
P937xA Streamline Series USB Vector Network Analyzers

P9370A, 300 kHz to 4 GHz

P9371A, 300 kHz to 6.5 GHz

P9372A, 300 kHz to 9 GHz

P9373A, 300 kHz to 14 GHz

P9374A, 300 kHz to 20 GHz

P9375A, 300 kHz to 26.5GHz

Notices

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CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Where to Find the Latest Information

For the latest information about these products, including the P937xA Help System, instrument software upgrades, application information, and product information, browse to one of the following URLs:

<https://www.keysight.com/find/usb-vna>

To receive the latest updates by email, subscribe to Keysight Email Updates at the following URL:

<http://www.keysight.com/find/emailupdates>

Information on preventing analyzer damage can be found at:

<http://www.keysight.com/find/tips>

Safety and regulatory information can be found in the Startup Guide, available online at:

<http://literature.cdn.keysight.com/litweb/pdf/P9370-90001.pdf>

Is your product software up-to-date?

Periodically, Keysight releases software updates to fix known defects and incorporate product enhancements. To search for software updates for your product, go to the Keysight Technical Support website at:

<https://www.keysight.com/find/usb-vna>

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1 Safety and Regulatory Information

Information in This Chapter

This chapter provides safety information that will help protect you and your network analyzer. It also contains information that is required by various government regulatory agencies.

Section Title	Summary of Content	Start Page
Safety Symbols	Descriptions of CAUTION and WARNING symbols used throughout this manual.	page 10
General Safety Considerations	A list of safety points to consider when servicing your network analyzer.	page 11
Electrostatic Discharge Protection	A discussion of electrostatic discharge (ESD) and related recommendations and requirements for ESD protection.	page 12
Regulatory Information	Definitions of instrument markings. Instructions for disposing of the analyzer's lithium battery.	page 14

Safety Symbols

The following safety symbols are used throughout this manual. Familiarize yourself with each of the symbols and its meaning before operating this instrument.

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 product. Do not proceed beyond a caution note until the indicated conditions are fully understood and met.

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.

General Safety Considerations

Before Applying Power

WARNING

If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only.

CAUTION

The measuring terminals on this instrument are designed to be used with external signals described in Measurement Category I, but NOT with external signals described in Categories II, III, and IV. The input of this instrument cannot be connected to the mains.

CAUTION

The Mains wiring and connectors shall be compatible with the connector used in the premise electrical system. Failure to ensure adequate earth grounding by not using the correct components may cause product damage, and serious injury.

Servicing

WARNING

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

Operating Conditions

WARNING

Operator is responsible for maintaining safe operating conditions. To ensure safe operating conditions, P937xAs should not be operated beyond the full temperature range documented in the P937xA Data Sheet (<http://literature.cdn.keysight.com/litweb/pdf/5992-2765EN.pdf>). Not maintaining safe operating conditions can result in shorter P937xA lifespans, improper P937xA performance, and user safety issues. If P937xAs are allowed to exceed the specified full temperature range, P937xA surface temperatures can cause discomfort or burns if touched. If a P937xA exceeds the full temperature range, always allow it to cool before touching it or removing it from the chassis.

CAUTION

This product is designed for use in Installation Category II and Pollution Degree 2 environment.

Electrostatic Discharge Protection

CAUTION

Most causes of instrument failure can be avoided if you will apply the information in this section. PLEASE READ!

Electrostatic discharge (ESD) can damage or destroy electronic components. Use a static-safe work station to perform all work on electronic assemblies. **Figure 1-1 on page 1-12** shows a static-safe work station using two types of ESD protection: conductive table-mat and wrist-strap combination, and conductive floor-mat and heel-strap combination. Both types, when used together, provide a significant level of ESD protection. Of the two, only the table-mat and wrist-strap combination provides adequate ESD protection when used alone. To ensure user safety, the static-safe accessories must provide at least 1 meg-ohm of isolation from ground.

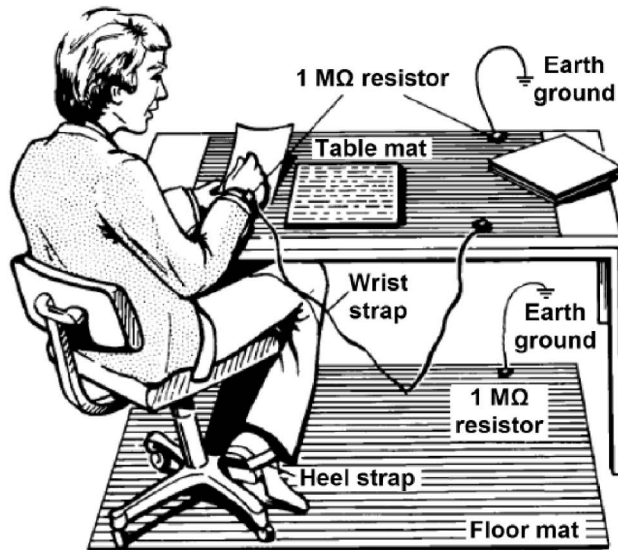
WARNING

Do NOT use these techniques for a static-safe work station when working on circuitry with a voltage potential greater than 500 volts.

Figure 1-1

ESD protection setup

ESD



M9370_001_101

Unpack the P937xA network analyzer from the shipping containers. Keep the black plastic port protectors and the shipping containers for possible reuse.

Inspect for Damage

After unpacking a network analyzer, inspect it for any shipping damage. Report any damage to the shipping agent immediately, as such damage is not covered by the warranty.

CAUTION

To avoid damage when handling the network analyzers, do not touch exposed connector pins.

Regulatory Information

This section contains information that is required by various government regulatory agencies.

Instruction for Use

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

EMC

Complies with the essential requirements of the European EMC Directive as well as current editions of the following standards (dates and editions are cited in the Declaration of Conformity):

- IEC/EN 61326-1
- CISPR Pub 11 Group 1, class A
- AS/NZS CISPR 11
- ICES/NMB-001

This ISM device complies with Canadian ICES-001.

Cet appareil ISM est conforme a la norme NMB-001 du Canada.

South Korean Class A EMC declaration: This equipment has been confirmed as suitable for use in business environments. In a residential environment it may cause radio interference.

※ This EMC statement applies to the equipment only for use in business

사 용 자 안 내 문
이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

※ 사용자 안내문은 "업무용 방송통신기자재"에만 적용한다.

Safety and Regulatory Information
Regulatory Information

Safety

Acoustic statement (European Machinery Directive)

- Acoustic noise emission
- $L_{pA} < 70$ dB
- Operator position
- Normal operation mode per ISO 7779

Complies with the following standard (dates and editions are cited in the Declaration of Conformity): IEC/EN 61010-1.

Instrument Markings

NOTE

Some instrument markings may not appear on your analyzer.



This symbol marks the ON position of the power line switch.



This symbol marks the ON position of the power line switch.



This symbol marks the standby position of the power line switch.



This symbol marks the OFF position of the power line switch.



This symbol marks the OFF position of the power line switch.



The instruction documentation symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the documentation.



This symbol indicates separate collection for electrical and electronic equipment, mandated under EU law as of August 13, 2005. All electric and electronic equipment are required to be separated from normal waste for disposal (Reference WEEE Directive, 2002/96/EC).



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



The CE mark is a registered trademark of the European Community (if accompanied by a year, it is the year when the design was proven). This product complies with all relevant directives.

ccr.keysight@keysight.com









The Keysight email address is required by EU directives applicable to our product.



The CSA mark is a registered trademark of the CSA International.

Safety and Regulatory Information

Regulatory Information

	This is a symbol of an Industrial Scientific and Medical Group 1 Class A product. (CISPR 11, Clause 5)
	Direct current.
	The RCM mark is a registered trademark of the Australian Communications and Media Authority.
	China Restricted Substance Product Label. The EPUP (environmental protection use period) number in the center indicates the time period during which no hazardous or toxic substances or elements are expected to leak or deteriorate during normal use and generally reflects the expected useful life of the product.
	ISO standard recycling symbol. This symbol satisfies the requirements for the China standard GB 18455-2001 as required by the China RoHS regulations for paper/fiberboard packaging.
	South Korean Certification (KC) mark; includes the marking's identifier code which follows this format: MSIP-REM-Kst- <u>ZZZZZZZZZZZZZZZZ</u> .
	USB connectors.
	Kensington security Lock.

For the AC/DC Adapter

WARNING	For safety reasons, only equipment Keysight approved accessories should be used with the instrument.
WARNING	No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.
WARNING	Use only the designated AC/DC adapter supplied with the instrument.
WARNING	Use a Keysight supplied power cord that is the same or better electrical rating.
WARNING	<p>Operated at an ambient temperature: 0 to 40°C. (Linearly derate, at rate of 3 watts per degree C, from 90W at 40°C to 45 W at 55°C, 30W at -20°C).</p> <p>Maximum output rating: +15V/6.0 A.</p> <p>Input rating: AC 100–240 V, 50–60Hz</p>

WARNING

To prevent electrical shock, disconnect the AC to DC adapter from the 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

When the is connected to the AC/DC adapter, position the adapter so the power cord is readily accessible. The power cord is the disconnecting device. It removes main power to the AC/DC adapter. The front panel switch is only for the DC power within the instrument, and not for the AC/DC adapter. Alternately, an AC switch or circuit breaker (which is readily identifiable and is easily reached by the operator) may be installed and used as a disconnecting device to remove mains power from the AC/DC adapter.

CAUTION

The AC/DC adapter has an auto-ranging line voltage input – be sure the supply voltage is within the specified range.

CAUTION

The AC/DC adapter is for indoor use only.

CAUTION

Never use a modified or damaged charger. Use the original AC–DC adapter ONLY.

CAUTION

The AC/DC adapter is designed for use in Installation Category II and Pollution Degree 2 per IEC 61010-1.

Equipment Installation (AC/DC Adapter)

WARNING

Use Keysight supplied power cord or one with same or better electrical rating.

CAUTION

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

WARNING

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

Equipment Operation (AC/DC Adapter)

CAUTION

To prevent electrical shock, disconnect the Keysight Technologies P937xA 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.

NOTE

Position equipment to ensure easy access to disconnecting device.

Operator Equipment Maintenance and Service (AC/DC Adapter)

WARNING

Use Keysight supplied power cord or one with same or better electrical rating.

Declaration of Conformity

A declaration of conformity is available upon request, or a copy is available on the Keysight Technologies Web site at

<http://www.keysight.com/go/conformity> or by contacting Keysight – see “Contacting Keysight” on page 22.

Equipment Ratings

The instruments can operate with mains supply voltage fluctuations up to $\pm 10\%$ of the nominal voltage.

Instrument	15 to 24 VDC
DC input	
External AC power adapter	VI
Efficiency Level	
Input	100 to 240 VAC, 50 to 60 Hz, 1.5 A to 0.75 A
Output	15 VDC $\pm 5\%$, 6A max (90W max @40°C, linearly derate to 45W at 55°C)
Power consumption (from the mains)	120V, 52 watts max 240V, 62 watts max

Environmental Conditions (Operating)

The instruments can operate with mains supply voltage fluctuations up to $\pm 10\%$ of the nominal voltage.

Environmental Conditions (Operating)

For indoor use only

Altitude up to: 3000m (9,842.2 ft)

Temperature: 0 to 55°C

Humidity:
Type tested at 95% RH, +40°C

2 General Product Information

Information in This Chapter

Section Title	Summary of Content	Start Page
Maintenance	Cleaning instructions for the external surfaces of your network analyzer. Information about electrical maintenance of your analyzer.	page 20
Analyzer Options, Accessories, and Upgrades Available	A hyperlink to the network analyzer Configuration Guide, which includes a list of options, accessories, and upgrades available for the network analyzer.	page 21
Keysight Support, Services, and Assistance	The Internet address (URL) for Keysight assistance. Service and support options available. Calibration options available. Important information about shipping your analyzer to Keysight for service or repair.	page 22

Maintenance

To remove dirt or dust from the external case of the network analyzer P937xA, clean the case using a dry or slightly-dampened cloth only.

WARNING

To prevent electrical shock, remove analyzer module from chassis slot for cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.

Analyzer Options, Accessories, and Upgrades Available

To see a list of the options, accessories, and upgrades available for the network analyzers, including ordering information, refer to the Keysight PNA Family Microwave Network Analyzers Configuration Guide, available online at <https://literature.cdn.keysight.com/litweb/pdf/5992-2823EN.pdf?id=2974638>

Keysight Support, Services, and Assistance

Information on the following topics is included in this section.

- [Service and Support Options](#)
- [Contacting Keysight](#)
- [Shipping Your Network Analyzer for Service or Repair](#)

Service and Support Options

The network analyzer's standard warranty is a 1-year return to Keysight Technologies service warranty.

NOTE

There are many other repair and calibration options available from the Keysight Technologies support organization. These options cover a range of service agreements with varying response times. Contact Keysight for additional information on available service agreements for this product. Refer to [Contacting Keysight](#).

Contacting Keysight

Assistance with test and measurement needs and information on finding a local Keysight office are available on the Web at:
www.keysight.com/find/assist. If you do not have access to the Internet, please contact your Keysight field engineer.

NOTE

In any correspondence or telephone conversation, refer to the Keysight product by its model number and full serial number. With this information, the Keysight representative can determine whether your product is still within its warranty period.

Shipping Your Network Analyzer for Service or Repair

Should it become necessary to return a network analyzer for repair or service, follow the steps below:

1. Review the warranty information shipped with your product.
2. Contact Keysight to obtain a Return Material Authorization (RMA) and return address. For assistance finding Keysight contact information, go to www.keysight.com/find/assist (worldwide contact information for repair and service).
3. Write the following information on a tag and attach it to the network analyzer.
4. Name and address of owner. A P.O. box is not acceptable as a return address.

General Product Information
Keysight Support, Services, and Assistance

5. network analyzer serial numbers. The serial number label is located on the bottom panel of the module. The serial number can also be read from the Soft Front Panel (SFP) interface, after the hardware is installed.
6. Description of the failure or service required.
7. On the shipping label, write ATTENTION REPAIR DEPARTMENT and the RMA number.
8. Ship the analyzer module using the original packaging materials. Shipping the analyzer module in anything other than the original packaging may result in non-warranted damage.

3 Tests, Adjustments, and Troubleshooting

Information in This Chapter

This chapter contains procedures to help you check, verify, adjust, and troubleshoot your network analyzer.

- The checks verify the operation of the assemblies in your network analyzer.
- The verification compares the operation of your analyzer to a gold standard.
- The adjustments allow you to tune your network analyzer for best performance.
- The troubleshooting assists you in finding the cause of a failure.

Section Title	Summary of Content	Start Page
Before You Begin	Items to consider or procedures to perform before testing is begun: <ul style="list-style-type: none">–Verify the Operating Environment.–Protect Against Electrostatic Discharge.–Allow the Analyzer to Warm Up.–Review the Principles of Connector Care.	page 27
About System Verification and Performance Tests	Descriptions of: <ul style="list-style-type: none">–System Specifications–Instrument Specifications–System Verification Procedure–Performance Tests–Certificate of Calibration	page 28
ANSI/NCSL Z540.3-2006 and ISO/IEC 17025 Verification	The ANSI/NCSL Z540.3-206 and ISO/IEC 17025 process of verifying your network analyzer.	page 31
Non-Standards Compliant Verification	The Non-Standards Compliant process of verifying your network analyzer.	page 32

Tests, Adjustments, and Troubleshooting
Information in This Chapter

Section Title	Summary of Content	Start Page
Preliminary Checks	Performing the Operator's Check. Checking your test cables. NOTE Perform these checks before performing system verification.	page 33
System Verification	What the system verification does. How to perform the verification test. How to interpret the results.	page 36
Test Management Environment (TME) Performance Tests	A list of equipment needed and TME webpage link information.	page 45
Troubleshooting	A list of troubleshooting suggestions.	page 51

Before You Begin

Before checking, verifying, or adjusting the analyzer, refer to the following paragraphs to:

- get the required Service Test equipment
- make sure the operating environment is within its requirements
- make sure that proper electrostatic discharge (ESD) protection is provided
- make sure the analyzer has warmed up properly to achieve system stability
- review the principles of connector care

Get the Hardware Required for your GPIB Instruments

The hardware required to connect your GPIB instruments to the network analyzer depends on the type of controller you use.

- Because the P937xA uses a remote controller, you need a GPIB card for the PC.

Verify the Operating Environment

For Operating Environment information, refer to the online Data Sheet at <http://literature.cdn.keysight.com/litweb/5992-2765EN.pdf>.

Protect Against Electrostatic Discharge (ESD)

For information on protecting against electrostatic discharge (ESD), refer to the online Startup Guide at <http://literature.cdn.keysight.com/litweb/pdf/P9370-90001.pdf>.

