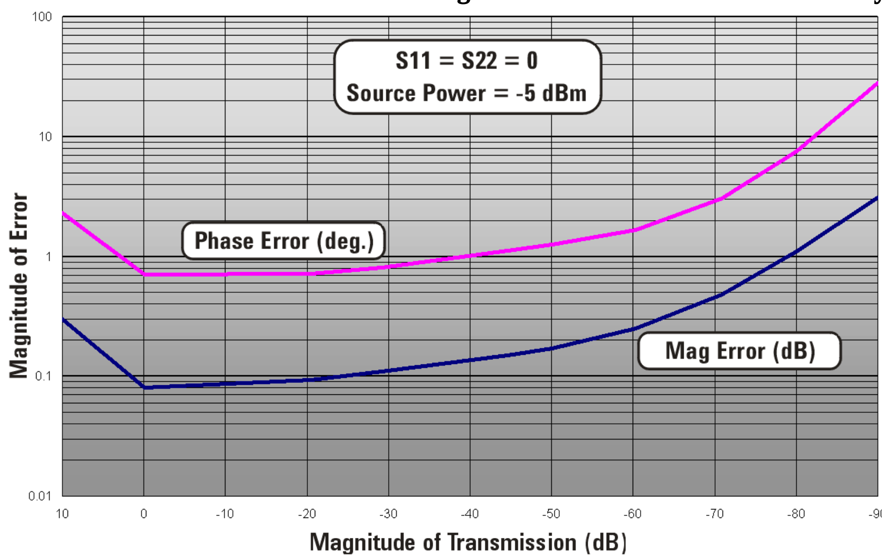
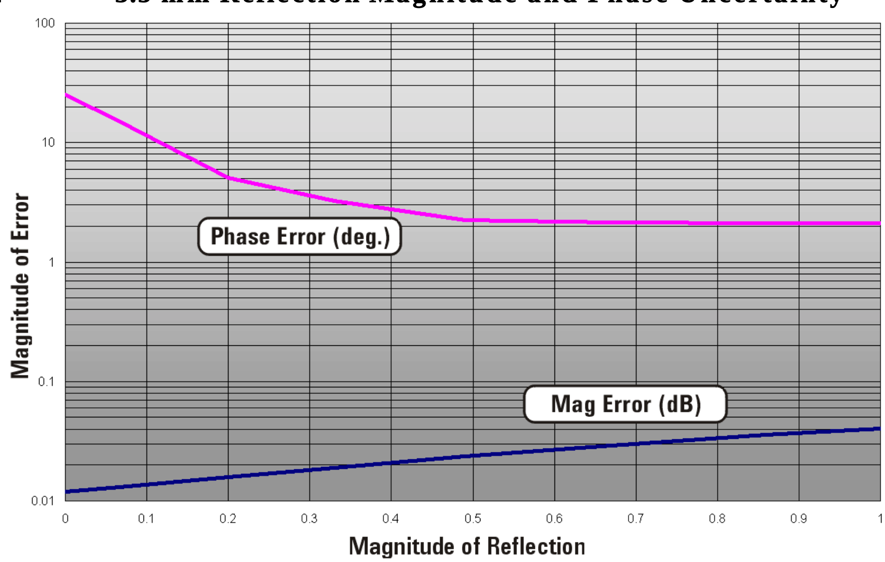


Figure B-2 3.5 mm Reflection Magnitude and Phase Uncertainty



Test Set Performance

Table B-7 Test Set Performance

Description	Specification	Supplemental Information
Frequency Range	300 kHz to 9.0 GHz	
Impedance		50 Ohms (nom.)
Insertion Loss		
Source Out to Coupler In	4.5 dB maximum	
Port 2 to A In and Port 4 to B In	8.5 dB maximum	
A In to A Out and B In to B Out	8.0 dB maximum	
Isolation (port to port and A to B)	≥ 105 dB	
Maximum Operating Level	+20 dBm	
Damage Level		+30 dBm (typ.)
Test Port Connectors		50 Ohms (nom.) Type-N Connectors

Power Supply

The power supply requirements for the test sets are listed below.

Table 8-1 Test Set Power Supply Specifications

Description	Specification
Input Voltage Range	100 to 120 Volts 220 to 250 Volts
Frequency Range	47 to 62 Hertz
Power	40 VA

N1951A Electrical Specifications and Characteristics

The following specifications are applicable for a system in the following configurations:

Network Analyzer:	Agilent 8720ES Option H32
Test Set:	Agilent N4418A
Calibration Kit:	Agilent 85052C Precision 3.5 mm
Test Port Cables:	Agilent N4418A Option B20
Calibration Technique:	Four-Port SOLT

System Dynamic Range

The test port transmission measurements are valid at 10 Hz IF bandwidth with four-port error correction and +5 dBm maximum output power. The dynamic range is the difference between the rms noise floor and the maximum output power.

Table B-8 System Dynamic Range

Frequency Range	Specification
50 MHz to 840 MHz	77 dB
840 MHz to 20.0 GHz	90 dB

Measurement Port

Residual uncertainties for corrected data using four-port error correction. These apply for 25 °C with less than 1 °C variation from calibration.

Table B-9 Measurement Port Characteristics

Description	Characteristic		
	50 MHz to 2.0 GHz	2.0 GHz to 8.0 GHz	8.0 GHz to 20.0 GHz
Directivity	48 dB	48 dB	43 dB
Source Match	41 dB	41 dB	38 dB
Load Match	48 dB	48 dB	43 dB
Reflection Tracking	± 0.005 dB	± 0.005 dB	± 0.008 dB
Transmission Tracking	± 0.014 dB	± 0.014 dB	± 0.035 dB

Measurement Uncertainties

The following graphics show the worst case transmission and reflection magnitude and phase uncertainty for the N1951A system.

Figure B-3 3.5 mm Transmission Magnitude and Phase Uncertainty

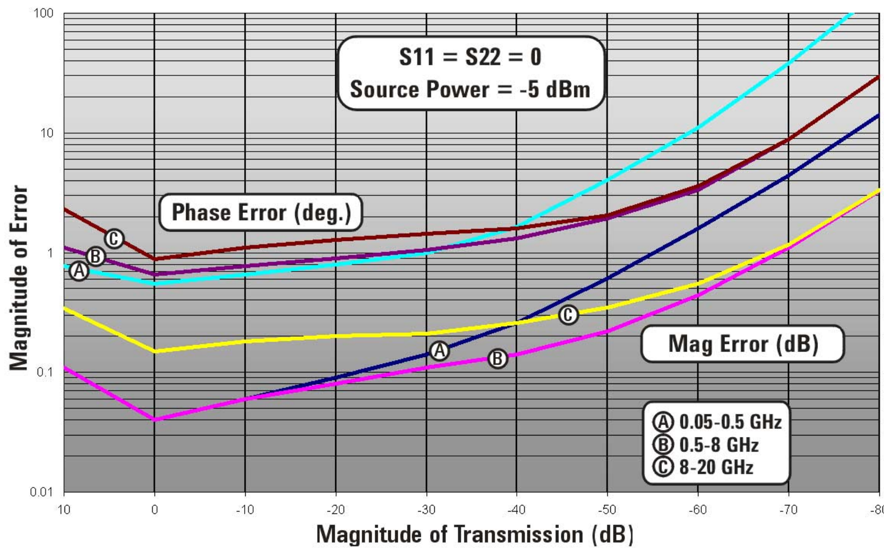
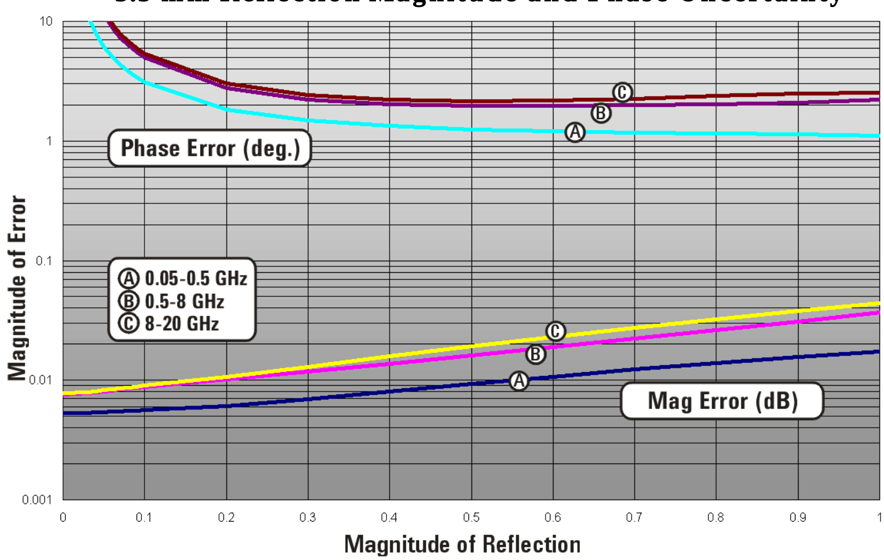


Figure B-4 3.5 mm Reflection Magnitude and Phase Uncertainty



Test Set Performance

Table B-10 Test Set Performance

Description	Specification	Supplemental Information
Frequency Range	50 MHz to 20.0 GHz	
Impedance		50 Ohms (nom.)
Insertion Loss	8 to 10 dB	
Isolation (port to port)	≥ 85 dB	
Maximum Operating Level	+20 dBm	
Damage Level		+30 dBm (typ.)
DC Bias Range (Option UNK only)		40 VDC, 500 mA
Test Port Connectors		50 Ohms (nom.) 3.5 mm (m) Connectors

Power Supply

The power supply requirements for the test sets are listed below.

