

# **Agilent N1923/4A Wideband Power Sensor**

## **User's Guide**



**Agilent Technologies**

## Notices

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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.

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#### 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.

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## Safety and Regulatory Symbols

The following symbols on the device and in the documentation indicate precautions that must be taken to maintain safe operation of the device.

 <b>N10149</b>	<p>The C-Tick mark is a registered trademark of the Spectrum Management Agency of Australia. This signifies compliance with the Australian EMC Framework Regulations under the terms of the Radio Communications Act of 1992.</p>		<p>This product complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical/electronic product in domestic household waste.</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>The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives.</p> <p>ICES/NMB-001 indicates that this ISM product complies with the Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.</p> <p>ISM GRP.1 Class A indicates that this is an Industrial Scientific and Medical Group 1 Class A product.</p>

## General Safety Information

The following general safety precautions must be observed during all phases of operation, service, and repair of this device. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the device. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

### **WARNING**

**Before connecting the sensor to other instruments, ensure that all instruments are connected to the protective (earth) ground. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in personal injury.**

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### **CAUTION**

Repair or service that is not covered in this manual should only be performed by qualified personnel.

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

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

Product Category:

With reference to the equipment types in the WEEE Directive Annex 1, this device is classified as a “Monitoring and Control Instrument” product.

The affixed product label is as shown below:



### **Do not dispose in domestic household waste**

To return this unwanted device, contact your nearest Agilent office, or visit

[www.agilent.com/environment/product](http://www.agilent.com/environment/product)

for more information.

# Environmental Conditions

This device is designed for indoor use only. The following table shows the general environmental requirements for this device.

## Operating environment

Environmental conditions	Requirements
Temperature	0°C to 55°C (Operating)
Humidity	Maximum: 95% at 40°C (non-condensing) Minimum: 15% at 40°C (non-condensing)
Altitude	Operating up to 3000 m (9840 ft)

## Storage condition

Environmental conditions	Requirements
Temperature	-30°C to 70°C (Non-operating)
Humidity	Non-operating up to 90% at 65°C (non-condensing)
Altitude	Non-operating up to 15420 m (50000 ft)

## Regulatory information

The N1923/4A wideband power sensor complies with the following Electromagnetic Compatibility (EMC) requirements:

- IEC 61326-1:2005/EN 61326-1:2006
- Canada: ICES/NMB-001:Issue 4, June 2006
- Australia/New Zealand: AS/NZS CISPR11:2004

## Declaration of Conformity (DoC)

The Declaration of Conformity (DoC) for this device is available on the Web site. You can search the DoC by its product model or description.

<http://regulations.corporate.agilent.com/DoC/search.htm>

### NOTE

If you are unable to search for the respective DoC, contact your local Agilent representative.

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## **In This Guide...**

### **1 Introduction**

Chapter 1 provides the general information and overview of the N1923/4A.

### **2 Specifications and Characteristics**

Chapter 2 describes the specifications and characteristics of the N1923/4A.



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This chapter gets you started with the N1923/4A wideband power sensor.



## General Information

This guide contains information on the initial inspection, connection, operation, and specifications of the N1923/4A wideband power sensor. You can also find a copy of this guide on the documentation CD supplied with the 8990B peak power analyzer.



**Figure 1-1** N1923A and N1924A wideband power sensors

## Initial inspection

- 1 Inspect the shipping container for damage. Signs of damage may include a dented or torn shipping container or cushioning material that shows signs of unusual stress or compacting.
- 2 Carefully remove the contents from the shipping container and verify that your order is complete.

### NOTE

- If the shipping container or packaging material is damaged, it should be kept until the contents have been checked mechanically and electrically. If there is mechanical damage, notify the nearest Agilent Sales and Service office. Keep the damaged shipping material (if any) for inspection by the carrier and an Agilent representative. If required, you can find a contact list for Agilent Sales and Service offices on the last page of this guide.
  - Ensure that you have read and understood the preceding safety information before proceeding.
- 

If you have ordered any optional items, verify that the items are included with the shipment by checking the shipment packing list.

### Original packaging

Containers and materials identical to those used in the factory packaging are available through Agilent Sales and Service offices. If the device is being returned to Agilent for servicing, attach a tag indicating the type of service required, return address, model number, and serial number. Also mark the container as FRAGILE to assure careful handling. In any correspondence, refer to the device by its model number and serial number.

