

Agilent Technologies
N4419B, N4420B, N4421B Multiport Test Sets
(excluding H67)
Service Guide

Use this manual with the following documents:

N4419B, N4420B, N4421B Users Guide
(N4421-90002)

PNA Series Network Analyzer On-line Help System



Manufacturing Part Number: N4421-90003

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Warranty Statement

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Safety Notes

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

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

This product has been designed and tested in accordance with the standards listed on the Manufacturer's Declaration of Conformity, and has been supplied in a safe condition. The documentation contains information and warnings that must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

Definitions

- *Specifications* describe the performance of parameters covered by the product warranty (temperature – 0 to 55 °C, unless otherwise noted.)
- *Typical* describes additional product performance information that is not covered by the product warranty. It is performance beyond specification that 80% of the units exhibit with a 95% confidence level over the temperature range 20 to 30 °C. Typical performance does not include measurement uncertainty.
- *Nominal* values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty.

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1 Operational Check

Operational Check

The Operational Check is used to confirm that the N4419B, N4420B, or N4421B test set and PNA together are meeting operational performance limits.

Equipment Required

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

Table 1-1 Equipment List

Description	Qty
N4419B, N4420B, or N4421B Multiport Test Set. Note: This procedure does NOT apply to N4421B H67. See the H67 Manual (N4421-90001).	1
One of the following recommended PNA models using firmware A.06.00 or higher. N4419B: E8362B Opt 014/550 or N5230A Opt 225/550 N4420B: E8363B Opt 014/550 or N5320A Opt 425/550 N4421B: E8364B Opt 014/550 or N5230A Opt 525/550	1
Cal Kit or ECal module appropriate for the connector type and frequency range of the system. For more information, see www.agilent.com/find/nacal and click on 'Mechanical & Electronic Calibration home page'.	1
Set of interconnect cables between PNA and test set (see User's Guide)	1

Prepare the PNA

1. Ensure that the interconnect the cables between the PNA and test set are configured correctly as shown in the Multiport Test Set Installation and User's Guide (N4421-90002). Specifically note the use of the R1 and R2 Reference channel interconnect cables. As noted in the User's Guide, the R1 and R2 Reference channel interconnect cables should NOT be used unless making high speed measurements of electrically long devices. This impacts the Operational check limits in Table 2.

NOTE A thorough check of the test set should include routing the R1 and R2 reference channels through the test set.

2. On the PNA, click **Calibration**, then **Cal Sets**. Delete or Rename any Cal Sets titled "999.1", "999.2", "999.3", "999.4" although it is unlikely that you will find Cal Sets with these names.
3. Verify that the PNA is in 4-port mode by clicking **Trace**, then **New Trace**. (This step

requires that the PNA has option 550 installed.)

- a. If only four S-parameters are listed, click **System**, then **Configure**, then **4-Port Capability**. On the Multiport Restart dialog, click **Restart as multiport PNA with this test set**. Select **N44xx** as the test set, select the appropriate GPIB address, then click **OK**. (See the Multiport Test Set Installation and User's Guide N4421-90002 for more information.)
 - b. If 16 S-parameters are available, click **System**, then **Preset**.
4. Verify that Stop frequency is set to the maximum of the PNA and test set.
 5. Verify that Start frequency is set to 10 MHz. If not, click **Channel**, then **Start/Stop** and type **10 MHz**.
 6. Click **Sweep**, then **IF Bandwidth**, then select **100 Hz**.
 7. Click **Sweep**, then **Number of Points**, then **401**.
 8. If an ECal module is used, connect the ECal module to the PNA USB port.
 9. Allow the ECal module (if used), Test Set, and PNA to warm up for a minimum of a 30 minutes.
 10. If 'Phase Lock Lost' errors occur, then perform the IF Gain Adjustment. To view the instructions for the procedure, on the PNA, press **Help**. In the index, type **IF gain**.

Procedure

1. Perform a 1-Port Calibration on Port 1. On the PNA, click **Calibration**, then **Cal Wizard**.
 - a. If using a mechanical cal kit, select **SmartCal**.
 - b. If using an ECal module, select **ECal**.
2. Continue following the Cal Wizard prompts. On the "Ports to Calibrate" page, select only **Port 1**. For further instructions during the cal, click the Cal Wizard page **Help** button.
3. At the **Calibration Completed** prompt, click **Save As User CalSet** and type the name **999.1**
4. Repeat the above three steps for ports 2, 3, and 4. When finished, there should be four Cal Sets saved with names "999.1", "999.2", "999.3", and "999.4".
5. On the PNA, click **Trace**, then **Delete Trace**. There should be NO traces on the PNA screen.
6. On the PNA click **Calibration**, then **Cal Set Viewer** to launch the Cal Set Viewer toolbar.
7. On the toolbar, click **Error Terms** and select **Enable**.
8. In the Cal Sets box, select **999.1**. Then in the Error Terms box, select **Reflection Tracking(1,1)**.
9. Compare the Reflection Tracking (1,1) trace to the appropriate limits in Table 1-2. This can be done using Limit Lines (click **Trace**, then **Limit Test**) or Markers. The trace should be above the limit values. (See Figure 1-1)

NOTE Although the following graphic and table shows a stop frequency of 50 GHz, use the limits that apply to the stop frequency of your test system (20 GHz or 40 GHz).