Table 8-2 Test Set Power Supply Specifications

Description	Specification
Input Voltage Range	100 to 120 Volts 220 to 250 Volts
Frequency Range	47 to 62 Hertz
Power	40 VA

N1953A Electrical Specifications and Characteristics

The following specifications are applicable for a system in the following configurations:

System:	N1953A
Network Analyzer:	Agilent E8362A Options 014 and UNL
Test Set:	Agilent N4419A
Calibration Kit:	Agilent 85052D 3.5 mm
Test Port Cables:	Agilent N4419A Option B20
Calibration Technique:	Four-Port SOLT

System Dynamic Range

The test port transmission measurements are valid at 10 Hz IF bandwidth with four-port error correction and –5 dBm default maximum output power. The dynamic range is the difference between rms noise floor and the output power.

Table B-11 System Dynamic Range

Frequency Range	Specification	Supplemental Information
45 MHz to 500 MHz	70 dB	
500 MHz to 2.0 GHz	100 dB	
2.0 GHz to 10.0 GHz	100 dB	
10.0 GHz to 20.0 GHz	85 dB	

Measurement Port

Residual uncertainties for corrected data using four-port error correction. These apply for 25 °C with less than 1 °C variation from calibration.

Table B-12 Measurement Port Characteristics

Description	Characteristic		
	45 MHz to 2.0 GHz	**2.0 GHz to 10.0 GHz**	**10.0 GHz to 20.0 GHz**
Directivity	56 dB	42 dB	40 dB
Source Match	42 dB	36 dB	33 dB
Load Match	56 dB	42 dB	40 dB
Reflection Tracking	± 0.0025 dB	± 0.009 dB	± 0.013 dB
Transmission Tracking	± 0.020 dB	± 0.032 dB	± 0.050 dB

Measurement Uncertainties

The following graphics show the worst case transmission and reflection magnitude and phase uncertainty for the system.

Figure B-5 3.5 mm Transmission Magnitude and Phase Uncertainty

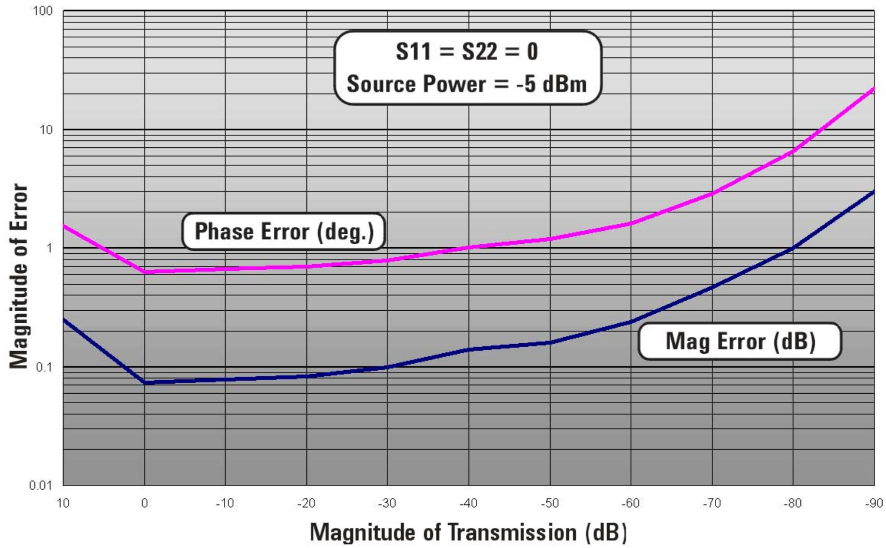
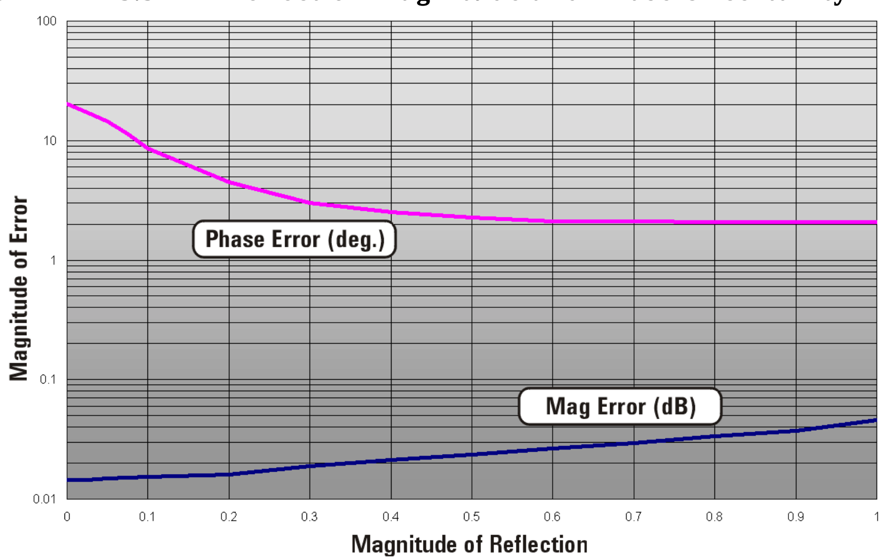


Figure B-6 3.5 mm Reflection Magnitude and Phase Uncertainty



Test Set Performance

Table B-13 Test Set Performance

Description	Characteristics	Supplemental Information
Frequency Range	45 MHz to 20.0 GHz	
Impedance		50 Ohms (nom.)
Insertion Loss		
Source Out to Coupler Thru	5.0 dB maximum	
Port 2 to Rcvr A In and Port 4 to Rcvr B In		
45 MHz to 1.0 GHz		18 to 45 dB (typical)
1.0 GHz to 20.0 GHz		18 to 25 dB (typical)
Rcvr A In to Cplr Arm and Rcvr B In to Cplr Arm	8.0 dB maximum	
Isolation (port to port)		
45 MHz to 200 MHz	≥ 70 dB	
200 MHz to 20 GHz	≥ 90 dB	
Maximum Operating Level	+20 dBm	
Damage Level		+30 dBm (typical)
Test Port Connectors		50 Ohms (nom.) 3.5 mm Connectors

Power Supply

The power supply requirements for the test sets are listed below.

Table 8-3 Test Set Power Supply Specifications

Description	Specification
Input Voltage Range	100 to 240 Volts
Frequency Range	47 to 63 Hertz
Power	40 VA

N1957A Electrical Specifications and Characteristics

The following specifications are applicable for the systems in the following configurations:

System:	N1957A
Network Analyzer:	Agilent E8364A Options 014 and UNL
Test Set:	Agilent N4421A
Calibration Kit:	Agilent 85056A 2.4 mm
Test Cables:	Agilent N4421A Option B20
Calibration Technique:	Four-Port SOLT

System Dynamic Range

The test port transmission measurements are valid at 10 Hz IF bandwidth with four-port error correction and –17 dBm default maximum output power. The dynamic range is the difference between rms noise floor and the output power.

Table B-14 System Dynamic Range

Frequency Range	Specification	Supplemental Information
45 MHz to 500 MHz	55 dB	
500 MHz to 10.0 GHz	70 dB	
10.0 GHz to 20.0 GHz	70 dB	
20.0 GHz to 50.0 GHz	55 dB	

Measurement Port

Residual uncertainties for corrected data using four-port error correction. These apply for 25 °C with less than 1 °C variation from calibration.

