

Keysight U9391C/F/G Comb Generator

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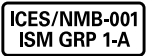




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The product complies with the EMC Directive by assessment according to IEC/EN61326-1 EMC standard.

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 <p>The RCM mark is a registered trademark of the Australian Communications and Media Authority.</p>	 <p>This symbol indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.</p>
 <p>This instrument is Class A suitable for professional use and is for use in electromagnetic environments outside of the home.</p> <p>A급 기기 (업무용 방송통신기자재)</p> <p>이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.</p>	 <p>This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.</p>

Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

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

Product category

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The affixed product label is as shown below.



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- www.keysight.com/find/mta
(product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
(worldwide contact information for repair and service)

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1 Introduction

Product Overview 12

This chapter provides an overview of the Keysight U9391C/F/G Comb Generator.

Product Overview

The Keysight U9391C/F/G comb generator was designed as a phase reference standard to provide precision phase calibration for non-linear measurements using the PNA-X non-linear vector network analyzer (NVNA), referenced to the National Institute of Standards and Technology (NIST). Additionally, the comb generators can be used to calibrate PNA and PNA-X network analyzers for phase and delay measurements of frequency converters without requiring reference or calibration mixers.

Comb generators generate frequency harmonics at integer multiples of an RF input signal. Generally, comb generators available in the open market today are made with SRD diodes. The U9391C/F/G comb generator is based on the Keysight InP MMIC technology to ensure superior phase stability of the combs.



Figure 1-1 U9391C comb generator



Figure 1-2 U9391F comb generator



Figure 1-3 U9391G comb generator

The U9391C/F/G comb generator offers the advantage of wide bandwidth 10 MHz to 26.5 GHz, 10 MHz to 50 GHz, and 10 MHz to 67 GHz output and small minimum tone spacing (10 MHz). When driven by low phase noise sources, this comb generator will operate at frequencies lower than 10 MHz, but performance is not guaranteed. The input power and fundamental frequency have lower sensitivity than other comb generators. This means a comb generator calibrated at a single power level and frequency can be used across a wide range of input power. It comes with the option of a female or male output connector.

The U9391C/F/G modules are solid state devices which provide excellent phase and amplitude flatness in the combs making them ideal for use in phase calibration applications. A built-in frequency divider, selectable via the PNA-X, reduces the noise of the combs. You can set the drive frequency at 1, 2, 4, 8, or 16 times the pulse repetition frequency (PRF).

Combining a frequency divider with a wide input signal frequency range allows for a broad range of possible harmonics spacing, making this suitable for characterizing non-linear devices. This module has a trigger output which enables synchronization with the pulse's repetition frequency. Calibration data stored inside the U9391C/F/G can be accessed directly by the PNA-X via the USB interface to be used in phase calibration.

Key features of the U9391C/F/G Comb Generator

- Excellent amplitude and phase flatness enable it to be used as a precision calibration phase reference standard for the PNA, PNA-X, and NVNA.
- NIST referenced phase calibration guarantees a reliable reference to international standards.
- Embedded calibration data can be easily accessed via the plug-and-play USB interface.
- The USB interface further facilitates frequency divider control and calibration data retrieval via the PNA-X.
- Rugged 1.85 mm, 2.4 mm, and 3.5 mm bulk-head connectors guarantee high repeatability throughout multiple connects and disconnects.
- The sine-to-square wave converter is provided as a standard accessory.
- The hand grip (U9391G only) is designed for better gripping and as a heat insulator for user's handling.
- Combined with the Keysight Signal Optimizer software (K3101A) for wideband calibrations of signal analyzers and oscilloscopes.

Comb generator configuration

The U9391C/F/G comb generator is controlled via a USB connection. The comb generator needs to be powered by separate power supplies (refer to “**Drive power supply**” on page 29 for more details). The network analyzer software automatically controls the U9391C/F/G via USB after it has been designated as a phase reference and/or calibration module. The phase calibration procedure is carried out by following the on-screen instructions on the PNA or PNA-X.

Options

There are two connector options available for the Keysight U9391C/F/G.

Table 1-1 U9391C/F/G options

Option	U9391C	U9391F	U9391G
Option FFF	3.5 mm female (output connector)	2.4 mm female (output connector)	1.85 mm female (output connector)
Option FFM	3.5 mm male (output connector)	2.4 mm male (output connector)	1.85 mm male (output connector)

NOTE

The Trigger and Input ports consist of 3.5 mm female connectors for all the above options.

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2 Installation

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This chapter provides you important information on how to check and prepare your instrument for operation.

Initial Inspection

- 1 Unpack and inspect the shipping container and its contents thoroughly to ensure that nothing was damaged during shipment. If the shipping container or cushioning material is damaged, the contents should be checked both mechanically and electrically.
 - Check for mechanical damage such as scratches or dents.
 - Procedures for checking electrical performance are given under “Operator’s check” on page 40.
- 2 If the contents are damaged or defective, contact your nearest Keysight Technologies Service and Support Office. Refer to “Sales and Technical Support” on page 4 of this manual. Keysight Technologies will arrange for repair or replacement of the damaged or defective equipment. Keep the shipping materials for the carrier’s inspection.
- 3 If you are returning the instrument under warranty or for service, repackaging the instrument requires original shipping containers and material or their equivalents. Keysight Technologies can provide packaging materials identical to the original materials. Refer to “Sales and Technical Support” on page 4 of this manual for the Keysight Technologies nearest to you. Attach a tag indicating the type of service required, return address, model number, and serial number. Mark the container **FRAGILE** to insure careful handling. In any correspondence, refer to the instrument by model number and serial number.

Kit contents

The following table lists the items in the U9391C/F/G kit.

Table 2-1 U9391C/F/G kit contents

Quantity	Description	Part number
1	Cable assembly – Banana plug ^[a]	U9391-20013
1	USB cable	8121-0506
1	Squaring circuit	U9391-60009

[a] Compatible cable: 87405-20006

Service and Recertification

If your comb generator modules require service or recertification, contact the nearest Keysight office for information on where to send it. Refer to “**Sales and Technical Support**” on page 4 of this manual. The performance of the comb generator modules can only be verified by specially manufactured equipment and calibration standards from Keysight.

Recertification of the comb generator modules

The suggested interval for recertification is 12 months. After reviewing the result of the initial recertification, you may establish a shorter interval that reflects greater use and wear of the module.

Operating and Safety Precautions

Observe the following guidelines before connecting or operating the U9391C/F/G comb generator.

ESD damage

Protection against electrostatic discharge (ESD) is important while handling and operating the U9391C/F/G comb generator.

Static electricity can build up on your body and can easily damage sensitive components when discharged.

Static discharges too small to be felt can cause permanent damage to the unit.

To prevent damage from ESD:

- **Use** a grounded antistatic mat in front of your test equipment and wear a grounded wrist strap attached to it when handling or operating the U9391C/F/G module.
- **Wear** a heel strap when working in an area with a conductive floor.
- **Ground** yourself before you clean, inspect, or make a connection to the U9391C/F/G module. You can, for example, grasp the grounded outer shell of the analyzer test port or cable connector briefly.
- **Avoid** touching the center conductor of the test ports.

Connector care

Because connectors can become defective due to wear during normal use, all connectors should be inspected and maintained to maximize their service life.

- Inspect the mating surface each time a connection is made. Metal particles from connector threads often find their way onto the mating surface when a connection is made or disconnected.
- Clean dirt and contamination from the connector mating surface and threads. This simple step can extend the service life of the connector and improve the quality of your calibration and measurements.
- Gage connectors periodically. This not only provides assurance of proper mechanical tolerances, and thus connector performance, but can also indicate situations where the potential for damage to another connector may exist.

CAUTION

The U9391C/F/G modules can be damaged if excessive torque is applied to the connectors.

The recommended torque value is 8 lb-in torque.

Applications

Squaring circuit

The 10 MHz reference output on the back panel of the PNA/PNA-X can be used as the driving source for comb generator. U9391-60009 sine-to-square wave converter is recommended to be used in this setup, as comb generator is not able to work at its optimum condition with input sine-wave below 100MHz.

