Keysight Technologies N1999A

Millimeter Downconverter

KEYSIGHT TECHNOLOGIES

User's Guide

Notices

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Manual Part Number

N1999-90001

Edition

Edition 1, May 2015

Supersedes: December 2010

Printed in:

Printed in USA

Published by:

Keysight Technologies Inc
1400 Fountaingrove Parkway
Santa Rosa, CA 95403

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Safety Notices

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.

N1999A

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Notice: This document contains references to Agilent.
Please note that Agilent's Test and Measurement business has become Keysight Technologies. For more information, go to www.keysight.com

N1999A

KEYSIGHT TECHNOLOGIES

Description

The Keysight N1999A is a 57 to 66 GHz Wide Bandwidth Downconverter with a 5 GHz IF Output. This document includes setup configuration and operational verification.

Figure 1 N1999A Millimeter Downconverter

Verifying the Shipment

To verify the contents shipped with your product, refer to the “Box Content List” included with the shipment.

Inspect the shipping container. If the container or packing material is damaged, it should be kept until the contents of the shipment have been checked mechanically and electrically. If there is physical damage refer to “Contacting Keysight” on page 22. Keep the damaged shipping materials (if any) for inspection by the carrier and a Keysight Technologies representative.

Required Accessories

The following components (or equivalent) are supplied by the customer and required for use with the N1999A. Waveguide attenuators and horns are available from several manufacturers.

- Signal Source (x2)
  LO - N5183A-520
  RF - E8257D-567
- Receiver DSO9404A (x1)
- V281A Coaxial Waveguide Adapter (x1)
- N4421B-K67 1.85 mm Cable (x1)
- SMA Cable (x2)
- 3/32 inch Hex Ball Driver

Direct Connect

- Attenuator WR15 3, 6, 10, 20 and/or 30 dB

Waveguide Connect Using a Horn

- Standard Gain Horn (WR15) (x2)

Recommended (but not required)

- 86118A-103 Connector Saver, 1.85 mm male to female (x1)

General Information

Typical performance for the N1999A are characteristics. Actual performance of the system is based on the customers instrumentation and software.

CAUTION Always use the three-prong ac power cord supplied with this instrument. Failure to ensure adequate earth grounding (by not using this cord) can cause instrument damage and the risk of electrical shock.

Power Requirements

Verify that the required ac power is available before turning on the instrument.

- 100/120/220/240 VAC (50/60Hz)
- Maximum Current < 1 A
- Maximum Power 30 W

WARNING **This is a Safety Class I product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted into a socket outlet provided with a protective earth contact. Any interruption of the protective conductor, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited.**

Dimensions and Space Requirements

Standard installation of the N1999A is on a customer provided lab bench or table top of adequate size and strength.

Table 1 Instrument Dimensions

Model	Weight	Height	Width	Depth
N1999A	1.8 kg (4 lb)	10 cm (4 in) adjustable to 14.0 cm (5.5 in)	15.5 cm (6.1 in)	26.7 cm (10.5 in)

N1999A Inputs

The AC/DC adapter supplied with the analyzer is equipped with a three-prong power cord, in accordance with international safety standards. The power cable appropriate to the original product shipping location is included with the N1999A.

Various AC power cables are available from Keysight that are unique to specific geographic areas. For the power cord part number information please visit us at http://www.keysight.com. In the search field type “power cords”.

Very often, coaxial cables and antennas build up a static charge, which if allowed to discharge by connecting to the N1999A, may damage the instrument input circuitry. To avoid such damage it is recommended to dissipate any static charges by temporarily grounding the coaxial cable.

Table 2 N1999A Input Level

Test Setup	Power Level
Maximum N1999A RF Power Levels:	
WR15 input	-25 dBm, 0 Vdc (55 to 66 GHz)
DC Input	15 VDC, 4 A
LO Input	13 to 15 GHz, +5 dBm

N1999A Attenuator

The N1999A attenuator is a micrometer controlled waveguide variable attenuator. It can be set from 0 dB to a minimum of 25 dB attenuation; though generally 30 dB or more of attenuation is available. Flatness is impacted with higher attenuation setting. The attenuator's purpose is to reduce signal amplitude to prevent distortion. Direct connection to the front panel waveguide (as opposed to the use of a waveguide horn) would tend to have higher power and need greater attenuation. Attenuation is logarithmic and is not consistent with the micrometer labeled values which indicate distance traveled by the internal mechanisms. External waveguide attenuation may be used if greater attenuation is required. These are commonly available in values of 3 dB, 6 dB, 10 dB, 20 dB and 40 dB.

