

N8262A P-Series Modular Power Meter and Power Sensors

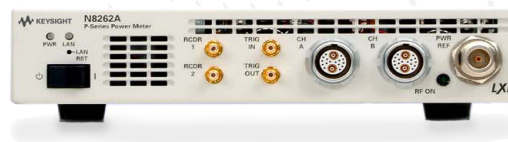


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Specification Definitions

There are two types of product specifications:

Warranted specifications

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

Characteristic specifications

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. These types can be placed in 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 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’.

The second group 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 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 ***N8262A P-Series Modular Power Meter User’s Guide***

Using the N8262A P-Series power meter with BenchVue software

The N8262A P-Series power meter is supported by Keysight BenchVue software’s BV0007B Power Meter/Sensor Control and Analysis app. Keysight BenchVue software for the PC accelerates testing by providing intuitive, multiple instrument measurement visibility and data capture with no programming necessary. You can derive answers faster than ever by easily viewing, capturing and exporting measurement data and screen shots. BenchVue software license (BV0007B) is now included with your instrument.

For more information, www.keysight.com/find/BenchVue

General features

Number of channels	Dual channel
Frequency range	N1921A P-Series wideband power sensor, 50 MHz to 18 GHz N1922A P-Series wideband power sensor, 50 MHz to 40 GHz
Measurements	Average, peak and peak-to-average ratio power measurements are provided with free-run or time gated definition. Time parameter measurements of pulse rise time, fall time, pulse width, time to positive occurrence and time to negative occurrence are also provided.
Sensor compatibility	P-Series modular power meter is compatible with all Keysight P-Series wideband power sensors, E-Series power sensors (except E9320 range) and 8480 Series power sensors ¹ .

1. Information contained in this document refers to operation with P-Series power sensors. For specifications when used with 8480 and E-Series power sensors (except E9320 range), refer to Lit Number 5965-6382E.

P-Series Modular Power Meter and Sensor

Key system specifications and characteristics ²

Maximum sampling rate	100 Msamples/sec, continuous sampling
Video bandwidth	≥ 30 MHz
Single shot bandwidth	≥ 30 MHz
Rise time and fall time	≤ 13 ns (for frequencies ≥ 500 MHz) ¹ , see Figure 1
Minimum pulse width	50 ns ²
Overshoot	≤ 5% ¹
Average power measurement accuracy	N1921A: ≤ ± 0.2 dB or ± 4.5% ³ N1922A: ≤ ± 0.3 dB or ± 6.7%
Dynamic range	-35 to +20 dBm (> 500 MHz) -30 to +20 dBm (50 to 500 MHz)
Maximum capture length	1 second
Maximum pulse repetition rate	10 MHz (based on 10 samples per period)

1. Specification applies only when the Off video bandwidth is selected.
2. The Minimum Pulse Width is the recommended minimum pulse width viewable on the power meter, where power measurements are meaningful and accurate, but not warranted.
3. Specification is valid over -15 to +20 dBm, and a frequency range 0.5 to 10 GHz, DUT Max. SWR < 1.27 for the N1921A, and a frequency range 0.5 to 40 GHz, DUT Max. SWR < 1.2 for the N1922A. Averaging set to 32, in Free Run mode.

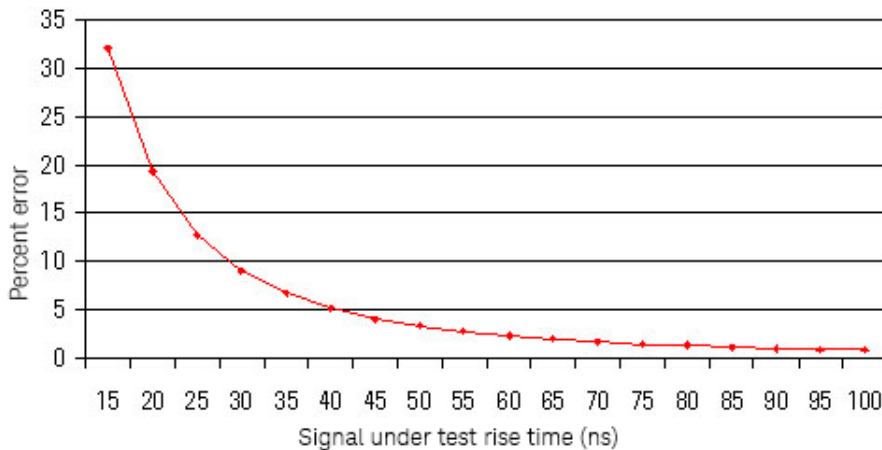


Figure 1. Measured rise time percentage error versus signal under test rise time.

