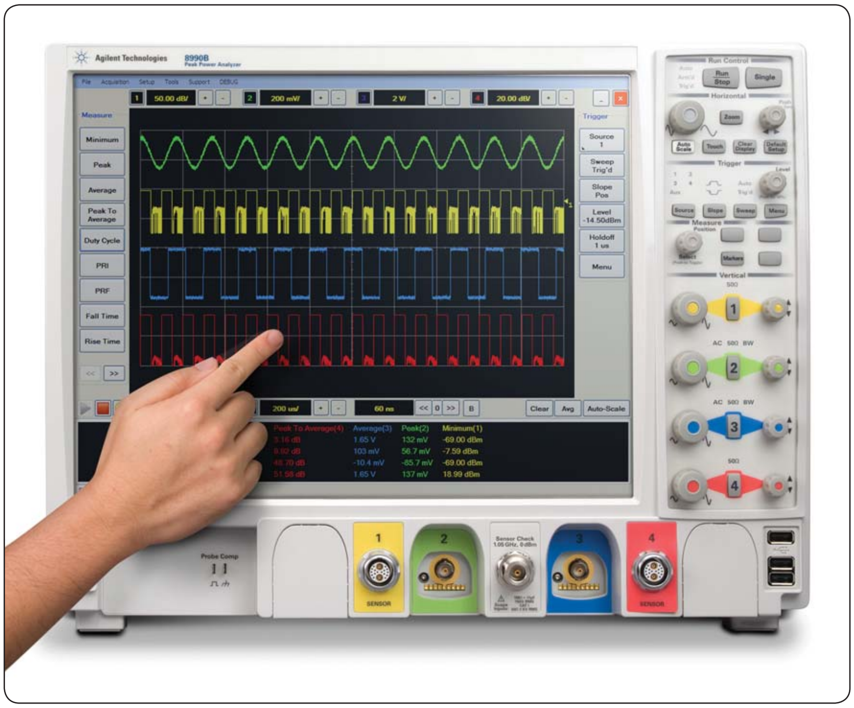
Agilent 8990B Peak Power Analyzer and N1923A/N1924A Wideband Power Sensors

Data Sheet

Faster measurement speed and greater measurement accuracy

Skip the complicated setup and go straight to making measurements with Agilent 8990B peak power analyzer. The 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 internal zero and 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

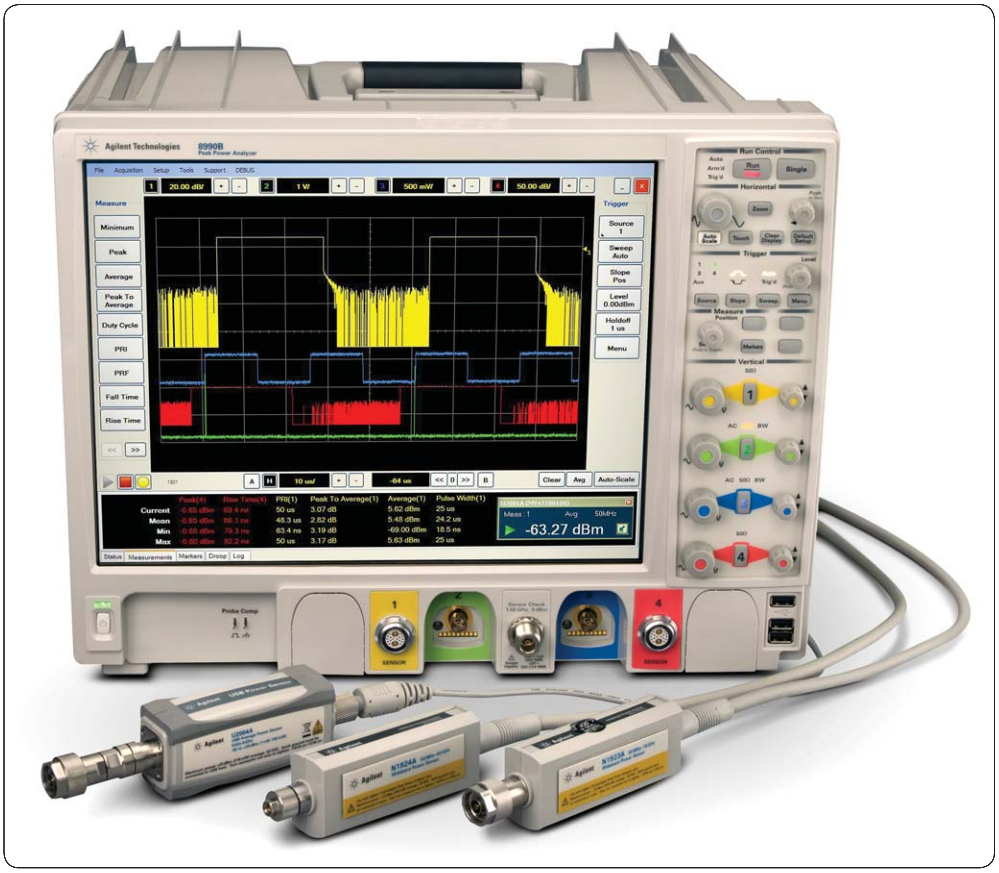
8990B peak power analyzer is rich with a host of key performance specifications, dedicated to give you accurate and more detailed pulse measurements, faster.