N1999A IF Input

The 5 GHz Output signal is nominally -10 dBm.

Front and Rear Panel Features

Figure 2 Front Panel

RF Input Connectors

- Connector WR15 Waveguide

Figure 3 Rear Panel

LEDs

- The illuminated LEDs indicates an active instrument. The red LED indicates normal operation, +12 Volt regulated supply, not an error condition. The green LED indicates +15 Volt external supply.

Rear Panel SMA Connectors

- +15 VDC 4 A MAX
- 13 to 15 GHz LO INPUT
- 5 GHz IF OUTPUT

Hardware Setup and Configuration

1. Connect the three-prong AC power cord (country specific) to the power supply (0950-5014).
2. Connect the power supply's DC +15 Volt connector to the rear panel on the N1999A. The rear panel LED's will be illuminated. Refer to Figure 3 on page 8. There is no front or rear panel power switch. The DC power cord from the switching power supply is the N1999A's disconnecting device.

Figure 4 Rear Panel (with power cord)

Operation Verification

This test verifies that the N1999A is operating correctly.

1. Apply DC power to the N1999A and allow the temperature to stabilize for 15 minutes.
2. Do not force the end stops of the attenuator micrometer or damage will occur. Carefully turn the variable attenuator fully counter clockwise. This is the maximum signal amplitude. Note: as the attenuator is turned clockwise the signal amplitude will decrease logarithmically. The value of the attenuation is not consistent with the labeled values; the labeled values indicate the linear distance traveled by the internal mechanism controlled by the micrometer. This mechanism controls the attenuation.
3. On the RF Signal Source:
   a. Turn off the RF Power.
   b. Set the Center Frequency to 58.32 GHz.
   c. Connect a 1.85 mm coax cable to the RF Signal Source RF Output.
   d. Turn on the RF Power. If you have measured insertion loss for the 1.85 mm coax cable adjust the RF Signal Source power for -50 dBm after cable loss. If there is no calibrated value available use -6 dB for loss in the cable.
   e. Turn off the RF Power.

CAUTION Care must be taken to avoid damaging the surface of the waveguide connectors. The connection must be made straight on and off the guide pins, and the torque applied evenly around the circumference of the connector.

If you are using a Direct Connect:

a. Connect the V281A Adapter to the N1999A Input. Torque the waveguide input (WR15) to 7 in-lb.
b. Connect the RF Signal Source RF Output 1.85 mm coax cable to the V281 Adapter and torque to 9 in-lb.
c. Turn on the RF Power.

If you are using a Standard Gain Horn:

a. Connect the RF Signal Source using a 1.85 mm coax cable to the Adapter and torque to 9 in-lb. Place a Standard Gain Horn on the Adapter and torque to 7 in-lb.
b. Connect a Standard Gain Horn to the N1999A and torque to 7 in-lb. Align the Output Horn and Input Horn.
c. Turn on the RF Power.

4. LO Signal Source:
    a. Turn off the RF Power.
    b. Set the Center Frequency to 13.33 GHz.
    c. Set the Amplitude to +5 dBm.
    d. Connect the Signal Source to the N1999A LO Input using an SMA cable. Torque the LO Input to 9 in-lb.
    e. Turn on the RF Power.
5. Spectrum Analyzer:
    a. Set the Center Frequency to 5 GHz.
    b. Set the Span to 2 GHz.
    c. Set the Reference Level to 10 dBm.
    d. Connect the Spectrum Analyzer to the N1999A IF Output using an SMA cable. Torque to 9 in-lb.

The 5 GHz IF Output signal will be approximately -10 dBm or greater. The amplitude may vary more if you are using a Horn.

N1999A Millimeter Downconverter Typical Product Performance

This test verifies that the N1999A is operating correctly.

1. On the RF Input:

- Input frequency range is 57 to 66 GHz
- Maximum Input power -25 dBm
- Damage level Input power -10 dBm
- IQ Bandwidth 2 GHz (in recommended bands, refer to Table 5 on page 15.

2. On the LO Input:

- Input frequency range is 13 to 15 GHz
- Normal Input Power + 5 dBm
- Damage Level Input power < +13 dBm

NOTE LO Input power of 5 dBm can be varied to improve measurement results.