Allow the Analyzer to Warm Up

NOTE

To achieve the maximum system stability, allow the network analyzer to warm up for at least 15 minutes.

Review the Principles of Connector Care

For online information on connector care, go to http://na.support.keysight.com/pna/connectorcare/Connector_Care.htm.

About System Verification and Performance Tests

The performance of the network analyzer is specified in two ways: system specifications and instrument specifications. It is the end user's responsibility to determine which set of specifications is applicable to their use of the network analyzer.

A network analyzer measurement "system" includes the network analyzer, calibration kit, test cables, and any necessary adapters. The system verification software is used to verify the system's conformance to the "system" specifications. A "pass" result demonstrates that the network analyzer test cables and adapters perform correctly as a system. It DOES NOT demonstrate that any one component performs according to its individual specifications. A change to any part of this measurement system requires a re-verification of the system.

Instrument specifications specify the network analyzer's uncorrected measurement port characteristics and its output and input behavior. The performance tests are used to verify the module's conformance to "instrument" specifications. Refer to **"Test Management Environment (TME) Performance Tests" on page 45.**

System Specifications

System specifications specify warranted performance of the measurement system when making error-corrected measurements using the same calibration kit and test cables used during the system verifications routine. System specifications are applicable only when the measurement system is used to make error-corrected measurements.

The network analyzer's system specifications are described in the Data Sheet, available online at <http://literature.cdn.keysight.com/litweb/5992-2765EN.pdf>.

System specifications are expressed in two ways:

- residual errors of the measurement system shown as tabular specification values
- graphs of measurement uncertainty versus reflection and transmission coefficients

System specifications are verified in one of the following ways:

- Complete the system verification procedure using a certified verification kit and certified calibration kit that will be used for future measurements.
- Complete all of the performance tests using a certified calibration kit that will be used for future measurements. This alternative verifies both the system specifications and the instrument specifications for the network analyzer.

Instrument Specifications

The network analyzer's instrument specifications are described in the Data Sheet, available online at

<https://literature.cdn.keysight.com/litweb/5992-2765EN.pdf>.

These specifications apply when the network analyzer is used to make either raw or error-corrected measurements.

System Verification Procedure

The system verification procedure tests the network analyzer measurement “system,” as defined previously, against the system specifications. If confirmation is successful, the measurement system is capable of making measurements to the accuracy specified by the graphs of measurement uncertainty.

The procedure consists of calibrating the analyzer with a calibration kit, measuring a set of characterized devices, and comparing the resultant measured data to the data and uncertainty limits supplied with the verification kit. The device data provided with the verification kit has a traceable path to NIST. The total measurement uncertainty limits for the performance verification are the sum of the factory measurement uncertainties and the uncertainties associated with measuring the same devices on the system being verified. The difference between the factory-measured data and the verification-measured data must fall within the total uncertainty limits at all frequencies for the total system uncertainty test to pass.

NOTE

Calibration kits are different from verification kits. Calibration kits are used to determine the systematic errors of a network analyzer measurement system. Verification kits are used to confirm system specifications and are not used to generate error correction.

Performance Tests

Performance tests are used to confirm network analyzer performance against the “instrument” specifications. If confirmation is successful, the network analyzer meets the instrument specifications. Refer to **“Test Management Environment (TME) Performance Tests” on page 45**.

An illustrated outline of the performance verification procedure

- for ANSI/NCSS Z540.3-206 and ISO/IEC 17025 verification, is shown in **Figure 3-1 on page 31**.
- for Non-Standards Compliant verification, is shown in **Figure 3-2 on page 32**.

Certificate of Calibration

Keysight Technologies will issue a certificate of calibration upon successful completion of system verification or completion of the performance tests. The certificate of calibration will apply to the “system” (network analyzer, calibration kit, test cables, and any necessary adapters) if the system verification procedure is used to confirm the system specifications. If the performance tests are used to confirm instrument specifications, the certificate of calibration will apply to the network analyzer as an independent instrument. The equipment and measurement standards used for the tests must be certified and must be traceable to recognized standards.

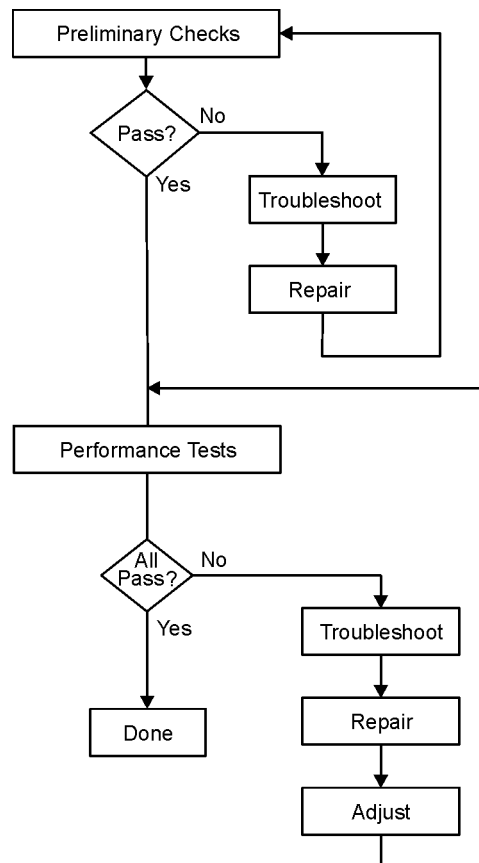
NOTE

If you have a measurement application that does not use all of the measurement capabilities of the network analyzer, you may ask your local Keysight Technologies service office to verify only a subset of the specifications. However, this “limited calibration” creates the possibility of making inaccurate measurements if you then use the analyzer in an application requiring additional capabilities.

ANSI/NCSL Z540.3-2006 and ISO/IEC 17025 Verification

To meet the criteria for ANSI/NCSL Z540.3-2006 and ISO/IEC 17025 verification, perform the preliminary checks and all performance tests without stopping to repair or adjust.¹ Refer to **Figure 3-1** for test flow. Print data at the completion of all the tests, even if you are aware that the network analyzer did not pass. If there is a failure, complete the verification before you troubleshoot, repair, and adjust. After the failure has been corrected, repeat the entire set of performance tests and generate a new set of data.

Figure 3-1 ANSI/NCSL Z540.3-2006 and ISO/IEC 17025 Verification Flowchart



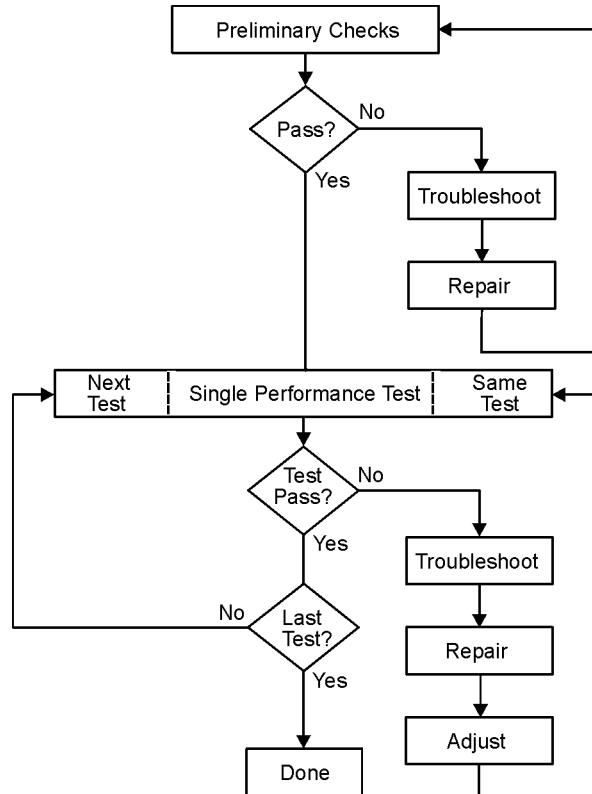
sc870b

1. Stop only in case of a catastrophic failure or cable connector damage.

Non-Standards Compliant Verification

To meet the criteria for non-standards compliant verification, perform the preliminary checks and the performance tests while stopping to troubleshoot. Refer to **Figure 3-2** for test flow. Troubleshoot and repair the first problem encountered without continuing to other tests. After you troubleshoot, repair, and adjust, repeat the last failed portion and generate a new set of data.

Figure 3-2 Non-Standards Compliant Verification Flowchart



sc869b

Preliminary Checks

Preliminary checks include the following:

- **The Operator's Check**

The Operator's Check tests the basic functionality of the source, switches, and receivers in the network analyzer.

The performance of the network analyzer is specified in two ways: system specifications and instrument specifications. It is the end user's responsibility to determine which set of specifications is applicable to their use of the network analyzer. This section includes system verification. If instrument specifications verification is required, contact Keysight. Refer to <https://www.keysight.com/find/usb-vna>.

A network analyzer measurement "system" includes the network analyzer, calibration kit, test cables, and any necessary adapters. The system verification software is used to verify the system's conformance to the "system" specifications. A "pass" result demonstrates that the network analyzer test cables and adapters perform correctly as a system. It DOES NOT demonstrate that any one component performs according to its individual specifications. A change to any part of this measurement system requires a re-verification of the system.

The Operator's Check

NOTE

Allow the network analyzer to warm up for at least 15 minutes before performing the Operator's Check.

The Operator's Check is a software driven test that checks the basic operation of the assemblies in all of the measurement port signal paths. By performing the Operator's Check, the following are determined:

- attenuation ranges of all internal attenuators
- calibration of the receivers
- frequency response of the receivers
- phase lock
- noise floor and trace noise
- various voltages throughout the network analyzer

Accessories Used in the Operator's Check

Male short(s) or open(s) from a 3.5 mm calibration kit.

Performing the Operator's Check

1. On the soft front panel, click **Utility > System > Service > Verification > Operator's Check**.
2. In the Operator's Check dialog box (refer to **Figure 3-3**), under **Configure**, click either **Prompt for attachment of Short/Open**, to pause at each step in the process to allow moving the short/open to the appropriate port, or **Shorts/Opens are attached to ALL ports**, to run through the test without stopping. Shorts and opens can be mixed on the test ports.

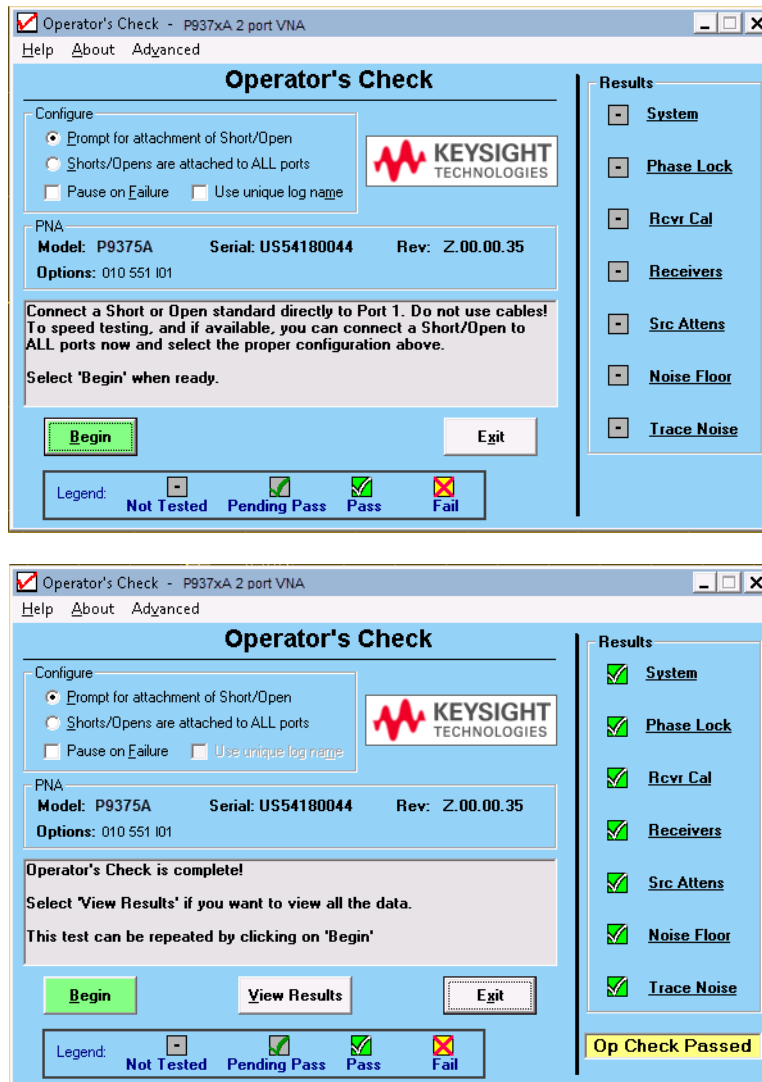
In most cases, the short/open is not required since the analyzer test port's female connector acts an "open." However, if the test fails, confirm the failure with a short/open attached.

3. Click **Begin**.
4. If shorts and opens are not connected to all ports, you will be prompted to connect them as they are needed.
5. The result of the Operator's Check will be shown as a **PASS** or **FAIL** to each test (refer to **Figure 3-3**).

Tests, Adjustments, and Troubleshooting

Preliminary Checks

Figure 3-3 Operator's Check Dialog Boxes



If the Operator's Check Fails

1. Clean the test ports, and the open(s) or short(s), and torque to specification. Repeat the check.
2. If the check still fails, return the network analyzer to Keysight. See ["Shipping Your Network Analyzer for Service or Repair"](#) on page 22.

System Verification

System verification is used to verify system-level, error-corrected uncertainty limits for network analyzer measurements. The verification procedure is automated and is contained in the firmware of the network analyzer.

The device data provided with the verification kit has a traceable path to a national standard. The difference between the supplied traceable data and the measured data must fall within the total uncertainty limits at all frequencies for the system verification to pass.

The total measurement uncertainty limits for the system verification are the sum of the factory measurement uncertainties for the verification devices and the uncertainties associated with the system being verified.

NOTE

Passing this system verification does not guarantee that the network analyzer meets all of its performance specifications. However, it does show that the network analyzer being verified measures the same devices with the same results as a factory system which has had all of its specifications verified and its total measurement uncertainty minimized.

What the System Verification Verifies

The system verification procedure verifies proper operation of the:

- network analyzer
- calibration kit
- test port cables

together as a “system.” It DOES NOT verify that any of these components pass their specifications independently. The user is responsible for independently calibrating and verifying the proper operation of the calibration kit and test port cables prior to performing the system verification.

NOTE

Additional equipment or accessories used with the above system are not verified by system verification.

Measurement Uncertainty

Measurement uncertainty is defined as the sum of the residual systematic (repeatable) errors, and the random (non-repeatable) errors in the measurement system after calibration.

The systematic errors are:

- directivity
- source match
- load match

Tests, Adjustments, and Troubleshooting

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- reflection and transmission frequency tracking, and
- isolation (crosstalk)

The random errors include:

- noise
- drift
- connector repeatability
- test cable stability

A complete description of system errors and how they affect measurements is provided in the network analyzer's Help system (search for Measurement Errors).