Table B-15 Measurement Port Characteristics

Description	**Characteristic**			
	45 MHz to 0.5 GHz	**0.5 GHz to 10.0 GHz**	**10.0 GHz to 20.0 GHz**	**20.0 GHz to 50.0 GHz**
Directivity	43 dB	39.5 dB	39 dB	33 dB
Source Match	38 dB	34 dB	34 dB	27 dB
Load Match	43 dB	39.5 dB	39 dB	33 dB
Reflection Tracking	± 0.001 dB	± 0.002 dB	± 0.008 dB	± 0.026 dB
Transmission Tracking	± 0.015 dB	± 0.020 dB	± 0.040 dB	± 0.20 dB

Measurement Uncertainties

The following graphics show the worst case transmission and reflection magnitude and phase uncertainty for the system.

Figure B-7 **2.4 mm Transmission Magnitude and Phase Uncertainty**

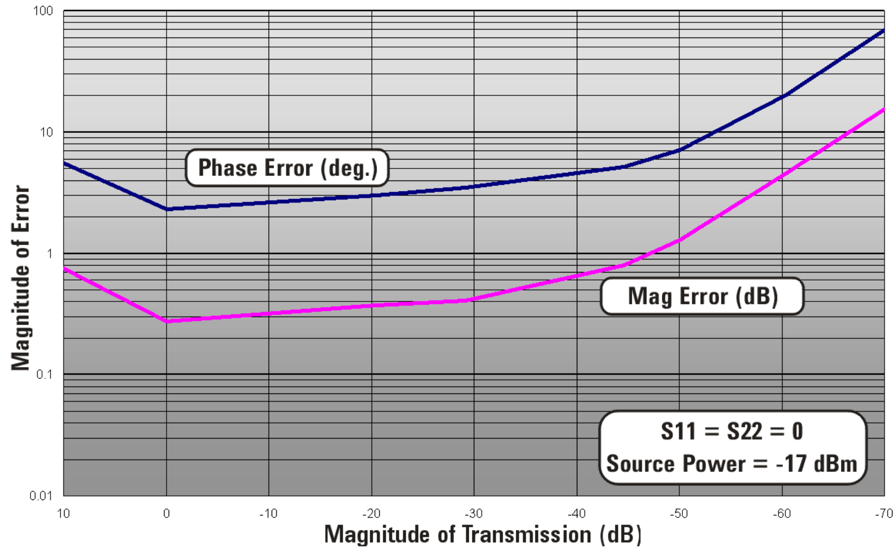
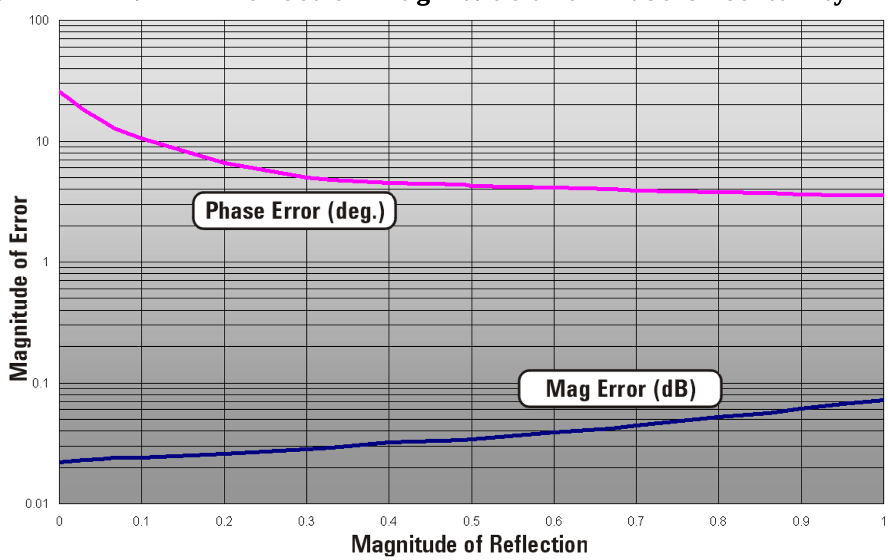


Figure B-8 **2.4 mm Reflection Magnitude and Phase Uncertainty**



Test Set Performance

Table B-16 Test Set Performance

Description	Characteristics	Supplemental Information
Frequency Range	45 MHz to 50.0 GHz	
Transition Time (10 to 90%, TR=.72/BW)	14 ps	
Impedance		50 Ohms (nom.)
Insertion Loss		
Source Out to Coupler Thru	12.0 dB maximum	
Port 2 to Rcvr A In and Port 4 to Rcvr B In		
45 MHz to 1.0 GHz		18 to 45 dB (typical)
1.0 GHz to 50.0 GHz		16 to 26 dB (typical)
Rcvr A In to Cplr Arm and Rcvr B In to Cplr Arm	15.0 dB maximum	
Isolation (port to port)		
45 MHz to 200 MHz	≥ 70 dB	
200 MHz to 50 GHz	≥ 90 dB	
Maximum Operating Level	+20 dBm	
Damage Level		+30 dBm (typical)
Test Port Connectors		50 Ohms (nom.) 2.4 mm (m) Connectors

Power Supply

The power supply requirements for the test sets are listed below.

Table 8-4 Test Set Power Supply Specifications

Description	Specification
Input Voltage Range	100 to 240 Volts
Frequency Range	47 to 63 Hertz
Power	40 VA

General Characteristics

The test set environmental operating conditions and physical characteristics are displayed on the following pages.

Environmental Operating Conditions

The environmental operating conditions for the test set are listed below.

Table 8-5 Test Set Environmental Operating Conditions

Description	Conditions
Operating Environment	Indoor use
Altitude	
Operating:	0 to 2.0 km (6,560 ft)
Storage:	0 to 15.24 km (50,000 ft)
Temperature	0 °C to 40 °C
Maximum Relative Humidity	80% for temperatures up to 31 °C decreasing linearly to 50% for a temperature of 40 °C

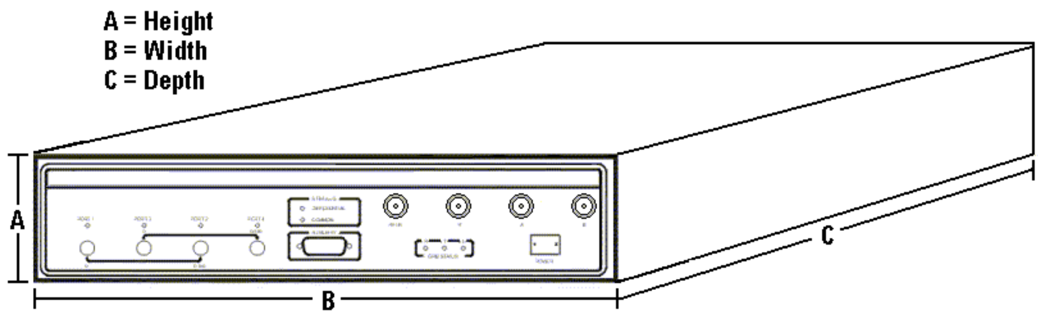
This product is designed for use in INSTALLATION CATEGORY II and POLLUTION DEGREE 2, per IED 61010-1 and 664, respectively.

Physical Characteristics

The weight and dimensions for the test sets are listed below.

Weight and Dimensions

Table B-17 Test Set Weight and Dimensions



Model Number	Weight	Dimensions		
		Height (A)	Width (B)	Depth (C)
N4415A, N4416A, N4417A, N4418A, and N4419A	9.0 kilograms (19.9 pounds)	3.0 in (7.62 cm)	16.75 in (42.55 cm)	19.25 in (48.90 cm)
N4421A	9.0 kilograms (19.9 pounds)	5.5 in (13.97 cm)	16.75 in (42.55 cm)	16.75 in (42.55 cm)

Discontinued System Information for Chapter 6. Test Set Front Panel and Rear Panel

This chapter provides a graphical overview of the test sets used as part of the physical layer test system. This chapter also illustrates the front and rear panels of the S-parameter test sets separately. The features of each front and rear panel (such as connectors, switches, LEDs, and fuses) are identified and briefly described.