Accuracy Measure RF power measurements with less error; 8990B has an overall accuracy rate of 0.2 dB.

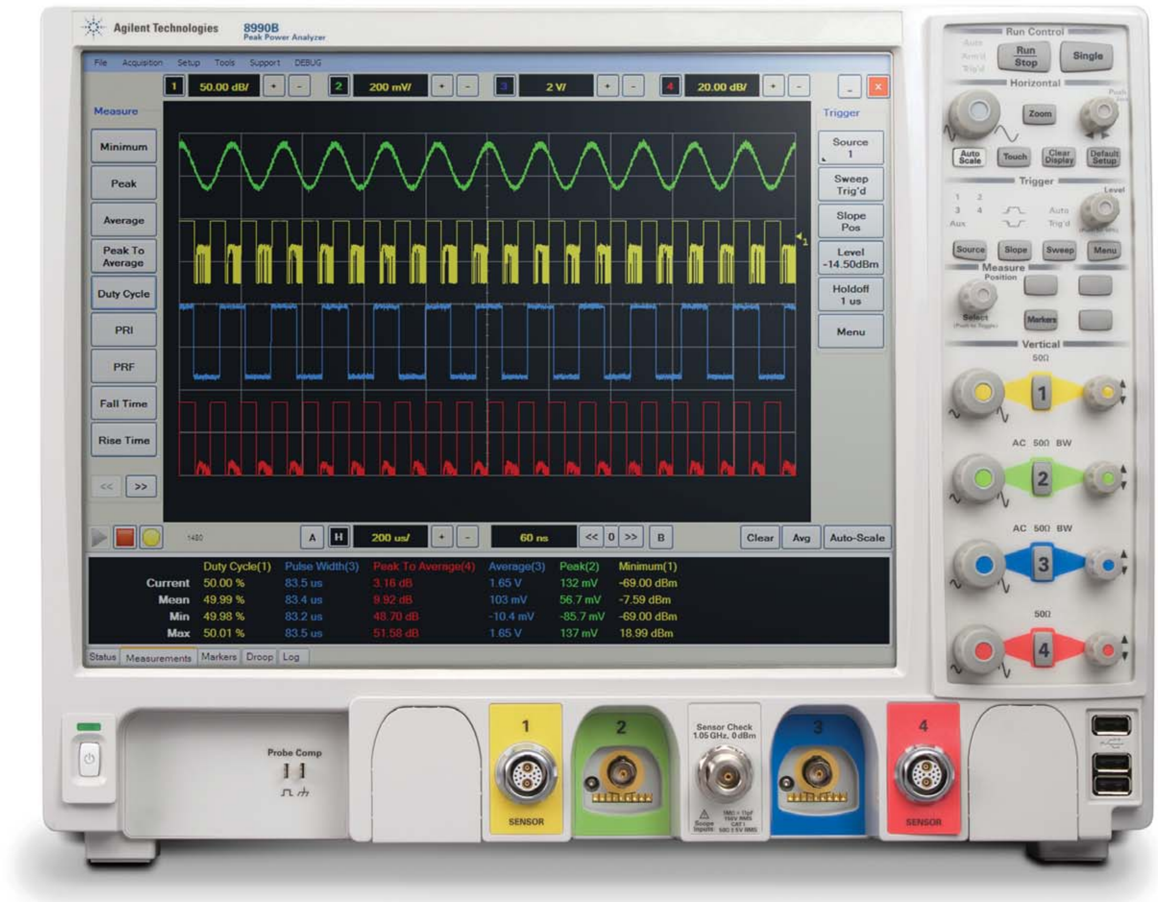
Detail View pulses in greater image detail with the large 15-inch XGA color display and get the high resolution needed to detect abnormalities in a signal trace with the 8990B's sampling rate of 100 MSamples/s.