Figure 1-1. Port 1 Reflection Tracking Trace



10. Repeat steps 8 and 9 for Cal Sets "999.2", "999.3", and "999.4".

Table 1-2 Operational Check - Limits for Reflection Tracking¹

Frequency	with OUT R1 and R2 cables through test set	with R1 and R2 cables through test set
10 MHz to 2 GHz	-16	-15
2 GHz to 10 GHz	-20	-17
10 GHz to 20 GHz	-24	-20
20 GHz to 30 GHz	-29	-24
30 GHz to 40 GHz	-34	-28
40 GHz to 50 GHz	-40	-33

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

Additional steps required for Reference channel path verification

These additional steps are performed if the PNA R1 and R2 channels are routed through the test set. Refer to the Test Set User's Guide to determine if your measurements require the R1 and R2 channels to be routed through the test set.

NOTE A thorough check of the test set should include these steps.

1. Click **System**, then **Preset**.
2. Connect Short or Open standards to Port 1 and Port 3 (both PNA ports).
3. Click **Trace**, then **New Trace**, then select **S33**. Click **OK**. Both S11 and S33 should be displayed in the same channel and window.
4. For each trace, click **Scale**, then **Scale**. In Per Division, type **5**, then click **OK**.
5. For each trace, click **Trace**, then **Math/Memory**. Click **Data -> Memory**, then select **Data/Memory**.
6. Remove the R channel cables that are connected from the PNA to the test set and replace them with the original PNA jumpers. To accomplish this, it is best to first remove the 'Port' cables. Be sure to replace and retorque the 'Port' cables when finished.
7. The resulting traces represent the additional R1 and R2 channel losses through the test set. Compare the resulting traces to the limits in Table 1-3. This can be done using Limit Lines (click **Trace**, then **Limit Test**) or Markers. The trace should be above the limit values.
8. Replace the R channel cables when finished.

Figure 1-2. R channel resulting traces

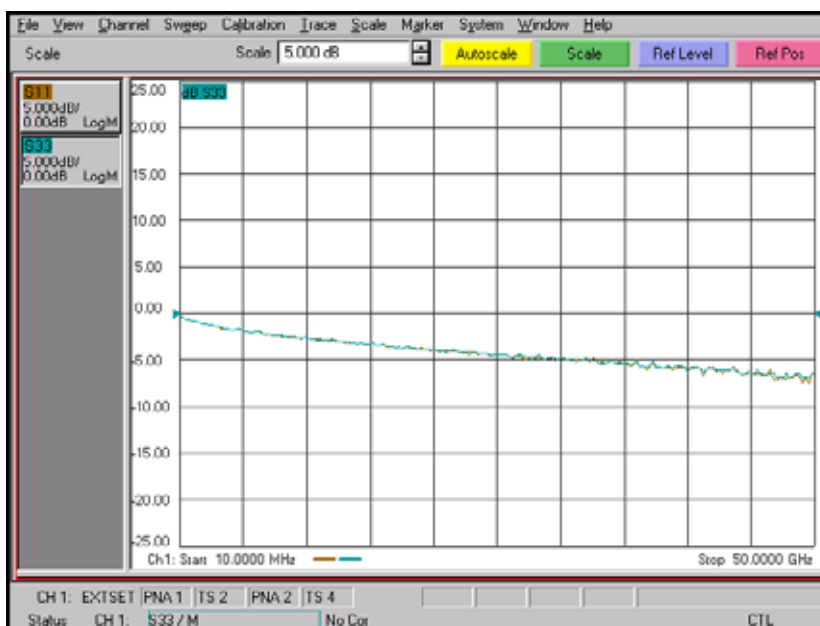


Table 1-3 Operational Check - Limits for R channel

Frequency	dB
10 MHz to 5 GHz	-5
5 GHz to 15 GHz	-8
15 GHz to 30 GHz	-10
30 GHz to 40 GHz	-12
40 GHz to 50 GHz	-13

Troubleshooting Operational Check Failures

If your test results fail the Operational Check limits, check the following before contacting Agilent:

1. Check all appropriate PNA and test set connectors for damage, cleanliness, and proper torque.
2. Repeat the relevant 1-port calibrations.
3. Make sure the stand-alone PNA is operating properly and meeting its published specifications. See http://na.tm.agilent.com/pna/pna_testing.html for more information.

2 Replaceable Parts

Replaceable Parts
TBD

TBD

This content is to be developed at a later date.

3 Troubleshooting

TBD

This content is to be developed at a later date.

4 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.



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).



The C-Tick mark is a registered trademark of the Australian Spectrum Management Agency.



This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/ electronic product in domestic household waste.

Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as a "Monitoring and Control instrumentation" product.

Do not dispose in domestic household waste.

To return unwanted products, contact your local Agilent office, or see <http://www.agilent.com/environment/product/> for more information.

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 test set 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 (N4419B, N4420B, and N4421B) 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 than 800 watts, then forced convection must be used.

Regulatory Information

The Agilent Technologies S-Parameter test set 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 Maschinenlaermrrerordnung –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

A Declaration of Conformity is on file for the N4419B, N4420B, and N4421B test sets, and a copy is available upon request.