Keysight 8990B
Peak Power Analyzer and N1923A/N1924A Wideband Power Sensors

Data Sheet

KEYSIGHT TECHNOLOGIES

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Faster Measurement Speed and Greater Measurement Accuracy

Skip the complicated setup and go straight to making measurements with the 8990B peak power analyzer from Keysight Technologies, Inc. This instrument offers faster measurement speed and greater measurement accuracy in key applications such as radar pulse analysis and wireless pulse measurement. Designed with both ease of use and high performance in mind, the 8990B peak power analyzer does more than just measure and analyze – it saves you time and effort, letting you focus on the important details.

Ease of use

8990B peak power analyzer is built for ease of use: the instrument is easy to set, easy to trigger and easy to measure pulse measurements with.

Setting	Set amplitude and time scale settings quickly with dedicated knobs and buttons, while the Autoscale function automatically displays waveforms scaled to the display. The function is accessible through a single touch button.
Trigger	Trigger the right pulse signal in three simple steps. Simply select the trigger source, the trigger edge and the trigger level, and the peak power analyzer will display the appropriate pulse signals.
Measure	Analyze a full range of parameters with 15 pulse parameter measurements, all pre-defined and executed automatically in two easy steps via the front panel touchscreen.

Additional features such as internal zero, calibration, and touchscreen capability make setup and data analysis both efficient and convenient, while a familiar button layout cuts the learning time needed to master using the instrument.

Performance

The 8990B peak power analyzer features a host of key performance specifications, dedicated to give you accurate and more detailed pulse measurements, faster.

Accuracy	Measure RF power measurements with less error; 8990B has an overall accuracy rate of 0.2 dB.
Detail	View pulses in greater image detail with the large 15-inch XGA color display and get the high resolution needed to detect abnormalities in a signal trace with the 8990B's sampling rate of 100 MSample/s (real time sampling) and 1 GSample/s (ETS mode).
Speed	Automatically execute pulse droop measurements for repetitive amplified pulse signals and delay measurement to detect the first pulse of the traces. The instrument's screen will instantly display the results.

And when combined with the N1923A/N1924A wideband power sensors, the 8990B achieves 5 nanosecond rise time/fall time – the fastest rise time/fall time in the peak power measurement market.

8990B Peak Power Analyzer Key Features

- Capture short radar pulses accurately with a 5 nanosecond overall rise time/fall time – the fastest rise time/fall time in the peak power measurement market – when the 8990B peak power analyzer is paired with the either the N1923A or N1924A wideband power sensor.
- A high sampling rate of 100 MSa/s lets you measure samples faster and view trace displays in high resolution.
- Analyze a full range of parameters with 15 pulse characterization measurements, including duty cycle, rise time, pulse top, pulse width, PRI and PRF.
- Verify design problems quickly with a 15-inch XGA color display that is capable of simultaneously displaying four channel results for more image detail, and manipulate data directly with a few touches of your finger with the touchscreen capability.
- Save time and eliminate inaccurate readings with the internal zero and calibration function.
- Continuously trigger and capture up to 512 pulses with the new multi-pulse measurement feature.
- Color coded channels allow you to pick out the channel data points of interest at a glance.
- Easily calculate the Power-Added Efficiency (PAE) of power amplifiers, and display instant PAE traces on the 8990B's display.

Graphical User Interface Overview

Measurement screen

The main measurement screen is capable of displaying up to four traces: two RF traces, and two video traces (the triggering signal). Results are shown in the panel directly under the graphical window, with measurements displayed in the same color as the channel to which it corresponds. When a USB sensor is connected, the results for this additional channel can be overlaid on the same graphical window in compact mode, The main screen also features a soft panel key to the side of the graphical window, which lists the 15 pulse characterization measurements for quick measurement analysis. Users can select these measurement parameters via the touchscreen display, or by using the mouse.

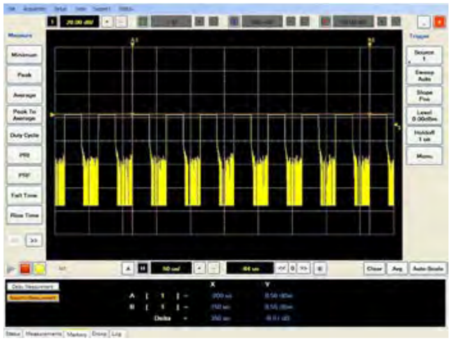
Delay measurement

Perform delay measurements by pressing the Delay Measurement button on the soft panel key and two vertical markers will automatically detect the first pulse of the traces. The time delay between the two traces will be displayed in the measurement panel below the graphical window.