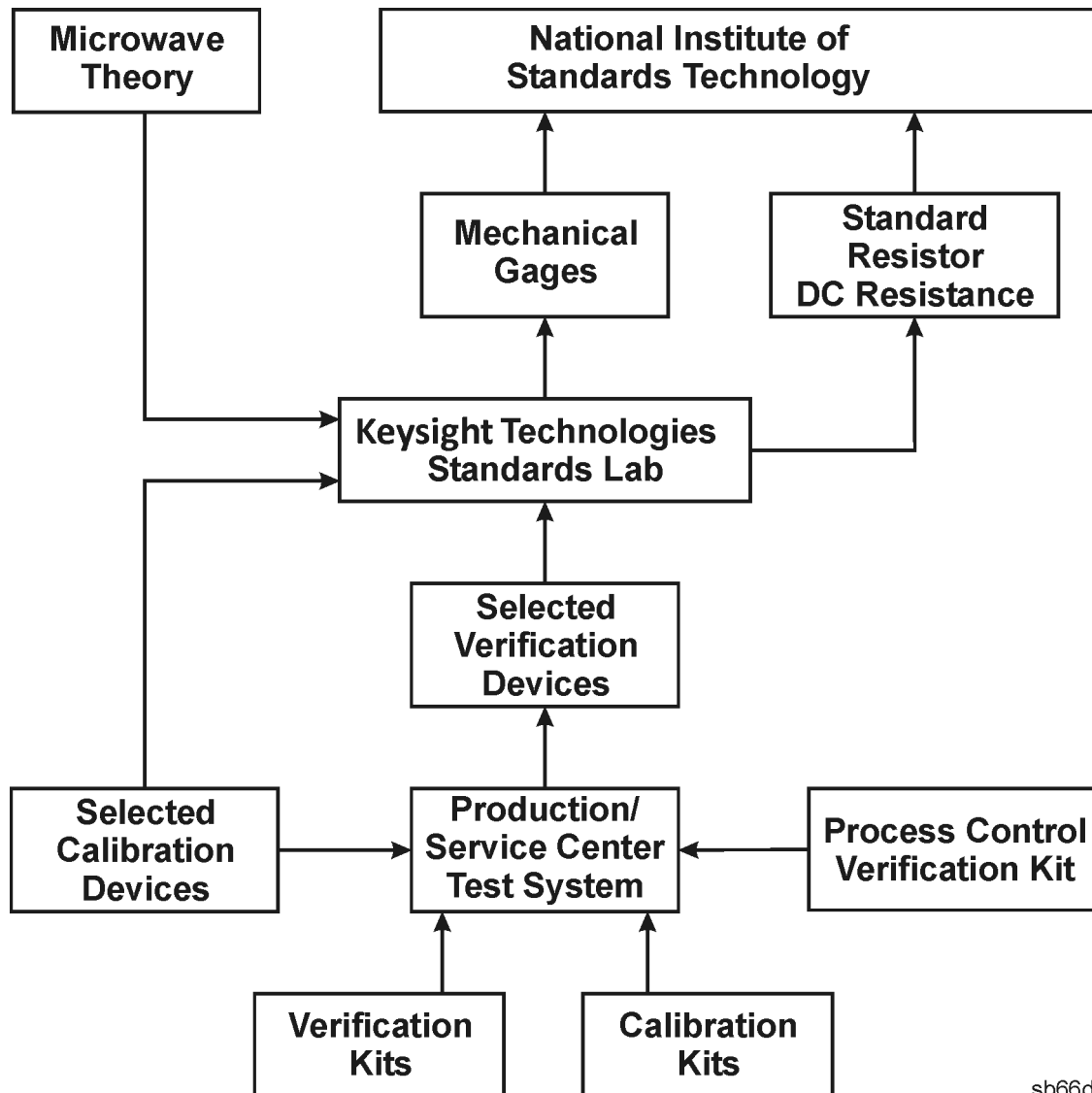
Any measurement result is the vector sum of the actual test device response plus all error terms. The precise effect of each error term depends on its magnitude and phase relationship to the actual test device response. When the phase of an error response is not known, phase is assumed to be worst-case (-180° to $+180^\circ$). Random errors such as noise and connector repeatability are generally combined in a root-sum-of-the-squares (RSS) manner.

Measurement Traceability

To establish a measurement traceability path to a national standard for a network analyzer system, the overall system performance is verified through the measurement of devices that have a traceable path. This is accomplished by measuring the devices in a Keysight verification kit.

The measurement of the devices in the verification kit has a traceable path because the factory system that measured the devices is calibrated and verified by measuring standards that have a traceable path to the National Institute of Standards and Technology (NIST) (see **Figure 3-4**).

Figure 3-4 NIST Traceability Path for Calibration and Verification Standard



sb66d

Performing System Verification

The following verification procedure is automated by the network analyzer firmware. The process for the verification is:

- connect cables to the analyzer test ports
- perform a calibration or recall a recent calibration
- run the system verification program for the verification devices

Each time through the verification process, you are prompted to make necessary connections and perform or recall a calibration as part of performing the verification. If you select to perform a calibration, you are guided through

the calibration procedure. This part of the process can be eliminated if you choose to load an existing recent calibration. If necessary, refer to the network analyzer's Help system for information on storing and recalling calibrations.

For each verification device, the analyzer reads a file from the verification disk and sequentially measures the magnitude and phase for all four S-parameters.

NOTE

For system verification to perform correctly, it is **NECESSARY** that the verification devices be measured with their female connectors connected to the network analyzer's Port 1 and male connectors to Port 2.

NOTE

Although the performance for all S-parameters are measured, the S11 and S22 phase uncertainties for the attenuators and airlines are less important for verifying system performance. Therefore, the limit lines will not appear on the printout.

Equipment Used in the System Verification Procedure

Table 3-1 Equipment Used in the System Verification Procedure

Equipment Type	3.5 mm
Calibration kit	85052B, C, D N4691B ECal
Verification kit	85053B
Cables	Single cable: 11500E Cable pair: 11500E and 8121-2111
Adapters	None required

Cable Substitution

The test port cables specified for the network analyzer system have been characterized for connector repeatability, magnitude and phase stability with flexing, return loss, insertion loss, and aging rate. Since test port cable performance is a significant contributor to the system performance, cables of lower performance will increase the uncertainty of your measurement. Refer to the plots in the cable tests (earlier in this chapter) that show the performance of good cables. It is highly recommended that the test port cables be regularly tested.

If the system verification is performed with a non-Keysight cable, ensure that the cable meets or exceeds the specifications for the test cable specified in **Table 3-1**. Refer to the cable's user's guide for specifications.

Kit Substitution

Non-Keysight calibration kits and verification kits are not recommended nor supported.

System Verification Procedure

1. If you want printed test outputs, connect a printer to the embedded or remote controller. For the printer, ensure that the correct driver is loaded and the printer is defined as the default printer. Refer to the network analyzer's Help system for information on printer setup.
2. Let the analyzer warm up for at least 15 minutes.
3. Insert the verification kit memory stick in a USB port of the embedded or remote controller.
4. Click **Utility > System > Service > System Verification**. The System Verification dialog box is displayed, as shown in **Figure 3-5**.

Figure 3-5 System Verification Dialog Box

System Verification
P937x2 port VNA

Insert the verification memory stick, select the calibration kit and cable(s) being used, select the desired printer and file outputs, then click "Run".

Select Calibration Kit:
Keysight 85052B (3.5 mm w/Sliding Load)

Compatible Verification Kit(s):
Keysight 85053B 3.5 mm

Test Cable(s)
☒ Single Cable (+Adapters) ☐ Cable Pair (+Adapters)
Cables: 85131C/E 3.5mm NMD to 3.5mm(f) cable.
Adapters: No adapters.
Cable Flex Factor: 100 % -- (0 to 100)

Outputs
☐ Print Tabular Data
☐ Print Graphs
☒ File Tabular Data
☒ File Graphs

Run **Exit**

5. In the Select Calibration Kit box, click on the calibration kit or electronic calibration module (ECal) being used. The corresponding verification kit to use is selected for you and displayed in the Compatible Verification Kit(s) box.
6. Under Outputs, click one of the following options. Refer to **Figure 3-5**.
 - Print Tabular Data: Prints the verification data in tabular form which includes measured data and uncertainty limits. For an example, refer to **Figure 3-7 on page 43**.
 - Print Graphs: Prints the verification data in graphical form. The graphical form includes measured data trace, factory supplied data trace, and uncertainty limits. For an example, refer to **Figure 3-8 on page 44**.

- File Tabular Data: Writes the tabular data to a text file in the C:\Users\Public\Public Documents\Network Analyzer\SysVer\ directory.
- File Graphs: Saves a screen image in PNG format in the C:\Users\Public\Public Documents\Network Analyzer\SysVer\ directory.

NOTE

For printed output, it is assumed that the printer has been tested and the Windows driver is installed for the printer that is being used. The system verification test prints to the printer that has been designated as the default printer. (On the Windows Desktop display, click on Start > Devices and Printers to verify the printer setup.

7. To modify the number of ports to be verified or to change the number of devices to measure, click on the Configure tab and make the desired selections.
8. Click Run.
9. Follow the instructions for performing a full calibration or recalling an existing recent calibration.
10. Follow the instructions for performing the system verification, inserting the verification devices as prompted.

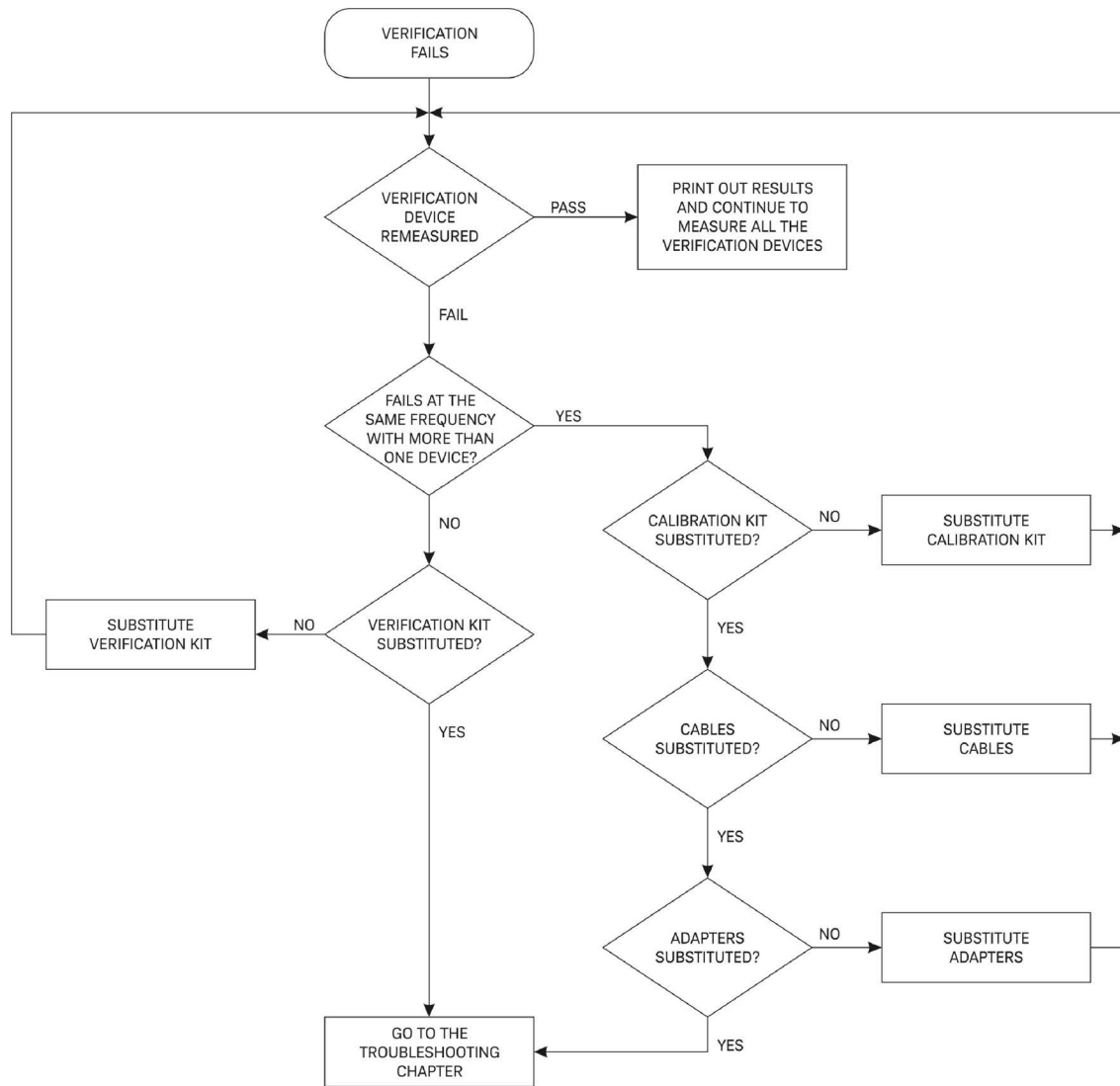
If the System Fails the Verification Test

NOTE

Inspect all connections. DO NOT remove the cable from the network analyzer test port. This will invalidate the calibration that you performed earlier.

1. Disconnect and clean the device that failed the verification test.
2. Reconnect the device, making sure that all connections are torqued to the proper specifications.
3. Measure the device again.
4. If the analyzer still fails the test, check the measurement calibration by viewing the description of the error terms. For more information, refer to the TME webpage at <http://cal.software.keysight.com>.
5. Refer to **Figure 3-6 on page 42** for additional troubleshooting steps.

Figure 3-6 System Verification Failure Flowchart



sb69d

Interpreting the Verification Results

Figure 3-7 shows an example of typical verification results with Print Tabular Data selected in the Output area of the System Verification dialog box.

At the top of the printed output is the name of the device, the serial number of the device, and the date tested.

Each S-parameter measurement result is printed with frequency tested, lower and upper limit lines, the measured data, and the result of the test.

Figure 3-7 Example of Printed Tabular Verification Results

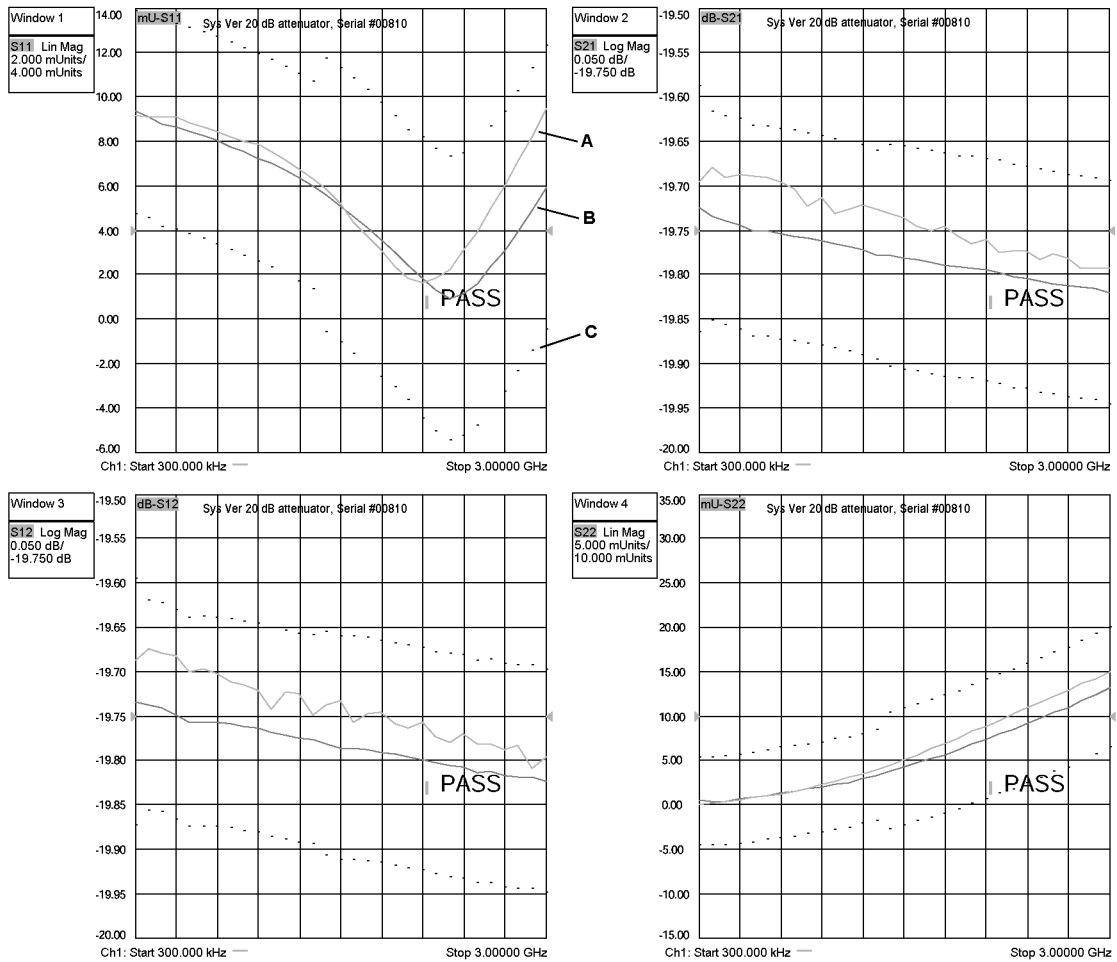
PNA System Verification								
Model: N5230A 225			Ser. Num.: US43390055		Test Time: 12/8/2004 2:08:35 PM			
Device: 20 dB Attenuator, Serial #02743					S11 Results		PASS	
	S11 MAGNITUDE (lin)				S11 PHASE (deg)			
Freq [GHz]	Lower Limit (lin)	Meas'd Data (lin)	Upper Limit (lin)	Total Uncert +/-	Lower Limit (deg)	Meas'd Data (deg)	Upper Limit (deg)	Total Uncert +/-
0.045	0.0067	0.0045	0.0113	0.0090	n/a	177.46	n/a	n/a
0.50	0.0067	0.0046	0.0114	0.0091	n/a	155.77	n/a	n/a
1.00	0.0057	0.0047	0.0125	0.0091	n/a	127.90	n/a	n/a
1.50	0.0043	0.0050	0.0139	0.0091	n/a	99.52	n/a	n/a
2.00	0.0034	0.0055	0.0148	0.0091	n/a	72.43	n/a	n/a
2.50	0.0076	0.0061	0.0208	0.0142	n/a	46.58	n/a	n/a
3.00	0.0068	0.0067	0.0216	0.0142	n/a	21.57	n/a	n/a
3.50	0.0066	0.0075	0.0227	0.0146	n/a	-0.45	n/a	n/a
4.00	0.0060	0.0086	0.0233	0.0146	n/a	-20.94	n/a	n/a
4.50	0.0056	0.0098	0.0237	0.0147	n/a	-39.48	n/a	n/a
5.00	0.0053	0.0109	0.0241	0.0147	n/a	-56.13	n/a	n/a
5.50	0.0051	0.0118	0.0242	0.0147	n/a	-71.75	n/a	n/a
6.00	0.0050	0.0125	0.0244	0.0147	n/a	-86.47	n/a	n/a
6.50	0.0049	0.0131	0.0244	0.0147	n/a	-100.81	n/a	n/a
7.00	0.0057	0.0136	0.0236	0.0147	n/a	-113.94	n/a	n/a
7.50	0.0061	0.0138	0.0232	0.0147	n/a	-125.68	n/a	n/a
8.00	0.0059	0.0138	0.0234	0.0147	n/a	-135.63	n/a	n/a
8.50	0.0110	0.0136	0.0287	0.0198	n/a	-144.53	n/a	n/a
9.00	0.0107	0.0133	0.0290	0.0199	n/a	-152.31	n/a	n/a
9.50	0.0101	0.0130	0.0297	0.0199	n/a	-159.32	n/a	n/a
10.00	0.0092	0.0129	0.0305	0.0199	n/a	-165.12	n/a	n/a
10.50	0.0080	0.0129	0.0317	0.0199	n/a	-169.47	n/a	n/a
11.00	0.0066	0.0130	0.0332	0.0199	n/a	-172.95	n/a	n/a
11.50	0.0051	0.0135	0.0347	0.0199	n/a	-176.46	n/a	n/a
12.00	0.0035	0.0140	0.0364	0.0199	n/a	-179.98	n/a	n/a

Figure 3-8 shows an example of typical verification results with Print Graphs selected in the Output area of the System Verification dialog box. The printed graphical results show the following:

- the name of the device measured
- the serial number of the device
- the parameters measured
- Results of the measurements. Labeled as A in Figure 3-8.
- Data measured at the factory from the verification kit. Labeled as B in Figure 3-8.
- Upper and lower limit points as defined by the total system uncertainty system. Labeled as C in Figure 3-8.