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

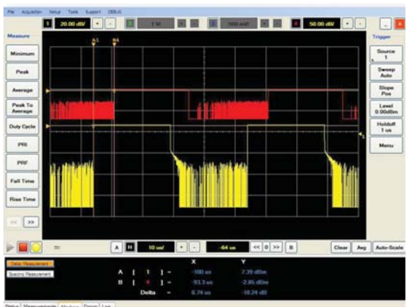


- Capture short radar pulses accurately with a 5 nanosecond overall rise time/fall time – the fastest rise time/fall time in the peak power measurement market – when the 8990B peak power analyzer is paired with the either the N1923A or N1924A wideband power sensor.
- A high sampling rate of 100 MSa/s 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.
- Execute commands and access functions easily with shallow command trees, a familiar graphical user interface and standard Agilent knobs layout.
- Color coded channels allow you to pick out the channel data points of interest at a glance.
- Secure sensitive data with the removable hard drive option. This option switches your attached hard drive with a removable version for added data security and allows you to use purchased another Agilent removable hard drive to back up critical measurement data.
- Backwards compatibility with P-series sensors and U2000 series USB power sensors widens your sensor options and offers you an additional channel to the current four when a USB power sensor is connected. Download and install the N1918A Power Analysis Manager software to use the USB power sensor with the 8990B.

Graphical User Interface Overview

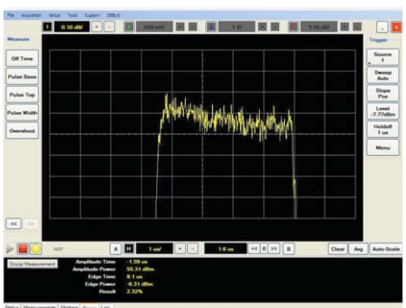
Measurement screen

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 it corresponds to. 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.



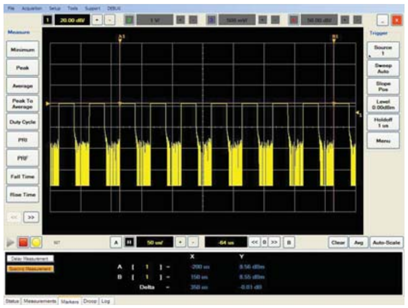
Delay measurement

Users can perform delay measurements by pressing the Delay Measurement button on the soft panel key. 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 that offers automated Pulse Droop measurement, eliminating the need to manually manipulate the horizontal markers to make this measurement. The Pulse Droop measurement is accessible via the soft panel key, and measures the amplitude degradation of the pulse top.



Spacing measurement

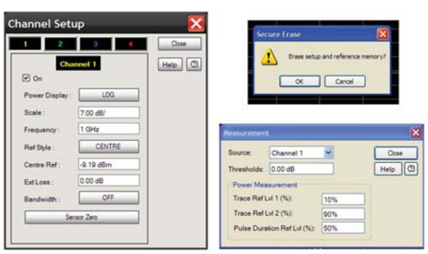
Easily measure the space between pulses when a long pulse train occurs. The 8990B allows users to select the starting pulse and the end pulse, a function that is important in pulse block validation. R&D engineers may use this function to detect potential abnormalities in certain pulse groups, and whether 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, 8990B offers several ways to secure both data and measurement settings such as the memory sanitization feature, a standard product feature in all Agilent 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.

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. Characteristics 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, and
- 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 V to 120 V (at 50 Hz - 60 Hz, 400 Hz) • 100 V to 240 V (at 50 Hz - 60 Hz) • Maximum power dissipated at 375 W
Operating environment	• Operating temperature from 5° C 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 Hz to 500 Hz, 10 min/axis, 0.21 g (rms)
Non-operating conditions	• Non-operating temperature from –40° C 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 Hz to 500 Hz, 10 minutes/axis, 2.09 g (rms); Resonant search at 5 Hz 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 & 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	*150 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 uW/div to 1 kW/div in 1-2-5 sequence or any arbitrary scaling, user defined	
Offset	± 99 dBm with 0.01 dB resolution	
Video inputs (channels 2 & 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: 150V 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 10 mV to < 20 mV/div 20 mV to < 100 mV/div 100 mV to < 1 V/div 1 V to 5 V/div	± 2 V ± 5 V ± 10 V ± 20 V ± 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 at +10 dBm power level
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, 1V.