Droop measurement

The 8990B is the first peak power analyzer on the market to offer automated Pulse Droop measurement, which measures the amplitude degradation of the pulse top. This eliminates the need to manually manipulate the horizontal markers to make this measurement. Access the Pulse Droop measurement via the soft panel key.

Graphical User Interface Overview (Continued)



Spacing measurement

Easily measure the space between pulses when a long pulse train occurs. The 8990B allows users to select the starting pulse and the end pulse, a function that is important in pulse block validation. R&D engineers may use this function to detect potential abnormalities in certain pulse groups, and whether those abnormalities are repeated in a long pulse train.

Zoom screen

The 8990B provides dual window zoom capability. When this function is enabled, the top screen will display the original signal, while the bottom screen displays the enlarged signal trace.

To focus and zoom in on a particular segment of the signal trace, use the white zoom box to select the area of interest on the original signal trace. The measurement panel below will display the results of the selected signal segment. This function provides R&D engineers the flexibility to focus on particular parts of the signal and to obtain only the measurement results they need.

The dual zoom window capability allows users to observe the original trace while focusing in on the selected signal segment instead of flipping between screens or losing the original trace after zooming in on the segment.

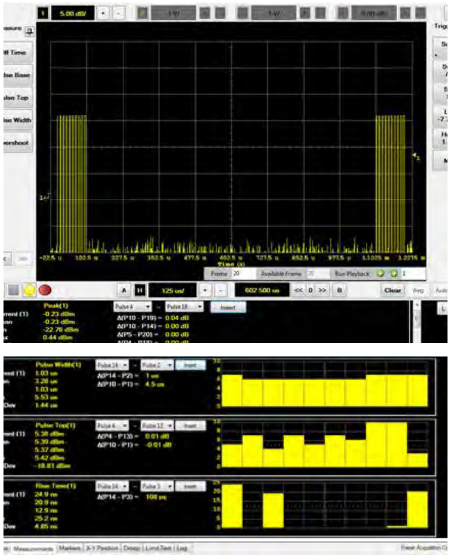
Threshold/power display settings and erase memory

The 8990B allows users to change channel settings. The default threshold setting is 90% and 10%; however, users may change the reference levels to any value. If a pulse has high overshoot in the traces, users can choose to reduce the upper trace level to 80% or 70% to eliminate the overshoot signal's impact on the results. Users can also modify the trace level of two different signals for the delay measurement according to what is the best reference level for the individual signal.

Users can also change their settings to display power measurements in either logarithmic or watts to help with easy result conversion or to match the results to the traces in the graphical window.

For users in the aerospace and defense industry, the 8990B offers several ways to secure both data and measurement settings such as the memory sanitization feature, a standard product feature in all Keysight equipment that will erase the system's setup and data results. Users can also opt for the removable hard drive option, which switches the attached hard drive with a removable version, so users can remove data and settings together with the hard drive without worrying about information leaks.

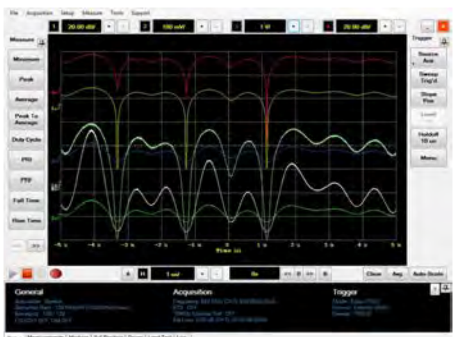
Additional Features



Multi-pulse measurement

View, measure and analyze continuous pulse trains from power amplifier modules or transmitters. The multi-pulse measurement feature allows continuously trigger and capture up to 512 pulses. This feature also adds pulse-to-pulse measurement and histogram distribution graph capabilities to the 8990B, which are crucial for testing RF and the pulse-to-pulse stability of power amplifiers and transmitters.

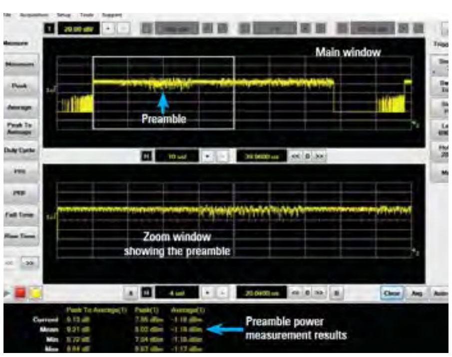
Additionally, operators can use the multi-pulse measurement feature to analyze short pulse with long off time or amplitude droop across the pulse train, or monitor the stability of the pulse shape (via the histogram graph functionality).