Although the rise time specification is ≤ 13 ns, this does not mean that the P-Series meter and sensor combination can accurately measure a signal with a known rise time of 13 ns. The measured rise time is the root sum of the squares (RSS) of the signal under test rise time and the system rise time (13 ns):

$$\text{Measured rise time} = \sqrt{(\text{signal under test rise time})^2 + (\text{system rise time})^2},$$

and the % error is:

$$\% \text{ Error} = ((\text{measured rise time} - \text{signal under test rise time}) / \text{signal under test rise time}) \times 100$$

1. See Appendix A on page 9 for measurement uncertainty calculations.

P-Series Modular Power Meter Specifications

Meter uncertainty	
Instrumentation linearity	$\pm 0.8\%$
Timebase	
Timebase range	<i>2 ns to 100 msec/div</i>
Accuracy	± 10 ppm
Jitter	≤ 1 ns
Trigger	
Internal trigger	
– Range	<i>-20 to +20 dBm</i>
– Resolution	<i>0.1 dB</i>
– Level accuracy	± 0.5 dB
– Latency ¹	<i>160 ns \pm 10 ns</i>
– Jitter	≤ 5 ns rms
External TTL trigger input	
High	> 2.4 V
Low	< 0.7 V
Latency ²	<i>90 ns \pm 10 ns</i>
Minimum trigger pulse width	<i>15 ns</i>
Minimum trigger repetition period	<i>50 ns</i>
Impedance	<i>50 Ω</i>
Jitter	≤ 5 ns rms
Maximum trigger	<i>15 V emf from 50 Ω dc (current $<$ 100 mA), or</i>
– Voltage input	<i>60 V emf from 50 Ω dc (pulse width $<$ 1 s, current $<$ 100 mA)</i>
External TTL trigger output	
Low to high transition on trigger event	
High	> 2.4 V
Low	< 0.7 V
Latency ³	<i>30 ns \pm 10 ns</i>
Impedance	<i>50 Ω</i>
Jitter	≤ 5 ns rms
Trigger delay	
Delay range	± 1.0 s, maximum
Delay resolution	<i>1% of delay setting, 10 ns maximum</i>
Trigger hold-off	
Range	<i>1 μs to 400 ms</i>
Resolution	<i>1% of selected value (to minimum of 10 ns)</i>
Trigger level threshold hysteresis	
Range	± 3 dB
Resolution	<i>0.05 dB</i>

1. Internal trigger latency is defined as the delay between the applied RF crossing the trigger level and the meter switching into the triggered state.
2. External trigger latency is defined as the delay between the applied trigger crossing the trigger level and the meter switching into the triggered state.
3. External trigger output latency is defined as the delay between the meter entering the triggered state and the output signal switching.

P-Series Wideband Power Sensor Specifications

The P-Series wideband power sensors are designed for use with the P-Series power meters N1911/12A and the P-Series modular power meter N8262A only.

Sensor model	Frequency range	Dynamic range	Damage level	Connector type
N1921A	50 MHz to 18 GHz	-35 dBm to +20 dBm (≥ 500 MHz)	+23 dBm (average power)	Type N (m)
		-30 dBm to +20 dBm (50 to 500 MHz)	+30 dBm (< 1 μ s duration) (peak power)	
N1922A	50 MHz to 40 GHz	-35 dBm to +20 dBm (≥ 500 MHz)	+23 dBm (average power)	2.4 mm (m)
		-30 dBm to +20 dBm (50 to 500 MHz)	+30 dBm (< 1 μ s duration) (peak power)	

Maximum SWR

Frequency band	N1921A/ N1921A	N1922A
50 MHz to 10 GHz	1.2	1.2
10 to 18 GHz	1.26	1.26
18 to 26.5 GHz	1.3	1.3
26.5 to 40 GHz	1.5	1.5

Sensor Calibration Uncertainty ¹

Frequency band	N1921A	N1922A
50 to 500 MHz	4.5%	4.3%
500 MHz to 1 GHz	4.0%	4.2%
1 to 10 GHz	4.0%	4.4%
10 to 18 GHz	5.0%	4.7%
18 to 26.5 GHz		5.9%
26.5 to 40 GHz		6.0%

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

Physical characteristics		
Dimensions (Length x Width x Height)	N1921A	135 mm x 40 mm x 27 mm
		127 mm x 40 mm x 27 mm
Weights with cable	Option 105	0.4 kg
	Option 106	0.6 kg
	Option 107	1.4 kg
Fixed sensor cable lengths	Option 105	1.5 m (5-feet)
	Option 106	3.0 m (10-feet)
	Option 107	10 m (31-feet)

Mechanical Characteristic

Mechanical characteristics such as center conductor protrusion and pin depth are not performance specifications. They are, however, important supplemental characteristics related to electrical performance. At no time should the pin depth of the connector be protruding.