The sine-to-square wave converter is provided with U9391C/F/G and shall be connected between the 10MHz reference output and the input to comb generator.

NVNA

Two units of U9391C/F/G are required to carry out non-linear measurements. One unit is used as the phase reference module and the second unit as the phase calibration module.

The U9391C/F/G units need to be powered by separate power supplies.

The NVNA software automatically controls the U9391C/F/G units via USB after the two units have been selected as the phase reference module and phase calibration module respectively.

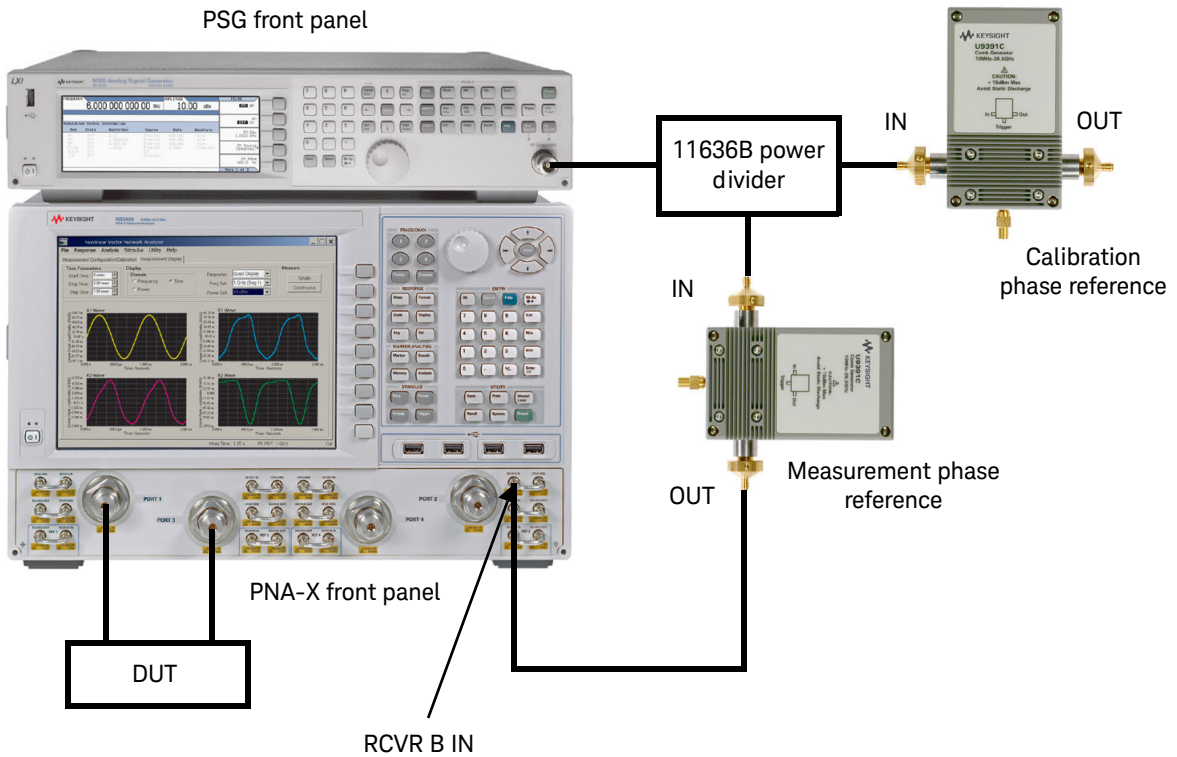


Figure 2-1 NVNA setup for arbitrary frequency grid

The phase calibration procedure is carried out by following the on-screen instructions on the PNA-X.

After completing the calibration, the U9391C/F/G unit used for phase calibration can be disconnected. The other unit that is used as the phase reference will remain connected while the measurement is carried out.

In most NVNA measurements, an external signal generator is used as driving source to drive comb generator that works as phase reference.

For measurements which require 10MHz driving source, the 10MHz reference output of PNA/PNA-X can be used. This setup will enable the NVNA measurement however with less accuracy in phase as compared with the conventional configuration using signal generator. The sine-to-square wave converter shall be

connected between the 10MHz output of the instrument and input to comb generator.

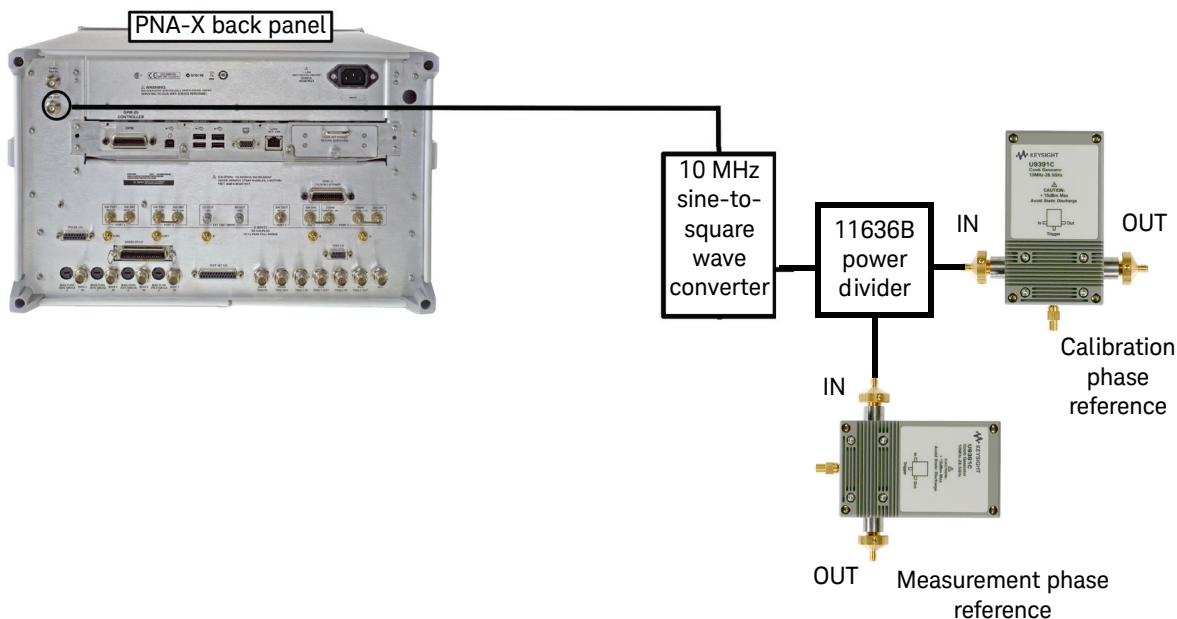


Figure 2-2 NVNA setup for 10 MHz frequency grid using the U9391-60009 sine-to-square wave converter

For more information on phase reference setup for different NVNA measurement configurations, please refer to NVNA online help (<http://na.support.keysight.com/pna/nvna/NVNAWebHelp/NVNAHelp.htm>). For more information about NVNA application, please refer the publication document 5989-8575EN.

CAUTION

When connecting the U9391C/F/G directly to the instrument test ports, the modules will require mechanical support so as not to overstress the test port connectors.

SMC+Phase

The scalar mixer/converter plus phase (SMC+Phase) measurement class, available on PNA and PNA-X network analyzers, provides fully calibrated conversion gain/loss, relative phase, and absolute group delay measurements of mixers and frequency converters without the need for reference mixers. To calibrate the relative phase and absolute group delay of the test setup, either a calibration mixer or a U9391C/F/G comb generator can be used. When using a comb generator, the calibration is done as a two-part process. In part one, a power meter, comb generator, and an S-parameter calibration kit (mechanical or ECal) are used to calibrate the magnitude and phase response of the network analyzer receivers across the full frequency range of the instrument. The calibration is typically performed directly at the test ports of the network analyzer, without the adverse effects of test cables. This first-tier calibration is very stable when the instrument is in an environment with little temperature variation, and can be used for many months. Step two adds an S-parameter calibration at the desired reference planes, and is typically performed over the frequency range of interest for a particular DUT. This second-tier calibration removes the effects of all of the adapters and cables used to connect the instrument to the DUT, and extends the magnitude and phase calibration planes of the first-tier calibration to the reference planes of the second tier calibration. When using a U9391G comb generator for calibration up to 67 GHz, an additional high-pass filter is required. Two back-to-back Keysight V281A waveguide-to-coax adapters are recommended.