Power-Added Efficiency math function

Calculate the Power-Added Efficiency (PAE) of power amplifiers and display instant PAE traces onscreen with the 8990B. Power-Added Efficiency, a typical power analyze measurement, is a measure of the power conversion efficiency – the percentage of DC power converted to RF power in the power amplifier – of power amplifiers.

Reduce test costs and the number of test equipment needed with the 8990B; the peak power analyzer measures RF power, voltage and current in a single solution box. The 8990B's two RF input channels allow users to measure the RF power gain from the power amplifier; using a DC current probe, scope probe or differential probe, they can also measure the power amplifier's voltage and current through the analog video input channels. The 8890B's PAE math function then uses the measurements from the RF and analog video input channels to easily determine the PAE of the power amplifier.



Adjustable ETS threshold for wider bandwidth measurement

Measure peak and peak-to-average of 802.11ac wide bandwidth signal accurately with the 8990B's 160 MHz video bandwidth capability. The peak power analyzer can execute power vs. time (PvT) measurements on an 80 MHz or 160 MHz 802.11ac signal by adjusting the ETS threshold according to the burst length.

Operators can also use the zoom function to analyze and measure the preamble power of the 802.11ac burst signal.

Performance Specifications

Specification definitions

There are two types of product specifications:

- **Warranted specifications** are specifications which are covered by the product warranty and apply over a range of 0 to 55 °C unless otherwise noted. Warranted specifications include measurement uncertainty calculated with a 95% confidence.
- **Characteristic specifications** are specifications that are not warranted. They describe product performance that is useful in the application of the product. These characteristic specifications are shown in ***italics***.

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 units. There are several types of characteristic specifications. They can be divided into two groups:

One group of characteristic types describes 'attributes' common to all products of a given model or option. Examples of characteristics that describe 'attributes' are the product weight and '50-ohm input Type-N connector'. In these examples, product weight is an 'approximate' value and a 50-ohm input is 'nominal'. These two terms are most widely used when describing a product's 'attributes'.

Conditions

The power meter and sensor will 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 power meter and sensor are within their recommended calibration period.
- Used in accordance to the information provided in the User's Guide.

Product Characteristics

The following specifications are applicable only when the N1923A/N1924A wideband power sensors are used with the 8990B peak power analyzer. Using the 8990B with other supported sensors might yield different results.

Power requirements	100 to 120 V (at 50 to 60 Hz, 400 Hz)
	100 to 240 V (at 50 to 60 Hz)
	Maximum power dissipated at 375 W
Operating environment	Operating temperature from 5 to 40 °C
	Relative humidity up to 95% at 40 °C (non-condensing)
	Operating altitude up to 4000 m (12000 ft.)
	Operating random vibration at 5 to 500 Hz, 10 minutes/axis, 0.21 g (rms)
Non-operating conditions	Non-operating temperature from –40 to +70 °C
	Relative humidity up to 90% at 65 °C
	Non-operating altitude up to 4600 m (15000 ft.)
	Non-operating random vibration at 5 to 500 Hz, 10 minutes/axis, 2.09 g (rms); resonant search at 5 to 500 Hz, swept sine, 1 octave/minute, sweep rate at 0.5 g (0 peak), 5 minutes resonant, dwell at 4 resonance/axis
Dimensions (W x D x H)	430 mm (16.9 in) x 347 mm (13.7 in) x 330 mm (13.0 in)
Weight	< 16 kg (net)
	< 23.5 kg (shipping)
Sound pressure level	45 dB
Electromagnetic compatibility	Complies with the essential requirements of the European (EC) Directives as follows: – IEC 61326-2-1:2005/EN 61326-2-1:2006 – CISPR 11:2003/EN 55011:2007 (Group 1, Class A)
	The product also meets the following EMC standards: – Canada: ICES-1:2004 – Australia/New Zealand: AS/NZS CISPR 11:2004
Safety	Conforms to the following product specifications: – EN61010-1: 2001/IEC 61010-1:2001 – CAN/CSA C22.2 No. 61010-1-04 – ANSI/UL std No. 61010-1-2004