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3. IF Section:

- Output Frequency 5.0 GHz (± 1 GHz)
- IQ Bandwidth 2 GHz
- Non-Harmonic Spurious -30 dBr
- Noise Figure: < 20 dB @ -25 dBm RF Input with 25 dB attenuation
- Dynamic Range 30 dBr

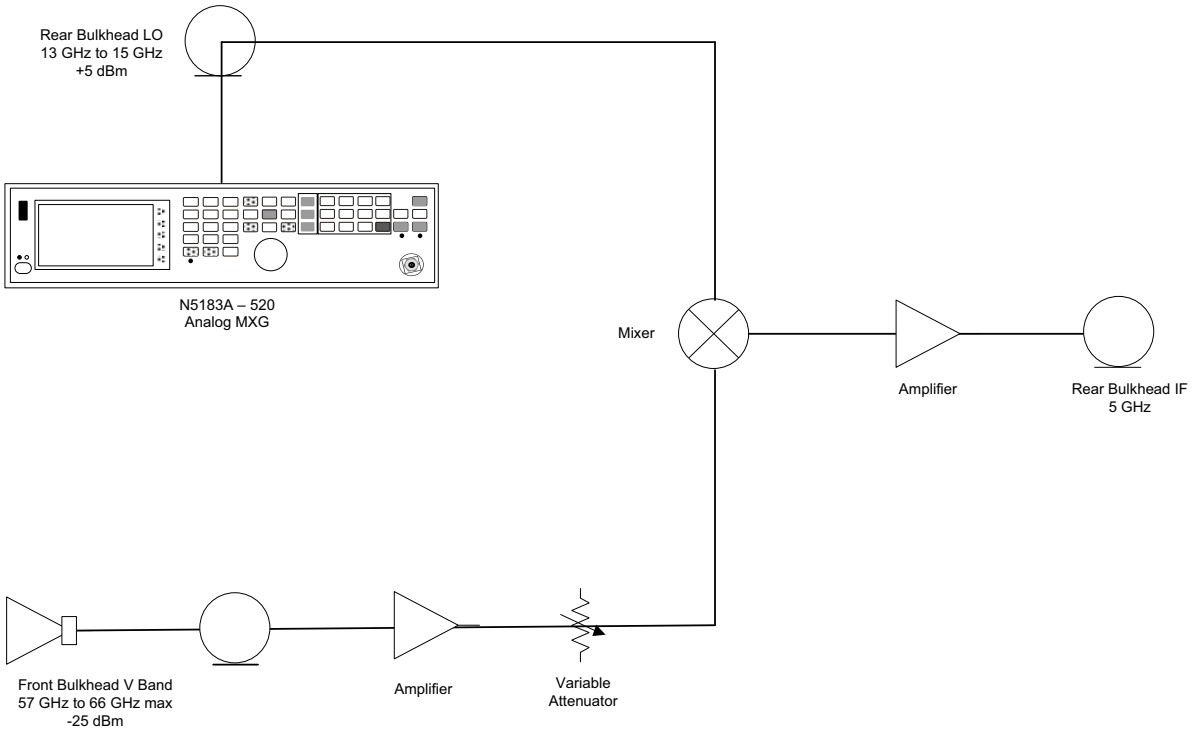
Table 3 WHD Tuning Chart

Band	External LO (GHz)	RF Center Freq (GHz)	IF Center Freq (GHz)	Bandwidth (GHz)
Band 1	13.33	58.32	5	± 1
Band 2	13.87	60.48	5	± 1
Band 3	14.41	62.64	5	± 1
Band 4	14.95	64.80	5	± 1

Table 4 General Tuning Chart

External LO (GHz)	Minimum RF (GHz)	Maximum RF (GHz)	Minimum IF (GHz)	Maximum IF (GHz)
12.0	49.0	53.4	1.0	5.4
13.0	53.0	57.8	1.0	5.8
14.0	57.0	62.4	1.0	6.4
15.0	61.0	66.8	1.0	6.8
16.0	65.0	71.4	1.0	7.4
17.0	69.0	75.8	1.0	7.8
17.5	71.0	75.8	1.0	5.8

Figure 5 N1999A Block Diagram



Service Information

Refer to "Contacting Keysight" on page 22.

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

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

Replaceable Parts

NOTE Special options are built to order, long lead times may be encountered when ordering replacement parts.