   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, 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	±*1 ns*[1]
Delay range	± 1 s max
Trigger	
Hardware trigger	
Sweep mode	Auto, triggered, single
Trigger mode	Postive and negative edge (all channels) Trigger by event (sensor channel 1 & 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 50Ω
Level resolution	Channel 1 and 4: 0.01dB Channel 2 and 3: 10uV[2]
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[3]
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% (50MHz)* *0 dBm ±1.2% (1.05GHz)*
Signal type	*Square pulse modulated (1.05GHz only) or CW (1.05GHz or 50MHz)*
Repetition rate	*1 kHz*
Connector type	*Type N (female)*
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	Plus, minus or divide
Statistical	CCDF (free run and triggered)
Video averaging	2, 4, 8, 32, 64, 128, 256, 512, 1024, 2048 selectable
Zoom	Dual window zoom

1. Specification applies only when ETS is turned off (capture length >5 µs)
2. The trigger level of video channels is dependent on the vertical scale setting.
3. The trigger delay range is dependant on the timebase setting.

8990B Peak Power Analyzer Specifications (continued)

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® XP Professional
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 dBm to +20 dBm	≤ 3 ns (applicable for frequencies of ≥ 500 MHz)	+23 dBm (average power); +30 dBm (< 1 μs duration, peak power)	Type N (m)
N1924A	50 MHz to 40 GHz	–35 dBm to +20 dBm	≤ 3 ns (applicable for frequencies of ≥ 500 MHz)	+23 dBm (average power); +30 dBm (< 1 μs duration, peak power)	2.4 mm (m)

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%
1GHz 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 N1924A	135 mm x 40 mm x 27 mm (5.3 in x 1.6 in x 1.1 in) 127 mm x 40 mm x 27 mm (5.0 in x 1.6 in x 1.1 in)
Weights with cable	Option 105 Option 106	0.4 kg (0.88 lb) 0.6 kg (1.32 lb)
Fixed sensor cable lengths	Option 105 Option 106	1.5 m (5-feet) 3.0 m (10-feet)

Environmental conditions	
General	Complies with the requirements of the EMC Directive 89/336/EEC
Operating	
Temperature	0° C 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° C 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 %*

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.

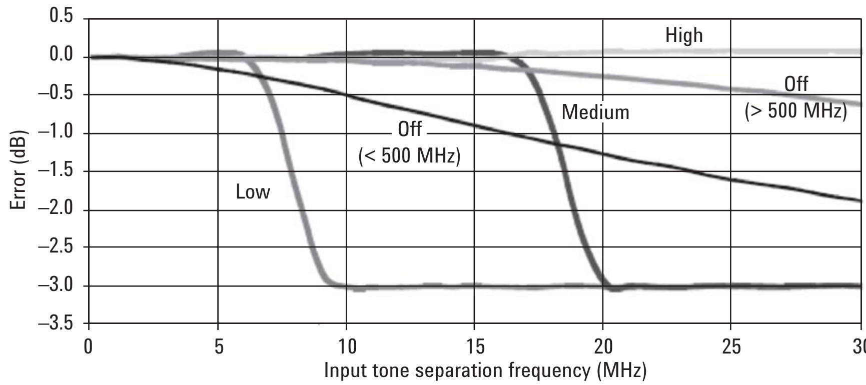


Figure 1. Flatness Response

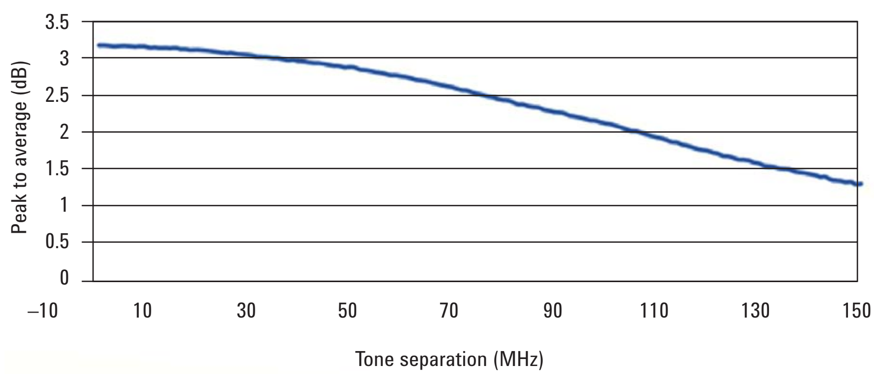


Figure 2. Video Bandwidth set to Off

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.