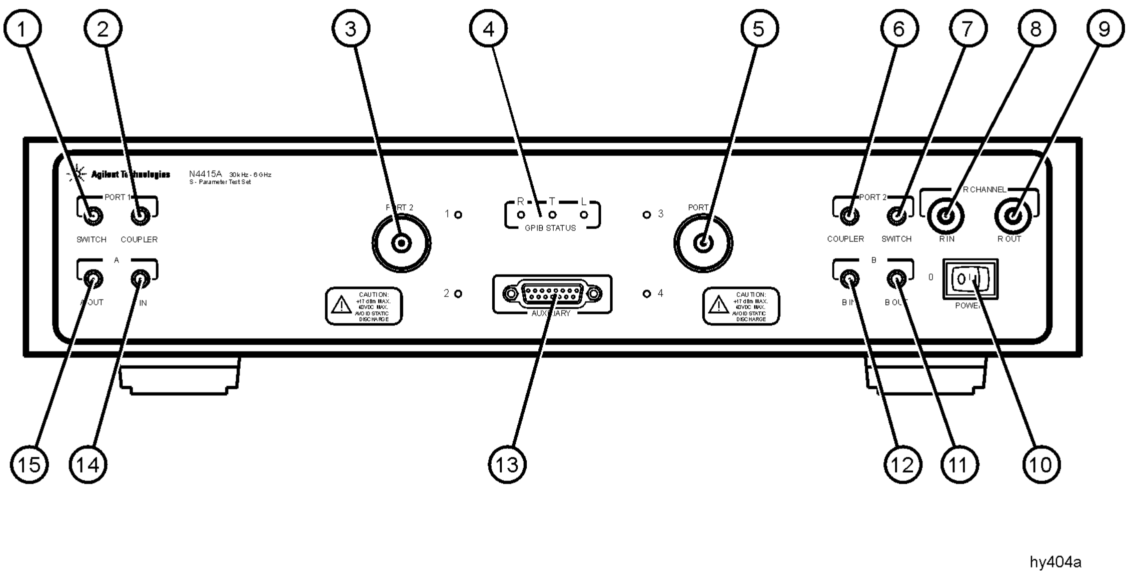
The individual network analyzer features are described in the network analyzer documentation. They are not be described in this document!

The front and rear panel of each S-parameter test set model is illustrated and described. Refer to the page number listed below for your test set model number.

For Model Number:	Refer to:
N4415A	page 323
N4416A	page 327
N4417A	page 331
N4418A	page 335
N4419A	page 339
N4421A	page 343

N4415A

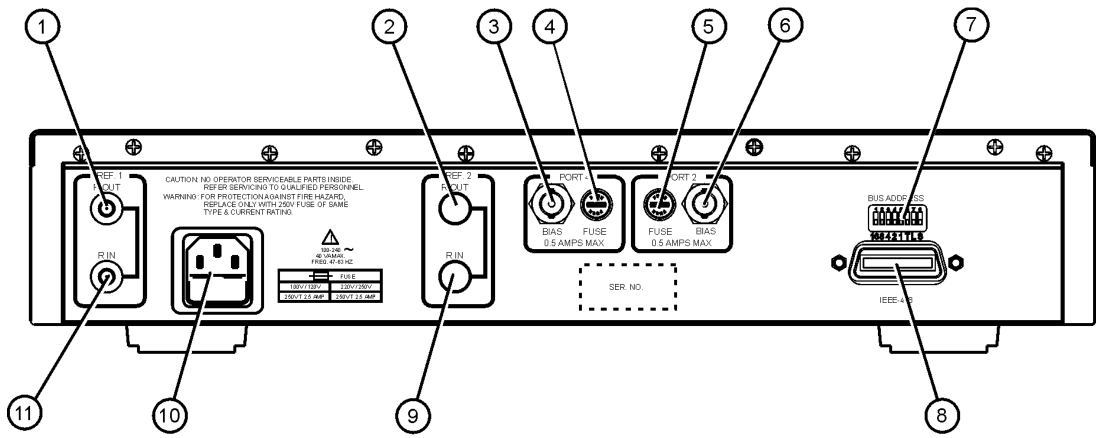
N4415A Front Panel



ID Number	Front Panel Feature	Feature Description
1	SWITCH	SMA (f) connector that is connected to the network analyzer PORT 1 SWITCH connector using a semirigid cable.
2	COUPLER	SMA (f) connector that is connected to the network analyzer PORT 1 COUPLER connector using a semirigid cable.
3	PORT 2	APC-7 connector that is connected to the DUT or fixture. (+17 dBm maximum operating level)
4	GPIB STATUS	Three LEDs (R, T, and L) that display the GPIB status of the test set when it is communicating with the network analyzer. R = Remote Operation, T = Talk mode, L = Listen mode.
5	PORT 4	APC-7 connector that is connected to the DUT or fixture. (+17 dBm maximum operating level)
6	COUPLER	SMA (f) connector that is connected to the network analyzer PORT 2 COUPLER connector using a semirigid cable.

ID Number	Front Panel Feature	Feature Description
7	SWITCH	SMA (f) connector that is connected to the network analyzer PORT 2 SWITCH connector using a semirigid cable.
8	R IN	SMA (f) connector that is connected to the network analyzer R Channel IN connector using a semirigid cable.
9	R OUT	SMA (f) connector that is connected to the network analyzer R Channel OUT connector using a semirigid cable.
10	POWER	ON/OFF switch that disconnects the mains circuits from the mains supply before other parts of the test set. The front panel POWER switch disconnects the mains circuits from the mains supply after the EMC filters and before other parts of the instrument.
11	B OUT	SMA (f) connector that is connected to the network analyzer B OUT connector using a semirigid cable.
12	B IN	SMA (f) connector that is connected to the network analyzer B IN connector using a semirigid cable.
13	AUXILIARY	15-pin ribbon (f) connector that may be connected to the Agilent N4430A/B ECal module to provide ECal capability.
14	A IN	SMA (f) connector that is connected to the network analyzer A IN connector using a semirigid cable.
15	A OUT	SMA (f) connector that is connected to the network analyzer A OUT connector using a semirigid cable.

N4415A Rear Panel



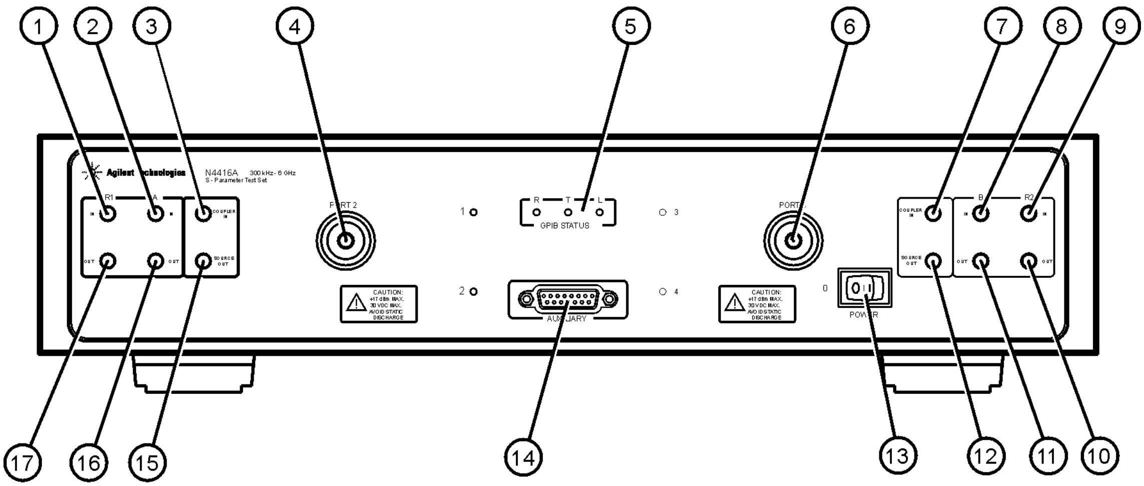
hy405a

ID Number	Rear Panel Feature	Feature Description
1	REF 1 R OUT	SMA (f) connector, used as an output reference signal
2	REF 2 R OUT	Not Used
3	PORT 4 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.
4	PORT 4 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
5	PORT 2 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
6	PORT 2 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.
7	BUS ADDRESS	Switch that is used to set the GPIB address. Refer to “Step 7. Set Up the General Purpose Interface Bus (GPIB)” on page 29 for further information.
8	IEEE-488	24-pin IEEE-488/PCB (f) connector. The GPIB is the communication bus with the PC and the network analyzer.
9	REF 2 R IN	Not Used