## Power meter and sensor cable requirements

The N1923/4A is ONLY compatible with the 8990B peak power analyzer.

The following table lists the length of cable options for the N1923/4A; these have no interconnecting cable requirements, as the cable is permanently connected (hard-wired) to the N1923/4A.

**Table 1-1** Cable length options

Option	Description
N1923A-105 N1924A-105	1.5 m (5 ft) cable length
N1923A-106 N1924A-106	3.0 m (10 ft) cable length
N1923A-107 N1924A-107	10.0 m (31 ft) cable length

## Interconnection

Connect the N1923/4A cable to the 8990B peak power analyzer RF channel input as shown in the following figure. Ensure that you align the red dots on the N1923/4A cable and the 8990B connector.



**Figure 1-2** Connecting the N1923/4A cable to the 8990B peak power analyzer

Allow a few seconds for the 8990B to read the data contained in the N1923/4A EEPROM and perform automatic zeroing of the N1923/4A.

**NOTE**

Ensure that the N1923/4A cable is attached and removed in an indoor environment.

**WARNING**

**Before connecting the N1923/4A to other instruments, ensure that all instruments are connected to the protective (earth) ground. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in personal injury.**

## Calibration

When calibrating the N1923/4A, there is no need to disconnect it from the RF power source.

The 8990B peak power analyzer performs internal zeroing and calibration routines on the N1923/4A. The process used for this internal zeroing and calibration is explained in [“Overview of the N1923/4A”](#) on page 7.

The 8990B *User's Guide* explains in more detail the methods used to perform zeroing and calibration of the N1923/4A.

## Operating instructions

To operate the N1923/4A, refer to the operating instructions in the 8990B *User's Guide*.

## Torque

The following table shows the connector types (for connection to devices-under-test) for the N1923/4A. A torque wrench must be used to tighten these connectors. Only use a wrench set to the correct torque value.

**Table 1-2** Wrench sizes and torque values

<b>Model</b>	<b>Connector</b>	<b>Wrench size</b>	<b>Torque value</b>
N1923A	Type-N (male)	3/4-inch open-end	12 in-lb (135 Ncm)
N1924A	2.4 mm (male)	5/16-inch open-end	8 in-lb (90 Ncm)



## Overview of the N1923/4A

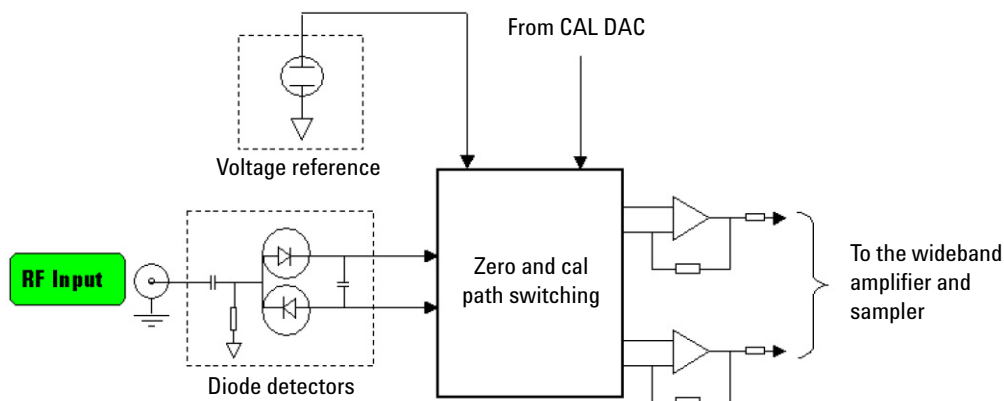
The N1923/4A is a wideband power sensor used with the 8990B peak power analyzer to measure the dynamic or time-dependent aspects of RF and microwave power. The N1923/4A-8990B combination is able to measure the RF pulse rise/fall times up to 5 nsecs. In use, the N1923/4A is connected to an RF or microwave source or a device-under-test (DUT) and to the 8990B. All calibration data for the N1923/4A is stored in EEPROM and is downloaded to the 8990B when the N1923/4A is connected.

The N1923A has a frequency range of 50 MHz to 18 GHz, while the N1924A has a frequency range of 50 MHz to 40 GHz.

### Internal zeroing and calibration

The N1923/4A internal zeroing and calibration process is used to combine the N1923/4A and the 8990B peak power analyzer to make accurate power measurements.