System Specifications and Characteristics (continued)

Dynamic response - rise time, fall time, and overshoot versus video bandwidth settings					
	Video bandwidth setting				
Parameter	Low: 5 MHz	Medium: 15 MHz	High: 30 MHz	Off	
				< 500 MHz	> 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		Zero drift[4]	Noise per sample
		< 500 MHz	> 500 MHz		
N1923A/N1924A	No RF on input	200 nW		*80 nW*	*3 μW*
	RF present	*550 nW*	200 nW	*80 nW*	*3 μW*

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*

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 √(gate length/10 ns) to a limit of 50 nW.

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.

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 <u>underlined</u>.]

Process:

1. Power level:	W
2. Frequency:	
3. Calculate meter uncertainty:	
Calculate noise contribution	
• <u>Noise</u> = <u>***Noise-per-sample x noise per sample multiplier***</u>	
Convert noise contribution to a relative term[1] = <u>Noise/Power</u>	%
Instrumentation linearity	%
Drift	%
RSS of above three terms ≥ <u>Meter uncertainty</u> = ...	%
4. ***Zero uncertainty***	
(Mode and frequency-dependent) = Zero set/<u>Power</u> = ...	%
5. Sensor calibration uncertainty	
(Sensor, frequency, power and temperature-dependent) = ...	%
6. <u>System contribution</u>, 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, $\mid \rho_{Sensor} \mid$ = (SWR–1)/(SWR+1) = ...	%
Max DUT SWR (frequency-dependent) = ...	%
convert to reflection coefficient, $\mid \rho_{DUT} \mid$ = (SWR–1)/(SWR+1) = ...	%
8. Combined measurement uncertainty @ k=1	
$U_C = \sqrt{\left(\frac{Max(\rho_{DUT}) \cdot Max(\rho_{Sensor})}{\sqrt{2}}\right)^2 + \left(\frac{sys_{rss}}{2}\right)^2}$	%
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 term[1] = 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} = ...	4.09%
(RSS three terms from steps 3, 4 and 5)	
7. Standard uncertainty of mismatch	
Max SWR (frequency-dependent) = ...	1.2%
convert to reflection coefficient, $\vert \rho_{Sensor} \vert$ = (SWR–1)/(SWR+1) = ...	0.091%
Max DUT SWR (frequency-dependent) = ...	1.26%
convert to reflection coefficient, $\vert \rho_{DUT} \vert$ = (SWR–1)/(SWR+1) = ...	0.115%
8. Combined measurement uncertainty @ k=1	
$U_C = \sqrt{\left(\frac{Max(\rho_{DUT}) \cdot Max(\rho_{Sensor})}{\sqrt{2}}\right)^2 + \left(\frac{sys_{rss}}{2}\right)^2}$	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 ohm BNC cable	
Sensor	N1923A N1924A	Wideband power sensor, 50 MHz to 18 GHz 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 8990B-801 8990B-U01 8990B-U02	Standard hard drive, installed Removable hard drive, installed With USB host Without USB host
Sensors	N1923A-105 N1923A-106 N1924A-105 N1924A-106	Fixed cable option length, 1.5 m (5 ft) Fixed cable option length, 3 m (10 ft) Fixed cable option length, 1.5 m (5 ft) Fixed cable option length, 3 m (10 ft)
Other accessories	8990B-1CM N6921A N6922A N6923A N6924A N6925A	Rackmount kit, 8U full rack Stacking kit BNC extension cable, male to female BNC adapter, right angle Additional hard drive with image Storage pouch
Warranty and calibration	8990B-1A7 8990B-A6J N1923A-1A7 N1923A-A6J N1924A-1A7 N1924A-A6J	Compliant calibration test data - ISO17025, printed Certificate of compliance calibration - ANSI/NCSL Z540, printed Certificate of compliance calibration - ISO 17025 with test data; printed Certificate of compliance calibration - ANSI Z540 with test data; printed Certificate of compliance calibration - ISO 17025 with test data; printed Certificate of compliance calibration - ANSI Z540 with test data; printed
Documentation	8990B-0BF 8990B-0BK 8990B-0BW 8990B-ABJ 8990B-0B0 8990B-ABA N1923A-ABJ N1923A-0B1 N1924A-ABJ N1924A-0B1 N1923A-0BN N1924A-0BN	English language programming guide, printed English language user and programming guide, printed English language service guide, printed Japanese user guide and English programming guide, printed Do not include printed manuals English language user guide, printed Japan, Japanese user guide, printed English language user guide, printed Japan, Japanese user guide, printed English language user guide, printed English language service guide, printed English language service guide, printed

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