8990B Peak Power Analyzer Specifications

Key specifications		
RF input channels	2	
Video input channels	2	
Maximum real time sampling rate	100 MSa/s [1] (Real Time), 1 GSa/s [1] (ETS On), 20 GSa/s [2]	
Maximum capture length	1 s	
Memory depth	Max 2M points	
Instrumentation linearity	*± 0.8%*	
Rise time/fall time	≤ 5 nsec (for frequencies ≥ 500 MHz) [3]	
RF inputs (Channels 1 and 4)		
Frequency range	50 MHz to 40 GHz	
Dynamic range	–35 dBm to +20 dBm	
Measurement unit	Linear (Watt) or Log (dBm) selectable	
Video bandwidth	*160 MHz* [4]	
Minimum pulse width	*50 ns*	
Maximum pulse repetition rate	*10 MHz*	
Input coupling	50 Ω	
Vertical scale	0.01 dB/div to 100 dB/div in 1-2-5 sequence or any arbitrary scaling, user defined	
	1 µW/div to 1 kW/div in 1-2-5 sequence or any arbitrary scaling, user defined	
Offset	± 99 dBm with 0.01 dB resolution	
ETS threshold	500 ns, 1 µs, 2 µs, 5 µs, 10 µs	
Video inputs (Channels 2 and 3)		
General characteristics		
Video bandwidth	*1 GHz*	
Input impedance	50 Ω ± 2.5%, 1 MΩ ± 1% (11 pF typical)	
Input coupling	1 MΩ: AC (3.5 Hz), DC	
	50 Ω: DC	
Vertical scale	1 MΩ: 1 mV/div to 5 V/div in 1-2-5 sequence or any arbitrary scaling, user defined	
	50 Ω: 1 mV/div to 1 V/div in 1-2-5 sequence or any arbitrary scaling, user defined	
DC gain accuracy	± 2% of full scale at full resolution on channel scale ± 5 °C from cal temp	
Offset accuracy	± (1.25% of channel offset +1% of full scale + 1 mV) [5]	
Maximum input voltage	1 MΩ: 150 V RMS or DC, CAT I	
	± 250 V (DC + AC) in AC coupling	
Offset range		
	Vertical sensitivity	Available offset
1 MΩ	1 mV to < 10 mV/div	± 2 V
	10 mV to < 20 mV/div	± 5 V
	20 mV to < 100 mV/div	± 10 V
	100 mV to < 1 V/div	± 20 V
	1 V to 5 V/div	± 100 V
50 Ω		± 12 div or ± 4 V, whichever is smallest

1. For RF input channel 1 and 4.
2. For video input channel 2 and 3.
3. Specification applies only when the Off video bandwidth is selected.
4. Video bandwidth tested by measuring peak-to-average on a two-tone separation signal at +10 dBm, frequency set at 1 GHz. Test limit set at 2 dB roll off from the nominal 3 dB peak-to-average flatness graph.
5. 50 Ω input: Full scale is defined as 8 vertical divisions. Magnification is used below 10 mV/div, full-scale is defined as 80 mV. The major scale settings are 5 mV, 10 mV, 20 mV, 50 mV, 100 mV, 200 mV, 500 mV, and 1 V.

   1 MΩ input: Full scale is defined as 8 vertical divisions. Magnification is used below 5 mV/div, full-scale is defined as 40 mV. The major scale settings are 5 mV, 10 mV, 20 mV, 50 mV, 100 mV, 200 mV, 500 mV, 1 V, 2 V, and 5 V.

8990B Peak Power Analyzer Specifications (Continued)

Time base	
Range	2 ns to 100 msec/div in 1-2-5 sequence or any arbitrary scaling, user defined
Delta time accuracy	*1 ns + 0.02 x (time/div)*
Timebase accuracy	± 1.4 ppm peak
Channel to channel offset	± *5 ns* (ETS Off), ± *3 ns* (ETS On)
Delay range	± 1 s max
Trigger	
Hardware trigger	
Sweep mode	Auto, triggered, single
Trigger mode	Postive and negative edge, pulse width (all channels)
	Trigger by event (sensor channel 1 and 4)
Trigger source	Channel 1, 2, 3, 4, AUX
Trigger level	
Level range	Channel 1 and 4: *–20 dBm* to *+20 dBm*
	Channel 2 and 3: ± 8 div from center screen (1 MΩ, edge mode)
	AUX: TTL (high > 2.4 V, low < 0.7 V at 50 Ω
Level resolution	Channel 1 and 4: 0.01 dB
	Channel 2 and 3: 10 µV [1]
Level accuracy	Channel 1 and 4: ± 0.5 dB (0.5 dB/ns slew rate in ETS mode)
Trigger delay	
Delay range	± 1.0 s max [2]
Delay resolution	*1% of delay setting, 10 ns maximum (50 ns/div)*
Trigger hold-off	
Range	1 µs to 1 s
Resolution	*1% of selected value (to a minimum of 10 ns)*
Vertical and horizontal markers	
Resolution	Minimum 1 ns
Sensor check source	
Frequency	*1.05 GHz or 50 MHz (selectable)*
Power level	*0 dBm ± 0.9% (50 MHz)*
	0 dBm ± 1.2% (1.05 GHz)
Signal type	*Square pulse modulated (1.05 GHz only) or CW (1.05 GHz or 50 MHz)*
Repetition rate	*1 kHz*
Connector type	*Type N (female)*
SWR	*1.05*
Waveform measurement and math	
Pulse measurement	Rise time, fall time, minimum, average, peak, peak-to-average, duty cycle, PRI, PRF, off time, pulse base, pulse top, pulse width, overshoot
Markers measurement	Delay measurement, pulse spacing, pulse droop
Waveform math	Add, averaging, common mode, divide, invert, magnify, multiply, PAE, PAE2, subtract, square root, XY display
Statistical	CCDF (free run and triggered)
Video averaging	2, 4, 8, 32, 64, 128, 256, 512, 1024, 2048 selectable
Zoom	Dual window zoom