ID Number	Rear Panel Feature	Feature Description
10	Power Cord Connector	Connector, 100-120 Vac or 220-250Vac input and Fuse, T 2.5 A 250 V (Agilent part number 2110-0681)
11	REF 1 R IN	SMA (f) connector, used as an input reference signal

N4416A

N4416A Front Panel

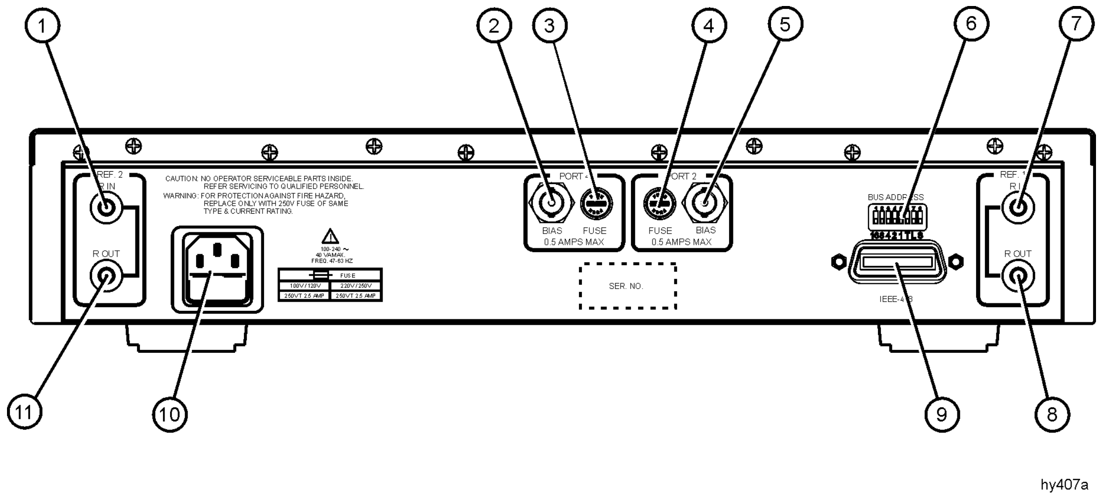


hy406a

ID Number	Front Panel Feature	Feature Description
1	R1 IN	SMA (f) connector that is connected to the network analyzer R1 IN connector using a semirigid cable.
2	A IN	SMA (f) connector that is connected to the network analyzer A IN connector using a semirigid cable.
3	COUPLER IN	SMA (f) connector that is connected to the network analyzer COUPLER IN connector using a semirigid cable.
4	PORT 2	APC-7 connector that is connected to the DUT or fixture. (+17 dBm maximum operating level)
5	GPIB STATUS	Three LEDs (R, T, and L) that display the GPIB status of the test set when it is communicating with the network analyzer. R = Remote Operation, T = Talk mode, L = Listen mode.
6	PORT 4	APC-7 connector that is connected to the DUT or fixture. (+17 dBm maximum operating level)

ID Number	Front Panel Feature	Feature Description
7	COUPLER IN	SMA (f) connector that is connected to the network analyzer COUPLER IN connector using a semirigid cable.
8	B IN	SMA (f) connector that is connected to the network analyzer B IN connector using a semirigid cable.
9	R2 IN	SMA (f) connector that is connected to the network analyzer R2 IN connector using a semirigid cable.
10	R2 OUT	SMA (f) connector that is connected to the network analyzer R2 OUT connector using a semirigid cable.
11	B OUT	SMA (f) connector that is connected to the network analyzer B OUT connector using a semirigid cable.
12	SOURCE OUT	SMA (f) connector that is connected to the network analyzer SOURCE OUT connector using a semirigid cable.
13	POWER	ON/OFF switch that disconnects the mains circuits from the mains supply before other parts of the test set. The front panel POWER switch disconnects the mains circuits from the mains supply after the EMC filters and before other parts of the instrument.
14	AUXILIARY	15-pin ribbon (f) connector that may be connected to the Agilent N4430A/B ECal module to provide ECal capability.
15	SOURCE OUT	SMA (f) connector that is connected to the network analyzer SOURCE OUT connector using a semirigid cable.
16	A OUT	SMA (f) connector that is connected to the network analyzer A OUT connector using a semirigid cable.
17	R1 OUT	SMA (f) connector that is connected to the network analyzer R1 OUT connector using a semirigid cable.

N4416A Rear Panel

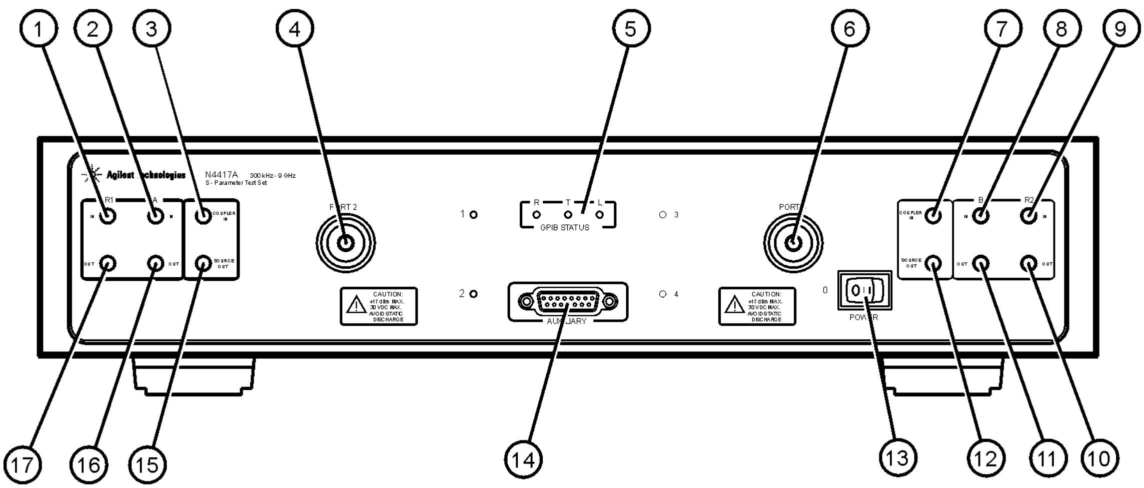


ID Number	Rear Panel Feature	Feature Description
1	REF 2 R IN	SMA (f) connector, used as an input reference signal
2	PORT 4 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.
3	PORT 4 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
4	PORT 2 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
5	PORT 2 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.
6	BUS ADDRESS	Switch that is used to set the GPIB address. Refer to “Step 7. Set Up the General Purpose Interface Bus (GPIB)” on page 29 for further information.
7	REF 1 R IN	SMA (f) connector, used as an input reference signal
8	REF 1 R OUT	SMA (f) connector, used as an output reference signal
9	IEEE-488	24-pin IEEE-488/PCB (f) connector. The GPIB is the communication bus with the PC and the network analyzer.

ID Number	Rear Panel Feature	Feature Description
10	Power Cord Connector	Connector, 100-120 Vac or 220-250Vac input and Fuse, T 2.5 A 250 V (Agilent part number 2110-0681)
11	REF 2 R OUT	SMA (f) connector, used as an output reference signal