In SMC+Phase application, 10MHz reference output of the PNA/PNA-X is used as the driving source to comb generator in Phase Reference Calibration. As such, U9391-60009 sine-to-square wave converter needs to be used.

For more information on SMC+Phase and phase reference calibration, please refer to PNA online help (<http://na.support.keysight.com/pna/help>).

Wideband calibration

The U9391C/F/G comb generator when used with the Keysight Signal Optimizer software (K3101A) enables wideband calibrations of signal analyzers and oscilloscopes. The Signal Optimizer software can establish a calibration plane at the DUT connection for transmit and receive with the U9391C/F/G comb generator calibration which flattens the amplitude and phase in wideband signals at RF, μ W, mmWave frequencies for 5G. This makes it easier for 5G R&D

engineers who are challenged to build reliable, accurate, and repeatable test systems especially for wideband calibrations. Following the calibration instructions, engineers can perform system calibration easier and simpler than ever.

The Signal Optimizer software provides a connection diagram from customers' DUT, receiver and transmitter hardware, calibration controller PC with Signal Optimizer, and all the necessary accessories such as cables and connectors including the U9391C/F/G comb generator. This helps engineers to set up and configure the DUT and test instruments easily and quickly for complicated 5G design verification test systems.

3 Specifications

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This chapter provides the specifications of the U9391C/F/G comb generator.

General Specifications

Specifications

Specifications refer to the performance standards or limits against which the U9391C/F/G is tested.

Typical and nominal characteristics are included for additional information only and they are not specifications:

- *Typical (typ.): Expected performance of an average unit which does not include guardbands. It is not covered by the product warranty.*
- *Nominal (nom.): A general, descriptive term that does not imply a level of performance. It is not covered by the product warranty.*

Table 3-1 U9391C/F/G specifications

Specification	U9391C	U9391F	U9391G
Output frequency range ^[a]	10 MHz to 26.5 GHz	10 MHz to 50 GHz	10 MHz to 67 GHz
Input frequency range ^[b]	10 MHz to 6 GHz	10 MHz to 6 GHz	10 MHz to 6 GHz
Input power range	–15 to +15 dBm	–15 to +15 dBm	–15 to +15 dBm
Min output power per picket	–80 dBm at 10 MHz Input PRF	–95 dBm at 10 MHz Input PRF	–100 dBm at 10 MHz Input PRF
Amplitude flatness vs. output frequency	<12 dB at 10 MHz Input PRF	<25 dB at 10 MHz Input PRF	<40 dB at 10 MHz Input PRF
Amplitude flatness vs. input power (typical)	0.1 dB	0.5 dB	1.0 dB
Phase flatness ^[c]	±8.5 ° (10 MHz to 3 GHz) ±6.5 ° (3 GHz to 20 GHz) ±8.5 ° (20 GHz to 26.5 GHz)	+10/–10 ° (10 MHz to 28 GHz) +20/–10 ° (28 GHz to 38 GHz) +20/–15 ° (38 GHz to 50 GHz)	+10/–10 ° (10 MHz to 26.5 GHz) +20/–10 ° (26.5 GHz to 38 GHz) +20/–15 ° (38 GHz to 50 GHz) +35/–35 ° (50 GHz to 67 GHz)
Pulse width (ps)	<23	<23	<23
Divide ratio	1, 2, 4, 8, 16	1, 2, 4, 8, 16	1, 2, 4, 8, 16
Input return loss, S11	>10 dB (10 MHz to 6 GHz)	>10 dB (10 MHz to 6 GHz)	>10 dB (10 MHz to 6 GHz)

Table 3-1 U9391C/F/G specifications

Specification	U9391C	U9391F	U9391G
Output return loss, S22	>10 dB (10 MHz to 26.5 GHz)	>10 dB (10 MHz to 20 GHz)	>10 dB (10 MHz to 20 GHz)
		>7 dB (20 GHz to 45 GHz)	>7 dB (20 GHz to 45 GHz)
		>5 dB (45 GHz to 50 GHz)	>5 dB (45 GHz to 67 GHz)

[a] When driven by low phase noise sources, the U9391C/F/G will operate at frequencies lower than 10 MHz, but performance is not guaranteed.

[b] For operations below 100 MHz, use a square wave to drive the U9391C/F/G.

[c] The specifications refer to the raw performance data. For the NVNA application, the phase performance is corrected with the calibration data.

Physical specifications

Table 3-2 U9391C/F/G physical specifications

Physical specification	U9391C	U9391F	U9391G
Net weight	0.370 kg	0.370 kg	0.435 kg
Shipping weight	3.155 kg	3.315 kg	3.385 kg
Shipping dimensions:			
– Length	52.5 cm	52.5 cm	52.5 cm
– Width	34.0 cm	34.0 cm	34.0 cm
– Height	19.5 cm	19.5 cm	19.5 cm

Drive power supply

Table 3-3 U9391C/F/G drive power supply

Model	U9391C	U9391F	U9391G
Voltage	+15 ± 10% Vdc	+15 ± 10% Vdc	+15 ± 10% Vdc
Current	300 mA (nominal) ^[a]	300 mA (nominal) ^[a]	850 mA (nominal) ^[a]

[a] Current drawn by the device under normal operating condition. Higher current is required during device start up.

NOTE

Current drawn will change when drive voltage changes.

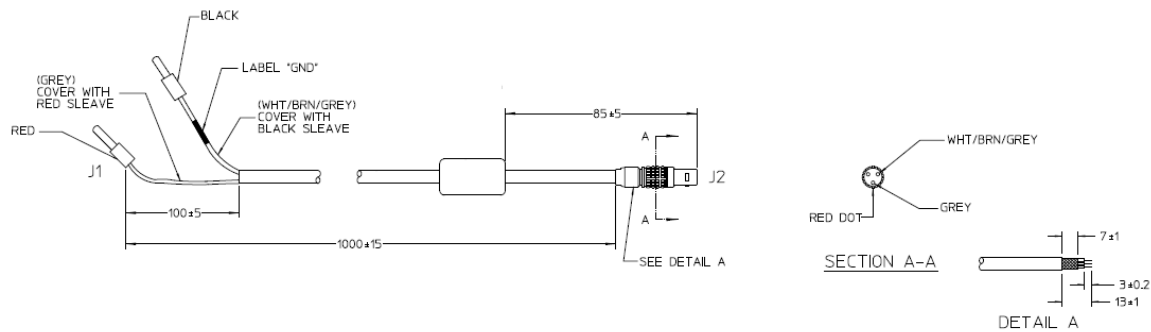


Figure 3-1 U9391-20013 DC bias cable

Mechanical Characteristics

Mechanical characteristics, such as center conductor protrusion and pin depth are not warranted performance specifications.

They are however important supplemental characteristics related to the electrical performance of the devices.

Keysight verifies the mechanical characteristics of the devices with special gaging processes and electrical testing.

These processes ensure that the device connectors do not exhibit any excess center conductor protrusion or improper pin depth when the module leaves the factory.

Pin depth

Pin depth is the distance the center conductor mating plane differs from being flushed with the outer connector mating plane.

The pin depth of a connector can be in one of two states — protrusion or recession.

Protrusion occurs when the center conductor extends beyond the outer conductor mating plane. It reads as a positive value on the connector gage.

Recession occurs when the center conductor is set back from the outer conductor mating plane. It reads as a negative value on the gage.

The pin depth for a 1.85 mm, 2.4 mm, and 3.5 mm connector is shown in [Figure 3-2 on page 32](#).