1. The trigger level of video channels is dependent on the vertical scale setting.
2. The trigger delay range is dependant on the timebase setting.

8990B Peak Power Analyzer Specifications (Continued)

N6904A/8990B-1FP multi-pulse analysis software option	
Multi-pulse specifications	
Maximum capture frame	512 (each channel 1 and channel 4)
Minimum pulse to pulse duration	1 µs
Number of histogram bins	20 (user adjustable)
Pulse to Pulse measurement	Compare any two pulses from the captured frames
Sensor compatibility	
N1921A	P-Series wideband power sensor, 50 MHz to 18 GHz
N1922A	P-Series wideband power sensor, 50 MHz to 40 GHz
N1923A	Wideband power sensor, 50 MHz to 18 GHz
N1924A	Wideband power sensor, 50 MHz to 40 GHz
Computer system and peripherals, I/O ports	
Display	
Display	15-inch color XGA TFT-LCD with touchscreen capability
Computer system and peripherals	
Operating system	Windows 7 Embedded Standard
CPU	Intel Core 2TM Duo CPU E8400 3 GHz microprocessor
System memory	4 GB
Drives	≥ 250 GB internal hard disk (option 800)
	≥ 250 GB removable hard disk (option 801)
Peripherals	Optical USB mouse and compact keyboard supplied
	Supports any Windows compatible input device with a PS/2 or USB interface.
File types	
Waveforms	Comma separated values (*.csv)
Images	BMP, TIFF, GIF, PNG or JPEG
I/O ports	
LAN	RJ-45 connector, supports 10Base-T, 100Base-T and 1000Base-T. Enables web-enabled remote control, e-mail on trigger, data/file transfers and network printing.
RS-232 (serial)	COM1, printer and pointing device support
PS/2	Two ports. Supports PS/2 pointing and input devices.
USB 2.0 Hi-Speed	Three ports (front panel)
	Four ports (side panel)
	Allows connection of USB peripherals like storage devices and pinitng devices while the peak power analyzer is turned on. One device port on the side.
Dual-monitor video output	15-pin XGA on side, full color output of scope waveform display or dual monitor video output
Auxiliary output	DC (± 2.4 V); square wave ~755 Hz with ~200 ps rise time
Trigger out	Output provides TTL compatible logic levels and uses a BNC connector
Time base reference output	10 MHz, amplitude into 50 Ω, 800 m Vpp to 12.6 Vpp (4 dBm ± 2 dB) if derived from internal reference.
	Tracks external reference input amplitude ± 1 dB if applied and selected.
Time base reference input	10 MHz, input Z = 50 Ω
	Minimum, –2 dBm
	Maximum, +10 dBm
Remote programming	
Interface	LAN and USB 2.0 interface
Command language	SCPI

N1923A/N1924A Wideband Power Sensor Specifications

Sensor model	Frequency range	Dynamic range	Rise/fall time	Damage level	Connector type
N1923A	50 MHz to 18 GHz	–35 to +20 dBm	≤ 3 ns (applicable for frequencies of ≥ 500 MHz)	+23 dBm (average power)	Type N (m)
				+30 dBm (< 1 µs duration, peak power)	
N1924A	50 MHz to 40 GHz	–35 to +20 dBm	≤ 3 ns (applicable for frequencies of ≥ 500 MHz)	+23 dBm (average power)	2.4 mm (m)
				+30 dBm (< 1 µs duration, peak power)	

The N1921A/N1922A P-series wideband power sensors are compatible for use with the 8990B peak power analyzer.