N4417A

N4417A Front Panel

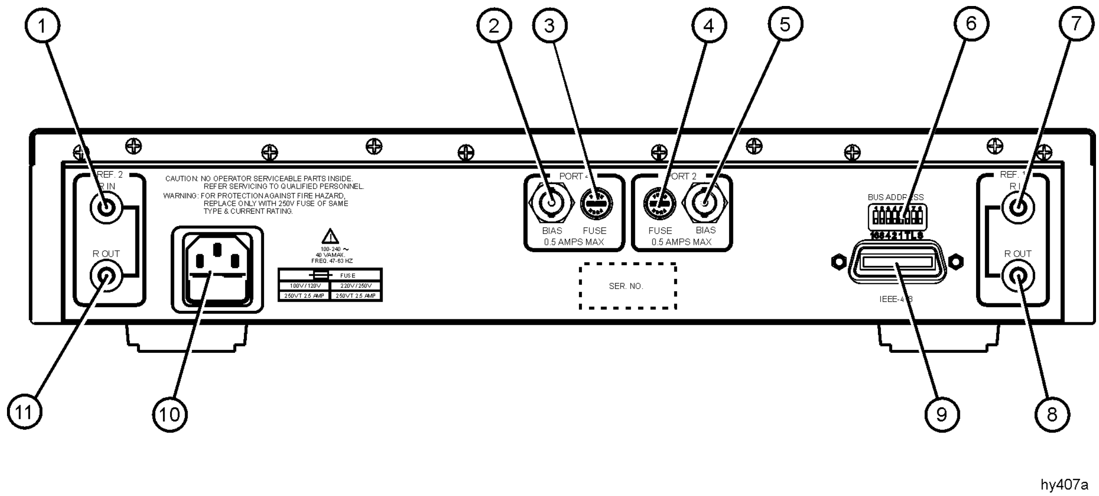


4417_frtpnl

ID Number	Front Panel Feature	Feature Description
1	R1 IN	SMA (f) connector that is connected to the network analyzer R1 IN connector using a semirigid cable.
2	A IN	SMA (f) connector that is connected to the network analyzer A IN connector using a semirigid cable.
3	COUPLER IN	SMA (f) connector that is connected to the network analyzer COUPLER IN connector using a semirigid cable.
4	PORT 2	APC-7 connector that is connected to the DUT or fixture. (+17 dBm maximum operating level)
5	GPIB STATUS	Three LEDs (R, T, and L) that display the GPIB status of the test set when it is communicating with the network analyzer. R = Remote Operation, T = Talk mode, L = Listen mode.
6	PORT 4	APC-7 connector that is connected to the DUT or fixture. (+17 dBm maximum operating level)

ID Number	Front Panel Feature	Feature Description
7	COUPLER IN	SMA (f) connector that is connected to the network analyzer COUPLER IN connector using a semirigid cable.
8	B IN	SMA (f) connector that is connected to the network analyzer B IN connector using a semirigid cable.
9	R2 IN	SMA (f) connector that is connected to the network analyzer R2 IN connector using a semirigid cable. This connector is installed on Option 104 only. It is not installed on Option 103.
10	R2 OUT	SMA (f) connector that is connected to the network analyzer R2 OUT connector using a semirigid cable. This connector is installed on Option 104 only. It is not installed on Option 103.
11	B OUT	SMA (f) connector that is connected to the network analyzer B OUT connector using a semirigid cable.
12	SOURCE OUT	SMA (f) connector that is connected to the network analyzer SOURCE OUT connector using a semirigid cable.
13	POWER	ON/OFF switch that disconnects the mains circuits from the mains supply before other parts of the test set. The front panel POWER switch disconnects the mains circuits from the mains supply after the EMC filters and before other parts of the instrument.
14	AUXILIARY	15-pin ribbon (f) connector that may be connected to the Agilent N4430A/B ECal module to provide ECal capability.
15	SOURCE OUT	SMA (f) connector that is connected to the network analyzer SOURCE OUT connector using a semirigid cable.
16	A OUT	SMA (f) connector that is connected to the network analyzer A OUT connector using a semirigid cable.
17	R1 OUT	SMA (f) connector that is connected to the network analyzer R1 OUT connector using a semirigid cable.

N4417A Rear Panel

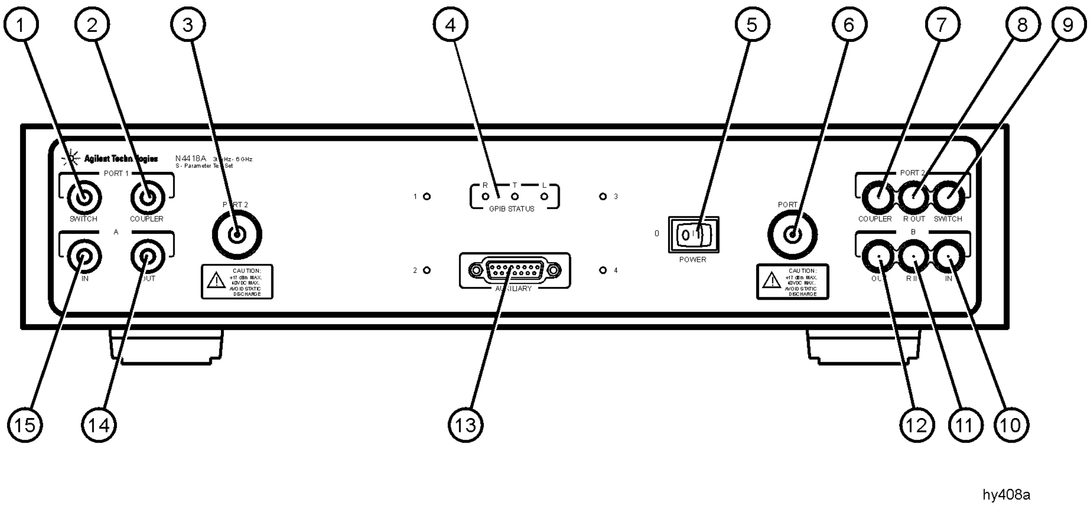


ID Number	Rear Panel Feature	Feature Description
1	REF 2 R IN	SMA (f) connector, used as an input reference signal. This connector is installed on Option 104 only. It is not installed on Option 103.
2	PORT 4 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.
3	PORT 4 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
4	PORT 2 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
5	PORT 2 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.
6	BUS ADDRESS	Switch that is used to set the GPIB address. Refer to "Step 7. Set Up the General Purpose Interface Bus (GPIB)" on page 29 for further information.
7	REF 1 R IN	SMA (f) connector, used as an input reference signal
8	REF 1 R OUT	SMA (f) connector, used as an output reference signal

ID Number	Rear Panel Feature	Feature Description
9	IEEE-488	24-pin IEEE-488/PCB (f) connector. The GPIB is the communication bus with the PC and the network analyzer.
10	Power Cord Connector	Connector, 100-120 Vac or 220-250Vac input and Fuse, T 2.5 A 250 V (Agilent part number 2110-0681)
11	REF 2 R OUT	SMA (f) connector, used as an output reference signal. This connector is installed on Option 104 only. It is not installed on Option 103.

N4418A

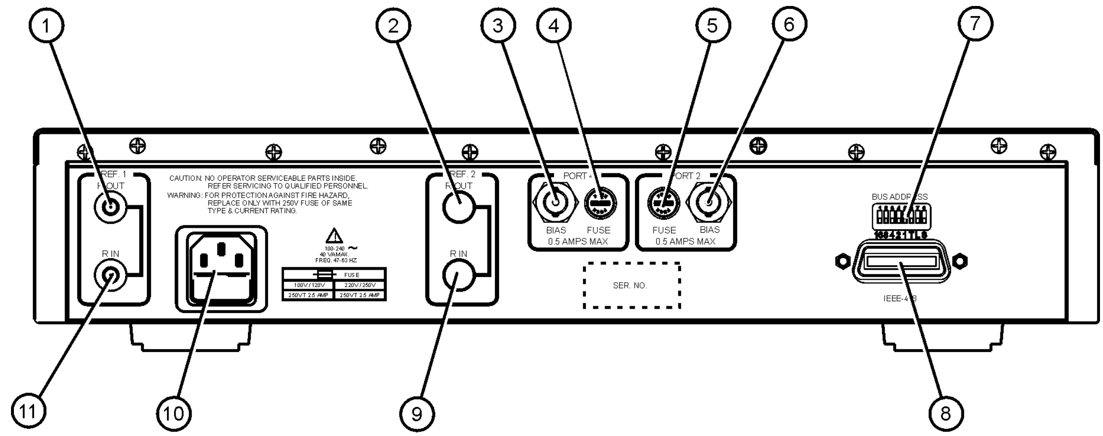
N4418A Front Panel



ID Number	Front Panel Feature	Feature Description
1	SWITCH	SMA (f) connector that is connected to the network analyzer PORT 1 SWITCH connector using a semirigid cable.
2	COUPLER	SMA (f) connector that is connected to the network analyzer PORT 1 BIAS TEE connector using a semirigid cable.
3	PORT 2	APC-3.5 (m) connector with 20 mm nut that is connected to the DUT or fixture. (+17 dBm maximum operating level)
4	GPIB STATUS	Three LEDs (R, T, and L) that display the GPIB status of the test set when it is communicating with the network analyzer. R = Remote Operation, T = Talk mode, L = Listen mode.
5	POWER	ON/OFF switch that disconnects the mains circuits from the mains supply before other parts of the test set. The front panel POWER switch disconnects the mains circuits from the mains supply after the EMC filters and before other parts of the instrument.