The typical pin depths for the U9391C/F/G connectors are listed in [“Typical pin depth values” on page 33](#).

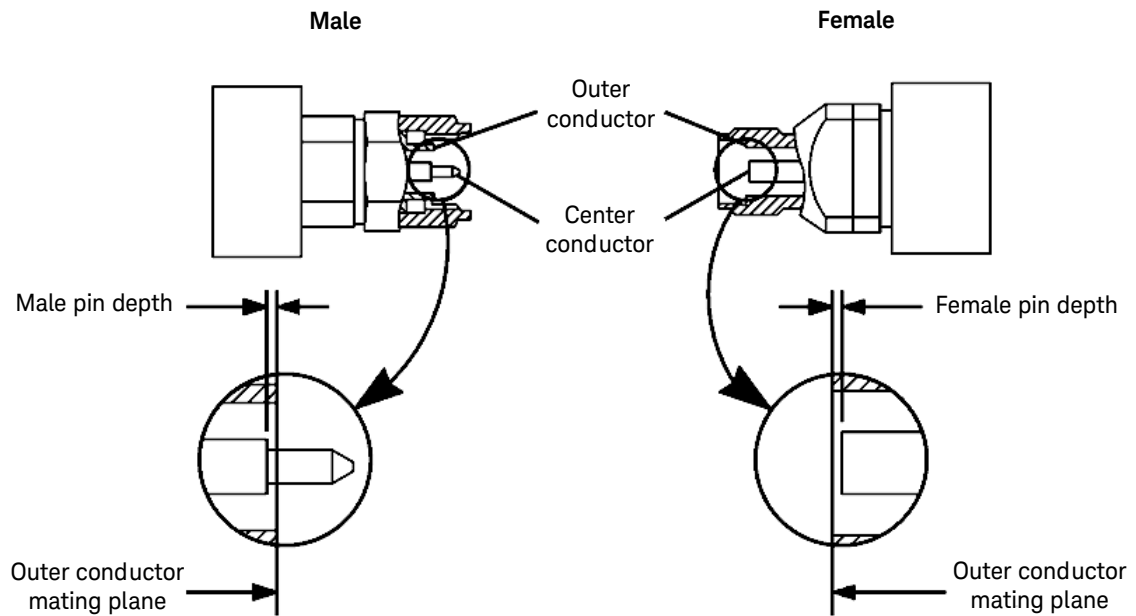


Figure 3-2 1.85 mm, 2.4 mm, and 3.5 mm connector pin depths

Typical pin depth values

The pin depth value of each device is not specified, but is an important mechanical parameter.

The electrical performance of the device depends, to some extent, on its pin depth.

The electrical specifications for each module takes into account the effect of pin depth on the device’s performance.

The following tables list the typical pin depths for the devices.

Table 3-4 U9391C/F/G pin depth characteristics

Port	Typical pin depth in micrometers (10 ⁻⁴ inches)		
	U9391C	U9391F	U9391G
In port	0 to -50.8 (0 to -20.0)	0 to -50.8 (0 to -20.0)	0 to -50.8 (0 to -20.0)
Out port	0 to -50.8 (0 to -20.0)	0 to -50.8 (0 to -20.0)	0 to -50.8 (0 to -20.0)
Trigger port	0 to -127.0 (0 to -50.0)	0 to -127.0 (0 to -50.0)	0 to -127.0 (0 to -50.0)

If the pin depth of a device does not measure within the observed pin depth limits, it may be an indication that the device fails to meet electrical specifications.