Maximum SWR

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

Sensor calibration uncertainty [1]

Frequency band	N1923A	N1924A
50 MHz to 500 MHz	4.5%	4.3%
500 MHz to 1 GHz	4.0%	4.2%
1 GHz to 10 GHz	4.0%	4.4%
10 GHz to 18 GHz	5.0%	4.7%
18 GHz to 26.5 GHz		5.9%
26.5 GHz to 40 GHz		6.0%
Physical characteristics		
Dimensions	N1923A	135 mm x 40 mm x 27 mm (5.3 in x 1.6 in x 1.1 in)
	N1924A	127 mm x 40 mm x 27 mm (5.0 in x 1.6 in x 1.1 in)
Weights with cable	Option 105	0.4 kg (0.88 lb)
	Option 106	0.6 kg (1.32 lb)
Fixed sensor cable lengths	Option 105	1.5 m (5-feet)
	Option 106	3.0 m (10-feet)

Environmental conditions

General	Complies with the requirements of the EMC Directive 89/336/EEC
Operating	
Temperature	0 to 55 °C
Maximum humidity	95% at 40 °C (non-condensing)
Minimum humidity	15% at 40 °C (non-condensing)
Maximum altitude	3,000 meters (9,840 feet)
Storage	
Non-operating storage temperature	–30 to +70 °C
Non-operating maximum humidity	90% at 65 °C (non-condescending)
Non-operating maximum altitude	15,420 meters (50,000 feet)

1. Beyond 70% humidity, an additional 0.6% should be added to these values.

System Specifications and Characteristics

Average power measurement accuracy	
N1923A	*≤ ± 0.2 dB or ± 4.5%* [1]
N1924A	*≤ ± 0.3 dB or ± 6.7%*

1. Specification is valid over a range of –15 to +20 dBm, and a frequency range of 0.5 to 10 GHz, DUT Max. SWR < 1.27 for the N1923A, and a frequency range of 0.5 to 40 GHz, DUT Max. SWR < 1.2 for the N1924A. Averaging is set to 32.

Video bandwidth

The video bandwidth in the peak power analyzer can be set to High, Medium, Low and Off. The video bandwidths stated in the table below are not the 3 dB bandwidths, as the video bandwidths are corrected for optimal flatness (except the Off filter). Refer to Figure 1 for information on the flatness response. The Off video bandwidth setting provides the warranted rise time and fall time specification and is the recommended setting for minimizing overshoot on pulse signals.

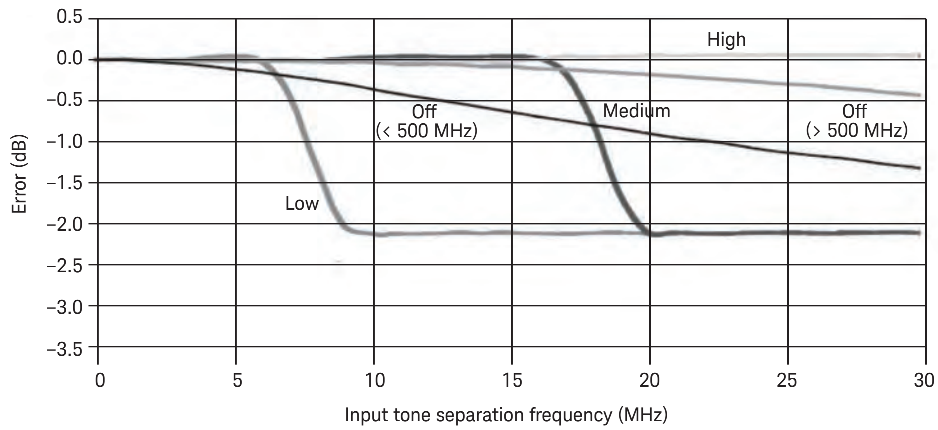


Figure 1. Flatness response.

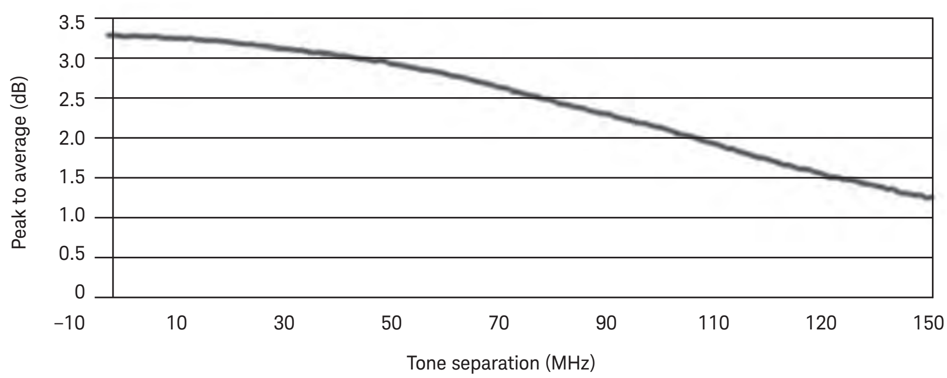


Figure 2. Video Bandwidth set to Off.