1 mW Power Reference

Note. The 1 mW power reference is provided for calibration of E-Series (except E9320 range) and 8480 Series power sensors. The P-Series sensors are automatically calibrated and do not need this reference for calibration.

Power output	1.00 mW (0.0 dBm). Factory set to $\pm 0.4\%$ traceable to the National Physical Laboratory (NPL) UK
Accuracy (over 2 years)	$\pm 1.2\%$ (0 to 55 °C) $\pm 0.4\%$ (25 \pm 10 °C)
Frequency	50 MHz nominal
SWR	1.08 (0 to 55 °C) 1.05 typical
Connector type	Type N (f), 50 Ω
Front panel inputs/outputs	
Recorder output(s)	Analog 0 to 1 volt, 1 k Ω output impedance. There are two recorder outputs with SMB connector
Trigger input	Input has TTL compatible logic levels and uses a SMB connector
Rear panel inputs/outputs	
100BaseT LAN	Interface allow communication with an external controller
Ground	Binding post, accepts 4 mm plug or bare-wire connection
Line power	
– Input voltage range	100 to 120 V \pm 10% 220 to 240 V \pm 10%
– Input frequency range	50 to 60 Hz \pm 10% (all voltages) 400 to 440 Hz (100 to 120 V only)
– Power requirement	Not exceeding 75 VA (50 Watts)
Remote programming	
Interface	10/100BaseT LAN interface
Command language	SCPI standard interface commands
Measurement speed	
Measurement speed via remote interface	≥ 1500 readings per second
Regulatory information	
Electromagnetic compatibility	Complies with the requirements of the EMC Directive 89/336/EEC
Product safety	Conforms to the following product specifications: EN61010-1: 2001/IEC 1010-1:2001 EN 55011:1991 IEC 61326-1:1997+A1:1998/EN 61326-1:1997+A1:1998 CISPR 11:1990/EN 55011:1991 Canada: CSA C22.2 No. 61010- 1:2004 USA: UL: 61010- 1:2004

1 mW Power Reference (Continued)

Physical characteristics	
Dimensions	The following dimensions exclude front and rear panel protrusions: 44.2 mm H x 212.6 mm W x 420.3 mm D (1.75 in x 8.5 in x 19.63 in)
Net weight	≤ 3.5 kg (7.7 lb) approximate
Shipping weight	≤ 7.7 kg (17.0 lb) approximate
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	-40 to +70 °C
Non-operating maximum humidity	90% at 65 °C (non-condensing)
Non-operating maximum altitude	15,420 meters (50,000 feet)

System Specifications and Characteristics

The video bandwidth in the power meter can be set to High, Medium, Low or 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 2 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.

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	> 500 MHz
Rise time/fall time ¹	< 56 ns	< 25 ns	≤ 13 ns	< 36 ns	≤ 13 ns
Overshoot ²				< 5 %	< 5 %

For Option 107 (10 m cable), add 5 ns to the rise time and fall time specifications.

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. For Option 107 (10 m cable), add 5 ns to the rise time and fall time specifications.

Recorder Output

N8262A offers recorder output only. The recorder output is used to output the corresponding voltage for the measurement that user sets on the Upper/Lower window of the power meter.

Characteristic Peak Flatness

The peak flatness is the flatness of a peak-to-average ratio measurement for various tone-separations for an equal magnitude two-tone RF input. Figure 2 refers to the relative error in peak-to-average ratio measurements as the tone separation is varied. The measurements were performed at -10 dBm with power sensors with 1.5 m cable lengths.