Mechanical dimensions of the U9391C/F/G

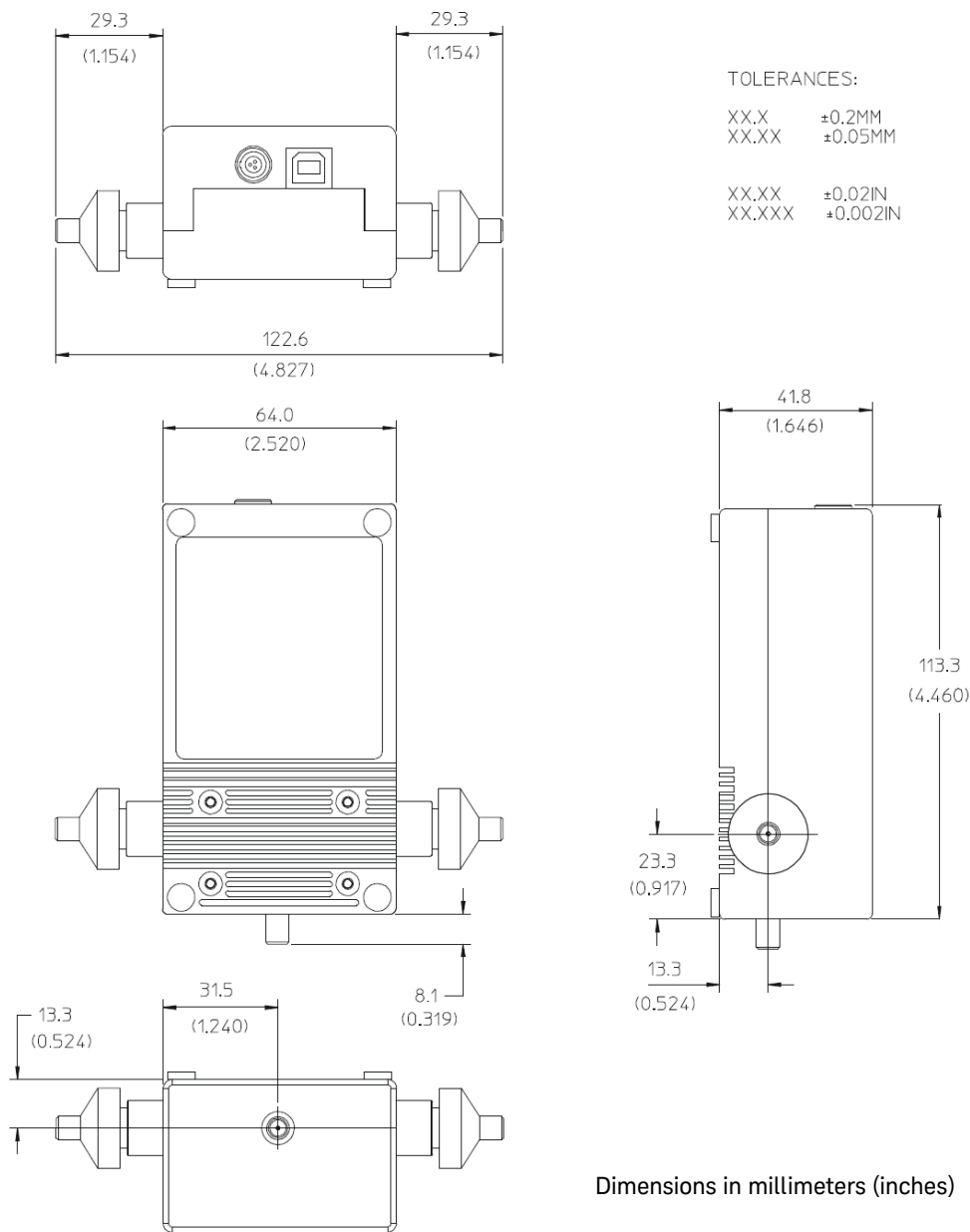


Figure 3-3 Dimensions of the U9391C comb generator

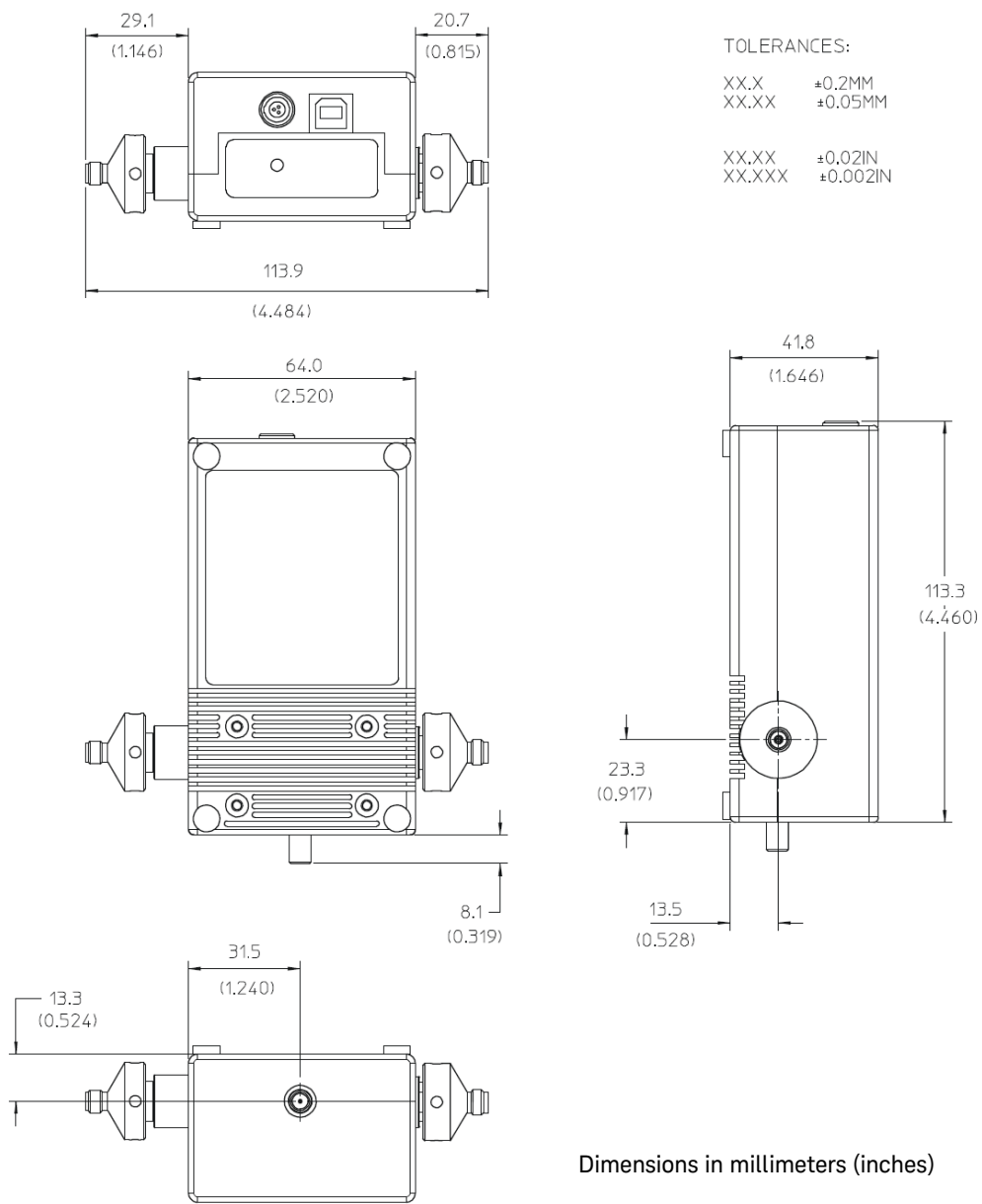


Figure 3-4 Dimensions of the U9391F comb generator

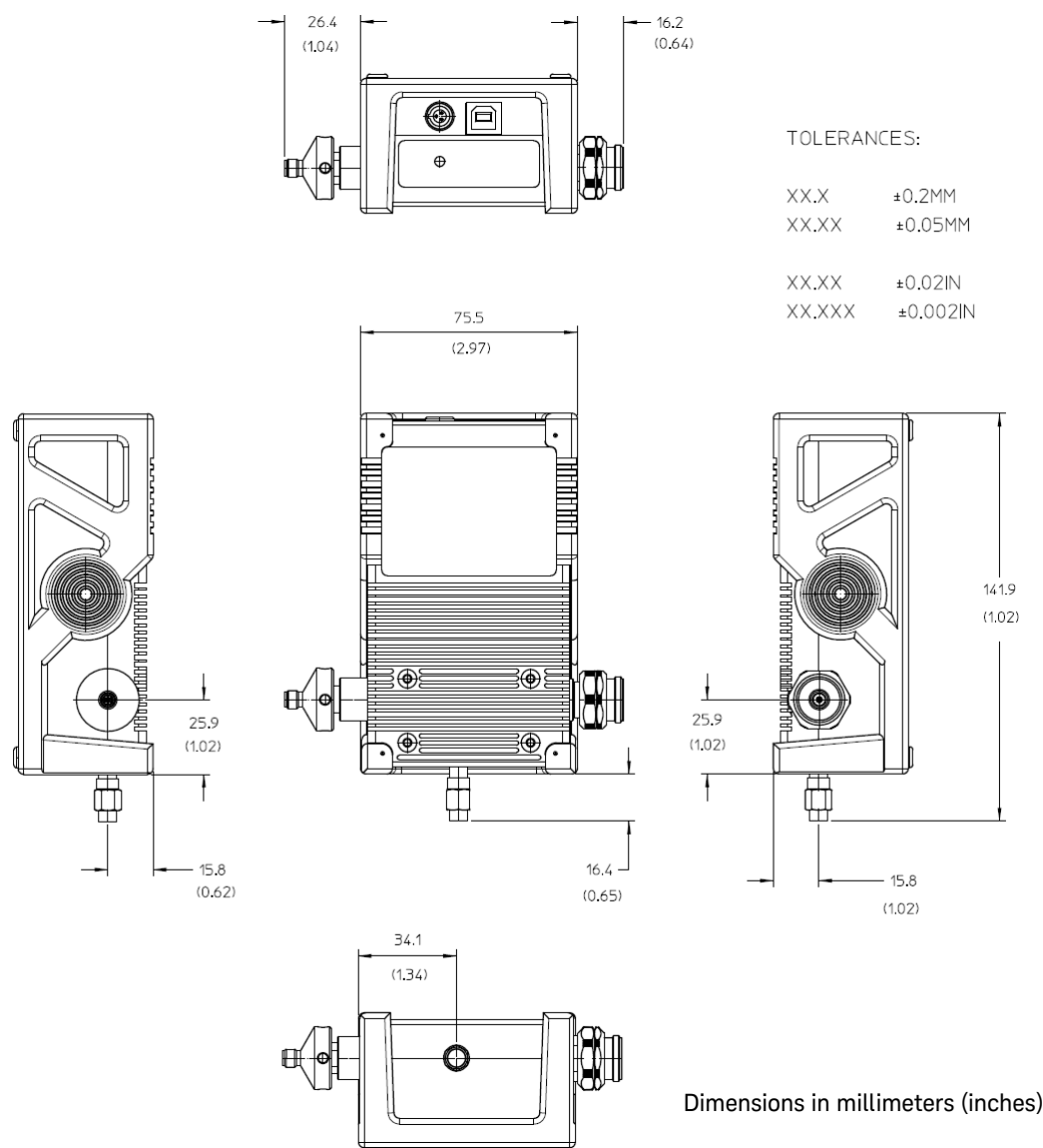


Figure 3-5 Dimensions of the U9391G comb generator

NOTE

The hand grip is designed for the U9391G only for better gripping and as a heat insulator for user's handling.