Tests, Adjustments, and Troubleshooting System Verification

Figure 3-8 Example of Printed Graphical Verification Results



Test Management Environment (TME) Performance Tests

The performance tests verify the electrical performance of your USB-network analyzer. For more information, refer to the TME webpage at

<http://cal.software.keysight.com>.

This section lists the test equipment needed to run performance tests. Models for each test equipment category are given in order of preference. Alternate models are also listed but should be considered a lower priority. All equipment is Keysight, Agilent, or Hewlett Packard unless otherwise specified. Refer to each individual test for specific setup configurations. The computer and all test equipment are connected to the unit under test (UUT) using GPIB and PXI.

NOTE

Requires a PC controller to run the (TME) Performance Tests.

Table 3-2 Required Test Equipment (TME Performance Testing)

Test Equipment	Recommended Model	Alternate Model
PNA network analyzer	N5245A	N5222A N5224A N5225A N5242A N5244A N5245AS E8363C E8364C
Power meter	N1914 ^a A	N1912A E4419A E4418A
Power sensor (Refer to Guidelines for Ordering Power-Sensor Calibration Service)	N8485A	None
Frequency counter	5320A Option 115	53131A 53132A Options 010 or 012, and 124 53181A Options 010 and 124
Frequency reference ^b	Frequency counter internal	House standard
Dynamic accuracy test set	U3020A-D01	None
Compression test set	U3070A-K01	None

Table 3-2 Required Test Equipment (TME Performance Testing)

Test Equipment	Recommended Model	Alternate Model
50 Ω termination	909D Option 301	909D Option 40
10 dB fixed attenuator (2 required)	8493C Option 010	None
Calibration kit, 3.5 mm	85052B (only the loads are used)	85052D
ECal module, 3.5 mm	N4691-60004 (order as N4691B Option M0F)	N4691-60008
Cables		
RF 3.5 mm (m) to 3.5 mm (f) (3 required)	8121-2111	
Adapters		
3.5 mm (f) to 3.5 mm (f)	85059B	1250-1749
3.5 mm (m) to 2.4 mm (m) (2 required)	11904A	
3.5 mm (m) to Type-N (m)	1250-1743	
BNC (m) to Type-N (f)	1250-1477	
3.5 mm (m) to 3.5 mm (m) (2 required)	83059A	1250-1748

- N1914A power meters with serial number prior to MY53040007 require Service Note N1914A-07 which fixes a power supply ground loop. The ground loop injects noise into the measurement circuits which can cause unstable measurements at low (-30 dBm) power levels.
- The frequency reference is optional. It may be a 10 MHz "house standard", or it may be the internal frequency reference time-base of the counter used for the frequency measurement. See the Frequency Reference Explanation section in the Frequency Accuracy test for details.

Guidelines for Ordering Power-Sensor Calibration Service

Use the following guidelines to ensure power sensors used by the N7800A application receive the correct calibration service:

- Order Option 1A7 when ordering new power sensors that will be used as working standards in N7800A TME calibrations.
- In the Americas region, order the Keysight Cal + Measurement Uncertainty for power sensor recalibration.
- Outside the Americas region, order ISO 17025/ILAC-G8 calibration service for power sensor recalibration.

4. When ordering periodic calibration for instruments used as lab standards in the N7800A software, we recommend using “Keysight calibration + uncertainties” for power sensors, and “Keysight calibration + uncertainties + guardbanding” for all other items (please visit [Selecting the Right Calibration Services](#)). The N7800A software incorporates the ISO GUM Uncertainty in point-to-point uncertainty calculations. The special “H-series” calibration options in this table provide lower measurement uncertainties through use of direct comparison to devices directly characterized by NPL or NIST (or another NMI). Please order Option H99 to get data on a CD for easy import into the N7800A (avoids manual entry). The overall resulting N7800A measurement uncertainties then reflects these lower device uncertainties. The equipment requirements of each N7800A calibration application are summarized in the special calibration matrix which can be found at the [Recommended Lab Standards and Special Cal Options](#) website.
5. The Keysight Option H99 is a special option for the Roseville Service Center [only] which provides a CD with calibration data included as a .csv file in TME N7800A format for all power sensors used with the N7800A TME application. N7800A TME is SSU calibration software used across Keysight SSU and by many self-maintainers. H99 must be requested from the Roseville SSU upon re-calibration only of any previously purchased power sensor and not for new purchases of BID Power Sensors. This option provides for adding the calibration data to a CD and may be ordered in addition to any other required or requested Std Lab Calibration option (must also be ordered in addition to H99).

Adjustments

These adjustments are firmware-driven tests that are used to fine-tune your analyzer. If multiple adjustments are to be performed, perform them in the order listed.

- **10 MHz Frequency Reference Adjustment**
- **Source Adjustment**
- **Receiver Adjustment**

10 MHz Frequency Reference Adjustment

The 10 MHz frequency adjustment is used to adjust the frequency accuracy of the network analyzer's 10 MHz frequency reference.

Equipment Used for the 10 MHz Frequency Reference Adjustment

Equipment Type	Model or Part Number	Alternate Model or Part Number
Cable, BNC, 50 Ohm, 24 inch	8120-1839	Any equivalent
Frequency counter	53151A, Option 001 ^a	Any that will accurately measure a signal at 10 MHz

- a. Refer to **"Get the Hardware Required for your GPIB Instruments" on page 27**.

Procedure

NOTE

This adjustment typically adjusts to within ± 0.01 ppm.

1. Make the proper connections for your USB equipment.
2. Press **Utility > System > Service > Adjustments**.
3. In the Select Desired Adjustment dialog box, click **10 MHz Freq Adjustment**.
4. Follow the instructions and prompts as they are displayed. Ensure the GPIB settings are correct if using the automated mode of operation.

Source Adjustment

The source calibration is used to adjust your network analyzer for a flat source power across its full frequency range. There are differences between each test port; therefore, an adjustment is required for each port.

Equipment Used for the Source Adjustment

Equipment Type	Model or Part Number	Alternate Model or Part Number
USB Thermocouple power sensor	U8485A Option 200	U8485A power meter
Adapter, 3.5 mm -m- to 3.5 mm -m-	83059A	85052-60014

Procedure

1. Connect the USB power sensor and adapter to the analyzer Port 1. If using a power meter, make the proper GPIB connections. Refer to **“Get the Hardware Required for your GPIB Instruments” on page 27**.
2. Press **Utility > System > Service > Adjustments**.
3. In the Select Desired Adjustment dialog box, click **Source Adjustment**.
4. Follow the instructions and prompts as they are displayed. If using a power meter, ensure the GPIB settings for the sensor(s) are correct in the dialog box.

Receiver Adjustment

The receiver calibration is used to adjust your network analyzer for a flat response across its full frequency range:

1. A USB power sensor is connected to analyzer Port 1 to establish a reference for flatness.
2. A cable is inserted between the power sensor and the test port to establish a reference for the cable.
3. The same cable is connected between analyzer Port 1 and Port 2, and a signal from Port 1 is used to adjust the “B” receiver at Port 2.
4. The adjustment is repeated using a signal from Port 2 to adjust the “A” receiver at Port 1.

Data obtained during this adjustment are stored in the analyzer and used in subsequent measurements. Data can be recreated by performing another receiver calibration adjustment.

Equipment Used for the Receiver Adjustment

Equipment Type	Model or Part Number	Alternate Model or Part Number
USB Thermocouple power sensor	U8485A Option 200 ^a	U8485A power meter
Adapter, 3.5 mm -m- to 3.5 mm -m-	83059A	85052-60014
RF cable, 3.5 mm (-m- to -m-)	11500E	Any equivalent

a. If not available, use any power meter with one or two sensors that cover the frequency range of the DUT.

Procedure

1. Connect the USB power sensor and adapter to the analyzer Port 1. If using a power meter, make the proper GPIB connections. Refer to **“Get the Hardware Required for your GPIB Instruments” on page 27**.
2. Press **Utility > System > Service > Adjustments**.
3. In the Select Desired Adjustment dialog box, click **Receiver Adjustment**.
4. Follow the instructions and prompts as they are displayed. If using a power meter, ensure the GPIB settings for the sensor(s) are correct in the dialog box.

Troubleshooting

Where you begin troubleshooting depends upon the symptoms of the failure. Start by checking the basics as outlined in the following section.

Check the Basics

CAUTION

The hardware does not support “hot-swap” (changing network analyzer modules while power is applied to the chassis) capabilities. Before installing or removing a module to/from the chassis, power-off the chassis to prevent damage to the module.

1. Is there power at the mains receptacle?
2. Is the chassis powered on? Check to see if the LED for the chassis line switch glows.
3. Is the analyzer powered on? Check to see if the analyzer’s front panel LED glows.

Explanation of power switch LED colors:

- OFF: Power supply off. P937XA VNA is disconnected from the external power supply.
- AMBER: Power supply is connected, but instrument power button switch is off.
- GREEN: Power button is on.

Explanation of Status LED colors:

- OFF: Power supply off. P937XA VNA is disconnected from the external power supply.
 - AMBER: Power supply is on, but no firmware is in control.
 - GREEN: Firmware is in control; analyzer is probably idle.
 - FLASHING GREEN: A sweep or measurement has been triggered.
4. If the chassis has power applied, but the power switch LED is not on, and the fans are not turning, then suspect this is due to a defective power switch. Consider changing the power switch by refer to **“Front Panel Replacement Procedure” on page 65**.

If the problem still persists, then the chassis A1 could be at fault. Refer to **“Chassis Replacement Procedure” on page 68**.
 5. If multiple analyzer P937xA’s are present, make sure the cables connecting the P937xA’s are fully inserted on the front panels.

For information on installing cables to multiple analyzer modules, refer to the online Startup Guide at
<http://literature.cdn.keysight.com/litweb/pdf/P9370-90001.pdf>.

Tests, Adjustments, and Troubleshooting

Troubleshooting

6. If other equipment, cables, and connectors are being used with the analyzer module, make sure they are clean, connected properly, and operating correctly.
7. Review the procedure for the measurement being performed when the problem appeared. Are all the settings correct?
If the analyzer is not functioning as expected, return the unit to a known state by clicking Utility > Preset.
8. Is the measurement being performed, and the results that are expected, within the specifications and capabilities of the analyzer? Refer to the online Data Sheet at <http://literature.cdn.keysight.com/litweb/pdf/5992-2765EN.pdf> for analyzer specifications.
9. With a soft failure, the network analyzer's performance has degraded to an unacceptable level, yet it continues to operate and display no error messages. For this type of failure, TME performance tests must be conducted to isolate the problem. If the network analyzer fails the TME performance tests but pass the operator's check, the connector could be at fault, consider change the connector by referring to **"Connector Replacement Procedure" on page 63**.
10. If the problem is thought to be due to firmware, check to see if the instrument has the latest firmware before troubleshooting further. Check for firmware updates at <https://www.keysight.com/find/usb-vna>.
11. If the necessary test equipment is available, perform the **"The Operator's Check" on page 33** and **"System Verification" on page 36**.

4 Replaceable Parts Listings

Information in This Chapter

This chapter:

- identifies the replaceable parts for the P937xA USB VNA.
- includes several tables and illustrations to assist you in identifying the correct part for your analyzer.
- contains ordering information for new assemblies.

Section Title	Summary of Content	Start Page
Ordering Information	How to order a replaceable part from Keysight Technologies.	page 54
Assembly Replacement Procedure	The correct sequence for determining the failure of and replacing a defective assembly.	page 55
Replaceable Parts Listings	Tables with illustrations that list all replaceable parts in your analyzer.	page 56

Ordering Information

To order a part listed in the replaceable parts lists:

- include the part number
- indicate the quantity required
- Contact Keysight Technologies for instructions on where to send the order. Refer to **“Contacting Keysight” on page 2-22.**

To order a part **that is not listed** in the replaceable parts lists:

- include the instrument model number and complete instrument serial number
- include the description and function of the part
- indicate the quantity required
- Contact Keysight Technologies for instructions on where to send the order. Refer to **“Contacting Keysight” on page 2-22.**

Assembly Replacement Procedure

The following steps describe how to replace an assembly in the analyzer.

- Step 1.** Identify the faulty group. Begin with **Chapter 3 “Troubleshooting”**. Follow up with the appropriate troubleshooting chapter that identifies the faulty assembly.
- Step 2.** Order a replacement assembly. Refer to this chapter for part numbers and ordering information.
- Step 3.** Replace the faulty assembly and determine what adjustments and performance tests are necessary. Refer to **Chapter 5, “Removal and Replacement Procedures.”**
- Step 4.** Perform the **“The Operator’s Check”** on page 3-33 and **“System Verification”** on page 3-36.

Replaceable Parts Listings

Entire Analyzer

Figure 4-1 Overview of P937xA USB VNA



Descriptions and part numbers for the assemblies and parts shown in the above illustration can be found at the following [Table 4-1](#).

Miscellaneous parts and accessories not illustrated in [Figure 4-2](#) are listed under [“Miscellaneous Parts”](#) on [page 4-58](#).

Table 4-1

P937xA USB VNA Assemblies Parts

Reference Designator	Part Number	Qty	Description
A1	P9375-65701 ^a	1	Chassis replacement
A2	P9370-65701/ P9370-69701	1	P937xA Module replacement
A3	P9375-60006	1	Front panel assembly - include the on/off keypad and the power switch board
A4	P9375-40003	2	Front handle
A5	P9375-40011	1	Front impact cover
Not Shown	P9370-80002	1	P937xA nameplate kits (Consists of P9370A to P9375A nameplates - 6 in total. If only one nameplate is required, purchase the individual item below.)
	P9370-80001	1	Nameplate - P9370A/ 4.5 GHz
	P9371-80001		Nameplate - P9371A/ 6.5 GHz
	P9372-80001		Nameplate - P9372A/ 9 GHz
	P9373-80001		Nameplate - P9373A/ 14 GHz
	P9374-80001		Nameplate - P9374A/ 20 GHz
	P9375-80001		Nameplate - P9375A/ 26.5 GHz

- a. If you are replacing a new chassis, you must also purchase the corresponding nameplate label according to product model.