Table 5 Replaceable Parts

Description	Keysight Part Number	Qty
Power Supply Switching (60 Watt, 1 Output)	0950-5014	1
N1999A User's Guide	N1999-90001	1
WR15 Bulkhead Dust Cover	N1999-20017	1
SMA Dust Cover	1401-0245	2

Safety and Information

Introduction

Review this product and related documentation to familiarize yourself with safety markings and instructions before you operate the instrument.

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

Safety Earth Ground

WARNING **This is a Safety Class I Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.**

CAUTION Always use the three prong AC power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause product damage and the risk of electrical shock.

Statement of Compliance

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.

Connector Care and Cleaning Precautions

Remove the power cord to the instrument. To clean the connectors use alcohol in a well ventilated area. Allow all residual alcohol moisture to evaporate, and fumes to dissipate prior to energizing the instrument.

WARNING **To prevent electrical shock, disconnect the N1999A from mains electrical supply before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.**

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

Before Applying Power

Verify that the premises electrical supply is within the range of the instrument. The instrument has an autoranging power supply.

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

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

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

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

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

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

Servicing

WARNING	**Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended. Discard used batteries according to manufacturer's instructions.**

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

WARNING	**The opening of covers or removal of parts is likely to expose the user to dangerous voltages. Disconnect the instrument from all voltage sources before opening.**

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

WARNING	**The detachable power cord is the instrument disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the instrument. The front panel switch is only a standby switch and is not a LINE switch (disconnecting device).**

WARNING	**The power cord is connected to internal capacitors that may remain live for 5 seconds after disconnecting the plug from its power supply.**

Electrostatic Discharge Protection

Electrostatic discharge (ESD) can damage or destroy electronic components. The product is shipped in materials that prevent damage from static, and should only be removed from the packaging in an anti-static area ensuring that the correct anti-static precautions are taken.

Two types of ESD protection are listed below. Purchase acceptable ESD accessories from your local supplier.

- Conductive table-mat and wrist-strap combination
- Conductive floor-mat and heal-strap combination

Both types, when used together, provide a significant level of ESD protection. To ensure user safety, static-safe accessories must provide at least 1 MΩ of isolation from ground.

WARNING **These techniques for a static-safe work station should not be used when working on circuitry with a voltage potential greater than 500 volts.**

Regulatory Information

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

Instrument Markings

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).

The CE mark is a registered trademark of the European Community. (If accompanied by a year, it is when the design was proven.)

The RCM mark is a registered trademark of the Australian Communications and Media Authority

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.

South Korean Certification (KC) mark; includes the marking's identifier code which follows the format: MSIP-REM-YYY-ZZZZZZZZZZZZZZ.

EMC

Complies with the essential requirements of the European EMC Directive as well as current editions of the following standards (dates 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 Korea Class A EMC Declaration

This equipment is Class A suitable for professional use and is for use in electromagnetic environments outside of the home.

A 급 기기 (업무용 방송통신기자재) 이 기기는 업무용 (A 급) 전자파적합기기로서 판 매자 또는 사 용자는 이 점을 주 의하시기 바라 며 , 가정외의 지역에서 사용하는 것을 목적으 로 합니다 .

Safety

Complies with the essential requirements of the European Low Voltage Directive as well as current editions of the following standards (dates and editions are cited int he Declaration of Conformity):

- IEC/EN 61010-1
- Canada: CSA C22.2 No. 61010-1
- USA: UL std no. 61010-1

Acoustic Statement (European Machinery Directive):

- Acoustic noise emission
  LpA<70 dB
  Operator position
  Normal operation mode Per ISO 7779

Declaration of Conformity

To find a current Declaration of Conformity for specific Keysight product, go to: http://regulations.about.keysight.com/DoC/search.htm

Keysight Support, Services, and Assistance

Service and Support Options

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.

Contacting Keysight

Assistance with test and measurements needs and information or finding a local Keysight office are available at: http://www.keysight.com/find/assist

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

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

Shipping Your Product to Keysight for Service or Repair

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

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

- To improve turn-around time, return your test set along with your analyzer and cables to Keysight so that we may verify the operation of the complete system.
- Include a complete description of the service requested or of the failure and a description of any failed test and any error message.
- Remove and retain the front handles and all rack mount hardware. The analyzer should be sent to Keysight in the same configuration as it was originally shipped.
- Ship the analyzer using the original or comparable antistatic packaging materials.
- Contact Keysight for instructions on where to ship your analyzer.

Edition 1, May 2015

N1999-90001

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