ID Number	Front Panel Feature	Feature Description
6	PORT 4	APC-3.5 (m) connector with 20 mm nut that is connected to the DUT or fixture. (+17 dBm maximum operating level)
7	COUPLER	SMA (f) connector that is connected to the network analyzer PORT 2 BIAS TEE connector using a semirigid cable.
8	R OUT	SMA (f) connector that is connected to the network analyzer R CHANNEL OUT connector using a semirigid cable.
9	SWITCH	SMA (f) connector that is connected to the network analyzer PORT 2 SWITCH connector using a semirigid cable.
10	IN	SMA (f) connector that is connected to the network analyzer B IN connector using a semirigid cable.
11	R IN	SMA (f) connector that is connected to the network analyzer R CHANNEL IN connector using a semirigid cable.
12	OUT	SMA (f) connector that is connected to the network analyzer B OUT connector using a semirigid cable.
13	AUXILIARY	15-pin ribbon (f) connector that may be connected to the Agilent N4430A/B ECal module to provide ECal capability.
14	OUT	SMA (f) connector that is connected to the network analyzer A OUT connector using a semirigid cable.
15	IN	SMA (f) connector that is connected to the network analyzer A IN connector using a semirigid cable.

N4418A Rear Panel



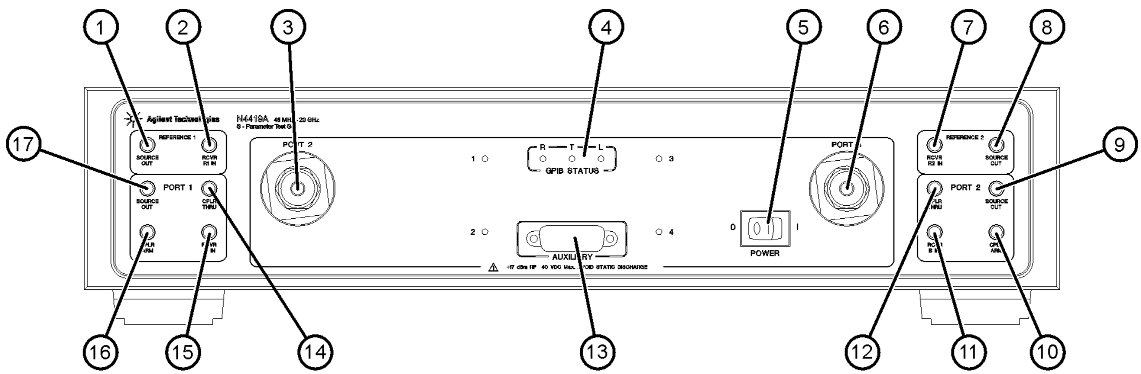
hy405a

ID Number	Rear Panel Feature	Feature Description
1	REF 1 R OUT	SMA (f) connector, used as an output reference signal
2	REF 2 R OUT	SMA (f) connector, used as an output reference signal
3	PORT 4 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.
4	PORT 4 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
5	PORT 2 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
6	PORT 2 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.
7	BUS ADDRESS	Switch that is used to set the GPIB address. Refer to “Step 7. Set Up the General Purpose Interface Bus (GPIB)” on page 29 for further information.
8	IEEE-488	24-pin IEEE-488/PCB (f) connector. The GPIB is the communication bus with the PC and the network analyzer.
9	REF 2 R IN	SMA (f) connector, used as an input reference signal.

ID Number	Rear Panel Feature	Feature Description
10	Power Cord Connector	Connector, 100-120 Vac or 220-250Vac input and Fuse, T 2.5 A 250 V (Agilent part number 2110-0681)
11	REF 1 R IN	SMA (f) connector, used as an input reference signal

N4419A

N4419A Front Panels

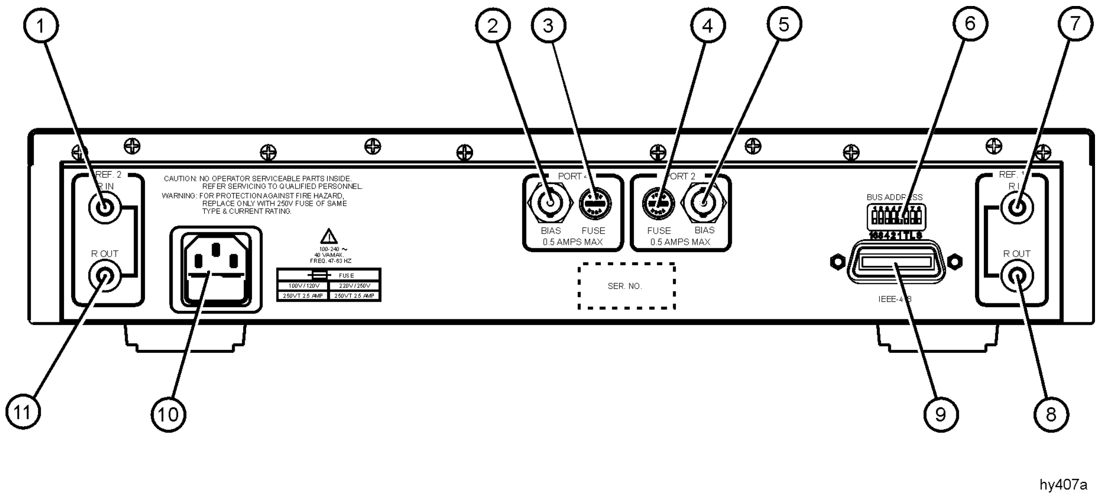


4419frnpnl

ID Number	Front Panel Feature	Feature Description
1	REFERENCE 1 SOURCE OUT	SMA (f) connector that is connected to the network analyzer REFERENCE 1 SOURCE OUT connector using a semirigid cable.
2	REFERENCE 1 RCVR R1 IN	SMA (f) connector that is connected to the network analyzer REFERENCE 1 RCVR R1 IN connector using a semirigid cable.
3	PORT 2	*PORT 2 - APC-3.5 (m) connector with 20 mm nut that is connected to the DUT or fixture. (+17 dBm maximum operating level)*
4	GPIB STATUS	Three LEDs (R, T, and L) that display the GPIB status of the test set when it is communicating with the network analyzer. R = Remote Operation, T = Talk mode, L = Listen mode.
5	POWER	ON/OFF switch that disconnects the mains circuits from the mains supply before other parts of the test set. The front panel POWER switch disconnects the mains circuits from the mains supply after the EMC filters and before other parts of the instrument.
6	PORT 4	*PORT 4 - APC-3.5 (m) connector with 20 mm nut that is connected to the DUT or fixture. (+17 dBm maximum operating level)*
7	REFERENCE 2 RCVR R2 IN	SMA (f) connector that is connected to the network analyzer REFERENCE 2 RCVR R2 IN connector using a semirigid cable.

ID Number	Front Panel Feature	Feature Description
8	REFERENCE 2 SOURCE OUT	SMA (f) connector that is connected to the network analyzer REFERENCE 2 SOURCE OUT connector using a semirigid cable.
9	PORT 2 SOURCE OUT	SMA (f) connector that is connected to the network analyzer PORT 2 SOURCE OUT connector using a semirigid cable.
10	PORT 2 CPLR ARM	SMA (f) connector that is connected to the network analyzer PORT 2 CPLR ARM connector using a semirigid cable.
11	PORT 2 RCVR B IN	SMA (f) connector that is connected to the network analyzer PORT 2 RCVR B IN connector using a semirigid cable.
12	PORT 2 CPLR THRU	SMA (f) connector that is connected to the network analyzer PORT 2 CPLR THRU connector using a semirigid cable.
13	AUXILIARY	15-pin ribbon (f) connector that may be connected to the Agilent N4430A/B ECal module to provide ECal capability.
14	PORT 1 CPLR THRU	SMA (f) connector that is connected to the network analyzer PORT 1 CPLR THRU connector using a semirigid cable.
15	PORT 1 RCVR A IN	SMA (f) connector that is connected to the network analyzer PORT 1 RCVR A IN connector using a semirigid cable.
16	PORT 1 CPLR ARM	SMA (f) connector that is connected to the network analyzer PORT 1 CPLR ARM connector using a semirigid cable.
17	PORT 1 SOURCE OUT	SMA (f) connector that is connected to the network analyzer PORT 1 SOURCE OUT connector using a semirigid cable.