System Specifications and Characteristics (Continued)

Dynamic response - rise time, fall time, and overshoot versus video bandwidth settings

Parameter	Video bandwidth setting: Low: 5 MHz	Medium: 15 MHz	High: 30 MHz	Off: < 500 MHz	Off: > 500 MHz
Rise time/Fall time [1]	*< 60 ns*	*< 25 ns*	*< 13 ns*	*< 50 ns*	*≤ 5.5 ns*
Overshoot [2]				*< 5%*	*< 5%*

Noise and drift [3]

Sensor model	Zeroing	Zero set: < 500 MHz	Zero set: > 500 MHz	Zero drift [4]	Noise per sample	Measurement noise [5]
N1923A/N1924A	No RF on input	200 nW	200 nW	*80 nW*	*3 µW*	*50 nW*
	RF present	*550 nW*	*200 nW*	*80 nW*	*3 µW*	*50 nW*

Noise per sample multiplier

	Video bandwidth setting: Low: 5 MHz	Medium: 15 MHz	High: 30 MHz	Off
< 500 MHz	*0.91*			*1*
> 500 MHz	*0.56*	*0.74*	*0.93*	*1*

Noise multiplier

Average setting	1	2	4	8	16	32	64	128	256	512	1024
< 500 MHz	*1.00*	*0.75*	*0.55*	*0.40*	*0.35*	*0.30*	*0.25*	*0.22*	*0.21*	*0.20*	*0.19*
> 500 MHz	*1.00*	*0.73*	*0.52*	*0.37*	*0.28*	*0.21*	*0.17*	*0.15*	*0.14*	*0.14*	*0.14*

1. Specified as 10 to 90% for rise time and 90 to 10% for fall time on a 0 dBm pulse.
2. Specified as the overshoot relative to the settled pulse top power.
3. In triggered mode with timebase setting at 4 msec/div.
4. Within 1 hour after a zero, at a constant temperature, after 24 hours warm-up of the peak power analyzer. This component can be disregarded with Auto-zero mode set to ON.
5. Measured over a one-minute interval, at a constant temperature, two standard deviations, with averaging set to 1.

Effect of video bandwidth setting

The noise per sample is reduced by applying the meter video bandwidth filter setting (High, Medium or Low). If averaging is implemented, this will dominate any effect of changing the video bandwidth.

Effect of time-gating on measurement noise

The measurement noise on a time-gated measurement will depend on the time gate length. 100 averages are carried out every 1 µs of gate length. The Noise-per-Sample contribution in this mode can approximately be reduced by $\sqrt{(\text{gate length}/10\text{ ns})}$ to a limit of 50 nW.

Appendix A

Uncertainty calculations for a power measurement (settled, average power)

[Specification values from this document are in **bold italic**, values calculated on this page are underlined.]

Process

1. Power level .... [   ] W
2. Frequency .... [   ]
3. Calculate meter uncertainty:

   Calculate noise contribution
   Noise = ***Noise-per-sample x noise per sample multiplier***

   Convert noise contribution to a relative term [1] = Noise/Power .... [   ] %

   Instrumentation linearity .... [   ] %

   Drift .... [   ] %

   RSS of above three terms ≥ Meter uncertainty = ... [   ] %

4. ***Zero uncertainty***
   (Mode and frequency-dependent) = Zero set/Power = ... [   ] %
5. Sensor calibration uncertainty
   (Sensor, frequency, power and temperature-dependent) = ... [   ] %
6. System contribution, coverage factor of 2 ≥ sys_{rss} = ...
   (RSS three terms from steps 3, 4 and 5) [   ] %
7. Standard uncertainty of mismatch

   Max SWR (frequency-dependent) = ... [   ] %

   Convert to reflection coefficient, $|\rho_{Sensor}|$ = (SWR–1)/(SWR+1) = ... [   ] %

   Max DUT SWR (frequency-dependent) = ... [   ] %

   Convert to reflection coefficient, $|\rho_{DUT}|$ = (SWR–1)/(SWR+1) = ... [   ] %

8. Combined measurement uncertainty @ k=1

$$U_C = \sqrt{\left(\frac{Max(\rho_{DUT}) \bullet Max(\rho_{Sensor})}{\sqrt{2}}\right)^2 + \left(\frac{sys_{rss}}{2}\right)^2}$$ .... [   ] %

   Expanded uncertainty, k = 2, = UC • 2 = ... [   ] %

1. The noise-to-power ratio is capped for powers > 100 µW, in these cases use: Noise/100 µW.

Worked Example

Uncertainty calculations for a power measurement (settled, average power)

[Specification values from this document are in **bold italic**, values calculated on this page are underlined.]