Referring to the following figure, the process for the internal zeroing and calibration explains how three objectives in this process are achieved.



**Figure 1-3** Simplified N1923/4A block diagram

- 1 To account for the environment that the system is working in – the temperature and the presence of electromagnetic signals.

This is achieved during the internal zeroing process, where the diode detectors are isolated from the active amplifier circuitry. The process allows the zero measurement to be made, regardless of the RF input signal, thus allowing the N1923/4A to remain connected to the DUT. The isolation is achieved by a network of transistor switches in the zeroing and calibration path switching.

- 2 To account for the combining of the N1923/4A and the 8990B, as these may never have been used together as a system.

This is achieved during the internal calibration; the amplifier circuitry is isolated from the diode detectors by a network of transistor switches, and the N1923/4A voltage reference is routed to the amplifier circuitry.

- 3 To verify traceability to National Standards, hence, verifying that your measurements are going to perform to specifications.

To achieve traceable and accurate RF power measurements, each N1923/4A is individually characterized during its production procedure. To achieve optimal accuracy, a 3-dimensional correction is generated across power, frequency, and temperature. This uses advanced modeling techniques, and is superior in accuracy and speed of evaluation to the overlaying of linearity, temperature corrections, and calibration factors.

The calibration factors are stored in EEPROM during the manufacturing process. All the compensation data is downloaded to the 8990B at power-on or when the N1923/4A is connected.

### NOTE

Between 50 MHz and 500 MHz, the N1923/4A is sensitive to the RF signal propagating through onto the detector amplifier circuitry and resulting in distorted power measurements. To reduce this effect, additional filtering is switched into the measurement path, which results in a 23 MHz video bandwidth limitation for signals below 500 MHz.



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This chapter contains the specifications, characteristics, and maintenance information for the N1923/4A.



# Specification Definitions

There are two types of product specifications:

- warranted specifications
- characteristic specifications

## Warranted specifications

Warranted specifications are covered by the product warranty and apply over 0°C to 55°C, unless otherwise noted. Warranted specifications include measurement uncertainty calculated with 95% confidence.

## Characteristic specifications

Characteristic specifications are not warranted. They describe product performance that is useful in the application of the N1923/4A by giving typical, but non-warranted performance parameters. These characteristics are shown in *italics* or denoted as “*typical*”, “*nominal*”, or “*approximate*”.

Characteristic information is representative of the product. In many cases, it may also be supplemental to a warranted specification. Characteristic specifications are not verified on all sensors. The types of characteristic specifications can be placed in two groups:

- The first group of characteristic types describes 'attributes' common to all products of a given model or option.

Examples of characteristics that describe 'attributes' are product weight and 50 Ω input Type-N connector. In these examples, product weight is an *approximate* value and a 50 Ω input is *nominal*. These two terms are most widely used when describing a product 'attributes'.

- The second group of characteristic types describes 'statistically' the aggregate performance of the population of products.

These characteristics describe the expected behavior of the population of products. They do not guarantee the performance of any individual product. No measurement uncertainty value is accounted for in the specification. These specifications are referred to as *typical*.

## Conditions

The 8990B peak power analyzer and N1923/4A meet its specifications when:

- Stored for a minimum of two hours at a stable temperature within the operating temperature range, and turned on for at least 30 minutes.
- The 8990B and N1923/4A are within their recommended calibration periods.
- Used in accordance to the information provided in the 8990B *User's Guide*.

## Specifications

### Frequency and dynamic power range

Sensor model	Frequency range	Dynamic power range
N1923A	50 MHz to 18 GHz	-35 dBm to +20 dBm
N1924A	50 MHz to 40 GHz	-35 dBm to +20 dBm

### Rise/fall time, damage level, and connector type

Sensor model	Rise/fall time	Damage level (average power)	Damage level (peak power)	Connector type
N1923A	$\leq 3$ ns <sup>[1]</sup>	+23 dBm	+30 dBm (<1 $\mu$ s duration)	Type-N (m)
N1924A	$\leq 3$ ns <sup>[1]</sup>	+23 dBm	+30 dBm (<1 $\mu$ s duration)	2.4 mm (m)

[1] Applicable for frequency of  $\geq 500$  MHz.