Mechanical dimensions for squaring circuit

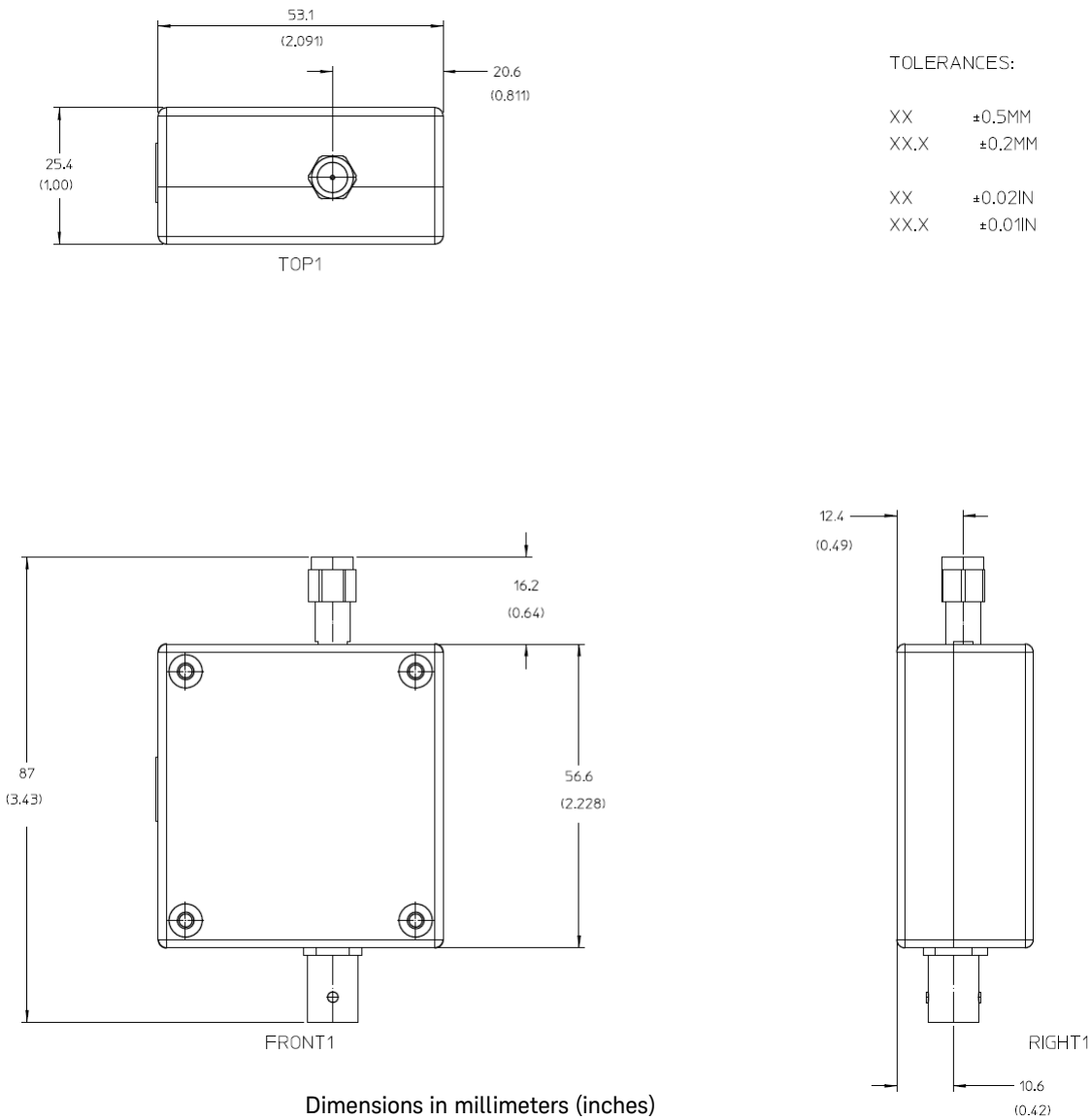


Figure 3-6 Dimensions of the U9391-60009 squaring circuit

Environmental Conditions

The table below shows the general environmental requirements for the U9391C/F/G.

Table 3-5 U9391C/F/G environmental conditions

Environmental condition	Requirement
Temperature	
– Operating condition	0 °C to +40 °C
– Storage condition	–40 °C to +70 °C
– Error corrected range condition	23 °C to ±3 °C
– Cycling condition	–65 °C to +85 °C, 10 cycles at 20 °C per minute, 20 minutes dwell time per MIL-STD-883F, Method 1010.8, Condition C (modified)
Humidity	
– Operating condition	50% to 95% RH at 40 °C, 24 hours cycling, repeated five times
– Storage condition	90% RH at 65 °C, one 24 hour cycle
Altitude	
– Operating condition	<4572 meters (15000 feet)
– Storage condition	<15000 meters (50000 feet)
Shock	
– End-use handling shock	Half-sine waveform, 2 to 3 ms duration, 60 in/s (1.6 ms) delta-V
– Transportation shock	Trapezoidal waveform, 18 to 22 ms duration, 337 in/s (8.56 ms) delta-V
Vibration	
– Operating random	5 to 500 Hz, 0.21 grms, 10 min/axis
– Survival random	5 to 500 Hz, 2.09 grms, 10 min/axis
– Swept sine	5 to 500 Hz, 0.5 grms, 10 min/axis, four resonance search, 10 min dwell
ESD immunity	
– Direct discharge ^[a]	8.0 kV per IEC 61000-4-2
– Air discharge	15 kV per IEC 61000-4-2

[a] To outer conductor

4 Operating Guide

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This chapter provides simple quick-check instructions to verify the U9391C/F/G comb generator's functionality prior to usage. It also provides information on service and maintenance of the U9391C/F/G.

Operating Instructions

Operator's check

The operator's check allows the operator to make a quick check of the instrument prior to use or if a failure is suspected.

CAUTION

ESD exceeding the level specified in “Compliance Notices and Regulatory Information” on page 3 or RF power applied is greater than the maximum specified in Table 3-1 may cause permanent damage to the device.

Operator's check for the S-parameter test

Recommended test equipment

The following table lists the test equipment required for this performance test verification. Equipment other than the recommended models can be used, provided minimum specifications are satisfied.

Table 4-1 Recommended test equipment for S-parameter test

Instrument type	Setting
PNA-X network analyzer ^[a]	PNA-X application:
	– Start frequency: 10 MHz
	– Stop frequency: 26.5 GHz/50 GHz/67 GHz ^[b]
	– Power level: –20 dBm
DC Power Supply	– Number of points: 201
	For the U9391C/U9391F:
	– Voltage: +15 Vdc
For the U9391G:	– Current: 2 x 0.3 A ^[c] ^[e]
	– Voltage: +15 Vdc
	– Current: 2 x 0.85 A ^[d] ^[e]

[a] N5242A, N5244A, N5245A, and N5247A
[b] 26.5 GHz for the U9391C, 50 GHz for the U9391F, and 67 GHz for the U9391G
[c] To power up two units of the U9391C/U9391F
[d] To power up two units of the U9391G
[e] Current drawn by the device under normal operating condition after start up.

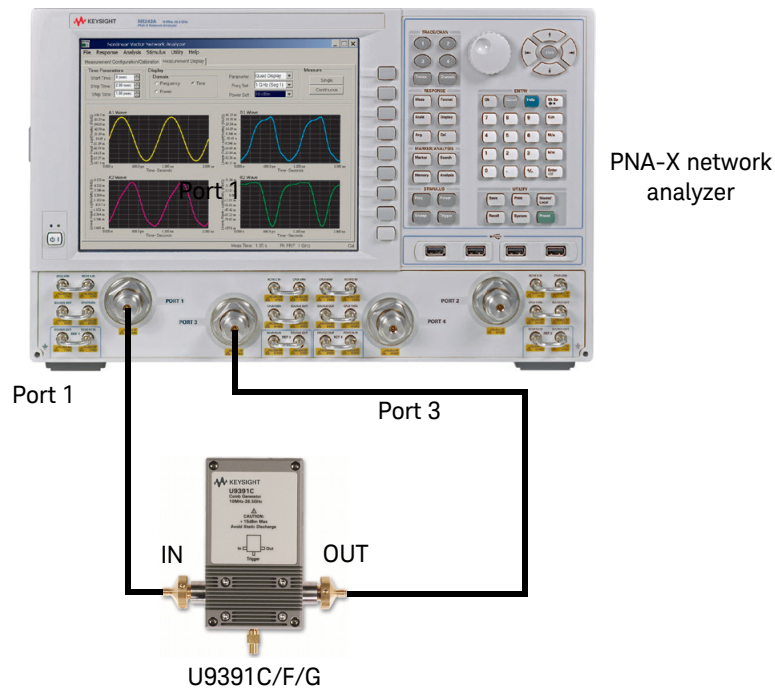


Figure 4-1 Quick-check configuration for the S-parameter test

Quick-check procedure

Set up the equipment as illustrated in [Figure 4-1](#).