Miscellaneous Parts

Figure 4-2 P937xA USB VNA Miscellaneous Parts

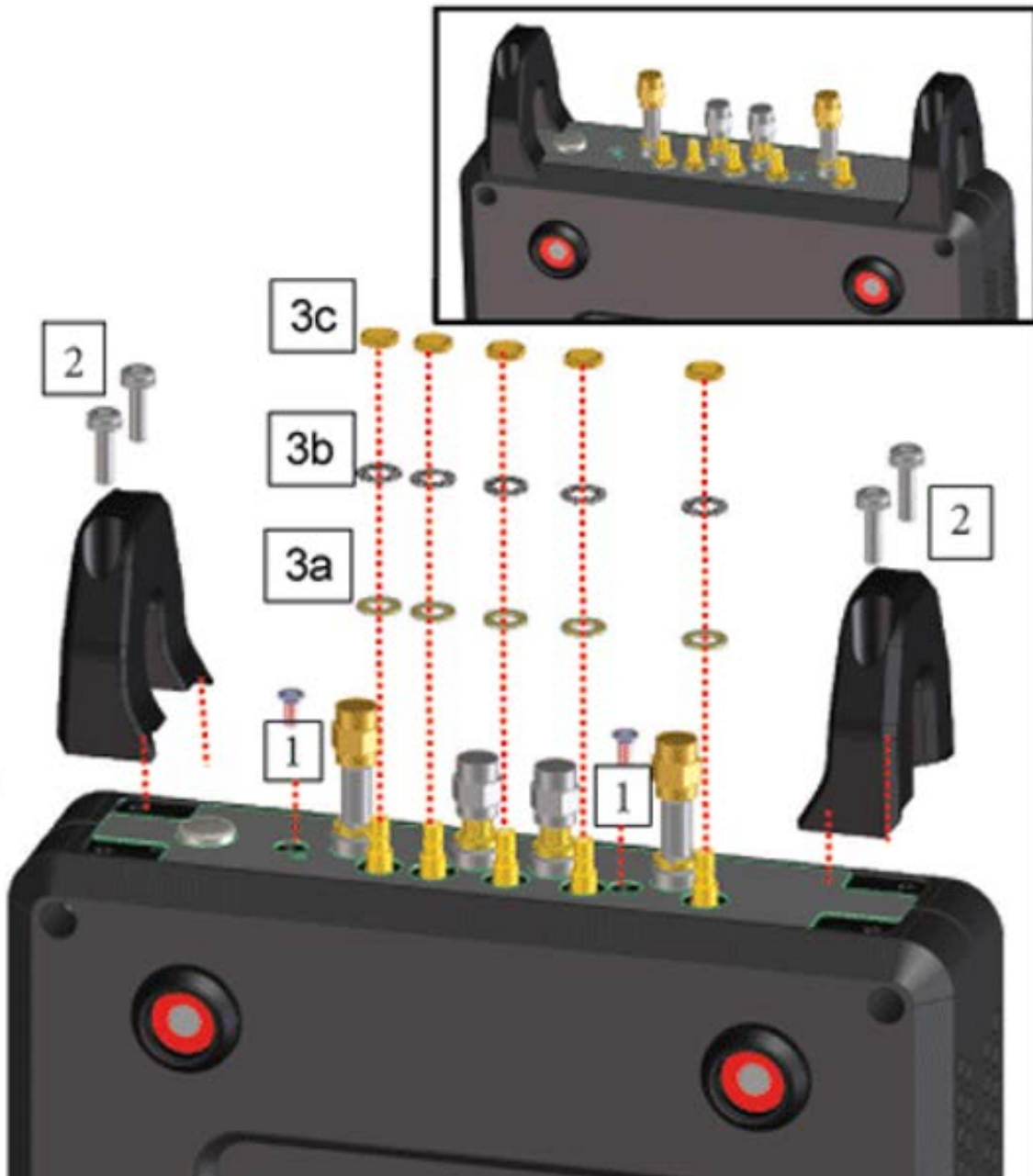


Table 4-2

Miscellaneous Parts

Reference Designator	Part Number	Qty	Description
1	0515-1375	2	M2.5 x 6 mm Flathead Screw
2	0515-0664	4	M3 x 12 mm Screw
3a	3050-2529	5	Flat Washer
3b	2190-0124	5	Lock Washer
3c	2950-0078	5	Nut
4	1250-4261	2	SMA Load for LO IN and LO OUT
Not Shown	P9375-20006	1	Light pipe
Not Shown	5188-5406	2	Port 1 and Port 2 Dust Cap
Not Shown	1401-0431	5	SMB Connectors Dust Cap

Accessories Part

Description	Part Number
USB 3.0 cable	P9375-60010
External Power Supply Desktop adapter 90-264 AC 15 VDC 6 A 90 W	0950-6128

Replaceable Parts Listings
Replaceable Parts Listings

5 Removal and Replacement Procedures

CAUTION

STOP!!! Please read all content before proceeding with this repair procedure. This repair must be done at a service center! If you think you may not be qualified to do the work, or need advice, contact Keysight. Refer to **“Keysight Support, Services, and Assistance”** on page 22.

Information in This Chapter

This chapter contains procedures for removing and replacing the major assemblies of your Keysight USB Streamline network analyzer.

Section Title	Summary of Content	Start Page
Electrostatic Discharge (ESD) Protection	Information pertaining to ESD protection.	page 62
Connector Replacement Procedure	A procedure for replacing the Streamline connectors.	page 63
Front Panel Replacement Procedure	Procedure for replacing the front panel.	page 65
Chassis Replacement Procedure	Procedure for replacing the USB-VNA chassis.	page 68
Module Replacement Procedure	Procedure for replacing the module inside the USB-VNA.	page 71
Post-Repair Procedures	A table for the proper tests, verifications and adjustments to perform on your analyzer after repair.	page 73

CAUTION

The hardware does not support “hot-swap” (changing network analyzer modules while power is applied to the chassis) capabilities. Before installing or removing a module to/from the chassis, power-off the chassis to prevent damage to the module.

Electrostatic Discharge (ESD) Protection

CAUTION

Many of the assemblies in this instrument are very susceptible to damage from electrostatic discharge (ESD). Perform the following procedures only at a static-safe workstation and wear a grounded wrist strap.

This is important. If not properly protected against, electrostatic discharge can seriously damage your analyzer, resulting in costly repair.

To reduce the chance of electrostatic discharge, follow all of the recommendations outlined in “**Electrostatic Discharge Protection**” on **page 12**, for all of the procedures in this chapter.

Connector Replacement Procedure

Parts Required

- SMA or 3.5 mm connectors
- Nuts for connectors

Tools Required

- “Spark plug” adapter
- Torque wrench (for “spark plug” adapter)
- ESD equipment:

Description	Keysight Part Number
ESD grounding wrist strap	9300-1367
5-ft grounding cord for wrist strap	9300-0980
2 x 4 ft conductive table mat and 15-ft grounding wire	9300-0797
ESD heel strap (for use with conductive floors)	9300-1308

Removal Procedure

NOTE

Although the photos in this section show a 3.5 mm connector being replaced, the procedure is the same for SMA connectors.

1. Place the module on its side on an ESD safe, flat surface.
2. Place the “spark plug” adapter on the nut of the connector you are going to replace. The adapter must fit snugly into the slots of the nut. Refer to **Figure 5-2 on page 64.**

Figure 5-1 Tools and Parts



Removal and Replacement Procedures

Connector Replacement Procedure

Figure 5-2 Removing the Nut



3. Use the torque wrench with the adapter to remove the nut.
4. Use the torque wrench to remove the connector. Refer to [Figure 5-3](#).

Figure 5-3 Removing the Connector



Replacement Procedure

1. Reverse the order of the removal procedure.
Be careful to install the nut with the slots facing outward.
2. Perform the Op Check to verify the new connectors are functional. Refer to [“The Operator’s Check” on page 33](#). If it fails, perform the Adjustments (refer to [“Adjustments” on page 48](#)), then repeat the Op Check.
3. For complete assurance that the connectors are meeting all criteria, perform the following TME Performance Tests. Refer to the TME webpage at <http://cal.software.keysight.com>:
 - “Source Power Accuracy Test”
 - “Source Maximum Power Output Test”
 - “Calibration Coefficients Test”

If any of the tests fail, perform the Adjustments (refer to [“Adjustments” on page 48](#)), then repeat the tests.

Front Panel Replacement Procedure

Removing and Replacing the A3 Front Panel Assembly

Tools required

- T-8 TORX driver (set to 6 in-lb)
- T-10 TORX driver (set to 10 in-lb)
- 1/4-inch nut setter bit (set to 6 in-lb)
- 5/16 inch open end torque wrench (set to 8 in lbs)
- ESD grounding wrist strap

Removal Procedure

Refer to **Figure 5-4** for this procedure.

1. Disconnect the power cord.
2. Remove SMA load (2x) 1250-4261 from the LO IN and LO OUT ports using the 5/16 inch open end torque wrench.
3. With a 1/4-inch nut setter bit, remove all the 5 dress nuts, follow by lock washer and flat washer (item 3c, 3b and 3a) from the SMB connector.
4. With a T-10 TORX driver, remove the front handles (item 2) by loosening the screws, on both ends until the handle is free of the analyzer.
5. Remove the flashhead screw (item 1) from the front panel with T-8 TORX driver.
6. Slide the front panel over the test port connectors.
7. Disconnect the ribbon cable from the front panel power switch board.

NOTE

When slide open the front panel and removing the ribbon cable, be careful not to misplace the light pipe as this small part is easily fall off. Refer **Figure 5-5**.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. When reinstalling the dress nut in step 3, make sure install in the sequences 3a flat washer, follow by 3b lock washer and 3c dress nut. Secure with 1/4-inch nut setter bit set to 6 in-lbs.

Figure 5-4 Removing and replacing A3 Front Panel Assembly

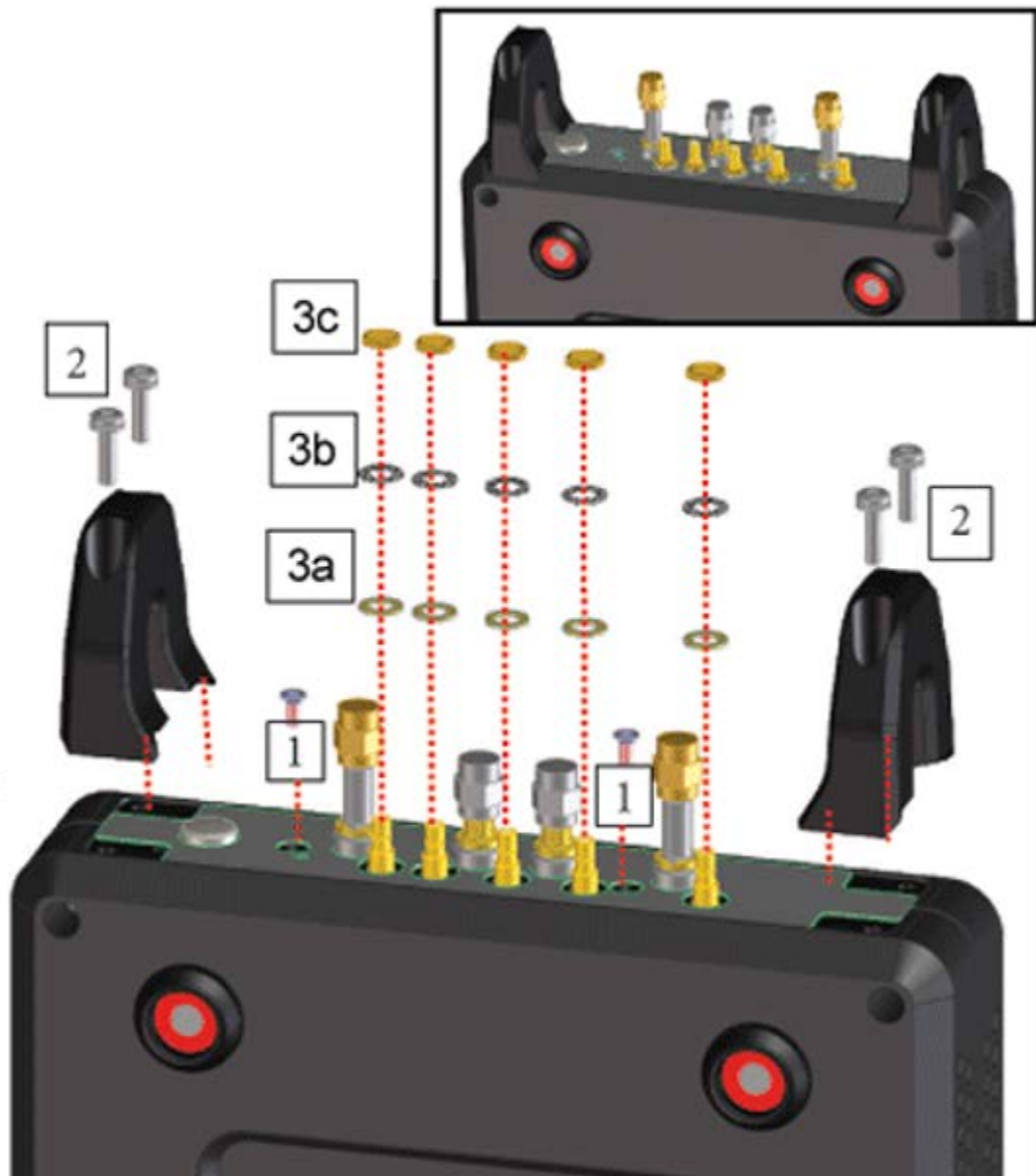
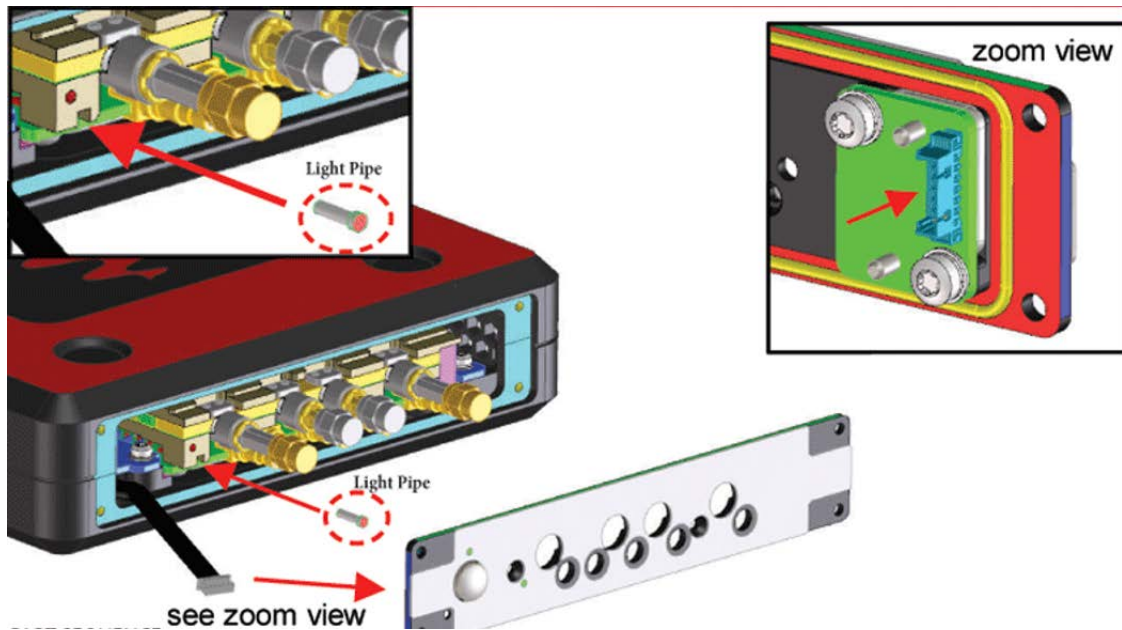


Figure 5-5 Light Pipe Assembly



Chassis Replacement Procedure

Removing and Replacing the A1 Chassis

Tools Required

- T-8 TORX driver (set to 6 in-lb)
- T-10 TORX driver (set to 10 in-lb)
- 1/4-inch nut setter bit (set to 6 in-lb)
- 5/16 inch open end torque wrench (set to 8 in lbs)
- ESD grounding wrist strap

Removal Procedure

1. Disconnect the power cord.
2. Turn the instrument over so the bottom feet are facing up.
3. Remove 0515-1227 (x4) screws and old secondary plate P9375-00007. Save screws and plate for reuse. Refer to [Figure 5-7](#).
4. Remove the front panel. Refer to [“Removing and Replacing the A3 Front Panel Assembly” on page 65](#).
5. Remove the light pipe from the module. Refer to the [Figure 5-5 on page 67](#).
6. Slide the A2 module out from the chassis.

NOTE

Each module is individually serialized, serial numbers are labeled into the body of each module known as manufacturing ID. Record down the module manufacturing ID as this is needed for the post replacements procedure.