Process		
1.	Power level	1 mW
2.	Frequency	1 GHz
3.	Calculate meter uncertainty:	
	Calculate noise contribution Noise = ***Noise-per-sample x noise per sample multiplier = 3 µW x 1***	
	Convert noise contribution to a relative term1 = Noise/Power = 3 µW/1 mW	0.3%
	Instrumentation linearity	0.8%
	Drift	
	RSS of above three terms ≥ Meter uncertainty =	0.85%
4.	***Zero uncertainty*** (Mode and frequency-dependent) = Zero set/Power = 200 nW/1 mW	0.02%
5.	Sensor calibration uncertainty (Sensor, frequency, power and temperature-dependent) =	4.0%
6.	System contribution, coverage factor of 2 ≥ sys_{rss} = (RSS three terms from steps 3, 4 and 5)	4.09%
7.	Standard uncertainty of mismatch	
	Max SWR (frequency-dependent) =	1.2%
	Convert to reflection coefficient, $\lvert\rho_{Sensor}\rvert$ = (SWR–1)/(SWR+1) =	0.091%
	Max DUT SWR (frequency-dependent) =	1.26%
	Convert to reflection coefficient, $\lvert\rho_{DUT}\rvert$ = (SWR–1)/(SWR+1) =	0.115%
8.	Combined measurement uncertainty @ k=1	
	$U_C = \sqrt{\left(\frac{Max(\rho_{DUT}) \bullet Max(\rho_{Sensor})}{\sqrt{2}}\right)^2 + \left(\frac{sys_{rss}}{2}\right)^2}$	2.045%
	Expanded uncertainty, k = 2, = UC • 2 =	4.09%

1. The noise-to-power ratio is capped for powers > 100 µW, in these cases use: Noise/100 µW.

Ordering Information

	Model	Description
Meter	8990B	Peak power analyzer
Standard-shipped accessories	Optical mouse	
	Stylus pen	
	Mini keyboard	
	Calibration certificate	
	IO libraries media suite	
	50 Ω BNC cable	
Sensor	N1923A	Wideband power sensor, 50 MHz to 18 GHz
	N1924A	Wideband power sensor, 50 MHz to 40 GHz
Standard-shipped accessories	Calibration certificate	
	N1923A/N1924A wideband power sensor operating and service guide - English	
	Options	**Description**
Meter	8990B-800	Standard hard drive, installed
	8990B-801	Removable hard drive, installed
	8990B-U01	With USB host
	8990B-U02	Without USB host
Sensors	N1923A-105	Fixed cable option length, 1.5 m (5 ft)
	N1923A-106	Fixed cable option length, 3 m (10 ft)
	N1924A-105	Fixed cable option length, 1.5 m (5 ft)
	N1924A-106	Fixed cable option length, 3 m (10 ft)
Other accessories	8990B-1CM	Rackmount kit, 8U full rack
	N6921A	Stacking kit
	N6922A	BNC extension cable, male to female
	N6923A	BNC adapter, right angle
	N6924A	Additional hard drive with image
	N6925A	Storage pouch
Calibration	8990B-1A7	Compliant calibration test data - ISO17025, printed
	8990B-A6J	Certificate of compliance calibration - ANSI/NCSL Z540, printed
	N1923A-1A7	Certificate of compliance calibration - ISO 17025 with test data; printed
	N1923A-A6J	Certificate of compliance calibration - ANSI Z540 with test data; printed
	N1924A-1A7	Certificate of compliance calibration - ISO 17025 with test data; printed
	N1924A-A6J	Certificate of compliance calibration - ANSI Z540 with test data; printed
Documentation	8990B-0BF	English language programming guide, printed
	8990B-0BK	English language user and programming guide, printed
	8990B-0BW	English language service guide, printed
	8990B-ABJ	Japanese user guide and English programming guide, printed
	8990B-0B0	Do not include printed manuals
	8990B-ABA	English language user guide, printed
	N1923A-ABJ	Japan, Japanese user guide, printed
	N1923A-0B1	English language user guide, printed
	N1924A-ABJ	Japan, Japanese user guide, printed
	N1924A-0B1	English language user guide, printed
	N1923A-0BN	English language service guide, printed
	N1924A-0BN	English language service guide, printed
Software	8990B-1FP	Multi-pulse analysis software, fixed perpetual license
	N6903A	Multi-pulse analysis software

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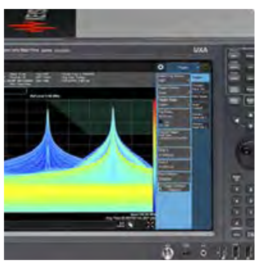


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