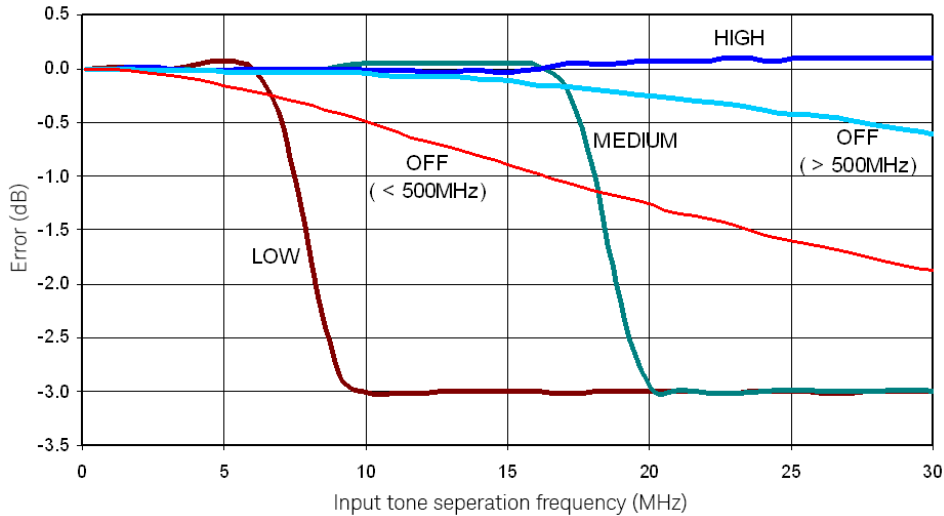


Figure 2. N192XA Error in peak-to-average measurements for a two-tone input (High, Medium, Low or Off filters).

Noise and drift						
Sensor model	Zeroing	Zero set		Zero drift ¹	Noise per sample	Measurement noise (Free run) ²
		< 500 MHz	> 500 MHz			
N1921A /N1922A	No RF on input	200 nW	200 nW	100 nW	2 μW	50 nW
	RF present	550 nW	200 nW			

Measurement average setting	1	2	4	8	16	32	64	128	256	512	1024
Free run noise multiplier	1	0.9	0.8	0.7	0.6	0.5	0.45	0.4	0.3	0.25	0.2

Video BW setting	Low 5 MHz	Medium 15 MHz	High 30 MHz	Off
Noise per sample multiplier	< 500 MHz	0.5	1	2
	≥ 500 MHz	0.45	0.75	1.1

1. Within 1 hour after a zero, at a constant temperature, after 24 hour warm-up of the power meter. This component can be disregarded with Auto-zero mode set to ON.
2. 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	
– If in Free Run mode, <u>Noise</u> = Measurement noise x free run multiplier	
– If in Trigger mode, <u>Noise</u> = Noise-per-sample x noise per sample multiplier	
– 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, ρ _{Sensor} = (SWR-1)/(SWR+1) =	
Max DUT SWR (frequency dependent) =	
Convert to reflection coefficient, ρ _{DUT} = (SWR-1)/(SWR+1) =	
8. Combined measurement uncertainty @ k = 1	
$U_c = \sqrt{\left(\frac{\text{Max}(\rho_{DUT}) \cdot \text{Max}(\rho_{Sensor})}{\sqrt{2}}\right)^2 + \left(\frac{\text{sys}_{rss}}{2}\right)^2}$	%
Expanded uncertainty, k = 2, = U _c · 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)

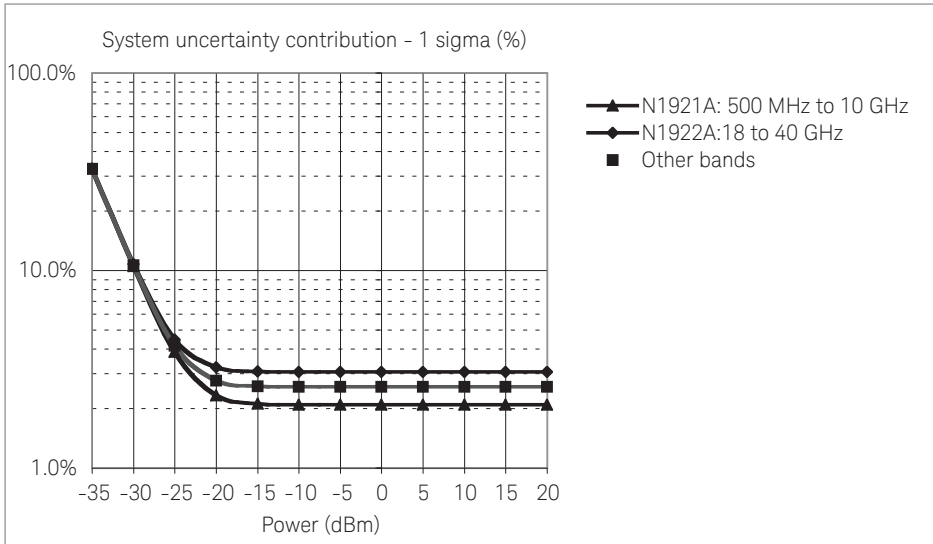
(Specification values from this document are in **bold italic**, values calculated on this page are underlined.)