Replacement Procedure

1. Reverse the order of the removal procedure.
2. Remember to place the light pipe back into the module. Refer to the **Figure 5-5 on page 67**.
3. Adhere and properly align appropriate nameplate overlay into the pocket shown below **Figure 5-6 on page 69**. There should also be a nameplate overlay included with the kit that matches your analyzer. Rub down the overlay with moderate finger pressure.
4. Attach the secondary plate P9375-00007 using 0515-1227 (x4) screws to the new chassis.
5. Perform the post-repair steps, verifications, and performance tests that pertain to this removal procedure. Refer to **Chapter 3, “Tests, Adjustments, and Troubleshooting”, on page 25**

Figure 5-6 Nameplate Overlay for P937xA

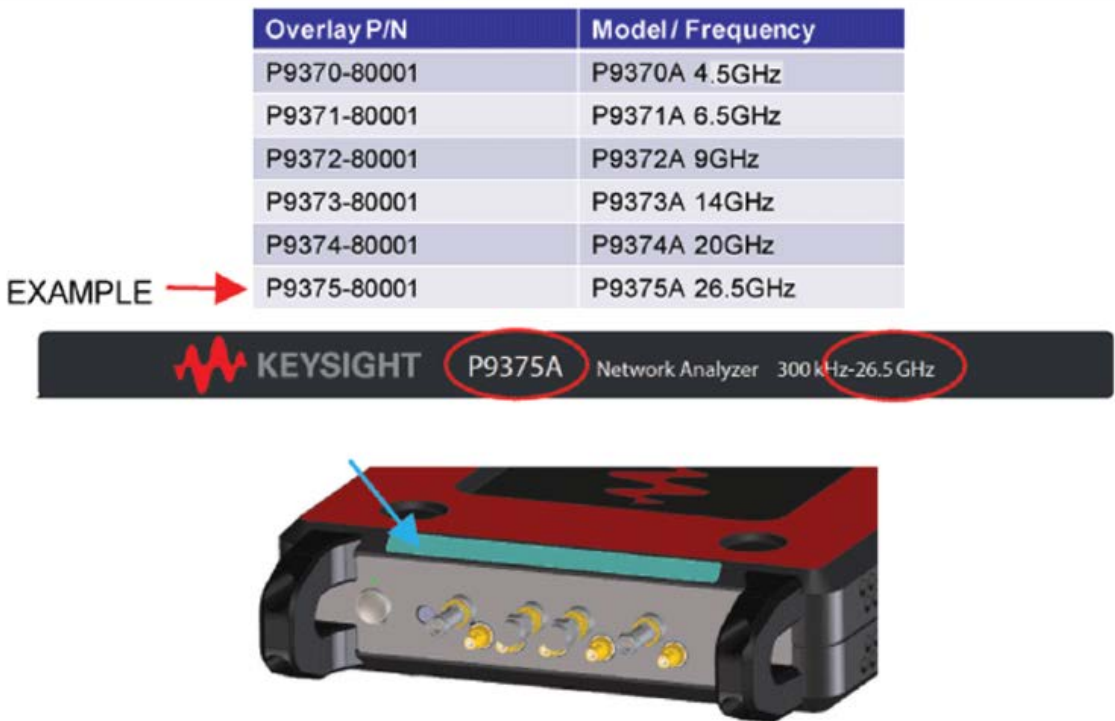
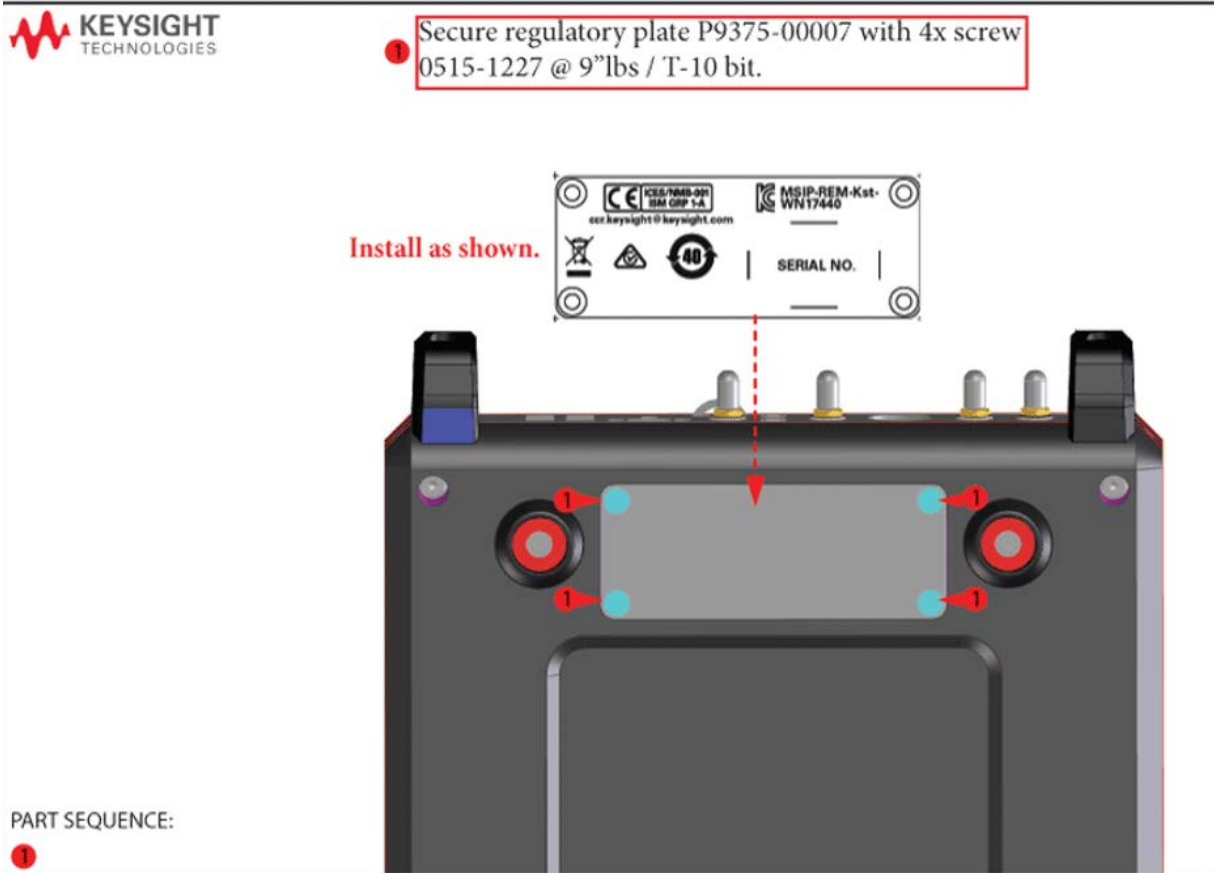


Figure 5-7 Secure Regulatory Plate (P9375-00007, 0515-1227 (x4))



Module Replacement Procedure

Removing and Replacing the A2 Module Assembly

Tools Required

- T-8 TORX driver (set to 6 in-lb)
- T-10 TORX driver (set to 10 in-lb)
- 1/4-inch nut setter bit (set to 6 in-lb)
- 5/16 inch open end torque wrench (set to 8 in lbs)
- ESD grounding wrist strap

NOTE

Recording the new module serial numbers.

Each new module is individually serialized, serial numbers are labeled into the body of each module known as manufacturing ID. Record down the module serial number as this is needed for the post replacements procedure.

Figure 5-8 Module serial number



Removal Procedure

1. Disconnect the power cord.
2. Turn the instrument over so the bottom feet are facing up.
3. Remove 0515-1227 (x4) screws and old secondary plate P9375-00007. Save screws and plate for reuse.
4. Remove the front panel. Refer to **“Removing and Replacing the A3 Front Panel Assembly” on page 65.**
5. Remove the light pipe from the module. Refer to the **Figure 5-5 on page 67.**
6. Slide the A2 module out from the chassis.

Replacement Procedure

1. Reverse the order of the removal procedure.
2. Remember to place the light pipe back into the module.
3. Perform the post-repair steps, verifications, and performance tests that pertain to this removal procedure. Refer to **“Post-Repair Procedures” on page 73.**

NOTE

When slide in the module, make sure the PCB board sitting in between the groove on the both side . Refer figure below.



Post-Repair Procedures

After the replacement of an assembly, you must perform the service procedures in the order listed in **Table 5-1**.

Table 5-1 Related Service Procedures

Replaced Assembly	Adjustment, etc.	TME Tests or Other Procedures
A1 Ingot Chassis	No adjustment needed	Perform the OF Ingot Utilities Operator's check All TME based tests that apply
A2 Module Assembly	No adjustment needed	Perform the OF Ingot Utilities Operator's check All TME based tests that apply
A3 Front Panel Assembly	No adjustment needed	Operator's check
Connector	No adjustment needed	Operator's check All TME based tests that apply

OF Ingot Utilities

Overview of the OF Ingot Utilities

The OF Ingot Utilities is a software used to program back all the necessary information back into the P937xA USB VNA. It should be performed whenever replacing a new chassis or module replacement.

Procedure

- Step 1.** Once the P937XA has been re-assembled, power up the USB VNA.
- Step 2.** Connect the chassis to the System Controller (PC) via USB cable.
 - a. Consult the user guide (P9370-90001) for the minimum requirements of the system controller.
- Step 3.** Download and install the “OF Ingot Utilities”.

NOTE

You will need to contact the Keysight factory support node to request the OF Ingot Utilities software.

- Step 4.** Run the OF Ingot Utilities.

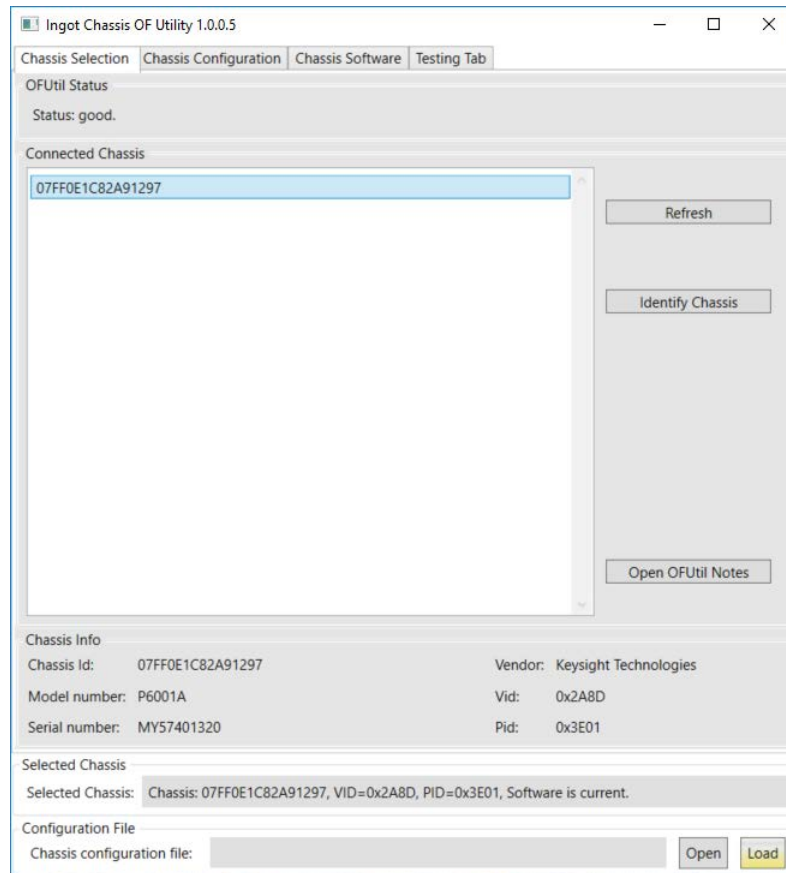


- Step 5.** When OF Ingot Utilities opens the main menu with look like the image below.
 - a. Make sure you see the host id in the Connected Chassis window.

Removal and Replacement Procedures

Post-Repair Procedures

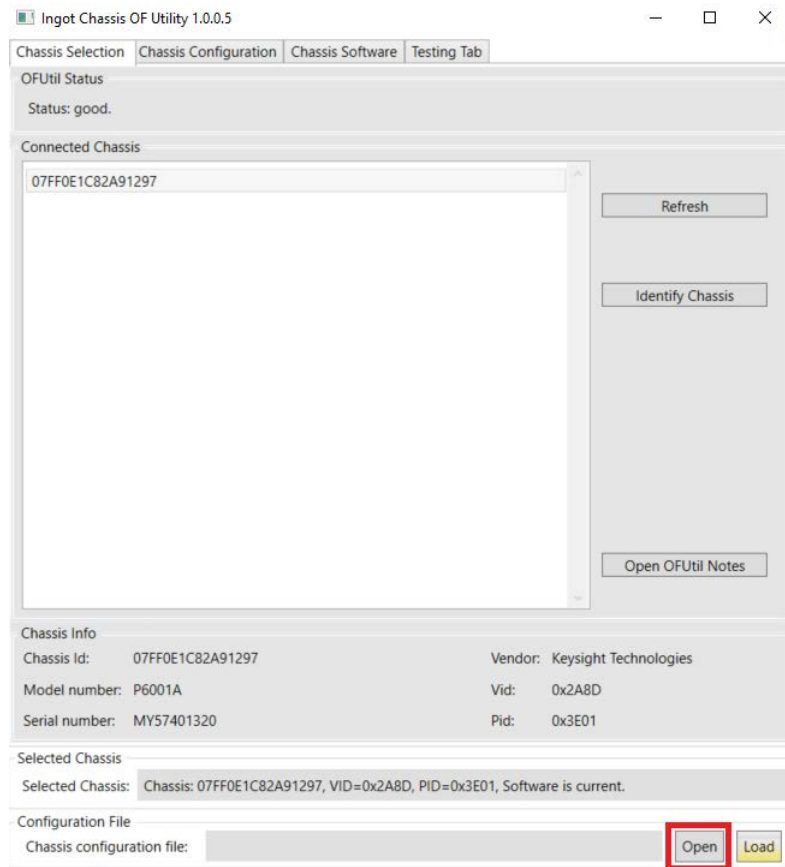
- b. If the chassis does not show, press the Refresh button.



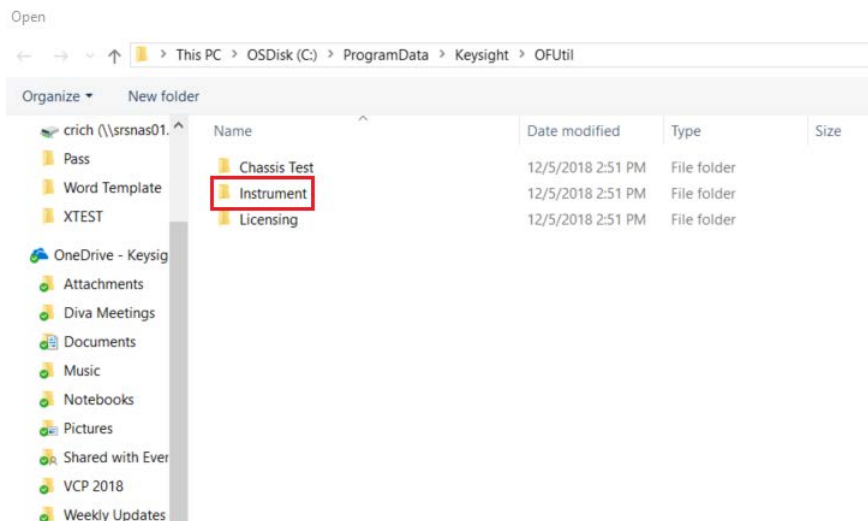
Removal and Replacement Procedures

Post-Repair Procedures

Step 6. Locate the “Chassis configuration file” area of the menu (at the bottom) and press the Open button.



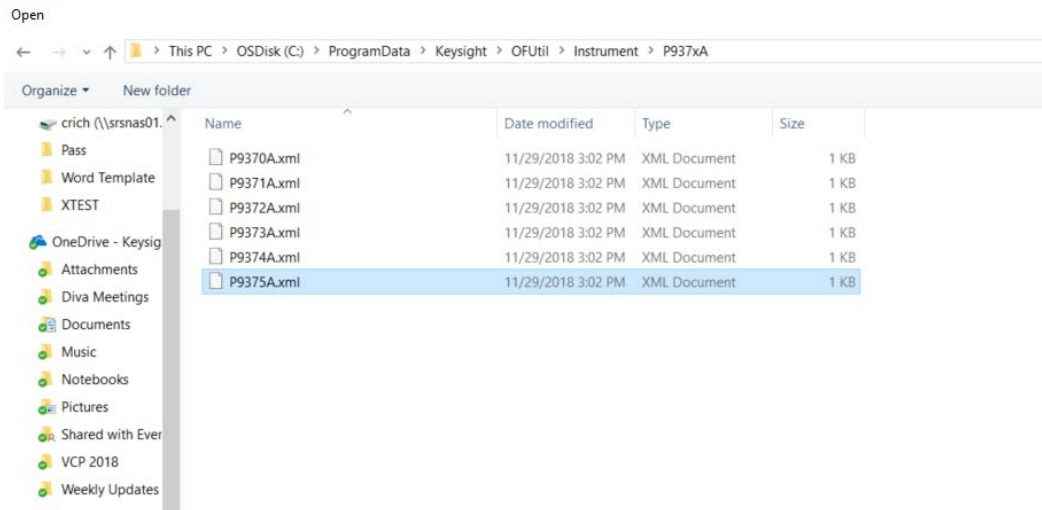
Step 7. In the “Open” Dialog box locate the directory “Instruments” and select it.