- 1 Click on the PNA-X application. Calibrate the network analyzer with full 2-port calibration using the appropriate electronic or mechanical calibration kit.
- 2 Connect the Input of the U9391C/F/G to Port 1 of the network analyzer and the Output of the U9391C/F/G to Port 2 of the network analyzer.
- 3 Turn ON the biasing of the U9391C/F/G by connecting to the power supply.
- 4 Obtain the measurement for Input Return Loss (S11) and Output Return Loss (S22).
- 5 Compare the measurement results with the specifications in [Table 3-1](#) on [page 28](#).

Operator's check for the non-linear vector network analyzer (NVNA) test

Recommended test equipment

The following table lists the test equipment required for this performance test verification. Equipment other than the recommended models can be used, provided minimum specifications are satisfied.

Table 4-2 Recommended test equipment for the NVNA test

Instrument type	Setting
PNA-X network analyzer ^[a]	NVNA application: – Start frequency and stop frequency: 10 MHz – Frequency points: 1 – Maximum harmonics: 2650/5000/6700 ^[b]
DC Power Supply	
For the U9391C/U9391F:	– Voltage: +15 Vdc – Current: 2 x 0.3 A ^[c] ^[e]
For the U9391G:	– Voltage: +15 Vdc – Current: 2 x 0.85 A ^[d] ^[e]
E8267D PSG signal source or any source that can provide 10 MHz to 6 GHz RF output	Not applicable
Power sensor and power meter	Not applicable
11636B power divider	Not applicable

[a] N5242A, N5244A, N5245A, and N5247A

[b] 2650 for the U9391C, and 5000 for the U9391F, and 6700 for the U9391G

[c] To power up two units of the U9391C/U9391F

[d] To power up two units of the U9391G

[e] Current drawn by the device under normal operating condition after start up

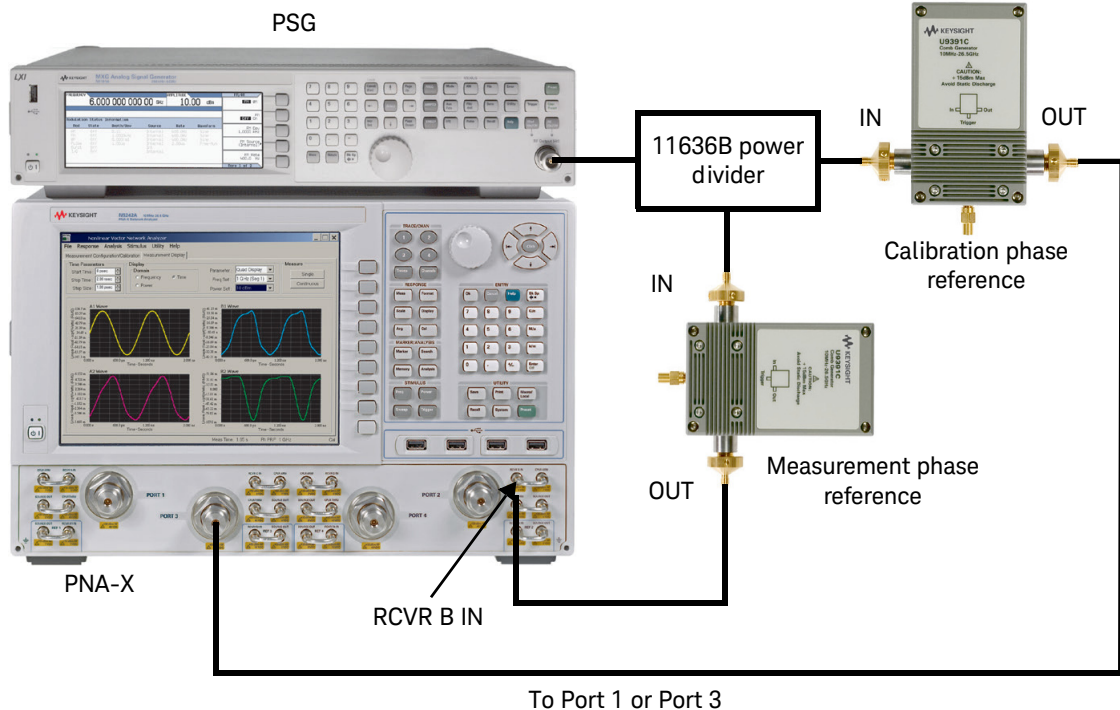


Figure 4-2 Quick-check configuration for the NVNA test

Quick-check procedure

Set up the equipment as illustrated in [Figure 4-2](#).

- 1 Connect GPIB linking to the PNA-X, PSG, and power meter.
- 2 Power up both the phase reference units and also connect the USB cable to the PNA-X.
- 3 Shut down the network analyzer application and turn on the NVNA application. Leaving the network analyzer application running in the background will cause the NVNA applications to not function properly.
- 4 Click **Response** and select **Couple Segment** from the Keysight NVNA's main menu as shown in [Figure 4-3](#).
- 5 Again, click **Response** and select **Receiver Attenuation**. Set 10 dB at the Receive B portion and then click **OK**.

- 6** Set the following parameters. Then click **Apply**.
- a** Start frequency and stop frequency: 10 MHz
 - b** Frequency points: 1
 - c** Maximum harmonics: 2650/5000/6700^[1]
 - d** IFBW: 10 Hz

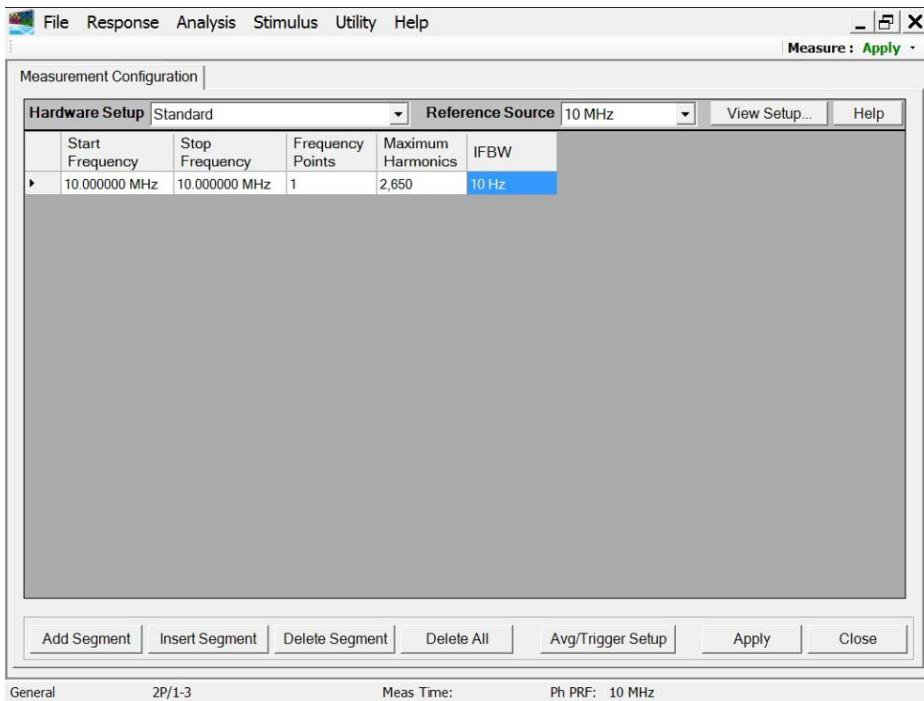


Figure 4-3 NVNA's main menu

- 7** Click **Response** and select **Calibration** to start the NVNA Cal Wizard.