Process	
1. Power level	1 mW
2. Frequency	1 GHz
3. Calculate meter uncertainty: Calculate noise contribution	
– If in Free Run mode, <u>Noise</u> = Measurement noise x free run multiplier	
– If in Trigger mode, <u>Noise</u> = Noise-per-sample x noise per sample multiplier	
– Convert noise contribution to a relative term ¹ = <u>Noise/Power</u>	0.03%
– Instrumentation linearity	0.8%
– Drift	–
– RSS of above three terms => <u>Meter uncertainty</u> =	0.8%
4. Zero uncertainty (Mode and frequency dependent) = Zero set/ <u>Power</u> =	0.03%
5. Sensor calibration uncertainty..... (Sensor, frequency, power and temperature dependent) =	4.0%
6. <u>System contribution</u> , coverage factor of $2 \geq \text{sys}_{RSS}$ =	
(RSS three terms from steps 3, 4 and 5)	4.08%
7. Standard uncertainty of mismatch Max SWR (frequency dependent) =	1.25
Convert to reflection coefficient, $ \rho_{\text{Sensor}} = (\text{SWR}-1)/(\text{SWR}+1) = \dots\dots\dots$	0.111
Max DUT SWR (frequency dependent) =	1.26
Convert to reflection coefficient, $ \rho_{\text{DUT}} = (\text{SWR}-1)/(\text{SWR}+1) = \dots\dots\dots$	0.115
8. Combined measurement uncertainty @ k = 1	
$U_c = \sqrt{\left(\frac{\text{Max}(\rho_{\text{DUT}}) \cdot \text{Max}(\rho_{\text{Sensor}})}{\sqrt{2}}\right)^2 + \left(\frac{\text{sys}_{RSS}}{2}\right)^2} \dots\dots\dots$	2.23
Expanded uncertainty, k = 2, = $U_c \cdot 2 = \dots\dots\dots$	± 4.46%

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

Graphical Example

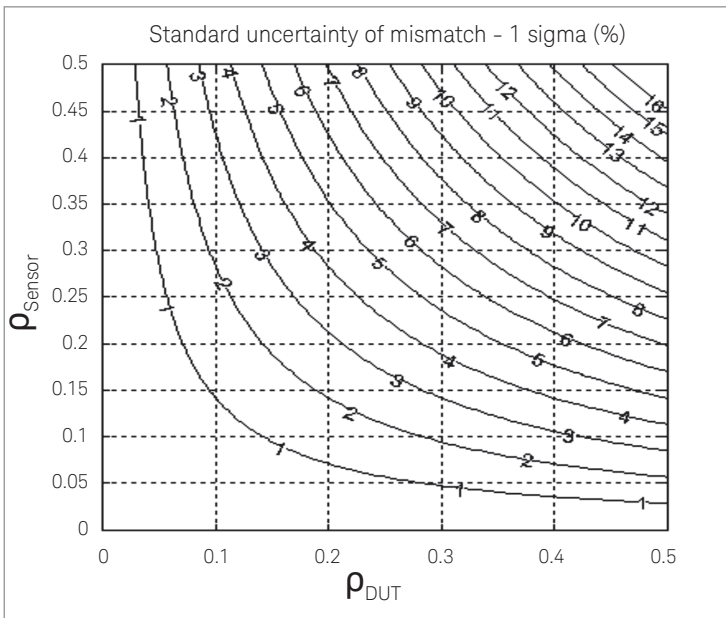
A. System contribution to measurement uncertainty versus power level (equates to step 6 result/2)



Note. This graph is valid for conditions of free-run operation, with a signal within the video bandwidth setting on the system.

Humidity < 70%.