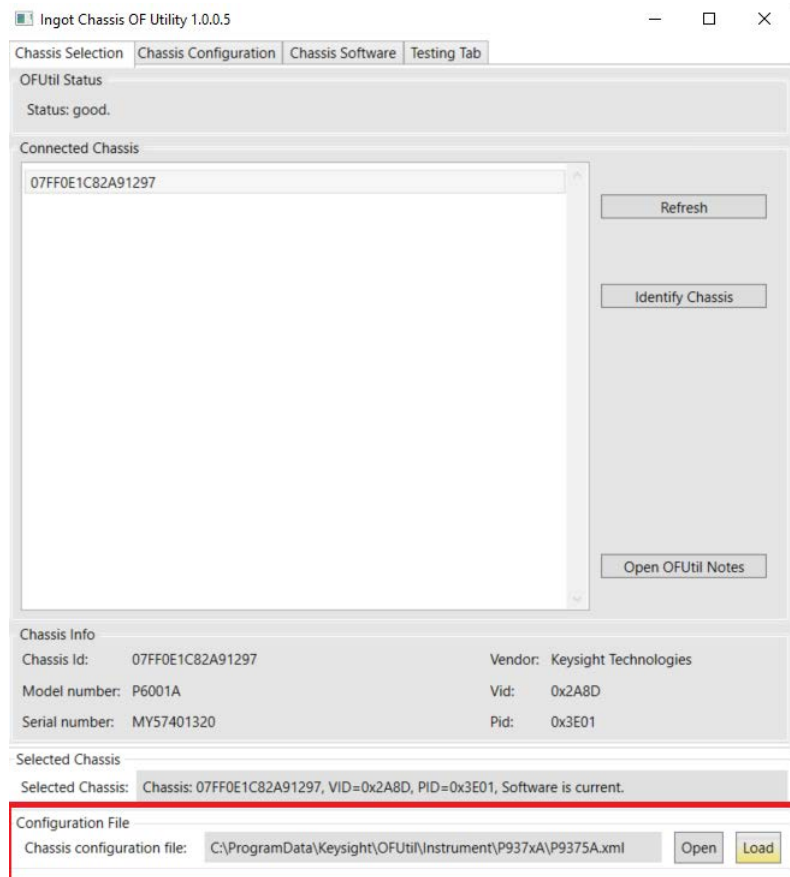
Removal and Replacement Procedures

Post-Repair Procedures

Step 8. Select the directory for the product number you are working on.



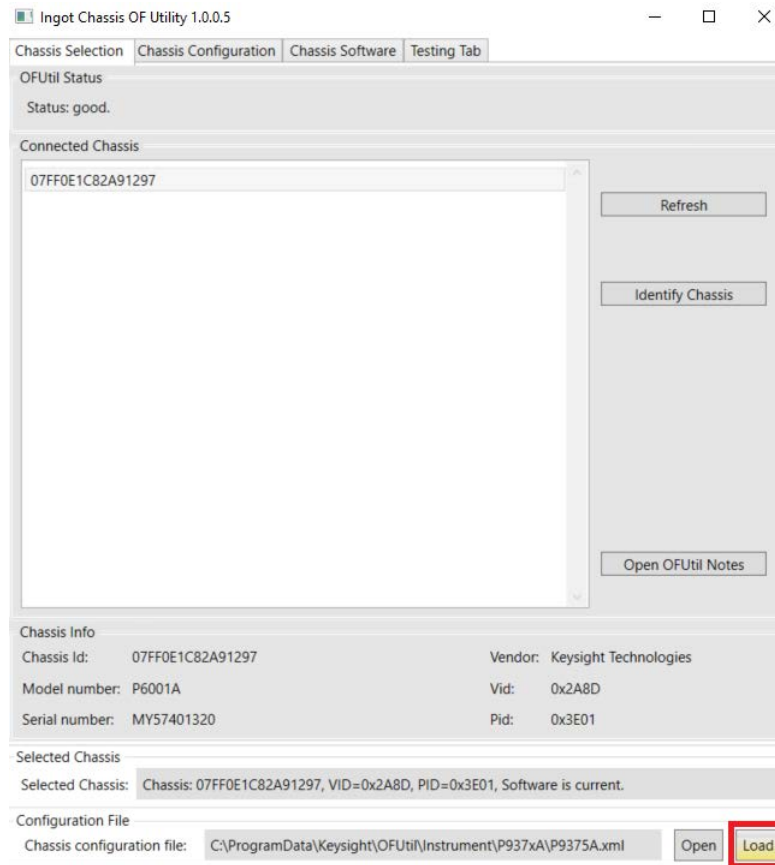
Step 9. The file name will now appear in the “Chassis configuration file:”



Removal and Replacement Procedures

Post-Repair Procedures

Step 10. Press the “Load” button to load the Chassis configuration file.



Removal and Replacement Procedures

Post-Repair Procedures

Step 11. Select the Chassis Configuration Tab.

Ingot Chassis OF Utility 1.0.0.5

Chassis Selection | **Chassis Configuration** | Chassis Software | Testing Tab

Chassis Information

Model number: P6001A Slot count: 1 Module count: 1

Serial number: MY57401320 Fan configuration: 255

Motherboard SN: M9370630222318360

Daughter board #1 SN: Daughter board #2 SN: Daughter board #3 SN:

Min. Ext. Supply Voltage: 14 Auto Power-On: ☐

Instrument Configuration

Model Number: Serial Number:

Slot Configuration

	Model Number	Manufacturing Number	VID (16 bit hex)	PID (16 bit hex)
Slot #1:			2A8D	3C01
Slot #2:			2A8D	
Slot #3:			2A8D	
Slot #4:			2A8D	

Licensing Configuration

Capabilities file: P9370A_licensing.xml

Software Configuration

FPGA binary filename: MB_TOP_P9370A.VER

Nios binary filename: MB_TOP_NIOSFW.VER

Backup binary filename: MB_TOP_GOLDEN.VER

Read from chassis Write to chassis Clear

Selected Chassis

Selected Chassis: Chassis: 07FF0E1C82A91297, VID=0x2A8D, PID=0x3E01, Software is current.

Configuration File

Chassis configuration file: C:\ProgramData\Keysight\OFUtil\Instrument\P937xA\P9375A.xml Open Load

Step 12. Keying the instrument configuration model number and serial number.

NOTE

This step is only required if you are replacing the chassis. If you are replacing only the module, skip this step and continue to the next step.

Refer to the **Figure 5-9**, both the model number (P937XA) and serial number (MY/USXXXXXXX) can be found on the Chassis regulatory plate from the original unit.

Ingot Chassis OF Utility 1.0.0.5

Chassis Selection Chassis Configuration Chassis Software Testing Tab

Chassis Information

Model number: P6001A Slot count: 1 Module count: 1

Serial number: MY57401320 Fan configuration: 255

Motherboard SN: M9370630222318360

Daughter board #1 SN: Daughter board #2 SN: Daughter board #3 SN:

Min. Ext. Supply Voltage: 14 Auto Power-On: ☐

Instrument Configuration

Model Number: Serial Number:

Slot Configuration

Slot	Model Number	Manufacturing Number	VID (16 bit hex)	PID (16 bit hex)
Slot #1:			2A8D	3C01
Slot #2:			2A8D	
Slot #3:			2A8D	
Slot #4:			2A8D	

Licensing Configuration

Capabilities file: P9370A_licensing.xml

Software Configuration

FPGA binary filename: MB_TOP_P9370A.VER

Nios binary filename: MB_TOP_NIOSFW.VER

Backup binary filename: MB_TOP_GOLDEN.VER

Read from chassis Write to chassis Clear

Selected Chassis

Selected Chassis: Chassis: 07FF0E1C82A91297, VID=0x2A8D, PID=0x3E01, Software is current.

Configuration File

Chassis configuration file: C:\ProgramData\Keysight\OFUtil\Instrument\P937xA\P9375A.xml Open Load

- Model Number = Model number of the USB VNA
- Serial Number = Serial number of the USB VNA

Figure 5-9 Regulatory Plate on Chassis



Removal and Replacement Procedures

Post-Repair Procedures

Step 13. Keying the slot configuration model number and manufacturing number.

Ingot Chassis OF Utility 1.0.0.5

Chassis Selection | Chassis Configuration | Chassis Software | Testing Tab

Chassis Information

Model number: P6001A Slot count: 1 Module count: 1

Serial number: MY57401320 Fan configuration: 255

Motherboard SN: M9370630222318360

Daughter board #1 SN: Daughter board #2 SN: Daughter board #3 SN:

Min. Ext. Supply Voltage: 14 Auto Power-On: ☐

Instrument Configuration

Model Number: Serial Number:

Slot Configuration

Slot	Model Number	Manufacturing Number	VID (16 bit hex)	PID (16 bit hex)
Slot #1:			2A8D	3C01
Slot #2:			2A8D	
Slot #3:			2A8D	
Slot #4:			2A8D	

Licensing Configuration

Capabilities file: P9370A_licensing.xml

Software Configuration

FPGA binary filename: MB_TOP_P9370A.VER

Nios binary filename: MB_TOP_NIOSFW.VER

Backup binary filename: MB_TOP_GOLDEN.VER

Read from chassis Write to chassis Clear

Selected Chassis

Selected Chassis: Chassis: 07FF0E1C82A91297, VID=0x2A8D, PID=0x3E01, Software is current.

Configuration File

Chassis configuration file: C:\ProgramData\Keysight\OFUtil\Instrument\P937xA\P9375A.xml Open Load

- Model number = Model number of the USB VNA
- Manufacturing Number = Manufacturing number off of the label on the PXI module. Refer to **Figure 5-8 on page 71**.

Removal and Replacement Procedures
Post-Repair Procedures

Example of all the fields filled in as below:

Ingot Chassis OF Utility 1.0.0.5

Chassis Selection | Chassis Configuration | Chassis Software | Testing Tab

Chassis Information

Model number: P6001A Slot count: 1 Module count: 1

Serial number: MY57401320 Fan configuration: 255

Motherboard SN: M9370630222318360

Daughter board #1 SN: Daughter board #2 SN: Daughter board #3 SN:

Min. Ext. Supply Voltage: 0 Auto Power-On: ☐

Instrument Configuration

Model Number: P9375A Serial Number: US57210033

Slot Configuration

	Model Number	Manufacturing Number	VID (16 bit hex)	PID (16 bit hex)
Slot #1:	P9375A	2155442561	2A8D	3C01
Slot #2:			2A8D	
Slot #3:			2A8D	
Slot #4:			2A8D	

Licensing Configuration

Capabilities file: (data read from chassis)

Software Configuration

FPGA binary filename: MB_TOP_P9370A.VER

Nios binary filename: MB_TOP_NIOSFW.VER

Backup binary filename: MB_TOP_GOLDEN.VER

Read from chassis Write to chassis Clear

Selected Chassis

Selected Chassis: Chassis: 07FF0E1C82A91297, VID=0x2A8D, PID=0x3E01, Software is current.

Configuration File

Chassis configuration file: Open Load

Step 14. Once all the files are filled in, press the Write to chassis button to program the values and information into the chassis.

Step 15. OF Ingot Utilities can be closed now, all the configuration has been completed.

Step 16. Reboot the USB-VNA.

Shutdown the USB-VNA and unplugged the power cord. Wait for a few second before power up again. The PC should able to identify the USB-VNA at the right bottom of the PC screen.

Step 17. Install back the Multiple License Files.

NOTE

This step is only required if you are replacing the chassis. If you are replacing only the module, skip this step.

NOTE

All of the licenses in your UBS VNA need to be re-host to the new hostID . Contact Keysight Technologies factory support early in your repair process to receive your licenses in a timely manner. See [“Contacting Keysight” on page 22.](#)

Go to **Help > About Network Analyzer**, you will need to provide Keysight with the following information:

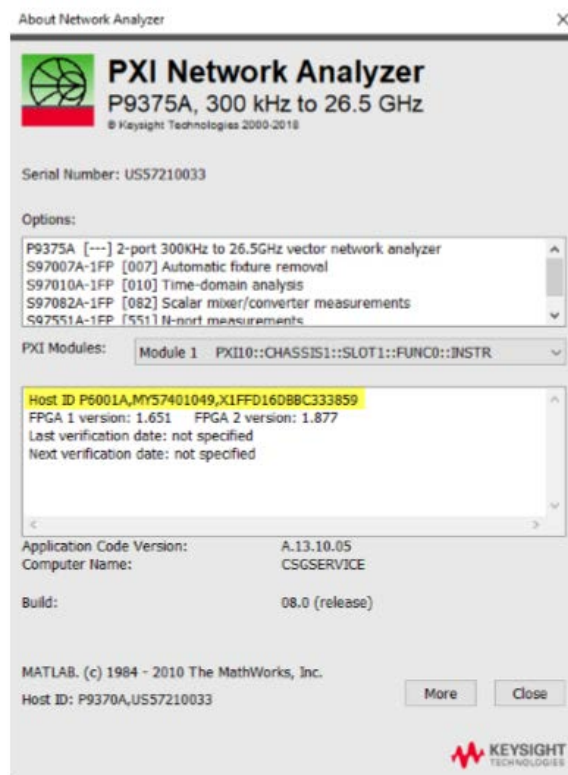
- model number
- serial number
- HostID

Instrument information is available in the USB network analyzer - on the toolbar, click Help, then click About Network Analyzer. Refer to [Figure 5-10](#).

Figure 5-10

About Network Analyzer Window

About Network Analyzer window



Step 18. Perform Operator's Check and Calibration

Operator's Check:

Perform the Operator's Check to check the basic functionality of the analyzer. For instructions, refer to the [Chapter 3, "Tests, Adjustments, and Troubleshooting."](#) of the Service Guide.

If you experience difficulty with the basic functioning of the analyzer, contact Keysight. Refer to ["Keysight Support, Services, and Assistance"](#) on page 22.

Calibration:

Although the analyzer functions, its performance relative to its specifications has not been verified. It is recommended that a full instrument calibration be performed using the TME Performance Tests. Refer to the TME webpage at <http://cal.software.keysight.com>. If any of the tests fail, perform the Adjustments (refer to “Adjustments” on page 48), then repeat the tests.

Removal and Replacement Procedures
Post-Repair Procedures

6 General Product Information

Information in This Chapter

Section Title	Summary of Content	Start Page
Error Terms	How to use error term data as a diagnostic tool.	page 88
Accessing the Keysight License Manager (KLM) and Installing Your License Files	How to use Keysight License Manager (KLM) to install your licenses on your instrument.	page 95
Firmware Upgrades	How to get firmware upgrades.	page 98

Error Terms

Using Error Terms as a Diagnostic Tool

By examining error terms, you can monitor system performance for preventive maintenance and troubleshooting purposes.

The magnitude and shape of the error terms are affected by:

- calibration kit devices
- cables
- adapters and accessories
- test port connectors

Calibration kit devices, cables, adapters and accessories are the most common cause of error term anomalies. Make sure of the following:

- Connectors must be clean, gaged, and within specification.
- Use proper connection technique during measurement and calibration. For online information on connector care, go to http://na.support.keysight.com/pna/connectorcare/Connector_Care.htm, or to the calibration kit's user's and service manual.

Preventive Maintenance

If you print or plot the error terms at set intervals (weekly, monthly, etc), you can compare current error terms to these records. A stable system should generate repeatable error terms over long intervals, (for example, six months). Look for the following:

- A long-term trend often reflects drift, connector and cable wear, or gradual degradation, indicating the need for further investigation and preventive maintenance. Yet, the system may still conform to specifications. The cure is often as simple as cleaning and gaging connectors and cables.
- A sudden shift in error terms may indicate the need for troubleshooting.

Troubleshooting

Refer to error term descriptions in **"Error Term Data" on page 92.**

NOTE

Always suspect calibration devices, cables, or improper connector maintenance as the primary cause of an error term anomaly.

Performing Measurement Calibration

CAUTION

Follow ESD-safe practices when working with the network analyzer. For more information, refer to Chapter 1 in the P937xA Startup Guide, viewable online at

<http://literature.cdn.keysight.com/litweb/pdf/P9370-90001.pdf>.