N4419A Rear Panel

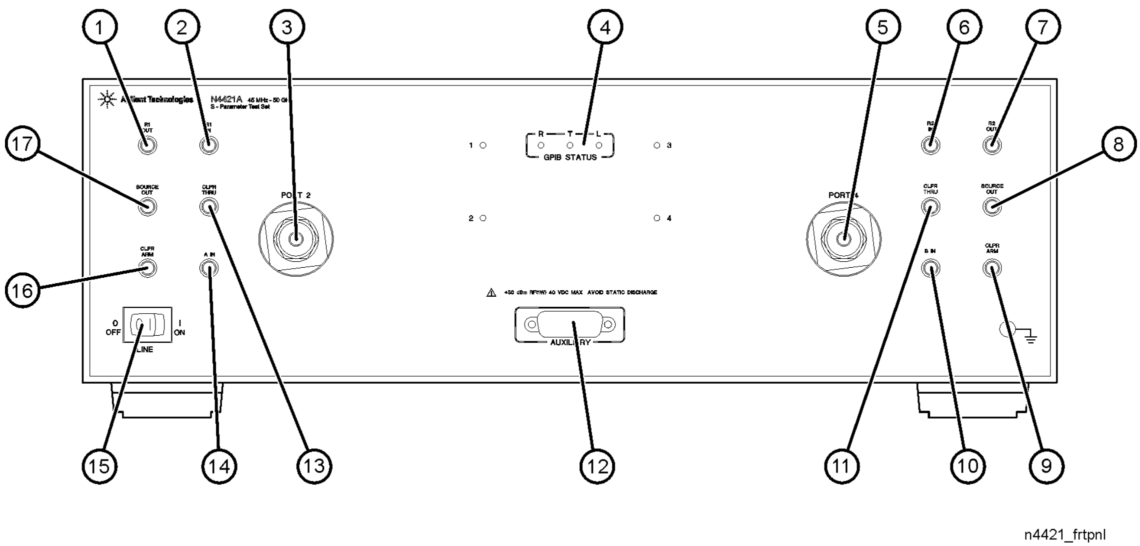


ID Number	Rear Panel Feature	Feature Description
1	REF 2 R IN	SMA (f) connector, used as an input reference signal
2	PORT 4 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.
3	PORT 4 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
4	PORT 2 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
5	PORT 2 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.
6	BUS ADDRESS	Switch that is used to set the GPIB address. Refer to “Step 7. Set Up the General Purpose Interface Bus (GPIB)” on page 29 for further information.
7	REF 1 R IN	SMA (f) connector, used as an input reference signal
8	REF 1 R OUT	SMA (f) connector, used as an output reference signal
9	IEEE-488	24-pin IEEE-488/PCB (f) connector. The GPIB is the communication bus with the PC and the network analyzer.

ID Number	Rear Panel Feature	Feature Description
10	Power Cord Connector	Connector, 100-120 Vac or 220-250Vac input and Fuse, T 2.5 A 250 V (Agilent part number 2110-0681)
11	REF 2 R OUT	SMA (f) connector, used as an output reference signal

N4421A

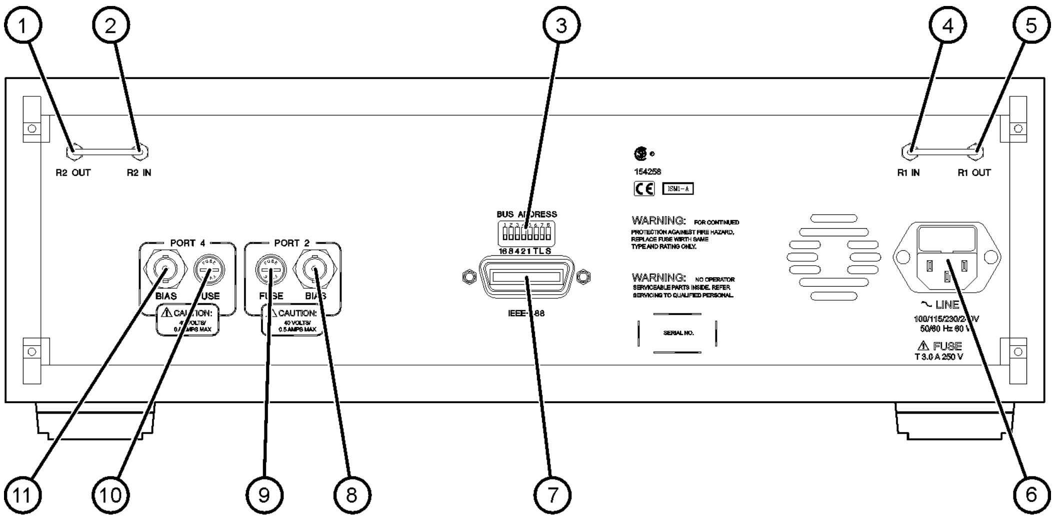
N4421A Front Panel



ID Number	Front Panel Feature	Feature Description
1	R1 OUT	2.4 mm (f) connector that connects to the network analyzer REFERENCE 1 OUT connector using a semirigid cable.
2	R1 IN	2.4 mm (f) connector that connects to the network analyzer REFERENCE 1 RCVR R1 connector using a semirigid cable.
3	PORT 2	2.4 mm bulkhead test port connector that is connect to the DUT or fixture. (+17 dBm maximum operating level)
4	GPIB STATUS	Three LEDs (R, T, and L) that display the GPIB status of the test set when it is communicating with the network analyzer. R = Remote Operation, T = Talk mode, L = Listen mode.
5	PORT 4	2.4 mm bulkhead test port connector that is connect to the DUT or fixture. (+17 dBm maximum operating level)
6	R2 IN	2.4 mm (f) connector that connects to the network analyzer REFERENCE 2 RCVR R2 connector using a semirigid cable.

ID Number	Front Panel Feature	Feature Description
7	R2 OUT	2.4 mm (f) connector that connects to the network analyzer REFERENCE 2 OUT connector using a semirigid cable.
8	SOURCE OUT	2.4 mm (f) connector that connects to the network analyzer PORT 2 SOURCE OUT connector using a semirigid cable.
9	CPLR ARM	2.4 mm (f) connector that connects to the network analyzer PORT 2 CPLR ARM connector using a semirigid cable.
10	B IN	2.4 mm (f) connector that connects to the network analyzer PORT 2 B IN connector using a semirigid cable.
11	CPLR THRU	2.4 mm (f) connector that connects to the network analyzer PORT 2 CPLR THRU connector using a semirigid cable.
12	AUXILIARY	15-pin ribbon (f) connector. Not currently used.
13	CPLR THRU	2.4 mm (f) connector that connects to the network analyzer PORT 1 CPLR THRU connector using a semirigid cable.
14	A IN	2.4 mm (f) connector that connects to the network analyzer PORT 1 A IN connector using a semirigid cable.
15	LINE	ON/OFF switch that disconnects the mains circuits from the mains supply before other parts of the test set. The front panel POWER switch disconnects the mains circuits from the mains supply after the EMC filters and before other parts of the instrument.
16	CPLR ARM	2.4 mm (f) connector that connects to the network analyzer PORT 1 CPLR ARM connector using a semirigid cable.
17	SOURCE OUT	2.4 mm (f) connector that connects to the network analyzer PORT 1 SOURCE OUT connector using a semirigid cable.

N4421A Rear Panel



4421_rearpnl

ID Number	Rear Panel Feature	Feature Description
1	REF 2 R OUT	2.4 mm (f) connector, used as an output reference signal
2	REF 2 R IN	2.4 mm (f) connector, used as an input reference signal.
3	BUS ADDRESS	Switch that is used to set the GPIB address. Refer to "Step 7. Set Up the General Purpose Interface Bus (GPIB)" on page 29 for further information.
4	REF 1 R IN	2.4 mm (f) connector, used as an input reference signal
5	REF 1 R OUT	2.4 mm (f) connector, used as an output reference signal
6	Power Cord Connector	Connector, 100-120 Vac or 220-250 Vac input and Fuse, T 2.5 A 250 V (Agilent part number 2110-0681)
7	IEEE-488	24-pin IEEE-488/PCB (f) connector. The GPIB is the communication bus with the PC and the network analyzer.
8	PORT 2 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.

ID Number	Rear Panel Feature	Feature Description
9	PORT 2 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
10	PORT 4 FUSE	Bias Fuse, 0.5 A, 250 V (Agilent part number 2110-0012)
11	PORT 4 BIAS	BNC (f) connector. The bias port is used to supply a dc voltage to an active DUT, such as an amplifier or a transistor.

Symbols

Numerics

A

B

C

G

H

I

L

M

R

S