B. Standard uncertainty of mismatch



SWR	ρ
1.0	0.00
1.05	0.02
1.10	0.05
1.15	0.07
1.20	0.09
1.25	0.11
1.30	0.13
1.35	0.15
1.40	0.17
1.45	0.18
1.5	0.20
1.6	0.23
1.7	0.26

SWR	ρ
1.8	0.29
1.90	0.31
2.00	0.33
2.10	0.35
2.20	0.38
2.30	0.39
2.40	0.41
2.50	0.43
2.60	0.44
2.70	0.46
2.80	0.47
2.90	0.49
3.00	0.50

Note. The above graph shows the standard uncertainty of mismatch = $\rho_{DUT} \cdot \rho_{Sensor} / \sqrt{2}$, rather than the mismatch uncertainty limits. This term assumes that both the source and load have uniform magnitude and uniform phase probability distributions.

C. Combine A and B

$$U_c = \sqrt{(\text{Value from Graph A})^2 + (\text{Value from Graph B})^2}$$

Expanded uncertainty, $k = 2$, = $U_c \cdot 2 = \dots\dots\dots$

±	%
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Related Literature List

Publication title	Publication number
<i>N8262A P-Series Modular Power Meter and Power Sensors – Configuration Guide</i>	5989-6608EN
<i>N8262A P-Series Modular Power Meter and Power Sensors - Technical Overview</i>	5989-6606EN
<i>N8262A P-Series Modular Power Meter - Demo Guide</i>	5989-6636EN
<i>Fundamentals of RF and Microwave Power Measurements (Part 1) - Application Note</i>	5988-9213EN
<i>Fundamentals of RF and Microwave Power Measurements (Part 2) - Application Note</i>	5988-9214EN
<i>Fundamentals of RF and Microwave Power Measurements (Part 3) - Application Note</i>	5988-9215EN
<i>Fundamentals of RF and Microwave Power Measurements (Part 4) - Application Note</i>	5988-9216EN
<i>4 Steps for Making Better Power Measurements - Application Note</i>	5965-8167E

Related Web Resources

For more information on the P-Series modular power meter and sensors, visit: www.keysight.com/find/N8262A

For the latest literature updates, visit: www.keysight.com

Ordering Information

Model	Description
N8262A	P-Series modular power meter (LXI-C compliant)

Standard-shipped accessories

- Power cord
- Documentation CD-ROM
- Keysight Instrument Control DVD
 - IO Libraries Suite
 - Command Expert
 - BenchVue Software Platform
 - 30-day free trial of BenchVue Power Meter/Sensor Control and Analysis app

Mechanical Characteristic

Mechanical characteristics such as center conductor protrusion and pin depth are not performance specifications. They are, however, important supplemental characteristics related to electrical performance. At no time should the pin depth of the connector be protruding.

Ordering Information (Continued)

Options

Sensors	Description
N192xA-105	P-Series sensors fixed 1.5 m (5 ft) cable length
N192xA-106	P-Series sensors fixed 3 m (10 ft) cable length
N192xA-107	P-Series sensors fixed 10 m (31 ft) cable length
Cables	Description
N1917A	P-series meter cable adaptor, 1.5 m (5 ft)
N1917B	P-Series meter cable adaptor, 3 m (10 ft)
N1917C	P-Series meter cable adaptor, 10 m (31 ft)
N1917D	P-Series meter cable adaptor, 1.8 m (6 ft)
N191xA-200	11730x cable adaptor
Other accessories	Description
34131A	Transit case for half-rack 2U-high instruments (e.g. 34401A)
34161A	Accessory pouch
N8262A-908	Rack mount kit (one instrument)
N8262A-909	Rack mount kit (two instruments)
Software	Description
BV0007B	BenchVue Power Meter/Sensor Control and Analysis app license
Calibration	Description
N8262A-1A7	ISO17025 calibration data including Z540 compliance
N8262A-A6J	ANSI Z540 compliant calibration test data
R-50C-011-3	Calibration Assurance Plan - Return to Keysight - 3 years
R-50C-011-5	Calibration Assurance Plan - Return to Keysight - 5 years
R-50C-021-3	ANSI Z540-1-1994 Calibration up front - 3 years plan
R-50C-021-5	ANSI Z540-1-1994 Calibration up front - 5 years plan
Documentation	Description
N8262A-0B1	Hard copy English language User's Guide and Installation Guide
N8262A-0BF	Hard copy English language Programming Guide
N8262A-0BK	Hard copy English language User's Guide and Programming Guide
N8262A-0BW	Hard copy English language Service and Calibration Guide
N8262A-ABJ	Hard copy Japanese localization User's Guide
N192xA-0B1	Hard copy P-Series sensor English language manual

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