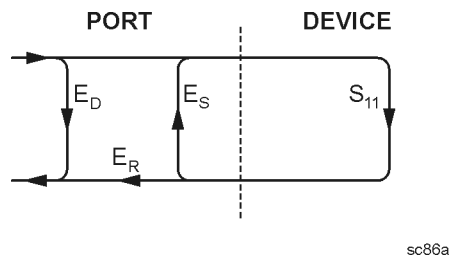
1. Connect a test cable to Port 2.
2. Perform a full 2-port calibration. Refer to Help if necessary.

Using Flowgraphs to Identify Error Terms

Flowgraphs are a graphical representation of signal flow through the measurement path. The flowgraphs in **Figure 6-1** and **Figure 6-2** illustrate the error terms associated with measurement calibration for 1-port and 2-port configurations respectively.

Figure 6-1

Flowgraph of 1-Port Error Terms for Port 1



Where:

E = Error term

Subscript:

D = Directivity

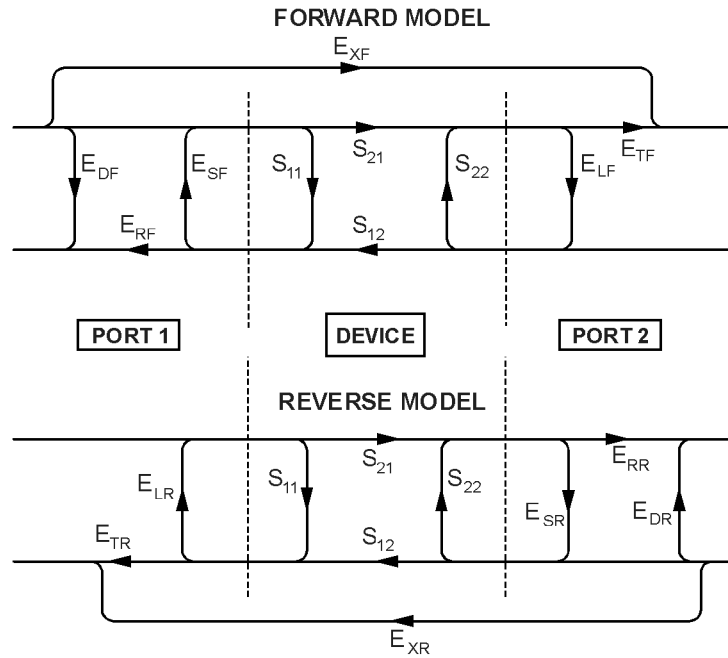
S = Source Match

R = Reflection Tracking

The error terms are the same for a 1-port measurement on Port 2 (S_{22}).

Figure 6-2

Flowgraph of 2-Port Error Terms



sc87a.cdr

Where:

E = Error term

1st Subscript:

D = Directivity

S = Source Match

R = Reflection Tracking

X = Crosstalk (Isolation)

L = Load Match

T = Transmission Tracking

2nd Subscript:

F = Forward measurement (Port 1 to Port 2)

R = Reverse measurement (Port 2 to Port 1)

Manual Access to Error Terms

Soft Front Panel Access to Error Terms

NOTE

Ensure the calibration correction is active by making sure that the check box for Correction on/OFF has been selected.

To access the error terms from the soft front panel, perform the following steps:

1. On the P937xA software's toolbar, click **Response > Cal > Cal Sets & Cal Kits > Cal Set Viewer**.
The Cal Set Viewer tool bar appears directly above the trace window.
2. In the Cal Sets drop-down list, select the desired cal set or use the System Default.
3. Click **Standards** to view the raw measurement data of the Standard (ONLY available with Unguided Cal (not ECal or Guided Cal)), or click **Error Terms** to view the corrected error term data.
4. Use the Error Term box drop-down list to select an error term or standard to view.
5. Select the Enable check box to view the data on the PC display.
6. Compare the displayed measurement trace to the equivalent data that starts in **"Error Term Data" on page 92**, or to previously measured data, or to the uncorrected performance specifications listed in **Table 6-1 on page 92**.
7. Print numerical data or print a plot of the measurement results.

Error Term Data

The error term descriptions in this section include the following information:

- a table of error terms
- description and significance of each error term
- measurements affected by each error term
- typical cause of failure for each error term

The same description applies to both the forward (F) and reverse (R) terms.

NOTE

Data are listed here as a convenience only. Detailed instrument specifications are in the Data Sheet, viewable online at <http://literature.cdn.keysight.com/litweb/5992-2765EN.pdf>.

Table 6-1 Error Term Data¹

Frequency Range	Directivity	Source match	Load match	Crosstalk ²
300 kHz to < 2 MHz	9	9	9	97
2 MHz to 1 GHz	21	19	21	95
> 1 to 2 GHz	21	20	19	123
> 2 to 4 GHz	21	20	15	121
> 4 to 6.5 GHz	20	15	11	121
> 6.5 to 9 GHz	11	11	9	119
> 9 to 14 GHz	9	9	7	110
> 14 to 20 GHz	4	6	6	98
> 20 to 24 GHz	3	5	4	82

1. The data in this table are uncorrected system performance. The values apply over an environmental temperature range of 25 °C ±5 °C, with less than 1 °C deviation from the calibration temperature.
2. All crosstalk values are typical.

If Error Terms Seem Worse than Expected

To verify that the system still conforms to specifications, perform a system verification. Refer to **“System Verification” on page 36**.

Directivity (E_{DF} and E_{DR})

E_{DF} and E_{DR} are the uncorrected forward and reverse directivity error terms of the system. The directivity error of the test port is determined by measuring the S_{11} and S_{22} reflection of the calibration kit load. The load has a much better return loss specification than does the uncorrected test port. Therefore, any power detected from this measurement is assumed to be from directivity error.

The measurements most affected by directivity errors are measurements of low reflection devices.

Typical Cause of Failure

The calibration kit load is the most common cause of directivity specification failure.

If the load has been gaged and its performance independently verified, the analyzer requires repair. Refer to **“Shipping Your Network Analyzer for Service or Repair” on page 22.**

Source Match (E_{SF} and E_{SR})

E_{SF} and E_{SR} are the forward and reverse uncorrected source match terms of the driven port. They are obtained by measuring the reflection (S_{11} , S_{22}) of an open, and a short that are connected directly to the ports. Source match is a measure of the match of the coupler, as well as the match between all components from the source to the output port.

The measurement most affected by source match errors are reflection and transmission measurements of highly reflective DUTs.

Typical Cause of Failure

The calibration kit open or short is the most common cause of source match specification failure.

If the open or short performance are independently verified, the analyzer requires repair. Refer to **“Shipping Your Network Analyzer for Service or Repair” on page 22.**

Load Match (E_{LF} and E_{LR})

Load match is a measure of the impedance match of the test port that terminates the output of a 2-port device. The match of test port cables is included in this response. Load match error terms are characterized by measuring the S_{11} and S_{22} responses of a “thru” configuration during the calibration procedure.

The measurements most affected by load match errors are all transmission measurements, and reflection measurements of a low insertion loss, 2-port device, such as an airline.

Typical Cause of Failure

The calibration kit load or a bad “thru” cable is the most common cause of load match specification failure.

If the load and “thru” cable performance are independently verified, the analyzer requires repair. Refer to **“Shipping Your Network Analyzer for Service or Repair” on page 22.**

Reflection Tracking (E_{RF} and E_{RR})

Reflection tracking is the difference between the frequency response of the reference path (R1 or R2 path) and the frequency response of the reflection test path (A or B input path). These error terms are characterized by measuring the reflection (S_{11} , S_{22}) of the open and the short during the measurement calibration.

All reflection measurements are affected by the reflection tracking errors.

Typical Cause of Failure

The calibration kit open or short is the most common cause of reflection tracking specification failure.

If the open or short performance has been independently verified, the analyzer requires repair. Refer to **“Shipping Your Network Analyzer for Service or Repair” on page 22.**

Transmission Tracking (E_{TF} and E_{TR})

Transmission tracking is the difference between the frequency response of the reference path (including the R input) and the frequency response of the transmission test path (including the A or B input) while measuring transmission. The response of the test port cables is included. These terms are characterized by measuring the transmission (S_{21} , S_{12}) of the “thru” configuration during the measurement calibration.

All transmission measurements are affected by the transmission tracking errors.

Typical Cause of Failure

The test port cable is the most common cause of transmission tracking specification failure.

If the test port cable performance has been independently verified, the analyzer requires repair. Refer to **“Shipping Your Network Analyzer for Service or Repair” on page 22.**

Isolation (E_{XF} and E_{XR})

Isolation, or crosstalk, is the uncorrected forward and reverse isolation error terms that represent leakage between the test ports and the signal paths. The isolation error terms are characterized by measuring the transmission (S_{21} ,

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Accessing the Keysight License Manager (KLM) and Installing Your License Files

S_{12}) with loads attached to both ports during the measurement calibration. Isolation errors affect transmission measurements primarily where the measured signal level is very low.

The measurements most affected by isolation error terms are DUTs with large insertion loss. Since these terms are low in magnitude, they are usually noisy (not very repeatable).

Typical Cause of Failure

A loose cable connection or leakage between components is the most likely cause of isolation problems.

After verifying the cable and its connections, the analyzer requires repair. Refer to **“Shipping Your Network Analyzer for Service or Repair” on page 22**.

Accessing the Keysight License Manager (KLM) and Installing Your License Files

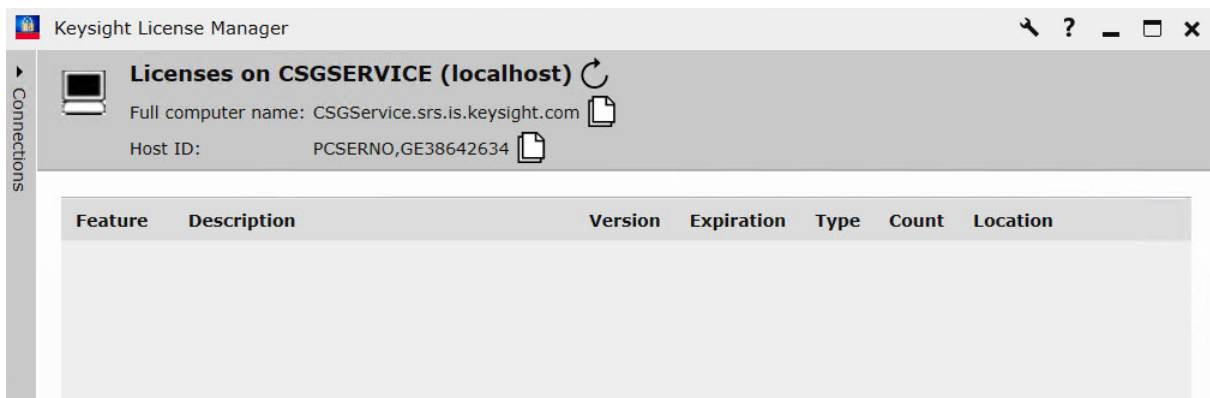
NOTE

This section assumes you have completed the Getting Prepared section (i.e., That you have already received your instrument's license key files from Keysight and downloaded them to a USB stick. And, that your USB stick is inserted in your instrument's PC controller.

To start KLM:

1. On the PC controller: In Windows 10, click the **Search Windows** icon (🔍).
2. In the Search Windows box that opens, type: "Keysight License Manager" and when the Keysight License Manager link appears under Best Match, click on the link.
3. The dialog box illustrated in **Figure 6-3** is displayed.

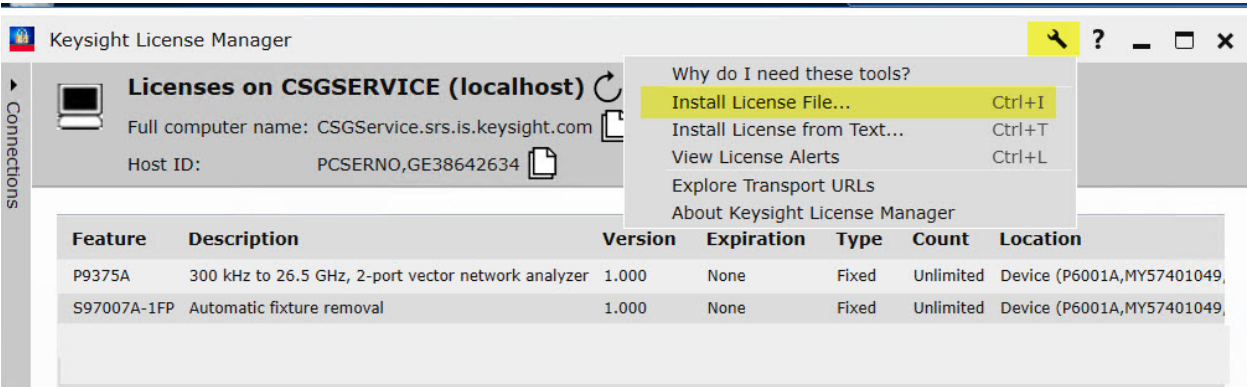
Figure 6-3 Keysight License Manager Dialog Box



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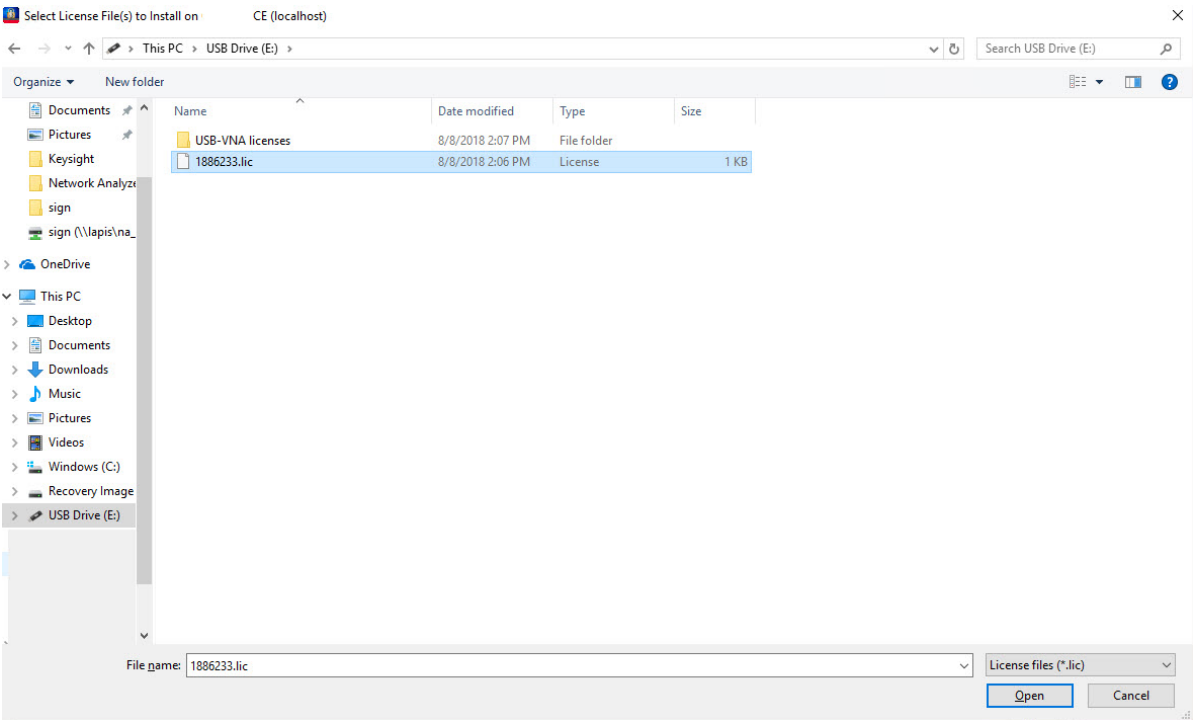
- Click on the wrench icon (🔧). Refer to **Figure 6-4**.
- Click on **Install License File...**

Figure 6-4 Keysight License Manager, Wrench icon, and Install License File...



- In the Select License File(s) to Install on window that opens, direct the path to the USB stick with your license files. Refer to **Figure 6-5**.
- Click on the license key file (#####.lic) > **Open**

Figure 6-5 Select License File(s) to Install Window



- The Select License File(s) window closes and the Keysight License Manager window should now display all of your license files.

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If you have any problems installing your files, refer to **“Contacting Keysight” on page 22.**

9. Shut down the instrument application and restart.

Optional: Cycle power on the instrument to activate the newly installed option upgrade(s). (Press the power button once to power down the instrument.)

NOTE

Attempting to re-install a license file that is already installed may generate a “Corrupt Media” error message. Ignore this message.

10. Disconnect the USB flash drive from the instrument.

Firmware Upgrades

How to Check the Current Firmware Version

1. With the Network Analyzer application running, click **Help > About Network Analyzer**. A dialog box showing the current installed Application Code Version is displayed.
2. To determine if a firmware update is available, proceed to:
<https://www.keysight.com/find/usb-vna>

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