### Maximum SWR

Sensor model	Frequency band	Maximum SWR
N1923A	50 MHz to 10 GHz	1.2
	10 GHz to 18 GHz	1.26
N1924A	50 MHz to 10 GHz	1.2
	10 GHz to 18 GHz	1.26
	18 GHz to 26.5 GHz	1.3
	26.5 GHz to 40 GHz	1.5

## Calibration uncertainty

Definition: Uncertainty resulting from non-linearity in the sensor detection and correction process. This can be considered as a combination of traditional linearity, calibration factor, temperature specifications, and the uncertainty associated with the internal calibration process.

Sensor model	Frequency band	Calibration uncertainty <sup>[1]</sup>
N1923A	50 MHz to 500 MHz	4.5%
	500 MHz to 1 GHz	4.0%
	1 GHz to 10 GHz	4.0%
	10 GHz to 18 GHz	5.0%
N1924A	50 MHz to 500 MHz	4.3%
	500 MHz to 1 GHz	4.2%
	1 GHz to 10 GHz	4.4%
	10 GHz to 18 GHz	4.7%
	18 GHz to 26.5 GHz	5.9%
	26.5 GHz to 40 GHz	6.0%

[1] Beyond 70% humidity, an additional 0.6% must be added to the values.

## Noise and drift

Sensor model	Zeroing	Zero set		Zero drift <sup>[1]</sup>	Noise per sample	Measurement noise (Free run) <sup>[2]</sup>
		<500 MHz	>500 MHz			
N1923/4A	No RF signal on input	200 nW		80 nW	3 $\mu$ W	50 nW
	RF signal present	550 nW	200 nW			

[1] Within 1 hour after zeroing, at a constant temperature, after a 24-hour warm-up of the peak power analyzer. This component can be disregarded with the auto-zeroing mode set to ON.

[2] Measured over a 1-minute interval, at a constant temperature, two standard deviations, with averaging set to 1.

## Physical Characteristics

### Dimensions

Sensor model	Dimensions (length × width × height)
N1923A	135 mm × 40 mm × 27 mm (5.3 in × 1.6 in × 1.1 in)
N1924A	127 mm × 40 mm × 27 mm (5.0 in × 1.6 in × 1.1 in)

### Cable lengths and weights

Option	Fixed cable length	Weight with cable
N1923A-105 N1924A-105	1.5 m (5 ft)	0.4 kg (0.88 lb)
N1923A-106 N1924A-106	3.0 m (10 ft)	0.6 kg (1.32 lb)
N1923A-107 N1924A-107	10.0 m (31 ft)	1.4 kg (3.01 lb)

## Recommended Calibration Interval

Agilent recommends a one-year calibration cycle for the N1923/4A.



## Environmental Conditions

<b>Operating environment</b>	
Temperature	0°C to 55°C (Operating)
Humidity	Maximum: 95% at 40°C (non-condensing) Minimum: 15% at 40°C (non-condensing)
Altitude	Operating up to 3000 m (9840 ft)
<b>Storage condition</b>	
Temperature	-30°C to 70°C (Non-operating)
Humidity	Non-operating up to 90% at 65°C (non-condensing)
Altitude	Non-operating up to 15420 m (50000 ft)
<b>EMC compliance</b>	
Complies with:	<ul style="list-style-type: none"> <li>• IEC 61326-1:2005/EN 61326-1:2006</li> <li>• Canada: ICES/NMB-001:Issue 4, June 2006</li> <li>• Australia/New Zealand: AS/NZS CISPR11:2004</li> </ul>

## **2 Specifications and Characteristics**

**www.agilent.com**

### **Contact us**

To obtain service, warranty, or technical assistance, contact us at the following phone or fax numbers:

United States:

(tel) (800) 829 4444 (fax) 800 829 4433

Canada:

(tel) (877) 894 4414 (fax) 800 746 4866

China:

(tel) 800 810 0189 (fax) 800 820 2816

Europe:

(tel) 31 20 547 2111

Japan:

(tel) 0120 (421) 345 (fax) 0120 421 678

Korea:

(tel) 080 769 0800 (fax) (080) 769 0900

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(tel) 0800 047 866 (fax) 0800 286 331

Other Asia Pacific Countries:

(tel) (65) 6375 8100 (fax) (65) 6755 0042

Or visit Agilent World Wide Web at:

[www.agilent.com/find/assist](http://www.agilent.com/find/assist)

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