[1] 2650 for the U9391C, 5000 for U9391F, and 6700 for U9391G

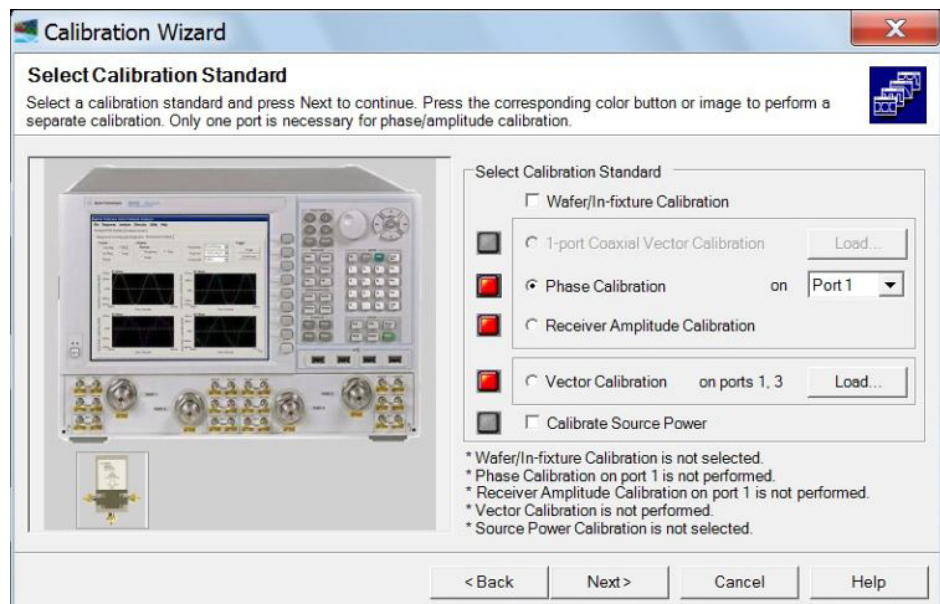


Figure 4-4 NVNA calibration wizard

- 8 Follow the on-screen instructions on the PNA-X to perform calibration.
- 9 **Vector Calibration** must be performed first. Click **Load** to recall Cal Set data from a previously performed calibration. However, the stimulus settings for the Cal Set must exactly match the current stimulus settings.
- 10 Select Port 1 or Port 3 and follow the instructions to perform the Amplitude Calibration using the power sensor, before performing the Phase Calibration.
- 11 To perform **Phase Calibration**, select the phase reference unit that is identified to use for calibration. Then click **Next**.

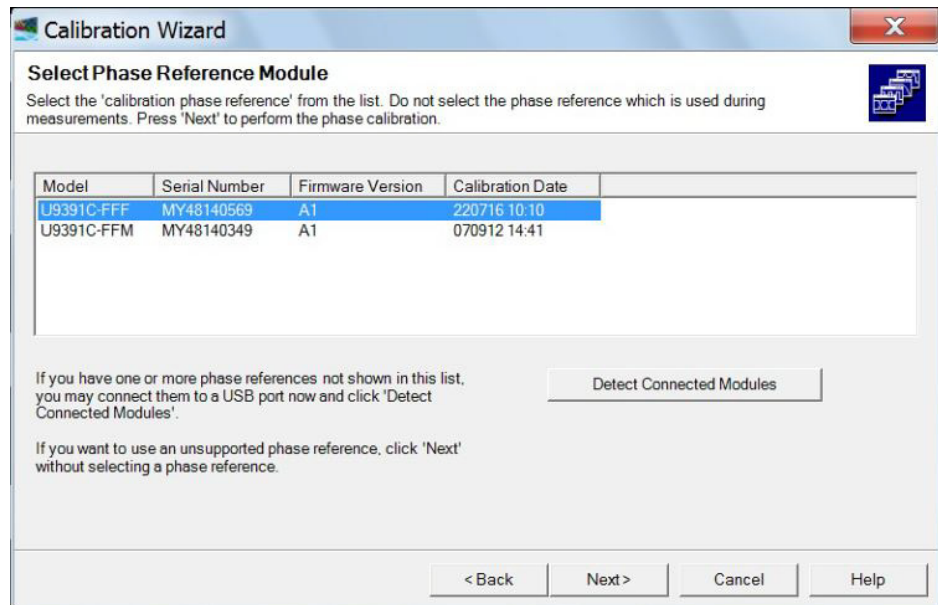


Figure 4-5 NVNA calibration wizard

- 12** Connect the **Output** of the phase reference unit (unit that has been selected as phase calibration) to **Port 3** of the network analyzer once calibration is completed.
- 13** Click **Response > Measure > Wave > Quad Display** in order to obtain the 4-quadrant display. Select the following parameters to perform comb amplitude and comb phase measurements.
 - a Format:** Select **Log Mag** (to measure comb amplitude) or **Phase** (to measure comb phase)
 - b Domain:** Select **Frequency**
Click **Apply** to apply the measurement settings before selecting the measurement mode (single or continuous).
 - c Measure:** Select **Single** or **Continuous**

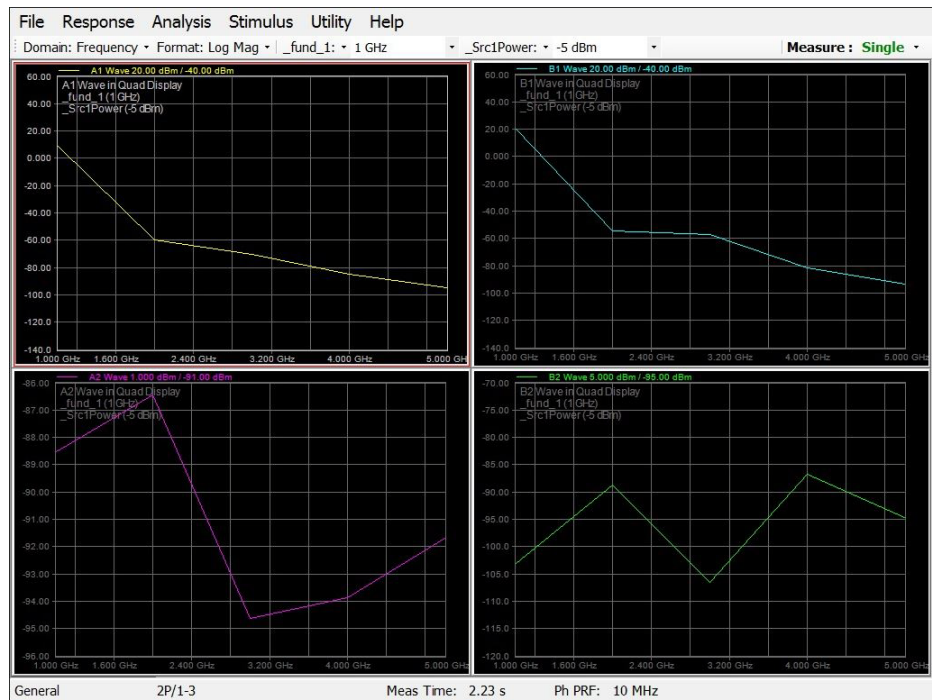


Figure 4-6 NVNA's main menu

- 14** Compare the measurement results with the specifications in [Table 3-1](#) on [page 28](#).
- 15** The phase measurement will fluctuate between +180 to -180 ° due to phase wrapping.

Service Instructions

Adjustment

The U9391C/F/G comb generator does not have internal adjustments and should not be opened.

Repair

If your U9391C/F/G comb generator requires repair services, contact your nearest Keysight Sales and Service Center.

Maintenance

The connectors, particularly the connector faces, must be kept clean. For instruction on connecting and care of your connectors, refer to the *Microwave Connector Care Quick Reference Card (08510-90360)*.



This information is subject to change without notice. Always refer to the English version at the Keysight website for the latest revision.

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